

# Arboretum Project

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# Background

- Physical arboretum map given to visitors is **outdated**
- Missing:
  - Parking information
  - Arboretum entrance point
  - Other important information (stairs, benches)
- Expressed desire to identify non-ADA compliant paths

Other work previously done in the arboretum includes:

- Identifying and numbering plant beds
- Tree Plotter tree inventories
- 2024 LiDAR drone flight



# Project Goals

## 1. Create an up-to-date arboretum map

- Include updated walking paths / trails, code by accessibility
- Identify stairs, benches, and other important points
- Develop an interactive web map that can be provided via QR code to visitors w/ parking information

## 2. Perform crown delineation / segmentation from LiDAR

# Overview of Our Methods/Work

- Walked the entire arboretum with a GPS unit
  - Identified trails, stairs, benches, central lawn
- Processed LiDAR point cloud w/ PDAL pipeline
  - Classified ground points, created HAG model, slope
- Extracted Tree Plotter Data
  - Accessed and extracted tree plotter data to provide information on specific trees to visitors
- ADA Compliance Assessment
  - Symbolized trails based on slope calculations

# Data

Data we were given:

- Existing Arboretum data from base map and Arboretum resources
  - Boundary polygon digitized from basemap, parking lot boundaries, etc
- Existing inventory on Tree Plotter
  - Points for each tree in arboretum

Data we gathered:

- LiDAR data from drone flight
- Field data from Arboretum visit
  - GPS ground truth provided points, grass polygon, and accurate trail map

# Achieving Goal #1: Creating an Updated Map

First step: Meet with Tiffany Faulstich

- Walked through arboretum with Tiffany, understand her goals in this project and what we can create/deliver to achieve them
- Main focuses were: **including accessibility information**, **mapping where visitors can park** (and how to get to the arboretum from their parking spots), **adding data from Tree Plotter**, **creating a generally updated map for visitor use**

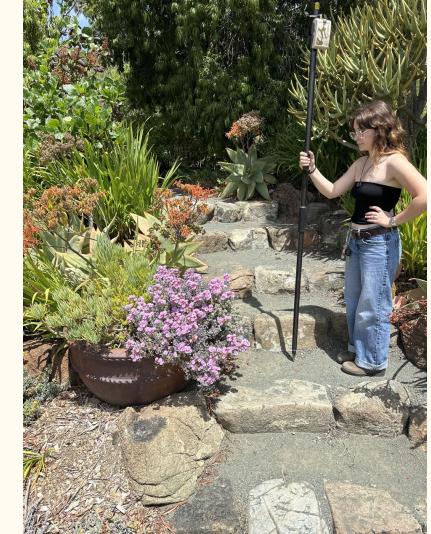
# Achieving Goal #1: Creating an Updated Map

- The GeoSpatial Systems Lab helped us in conducting a drone flight to get LiDar data of the arboretum
- Dr. Fricker also flew his personal imagery drone
- Drone data took longer than expected to receive so we did our best to make progress by other means (starting the web map, ground truthing, researching parking and ADA info)



# Achieving Goal #1: Creating an Updated Map

- Our first step in creating this new map was to create an updated map of walking trails throughout the arboretum
  - Received point cloud late, so we **ground truthed**:



# Achieving Goal #1: Creating an Updated Map

- Meeting with Russ White, GIS specialist at the library, to help us with making a interactive web map we can all collaborate on
- Made ArcGIS Online group
- Add data from ground truthing to the group for us to all process and add to our map

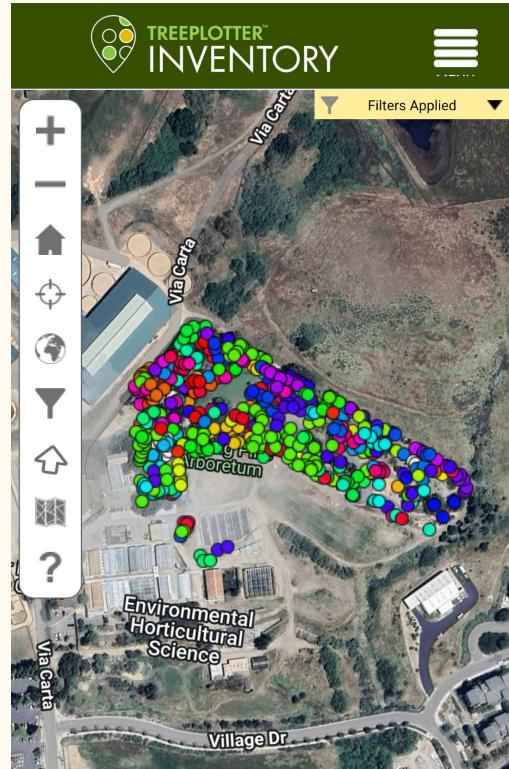
# Achieving Goal #1: Creating an Updated Map

- One issue noted by Tiffany was recurring visitor confusion surrounding parking
- I (Ava) took on creating the parking aspect of the map
  - Walked to the arboretum to look at the signs posted
  - Looked online to see how parking lots are described → found inconsistencies
  - Talked to arboretum staff Tiffany and Wendy to understand what they would like visitors to do or know



# Achieving Goal #1: Creating an Updated Map

- A resource Tiffany gave us was a link to the Tree Plotter for the arboretum
  - Website showing points representing all trees in the arboretum, what kind of tree they are, etc
- She asked us to get tree plotter points into the interactive map so that visitors can learn about specific trees



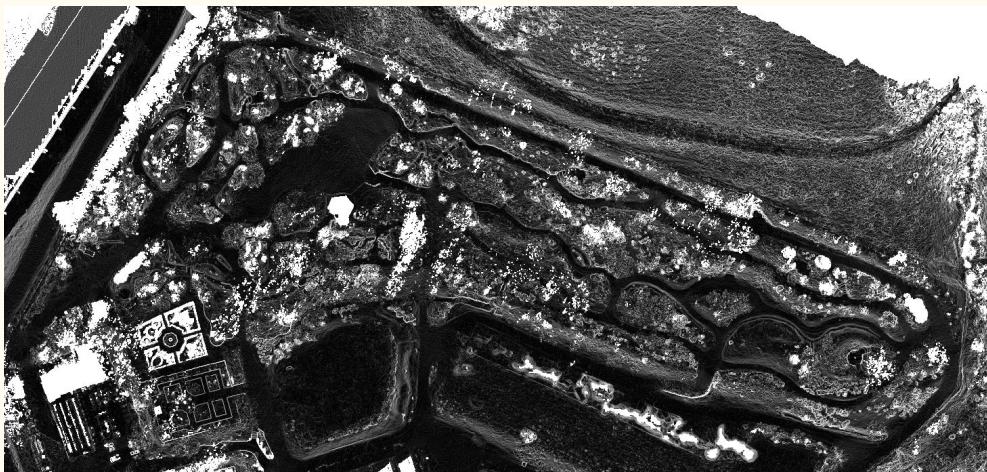
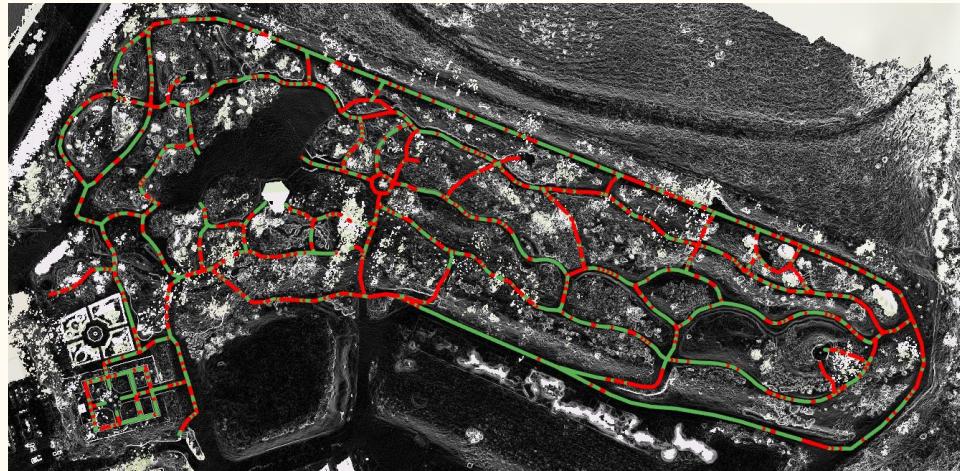
# Achieving Goal #1: Creating an Updated Map

- The future of the arboretum includes constructing an ADA-compliant parking area and redoing paths to make them as ADA compliant as possible
- It was important to Tiffany to be able to tell guests where in the arboretum is currently ADA compliant
- Analyzed slope of trails w/ LiDAR
- Converted the .json file into a .geojson using python and accreates features in ArcGIS
- Created color-coded trails layer:



# Slope Analysis

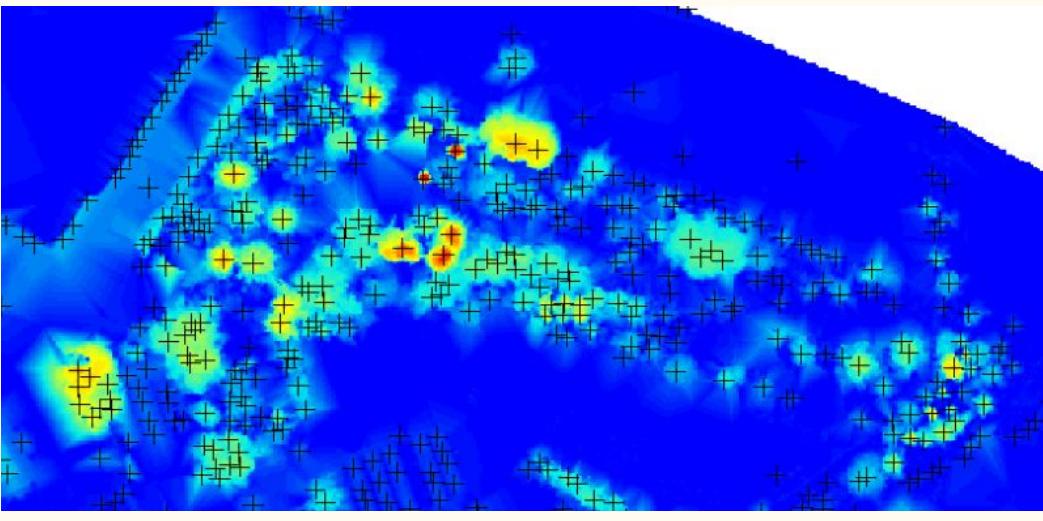
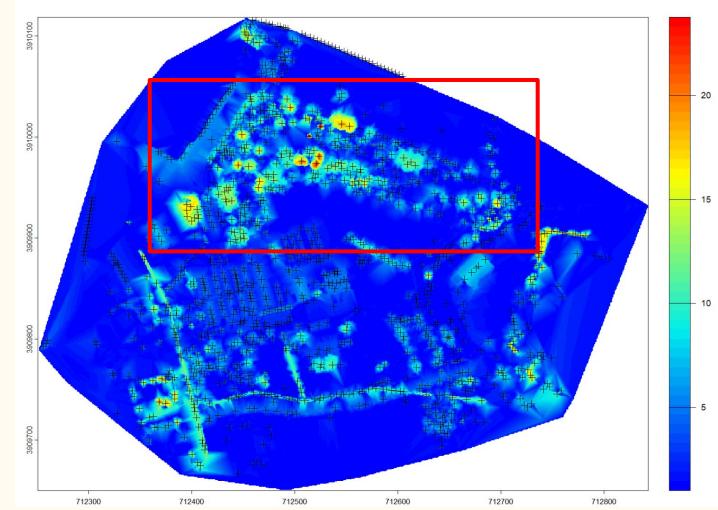
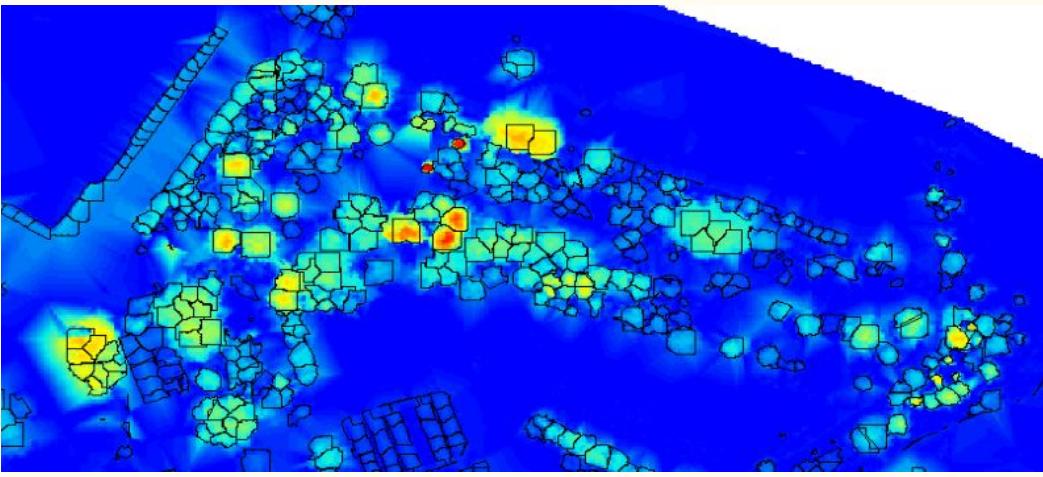
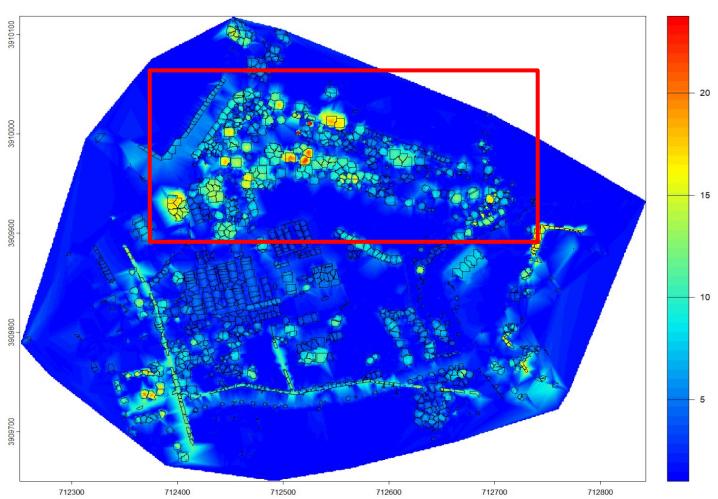
- Images from processed LiDAR data
- Walking paths cross referenced from ground classified layer



# Achieving Goal #2: Processing LiDAR Data

- LiDAR data had to be processed to create ground classifications for points, remove noise, etc
- Point cloud was processed in PDAL pipelines to create various layers
  - Reproject, decimate by a factor of 100
  - Ground layer, height above ground model
- Crown segmentation and identifying treetops using R

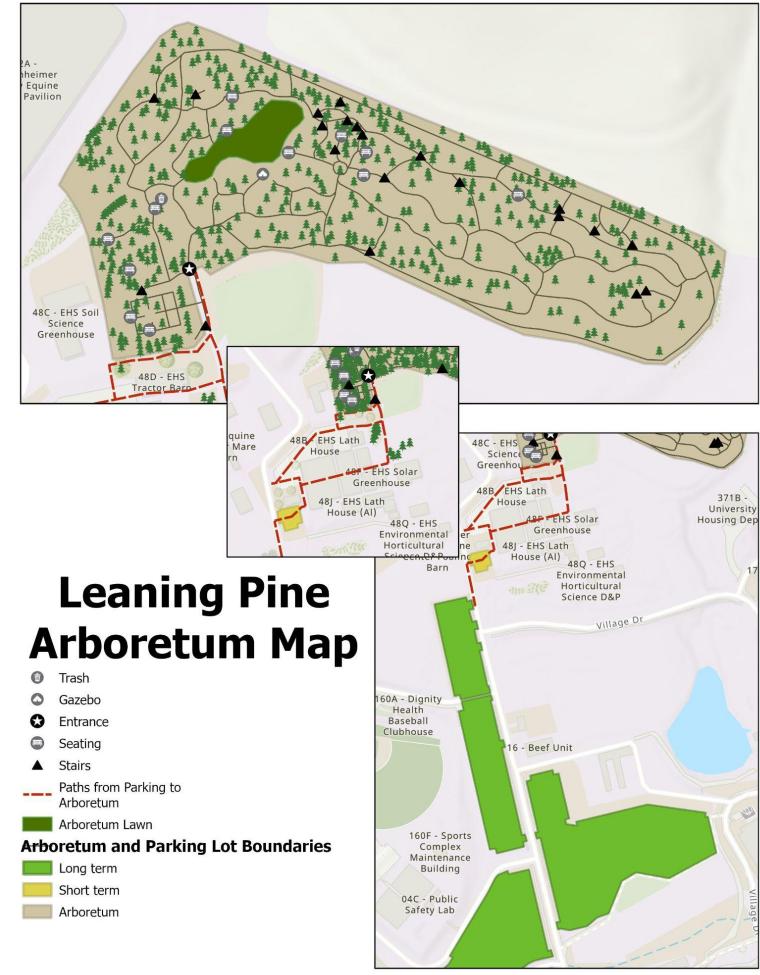
```
46  
47 Defining points and functions for identifying treetops  
48  
49 ````{r}  
50 p2 <- c(712440.04, 3910137.43) #Coordinates for northmost point (derived from QGIS)  
51 w <- matrix(1, 3, 3)  
52 arb_smoothed <- terra::focal(arb_chm, w, fun = mean, na.rm = TRUE)  
53  
54 wf <- function(x){  
55   y <- abs(x/8)  
56   y[x <= 30] <- 4  
57   y[x > 80] <- 10  
58   return(y)  
59 }  
60 ...  
61  
62 Identify and define treetops (this includes tops of buildings, but could be processed out)  
63  
64 ````{r}  
65 arb_ttops <- locate_trees(arb_smoothed, lmf(wf))  
66  
67 arb_sub <- sf::st_bbox(sf::st_buffer(sf::st_point(p2), 1000))  
68 plot(terra::crop(arb_chm, arb_sub), col = height.colors(50))  
69 plot(sf::st_geometry(arb_ttops), add = TRUE, pch = 3)  
70 ...  
71  
72 Segment trees and create crown segmentation map  
73  
74 ````{r}  
75 arb_segs = segment_trees(  
76   las_normed,  
77   dalponte2016(arb_smoothed, arb_ttops)  
78 )  
79  
80 arb_crowns <- crown_metrics(  
81   arb_segs,  
82   func = .stdmetrics,  
83   geom = 'concave'  
84 )  
85
```



# Deliverables

- Layout for visitors

## Leaning Pine Arboretum Map



**Leaning Pine  
Arboretum Map**

● Trash

● Gazebo

● Entrance

● Seating

▲ Stairs

— Paths from Parking to Arboretum

■ Arboretum Lawn

### Arboretum and Parking Lot Boundaries

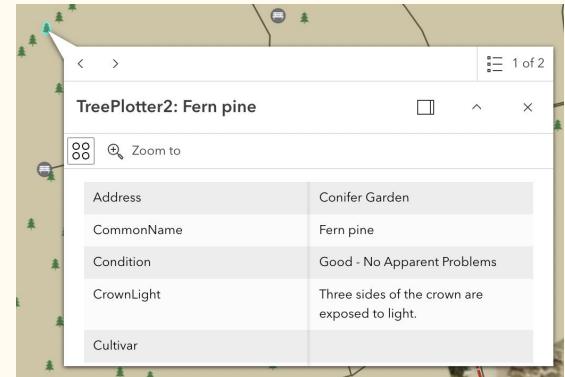
■ Long term

■ Short term

■ Arboretum

# Deliverables cont.

- **ArcGIS Web Experience**
  - Scan QR code to access interactive, online map
  - Updating “You are here” point
  - Click on tree icons to see plant name and additional information
  - Stairs, benches, and paths marked
- **In progress:** Removal of non essential information, informational panel with instructions on how to navigate the experience, no login necessary.



# Results

- Many trails are not ADA compliant (>5% slope)
- Web experience is mostly complete with accessible QR code
  - Updated trails map is quite different from original map
  - Parking paths were identified and labelled
  - Seating, stairs, and Tree Plotter data included
- Treetops that were identified with R are similar to Tree Plotter

# Limitations

Time

Data  
Delays

ESRI