Appendix A
A Guide for Species Selection

Managing trees in a changing climate is challenging for arborists and urban foresters. Species that are currently thriving could decline as future climatic conditions alter weather events and patterns. Local knowledge and expertise of Cleveland's urban forest was utilized to produce the following guide for the selection of trees that can tolerate extreme environmental conditions.

Trees were selected and compiled into a recommended species list for Cleveland's urban forest by Holden Arboretum's Plant Collection and Records Curators. This list is intended to aid species selection for public and private land across the community with consideration given to trees that tolerate urban conditions like compaction, drought, pollution, and salt.

Specific characteristics were considered in selecting species that could collectively contribute to a more sustainable urban and community forest, including the promotion of diversity, selective use of native plants, maximization of benefits, and improvement of overall population resiliency. Ultimately, all species should be matched to the prospective site after a detailed assessment of the above- and below-ground landscape is performed and considered.

Tree Planting Guidelines

All future tree plantings should fall within specific guidelines outlined below and according to industry standards, such as ANSI A300.6-2014 *Planting and Transplanting* standards and ANSI Z60.1-2014-American Standards for Nursery Stock. The following tree planting guidelines help emphasize important concepts in urban and community forestry management and planning.

- **Right Tree Right Place.** Improperly siting trees can result in economic, environmental, and social losses to the community. The "*right tree right place*" maxim is central to changing the conversation around trees, specifically with respect to thinking of trees as assets versus liabilities (Arbor Day Foundation). Tree planting and transplanting projects should carefully consider plant characteristics at maturity, above- and below-ground site factors, and urban forest composition.

  A unique tool is also available to assess the urban site index (USI) developed by regional urban foresters at the Ohio Department of Natural Resources Division of Forestry (Leibowitz 2012). The tool utilizes a rapid assessment of factors to score sites between 0 and 20 as a means to identify planting suitability. A long-term commitment to USI could provide an opportunity to quantify planting site suitability and track urban tree growth, longevity, and performance over time.

- **Diversity.** As a general rule of thumb, no more than 30% of any family, 20% of any genus, or 10% of any species should comprise the collective urban forest (Santamour 1990). The same diversity guidelines should apply to individual reforestation or planting and transplanting projects.

Many pests and diseases leave genera susceptible to infestation and damage as opposed to the overall tree family (Ball et al. 2007). Proposed tree plantings should, at a minimum, consider limiting the number of trees within a single genus to less than 10% per planting. Ambitious projects may aspire to meet more rigorous guidelines of planting no more than 15% of any family, 10% of any genus, or 5% of any species.

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Diversity should also be promoted within fine scale street segments to ensure large contiguous losses of canopy does not occur (ODNR 2013). A master planting plan can aid in urban forest diversity.

Native species should be prioritized where possible and practical for biodiversity as the site allows. Known invasive trees and trees likely not native to the region should be avoided. If a tree is scientifically deemed invasive in the 25-75 year urban forest management cycle, then the trees should not be planted.

- **Evergreen Conifers and Ecosystem Services.** Many of the benefits attributed to urban trees in the United States and Canada are derived from broadleaf deciduous species (Klapp 2014); these benefits are lost during leaf-off periods. Therefore, a concerted effort should be made to account for and ensure canopy-dependent benefits. For example, year-round stormwater mitigation and pollution reduction benefits can be increased via inclusion of evergreen conifers. To sustain benefits and improve diversity, all planting projects should include at least 5% conifers that retain their foliage.

- **Growing Space Potential, Volume, and Size.** Potential planting sites are defined as areas suitable for tree planting within the existing right-of-way. The size of the site should be designated as small, medium, or large, depending primarily on the growing space available and the presence of overhead wires. The overall landscape and existing planting scheme should also be taken into consideration for the spacing and sizes of recommended planting sites.

Ensuring that a tree reaches its full size potential depends on the amount of available soil volume and surrounding site constraints. Minimum soil volumes for root space are suggested to be 1–2 ft^3 for each square foot of projected mature crown (Lindsey and Bassuk 1991). Other formulas have derived minimum soil volumes based on trunk to crown diameter (Urban 2008). Urban foresters generally adhere to the following soil volume minimums: 300 cubic feet for small trees, 600 cubic feet for medium trees, and 1,000 cubic feet for large trees.

Planting site width is critical to calculating available soil volume; a site's capacity influences the size of trees selected. Small trees require minimum widths of 4–6 feet, medium trees 6–8 feet, and large trees 8 feet or greater. Spacing depends on the size of adjacent or projected tree canopy diameters and should be no less than half of the projected crown. Each prospective planting site will vary in its tree-carrying capacity.

- **Limitations and Moratoriums.** Urban forest canopy has been lost from mortality associated with pests, diseases, and structurally weak tree species. Limitations and moratoriums should be considered to limit future loss due to susceptibility:

  o **Ash** – Trees in the *Fraxinus* genus should not be planted due to the confirmed presence of emerald ash borer (*Agrilus planipennis*) within the community.

  o **Elm** – Trees in the *Ulmus* genus that do not have Dutch elm disease (*Ophiostoma ulmi; Ophiostoma novo-ulmi*) resistance should not be planted within the community.

  o **Maple** – Trees in the *Acer* genus are susceptible to Asian longhorned beetle (*Anoplophora glabripennis*) and are currently in excess of the 20% genus rule. Planting of maple should be limited within the community. Planting of Norway maple (*Acer platanoides*) should also be limited as it currently exceeds the 10% species rule.

  o **Oak** – Planting of trees in the red oak group of the *Quercus* genus should be limited due to the presence of oak wilt (*Ceratocystis fagacearum*) within the community.

  o **Pear** – *Pyrus calleryana* is a non-native and invasive tree with weak branch and wood structure; it should not be planted in the community.

- **Utilities.** Planting medium or large trees underneath overhead utilities is a potentially costly mistake. Only small trees less than 25 feet tall at maturity should be planted underneath utility lines to limit the potential for future conflicts as trees mature in size (Ohio Consumers' Council 2012). There may be situations where overhead utility lines are constructed at greater heights, but only qualified arborists should investigate those instances for planting.

  The location of below-ground utilities is equally concerning to overhead utilities. The presence of buried electrical, natural gas, and water lines can limit the viability of planting sites. Detection of these utilities can be accomplished by dialing 811 for Ohio Utilities Protection Services (OUPS) at least 48 hours in advance of underground site assessment and planting.

- **Infrastructure Conflicts.** Green and grey infrastructure conflicts are common occurrences. Such conflicts are usually caused by siting large-growing species in spaces that are unsuitable for their mature size or not considering existing infrastructure in the site selection and planting process.

Trees should always be sited away from existing infrastructure at these minimum distances:

- **Street Intersections –** at least 35 feet

- **Utilities (poles, water boxes, street lamps, etc.) –** 10 to 15 feet

- **Alleys –** 15 feet

- **Driveway and Walkway Intersections –** 10 to 15 feet

- **Fire Hydrants –** 10 to 15 feet

When trees are given adequate space, less conflicts arise, management costs are reduced, and access to municipal amenities is more efficient.

Characteristics and Scenarios

Planning, planting, and maximizing the benefits of the urban forest requires careful consideration of the following: characteristics of tree selection; realistic scenarios to create equitable distribution of canopy; and identifying specific community goals. Cleveland's urban and community forest can function at optimum levels through the maximization of proper tree selection, installation, and continued care and focus towards ensuring a sustainable future.

Tree Characteristics

The following recommended species list for Cleveland's urban forest was compiled to address limiting factors in urban forest management and planning. With an understanding of species characteristics, trees can be selected to flourish in a wide range of scenarios. Tree characteristics should be considered only after a detailed site assessment has been performed.

- **Diversity** – over 70 species and cultivars of trees were selected to promote diversity; there has not been a recent inventory to assess the diversity of public and private trees.

- **Invasiveness** – non-native invasive tree species like *Ailanthus altissima* (tree-of-heaven) colonize vacant lots, displace native trees, and fragment forests; these types of trees were not included.

- **Hardiness** – increased temperatures from urban heat island effect and challenging microclimates; large buildings were considered in selecting trees that are tolerant of extreme climatic conditions.

- **Disease and Pest Resistance** – the presence of lethal pests and diseases was considered in excluding certain genera/species of trees and selecting specific varieties (e.g., no ash trees; emerald ash borer).

- **Mature Size and Form** – since urban environments are often limited in growspace, species and varieties were selected to provide options when existing tree canopy and infrastructure are present or could potentially obstruct growth.

- **Longevity** – trees are often short-lived in urban environments due to poor species selection, lack of care, and challenging growing conditions; all species are intended to last at least 25 years.

- **Aesthetics** – the functional shape and beauty (bark, flowers, foliage, and fruit) associated with specific species of trees was highlighted, as Cleveland has a rich horticultural legacy of curating plants.

Native – The majority of plants in Cleveland's urban forest are likely not native to the region, however, native plants can be appropriate as the quality of the site allows.

- **Messiness** – Fruit can clutter the landscape, but notorious species (i.e., ginkgo, Kentucky coffeetree, persimmon) have fruitless varieties or can be sited away from infrastructure and traffic.

- **Notes** – Local knowledge and expertise and unique plant needs or considerations were highlighted to ensure proper use within Cleveland.

Common Planting Scenarios

Planting in the urban forest typically involves three different planting scenarios: street trees, park trees, and private trees. A site inspection presents opportunities to identify important species selection considerations and space out and plan where future trees can be planted. Scenarios provide valuable perspective on existing processes and potential limiting factors. The following recommended species list for Cleveland's urban forest should be utilized when selecting species for any planting project.

- **Street Trees.** A 'street tree' is defined as a tree growing within the public rights-of-way (generally the area between a curb and a sidewalk) which has been planted by the city or its residents. If you want to plant a street tree in Cleveland, there are a series of steps that should be taken. First and foremost, you should request a tree from the Division of Park Maintenance and Properties. Tree planting should be coordinated with the Urban Forestry Section by dialing 216-664-3104 to obtain Priority Planting status on the city's database. A tree can be installed by the city through this process.

  All other street tree plantings require a permit, which can be acquired by dialing 216-664-2388 for procurement. The Urban Forestry section's urban forester will then inspect the site, select an appropriate tree species, and acquire insurance from the planting contractor. Plantings are typically completed by contractors who are required to abide by the city's tree planting details and specification.

- **Park Trees.** A 'park tree' may have different definitions depending on the type of park, the managing agency, and the desired goals and objectives. In general, many parks were created from open areas that were originally forestland. Some exceptions may be applied for historically conserved areas. In Cleveland, park trees fall under the management of the Division of Park Maintenance and Properties with oversight from the Urban Forestry Section's urban forester. All tree plantings within the park require a process in which the Urban Forestry section's urban forester can inspect, select, and oversee the process. All planting is based on the availability of funding.

- **Private Trees.** The majority of urban tree canopy is located on private lands across the community. Land uses may include: residential, multi-family residential, commercial/industrial, cemeteries, golf courses, agricultural, vacant, institutional, utility, wetlands, transportation, and other mixed or independent uses. Trees may be planted in specific land uses with a performance goal in mind. For example, riparian corridors may be planted with trees to improve stream flow. Medical campuses may utilize trees to improve human health. Industrial districts may plant to improve air quality and mitigate climate change. Also, high-density, mixed-use districts with a large amount of impervious cover may find innovative ways to site trees in an effort to offset urban heat island effect.

The most important part of identifying scenarios for planting is the careful consideration of environmental conditions and

cultural constraints (site factors) in tandem with economic and cultural factors (Miller 1997). It is important to examine the landscape and assess the soil, climatic, physiographic, and biological variables of a prospective planting site. The surrounding constraints (utilities, structures, land cover, and pollution) may limit species selection while informing best arboricultural and urban forest management practices around tree selection and planting.

Please note that planting of trees is based on availability. Most of the following cultivars may not be widely available:

Climate Resilient Trees for Cleveland

Street/Tree Lawn

Small: Under 25'

Genus	Species
Acer buergerianum	trident maple
Quercus prinoides	dwarf chinkapin oak (super lime and drought tolerant)
Styphnolobium japonicum	'Pendulum' weeping Japanese pagodatree
Syringa reticulate	Ivory Silk' Japanese tree lilac
Tilia cordata	Summer Sprite, littleleaf linden
Zelkova serrata	City Sprite, Japanese zelkova

Medium: 26–50'

Genus	Species
Acer campestre	hedge maple ('Queen Elizabeth' not fully hardy in Zone 5)
Acer miyabei 'Morton'	State Street Miyabe maple
Carpinus betulus	Emerald Avenue, European hornbeam
Celtis laevigata	sugar hackberry
Celtis 'Magnifica'	hackberry hybrid
Koelreuteria paniculata	goldenrain tree

Medium (Continued)

Genus	Species
Maackia amurensis 'MaacNificent'	Amur maackia
Maackia amurensis 'Starburst'	Amur maackia
Maclura pomifera	'White Shield', Osage orange
Parrotia persica 'Vanessa'	Persian ironwood
Quercus robur x *bicolor* 'Nadler'	Kindred Spirit oak
Ulmus parvifolia Allee	lacebark elm
Ulmus propinqua Emerald Sunshine	elm
Zelkova serrata 'Mushashino'	columnar Japanese zelkova
Zelkova serrata 'Village Green'	Japanese zelkova

Large: Over 50'

Genus	Species
Acer x freemanii 'Autumn Blaze'	Freeman maple
Betula nigra	river birch - tree form, single stem
Ginkgo biloba	ginkgo (male clones)
Gleditsia triacanthos var. inermis	honeylocust [Imperial, 'Shademaster', Skyline, StreetKeeper]
Gymnocladus dioica	Kentucky coffeetree - male clones [Espresso, Prairie Titan, Stately Manor]
Ostrya virginiana	hophornbeam
Platanus x acerifolia 'Exclamation'	London planetree
Quercus bicolor	swamp white oak
Quercus imbricaria	shingle oak
Quercus macrocarpa	bur oak
Quercus muehlenbergii	chinkapin oak
Quercus palustris	pin oak
Quercus palustris Green Pillar	columnar pin oak

Large (Continued)

Genus	Species
Quercus robur x *bicolor* 'Long'	Regal Prince oak
Quercus rubra	red oak
Quercus shumardii	Shumard oak
Styphnolobium japonicum 'Regent'	Japanese pagodatree
Taxodium distichum	baldcypress
Tilia × euchlora	Crimean Linden
Tilia cordata	Greenspire, littleleaf linden
Tilia tomentosa	silver linden
Ulmus americana	American elm cultivars. 'Princeton', 'Jefferson', 'New Harmony'
Ulmus 'Patriot'	elm hybrid
Ulmus 'Triumph'	elm hybrid
Zelkova serrata 'Green Vase'	Japanese zelkova

Deciduous Trees for Parks and Other Larger Plots Including Private Land

Small: Under 25'

Genus	Species
Acer buergerianum	trident maple
Aesculus pavia	red buckeye
Asimina triloba	pawpaw
Cercis canadensis	redbud
Chionanthus retusus	Asian fringetree
Cornus florida 'Appalachian Spring'	flowering dogwood
Cornus kousa	Asian flowering dogwood
Magnolia 'Golden Gift'	yellow magnolia
Magnolia x *loebneri*	loebner magnolia
Magnolia stellata	star magnolia

Small (Continued)

Genus	Species
Magnolia virginiana	sweetbay magnolia
Malus 'Bob White'	flowering crab apple
Malus 'Prairifire'	flowering crab apple
Malus 'Red Jewel'	flowering crab apple
Malus 'Sugar Tyme'	flowering crab apple
Syringa reticulata 'Ivory Silk'	Japanese tree lilac
Tilia cordata 'Summer Sprite'	littleleaf linden
Zelkova serrata 'City Sprite'	Japanese zelkova

Medium: 26-50'

Genus	Species
Acer campestre	(Avoid Queen Elizabeth: not reliably winter hardy in Zone 5)
Acer griseum	paperbark maple
Acer miyabei 'Morton'	State Street Miyabe maple
Acer triflorum	threeflower maple
Aesculus glabra	Ohio buckeye
Amelanchier x *grandiflora*	apple serviceberry
Amelanchier laevis	Allegheny serviceberry
Carpinus betulus 'Emerald Avenue'	European hornbeam
Carpinus caroliniana	American hornbeam
Celtis laevigata	sugar hackberry
Celtis 'Magnifica'	hackberry hybrid
Cladrastis kentukea	yellowwood
Crataegus viridis 'Winter King'	green hawthorn
Halesia tetraptera	Carolina silverbell
Koelreuteria paniculata	goldenrain tree
Maackia amurensis 'MaacNificent'	Amur maackia
Maackia amurensis 'Starburst'	Amur maackia
Maclura pomifera 'White Shield'	Osage orange

Medium (Continued)

Genus	Species
Magnolia 'Butterflies'	yellow magnolia
Magnolia 'Coral Lake'	magnolia
Magnolia 'Daybreak'	magnolia
Magnolia 'Elizabeth'	yellow magnolia
Magnolia tripetala	umbrella magnolia
Magnolia 'Yellow Bird'	yellow magnolia
Parrotia persica	Persian ironwood
Quercus robur x *bicolor* 'Nadler'	Kindred Spirit oak
Ulmus 'Frontier'	elm hybrid
Ulmus parvifolia Allee	lacebark elm
Ulmus propinqua 'Emerald Sunshine'	elm
Zelkova serrata 'Mushashino'	columnar Japanese zelkova
Zelkova serrata 'Village Green'	Japanese zelkova

Large: Over 50'

Genus	Species
Acer x *freemanii* 'Autumn Blaze'	Freeman maple
Aesculus flava	yellow buckeye
Betula nigra	river birch - tree form, single stem
Cercidiphyllum japonicum	katsuratree
Diospyros virginiana	common persimmon
Fagus sylvatica	European beech
Ginkgo biloba	ginkgo (male clones)
Gleditsia triacanthos var. *inermis*	honeylocust [Imperial, 'Shademaster', Skyline, StreetKeeper]
Gymnocladus dioica	Kentucky coffeetree
Liriodendron tulipifera	tuliptree
Liquidambar styraciflua	sweetgum ['Moraine', 'Variegata', plants of Ohio provenance]

Large (Continued)

Genus	Species
Magnolia acuminata	cucumber tree
Metasequoia glyptostroboides	dawn redwood
Nyssa sylvatica	black gum
Ostrya virginiana	hophornbeam
Platanus × acerifolia 'Exclamation'	London planetree
Quercus bicolor	swamp white oak
Quercus imbricaria	shingle oak
Quercus macrocarpa	bur oak
Quercus muehlenbergii	chinkapin oak
Quercus palustris	pin oak
Quercus palustris	Green Pillar, columnar pin oak
Quercus robur × bicolor 'Long'	Regal Prince oak
Quercus rubra	red oak
Quercus shumardii	Shumard oak
Styphnolobium japonicum 'Regent'	Japanese pagodatree
Taxodium distichum	bald cypress
Tilia × euchlora	Crimean Linden
Tilia americana	American linden
Tilia cordata 'Greenspire'	littleleaf linden
Tilia tomentosa	silver linden
Ulmus americana	American elm cultivars. 'Princeton', 'Jefferson', 'New Harmony'
Ulmus 'Patriot'	elm hybrid
Ulmus Triumph	elm hybrid
Zelkova serrata 'Green Vase'	Japanese zelkova

Evergreen Trees for Parks and Other Larger Plots Including Private Land

Small: Under 25'

Genus	Species
Juniperus chinensis 'Keteleeri'	Chinese juniper (average to dry sites)

Medium: 26-50'

Genus	Species
Juniperus virginiana	('Canaertii', 'CorCorCor' Emerald Sentinel), eastern redcedar (average to dry sites)
Pinus virginiana	Virginia pine (average to dry sites)
Thuja occidentalis	Eastern arborvitae (upright types)
Thuja 'Green Giant' a.k.a. 'Spring Grove'	arborvitae hybrid

Large: Over 50'

Genus	Species
Abies concolor	white fir
Abies nordmanniana	Nordman fir
Picea orientalis	oriental spruce
Pinus rigida	pitch pine
Pinus rigida × taeda	pitch-lob pine

*Compiled by Charles Tubesing, Curator of Plant Collections, The Holden Arboretum, with input on conifers from Ethan Johnson, Plant Records Curator.

Species Selection Matrix

Species[1]	Common Name	Cultivars	Size[2]	Spread	Form	Hardiness Zone	Growth Rate	Longevity	Aesthetics	Native[3]	Scenario	Performance[4]	Notes
Abies concolor	white fir	•••	L	20'	conical	3 to 7	slow	50 > years	•••	•••	park or private	AQ	conifer; protected sites
Abies nordmanniana	Nordman fir	•••	L	30'	pyramidal	4 to 6	slow	50 > years	•••	•••	park or private	AQ	conifer
Acer buergerianum	trident maple	•••	S	25'	oval	5 to 8	slow	50 > years	•••	•••	park, private or street	•••	overhead-utility line compatible
Acer campestre	hedge maple	•••	M	30'	rounded	5 to 8	slow	50 > years	•••	•••	park, private or street	•••	Queen Elizabeth not fully hardy in Zone 5
Acer griseum	paperbark maple	•••	M	20'	rounded	5 to 7	slow	50 > years	bark	•••	park	•••	•••
Acer miyabei	Miyabe maple	Morton	M	25'	upright oval	4 to 6	slow	50 > years	•••	•••	park, private or street	•••	
Acer triflorum	threeflower maple	•••	M	30'	upright spreading	5 to 7	slow	50 > years	bark	•••	park	•••	•••
Acer x freemanii	Freeman maple	Autumn Blaze	L	40'	broad oval	4 to 7	fast	25-50 years	foliage	Ohio	park, private or street	CC,H,S,UHI	dominant central leader
Aesculus flava	yellow buckeye	•••	L	50'	upright oval	4 to 8	moderate	50 > years	•••	Ohio	park	CC,H,S,UHI	requires a sheltered site
Aesculus glabra	Ohio buckeye	•••	M	40'	rounded	3 to 7	moderate	50 > years	•••	Cuyahoga County	park	CC,H,S,UHI	shade tolerant
Aesculus pavia	red buckeye	•••	S	20'	rounded (varies)	4 to 8	moderate	50 > years	flowers	Ohio	park	•••	red flower
Amelanchier laevis	Allegheny serviceberry	•••	M	40'	rounded	4 to 8	moderate	50 > years	flowers	Ohio	park	AQ	prefers shade
Amelanchier x grandiflora	apple serviceberry	•••	M	30'	rounded	5 to 8	moderate	50 > years	fruit	North America	park	AQ	prefers shade
Asimina triloba	paw-paw	•••	S	20'	pyramidal (multi-stem)	5 to 9	moderate	25-50 years	fruit	Cuyahoga County	park	AQ	•••
Betula nigra	river birch	•••	L	50'	pyramidal (rounded)	4 to 9	fast	25-50 years	bark	Cuyahoga County	park, private or street	•••	tree form, single stem
Carpinus betulus	European hornbeam	Emerald Avenue	M	30'	pyramidal (oval-rounded)	4 to 7	moderate	50 > years	•••	•••	park, private or street	•••	•••
Carpinus caroliniana	American hornbeam	•••	M	30	round (irregular)	3 to 9	slow	50 > years	•••	Cuyahoga County	park	•••	•••
Celtis laevigata	sugarberry	•••	M	50'	broad-rounded	5 to 9	moderate	50 > years	bark	North America	park, private or street	CC,H,UHI	•••
Celtis x	hybrid hackberry	Magnifica	M	40'	broad-oval	5 to 9	fast	50 > years	•••	North America	park, private or street	CC,H,UHI	•••
Cercidiphyllum japonicum	katsuratree	•••	L	50'	pyramidal (oval-rounded)	4 to 8	moderate	25-50 years	•••	•••	park or private	AQ	moist and protected sites
Cercis canadensis	redbud	•••	S	25	flat-topped (rounded)	4 to 9	moderate	25-50 years	flowers	Ohio	park or private	•••	lime tolerant; well drained sites
Chionanthus retusus	Chinese fringetree	•••	S	20'	broad-rounded	4 to 9	slow	25-50 years	fruit	•••	park or private	•••	•••
Cladrastis kentukea	Kentucky yellowwood	•••	M	40'	broad-rounded	4 to 8	moderate	25-50 years	•••	Ohio	park or private	•••	attention to structural pruning
Cornus florida	flowering dogwood	Appalachian Spring	M	20'	flat-topped (rounded)	5 to 9	slow	25-50 years	flowers	Cuyahoga County	park or private	•••	Appalachian Spring anthracnose resistant
Cornus kousa	Asian flowering dogwood	•••	M	30'	rounded (horizontal)	5 to 8	slow	25-50 years	fruit	•••	park or private	•••	•••

Species[1]	Common Name	Cultivars	Size[2]	Spread	Form	Hardiness Zone	Growth Rate	Longevity	Aesthetics	Native[3]	Scenario	Performance[4]	Notes
Crataegus viridis	green hawthorn	Winter King	M	25'	vase (spreading)	4 to 7	slow	25-50 years	fruit	North America	park or private	•••	Winter King thornless
Diospyros virginiana	common persimmon	•••	L	35	pyramidal (oval-rounded)	4 to 9	moderate	25-50 years	•••	Ohio	park or private	AQ	not widely available; plant where fruit is not an issue
Fagus sylvatica	European beech	•••	L	50'	pyramidal (rounded)	5 to 7	moderate	50 > years	•••	•••	park or private	CC	•••
Ginkgo biloba	ginkgo	see notes	L	40'	pyramidal (wide-spread)	4 to 7	slow	50 > years	•••	•••	park, private or street	CC,H,S	male clones
Gleditsia triacanthos var. inermis	honeylocust	Imperial	L	40'	broad-spreading	4 to 7	fast	25-50 years	•••	Cuyahoga County	park, private or street	•••	•••
		'Shademaster'	L	40'	upright-spreading	4 to 7	fast	25-50 years	•••	Cuyahoga County	park, private or street	•••	•••
		Skyline	L	35'	pyramidal-spreading	4 to 7	fast	25-50 years	•••	Cuyahoga County	park, private or street	•••	•••
		StreetKeeper	L	20'	broad-columnar	4 to 7	fast	25-50 years	•••	Cuyahoga County	park, private or street	•••	•••
Gymnocladus dioica	Kentucky coffeetree	Espresso	L	35'	vase (irregular)	4 to 8	slow	50 > years	•••	Ohio	park, private or street	•••	
		Prairie Titan	L	45'	oval (irregular)	4 to 8	slow	50 > years	•••	Ohio	park, private or street	•••	male clones
		Stately Manor	L	40'	obovate (irregular)	4 to 8	slow	50 > years	•••	Ohio	park, private or street	•••	
Halesia tetraptera	Carolina silverbell	•••	M	30	round headed	5 to 8	moderate	50 > years	flowers	Ohio	park or private	•••	white flower
Juniperus chinensis	Chinese juniper	Keteleeri	S	15'	pyramidal	3 to 9	moderate	25-50 years	foliage	•••	park or private	•••	average to dry sites; conifer
Juniperus virginiana	eastern redcedar	'Canaertii'	M	20'	dense-pyramidal	4 to 9	moderate	25-50 years	•••	Ohio	park or private	•••	average to dry sites; conifer
		Emerald Sentinel	M	10'	pyramidal column	4 to 9	moderate	25-50 years	•••	Ohio	park or private	•••	average to dry sites; conifer; good fruiting form
Koelreuteria paniculata	goldenrain tree	•••	M	30'	rounded	5 to 8	moderate	25-50 years	flowers	•••	park, private or street	•••	heat tolerant
Liquidambar styraciflua	sweetgum	'Moraine'	L	40'	pyramidal	5 to 9	fast	25-50 years	foliage	Ohio	park or private	CC,H,S,UHI	•••
		'Variegata'	L	35'	pyramidal	5 to 9	moderate	25-50 years	foliage	Ohio	park or private	CC,H,S,UHI	variegated
Liriodendron tulipifera	tuliptree	•••	L	40'	pyramidal (rounded)	4 to 9	fast	50 > years	•••	Cuyahoga County	park or private	CC,H,S,UHI	•••
Maackia amurensis	amur maackia	MaacNificent	M	25'	upright vase	4 to 7	slow	25-50 years	bark	•••	park, private or street	•••	•••
		'Starburst'	M	20'	vase (rounded)	4 to 7	slow	25-50 years	bark	•••	park, private or street	•••	•••
Maclura pomifera	osage organge	'White Shield'	M	35'	rounded	4 to 9	fast	25-50 years	•••	Cuyahoga County	park, private or street	•••	fruitless; thornless
Magnolia acuminata	cucumber tree	•••	L	40'	pyramidal (rounded)	4 to 8	moderate	50 > years	fruit	Cuyahoga County	park or private	CC,H,S,UHI	•••

Species[1]	Common Name	Cultivars	Size[2]	Spread	Form	Hardiness Zone	Growth Rate	Longevity	Aesthetics	Native[3]	Scenario	Performance[4]	Notes
Magnolia spp.	magnolia	'Butterflies'	M	10'	upright pyramidal	4 to 8	moderate	25-50 years	flowers	•••	park or private	•••	shelter from wind; yellow flower
		'Coral Lake'	M	20'	upright pyramidal	4 to 8	moderate	25-50 years	flowers	•••	park or private	•••	coral flower; shelter from wind
		'Daybreak'	M	20'	upright pyramidal	4 to 8	moderate	25-50 years	flowers	•••	park or private	•••	pink flower; shelter from wind
		'Elizabeth'	M	20'	upright pyramidal	4 to 8	moderate	25-50 years	flowers	•••	park or private	•••	shelter from wind; yellow flower
		'Golden Gift'	S	5'	compact	5 to 7	moderate	25-50 years	flowers	•••	park or private	•••	shelter from wind; yellow flower
		'Yellow Bird'	M	20'	upright pyramidal	4 to 8	moderate	25-50 years	flowers	•••	park or private	•••	shelter from wind; yellow flower
Magnolia stellata	star magnolia	•••	S	15'	dense-rounded	4 to 8	moderate	25-50 years	flowers	•••	park or private	•••	pink and white flower; heat and cold tolerance
Magnolia tripetala	umbrella magnolia	•••	M	15'	pyramidal	4 to 8	moderate	25-50 years	flowers	Ohio	park or private	H	•••
Magnolia virginiana	sweetbay magnolia	•••	S	20'	oval (rounded)	5 to 9	moderate	25-50 years	flowers	North America	park or private	•••	fragrant flowers
Magnolia x *loebneri*	Loebner magnolia	•••	S	15'	rounded (dense)	5 to 8	moderate	25-50 years	flowers	•••	park or private	•••	pink or white fragrant flower
Magnolia stellata	star magnolia	•••	S	15'	dense-rounded	4 to 8	moderate	25-50 years	flowers	•••	park or private	•••	pink and white flower; heat and cold tolerance
Magnolia tripetala	umbrella magnolia	•••	M	15'	pyramidal	4 to 8	moderate	25-50 years	flowers	Ohio	park or private	H	•••
Magnolia virginiana	sweetbay magnolia	•••	S	20'	oval (rounded)	5 to 9	moderate	25-50 years	flowers	North America	park or private	•••	fragrant flowers
Magnolia x *loebneri*	Loebner magnolia	•••	S	15'	rounded (dense)	5 to 8	moderate	25-50 years	flowers	•••	park or private	•••	pink or white fragrant flower
Malus spp.	crab apple	Bob White	S	20'	dense-rounded	4 to 7	moderate	25-50 years	flowers	•••	park or private	•••	white flower
		Prairiefire	S	20'	dense-rounded	4 to 7	moderate	25-50 years	flowers	•••	park or private	•••	fuchsia flower
		Red Jewel	S	15'	dense-rounded	4 to 7	moderate	25-50 years	fruit	•••	park or private	•••	red fruit
		Sugar Tyme	S	15'	dense-rounded	4 to 7	moderate	25-50 years	fruit	•••	park or private	•••	red fruit
Metasequoia glyptostroboides	dawn redwood	•••	L	25'	pyramidal (conical)	5 to 8	fast	50 > years	bark	•••	park or private	CC,H,S,UHI	best near water source; riparian
Nyssa sylvatica	blackgum	•••	L	30'	pyramidal	4 to 9	moderate	50 > years	foliage	Cuyahoga County	park or private	•••	fall color
Ostrya virginiana	American hop-hornbeam	•••	L	30'	rounded (horizontal)	4 to 9	slow	50 > years	fruit	Cuyahoga County	park, private or street	CC,UHI	•••
Parrotia persica	Persian ironwood	'Vanessa'	M	15'	pyramidal	4 to 8	moderate	25-50 years	bark	•••	park, private or street	•••	•••
Picea orientalis	oriental spruce	•••	L	20'	pyramidal	4 to 7	slow	50 > years	•••	•••	park or private	•••	conifer
Pinus rigida	pitch pine	•••	L	40'	pyramidal (irregular)	4 to 7	moderate	50 > years	•••	Ohio	park or private	•••	conifer; well drained
Pinus rigida x taeda	pich-lob pine	•••	L	40'	pyramidal	4 to 7	fast	50 > years	•••	North America	park or private	•••	conifer
Pinus virginiana	Virginia pine	•••	M	30'	broad (pyramidal)	4 to 8	slow	25-50 years	•••	Ohio	park or private	•••	average to dry sites; conifer

Species[1]	Common Name	Cultivars	Size[2]	Spread	Form	Hardiness Zone	Growth Rate	Longevity	Aesthetics	Native[3]	Scenario	Performance[4]	Notes
Platanus x acerifolia	London planetree	Exclamation	L	40'	upright-pyramidal	4 to 8	moderate	50 > years	bark	•••	park, private or street	CC,H,S	cold hardy
Quercus bicolor	swamp white oak	•••	L	50'	broad rounded	3 to 8	moderate	50 > years	•••	Cuyahoga County	park, private or street	•••	soil adaptability
Quercus imbricaria	shingle oak	•••	L	60'	broad rounded	4 to 7	slow	50 > years	•••	Cuyahoga County	park, private or street	•••	•••
Quercus macrocarpa	bur oak	•••	L	70'	broad rounded	2 to 8	slow	50 > years	•••	Cuyahoga County	park, private or street	•••	drought and lime tolerant
Quercus muehlenbergii	chinkapin oak	•••	L	40'	rounded	4 to 7	moderate	50 > years	•••	Cuyahoga County	park, private or street	•••	drought and lime tolerant
Quercus palustris	pin oak	•••	L	40'	pyramidal	4 to 7	fast	50 > years	•••	Cuyahoga County	park, private or street	CC	lime intolerant
		Green Pillar	L	15'	narrow-columnar	4 to 7	fast	50 > years	•••	Cuyahoga County	park, private or street	CC	
Quercus prinoides	dwarf chinkapin oak	•••	S	10'	pyramidal	4 to 8	slow	25-50 years	•••	North America	street	•••	lime and drought tolerant; overhead-utility line compatible
Quercus robur x *bicolor*	hybrid English oak	'Nadler' Kindred Spirit Oak	M	10'	narrow-columnar	3 to 7	slow	25-50 years	•••	•••	park, private or street	•••	•••
		'Long' Regal Prince Oak	L	20'	narrow-columnar	4	slow	25-50 years	•••	•••	park, private or street	•••	•••
Quercus rubra	red oak	•••	L	60'	rounded	4 to 7	fast	50 > years	•••	Cuyahoga County	park, private or street	•••	•••
Quercus shumardii	Shumard oak	•••	L	50'	rounded	5 to 9	moderate	25-50 years	•••	Ohio	park, private or street	CC,H,S,UHI	soil adaptability
Styphnolobium japonicum (Sophora japonica)	Japanese pagodatree	'Regent'	L	40'	oval (rounded)	4 to 7	fast	25-50 years	•••	•••	park, private or street	•••	•••
		'Pendulum'	S	15'	weeping	4 to 7	fast	25-50 years	•••	•••	street	•••	overhead-utility line compatible
Syringa reticulata	Japanese tree lilac	'Ivory Silk'	S	20'	rounded	3 to 7	moderate	25-50 years	flowers	•••	park, private or street	•••	overhead-utility line compatible
Taxodium distichum	bald cypress	•••	L	25	pyramidal	4 to 9	moderate	50 > years	bark	Ohio	park, private or street	H,S	•••
Thuja occidentalis	eastern arborvitae	many exist	L	15'	pyramidal	2 to 7	slow	50 > years	•••	Ohio	park or private	•••	upright types; conifer
Thuja x	hybrid arborvitae	'Green Giant' or 'Spring Grove'	L	20'	broad-pyramidal	4 to 7	slow	50 > years	•••	•••	park or private	•••	conifer
Tilia americana	American linden	•••	L	40'	oval rounded (arched)	2 to 8	moderate	50 > years	•••	Cuyahoga County	park or private	CC,H,S,UHI	low urban tolerance
Tilia cordata	littleleaf linden	Greenspire	L	30'	oval-rounded	4	moderate	50 > years	•••	•••	park, private or street	CC,H,S,UHI	•••
		Summer Sprite	S	15'	rounded	4	moderate	50 > years	•••	•••	street	CC,H,S,UHI	overhead-utility line compatible
Tilia tomentosa	silver linden	•••	L	40'	pyramidal (oval-egg)	2 to 6	moderate	50 > years	•••	•••	park, private or street	CC,H,S,UHI	•••
Tilia x euchlora	Crimean linden	•••	L	25'	rounded	3 to 7	moderate	25-50 years	•••	•••	park, private or street	H	•••

Species[1]	Common Name	Cultivars	Size[2]	Spread	Form	Hardiness Zone	Growth Rate	Longevity	Aesthetics	Native[3]	Scenario	Performance[4]	Notes
Ulmus americana	American elm	'Princeton'	L	50'	vase (spreading)	4	moderate	50 > years	•••	Cuyahoga County	park, private or street	CC,H,S,UHI	•••
		'Jefferson'	L	50'	vase (arching)	4	moderate	50 > years	•••	Cuyahoga County	park, private or street	CC,H,S,UHI	•••
		'New Harmony'	L	65'	vase (arching)	4	moderate	50 > years	•••	Cuyahoga County	park, private or street	CC,H,S,UHI	•••
Ulmus parvifolia	Chinese elm	Allee	M	30'	vase (upright-rounded)	5 to 9	moderate	25-50 years	bark	•••	park, private or street	•••	•••
Ulmus propinqua	emerald sunshine elm	Emerald Sunshine	M	25'	vase (pyramidal)	5	fast	25-50 years	•••	•••	park, private or street	•••	•••
Ulmus x	hybrid elm	'Frontier'	M	30'	vase (oval)	5	fast	25-50 years	foliage	•••	park or private	•••	•••
		'Patriot'	L	40'	vase (upright-narrow)	4	fast	50 > years	•••	•••	park, private or street	•••	•••
		Triumph	L	45'	vase (upright-oval)	4	fast	50 > years	•••	•••	park, private or street	•••	•••
Zelkova serrata	Japanese zelkova	City Sprite	S	20'	vase (compact)	5	moderate	50 > years	•••	•••	street	CC,H,S,UHI	overhead-utility line compatible
		Green Vase	L	30'	vase (spreading)	5 to 8	moderate	50 > years	•••	•••	street	CC,H,S,UHI	•••
		'Mushashino'	L	15'	narrow (upright)	5 to 8	moderate	50 > years	•••	•••	park, private or street	CC,H,S,UHI	•••
		'Village Green'	L	40'	vase (rounded)	5 to 8	moderate	50 > years	•••	•••	park, private or street	CC,H,S,UHI	•••
Ulmus americana	American elm	'Princeton'	L	50'	vase (spreading)	4	moderate	50 > years	•••	Cuyahoga County	park, private or street	CC,H,S,UHI	•••
		'Jefferson'	L	50'	vase (arching)	4	moderate	50 > years	•••	Cuyahoga County	park, private or street	CC,H,S,UHI	•••
		'New Harmony'	L	65'	vase (arching)	4	moderate	50 > years	•••	Cuyahoga County	park, private or street	CC,H,S,UHI	•••
Ulmus parvifolia	Chinese elm	Allee	M	30'	vase (upright-rounded)	5 to 9	moderate	25-50 years	bark	•••	park, private or street	•••	•••

[1] Developed by Charles Tubesing and Ethan Johnson with edits from Chad Clink *Reference Dirr's Encyclopedia of Trees and Woody Plants; Dirr's Manual of Woody Plants; The Practical Science of Planting Trees and Shrubs. Check for local availability.

[2] Small trees >25', Medium trees 25-50', Large trees >50'

[3] The Woody Plants of Ohio, E. Lucy Brown (cultivars are not considered native)

[4] H = Health; S = Stormwater; AQ = Air Quality; UHI = Urban Heat Island; CC = Climate Change

Appendix B
How to Plant with a Purpose: Trees for Neighborhood Equity

"Right Tree, Right Place" is an urban forestry concept typically associated with planting around utilities. However, this concept should guide decisions and planning for *every* planting project. What do we want our trees to do? What benefits do we need to realize from this planting project? Why are we planting trees? Planting trees purposefully (meeting a benefit need) ensures that trees provide the greatest benefits to communities with the highest need.

Strategies for Purposeful Planting. For each tree planting project, desired outcomes should be defined in advance and link to improvements in city quality of life.

Davey Resource Group has developed this tree planting strategy guide based on data from the 2013 urban tree canopy analysis, demographic data, and i-Tree benefit models. Potential tree planting project objectives needing improvement in Cleveland include existing tree canopy, stormwater retention, energy savings, urban heat island mitigation, human health, economic development potential, equity, use of available vacant land, large land ownership cooperation, and neighborhood support. As shown in Table 1, the results were ranked by neighborhood and also grouped into three categories that reflect the degree of need (*red* suggests high need, *green* suggests moderate need, and *yellow* suggests low need). For example, air quality improvements and asthma reduction are two social benefits of trees (Table 1). Objective-based planting may mitigate air pollutants and yield lesser rates of asthma.

The following sections shed light on potential needs by neighborhood. Tree planting activity that is guided by clear objectives will help Cleveland strategically determine why and where tree planting efforts should be concentrated. Purposeful planting means that Cleveland's urban forestry partners will use this information to prioritize needs that can be improved through tree planting, match neighborhood needs to funders' missions and work to narrow the gap between neighborhood canopy cover and the need for benefits.

Different species can provide more efficient benefits and the i-Tree Species tool can assist with selecting suitable tree species for the desired tree function. Table 2 lists the top 10% of tree species (out of 1,600 in i-Tree Species database) recommended for planting in Cleveland, Ohio. A more comprehensive list can be created in i-Tree Species, but not all listed species should be planted in the northeast region of Ohio. Special consideration should be made for planting tree species suited for the northeast region of Ohio. Each of the species listed in Table 2 is included in the recommended Species Selection list provided in this plan (see Appendix A).

Table 1. Cleveland Neighborhood Canopy Cover Compared to Purposeful Planting Objectives and the Relative Need for Benefits

	HIGH NEED	MEDIUM NEED	LOW NEED											
			Socio-Economic Factors				Risk of Stormwater Runoff Ranking	Energy Savings	Urban Heat Island Ranking	Human Health			Increases in Property Value from Canopy	Median Household Income
Neighborhoods	Canopy Cover	Relative Canopy Cover	Population Density (pp per sq mi)	% of Workforce Unemployed	Child Poverty Rate	Combined Needs/Equity Ranking				Value of Air Quality Benefits from Trees	Population with Asthma	% Elderly Population		
Bellaire-Puritas	15%	21%	1,242	16%	33%	9	21	$114,537	6	$49,269	11%	21%	$168,371	$32,861
Broadway-Slavic Village	18%	25%	921	29%	35%	20	24	$205,774	15	$79,590	11%	16%	$252,807	$23,332
Brooklyn Centre	24%	32%	4,476	19%	39%	24	22	$78,192	18	$33,720	13%	14%	$89,266	$27,152
Buckeye-Shaker Square	25%	35%	9,052	13%	26%	13	3	$70,632	34	$28,101	14%	23%	$108,067	$31,191
Buckeye-Woodhill	24%	33%	5,036	41%	47%	34	5	$46,395	24	$28,333	14%	21%	$96,566	$15,013
Central	13%	18%	2,036	41%	50%	32	7	$13,683	8	$28,981	14%	12%	$66,759	$10,258
Clark-Fulton	20%	29%	8,630	26%	36%	26	9	$71,804	19	$17,893	13%	15%	$57,919	$26,456
Collinwood-Nottingham	14%	19%	1,197	22%	34%	12	19	$76,410	5	$42,312	11%	19%	$149,325	$27,168
Cudell	16%	24%	7,625	23%	37%	27	14	$46,520	7	$16,572	15%	11%	$58,637	$24,082
Cuyahoga Valley	5%	7%	354	17%	36%	7	33	$3,908	2	$17,831	15%	9%	$18,802	$19,811
Detroit Shoreway	19%	27%	4,295	18%	29%	16	16	$67,157	22	$26,864	15%	17%	$80,934	$24,430
Downtown	4%	8%	1,257	13%	10%	3	32	$353	3	$10,891	14%	9%	$12,613	$37,393
Edgewater	30%	40%	8,850	10%	21%	8	25	$43,748	30	$23,429	15%	14%	$76,371	$32,405
Euclid-Green	39%	50%	4,125	18%	33%	11	31	$75,405	23	$42,556	11%	18	$197,542	$41,660
Fairfax	18%	25%	2,210	28%	44%	22	10	$42,307	14	$27,195	14%	32%	$95,162	$19,934
Glenville	26%	35%	1,800	26%	39%	29	18	$323,668	28	$94,394	11%	28%	$321,309	$20,998
Goodrich-Kirtland Park	8%	15%	1,381	14%	28%	4	27	$9,224	4	$13,696	14%	23%	$25,930	$24,092
Airport (Hopkins)	9%	17%	165	18%	49%	14	34	$10,701	1	$33,850	11%	22%	$39,735	$33,310
Hough	24%	33%	4,631	28%	43%	33	8	$97,169	31	$39,018	14%	26%	$157,976	$22,223
Jefferson	17%	24%	2,346	12%	38%	18	4	$171,045	11	$42,664	11%	18%	$142,677	$40,560
Kamm's	34%	44%	1,027	10%	26%	5	28	$403,185	29	$160,761	11%	20%	$459,043	$49,377
Kinsman	22%	29%	2,871	32%	45%	30	1	$49,363	16	$34,805	14%	23%	$111,817	$13,899
Lee-Harvard	20%	26%	3,605	20%	37%	21	2	$134,957	32	$31,222	11%	41%	$109,730	$39,142
Lee-Seville	21%	26%	2,421	30%	33%	17	26	$67,533	10	$28,020	11%	35%	$102,304	$35,563
Mount Pleasant	22%	31%	3,348	25%	35%	23	6	$162,431	33	$46,822	11%	26%	$192,622	$23,772
North Shore Collinwood	22%	31%	2,977	17%	30%	15	20	$123,889	26	$48,065	11%	22%	$177,095	$36,293
Ohio City	22%	34%	5,180	14%	32%	10	13	$42,323	21	$23,657	15%	13%	$63,575	$20,655
Old Brooklyn	22%	29%	961	12%	31%	6	23	$358,912	17	$126,266	13%	20%	$350,141	$40,890
St. Clair-Superior	19%	27%	2,519	28%	34%	19	29	$57,261	12	$29,723	14%	18%	$84,734	$21,434
Stockyards	16%	22%	3,755	27%	37%	25	12	$64,264	13	$25,501	13%	17%	$75,968	$22,896
Tremont	17%	24%	1,987	9%	26%	1	15	$33,937	9	$26,154	15%		$68,706	$25,994
Union-Miles	22%	29%	1,849	30%	40%	31	17	$255,206	25	$66,627	11%	30%	$263,988	$25,973
University	26%	38%	2,675	10%	6%	2	30	$16,822	20	$37,833	14%	22%	$61,769	$10,609
West Boulevard	20%	29%	5,287	18%	38%	28	11	$145,758	27	$36,801	13%	14%	$131,073	$33,659

Table 2. Top 10% of Species for Selected Benefit Functions for Cleveland, Ohio

Tree Species	Streamflow Reduction	Building Energy Reduction	Wind Reduction	Air Temperature Reduction	UV Radiation Reduction	Overall Air Pollutant Removal	Carbon Monoxide	Nitrogen Dioxide	Sulfur Dioxide	Ozone	Particulate Matter	Carbon Storage	Low VOC Emissions	Low Allergenicity
Abies concolor			X		X						X			
Abies nordmanniana			X								X			X
Acer × freemanii	X	X		X		X		X	X	X		X		
Aesculus flava	X	X		X		X	X	X	X	X		X		
Aesculus glabra	X	X		X		X	X	X	X	X				
Asimina triloba														X
Carpinus betulus						X	X			X			X	
Celtis laevigata		X			X	X				X		X		
Cercidiphyllum japonicum														X
Cladrastis kentukea												X		
Diospyros virginiana														X
Fagus sylvatica		X			X	X	X			X		X		
Halesia tetraptera							X						X	X
Ginkgo biloba	X	X						X	X			X		
Gymnocladus dioicus												X		
Liquidambar styraciflua	X	X		X				X	X					
Liriodendron tulipifera	X	X	X	X		X	X	X	X	X		X		
Magnolia acuminata	X	X	X	X		X		X	X			X		
Metasequoia glyptostroboides	X	X		X		X		X	X	X				
Ostrya virginiana						X				X				
Pinus rigida			X		X									
Pinus virginiana					X									
Platanus × acerifolia	X	X		X	X			X	X			X		
Quercus bicolor												X		
Quercus imbricaria												X		
Quercus macrocarpa				X								X		
Quercus meuhlenbergii				X								X		
Quercus palustris												X		
Quercus robur				X								X		
Quercus rubra				X								X		
Quercus shumardii	X	X		X				X	X			X		
Taxodium distichum	X							X	X					
Tilia americana	X	X	X	X		X	X	X	X	X		X		
Tilia cordata	X	X		X		X		X	X					
Tilia tomentosa	X	X		X		X	X	X	X	X				
Ulmus americana	X	X	X	X		X	X	X	X	X		X	X	
Ulmus parvifolia						X	X			X			X	
Zelkova serrata	X	X		X		X	X	X	X	X		X		

Relative Canopy

Relative canopy can be used as a way to compare neighborhoods and account for their differences in land use and character. Relative tree canopy is expressed as a percentage of existing tree canopy compared to what is possible. For example, while Cleveland's total tree canopy cover is 19%, it has been estimated in the recent UTC that a 71% canopy level is possible. Therefore, Cleveland has achieved 19% of its possible 71% canopy, or 27% relative canopy (19/27).

Where to Plant. Relative canopy percentages by neighborhood are presented in Table 1 and mapped in Figure 1. The neighborhoods with the lowest amounts of relative tree canopy (Bellaire-Puritas, Central, Collinwood-Nottingham, Cudell, Cuyahoga Valley, Downtown, Goodrich-Kirtland Park, Stockyards, and Tremont) may warrant greater planning, financial, technical, and implementation assistance to increase canopy. All of these neighborhoods have the lowest amount of tree canopy across all neighborhoods. Two neighborhoods, Kinsman and Union-Miles, have above average tree canopy (19%) and high potential for increased canopy.
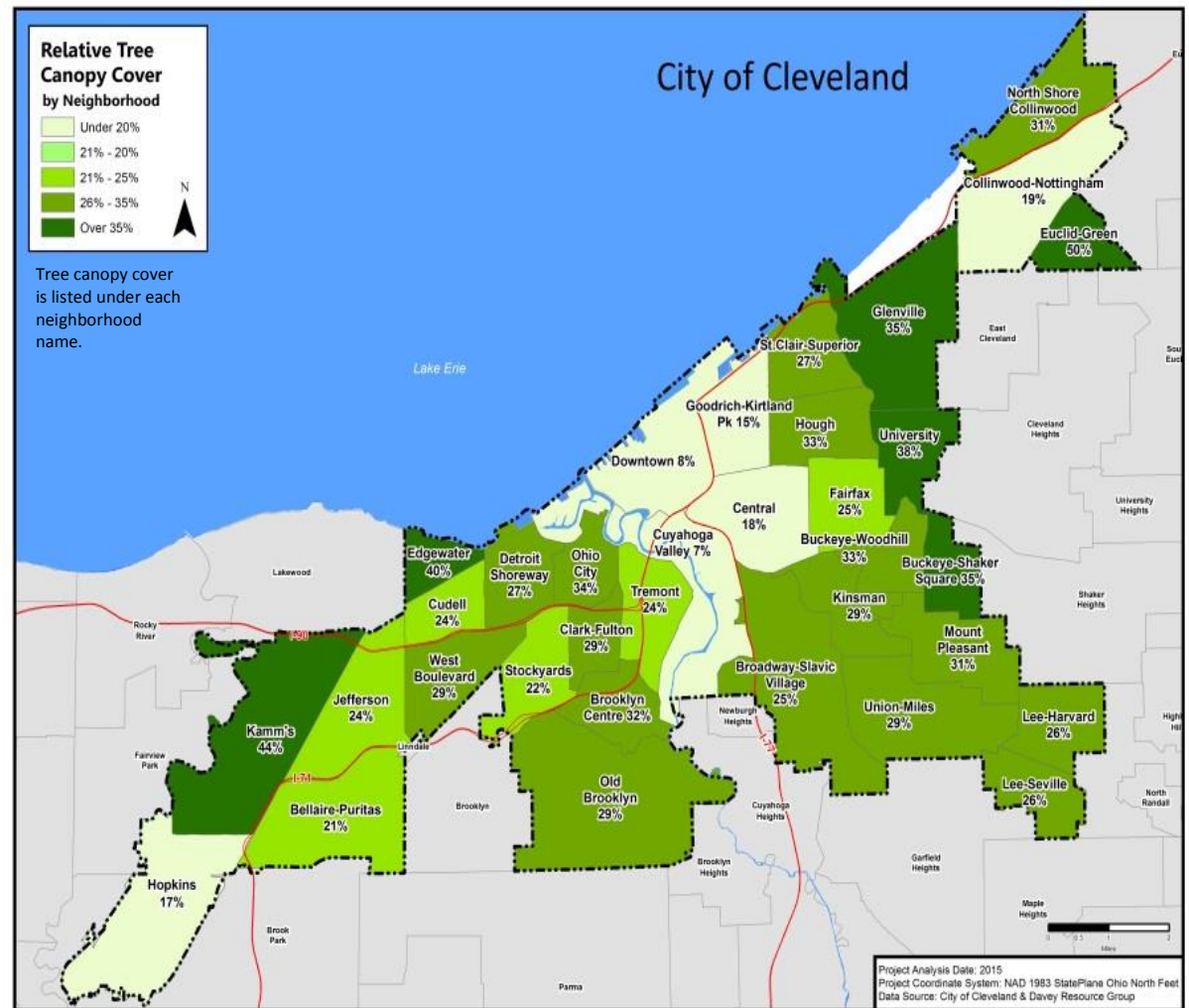
Figure 1. Relative tree canopy cover by neighborhood.

What to Plant. A large shade tree provides up to eight times the benefits of a small ornamental tree planted in the same environment (Geiger 2004). The benefits large trees provide can far exceed the initial cost and long-term maintenance needs they require. While planting small trees may reduce occurrence of associated risk potential, the long-term benefits of planting large shade trees on public and private land within residential and industrial land uses of Cleveland may result in the greatest future change in canopy.

Socioeconomics

Addressing disparities in environmental justice should be considered in every tree planting campaign. In urban forest planning, equity can be measured by the distribution of tree canopy benefits, specifically how those benefits influence population density, unemployment rates, and child poverty. Inequality occurs when one geographic area receives less canopy benefit than another, yet the need for canopy benefit is greater.

Where to Plant. An equity ranking was devised to assist in the development of strategies for narrowing the gap in canopy at the neighborhood level. With the guidance of Quentin Karpilow, Davey Resource Group utilized population density, unemployment rates, and child poverty rates to show the neighborhoods most in need of the benefits afforded by tree canopy (Figures 2–4). When aggregated, these equity indicators suggest areas to concentrate tree planting efforts to minimize inequities in canopy cover (Figure 5).

Figure 2. Population density by neighborhood.

Figure 3. Unemployment rates by neighborhood.

Cleveland neighborhoods with the greatest need to increase residents' access to trees include Broadway-Slavic Village, Brooklyn Centre, Buckeye-Woodhill, Central, Clark-Fulton, Cudell, Fairfax, Glenville, Hough, Kinsman, Lee-Harvard, Mount Pleasant, Stockyards, Union-Miles, and West Boulevard. These neighborhoods may warrant greater planning and more financial and technical assistance to strategically implement more tree canopy.

What to Plant. Planting a mix of large-growing and small- or medium-growing ornamental/flowering trees will create the greatest impact, as canopy impacts in this category are focused on aesthetics and property values. Specific species choices will depend on what other focuses existing in each neighborhood (energy savings, stormwater management, etc.). Trees planted on public and private land within residential, recreational, and vacant land uses of Cleveland may lead to the greatest changes in equity of environmental justice.

Figure 4. Property value increases attributed to canopy cover by neighborhood.
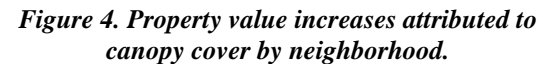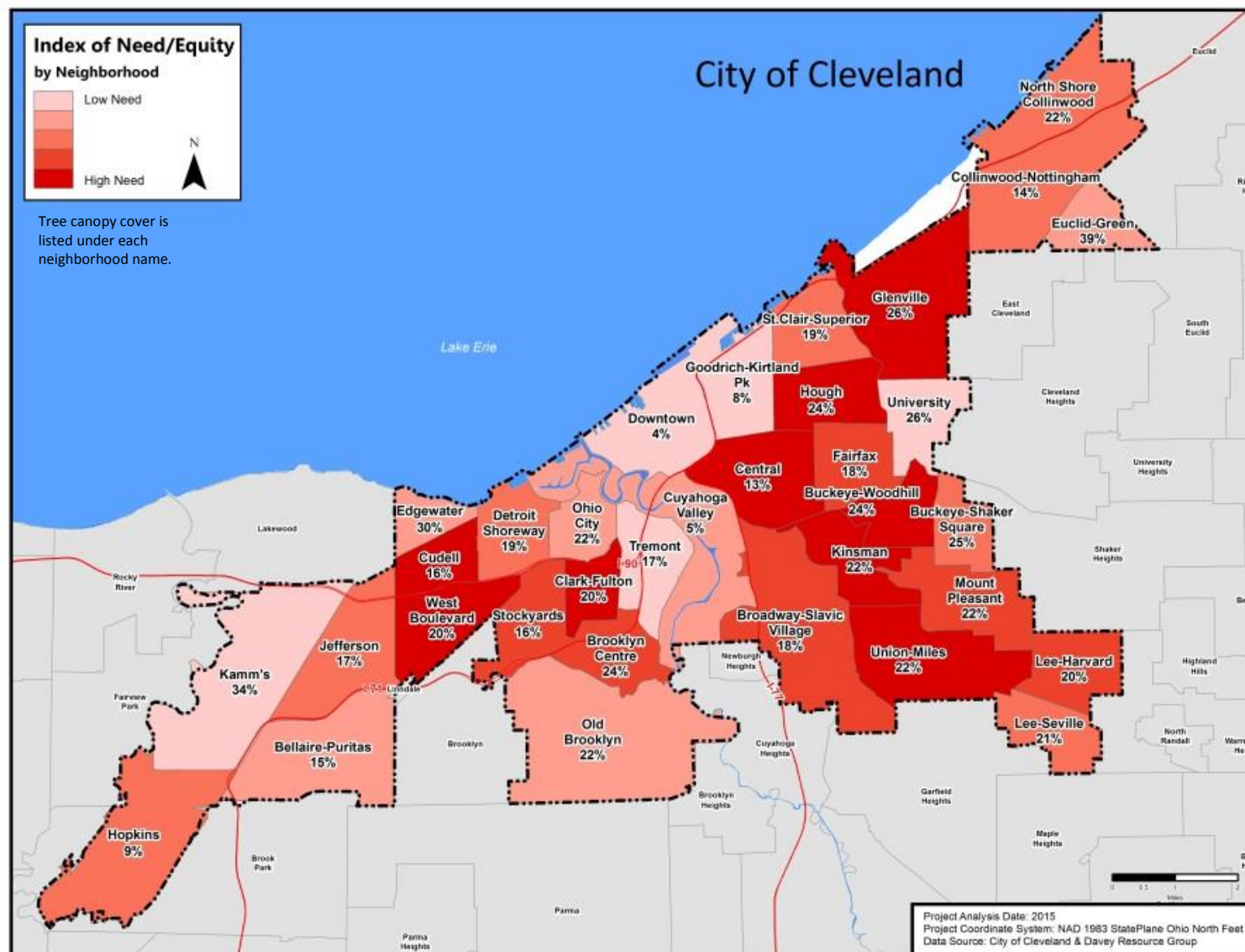
Figure 5. Equity index to indicate need for tree benefits by neighborhood.

Stormwater Retention

Trees play a significant role in stormwater management (alongside watershed topography, soil type, and prevalence of impervious surfaces). Trees can reduce the amount of stormwater that enters into sewer systems by acting as mini-reservoirs, which is especially important in highly developed urban areas like Cleveland. One hundred mature trees can intercept roughly 100,000 gallons of rainfall per year (USFS 2003). And for every 5% of tree cover added to a community, stormwater runoff is reduced by approximately 2% (Coder 1996). Trees also trap contaminants (oils, solvents, pesticides, and fertilizers), which often mix with rainwater after flowing across parking lots or lawns, thus reducing pollutants that enter waterways. The amounts of tree canopy and impervious surface within an urban watershed influence the quantity of stormwater that needs to be managed.

Where to Plant. Factoring in many of these considerations for the watershed, Figure 6 illustrates the need for stormwater management by neighborhood. Cleveland neighborhoods with the greatest need for stormwater management improvements (increasing canopy and decreasing impervious surfaces) include Buckeye-Shaker Square, Buckeye-Woodhill, Central, Clark-Fulton, Collinwood-Nottingham, Cudell, Detroit Shoreway, Fairfax, Glenville, Hough, Jefferson, Kinsman, Lee-Harvard, North Shore Collinwood, Ohio City, Stockyards, Tremont, Union-Miles, and West Boulevard. These neighborhoods may warrant financial, technical, and implementation assistance towards increasing canopy.

What to Plant. Trees reduce the volume and speed of rainwater during a rain event due to the amount of surface area in their trunk, branches, and leaves and their water-absorbing capabilities from the roots (directly) and surrounding soil (indirectly). Generally, planting large-growing trees creates the greatest stormwater management impact. There are a few tree species which perform this function best, and the top 10% for Cleveland are listed in Table 3. Planting trees on public and private land within industrial, commercial, and institutional land uses of Cleveland may lead to the greatest change in water retention.

Table 3. Top 10% of Species that Contribute Stormwater Retention Benefits for Cleveland, Ohio

Acer × freemanii
Aesculus flava
Aesculus glabra
Ginkgo biloba
Liquidambar styraciflua
Liriodendron tulipifera
Magnolia acuminata
Metasequoia glyptostroboides
Platanus × acerifolia
Quercus shumardii
Taxodium distichum
Tilia americana
Tilia cordata
Tilia tomentosa
Ulmus americana
Zelkova serrata

Risk Level of Stormwater Runoff by Neighborhood

Low Risk

High Risk

N

Tree canopy cover is listed under each neighborhood name.

City of Cleveland

Lake Erie

North Shore Collinwood 22%

Collinwood-Nottingham 14%

Euclid-Green 39%

Glenville 26%

St.Clair-Superior 19%

Goodrich-Kirtland Pk 8%

Hough 24%

University 26%

Downtown 4%

Fairfax 18%

Central 13%

Buckeye-Woodhill 24%

Buckeye-Shaker Square 25%

Edgewater 30%

Detroit Shoreway 19%

Ohio City 22%

Cuyahoga Valley 5%

Tremont 17%

Kinsman 22%

Mount Pleasant 22%

Cudell 16%

Clark-Fulton 20%

West Boulevard 20%

Stockyards 16%

Brooklyn Centre 24%

Broadway-Slavic Village 18%

Union-Miles 22%

Lee-Harvard 20%

Jefferson 17%

Lee-Seville 21%

Kamm's 34%

Bellaire-Puritas 15%

Old Brooklyn 22%

Hopkins 9%

Project Analysis Date: 2015
Project Coordinate System: NAD 1983 StatePlane Ohio North Feet
Data Source: City of Cleveland & Davey Resource Group

Figure 6. Stormwater retention needs by neighborhood.

Energy Savings

When trees are properly placed around houses, offices, and businesses, their shade and windbreak can reduce cooling and heating energy uses. Trees also reduce surrounding air temperatures by releasing water vapor, which further reduces the need for air conditioning.

Where to Plant. Factoring in the prevalence of real estate in correlation to the prevalence of canopy, Figure 7 illustrates estimated energy conservation benefits through tree canopy by neighborhood. Cleveland neighborhoods with the greatest need to increase canopy near buildings include Buckeye-Woodhill, Central, Cudell, Cuyahoga Valley, Downtown, Edgewater, Fairfax, Goodrich-Kirtland Park, Kinsman, Ohio City, St.Clair-Superior, Tremont, and University. These neighborhoods may warrant greater planning, and more financial and technical assistance to strategically implement more tree canopy.
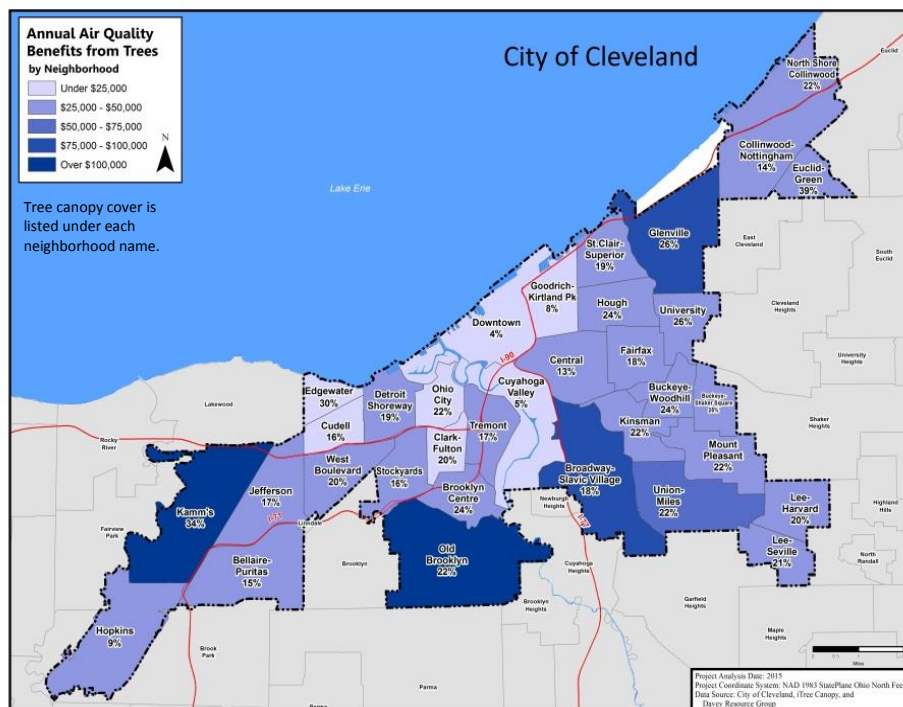
What to Plant. Planting large-growing trees will generally create the greatest impact because those trees provide the highest amount of shade and wind block for air conditioned and heated spaces. The top 10% of species that best perform this function for Cleveland are listed in Table 4. Planting trees on public and private land within residential, commercial, and institutional land uses of Cleveland may lead to the greatest change in energy savings.

Table 4. Top 10% of Species that Can Improve Energy Savings for Cleveland, Ohio

Species that Reduce Energy Usage Best for Improved Performance in Energy Savings.	Species Best Used to Break Penetrating Winds for Improved Performance in Energy Savings.
Acer × freemanii	*Abies concolor*
Aesculus flava	*Abies nordmanniana*
Aesculus glabra	*Liriodendron tulipifera*
Celtis laevigata	*Magnolia acuminata*
Fagus sylvatica	*Pinus rigida*
Ginkgo biloba	*Ulmus americana*
Liquidambar styraciflua	*Tilia americana*
Liriodendron tulipifera	
Magnolia acuminata	
Metasequoia glyptostroboides	
Platanus × acerifolia	
Quercus shumardii	
Tilia americana	
Tilia cordata	
Tilia tomentosa	
Ulmus americana	
Zelkova serrata	

Figure 7. Annual energy savings from trees by neighborhood.

Mitigating Urban Heat Island Effect

Heat islands are caused by impervious surfaces including buildings, streets, driveways, and parking lots. Within one urban geographical area, large concentrations of impervious surface types and small concentrations of tree canopy cover negatively affect ambient air temperatures. When little to no shade is cast over heat-absorbing surfaces, the area is prone to prolonged higher temperatures throughout the night; and if temperatures are high the following day, the issue can be compounded because the air has not had the proper time to cool.

Where to Plant. Figure 9 illustrates where heat islands are greatest and lowest within Cleveland by neighborhood. Cleveland neighborhoods with the greatest need to reduce their heat island over impervious surfaces include: Collinwood-Nottingham, Cuyahoga Valley, Downtown, and Goodrich-Kirtland Park. The neighborhoods with a high need to lower their heat island hot spots may warrant greater planning, and more financial and technical assistance to strategically implement more tree canopy.

What to Plant. Planting large-growing trees will generally create the greatest impact because those trees will provide the greatest amount of shade over impervious surfaces. The top 10% of species that perform this function the best for Cleveland are listed in Table 5. Planting trees on public and private land within residential, recreational open spaces, and commercial land uses of Cleveland may lead to the greatest change in heat island.
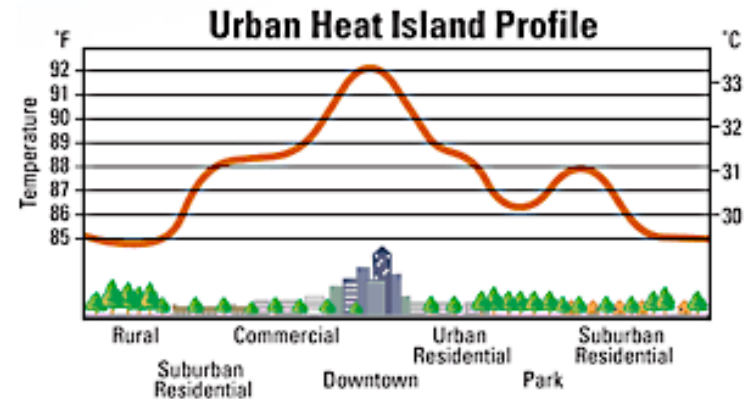
Figure 8. Urban heat island profile for typical urban-rural transect
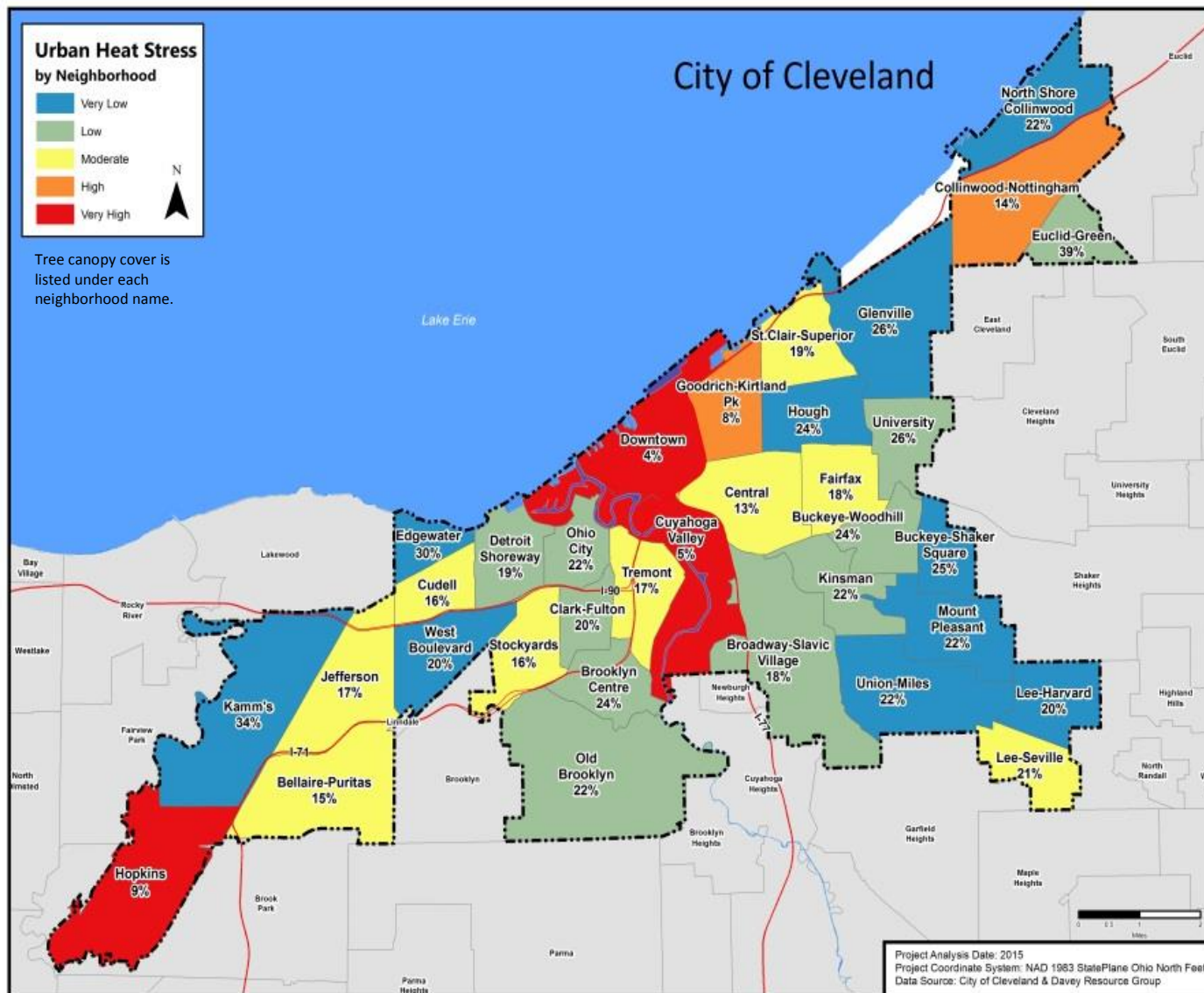
Figure 9. Urban heat island intensity by neighborhood.

Table 5. Top 10% of Species That Can Mitigate Urban Heat Island Effect for Cleveland, Ohio

Top Shade-Providing Species that Cool Air Temperatures	Top Species in Reducing UV Radiation
Acer × freemanii	Abies concolor
Aesculus flava	Celtis laevigata
Aesculus glabra	Pinus rigida
Liquidambar styraciflua	Pinus virginiana
Liriodendron tulipifera	Platanus × acerifolia
Magnolia acuminata	Quercus macrocarpa
Metasequoia glyptostroboides	Quercus meuhlenbergii
Platanus × acerifolia	Quercus robur
Quercus shumardii	Quercus rubra
Tilia americana	
Tilia cordata	
Tilia tomentosa	
Ulmus americana	
Zelkova serrata	

Human Health

Trees create a healthier environment for people by improving air quality. Reductions in ozone, carbon, particulate matter, and other air pollutants lower incidence of respiratory illnesses and hospital visits.

Where to Plant. The Cleveland neighborhoods with the greatest needs for air quality improvement include: Buckeye-Woodhill, Clark-Fulton, Cudell, Detroit Shoreway, Downtown, Edgewater, Stockyards, and Tremont. Additional consideration for increased canopy could be in neighborhoods where asthma rates are highest. Figures 10 and 11 illustrate neighborhoods in high need of increasing tree canopy, and thus improving air quality. These neighborhoods may warrant greater planning, along with additional financial and technical assistance in strategically implementing more canopy.

What to Plant. Generally, planting large-growing trees creates the greatest impact because those trees provide the most cooling effects, store the most carbon, collect the most pollutants, and produce the most oxygen. The top 10% of species that perform this function the best for Cleveland are listed in Table 5. Planting trees on public and private land within residential, recreational, and industrial land uses of Cleveland may lead to the greatest improvements in air quality and, thus, human health.

Additionally, trees largely influence the social health of the community. Trees create a natural calming effect on people and have been found to reduce incidence of domestic violence, crime, and abuse. Also, social ties with neighbors are strengthened because trees bring people outside and more frequent outdoor visits reinforce stronger bonds between neighbors. Trees benefit the neighborhood by making streets safer. Large-growing trees can cause moving vehicles to slow speeds. Tree-lined streets guard sidewalks and pedestrians from vehicles traveling off the road.

Figure 10. Air quality benefits by neighborhood.
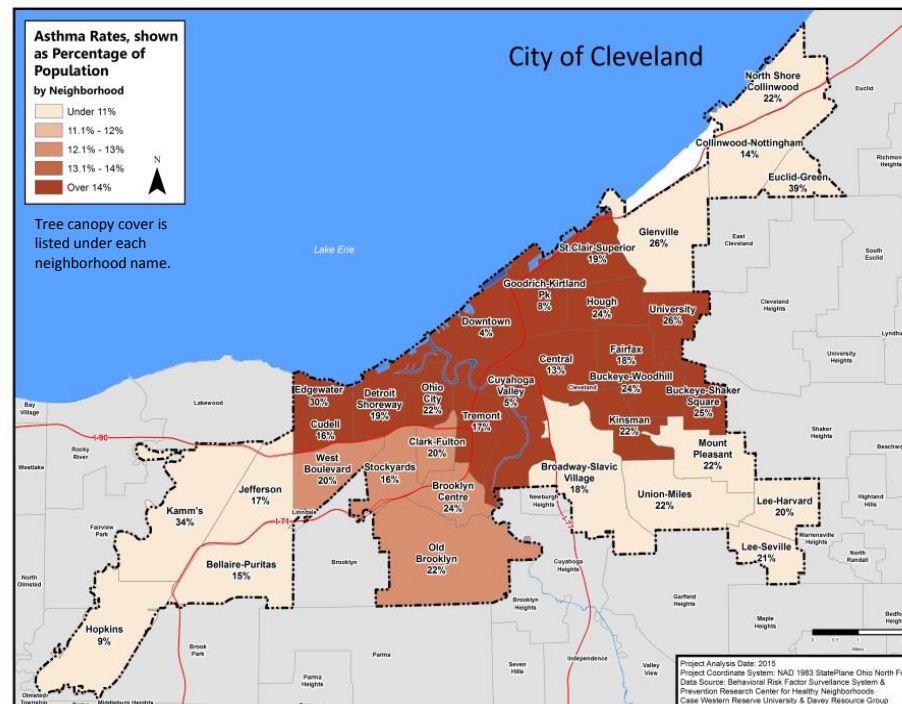
Figure 11. Asthma prevalence by neighborhood.

Economic Development Potential

Trees have an influence on a community's economy by way of job creation, worker productivity, frequency of shoppers and duration or time shopping, business or home vacancy prevalence, and property value increases. Studies show that the simple presence of trees around workers decreases the number of work days missed and alleviates work-related stress at a quicker rate compared to workers who do not see trees during the workday. The occurrence of vacant homes and businesses may be less due to the demand to live where trees are present in the landscape. Landscapes with trees also increase a buyer's willingness to pay more for a home than one without trees. Shoppers also spend more and potentially buy more merchandise or services in canopy-covered commercial districts.

Where to Plant. Figure 12 illustrates where Cleveland may want to concentrate ontree planting to increase property values. Cleveland neighborhoods with the greatest need to increase property values include: Brooklyn Centre, Buckeye-Woodhill, Central, Clark-Fulton, Collinwood-Nottingham, Cudell, Cuyahoga Valley, Detroit Shoreway, Downtown, Edgewater, Fairfax, Goodrich-Kirtland Park, Ohio City, St. Clair-Superior, Stockyards, Tremont, and University. Neighborhoods with a high need to increase property values may warrant greater planning, and more financial and technical assistance to strategically implement more tree canopy.

Cleveland neighborhoods with the lowest average annual household income are illustrated in Figure 13 and include: Broadway-Slavic Village, Buckeye-Woodhill, Central, Cudell, Cuyahoga Valley, Detroit Shoreway, Fairfax, Glenville, Goodrich-Kirtland Park, Hough, Kinsman, Mount Pleasant, Ohio City, St. Clair-Superior, Stockyards, and University. These neighborhoods may also warrant increased attention for tree planting based on the influence tree canopy can have on economic development potential.
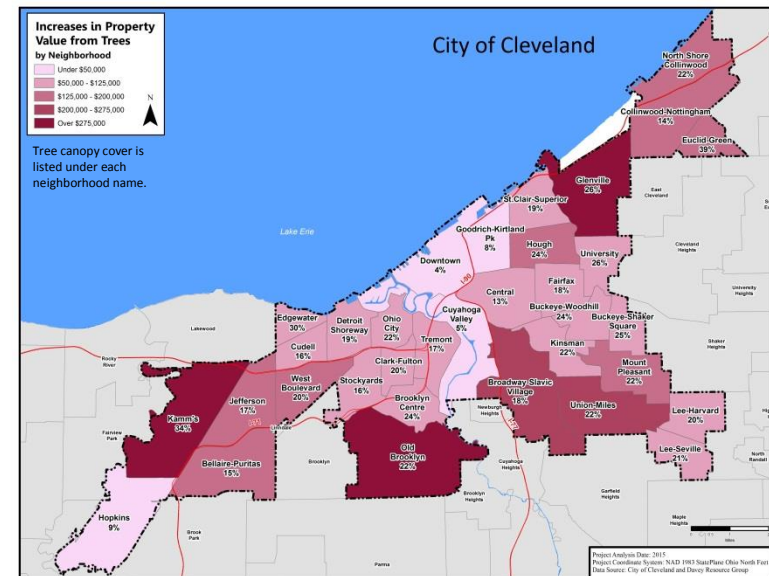
Figure 12. Property value increases attributed to canopy cover by neighborhood.
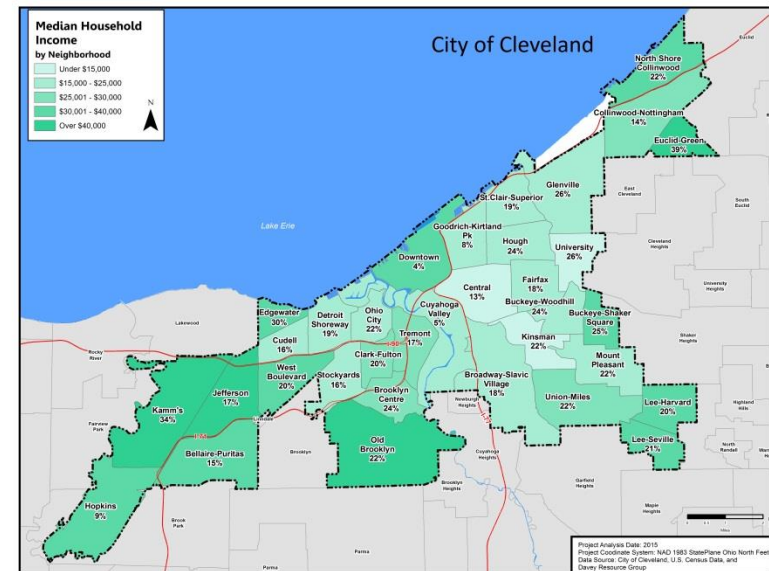
Figure 13. Median income by neighborhood.

What to Plant. Planting a mix of large-growing and small- or medium-growing ornamental/flowering trees will create the greatest impact. Trees planted on public and private land within commercial, industrial, and institutional land uses of Cleveland may lead to the greatest changes in economic development.

Availability of Vacant Land

The urban ecosystem is extremely complex. Small, functional ecosystems together form a larger diverse system, each of which may need to be managed differently. The overall health of the urban ecosystem depends on the ability of trees, plants, wildlife, insects, and humans to coexist as a whole. Often, the health and diversity of the overall canopy can be greatly improved by creating connections between multiple patches of forest. Planting vacant lands adjacent to contiguous canopy may help improve the distribution and composition of the canopy.

Davey Resource Group analyzed Cleveland's existing urban tree canopy for fragmentation. The analysis found the following:

- 862 acres of Core Canopy. Tree canopy that exists within and relatively far from the forest/non-forest boundary (i.e., forested areas surrounded by more forested areas).
- 144 acres of Perforated Canopy. Tree canopy that defines the boundary between core forests and relatively small clearings (perforations) within the forest landscape.

- 2,342 acres of Edge Canopy. Tree canopy that defines the boundary between core forests and large non-forested land cover features. When large enough, edge canopy may appear to be unassociated with core forests.
- 6,159 acres of Patch Canopy. Tree canopy that comprises a small forested area that is surrounded by non-forested land cover.

Where to Plant. Using this forest fragmentation analysis, Davey Resource Group prioritized Cleveland's parcels of vacant land by adjacency to core, edge, perforated, and patch forests. Table 6 illustrates this prioritization of available land by land use. Figure 14 shows the availability of land by neighborhood. Neighborhoods with higher priority planting should plant native large-growing species within vacant parcels and determine whether parcels should be part of the maintained landscape (park-like area) or if natural forest regeneration should take place. Cleveland neighborhoods with the greatest potential to increase canopy by foresting vacant land include: Bellaire-Puritas, Broadway-Slavic Village, Brooklyn, Central, Collinwood-Nottingham, Cuyahoga Valley, Fairfax, Glenville, Hough, Kinsman, Old Brooklyn, and Union-Miles. The neighborhoods with high potential to increase tree canopy through planting vacant land may warrant greater planning and more financial and technical assistance to strategically implement more canopy.

Additionally, private landowners who own large tracts of land comprise 21% (11,092 acres) of all the land in Cleveland. Landowners are a mix of city, state, park, rail, civic, health, and utility organizations. The cooperation and partnerships with these organizations to plant trees on their properties will play a major role in reaching canopy goals. Large landowners could use the same principles as stated above to determine where and what to plant.

What to Plant. Planting a mix of large-growing and small- or medium-growing ornamental/flowering trees will create the greatest impact. The city, neighborhood organizations, and future funders could determine what tree species to plant for what beneficial purpose (maintained landscape versus natural area).

Conclusion

Achieving significant increases in canopy cover over the next 25 years will be challenging, which is why establishing canopy goals is essential for Cleveland. All partners will need to work together in the development of new and innovative planting programs based on a unified vision to achieve a canopy goal. The six neighborhoods with the highest need (Central, Clark-Fulton, Cudell, Fairfax, Stockyards, and West Boulevard) present the greatest potential for increased canopy cover. Neighborhoods can individually utilize these maps and data to strategically determine and prioritize tree planting needs. The services trees provide far exceed the investment of time and money in planting and maintaining the city's existing trees.

Table 6. Acres of Vacant Parcels by Land Use

General Land Use	Very Low Priority	Low Priority	Moderate Priority	High Priority	Very High Priority	Total
Agricultural	0	0	0	0	2	2
Commercial	122	246	109	250	221	948
Industrial	169	336	197	351	919	1,972
Institutional	12	20	14	14	23	83
Recreation/Open Space	6	4	1	3	47	61
Residential - Multifamily	43	102	61	133	227	566
Residential - Single Family	307	602	367	427	463	2,166
ROW	5	4	8	13	0	30
Transportation/Utilities	14	2	12	8	23	59
Total	678	1,316	769	1,199	1,925	
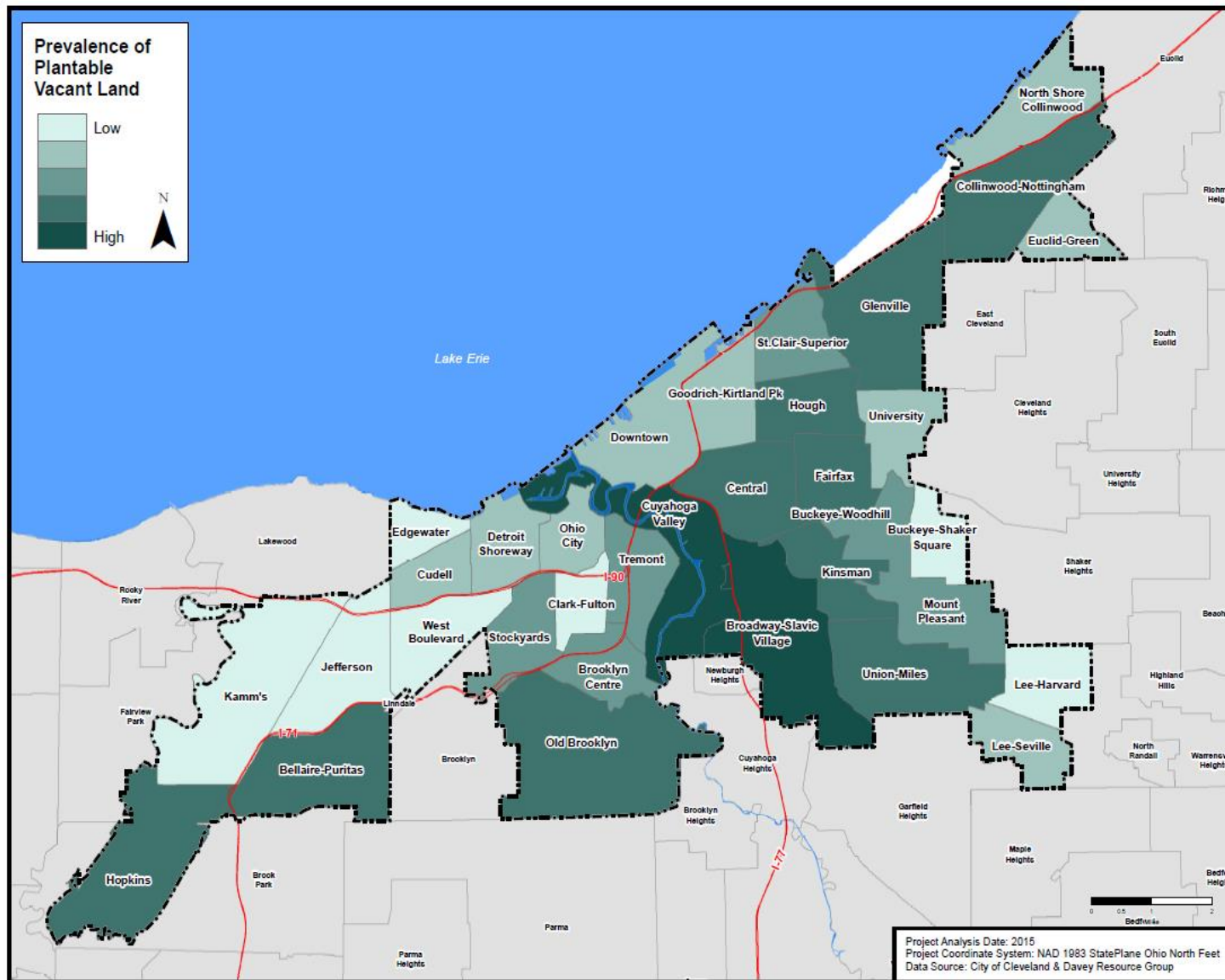
Figure 14. Prevalence of vacant land available for planting by neighborhood.

Appendix C
Players

There are a large number of active players in Cleveland's urban forest. This summary list provides short descriptions of each organization or institution.

Cleveland Botanical Garden. Cleveland Botanical Garden is a non-for-profit organization with inspirational gardens located in East Cleveland. The Garden is committed to attracting visitors and residents of Cleveland and serves the Cleveland area through educational outreach programs. Green Corps, one program example, helps young adults develop skills through changing the landscape of vacant city lots into usable urban farms. The Garden is involved with the applied research of restoring abandoned properties into green infrastructure.

City of Cleveland. There are a number of divisions and departments within the City of Cleveland that are active in the urban forest. They include:

- **Land Bank.** Housed in the Division of Neighborhood Development, the City's Land Reutilization (Land Bank) Program is designed to acquire vacant land and market it to individuals, developers, and non-profit organizations for redevelopment. The goal is to contribute to the economic, social, and environmental betterment of the city through redevelopment of city-owned land.

- **Mayor's Office of Capital Projects.** Provides for the planning, designing, construction, and preservation of the city's facilities and infrastructure.

- **Office of Sustainability (OoS).** OoS collaborates with the community to improve the economic, environmental, and social well-being of its citizens. Sustainable Cleveland 2019 is a 10-year initiative that engages people from all walks of life, working together to design and develop a thriving and resilient Cleveland region.

- **Planning Commission.** The City Planning Commission and its professional planning staff provided services in zoning, design review, historic preservation, maps and data, development planning, neighborhood plans, and special purpose plans such as the Cleveland 2020 Citywide Plan, Cleveland Waterfront District Plan, and the Cleveland Bikeway Plan.

- **Public Works > Division of Park Maintenance & Properties > Urban Forestry.** The Urban Forestry department provides a safe urban forest while preserving its natural beauty. Activities include the maintenance of all public street and park trees, including the removal of dead and hazardous street trees and overgrown roots which raise sidewalks, planting of replacement trees (based on availability of funding), trimming, and providing public information.

Cleveland-Cuyahoga County Port Authority. The Port Authority's sole mission is to enhance economic vitality in Cuyahoga County through job creation and helping the region compete globally by connecting local businesses to world markets through the most cost-effective method of freight transportation in the region. The Port Authority also connects private investors with landmark projects throughout the region and serves as an environmental steward of Cleveland Harbor and the Cuyahoga River.

Cleveland Foundation. The Cleveland Foundation (CF) is a charitable organization supported by private donors and governed by local citizens. Since 1914, CF has invested in helping citizens give back purposefully to their communities through directed funding for reinvented K-12 education, neighborhood revitalization and redevelopment, youth development, arts and culture, economic development, and Greater University Circle. The foundation has partnered with Neighborhood Progress, Inc. to strategically invest in supporting the recovery of nine Cleveland neighborhoods and collaborating with other partners who want to create a vibrant "urban core" in Greater University Circle.

Cleveland Metroparks. CMP is a network of 18 parks (called reservations) mostly in Cuyahoga County, as well as the Cleveland Zoo. Aside from plantings on park property, CMP works with local neighborhood and watershed groups on tree planting campaigns in areas surrounding the reservations in efforts to clean air and water affecting/entering the reservations. CMP is a separate government entity funded by taxes from all of Cuyahoga County and Hinckley Township.

Cleveland Museum of Natural History (CMHN). CMNH has been in existence for nearly 100 years and encourages discovery of nature and science. Visitors explore exhibits, meet wild animals, take a hike through natural areas, and join educational classes. Beyond the foundation, the Museum is a leader in sustainability through their Green City Blue Lake Institute, which works to improve conditions in nine environmentally minded areas: clean air, energy, water, connecting with nature, green buildings, local food system, transportation choices, vibrant cities and towns, and zero waste.

Cleveland Neighborhood Progress (CNP). CNP is a local community development funding intermediary with an approach to neighborhood revitalization that incorporates real estate development, safety, access to education, work and amenities, and civic involvement.

Cleveland Public Power (CPP). CPP is the largest municipally owned electric utility in the State of Ohio, services 80,000 customers, and is a Tree Power Participant of the American Public Power Association. A utility that is a Tree Power Participant must sustain a tree planting program and work to reach the goal of one tree per customer. The Tree Power program helps to educate the public and utilities on the beneficial relationship between trees and energy savings.

Community Development Corporations (CDC). CDC's are typically neighborhood-based, non-profit entities working at the forefront of critical issues that confront neighborhoods, including economic development, stabilization, and revitalization. Cleveland's active CDCs are listed below.

- **Bellaire Puritas Development Corporation** serving the Bellaire-Puritas, Jefferson, and Hopkins (airport) neighborhoods.
- **Buckeye Shaker Square Development Corporation** serving the old Buckeye, Larchmere, Woodland Hills, and Shaker Square neighborhoods.
- **Burten, Bell, Carr Development Corporation** serving Central, Kinsman, and Garden Valley neighborhoods.
- **Collinwood Nottingham Villages** serving the South Collinwood neighborhood.
- **Cudell Improvement, Inc.** serving the Cudell/Edgewater neighborhood.
- **Detroit Shoreway Community Development Organization** serving the Detroit Shoreway neighborhood.
- **Downtown Cleveland Alliance** serving the downtown urban core.
- **Fairfax Renaissance Development Corporation** serving the Fairfax neighborhood.
- **Famicos Foundation** serving the Glenville and Hough neighborhoods.

- **Harvard Community Services Center** serving the Lee-Harvard, Miles, and Seville neighborhoods.
- **Historic Gateway Neighborhood Corp.** serving downtown Cleveland's Gateway neighborhood.
- **Hough Development Corporation** serving the Hough neighborhood.
- **Kamm's Corners Development Corporation** serving the West Park neighborhood.
- **Little Italy Redevelopment Corporation** serving the Little Italy neighborhood, also referred to as Murray Hill.
- **Maingate Business Development** serving the Maingate industrial district.
- **Midtown Cleveland, Inc.** serving a two-square-mile area between downtown Cleveland and University Circle.
- **Mt. Pleasant NOW Development**. **Corporation** serving the Mt. Pleasant neighborhood.
- **Northeast Shores** serving the North Shores Collinwood neighborhood.
- **Ohio City Near West Development Corporation** serving the Ohio City neighborhood.
- **Old Brooklyn Community Development Corporation** serving the Old Brooklyn neighborhood.
- **Shaker Square Area Development Corporation** serving the Shaker Square/Ludlow Historic District, Larchmere and Ludlow neighborhoods.
- **Slavic Village Development** serving the neighborhoods of Hyacinth, Forest City, Mill Creek Falls, Trailside, and Warszawa.
- **St. Clair Superior Development Corporation** serving the St. Clair Superior neighborhood.
- **Stockyard/Clark Fulton/Brooklyn Center** serving the Stockyard, Clark-Fulton and Brooklyn Centre neighborhoods.

- **The Campus District, Inc.** serving downtown Cleveland's Campus District.
- **Tremont West Development Corporation** serving the Tremont neighborhood.
- **Union-Miles Development Corporation** serving the Union-Miles neighborhood.
- **University Circle, Inc.** serving the University Circle neighborhood.
- **Westtown Community Development Corporation** serving the Westtown neighborhood (Ward 11)

Cuyahoga County Board of Health (CCBH). CCBH serves to prevent disease and injury, promote positive health outcomes, and to provide critical services to improve the health status of the community. They work to protect and promote public health through addressing air pollution, climate change, noise control, drinking water, emergency preparedness and response, housing, injury prevention, land use, environmental health, sustainability, and watershed management.

Cuyahoga County Land Bank. The Cuyahoga Land Bank, formed in 2006, acquires blighted properties and returns them to productive use. It has the ability to acquire vacant and abandoned foreclosed properties from a variety of sources, including those held by banks, federal and state agencies, as well as real estate lost to tax foreclosure and donated properties. The Land Bank's partnership with the City of Cleveland, which has its own land bank, includes handing over title to all vacant land after completing demolition. The goal of the Cuyahoga Land Bank's partnerships with local municipalities is to promote collaboration, spread risk, and to make joint code enforcement and nuisance abatement operations possible.

Cuyahoga Metropolitan Housing Authority. CMHA provides homeownership opportunities for qualified families, and develops career-training programs to enhance the quality of life of its residents. The CMHA's Green Team recruits public housing residents and provides them with the training and education necessary to cultivate, plant, and harvest fruits and vegetables on urban farms.

Dominion East Ohio. Dominion is a regulated natural gas delivery company serving Cleveland.

First Energy. Also referred to as The Illuminating Company, FE is a regulated power company headquartered in Akron, serving Cleveland, along with other areas in OH, PA, WV, MD, and NJ.

Forest City Working Group (FCWG). The FCWG is one of many working groups associated with the 2019 Sustainable Cleveland initiative. The FCWP's vision is to make Cleveland the Forest City once again by providing raising awareness about tree benefits and providing resources and expertise to assist in reforestation.

The George Gund Foundation (GUND). GUND is a private, nonprofit organization founded in 1952 to advance human welfare. GUND has a long-standing interest in awarding funding to the arts, economic development and community revitalization, education, and environment and human services. The foundation promotes plans to help Cleveland become a model of environmental sustainability.

Great Lakes Restoration Initiative (GLRI). GLRI is an EPA-funded program, developed to support efforts to protect and restore the Great Lakes, the largest fresh water system in the world. GLRI focuses on five areas: toxic substances and areas of concern, invasive species, nearshore health and nonpoint source pollution, habitat and wildlife protection and restoration, and accountability, education, monitoring, evaluation, communication, and partnerships.

Holden Arboretum. Holden Arboretum is a natural museum aiming to connect people with nature, be a resource for professional and novice landscapers, and partner with communities in natural resource education. Outside the arboretum, the organization promotes the beauty and importance of trees in creating healthy and sustainable communities with the region through conservation, engagement, and creating place.

L.A.N.D. Studio. L.A.N.D. Studio (Landscape, Art, Neighborhoods, Development) is a nonprofit, created from a merger between Cleveland Public Art and ParkWorks, active in revitalization and beautification projects involving park redesigns, public art installation, and vacant lot reuse across Cleveland.

Northeast Ohio Regional Sewer District (NEORSD). NEORSD is Cleveland's sewer district, responsible for wastewater treatment facilities and interceptor sewers in the greater Cleveland Metropolitan Area. This service area encompasses the City of Cleveland and all or portions of 61 surrounding suburban municipalities. They are an active partner in protecting the water quality of the Cuyahoga River and Lake Erie for public health. NEORSD's Project Clean Lake is a clean water program to address sewage overflow during rain events and help bring the region into compliance with the Clean Water Act.

Ohio Department of Natural Resources, Division of Forestry, Urban Forestry Program. ODNR's Ohio Urban Forestry Program guides local community urban forestry programs in proper tree care through providing leadership and science-based information. The program encourages Tree City USA participation, effective tree canopy ordinances for ensuring the protection of existing trees, trains volunteer tree commissions, and preaches urban forestry best practices.

Saint Luke's Foundation (SLF). SLF is a non-profit organization aiming to support community based collaborative efforts to improve physical environments and social conditions within targeted communities. SLF is interested in reestablishing the urban forest in Cleveland to improve the lives of residents in these neighborhoods by creating more useful, green, and beautiful spaces for communities to engage in.

Watershed Organizations: Non-profit organizations dedicated to protecting and restoring a watershed (an area of land that drains to a particular stream, river, lake, or ocean).

- **Big Creek Connects,** formerly known as Friends of Big Creek, works to restore and protect the 38-square-mile Big Creek watershed spanning 8 municipalities: Cleveland, Brooklyn, Brook Park, Linndale, Middleburg Heights, North Royalton Parma, and Parma Heights.

- **Chagrin River Watershed Partners** works to restore and protect the 267-square-mile Chagrin River watershed, partially located on the eastern side of Cuyahoga County and southern portions of Lake County.

- **Cuyahoga River Restoration** works to restore and protect the 813-square-mile Cuyahoga River watershed and the near shore of Lake Erie, spanning six counties. CRR's ReLeaf program promotes the relationship between healthy forests and healthy watersheds and is an active participant in the restoration and protection of the forest canopy.

- **Doan Brook Watershed Partners** works to restore and protect the 12-square-mile Doan Brook watershed area in the eastern metropolitan area of Cleveland.

- **Friends of Euclid Creek** works to restore and protect the 24-square-mile Euclid Creek watershed in northeastern Cuyahoga and Lake Counties, crossing portions of 11 communities.

- **Mill Creek Watershed Partnership** works to restore and protect the Mill Creek watershed, running through the cities of Beachwood, Cleveland, Cuyahoga Heights, Garfield Heights, Highland Hills, Maple Heights, North Randall, Shaker Heights, and Warrensville Heights.

- **Rocky River Watershed Council** works to restore and protect the 294-square-mile Rocky River Watershed stretching from Medina to Lake Erie through parts of Cuyahoga, Lorain, Medina, and Summit Counties, including all or part of 32 municipalities and townships.

- **Tinkers Creek Watershed Partners** works to restore and protect the 96-square-mile Tinker Creek Watershed—the largest tributary to the Cuyahoga River. The watershed area spans 24 communities in Cuyahoga, Geauga, Portage, and Summit counties.

- **Westcreek Conservancy** works to restore and protect the West Creek watershed through the creation of greenways (Greater Cleveland Trails and Greenways/Tails for Trails) and vacant land reuse.

Western Reserve Land Conservancy. WRLC is a nonprofit collaborative organization formed in a merger of 13 land trusts that work with landowners, communities, government agencies, park systems, and other nonprofit organizations to create an interconnected 400,000-acre network of protected property throughout northern Ohio. WRLC's *Thriving Communities Institute* was recently formed to serve as the urban arm of conservation efforts, and focuses on multiple efforts including tree planting in cities.

Appendix D
Methods

Calculating Tree Benefits

Air Quality

The i-Tree Canopy v6.1 Model was used to quantify the value of ecosystem services for air quality. i-Tree Canopy was designed to give users the ability to estimate tree canopy and other land cover types within any selected geography. The model uses the estimated canopy percentage and reports air pollutant removal rates and monetary values for carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2), and particulate matter (PM) (Hirabayashi 2014).

Within the i-Tree Canopy application, the U.S. EPA's BenMAP Model estimates the incidence of adverse health effects and monetary values resulting from changes in air pollutants (Hirabayashi 2014; U.S. EPA 2012). Different pollutant removal values were used for urban and rural areas. In i-Tree Canopy, the air pollutant amount annually removed by trees and the associated monetary value can be calculated with tree cover in areas of interest using BenMAP multipliers for each county in the United States.

To calculate ecosystem services for the study area, canopy percentage metrics from UTC land cover data performed during the assessment were transferred to i-Tree Canopy. Those canopy percentages were matched by placing random points within the i-Tree Canopy application. Benefit values were reported for each of the five listed air pollutants.

Carbon Sequestration

The i-Tree Canopy v6.1 Model was used to quantify the value of ecosystem services for carbon storage and sequestration. i-Tree Canopy was designed to give users the ability to estimate tree canopy and other land cover types within any selected geography. The model uses the estimated canopy percentage and reports carbon storage and sequestration rates and monetary values. Methods on deriving storage and sequestration can be found in Nowak et al. 2013.

To calculate ecosystem services for the study area, canopy percentage metrics from UTC land cover data performed during the assessment were transferred to i-Tree Canopy. Those canopy percentages were matched by placing random points within the i-Tree Canopy application. Benefit values were reported for carbon storage and sequestration.

Stormwater and Sewersheds

How tree benefits of stormwater are calculated. The i-Tree Hydro v5.0 (beta) Model was used to quantify the value of ecosystem services for stormwater runoff. i-Tree Hydro was designed for users interested in analysis of vegetation and impervious cover effects on urban hydrology. This most recent beta version (v5.0) allows users to report hydrologic data on the city level rather than just a watershed scale giving users more flexibility. For more information about the model, please consult the i-Tree Hydro v5.0 manual. (http://www.itreetools.org).

To calculate ecosystem services for the study area, land cover percentages derived for Cleveland were used as inputs into the model. Precipitation data from 2010 were selected within the model as that year closely represented the average rainfall (37 in.) for the City of Cleveland (NOAA 2015). Model simulations were run under a Base Case as well as an Alternate Case. The Alterative Case increased canopy by 1% and assumed that impervious and vegetation cover would decrease by 0.3% and 0.7%, respectively, as plantings would ultimately reduce these land cover types. This process was completed to assess the runoff reduction volume associated with a 1% increase in tree canopy since i-Tree Hydro does not directly report the volume of runoff reduced by tree canopy. The volume (in cubic meters) was converted to gallons and multiplied by the current canopy percentage (19%) in Cleveland to retrieve the overall volume *reduced by the tree canopy.*

Through model simulation, it was determined that tree canopy decreases the runoff volume in Cleveland by 1.79 billion gallons during an average precipitation year. This equates to approximately 188,000 gallons per acre of tree canopy (1.79 billion/9,491.4 acres). To validate the model, the results were compared to the City of Indianapolis Municipal Forest Resource Analysis report (Peper et al. 2008) which detailed the ecosystem services of trees in the Lower Midwest STRATUM climate zone (U.S. Forest Service 2012). This report was consulted because the City of Cleveland is located in a similar climate zone and the two cities are less than 330 miles apart in distance making their climate and weather patterns similar in nature.

In order to assess runoff reduction volume on the neighborhood level, the 188,000 gallons per acre value was used since i-Tree Hydro does not directly utilize boundaries other than watershed and city limits. To place a monetary value on stormwater reduction, the City of Cleveland provided the price to treat a gallon of stormwater in 2015 ($45 per McF).

About Stormwater Priority Ranking. During the ranking process, data derived from the UTC analysis, data provided by MSD, and environmental data were used to prioritize neighborhoods (see Table 7). The datasets were classified based on the value of "risk" from 0–4, with 4 posing the highest "risk" of contributing to stormwater runoff. Variables were weighted to produce a results grid. The grid was summarized using zonal statistics by each feature layer and given an average risk score. These scores were divided up into five bins to produce the final maps. Higher priority areas received a larger risk score.

Table 7. Prioritization Factors and Weights

Dataset	Weight	Source
Impervious Distance	0.30	Urban Tree Canopy Assessment
Slope	0.25	National Elevation Dataset
Floodplain	0.20	City of Cleveland
Soils	0.15	Natural Resource Conservation Service
Canopy Distance	0.10	Urban Tree Canopy Assessment

Energy Savings

Trees have a profound effect on building energy and has been studies using various methods (Carver et al. 2004; McPherson and Simpson 2003). The process of estimating energy (electricity) savings starts with determining the number of one-unit structures by vintage (age) class within each census block group. Vintage refers to construction type for a building (i.e., average floor area, floor types, insulation (R-value), and number of stories) and was broken into three categories: pre-1950, 1950–80, and post–1980.

Census data obtained from the 2010 American Community Survey (Table B25024 – UNITS IN STRUCTURE and Table B25034 - YEAR STRUCTURE BUILT) were used to determine the number of one-unit structures.

The data were based on five-year estimates. Since the number of one-unit structures differed at the block group level, the number of one-unit structures was determined by vintage and block group by multiplying the percentage of units in each vintage by the total number of one-unit structures in each block group (McPherson et al. 2013). For each block group, total energy savings were tallied for each block group using a function of percent UTC, vintage class, and energy saving coefficients (McPherson and Simpson 2003, McPherson et al. 2013).

To provide energy savings for neighborhoods, block groups were assigned based on their spatial positioning related to the block group data. While the boundaries do not overlay perfectly, it does provide a rough estimate for these boundaries. The kWh saved were summarized for each neighborhood by adding up the kWh from each assigned block group.

The monetary value for energy savings was valued by summing all estimated kWh saved for each vintage class and multiplied by the current 2015 electricity cost priced at $0.11 per kWh.

Table 8. Prices for Ecosystem Services in 2014

	Energy Savings	CO_2 Storage	CO_2 Sequestration	CO	NO_2	O_3	SO_2	PM_{10}	Rainfall Interception
	$/MWh	$/Ton	$/Ton	$/Ton	$/Ton	$/Ton	$/Ton	$/Ton	$/McF
Service Value	110	49.43	19.43	85.08	26.86	140.47	7.45	304.43	45

Property Values

Many benefits of tree canopy are difficult to quantify. When accounting for wildlife habitat, well-being, shading, and beautification, these services are challenging to translate into economic terms. In order to provide some estimation of these additional services, this report calculated a property value based on the value of home prices for the City of Cleveland. Limitations to this approach include determining actual value of individual trees on a property and extrapolation of residential trees to other land use categories (McPherson et al. 2013).

In a study completed in 1988, it was found that single-family residences in Athens, Georgia had a 0.88% increase in the average home sale price for every large front-yard tree on the property (Anderson and Cordell 1988). Using this study, the sales price increase was utilized as an indicator of additional tree benefits. While home sales vary widely, in 2014 the median home sales value in the City of Cleveland was $27,050 (Exner 2014). Using this median sales price and multiplying by 0.88%, the value of a large front-yard tree was $238. To convert this value into annual benefits, the total added value was divided by the leaf surface area of a 30-year-old shade tree which yields a base value of $0.33/ft^2. Using methodology from McPherson et al. 2013 to convert into units of UTC, the base value of tree canopy was determined to be $0.03795 ft^{-2} UTC. Since this value was derived using residential land use designations, transfer functions were used to adapt and apply the base value to other land use categories.

To be conservative in the estimation of tree benefits, the land use reduction factors calculated property value at 50% impact for single-family residential parcels, 40% for multi-residential parcels, 20% for commercial parcels, and 10% for all other land uses.

The price per unit of UTC values were multiplied by the amount of square feet of tree canopy within each land use category and summarized for the city and neighborhoods.

Table 9. Land Use Reduction Transfer Function Values

Land Use Category	Impact	Price Per Unit of UTC
Single-Family Residential	50%	$0.0190
Multi-Family Residential	40%	$0.0152
Commercial	20%	$0.008
All Other	10%	$0.004

Mapping Surface Temperature and Hot Spots.

A metric to identify urban heat island within the City of Cleveland was to create a ratio of impervious surface to canopy cover by establishing a grid of 50 X 50 meter squares. For each square, the amount of impervious surface and tree canopy was calculated. The amount of impervious area was then divided by the canopy cover, yielding a ratio value for each grid cell. A larger ratio indicated areas of "hotter" surfaces, or the presence of urban heat islands. These areas were synonymous with impervious surfaces such as buildings and parking lots. Small ratio values (less than 1) had a much greater presence of tree canopy.

Vacant Land Analysis

As a focus to plant readily available land with the City of Cleveland, a prioritization of vacant parcels was essential. A prioritization framework was set up using the amount of current tree canopy cover, canopy type (i.e., fragmentation level), and the amount of available planting space. Each vacant parcel was analyzed based on these three factors. The current tree canopy percentage was calculated based on the UTC assessment that was previously complete. Canopy type was derived using a customized tool to assess forest/canopy fragmentation throughout the City. There were four levels of fragmentation: patch canopy, edge, perforated, and core. The amount of available planting space was estimated by combining the area of bare soil and grass/low-lying vegetation from the UTC assessment.

About the Ranking Determination: Rankings were split up into five bins or classes that ranged from Very Low to Very High priority. Each of the three factors was distributed into these bins.

- *Current Canopy Percentage.* To assign a rank to current canopy percentage, the data were divided into five 20% canopy level intervals (e.g., 0–20, 21–40, 41–60, etc.) with higher levels of canopy receiving a lower score rank because they were already well served with having robust tree canopy already present. As an example, canopy percentages within the 80–100% range were assigned a value of 1 while percentages in the 0–20% bracket were assigned a 5 to indicate that they would benefit from planting trees.

- *Canopy Type/Fragmentation.* A canopy fragmentation layer was created prior to analysis. Using this layer, the amount of area for each fragmentation type was weighted with core canopy forest receiving the greatest weighting for prioritization. This would identify what type of canopy structure was present within the parcel and at what priority level it should be assigned. The lower the overall result of the weighted values would indicate that the parcel was consisted of all or mostly all patch canopy and, therefore, not a higher priority when it came to planting since fragmentation was so great that additional tree planting would not increase canopy function. These values were also assigned into five classes with a 1–5 ranking.

- *Available Planting Space.* The final metric used for prioritization was determining the amount of actual planting space available within each parcel. If a parcel had smaller percentages of planting space, there would be little benefit to focus on that parcel since it would have small amounts of available space in which to plant trees. Similar to current canopy, the data were extracted from the UTC assessment and binned into five 20% class intervals. However, instead the rankings were flipped with higher percentages of space receiving a higher rank in efforts to put a greater focus on parcels with sufficient planting space to support numerous trees.

- *Composite Ranking.* The ranking from each variable was additively combined to form the final result dataset. Higher result values equaled a higher priority rank as those scores would indicate low amount of present tree canopy, with more core forest, and high amounts of planting space.

Demographics and Socioeconomic Data

Data acquired for the socioeconomic analysis were provided by the U.S. Census Bureau at the census tract and census block levels, specifically 2006–2010 American Community Survey 5-Year Estimates, as shown in Table 10.

Table 10. Socioeconomic Data Sources

Variable	Data Source	Table Number	Table Description
Age	ACS 2006-2010 5YR	B01001	Age of Population
Education Level	ACS 2006-2010 5YR	B15001	Educational Attainment Population 18+
Median Income	ACS 2006-2010 5YR	B19013	Median Income of Population
Building Value	ACS 2006-2010 5YR	B25075	Value of Buildings
Building Age	ACS 2006-2010 5YR	B25034	Year Structure Built
Single Family Homes	ACS 2006-2010 5YR	B25024	Units in Structure (1-Detached)

Equity Calculations

The Equity Index was created by ranking each of the 34 Cleveland neighborhoods in three socioeconomic categories: rates of child poverty, unemployment, and population density. Rankings were created on a scale of 1–34 with 34 representing the highest priority or need. The highest percentage of child poverty, highest unemployment rates, and the most densely populated neighborhoods given the highest scores in each category. After rankings were assigned, a composite score was tabulated by adding the scores from each category. Neighborhoods that received the highest composite scores are considered as having the greatest need in terms of equity. Note that this need ranking does not, however, take into account the canopy cover level for each neighborhood. Thus, focus should be on the neighborhoods with the highest equity need score and lowest canopy cover. Methodology for data collection and analysis in each of the three categories follows:

- **Child Poverty.** This category determines the dispersal of children (an individual under the age of 18) who are considered to be living below poverty within neighborhoods throughout the City of Cleveland. In order to complete this analysis, both the census tract data and the block group data were obtained for the City of Cleveland. Census tract data specifying populations age and block group data defined the poverty levels were joined together. Because neighborhood boundaries do not correlate to census tract and block group boundaries, data were estimated using the largest percent of the block group and tracts that were contained within a neighborhood boundary. The area of the neighborhood was then divided by the population that was under the age of 18 and below the poverty line.

Data sources used to obtain Child Poverty by Block Group and Census Tract: U.S. Census Bureau, Age by Census Tract: File Name: H17, http://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t&keepList=f and Minnesota Population Center. National Historical Geographic Information System: Version 2.0. Minneapolis, MN: University of Minnesota 2011. File Name: nhgis0005_ds201_20135_2013_blck_grp, https://www.nhgis.org/documentation.

- **Unemployment.** This category depicts the total participation in the labor force to understand the unemployment rate. The labor force includes those individuals who are currently employed and/or those who have the ability to work. In order to complete this analysis, 2013 census block group data were aggregated for each Cleveland neighborhood. Because neighborhood boundaries do not correlate to census tract and block group boundaries, data were estimated. In instances where more of the block group area was incorporated in the neighborhood it was included in that neighborhood's unemployment value. The total population within the neighborhood was then divided by the individuals currently seeking work or employed within each neighborhood.

Data source used to obtain Unemployment by Block Group: Minnesota Population Center. National Historical Geographic Information System: Version 2.0. Minneapolis, MN: University of Minnesota 2011. File Name: nhgis0005_ds201_20135_ 2013_blck_grp, https://www.nhgis.org/documentation.

- **Population Density.** This category determines how population is dispersed throughout Cleveland's neighborhoods. Neighborhoods with a higher population density will require more tree canopy to benefit more people. A correlation exists between canopy coverage and social-economic issues. In order to complete this analysis, 2013 census block group data were aggregated for each Cleveland neighborhood. Again, because neighborhood boundaries do not correlate to census tract and block group boundaries, data were estimated. If more of the block group area was incorporated in the neighborhood it was included in the population value. The amount of people within the neighborhood was then divided by the area of the neighborhood to provide the population density for each neighborhood.

Data source used to obtain Population Density by Block Group: Minnesota Population Center. National Historical Geographic Information System: Version 2.0. Minneapolis, MN: University of Minnesota 2011., File Name: nhgis0005_ds201_20135_2013_blck_grp, https://www.nhgis.org/documentation.

Environmental Benefits Mapping and Analysis Program (BenMAP)

BenMAP is a software application developed by the U.S. EPA that uses community-level ambient pollution exposure data to estimate the health impacts and economic benefits occurring when populations experience changes in air quality. Benefit values derived from the BenMAP model focus only on adverse human health effects of air pollution and related patient treatment costs. The U.S. Forest Service incorporated an adaptation of the BenMAP model within their own i-Tree Eco model which allowed for estimation of reductions in air pollution and the resulting positive public health impact attributable to tree canopy.

Canopy Projections: Development and Applications

This plan references past, current, and projected tree canopy cover levels in Cleveland. The following describes the methodology used to obtain this canopy data.

The current urban tree canopy (UTC) cover rate of 19% was obtained from the 2013 Cuyahoga County Urban Tree Canopy Assessment.
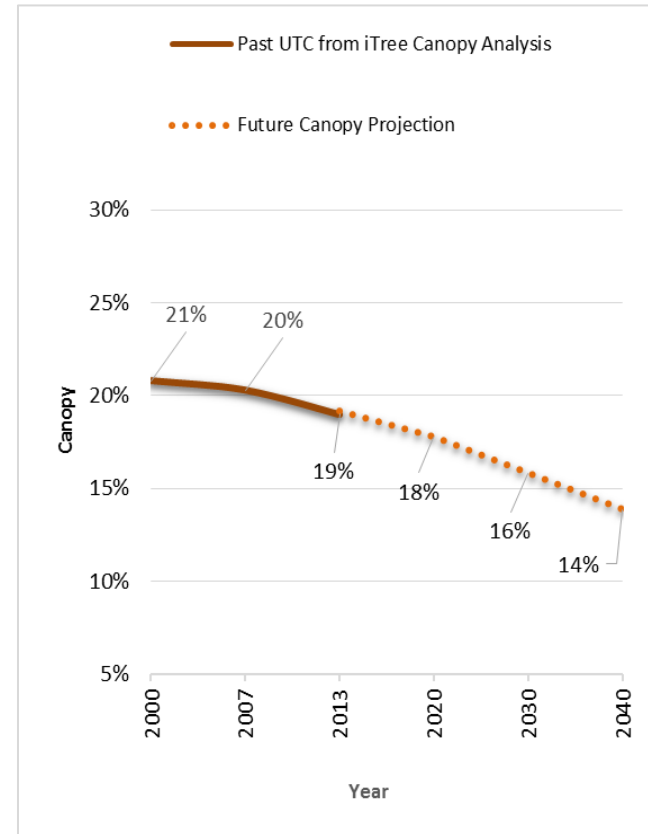
Past canopy cover was obtained using the i-Tree Canopy application, which utilized Google aerial imagery from 2000 and 2007. In i-Tree Canopy, 500 sample data points from each year were used to provide an estimated canopy and assess the change. Results showed a 2.24% drop in canopy from 2000 to 2007 and a 6.11% drop in canopy from 2007 to 2013. By applying these rates of change to today's 19% canopy coverage, past canopy levels could be estimated, as shown in Table 11.

Future canopy projections applied the average acres of canopy lost per year from 2007 and 2013 (97 acres) to future years. Based on this projection, canopy will drop to 14% by the year 2040 as shown in Figure 15.

Figure 15. Canopy Projections at Current Rate of Loss

Table 11. Canopy Projection Data Table

Year	% Change Determined by i-Tree Canopy	Change Translated to UTC	Change Translated to Actual Canopy Acres	Canopy Acres Lost	Avg. Lost/ Yr
2000	n/a	21%	10,296	n/a	n/a
2007	-2.24%	20%	10,071	226	32
2013	-6.11%	19%	9,491	580	97
Total canopy acreage lost since 2000:			805		
Average acres lost over 14 years:			58		
Average acres lost per year (using recent 6 years)			97		
Projected acres loss 2013 to 2040			2,619		

Using the resulting canopy levels from the above processes, we see that 805 acres of canopy were lost between 2000 and 2013. This is a net loss, combining all canopy loss with all canopy growth (new plantings or growth of existing trees).

Over the most recent six years (2007 to 2013), Cleveland lost an average of 97 acres of canopy per year. If this rate of loss holds, Cleveland is expected to lose another 2,619 acres of canopy between 2013 and 2040 (27-year time span), as shown in Figure 15.

Estimate of Quantity of Trees Lost. The number of individual trees lost can be estimated using an average tree canopy diameter of 29 feet, allotting for an estimated 66 trees per acre. Based on the acres of canopy Cleveland is projected to lose between now and 2040, this equates to an estimated 172,854 trees lost total, or 6,402 trees lost per year.

Urban Forestry Budget Calculations

Without current and comprehensive data on the quantity and condition of all public trees, estimating appropriate funding levels is difficult. There is no standard table or formula to use, and need is always in flux. When inventory data are not reliable, current funding can be compared to national statistics provided by the American Public Works Association's series on urban forestry management.

National urban forestry statistics are provided by the National Arbor Day Foundation (NADF) and the U.S. Forest Service, calculated per capita and per tree. Using Cleveland's current population and spending levels, these statistics are compared in Table 12.

Based on these national statistics, Cleveland's current urban forestry budget is higher than the minimum spend required to be a NADF Tree City USA, and 20% lower than the NADF's average of $5.83 per capita budget finding for a city of Cleveland's size. Because of the large backlog of maintenance, the current urban forestry budget is inadequate for today's maintenance needs. However, it is *possible* that once caught up with the backlog of maintenance, the current budget levels may not be far off from an adequate level. A comprehensive inventory would be required to recommend a firm budget range.

About the APWA Series. On the recommendation of the National Urban and Community Forestry Advisory Council (NUFAC), and with the support of the U.S. Forest Service Urban & Community Forestry Council, the American Public Works Association researched and developed four reports in centered on best management practices in urban forestry management: Budget & Funding, Staffing, Ordinances, Regulations & Public Policies, and Urban Forest Management Plans. All four studies can be downloaded here: https://www2.apwa.net/about/coopagreements/urbanforestry.

Table 12. Urban Forestry Budget Calculations Table

	Cleveland TODAY	NADF Minimum ($2/capita)	NADF's Finding ($5.83/capita)	Pittsburgh, PA	Charlotte, NC	Charleston, SC	Minneapolis, MN
Population (approx.)	390,000	390,000	390,000	300,000	800,000	120,000	380,000
City Budget	$541,700,000						
Urban Forestry Budget	$1,800,000	$780,000	$2,273,700	$788,140	$1,819,460	$531,200	$9,209,040
Quantity of Street Trees (approx.)	120,000	120,000	120,000	30,538	85,141	15,242	198,642
Urban Forestry Spend Per Capita	$4.62	**$2.00**	**$5.83**	$2.44	$3.05	$5.06	$24.07
Urban Forestry Spend Per Tree	$15.00	$6.50	$18.95	$26.59	$21.37	$34.85	$46.36
		$2/capita Minimum Spend Required for Tree City USA Designation	*2006 Survey Findings (3,130 communities) result: Average $5.83 per capita spend for a city Cleveland's size.*	*Source: USFS's i-Tree Cost-Benefit Analyses Data, APWA*			

Appendix E
Data Tables and Maps, and Other Information

Data Tables

Land Cover by Neighborhood

Neighborhood	Total Acres	Canopy		Low Veg		Soil		Water		Impervious		Additional Canopy Possible		Total Canopy Potential		
		Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Additional Acres	Additional Percent	Possible Canopy Acres	Possible Canopy Percent	Relative Tree Canopy
Bellaire-Puritas	2,191	332	15%	717	33%	38	2%	7	0.3%	1,136	52%	1,268	58%	1,600	73%	21%
Broadway-Slavic Village	2,901	531	18%	808	28%	142	5%	6	0.2%	1,557	54%	1,584	55%	2,115	73%	25%
Brooklyn Centre	938	226	24%	267	28%	38	4%	5	0.5%	441	47%	472	51%	697	75%	32%
Buckeye-Shaker Square	742	188	25%	189	26%	0	0%	0	0.0%	364	49%	344	46%	532	72%	35%
Buckeye-Woodhill	790	190	24%	248	31%	23	3%	0	0.0%	352	45%	383	49%	573	73%	33%
Central	1,501	194	13%	401	27%	33	2%	0	0.0%	906	60%	857	57%	1,050	70%	18%
Clark-Fulton	611	120	20%	149	24%	1	0%	0	0.0%	341	56%	298	49%	418	68%	29%
Collinwood-Nottingham	2,110	286	14%	539	26%	89	4%	3	0.2%	1,282	61%	1,203	57%	1,490	71%	19%
Cudell	698	112	16%	170	24%	21	3%	0	0.0%	416	60%	360	52%	471	68%	24%
Cuyahoga Valley	2,573	125	5%	369	14%	489	19%	238	9.2%	1,841	72%	1,588	68%	1,713	73%	7%
Detroit Shoreway	974	181	19%	261	27%	19	2%	1	0.1%	531	55%	482	50%	663	68%	27%
Downtown	1,779	72	4%	424	24%	39	2%	54	3.0%	1,229	69%	852	49%	925	54%	8%
Edgewater	533	158	30%	145	27%	3	1%	1	0.2%	230	43%	241	45%	399	75%	39%
Euclid-Green	733	287	39%	174	24%	2	0%	0	0.0%	272	37%	289	39%	576	79%	50%
Fairfax	1,031	182	18%	266	26%	26	3%	0	0.0%	582	56%	549	53%	731	71%	25%
Glenville	2,454	630	26%	707	29%	20	1%	1	0.1%	1,115	45%	1,169	48%	1,800	73%	35%
Goodrich-Kirtland Pk	1,071	91	8%	179	17%	12	1%	3	0.3%	799	75%	519	49%	610	57%	15%
Hopkins	2,642	228	9%	1,091	41%	124	5%	16	0.6%	1,308	50%	1,119	43%	1,346	51%	17%
Hough	1,089	263	24%	346	32%	10	1%	0	0.0%	480	44%	543	50%	806	74%	33%
Jefferson	1,655	286	17%	469	28%	5	0%	0	0.0%	899	54%	889	54%	1,175	71%	24%
Kamm's	3,199	1,075	34%	954	30%	9	0%	40	1.2%	1,131	35%	1,389	44%	2,464	78%	43%
Kinsman	1,071	234	22%	358	33%	32	3%	0	0.0%	479	45%	588	55%	823	77%	28%
Lee-Harvard	1,059	210	20%	408	39%	10	1%	0	0.0%	441	42%	601	57%	811	77%	26%
Lee-Seville	914	189	21%	323	35%	7	1%	0	0.0%	401	44%	532	58%	721	79%	26%
Mount Pleasant	1,402	315	22%	458	33%	5	0%	0	0.0%	629	45%	709	51%	1,024	73%	31%
North Shore Collinwood	1,451	323	22%	441	30%	13	1%	8	0.6%	679	47%	726	50%	1,049	73%	31%
Ohio City	709	159	22%	164	23%	3	0%	0	0.0%	386	54%	314	44%	473	67%	34%
Old Brooklyn	3,794	847	22%	1,240	33%	20	1%	25	0.7%	1,682	44%	2,055	55%	2,902	77%	29%
St.Clair-Superior	1,037	199	19%	275	27%	25	2%	6	0.6%	557	54%	531	51%	730	71%	27%
Stockyards	1,065	172	16%	335	31%	5	0%	2	0.1%	557	52%	617	58%	789	74%	22%
Tremont	1,068	177	17%	282	26%	41	4%	1	0.1%	608	57%	569	53%	746	70%	24%
Union-Miles	2,045	449	22%	624	31%	66	3%	1	0.0%	971	47%	1,084	53%	1,533	75%	29%
University	971	254	26%	203	21%	4	0%	8	0.8%	506	52%	422	44%	676	70%	37%
West Boulevard	1,219	246	20%	351	29%	4	0%	0	0.0%	621	51%	615	50%	861	71%	29%

Benefits by Neighborhood

Neighborhood Data			Air Pollution Avoided		Carbon Recution		Stormwater Intercepted		Energy Savings		Property Value Increase	Total Benefits	
Name	Canopy %	Size (Acres)	Unit (lb)	Value ($)	Unit (tons)	Value ($)	Units (gallons)	Value ($)	Units (kWhs)	Value ($)	Value ($)	Total Value	Value Per Acre
Bellaire-Puritas	15%	2,191	22,402	$49,269	43,107	$834,704	62,373,697	$374,242	1,041,247	$114,537	$168,371	$1,541,123	$703
Broadway-Slavic Village	18%	2,901	36,229	$79,590	69,637	$1,348,401	99,783,989	$598,704	1,870,672	$205,774	$252,807	$2,485,275	$857
Brooklyn Centre	24%	938	15,340	$33,720	29,503	$571,284	42,413,963	$254,484	710,833	$78,192	$89,266	$1,026,946	$1,095
Buckeye-Shaker Square	25%	742	12,793	$28,101	24,587	$476,087	35,425,050	$212,550	642,106	$70,632	$108,067	$895,437	$1,207
Buckeye-Woodhill	24%	790	12,886	$28,333	24,790	$480,020	35,682,216	$214,093	421,773	$46,395	$96,566	$865,407	$1,095
Central	13%	1,501	13,182	$28,981	25,357	$490,994	36,407,741	$218,446	124,392	$13,683	$66,759	$818,863	$546
Clark-Fulton	20%	611	8,150	$17,893	15,655	$303,142	22,570,525	$135,423	652,762	$71,804	$57,919	$586,181	$960
Collinwood-Nottingham	14%	2,110	18,249	$42,312	37,021	$716,842	53,801,913	$322,811	694,639	$76,410	$149,325	$1,307,701	$620
Cudell	16%	698	5,437	$16,572	14,500	$280,768	21,023,576	$126,141	422,908	$46,520	$58,637	$528,639	$757
Cuyahoga Valley	5%	2,573	8,122	$17,831	15,601	$302,088	23,533,822	$141,203	35,530	$3,908	$18,802	$483,832	$188
Detroit Shoreway	19%	974	12,226	$26,864	23,505	$455,129	33,999,577	$203,997	610,515	$67,157	$80,934	$834,081	$856
Downtown	4%	1,779	4,951	$10,891	9,529	$184,516	13,566,182	$81,397	3,213	$353	$12,613	$289,770	$163
Edgewater	30%	533	10,657	$23,429	20,499	$396,938	29,666,495	$177,999	397,711	$43,748	$76,371	$718,486	$1,348
Euclid-Green	39%	733	19,262	$42,556	37,234	$720,975	53,900,334	$323,402	685,502	$75,405	$197,542	$1,359,880	$1,855
Fairfax	18%	1,031	12,364	$27,195	23,794	$460,736	34,279,936	$205,680	384,612	$42,307	$95,162	$831,080	$806
Glenville	26%	2,454	42,928	$94,394	82,590	$1,599,217	118,555,572	$711,333	2,942,436	$323,668	$321,309	$3,049,922	$1,243
Goodrich-Kirtland Pk	8%	1,071	6,239	$13,696	11,983	$232,030	17,081,311	$102,488	83,851	$9,224	$25,930	$383,368	$358
Hopkins (Airport)	9%	2,642	15,407	$33,850	29,617	$573,491	42,793,849	$256,763	97,283	$10,701	$39,735	$914,541	$346
Hough	24%	1,089	17,749	$39,018	34,138	$661,031	49,497,136	$296,983	883,353	$97,169	$157,976	$1,252,176	$1,150
Jefferson	17%	1,655	19,408	$42,664	37,329	$722,814	53,855,121	$323,131	1,554,956	$171,045	$142,677	$1,402,331	$847
Kamm's	34%	3,199	73,139	$160,761	140,658	$2,723,599	202,207,281	$1,213,244	3,665,319	$403,185	$459,043	$4,959,831	$1,550
Kinsman	22%	1,071	15,839	$34,805	30,453	$589,670	44,096,775	$264,581	448,754	$49,363	$111,817	$1,050,236	$981
Lee-Harvard	20%	1,059	14,204	$31,222	27,317	$528,954	39,529,462	$237,177	1,226,879	$134,957	$109,730	$1,042,040	$984
Lee-Seville	21%	914	12,749	$28,020	24,516	$474,719	35,610,874	$213,665	613,932	$67,533	$102,304	$886,241	$970
Mount Pleasant	22%	1,402	21,315	$46,822	40,967	$793,254	59,207,420	$355,245	1,476,642	$162,431	$192,622	$1,550,373	$1,106
North Shore Collinwood	22%	1,451	21,883	$48,065	42,054	$814,308	60,763,263	$364,580	1,126,266	$123,889	$177,095	$1,527,937	$1,053
Ohio City	22%	709	10,767	$23,657	20,699	$400,795	29,886,271	$179,318	384,754	$42,323	$63,575	$709,668	$1,002
Old Brooklyn	22%	3,794	57,455	$126,266	110,476	$2,139,178	159,255,586	$955,534	3,262,840	$358,912	$350,141	$3,930,030	$1,036
St.Clair-Superior	19%	1,037	13,522	$29,723	26,006	$503,559	37,430,687	$224,584	520,554	$57,261	$84,734	$899,860	$868
Stockyards	16%	1,065	11,609	$25,501	22,312	$432,031	32,373,255	$194,240	584,218	$64,264	$75,968	$792,004	$744
Tremont	17%	1,068	11,887	$26,154	22,883	$443,092	33,254,364	$199,526	308,522	$33,937	$68,706	$771,414	$722
Union-Miles	22%	2,045	30,315	$66,627	58,295	$1,128,780	84,362,987	$506,178	2,320,050	$255,206	$263,988	$2,220,778	$1,086
University	26%	971	17,205	$37,833	33,102	$640,957	47,855,703	$287,134	152,929	$16,822	$61,769	$1,044,515	$1,076
West Boulevard	20%	1,219	16,728	$36,801	32,199	$623,473	46,287,304	$277,724	1,325,077	$145,758	$131,073	$1,214,829	$997

Current Tree and Tree Commission Ordinances

CHAPTER 509 – TREES (accessed online via American Legal Publishing Corporation, July 29, 2015)
City of Cleveland Code of Ordinances> Part Five: Municipal Utilities and Services Code > Title I: Streets and Sidewalk Areas > Chapter 509 – Trees

  Note: The legislative history of this chapter, except where specifically noted at the end of a section, is as follows: Ordinance No. 63410-A, passed September 22, 1924.
Cross-reference:
  Climbing trees in parks prohibited, CO 559.35
  Destruction of shrubs, trees, or crops, CO 623.06
  Location of shade trees on streets, CO 503.04
Statutory reference:
  Assessments for tree planting or maintenance, RC 727.011
  Power to regulate shade trees and shrubbery, RC 715.20

§ 509.01 Climbing, Breaking, Injuring Trees Prohibited; Exceptions; Permit

No person, firm, or corporation without a written permit from the Director of Public Properties shall cut, break, climb, or injure any tree or portion of the tree planted or growing in any public highway within the City or cause, authorize, or procure any person to cut, break, climb, or injure any such tree or portion thereof; cut, break, climb, or injure any tree or plant, or injure, misuse, or remove, or cause, authorize, or procure any person to injure, misuse, or remove any device set for the protection of any tree or plant in any public highway of the City. Any person, firm, or corporation desiring for any lawful purpose to cut, prune, treat, with a view to its preservation from disease or insect, or trim any tree in any public highway of the City, may apply to the Director, and if in the judgment of the Director the desired cutting, pruning, treatment, or trimming appears necessary and the proposed method and workmanship thereof are such as the Director approves, the Director may thereupon issue a written permit for such work. Any work done under such written permit must be performed in strict accordance with the terms thereof.

§ 509.02 Killing, Removing Trees Prohibited; Exceptions; Permit

No person, firm, or corporation shall kill or remove, or cause, authorize or procure the death or removal of any tree planted or growing in any public highway within the City. Any person, firm, or corporation desiring for any lawful purpose to take down or remove any tree in any public highway of the City may apply to the Director of Public Properties, and if in the judgment of the Director, the desired taking down or removal appears necessary, the Director may thereupon issue a written permit therefor. Any work done under such written permit must be performed in strict accordance with the terms thereof.

§ 509.03 Injurious Substances in Soil around Tree Roots

No person, firm, or corporation owning or using, or having control or charge of gas or other substance deleterious to tree life, shall allow such gas or other substance to come into contact with the soil surrounding the roots of any tree in any public highway in the City in such manner as may injure such tree or plant.

§ 509.04 Lethal Substances in Soil around Tree Roots

No person, firm, or corporation owning or using, or having control or charge of gas or other substance deleterious to tree life, shall allow such gas or other substance to come into contact with the soil surrounding the roots of any tree in any public highway in the City in such manner as shall kill or destroy such tree or plant.

§ 509.05 Injurious Substances Flowing into Tree Soil

No person, firm, or corporation shall cause, authorize, or procure any brine water, oil, liquid dye, or other substance deleterious to tree life to lie, leak, pour, flow, or drip on or into the soil about the base of any tree in any public highway in the City, or onto the sidewalk, road, or pavement therein at a point whence such substance may be lying on, or by flowing, dripping, or seeping into such soil, or in any other manner whatever, injure such tree; or cause or procure such lying, leaking, flowing, dripping, seeping, or injuring.

§ 509.06 Stone, Cement Obstructing Tree's Air, Water; Permit

No person, firm, or corporation, except with the written permit of the Director of Public Properties, shall place or maintain upon the ground in any public highway within the City, any stone, cement, or other material or substance in such manner as may obstruct the free access of air and water to the roots of any tree or ornamental plant in such highway. Unless otherwise provided for in such written permit, there must be maintained about the base of the trunk of each shade tree in the public highways of the city at least six (6) square feet of open ground for a tree three (3) inches in diameter, and for every two (2) inches of increase of such diameter there must be an increase of at least one (1) square foot of open ground.

§ 509.07 Power to Preserve or Remove Trees

The Director of Public Properties shall have the right to plant, trim, preserve, and remove all trees within the lines of all streets, alleys, avenues, lands, lanes, squares, and public grounds as may be necessary to ensure safety, or to preserve the symmetry and beauty of such public grounds. The Director, under the power given herein, may cause any tree which is in an unsafe condition, or which by reason of its nature is injurious to sewers or other improvements, or is affected by any injurious scale or other pest, to be removed.

§ 509.08 Interference with Properties Director and City Employees

No person, firm, or corporation shall interfere, cause, authorize, or procure any interference with the Director of Public Properties, or any of his or her employees, agents, or servants, while they are engaged in and about the planting, cultivating, mulching, pruning, spraying, or removing of any tree in any public highway within the City, or in removing any device attached to a tree or in such removing of stone, cement, sidewalk, or other material or substance as may be

necessary for the protection and care of any such tree in accordance with the requirements set forth in Section 509.06, as to the area of open ground to be maintained about the base of the trunk of each shade tree in the public highways of the City.

§ 509.09 Electrical Wires Injuring Trees

No person, firm, or corporation shall cause, authorize, or procure a wire or other conductor, charged with electricity, to come into contact with any tree in a public highway in the city, in such manner as may injure or abrade such tree or plant.

§ 509.10 Electrical Wires Killing Trees

No person, firm, or corporation shall cause or authorize or procure a wire or other conductor charged with electricity, to come into contact with any tree in any public highway in the city in such manner shall destroy or kill such tree or plant.

§ 509.11 Attaching Wire, Signs to Trees Restricted

No person, firm, or corporation shall attach or keep attached to any tree in any public highway in the city or to the guard or stake intended for the protection of such tree, any rope, wire, sign, or any other device whatsoever, except for the purpose of protecting it or the public.

§ 509.12 Animals Prohibited from Injuring Trees

No person, firm, or corporation shall tie any horse or any other animal to any tree in any public highway within the City or having charge of such horse or other animal, allow or cause or procure it to injure any such tree; nor shall any person in charge of such horse or other animal cause or allow it to stand so that it can injure such tree.

§ 509.13 Tree Planting Permit; Planting Plan

(a) No person, firm, or corporation shall plant or set out any shade tree or cause or authorize or procure any person to plant or set out any shade tree, in or on any part of any public highway within the City, without first obtaining from the Director of Public Properties a written permit to do so or without complying in all respects with the conditions set forth in such written permit.

(b) Before any permit shall be issued for planting more than twenty-five (25) trees on any one (1) permit, the Director may request from the applicant a detailed declaration of intentions either in the form of a planting plan or written statement in duplicate. All planting plans shall be drawn on tracing cloth in ink. One (1) copy of each plan or statement of intentions shall, when approved by the Director, be returned to the applicant and the other copy shall be kept on file by the Director.

(c) All planting plans shall show accurately:

(1) The proposed street width, together with its subdivisions of pavement, curb, gutter, parking strip, and sidewalk areas, to a definite indicated scale;

(2) The proposed location of each and every proposed tree together with the location of each existing within the proposed street lines in scaled relation to the other features of the plan;

(3) The variety of each and every tree proposed to be planted and of those already existing within the proposed street lines, either indicated on the plan or referenced with a number to key list;

(4) The distance between trees in any one (1) row in feet;

(5) The nature of the soil in the planting space, to a depth of three (3) feet, and all existing and proposed surface or subsoil drainage system.

(d) All statements filed in lieu of a planting plan shall contain the same information as required on the plan.

§ 509.14 Protecting Trees from Construction

During the erection, repair, alteration, or removal of any building or structure within the City, no person in charge of such erection, repair, alteration, or removal, shall leave any street tree in the vicinity of such building or structure without such good and sufficient guards or protectors as shall prevent injury to the tree arising out of or by reason of the erection, repair, alteration, or removal.

§ 509.15 Authority of Properties Director over Trees on Private Grounds

The Director of Public Properties shall have power to enter upon any private grounds in the City and cause to be sprayed or otherwise treated any tree or shrub infected or infested by any parasite or insect pest when it shall be necessary in the opinion of the Director to do so, to prevent the breeding or scattering of any parasite or animal pest, and to prevent danger therefrom to shade trees and shrubbery planted in the streets, alleys, and public grounds of the City. Whenever in the opinion of the Director, trimming, treatment, or removal of any such tree or shrub located on private grounds shall be deemed wise, the Director shall have power to trim, treat, or remove any such shrub.

§ 509.16 Control of Elm Disease

Council finds and determines that the Dutch elm disease and the virus disease phloem necrosis commonly known as elm blight threaten shade trees in the streets and public grounds and places of the city, and that in order to preserve such trees it is necessary to discover and control these diseases.

(Ord. No. 1779-48. Passed 10-18-48)

§ 509.17 Inspection and Destruction of Diseased Trees

The Commissioner of Shade Trees is authorized to inspect any tree within the city reported or supposed to be infected with the Dutch elm disease or the virus disease phloem necrosis commonly known as elm blight. If upon such inspection the Commissioner determines that such tree is infected with either of the diseases, he or she shall, if the tree is in any public street, ground, or place within the city, immediately remove and burn the same in such manner as to prevent as fully as possible the spread of such disease. If such tree is located on private property, the Commissioner shall immediately serve upon the owner of such property a written notice that such tree is so infected and that the same must be removed and burned under the supervision of the Commissioner within five (5) days of the service of notice. If such owner cannot be found, a copy of the notice shall be posted upon the infected tree. If the tree is not so removed and burned within five (5) days after the service or posting of notice, the Commissioner shall cause the tree to be so removed and burned. The cost of removal and burning shall be reported to the owner of the property, if he or she can be found, and also Council. If the cost is not paid within thirty (30) days of such report, Council may assess the same as in other cases of the abatement of nuisances.

(Ord. No. 1779-48. Passed 10-18-48)

§ 509.18 Additional Tests to Determine Presence of Disease

If upon the inspection of any tree within the city reported or supposed to be infected as aforesaid, it is impossible to determine with certainty the existence of either of the diseases in such tree, it is hereby determined that in such event specimens from the tree shall be forwarded for complete examination, diagnosis, and report to either the Ohio State Experimental Station at Wooster, Ohio, or to the United States Department of Agriculture Station at Beltsville, Maryland.

The action of the Commissioner of Shade Trees under this section shall await and be determined by the report received from such examination and diagnosis.

(Ord. No. 1779-48. Passed 10-18-48)

§ 509.19 Property Owner's Responsibility to Trim or Remove Trees

The owner or agent of any lot or parcel of land fronting on any street, avenue, or public ground in the City, in which shade trees are planted and growing, shall trim or cause to be trimmed, the branches from the trees in or in front of their respective lots or lands, near which any street lamp is placed, so as not to obstruct the passage of light from such lamp to the street or sidewalk adjacent, and shall trim all branches overhanging any sidewalk or roadway, so as to have a clear height of eight (8) feet above the surface of the sidewalk, and a clear height of ten (10) feet above the surface of the roadway, unobstructed by branches, and shall remove from the trees all dead, decaying, and broken limbs or branches that overhang the sidewalk or street, or are liable to fall thereon. When any trees are dead the owner thereof shall take up, or cause to be taken up, the dead trees and remove the same from the lot or parcel of land. If any owner or agent of any lot or land in which shade trees are planted fails or refuses to comply with the requirements of this section, after being duly notified to do so, the Shade Tree Commissioner shall cause the same to be done at the expense of the owner of the property in or in front of which the trees may be located, which expense, together with the cost of suit, may be collected by a suit in Municipal Court.

§ 509.20 Trimming, Preservation and Removal of Trees on Private Property

(a) The Commissioner of Shade Trees shall have the authority and he or she shall order the trimming, preservation, or removal of any dead or diseased tree or branch or limb thereof located upon private property when he or she finds that such action is necessary to prevent injury to person or damage to property, or to prevent the spread of disease to trees located upon or adjacent to public land or a dedicated street.

(b) Such order of the Commissioner shall be in writing and shall be served either personally or by certified mail upon the owner of such private property. If service is by certified mail it shall be sent to the last known residence of the owner.

(c) When the owner to whom such an order is directed fails to comply within the time specified in such order, the Commissioner shall cause the condition to be remedied at the cost of the person to whom the order is directed. The Commissioner or persons designated by him or her to remedy the condition complained of in the order shall be authorized to enter upon private premises for the purpose of carrying out such order.

(Ord. No. 2096-66. Passed 12-12-66, eff. 12-14-66)

§ 509.99 Penalty

(a) Any person, firm, or corporation which violates Sections 509.01, 509.05, 509.09, 509.11, or 509.13 shall be fined not more than five dollars ($5.00) for each offense.

(b) Any person, firm, or corporation which violates Sections 509.03, 509.06, 509.08, 509.12, or 509.14 shall be fined not more than ten dollars ($10.00) for each offense.

(c) Any person, firm, or corporation which violates Sections 509.02, 509.04, or 509.10 shall be fined not more than fifty dollars ($50.00) for each offense.

(d) Every violation by the same person, firm, or corporation of Sections 509.01 to 509.14 which continues on any day succeeding the first violation thereof, constitutes an additional violation for each of such succeeding days.

(e) In addition to civil liability for the cost of any work performed by the Commissioner of Shade Trees or persons designated by him or her, any person who fails to comply with an order of the Commissioner to trim, preserve, or remove any dead or diseased tree or branch or limb thereof dangerous to person or property or to prevent the spread of disease to trees upon public property or streets within the time specified in such order shall be fined not more than five hundred dollars ($500.00) and imprisoned for not more than thirty (30) days, or both.

(Ord. No. 2096-66. Passed 12-12-66, eff. 12-14-66)

CHAPTER 163 – TREE COMMISSION (accessed online via American Legal Publishing Corporation, July 29, 2015) *City of Cleveland Code of Ordinances> Part One: Administrative Code > Title IX: Boards and Commissions > Chapter 163 – Tree Commission*

§ 163.01 Tree Commission, Composition, Terms, and Compensation

(a) There is hereby created the Cleveland Tree Commission, which shall consist of nineteen (19) members, eighteen (18) of whom shall be appointed by the Mayor, subject to the confirmation of Council. The remaining member shall be the Commissioner of Park Maintenance and Properties, or his or her designee.

(b) Other than the Commissioner of Park Maintenance and Properties, the term of the members shall be three (3) years; provided that of the initial appointments, six (6) members shall serve three (3) years, six (6) members shall serve two (2) years, and six (6) members shall serve one (1) year. In the event that a vacancy occurs during the term of any member, the Mayor shall appoint a successor to serve the unexpired portion of that term.

(c) The members of the Commission shall serve without compensation.

(Ord. No. 2044-92. Passed 12-7-92, eff. 12-14-92)

Note: Pursuant to Sections 5, 6, and 7 of Ord. No. 2044-92, any references to Division of Park Maintenance and Commissioner of Park Maintenance shall be amended to read Division of Park Maintenance and Properties and Commissioner of Park Maintenance and Properties, respectively.

§ 163.02 Organization and Procedures

(a) The Mayor shall appoint a chairperson. At the first meeting of the Commission, the chairperson shall appoint from the Commission's membership a vice chairperson and secretary.

(b) The Commission shall meet at least once a month at such time and place as it shall decide. Special meetings may be called by the chairperson at the chairperson's discretion. A simple majority of the members shall constitute a quorum for the transaction of business. Any member who is absent from three (3) consecutive duly called meetings shall be removed from the Commission unless said member files a written appeal with the Commission and a majority thereof votes to retain said member.

(c) The Commission shall adopt such rules and regulations governing its own conduct as are not in conflict with the Charter or these Codified Ordinances.

(d) The Commission shall keep minutes of its meetings, a copy of which shall be kept on file in the Division of Park Maintenance and Properties. All plans, findings, reports, and recommendations of the Commission shall be in writing and shall designate thereon the names of the members concurring therein. A member who does not concur in any such plan, finding, report, or recommendation may note thereof the reasons for said member's failure to concur.

(Ord. No. 2044-92. Passed 12-7-92, eff. 12-14-92)

Note: Pursuant to Sections 5, 6, and 7 of Ord. No. 2044-92, any references to Division of Park Maintenance and Commissioner of Park Maintenance shall be amended to read Division of Park Maintenance and Properties and Commissioner of Park Maintenance and Properties, respectively.

§ 163.03 Duties of the Commission

The Commission shall:

(a) Study, plan, and recommend to the Director of Parks, Recreation and Properties any action or program which the Commission deems necessary or advisable for the care, preservation, trimming, planting, removal, or disposition of trees, shrubs, and planting sites in public rights-of-way, parks, or other public grounds owned and controlled by the City;

(b) Disseminate to the public information regarding the selection, planting, and maintenance of trees within the city;

(c) Promote the programs and policies of the Division of Park Maintenance and Properties relating to trees, shrubs, and planting sites and recommend improvements thereto;

(d) Investigate and make findings and recommendations regarding any special matter involving trees, shrubs, or planting sites when so requested by Council or the Administration;

(e) Solicit grants or contributions on behalf of the City for use in enhancing the urban forest and educating the public with respect thereto.

(Ord. No. 2044-92. Passed 12-7-92, eff. 12-14-92)

Note: Pursuant to Sections 5, 6, and 7 of Ord. No. 2044-92, any references to Division of Park Maintenance and Commissioner of Park Maintenance shall be amended to read Division of Park Maintenance and Properties and Commissioner of Park Maintenance and Properties, respectively.

American National Standards Institute (ANSI): ANSI is a private, nonprofit organization that facilitates the standardization work of its members in the United States. ANSI's goals are to promote and facilitate voluntary consensus standards and conformity assessment systems, and to maintain their integrity.

*ANSI A300***:** Tree care performance parameters established by ANSI that can be used to develop specifications for tree maintenance.

bare soil land cover: The land cover areas mapped as bare soil typically include vacant lots, construction areas, and baseball fields.

canopy: Branches and foliage which make up a tree's crown.

canopy assessment: See **urban tree canopy (UTC) assessment**.

canopy cover: As seen from above, it is the area of land surface that is covered by tree canopy.

canopy spread: A data field that estimates the width of a tree's canopy in five-foot increments.

extensively-managed: A term used to describe trees managed as a group, such as in wooded or natural areas (not street trees).

community forest: see **urban forest**.

DBH: see **tree size**.

existing UTC: The amount of urban tree canopy (UTC) present within the study boundary. See **urban tree canopy**.

genus: A taxonomic category ranking below a family and above a species and generally consisting of a group of species exhibiting similar characteristics. In taxonomic nomenclature, the genus name is used, either alone or followed by a Latin adjective or epithet, to form the name of a species.

geographic information system (GIS): A technology that is used to view and analyze data from a geographic perspective. The technology is a piece of an organization's overall information system framework. GIS links location to information (such as people to addresses, buildings to parcels, or streets within a network) and layers that information to give you a better understanding of how it all interrelates.

global positioning system (GPS): GPS is a system of earth-orbiting satellites that make it possible for people with ground receivers to pinpoint their geographic location.

greenspace: A land use planning and conservation term used to describe protected areas of undeveloped landscapes.

impervious land cover: The area that does not allow rainfall to infiltrate the soil and typically includes buildings, parking lots, and roads.

intensively managed: A term used to indicate street trees and park trees that are managed individually (not wooded areas or natural areas).

land cover: Physical features on the earth mapped from satellite or aerial imagery such as bare soils, canopy, impervious, pervious, or water.

mitigate: Make less severe, or lessen impacts.

monoculture: A population dominated by one single species or very few species.

open water land cover: The land cover areas mapped as water typically include lakes, oceans, rivers, and streams.

pervious land cover: The vegetative area that allows rainfall to infiltrate the soil and typically includes parks, golf courses, and residential areas.

possible UTC: The amount of land that is theoretically available for the establishment of tree canopy within the town boundary. This includes all pervious and bare soil surfaces.

potential plantable area: The amount of land that is realistically available for the establishment of tree canopy within the town boundary. This includes all pervious and bare soil surfaces with specified land uses.

pruning: The selective removal of plant parts to meet specific goals and objectives.

relative tree canopy: The level or amount of canopy achieved compared to what has been defined as realistically possible.

removal (primary maintenance need): Data field collected during the inventory identifying the need to remove a tree. Trees designated for removal have defects that cannot be cost-effectively or practically treated. Most of the trees in this category have a large percentage of dead crown.

right-of-way (ROW): A strip of land generally owned by a public entity over which facilities, such as highways, railroads, or power lines, are built.

risk: Combination of the probability of an event occurring and its consequence.

stormwater management: management of the runoff that occurs during and after precipitation. Typically involves managing stormwater that cannot infiltrate naturally into the ground because of hard surfaces like roads, sidewalks, and buildings.

street tree: A street tree is defined as a tree within the right-of-way.

structural defect: A feature, condition, or deformity of a tree or tree part that indicates weak structure and contributes to the likelihood of failure.

species: Fundamental category of taxonomic classification, ranking below a genus or subgenus and consisting of related organisms capable of interbreeding.

tree: A tree is defined as a perennial woody plant that may grow more than 20 feet tall. Characteristically, it has one main stem, although many species may grow as multi-stemmed forms.

Tree benefit: An economic, environmental, or social improvement that benefited the community and resulted mainly from the presence of a tree. The benefit received has real or intrinsic value associated with it.

tree canopy land cover: The area of land surface that is covered by the tree's canopy (leaf covered branches) as seen from above an aerial view in summer months.

tree inventory: Comprehensive database containing information or records about individual trees typically collected by an arborist.

tree ordinance: Tree ordinances are policy tools used by communities striving to attain a healthy, vigorous, and well-managed urban forest. Tree ordinances simply provide the authorization and standards for management activities.

tree size: A tree's diameter measured to the nearest inch in one-inch size classes at 4.5 feet above ground, also known as diameter at breast height (DBH) or diameter.

urban forest: All of the trees within a municipality or a community. This can include the trees along streets or rights-of-way, parks and greenspaces, and forests.

urban tree canopy assessment: A study performed of land cover classes to gain an understanding of the tree canopy coverage, particularly as it relates to the amount of tree canopy that currently exists and the amount of tree canopy that could exist. Typically performed using aerial photographs, GIS data, or LIDAR.

urban heat island: a city or urban area that is significantly warming than the surrounding more rural areas, due in large part to development and its related hard surfaces (roads, buildings).

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