MAPPING MANUAL

Image Source: Google Earth (https://earth.google.com/)

Executive Summary

The UBC Botanical Garden (UBCBG) plays an integral role in maintaining biodiversity across campus, acting as a hub of ecological interactions for thousands of plant, bird and insect species. To ensure continued success in this unique ecosystem, it is necessary to accurately map the location of each plant. Through the use of field measurements and GIS, this project aims to create a fully delineated representation of the UBCBG that can act as the basemap for long-term database project of plant species inventory.

The goals of this project are to:

1. Map the features within the UBCBG in order to:
    a. Accurately delineate garden boundaries.
    b. Track/update plant inventories at the garden bed level.
2. Create point-lines that represent the pathways and other features of interest throughout the Gardens using highly accurate GPS equipment.

Equipment

The follow equipments are required in order to successfully execute this project:

1. Ashtech FAST Survey GPS Receiver unit *
2. Rangefinder*
3. Total Station (for highly accurate elevation change detection)**
4. Garmin handheld GPS units**
5. ArcGIS Software***

* available from the Integrated Remote Sensing Studio (IRSS) lab in the Faculty of Forestry, 2424 Main Mall, contact: Nicholas Coops (nicholas.coops@ubc.ca)

** available from the UBCBG Facility, contact: Egan Davis (egan.davis@ubc.ca)

*** for inquiries regarding ArcGIS licences, contact: Susan Hunt (susan.hunt@ubc.ca)

Methodology

Data Collection

1. Establish a naming convention for features, and plan a route to ensure points are consistently taken.
2. Calibrate all GPS units being used, to ensure that they are using the same coordinate systems.
3. Use a highly accurate GPS to collect GCPs for other relevant features, such as the food garden to verify accuracy of digitization (refer to appendix).

Data Processing

1. Load GPS points into ArcMap.
2. Import GPS points into the "Botanical Garden.gdb"
   a. Note: this geodatabase already includes a sub-1m resolution georeferenced tiff of the Northern Garden obtained from Google Earth (July 28, 2017) and a mosaic of vancouver orthophotos (summer 2015) with a spatial resolution of 7.5cm.
   b. The GPS points can be used to further enhance and validate digitized features.
3. Digitize desired features based on the georeferenced images in combination with collected point features using the "Drawing" or "Editor" toolbars in ArcMap.
   a. Current feature layers can be updated, adjusted, and added to using Editor.
   b. New feature layers can be added using the Draw toolbar.
   c. Update metadata in Attribute Table of created features as needed. Follow current Garden nomenclature when adding bed number, path names etc.

Advantages and Limitations of Current Methodology

Advantages

1. Ashtech GPS units are highly accurate.
2. Rangefinder and Total Station allow for accurate measurement of non-local features.
3. ArcGIS allows for easy and consistent methods of creating, editing and delineating features.

Disadvantages

1. Ashtech GPS unit can not be used in rain or snow.
2. Metallic objects near Garmin and Ashtech GPS units can cause error (i.e. glasses, cell phone, pen, etc.).
3. Measurement and mapping complexity increases when working in areas of high tree cover.
4. Garmin handheld GPS units are highly inaccurate (see Figure 1.).
5. Digitizing cannot delineate areas under tree cover or areas that have been changed since last the last image was taken.
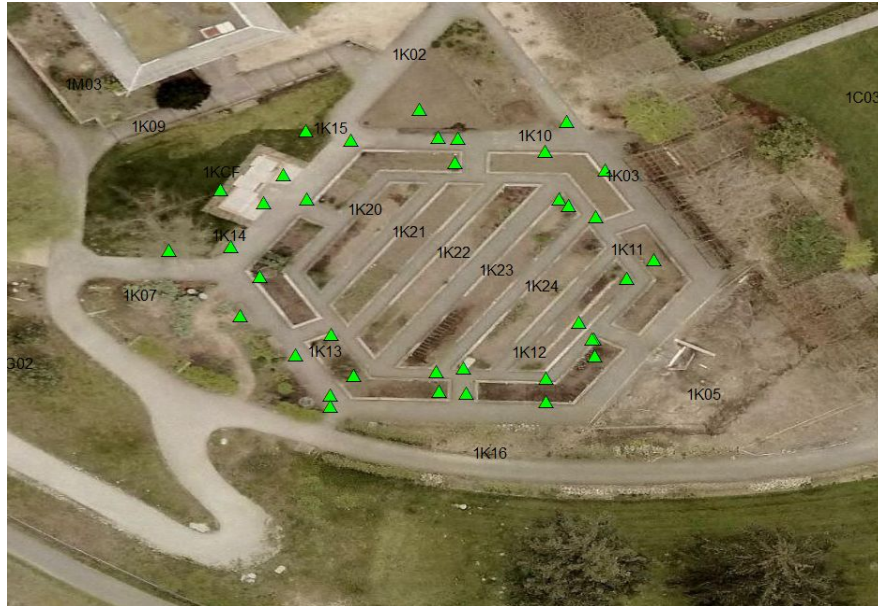
Figure 1. GPS points taken directly above the corners of each raised bed in the UBCBG Food Garden (shown in green triangles). The majority of the measured points are inaccurate.

Recommendations

1. Integration into ArcGIS Pro.

2. Potential continued cooperation with the IRSS lab for loaning Rangefinder and Ashtech GPS unit (MGEM students should have access to equipment upon request).

3. Create a more fine-tuned methodology for working in tree-covered areas (by creating tie-points in open areas etc.), as we only tested this methodology in open-canopy areas.

4. Create a methodology for updating and delineating areas that have changed beyond available Google Earth imagery (i.e. the alpine garden).

5. Ensure a consistent and standardized framework is used when formatting and sharing data throughout the Botanical Gardens databases.

6. Use a highly accurate GPS to get GCPs for property boundary delineation (at Beryl's discretion).

7. Better define level of detailed desired within the attribute tables and the features to be mapped in order to build next-steps.
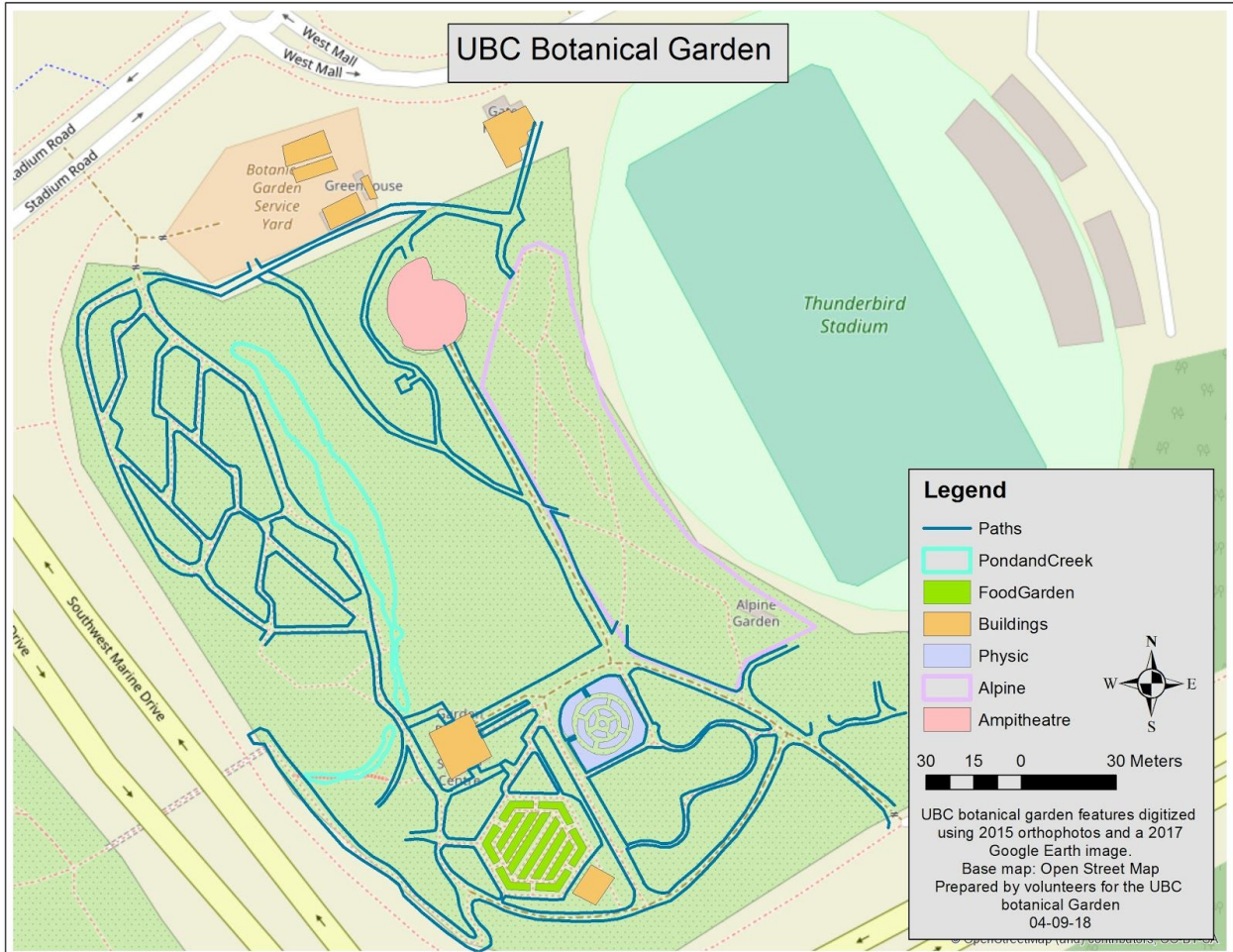
Appendix
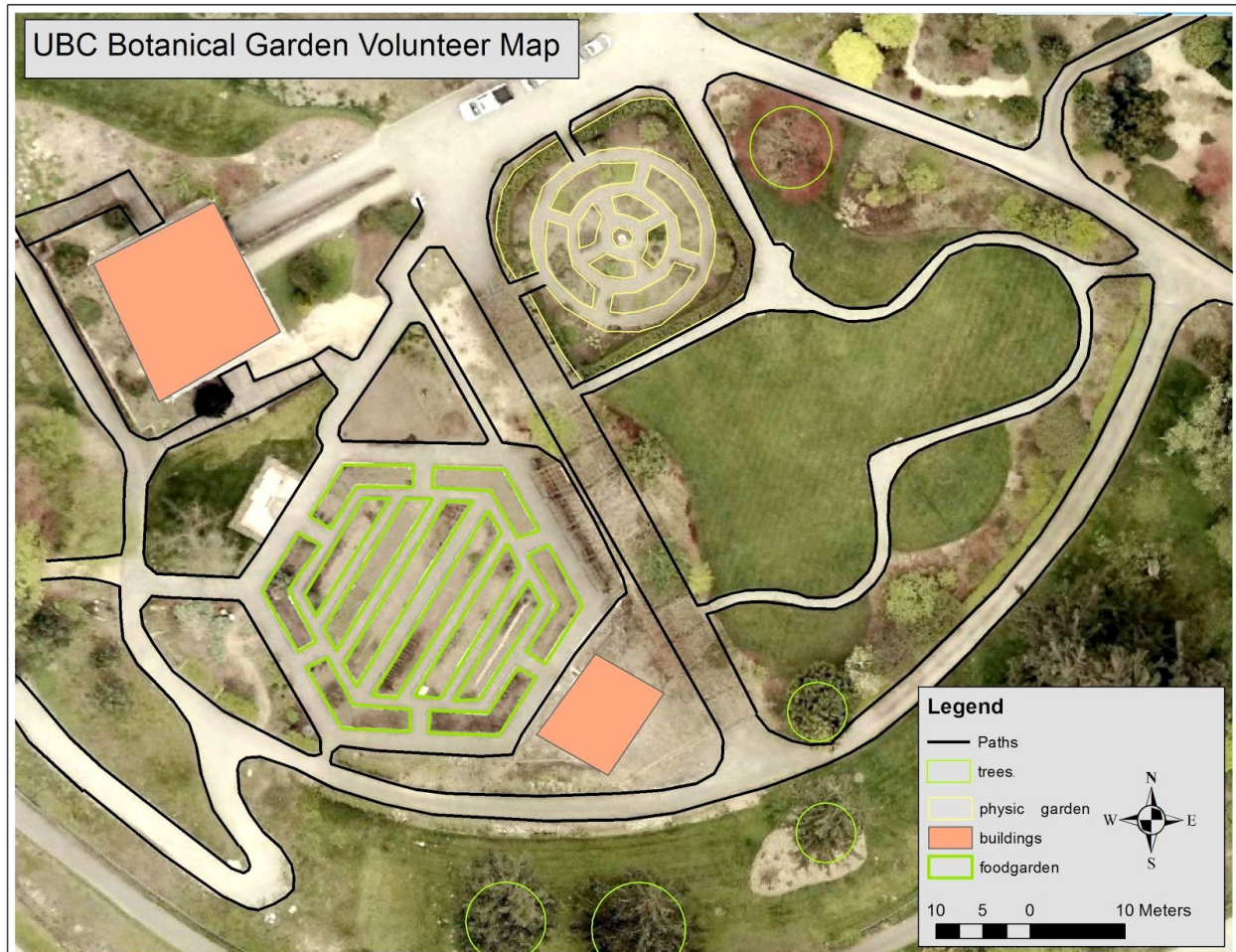
Map 1. High-detail map of the Food Garden (shown in green polygons) in relation to the location of other Garden assets in close proximity. 2015 Orthophoto obtained from Vancouver's open data catalogue.
(http://data.vancouver.ca/datacatalogue/2015orthoPhotos.htm)

Map 2. Mapped features of the UBC Botanical Garden area.

Using the Ashtech GPS unit

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Link to Fast Survey Manual
https://ashgps.com/mirror/master/FAST%20Survey/Manuals/FAST%20Survey_RM_D_en.pdf

1.   Set up the stake (pole) in the ground with antenna screwed into place and cable attached to antenna. Raise the antenna to desired height. You may wish to also set up the GPS unit holder, which clamps to the pole. Connect the antenna cable to the GPS unit. Do your best to ensure that the pole is straight up and down using judgement and the small level on the pole. *Please keep the antenna cable end from contacting dirt!!*

2.   Hold power button on left side of the unit to turn on. (May have to carefully peel the cover and use something pointy to get at the button). Tap Fast Survey and wait for load

3.   "Continue last job" will default to the last point file opened, alternatively, you can create a "new job" which will create a new .crd file equivalent to a blank job with no points and you will be prompted for job settings (coordinate system, tolerances, pole height). These settings can be changed at any time under FILE > JOB SETTINGS.

4.   When you are happy with the selected job file and settings go to **EQUIP > Monitor Skyplot** and ensure that 'external antenna' is showing. Wait for the HRMS and VRMS to stabilize (may take a few minutes depending on sky field of view and weather). If 'internal antenna' is showing, you may need to reconnect the antenna cable or try restarting Fast Survey or both.

5.   Go to **EQUIP > Tolerances**. Tolerances: HRMS – horizontal error (x, y) VRMS – vertical error (z)
From your 'MONITOR SKYPLOT' and RMS values to decide what you will set tolerances. When measuring points, if the RMS values go above tolerances, readings will not be counted as valid.

6.   Go to **EQUIP > GPS Rover > Receiver.** The first drop down is the antenna model number. Match the Antenna model with the number found on the bottom of the antenna (should be done by default). Choose 'vertical', and set the antenna height (the value you have chosen for the pole height). Elevation mask = 15. *See manual for details on any of these.*

7.   Go to **SURVEY > Store Points**. By default the cursor is on the DESC (description) of point about to be measured. Put a thorough description of what this point means to you so you can recognize it later. Now click the 'A' (averaging). Use the 'By Time in min' which will take 1 reading/sec. The point stored will be an average of all those measurements.

Anything above 2 min (120 readings) should provide you with accurate estimate of the point.

8.   Repeat 7 for more points!

9.   Go to **FILE > Points** to see a list of collected points in your .crd file.

10.   Go to **FILE > Import/Export** to export and ASCII text file of your points. This will be saved on the the SD card.

Acknowledgements: