Liberty, Missouri
Community Forest Conservation Assessment

Prepared for the City of Liberty – May 2013

By:

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Project Partners & Acknowledgements

Project partners:

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35%
Liberty's Tree Cover in 2012

+ 8%
Change in Liberty's Tree Cover from 1990 – 2012 (a 28% increase)

+ 4%
Change in Liberty's Impervious Cover from 1990 – 2012 (a 68% increase)

239
The number of forest tracts in Liberty assessed in this project

55%
**Percent of Liberty's total tree canopy that is in forest tracts**

383,000
Pounds of air pollutants removed by Liberty's forest tracts each year

The City of Liberty lies at the northeastern edge of the Kansas City Urban Area in a region that continues to experience rapid growth and development. Liberty's citizens strive to maintain their community's identity and character by appreciating the contribution of trees and forests toward quality of life for residents, businesses and visitors. Liberty's community forest is comprised of forest tracts and all of the individual trees that shade the lawns, line the streets, beautify the parks, and provide habitat for the wildlife in undeveloped woodlots and streamside corridors that are ingrained in the fabric of the City.

Liberty's Community Forest Conservation Assessment project assesses the multiple values of existing tracts of forest across the city and ranks tracts by conservation value based on community input, mapping, and analysis tools. The final map and other information gained support ongoing planning processes to ensure these values are preserved as Liberty continues to grow.

Some of the key findings from this project are provided at left and in the Major Findings on the next page.

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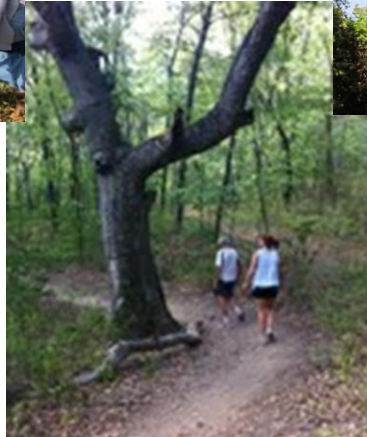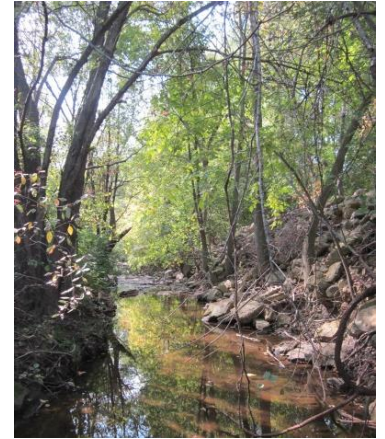
Major Findings

🌳 Liberty currently has 6,478 acres of tree canopy that covers 35% of the city. Sampling of an aerial image from 1990 indicated canopy cover has increased from 27% (an 8% increase).

🌳 Roughly 55% of the total tree canopy cover (3,500 acres) is contained in contiguous forest tracts with the rest coming from individual trees.

🌳 In an online Forest Values survey, Liberty respondents chose the provision of wildlife habitat as the highest ranking benefit that forest tracts provide. The next highest ranking benefits were stormwater retention/flood protection and stream protection (stream bank stabilization and reduction in bank erosion and sedimentation).

🌳 Liberty's largest forest tracts tend to have the highest priority for conservation. Many of the city's largest tracts also cover riparian and floodplain areas, maximizing benefits.

🌳 Liberty has 6,671 acres of land that is potentially available for development without resulting in a loss of any forest tracts.

🌳 There are 4,097 acres where restoring forests would be a priority for enhancing forest values especially along riparian and floodplain corridors. If half of these areas are restored, Liberty's canopy cover would be 46% (an 11% increase).

🌳 Maps in this report:
   - Forest tracts in Liberty (page 4)
   - Community Forest Conservation Values (page 8)
   - Development Compatibility of Undeveloped Land (page 10)
   - Forest Restoration Priority Areas (page 11)
   - Forest Tracts: Tract ID Numbers (page 25)
   - Forest Tracts: Overall Ecological Quality (page 26)
   - Forest Tracts: Amount of Invasive Species (page 27)
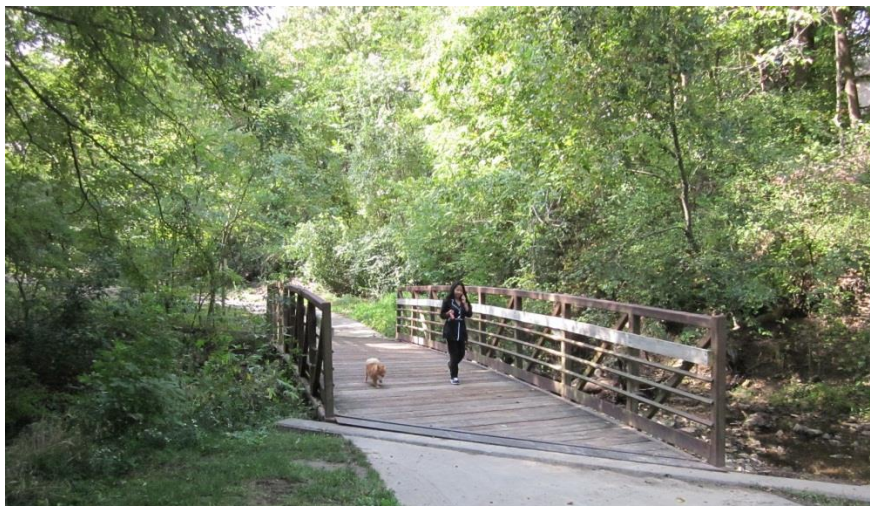
In 2012, the City of Liberty received a Tree Resource Improvement and Maintenance (TRIM) grant from the Missouri Department of Conservation to conduct a Community Forest Conservation Assessment (CFCA). With this funding, the city contracted with Plan-It Geo LLC (Arvada, Colo.) to provide professional mapping, assessment, and reporting services.

The overarching goal was to measure the conservation values of the many natural forest tracts throughout the City of Liberty. The objectives are to inventory forest tracts in the city, assess the value that each tract provides to Liberty's citizens, and to develop a forest conservation values map (see pg. 8). This project serves as a baseline inventory of Liberty's forested areas to be used as an informational tool for future community planning.

Forest tracts were mapped using Geographic Information Systems (GIS) and 2012 aerial imagery (see Figure 1 on page 4). After mapping tracts, careful consideration was given to the question ***"What makes a forest tract valuable to the City of Liberty and its citizens?"*** Plan-It Geo, the City, and a Project Advisory Team (PAT) collaborated to identify criteria for measuring the value of individual forest tracts. Tracts were mapped in a GIS and cataloged by size, shape, and relative location to other key landscape features (see Methods on page 15 for a complete listing and description of criteria). Ecosystem services (see Terms and Acronyms on page 5) were estimated for each forest tract using the i-Tree suite of software tools.

Goal of the Liberty CFCA: To measure the conservation values of Liberty's natural forest tracts:

- 🌳 *Map forest tracts within the city limits*
- 🌳 *Conduct a survey to determine what makes a forest tract valuable to the city & its citizens*
- 🌳 *Create a GIS model that prioritizes tracts for preservation*
- 🌳 *Develop tools to promote and enhance future use of this data for decision making*

Criteria were released to the public through an online survey to include citizen's input. These criteria were then used as inputs to a GIS-based Conservation Priority Ranking Model (CPRM) which was used to assign a score for each tract based on the criteria. Additionally, a land cover change assessment was conducted to measure change between 1990 and 2012.
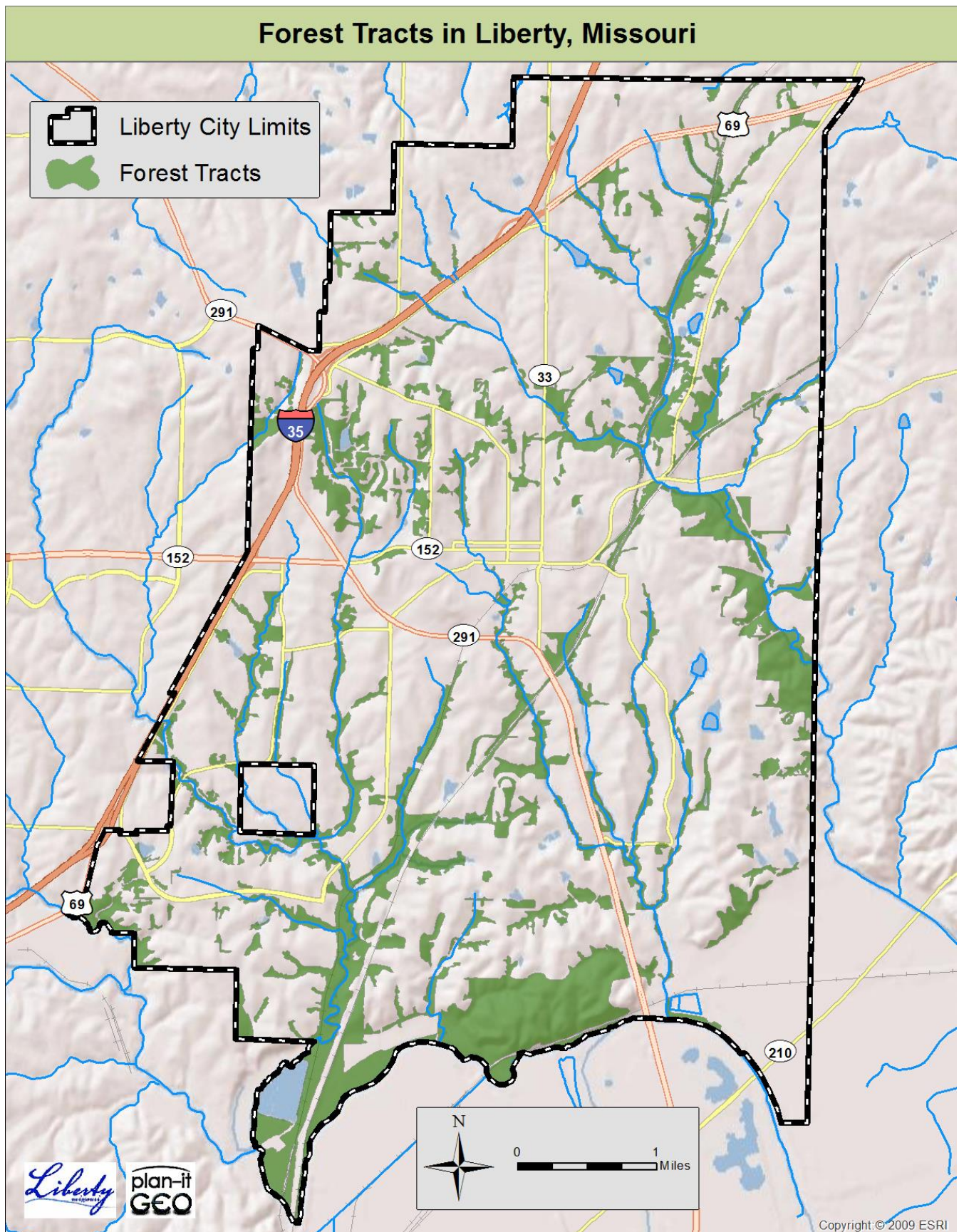
Figure 1: Forest stands (green) were assessed for conservation priority in this study.

Terms and Acronyms Used in this Report

🌳 **CFCA - Community Forest Conservation Assessment**

The title of this project.

🌳 **CPRM - Conservation Priority Ranking Model**

The GIS model used to prioritize forest tracts by their conservation priority.

🌳 **Ecosystem Services**

The benefits and functions provided by trees and the environment. This includes removal of air pollutants, absorption of stormwater, storage of atmospheric carbon, and energy savings in homes.

🌳 **Forest Tract**

Any area where tree canopy covers >90% the ground over a contiguous area of at least 0.5 acre when viewed from above (map view).

🌳 **GIS – Geographic Information System**

Computer software for conducting spatial analysis and creating map products based on data layers with real-world coordinates. The GIS software used in this assessment is ArcGIS v10.1 from ESRI.

🌳 **UTC - Urban Tree Canopy**

The area of trees, branches, and foliage when viewed from above (map view).

Steps to Complete Liberty's CFCA

Map Forest Tracts – using aerial imagery & GIS

Determine Forest Tract Values – develop a list of forest ranking criteria with input from the PAT

Create a GIS Model to Rank Tracts by their Conservation Priority – use forest values criteria and survey results

Weight Forest Criteria by Importance – conduct a community survey to get public opinions

Present Results – in the form of a report and accompanying maps

Use The Results – Liberty planners and managers will use this information to develop future management plans

Figure 2: Flowchart of the process used in the Community Forest Conservation Assessment

Results

Conservation Priority Ranking Model Results

The CPRM ranked 228 forest tracts in Liberty with a priority ranking score of 1-100 (11 tracts less than 1 acre in size were not ranked). Scores are based on an aggregation of how well each tract meets each piece of criteria. A score of 100 signifies the most valuable stand, or the stand which best meets all of the weighted criteria.

Based on input from the Project Advisory Team and results of the public survey, overall ecological quality (habitat quality) was the most important criteria in the model. Forested floodplains and forested streams were assigned the next highest values for the stormwater retention, flood protection, and stream conservation benefits they provide. The enhancement of forested areas for outdoor recreation was incorporated as the least important.

Liberty's highest ranked stands are generally in the southern portion of the city, along Rush Creek and Little Shoal Creek, and in less developed floodplains near the old oxbow of the Missouri River. See Community Forest Conservation Values map in Figure 4 on the next page.

Histogram of Priority Ranking Scores
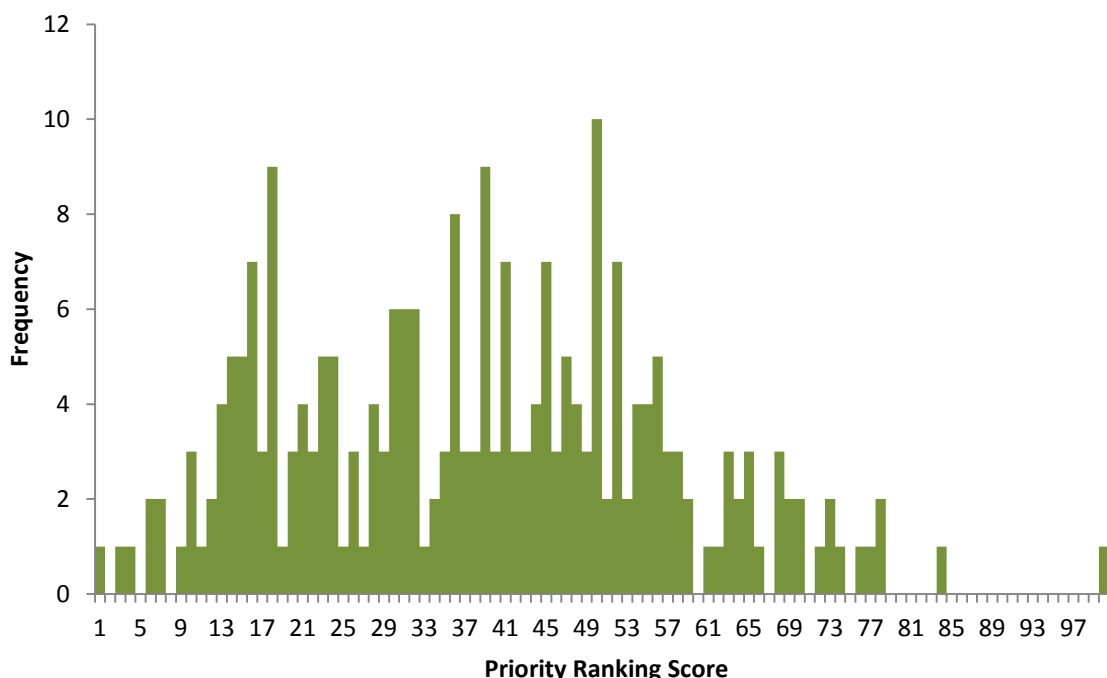
Figure 3: The priority ranking scores illustrate the relative value associated with each of the City's forest tracts based on selected criteria and citizen input.
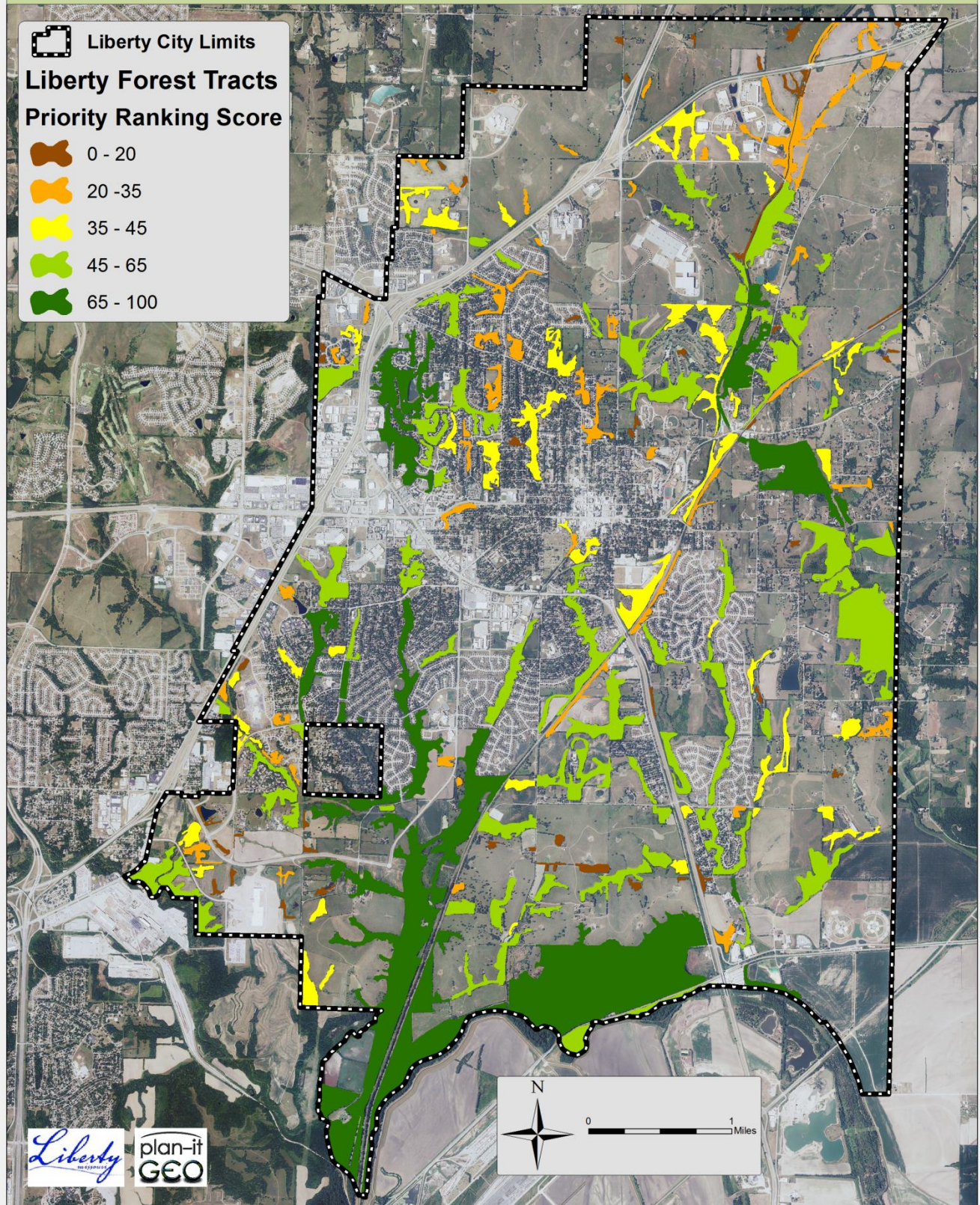
Figure 4: Community forest values for Liberty's forest tracts. Higher scores reflect tracts more important to the Liberty community.

Development Compatibility & Forest Restoration Areas Results

One goal of this assessment was to develop a mapping tool to assist planners in identifying and-where possible-preserving existing forest tracts with the highest overall conservation values. Healthy, functioning natural ecosystems provide the greatest amount of benefits through countless natural interactions that are impossible to fully quantify. It is exceedingly difficult, if not impossible, for humans to recreate all of the components of a complex natural ecosystem like those provided by Liberty's forest tracts. Therefore, prioritizing development away from the city's most valuable tracts (and avoiding development over *any* tracts where possible) is the primary way these ecosystem benefits will be preserved.

The second important method of preserving forest values is to restore or establish natural forest where possible. Tree plantings, restoration, and other conservation initiatives will be most effective if they are done strategically to maximize their future values by connecting and expanding forest tracts. By identifying forest restoration priority areas we can ensure that our efforts today make the biggest possible difference tomorrow.

As tools to visualize these conservation methods, the maps on the following two pages were created. The **Development Compatibility Map** (Figure 5) shows all currently undeveloped areas of the city. These "developable" areas are symbolized by how desirable they are to develop, with respect to preserving Liberty's forest values. The most compatible areas (Tier 1 in the map) are those that would not require removal of any forest in order to develop. Where development would impact forest tracts, its level of compatibility is greater where forest conservation values are lowest. Development would be most incompatible where it would eliminate all or parts of forest tracts with the highest conservation values.

The **Forest Restoration Priorities Map** (Figure 6) identifies areas in Liberty where it is the most ecologically advantageous to conduct forest restoration. Forest restoration would provide the highest levels of overlapping values in riparian areas (Tier 1). The next priority for restoration would be to connect forest tracts that are near one another (Tier 2). Tier 3 would include non-forested floodplains. In Liberty, the greatest amount of area for prioritized restoration exists around the edges of existing tracts (Tier 4). In these areas it is more likely that the native plant communities already existing in the forest will be able to effectively reclaim the land than if plantings are focused elsewhere.

Through a public survey the city learned that, to its citizens, the most important value of a forest tract is providing habitat for wildlife.

Liberty, Missouri Development Compatibility

Liberty City Limits

Development Compatibility of Land

- Tier 1 (Most Compatible)
- Tier 2
- Tier 3
- Tier 4 (Least Compatible)
- Undevelopable (Floodplain & Riparian Areas)

What are Development Compatibility Tiers?

Tier 1 – All currently undeveloped areas that are not part of a forest tract

Tier 2 – Forest tracts with a priority score of 0-33

Tier 3 – Forest tracts with a priority score of 33-66

Tier 4 – Forest tracts with a priority score of 66-100

Figure 5: Tiers of development compatibility among Liberty's undeveloped land.

Liberty, Missouri Forest Restoration Priority Areas

Liberty City Limits

Forest Restoration Priority Areas

- Tier 1
- Tier 2
- Tier 3
- Tier 4

What are the Forest Restoration Priority Tiers?

Tier 1 – Stream corridors (riparian areas) that are not forested

Tier 2 – Areas where there is a closable gap and it is feasible to connect two tracts into one larger one.

Tier 3 – Floodplain areas that are not forested

Tier 4 – Areas within 100ft of the edge of an existing forest tract

N

0   1
Miles

Figure 6: Forest restoration priority tiers in Liberty.

i-Tree Canopy Land Cover Change Assessment Results

Tables 1a, 1b, 1c: Statistical estimates of land cover change in Liberty from 1990 to 2012.

Liberty 1990

Land Cover Class	Number of Points	Percent of Points	Standard Error	95% CI*
Tree Canopy	317	27.6%	0.013	2.586
Impervious	72	6.3%	0.010	2.055
Other LC	759	66.1%	0.011	2.236
Total	**1148**	**100.0%**	**0.035**	

Liberty 2012

Land Cover Class	Number of Points	Percent of Points	Standard Error	95% CI*
Tree Canopy	405	35.3%	0.014	2.764
Impervious	121	10.5%	0.010	2.055
Other LC	622	54.2%	0.011	2.236
Total	**1148**	**100.0%**	**0.036**	

The land cover change analysis revealed that Liberty's tree canopy increased from an estimated 28% in 1990 to 35% in 2012 representing a substantial (28%) increase in forest cover and associated benefits for the City in a relatively short time span. Increases in canopy are likely the result of natural regeneration and the growth of existing trees between the two time periods. The assessment included land areas annexed by the City between 1990 and 2012.

Liberty Change 1990 - 2012

Land Cover Class	Change in Number of Points	Percent of Points
Tree Canopy	88	7.7%
Impervious	49	4.3%
Other LC	-137	-11.9%

Between 1990 and 2012, Liberty gained 7.7% (about 1,400 acres) of tree canopy, an increase of 28%! Much of this is from growth of existing trees and natural regeneration of forest.

Between 1990 and 2012 Liberty gained 4.3% (about 800 acres) impervious surface cover from new development, an increase of 68%!
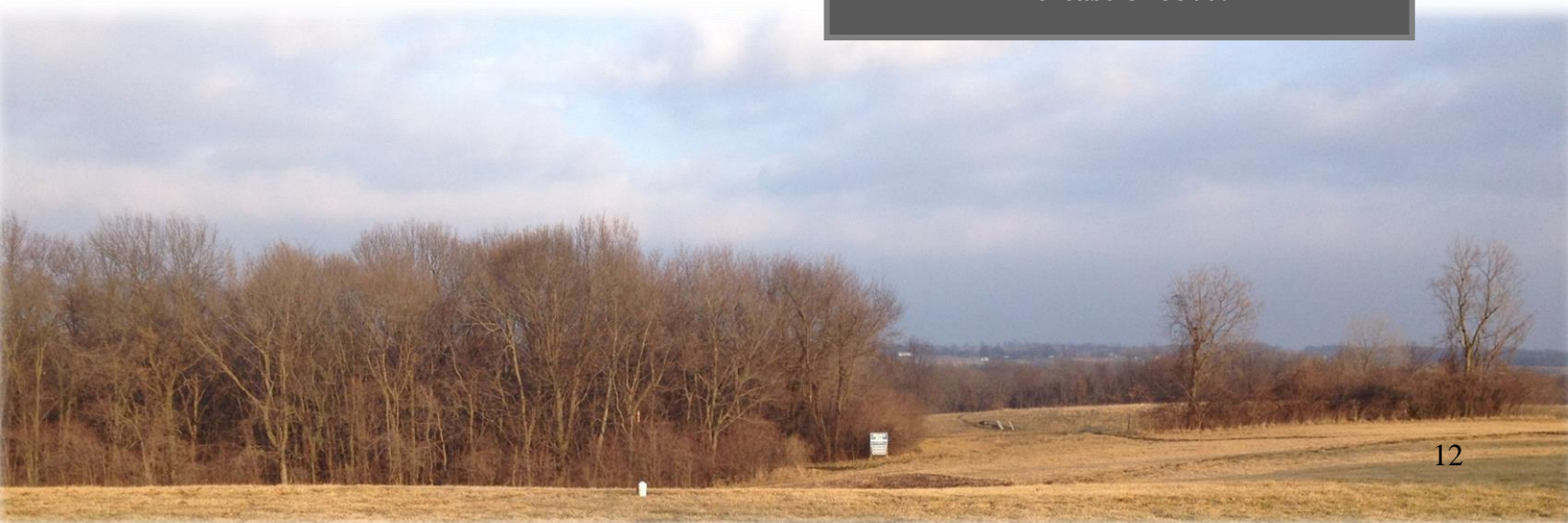
Liberty Then and Now

Forest Loss Example:

The Liberty Triangle in March 1990. There is little development and a large patch of forest occupies much of the central and west.
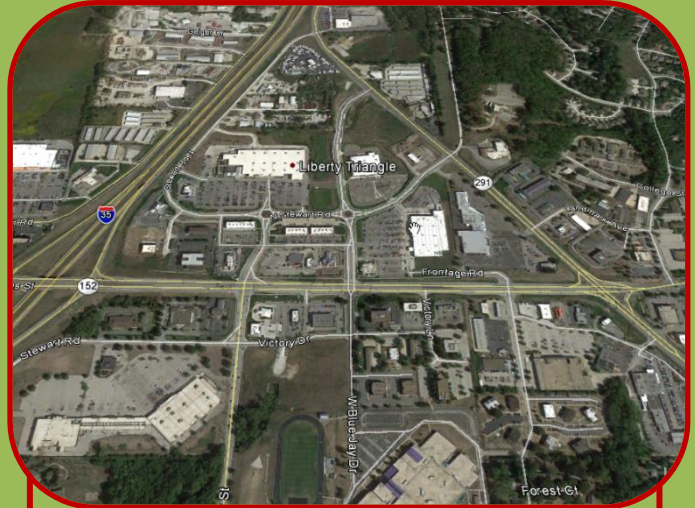
The Liberty Triangle in September 2012. Commercial development has replaced the forest tract. Note the bareness of the large parking lots; this is a prime area to replace some of the canopy lost to development while also maximizing ecosystem service benefits.

Forest Gain Example:
A vacant field in south Liberty next to the railroad tracks in March 1990. There is predominantly small scrub and grass cover.
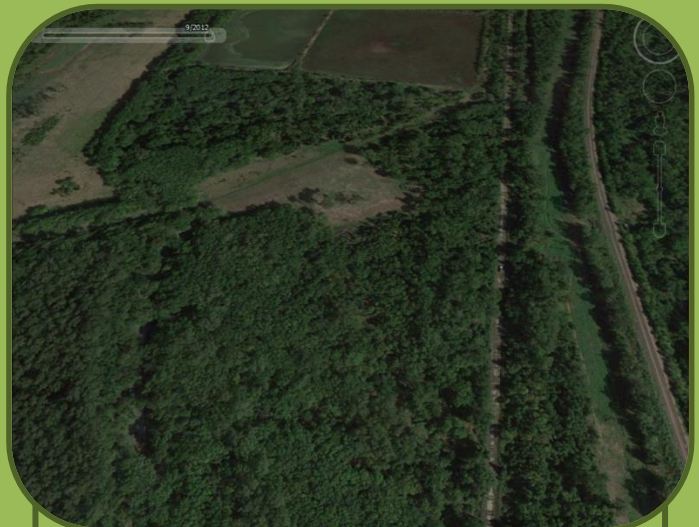
The same vacant field 22 years later (9/2012) where natural regeneration of forest cover in this area is quite impressive. Medium and large trees now dominate the area.

Figure 7: Examples of forest gain and forest loss in Liberty between 1990 and 2012.

i-Tree Eco Ecosystem Services Assessment Results

Trees and forests in Liberty provide many ecosystem services that enhance the environment, economy, and well-being for the City's residents. In 2007, the Mid-America Regional Council (MARC) conducted an i-Tree Eco analysis to assess the structure, value, and function (ecosystem services) provided by trees and forests in the Kansas City Metro region. Plan-It Geo used the results of this field survey data to estimate the annual value of the average acre of forest cover in Liberty for several benefit types.

- Trees *improve air quality* by absorbing and storing pollutants, and lowing air temperature.

- Trees *sequester carbon* from the atmosphere and store it within leaves, stems, and roots.

- Trees *reduce storm water runoff* and prevent flooding by absorbing rain and increasing soil percolation.

- Trees *reduce energy costs* by providing shade when planted near a home.

Results show that for every acre of forest in Liberty, the city saves roughly $129 per year in the installation and maintenance costs of stormwater management infrastructure. Additionally, each acre of forest saves more than $500 per year in avoided public health costs associated with reduced air pollution (i.e. reduced hospital visits for people with respiratory problems). Over its lifetime, each managed tree or forest tract can yield a positive return on investment that is far greater than the cost of planting and maintenance.

Table 2: Ecosystem services provided by each acre of forest in Liberty each year

Category→	Stormwater Mitigation	Carbon Removal		Pollution Removal						
Benefit→	Stormwater Intercepted	C Stored	C sequestered	O_3	SO_2	NO_2	CO	PM <10μ	PM <2.5μ	Total Pollution
Units→	(gal/acre/yr)	(lbs/acre/yr)	(lbs/acre/yr)				(lbs/acre/yr)			
Amount (units/ac/yr)→	14,443	51,555	4,237	59	10	4	3	30	4	109
Value ($/ac/yr)→	$129	$1,834	$151	$71	$1	$1	$2	$265	$187	$528

Conservation Priority Ranking Model (CPRM) Methodology

The first step in developing the CPRM was to map (digitize) forest tracts within Liberty's city limits using GIS. The 2012 National Agricultural Imagery Program (NAIP) aerial imagery at 1-meter pixel resolution was used for this step. Forest tracts were defined as a contiguous area greater than one half acre with continuous tree cover greater than 90 percent.

Next, criteria were developed to describe qualities that make a tract valuable to the community. All criteria were created using the following qualifications:

- A criterion must be directly related to positive benefits of a forest tract
- A criterion must be easily measurable (can put numbers to it)
- A criterion must be differentiable between forest tracts
- GIS data must exist to support any analysis needed to calculate a criterion

Criteria used to rank forests by conservation value were grouped into the following three types. The complete list of final criteria is on pages 17 and 18.

- Tract size and shape (top of page 17)
- Location of a tract in relation to other features of interest (bottom of page 17)
- The ecological/environmental quality of a tract, where ecological criteria were assessed in the field by the City via rapid windshield survey using five sub-criteria that were scored and summarized (page 18).

It should be noted that the quality and value associated with a forest tract can be subjective based on differing knowledge base or opinion. The project team consulted with forestry and social science experts to determine appropriate forest tract criteria and surveyed citizens to select and rank criterion by importance to individuals (details about survey methodology can be found in Appendix 2).

Using the survey results, each criterion was weighted from 1-10 with 10 being the most important (highest weighting). The weights were then used to prioritize and assign scores for each forest tract based on local conditions (as they relate to the selected criteria) through the CPRM.

Weights reflect the relative importance of each criterion for computing the final priority scores for each forest tract. By adjusting the weight to apply to each criterion in the CPRM, the final score of each forest tract will change based on characteristics of the tract. Assigning a higher weighting factor will increase the influence of that criterion in determining a tract's final score.

Weighting Factors Used in Computing Priority Ranking Scores
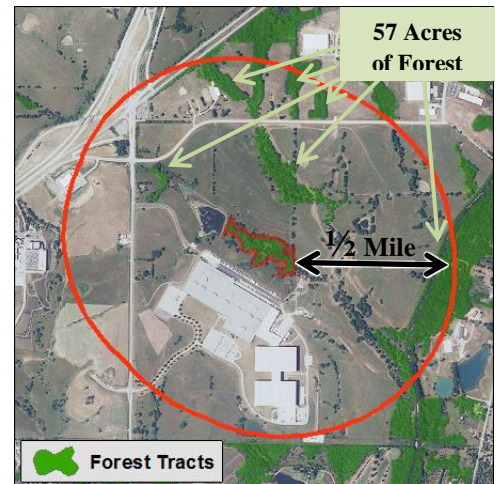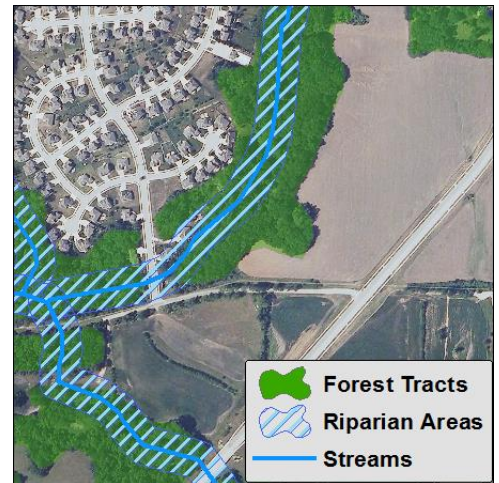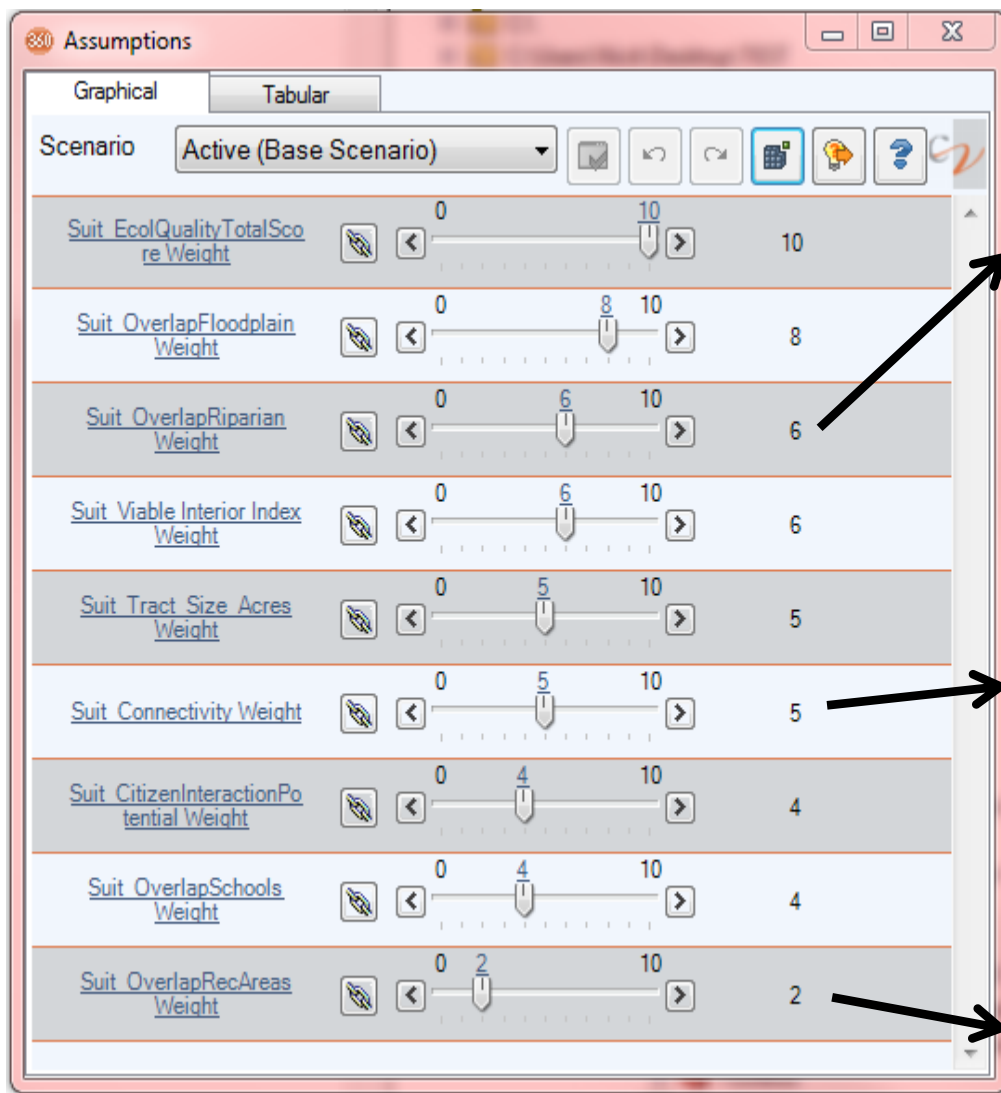
Figure 8: Weighting factors used to prioritize tracts in the CPRM.

Criteria Used to Determine Conservation Priority

Table 3: Description of the criteria used to prioritize forest tracts for preservation

Criteria	Definition (GIS Query)	Conservation Ranking	Notes/Reasoning
Size & Shape Criteria			
Size of Tract	Size of tract	Greater Size = Higher Ranking	Bigger tracts are harder to replace, also increased size leads to increases in positive benefits.
Edge Effect (Viable Interior)	Ratio of forest edge (area in tract within 30ft of edge of tract) to forest core (area in tract more than 30ft from edge of tract)	Lower edge/core = higher ranking	This is based on the ecological principal that the farther any given point in the forest is from the edge of that forest, the less susceptible it is to outside disturbances and the more likely that it is ecologically healthy
Location-Based Criteria			
Overlap with Floodplain	Amount of overlap between forest tract and floodplain (zones A and X500)	More Overlap = higher ranking	Floodplains will not/cannot be developed, so conservation here is feasible. Forests in floodplains also help prevent flood damage through interception, absorption and soil stabilization
Overlap with Riparian Areas	Amount of overlap between forest tract and Riparian Areas (100ft buffer of streams)	More Overlap = higher ranking	Riparian areas will not/cannot be developed (usually), so conservation is feasible. They are of high importance for ecosystem quality
Overlap with Recreation Areas	Amount of overlap between forest tract and recreation areas (750ft buffer of park boundaries & 250 ft buffer of trails)	More Overlap = higher ranking	Trees provide aesthetic benefits to rec. areas and enhance recreation experiences through their multiple benefits
Overlap with Public Facilities	Amount of overlap with grounds of important public facilities (parcels containing: schools, health care facilities, community centers, golf courses, cemeteries)	More Overlap = higher ranking	Trees enhance the character of public areas and improve quality of life
Potential for Citizen Interaction	Weighted average of the number of housing units in census blocks that the tract intersects (weighted by the amount of overlap between each census block and the tract)	Higher Average Housing Units = higher ranking	Trees that citizens see/interact with on a day-to-day basis enhance community character, stimulate community pride and improve quality of life
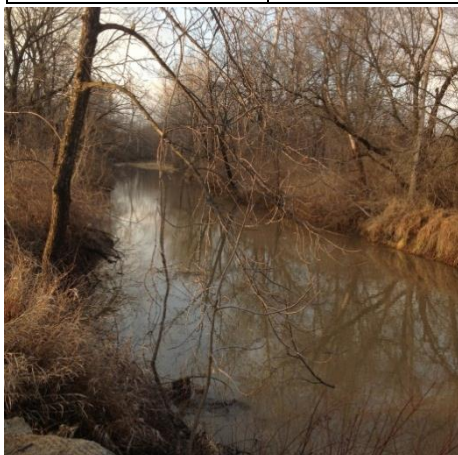
Urban trees enhance the ecological stability of important riparian areas. They also enhance the quality of public recreation areas

Criteria Used to Determine Conservation Priority (cont'd.)

Criteria	Definition (GIS Query)	Conservation Ranking	Notes/Reasoning
Ecological/Environmental Criteria			
Forest Structure	Forest structure is a measure of the maturity of the ecosystem within a tract. Tracts with better structure have mature trees of different sizes and species. Qualitative ranking 1(poor structure) - 3(good structure)	higher structure = higher ranking	Healthier trees provide more ecosystem services
Species composition of tract	Species composition refers to the types of trees growing in a tract. Desirable species are those that fit in well with the local ecosystem (native species). Qualitative ranking 1(more undesirable species) - 3 (more desirable species)	more desirable species = higher ranking	Desirable species are those that provide the greatest amount of ecosystem services in this area/climate
Amount of invasive species	Invasive species are non-native species that are detrimental to the ecosystem. Qualitative ranking 1(lots of invasives) - 3(few invasives)	less invasives = higher ranking	Less invasives = healthier ecosystem & more ecosystem. Services
Health of trees in stand	Health concerns in trees include: diseases, pests and storm damage. Qualitative ranking 1(unhealthy) - 3(healthy)	healthier = higher ranking	Healthier trees provide more ecosystem services
Past Disturbance	This is a measure of the amount of human disturbance to a tract. Disturbances can include: reworking of soil, non-native groundcover, and littering/vandalism. Qualitative ranking 1 (more disturbed) - 3 (less disturbed)	less disturbance = higher ranking	Less disturbance = healthier ecosystem & more ecosystem services. Stands with more disturbance may require additional work to return them to a natural state.
Connectivity	The number of acres of forest that fall within a half mile buffer of a tract (excluding the tract itself)	More acres of forest within 1/2 mile = higher ranking	Maintaining connectivity/movability between natural areas is a key factor in preserving ecosystem health.

Unhealthy stands have mostly immature trees and may be overgrown with invasive species.

Healthy stands have a mix of mature and young trees with few invasive species.

i-Tree-Canopy Methodology

i-Tree Canopy® is a web-based tool that is a part of the i-Tree suite of software developed by the U.S. Forest Service. i-Tree Canopy combines a Google Maps® base map with a data spreadsheet to record and statistically assess land cover data in a study area and continually assess statistical error. i-Canopy provides a quick tool for estimating the amount of different land cover types. Using historical imagery in Google Earth® allows for analysis of past land cover conditions for land cover change assessment.
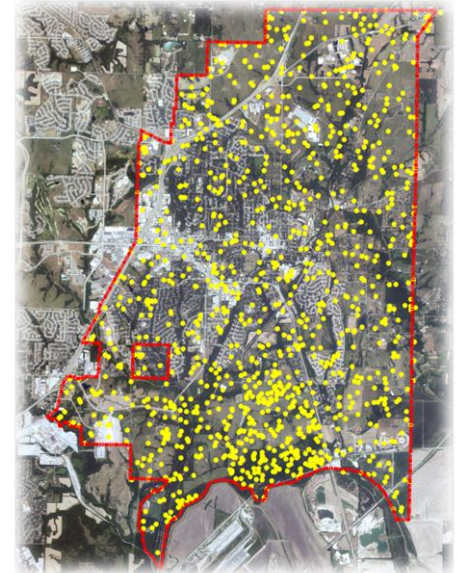
Random points used to assess land cover in i-Canopy (1,150 total) →

In i-Tree Canopy, users view random points within their study area one at a time in the map window and then record the land cover at each point in the datasheet on the right.

Figure 9: Screenshot of using the web-based i-Tree Canopy Tool

i-Tree Eco Methodology

The 2007 MARC ecosystem services study, from which values in this assessment are derived, used the i-Tree Eco model (also in the i-Tree suite of tools). i-Eco uses on-the-ground tree surveys to measure tree and forest structure which is used to estimate ecosystem service benefits in dollars and resource units in a study area. A typical i-Eco study comprises one or more field survey crews working for long periods of time to inventory 200-300 1/10th-acre sample plots in a study area. Each sample plot is exhaustively surveyed including all trees, groundcover, and buildings. Survey results are then sent electronically to the U.S. Forest Service and processed through ecological models for calculating ecosystem service values.

Plan-It Geo undertook a reanalysis of the original MARC study data. They modified the original i-Eco plot data to reflect this assessment. Each original plot was visually assesse d using aerial imagery in GIS. Plots which were forested (>90% tree cover) were exported as a subset of the original data. This new dataset, consisting of only survey plots that are forested, was rerun through the i-Eco processing models. These results provide a good estimation of the value that forest tracts provide in Liberty.

An example of one of the 30 forested sample plots used in Plan-It Geo's analysis.
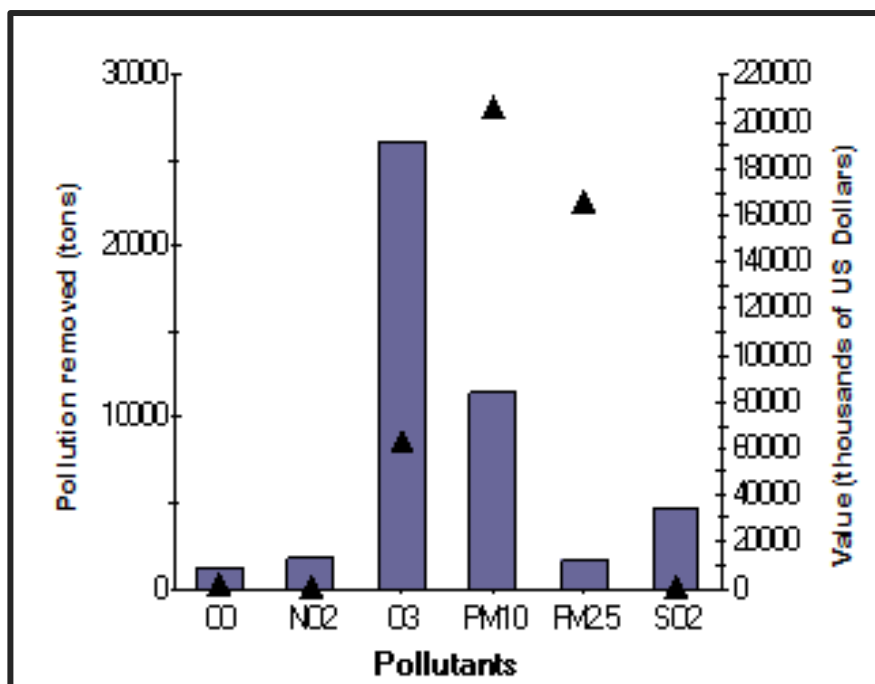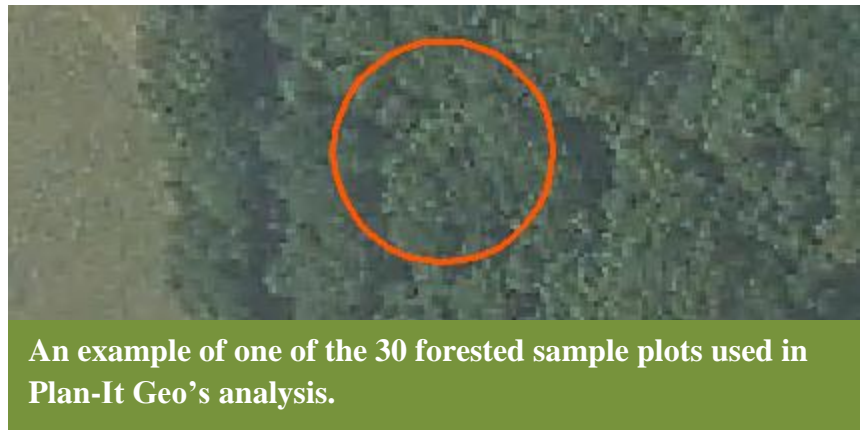
Figure 10: Example of an output from i-Tree-Eco, this graph shows total amount of pollutants removed in tons (blue bars) as well as the associated dollar values of each pollutant (triangles). Note that particulate matter (PM) has a particularly high value, as it is a leading cause of pollution related human health issues.

Conclusions

This study assessed the natural tracts of forest that---along with the individual trees and groups of trees along streets, in lawns, parks, and elsewhere throughout the city---comprise Liberty's Community Forest. Results indicate that trees cover 35% of the City of Liberty, and most of this cover comes from natural tracts of forest along streams, bottomlands, and other undeveloped areas. Tree cover has increased nearly 8% in the past two decades due to growth of existing trees and the expansion of forest in undeveloped areas. This study identified 239 tracts of forest throughout the city, and it evaluated these tracts based on the multiple values they provide for individuals, the community, and the environment.

Forests provide multiple benefits by reducing pollution, holding stormwater, protecting streambanks, providing wildlife habitat, and enhancing outdoor recreation. Specifically, Liberty's forest tracts prevent nearly 52 million gallons of stormwater runoff each year at an estimated value of $461,581. Air pollution removal was valued at nearly $2 million annually.

The study utilized a criteria-based Conservation Priority Ranking Model to produce a map that shows the relative importance of every forest tract in Liberty. Large tracts along Little Shoal Creek, Rush Creek, and the old Missouri River oxbow ranked among the most important tracts for conservation. These tracts are highly valued for stream protection, stormwater retention, wildlife habitat, and future recreation opportunities---especially as potential greenways for a trail network.

While forest cover has increased since 1990, the report noted a significant increase in impervious cover from new development. Impervious cover includes surfaces such as rooftops and parking lots that do not absorb rainwater, thus contributing to stormwater runoff. Total impervious cover increased from 6.3% to 10.5%, representing a gain of approximately 800 acres from new development.

The models used in this study also generated mapping tools for conducting future forest restoration, as well as for identifying areas where development would be most compatible with forest conservation. A Forest Restoration Priorities Map identifies areas in Liberty where it is most ecologically advantageous to conduct forest restoration, which includes non-forested riparian zones and areas that would connect fragmented forest tracts. A Development Compatibility Map shows all currently undeveloped areas of the city based on their desirability

to develop, with respect to preserving Liberty's forest values. Development would be most incompatible where it would eliminate all or parts of forest tracts with the highest conservation values.

This report and its associated maps should serve as an informational tool to facilitate long-term forest conservation in Liberty. Assessment results can be used to identify key areas for further study, discover areas to target outreach and communication with community members, and develop new tools for protecting and enhancing Liberty's existing forest tracts. As Liberty continues to grow and develop, maintaining forest values will require thoughtful and strategic planning.

Conservation strategies to protect, enhance, and reforest urban and community tree canopy are presented on the next page followed by appendices with additional information on this assessment.

Strategies for Maintaining and Increasing Forest Cover

Liberty's city managers and planners will use the products of this assessment to develop forest management strategies as the city grows. Unique forest management methods that fit into Liberty's community, ecosystem, and growth plans will be necessary. While the City must make final decisions about actions to be taken, a general set of techniques will serve as a starting point. Below are 29 different techniques for maintaining current canopy and increasing canopy into the future. They were developed by the US Forest Service State and Private Forestry division. These techniques could all be developed into customized action plans for the city.

Table 4: Recommendations for maintaining and increasing forest cover, taken from the US Forest Service's Urban Watershed Forestry Manual, Part 1: Methods for Increasing Forest Cover in a Watershed.

Goals	Objectives	Techniques
Protect	A. Protect Priority Forests	1. Conservation easements 2. Land acquisition 3. Transfer of development rights
	B. Prevent Forest Loss During Development and Redevelopment	4. Bonus and incentive zoning 5. Clearing and grading requirements 6. Forest conservation regulations 7. Open space design 8. Overlay zoning 9. Performance-based zoning 10. Storm water credits 11. Stream buffer ordinances
	C. Maintain Existing Forest Canopy	12. Protection of significant trees 13. Tree removal restrictions for developed areas
Enhance	D. Enhance Forest Fragments	14. Increase forest area where possible 15. Increase habitat diversity 16. Manage deer 17. Protect soils from erosion and compaction 18. Provide food, cover, and nesting sites for wildlife 19. Reduce or eliminate invasive species 20. Remove trash and prevent dumping
Reforest	E. Plant Trees During Development and Redevelopment	21. Landscaping requirements 22. Planting trees in storm water treatment practices 23. Planting trees in other open areas 24. Shading and canopy requirements
	F. Reforest Public Land	25. Allow natural regeneration 26. Actively reforest public lands
	G. Reforest Private Land	27. Education 28. Incentives for tree planting 29. Stewardship and neighborhood action

Appendices

The appendices contain information that is not critical to understanding the Liberty CPRM assessment but which is necessary for fully interpreting the results. There are three appendices:

- 🌳 Appendix 1: Detailed Results

    - o Map of forest tracts with tract ID numbers for use as a reference with data tables

    - o Map of forest tracts by total ecological quality score

    - o Map of forest tracts by amount of invasive species

    - o Table of ecosystem services provided by each forest tract

    - o Table of complete CPRM results for each tract

- 🌳 Appendix 2: Detailed Methodology

    - o Public survey methods

    - o CommunityViz priority ranking (aka suitability model) methods

- 🌳 Appendix 3: References

    - o Works Cited

    - o Photo Credits

Appendix 1: Detailed Results

Figure 11: Liberty forest tracts labeled with their tract ID numbers, these numbers correspond to the values in the detailed results tables below in this appendix (tables 4 & 5)

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Liberty, Missouri Forest Tracts by Ecological Quality

Liberty City Limits
Liberty Forest Tracts
Ecological Quality Score
- Not Assessed
- 5 - 7
- 8 - 10
- 11 - 13
- 14 - 15 (Highest Quality)
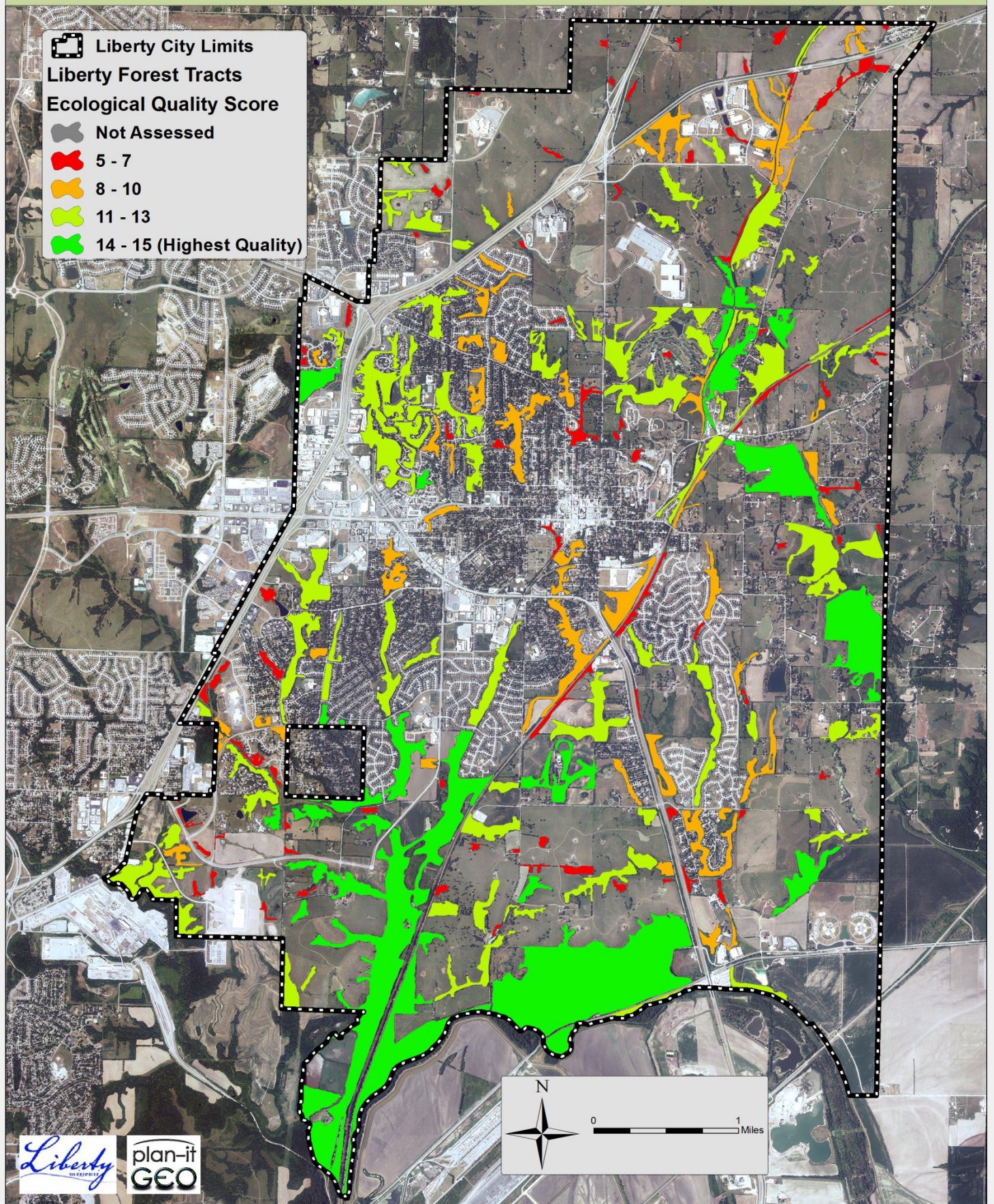
Figure 12: Liberty forest tracts shown symbolized by their ecological quality score. Tracts with a higher score have a healthier, more productive ecosystem within them

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Liberty, Missouri Forest Tracts by Amount of Invasive Species

Legend:

Liberty City Limits

Liberty Forest Tracts

Amount of Invasive Species

- Not Assessed
- 1 (Most Invasives)
- 2
- 3 (Least Invasives)

N

0   1 Miles
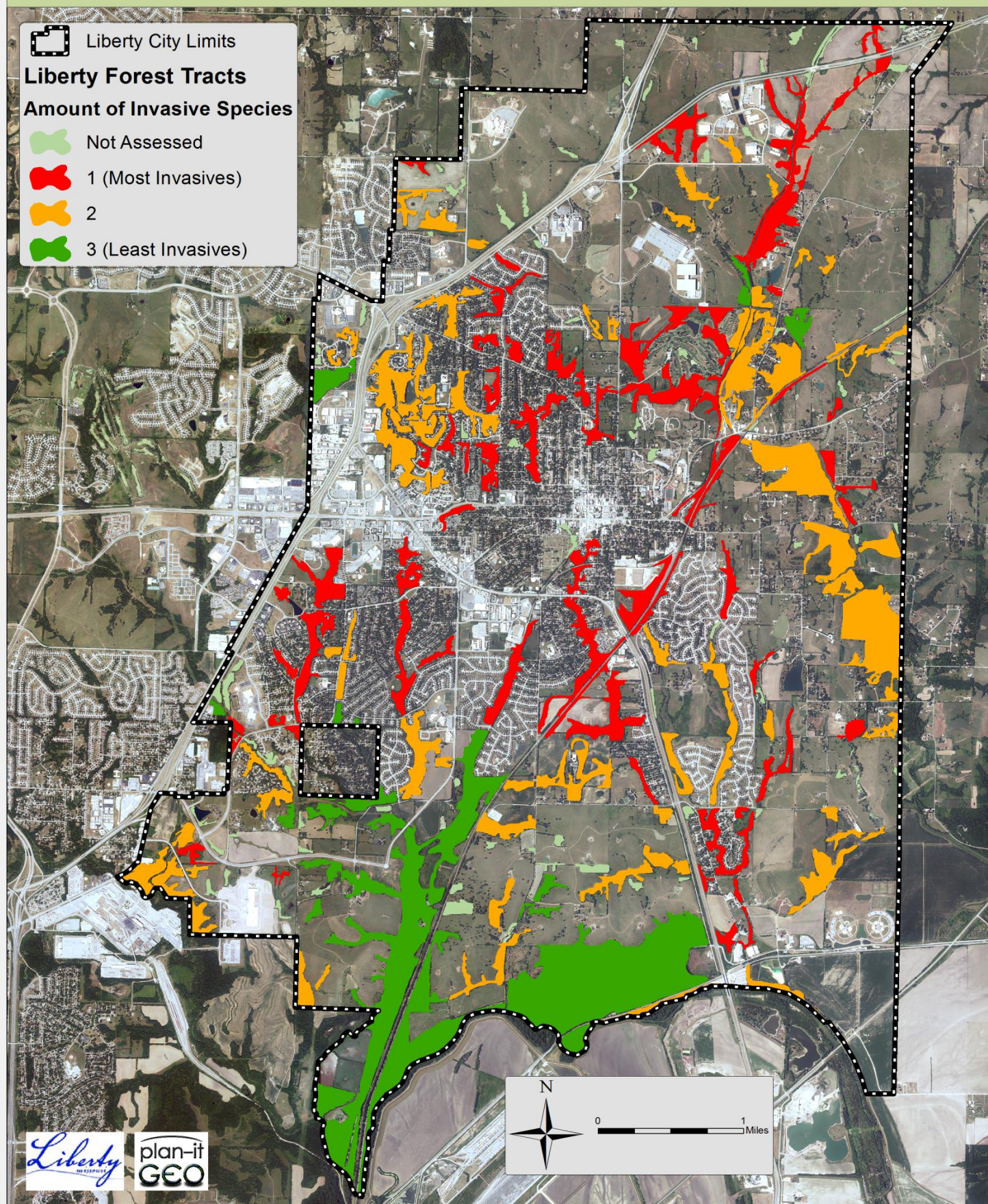
Figure 13: Liberty forest tracts shown symbolized by their amount of invasive species. Tracts with a higher value have fewer invasive species, and a healthier ecosystem within them.

Table 5: Approximate ecosystem service benefit values provided by each forest tract in Liberty annually

Tract ID Number	Tract Size (Acres)	Carbon Sequestered		Carbon Stored		Air Pollution Removed		Stormwater Mitigated	
		lbs/year	$/year	lbs/year	$/year	lbs/year	$/year	gal/year	$/year
1	2	6,896	$247.01	83,915	$2,984.93	178	$859.41	23,509	$209.24
2	4	18,020	$645.44	219,268	$7,799.57	464	$2,245.63	61,428	$546.73
3	4	18,723	$670.61	227,818	$8,103.71	482	$2,333.20	63,824	$568.05
4	3	14,313	$512.64	174,152	$6,194.75	369	$1,783.58	48,789	$434.24
5	4	15,374	$550.66	187,067	$6,654.15	396	$1,915.84	52,407	$466.44
6	1	5,854	$209.68	71,231	$2,533.76	151	$729.51	19,956	$177.61
7	22	94,603	$3,388.45	1,151,113	$40,946.16	2,436	$11,789.11	322,486	$2,870.25
8	20	83,461	$2,989.37	1,015,539	$36,123.68	2,149	$10,400.63	284,505	$2,532.20
9	14	58,262	$2,086.82	708,927	$25,217.20	1,500	$7,260.47	198,607	$1,767.68
10	1	3,666	$131.30	44,604	$1,586.62	94	$456.81	12,496	$111.22
11	8	32,452	$1,162.37	394,875	$14,046.06	836	$4,044.10	110,625	$984.60
12	26	110,309	$3,951.01	1,342,221	$47,744.08	2,841	$13,746.35	376,026	$3,346.77
13	3	10,672	$382.25	129,855	$4,619.08	0	$1,329.91	36,379	$323.79
14	8	32,555	$1,166.05	396,126	$14,090.56	838	$4,056.92	110,975	$987.72
15	3	12,241	$438.44	148,947	$5,298.18	315	$1,525.44	41,728	$371.39
16	4	16,120	$577.40	196,151	$6,977.27	415	$2,008.88	54,952	$489.09
17	4	15,388	$551.16	187,237	$6,660.18	396	$1,917.58	52,455	$466.87
18	47	201,030	$7,200.40	2,446,094	$87,009.88	5,177	$25,051.65	685,278	$6,099.22
19	6	25,392	$909.50	308,971	$10,990.40	654	$3,164.32	86,559	$770.41
20	15	62,063	$2,222.93	755,166	$26,861.95	1,598	$7,734.02	211,561	$1,882.97
21	5	21,084	$755.18	256,545	$9,125.56	118	$2,627.41	71,872	$639.68
22	3	13,110	$469.55	159,514	$5,674.06	338	$1,633.66	44,688	$397.74
23	1	6,244	$223.65	75,978	$2,702.60	161	$778.13	21,285	$189.45
24	2	10,418	$373.16	126,770	$4,509.33	268	$1,298.31	35,515	$316.09
25	14	59,441	$2,129.04	723,268	$25,727.33	1,531	$7,407.34	202,625	$1,803.44
26	15	64,073	$2,294.93	779,624	$27,731.95	1,641	$7,984.51	218,413	$1,943.96
27	5	20,707	$741.69	251,963	$8,962.56	239	$2,580.48	70,588	$628.26
28	5	19,988	$715.91	243,207	$8,651.10	515	$2,490.80	68,135	$606.42
29	9	36,903	$1,321.76	449,025	$15,972.24	950	$4,598.68	125,795	$1,119.62
30	6	24,732	$885.84	300,934	$10,704.51	637	$3,082.01	84,307	$750.36
31	5	22,351	$800.55	271,958	$9,673.81	576	$2,785.26	76,190	$678.12
32	3	13,559	$485.65	164,984	$5,868.63	349	$1,689.68	46,220	$411.38
33	4	19,037	$681.87	231,643	$8,239.77	490	$2,372.37	64,895	$577.59
34	4	18,547	$664.31	225,676	$8,027.52	478	$2,311.26	63,224	$562.71
35	5	22,574	$808.54	274,675	$9,770.45	581	$2,813.08	76,951	$684.89
36	4	14,872	$532.67	180,957	$6,436.82	383	$1,853.27	50,696	$451.21
37	9	36,515	$1,307.87	444,306	$15,804.38	940	$4,550.35	124,473	$1,107.86
38	4	18,496	$662.48	225,056	$8,005.46	476	$2,304.91	63,050	$561.17
39	18	77,149	$2,763.28	938,730	$33,391.49	1,987	$9,613.99	262,987	$2,340.68
40	11	48,495	$1,736.99	590,083	$20,989.82	1,249	$6,043.33	165,313	$1,471.35
41	13	53,398	$1,912.59	649,736	$23,111.73	1,375	$6,654.27	182,025	$1,620.09
42	14	58,944	$2,111.22	717,215	$25,512.03	1,518	$7,345.35	200,929	$1,788.34
43	9	39,411	$1,411.60	479,544	$17,057.82	1,015	$4,911.24	134,345	$1,195.72
44	5	21,907	$784.66	266,561	$9,481.84	564	$2,729.98	74,678	$664.66
45	5	23,040	$825.25	280,352	$9,972.37	593	$2,871.22	78,541	$699.04
46	45	190,315	$6,816.61	2,315,713	$82,372.11	4,901	$23,716.36	648,751	$5,774.12

Table 5 (Continued)

Tract ID Number	Tract Size (Acres)	Carbon Sequestered		Carbon Stored		Air Pollution Removed		Stormwater Mitigated	
		lbs/year	$/year	lbs/year	$/year	lbs/year	$/year	gal/year	$/year
47	12	49,494	$1,772.74	602,229	$21,421.85	1,275	$6,167.72	168,716	$1,501.63
48	28	118,590	$4,247.61	1,442,983	$51,328.26	3,054	$14,778.29	404,254	$3,598.01
49	5	21,337	$764.24	259,624	$9,235.08	549	$2,658.94	72,734	$647.36
50	1	2,928	$104.87	35,626	$1,267.24	75	$364.86	9,981	$88.83
51	1	2,831	$101.39	34,443	$1,225.16	73	$352.75	9,649	$85.88
52	2	6,458	$231.32	78,585	$2,795.33	166	$804.82	22,016	$195.95
53	6	23,872	$855.03	290,467	$10,332.18	615	$2,974.81	81,375	$724.27
54	1	4,462	$159.83	54,296	$1,931.37	115	$556.07	15,211	$135.39
55	1	3,207	$114.87	39,024	$1,388.11	83	$399.66	10,933	$97.30
56	25	105,746	$3,787.57	1,286,699	$45,769.09	1,910	$13,177.71	360,471	$3,208.32
57	11	48,095	$1,722.64	585,208	$20,816.41	802	$5,993.41	163,947	$1,459.19
58	7	31,362	$1,123.32	381,611	$13,574.27	54	$3,908.27	106,909	$951.53
59	3	12,594	$451.07	153,237	$5,450.80	324	$1,569.38	42,930	$382.09
60	5	19,628	$703.02	238,827	$8,495.30	505	$2,445.94	66,908	$595.50
61	8	34,832	$1,247.59	423,828	$15,075.96	897	$4,340.63	118,736	$1,056.80
62	1	4,892	$175.20	59,520	$2,117.17	126	$609.57	16,675	$148.41
63	1	5,615	$201.11	68,322	$2,430.28	145	$699.72	19,141	$170.36
64	25	105,446	$3,776.84	1,283,053	$45,639.39	2,715	$13,140.37	359,449	$3,199.23
65	7	29,495	$1,056.43	358,886	$12,765.92	760	$3,675.53	100,543	$894.87
66	4	15,754	$564.28	191,695	$6,818.77	406	$1,963.24	53,704	$477.98
67	120	506,673	$18,147.81	6,165,107	$219,298.70	13,048	$63,139.88	1,727,166	$15,372.41
68	5	22,977	$822.98	279,580	$9,944.91	592	$2,863.31	78,325	$697.12
69	17	71,354	$2,555.72	868,220	$30,883.42	1,837	$8,891.87	243,234	$2,164.87
70	5	22,472	$804.88	273,430	$9,726.15	579	$2,800.33	76,602	$681.78
71	8	33,527	$1,200.84	407,945	$14,510.98	863	$4,177.96	114,286	$1,017.19
72	28	117,663	$4,214.41	1,431,702	$50,927.00	3,030	$14,662.77	401,094	$3,569.88
73	13	54,847	$1,964.47	667,363	$23,738.71	1,412	$6,834.79	186,963	$1,664.04
74	18	77,942	$2,791.70	948,384	$33,734.92	2,007	$9,712.87	265,692	$2,364.75
75	35	148,801	$5,329.69	1,810,582	$64,404.10	3,832	$18,543.05	507,238	$4,514.60
76	14	58,852	$2,107.95	716,105	$25,472.54	1,516	$7,333.98	200,618	$1,785.58
77	5	20,952	$750.46	254,945	$9,068.62	540	$2,611.01	71,423	$635.69
78	7	31,770	$1,137.92	386,571	$13,750.70	818	$3,959.06	108,299	$963.90
79	37	158,103	$5,662.88	1,923,774	$68,430.45	4,071	$19,702.31	538,949	$4,796.84
80	8	32,383	$1,159.90	394,036	$14,016.23	834	$4,035.51	110,390	$982.51
81	4	18,531	$663.73	225,480	$8,020.53	477	$2,309.25	63,169	$562.22
82	7	29,455	$1,055.01	358,404	$12,748.78	759	$3,670.59	100,408	$893.66
83	3	13,714	$491.21	166,871	$5,935.74	290	$1,709.00	46,749	$416.08
84	3	13,435	$481.22	163,480	$5,815.13	295	$1,674.27	45,799	$407.62
85	2	8,474	$303.50	103,105	$3,667.53	218	$1,055.95	28,885	$257.09
86	7	28,794	$1,031.31	350,354	$12,462.42	741	$3,588.15	98,152	$873.59
87	4	16,762	$600.39	203,962	$7,255.10	432	$2,088.87	57,140	$508.57
88	4	17,597	$630.30	214,122	$7,616.52	453	$2,192.93	59,987	$533.90
89	4	18,874	$676.04	229,661	$8,169.27	486	$2,352.07	64,340	$572.65
90	4	17,780	$636.85	216,349	$7,695.74	276	$2,215.74	60,611	$539.46
91	5	21,712	$777.68	264,190	$9,397.49	559	$2,705.70	74,013	$658.75

Table 5(Continued)

Tract ID Number	Tract Size (Acres)	Carbon Sequestered		Carbon Stored		Air Pollution Removed		Stormwater Mitigated	
		lbs/year	$/year	lbs/year	$/year	lbs/year	$/year	gal/year	$/year
92	28	119,285	$4,272.49	1,451,434	$51,628.88	3,072	$14,864.85	406,622	$3,619.08
93	28	119,636	$4,285.06	1,455,706	$51,780.84	3,081	$14,908.60	407,819	$3,629.74
94	4	17,946	$642.77	218,359	$7,767.24	462	$2,236.32	61,174	$544.47
95	3	10,600	$379.65	128,973	$4,587.68	273	$1,320.87	36,132	$321.59
96	8	31,907	$1,142.82	388,234	$13,809.85	822	$3,976.09	108,765	$968.04
97	2	7,007	$250.98	85,261	$3,032.81	180	$873.20	23,886	$212.59
98	13	57,120	$2,045.89	695,023	$24,722.62	1,471	$7,118.07	194,712	$1,733.01
99	1	3,168	$113.46	38,543	$1,371.00	82	$394.73	10,798	$96.10
100	10	41,532	$1,487.56	505,350	$17,975.77	1,070	$5,175.53	141,575	$1,260.07
101	3	11,263	$403.41	137,044	$4,874.77	290	$1,403.53	38,393	$341.71
102	9	39,920	$1,429.83	485,735	$17,278.07	1,028	$4,974.65	136,080	$1,211.16
103	4	16,643	$596.12	202,513	$7,203.56	429	$2,074.03	56,734	$504.96
104	63	266,976	$9,562.42	3,248,510	$115,552.60	6,875	$33,269.58	910,076	$8,100.01
105	3	11,261	$403.35	137,023	$4,874.04	290	$1,403.32	38,387	$341.66
106	2	8,235	$294.96	100,203	$3,564.30	212	$1,026.22	28,072	$249.85
107	2	10,291	$368.59	125,215	$4,454.01	265	$1,282.39	35,079	$312.22
108	3	13,013	$466.11	158,344	$5,632.46	335	$1,621.68	44,360	$394.82
109	21	88,044	$3,153.53	1,071,305	$38,107.32	2,267	$10,971.76	300,128	$2,671.25
110	3	14,405	$515.94	175,272	$6,234.60	371	$1,795.05	49,103	$437.03
111	426	1,803,462	$64,595.67	21,944,198	$780,575.80	46,205	$224,741.28	6,147,706	$54,716.84
112	146	618,444	$22,151.16	7,525,111	$267,675.30	15,926	$77,068.35	2,108,173	$18,763.51
113	25	107,343	$3,844.78	1,306,134	$46,460.43	2,764	$13,376.76	365,916	$3,256.78
114	15	64,232	$2,300.63	781,561	$27,800.87	1,654	$8,004.35	218,956	$1,948.79
115	11	47,363	$1,696.43	576,306	$20,499.75	1,220	$5,902.23	161,453	$1,436.99
116	3	11,721	$419.82	142,621	$5,073.15	302	$1,460.65	39,955	$355.62
117	6	23,522	$842.49	286,209	$10,180.72	606	$2,931.21	80,182	$713.65
118	23	99,389	$3,559.88	1,209,348	$43,017.65	2,559	$12,385.52	338,801	$3,015.45
119	8	31,830	$1,140.06	387,298	$13,776.57	820	$3,966.51	108,502	$965.71
120	44	185,117	$6,630.44	2,252,468	$80,122.39	4,767	$23,068.62	631,033	$5,616.42
121	11	47,856	$1,714.07	582,298	$20,712.89	1,232	$5,963.60	163,132	$1,451.93
122	16	69,074	$2,474.06	840,479	$29,896.65	1,779	$8,607.76	235,462	$2,095.70
123	8	35,809	$1,282.60	435,721	$15,498.99	922	$4,462.43	122,068	$1,086.45
124	37	158,711	$5,684.64	1,931,166	$68,693.40	4,087	$19,778.02	541,020	$4,815.27
125	5	21,235	$760.59	258,385	$9,191.01	547	$2,646.25	72,387	$644.27
126	7	27,804	$995.89	338,319	$12,034.34	716	$3,464.89	94,781	$843.58
127	33	138,901	$4,975.11	1,690,126	$60,119.39	3,577	$17,309.41	473,492	$4,214.25
128	3	12,805	$458.65	155,813	$5,542.40	330	$1,595.75	43,651	$388.51
129	3	12,897	$461.94	156,927	$5,582.05	332	$1,607.17	43,963	$391.29
130	23	95,694	$3,427.54	1,164,391	$41,418.49	2,464	$11,925.10	326,206	$2,903.36
131	19	79,149	$2,834.94	963,075	$34,257.50	2,038	$9,863.33	269,807	$2,401.38
132	20	84,686	$3,033.25	1,030,443	$36,653.82	2,181	$10,553.27	288,680	$2,569.36
133	14	58,224	$2,085.46	708,464	$25,200.75	1,499	$7,255.73	198,478	$1,766.52
134	7	28,525	$1,021.68	347,082	$12,346.02	735	$3,554.63	97,236	$865.43
135	45	192,610	$6,898.83	2,343,645	$83,365.68	4,960	$24,002.42	656,576	$5,843.77
136	45	189,405	$6,784.02	2,304,643	$81,978.32	4,875	$23,602.98	645,650	$5,746.52

Table 5(Continued)

Tract ID Number	Tract Size (Acres)	Carbon Sequestered		Carbon Stored		Air Pollution Removed		Stormwater Mitigated	
		lbs/year	$/year	lbs/year	$/year	lbs/year	$/year	gal/year	$/year
137	2	10,142	$363.27	123,408	$4,389.74	261	$1,263.88	34,573	$307.71
138	4	18,633	$667.38	226,720	$8,064.64	480	$2,321.95	63,516	$565.32
139	1	5,593	$200.33	68,056	$2,420.82	144	$696.99	19,066	$169.69
140	41	173,668	$6,220.35	2,113,155	$75,166.90	4,472	$21,641.85	592,004	$5,269.05
141	30	127,074	$4,551.50	1,546,219	$55,000.46	2,209	$15,835.58	433,176	$3,855.42
142	30	126,004	$4,513.16	1,533,194	$54,537.14	3,245	$15,702.19	429,527	$3,822.95
143	8	33,047	$1,183.67	402,112	$14,303.51	851	$4,118.23	112,652	$1,002.65
144	7	30,098	$1,078.04	366,229	$13,027.10	775	$3,750.73	102,600	$913.17
145	2	8,793	$314.95	106,994	$3,805.88	226	$1,095.78	29,975	$266.78
146	33	138,042	$4,944.32	1,679,665	$59,747.26	3,555	$17,202.27	470,561	$4,188.17
147	5	22,286	$798.22	271,167	$9,645.66	574	$2,777.15	75,968	$676.14
148	4	17,040	$610.32	207,337	$7,375.16	439	$2,123.44	58,086	$516.98
149	20	83,949	$3,006.85	1,021,475	$36,334.82	2,162	$10,461.42	286,168	$2,547.00
150	8	34,174	$1,224.02	415,819	$14,791.07	880	$4,258.60	116,492	$1,036.83
151	15	62,116	$2,224.85	755,817	$26,885.13	1,600	$7,740.69	211,744	$1,884.60
152	43	182,748	$6,545.60	2,223,647	$79,097.22	4,706	$22,773.46	622,959	$5,544.56
153	1	5,854	$209.66	71,226	$2,533.56	151	$729.46	19,954	$177.60
154	13	54,972	$1,968.97	668,892	$23,793.11	1,416	$6,850.45	187,391	$1,667.85
155	10	44,367	$1,589.12	539,851	$19,202.99	1,143	$5,528.87	151,240	$1,346.09
156	32	134,281	$4,809.63	1,633,908	$58,119.64	3,458	$16,733.65	457,742	$4,074.07
157	15	63,936	$2,290.03	777,961	$27,672.79	1,646	$7,967.48	217,947	$1,939.81
158	10	41,349	$1,481.01	503,123	$17,896.57	0	$5,152.73	140,951	$1,254.51
159	3	10,693	$383.01	130,116	$4,628.34	275	$1,332.58	36,452	$324.44
160	2	6,964	$249.43	84,737	$3,014.18	0	$867.83	23,739	$211.29
161	3	12,112	$433.83	147,378	$5,242.39	0	$1,509.37	41,288	$367.48
162	8	33,615	$1,204.02	409,024	$14,549.38	0	$4,189.02	114,589	$1,019.88
163	20	85,861	$3,075.34	1,044,744	$37,162.52	2,211	$10,699.73	292,687	$2,605.02
164	7	30,300	$1,085.29	368,690	$13,114.66	780	$3,775.94	103,289	$919.31
165	46	196,812	$7,049.34	2,394,776	$85,184.43	5,068	$24,526.07	670,901	$5,971.26
166	17	71,458	$2,559.46	869,491	$30,928.61	1,840	$8,904.88	243,589	$2,168.04
167	1	4,787	$171.45	58,243	$2,071.75	123	$596.49	16,317	$145.23
168	1	4,347	$155.69	52,890	$1,881.35	112	$541.67	14,817	$131.88
169	6	25,995	$931.06	316,297	$11,250.97	669	$3,239.35	88,611	$788.67
170	5	21,455	$768.46	261,057	$9,286.05	553	$2,673.61	73,136	$650.93
171	97	413,004	$14,792.79	5,025,351	$178,756.50	10,636	$51,467.08	1,407,861	$12,530.48
172	9	36,262	$1,298.81	441,228	$15,694.90	934	$4,518.83	123,611	$1,100.18
173	3	11,443	$409.87	139,238	$4,952.82	295	$1,426.00	39,008	$347.18
174	1	5,074	$181.75	61,742	$2,196.24	131	$632.34	17,297	$153.95
175	4	14,983	$536.64	182,306	$6,484.80	386	$1,867.09	51,073	$454.57
176	4	17,216	$616.63	209,478	$7,451.33	443	$2,145.37	58,686	$522.32
177	2	8,898	$318.69	108,264	$3,851.04	229	$1,108.78	30,330	$269.95
178	1	4,030	$144.36	49,041	$1,744.44	104	$502.25	13,739	$122.28
179	41	172,030	$6,161.70	2,093,229	$74,458.14	4,430	$21,437.79	586,422	$5,219.37
180	6	24,618	$881.76	299,547	$10,655.17	634	$3,067.81	83,919	$746.91
181	1	4,578	$163.98	55,706	$1,981.51	118	$570.51	15,606	$138.90

Table 5(Continued)

Tract ID Number	Tract Size (Acres)	Carbon Sequestered		Carbon Stored		Air Pollution Removed		Stormwater Mitigated	
		lbs/year	$/year	lbs/year	$/year	lbs/year	$/year	gal/year	$/year
182	1	4,065	$145.59	49,459	$1,759.31	105	$506.54	13,856	$123.32
183	3	11,235	$402.40	136,702	$4,862.61	289	$1,400.03	38,297	$340.86
184	8	35,812	$1,282.70	435,754	$15,500.19	922	$4,462.77	122,077	$1,086.53
185	1	5,151	$184.49	62,674	$2,229.38	133	$641.88	17,558	$156.28
186	1	5,907	$211.58	71,876	$2,556.68	152	$736.11	20,136	$179.22
187	8	35,976	$1,288.59	437,755	$15,571.35	926	$4,483.26	122,638	$1,091.52
188	1	4,760	$170.50	57,921	$2,060.32	123	$593.20	16,227	$144.42
189	1	6,003	$215.03	73,048	$2,598.37	155	$748.12	20,464	$182.14
190	1	5,724	$205.01	69,644	$2,477.30	147	$713.26	19,511	$173.65
191	2	7,861	$281.58	95,657	$3,402.62	202	$979.67	26,799	$238.52
192	6	25,298	$906.10	307,816	$10,949.30	651	$3,152.49	86,235	$767.52
193	2	6,769	$242.44	82,361	$2,929.68	174	$843.50	23,074	$205.36
194	2	9,002	$322.42	109,531	$3,896.12	232	$1,121.76	30,685	$273.11
195	8	33,834	$1,211.87	411,692	$14,644.27	871	$4,216.34	115,336	$1,026.53
196	3	11,830	$423.72	143,943	$5,120.20	305	$1,474.19	40,326	$358.92
197	1	5,584	$199.99	67,941	$2,416.74	144	$695.82	19,034	$169.41
198	3	13,487	$483.09	164,113	$5,837.64	347	$1,680.76	45,976	$409.21
199	5	19,627	$702.98	238,815	$8,494.87	505	$2,445.82	66,904	$595.47
200	3	14,171	$507.57	172,430	$6,133.51	365	$1,765.94	48,307	$429.95
201	10	44,385	$1,589.77	540,072	$19,210.88	1,143	$5,531.14	151,302	$1,346.65
202	5	21,971	$786.96	267,344	$9,509.67	566	$2,738.00	74,897	$666.61
203	6	23,686	$848.37	288,206	$10,251.76	610	$2,951.66	80,741	$718.63
204	1	6,230	$223.15	75,809	$2,696.60	160	$776.40	21,238	$189.03
205	1	4,637	$166.10	56,427	$2,007.16	119	$577.90	15,808	$140.70
206	2	7,576	$271.37	92,188	$3,279.22	195	$944.14	25,827	$229.87
207	2	9,386	$336.17	114,203	$4,062.31	242	$1,169.61	31,994	$284.76
208	1	4,915	$176.03	59,799	$2,127.12	127	$612.44	16,753	$149.11
209	2	9,333	$334.28	113,561	$4,039.49	240	$1,163.04	31,814	$283.16
210	2	7,126	$255.25	86,712	$3,084.42	184	$888.06	24,292	$216.21
211	2	9,979	$357.44	121,427	$4,319.27	257	$1,243.59	34,018	$302.77
212	2	7,459	$267.15	90,757	$3,228.31	192	$929.49	25,426	$226.30
213	2	6,986	$250.23	85,008	$3,023.82	180	$870.61	23,815	$211.96
214	0	1,923	$68.88	23,401	$832.40	50	$239.66	6,556	$58.35
215	129	547,216	$19,599.96	6,658,424	$236,846.40	14,092	$68,192.18	1,865,369	$16,602.47
216	17	71,899	$2,575.24	874,852	$31,119.32	1,852	$8,959.79	245,091	$2,181.40
217	10	43,169	$1,546.20	525,269	$18,684.32	1,112	$5,379.54	147,155	$1,309.73
218	12	52,322	$1,874.05	636,644	$22,646.04	1,347	$6,520.19	178,357	$1,587.44
219	0	820	$29.38	9,980	$355.01	21	$102.21	2,796	$24.89
220	2	8,675	$310.73	105,559	$3,754.85	223	$1,081.09	29,573	$263.21
221	2	6,410	$229.59	77,994	$2,774.33	165	$798.78	21,850	$194.47
222	6	27,028	$968.09	328,875	$11,698.39	408	$3,368.17	92,135	$820.03
223	11	47,467	$1,700.16	577,570	$20,544.72	172	$5,915.18	161,807	$1,440.14
224	22	94,999	$3,402.62	1,155,924	$41,117.32	2,133	$11,838.39	323,834	$2,882.24
225	8	32,143	$1,151.27	391,105	$13,911.96	828	$4,005.49	109,569	$975.20
226	3	10,753	$385.14	130,839	$4,654.06	277	$1,339.98	36,655	$326.24

Table 5(Continued)

Tract ID Number	Tract Size (Acres)	Carbon Sequestered		Carbon Stored		Air Pollution Removed		Stormwater Mitigated	
		lbs/year	$/year	lbs/year	$/year	lbs/year	$/year	gal/year	$/year
227	9	40,061	$1,434.87	487,450	$17,339.05	1,032	$4,992.21	136,560	$1,215.43
228	3	11,708	$419.37	142,465	$5,067.63	302	$1,459.06	39,912	$355.23
229	6	23,959	$858.16	291,532	$10,370.05	605	$2,985.72	81,673	$726.92
230	1	4,057	$145.30	49,362	$1,755.85	104	$505.54	13,829	$123.08
231	3	11,798	$422.59	143,560	$5,106.58	304	$1,470.27	40,219	$357.96
232	1	3,577	$128.11	43,520	$1,548.06	92	$445.71	12,192	$108.52
233	7	31,213	$1,117.97	379,794	$13,509.63	804	$3,889.66	106,400	$947.00
234	1	5,798	$207.66	70,546	$2,509.37	149	$722.49	19,763	$175.90
235	416	1,762,081	$63,113.47	21,440,673	$762,665.00	45,377	$219,584.43	6,006,642	$53,461.32
236	18	77,832	$2,787.74	947,039	$33,687.08	2,004	$9,699.09	265,315	$2,361.40
237	17	70,336	$2,519.28	855,839	$30,443.00	1,811	$8,765.07	239,765	$2,133.99
238	2	9,505	$340.45	115,655	$4,113.96	245	$1,184.48	32,401	$288.38
239	1	5,127	$183.63	62,381	$2,218.96	132	$638.88	17,476	$155.54
Total	**3,591**	**15,213,667**	**544,917**	**185,117,099**	**6,584,790**	**382,715**	**1,895,875**	**51,860,881**	**461,581**

Table 6: Complete results of each factor in the CPRM for each forest tract

Tract ID Number	Tract Size (Acres)	Viable Interior Index (0-1)	Overlap w/ floodplain (% of tract)	Overlap w/ Riparian Areas (% of tract)	Overlap w/ Rec. Areas (% of tract)	Overlap w/ Schools (% of tract)	Ecological Quality Score (5-15)	Connectivity (acres of forest within 1/2 mile)	Potential for Citizen Interaction (avg. housing density of CB's in tract)	Priority Ranking Score (1-100)	Priority Rank (1-239)
1	2	0.74	0%	0%	92%	0%	N/A	4	0.0	17	202
2	4	0.85	0%	26%	0%	0%	N/A	35	0.0	19	191
3	4	0.50	0%	0%	0%	0%	11	63	0.0	27	165
4	3	0.23	0%	0%	0%	0%	11	66	0.0	22	180
5	4	0.88	0%	0%	0%	0%	7	31	0.1	21	183
6	1	0.85	0%	0%	0%	0%	N/A	24	0.0	14	215
7	22	0.70	0%	19%	3%	0%	8	115	0.0	28	163
8	20	0.69	0%	21%	5%	0%	8	119	0.4	28	162
9	14	0.74	0%	0%	0%	0%	7	70	0.3	20	188
10	1	0.36	0%	0%	100%	18%	N/A	0	0.0	13	224
11	8	0.73	0%	54%	100%	0%	10	64	0.0	44	90
12	26	0.81	0%	5%	99%	0%	10	60	0.1	38	123
13	3	0.88	0%	0%	100%	0%	N/A	76	0.0	22	179
14	8	0.85	0%	0%	20%	0%	13	124	0.0	43	96
15	3	0.67	0%	87%	0%	0%	N/A	109	0.0	29	156
16	4	0.58	0%	0%	40%	0%	10	109	0.1	30	155
17	4	0.74	0%	0%	6%	0%	12	115	0.2	37	125
18	47	0.90	27%	31%	5%	0%	11	142	3.7	52	57
19	6	0.29	7%	13%	33%	0%	6	173	0.3	18	194
20	15	0.81	29%	56%	97%	0%	13	112	0.8	64	20
21	5	0.81	0%	44%	0%	0%	11	47	0.0	41	107
22	3	0.66	0%	15%	0%	0%	10	26	0.0	29	161
23	1	0.78	0%	0%	100%	0%	N/A	52	0.2	20	189
24	2	0.87	0%	0%	100%	0%	N/A	51	0.3	21	182
25	14	0.66	0%	17%	91%	0%	13	35	1.7	45	89
26	15	0.88	0%	28%	83%	0%	11	60	1.9	45	87
27	5	0.89	0%	62%	92%	0%	11	75	0.0	52	53
28	5	0.81	0%	85%	100%	0%	8	62	12.6	47	78
29	9	0.90	55%	37%	0%	0%	14	181	0.6	68	15
30	6	0.93	0%	0%	0%	0%	14	172	0.3	48	75
31	5	0.75	12%	29%	53%	0%	14	167	0.3	56	37
32	3	0.79	0%	1%	0%	0%	12	156	0.3	39	116
33	4	0.76	0%	60%	100%	0%	11	85	0.1	50	61
34	4	0.72	0%	0%	0%	0%	11	117	0.1	33	140
35	5	0.78	0%	59%	0%	0%	13	25	0.2	48	74
36	4	0.74	0%	71%	0%	0%	13	49	0.1	50	60
37	9	0.55	3%	36%	0%	0%	13	97	0.3	43	98
38	4	0.69	0%	0%	0%	0%	13	103	0.1	38	121
39	18	0.89	0%	34%	63%	0%	14	181	0.6	58	32
40	11	0.84	0%	0%	0%	0%	14	240	0.6	49	73
41	13	0.59	10%	18%	47%	0%	8	281	0.6	36	129

Table 6(Continued)

Tract ID Number	Tract Size (Acres)	Viable Interior Index (0-1)	Overlap w/ floodplain (% of tract)	Overlap w/ Riparian Areas (% of tract)	Overlap w/ Rec. Areas (% of tract)	Overlap w/ Schools (% of tract)	Ecological Quality Score (5-15)	Connectivity (acres of forest within 1/2 mile)	Potential for Citizen Interaction (avg. housing density of CB's in tract)	Priority Ranking Score (1-100)	Priority Rank (1-239)
42	14	0.88	0%	0%	0%	0%	12	233	0.2	43	95
43	9	0.85	0%	0%	0%	0%	12	185	0.2	41	103
44	5	0.66	81%	89%	0%	0%	13	238	0.2	78	3
45	5	0.80	24%	1%	0%	0%	13	198	0.5	49	68
46	45	0.83	42%	29%	10%	0%	14	267	3.6	67	17
47	12	0.84	0%	3%	0%	0%	12	161	0.2	41	106
48	28	0.81	12%	24%	42%	0%	12	151	1.2	50	63
49	5	0.46	0%	0%	0%	0%	8	70	0.0	18	195
50	1	0.16	0%	0%	0%	0%	N/A	74	0.0	3	238
51	1	0.00	0%	0%	0%	0%	N/A	73	0.0	0	239
52	2	0.69	0%	0%	0%	0%	N/A	70	0.0	13	225
53	6	0.78	0%	0%	0%	0%	11	35	0.7	32	145
54	1	0.79	0%	0%	0%	0%	N/A	41	0.1	14	218
55	1	0.91	0%	0%	100%	0%	N/A	61	0.1	23	178
56	25	0.78	0%	0%	6%	0%	13	130	38.7	46	81
57	11	0.69	0%	0%	73%	0%	9	103	22.7	33	139
58	7	0.81	0%	0%	32%	0%	8	130	11.5	29	157
59	3	0.75	0%	85%	0%	0%	N/A	77	0.3	30	154
60	5	0.62	0%	17%	100%	0%	8	77	9.1	31	148
61	8	0.89	0%	0%	19%	0%	8	130	13.7	30	151
62	1	0.88	0%	0%	0%	0%	N/A	57	0.1	16	206
63	1	0.88	0%	0%	0%	0%	N/A	63	0.1	16	205
64	25	0.93	0%	21%	0%	0%	15	93	1.7	53	49
65	7	0.65	0%	31%	0%	0%	13	97	0.7	43	97
66	4	0.73	0%	33%	0%	0%	9	86	3.3	33	141
67	120	0.91	0%	14%	29%	1%	13	197	104.3	66	18
68	5	0.87	0%	0%	100%	0%	13	215	7.4	52	52
69	17	0.82	0%	10%	62%	0%	13	212	39.2	55	43
70	5	0.85	0%	0%	70%	0%	14	144	17.8	52	55
71	8	0.78	0%	0%	70%	0%	10	211	20.2	41	105
72	28	0.81	0%	36%	100%	0%	13	253	33.2	63	25
73	13	0.76	0%	0%	38%	0%	8	185	14.4	31	147
74	18	0.81	0%	6%	0%	0%	11	153	23.2	40	108
75	35	0.88	0%	34%	42%	11%	12	84	3.8	50	64
76	14	0.83	32%	29%	54%	0%	10	60	18.6	49	69
77	5	0.89	0%	0%	0%	0%	7	74	1.0	23	177
78	7	0.84	65%	50%	85%	0%	8	65	15.1	57	35
79	37	0.82	54%	53%	79%	0%	12	136	46.6	73	9
80	8	0.88	41%	82%	0%	0%	13	105	12.6	68	14
81	4	0.94	0%	0%	75%	0%	9	106	5.6	36	128
82	7	0.65	44%	50%	3%	0%	11	143	14.3	54	45
83	3	0.86	48%	46%	0%	0%	N/A	42	0.2	35	135

Table 6(Continued)

Tract ID Number	Tract Size (Acres)	Viable Interior Index (0-1)	Overlap w/ floodplain (% of tract)	Overlap w/ Riparian Areas (% of tract)	Overlap w/ Rec. Areas (% of tract)	Overlap w/ Schools (% of tract)	Ecological Quality Score (5-15)	Connectivity (acres of forest within 1/2 mile)	Potential for Citizen Interaction (avg. housing density of CB's in tract)	Priority Ranking Score (1-100)	Priority Rank (1-239)
84	3.1	0.83	48%	43%	0%	1%	N/A	58	0.1	36	130
85	2	0.86	0%	0%	0%	0%	N/A	49	0.0	15	210
86	7	0.78	54%	0%	58%	0%	7	92	17.0	40	110
87	4	0.87	20%	29%	0%	0%	13	44	0.3	50	62
88	4	0.77	0%	0%	71%	0%	9	93	2.9	32	142
89	4	0.84	59%	57%	100%	0%	10	104	2.3	63	24
90	4	0.83	20%	33%	6%	13%	8	67	0.0	37	124
91	5	0.71	0%	17%	75%	0%	10	73	0.0	36	127
92	28	0.75	46%	34%	32%	0%	13	104	13.5	61	27
93	28	0.82	64%	52%	53%	0%	15	275	24.7	84	2
94	4	0.68	71%	2%	0%	0%	N/A	88	1.3	31	149
95	3	0.68	56%	0%	33%	0%	N/A	95	0.7	29	159
96	8	0.82	15%	9%	7%	0%	15	91	2.5	52	51
97	2	0.55	10%	0%	1%	0%	N/A	94	0.6	13	220
98	13	0.80	74%	46%	71%	0%	14	128	4.5	75	6
99	1	0.37	0%	0%	0%	0%	N/A	50	0.0	6	234
100	10	0.89	0%	0%	0%	0%	11	80	0.0	35	134
101	3	0.28	0%	0%	5%	0%	N/A	80	0.1	6	236
102	9	0.71	0%	0%	17%	0%	10	94	0.0	30	152
103	4	0.74	0%	0%	0%	0%	13	95	0.0	39	115
104	63	0.85	33%	11%	0%	0%	13	38	0.0	51	58
105	3	0.68	0%	0%	0%	0%	N/A	96	0.0	13	219
106	2	0.74	0%	0%	15%	0%	N/A	86	0.0	15	211
107	2	0.50	0%	0%	0%	0%	N/A	64	0.0	9	231
108	3	0.44	0%	0%	3%	0%	11	71	0.0	27	167
109	21	0.94	0%	0%	0%	0%	12	61	0.1	39	113
110	3	0.73	0%	0%	0%	0%	13	102	0.0	39	114
111	426	0.99	64%	24%	13%	0%	15	428	34.4	100	1
112	146	0.93	36%	15%	47%	0%	14	472	0.0	77	5
113	25	0.73	1%	27%	47%	0%	12	416	0.0	55	42
114	15	0.86	0%	0%	0%	0%	13	207	0.0	45	85
115	11	0.95	0%	0%	0%	0%	13	217	0.0	47	79
116	3	0.90	0%	0%	0%	0%	N/A	200	0.0	21	185
117	6	0.88	0%	0%	0%	0%	14	78	0.0	44	93
118	23	0.90	0%	0%	7%	0%	13	183	0.0	46	83
119	8	0.90	0%	0%	0%	0%	13	164	0.3	44	92
120	44	0.79	0%	0%	3%	0%	14	191	17.1	49	67
121	11	0.84	70%	31%	0%	0%	15	201	0.0	73	8
122	16	0.78	85%	49%	43%	0%	13	86	0.0	72	10
123	8	0.84	0%	0%	52%	0%	8	153	8.5	32	144
124	37	0.88	1%	0%	87%	0%	14	47	7.2	51	59
125	5	0.93	0%	0%	0%	0%	13	63	0.8	41	101

Table 6(Continued)

Tract ID Number	Tract Size (Acres)	Viable Interior Index (0-1)	Overlap w/ floodplain (% of tract)	Overlap w/ Riparian Areas (% of tract)	Overlap w/ Rec. Areas (% of tract)	Overlap w/ Schools (% of tract)	Ecological Quality Score (5-15)	Connectivity (acres of forest within 1/2 mile)	Potential for Citizen Interaction (avg. housing density of CB's in tract)	Priority Ranking Score (1-100)	Priority Rank (1-239)
126	7	0.71	0%	0%	20%	0%	13	49	1.0	38	120
127	33	0.77	61%	71%	57%	0%	9	148	10.8	62	26
128	3	0.85	0%	0%	83%	0%	8	84	0.7	30	150
129	3	0.68	0%	0%	100%	0%	13	46	0.4	42	99
130	23	0.79	0%	78%	100%	0%	13	136	25.0	65	19
131	19	0.82	52%	60%	5%	0%	10	135	7.7	58	33
132	20	0.70	0%	29%	0%	0%	10	95	5.9	35	133
133	14	0.85	0%	50%	100%	0%	13	67	12.6	57	34
134	7	0.90	0%	38%	0%	0%	13	59	2.0	48	76
135	45	0.88	23%	23%	1%	0%	12	169	20.5	54	44
136	45	0.77	17%	28%	68%	0%	10	221	55.4	56	39
137	2	0.87	100%	38%	0%	0%	N/A	144	0.0	50	65
138	4	0.87	0%	0%	0%	0%	9	156	1.5	31	146
139	1	0.95	0%	0%	0%	0%	N/A	172	0.5	21	186
140	41	0.88	41%	35%	86%	6%	14	203	13.8	73	7
141	30	0.85	12%	32%	25%	0%	11	136	38.8	52	56
142	30	0.83	67%	58%	100%	0%	12	110	49.1	77	4
143	8	0.74	14%	0%	100%	0%	12	76	11.4	46	82
144	7	0.75	0%	0%	0%	0%	9	87	4.2	27	166
145	2	0.72	0%	0%	56%	0%	N/A	196	2.5	21	184
146	33	0.80	0%	40%	0%	0%	8	147	52.0	41	104
147	5	0.74	0%	63%	4%	0%	11	187	12.3	49	72
148	4	0.59	0%	0%	0%	0%	8	191	8.6	25	171
149	20	0.77	0%	0%	0%	0%	12	137	25.1	41	102
150	8	0.78	0%	0%	0%	0%	10	124	2.3	32	143
151	15	0.68	0%	0%	0%	0%	7	140	18.1	23	175
152	43	0.86	11%	23%	51%	0%	12	215	2.2	53	47
153	1	0.71	0%	0%	0%	0%	N/A	89	0.1	14	217
154	13	0.79	0%	49%	58%	0%	12	129	18.1	53	50
155	10	0.56	0%	8%	46%	0%	7	129	19.1	25	170
156	32	0.87	0%	27%	32%	0%	10	119	25.2	44	94
157	15	0.78	0%	62%	96%	12%	10	65	10.4	50	66
158	10	0.79	13%	41%	0%	0%	9	55	20.3	40	111
159	3	0.78	0%	0%	0%	0%	N/A	110	3.9	16	204
160	2	0.51	45%	86%	0%	44%	N/A	30	1.0	40	109
161	3	0.66	39%	80%	0%	0%	N/A	33	0.4	35	136
162	8	0.67	32%	56%	57%	0%	9	82	22.1	49	71
163	20	0.67	1%	3%	11%	0%	11	175	22.4	39	117
164	7	0.47	0%	0%	0%	0%	10	106	0.6	25	168
165	46	0.90	7%	8%	25%	0%	13	207	3.2	52	54
166	17	0.93	6%	41%	0%	0%	13	146	0.5	53	46
167	1	0.82	85%	14%	96%	0%	N/A	153	0.0	47	80

Table 6(Continued)

Tract ID Number	Tract Size (Acres)	Viable Interior Index (0-1)	Overlap w/ floodplain (% of tract)	Overlap w/ Riparian Areas (% of tract)	Overlap w/ Rec. Areas (% of tract)	Overlap w/ Schools (% of tract)	Ecological Quality Score (5-15)	Connectivity (acres of forest within 1/2 mile)	Potential for Citizen Interaction (avg. housing density of CB's in tract)	Priority Ranking Score (1-100)	Priority Rank (1-239)
168	1	0.67	0%	67%	0%	0%	N/A	87	0.0	25	169
169	6	0.88	66%	66%	100%	0%	10	177	1.1	69	12
170	5	0.61	0%	0%	52%	0%	7	156	1.1	23	174
171	97	0.95	25%	20%	98%	0%	14	214	13.2	70	11
172	9	0.91	2%	0%	100%	0%	10	151	1.8	42	100
173	3	0.89	0%	0%	0%	98%	N/A	80	0.8	29	160
174	1	0.90	0%	0%	0%	0%	N/A	69	0.1	17	201
175	4	0.68	25%	0%	0%	0%	12	207	0.3	44	91
176	4	0.72	60%	71%	0%	0%	9	141	0.1	55	41
177	2	0.73	65%	83%	0%	0%	N/A	94	0.1	45	86
178	1	0.45	7%	0%	60%	0%	N/A	185	0.0	17	200
179	41	0.88	0%	24%	49%	0%	13	264	1.2	55	40
180	6	0.48	0%	16%	40%	0%	6	223	0.1	22	181
181	1	0.78	0%	0%	0%	0%	N/A	31	0.0	13	221
182	1	0.61	0%	0%	0%	0%	N/A	29	0.0	10	229
183	3	0.23	0%	0%	0%	0%	N/A	35	0.1	3	237
184	8	0.66	0%	0%	0%	0%	8	35	0.0	20	187
185	1	0.62	0%	0%	0%	0%	N/A	11	0.0	9	230
186	1	0.75	0%	0%	0%	0%	N/A	39	0.0	13	223
187	8	0.79	32%	63%	0%	0%	13	57	0.5	58	31
188	1	0.66	0%	0%	0%	0%	N/A	180	0.0	16	207
189	1	0.77	0%	0%	0%	0%	N/A	177	0.0	17	197
190	1	0.79	0%	0%	0%	0%	N/A	131	0.1	16	203
191	2	0.61	0%	100%	100%	0%	N/A	64	1.3	35	132
192	6	0.63	0%	82%	65%	0%	8	54	1.8	39	112
193	2	0.55	0%	28%	0%	0%	N/A	57	0.5	15	212
194	2	0.38	0%	0%	28%	0%	N/A	117	0.0	10	228
195	8	0.74	60%	89%	10%	0%	10	149	11.6	64	21
196	3	0.90	46%	63%	62%	0%	N/A	107	2.3	45	88
197	1	0.86	0%	86%	75%	0%	N/A	76	0.3	36	126
198	3	0.77	100%	93%	100%	0%	7	105	1.2	69	13
199	5	0.50	92%	81%	100%	0%	8	131	0.5	64	22
200	3	0.61	0%	0%	0%	0%	5	147	3.4	14	216
201	10	0.54	7%	11%	23%	0%	6	216	4.3	23	173
202	5	0.67	0%	0%	2%	0%	12	99	1.4	35	137
203	6	0.52	29%	64%	99%	0%	12	88	1.6	56	36
204	1	0.68	0%	0%	0%	0%	N/A	77	2.1	13	222
205	1	0.81	0%	90%	0%	0%	N/A	31	1.8	30	153
206	2	0.60	0%	66%	19%	0%	N/A	41	0.1	23	176
207	2	0.62	0%	99%	0%	0%	N/A	5	0.0	27	164
208	1	0.83	0%	0%	98%	0%	N/A	22	0.0	20	190
209	2	0.67	0%	98%	0%	0%	N/A	36	0.0	29	158

Table 6(Continued)

Tract ID Number	Tract Size (Acres)	Viable Interior Index (0-1)	Overlap w/ floodplain (% of tract)	Overlap w/ Riparian Areas (% of tract)	Overlap w/ Rec. Areas (% of tract)	Overlap w/ Schools (% of tract)	Ecological Quality Score (5-15)	Connectivity (acres of forest within 1/2 mile)	Potential for Citizen Interaction (avg. housing density of CB's in tract)	Priority Ranking Score (1-100)	Priority Rank (1-239)
210	2	0.79	0%	0%	0%	0%	N/A	160	0.0	17	199
211	2	0.62	0%	0%	0%	0%	N/A	80	0.1	12	226
212	2	0.73	0%	0%	55%	0%	N/A	100	0.6	18	196
213	2	0.66	40%	58%	97%	0%	N/A	76	0.5	39	118
214	0	0.00	77%	20%	11%	0%	N/A	92	0.1	24	172
215	129	0.95	19%	9%	96%	0%	14	104	8.8	64	23
216	17	0.85	14%	12%	99%	0%	13	182	1.2	56	38
217	10	0.91	0%	0%	0%	0%	12	74	0.6	39	119
218	12	0.69	0%	0%	0%	0%	12	67	0.7	34	138
219	0	0.38	0%	0%	0%	0%	N/A	38	0.0	6	235
220	2	0.52	0%	0%	0%	0%	N/A	39	0.1	9	232
221	2	0.67	0%	0%	0%	0%	N/A	54	0.1	12	227
222	6	0.92	4%	51%	56%	0%	12	106	0.0	53	48
223	11	0.94	0%	0%	66%	0%	13	124	0.1	48	77
224	22	0.77	0%	0%	85%	0%	13	217	0.2	49	70
225	8	0.89	0%	0%	5%	0%	N/A	86	0.1	17	198
226	3	0.95	0%	0%	0%	0%	N/A	103	0.0	19	192
227	9	0.85	0%	47%	80%	0%	14	136	0.1	59	29
228	3	0.84	0%	0%	4%	0%	N/A	138	0.0	18	193
229	6	0.94	0%	0%	97%	0%	9	139	0.0	38	122
230	1	0.66	0%	0%	0%	0%	N/A	143	0.0	14	214
231	3	0.34	0%	31%	34%	0%	N/A	95	0.0	15	213
232	1	0.74	0%	0%	9%	0%	N/A	112	0.0	15	209
233	7	0.59	0%	10%	62%	0%	13	196	0.1	45	84
234	1	0.59	0%	86%	99%	0%	N/A	164	0.0	35	131
235	416	0.99	0%	2%	34%	0%	14	214	0.5	67	16
236	18	0.98	0%	28%	0%	0%	15	263	0.0	60	28
237	17	0.70	0%	57%	1%	0%	13	397	0.0	59	30
238	2	0.67	0%	0%	40%	0%	N/A	90	0.0	15	208
239	1	0.27	0%	4%	0%	0%	N/A	96	0.4	7	233

Appendix 2: Detailed Methodology

Survey methods

A short survey was administered to get community member opinions on which values were most important to each respondent. Surveys were comprised of 16 questions where respondents were asked to rank preservation criteria according to personal preference. The survey used a pairwise ranking method. In this method the survey-taker is prompted with every possible pair of factors, one pair at a time, and asked simply "Which do you feel is more important?". In this way each factor is compared to every other factor and their relative order of importance can be easily found. The survey was administered using a web-based survey tool called Survey Monkey (www.surveymonkey.com). The full text of the survey is below, followed by a screenshot of what the survey interface looked like to survey takers.

Survey Text:

Liberty Parks and Recreation is using a Tree Resource Improvement and Maintenance (T.R.I.M.) grant to conduct a Community Forest Conservation Assessment. This assessment will determine the relative importance of forest tracts across the City based on several important values. Citizen input is a key part of the model that will tell us which tracts hold the most overall value to our community. The results of this study will be used to develop partnerships, pursue funding opportunities, provide vital data for future Parks and Open Space planning efforts, and inform future land use, stormwater, and development plans and programs.

This assessment has found that the canopy of our entire community forest--- the individual trees in lawns, parks, roadsides, and forest tracts---comprises approximately 23% of Liberty's land cover. We all recognize that trees provide many benefits to humans and wildlife. Intact tracts of forest are especially important for the extensive environmental, social, and economic values and benefits they provide to our community. For the purpose of this study, a "forest tract" is any area with at least 90% tree cover over an area greater than one acre.

This short survey will use several questions to get your opinions on which of these values/benefits are *most important to you*. The survey is comprised of 16 questions and will take approximately 10 minutes to complete. We appreciate your contribution to this important study.

For the first several questions, you will be asked to compare two values/benefits that forest tracts provide to our community and to choose which value you feel is the **more important** of the two choices. As you consider your response, keep in mind that you are not choosing one value as important and another as *un*important; you are simply choosing the value that you feel is *more important* than the other.

1. Please consider the following two values/benefits that Liberty's forest tracts provide.

Which value/benefit do you feel is more important?

(The next several questions asked this question as a pairwise comparison among all of the following values/benefits).

Air Quality Enhancement and Carbon Storage--Trees improve air quality via direct leaf absorption of pollutants, including nitrogen dioxide, sulfur dioxide, carbon monoxide, ozone, and particulate matter such as dust, pollen, and smoke. Trees hold carbon in new growth every year, thus reducing the amount of this greenhouse gas being released to the atmosphere.

Access to nature**---** A patch of "woods" in the neighborhood provides immeasurable opportunities for kids to explore and experience the outdoors. Trees near our homes are proven to provide extensive mental and physical health benefits. Research shows that---for both adults and children---everyday encounters with nature restore the ability to concentrate and reduce anxiety, stress and aggression.

Stream Protection**---**Forested streams help to stabilize streambanks and hold soil in place. This reduces bank erosion and sedimentation that degrades downstream water quality. Trees provide habitat for fish and birds, and shade prevents excess algae buildup in streams.

Stormwater Retention and Flood Protection**---**Forested floodplains capture rainwater on tree leaves and absorb stormwater through tree roots and forest litter, thus slowing the volume and velocity of runoff into streams. This reduces the impacts of major storm events while helping to recharge groundwater.

Providing Natural Habitat**---**Forest tracts differ in their ecological quality and their value as wildlife habitat. Tracts with high ecological quality would have large trees, high species diversity, and little presence of invasive species. Such tracts would be expected to provide essential food and cover for birds and other forest wildlife.

Recreation Enhancement**---**Forested parks or multi-use trails allow us to easily and safely enjoy the outdoors. Outdoor playgrounds, ballfields, trails, and public use areas are enhanced by the added benefits of forest cover within or around these areas.

For the next question, you will be asked to rank four different values or benefits that forest tracts provide to our community. A short summary is provided as background for each value. Please read through the four summaries, and then rank their importance.

1. Air Quality---Trees improve air quality via direct leaf absorption of pollutants, including nitrogen dioxide, sulfur dioxide, carbon monoxide, ozone, and particulate matter such as dust, pollen, and smoke. Liberty is especially susceptible to air pollution from the Kansas City Metro Area due to prevailing winds from the south. Breathing these pollutants can trigger a variety of respiratory problems including bronchitis, emphysema, and asthma.

2. Climate Change---Scientists recognize that Carbon is a greenhouse gas whose increase in the atmosphere is linked to global climate change. Trees hold carbon in new growth every year, thus reducing Carbon being released to the atmosphere. Each acre of forest in Liberty is estimated to store 4,237 pounds of carbon per year.

3. Energy Conservation and the Heat Island Effect—Roads, parking lots, and other non-vegetated areas can raise surface temperatures in cities and towns. Forest tracts can buffer this effect by providing shade and evaporative cooling, as well as blocking winter winds, which can decrease heating and cooling costs. Shaded surfaces may be 20-45 degrees cooler, and evapotranspiration can reduce peak summer temperatures by 2-9 degrees. Reduced air temperature due to trees can improve air quality because the emissions of many pollutants and/or ozone-forming chemicals are temperature dependent.

4. Community "Livability"---Research demonstrates a wide array of social, psychological, and economic benefits of trees in our communities. Visually, forest tracts may enhance the aesthetics of developed areas, especially those that lack "greenness". Certain forest tracts may be important to a town's character due to location, size, public use, or historical significance. Trees near our homes enhance property values, reduce stress, deter crime, and provide extensive mental health benefits.

Please rank these values in order from 1 to 4, with the highest rank being 1, the next highest rank being 2, etc.

Please select the response that best describes your connection to Liberty.

a. I am a resident or business owner in Liberty.
b. I live outside of Liberty but within the Liberty School District.
c. I live outside of Liberty and the school district, but I work, shop, dine, attend church or conduct other activities within Liberty.
d. None of the above

∗9. Please consider the following two values/benefits that Liberty's forest tracts provide.

Access to Nature---A patch of "woods" in the neighborhood provides immeasurable opportunities for kids to explore and experience the outdoors. Trees near our homes are proven to provide extensive mental and physical health benefits. Research shows that---for both adults and children---everyday encounters with nature restore the ability to concentrate and reduce anxiety, stress and aggression.

Recreation Enhancement---Forested parks or multi-use trails allow us to easily and safely enjoy the outdoors. Outdoor playgrounds, ballfields, trails, and public use areas are enhanced by the added benefits of forest cover within or around these areas.

Which value/benefit do you feel is more important?

- ✔ Access to Nature
- ○ Recreation Enhancement

Prev   Next

CPRM Methods

The CPRM was built using CommunityViz software ([Placeways](#) LLC). CommunityViz (CV) is an extension to ESRI ArcGIS, the most commonly used GIS software. Extensions are programs that work "on top of" ArcGIS. Users interact with both ArcGIS and CV at the same time as though they are the same software.

One of the many tools in CV is the suitability wizard, which was used for the CPRM. This tool looks at a set of features and, for each feature, calculates a score of how suitable (desirable) that feature is for a certain activity (e.g. development, conservation, restoration, management regime, etc.). The scores are based on input criteria given by the user.

In Liberty's CPRM, the suitability wizard analyzed each forest tract by computing a priority ranking score representing how suitable that forest tract is for conservation. The priority ranking scores are calculated using a weighted average formula. The numerical value of each criterion describe in Table 3 (pg. 17) was calculated for each forest tract. For example, the tract size criterion is simply a measure of how big the tract is (in acres). The four 'overlap factors' are a measure of how much of the tract overlaps with the features of interest (expressed as a percentage of the tract area). The ecological quality factors are qualitative; they are based on a visual field survey completed by Chris Wilson (Liberty Parks & Open Space Manager). The numerical values for each criterion are then normalized from 1-100 for all tracts (i.e for each criteria the tract with the lowest numerical value gets a 0 and the tract with the highest numerical value gets a 100 with the rest proportionately dispersed between). This normalization is done so the numerical values of all factors can be accurately compared. For instance, the values for the overlap factors can only be between 0 and 100 since they are percentages, but the value for tract size acres ranges from <1 to 425. With normalization, the relative values of criteria in each tract are preserved while making the absolute magnitude of all criteria the same. Once the values for each criterion have been normalized, they are multiplied by their respective weighting factors (Figure 8 pg. 16). These weighted scores for each criterion are summed for each forest tract to get a raw suitability score. The last step is to normalize the raw suitability scores from 1-100 to arrive at the final suitability (Priority Ranking Score).

An example of the weighted average calculation on one criterion for one tract:

Tract number 67 is the fifth largest in Liberty at 119 acres. When the tract size criterion is normalized across all tracts, tract 67 gets a value of 98 (which is close to 100 because this is one of the largest tracts). The weighting factor for the tract size criteria is 5. The normalized tract size of 98 gets multiplied by the weighting factor of 5. This calculation happens for each criterion for tract 67 (and every other tract too). All of tract 67's normalized, weighted values are summed to find its raw suitability score. Tract 67's raw suitability score is 44. The raw suitability scores for all tracts ranges from 1 to 67. When the raw suitability scores are normalized to find the final Priority Ranking Scores tract 67 gets a final score of 66 (which is equal to (44/67)*100).

Appendix 3: References

1. Urban Watershed Forestry Manual – Part 1: Methods for Increasing Forest Cover in a Watershed. US Department of Agriculture, Forest Service, Northeastern Area, State and Private Forestry. July 2005. www.na.fs.fed.us

Photo Credits:

Cover page photo
http://steve-karol.artistwebsites.com/products/barn-in-liberty-mo-steve-karol-art-print.html?currencyid=EUR

Residential Home – i-Tree Eco Ecosystem Services Results (pg. 14):
http://www.reeceandnichols.com/homes-for-sale/MO/Liberty

Invasive overgrown stand (pg. 18):
http://www.invasive.org/weedcd/images/1536x1024/2132058.jpg

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http://1.bp.blogspot.com/_gzPWxB1yBog/TI5MSnrmq8I/AAAAAAAAA_8/lsSoCD3uJiI/s1600/palos+singletrack.JPG

Raccoons – CPRM methodology (pg. 9):
http://commons.wikimedia.org/wiki/File:Raccons_in_a_tree.jpg

Downy Woodpecker – CPRM methodology (pg. 9): http://stevecreek.com/a-downy-woodpecker-with-a-mouthful/

Squirrel CPRM methodology (pg. 9): http://www.colorsphere.com/photographs/Squirrels/

Photos taken by Ian Hanou, Plan-It Geo on 2/07/2013

- 🌳 Trees along road – project background (pg. 3)
- 🌳 Field and forest tract panoramic – i-Tree Canopy results (pg. 12)
- 🌳 Curving road w/ mailbox – i-Tree Eco results (pg. 19)
- 🌳 Trees and forests in Liberty – Conclusions (pg. 21 and 22)

Photos taken by Chris Wilson, Liberty Parks & Open Space

- 🌳 Stream corridor, large tree, tree planting – Executive Summary (pg. 1)
- 🌳 Bridge with dog walker, hikers on trail – Executive Summary (pg. 2)