

Arboretum Explorer: Using GIS to map the Arnold Arboretum

Donna Tremonte, Arnold Arboretum of Harvard University
[2015 Esri User Conference \(UC\)](#), July 22, 2015



Scan this QR code or go to
<http://is.gd/arbcm>



<http://arboretum.harvard.edu/explorer>

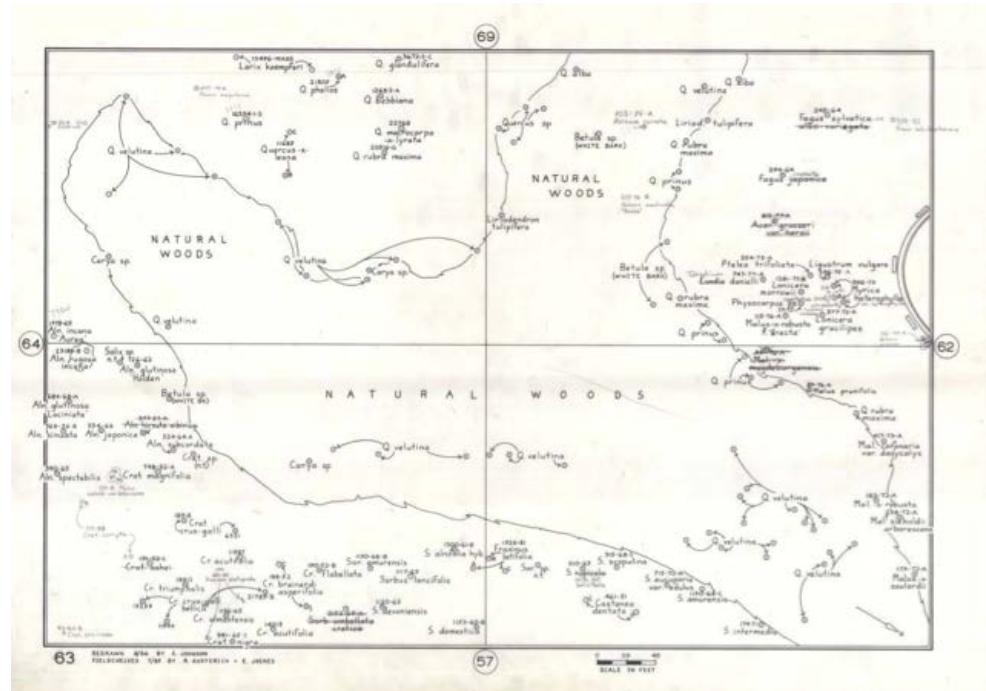


Mission

The Arnold Arboretum of Harvard University discovers and disseminates knowledge of the plant kingdom to foster greater understanding, appreciation, and stewardship of Earth's botanical diversity and its essential value to humankind.

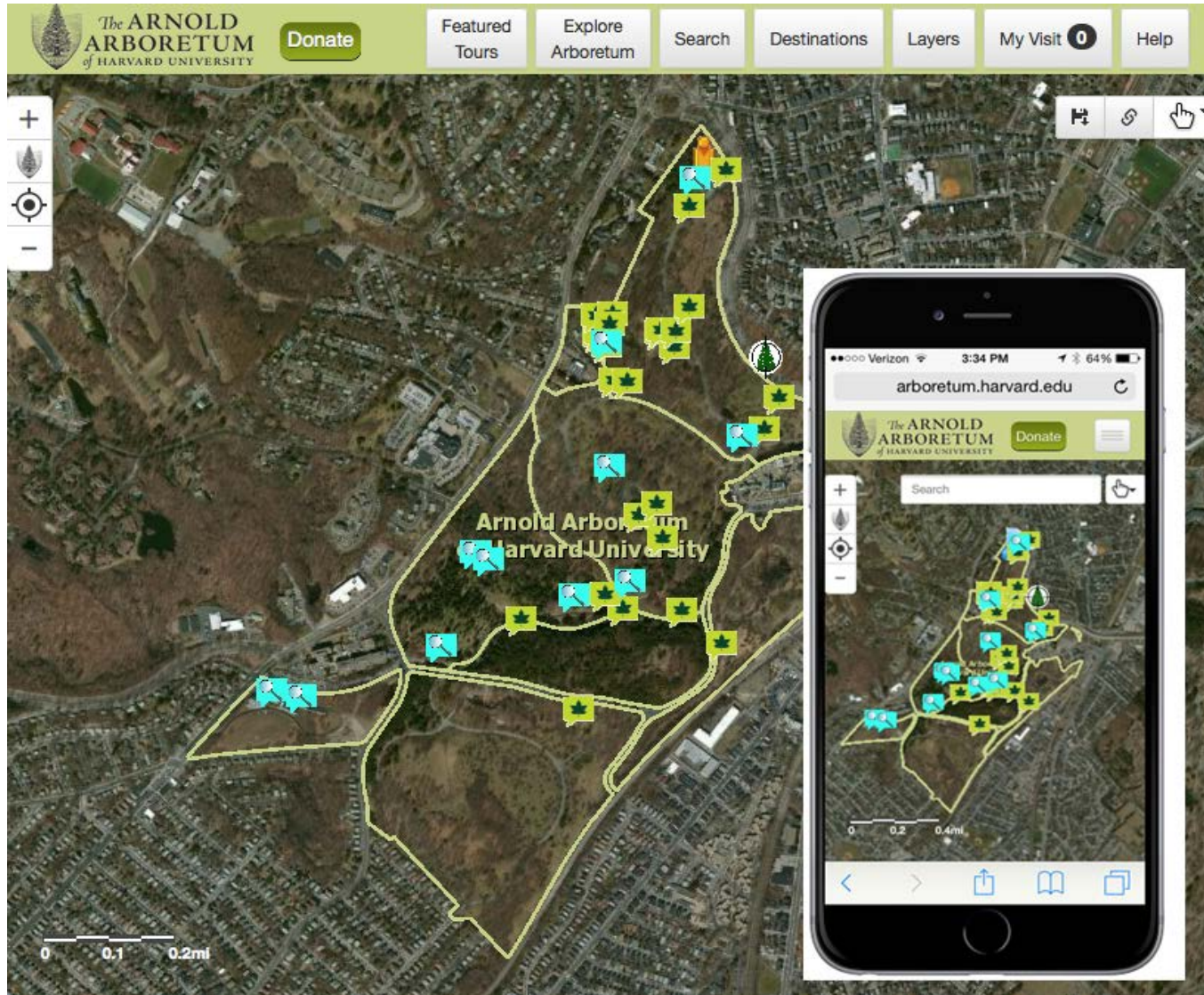
History of GIS at the Arboretum

- 1887, Henry Sargent Codman, Sargent's cousin, made the first map documenting the location of accessioned trees at the Arboretum
- Since the 1990s, staff have captured coordinates for all accessioned plants using Global Positioning System (GPS) technology.
- Today, the Arboretum utilizes a suite of ESRI Desktop and Mobile GIS software applications to manage, analyze, query, capture, manipulate, and display geographic information.
- Decimeter accurate field mapping of landscape features (e.g., plants, benches) is accomplished using a Trimble Geo 7X, with rangefinder, connected to a Zephyr Model 2 antenna.



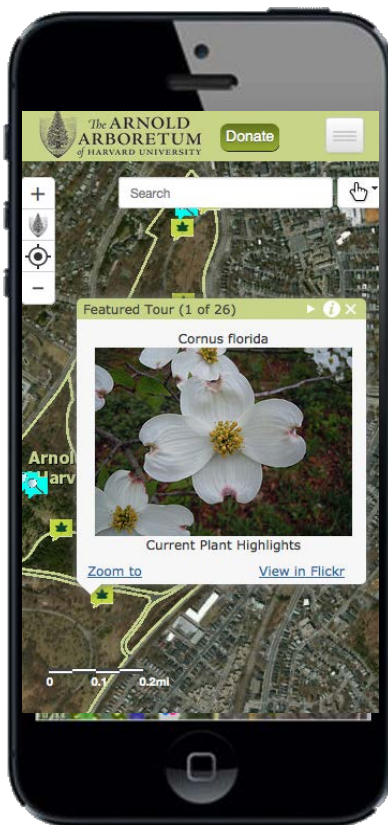
Archival map of the Peters Hill Natural Woods drawn in 1985. Almost 1800 flat files of our archival maps have been scanned and georeferenced and added to our GIS (maps from the 1930s to 1980s).

Arboretum Explorer



The Technology

- The user interface is written using HTML5, JavaScript, [AngularJS 1.12.16](#), and [Bootstrap 3.2.0](#)
- The mapping components are written using the [ArcGIS Server JavaScript API, version 3.13](#), which is built off of [Dojo 1.10.4](#).
- Our GIS data is available through [ArcGIS Server REST services](#)
 - e.g., [Phylogeny Layer](#)



Inventory Data

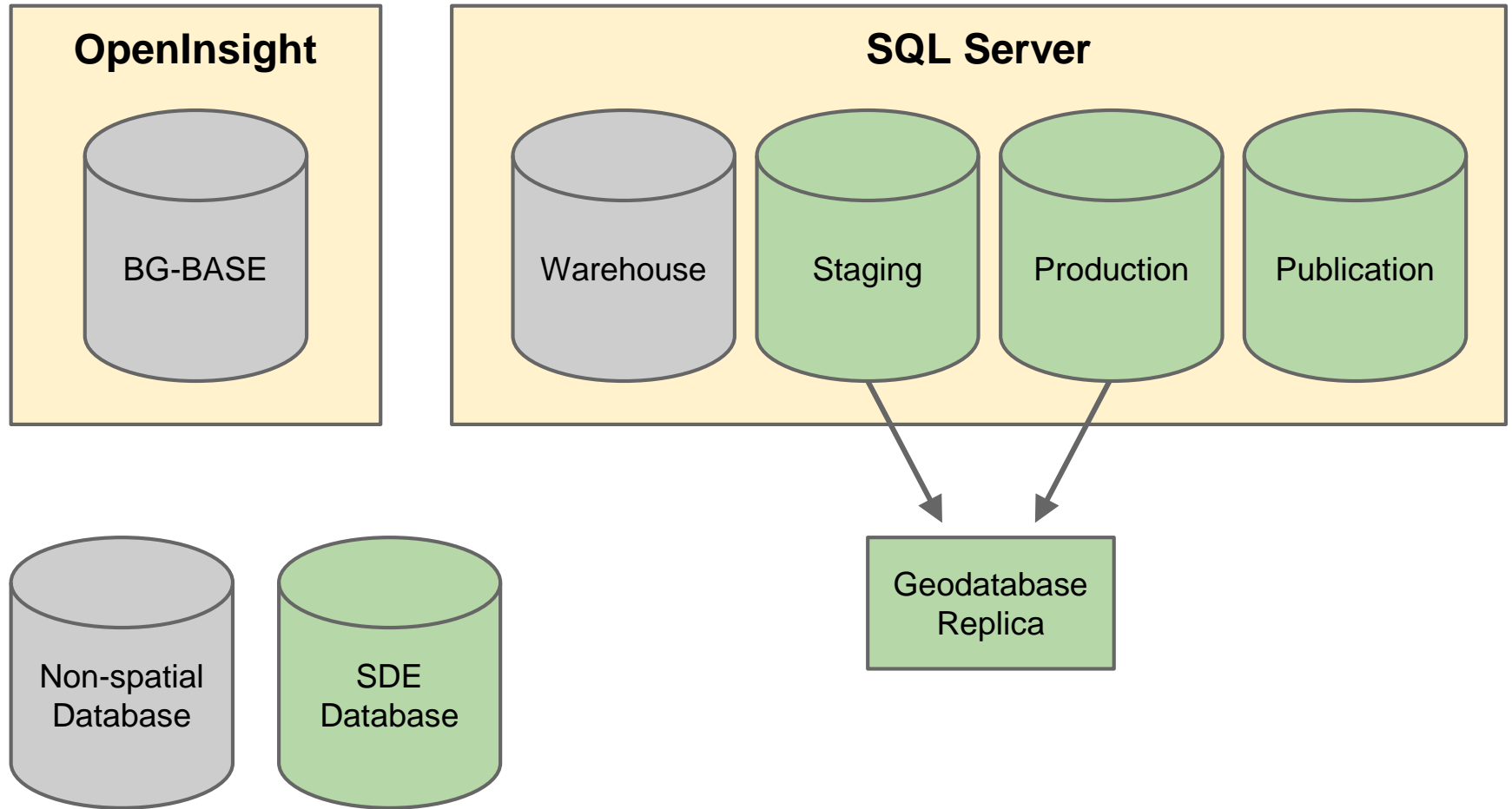
The Arnold Arboretum uses *BG-BASE* software to maintain its collection inventory

BG-BASE uses an OpenInsight database to store the inventory data

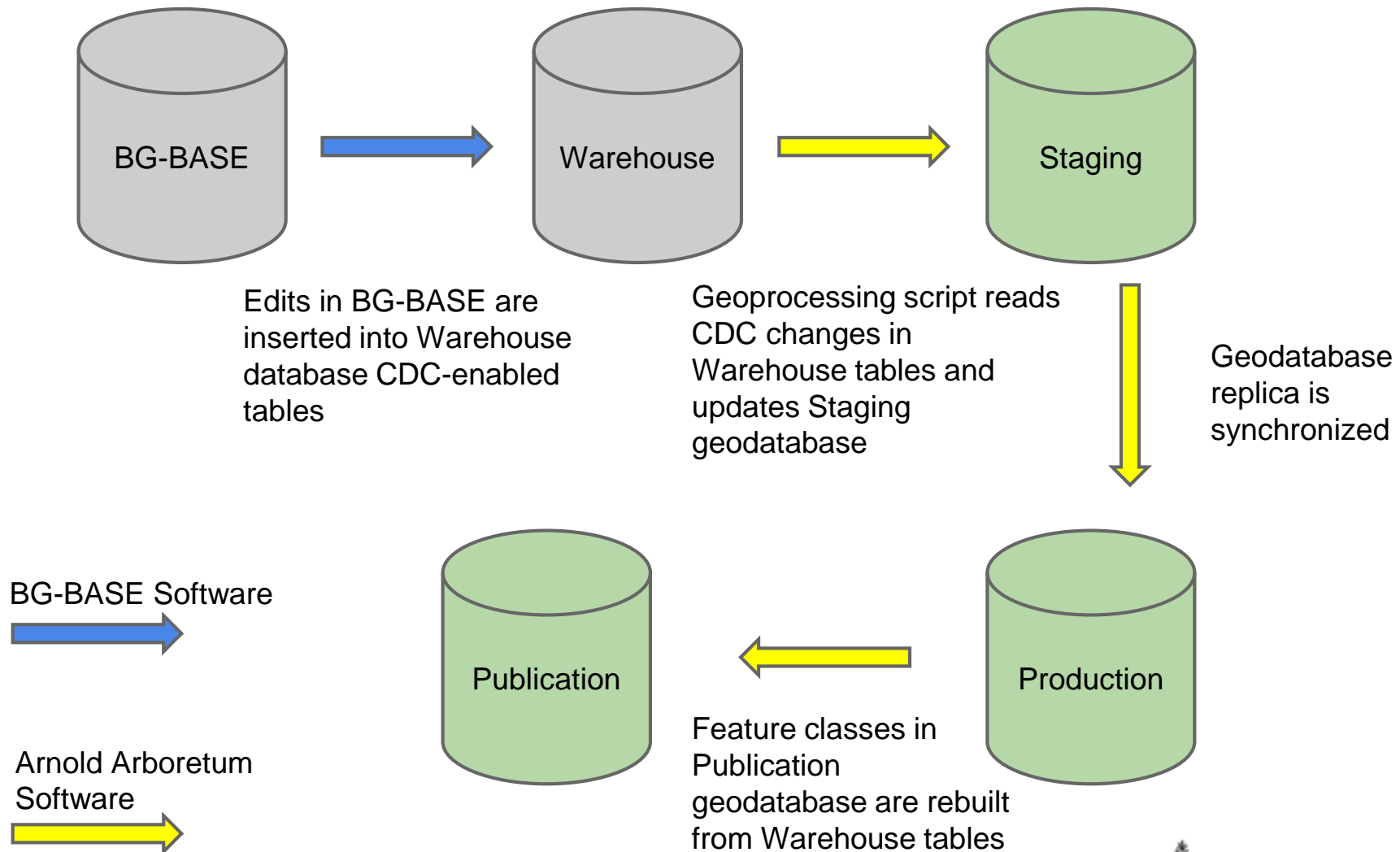
BG-BASE and the Arnold Arboretum worked together to create a SQL Server representation of the data so that the data could be imported into an ESRI Geodatabase

BG-BASE and the Arnold Arboretum also worked together to create a synchronization process to keep the inventory data and spatial data in sync. The software to achieve the synchronization is called the BG-BASE ArcGIS Connector.

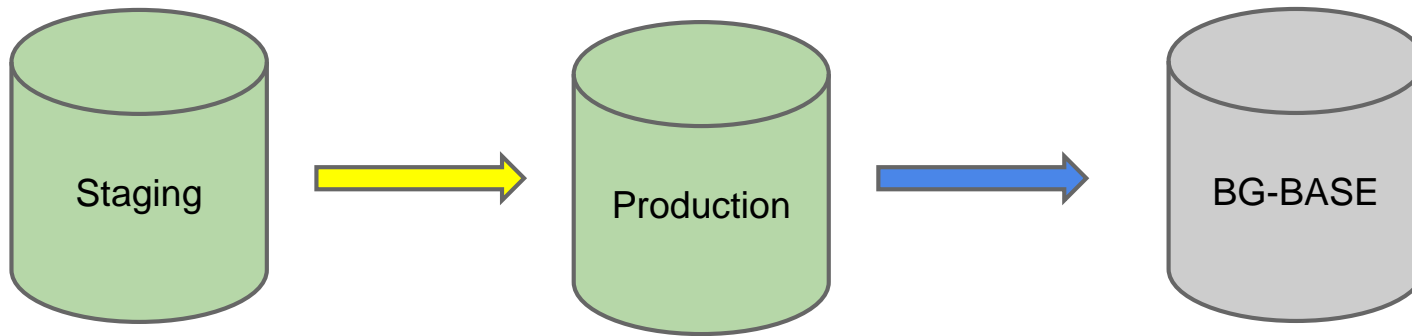
Inventory Data



ArcGIS Connector: BG-BASE to SDE



ArcGIS Connector: SDE to BG-BASE



Edits made in Staging geodatabase are captured via ArcGIS Geodatabase Replica XML change file

XML change file sent to BG-BASE. BG-BASE reads changes from XML change file and updates BG-BASE database.

BG-BASE Software



Arnold Arboretum Software



Data Sources

- ArcGIS Server Map Services
 - [ESRI World Imagery Map Service](#)
- Arnold Arboretum Map Services
 - [Arnold Arboretum Imagery Map Service](#)
 - [Arnold Arboretum Collection Explorer Map Service](#)
 - [Plants by Phylogeny](#)
- Custom Feature Layer
 - [Arnold Arboretum Flickr Albums](#)
 - [Flickr Geotagged Photosets](#) (e.g., [Current Plant Highlights](#))

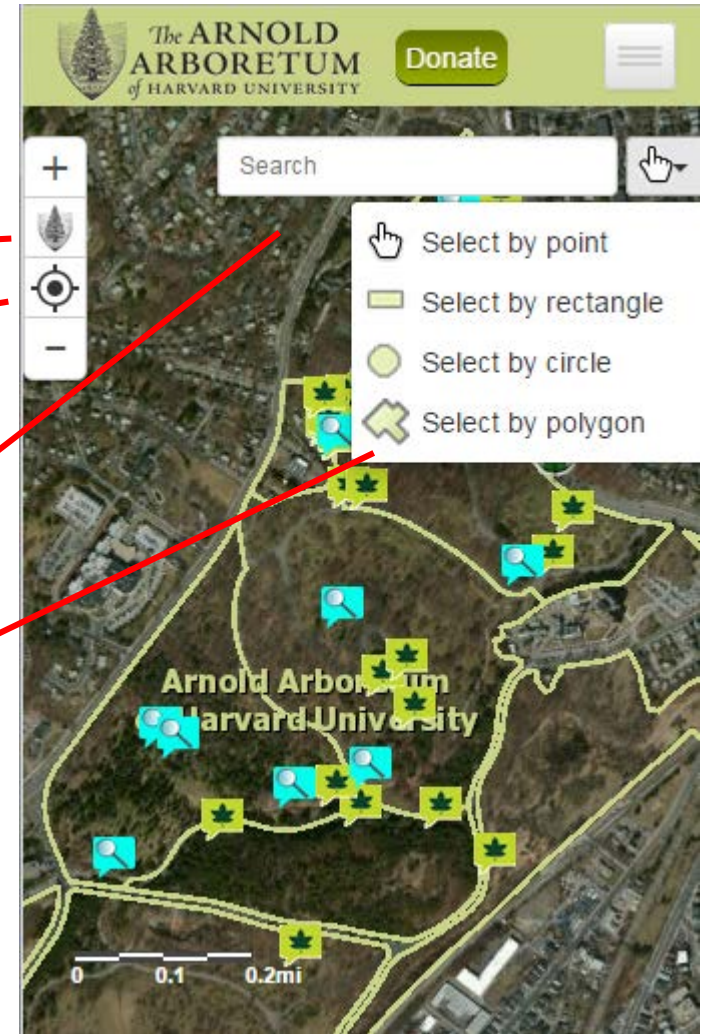
Application

Find Arboretum: Centers the user's map to the location of the Arnold Arboretum.

Zoom to User: Centers the user's map to the user's current location.

Quick Search: Performs an attribute query against the Arboretum's plant data.

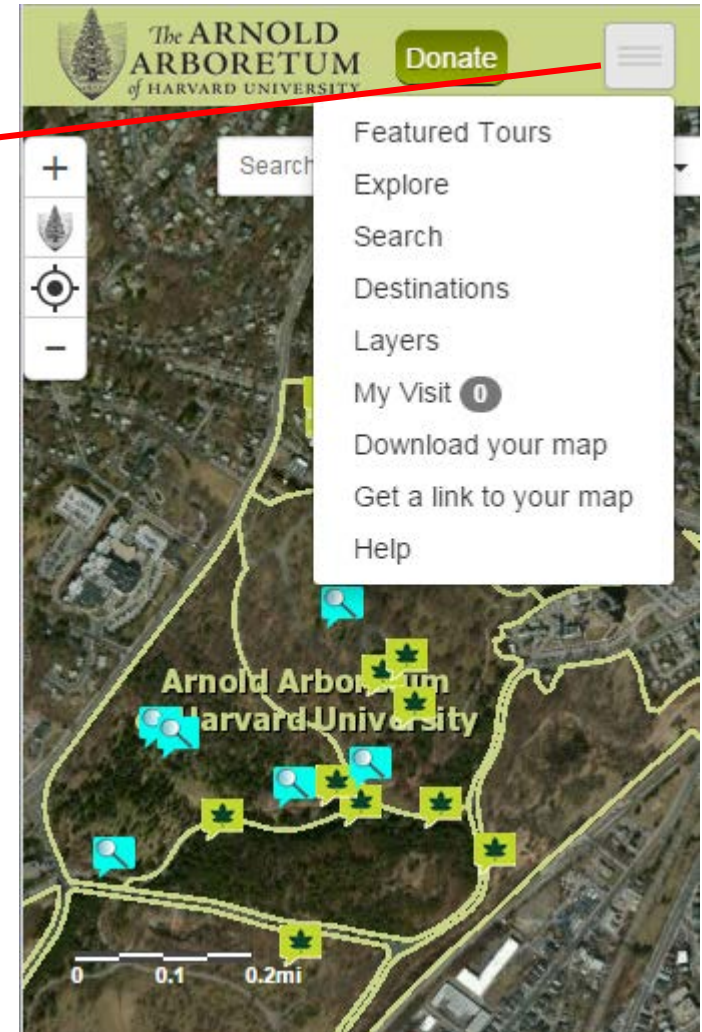
Select Tools: Allows the user to draw a shape on the map to select plants.



Functions

Menu: Tapping the Menu button shows the user additional functions that are available in Explorer.

- Featured Tours
- Explore Arboretum
- Search
- Destinations
- Layers
- My Visit
- Download Map
- Link Map
- Help

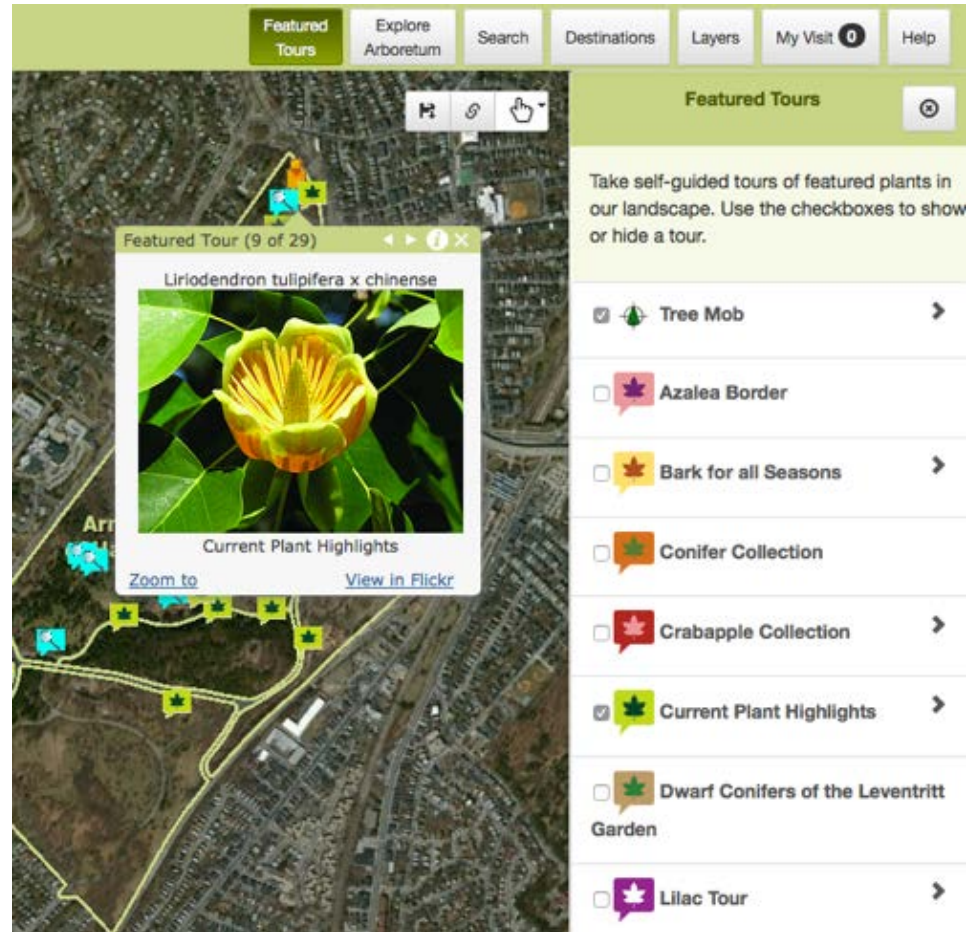


Featured Tours

The Featured Tours in Explorer are geotagged photos from the Arboretum's Flickr account.

The Featured Tours layer is a custom feature layer written in PHP.

Turning on a tour will zoom the user to the extent of the tour.



Explore Arboretum

The Explore Arboretum function shows a list of plants keyed by a selected attribute in the Arboretum.

The plant list and counts are derived using ArcGIS Server Query Statistics services.

Clicking on a plant will highlight the plants on the map and zoom the user to the extent of the plants.

The screenshot shows the 'Explore Arboretum' web application. At the top, there is a green header with the title 'Explore Arboretum' and two buttons: a help button (question mark) and a close button (X). Below the header is a search bar with a clear button (X) and a search button (magnifying glass). Under the search bar is a keyboard layout with letters A through Z, each in its own button. Below the keyboard is a green button labeled 'All'. Below that is a dropdown menu labeled 'Genus' with a downward arrow. A dropdown menu is open, showing the following options: 'Common Name', 'Scientific Name', 'Family', 'Genus', and 'Order'. Below the dropdown menu is a table with the following data:

Genus	Count
Abelice	5
Abelice	7
Abies	173
Acer	478
Aconitum	1
Actinidia	26
Aesculus	97

Search

Users can perform a simple search, or, users can perform an advanced search.

The advanced search mode will allow users to specify values against individual fields using an AND operator.

Search Arboretum ? ✕

☒ Advanced Search

☐ Wild Collected Only ☐ Exact Match

Plant ID ?

e.g., 63-78*A, 63-78

Common Name ?

e.g., White Willow

Scientific Name ?

e.g., Salix alba, Salix, alba

Family ?

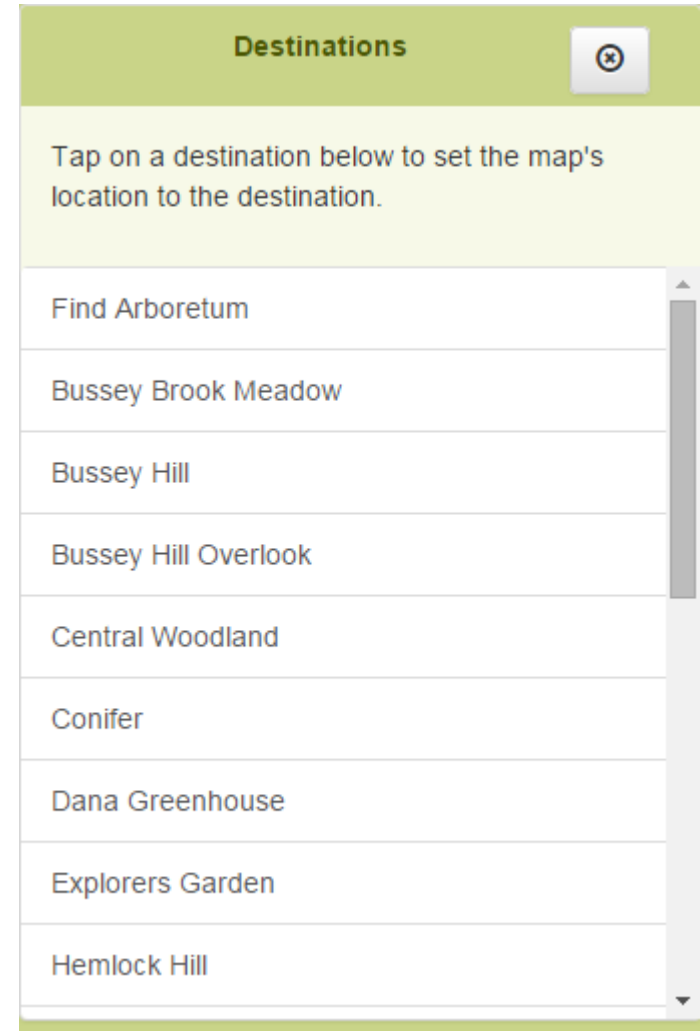
e.g., Salicaceae

Reset Search

Destinations

The Destinations function presents the user with a list of areas within the Arboretum.

Clicking on a destination will zoom the user to the location of the destination.

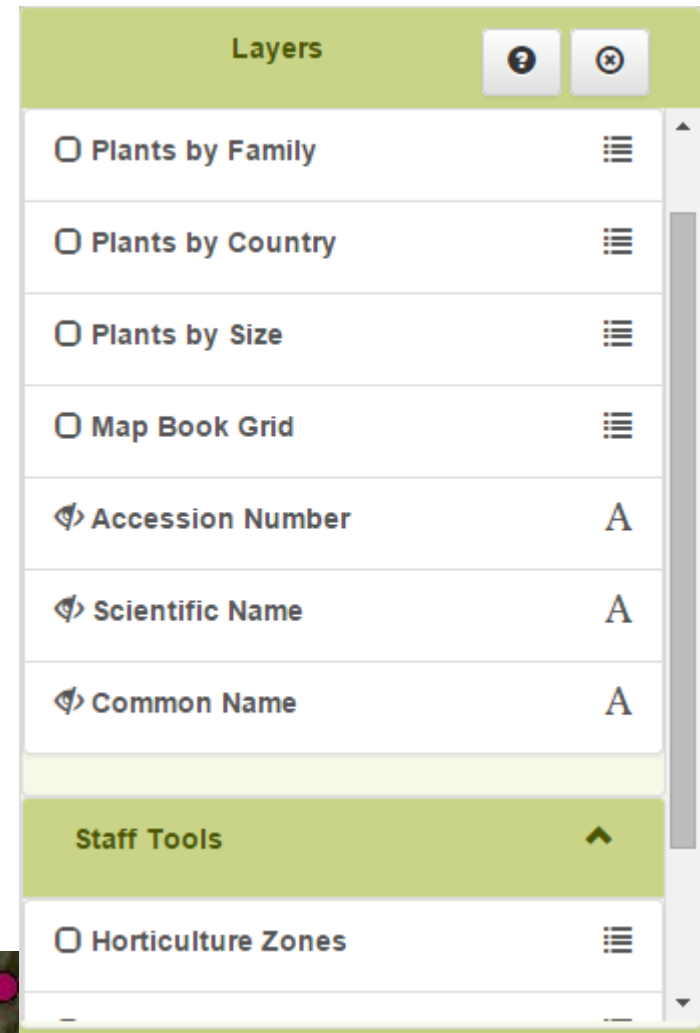
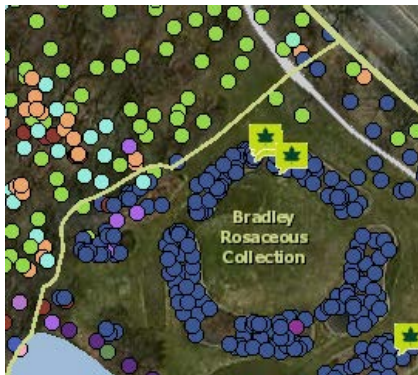


Layers

Explorer uses a dynamic map service to show the various Arboretum GIS layers.

The Layers function allows a user to turn GIS layers on and off in the map.

The Layers function also allows users to turn labels on and off, and also provides a legend for the layers, if available.

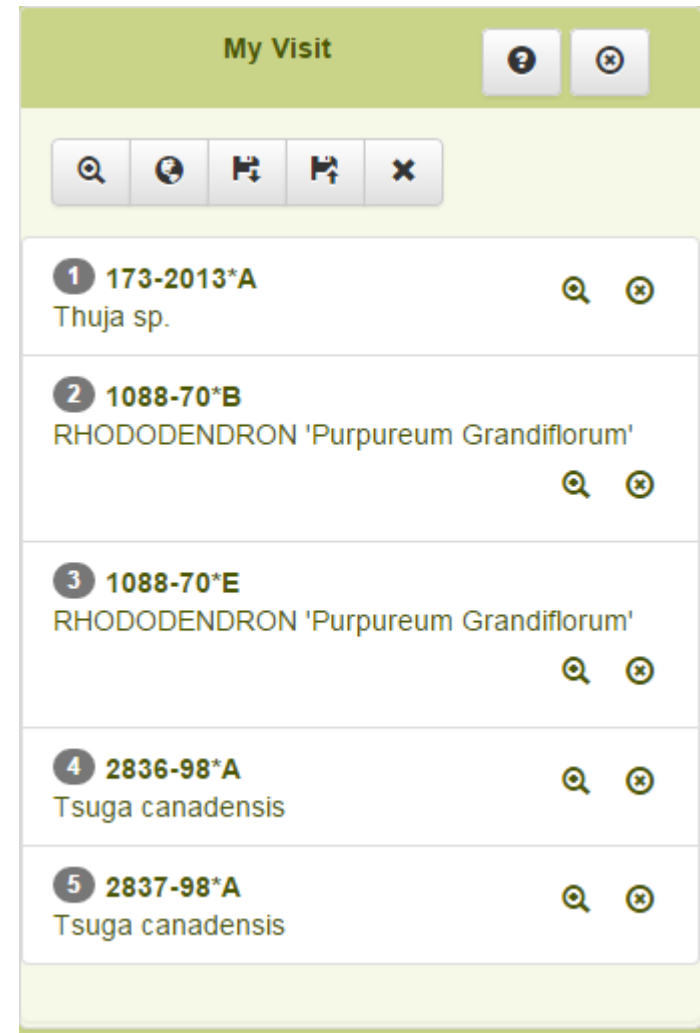


My Visit

The My Visit function allows users to add selected plants to their own custom tour.

Users can reorder the plants in their visit by dragging the plants in the user interface.

Plants that are added to a visit will show when printing the map and when sending a link to the map.



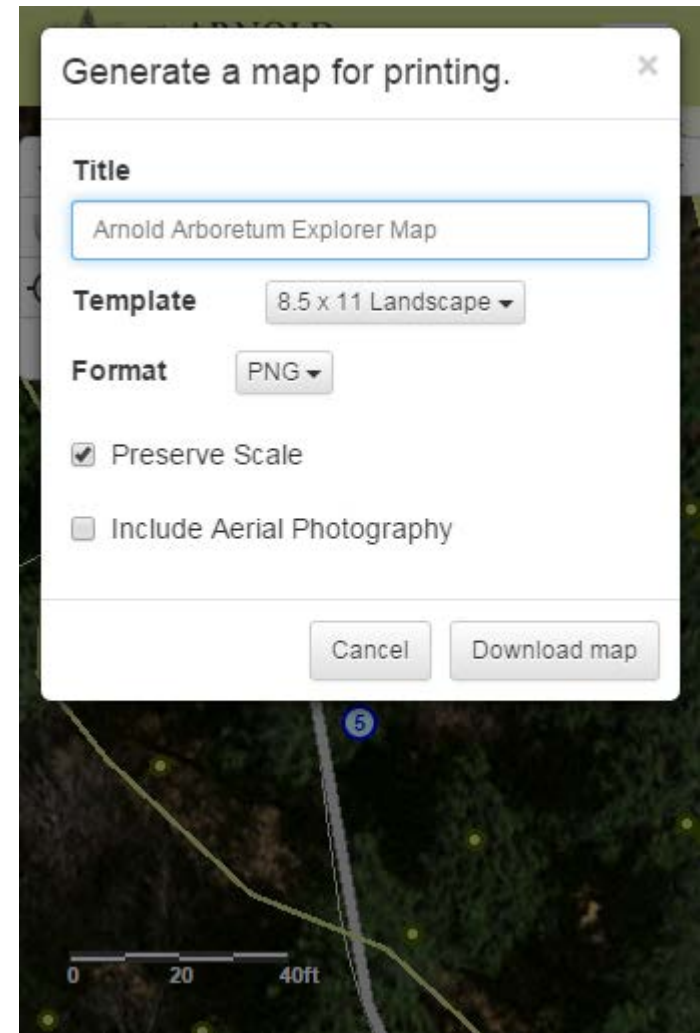
Download Map

The Download Map function uses the ArcGIS Server Export Web Map geoprocessing function to create a file of the user's map.

Vector graphics that have been added to the map (e.g., Featured Tours, User Visits) are included in the exported map.

The Download Map Function allows users to select a template to print to, the file format of the export, and optional extent and display preferences.

The templates are provided via ArcMap documents from the server.

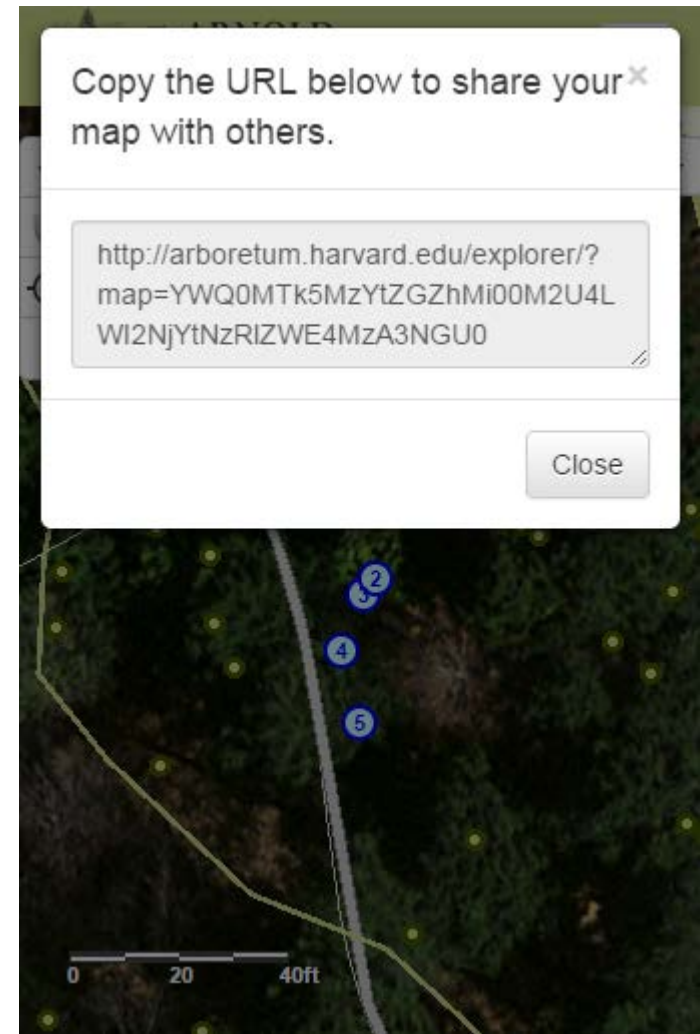


Link Map

The Link Map function creates a representation of the user's current map, and makes the representation of the user's map available as a URL.

The representation of the map is stored and retrieved via ArcGIS Server Feature Services.

The representation of the map includes the map extent, the visibility of the layers (including the Featured Tours) and the plants that a user may have added to My Visit.



Selecting Plants

Users can select plants either using a spatial selection or a text search.

The selected plants are highlighted on the map, and some of their attributes are displayed in a grid.

Users can add selected plants to their visit, as well as download a CSV formatted of the selected plants' attribute data.

Clicking on a row in the selection grid will open the Plant Detail.



The screenshot shows the website interface for The Arnold Arboretum of Harvard University. At the top, there is a green header with the logo and a 'Donate' button. Below the header is a map of the North Woods area, showing various plant locations marked with yellow circles. A red polygon highlights a specific area in the North Woods. A search bar is visible at the top right, and a legend on the right side lists selection methods: 'Select by point', 'Select by rectangle', 'Select by circle', and 'Select by polygon'. Below the map, a table displays 29 selected plants with columns for Plant ID, Family, and Name.

Plant ID	Family	Name
500-2009*A	Fagaceae	Quercus rubra
533-2009*A	Ericaceae	Rhododendron sp.
522-2009*A	Lauraceae	Lindera benzoin
151-85*B	Hamamelidaceae	Hamamelis virginiana

Plant Detail

The Plant Detail shows users additional attributes for the selected plant.




External resources (e.g., JSTOR, USDA, Google Images, etc.) are made available for the selected plant.

Users can generate an email message for the selected plant, and can also add the plant to their visit.



Plant Detail

6621*B




Name
Aesculus glabra var. glabra

Common Name
Ohio Buckeye

Family
Sapindaceae

Accession Date
11-15-1901

Data Source
Kräussmann, G. 1984. Manual of Cultivated Broad-leaved Trees & Shrubs. Vol. I. Portland, OR: Timber Press. 448 pp.



Plant Detail

About this Species

[Google Images](#)

[USDA Plants Databases](#)

[Inside Wood](#)

[Harvard Herbaria](#)

[The Plant List](#)


[Harvard Library](#)

[USDA Agricultural Research Service](#)

[Nucleotide GenBank](#)

[Angiosperm Phylogeny Website](#)

For **Quercus rubra** there is a **Type?** specimen of **Quercus buckleyi Nixon**, collected in Texas: Near Austin



Go to record in Jstor Plants

Acknowledgements

Thanks to:

Jason Sardano, GIS Software Engineer

George Morris, Director of IT

Stephen Hill, System Administrator

Brian Morgan, Alliance for Public Gardens GIS

Mike O'Neal, *BG-BASE*

Prof. Ned Friedman, Director of Arnold Arboretum

And thanks to all of the staff of the Arnold Arboretum, especially Visitor Education, Curation, and our Horticulturists.

@donnatremonte, dtremont@oeb.harvard.edu

