

Farm Land Suitability Analysis for Vector Data in Groton, MA

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Introduction

In this lab assignment, you will help to identify potentially suitable parcels for farming for the New Entry Sustainable Farming Project (“New Entry”). This project supported by Tufts University, “assists people with limited resources who have an interest in small-scale commercial agriculture to begin farming in Massachusetts” (<http://www.nesfp.org/>). Much of the prime farmland in Middlesex County (where the town of Groton is located) has been developed, mostly for residential use. However, a growing population of beginning farmers has created a demand for active agricultural uses on some of this land.

In this assignment, you will employ basic GIS vector overlay analysis tools you have learned about in class to identify potentially suitable farming sites in Groton, MA. Please note that this exercise provides a very simplified version of New Entry’s GIS analysis – this is not the full process, but is intended to introduce students to overlay tools and analysis in a short lab session.

New Entry’s Criteria for Suitable Farmland Areas:

- Minimum lot size of 2 acres
- No wetlands
- Suitable land use for agricultural activities
- Prime Farm Land - soils which are good for farming.

A question to consider: This analysis will not take into account information about infrastructure such as water, sewage, and electricity, and it does also not include open space or conservation areas. Consider its limitations as you complete the project- how might the analysis be more “robust” and detailed with more specific information?

Objectives

At the conclusion of this lab, you will have:

- Explored metadata to determine the suitability of datasets for GIS analysis.
- **Clipped** datasets at the state scale to a smaller town extent.
- Performed **Select by Attribute** queries to identify specific features of datasets, and **created new shapefiles** from these queries.
- **Joined** a table to a shapefile.
- Performed an **Intersect** to identify areas that meet the suitable farming criteria.

- Performed a **Union** to join features from two shapefiles.
- **Calculated area** of polygons in a shapefile.

Data sets and sources

Data sets for this exercise are organized in the New Entry Farming Assignment folder as follows. All datasets were originally obtained from [MassGIS](#).

List of Datasets & Preprocessing

Topic	Original Dataset Name	Source	Pre-processing
Assessor's Parcels (Level 3)	L3_SHP_M115_GROTON	Mass GIS	None
Land Use	LANDUSE2005_POLY_MIDD	Mass GIS	None
Towns	TOWNS_POLY	Mass GIS	Selected Groton and exported to new shapefile
Wetlands	WETLANDSDEP_POLY	Mass GIS	Clipped to Groton Town Boundary
Prime Farmland	PrimeFarmlandSoils.lyr	Mass GIS	Clipped to Groton Town Boundary

You will notice that several of the original layers obtained by MassGIS were clipped to the Groton's boundary. This will facilitate the use of these layers when we are doing our analysis.

Shapefiles to use:

- Assessor's Parcels: M115TaxPar.shp
- Land Use: LANDUSE2005_POLY_MIDD
- Town Boundary: GrotonBoundary.shp
- Wetlands: Wetlands_Groton.shp
- Prime Farmland: Prime_Farmland_Groton.shp

Image files to use:

- DOQQ files in DOQQ folder for Groton, MA

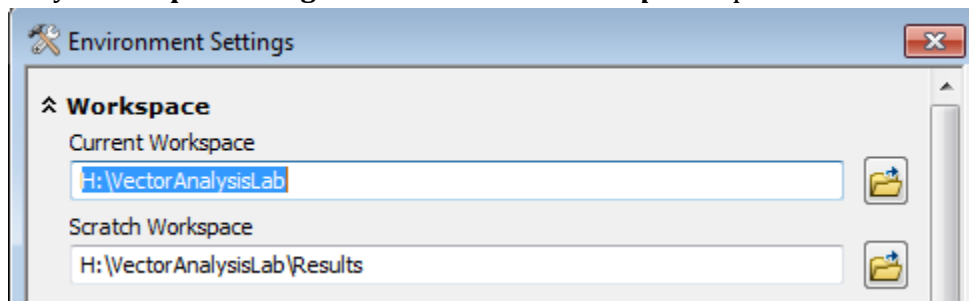
Tables to use:

- M115Assess.dbf

Getting Started

1. Open ArcMap and start a blank map file. Click on ArcCatalog on the right hand side and create a folder connection to S:\classes\UEP_ENV\VectorAnalysisLab where the above datasets are stored. **Copy** the folder and **paste** the entire folder into your H Drive.

- The data can also be found in the S:\Tutorials & Tip Sheets\Tufts\Tutorial Data or at GIS@Tufts website.
2. Add the following list of shapefiles, created according to the pre-processing steps outlined in the table above.
 - From the Parcels\L3_SHP_M115_GROTON folder - *M115TaxPar.shp*
 - From the LandUse folder - *LANDUSE_POLY_MIDD*
 - From the Towns folder - *GrotonBoundary*
 - From the Wetlands folder - *Wetlands_Groton*
 - From the Soils folder - *Prime_Farmland_Groton*
 3. Arrange these layers in a logical manner, and symbolize them accordingly (e.g., make the prime farmland green, wetlands blue, etc.).
 4. Take a few minutes to explore each dataset and associated attribute table and familiarize yourself with the information in each.
 5. Set your **Geoprocessing - Environments - Workspace** options as follows:



Finding Suitable Land Use Locations

First, we will select the appropriate land uses that are within the Town of Groton's boundary and considered suitable for farm land.

These are the existing land use categories that New Entry has determined appropriate for potential new farms out of all the possible land uses located within the LANDUSE2005_Poly_MIDD layer:

- Cropland
- Nursery
- Orchard
- Pasture
- Brushland/Successional
- Very Low Density Residential

Read the descriptions of these land use categories [here](#) for more information about why they are considered suitable for agriculture (some of may be self-explanatory, but it's always good practice to review the attribute information in metadata).

You will notice that we are looking at a shapefile for the entire state of Massachusetts. We only need to review the land use categories within the Town of Groton's boundaries.

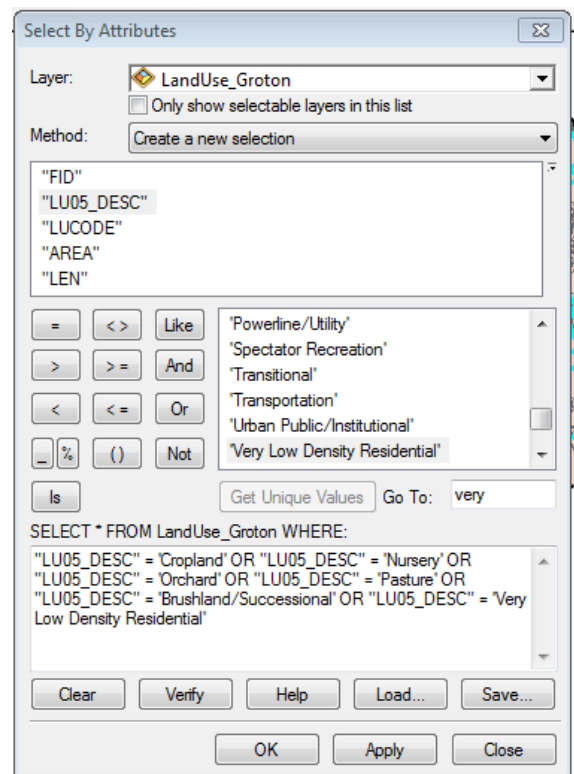
1. **Clip** the *LANDUSE2005_POLY_MIDD* to the *GrotonBoundary* shapefile. Save it in your *VectorAnalysisLab_Results* folder as *LandUse_Groton*.
 - The CLIP tool is under the Geoprocessing Menu - remember you can show help when using the CLIP tool to guide you.
 - If you get an error message, check to see if you have room on your H: drive. If you don't have room, save your results to a different location, and change your Workspace options under Geoprocessing Environments to this new location.

2. Remove the original *LANDUSE_POLY_MIDD* from your map session after the Groton clip is complete.

3. Determine which field provides information on land use type. Perform a **Select by Attributes** query on the *LandUse_Groton* layer to isolate the following land uses which are deemed appropriate for farming:
 - Cropland
 - Nursery
 - Orchard
 - Pasture
 - Brushland/Successional
 - Very Low Density Residential

Note: You can select all the land uses together in one query using the *OR function*.

Hint: It is easier to perform a successful query by using the "buttons" and "get unique values", rather than typing in the query directly into the text box.



4. **Export** the selected land uses (using **Data > Export Data**) as a new shapefile and save as *SuitableLandUse_Groton*.
 - Remember to name your exported shapefiles with logical names and save them in your results folder – this will save you much time later in the project!

5. Clear the selection from the *LandUse_Groton* layer after you have exported the new *SuitableLandUse_Groton* shapefile. Symbolize your new layer with a unique values color scheme for each different land use category. Turn off the old *LandUse_Groton* layer.

Intersecting Suitable Land Uses and Prime Farmland

In order to determine where New Entry farmers could potentially farm land in Groton, we need to determine the locations where our criteria start to **Intersect** (or overlap). You should currently have the following shapefiles in your GIS session:

- Areas of suitable land use (*SuitableLandUse_Groton*- determined above)
 - Prime Farmland in Groton
 - Wetlands (we will discuss the wetlands layer in a moment)
6. Perform an **Intersect** (Geoprocessing -> Intersect) using *SuitableLandUse_Groton* and *Prime_Farmland_Groton* (but not wetlands).
 - Give your new shapefile a logical name, such as *SuitableManagementUnits*, and save it to the same location as the other shapefiles.
 - Review your new shapefile. Does it seem logical? This layer now shows only areas that were both “prime farm land” AND a suitable land use that we determined in the previous step. Turn off the old *Prime_Farmland_Groton* layer and the *SuitableLandUse_Groton* layer.

Next, spend some time reviewing this *SuitableManagementUnits* (SMUs) with the *Wetlands* layer. Do you see any areas that intersect with wetlands? If you look at your original land use layer, you will notice that Wetlands is listed as a separate land use category. Therefore, you will likely not have any suitable areas where wetlands are located.

Determining Appropriate Suitable Management Units based on Size

Next, we need to determine which parcels meet the minimum lot size criteria (2 acres in this case) for suitable farm lands.

7. Open the attribute table for *M115TaxPar* and review its contents. There is not much useful information there, is there? For example, there is nothing about the owners of the parcel, the addresses, or even the size of the parcels. We need to join this shapefile with another table that has this information.
8. Add the *M115Assess.dbf* file to your map (from the *Parcels - L3_SHP_M115_GROTON* folder) and **Join** the *M115TaxPar* with the *M115Assess.dbf*
 - To **join** the data, right click on *M115TaxPar* layer and go to Joins and Relates> **Join...**
 - Choose *LOC_ID* as the field on which to base the join – the attribute table and the .dbf each have this field so we will use it to join these two tables together.
 - When the join is complete, open the attribute table again for *M115TaxPar* – note that the information from *M115Assess.dbf* is now in that table. Scroll across the

table to see the new information in the attribute table. This information (parcel owner, address, et cetera) will be important to identify the landowners of parcels that have potentially suitable land for New Entry farmers.

Now that we have included more information in the parcels layer, we can combine the layers using the **Union** tool so we can associate the *SuitableManagementUnits* (units that are both prime farm land AND one of the approved land uses) to their respective assessor's parcels.

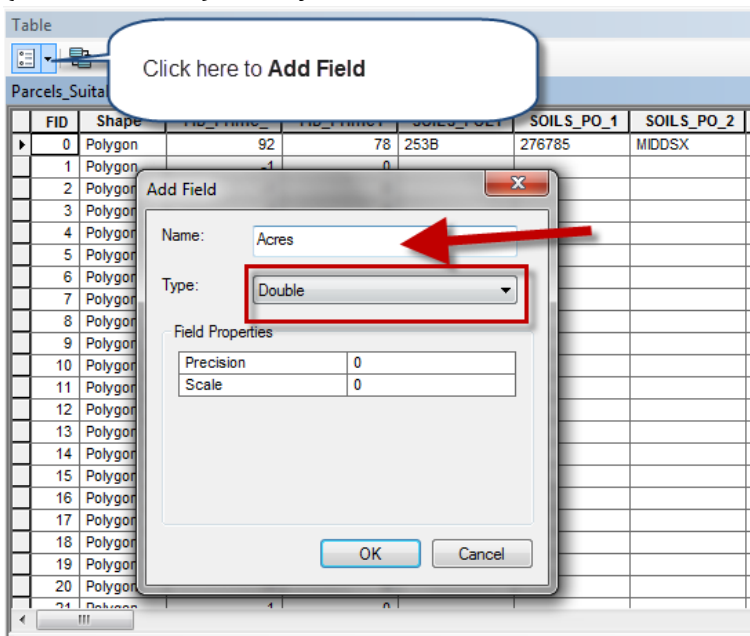
9. **Union** (Geoprocessing -> Union) the *SuitableManagementUnits* and your *M115TaxPar* shapefile.
 - Save your new shapefile as *SMUTaxParcels*.
 - [Here](#) is more information on the **Union** tool.

Spend a few moments exploring the new attribute table and the associated geometry. Are the Suitable Management Units and parcels merged together? Or are they still separate? You have now combined ALL the tax parcels for the town of Groton with the layer that contains the location of the prime farm lands and appropriate land uses.

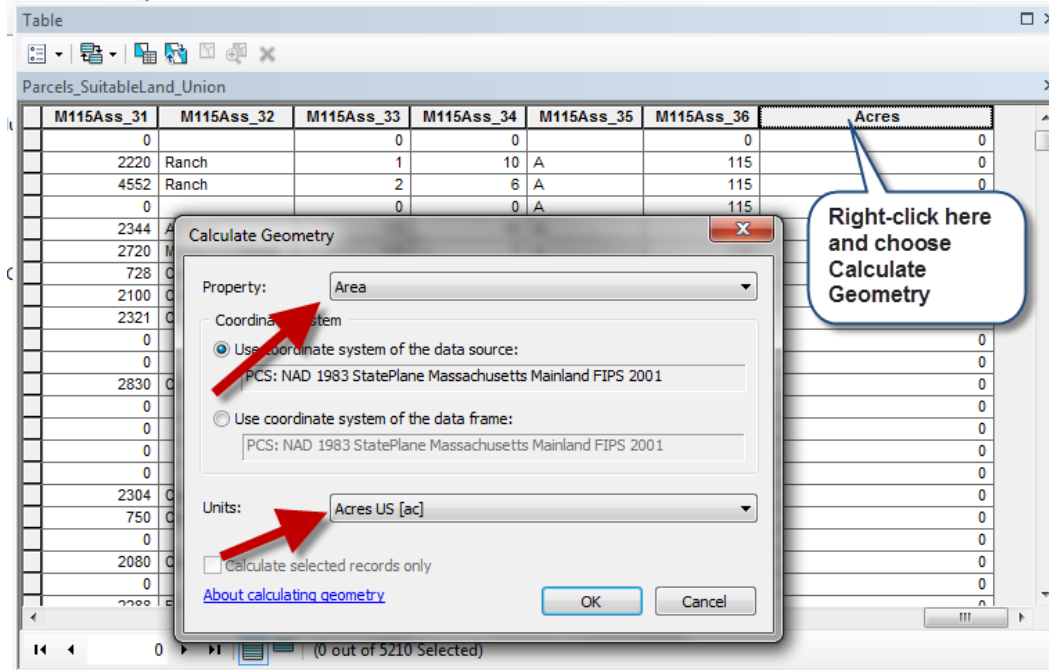
We will now move towards identifying suitable management units that are the appropriate size (> 2 acres) for farming.

10. Examine the attribute table of the *SMUTaxParcels* layer. Does it have any information on the size of the parcels for every polygon? We will need to calculate that first.
 - **Note:** None of the existing area fields in the table were recalculated after the running the intersect or union tools – they still have their original areas, which are now wrong.

11. To **Calculate the Geometry** in acres, open the attribute table of your unioned data set (*SMUTaxParcels*). First, you need to add a field in order to have a place to calculate area.



12. After adding your new *Acres* field, right-click on it and choose **Calculate Geometry** to calculate the area for every polygon in Acres:



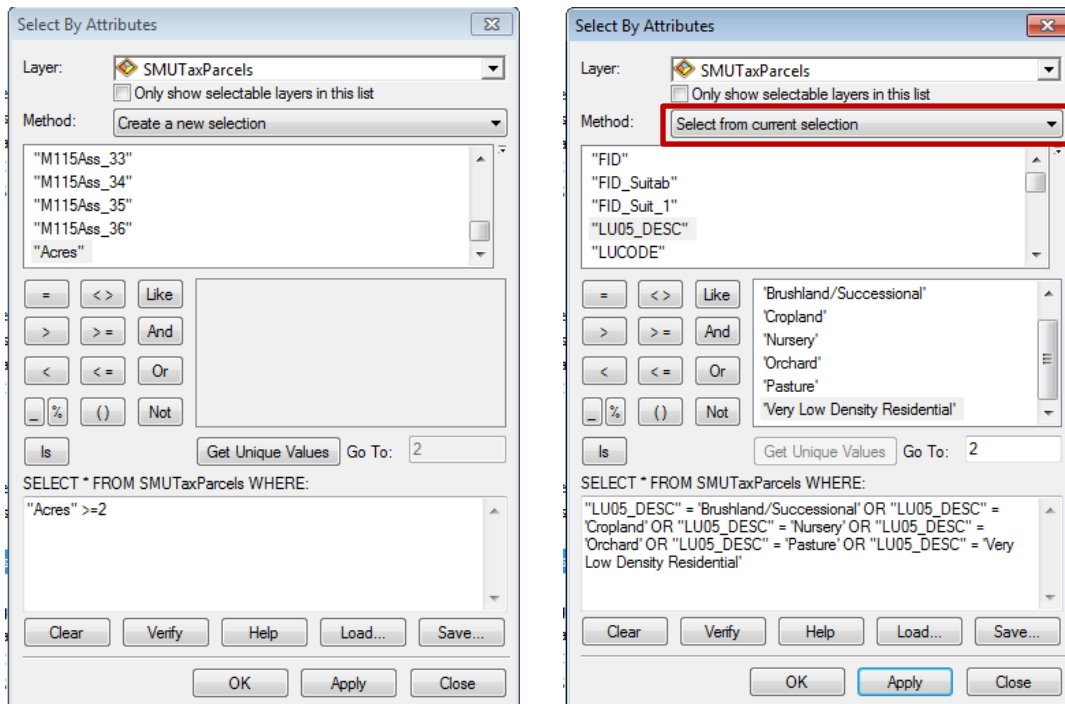
This attribute table contains information on suitable land use categories and areas for all the tax parcels in the state of Groton. As you know, we are only interested in the areas that have *suitable land uses, prime farmland* and are *greater than 2 acres*. You can perform a **Select by Attribute** query to find the locations that match all of these criteria.

13. Perform a **Select by Attribute** query to select all the features in that shapefile that are > 2 acres and are of the following land use categories:

- Cropland
- Nursery
- Orchard
- Pasture
- Brushland/Successional
- Very Low Density Residential

This can be done several ways. You can select areas that are greater than 2 acres and then “select from your current selection” to choose only those that have the appropriate land uses listed above. Alternatively, you could perform an all-encompassing query using the *AND function*, that looks for all the criteria. Both examples shown below.

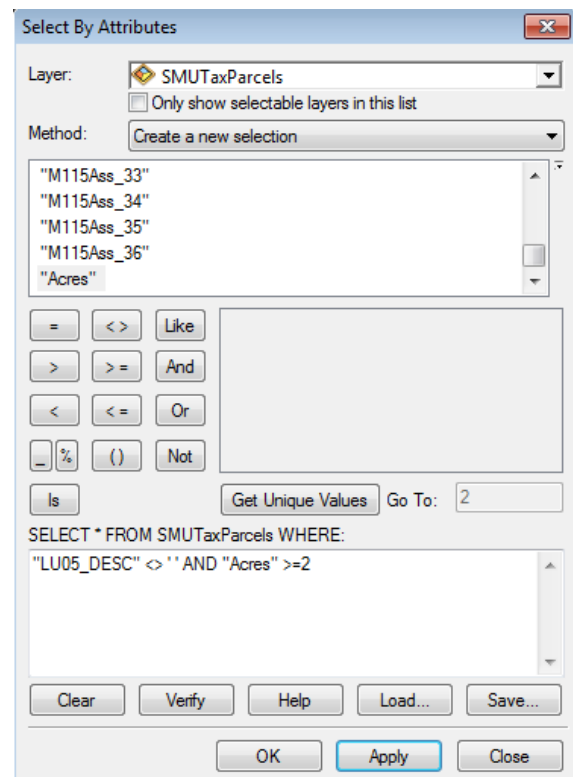
1. This query first selects the parcels that are greater than 2 acres. The 2nd query selects “from the current selection” the areas with the appropriate land use categories using the *OR* function.



2. Alternatively, you could use this query.

Do you see why this works?

We are asking to select land use polygons where the land use does not equal (<>) “blank” (‘ ’). Since this layer only includes land use information for acceptable types, so using the “does not equal” with the blank (‘ ’) option will select all the appropriate land uses AND the areas greater than 2 acres.



14. **Export** (using Data > Export Data) that selection as a new layer to your map and save it as *SMUs_2Acres*.

You have now identified those land areas greater than 2 acres in size, under appropriate land use, and with suitable soils (prime farm land), that could potentially be used by New Entry farmers.

Deliverables

At the conclusion of this lab, you should submit:

- A map showing the Town of Groton and the Suitable Management Units (SMUs) that are greater than 2 Acres. The map should:
 1. Symbolize the SMUs to differentiate between the different land use categories.
 2. Possibly include other appropriate information (e.g., location of wetlands, hydrology layer, etc.).
 3. An inset map showing the location of Groton within Massachusetts.
 4. Standard map elements
 - Title
 - North Arrow
 - Scale Bar (appropriate units)
 - Legend
 - Data source
 - Author
 - Class
 - Date