# The UC Davis Arboretum GIS User Manual

By
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Landscape Architecture
Senior Project - LDA 193B
June 11, 2010

Teucrium chamaedrys
M09.9098

Lavandula angustifolia
'Stratford-on-Avon'
A89.0647

Origanum vulgare
M09.9045

Salvia sp.
M09.9085

Teucrium chamaedrys
M09.9099

Bulbine frutescens
M06. 0311

Lavandula stoechas 'Otto Quast'
M06.0712

Foeniculum vulgare 'Atropurpurea'
M09.9025

Aloysia sp.
M09.9107

Echeveria 'Imbricata'
M09.9024

Salvia elegans
M09.9087

Bulbine frutescens
M09.9013

Pelargonium citronellum
M09.9051

Erigeron karvinskianus
A80.0188/

Iris x germanica
M06.0310

Thymus capitatus
M09.9101

Echeveria 'Imbricata'
M09.9022

Lavandula x ginginsii 'Goodwin Creek Grey'
A97.0248/

Penstemon 'Sour Grapes'
M09.9111

PAGE 2
Monday, February 01, 2010

BOA
GARD

1 cm = 1.2 m
Meters
0    5

Feet
60
50
40
30
20
10
0
1 inch = 10 feet

UC DAVIS
ARBORETUM

G

nse) 'Biokovo'

# The UC Davis Arboretum GIS User Manual

A senior project presented
to the faculty of the Landscape Architecture Program
at the University of California, Davis
in partial fulfillment of the requirement for the degree of
Bachelors of Science in Landscape Architecture

The UC Davis Arboretum GIS User Manual

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by
Sophie Klenner
June 11, 2010

# ABSTRACT

The UC Davis Arboretum is home to over 30,000 plants which are the main source of horticultural information to inland California. Keeping track of every plant is a daunting task, so the Arboretum staff decided to implement the use of a Geographic Information System. With no GIS model to emulate, the Arboretum decided to create there own geographic database that was specifically geared towards the cataloging of plants. With their GIS created the Arboretum wanted to share it with other botanic gardens; however, in order to do this a manual on how to use the new GIS database would be needed. The creation of the UC Davis Arboretum GIS User Manual is the purpose of this Senior Project.

In order to create an understandable easy to follow guide, a simple format will have to be created. Once a format is determined step by step instructions on how to use the database and create maps will be written. These written instructions will be supported by actual color screen shot graphics. Throughout the guide, additional information will be provided on how to solve and/or avoid problems. The final product will be posted to the Arboretum website for easy download.

A user manual to accompany a how to guide on setting up a GIS plant database will allow for this new system to be used by other living museums throughout the world.

# Acknowledgements

# TABLE OF CONTENTS

# CHAPTER 1
## INTRODUCTION

Chapter 1 provides an explanation of why the UC Davis Arboretum documents all of their plant collections and why it is important to do so. This chapter also covers how GIS, Geographic Information Systems, work when applied to a botanic garden or Zoo. Lastly this chapter explains how the UC Davis Arboretum has implemented the use of GIS to their plant collections.

# Table of Contents
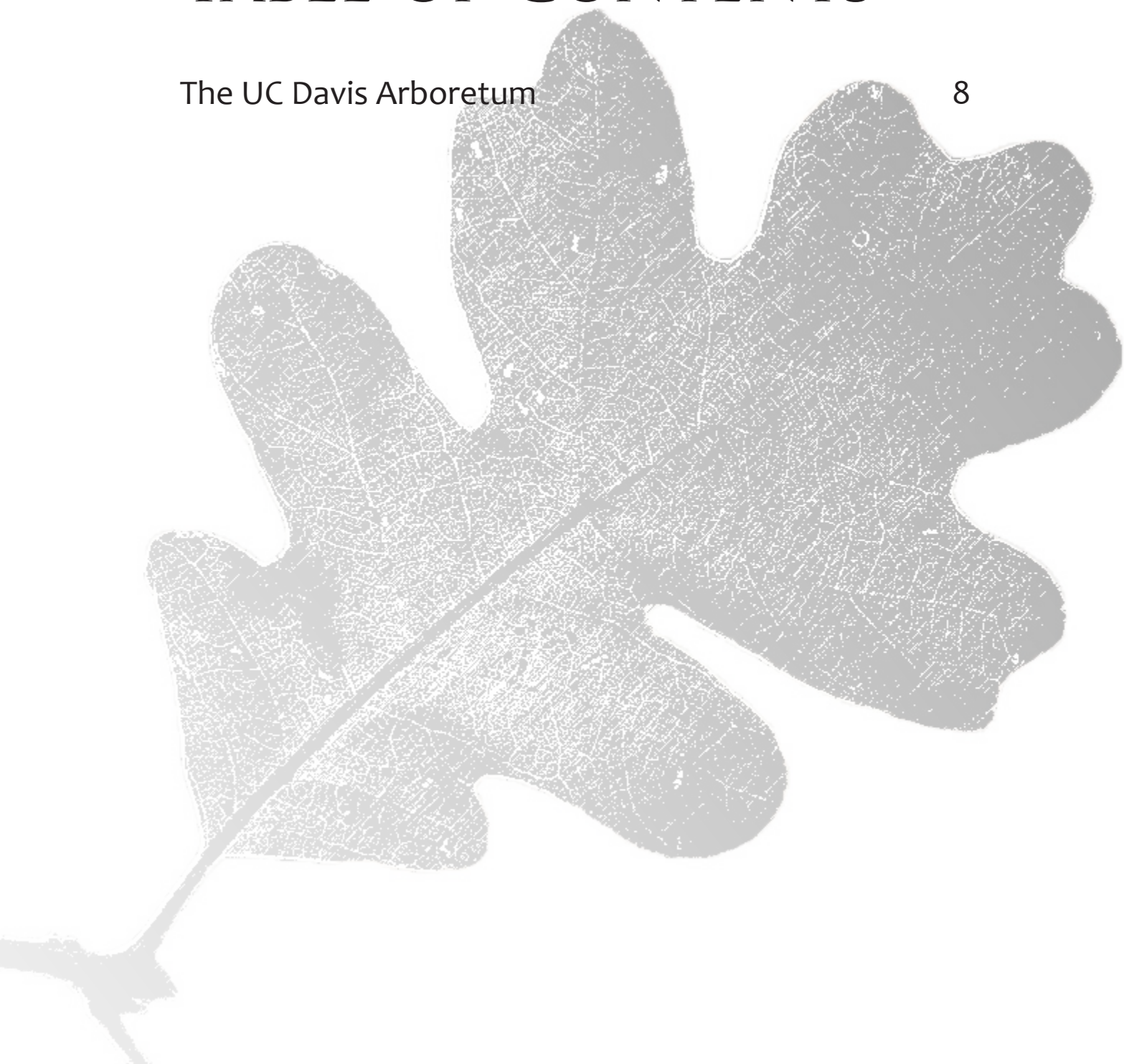
# The UC Davis Arboretum

The University of California Davis Arboretum is a 100 acre garden that encompasses the banks of the old North channel of Putah Creek, in Davis, California. The Arboretum was founded in 1936 to support teaching and research at the University. In addition to its mission of University support, the Arboretum's objectives have evolved to include wildlife exhibition, visitor education, biodiversity conservation, and scientific research.

## Collections Management

The UC Davis Arboretum houses over 30,000 plants in its plant collections with a focus on taxa, adapted to Mediterranean climates. Due to the large quantity of plants it is essential that the documentation of plant names, locations, and sizes, is done efficiently. In order to accomplish this goal the UC Davis Arboretum has developed a system of documenting their Living collections through the use of GIS maps. The maps are not only used for locating plants, they have become an all in one system for plant information management that assists in the decision making process in collection development and planning.

## Overview of GIS and how it works in Arboretums & Botanic Gardens

Currently there are two standards used for map making in today's botanic gardens. One system uses computer aided drafting (CAD) and the other uses geographic information systems (GIS). CAD systems essentially allow the user to create computer generated graphic drawings of maps that can be edited easily and used in conjunction with database systems to document additional information about the maps. GIS systems offer the drawing capabilities of a CAD system as well as the information storage capabilities of a database system all in one. The most widely used GIS system is ArcGIS.

ArcGIS is a software suite consisting of geographic information system products produced by the software company ESRI. These GIS products work together to allow the user to conduct spatial analysis, data management and mapping. ArcMap is the main component of the ArcGIS suite of geospatial processing programs, and it is used to view, edit, create, and analyze data. ArcMap permits the user to explore data within a data set, symbolize features accordingly, and to create maps.

## How the UC Davis Arboretum Uses GIS

The UC Davis Arboretum began surveying GPS locations for every plant in the Arboretum in 2004. These coordinates were then uploaded into the Arboretum's GIS database and individual map documents were created for every section and garden found within the Arboretum. When a plant dies or is added to a collection the map document requires updating. Horticultural staff will note the changes on a printed version of the map, then curatorial staff, interns and volunteers will make these updates in the GIS. The new maps are regularly distributed to faculty, staff, students, researchers, and the public to aid in plant location. The collection maps are regularly used by the Arboretum staff to help make decisions regarding collection development and planning within the Arboretum.

# CHAPTER 2
## GETTING STARTED

Chapter 2 covers all the basics that need to be done before you can begin working an the Arboretum maps. This process begins with creating network logins and passwords and the steps you need to take to connect to the VPN (Virtual Private Network) and the server.

In addition this chapter briefly covers a few basics on principles of the ArcMap interface and goes over the most commonly used ArcMap toolbars and their functions. You will also learn about the additional extensions for ArcMap that the Arboretum uses to create their maps.

# TABLE OF CONTENTS
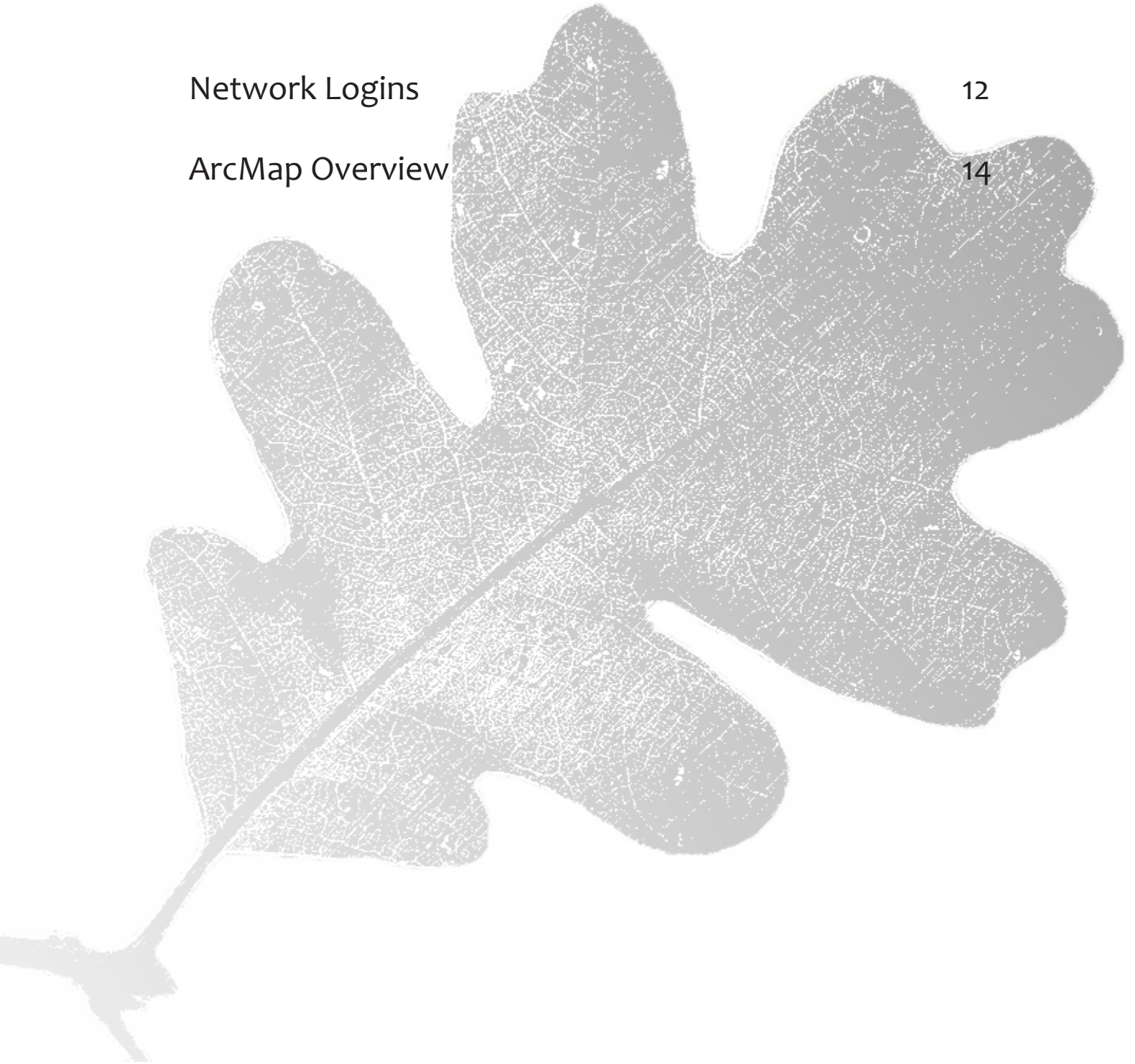
# NETWORK LOGINS

User names and passwords are necessary to ensure that campus computers are used by authorized users only.

## UC DAVIS ARBORETUM COMPUTER LOGIN

Upon turning on the computer you see a window prompting you to press ctl + alt + del. Once you have done this, another window opens that allows you to enter your user name and password. In the first field enter the user name issued to you by CAES Deans Office and in the second field enter your corresponding password.

Your CAES Password has the following requirements:

7 character minimum length, with an additional minimum of three out of the following four categories:

- Upper Case (A-Z)
- Lower Case (a-z)
- Numeral (0-9)
- Non-numeral, non-alpha (e.g. ~!@#$%^&*()_+{}:"<>?)

Write down all your user names and corresponding passwords on the Arboretum login form provided. Bring this with you every time you work at the Arboretum.

## ENVIRONMENTAL DESIGN VIRTUAL PRIVATE NETWORK (VPN) LOGIN

In order to work on the Arboretum maps you need to connect to a virtual private network (VPN). Begin by clicking on the VPN icon on the desktop. This opens a window in which you need to enter your user name and password. In this window enter your VPN user name and password as recorded on your login form. Click connect. In the

**Figure 2.1**
VPN Login dialog box.

lower right hand corner of your computer's taskbar an icon will appear indicating that you are connected to the VPN. Now click the start button of the taskbar and then click run.  Wait a few seconds and eventually a window will open.  Type "mstsc" in the "Open" field.  This stands for Microsoft Terminal Server Client.

## CREATING PASSWORDS FOR THE DESIGN AND LDA VIRTUAL PRIVATE NETWORK, OCT. 2009

Each person must have their own unique password that will correspond to their VPN user ID. Here are some guidelines and the password rules the server will enforce:

1. User ID's will be a persons UCD email address without "@ucdavis.edu". For example, the email address sjklenner@ucdavis.edu will correspond to the user ID sjklenner.

2. Passwords must pass a strength test. The VPN allows access to nearly all internal network resources through the firewall, so creating strong passwords is necessary. Please follow these rules when creating passwords:

- Each password must be at least nine (9) characters long.
- It cannot contain three or more characters from the user ID.
- It must not be the user's UCD kerberos password.
- It must contain characters from the following categories:
- English uppercase characters (A - Z)
- English lowercase characters (a - z)
- Base 10 digits (0 - 9)
- Non-alphanumeric character (E.g.: !, $, #, %)
- Passwords cannot contain spaces.

Here are some password tools you might find handy:

Secure password generator -
    http://www.pctools.com/guides/password/

Password strength checker -
    http://www.microsoft.com/protect/ yourself/password/checker.
    mspx

4. Please come up with passwords and phone (not email!) them to Brian Morgan at 752-6821.  You can safely leave passwords on the voicemail as nobody else has access to this mailbox.

## UC DAVIS ARBORETUM GIS SERVER LOGIN

After starting the Microsoft Terminal Server Client, a login page will open and here you should enter your GIS user name and password from your Arboretum login form. To create a server user name and password follow these steps:

**Figure 2.2**
Server Connection window.
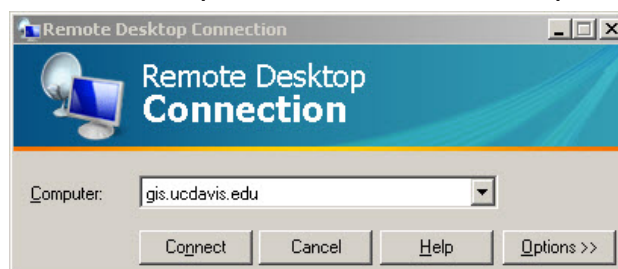
**Figure 2.3** Server login window.

Step 1 - Contact Brian Morgan at bjmorgan@ucdavis.edu to request a new account on the GIS server.

Step 2 - You will receive an email with your account name and temporary password usually within 24 hours.

Step 3 - Logins will be your first name. You will be asked to set a new password upon first login.

Step 4 - You should now see the virtual desktop. Once the virtual desktop is open, click the start button and navigate to All Programs>GIS>ESRI Arc-Map.

# ArcMap Overview

ArcGIS is a collect of GIS, (Geographic Information System) products that work together to allow the user to conduct thing such as spatial analysis, data management and mapping. ArcMap is the fundamental application used in ArcGIS.

## Program Layout

The geographic information used in ArcMap is displayed as a collection of **layers** that can be added or removed. Final map documents typically include elements such as a scale bar, north arrow, text etc. that can all be added to a map layout in ArcMap.

## Data & Layout Views

ArcMap displays map features and content in one of two views, data view and layout view. In Data view there is the data frame which acts like a window to the active layers in a map. The geographic information displayed in the data frame use real world coordinates such as feet and meters. This is where any edits of features takes place.

Layout view, also called page layout view, is where map elements such as the scale bar, north arrow and text are displayed together on a sheet of paper in a clear, easy to understand design. Layout view also features the data frame that we see and use in data view, only in layout view it is like another map element in the design. Page layouts are generally used for maps that require printing or exporting to printable formats such as Adobe PDF.
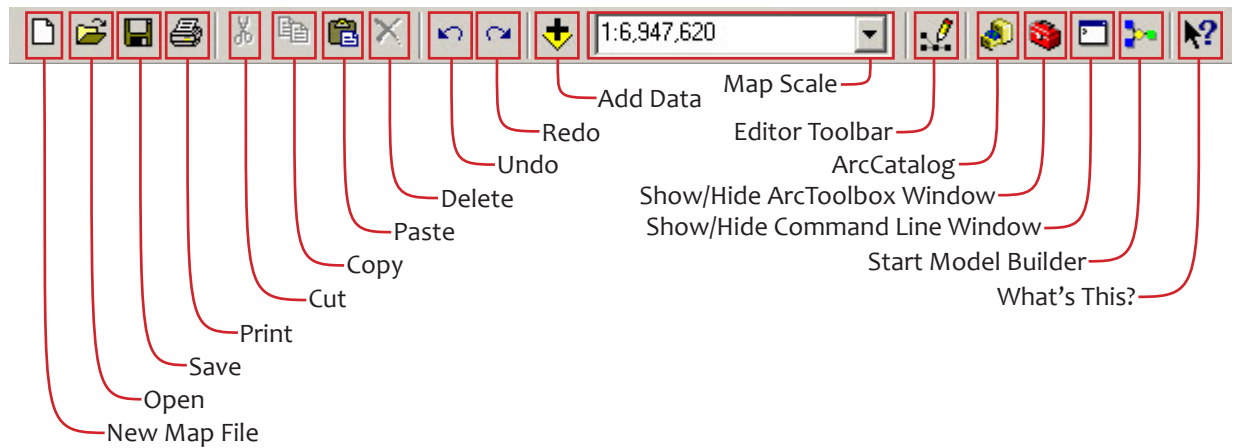
## Common Toolbars

ArcMap features a collection of toolbars for different purposes and uses; they can be

floating or docked. A few of the most commonly used toolbars and their functions are shown below:
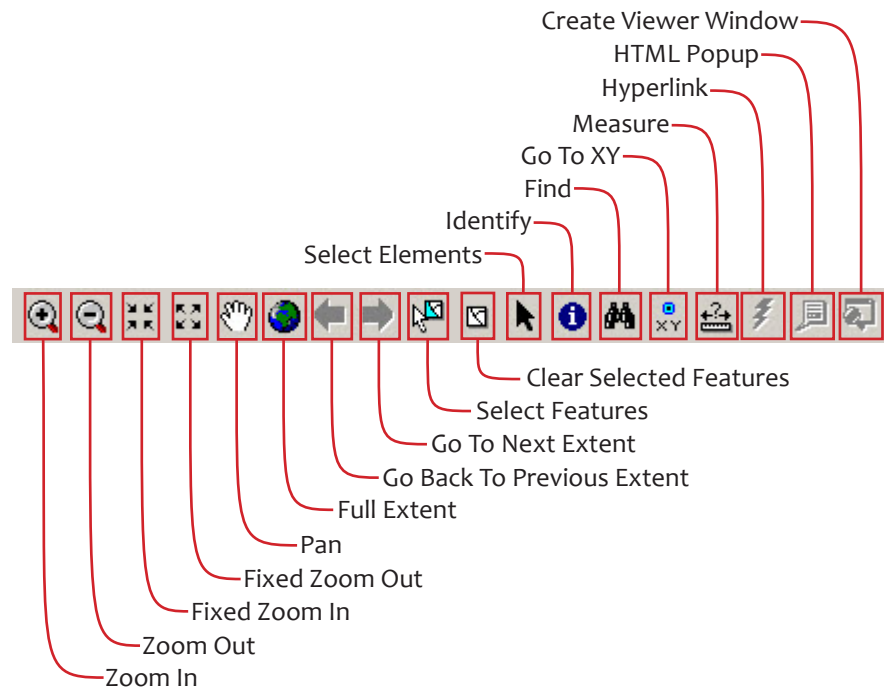
## Standard Toolbar
This toolbar generally appears just below the menu toolbar at the top of the ArcMap window. It allows you to copy, past, cut, save and more.
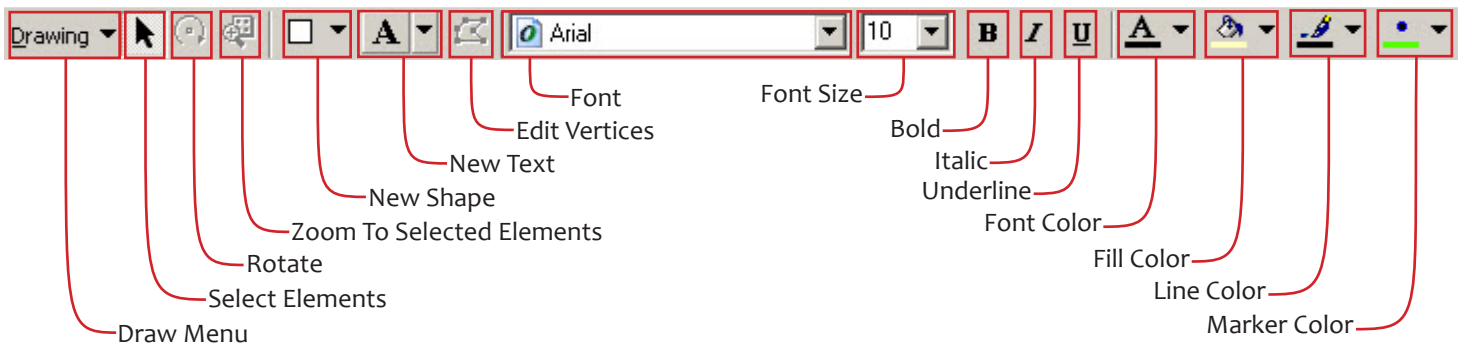
Map Scale
Add Data
Redo
Undo
Delete
Paste
Copy
Cut
Print
Save
Open
New Map File

Editor Toolbar
ArcCatalog
Show/Hide ArcToolbox Window
Show/Hide Command Line Window
Start Model Builder
What's This?

## Tools Toolbar
This toolbar is used to navigate and query within a active data frame.

Create Viewer Window
HTML Popup
Hyperlink
Measure
Go To XY
Find
Identify
Select Elements

Clear Selected Features
Select Features
Go To Next Extent
Go Back To Previous Extent
Full Extent
Pan
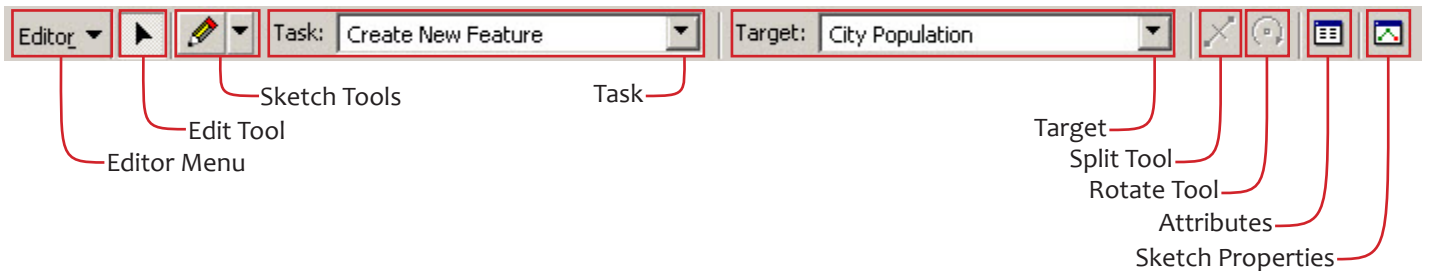Fixed Zoom Out
Fixed Zoom In
Zoom Out
Zoom In

## Draw Toolbar

This toolbar generally appears at the bottom of the ArcMap window. It is used when in layout view to create and edit graphic elements in the map.
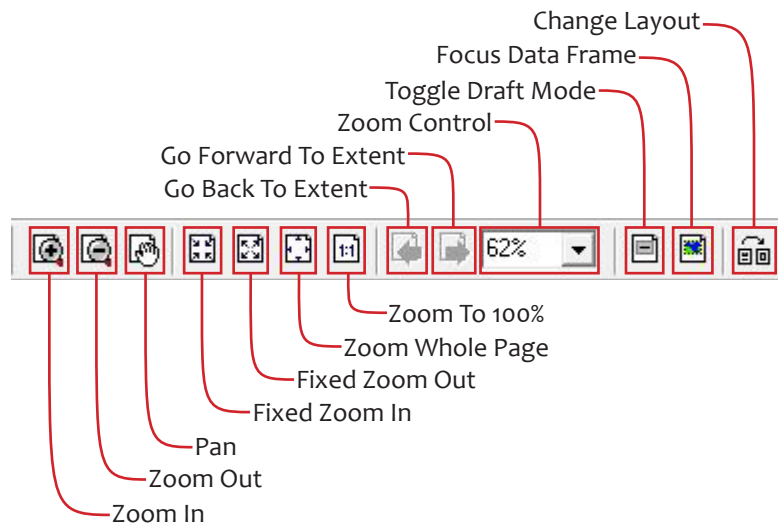
Font
Edit Vertices
New Text
New Shape
Zoom To Selected Elements
Rotate
Select Elements
Draw Menu

Font Size
Bold
Italic
Underline
Font Color
Fill Color
Line Color
Marker Color

## Editor Toolbar

Use this toolbar when you want to make changes to a map or layer attribute table by moving, deleting, or adding features.

Sketch Tools
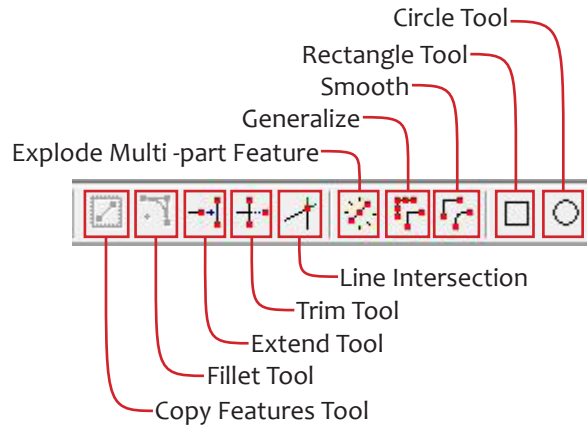Edit Tool
Editor Menu

Task

Target
Split Tool
Rotate Tool
Attributes
Sketch Properties

## Layout Toolbar

Use this toolbar to navigate around the page in layout view.

Change Layout
Focus Data Frame
Toggle Draft Mode
Zoom Control
Go Forward To Extent
Go Back To Extent

Zoom To 100%
Zoom Whole Page
Fixed Zoom Out
Fixed Zoom In
Pan
Zoom Out
Zoom In

## Advanced Editing Toolbar

This toolbar offers more editing functions when your in an edit session.

Circle Tool
Rectangle Tool
Smooth
Generalize
Explode Multi -part Feature

Line Intersection
Trim Tool
Extend Tool
Fillet Tool
Copy Features Tool

## Extensions

Extensions add further capabilities to ArcGIS Desktop.  To activate an extension:

Step 1 - On the menu bar, click on tools, then Extensions.

Step 2 - A window will open up listing all the extensions available to you, check the box next to the desired extension, then click close.

Step 3 - The extension you chose is now active, next you will need to open its toolbar in order to use it.

Step 4 - Right click the menu bare and a long list of toolbars will appear. Find the toolbar that allows you to use the activated extension and click on it.

Step 5 - The toolbar can be either docked or floating, choose which method you prefer

Generally once an extension has been turned on it does not need to be turned on again.  If it is not on and you try to use it, you will receive an error message.  Maplex, shown below, is one extension that is essential to the functionality of the Arboretum's maps.

## Maplex

Maplex is a text placement and labeling extension.  It reduces the need for manual editing which reduces the time spent on creating a final map document.  Maplex also offers greater control on how labels are placed in relation to map features and other labels.  In addition label placement will automatically change as changes are made to features and other labels within the map.  The Maplex toolbar and it functions are featured below.

## Maplogic Layout Manager

The cartographic tools in ArcMap are meant to create individual maps.  MapLogic Layout Manager is an extension to ArcGIS which provides all the tools necessary to create and print multiple page layouts, map series and map books within ArcMap.  Maplogic allows the user to take one big map and break it up into many pages so it will be easier to use and interpret.  With MapLogic the Arboretum can use numbering, indexing, two-sided printing, and print previewing exactly the same way you would in a word processing program.

## MapLogic Active Layout Toolbar

This toolbar is only used in Layout view when you are ready to print a map book page. The purpose of this toolbar is to allow you to move from one page to another. It also lists all the pages that will be included in a given map book. To change the page you are on double click on the page you want to go to. You can check whether you are on the right page by checking what page number displays at the bottom of the virtual page.



## MapLogic Layout Manager Toolbar

This toolbar holds all the tools necessary to create a map book. It is also the place to go when you want to export a map page.
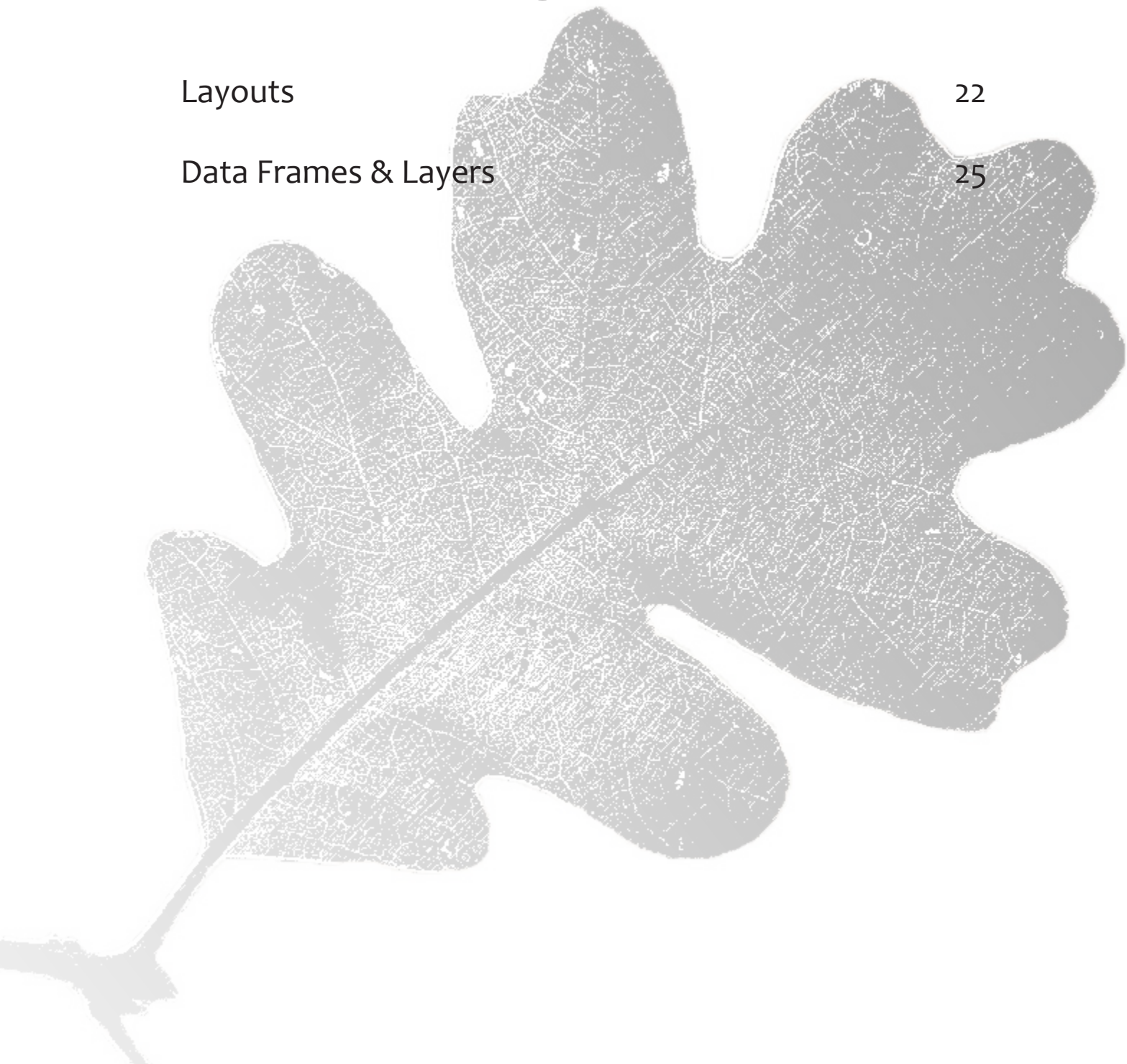
# CHAPTER 3
## THE MAP DOCUMENT

This chapter provides an over view of the maps that are created at the Arboretum and shows examples of the Overview, Map, Index, Legend and Sections pages of a typical map book. In addition, this chapter also covers all the descriptions of the column headings in the attribute tables for each layer.

# TABLE OF CONTENTS

# LAYOUTS

When working within a map book several different page layouts may be needed for the different types of pages that comprise a map book.
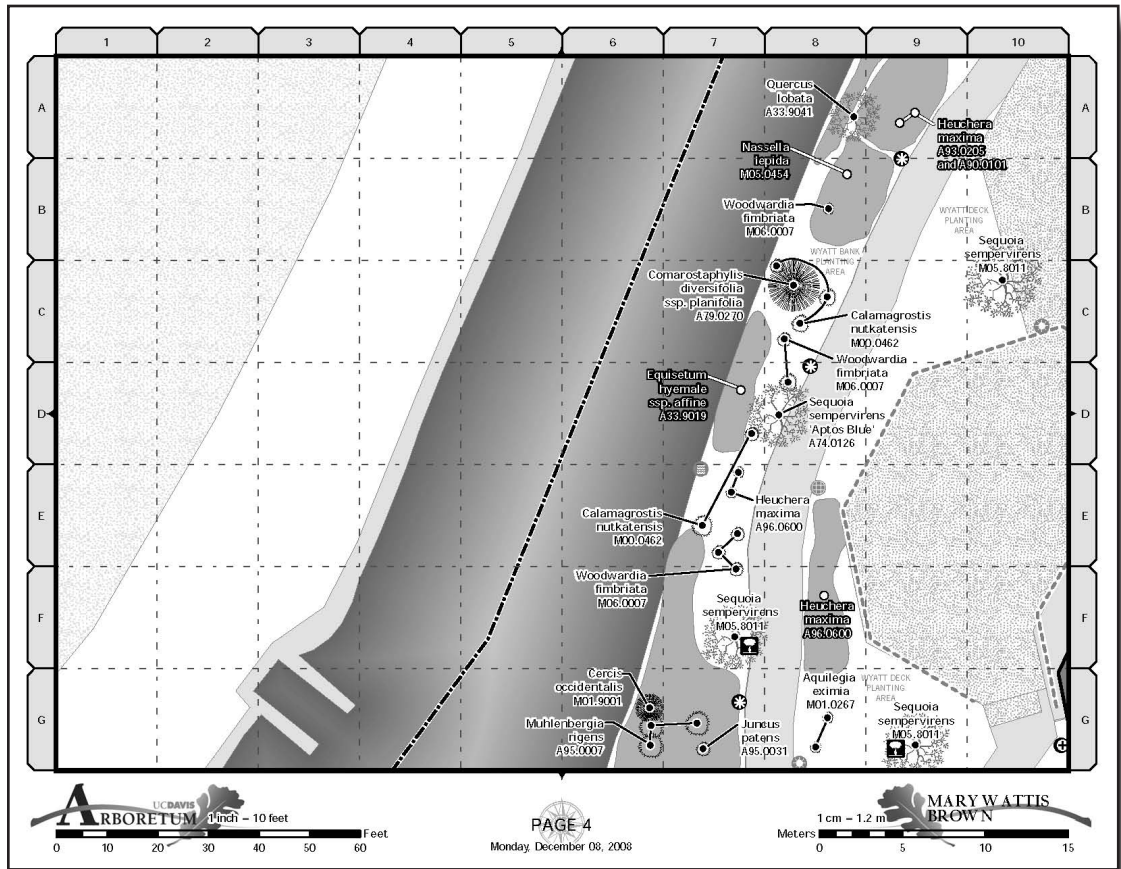
## MAP BOOK

The UC Davis Arboretum map books layout functions as the structure for all the 8.5 x 11" format maps. Within each map book you will find an overview page showing the extent of the map pages, the map pages, an index of all the plant names and their locations within the map pages, a legend explaining map symbology and an Arboretum section overview for the entire collection. Below are some examples of what each of these layouts looks like.

## OVERVIEW
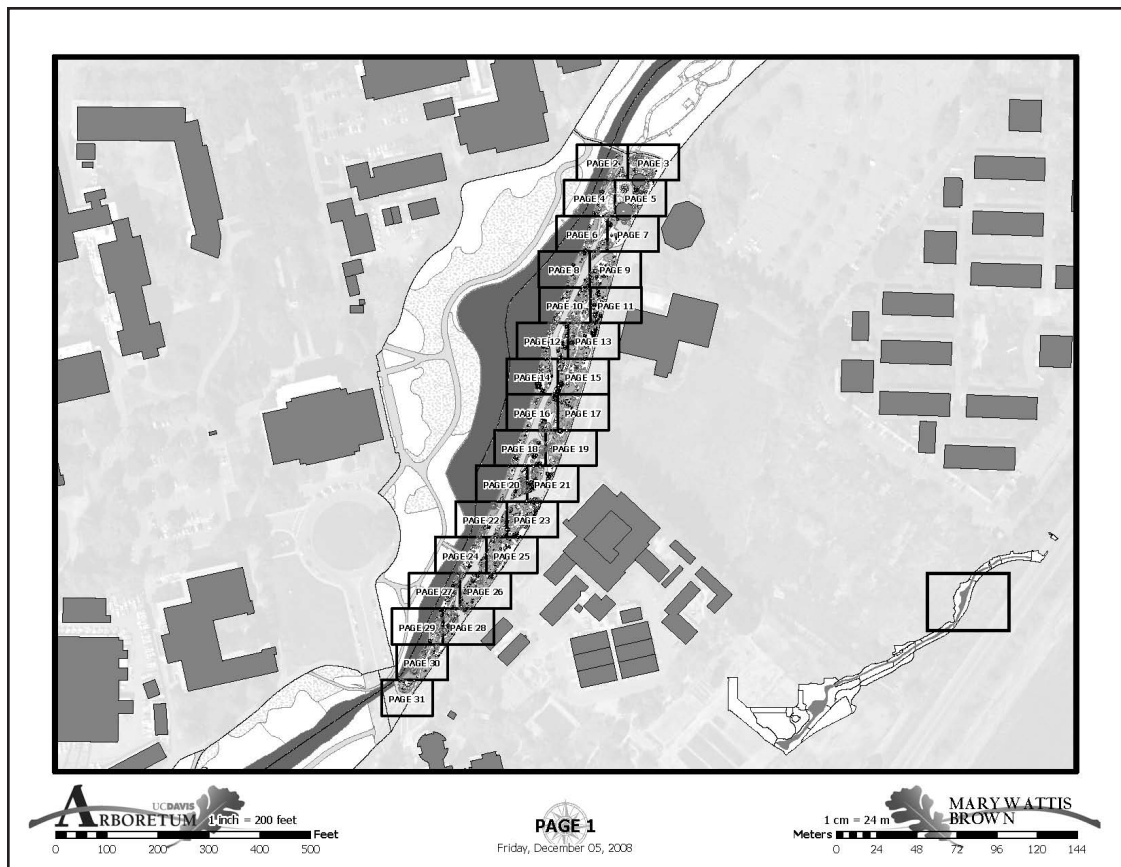
# MAPS

# INDEX

| Specimen Name | Page | Specimen Name | Page | Specimen Name | Page | Specimen Name | Page | Specimen Name | Page |
|---|---|---|---|---|---|---|---|---|---|
| Acer negundo v. californicum A33.9001 | 10 B-6 | Angelica tomentosa M00.0323 | 24 G-9 | Arctostaphylos densiflora 'Lynne' A91.0626 | 9 C-3 | Artemisia pycnocephala 'David's Choice' A95.0514 | 8 F-10 8 G-10 9 F-1 9 G-1 10 A-10 14 A-8 14 A-9 14 B-9 30 C-7 | Baccharis pilularis 'Twin Peaks Two' A58.0080 | 2 E-8 8 A-9 18 F-7 20 A-8 20 B-8 |
| Achillea millefolium 'Channel Islands' A93.0249 | 30 C-6 | Aquilegia eximia M00.0324 | 5 C-4 | Arctostaphylos 'Emerald Carpet' M05.0352 | 28 E-1 | | | Baccharis pilularis 'Twin Peaks Two' A87.0403 | 9 C-4 9 D-3 9 E-3 11 C-2 20 E-6 28 A-1 29 E-9 |
| Achillea millefolium M03.0120 | 16 B-8 16 C-8 | Aquilegia eximia M00.0456 | 5 B-6 | Arctostaphylos glauca M05.0353 | 13 G-3 15 E-3 | | | | |
| Adenostoma fasciculatum v. prostratum A75.0042 | 16 F-7 | Aquilegia eximia M01.0267 | 4 G-8 8 A-10 15 A-5 15 C-3 16 E-10 16 F-10 17 F-1 19 A-3 | Arctostaphylos pajaroensis A56.0021 | 31 A-5 | Artemisia pycnocephala 'David's Choice' M02.0286 | 10 B-10 | | |
| Adenostoma fasciculatum A75.0042 | 15 B-1 15 B-2 15 C-1 | | | Arctostaphylos pajaroensis A79.0088 | 27 F-8 | Asclepias fascicularis M01.0291 | 14 B-9 14 C-7 | Baccharis pilularis A66.0095 | 17 B-4 |
| Adenostoma fasciculatum M02.0455 | 26 B-3 28 A-3 | Aquilegia eximia M05.0337 | 12 C-10 12 D-10 | Arctostaphylos rudis A65.0106 | 27 C-10 27 E-8 27 E-9 27 F-8 27 G-7 27 G-9 28 C-1 | Asclepias fascicularis M06.0562 | 16 C-9 16 D-9 | Baccharis pilularis A87.0403 | 18 D-5 18 E-6 |
| Adenostoma fasiculatum v. prostratum A75.0042 | 14 G-10 16 A-10 16 B-6 26 D-3 | Aquilegia eximia M06.9163 | 12 D-9 | | | Asclepias speciosa A92.0262 | 23 E-1 | Baccharis pilularis, Pt. Ano Nuevo form A76.0217 | 22 C-7 |
| | | Aquilegia formosa A98.0424 | 15 A-4 | | | Asclepias speciosa A98.0441 | 12 G-9 | Beberis pinnata M06.0990 | 6 A-10 |
| Adenostoma fasiculatum M02.0455 | 26 D-1 26 D-2 26 F-1 | Aquilegia formosa M00.0003 | 3 D-1 3 D-2 3 D-3 3 D-4 3 F-1 6 A-10 6 B-10 | Arctostaphylos rudis A77.0088 | 27 E-8 27 G-9 | Asclepias speciosum A92.0262 | 22 E-10 | Berberis aquifolium 'Compacta' M01.0129 | 28 C-1 28 D-3 28 E-1 |
| Aesculus californica A57.0044 | 3 E-2 25 A-2 | | | Arctostaphylos 'Sunset' A98.0347 | 8 G-10 | Aster chilensis 'Point Saint George' A98.0376 | 6 B-8 23 B-5 30 B-6 | Berberis aquifolium 'Skylark' A88.0100 | 11 C-1 |
| Aesculus californica M03.0425 | 2 C-9 | | | Aristida purpurea M07.0499 | 31 B-7 | Aster chilensis A96.0481 | 15 F-3 17 B-1 | Berberis aquifolium M03.0391 | 3 E-6 3 E-7 3 F-3 3 F-6 3 G-4 3 G-5 5 A-7 |
| Agave utahensis A91.0100 | 26 D-1 | Aquilegia formosa M05.0419 | 21 G-1 28 D-1 29 E-8 29 E-9 29 F-8 29 G-8 | Aristolochia californica A87.0199 | 13 A-5 13 B-5 14 D-7 | **B** | | | |
| Alnus cordata A68.9001 | 22 G-5 22 G-6 | | | Aristolochia californica A90.0269 | 27 C-9 | Baccharis pilularis 'Compacta' A96.0687 | 16 A-7 | | |
| Alnus rhombifolia A68.9002 | 18 F-5 22 A-8 | Aquilegia sp. | 23 G-1 | Aristolochia californica A90.0598 | 22 F-6 22 G-5 24 A-9 | Baccharis pilularis 'Pigeon Point' A77.0307 | 13 F-1 16 E-5 18 A-6 20 F-6 | Berberis aquifolium Unknown | 15 A-5 |
| Anemopsis californica A95.0663 | 14 B-8 14 E-9 | Arctostaphylos densiflora 'Harmony' A83.0214 | 9 B-3 | | | | | Berberis pinnata ssp. insularis A64.1132 | 10 D-8 |
| Anemopsis californica A98.0264 | 12 G-6 12 G-7 | Arctostaphylos densiflora 'Howard McMinn' M04.0136 | 17 C-3 | Artemisia californica 'Montara' A90.0823 | 14 D-8 | Baccharis pilularis 'Santa Ana' A95.0611 | 15 F-3 25 D-1 25 E-1 | Bothriochloa barbinodis A98.0035 | 23 A-6 23 D-5 |

# Legend
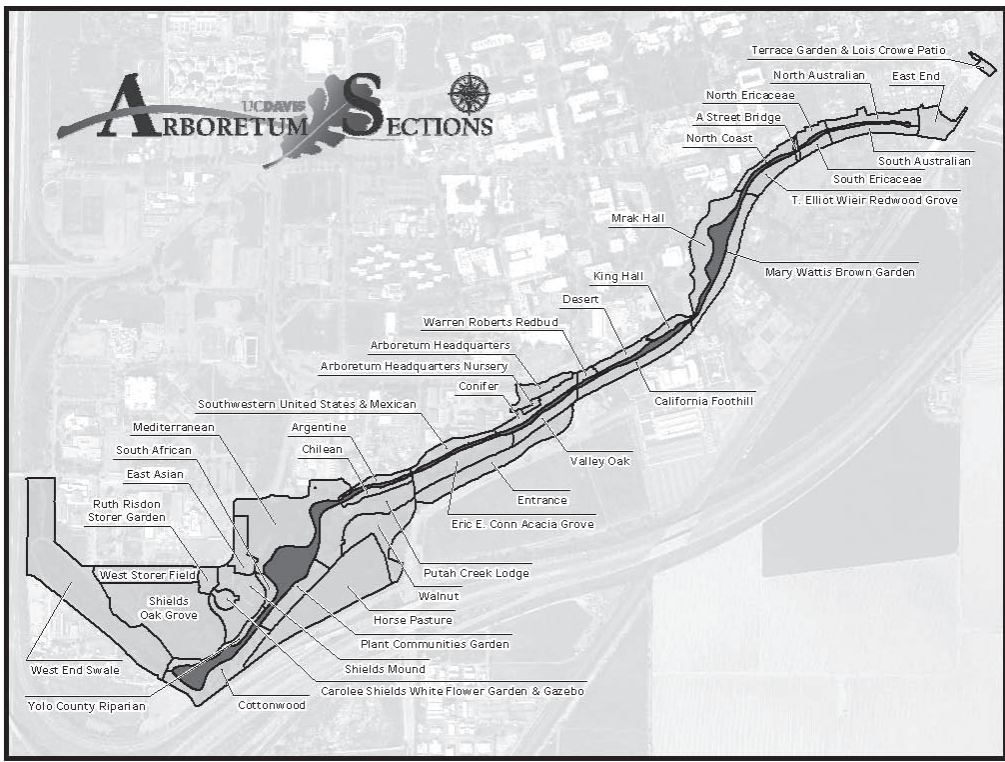
**UCDAVIS Arboretum Legend**

### Plants
- Herbaceous
- Graminoid
- Vine
- Shrub
- Tree
- Mass Plantings

### Amenities
- Bench
- Bollard
- Drinking Fountain
- Picnic Table
- Public Restroom
- Trash Can
- Fence

### Irrigation
- Sprinkler Head
- Quick Coupler Valve
- Irrigation Control Valve
- Water Main
- Hose Valve
- Backflow Preventer

### Utilities
- Drain Inlet
- Drain Outlet
- Light
- Manhole
- Utility Box
- Utility Pole

### Surfaces
- Primary Pathway
- Secondary Pathway
- Unimproved Pathway
- Soil
- Turf
- Wild Area
- Unplantable Surface
- Structures
- Waterway

### Boundaries
- Section Boundary
- Page Boundary

### Signs
- Plant Label
- Collection
- Wayfinding
- Orientation
- Interpretive
- All-Stars
- Vintage Informational
- Visitor Map
- Kiosk
- Regulatory
- Temporary
- Commemorative

# Sections

**UCDAVIS Arboretum Sections**

- Terrace Garden & Lois Crowe Patio
- North Australian
- East End
- North Ericaceae
- A Street Bridge
- North Coast
- South Australian
- South Ericaceae
- T. Elliot Wieir Redwood Grove
- Mrak Hall
- Mary Wattis Brown Garden
- King Hall
- Desert
- Warren Roberts Redbud
- Arboretum Headquarters
- Arboretum Headquarters Nursery
- Conifer
- California Foothill
- Southwestern United States & Mexican
- Mediterranean
- Argentine
- South African
- Chilean
- East Asian
- Valley Oak
- Ruth Risdon Storer Garden
- Entrance
- Eric E. Conn Acacia Grove
- West Storer Field
- Putah Creek Lodge
- Shields Oak Grove
- Walnut
- Horse Pasture
- Plant Communities Garden
- West End Swale
- Shields Mound
- Yolo County Riparian
- Cottonwood
- Carolee Shields White Flower Garden & Gazebo

## FORMAT SIZES

The map books can be printed in four different sizes, standard 8.5" x 11" and the ones listed below.

### TABLOID

Tabloid sized pages are 11" x 17".

### ARCH D

ARCH D is a 24" x 36" large format page size that requires a specialty large format printer or plotter to produce. The Arboretum Curators Office has an HP Designjet500 plotter that can produce documents of this size.

### ARCH E

ARCH E is a 36" x 48" large format page size that also requires a specialty large format printer or plotter. The plotter in the Arboretum Curators Office cannot accommodate this size.

# DATA FRAMES & LAYERS

Each data frame in a map can have one or more layers displayed within it. Each layer references a feature class that holds information about the layer and can be accessed through the layers attribute table.

## ARBORETUM SECTIONS

The Arboretum Sections is an orientation data frame that is only found on the Overview page of each map book. It is an inset map of the entire Arboretum that highlights the section of that particular map book. The only layers in this data frame are the Waterway and Sections.

### WATERWAY

The waterway consists of the old north channel of Putah Creek that lies within the Arboretum. This layers attribute table consists of the information listed below:

| Column Heading | Description (Waterway) |
|---|---|
| Object ID | The number given by ArcMap to each feature in the layer. |
| Notes | Any additional information about the waterway. |
| Mapping Date | The date that the waterway was originally mapped. |
| Mapping Team | The person who originally mapped the waterway. |
| SHAPE | What kind of shape the features are, for example point, line or polygon. |
| SHAPE.area | The total area of the waterway. |
| SHAPE.len | The length of the waterway at it's longest. |

## Sections

The Arboretum is divided up in to 36 different gardens and collections.  The section line on each corresponding map defines the extent of each garden and collection.  Within the sections attribute table you will find the information listed below:

| Column Heading | Description (Sections) |
|---:|---|
| Object ID | The number given by ArcMap to each feature in the layer. |
| Section Code | The code given to the garden or collection that the feature falls within. |
| Section Name | The name of the garden or collection that the feature falls within. |
| Survey User Name | The person who originally surveyed the location of the feature. |
| Survey Date | The date that the original survey was taken. |
| Update User Name | The person who last made updates or changes to the feature. |
| Update Date | The date that the last updates or changes were made. |
| Statues | This column indicates what stage of completion the maps of each garden or collection are in. |
| Notes | Any additional information about the waterway. |
| SHAPE | What kind of shape the features are, for example point, line or polygon. |
| SHAPE.area | The total area of the waterway. |
| SHAPE.len | The length of the waterway at it's longest. |

## Overview & Maps

### Amenity Points

The Amenity Points layer consists of any benches, fountains, tables, bollards, trash cans, etc. that are throughout the Arboretum.  Within the Amenity Points layer you will find the columns listed below:

| Column Heading | Description (Amenity Points) |
|---:|---|
| Object ID | The number given by ArcMap to each feature in the layer. |
| Feature Type | Field defining the feature, example bench or table. |
| Location | The garden/collection the feature is in. |
| Grid | The map book page and (x,y) letter-number coordinates (i.e. B5, C10) where a feature is located in the map pages in layout view, also known as the Reference Grid. |
| Latitude | The latitude (x coordinate) at which the feature can be found. |
| Longitude | The longitude (y coordinate) at which the feature can be found. |
| GPS User Name | The person who originally surveyed the location of the feature. |
| GPS Date | The date that the original survey was taken. |
| Update User Name | The person who last made updates or changes to the feature. This field needs to be manually edited each time a change is made. |

| | |
|---|---|
| Update Date | The date that the last updates or changes were made. This field needs to be manually edited each time a change is made. |
| Notes | Any additional information about the amenity point. |
| Bed Number | The bed number that the amenity is within, if applicable. |
| Shape | What kind of shape the features are, for example point, line or polygon. |

## IRRIGATION

The Irrigation layer consists of any sprinklers, quick couplers, valves, etc. that are throughout the Arboretum. The information that is in the attribute table for irrigation is the same as that found in the Amenity Points attribute table.

## UTILITIES

The Utilities layer consists of any drains, catchment basins, manholes, lights etc. that are throughout the Arboretum. The information that is in the attribute table for utilities is the same as that found in Amenity Points and Irrigation.

## SIGNS

The Signs layer consists of any interpretive sign, garden/collection name sign, etc. The information that is in the attribute table for signs is listed below.

| Column Heading | Description (Signs) |
|---|---|
| Object ID | The number given by ArcMap to each feature in the layer. |
| Primary Type | Field defining the feature, example bench or table. |
| Secondary Type | The secondary, less prominent sign found within a garden/collection. |
| Size | The size of the sign. |
| Location | The garden/collection the feature is in. |
| Grid | The map book page and (x,y) letter-number coordinates (i.e. B5, C10) where a feature is located in the map pages in layout view, also known as the Reference Grid. |
| Latitude | The latitude (x coordinate) at which the feature can be found. |
| Longitude | The longitude (y coordinate) at which the feature can be found. |
| GPS User Name | The person who originally surveyed the location of the feature. |
| GPS Date | The date that the original survey was taken. |
| Update User Name | The person who last made updates or changes to the feature. This field needs to be manually edited each time a change is made. |
| Update Date | The date that the last updates or changes were made. This field needs to be manually edited each time a change is made. |
| Notes | Any additional information about the amenity point. |
| Bed Number | The bed number that the amenity is within. |
| Shape | What kind of shape the features are, for example point, line or polygon. |

## Plant Centers

The Plant Centers layer consists of the center point of each plant found within the Arboretum. The information that is in the attribute table for plant centers is listed below. Plant Annotation

| Column Heading | Description (Plant Centers) |
|---|---|
| Object ID | The number given by ArcMap to each feature in the layer. |
| Plant Center ID | A unique number given to each plant that is different from the OBJECTID but the same as the Qualifier. |
| Plant Center Type | Forb or Herbaceous, Graminoid, shrub, Tree, or Vine. |
| Accession Number | A unique identifier given to plant material received by the Arboretum. The accession number ties a plant to its original source. |
| Qualifier | A unique number given to each plant that is different from the OBJECTID but the same as the Plant Center ID. |
| Intergeneric Hybrid | Capitalized X used to denote hybrids between different genera. |
| Genus | The genus name of the scientific name of a plant. |
| Hybrid | Indicates whether a plant is an interspecific hybrid with a lower case letter x. |
| Species | The species name of the scientific name of a plant. |
| Rank | Abbreviation for the indication of a taxonomic rank subordinate to species. Denotes as either v. (variety), ssp. (subspecies), or f. (forma). |
| Infraspecific Epithet | The infraspecific epithet of the scientific name. |
| Cultivar Name | The cultivar name of the plant. |
| Trade Name | The patent or trademark part of the scientific name. |
| Description | Special descriptions of the plant that are part of the scientific name but do not fall into any of the above categories i.e. "yellow flowered form" or "small leaved form". |
| Scientific Name | The full name of the plant. |
| Plant Size | The radius of the plant in inches. |
| Plant Size Units | The unit of measure for the radius of the plant. |
| Section Code | The code given to the garden or collection that the feature is planted in. This code corresponds to the codes given to the sections by the Arboretum's plant records database, BG-Base. |
| Section Name | The name of the garden or collection that the feature is planted in. |
| Collection Name | The name of the collection that the feature is planted in. |
| Planting Bed Number | The planting bed number that the feature fall within. |
| Reference Grid Name | The (x,y) letter-number coordinates (i.e. B5, C10) where a feature is located in the map pages in layout view, also known as the Reference Grid. |
| Latitude | The latitude (x coordinate) at which the feature can be found. |

| | |
|---:|:---|
| Longitude | The longitude (y coordinate) at which the feature can be found. |
| GPS User Name | The person who originally surveyed the location of the feature. |
| GPS Date | The date that the original survey was taken. |
| Update User Name | The person who last made updates or changes to the feature. This field needs to be manually edited each time a change is made. |
| Update Date | The date that the last updates or changes were made. This field needs to be manually edited each time a change is made. |
| Update User Name | Any additional information about the amenity point. |
| Status | The bed number that the amenity is within. |
| Mass Planting ID | What kind of shape the features are, for example point, line or polygon. |
| Planting Bed ID | The Planting Bed ID of the planting bed the plant is in. |
| Planting Hardscape ID | The Planted Hardscape ID of the container or other planted hardscape the plant is in. |
| Planting Area ID | The Planting Area ID of the planting area the plant is in. |
| Collection ID | The Collection ID of the collection the plant is part of. |
| Comments | Comments about the feature. |
| Shape | What kind of shape the features are, for example point, line or polygon. |

## PLANT ANNOTATION

The Plant Annotation layer consists of the labels given to each plant that you see on the maps. The information that is in the attribute table for plant annotation is listed below.

| Column Heading | Description (Plant Annotation) |
|---:|:---|
| Object ID | The number given by ArcMap to each feature in the layer. |
| Feature ID | A unique number assigned to the feature. This number corresponds to the Object ID of the Plant Center the label is related to. |
| Section Name | The name of the garden or collection that the feature is planted in. |
| Planting Bed Number | The planting bed number that the feature fall within. |
| Z Order | The order which labels are drawn in the event that they overlap. |
| Annotation Class ID | Whether the annotation corresponds to a plant center or a mass planting. |
| Element | |
| Symbol ID | The ID of the symbol used to draw the label. |
| Status | Whether the annotation for the plant has been placed are not |
| Text String | The text that makes up the label for each plant. |
| Font Name | The type of font used |

| | |
|---:|:---|
| Font Size | The size of font used |
| Bold | Whether bold was used in the annotation or not, options are Null, yes or no. |
| Italic | Whether italic was used in the annotation or not, options are Null, yes or no. |
| Underline | Whether underline was used in the annotation or not, options are Null, yes or no. |
| Vertical Alignment | The vertical position of the text, options are: Null, Top, Center, Baseline, and Bottom |
| Horizontal Alignment | The horizontal position of the text, options are: Null, Left, Center, Right, and Full. |
| X Offset | |
| Y Offset | |
| Angle | |
| Font Leading | The planting bed number that the feature fall within. |
| Word Spacing | The amount of space between each word in the annotation. |
| Character Width | The width of each character within the annotation. |
| Character Spacing | The amount of space between each character in the annotation. |
| Flip Angle | |
| Override | |
| Horizontal | |
| Vertical | |
| Shape | What kind of shape the features are, for example point, line or polygon. |
| SHAPE.area | The total area of the section. |
| SHAPE.len | The length of the section at it's longest. |

## Plant Symbols

The plant symbols layer consists of all the symbols that denote a plant within the maps. To see a list of all the plant symbols and what they mean refer to Legend in Chapter 2's Layouts section under Map Book. The information that is in the attribute table for plant symbols is the same as that found in Plant Centers.

## Amenity Lines

The Amenity Lines layer consists of any fences, walls, gates, etc. that can be found within the Arboretum. The information that is in the attribute table for amenity lines is listed below.

| Column Heading | Description (Amenity Lines) |
|---:|:---|
| OBJECTICID | The number automatically given by ArcMap to each feature in the layer. |
| Feature Type | What the amenity line is, options are: Unknown, Fence, Other, Retaining Wall, Seat Wall, and Pathway Edge. |
| Location | The garden/collection the feature is in. |

| | |
|---|---|
| Grid | The (x,y) letter-number coordinates (i.e. B5, C10) where a feature is located in the map pages in layout view, also known as the Reference Grid. |
| Latitude | The latitude (x coordinate) at which the feature can be found. |
| Longitude | The longitude (y coordinate) at which the feature can be found. |
| GPS User Name | The person who originally surveyed the location of the feature. |
| GPS Date | The date that the original survey was taken. |
| Update User Name | The person who last made updates or changes to the feature. This field needs to be manually edited each time a change is made. |
| Update Date | The date that the last updates or changes were made. This field needs to be manually edited each time a change is made. |
| Notes | Any additional information about the amenity point. |
| Bed Number | The bed number that the amenity is within. |
| SHAPE | What kind of shape the features are, for example point, line or polygon. |
| Shape.len | The length of the section at it's longest. |

## LAYOUT GRID

The Layout Grid layer consists of the outline of each page within the map book. The information that is in the attribute table for the layout grid is listed below.

| Column Heading | Description (Layout Grid) |
|---|---|
| OBJECTID | The number automatically given by ArcMap to each feature in the layer. |
| Page Name | The name given to the page , if applicable. |
| Page Number | The number of the page within the map book |
| Page Scale | The scale of the page. |
| Bed Number | The bed number that the amenity is within. |
| SHAPE | What kind of shape the features are, for example point, line or polygon. |
| Shape.area | The total area of the section. |
| Shape.len | The length of the section at it's longest. |

## STRUCTURES

The Structures layer consists of any buildings that can be found throughout the Arboretum. The information that is in the attribute table for structures is listed below.

| Column Heading | Description (Structures) |
|---|---|
| OBJECTID | The number automatically given by ArcMap to each feature in the layer. |
| Primary Name | The name of the building/structure. |
| Secondary Name | The full name of the build/structure, no abbreviations. |
| Street Number | The street number of the structure, if applicable. |

| | |
|---|---|
| Street Name | The name of the street that the structure is on if it is on a street. |
| Street Type | Whether the street is a road, avenue, way, etc. |
| Address | The full address of the structure, if applicable. |
| Number of Levels | The number of stories that the building/structure has. |
| Outside Area (Square Feet) | The square footage of the building measured from its outside walls. |
| Construction Year | The year in which the building/structure was built. |
| Construction Material | The predominant material used to construct the building/structure. |
| Steam | Whether the structure has piped steam or not. |
| Gas | Whether the structure has piped steam or not. |
| Chilled Water | Whether the structure has piped water or not. |
| Boiler | Whether the structure has a boiler or not. |
| Jurisdiction | The name of the city, campus, county or other legal jurisdiction the structure is in. |
| Notes | Any additional information about the structure. |
| Mapping Date | The date that the structure was mapped. |
| Mapping Team | The person/people who mapped the structure. |
| SHAPE | What kind of shape the features are, for example point, line or polygon. |
| Shape.area | The total area of the section. |
| Shape.len | The length of the section at it's longest. |

## Sections

The Sections layer within the Maps data frame is the same as the layer in the Arboretum Sections data frame. The information in the attributes table is the same as well.

## Mass Plantings

The Mass Plantings layer consists of all polygon features of the mass plantings in the Arboretum which are denoted by any gray areas with a white plant center on the maps. The information that is in the attribute table for mass plantings is listed below.

| Column Heading | Description (Mass Plantings) |
|---|---|
| OBJECTID | The number automatically given by ArcMap to each feature in the layer. |
| Mass Planting ID | A unique number assigned to each mass planting. |
| Mass Planting Type | Describes whether the mass planting is made up of one kind of plant or more than one kind of plant. Options available are: Unknown, Homogeneous, Mixed (2 species), Mixed (3 species), Mixed (4 species), Mixed (5 species), or Mixed (5+ species). |
| Planting Size | The size of the mass planting. Options available are: Unknown, Small (6-20), Medium (21-50), Large (51-100), or Extra Large (500+). |
| Section Name | The name of the section that the mass plantings are within. |

| | |
|---|---|
| Collection Name | The name of the collection that the feature falls within. |
| Survey Date | The date that the original survey was taken. |
| Survey User Name | The person who originally surveyed the location of the feature. |
| Update Date | The date that the last updates or changes were made. This field needs to be manually edited each time a change is made. |
| Update User Name | The person who last made updates or changes to the feature. This field needs to be manually edited each time a change is made. |
| Comments | Any relevant comments about the mass plantings. |
| Shape | What kind of shape the features are, for example point, line or polygon. |
| Planting Bed Number | The bed number that the feature fall within. |
| SHAPE.area | The total area of the section. |
| SHAPE.len | The length of the section at it's longest. |

## Planting Area Annotation

The Planting Area Annotation consists of the labels given to the sections layer features. The information that is in the attribute table for plant planting area annotation is the same as that found in Plant Annotation.

## Planting Areas

The Planting Areas layer consists of any planting areas throughout the Arboretum. The information that is in the attribute table for planting areas is listed below.

| Column Heading | Description (Planting Areas) |
|---|---|
| OBJECTID | The number automatically given by ArcMap to each feature in the layer. |
| Code | The type of planting area. Options available are: Unknown, Soil, Turf, Not Plantable, Wild, or Other. |
| Name | The name of the planting area. |
| Notes | Any additional information about the planting area. |
| Mapping Date | The date that the planting area was mapped. |
| Mapping Team | The person/people who mapped the planting area. |
| Shape | What kind of shape the features are, for example point, line or polygon. |
| Shape.area | The total area of the section. |
| Shape.len | The length of the section at it's longest. |

## Pathways

The Pathways layer consists of any pathways throughout the Arboretum. The information that is in the attribute table for pathways is the same as the attributes for planting areas.

## Waterways

The Waterways layer is the same layer that is in the Arboretum Sections Data Frame.

## Aerial Photography

The Aerial Photography layer consists of an aerial photograph of the Arboretum. It does not have an attribute table. Although the Arboretum has aerial photography for multiple years the maps are based on the photo from 2004.

# CHAPTER 4
## CREATING MAP DOCUMENTS

Before beginning a map book it must be setup, formatted and saved using the same conventions of the other existing map books. In this chapter you will learn where to save your map documents, as well as the PDF version of the map books.

While saving a map document is relatively easy, setting up the formatting of a new map document is a bit involved. You will learn the steps needed to create a new map document from an existing template in the Document Templates section. Once you have created a map document from a template you will then learn how to change its title in the Document Properties Section and how to copy all the needed layer from an existing map document. Copying layers may cause them to break their link to their source. How to remedy this is shown in the Data Sources section.

After the document has been set up it is time to start mapping, however, before this can be done the symbology that is used needs to be imported and defined. At this time you will begin to use definition queries, which you will learn about in the Definition Queries section. This section will also give examples of definition queries for each layer and how to use definition queries when working in multi-bed sections.

After the basic map document is set up it is time to decide how your map will be scaled so that the layout grids that make up the map pages can be created, you will learn how to do all of this in the Map Scale & Layout Grids section. This process will include the planning, creating, attributes and annotation of layout grids. Lastly this chapter will cover the all import reconnection of the map series process that needs to be done to put the map pages back in order after you have been editing.

# Table of Contents
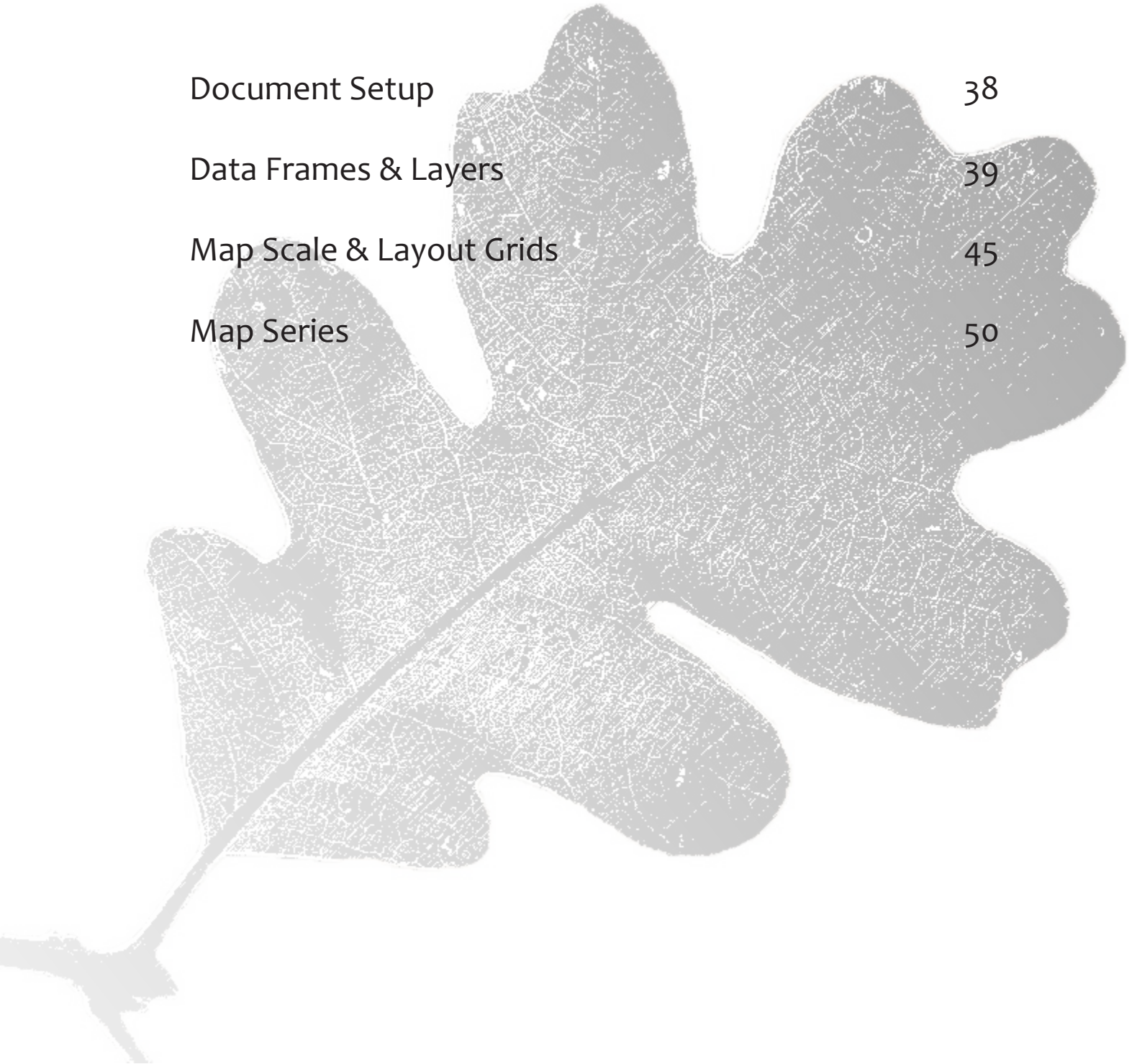
# Document Setup

Before beginning a map book it must be setup, formatted and saved using the same conventions of the other existing map books.

## File Name & Location

Each section of the Arboretum is represented with an individual map document. For example the Boathouse Garden live ArcMap document is called Boathouse Garden.mxd. All live map book files are saved in the maps folder on the Arboretum GIS server. To navigate to the maps folder follow this path:

Local Disk C:>GIS>Arboretum>Maps.

In addition to the live map documents a pdf version of all the map books is also made. All PDF map books are saved in the Map Books folder on the Arboretum GIS server. These file names mirror those of the .mxd files. To navigate to the Map Books folder follow this path:

Local Disk C:>GIS>Arboretum>Maps>Map Books

## Document Templates

There is a document template available in the Maps folder to make the document setup process easier. To navigate to the template follow the path below:

Local Disk C:>GIS>Arboretum>Maps>UC Davis Arboretum Collection Section Maps TEMPLATE

Once you have opened the template file you can save it again with the new name, to do this follow the steps below:

Step 1 – On the menu bar click "File" then "Save As"
Step 2 – A window will open, make sure that Maps is displayed in the "Save In" box
Step 3 - In the "File Name" box type in the new maps name then click save.

The new map document has been created from the template.

## Document Properties

Step 1 – Select Layout view.
Step 2 – Select the Layouts tab at the bottom of the Table of Contents and make the Overview page active by right clicking it and selecting "Activate"
Step 3 – Double click the section name text box in the lower right hand corner of the map page.
Step 4 – In the text box type the section name of the map you are working on, be sure to type it in all caps.
Step 5 – Click the Display tab at the bottom of the Table of Contents.
Step 6 – Double click the "Section Overview" data frame and rename it to reflect the section name you enter on the map page.
Step 7 – Select the Layout tab once again and repeat steps 1-6 for the Maps and Index pages.

**Figure 4.1**
Section Name text box on a map page.
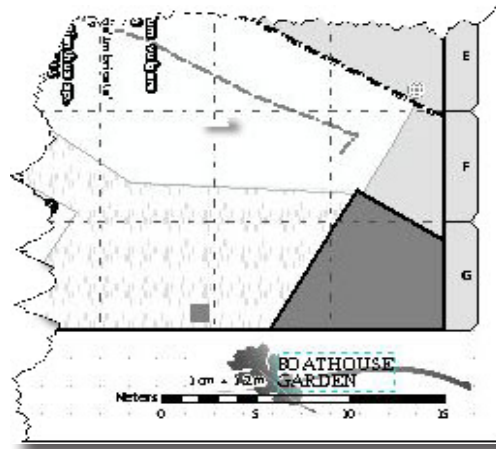
# DATA FRAMES & LAYERS
## COPYING LAYERS

Once you have created a new map document saved from the template document you will need to bring in all the layers that are used in the map documents. To do this, follow the steps below:

Step 1 – Open the new map document you wish to add layers to, then open another window of ArcMap and open an existing map document.

Step 2 – In the existing map document that you opened, click on the first line or data frame Each section of the Arboretum is represented with an individual map document. For example the Boathouse Garden live ArcMap document is called Boathouse Garden.mxd. in the Table of Contents then press shift and click on the last layer in the Table of Contents.

Step 3 – All the layers in the Table of Contents should now be selected. Right click on the selected layers and click "Copy".

Step 4 – Go to the new map document and click on the "Paste" button on the menu bar.

Step 5 – You should now see all the layers in the Table of Contents of the new map document.

Step 6 – Repeat steps 1-5 for the Overview and Maps Book Layouts.

Step 7 – Close the existing map document.

## DATA SOURCES

Each layer in a map references data that can be viewed in the layer's attribute table. When a map document is opened ArcMap searches for the location of each layers data. If the data has been moved, renamed, deleted or is generally inaccessible, ArcMap will not be able to find the layers data source and so that layer will not be drawn in the map. You will know if this has happened by the red exclamation point that appears to the right of the layer name in the Table of Contents. All broken data sources must be repaired for the Layout Grid layer in order to set up a new map document. To repair the data source of a layer follow the steps below:

Step 1 – Right click on the layer name that displays a red exclamation point next it.

Step 2 – In the list that displays click "Data" then "Repair Data Source"

Step 3 – In the dialog box that appears navigate to the layer.

   Step 3A - You may need to click the Connect to Folder button in order to estab-

lish connections to the folder containing the data. If you do this the Connect to folder dialog box will appear navigate to the workspace location you wish to connect to and then click "OK". The Data Source dialog box will automatically navigate to the folder you chose in the Connect to Folder dialog box. You can then continue navigating till you find the layer you wish to repair. Once you have done this click "Add".

**Figure 4.2**
Data Source
dialog box.
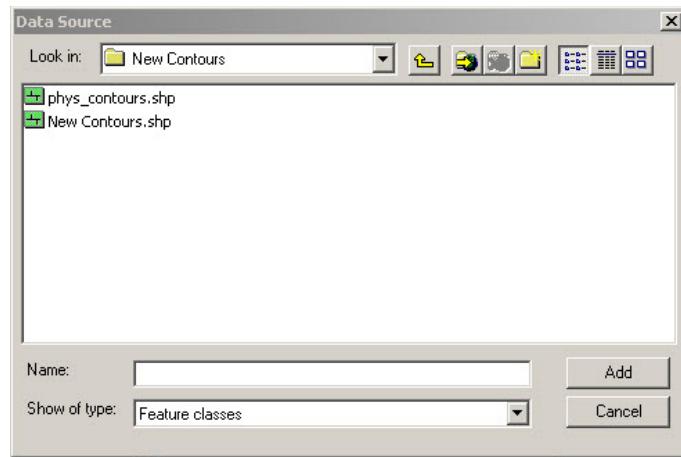


**Figure 4.3**
Connect to
Folder dialog
box.
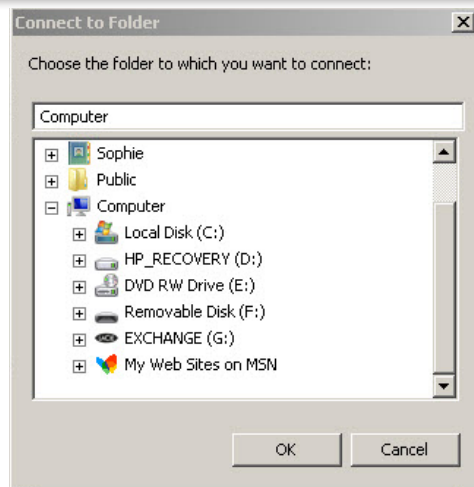


Step 4 – If you located the correct location of the data the red exclamation point will disappear and the layer will be drawn in the map.

# Symbology

When a new plant is added to a section, unless it is a mass planting, it will require a plant symbol. There are 5 different plant symbols used for the different types of plants found within the Arboretum, these are Forb or Herbaceous, Graminoid, Shrub, Tree, and Vine.

## Importing

On occasion when adding new plant symbols it will be necessary to import the plant symbols from their source file into ArcMap. To do this follow the steps below:

Step 1 – Right click the Plant Symbols layer and select Layer Properties.
Step 2 – In the Layer Properties window select the Symbology tab.
Step 3 – Double click the first plant symbol in the list that you see.
Step 4 – The Symbol Selector window opens, select "More Symbols".
Step 5 – In the list that appears select "Add"

**Figure 4.4**
Symbology Layer
Properties
dialog box.
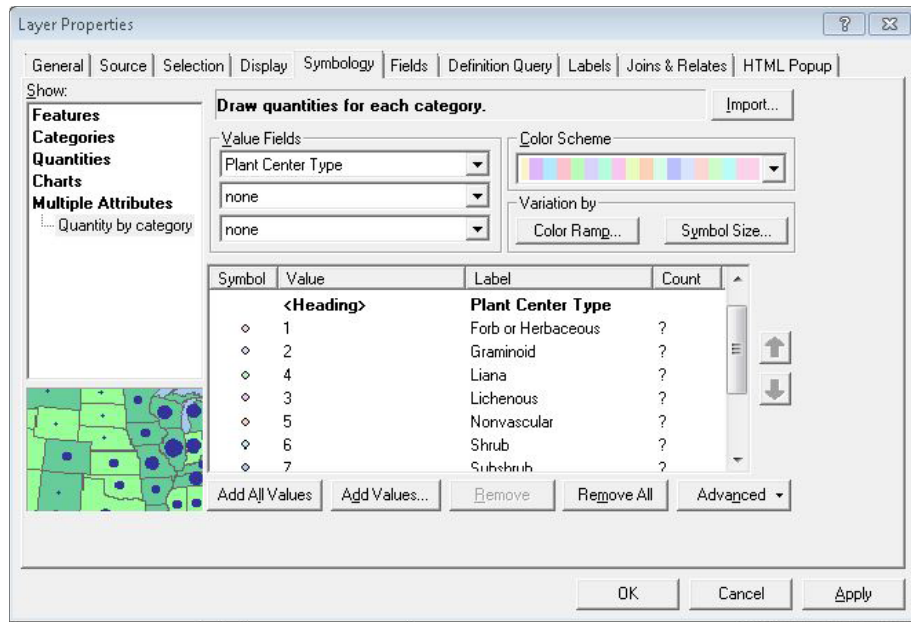
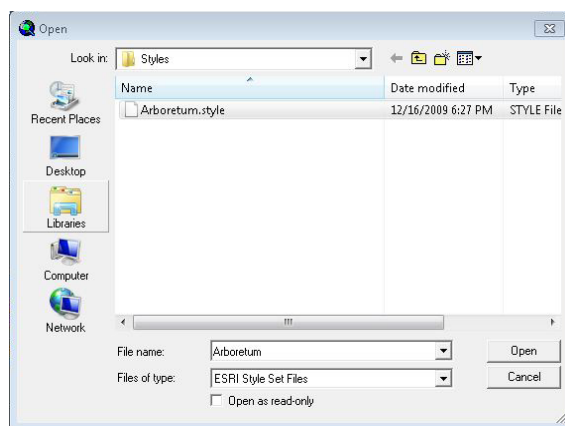

**Figure 4.5**
Symbology
Selector
dialog box.
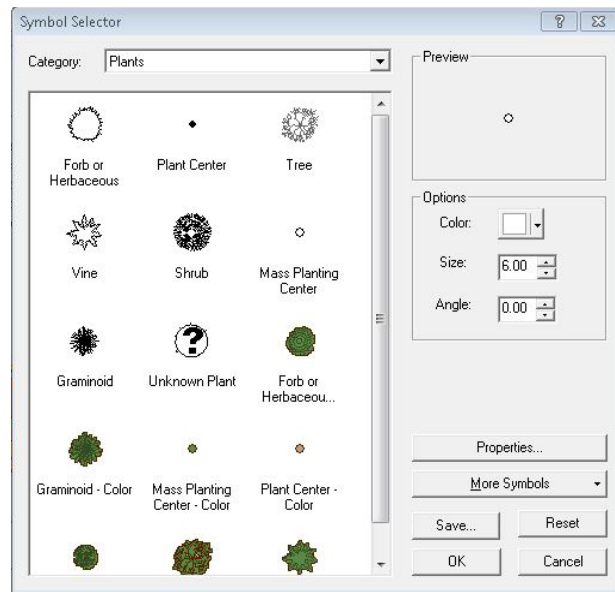


Step 6 – In the window that opens navigate to:

C://GIS/ARBORETUM/Resources/Styles/Arboretum.style

and click "Open"

**Figure 4.6**
Open file
dialog box.

Step 7 – Back in the Symbol Selector window In the drop down list next to Category you should see listed all the symbols that are used in the Arboretum maps, scroll down and select "Plants".

## Defining

When a new map document is created it is necessary to define the symbology for plant centers and symbols. To do this follow the steps below:

### Plant Centers

Step 1 – Double click or right click the plant centers layer, then select Layer Properties in the drop down list.

Step 2 – Select the Symbology tab.

Step 3 – In the list under Show select Quantities – Graduated Colors
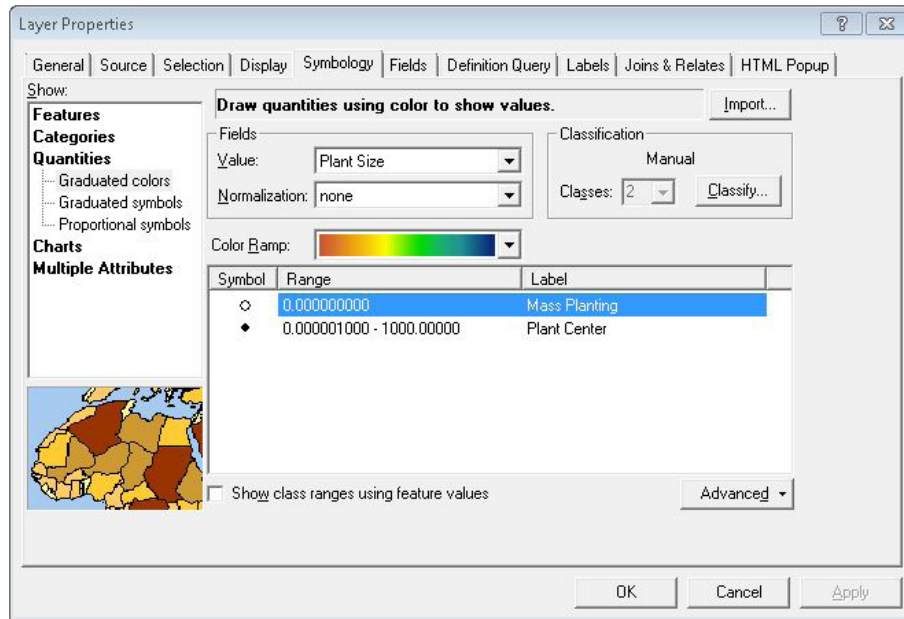
**Figure 4.6** Symbology tab of the Layer Properties dialog box.



Step 4 – In the first drop down box under Value select "Plant Size"

Step 5 – In the section labeled Classification you should see the word Manual, if not select the button "Classify…" and in the drop down list next to Method select "Manual" then click OK.
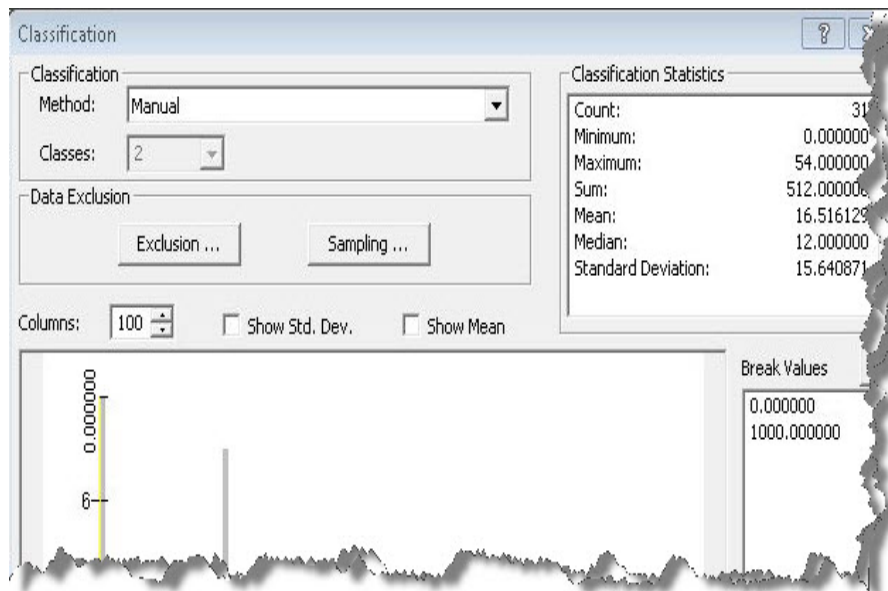
**Figure 4.7** Classification dialog box.



Step 6 – Back in Layer Properties enter 2 In the Classification box next to classes.

Step 7 – In the Range column change the first range to 0.000-0 and the second range 0.000-1000.

Step 8 – Follow step 1-7 of Importing to import the plant symbols.

Step 9 – From the selection of plant symbols that appear select the  white Mass Planting Center to represent mass plantings.

Step 10 – Repeat steps 8-12 for the second plant symbol in the layer properties list only this time use the black plant centers to represent single plant centers.

PLANT SYMBOLS

Step 1 - Double click or right click the plant symbols layer, then select Layer Properties in the drop down list.

Step 2 – Select the Symbology tab.

Step 3 – In the list under Show select Multiple Attributes – Quantity by Category.

**Figure 4.8** Symbology tab of the Layer Properties dialog box.
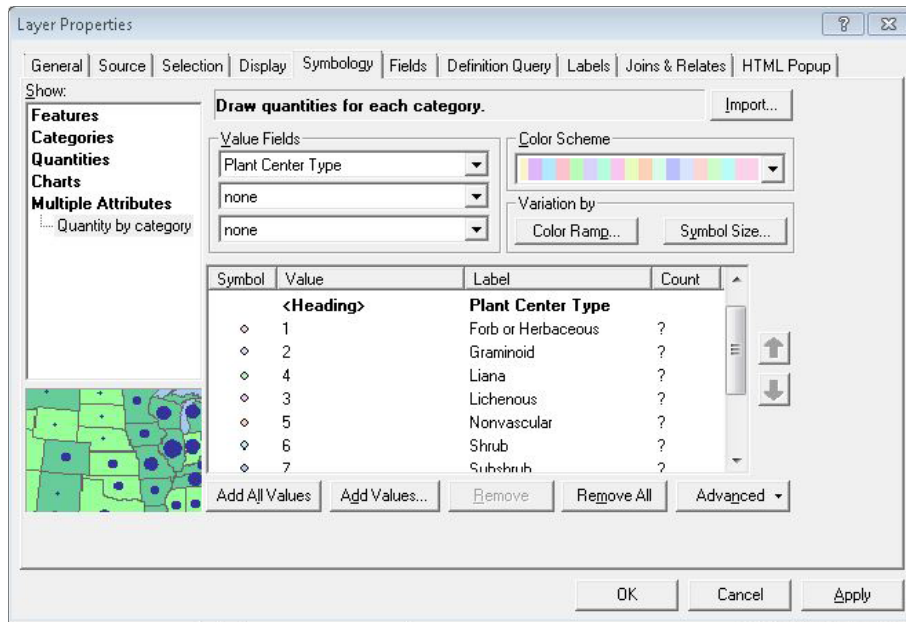


Step 4 – In the first drop down box under value field select "Plant Center Type" then click "Add All Values" at the bottom of the window.

Step 5 – From the list under the Label column delete Liana, Lichen, Nonvascular, and Subshrub.

Step 6 – Click on the "Symbol Size" button on the right.

Step 7 – In the drop down list next to value select Plant size

**Figure 4.9** Symbol Size dialog box.
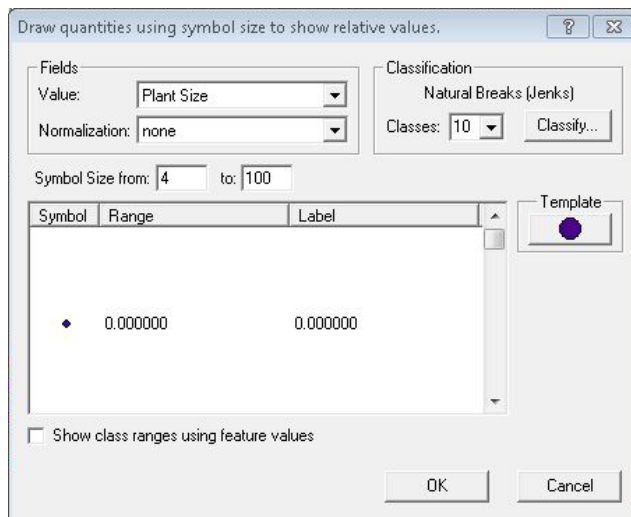
Step 8 – In the boxes next to "Symbol Size From" enter 4 to 100
Step 9 – In the section labeled Classification enter 32 in the box next to classes
Step 10 – Select the "Classify" button, in the window that opens select "Natural Breaks (Jenks)" from the drop down list next to "Method".
Step 11 – Click OK in all three open windows.

## Definition Queries

Definition Queries allow you to display a subset of features within a layer. The mapped collection information is located in one complete database. Definition queries are used to only display features that are alive and located in a given section. The data is narrowed down with the use of SQL, Structured Query Language. SQL expressions use Boolean operators to create a logical expression. The definition query must be re-created in every layer that currently has a definition query in the new map document in order to reflect the new location information. To create a definition query follow the steps below: Why a new map document

Step 1 – Right click the layer in the Table of Contents you wish to apply a definition query to, then click "Properties".
Step 2 – Go to the Definition Query tab.



**Figure 4.10**
Query Builder dialog box.
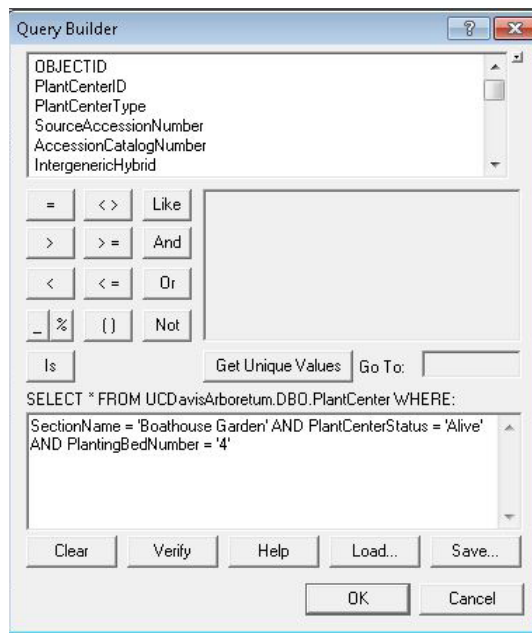
Step 3 – Enter your definition query in the text field or click on "Query Builder".
Step 3A - Query Builder helps you build a SQL definition query so you can filter your data however you want to.

You can find more information on how to build SQL expressions at the website listed below:

http://webhelp.esri.com/arcgisdesktop/9.2/index.cfm?TopicName=About_building_an_SQL_expression

EXAMPLES FOR EACH LAYER

| Layer | Possible Definition Query |
|---|---|
| Amenity Points | Location='A Street Bridge' |
| Irrigation | Location = 'A Street Bridge' |
| Utilities | Location = 'A Street Bridge' |
| Signs | Location = 'A Street Bridge' |
| Plant Centers | SectionName = 'A Street Bridge' AND PlantCenterStatus = 'Alive' |
| Plant Annotation | Location = 'A Street Bridge' OR Location IS NULL |
| Plant Symbols | 'A Street Bridge' AND PlantCenterStatus = 'Alive' |
| Amenity Lines | Location = 'A Street Bridge' |
| Layout Grid | Location = 'A Street Bridge' |
| Structures | No Definition Query Applied |
| Sections | No Definition Query Applied |
| Mass Plantings | SectionName = 'A Street Bridge' |
| Planting Areas Annotation | No Definition Query Applied |
| Pathways | No Definition Query Applied |
| Waterway | No Definition Query Applied |
| Aerial Photography | No Definition Query Applied |

## MULTI-BED SECTIONS EXCEPTION

The Boathouse Garden, Ruth Risdon Storer Garden, Carolee Shields White Flower Garden & Gazebo and the Arboretum Terrace Garden & Lois Crowe Patio all have a high density of planting. This high density requires that some sections overlap, causing multi-bed sections. The definition query must specify the bed number as well as section name or you will have a congestion of plant centers, symbols and annotation.

Example: SectionName = 'Boathouse Garden' AND PlantCenterStatus = 'Alive' AND PlantingBedNumber = '4'

When it is time to publish a map book, this query will need to be changed before printing or exporting each map page of the map book, with the exception of the overview map, to reflect the bed number for that page. So if Page 5 displays Bed 3, the definition query needs to be set to show only features in Bed 3.

# MAP SCALE & LAYOUT GRIDS

The scale of each map is determined by the density of the plantings. Less dense gardens such as the Entrance section will have a larger scale because the plantings are spaced out. Gardens that are densely planted like the Boathouse Garden have a smaller scale. Most gardens are either in 1:2400 scale or 1:1200 scale and all layouts must be in multiples of 120 or 10 feet.

The Layout Grid is used to create the page outlines for the map books. The page edge will be represented by a dotted line and any symbology or annotation that falls out-

side the layout grid boxes will be cut off and not appear on the page when the map is printed.

## PLANNING

When creating layout grids it is important to consider plant density and optimal orientation in order to effectively place page locations.  Depending on the direction of a given section, it may be better to represent the information in portrait or landscape orientation.  It is also important to place the grid in such a way that there is enough room around each plant center to place its annotation.

## CREATING

Once all GPS points (Amenities to Mass Plantings) have been mapped you are ready to set the map scale and create a layout grid.  In order to create a layout grid follow the steps below.

Step 1 – Make sure ArcMap is closed.
Step 2 – From the start menu select ArcCatalog.
Step 3 – Using the navigation pane on the left, locate: Database Connections\UCDavisArboretum-Edit.sde\UCDavisArboretum.DBO.LayoutGrids.
Step 4 – Right click on an existing grid and select copy.
Step 5 – Right click and select paste.
Step 6 – Rename the copied layout grid to reflect the section name you are creating.
Step 7 – Close ArcCatalog and open the ArcMap document you originally created.
Step 8 – Begin in layout view with the Overview page active.  To activate the Overview page follow Steps 1A below:
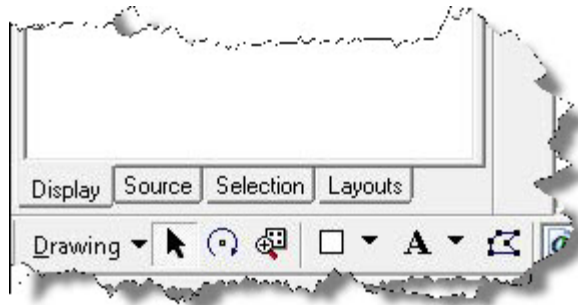 Step 1A –  Click on the Layouts tab at the bottom of the table of contents.
 Step 1B –  In the table of contents listed under Letter (8.5"x11") – Grayscale locate Overview.
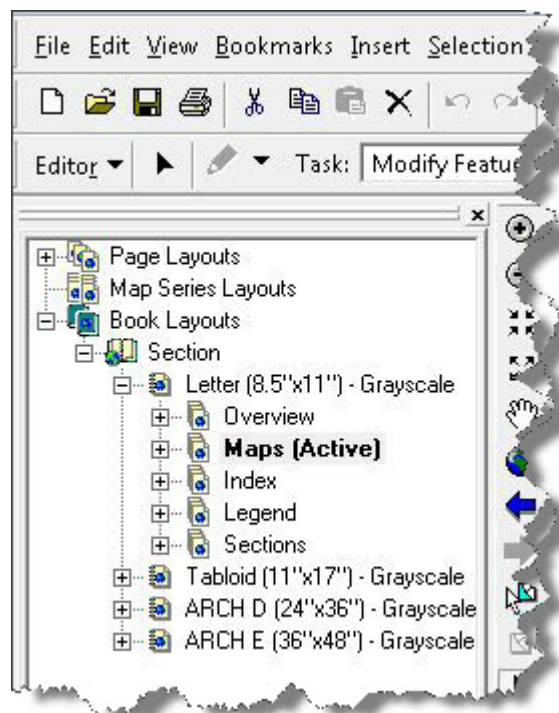


Step 1C – Expand the Overview section and double click the page listed as "1".
The overview page should now appear in the layout view window.

Step 9 – Select the scale you want to use for the overview map 1:1200, 1:2400, or a multiple of 1200 and center the map page over the area you are interested in.

Step 10 – Click the display tab and right click the layer group called "Section Name Section Overview" then select activate.

Step 11 – Click on the selection tab at the bottom of the table of contents and make "Layout Grid" the only selectable layer.



Step 12 – Switch to data view. Click on the Display tab at the bottom of the table of contents and make sure that the "Layout Grid" layer is on.

Step 13 – Start editing (Editor toolbar>Start Editing>OK)

Step 14 – In the task drop down list select "Create New Feature". In the target drop down list select "Layout Grid".

Step 15 – It is important to assess three different criteria before creating a layout grid:
1) Determine the orientation of the garden or section you are creating the grid for.
2) Assess the location and densities of plant centers.
3) Consider the future placement of the annotation.

Step 16 – Depending on your assessment use the following scale and length.

1:120 map pages: The sides of each layout grid will be 70 and 100
1:240 map pages: The sides of each layout grid will be 140 and 200

Denser gardens will use 1:120 for the scale within the map pages. All other maps will be in the 1:240 scale.

Step 17 – Using the pencil tool left click to draw the first point, then right click away from the point and in the list that appears click "Direction/Length". Direction
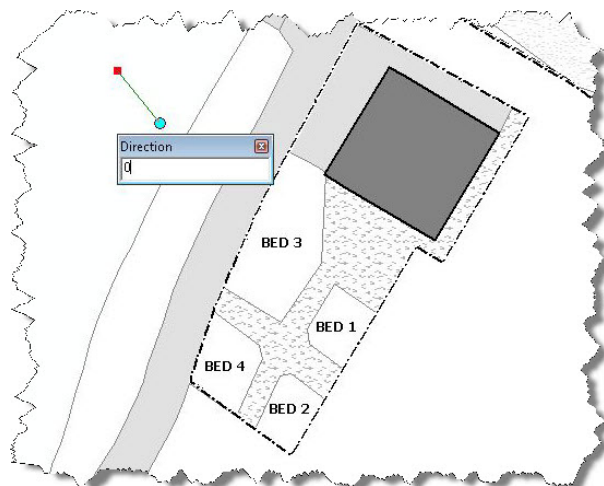


allows you to make a perfectly straight line segment in any of the following

directions: 0, 90, 180, 270, or 360. In length type either 70, 100, 140, 200 depending on your map scale and which side you are currently drawing

Step 18 – Right click again and click "Length". In this window you will type in the length of the line segment based on your
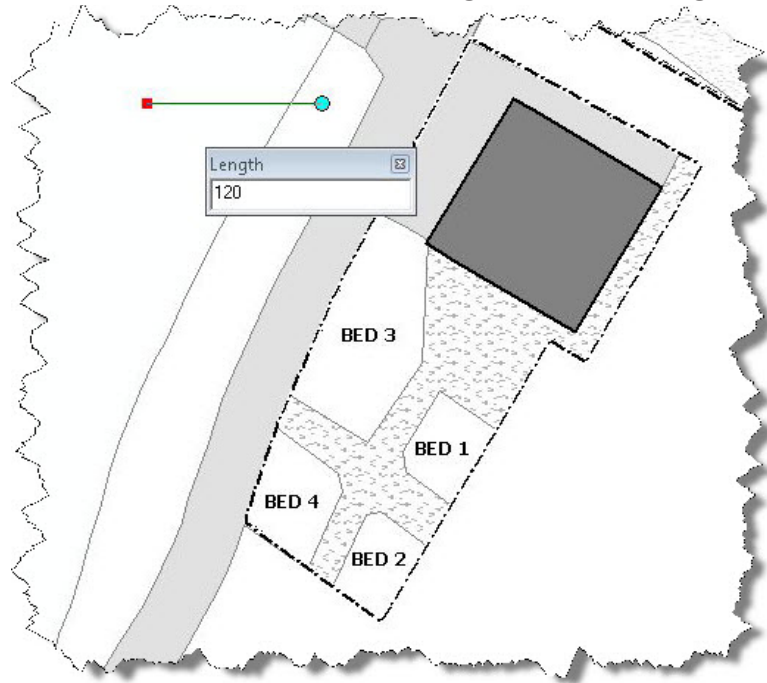


previous assessment of the area you are creating the grid for.

Step 19 – Repeat steps 8 for all four sides of the box you create. Complete your box by double clicking on the last point.
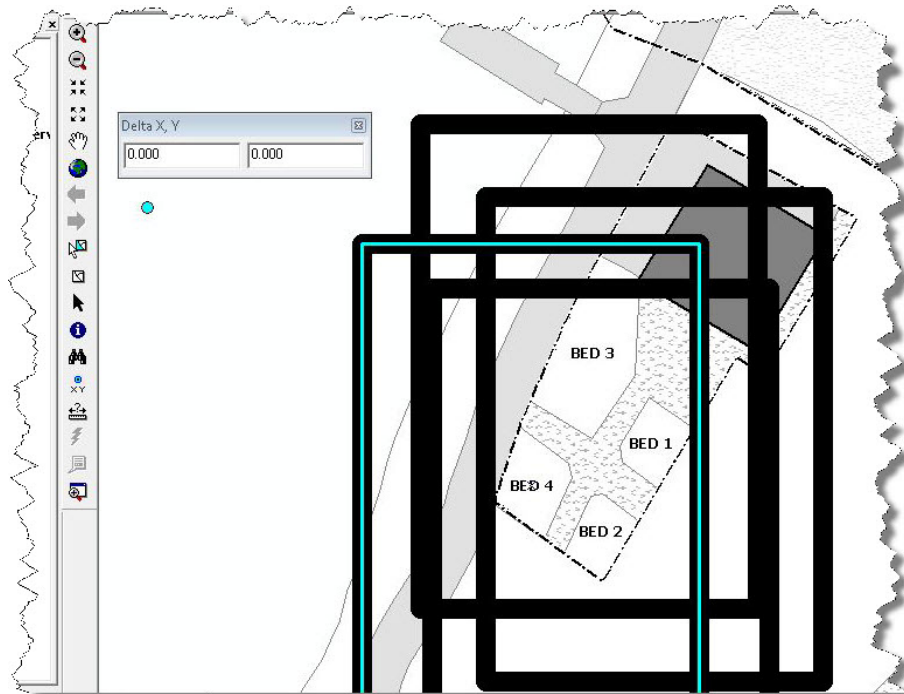


Step 20 – Make sure to correctly place the first box exactly where you want it so that the garden or section falls within it.

Step 12 – Once you have completed the first box, copy and paste

it to create any additional pages for the map book.  These pages have to be perfectly aligned for the layout to function properly.

Step 13 – In order to accomplish the perfect overlay select the Editor drop down menu click "Move". Use the appropriate lengths (x,y) to align the grids so that they share one side or more perfectly.

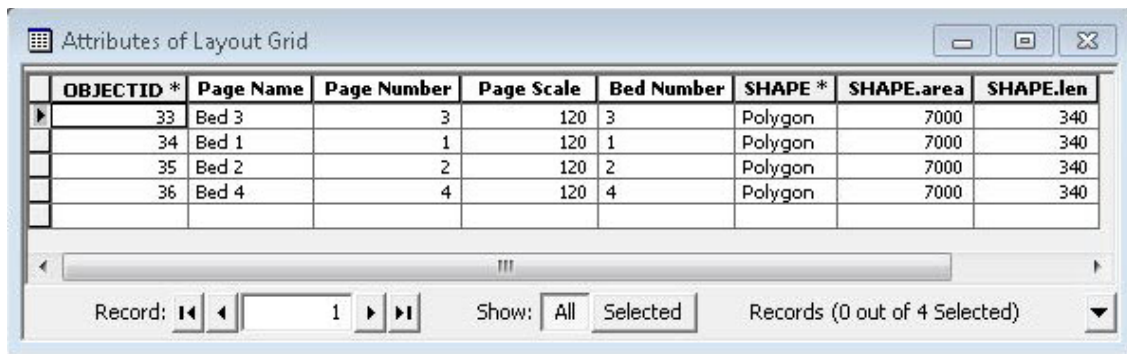Step 14 – Click Editor and Save your edits.

Step 15 – Switch back to layout view.

Step 16 – Save the map document

## ATTRIBUTES

Once all layout grids have been created, the Layout Grid attribute table will need to be updated.

Step 1 – Right click the Layout Grid layer and select "Open Attribute Table"



Step 2 – Select and delete the record(s) that do not correspond to the current sections.
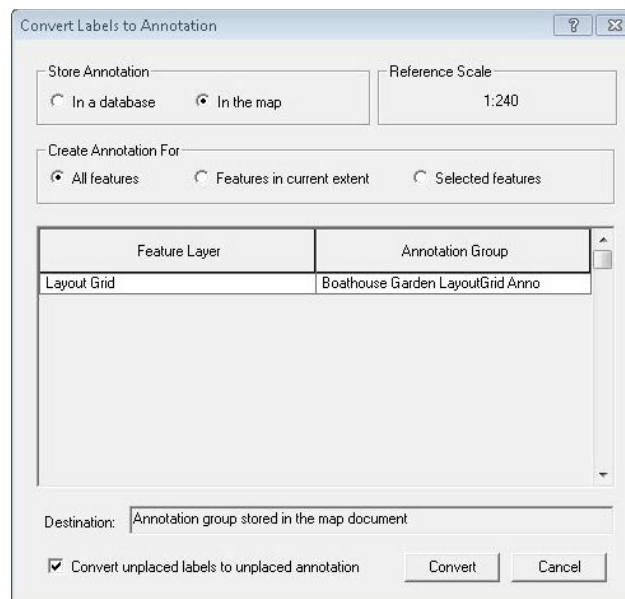
Step 3 – Appropriately fill in all fields for Page Name, Bed Number (if applicable) and Page Scale.

Step 4 – When done save your edits.

## ANNOTATION

Each grid needs to be labeled, to do this follow the steps below:

Step 1 – In the Display tab turn off all layers except for the Layout Grid.

Step 2 – Right click Layout Grid and click "Label Features".

Step 3 – Right click Layout Grid again and click "Convert Labels to Annotation".

Step 4 –In the window that opens under "Store Annotation" click the radio button next to "In the map".

Step 5 –Below that in the section labeled "Annotation Group" add the name of the garden or section before "LayoutGridAnno".

Step 6 – Click Convert.

Step 7 – Save your edits, stop editing and save the map document

# MAP SERIES

The map series is the collection of pages created by the layout grid that are based on the same layout i.e. Arboretum logo, scale, and title, that make the map book. Each time you alter the scale or pan in either data view or layout view the settings for the map series are disconnected. The map series needs to be reconnected in order to (1) Navigate to individual pages using the Layouts tab and (2) Export and print the map book.

To reconnect the map series follow the steps below:

Step 1 – Make sure you are in Layout View.

Step 2 – Stop editing if you are in an edit session.

Step 3 – Right click on the data frame and select Properties.
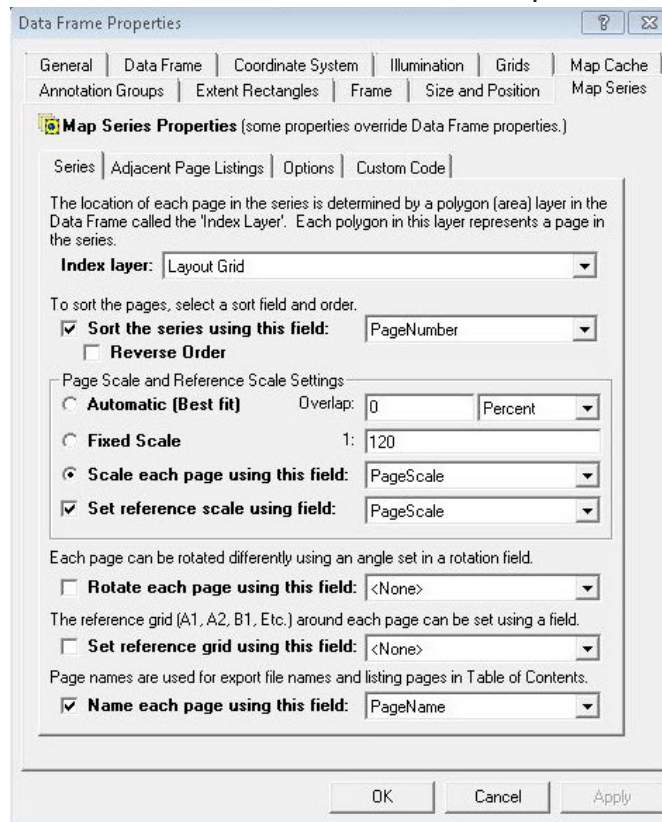


Step 4 – In the Properties window click the Map Series Tab.

Step 5 – Reselect "Layout Grid" in the drop down list next to "Index Layer".

Step 6 – In the "Sort the series using this field" drop down list select "Page Number".

Step 7 – In the "Scale each page using this field" drop down list select "Page Scale".
Step 8 - Click OK, the map series should be reconnected.

The map series should be re-connected and the map should be saved every time you close a map document after altering the scale or panning in a map document.

# CHAPTER 5
## EDITING & ANNOTATING DATA

The Arboretum is constantly changing. This fact makes editing and annotating data a major part of the collections process. Editing data involves many steps that are broken down in this chapter.

In the section titled Creating New Features you will be taken through the step by step process of creating features whether they be Amenity Points or Plant Centers. In Modify Features you will learn how to modify existing map features, such as moving or resizing. In addition you will learn how to delete features and which features can be deleted and which ones cannot.

Each plant center in a map is labeled with its name and accession number. These labels are called annotation. Annotation also includes the leader lines that point to a plant center. Annotation, like features can also be created, edited and deleted, however, in addition annotation follows conventional cartographic placement rules. These rules are addressed in the Placement Rules section. Annotation also follows certain formatting that is explained in the Formatting section. Lastly this chapter addresses leader lines and the different styles that the Arboretum uses.

# Table of Contents
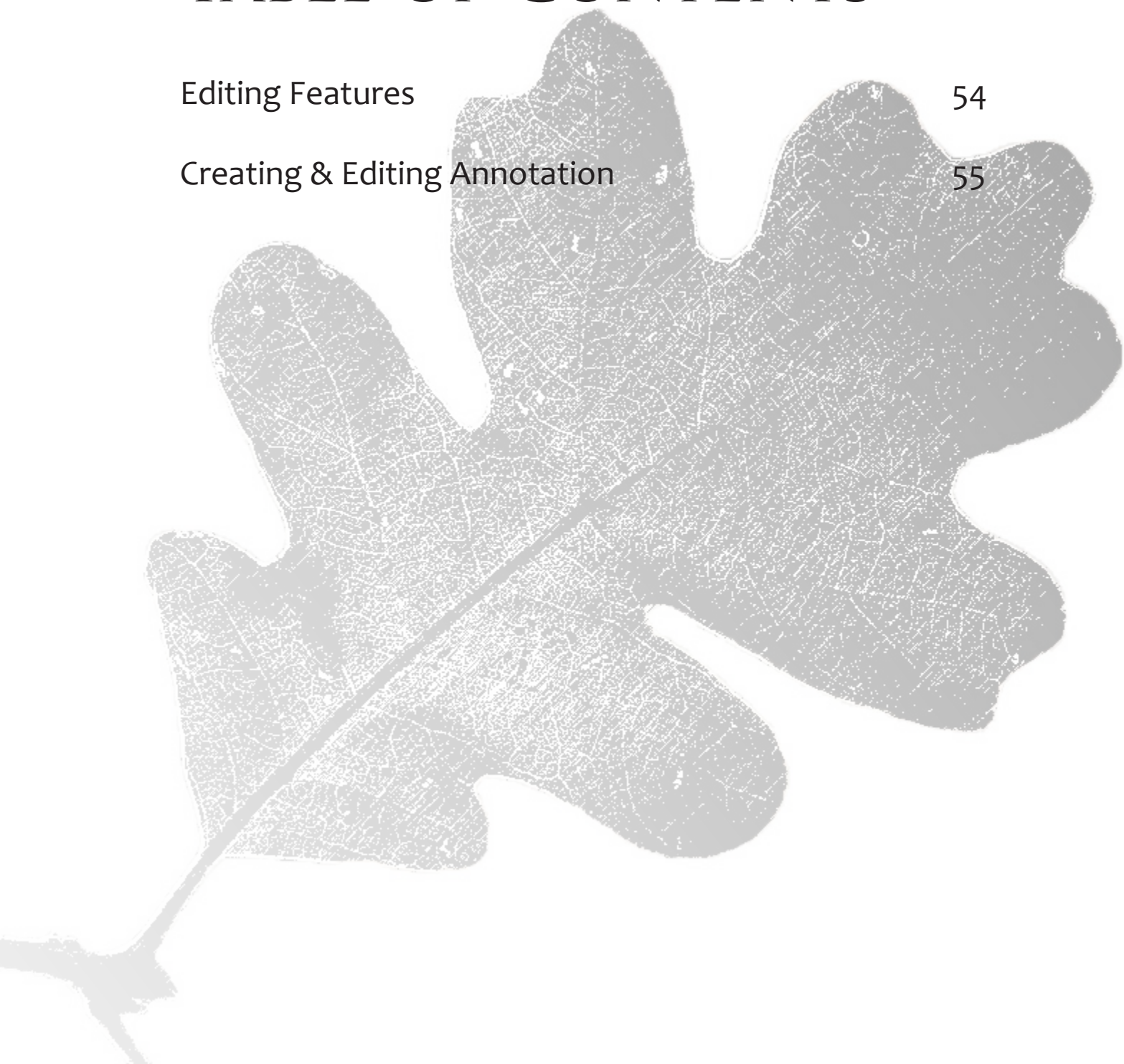
# EDITING FEATURES

The Arboretum is constantly changing and plants are often removed, planted, or die. Because of this constant flux the arboretum maps require frequent updating; this is done through the editing function in ArcMap.

## CREATING FEATURES

When new features, such as plants, are added to the arboretum new symbols need to be created representing those features. (Note: This should only be done if it has been determined that these points will not be surveyed and imported into the GIS). To add points or polygons, follow the steps below:

Step 1 – Be in data view and have the Editing toolbar open.

Step 2 – Click the Editor menu and select Start Editing. A window will open asking you what folder or database you want to edit data from. The folder or database you want will be the one that houses the layer/s your will be editing. Once you have selected the folder click OK.

Step 3 – You are now in an edit session. On the Editor Toolbar in the Task drop down menu select "Create New Feature", in the Target drop down menu select the layer you wish to add a feature to.

Step 4 – To add:

• Amenity Points, Irrigation, Utilities, Signs, and Plant Centers, using the pencil tool, click once in the location you wish to add the new point feature.

• To add Amenity Lines, using the pencil tool, click to create as many vertices as you need to in order to complete the line, then double click the last vertex to finish the line.

• To add Structures, Sections, Mass Plantings, Planting Areas, Pathways, and Waterways, using the pencil tool, click to create vertices until you have created the desired polygon feature. Then double click the last point to close the polygon.

Step 5 – Once a given feature is added then the attributes of that feature needs to be filled in.

Step 6 – After updating, save your edits.

## MODIFYING FEATURES

To modify a feature begin by following steps 1 and 2 of Creating Features then follow the steps below:

Step 1 - On the Editor Toolbar in the Task drop down menu select "Modify Feature", in the Target drop down menu select the layer you wish to modify.

Step 2 – Using the selection tool, select the feature you wish to edit.

Step 3 - With the feature selected you can use the Edit tool to:

• Pick the feature up and move it to a new location.

• Double click on the selected feature so that all its vertices are showing.

When you hover over an individual vertex the edit tool cursor will change to a star with a magnifier in the center. With this cursor you can pick up individual points and move them in order to reshape the polygon, you can delete vertices by right clicking on them and selecting "Delete Vertex", or you can right click between two vertices and select "Create New Vertex".

## Deleting Features

All features can be deleted except Plant Centers.   All dead Plant Centers have their status changed to "Dead" in order to have a historic record, of Arboretum plantings. This information is used for planning purposes.  To remove a Plant Center from a map without deleting it open the attribute table for Plant Centers and change the Status of the plant to dead.  To delete all other features, open the corresponding attribute table for the feature you wish to delete.  Select the feature in the table and right click on the box next to it then select "Delete Selected Feature" from the list that appears.

# Creating & Editing Annotation

◼ The annotation of a feature consists of its label and its leader line if it has one.

## Creating Annotation

To create annotation follow the steps below:

Step 1 - Highlight the feature(s) you wish to label
Step 2 – In the Selection tab right click on the layer you wish to create annotation for.
Step 3 – In the menu that appears select "Annotate Selected Feature"
Step 4 – Click OK.  Annotation will appear.

In the event that a map page becomes too congested to place labels you can create a numbered list of plants and then number the plant centers.  This is done using the same steps as above only each plant center in the list must be annotated twice.  This insures that the annotation is linked to a given plant center.  When the secondary annotation appears:

Step 1 – Double click the text box with the drawing toolbar pointer.
Step 2 – Erase the current text and put in the correct number
Step 3 – Double click the text box of the plant name.
Step 4 – Put the number before the plant name with a period and two spaces.
Step 5 – Once your list is created, highlight all the plant names and right click and select "Align" then "Align Left".
Step 6 – Keep you names highlight, right click and select "Distribute" then "Distribute Vertically".

## Placement Rules

The Arboretum follows standard mapping conventions of annotation placement.  Refer to the list below for all annotation placement rules.

1) Do not cross leader lines or plant connector lines.
2) Plants symbols are the only features that may overlap.
3) Do not connect plant centers that fall on two different pages.
4) Left justify annotation when it falls on the right side of the map and right justify annotation when it falls on the left side of the map.
5) When map page becomes too congested with plant names to place annotation you may create a list and number those plant centers.
6) Never place a number beneath its corresponding symbol.
7) When there is no room for straight leader lines, arced leader lines may be used

# Formatting

Depending on what scale the map you are working on is in, you may need to reformat the annotation. This is because all annotation is automatically created at size 8.00 font. If the map scale of your map is 120 that size 8.00 font will appear very large. In addition to adjusting the font size it will also be necessary to change the justification of the annotation according to the leader line position. To format annotations follow the steps below:

Step 1 – Begin a new edit session.

Step 2 – Double click on the annotation with the select elements tool.

Step 3 – Select the correct justification by using the justification buttons in the dialog box that appears.

Step 4 – To change the font size click on "Change Symbol"

Step 5 – In the window that opens, use the drop down list next to size to select the correct size.

Step 6 – Click OK then click OK again.

# Leader Lines

Leader lines are considered annotation as well and follow many of the same rules as label annotation. The Arboretum uses two different types of leader lines, solid black with a white outline for individual plants and a solid white with a black outline for mass plantings. The attribute table for all leader lines must also be completed or the lines will not show up in the map.

# Deleting Annotation

Unlike plant centers you can delete annotation; however, you must be in an edit session in order to do so.

# Chapter 6
## Field Verification

Regardless of being one of the more simple steps in the UC Davis Arboretum map making process, field verification remains one of the most important. The accuracy of the maps relies on the accuracy and detail of the notes taken of each and every plant and feature. Without this accuracy and attention to detail the purpose of documenting plant collections would be useless. For this reason this chapter stresses the importance of proper plant identification and the resources you can use to aid you in this area.
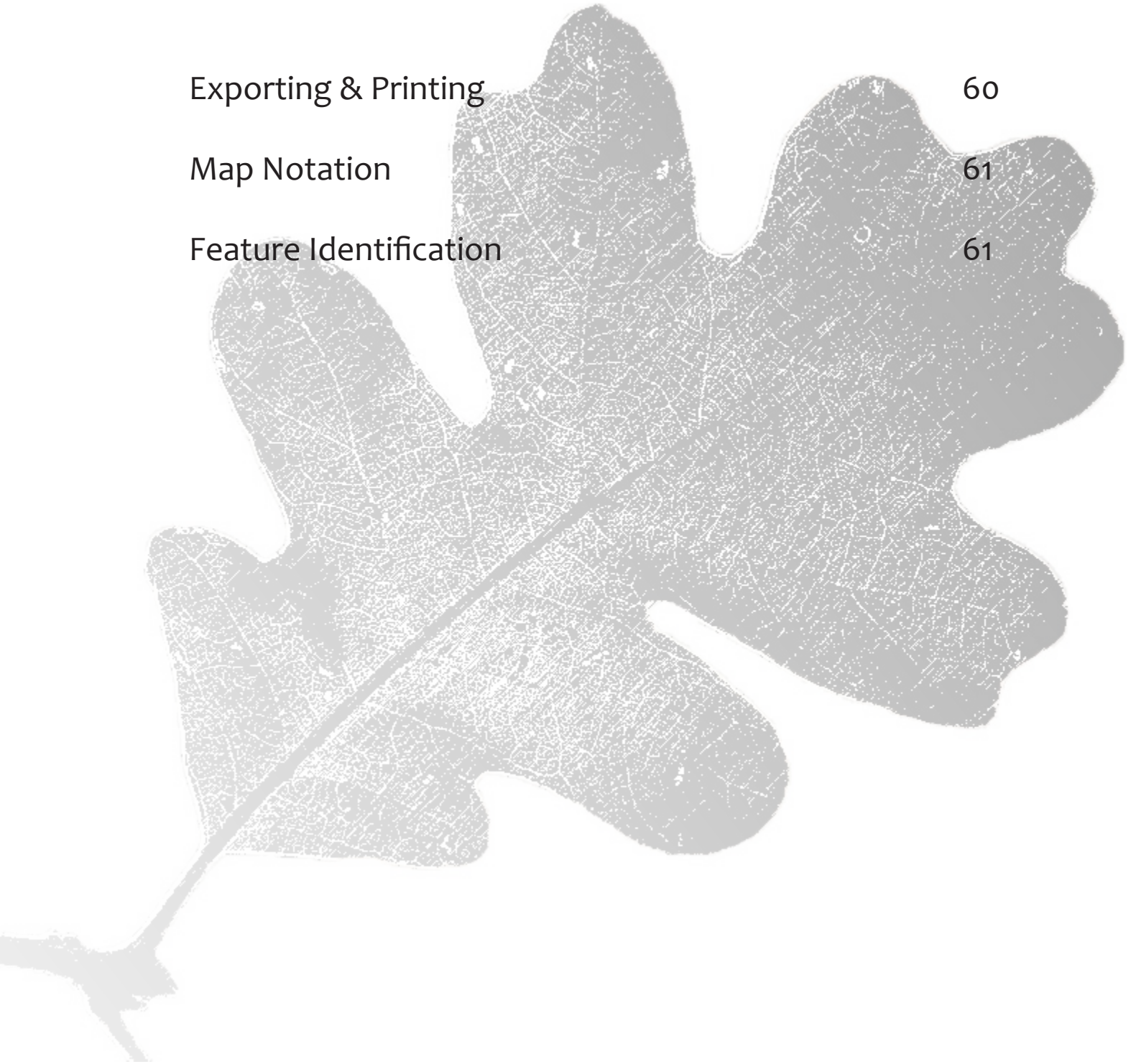
In this chapter you will also learn how to print out a hardcopy and export a PDF version of a single map page or a complete map book. Knowing how to export and print from the curators office is necessary not just for completed map books but also for any subsequent map pages you will need for field verification. In addition you will be able to exercise your querying skills when exporting or printing multi-bed maps.

In this chapter you will also find suggestions for taking accurate map notes that have been field tested to work in the Map Notation section. Lastly, in the Feature Identification section there is an explanation of what feature identification is and advice on what to do if you are unable to identify a feature.

# TABLE OF CONTENTS

# EXPORTING & PRINTING

Once a map is presumed to be complete, it is necessary to go out to the site and field check that the map is accurate. This process is much easier if you have some plant knowledge. If you don't know what some of the plants in your map look like, you will have to look up plants that you don't know in books or on the internet so that you will be able to identify them if you see them. Do not delete plants off the map if you are not familiar with the life cycle of a given species. It may be that a plant is simply dormant. Take time to research plant species behavior before presuming them dead when they can no longer be located in the field. You will need to take a copy of your completed map so that you may take note of any changes that need to be made to the map. In order to print a map page follow the steps below:

Step 1 – If you are in an edit session, stop editing

Step 2 – While in Layout View change the map scale in the Standard Toolbar to be the same scale you chose for the layout grid, ex. 1:120 or 1:240.

Step 3 – Depending on the orientation of the map you are working on you may have to correct the map rotation, to do this follow the steps below:
> Step 3A – While in Layout View, right click the Data Frame and select Properties
> Step 3B – Rotation is 0 for landscape layouts and 270 for portrait layouts.

Step 4 – While you are still in Data Frame Properties, reconnect the map series using the steps previously explained under Map Series.

Step 5 – Open the MapLogic Toolbar if it is not already. Click Layout then Export.

Step 6 – In the window that open give the map page a name and save it to the desktop.

Step 7 – In the window that opens under Page Range, select Current Section.

Step 8 – Click OK

Step 9 – Combine all the pages in Adobe by highlighting the pages on your desktop, right clicking, selecting "Combine in Adobe Acrobat". Don't forget to include a Legend and Section Overview, these can be copied and pasted from another completed map book.

Step 10 –This document must be saved in C:\GIS\ARBORETUM\Maps\Map Books once combined.

Step 11 – Delete the individual pages from the desktop.

Step 12 – In order to print the map you will need to disconnect from the VPN. Before doing this copy the exported pdf file from the server desktop and paste it onto the desktop of the computer you are working on, then disconnect from the VPN.

Step 13 – Open the pdf file and select File and print on the menu bar.

Step 14 – Select the kif:Arbor/Color printer and then click print.

Step 15 – Your document should print on the large color printer in the Arboretum kitchen.

## EXPORTING MULTI-BED MAPS

Multi bed maps are maps that have overlapping layout grids, as opposed to one next to another. The Boathouse Garden, Ruth Risdon Storer Garden, Carolee Shields White Flower Garden & Gazebo, and Arboretum Terrace Garden & Lois Crowe Patio are all

multi-bed maps.

In order to export a map page follow the steps below:

Step 1 – If you are in an edit session, stop editing.
Step 2 – While in Layout View change the map scale in the Standard Toolbar to be the same scale you chose for the layout grid, ex. 1:120 or 1:240.
Step 3 – Set the definition query in layout grid for the bed you want to print.
Step 4 – Depending on the orientation of the map you are working on you may have to correct the map rotation, to do this follow the steps below:
    Step 4A – While in Layout View, right click the Data Frame and select Properties
    Step 4B – Rotation is 0 for landscape layouts and 270 for portrait layouts.
Step 5 – While you are still in Data Frame Properties, reconnect the map series using the steps previously explained under Map Series.
Step 6 – Open the MapLogic Toolbar if it is not already.  Click Layout then Export.
Step 7 – In the window that opens give the map page a name and save it to the desktop.
Step 8 – In the window that opens under Page Range, select Current Page.
Step 9 – Click OK
Step 10 – Repeat these steps for every bed in the section.
Step 11 – Combine all the pages in Adobe by highlighting the pages on your desktop, right clicking, selecting Combine in Adobe Acrobat.  Don't forget to include a Legend and Section Overview page.
Step 12 – This document must be saved in:

C:\GIS\ARBORETUM\Maps\Map Books once combined.

Step 13 – Delete the individual pages from the desktop once you have combined them all in one file.

# Map Notation

Map notation consists of the notes you take when you are field checking.  There are no formal rules to map notation, however, it is advised that you make your notation legible, easy to see by using a contrasting color to the map, and writing enough down so that you know what it is you were talking about when you get back to the office.

# Feature Identification

Feature identification consists of identifying all the other items found in the Arboretum other than the plants.  While most items are easy to identify, such as tables, benches, and drinking fountains, other like irrigation are not as easy to identify.  In cases where you are not sure what a feature is make note of it on your map during a field check and ask your supervisor when you get back to the office.

# CHAPTER 7
## MAP PUBLISHING

Before a map book can be called completed there are a few "house cleaning" items that need to be taken care of.  Once all plant centers have been placed their grid locations in the map book need to be calculated in order to produce the Index page of the map book.  This process involves joining two tables together to make one, through the use of a common field.  You will learn this invaluable process in the Index and Layer Attributes sections of this chapter. You will also lean how to update an index after a map has been changed.

Once all the "house cleaning" has been taken care of and the map book is complete and ready to print, you will need to know how many copies you need to print and to whom or what they go to.  You will learn all of this in the hardcopies section of this chapter.  In addition you will also learn what to do with the old map books.
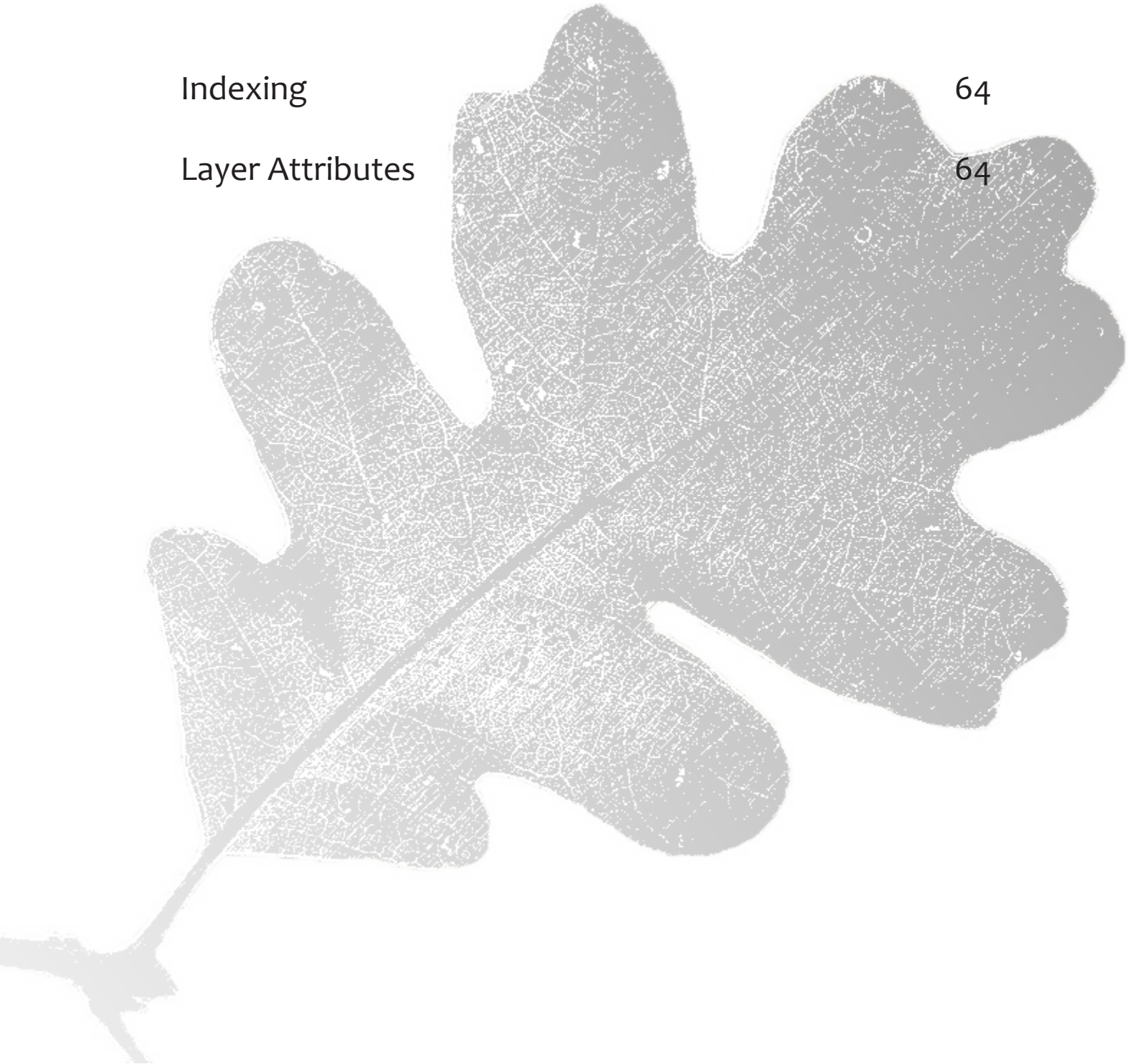
# TABLE OF CONTENTS

# Indexing

Once the maps are complete the index containing all the plants and their grid locations can be created. To do this follow the steps below:

Step 1 – Click the Layout tab at the bottom of the Table of Contents and make the map pages active.

Step 2 – On the menu bar click Selection then Select by Attribute

Step 3 – In the window that opens make sure that Plant Centers is listed as the selectable layer and create a query to select all plants with "PlantCenterStatus = Alive" and in a given section, press OK.

Step 4 - Go to the Map Logic layout toolbar. Click Tools> Outdated tools>Create location listing database.

## Index Update

If any changes occur to a map its corresponding index need to be updated as well. To do this follow the steps under Indexing above.

# Layer Attributes

## Reference Grid Name

The location listing tables contain the grid locations for each plant, however, it is necessary to join the location listing table to the plant center table to make one complete table. Once you join both tables, you can calculate the grid location values from the page number, row, and column values in the location listing. Follow the steps below to join the tables:

Step 1 - Right click on the plant center layer in the table of contents, select joins and relates, and then join.

Step 2 – In the dialog box that opens, select join attributes from table, and then select Location Listing ID for box one, the appropriate location listing table for box two, and ID for box three.

Step 3 - Once the join is complete, make sure that the scientific names are the same in both the Scientific Name and SCIENTIFIC fields. Make sure the number of records you start with is the same as the number resulted. If they are, you can calculate Grid=Page&"-"&Row&Column. If not, you will need to re-create the location listing.

## Latitude & Longitude

To calculate the latitude and longitude values, follow the steps below:

Step 1 – Open a new ArcMap session and add the Plant Center table.

Step 2 – Right click on the Data Frame and select properties. In the Coordinate system tab change the coordinate system to:

Predefined > Geographic > North America > North American Datum 1983.

Step 3 - Open the Plant Center table and right-click on the column heading for Latitude and select Calculate Geometry,

Step 4 – In the dialog box that opens select Y Coordinate of Point and Use coordinate system of data frame.  Repeat this step for longitude, but use the X Coordinate of Point option.

## Hardcopies

Three hardcopies of the finished map book will need to be printed, how to prepare them and where they go is listed below:

Copy 1 – Three hole punch and staple and put in the nursery manager's box.
Copy 2 – Three hole punch and file in the UC Davis Arboretum Collection Maps binder in the curator's office.

Information: If there is a map book that is already existing in this binder, take it out, recycle it and replace it with the new updated map book.

Copy 3 – Label "Working Copy" and file in the green working copy folder in the curator's office.

Information: If there is an existing map book in this folder, write the "retired" date on it and move it to the pink historic folders below. These maps are very important as a historical reference.

# CHAPTER 8
## TROUBLESHOOTING

From time to time we all need a little help with GIS. To make things a little easier during the rough times we developed a Troubleshooting chapter. In this chapter you will find answers to the questions and possible roadblocks you may encounter while working on the Arboretum maps.

While GIS can be a daunting program it is nothing to be afraid of. Every problem has a solution, whether its something as complex as symbols not printing correctly to something as simple as the difference between the types of annotation. Whatever your question you can find you answer here in Troubleshooting.

# Frequently Asked Questions

### Why are the plant centers, plant symbols, leader lines, etc. not showing?

This probably has something to do with your definition query. Go back into the layer properties and reevaluate your query or rebuild it using query builder.

### Why is there a red exclamation mark next to a layer name?

When a map document is opened ArcMap searches for the location of each layers data. If the data has been moved, renamed, deleted or is generally inaccessible, ArcMap will not be able to find the layers data source and so that layer will not be drawn in the map. You will know if this has happened by the red exclamation point that appears to the right of the layer name in the Table of Contents. To repair the data source of a layer follow the steps below:

Step 1 – Right click on the layer name that displays a red exclamation point next it.

Step 2 – In the list that displays click "Data" then "Repair Data Source"

Step 3 – In the dialog box that appears navigate to the layer.

Step 4 – If you located the correct location of the data the red exclamation point will disappear and the layer will be drawn in the map.

### Why am I not able to navigate to the source data for the layers?

The database connection may not be correctly set up on your profile and/or work station. You may need to click the Add Spatial Database Connection button in order to establish connections to the folder containing the data and enter the information to match the screen capture below.

Please be sure to make sure to change the version in the Connection details section to the DBO.EDIT version of the geodatabase. Once you click OK, the connection will be saved and you will be able to access the Arboretum GIS data. Please rename this connection as UCDavisArboretum - EDIT for consistency across user accounts.

### I annotated a plant center and the label did not appear, why?

There are two possible reasons why this is happening. The first may be that your definition query is not querying for annotation. The second may be due to what you have selected as your active annotation target. To check this follow the steps below:

Step 1 – Click the Draw menu on the Draw toolbar and select "Active Annotation Target".

Step 2 – In the list that appears select

### Why are the plant center symbols different?

The black plant centers with white outlines represent single plantings. The white plant centers with black outlines represent the point and plant information for mass plantings.

## WHAT ARE THE GREY POLYGONS?

The grey polygons represent the area that a mass planting occupies.

## WHY ARE THE PLANT SYMBOLS NOT CORRECTLY DISPLAYED ON MY PRINTED MAP?

The font that is used on the Arboretum maps is not a standard font. The computer you are using may not have the font that is used in the maps, so the computer puts in a generic symbol as a place holder. To fix this you need to install the correct font into ArcMap, which can be found in the fonts folder on your computer.

## WHAT ARE THE UNITS USED IN THE AREA COLUMN OF THE ATTRIBUTES TABLE?

The area column uses the same units of measure as the projected coordinate system. This can be found by right clicking the data frame, selecting properties then the coordinate system tab. In the "Current Coordinate System" box you will find the unit of measure used in the map.

## CAN I CALCULATE DISTANCE?

Yes, you can calculate distance using the measure tool located on the tools toolbar.

## WHY CAN I NOT SELECT THE PLANT CENTERS, PLANT SYMBOLS, LEADER LINES, ETC?

This is probably due to not having those layers set a selectable. To fix this click the on the Selection tab at the bottom of the table of contents and select the radio buttons next to the layers you want to be able to select.

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