HEALTHY TREES · HEALTHY CITIES

HEALTHY TREES, HEALTHY CITIES
TREE HEALTH MONITORING TOOLS
MANUAL

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Introduction

What is the Healthy Trees, Healthy Cities (HTHC) Initiative?

Healthy Trees, Healthy Cities is an urban tree health monitoring initiative coordinated by The Nature Conservancy and the USDA Forest Service, which supports researchers, managers, and citizen scientists in the maintenance and protection of city trees and forests nationwide.

The nation's trees and forests are one of our greatest assets – especially in cities where they provide myriad benefits for people and nature. Accordingly, urban forest managers must maintain a healthy urban tree canopy to ensure those benefits (often called "ecosystem services") are experienced by the communities well into the future.

Healthy Trees, Healthy Cities offers urban forest managers and tree stewards critical tools to monitor and prioritize stewardship and management of trees in the urban landscape. The data gathered through these efforts has both local and national implications: locally, managers and stewards use the data to prioritize the care of stressed trees and intervene to restore health; nationally, USDA Forest Service researchers study the effects of the urban environment on trees, and the impact healthy trees have on communities.

HTHC's tools are not meant to replace commercially available tree management software and do not replicate the large range of tools these providers offer. HTHC's rigorous health metrics and pest protocol can complement these tools by providing users with more in-depth understandings of a tree's overall health.

The HTHC Mobile App and Web Dashboard were developed in collaboration with the Center for Invasive Species and Ecosystem Health at the University of Georgia. Other programs developed by the Center include EDDMapS, which is used by a wide range of institutions and organizations to track early detection of, and response to, invasive species.

Using This Manual

This manual is meant to explain HTHC's tools and how they work. Supplementary materials are available through the HTHC Conservation Gateway website: <LINK>. These include additional tutorials on use of the Web Dashboard, guides for the health metrics and pest/disease symptoms, and additional documents to assist users with setting up projects that use HTHC's tools.

Contact

To contact HTHC for any reason, email Rachel Holmes (rholmes@tnc.org).

How HTHC's Tools Work

Healthy Trees, Healthy Cities offers a suite of tools packaged in a mobile app and web-based project management dashboard. These tools allow users to monitor tree health in a holistic way by recording visual signs of stress and signs of pests. In addition, these tools encourage regular tree stewardship activities aimed at keeping trees healthy, nationwide.

The HTHC Mobile App is the primary data collection tool. With it, users can record vital tree health information, note signs of pests, record stewardship activities, and inventory trees. The Mobile App can also report useful information back to the user, such as the Stress Index. For some users, the HTHC Mobile App can stand-alone as a tree management tool. Users can inventory trees, check trees for signs of pests, record tree care, and get Stress Index values reported back after health checks. However, some details, like data from previous health or pest checks, can only be viewed via the HTHC Project Management Dashboard.

The HTHC Web-based Project Management Dashboard has been set up to help HTHC users manage data collection or tree care projects. With the dashboard, Project Leaders can set up Projects specific to their needs, add users who can then collect data or record tree care using the mobile app, and download data for analysis or sharing. These two tools work together to make monitoring tree health and recording stewardship activities a seamless process (Figure 1).

HTHC Mobile App

Collect Data in the Field
- Basic Tree Inventory
- Health Data – Visual Signs of Stress
- Pest/Disease Signs and Symptoms
- Tree Care/Stewardship Activities

HTHC Web-based Project Management Dashboard

Manage Data Collection
Track and Manage Field Work
Create Projects Specific to Your Needs
Manage Users in Projects
Track Tree Care Activities
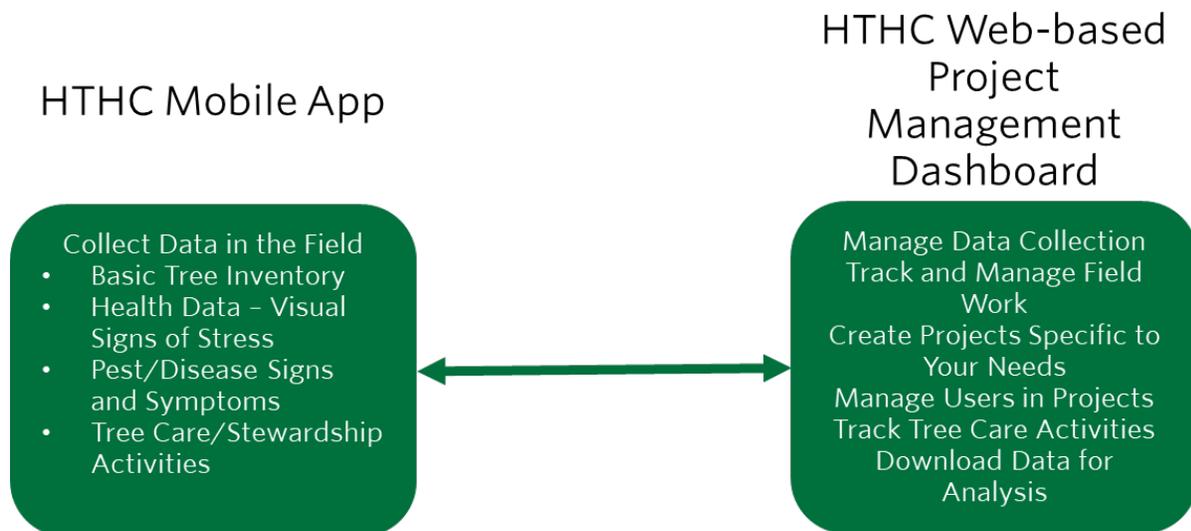Download Data for Analysis

Figure 1: Relationship between the HTHC Mobile App and HTHC Web-based Project Management Dashboard for data collection purposes.

HTHC also contains many resources for educating users on aspects of tree health and the threats facing trees. The mobile app and dashboard contain guides and resources focused on tree health assessment, pest and disease detection and tree care.

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The manual, along with supplementary materials designed to assist in training others on using HTHC's tools and methods, conduct field work, and do outreach, can be found at the HTHC Conservation Gateway website:

- https://conservationgateway.org/ConservationPractices/cities/hthc/Pages/default.aspx
- Manual: https://conservationgateway.org/ConservationPractices/cities/hthc/library/Pages/HTHCManual.aspx
- Annotated Document List: https://www.conservationgateway.org/ConservationPractices/cities/hthc/library/Documents/Annotated%20Document%20List.xlsx
- All Resources: https://conservationgateway.org/ConservationPractices/cities/hthc/library/Pages/default.aspx

Deciding When and How to Use HTHC Tools

HTHC's tools are useful instruments for tree data collection, analysis, and stewardship, and can be adapted for many uses. Understanding whether HTHC tools are a good match for your situation is important. HTHC's tools are completely free, which makes them ideal for use by community groups, university professors, researchers, or small municipal organizations. HTHC's Health Checks, with their Stress Indexes, and the Pest Detection info, are valuable for any tree steward. If your organization already uses a commercial tree inventory program, HTHC may be able to assist in adding the Health Metrics and Pest Detection info into your version. Contact rholmes@tnc.org for more info.

Below are some samples of how HTHC's tools can be used in real-world situations:

- A city parks department can use the HTHC Mobile App to record health and pest data for a citywide park tree inventory.
- A professor can have students use the HTHC Mobile App to inventory and record tree health and pest data as part of a study of trees planted around parking lots on campus. Follow-up checks can use the HTHC Dashboard to assign the inventoried trees to new cohorts of students to check.
- A community group can inventory trees in their neighborhood and use the HTHC Dashboard to check when the trees were last watered, weeded, and pruned. When trees are due for care, the group's Project Leader can assign trees to volunteers, or include them in their next volunteer stewardship event.
- A homeowner can use the HTHC Mobile App to inventory the trees on their property and perform regular health checks on them. If they notice the stress

index values change, they can contact an ISA-certified arborist to plan proper stewardship for their trees.

The HTHC team is happy to help potential users plan how HTHC's tools can work for their needs. This can include ensuring HTHC's tools will suit the project's needs, discussing research needs, and helping potential users in touch with local experts for assistance.

HTHC's Methods: Health Check and Pest Detection

The Health and Pest Detection Checks, performed via the HTHC Mobile App, are designed to provide tree stewards and tree researchers with valuable information that can be used to assist in tree management decisions and in furthering studies of tree health in urban and suburban areas. These checks do not diagnose specific issues – instead they call on users to look for visually apparent signs of stress, harmful insects, and diseases. While this information is valuable by itself, diagnosing a specific tree's ailments and determining what actions to take should be done in consultation with local tree experts and/or ISA certified arborists.

The Health and Pest Detection Checks involve methods designed to be understandable to people without expert tree knowledge, however some background knowledge is needed, particularly tree species identification. Species identification skills are critical, especially for projects that involve large numbers of trees or trees without tags or identification markers. HTHC's training materials, found in the supplements online, guide users through how to conduct Health and Pest Detection Checks.

Health Checks – Non-Stressor Specific Visual Signs of Stress

Health Checks in HTHC focus on the tree crown and use health metrics based on assessment techniques used in rural forestry research. The tree health assessment methods use visual estimates of crown health factors, normalize the measurements across a species, and calculate a standardized stress index (Z-score) based on values for all trees of a given species contained in a national database. The scores are then binned into a 1-10 scale creating a simplified 'Stress Index' – an easily understandable way to report the complex statistical analyses back to users. The calculated Stress Index shows users how healthy or stressed an individual tree is as compared to all other trees contained in the database.

The metrics used in the health checks are meant to ensure that symptoms of early stress through symptoms of the most severe decline are captured. These include canopy thinning assessed as crown transparency (early stress response), leaf discoloration and leaf defoliation (early stress response), branch and limb dieback

assessed as fine twig dieback (moderate stress response) and crown vigor (captures later decline symptoms). Crown transparency and fine twig dieback are based on FIA guidelines (Schomaker et al, 2007) and canopy vigor estimates follow the North American Maple Protocol (Cooke et al., 1996). Other measurements are based on Pontius & Hallett, 2014. The final measure is crown light exposure, a measure of how much full sunlight a tree receives.

Fine twig dieback, leaf discoloration, leaf defoliation, crown vigor, and crown transparency all rely on visual estimates of the percentage of the crown affected by each of these health metrics. Surveyors estimate the percentage affected and assign the tree the correct class value for each metric. Crown light exposure is based on estimating how much sunlight each side of a tree receives. The health metric guides, which are located in the supplementary materials available online and in the HTHC Mobile App, explain in detail the criteria for measuring each health metric.

Estimating Percentages and Measuring Health Metrics

All the health metrics require surveyors to estimate the percentage of the crown affected by the metric in question. The Mobile App and associated guides provide written descriptions and visual aids (e.g. Figure 2) to assist users in selecting the appropriate class for each variable. These rubrics and guides are an important part of the methodology and insure that the subjective ratings are as reliable and accurate as possible.

For all metrics, it is important to measure the percentage of the crown affected, and not to include areas of crown missing due to trimming or pruning (around powerlines or buildings, for example). HTHC recommends data collection be done by two people working as a pair, and with both surveyors viewing a tree from multiple angles before making an estimate. When disagreements on class values arise, partners should work together to reach consensus.
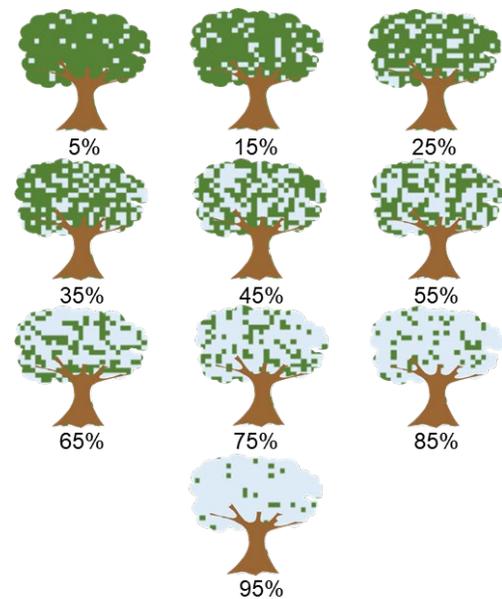

Figure 2: Example diagrams of Crown Transparency percentage classes.

Stress Index

The Stress Index is a way to quickly display the relative level of stress apparent in a tree. After calculations of Z-score values are made, HTHC bins the data into a 1-10 scale so it can be more easily understood (Figure 3). Lower numbers indicate lower levels of visible stress, higher numbers indicate higher levels of stress. These values are normalized across a species. See Pontius and Hallett, 2014, for more information.

The Stress Index can only be calculated for species that have 100 or more health checks in the HTHC database. For species below this threshold, a "?" will appear in the HTHC Mobile App where Stress Index values are displayed. The "?" also appears when a tree has no health check on record. In data downloads, trees without Stress Index values have blank values in the Stress Index column. Stress Index values are displayed in the 'My Trees' and 'Nearby Trees' pages in the Mobile App.

The Stress Index is based on a normalization of all trees in a species and is recalculated nightly to account for new health checks of trees being added during the day. Users will not get a Stress Index value immediately after recording a Health Check – instead, they can view it in the Mobile App the day afterwards, or in the Project Management Dashboard.

Figure 3: My Trees page on HTHC Mobile App, with Stress Index values in boxes on right.

Pest Detection Checks

To create an easy-to-use method for checking trees for pests, representatives of the Continental Dialogue on Non-native Pests, USDA Forest Service staff, practitioners and entomologists, considered the common signs and symptoms of several of the most serious pests currently impacting forests across the United States. With this information, HTHC's team created a checklist of the signs and symptoms that would be readily visible to tree surveyors. This checklist uses multiple choice and yes/no questions, giving surveyors easy-to-assess questions that can be readily analyzed. Pest checks are automatically linked to species and location data, making searching for patterns, or signs of new infestations or tree disease problems simpler.

Videos and presentations on significant insect and disease threats can be found in the HTHC Mobile App (under Resources), the HTHC Web Dashboard (under the Resources and Videos tabs, and on the HTHC Conservation Gateway page (in the Resource Library).

Pest Detection Checks do not diagnose insect infestations or tree diseases – and many of the signs and symptoms in the checklist can be caused by multiple factors. They do provide valuable information to help guide management decisions or to help local managers target follow-up insect/disease surveys by professionals.

Each sign or symptom of pests has a guide detailing what the sign/symptom is, how to check for it, and other pests for which it can be confused. These pest symptom guides are located in the supplementary materials online.

Responding to Signs of Tree Stress, Pests, or Disease

The response to the data collected during Health Checks and Pest Detection Checks is important and will depend on local relationships and local concerns. The data collected do not specify what ailment may be impacting a tree – rather, the data can be used to prioritize follow-up with tree care professionals who can diagnose issues with a tree's health. HTHC is developing a generalized Standard Operating Procedure document to assist with how to respond to signs of insects or diseases which may be a significant threat.

The data collected through pest checks is accessible via the project management dashboard. This data is linked to any other records a tree may have – health checks, previous pest checks, and tree care activities.

The HTHC Mobile App

The HTHC Mobile App is a field data collection and educational tool designed to assist tree monitoring work and make recording tree health, pest detection, and stewardship data easy.

The HTHC Mobile App has several modules which cover the most important parts of tree health monitoring and stewardship. The modules are:

- **Add a Tree:** a way to inventory newly-planted or existing trees.
- **Health Check:** measure signs of stress in an individual tree, which can be compared to a national tree stress database.
- **Pest Detection:** check trees for signs and symptoms of insect infestations or tree diseases, designed to augment early detection efforts.
- **Tree Care:** record stewardship activities on trees.

The app has several other features, including a link to find an International Society of Arboriculture (ISA)-certified arborist in your area, a resource library with resources on significant insect and disease threats, and a mapping function that displays trees added by the user or trees assigned to the user (see the *Dashboard* section of this manual for more information). The following sections explain the modules and resources found in the HTHC Mobile App, with instructions on how to use them to record information about trees and tree care actions.

Features in the HTHC Mobile App

Find an Arborist

This feature links to the International Society of Arboriculture's Find an Arborist page, to help users find professional arborists who can help diagnose tree issues and diseases and offer advice on how to keep trees healthy and thriving.

Tapping on the Find an Arborist link will open the [ISA's Find an Arborist](#) website. Fill out the information here (search by location, like State, Town, or Zip Code) to find certified arborists in your area.

My Trees and Assigned Trees List

A user's My Trees list (Figure 4) displays all trees that user has added via the 'Add a Tree' tool and trees assigned to them via the HTHC Web Dashboard. Trees assigned to a user or to a team the user is a part of will display in the My Trees list. Assigned trees in the list are tinted red, other trees have no tint.
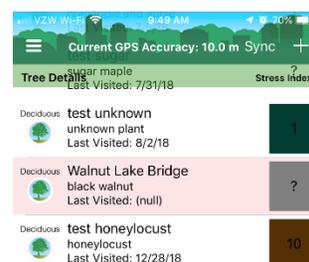

Figure 4: Screenshot of a user's My Trees list. Note the 'Walnut Lake Bridge' tree tinted red to denote a tree assigned to the user via a Project in the HTHC Web Dashboard.

The My Trees list displays the following information for a tree: Its name, species (common), the date it was last visited, and the tree's most recent Stress Index value.

To view their list, users should tap on Sync (located at the upper right of the iOS version) to update their list to match their current location. Users can select a tree from the My Trees list by tapping on it. This opens the tree's page in the Mobile App, where users can add activities (Tree Care, Health Check, Pest Detection), take new photos of the tree, add Reminders to check the tree later, and edit the tree's info.

Assigned trees are only visible to users that are signed in and have had trees assigned to them by a Project in the HTHC Web Dashboard. See 'Assigning Trees' for more information on how this process works.

Reminders

Reminders are a way to schedule an activity on one of your trees. To view upcoming Reminders, tap on the Reminders tab in the Main Menu. To set a Reminder, select a tree from your 'My Trees' tab.

Map

The map view displays a users' 'My Trees' and any trees Assigned to them through a Dashboard Project (Figure 5). This helps a user navigate to the trees they are interested in visiting and more easily see the trees near them. Trees displayed on the map include a user's My Trees and Assigned Trees – *not* all nearby trees in the HTHC database. This was chosen to aide in project management, so tree checkers would see just the trees of interest to their work.

A user's My Trees are displayed on the map in red, while Assigned trees are displayed in yellow. When a user taps on a tree in the map, a pop-up appears leading to the tree's page in the Mobile App. From there, the user can record a tree activity, add a photo, and more.

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Figure 5: Screenshot of the Map in the HTHC Mobile App. Note the tree at bottom right - colored yellow to denote an Assigned tree.

Main Menu

The Main Menu (Figure 6) serves as a navigation bar to all features of the HTHC Mobile App and to app settings. Access it by tapping on the menu button at top left on the Home Page.

1. My Trees. Tap here to view a list of a user's 'My Trees, of which there are two kinds:
   a. Trees a user has added (via Add A Tree) while signed in on their device. These trees are saved to the device, and visible while the user is signed in.
   b. Trees a user has been assigned to check by a Project Leader in the Project Management Dashboard. These trees appear tinted in red on the My Trees list. See the HTHC Web-Based Project Management Dashboard section for more details.

   Tapping on a tree will bring up the tree's page in the Mobile App. From this page, users can add a new activity (such as a Health Check) or edit the tree's info, like the DBH. This is also where the user can add Reminders to perform Tree Care activities on a tree.

Figure 6: Main Menu of the HTHC Mobile App. (iOS View). Numbers correspond to bullet items to the left.

2. Activity Log. Tap here to view all activity performed in the app on this device (with the user signed in). This includes any Tree Care, Health Checks, or Pest Detection Checks recorded. If an activity has a yellow triangle next to it, it has not been synced to the HTHC Database. This can be due to a data connection issue or because the activity was not completed.
3. Tree Photos. Tap here to view any photos taken of trees using the device can be accessed here.
4. Resources. Tap here to access HTHC resources, including:
   a. Videos on tree stewardship and pest identification.
   b. Documents on Best Management Practices for stewardship and tree planting; and presentations on Pest Identification.
   c. More resources, including guides for health metrics and pest symptoms, can be found in the Tree Care and Pest Detection modules.
5. Reminders. Tap here to view reminders to perform Tree Care activities on your trees. These reminders can be added via the 'My Trees' button.
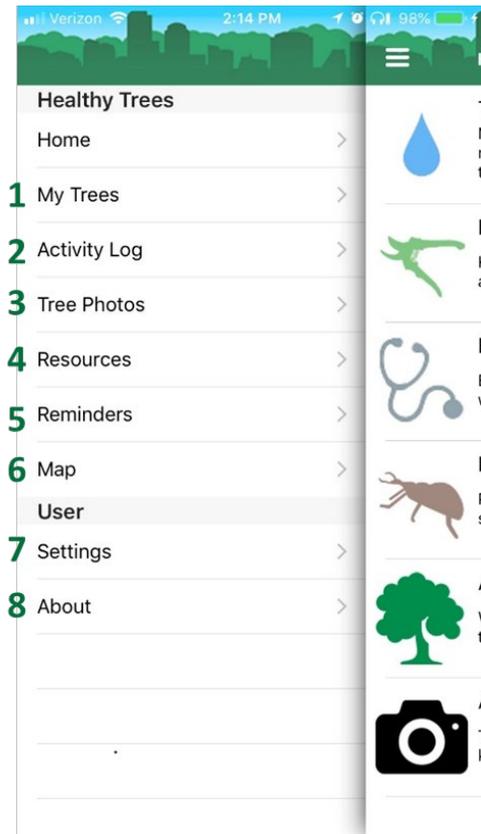
6. Map. Tap here to view a map of the trees listed in 'My Trees' and any trees assigned to the user in a project on the Web Dashboard.
7. Settings. Tap here to view the Account info for the app. This is also where a user can sign in or out.
   a. Sync – HTHC recommends turning Enable Auto-Sync on, which automatically syncs all the activity a user performs using the app.
8. About. Tap here to view info about the HTHC Mobile App.
   a. This is where a user can find the version of the app they have installed, which is useful in case troubleshooting is needed on an issue.

Using the HTHC Mobile App

The HTHC Mobile App is how users can check trees or collect data in the field. The HTHC Mobile App is available, for free, on the Apple App Store and the Google Play store for Android devices and can be used by anyone – whether or not they have contacted and worked with HTHC specifically. The HTHC Mobile App links to the HTHC database of trees via a data connection, so proper use in the field requires either cellular data access or a mobile WiFi connection. While the HTHC Mobile app does not use large amounts of data like streaming video, its key features do not work properly when offline.

This section goes through step-by-step instructions for performing tasks with the HTHC Mobile App. *It is suggested that readers have the HTHC Mobile App available on their mobile device to assist them while reviewing this section of the manual. Screenshots presented in the Manual reflect the Apple iOS version. The Android version shares the same features, with small differences in layout and style.*

Signing In

While it is possible to use the app without creating an account, we recommend that new users create one and stay signed in when using it. (The My Trees and Assigned Trees lists sync to the user's account). The HTHC Mobile App will automatically keep a user signed in, so signing in only needs to occur the first time a user wants to use the app on a device or when switching accounts.

1. The first time a user opens the app, a sign in screen will pop-up, giving the user an opportunity to create an account, sign in via Google, or sign-in with an existing EDDMaps account.
   a. Users should use identifiable first and last names – these are necessary for searching for and adding participants to projects.
   b. To sign-in with an existing HTHC account, tap on the 'Sign in with EDDMaps' option.
2. Participants in a project must create an account and be signed in when using the app for tree assignment data to sync. Additionally, a user's My Trees list will only display when the user is signed in.

3. To sign out, or switch accounts, follow these steps:
    a. Go to the Main Menu
    b. Tap on Settings
    c. Choose 'Sign Out', then tap on any button in the app to refresh the screen.
    d. If switching accounts, sign back in with the account you wish to use.

Home Page

The Home Page (Figure 7) in the HTHC Mobile App contains links to all the modules (Health Check, Pest Detection, etc.) and resources the app has.

1. The Main Menu button. Tap here to access the Main Menu, where resources, app settings, and more are accessed.
2. Tree Care. Tap here to start adding a Tree Care (stewardship) activity to a tree, like pruning, mulching, or weeding.
3. Health Check. Tap here to record a Health Check on a tree.
4. Pest Detection. Tap here to record a Pest Check on a tree.
5. Add A Tree. Tap here to inventory a tree and add it to the HTHC database.
6. Find an Arborist. Tap here to be directed to the ISA's Find an Arborist site, which helps users find certified arborists to assist with tree management.
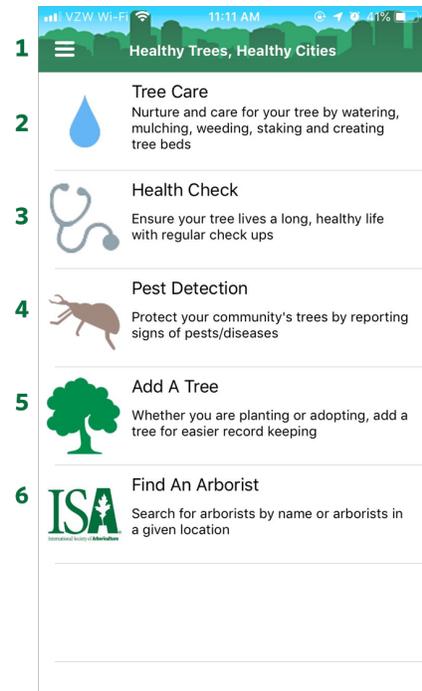
Figure 7: Home Page of the HTHC Mobile App. (iOS View). Numbers correspond to bullet items to the left.

Recording an Activity on a Tree

These are the general steps to take when using the HTHC Mobile App to record any data about a tree. The steps for recording an Activity (Tree Care, Health Check, Pest Detection Check) vary depending on the status of the tree: whether it is in the HTHC database or not, if it is one of a user's 'My Trees', and if it has been Assigned to a user. Four common protocols are laid out below.

Adding a Tree: Follow these steps if you want to inventory a tree that is not in the HTHC database (AKA a 'new' tree), but don't need to run a Health or Pest Check or record Tree Care at the same time.

    A. From the Home Page, tap on Add A Tree.

    B. Fill out the Add A Tree form and hit Save (bottom right) when complete.

    C. You are done. The tree is now in the HTHC database and is visible in your 'My Trees' page in the Mobile App. To record more activities on this tree, follow the steps laid out below.

Recording an Activity on a tree that is not in the HTHC database: Follow these steps when recording an Activity on a tree that is not in the HTHC database (AKA a 'new' tree).

    A. From the Home Page, tap on the Activity you want to record on the tree. This will automatically open the Add A Tree form.

    B. Fill out the Add A Tree form and hit Next (bottom right) when complete.

    C. Fill out the Activity's form completely and hit Save when complete.

    D. You are done. The tree is now in the HTHC database and is visible in your 'My Trees' page in the Mobile App. To record more activities on this tree, follow the steps laid out below.

Recording an Activity on a tree already in the HTHC Database: Follow these steps when recording an activity on a tree that is already in the HTHC database – either a tree from your 'My Trees' list or a tree that is near you (Nearby Trees).

    A. From the Home Page, tap on the Activity you want to record on the tree. This will automatically open the Add A Tree form.

    B. Scroll to the bottom of the Add A Tree form (do not fill out any tree info).

    C. Choose 'My Trees' if the tree is a tree you added (while signed in on the device you are using).

    D. Choose 'Nearby Trees' if the tree is near you.

E. Both the 'My Trees' and 'Nearby Trees' pages will display a list of trees, with the following information listed:

    a. Tree Name

    b. Species (Common and Scientific)

    c. Distance from your location in meters

    d. DBH (inches)

    e. Stress Index value

F. Tap on the tree you want to record an Activity on.

G. Fill out the Activity's form completely and hit Save when complete.

H. You are done. The data you recorded is sent to the HTHC database immediately.

Recording an Activity on a tree that has been assigned to you in a project or is in your My Trees list

A. From the Home Page, navigate to the Main Menu. You can find an Assigned trees and any of your My trees via the 'My Trees' list (Go to B) or via the Map (Go to C).

B. From the 'My Trees' list, scroll to the tree you are interested in, and tap on it.

    a. Tap the Add an Activity button (a '+' at bottom right).

    b. Tap on the Activity you wish to perform.

    c. Fill out the Activity's form completely and hit Save when complete.

    d. You are done. The data you recorded is sent to the HTHC database immediately.

C. From the Map, navigate to your location.

    a. Tap on a tree. A pop-up with the tree's name and species will appear.

    b. Tap on the pencil-shaped Edit button.

    c. Tap the Add an Activity button (a '+' at bottom right).

    d. Tap on the Activity you wish to perform.

    e. Fill out the Activity's form completely and hit Save when complete.

    f. You are done. The data you recorded is sent to the HTHC database immediately.

The Add A Tree Module

The Add A Tree module is the HTHC Mobile App's basic tree inventory tool. Access it via the Home Page on the Mobile App. Once the Add a Tree form (Figure 8) has been filled out and saved, the tree data will be synced with the HTHC database, and the user can perform other activities (Health Check, Pest Check, Tree Care) on the tree. The steps for adding a tree are laid out below.

1. Tap on 'Add A Tree' from the Home Page on the HTHC Mobile App.

A. The Add A Tree form will open. All fields on this form are required.

B. Tree Name: Give this tree a name so it can readily identified in the app and on the Project Management Dashboard. The Mobile app will automatically give the tree a unique identifier that is visible via data downloads. However, the Tree Name is displayed in the Mobile App and in the Project Management Dashboard, so it is suggested projects consider a standardized format for naming trees based on their needs.

Figure 8: The Add a Tree form.

C. Species: The HTHC database contains thousands of the most common trees from across the United States. You can search by common name (tulip tree, Norway - maple) or by scientific name (*Liriodendron tulipifera, Acer platanoides)*. For iOS, toggle the common name and scientific name choices to search by name. For Android, simply tap the search bar above the species list, and type in either the common or scientific name.

   a. If you are unsure of the species, you can either add an identification at the genus-level (*Acer spp.* or maple species), indicating you know the tree is a certain kind, but you don't know which one; or you can list it as 'Unknown'.

   b. If the species is not listed in the app, you can add an identification of 'Unlisted Plant' and include the correct species name in the Notes section. To add a new species, contact HTHC (rholmes@tnc.org).

D. Choose an Icon: Select 'Evergreen', 'Deciduous', or 'Palm' – whichever best fits your tree.

E. Add a Location: This consists of two components: Address and Latitude/Longitude (Figure 9). The Lat/Long component is required, address information is optional and can filled out based on your needs.

a. Adding an Address: Tap on the 'Address' space and start typing in an address or tap the Target-Shaped button to automatically generate an address based on your location. *Note – the automatic address generation is only as accurate as your mobile device's own GPS/location tracking – it can often be 10-50 meters off depending on your location and conditions.*

b. Adding Latitude/Longitude: While the HTHC Mobile App will automatically find an estimated Lat/Long, it *is not recommended* you use the estimate. Mobile devices are not as accurate as fine-tuned GPS devices, and can only be accurate to about 5 meters in the best conditions. To accurately map the location of the tree, *you must manually map the location using the mapping tool* (Pencil-Shaped Button).

Figure 9: The Location section of the Add a Tree form. The auto-generate an address button is at top right. The tool for manually mapping a tree's location is the pencil-shaped button to the right of the Latitude and Longitude. Note the poor accuracy (65m) offered by the mobile device in a poor cell service area.

   i. Tap the Pencil-Shaped button. This will open a map with a pin mark where the mobile device currently thinks you are. Tap on the screen to move the pin to the location of the tree.

   ii. Once you have edited the location of the tree, the displayed accuracy reading (underneath Lat/Long) will show 0 meters, indicating it is no longer relying on the mobile device's guess of your location.

F. Details: (Figure 10) DBH (Diameter at Breast Height) or Caliper size and planting information. If you are planting a tree, choose 'Planting'. If the tree is already established, choose 'Adopting'.

   a. Planting: Choose how the tree was packaged (Containerized, Bare Root, or Balled and Burlap). If applicable, add the Container Size in gallons. Take a caliper measurement of the tree's stem.

Figure 10: The Details section of the Add a Tree form: Planting view above, Adopting view below, followed by the Notes section.

b. Adopting: Measure the DBH at 4.5' above the ground (or following rules for odd-shaped +trees, see Appendix). Include it in the DBH (Inches) space. If you are using a regular tape measure instead of a DBH tool, record the circumference and type it into the Circumference (inches) space. The Mobile App automatically calculates circumference from DBH, and DBH from circumference, so you only need to measure one.

G. Notes: Type in any extra information here. Type down the height your recorded DBH, for instance, or any information about the tree to help future users. This is also a spot for projects to include project-specific data collection, as this field is open-ended.

2. When finished recording the above information, hit Save. Your mobile device should immediately sync this data to the HTHC database.

Tree Care

The Tree Care Form (Figure 11) is where users can record Tree Care Activities. It consists of three parts:

1. Stewardship Tasks: Tap here to open the drop-down menu with Tree Care Activities listed. Once open, follow these steps:
   a. Tap on each activity to select it.
   b. A check mark will appear on a selected activity. Tap a selected activity again to de-select it.
   c. You can select as many activities as you want.
2. Time Spent: Record the amount of time spent performing tree care, allowing you to track the time spent taking care of your trees. This data can be aggregated through the HTHC Web Dashboard so volunteer organizers can tabulate volunteer hours and other data. Record time using hours with decimals, rather than hours + minutes. (Record 1.5 hours instead of 1 hr. 30 minutes or 90 minutes).
3. Notes: Tap here to include any extra information, like unlisted tree care activities, or important details.

Figure 11: Screenshot of the Tree Care Form. Numbers correspond to bullet items at left.

Health Check

The Health Check Form (Figure 12) is where users can record their estimates of health metric data. Each health metric is laid out in the form with either class options displayed (Leaf Discoloration, Leaf Defoliation, Crown Vigor, Crown Light Exposure) or drop-down menu choices (Fine Twig Dieback, Crown Transparency). For more information, see the Health Metric Guides, found in the Health Check Form and online with the supplementary materials. Below are the steps for filling out the Health Check Form:

1. Give each Health Metric a measurement. The app will not let you Save a Health Check without some measurement for each Health Metric.
   a. When you are unsure of a measurement, tap on the **"i"** button to the right of the metric. This will open the Health Metric Guide page for the metric, with information on what to measure and how to do so.
   b. If for some reason you are unable to measure a health metric, select 'N/A' or consider checking the tree when you can measure all metrics.
   c. If the tree is **Dead**, select '5' for Crown Vigor. The app will automatically set the other metrics to 'N/A'.
2. Add a Picture of your tree.
3. Add any Notes about the Health Check you have performed. Often, this is a place to make comments on other aspects of the tree's health that are not captured with the Health Metrics (i.e. wounds, pavement issues, etc.). It is also a field that can be used to measure other aspects of the tree for analysis, like crown size.
4. Hit Save when finished.

Figure 12: The Health Check form, with classes for health metrics chosen.

Pest Detection

The Pest Detection Form (Figure 13) is where users can record the results of a Pest Check on the tree. It takes the form of a checklist, guiding users through checking a tree for several different signs and symptoms of insect infestations and diseases. Each sign and symptom has a drop-down menu of choices or a "Yes/No" option for presence/absence. For more information on each sign or symptom, see the Pest Symptom Guides, found in the Pest Detection Form and online with the supplementary materials. Below are the steps for filling out the Pest Detection Form:

1. Check your tree for each sign or symptom.
   a. Each sign or symptom has an **"i"** button on the right side of the screen – tap on that to open the Pest Detection Guide for that sign or symptom, with information on how to measure it.
2. The first 6 signs and symptoms have drop-down menus – tap to open them and see the options. All the drop-down menus include an "other" option – use it when you see something that doesn't match the listed options.
3. The remaining signs and symptoms are Yes/No – tap 'Yes' whenever you see evidence of that sign or symptom.
4. Scroll down – be sure to check for every symptom.
5. Add Notes on your pest check – include any information that may help someone who returns to the tree for follow-up. Record any "other" values here, as well as info about where on the tree you saw signs of insects or diseases.
6. Hit Save when done.

Figure 13: Top of Pest Detection Form on HTHC Mobile App. Form continues, users can scroll down in the Mobile App to see the entire form. The Notes section is at the bottom of the form. The numbers correspond to bullet items in the text to the left.

The Healthy Trees, Healthy Cities Project Management Dashboard

The HTHC Project Management Dashboard is a web-based tool that serves as a project management complement to the HTHC Mobile App. The Dashboard allows managers to access data collected and run projects by assigning trees to specific users. The Dashboard also allows participants in HTHC projects, such as field staff or volunteers, the ability to see statistics and data for the trees assigned to them in projects. Access the HTHC Dashboard at https://healthytreeshealthycitiesapp.org/. To view additional training materials, including a tutorial that guides users through creating a sample project, and annotated page views, go to the HTHC Conservation Gateway site.

Roles and Permissions

The Dashboard has 3 main roles, with different permission levels.

1. General public: The general public can view the landing page for the Dashboard, and access the Resources (Video and Documents). In summer of 2019, HTHC expects to roll out an option for public-facing Project Home Pages, where the public can view details of specific projects that use the HTHC Dashboard.
2. Participants: The Participants role is meant for field staff, interns, or volunteers who may contribute to projects using HTHC Tools. Participants can be added to Projects by Project Leaders, but cannot search and join Projects on their own. For Mobile App-Dashboard connectivity features (like Assigned Trees) to work, users must be signed in to the Mobile App, and be a Participant in a Project.
3. Project Leaders: Project Leaders can create and run Projects. To become a Project Leader, contact Rholmes@tnc.org.

Creating Projects

The Dashboard lets users with Project Leader status create and manage Projects, which is how they can access tree data and can manage data collection efforts (Health and Pest Checks) and stewardship (Tree Care). The data in the HTHC database is open for use in any project, and trees can be in multiple projects. This way, Project Leaders can create as many projects as needed for data and field work management, and multiple groups can address tree needs through the dashboard, even in the same place.

For example, a stewardship group could have a project with all the trees in a local park and be assigning volunteers trees to perform Tree Care activities on. Simultaneously, a local university professor could create their own project on the same trees and assign students to run Health Checks on them. Data collected by either group would be linked to the trees, and visible to either group's Project.

Projects in the HTHC Dashboard are meant to work with trees in the HTHC database – while Project Participants can be assigned trees to check, the assignment of zones and the placement of future tree sites or empty planting strips is not supported. When

trees are added via the Mobile App, they appear nearly instantaneously as available for Projects

Creating a Project on the Dashboard is straightforward. The general steps are below, followed by more detailed instructions for each step.

1. Setup Project
   a. Set a general area for the Project, give the Project a name and description.
2. Add Trees to the Project
   a. Select trees from the Project's general area to include in the Project. Trees can be sorted and filtered by species, DBH ranges, name, and address. Trees can be in many projects at once.
3. Add Participants to the Project
   a. Add HTHC users to the Project. Participants must set up an HTHC account before they can be added. Project Leaders can add Participants to a Project (and also set some as additional Project Leaders), but Participants cannot join Projects on their own.
4. Manage the Project by Assigning Trees to Participants or Teams and checking their progress
   a. Group Participants into Teams, if desired.
   b. Assigned Trees will appear in the 'My Trees' section of the HTHC Mobile App. When Participants go to a tree's location, they can run a check on it.
   c. Use the Dashboard to track progress. As trees are checked, they will be automatically marked as 'Completed'.
5. Manage Data issues by Flagging trees with problems
   a. If field staff/volunteers report an issue with a tree, use the Flagging option to Flag the tree for later review by experts.
6. Download Data for further analysis
   a. The spreadsheet views of data on the Dashboard itself are limited – download data to view the entire data record for all your trees. This includes a record of each visit to a tree when a HTHC Activity was recorded, including any done before or outside of your Project.

Signing In

Sign in to the Dashboard by clicking on the 'Login' button at the top right of the page. New users can also Create a Profile by clicking on the Login button, then selecting 'Create Profile', below the Sign In and Forgot Password options. If a user already has an account with EDDMaps, they can use that account information to sign in, instead of creating a new username/password for HTHC.

Setting up a Project

1. From the My Account page, select 'Setup Project'. (Figure 14)
   a. If the 'Setup Project' button is not visible, you may not have Project Leader status. Contact HTHC to request Project Leader status.
2. The Project Setup page will open (Figure 15). Choose a general area for your Project by drawing a box on the map.
   a. This step tells the HTHC database what trees to make available for Adding to the Project in a later step – only trees within the box drawn will be available to your Project.
3. Give your Project a name, description, and city.
   a. If your city isn't listed, contact HTHC to get it added. You can also choose a different city – this field will not affect your ability to manage any aspects of the project.
4. Select the Tree Care Activities to be included in the Project.
5. When done, hit Submit and your Project is ready – the Project Homepage will open automatically.
6. Projects start with 0 trees and 0 Participants – you must add them using the steps laid out in the following pages.
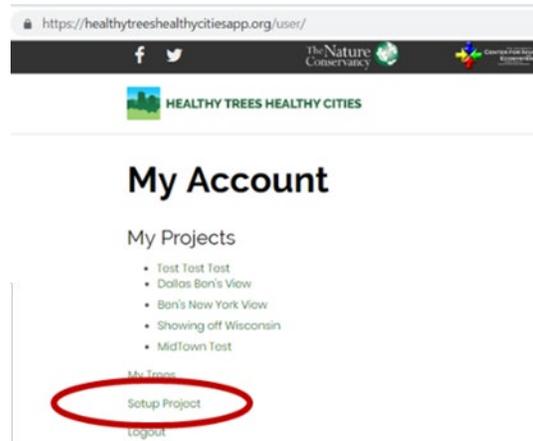

Figure 14: My Account page of HTHC Dashboard, with 'Setup Project' button circled in red.
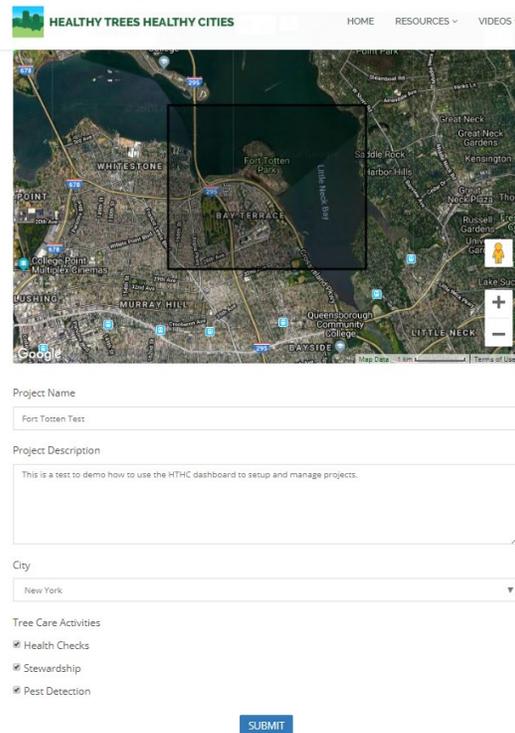

Figure 15: Screenshot of Setup Project page in HTHC Dashboard, with General Area box visible (dark shaded section in map) and sample information filled out for Project details.

Adding Trees to your Project

Once your Project is complete, you must Add Trees to it. Trees in the Project's general area are not automatically added – so you can choose which trees you do and do not want to include. Only trees that are in HTHC's database will appear in the Add Trees page.

The Add Trees to Project page contains a map and a spreadsheet displaying data on trees in your Project's general area. The map view displays the locations of trees, with trees color coded: red if not in the project, and blue if added to the project. Clicking on a tree's point will open a pop-up box with info about the tree, including its name, species, and a photo if available.

The spreadsheet, located below the map, includes columns for species, DBH, address, tree name, and stress index value. You can select trees by clicking the checkboxes on the left side of the spreadsheet.

1. Select 'Add Trees to Project' from the Project Homepage.
2. The Add Trees to Project page will open (Figure 16). It contains a map view of your Project's general area, and a spreadsheet with data about the trees in the general area listed.
3. You can add trees by:
   a. Drawing a box around them in the map
   b. Selecting trees in the spreadsheet.
4. To Add Trees on the map, select the Polygon tool located in the center top of the map.
   a. Draw a polygon around the trees you want to include in your Project.
   b. Hit 'Add to Project', just below the map.
5. To add trees on the spreadsheet, select the check boxes located to the left of each tree's record.
   a. Select the top check box to select all.
   b. Use the search, sort, and filter features, located above the

Figure 16: Screenshot of the Add Trees to Project page. Trees in the General Area of the project are visible as points on map.

spreadsheet and below each column, to find specific trees you are interested in, such as:
   i. DBH ranges
   ii. Species
   iii. Name/Tree ID

6. Once a tree has been added, it will turn blue on the map. If you return to this page later, any trees already in your Project will be hidden.
7. When new trees are added (inventoried) via the Mobile App in this Project's set general area, they will appear in the 'Add Trees to Project' page. They are not automatically added to a Project – if you are managing a Project that is routinely inventorying trees via the Mobile app, check the Add Trees to Project page regularly to add the new trees to your Project.

Importing Trees from an Existing Inventory

If you wish to include inventory data from an existing tree inventory, contact HTHC to begin the process. Tree data must include a name or ID number, species, and location. Other details can be included in a 'Notes' column, but the HTHC database cannot add additional fields beyond what is specified in the data dictionary (see Appendices at the HTHC Conservation Gateway site. The data can be easily exported from HTHC and then re-joined to any preferred data management software.

Adding and Managing Participants in your Project

Add Participants to your Project so you can Assign them trees to check. Since a Project Leader can only Assign trees already in the HTHC database, this step is unnecessary for Projects that are using the Add a Tree module in the HTHC Mobile App to add new trees to the HTHC database, or Projects using another method to manage field work.

Project Participants: The HTHC Dashboard can send tree data to users added to a Project at the Participant role level. In HTHC Projects, only Project Leaders can add users to a Project. Once added to a Project, Participants can be Assigned trees and can view their Assigned trees in their Mobile App and when they are signed in at the HTHC Dashboard. Project Leaders can only add existing users to a Project – Participants must have an account with HTHC before they can be added to a Project. You can add or remove Participants at any time.

Project Leaders: A Project may have more than one Project Leader. You can turn a Participant into a Project Leader at any time by Editing their Role, found under Options in the Manage column of the Manage Participants page.

Teams: Once Participants have been added to a Project, Project Leaders can sort them into Teams. This is designed to streamline the process of performing field checks on trees, as this usually requires field crews of 2-3. Once created, trees can be Assigned to Teams, and Assigned trees will be visible for all members of that Team.

Notes: Project Leaders can also add Notes about Participants in the Project. These Notes are visible only to Project Leaders and are a way to note information about a Participant that is important for managing them in the Project, like their relative tree ID skills, interests, or any other useful information.

The steps below describe how to manage Participants using the Dashboard.

To add Participants or new Project Leaders, follow these steps:

1. From the Project Homepage, select 'Manage Participants'. This will open a new page.
2. To add Participants or additional Project Leaders, select 'Add Users to Project'. This opens a pop-up window with a search bar to find Users.
   a. Search by name or email address.
   b. If desired, sort the User into a Team.
   c. Choose a role for the new user (Participant or Project Leader).
   d. Hit Submit.

To create and manage teams, follow these steps:

1. From the Project Homepage, select 'Manage Participants'. This will open a new page.
2. Select 'Create Teams'.
   a. Give the team a name.
   b. Search for Participants in your Project, and add them to the team.
   c. Hit Submit.

To manage Participants in the Project, (add notes, change their role, or remove them) follow these steps:

1. From the Project Homepage, select 'Manage Participants'. This will open a new page.
2. Select 'Options' from the spreadsheet on the Manage Users page.
   a. Here, you can add a Note about the Participant. These Notes are visible only to Project Leaders.
   b. Select 'Edit Team' to change the Team the Participant is in.
   c. Select 'Edit Role' to change the Participant's role.
   d. Select 'Remove User from Project' to remove this Participant from your Project.

Assigning Trees to Participants and Teams (Managing Trees)

The Assign Trees to Participants/Teams page is where you can manage the trees in your Project – Assign them, track their progress, and change their status in the Project.

The Assign Trees to Participants/Teams page (Figure 17) is similar to the Add Trees to Projects Page and contains a map and a spreadsheet displaying data on trees in your Project's general area. The map view displays the locations of trees, with trees color-coded by status. Clicking on a tree's point will open a pop-up box with info about the tree, including its name, species, and a photo if available.

The spreadsheet, located below the map, includes columns for species, DBH, address, tree name, stress index value, tree assignment, status, and a column to access management options. You can select trees by clicking the checkboxes on the left side of the spreadsheet.

Figure 17: Screenshot of the Assign Trees to Participants/Teams page.

Managing the trees is similar to how you added trees to your Project – you can select them by drawing a box on the map or by sorting, filtering, and clicking the checkboxes in the spreadsheet.

1. Unassigned: All trees are put in this category by default. Trees appear in red on the map.
2. Assigned: Once you assign a tree to a Participant or Team, it will change color on the map to blue.
3. Completed: If a Participant visits an Assigned tree and completes a check on it, it will switch to Completed status and appear green in the map.
4. Flagged: If a Participant reports an issue with a tree, or you notice a problem you can Flag the tree on this page. Trees will appear in yellow on the map.

To Assign a tree or change its status, follow the steps below:

1. Open the Assign Trees to Participants/Teams page from the Project Home page.
2. Here, you see a map view of your Project's general area, and a spreadsheet with data about the trees in the general area listed.

3. You can assign or change a tree's status in two ways: by drawing a box around them in the map, or by selecting trees in the spreadsheet.
4. To Assign or change a tree's status on the map, select the Polygon tool located in the center top of the map.
   a. Draw a polygon around the trees you want to include in your Project.
   b. Hit 'Manage Selected Trees', just below the map
   c. A pop-up will open. Choose what you want to do to the tree and hit submit.
5. To assign or change a tree's status on the spreadsheet, select the check boxes located to the left of each tree's record.
   a. Select the top check box to select all.
   b. Use the search, sort, and filter features, located above the spreadsheet and below each column, to find specific trees you are interested in, such as:
      i. DBH ranges
      ii. Species
      iii. Name/Tree ID
      iv. Tree status
6. Each tree status type has a different color displayed on the map (see above). You can change a tree's status at any time.
7. To remove trees from the Project, follow the steps above, but select 'Remove Tree(s) From Project' from the pop-up that opens. You can always re-add a tree that has been removed.

Viewing and Exporting Data

The HTHC Dashboard only displays a small piece of the data collected by the HTHC Mobile App. The Dashboard is meant to allow for easy access to the data for project management, so the data visible were limited to keep the Dashboard's features streamlined. Data not visible in the Dashboard's views include all Pest Detection data, raw health scores, past Tree Care Activities, and more.

Figure 18: Project Home Page with Download Project Trees button circled in green.

For analysis, data export, and for cross-walking HTHC data to other platforms, the HTHC Dashboard makes it simple to download the data associated with trees in Projects. Download data associated with a Project by selecting the 'Download Project Trees' button (Figure 18). A page will open confirming this, and an email will be sent to you with your tree data attached via a link.
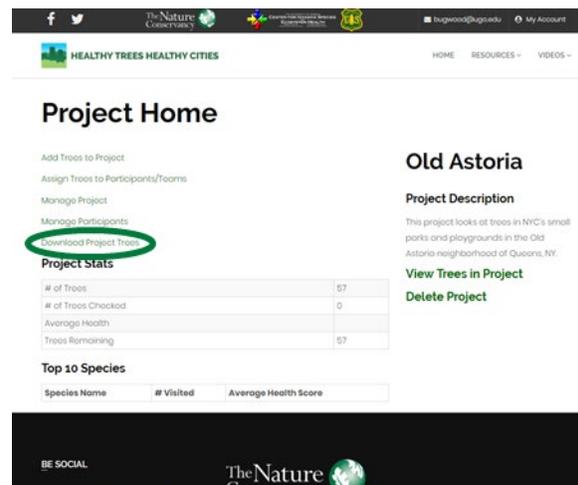
Data downloads contain a CSV file with all data associated with the trees in your Project. This includes species, tree name, DBH, and location, as well as records of all visits to a tree. Included visits are not limited to those performed by Participants in the Project – all recorded visits to a tree, regardless of when or by whom they were performed, are included in the data downloads. This gives Project Leaders a complete view of the history of visits to their trees. The Data Dictionary, found in the supplementary materials online, explains the data contained in each field of the data download spreadsheet.

Running Projects Using the HTHC Dashboard and HTHC Mobile App

The HTHC Dashboard complements the HTHC Mobile App by allowing users of both to manage data collection and tree stewardship efforts. At a minimum, the HTHC Dashboard is the tool for viewing and exporting data collected via the HTHC Mobile App. With the HTHC Dashboard, tree managers can access their tree data as soon as it is collected with the HTHC Mobile App, allowing managers to use the data for quick analysis, to better coordinate field work, and more.
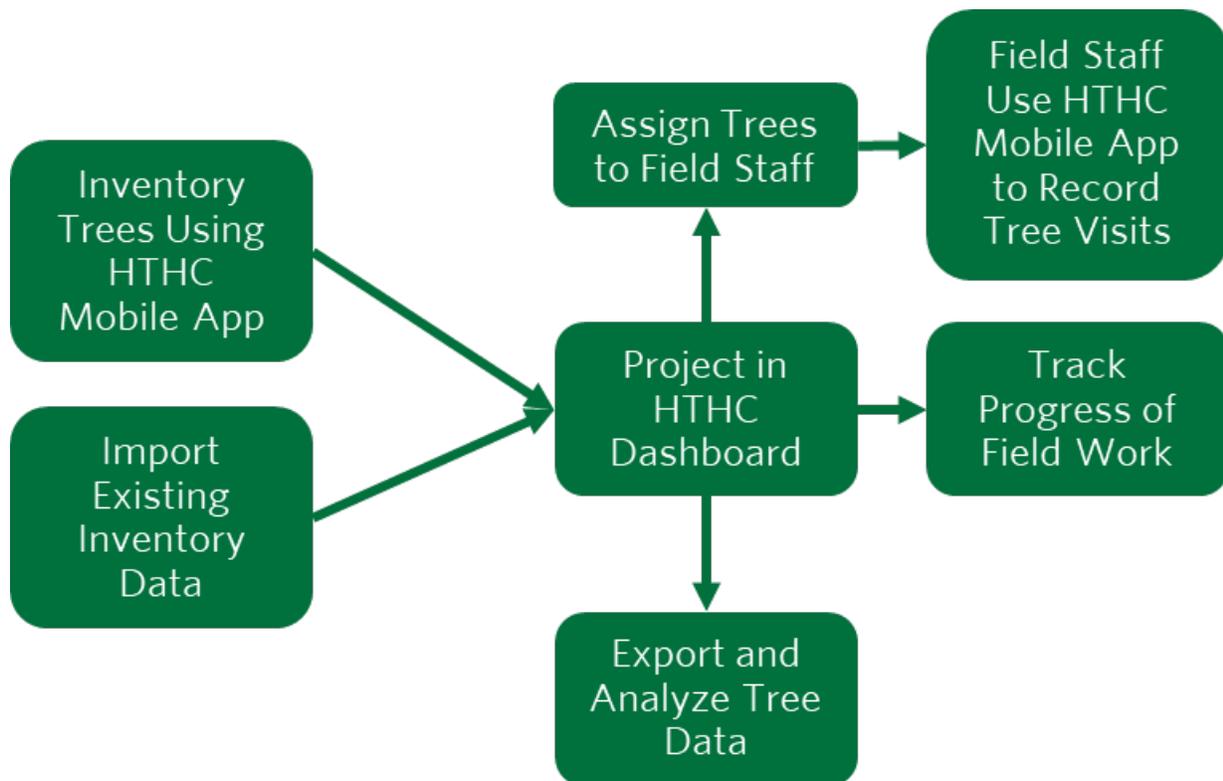

Figure 19: Simplified workflows for using HTHC's tools to manage tree projects.

HEALTHY TREES · HEALTHY CITIES

The Dashboard also integrates with the HTHC Mobile App – allowing Project Leaders to manage data collection efforts by Assigning trees to specific Participants. Data collected in the field is reflected on the Dashboard nearly simultaneously once uploaded, so Project Leaders can track progress daily, and make adjustments easily.

Assigning trees and having all users in your Project be signed up as Participants aren't requirements for collecting data using HTHC tools. HTHC included these features to assist with project management, but these features aren't necessary if you have a different method for managing data collection or tree visits. At a minimum, the HTHC Dashboard is where tree stewards can access and download the data collected with the HTHC Mobile App.

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The HTHC Team has worked closely with many people and organizations during the development and refinement of the HTHC Mobile App and Web Dashboard.

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