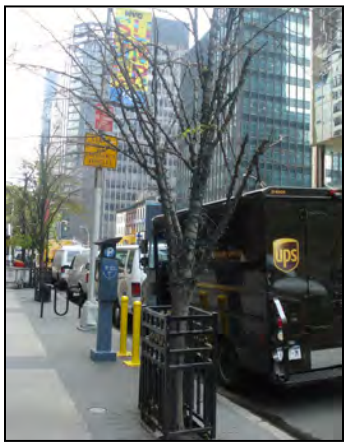
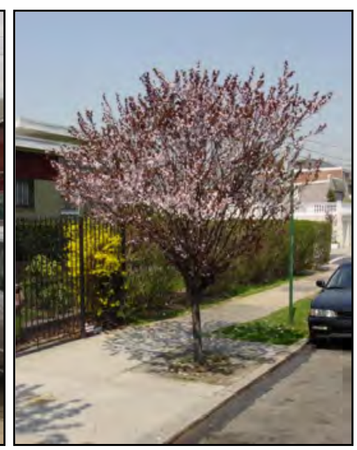
New York City's
Young Street Tree Mortality Study

Site Assessment Tools Description







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Site Assessment Tools Description

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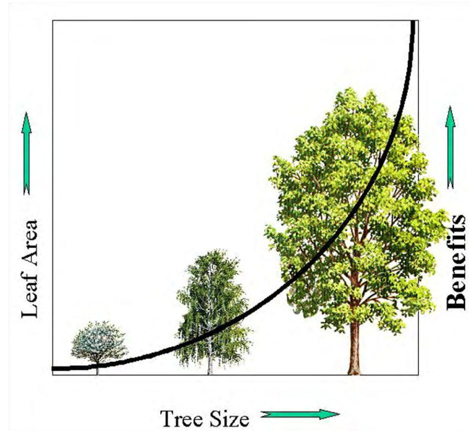
INTRODUCTION

Background

It is assumed that the early years, from 5 to 10 years after planting, are critical to the establishment of a healthy urban street tree. Yet little is known about the factors or significant relationships that ultimately contribute to tree mortality or survival. This project provides a context in which to understand how social, biophysical and neighborhood design factors impact the establishment of street trees. The project brought together a multi-disciplinary set of researchers and practitioners to study the conditions of the urban street tree in an unprecedented study of unique spatial design, scale and intensity.



One of the fundamental challenges to city managers and civic groups is to ensure the survival of newly planted street trees in places as dynamic and diverse as cities. Because residents and managers value the health and benefits of an older tree canopy, we need ensure that what we plant today will live as long as this older stock. Population growth, vehicular traffic, poor air quality and building and sidewalk designs all present challenges to the contemporary urban street trees. Yet in order to maximize proven urban forestry benefits (both biophysical and social), trees must reach maturity. While there is much research on soil regimes, nursery stock, and species selection, survival rates still vary widely—from 34.7% to 99.7% according to a recent review of the literature (Roman, 2006). As cities around the United States increase their investment in tree planting, we must be able to ensure the trees' best chance of survival.

The Purpose of This Report

This report is intended to provide a step by step guide for city managers and researchers on how to assess early street tree survival and mortality. While it is based on the 2006/2007 study completed in New York City, it does not report its results. Rather it provides a detailed look at what data we collected and why in order to serve as a stand-alone guidance document. Our hope is that other cities will replicate at least part of this study in order to add to the profession's body of knowledge about early tree planting success in ways that allows us to compare our successes and learn from one another.

About the Study

Funded by the National Urban and Community Forestry Advisory Council and the Tree Fund, the New York City Department of Parks & Recreation (Parks) assembled a multi-disciplinary team of researchers to develop preliminary hypotheses and data collection tools. The data set consisted of 45,000 street trees planted by Parks between 1999 and 2003. Street tree locations varied widely, from concrete downtown to grassy outer borough. The team used a combined study approach that examined social (presence of garbage, stewardship, graffiti, etc), biological (soil compaction, tree condition, etc.) and physical (street width, building height, street slope, etc.) factors with the potential to impact trees in the first decade of street tree establishment. The study investigated factors on two scales. First, we looked at the entire tree population using existing data sets. Second we sampled 14,000 street trees from the larger group of trees , visited them, and collected over 40 additional pieces of related data.

All field work was conducted by interns hired and trained by Parks. Data collection took two summers (2006 and 2007). Interns used a survey tool on palm pilots to record data in the field.

SITE TYPES

New York City, with a population of eight million people and five different boroughs, is a heterogeneous urban landscape with a wide variety of sit types. Each site type provides a different growing environment and different challenges for street trees. The most common site types are:

1. Skyscraper dominated business districts

These streets resemble canyons of concrete, steel, and glass. There is high pedestrian and car traffic, reduced sunlight and likely increased water pollution.

2. Residential neighborhoods with high-rise apartment buildings

These residential areas have very tall buildings with thousands of tenants, but they have little if any street level commerce.

3. Densely populated residential neighborhoods with 1, 2, or 3 family homes

These residential neighborhoods are filled with smaller buildings with no more than three units each. Although these blocks are densely populated, but less dense than #2 above, there is little if any commerce.

4. Suburban-like neighborhoods with lawns in front of single family homes

These neighborhoods have low buildings on relatively large properties and residents often own rather than rent their homes.

5. Industrial districts

Industrial districts' activities are typically limited to the early part of the day when streets are filled with trucks loading and unloading merchandise. At all other times these neighborhoods are relatively devoid of street life.

6. Neighborhood commercial centers

Pedestrians, outdoor vendors, and delivery trucks all compete for limited sidewalk space in these areas, which serve as commercial centers for local residents. These blocks may or may not include residences above the shops, but the street level is dominated by commerce.

7. Big box shopping districts

Vehicle traffic, pollution, limited soil volume, and extreme heat from an abundance of reflective surfaces characterize these shopping districts.

8. Neighborhoods in transition from industrial to residential.

In the past decade, many city neighborhoods have seen a conversion of industrial zones to residential neighborhoods. These areas have industrial conditions side by side with large-scale construction of new high-rise residential buildings. Street tree plantings typically accompany the construction of new residences.

9. Low-density residential neighborhoods in transition from high vacancy rates to new homes

In these neighborhoods old and/or vacant houses are torn down and are replaced by new low-density residential buildings. Often the new buildings are larger with the new footprints occupying more space than the previous building.

10. Waterfront neighborhoods

These communities may have any number of residential or commercial development but share harsh environmental conditions with salt spray and wind.

Field Data Indicators

The data collected comprised of 42 criteria grouped with three broad areas: biological, sociability and stewardship, and physical. Below is a list of the data categories including the rationale behind each one. Please note that several indicators are cross-listed due to their applicability to more than one category.

Biological Factors

Data collected	May indicate
Sucker growth, leaf chlorosis, insect/disease damage, twig dieback, whole branch dieback, broken branches, unnatural lean, or trunk wound.	Overall tree health
Diameter at breast height, time in ground, species	Growth rates
Planting too high, soil erosion	Tree root damage, storm water damage
Planting too low, added soil level	Trunk decay
Compacted soil	Soil moisture and oxygen levels
Pooling water	Compacted soil
Tree pit opening	Soil moisture
Animal scat	Soil chemistry, animal urine
Strong wind	Growth rate

Sociability and Stewardship Factors

Data collected	May Indicate
Type of front yard and barrier, visibility into front yard, presence of play equipment, presence and condition of garden, ground floor door in vicinity of tree, seating area, porch, stoop, ramp, balcony, type of building security, door decorations, flower planters, or flag.	Building sociability
Chalk or art on the sidewalk, murals, and public facilities.	Neighborhood sociability
Amount of loose trash, canopy debris, graffiti, broken windows, vacancies.	Neighborhood decay
Citizen encounters	Public perception of urban street trees
Evidence of pruning, bench, bird feeder, or sign-age in tree pit; evidence of weeding; tree gator bag	Tree stewardship
Presence and condition of a walled tree well, pe-rimeter pit guard, or tall, narrow pit guard	Protection of the tree
Block paving, gravel, mulch, or plantings in the pit	Protection from soil compaction and tree root damage.
Choking guards, grates, or wires; electrical outlet in the pit; bicycle locked to tree; tree lights	Negative attitudes or lack of understanding about street tree care

Physical Neighborhood Factors

Data collected	May Indicate
Median strip, number of traffic lanes, and traffic volume	Traffic patterns, air pollution levels and potential for mechanical damage from vehicles
Parallel or perpendicular street parking and pit location (on or off curb)	Tree's proximity to vehicular traffic
Sidewalk width	Increased pedestrian impacts in tree pit
Pit type and cutout size	Amount of available soil, soil moisture, and rooting space
Slope	Drainage and potential for soil erosion.
Proximity to driveway or bus stop	Potential for mechanical damage from vehicles
Presence and condition of a walled tree well, perimeter pit guard, or tall, narrow pit guard indicates	Protection of the tree
Block paving, gravel, mulch, or plantings in the pit	Protection from soil compaction and tree root damage.
Choking guards, grates, or wires	Negative impact on tree health
Electrical outlet in the pit	Tree lights are used.
Bike locked to tree	Source of trunk damage
Telephone wires, awnings, and scaffolding	Limited above growing space
Building height	Available light

Methods

Sampling Plan

Trees were selected for inclusion in the study using a partial inventory technique based on stratified random sampling (Sun and Bassuk, 1991 and Jaenson et al., 1992). A 14,000 tree sample was pulled from a 45,000 tree data set. The sample was stratified by time in-ground and land use. A sampling plan was developed to determine the required sample size for each planting period and land use grouping.

A random number was assigned to each of the 45,000 records using a script in the GIS. The records were exported in groups based on their land use and planting period. In Excel, the records for each exported group were sorted by the random number. The highest random number to be included in the sample (based on required sample size per planting period/land use) was noted. The records with a sample number within the required range were given an attribute in the GIS field, “InSamp.” The final sample contained 14,090 trees.

The data was stratified by time in ground and land use. To confirm a large enough sample size, some land use categories were combined.

Field Data Collection

We pulled information from the existing data set to help confirm the exact trees included in the study. In addition, a grid map series at roughly 1:10,000 was produced using ArcGIS.

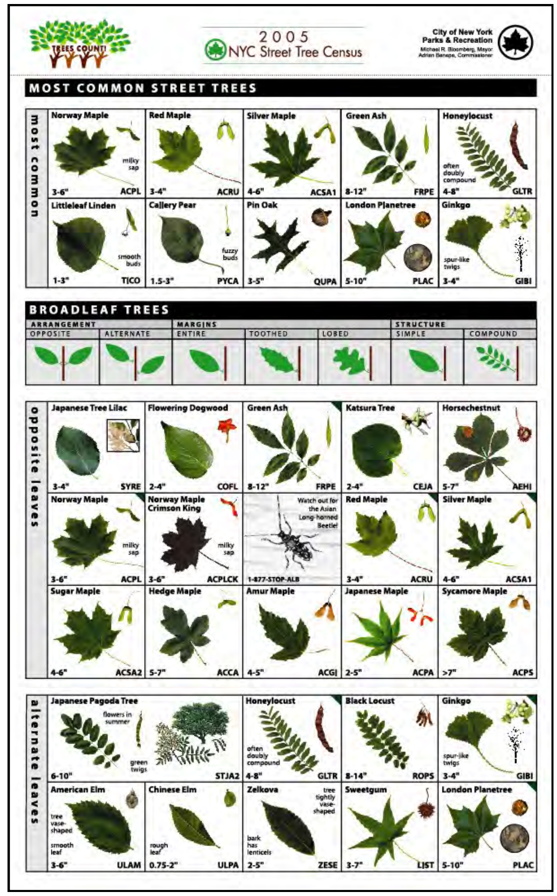
Tree Sample Number	Address	Loc	No.	Tree Species	DBH	Year Planted	Comm. Board	Land Use	Tree Not Found
1	1710. WEBSTER AV	S	4	GIBI	3	2001	0	05	
2	498. CLAREMONT PKWY	S	0	TITO	3	1999	103	01	
3	1573. WASHINGTON AV	S	0	TITO	3	1999	103	06	
4	1573. WASHINGTON AV	S	0	TITO	3	1999	103	06	
5	1824. WASHINGTON AV	S	3.0A	ZESE	3	2001	106	02	
6	499. E 175 ST	S	2.0X	GLTR	3	2001	106	08	
7	410. E 173 ST	S	1	PYCA	3	2003	103	08	
8	4006. 3 AV	S	1	TICO	3	2001	103	06	
9	1745. BATHGATE AV	S	0	GLTR	3	2002	103	11	
10	1745. BATHGATE AV	S	0	GLTR	3	2002	103	11	
11	3805. 3 AV	S	1	GLTR	3	19992000	103	02	
12	3823. 3 AV	S	1	GLTR	3	19992000	103	02	

Researchers prepared the data collection fields based on the key factors under study. Then, they collaborated to develop a field observation assessment tool. Standards were determined for each data field to ensure consistency and so that the study could be replicated in the future. See Appendix I: Field Observation Guide for complete survey questions and descriptions.

In order to record data in the field, a custom data collection form was designed in Pendragon Forms, an application designed for Palm handhelds. This program allowed survey questions to be loaded on a Palm Pilot for mobile data collection. The field data was then directly synchronized into Microsoft Excel.

For two summers, 18 interns collected data in all five boroughs. Two interns from the first field season returned to coordinate the second season's data collection. This helped provide consistency from one year to the next.

The interns worked in pairs and traveled either on foot or by car. Manhattan and the more urban parts of the Bronx, Queens and Brooklyn were surveyed on foot while Staten Island and the less urban parts of the Bronx, Queens and Brooklyn were surveyed by car.
In the field, the interns carried:



- Road maps
- Detailed GIS generated field maps showing the location of the trees to be surveyed
- A list of all trees with information obtained from the original data set:
  - a unique sample number
  - address
  - additional location information (such as across from, adjacent to, or at rear of address)
  - the tree number at that address (1st tree, 4th tree, etc.)
  - species
  - DBH at time of planting
  - the season and year of planting.
- Census tree ID guide (see image at right)
- Husky #2 Phillips screwdriver (product number 537-340 U HD) to measure soil compaction.
- Caliper to measure DBH
- Palm Zire21 handheld device
- Tree species identification guide
- Data collection instructions

All data was entered in the Palm Pilot. It took 4,320 person hours to survey 14,667 trees over the two survey seasons. Additional time was spent cleaning up the data after it was uploaded from the Palms.

Recommendations

In preparing for this study and in the course of two summers of data collection clean up, we have collected a vast amount of wisdom and some recommendations on the best ways to conduct such a study. What follows are some of the key suggestions useful for similar efforts.

- Verify Tree Locations
  Finding and confirming the study tree was the single most time consuming part of the study. It is important to keep excellent records on planting location from the initial time of planting using whatever method is preferred, such as GPS, geocoding, or address association.

- Confirm the Quality of Data Sets
  If possible, it is important to field verify remotely gathered data. For example, we found the city generated land use designation for the parcel associated with the study tree did not always match field conditions. In fact they only matched 52% of the time.

- Avoid Extraneous Variables
  Some data proved may be less useful than we had hoped. For example: pooling water and measured compaction is highly impacted by recent rainfall. Other data was difficult to detect: e.g. weeded pits and strong winds.

- Consider Importance of Rarely Occurring Variables
  Some data, such as electrical outlets or tall tree guards were found so rarely, that it is difficult to make any conclusions about the impact of their presence; however, if combined with data from other cities, we may be able to gain useful insight.

- Streamline Data Collection Fields
  It is important to test the data collection tool before the collection instrument is finalized. We found that by carefully organizing the order in which the fields were listed, the choices within each field, and the default responses, we could streamline data collection significantly. For example, we placed the tree condition choice "good" first on the check off list since that one was most often noted. In addition, we kept all of the items that required examining a specific location together; area around the base of the tree, tree canopy, street area, and adjacent building required different places to look and these observations were grouped. In addition we ordered fields so that later ones built on information collected in earlier fields. For example, we placed overall tree condition in the list after the more specific health assessments (such as tree damage).

- Standardize Data Collection with Visuals
  Data collection standards must be clearly defined with detailed descriptions and photos.

Appendix I
Field Observation Guide

Data for over 14,000 randomly selected street trees planted between 1999 and 2003 and stratified by land use and planting period, was collected using palm pilots loaded with Pendragon Forms. The following list details what data was collected and how it was collected and entered into the Palm. **Bold** face type indicates the exact wording as it appeared in the palm pilot.

I. Preliminary

The following four entries need to be completed in order for the data to be saved

Tree Inventory #

This number is automatically generated by the palm pilot. Each palm is set so that its unique number will not overlap with another palm.

Tree Sample #

This unique number is entered manually and corresponds to the sample number on the list of trees.

Date & Time

These two entries record the date and time the survey was performed. The palm pilot is programmed with the current date and time so that the two entries need only to be confirmed in order for both to be recorded.

Team & Team 2

These two entries include the initials or code numbers of the team members that filled out the survey for that individual tree sample.

II. Tree Level

This portion of the survey refers to the tree itself and the building the tree is located in front of.

1. **Median Strip: Yes / No**
   Note whether there is a median present. Check even if the tree is located in the median. If tree is located in median strip, then the following questions should not be answered: pit off curb (5), ground floor door (24), building type (25), front yard (26), Sociability (27) , Building/façade (28), Building Security (29), Building Stewardship (30), Building Stories (31). The following should only be answered if the tree is planted in a sidewalk cutout in the median: sidewalk width (4) and sidewalk condition (9).

Median

2. **# Traffic Lanes**: limited list of 1-10
   Count the number of traffic lanes, including parking lanes.

3. **On Street Parking Yes / No**
   Parallel **o**
   Perpendicular **o**

Parallel parking

Perpendicular

Select yes if there is parking directly in front of specified tree. If there is parking, check only one box to indicate if the parking is parallel to the curb or perpendicular to the curb.

4. **Sidewalk Width: select one**
   <5, 5-10, 10-15, >15
   Estimate the sidewalk width (in feet) from the tree pit edge to the point where the sidewalk meets a limited object, e.g. porch, lawn, fence, stoop, building. This was not measured with a measuring tape.


Sidewalk < 5 feet


Sidewalk 5-10 feet


Sidewalk 10-15 feet


Sidewalk > 15 feet

5. **Pit Off Curb: Yes / No**
   Note whether the tree pit is located along the curb (select No) or at least five feet off the curb (Yes).

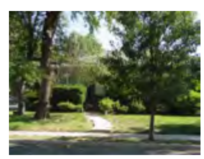

Pit off curb


Pit on curb

6. **Pit Type**
   Select one of the three choices:
   - ❑ **Sidewalk**-a pit cut out of the paved sidewalk surface.
   - ❑ **Continuou**s- pit with two or more trees planted in a shared sidewalk cut out or growing space with block paving in between trees.
   - ❑ **Lawn**- trees planted in a curb strip dominated by grass or soil.


Sidewalk pit


Continuous pit


Lawn pit

7. **Cutout Size**
   For sidewalk pits: use a measuring tape to measure the length (side parallel to the curb) and the width (side perpendicular to the curb).
   For lawn or continuous pits, use a measuring tape to measure only the width. Count the number of trees in the stretch of lawn pit (or number that could fit) and put that number in continuous pit length. If there is a double/parallel row of trees, only count the number which would indicate the length of the pit.

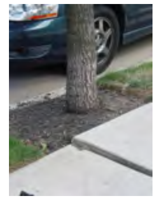
8. **Is there a Slope Yes / No**
   Use your eye/judgement to determine if a slope is present. A slope indicates the whole street, not just within the pit. Select the placement of the tree in relationship to the slope.

Degree of Slope: select one
Low, Med, High Slope
Placement: select one
Bottom, Middle, Top


Cracked sidewalk


Chalk drawings

9. **Sidewalk Condition: select as many as necessary**
   - ❑ **Chalk/play drawings-** temporary chalk that will most likely wash away after precipitation
   - ❑ **Good**- no cracks and is not raised
   - ❑ **Cracked**- cracks in flags adjacent to tree pit
   - ❑ **Raised**- pavement that is pushed up by at least an inch in flags adjacent to the tree pit
   - ❑ **Art-** permanent drawings on pavement


Raised sidewalk


Curb not intact

10. **Curb intact? Yes / No**
    An "intact" curb is one that still functions as a curb--holding soil back from the street, and keeping street and storm runoff from entering the tree pit. Select "no" if the curb is broken to the extent that soil can wash away. Cracks and small missing chunks alone <u>do not</u> indicate that a curb's function is undermined.


Tree near bus stop

11. **Tree Pit:** **Within 5'of Driveway** **o**
    Within 5'of Bus **o**
    Check the appropriate box. "Bus" actually means the entire bus stop and includes school buses; bus should be checked off if it appears that any part of the bus stops within 5 feet of the tree pit on a regular basis.

Signage present on tree guard


Signage present on tree

12. **Signage Present Yes / No**
    Record only signs in these three specific locations. You do not need to record signs that are posted directly in the sidewalk or on nearby buildings. Note: Tree Pit-Pole means that there is a sign post inside the tree pit.

    On Tree **o**
    On Tree Pit-Pole **o**
    On Tree Guard **o**


Signage present on tree guard


Signage present on tree pit pole

Signage Type
Record the type of sign that you noted above.
- ❑ **Other**
- ❑ **Parking**: may be temporary paper sign or permanent sign.
- ❑ **Trash**: e.g. "No Littering"
- ❑ **Advertising**
- ❑ **Tree Care- General**: may include instructions on how to take care of the tree
- ❑ **Tree Care- Animals**: e.g. Curb Your Dog signs

- **Tree Care- Stewardship**: indicates who takes care of the tree. This could be a block group, business improvement zone, or an individual.
- **Commemorative**: Indicates the tree was planted to memorialize a person or event, or in honor of someone.

Planted too high

Planted too low

13. **Site Conditions**: Check as many as apply

    - **Planted too High**: top of root ball visible, surface woody roots do not count.
    - **Planted too Low**: cannot see the flared base of the tree trunk.
    - **Choking Wires:** wires that restrict growth of tree.
    - **Water Pooling**: water pooled in tree pit at time of inspection.

Choking wires

Soil compaction

14. **Soil Compaction**
    Use a Husky #2 Phillips head screwdriver to determine the level of difficulty to penetrate the soil. Measure the soil one foot from the trunk of the tree. If you can feel a rock or other solid impediment, try shifting the screwdriver slightly.

    - **Difficult/Impossible to Penetrate**- this means that a great amount of force is required to push screwdriver into soil or the soil is impossible to penetrate.
    - **Easy to Penetrate**- little to moderate amount of force is required to penetrate soil.

15. **Pit Soil Level**

Erosion

Added soil

- ❑ **Erosion**- soil appears to have washed away over time with roots exposed
- ❑ **Added Soil**- soil is piled in a mound around the tree trunk or added to fill a pit with a walled tree wall
- ❑ **None:** the soil level has not been altered.

16. Pit Observation

Check all that apply.

- ❑ **Pruned**- you can see one or more clean pruning cuts
- ❑ **Stakes, no wires**
- ❑ **Gator Bag**- an irrigation bag that wraps around the tree trunk
- ❑ **Bench**- bench may be part of walled tree guard or may be in pit
- ❑ **Bird Feeder**- stuck in ground or attached to tree
- ❑ **Bike Rack**- This includes a bike rack in a tree pit as well as a bike resting or locked to a tree.
- ❑ **Walled Tree Wall**- (typo: should be “Walled Tree Well”) solid wall around the perimeter of tree pit; could be brick railroad ties or other solid material.
- ❑ **Tree Grate**- flat metal grate lying at sidewalk grade directly covering the tree pit.
- ❑ **Plantings**- intentionally planted in tree pit
- ❑ **Mulched**- wood chips intentionally placed in tree pit; not natural debris.


Pruned


Stakes, no wires

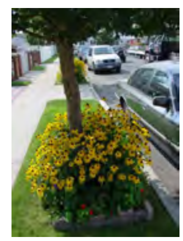

Gator bag


Bird feeder


Bike rack


Bench


Mulched


Plantings


Walled tree well


Tree grate


Walled tree well


Gravel


Weeded


Animal scat


Suckers

- ❑ **Weeded**- note when there is evidence that someone has recently weeded the tree pit, this should not be checked if there is merely an absence of weeds.
- ❑ **Gravel**- intentionally added, not just natural debris
- ❑ **Animal Scat**- animal feces in or within 5 feet of tree pit
- ❑ **Suckers**- shoots coming from base of tree trunk
- ❑ **Block Paving?** ***Yes/No***
  This could be cement or stone blocks in tree pit; may or may not have mortar in between blocks. Most of the time these are the blocks that Parks installs after planting. They also may include non-standard materials such as bricks.


Granite block


Concrete block

Granite	**o**
Concrete	**o**
Other	**o**

If block paving is checked, then look for the following conditions and check all that apply.


Gaps/unaligned


Missing block pav-

Block Paving Status

- o **Unaligned:** blocks are not sitting in straight lines.
- o **Gaps:** there are gaps larger than 1" between blocks, or the gaps are inconsistently sized, indicating a deterioration of the installation over time.
- o **Missing:** one or more blocks are missing from the established installation pattern.
- o **Raised:** one or more blocks are sitting 1" or higher above the established grade of the block pavers.
- o **Sunken :** one or more blocks are sitting 1" or lower than the established grade of the block pavers.


Raised block pav-


Sunken block


Damaged guard

- **Perimeter Tree Pit Guard?** ***Yes / No***
  This means an open structure usually fabricated from steel but could be a picket fence. It would be constructed around the edge of the tree pit. Do not check this for a walled tree well.
  - ❑ **Guard Damaged**?- broken, deformed, or piece missing from guard, do not note if guard is intentionally three sided.
  - ❑ **Guard Choking?-** note if guard is causing damage to the tree or impeding growth
- **Tall, Narrow Tree Guard?** ***Yes / No***


Tall, narrow


Tall, narrow

These are usually made from steel or some other metal and are constructed close to the tree trunk within the tree pit.

- ❑ **Guard Damaged?** - broken, deformed, or piece missing from guard
- ❑ **Guard Choking?** - causing damage to tree; impeding growth

17. Loose Trash? *Yes / No*

Look for trash in and around the tree.

In Tree Pit	**o**
On Sidewalk	**o**
Against Building	**o**

Man-made	**o**
Natural Debris	**o**

Include grass clippings; wood chips; fallen, or collected tree branches

Trash Amount

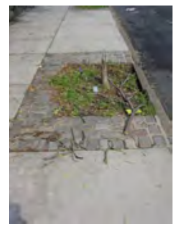
- ❑ **Light**
- ❑ **Heavy**


Light man-made


Heavy man-made


Light man-made


Heavy man-made


Natural debris

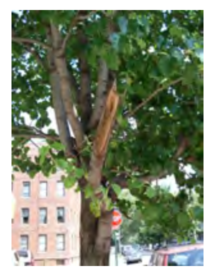

Leaf Chlorosis

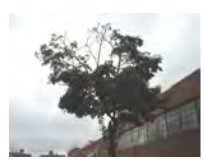

Insect/Disease

18. Tree Damage *Yes / No*

- ❑ **Leaf Chlorosis**- yellowing of leaves throughout the tree
- ❑ **Insect Disease/Damage**- could be any number of signs including small holes around the trunk; spots on leaves, holes in leaves, insect skeletons.
- ❑ **Twig Dieback**- dead twigs at the tips of branches throughout tree
- ❑ **Whole Branch Dieback**- dead branch or branches; does not include broken branches


Twig dieback


Broken branch


Whole branch dieback

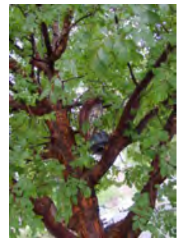

Unnatural lean


Trunk wound

- ❑ **Broken Branch**- broken part of branch may or may not be there
- ❑ **Unnaturally Lean**- (typo: should be "Unnatural Lean") entire tree leaning in one direction
- ❑ **Trunk Wound-** at least one unhealed or healed wound; deeper than bark

19. Infrastructure Conflicts? ***Yes / No***

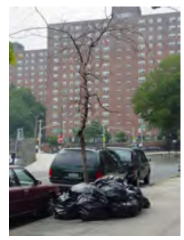
- ❑ **Canopy Debris**- large or significant amount of trash stuck either in canopy or intersection of branch and trunk, this could include plastic bags (not just one bag), shoes, etc.
- ❑ **Paved to Trunk**- pavement extends to the base of trunk; could be solid concrete or paving blocks/bricks
- ❑ **Choked by Guard/Grate**- causing damage to tree; impeding growth
- ❑ **Tree Lights**- lights wrapped around trunk and/or branches
- ❑ **Electrical Outlet**- in tree pit
- ❑ **Bagged Trash in Pit**
- ❑ **Other-** examples include wires (marked "tw")


Canopy debris


Choked by tree guard


Paved to trunk


Choked by grate


Bagged trash in


Electrical outlet in tree


Telephone wires

20. Pavement in Canopy Zone

Estimate how much of the tree's canopy covers paved surfaces.

- ❑ 0 – 24%
- ❑ 25 – 49%
- ❑ 50 – 74%
- ❑ 75 – 100%


0-24%


25-49%


50-74%


75-100%

21. **Overall Tree Condition (*Choose one*)**

The tree condition should take into account canopy health, trunk wounds, decay, and evidence of insect and disease. Follow these guidelines for canopy damage or dieback. For example, if a tree just has 20-40% canopy damage then it is rated good, but if it has 20-40% damage as well as a large trunk cavity it would be rated poor.

- ❑ **Good**- damage on 20-40% of tree
- ❑ **Excellent**- damage on 0-20% of tree as recommended by Jason Grobasky (in reality more like 0-5% damage)
- ❑ **Fair**- damage on 40-60% of tree
- ❑ **Poor**- damage on 60-80% of tree
- ❑ **Dead**
- ❑ **Stump**
- ❑ **Absent**- tree not on site, regardless of presence of pit. Also check if tree has been replaced.

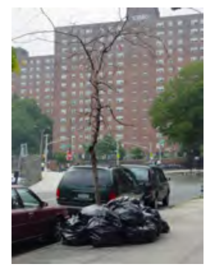

Excellent

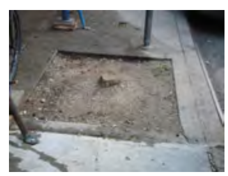

Good


Fair


Poor

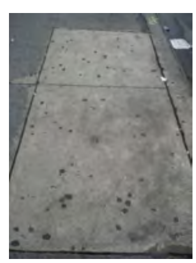

Dead


Dead


Stump

If tree is absent what remains? (*Choose one)*

- ❑ **Empty Pit**: choose this for any one of the following situa-tions…
  - pit remains with no tree
  - pit obviously belonging to study tree has been replaced with a new tree after the guarantee period. Evidence includes a planting tag with a recent year.
  - Lawn area with a newly planted tree in location study tree would have been in
- ❑ **Filled In** - a sidewalk pit filled in with relatively new asphalt or concrete surface; not a new sidewalk; can distinguish from surrounding pavement; filled in area should approximate the


Filled in


Empty pit

size of an average tree pit; obvious that tree pit once existed there

- ❑ **New Sidewalk** - unclear whether or not tree pit once existed

26. DBH

Using a caliper measure, measure the DBH (diameter at breast height), making sure that the measurement is taken 4 ½ feet from the base of the tree. If trunk is clearly uneven measure around trunk 2-3 times and record the average diameter. If trunk splits below 4 ½ feet measure the trunk at the highest point before the swell. Round to the nearest half -inch and select from the drop down list.

27. Species Correct? *Yes / No*

Confirm that the tree found in the field matches the species code on the tree sample listing.

Correct Species (Lookup table)

If the tree listing is incorrect use the lookup table to record the code for the actual species found. If it is not found on the lookup table, use the free text field under **Other Species** to record the encountered species.

28. Ground Floor Door *Yes / No*

Indicate if there is an entrance/exit in front of the tree location or within your field of vision when standing at the tree.

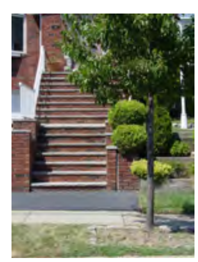
29. Building Type *(choose one)*

- ❑ **Retail/Comm**: any retail or commercial business on ground floor of building directly in front of tree. Do not use this if the business is within the same building but down the block from the tree.
- ❑ **Industrial**: select this for light or heavy manufacturing, not a patron based operation.
- ❑ **Public Instit**: select this for schools (including private), churches, hospitals, recreation center, senior center—as long as it on the ground floor in front of tree.
- ❑ **Private Res**- apartment buildings, houses, (includes public housing) etc.
- X **Mixed Use**- was on the original version but should not have been used. If it was checked then it should be changed to Retail/Commercial. We are only interested in the ground floor activity, not the zoning.

Select the appropriate response for each of the following items encountered directly in front of the tree—not down the block.

- **Seating Area *Yes / No***
  - benches, area where people are likely to bring folding chairs
- **Porch/Stoop *Yes / No***

Seating area



Porch/stoop

Ramp

- **Ramp** ***Yes / No***
- **Balcony** ***Yes / No***

  - within the height of the tree

30. Front Yard

- **Yard Present?** ***Yes / No***
  - Yard should be large enough and capable of being used in some way, e.g. sitting, throwing a ball.

- **Yard Paving**

  Paved o
  Unpaved o

- **Barriers Present?** ***Yes / No***

  Check all that apply.

  ❑ **High Fence**- greater than five feet
  ❑ **Low Fence**- less than five feet
  ❑ **Chain Link Fence**
  ❑ **Ornamental Fence**

- **Shrubs** ***Yes / No***

- **Visibility (Select one)**

  ❑ **Good**
  ❑ **Poor**

Paved yard

Unpaved yard

High fence; good visibility

High fence; poor visibility

Ornamental fence

Low fence

31. Sociability

- **Play Equipment** ***Yes / No***

  This could include small private jungle gym type equipment or extensive playgrounds

- **Garden Present** ***Yes / No***

  Select Yes if there is any type of ornamentation beyond a grass lawn including flowering or ornamental plantings purposely installed.

Garden Type (select one)

❑ **Plastic**- only plastic decorations
❑ **Natural**- may include plastic decorations, but majority of garden must have organic, live plantings

Play equipment

Play equipment

Good natural garden

Good natural

Poor natural garden

If natural garden, care status

- ❑ **Good**- properly maintained, cared for on a regular basis
- ❑ **Poor**- dead plants, no recent sign of any maintenance

32. Building/Facade

- ❑ **Graffiti**- not considered art; tagging
- ❑ **Mural-** solid painting that takes up most or entire side of wall
- ❑ **Advertising**- large sign or mural advertising for business not at present location (not checking advertising if sign is for on-site business)
- ❑ **Broken Windows**- one or more windows
- ❑ **No Windows-** facing the tree
- ❑ **Awning**- within or near tree canopy or trunk
- ❑ **Scaffolding-** temporary structure within or near tree canopy or trunk

Graffiti

Mural

Advertising

Awning

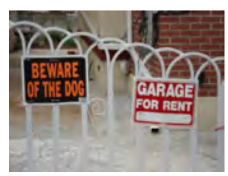
Scaffolding

33. Building Security *Yes / No*

- ❑ **Home Alarm**- signage is present
- ❑ **Surveillance Camera**- signage that indicates presence of camera and/or camera itself
- ❑ **Doorman**
- ❑ **No Trespassing Sign**
- ❑ **No Parking Sign:** not official city DOT sign**.**
- ❑ **Window Bars**- do not include child safety bars

Home alarm

Surveillance



No trespassing

No trespassing;

Doorman

Window bars

34. Building/Stewardship

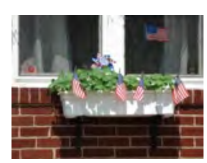
- ❑ **Door Decorations**
- ❑ **Flower Planters**- in yard, on porch/stoop or in window boxes
- ❑ **Flag**- visible from street
- ❑

35. Building Stories (Select one)

Visually inspect building and estimate the number of stories and select the correct range from the drop down list.

- ❑ **< 5**
- ❑ **5 – 10**

Door decorations



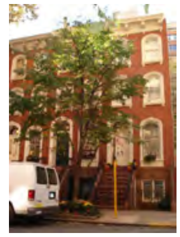
Flower planters; flag

- ❑ **10 – 20**
- ❑ **> 20**

36. Correct Land Use? *Yes / No*

Confirm that the land use listed on the tree sample listing matches the building in front of the tree. If the tree is on the median, select the more dominating land use or has a greater potential impact. For example, if there is a single family home on one side and a large apartment building on the other, select "Multi-family elevator". If the land use on the listing is not correct, then select correct land use. Note that the code listed below is not on the palm but is on the listing.

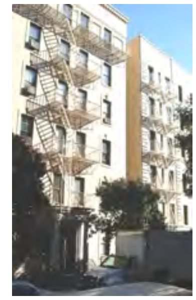
- ❑ **01: 1 or 2 Family**
- ❑ **02: Multi-Fam walk-up**
- ❑ **03: Multi Fam Elevator- assume that any building which exceeds 6 stories has an elevator.**
- ❑ **04: Residential/Commercial mix**
- ❑ **05: Commercial/Office**
- ❑ **06: Industrial**
- ❑ **07: Transportation / utility**
- ❑ **08: Parking**
- ❑ **09: Public Institution- schools (including private), churches, hospitals, recreation centers**



1-2 family

1-2 family

Multi-family



Multi-family walk-up

Multi-family elevator

Commercial/ office

Residential/ commercial mix

Industrial

Commercial/office

Vacant land

Transportation/

Transportation/ utility

Parking

Open space

- ❑ **10: Open Space- Parks (city, state, private), community garden**
- ❑ **11: Vacant Land- no sign that land is being used**

<u>III. Block Level</u>

This portion of the survey refers to the entire block on which the tree is planted. These observations should reflect a visual check of the entire block.

1. **Traffic Volume** ***(Select one)***
   - ❑ **Light**
   - ❑ **Moderate**
   - ❑ **Heavy**

2. **Murals** ***Yes / No***

   These represent purposeful efforts of art and not graffiti.
   - ❑ **Nature**- environmental, animals, plants, planets, etc.
   - ❑ **Memorial/RIP**
   - ❑ **Advertisement/Retail-** can be for present business or other businesses
   - ❑ **Hate/Profanity**- derogatory or hateful message
   - ❑ **Public Health**- promotes awareness of health issues
   - ❑ **Art**- murals that cannot be categorized or do not pertain to any specific topic
   - ❑ **Nationality**- flags or other symbols of U.S. or other countries
   - ❑ **Community**- depiction of people/surroundings/ name of community
   - ❑ **Religion-** religious symbols or words

3. **Vacancy** ***(Choose one)***

   This refers to vacant lots, undeveloped lots in less urban contexts, abandoned buildings, or high vacancy rates of existing residential or commercial buildings.
   - ❑ **Few**- less than half of the block
   - ❑ **Many**- more than half of block
   - ❑ **None**

4. **Public Facilities**
   - ❑ School (not nursery)
   - ❑ Hospital
   - ❑ Fire Station
   - ❑ Police Station
   - ❑ Senior Center

School

Hospital

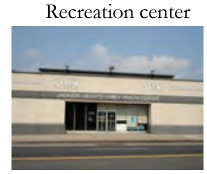
Fire station

Police station

Senior center

Recreation center

Place of worship



Other

- ☐ Recreation Center
- ☐ Place of Worship
- ☐ Other

5. **Strong Wind?** ***Yes / No***
   Select if you feel a constant strong wind

6. **Citizen Encounter?** ***Yes / No***
   Note if surveyor met anyone while surveying the tree,.
   - **Citizen Age (select one)**
     - ☐ **Senior**- about 65 or over
     - ☐ **Adult**- age 18-65
     - ☐ **Child**- less than 18 years of age

   - **Citizen Sex**
     - ☐ **Male**
     - ☐ **Female**
     - ☐ **M/F Couple**
     - ☐ **F/F Couple**
     - ☐ **M/M Couple**

   - **Citizen Attitude**
     - ☐ **Positive**- appreciates tree, curious about tree condition or survey
     - ☐ **Negative**- suspicious, not appreciative of tree or parks department
     - ☐ **Neutral**- no positive or negative comments or actions regarding tree or survey

7. **Location Comments**
   Please use this space to provide any clarifications or corrections to the location provided in the listing.

8. **Misc.**
   Please include any other notes that may be needed, including picture taken and if so the picture #; also if and when tree was replaced. Also include information given by neighbors that may provide useful in study.

9. **Is all the information finalized and complete for this tree? Yes/No**

Appendix II: Literature Review

Survey techniques

Goodwin, D.W. 1996. A street tree inventory for Massachusetts using a geographic information system. J. Arboriculture. 22(1): 19-28. Explores various techniques for mapping tree locations and creates a spatial database of tree locations and fourteen tree attributes.

Smiley, E.T. and F.A. Baker. 1988. Options in street tree inventories. J. Arboriculture 14(2): 36-42. Outlines and discusses how to set up and carry out street tree inventories. Includes what data should be collected, how it should be collected, budgeting.

i-Tree Sample Plot Generator for UFORE. Typically, 200 one-tenth acre plots for a large city and 30 plots for a small town.

Johannsen, H.J. 1975. Municipal tree survey and urban tree inventory. J. Arboriculture April 1975: 71-74. Describes system for identifying street trees.

Cumming, A.B., M.F. Galvin, R.J. Rabaglia, J.R. Cumming, and D.B. Twardus. 2001. Forest health monitoring protocol applied to roadside trees in Maryland. J. of Arbor. 27(3):126-138. Methodology for assessing the condition of roadside trees.

Jaenson, R., N. Bassuk, S. Schwager, and D. Headley. 1992. A statistical method for the accurate and rapid sampling of urban street tree populations. J. Arboriculture. 18(4): 171-183. Develops statistical sampling method, based on stratified random sampling, that can be used to estimate the species composition of an urban street tree population. Results presented for four New York cities.

Sun, W.-Q. and N.L. Bassuk. 1991. Landscape Urban Plann. 20: 277-283. Recommends sampling size for street tree surveys. Computer simulation concludes that sample quality improves little after a certain sampling size, but quality declines significantly at a smaller size.

Tree health studies

Berrang, P., K.F. Karnosky, and B.J. Stanton. 1985. Environmental factors affecting tree health in New York City. J. Arboriculture. 11(6): 185-189. Presents the results of data collection on over 80 variables for 375 trees planted near Consolidated Edison Company facilities in New York City. The study finds excessive soil moisture, mounding of soil on roots, soil salts, and root system size to be the most important factors affecting tree health.

Chacalo, A., A. Aldama, and J. Grabinsky. 1994. Street tree inventory in Mexico City. J. Arboriculture. 20(4): 222-226. Surveyed 1261 street trees in Mexico City, collecting data for seven variables. Problems with tree health are attributed to planting in inappropriate locations, species choice, and lack of adequate maintenance and planning.

Gartner, J.T., T. Treiman, and T. Frevert. 2002. Missouri urban forest—a ten-year comparison. J. Arboriculture. 28 (2): 76-83. Surveyed sample plots in 44 urban communities throughout Missouri as a follow-up to a 1989 survey of tree size, condition, and history, conducted by the American Forestry Association and the USDA Forest Service. The study finds that communities need to devote more of their resources and time to tree maintenance, as opposed to new plantings.

Skiera, Bob and Gary Moll. 1992. The sad state of city trees. American Forests. Summary of the American Forestry Association's survey of 20 U.S. cities. Finds that average life of a downtown street tree is 13 years.

Hauer, R.J., R.W. Miller, and D.M. Ouimet. 1994. Street tree decline and construction damage. J. of Arboriculture. 20(2): 94-97. Hauer et al. (1994) followed a cohort 10 years after planting, examining 845 trees. Construction damage from street widening and curb and sidewalk replacement were found to negatively affect both tree sur-

vival and condition. Trees in narrow tree lawns suffered the greatest reduction in condition from construction damage. Construction damage was found to have a high economic impact on street tree value.

Nowak, D.J., M. Kuroda, and D.E. Crane. 2004. Tree mortality rates and tree population projections in Baltimore, Maryland, USA. Urban For. and Urban Green. 2: 139-147. Research by scientists in the LTER Baltimore Ecosystem Study. Nowak et al (2004) found that smaller diameter trees have significantly higher mortality than larger trees, but this study did not focus on causality.

Thompson, J.R. , D.J. Nowak, D.E. Crane, and J.A. Hunkins. 2004. Iowa, U.S., communities benefit from a tree-planting program: characteristics of recently planted trees. J of Arbor. 30(1): 1-9. Species diversity, survival, size, growth, carbon uptake, carbon storage, and pollution removal of 932 trees planted in 21 communities in different parts of Iowa were assessed by repeated measurements over a 4-year period.

Management

Tate, R.L. 1985. Uses of street tree inventory data. J. Arboric. 11(7): 210-213. How to create, increase, improve or save an urban tree management program.

Meza, H.M. 1992. Current situation of the urban forest in Mexico City. J. Arboriculture. 18(1): 33-36. Discusses history of arboriculture in Mexico City, current problems with management of urban trees and programs in place to improve the situation.

Tree benefits

Nowak, D.J. and D.E. Crane. 2002. Carbon storage and sequestration by urban trees in the USA. Environmental Pollution 116: 381-389. Carbon storage and sequestration by urban trees based on field data from 10 cities in the USA and national urban tree cover data. Regional variation dicussed. Urban trees currently store 700 million tons of carbon, with an annual sequestration rate of 22.8 million tons (equal to USA population emissions over 5 days).

Urban ecology theory

Zipperer, W.C., S.M. Sisinni, and R.V. Pouyat. 1997. Urban tree cover: an ecological perspective. Urban Ecosystems 1: 229-246. Evaluation of urban tree cover based on patch dynamics. Treed patches are classified by their origin, structure, and management intensity. Using the patch approach, Zipperer et al. evaluate ecological patterns and processes for remnant, emergent and planted patches, which differ according to origin. A patch is a fundamental unit of measurement for landscape analysis and management. Patches imply a relatively discrete spatial pattern and a relationship of interactions and exchanges between patches. Ecological patterns and processes discussed include morphology, canopy cover, forest development, species richness, biomass, succession and nutrient and carbon cycling.

Social science

Hope, D., C. Gries, W.Zhu, W.F. Fagan, C.L. Redman, N.B. Grimm, A.L. Nelson, C. Martin, and A. Kinzig. 2003. Socioeconomics drive urban plant diversity. PNAS 100(15): 8788-8792. Spatial variation in plant diversity was found to be driven by a combination of land use, elevation, median family income, and whether the site has ever been farmed. This study finds a relationship between wealth and plant diversity that has been observed in other cities as well.

Gorman, James. 2004. Residents' opinions on the value of street trees depending on tree location. J. Arboric. 30 (1): 36-44. Residents' opinions on the value (or negative aspects) of street trees were impacted by the presence or absence of a tree directly in front of their residence. Statistical significance found for 5 positive factors: give shade; flowers on tree; neighborhood is more liveble; increased property values. And 3 negative factors: branches break power lines in storms; sidewalk damage; and trees block visibility.

Grove, J. Morgan; Cadenasso, Mary L.; Burch, William R., Jr.; Pickett, Steward T.; Schwarz, Kirsten; O'Neil-Dunne, Jarlath; Wilson, Matthew; Troy, Austin; Boone, Christopher 2006. Data and methods comparing social structure and vegetation structure of urban neighborhoods in Baltimore, Maryland Society and Natural Resources 19:117-136. Looks at diversity as it relates to population, lifestyle behavior and social stratification.