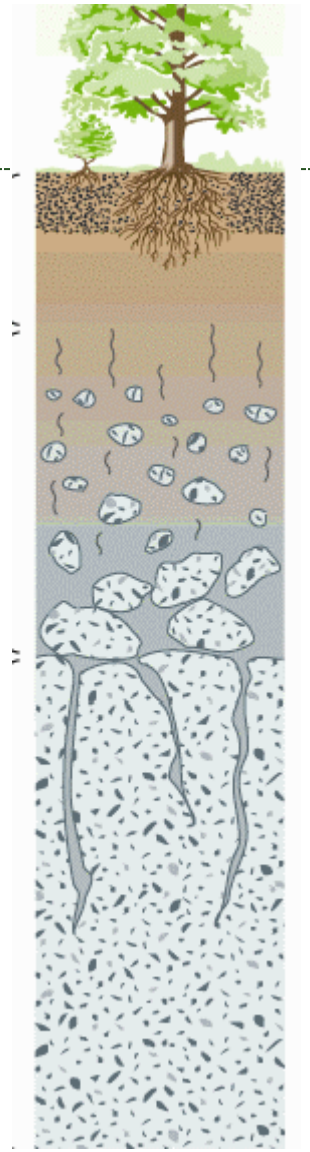
Soils Component

NRCS

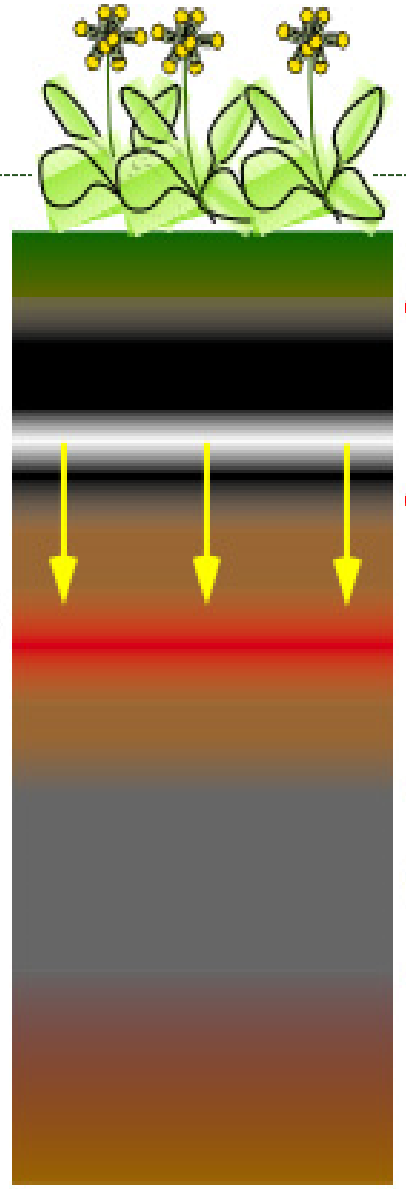
THE AMERICAN CHESTNUT FOUNDATION®

Site Selection



- The #1 Most Important Step in Planting Anything
- Soils a major component
  - Physical Characteristics
    - Drainage
    - Texture
    - Saturated Hydraulic Conductivity
    - Permeability
    - Swales
  - Chemical Composition
    - Nutrition
    - Get a soil test

Horizons



O Horizon

- O = Organic Layer

A Horizon

- A = Mineral Particles

B Horizon

- B = Mineral particles + material from A horizon. More clay

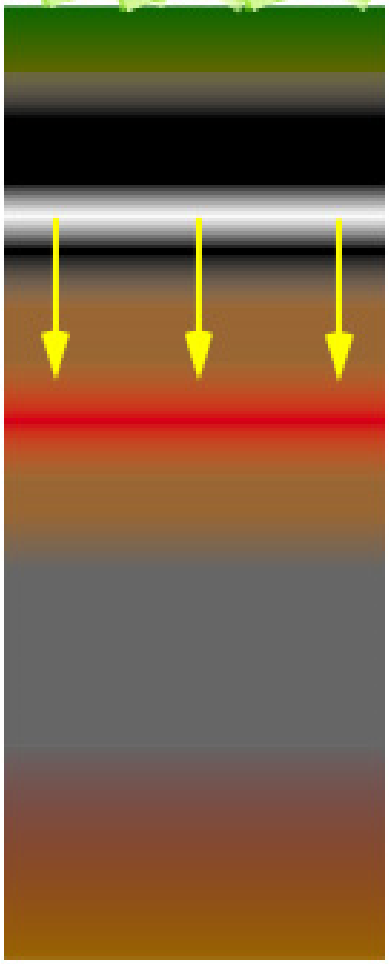
C Horizon

- C = Weathered parent material

R Horizon

- R = Parent material; unweather bedrock.

Horizons



Eluviation Layer

Illuviation Layer

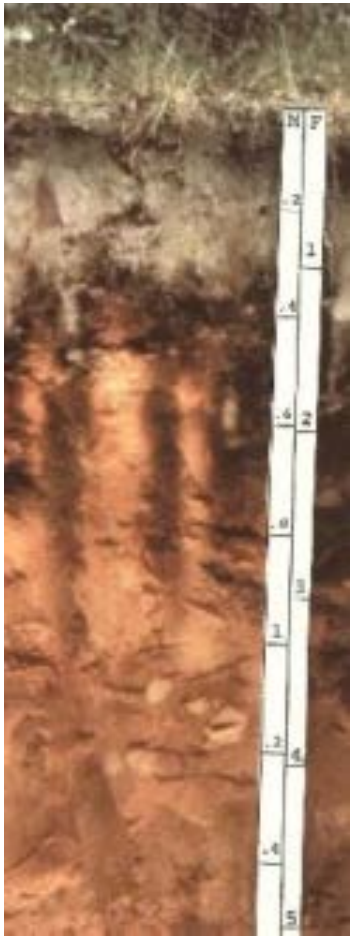
O Horizon

A Horizon

B Horizon

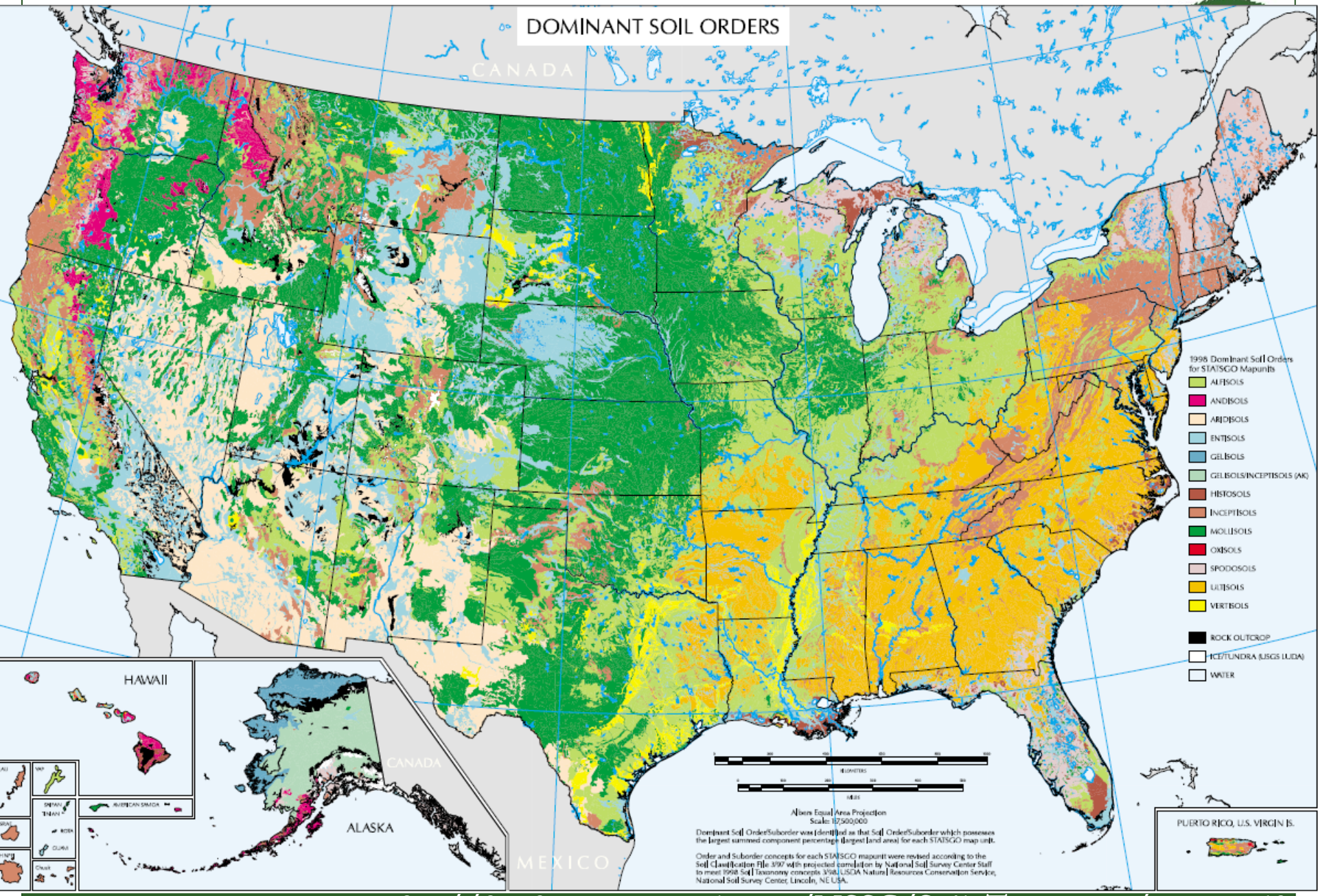
C Horizon

R Horizon



Soil Taxonomy

- **Alfisols** - moderately leached soils with a subsurface zone of clay accumulation and >35% base saturation
- **Andisols** - soils formed in volcanic ash
- **Aridisols** - CaCO3-containing soils of arid environments with subsurface horizon development
- **Entisols** - soils with little or no morphological development
- **Gelisols** - soils with permafrost within 2 m of the surface
- **Histosols** - organic soils = peat bogs
- **Inceptisols** - soils with weakly developed subsurface horizons
- **Mollisols** - grassland soils with high base status
- **Oxisols** - intensely weathered soils of tropical and subtropical environments
- **Spodosols** - acid forest soils with a subsurface accumulation of metal-humus complexes
- **Ultisols** - strongly leached soils with a subsurface zone of clay accumulation and <35% base saturation
- **Vertisols** - clayey soils with high shrink/swell capacity



Sara Fitzsimmons

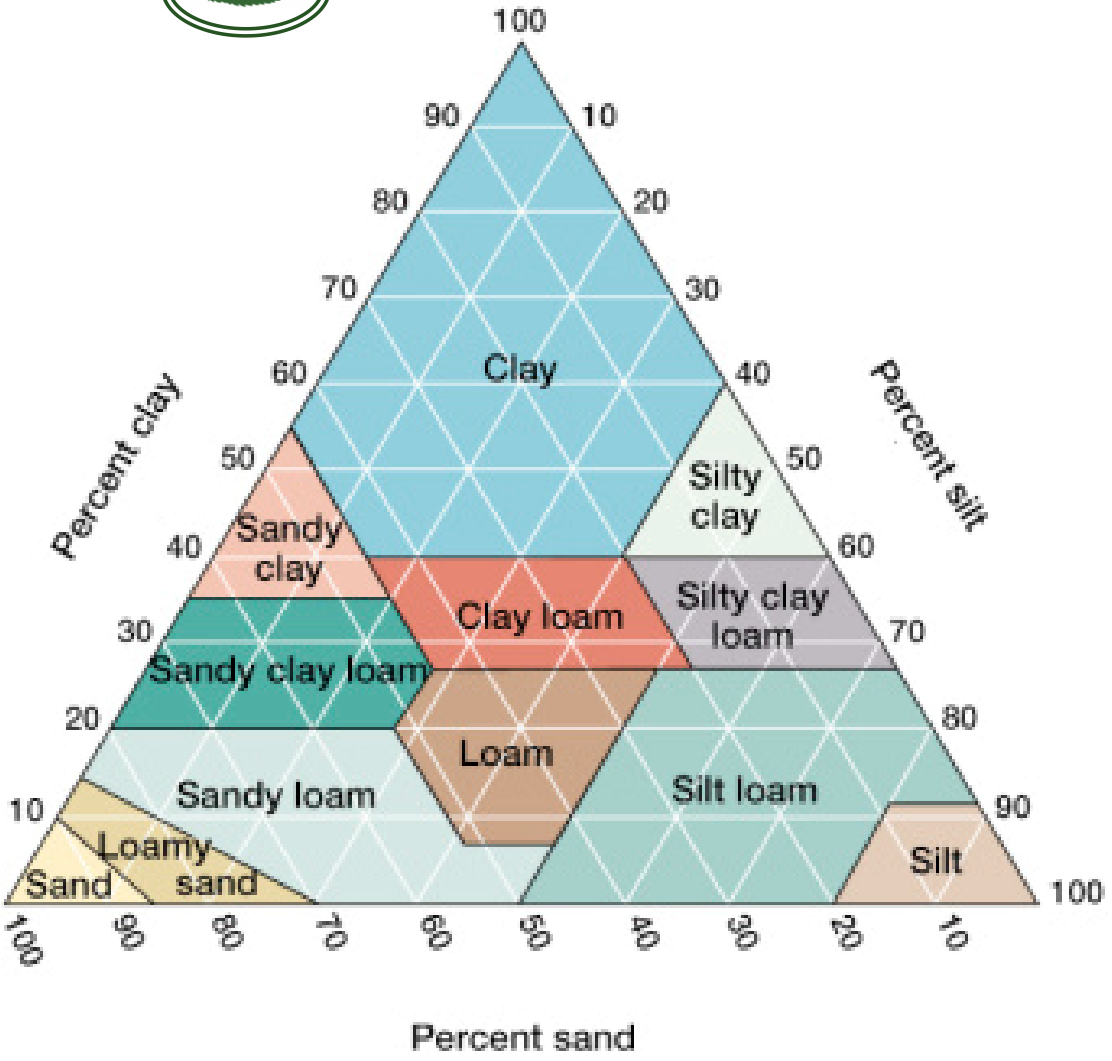
ftp://ftp-fc.sc.egov.usda.gov/NSSC/Soil_Taxonomy/maps.pdf

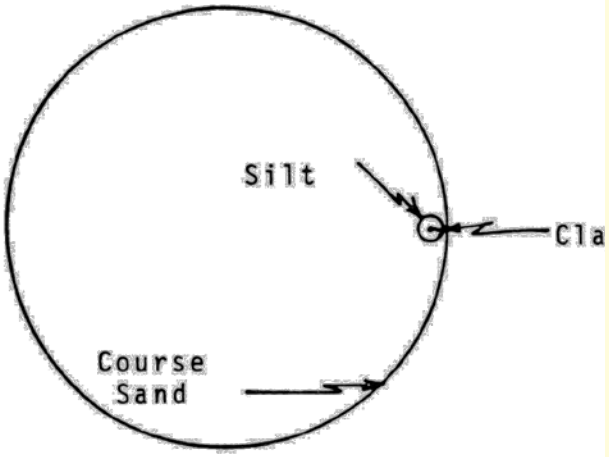
Soil Traitw and Characteristics

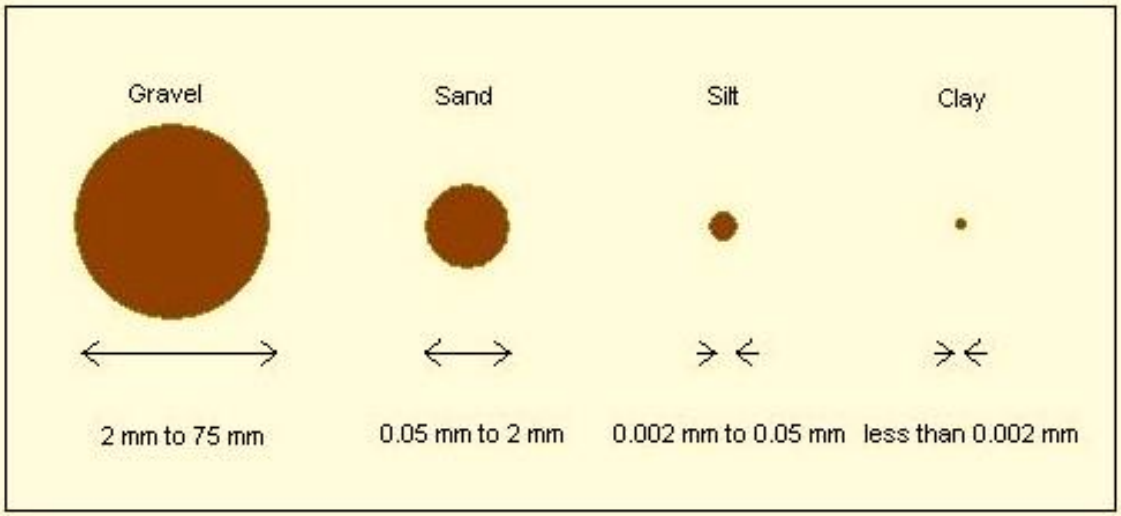
- Texture
  - Particle Size
  - Ability to hold nutrients
    - Cation Exchange Capacity
  - Ability to hold water
    - Drainage
    - Permeability
- Color

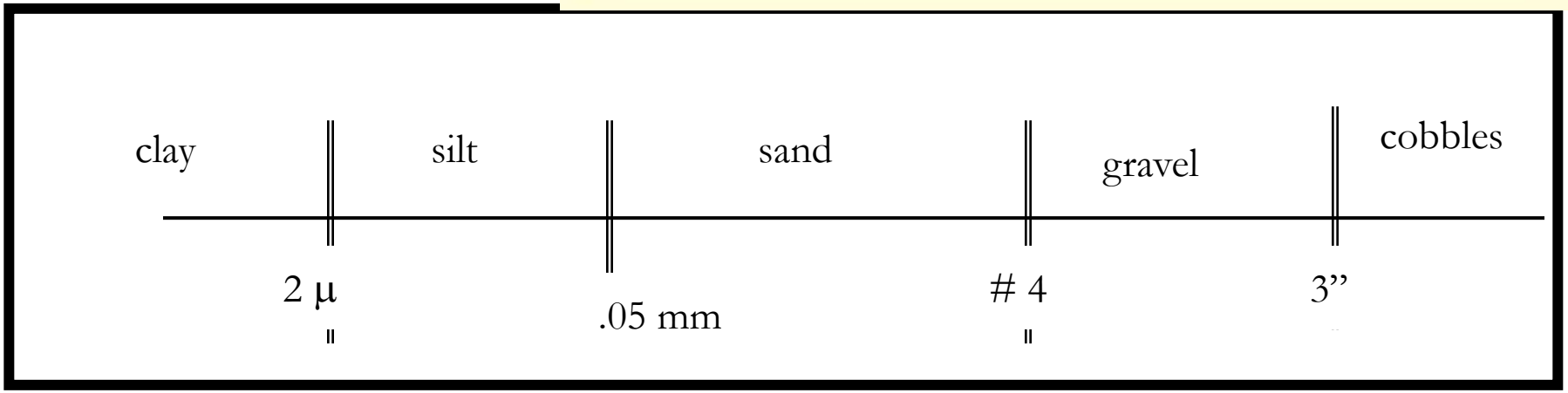
Physical Soil Characteristics

- TEXTURE
- Particle Size
  - CLAY : SILT : SAND




Silt
Cla
Course
Sand


Gravel
Sand
Silt
Clay
2 mm to 75 mm
0.05 mm to 2 mm
0.002 mm to 0.05 mm
less than 0.002 mm


clay
silt
sand
gravel
cobbles
2 µ
.05 mm
4
3”

Particle Size Activity

- http://globe.gov/sda/tg/soil/ParticleSize.pdf

What is Affected by Texture?

- Porosity – a measure of void space
- Drainage – roughly indicates the degree, frequency, and duration of wetness
- Permeability – the ability of water to flow through a soil

  http://techalive.mtu.edu/meec/module06/Percolation.html

- Ribbon Test

Place ball of soil between thumb and forefinger, gently pushing the soil between with the thumb, squeezing it upward into a ribbon. Form a ribbon of uniform thickness and width. Allow ribbon to emerge and extend over the forefinger, breaking from its own weight.
Does the soil form a ribbon?

No → **Loamy Sand**

Yes

What kind of ribbon does it form?

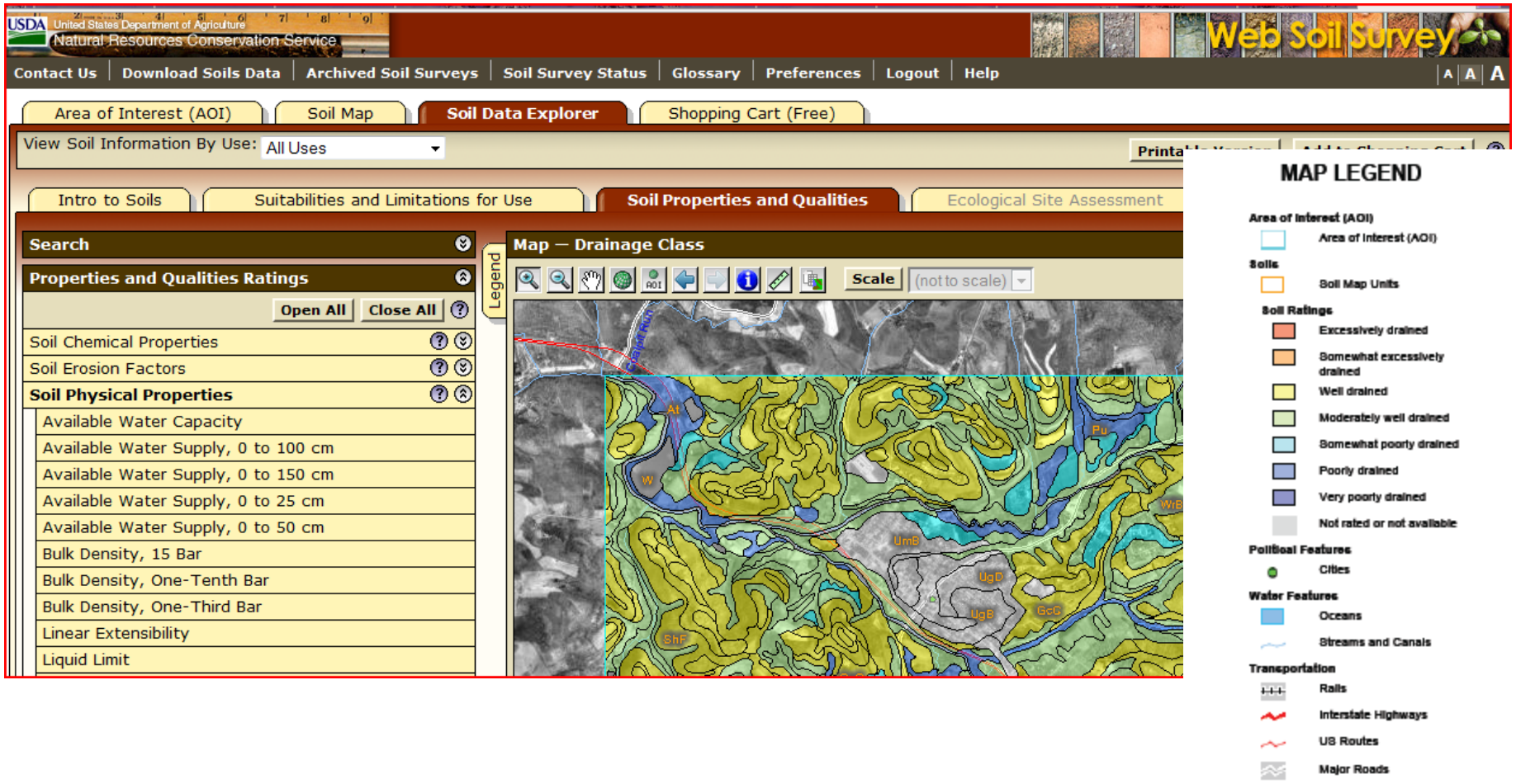
Moisten a pinch of soil in palm and rub with forefinger		Forms a weak ribbon less than 1" before breaking	Forms a ribbon 1-2" before breaking	Forms a ribbon 2" or longer before breaking
		LOAM	**CLAY LOAM**	**CLAY**
Does it feel very gritty?	Yes	**Sandy Loam**	**Sandy Clay Loam**	**Sandy Clay**
Does it feel equally gritty and smooth?	Yes	**Loam**	**Clay Loam**	**Clay**
Does it feel very smooth?	Yes	**Silt Loam**	**Silty Clay Loam**	**Silty Clay**

Soils

- Possible soil issues to look out for:
  - Compaction
    - **Check land-use history**
    - Old log landings
    - Previous construction
  - Ledge/depth to bedrock
    - Roots need room to grow
    - Depth to bedrock: 4-6 feet minimum
  - Fragipan
    - Subsurface soil layer
    - Restricts flow of water and root penetration
    - Bx or Btx in soil descriptions

Empty up-hill rows were planted over ledge. Chestnuts sprouted but quickly died.

Web Soil Survey



Web Soil Survey

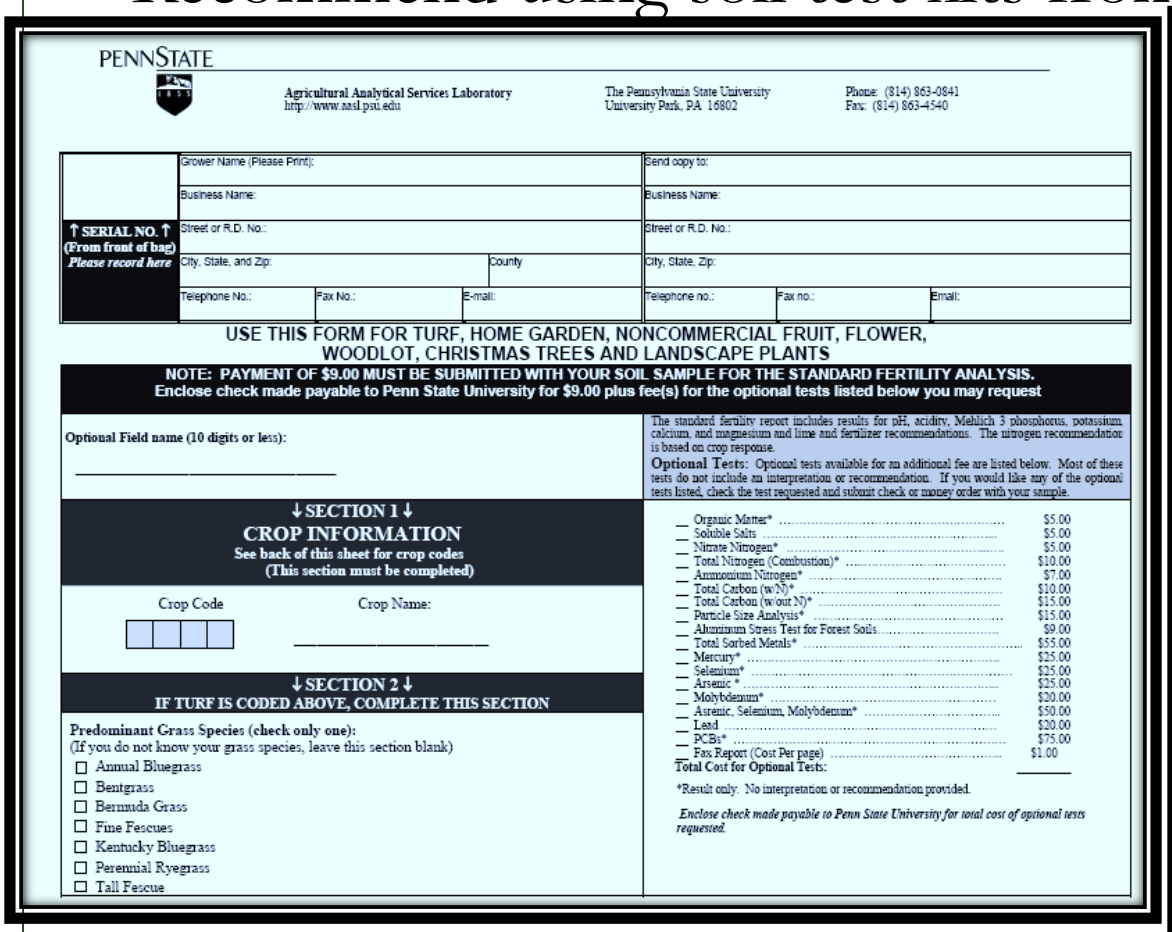
- Area of Interest (AOI)
- Find soil type
  - Enter into Official Soil Description Website

- Drainage Class vs. Hydrologic Soil Group
- % Sand, % Clay, % Silt
- Saturated Hydraulic Conductivity
  - Drainage
  - Permeability

- Frost-heave capacity

Soil Testing

- Recommend using soil test kits from Penn State



PENNSTATE

Agricultural Analytical Services Laboratory
http://www.aasl.psu.edu

The Pennsylvania State University
University Park, PA 16802

Phone: (814) 863-0841
Fax: (814) 863-4540

	Grower Name (Please Print):			Send copy to:		
	Business Name:			Business Name:		
↑ SERIAL NO. ↑ (From front of bag) *Please record here*	Street or R.D. No.:			Street or R.D. No.:		
	City, State, and Zip:		County	City, State, Zip:		
	Telephone No.:	Fax No.:	E-mail:	Telephone no.:	Fax no.:	Email:

USE THIS FORM FOR TURF, HOME GARDEN, NONCOMMERCIAL FRUIT, FLOWER, WOODLOT, CHRISTMAS TREES AND LANDSCAPE PLANTS

NOTE: PAYMENT OF $9.00 MUST BE SUBMITTED WITH YOUR SOIL SAMPLE FOR THE STANDARD FERTILITY ANALYSIS.
Enclose check made payable to Penn State University for $9.00 plus fee(s) for the optional tests listed below you may request

Optional Field name (10 digits or less):

_____

The standard fertility report includes results for pH, acidity, Mehlich 3 phosphorus, potassium, calcium, and magnesium and lime and fertilizer recommendations. The nitrogen recommendation is based on crop response.

Optional Tests: Optional tests available for an additional fee are listed below. Most of these tests do not include an interpretation or recommendation. If you would like any of the optional tests listed, check the test requested and submit check or money order with your sample.

↓SECTION 1↓
CROP INFORMATION
See back of this sheet for crop codes
(This section must be completed)

Crop Code ☐☐☐☐ Crop Name: _____

↓SECTION 2↓
IF TURF IS CODED ABOVE, COMPLETE THIS SECTION

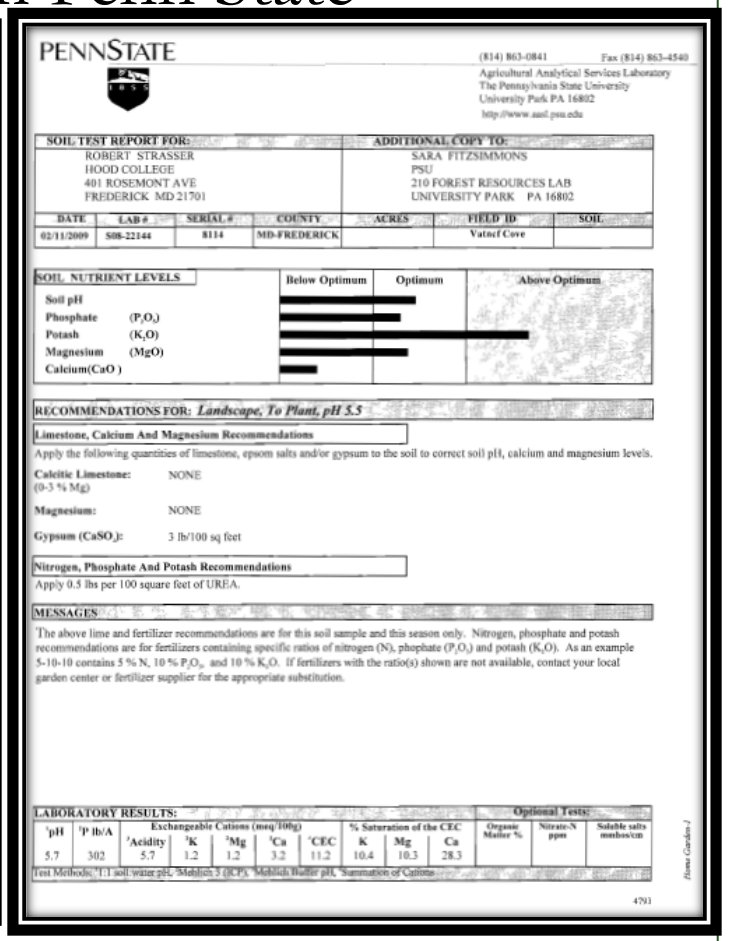
Predominant Grass Species (check only one):
(If you do not know your grass species, leave this section blank)

- ☐ Annual Bluegrass
- ☐ Bentgrass
- ☐ Bermuda Grass
- ☐ Fine Fescues
- ☐ Kentucky Bluegrass
- ☐ Perennial Ryegrass
- ☐ Tall Fescue

__ Organic Matter*	$5.00
__ Soluble Salts	$5.00
__ Nitrate Nitrogen*	$5.00
__ Total Nitrogen (Combustion)*	$10.00
__ Ammonium Nitrogen*	$7.00
__ Total Carbon (w/N)*	$10.00
__ Total Carbon (w/out N)*	$15.00
__ Particle Size Analysis*	$15.00
__ Aluminum Stress Test for Forest Soils	$9.00
__ Total Sorbed Metals*	$55.00
__ Mercury*	$25.00
__ Selenium*	$25.00
__ Arsenic *	$25.00
__ Molybdenum*	$20.00
__ Arsenic, Selenium, Molybdenum*	$50.00
__ Lead	$20.00
__ PCBs*	$75.00
__ Fax Report (Cost Per page)	$1.00
Total Cost for Optional Tests:	_____

*Result only. No interpretation or recommendation provided.

Enclose check made payable to Penn State University for total cost of optional tests requested.



PENNSTATE

(814) 863-0841 Fax (814) 863-4540
Agricultural Analytical Services Laboratory
The Pennsylvania State University
University Park PA 16802
http://www.aasl.psu.edu

SOIL TEST REPORT FOR:	ADDITIONAL COPY TO:
ROBERT STRASSER HOOD COLLEGE 401 ROSEMONT AVE FREDERICK MD 21701	SARA FITZSIMMONS PSU 210 FOREST RESOURCES LAB UNIVERSITY PARK PA 16802

DATE	LAB #	SERIAL #	COUNTY	ACRES	FIELD ID	SOIL
02/11/2009	S08-22144	8114	MD-FREDERICK		Vatnef Cove	

SOIL NUTRIENT LEVELS		Below Optimum	Optimum	Above Optimum
Soil pH				
Phosphate	(P_2O_5)			
Potash	(K_2O)			
Magnesium	(MgO)			
Calcium(CaO)				

RECOMMENDATIONS FOR: *Landscape, To Plant, pH 5.5*

Limestone, Calcium And Magnesium Recommendations

Apply the following quantities of limestone, epsom salts and/or gypsum to the soil to correct soil pH, calcium and magnesium levels.

Calcitic Limestone: NONE
(0-5 % Mg)

Magnesium: NONE

Gypsum ($CaSO_4$): 3 lb/100 sq feet

Nitrogen, Phosphate And Potash Recommendations

Apply 0.5 lbs per 100 square feet of UREA.

MESSAGES

The above lime and fertilizer recommendations are for this soil sample and this season only. Nitrogen, phosphate and potash recommendations are for fertilizers containing specific ratios of nitrogen (N), phophate (P_2O_5) and potash (K_2O). As an example 5-10-10 contains 5 % N, 10 % P_2O_5, and 10 % K_2O. If fertilizers with the ratio(s) shown are not available, contact your local garden center or fertilizer supplier for the appropriate substitution.

LABORATORY RESULTS:

pH	P lb/A	Exchangeable Cations (meq/100g)					% Saturation of the CEC			Optional Tests:		
		Acidity	K	Mg	Ca	CEC	K	Mg	Ca	Organic Matter %	Nitrate-N ppm	Soluble salts mmhos/cm
5.7	302	5.7	1.2	1.2	3.2	11.2	10.4	10.3	28.3			

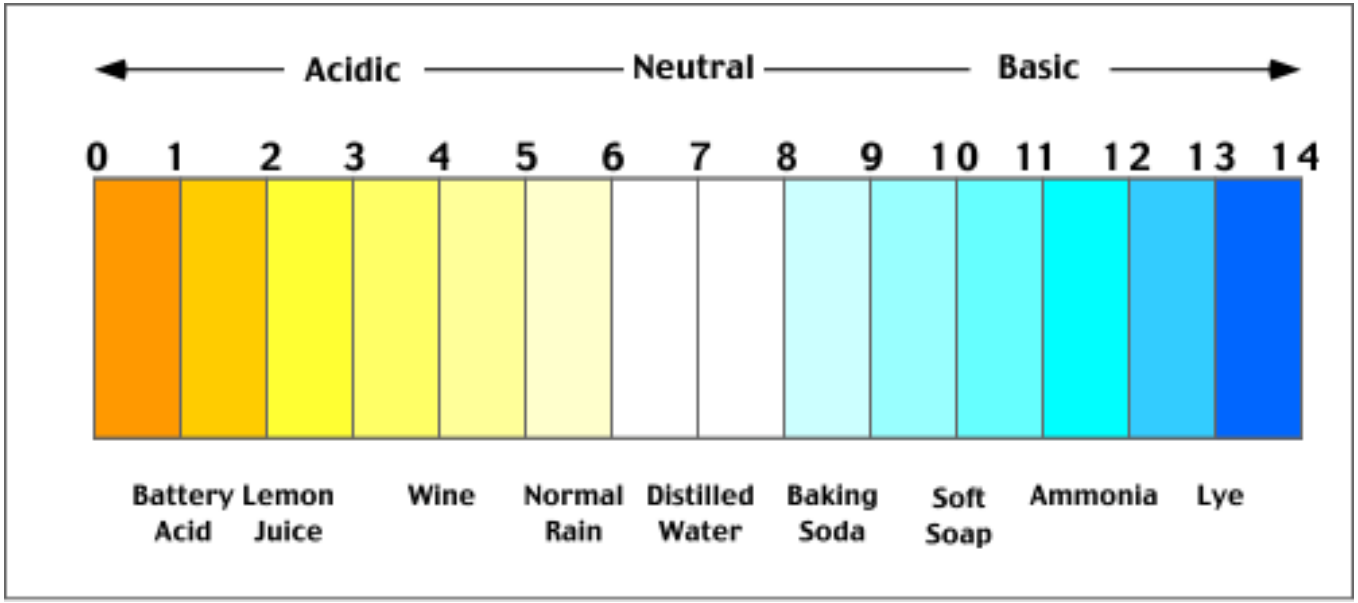
Test Methods: 1:1 soil: water pH, Mehlich 3 (ICP), Mehlich Buffer pH, Summation of Cations

4791

Photo courtesy Katy McCune

Sara Fitzsimmons

Soil pH



- How to increase?
  - Lime
- How to decrease?
  - Sulfur

Soil Test!

N : P : K

- N : P : K
  - N = Nitrogen
    - Important for vegetative growth
  - P = Phosphorous
    - Important for root growth and flower development
  - K = Potassium
    - Important for flower and fruit development as well as in assisting in disease resistance.

Chestnut Response to Nitrogen Input

Cation Exchange Capacity (CEC)

- the capacity of a soil for ion exchange of cations between the soil and the soil solution
- Clay and other organic matter (OM) are negatively charged
  - Will loosely attract cations – positively charged ions
  - Measuring CEC provides an indication of soil fertility
- Increase clay/OM : increase CEC
  - Sandy or low clay soils = low fertility?
  - What do chestnuts like?

CEC

- Ca : Mg : K
  - Ca: 1 – 5%
  - Mg: 10 – 15%
  - K: 60 – 80%

- Will be given in % Saturation
  - If don't add up to 100, the rest is hydrogen.
  - Decrease hydrogen, increase usable nutrients

PENNSTATE

(814) 863-0841 Fax (814) 863-4540
Agricultural Analytical Services Laboratory
The Pennsylvania State University
University Park PA 16802
http://www.aasl.psu.edu

THE AMERICAN CHESTNUT FOUNDATION®

NRCS

SOIL TEST REPORT FOR:	ADDITIONAL COPY TO:
RONALD KUIPERS 9606 CULVER ST KENSINGTON MD 20895	SARA FITZSIMMONS PSU 206 FOREST RESOURCES LAB UNIVERSITY PARK PA 16802

DATE	LAB #	SERIAL #	COUNTY	ACRES	FIELD ID	SOIL
12/02/2009	S09-15541	8118	MD-MONTGOME		Sha	

SOIL NUTRIENT LEVELS	Below Optimum	Optimum	Above Optimum
Soil pH			
Phosphate (P_2O_5)			
Potash (K_2O)			
Magnesium (MgO)			
Calcium(CaO)			

RECOMMENDATIONS FOR: *Landscape, To Plant, pH 5.5*

Limestone, Calcium And Magnesium Recommendations

Apply the following quantities of limestone, epsom salts and/or gypsum to the soil to correct soil pH, calcium and magnesium levels.

Calcitic Limestone: NONE
(0-3 % Mg)

Magnesium: NONE

Gypsum ($CaSO_4$): NONE

Nitrogen, Phosphate And Potash Recommendations

Apply 1.5 lbs per 100 square feet of 5-10-5 and 1.0 lbs per 100 square feet of 0-46-0.

MESSAGES

The above lime and fertilizer recommendations are for this soil sample and this season only. Nitrogen, phosphate and potash recommendations are for fertilizers containing specific ratios of nitrogen (N), phophate (P_2O_5) and potash (K_2O). As an example 5-10-10 contains 5 % N, 10 % P_2O_5, and 10 % K_2O. If fertilizers with the ratio(s) shown are not available, contact your local garden center or fertilizer supplier for the appropriate substitution.

pH is high. Use sulfur (see Table on back of report) to lower pH to optimum level of 5.5

LABORATORY RESULTS:

[1]pH	[2]P lb/A	Exchangeable Cations (meq/100g) [3]Acidity	[2]K	[2]Mg	[2]Ca	[4]CEC	% Saturation of the CEC K	Mg	Ca	Optional Tests: Organic Matter %	Nitrate-N ppm	Soluble salts mmhos/cm
7.0	48	0.0	0.4	1.9	7.4	9.8	4.5	19.8	75.7			

Test Methods: [1]1:1 soil/water pH, [2]Mehlich 3 (ICP), Mehlich Buffer pH, [4]Summation of Cations

7376

Home Garden-1

PENNSTATE

(814) 863-0841 Fax (814) 863-4540
Agricultural Analytical Services Laboratory
The Pennsylvania State University
University Park PA 16802
http://www.aasl.psu.edu

SOIL TEST REPORT FOR:	ADDITIONAL COPY TO:
ROBERT STRASSER HOOD COLLEGE 401 ROSEMONT AVE FREDERICK MD 21701	SARA FITZSIMMONS PSU 210 FOREST RESOURCES LAB UNIVERSITY PARK PA 16802

DATE	LAB #	SERIAL #	COUNTY	ACRES	FIELD ID	SOIL
02/11/2009	S08-22144	8114	MD-FREDERICK		Vatncf Cove	

SOIL NUTRIENT LEVELS	Below Optimum	Optimum	Above Optimum
Soil pH			
Phosphate (P_2O_5)			
Potash (K_2O)			
Magnesium (MgO)			
Calcium(CaO)			

RECOMMENDATIONS FOR: *Landscape, To Plant, pH 5.5*

Limestone, Calcium And Magnesium Recommendations

Apply the following quantities of limestone, epsom salts and/or gypsum to the soil to correct soil pH, calcium and magnesium levels.

Calcitic Limestone: NONE
(0-3 % Mg)

Magnesium: NONE

Gypsum ($CaSO_4$): 3 lb/100 sq feet

Nitrogen, Phosphate And Potash Recommendations

Apply 0.5 lbs per 100 square feet of UREA.

MESSAGES

The above lime and fertilizer recommendations are for this soil sample and this season only. Nitrogen, phosphate and potash recommendations are for fertilizers containing specific ratios of nitrogen (N), phophate (P_2O_5) and potash (K_2O). As an example 5-10-10 contains 5 % N, 10 % P_2O_5, and 10 % K_2O. If fertilizers with the ratio(s) shown are not available, contact your local garden center or fertilizer supplier for the appropriate substitution.

LABORATORY RESULTS:

[1]pH	[2]P lb/A	Exchangeable Cations (meq/100g) [3]Acidity	[3]K	[3]Mg	[3]Ca	[3]CEC	% Saturation of the CEC K	Mg	Ca	Optional Tests: Organic Matter %	Nitrate-N ppm	Soluble salts mmhos/cm
5.7	302	5.7	1.2	1.2	3.2	11.2	10.4	10.3	28.3			

Test Methods: [1]1:1 soil:water pH, [2]Mehlich 3 (ICP), [3]Mehlich Buffer pH, [4]Summation of Cations

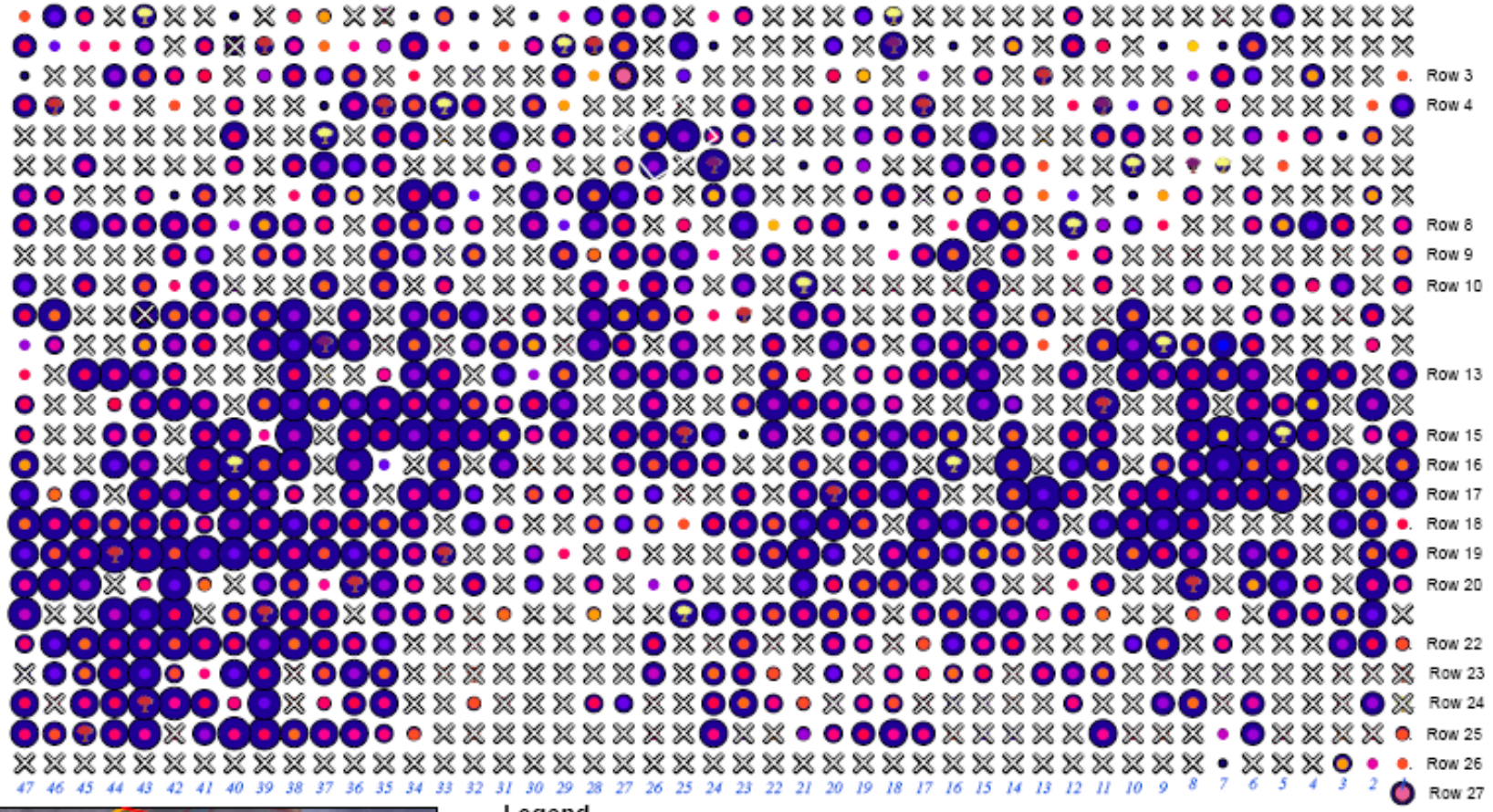
4793

Home Garden-1

THE AMERICAN CHESTNUT FOUNDATION®

NRCS

Kuhns Clapper BC3 Orchard Map



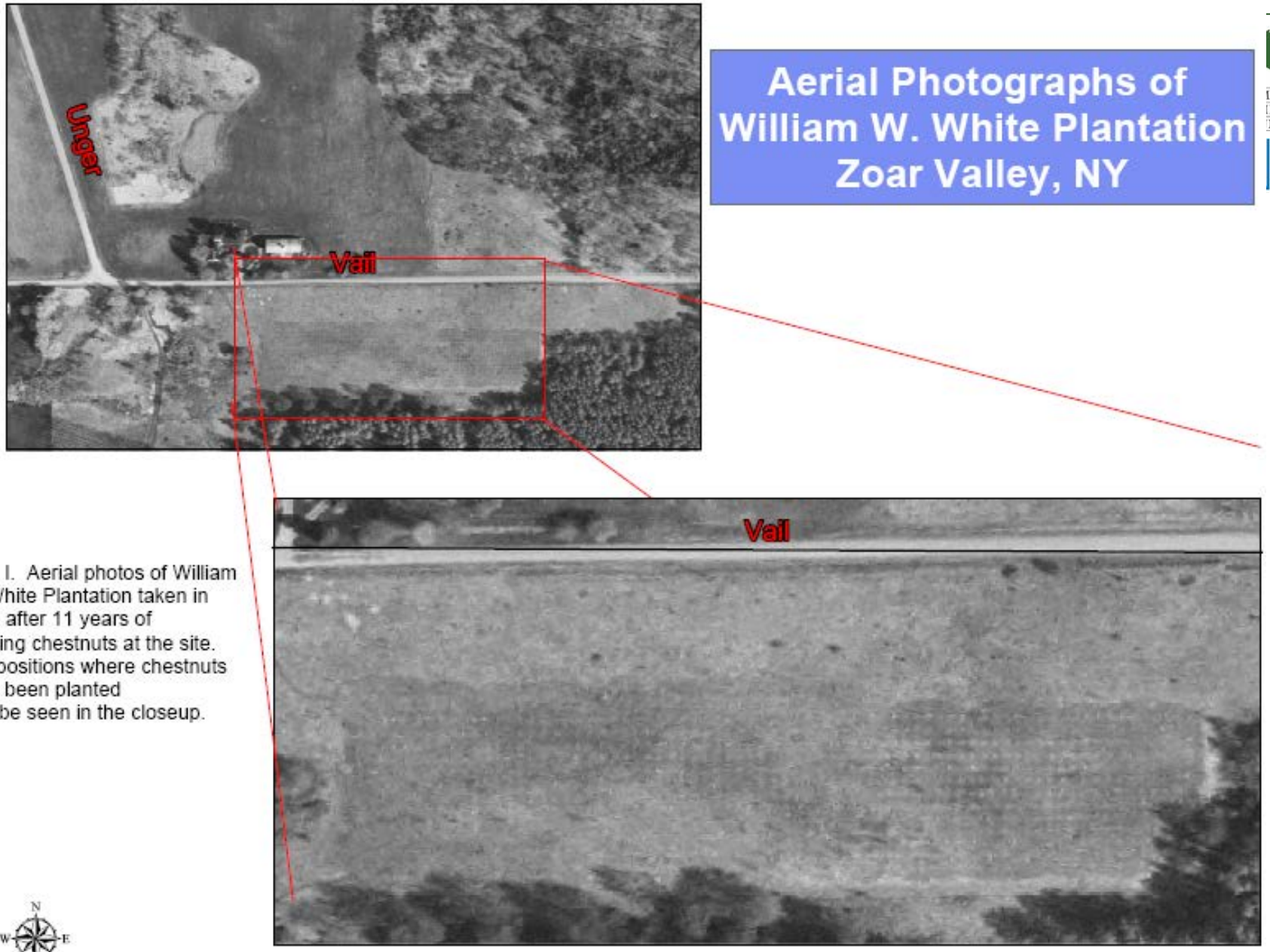
Legend

06_HT

- 0.00 - 2.50
- 2.51 - 5.00
- 5.01 - 7.50
- 7.51 - 10.00
- 10.01 - 12.50
- 12.51 - 15.00
- 15.01 - 17.50

Kuhns BC3 Orchard
Planted 2000; As Seedlings; No Replants
Soil Type: Andover
Inoculated 6/23/2006

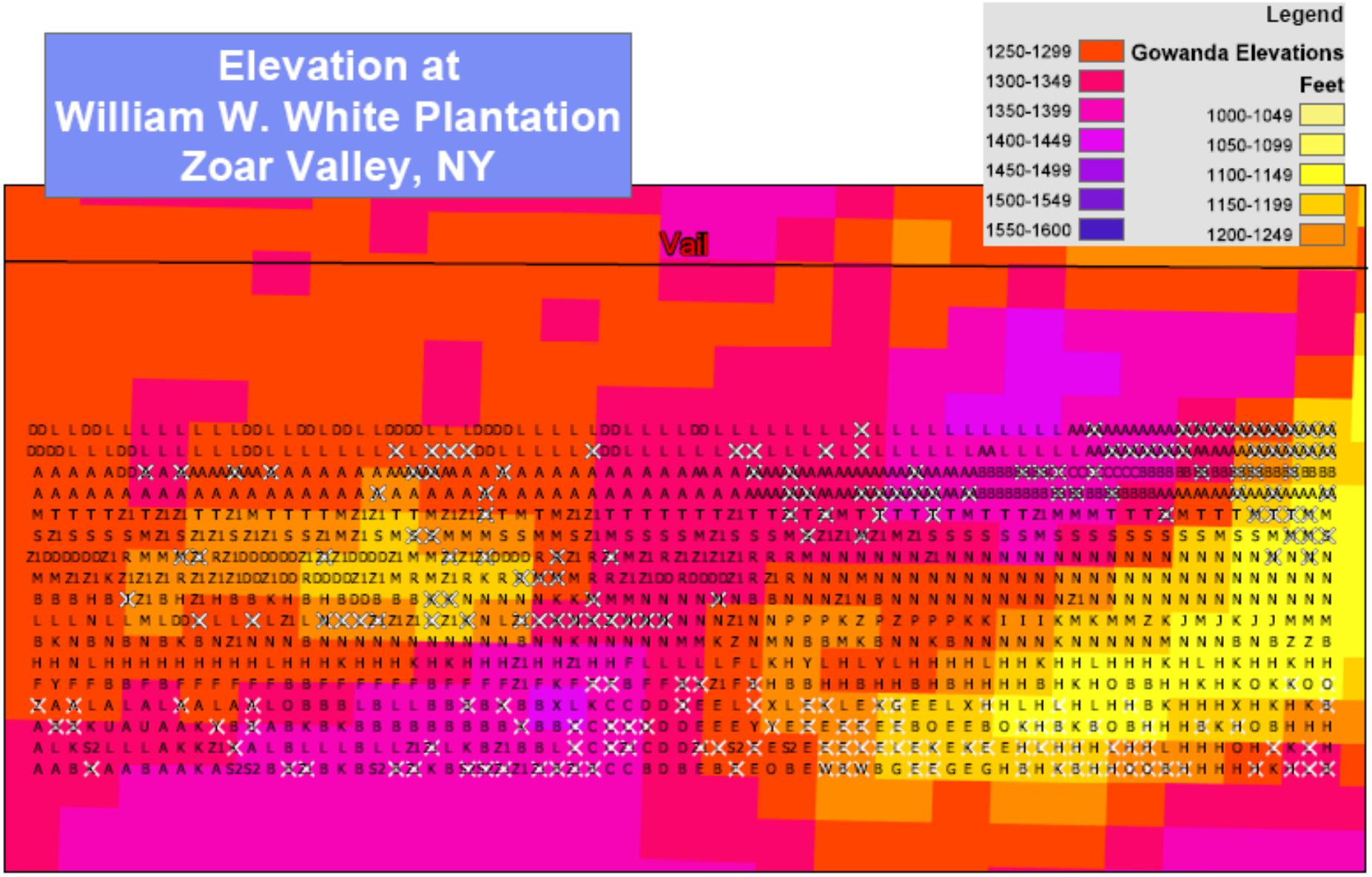
Aerial Photographs of William W. White Plantation Zoar Valley, NY



AP I. Aerial photos of William
'. White Plantation taken in
)02 after 11 years of
anting chestnuts at the site.
ıe positions where chestnuts
ave been planted
ay be seen in the closeup.

10/24/04, SFF

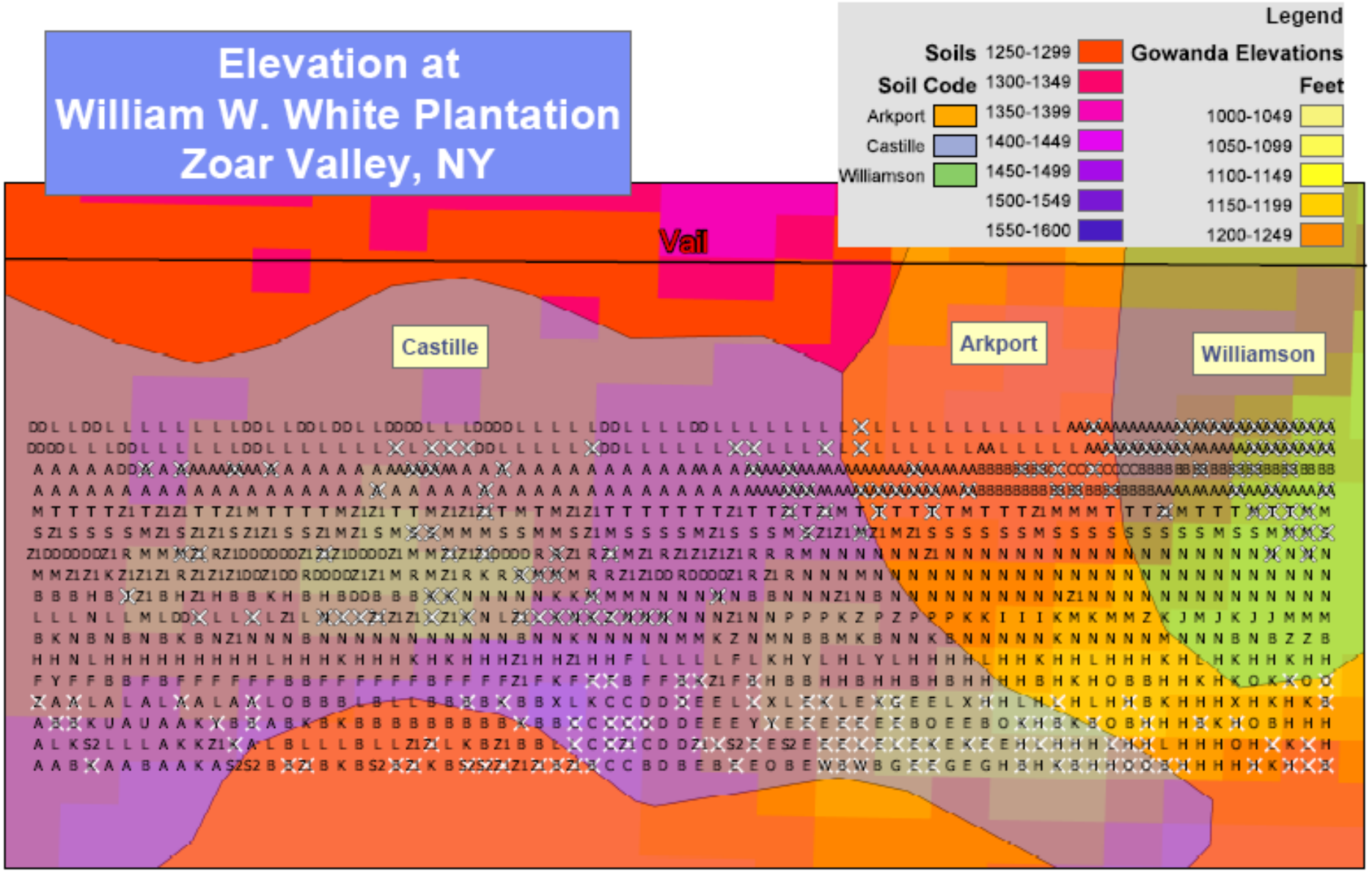
Elevation at William W. White Plantation Zoar Valley, NY



MAP II. Elevation, in feet, of William W. White Plantation in Zoar Valley, NY. Of particular particular interest is the low lying area in the middle left of the planting (indicated by yellow and orange). Within this are appears to be a wet area where growth is low and extensive replanting has occured. Tree locations are identified by tree type code which relates back to mother tree (Those values may be found in Table 5). Dead positions as of September 2004 are symbolized by a white "X".

10/24/04, SFF

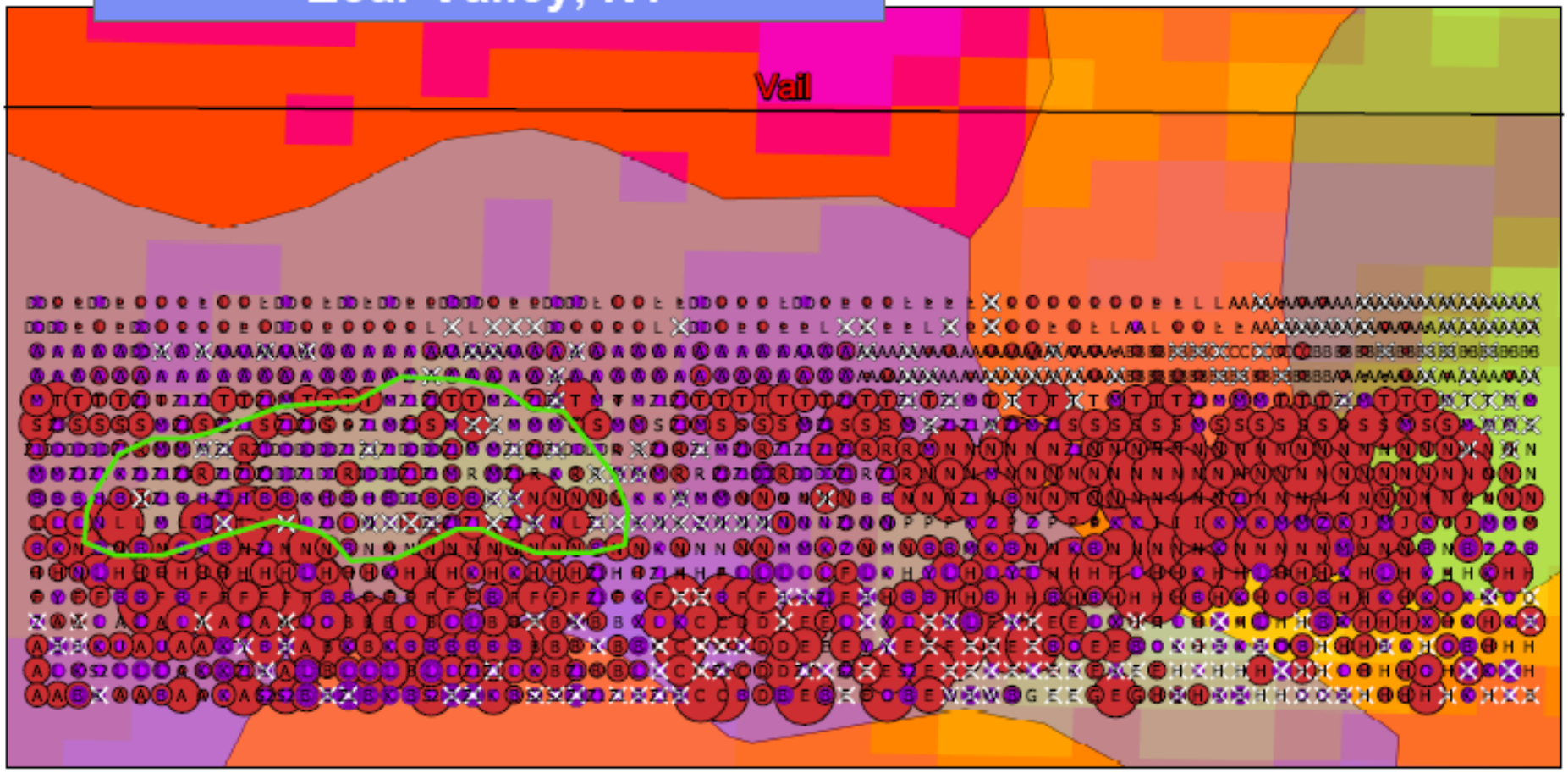
Elevation at William W. White Plantation Zoar Valley, NY



MAP III. Soils and Elevation of William W. White Plantation, Zoar Valley, NY. There are three different soil types found at the chestnt orchard, Arkport, Castille, and Williamson.

10/24/04, SFF

Replacements and "Wetland" of William W. White Plantation Zoar Valley, NY



10/24/04, SFF

MAP IV. Location of "wetland" is in green, positioned by some observation at site, soil type, and elevation. Replaced positions are symbolized by graduated purple circles -- the larger the circle, the more times that position has been placed. The maximum amount of times a position has been replaced at this orchard is five. Heights are shown by graduated red circles -- the larger the circle, the taller the tree

Sara Fitzsimmons

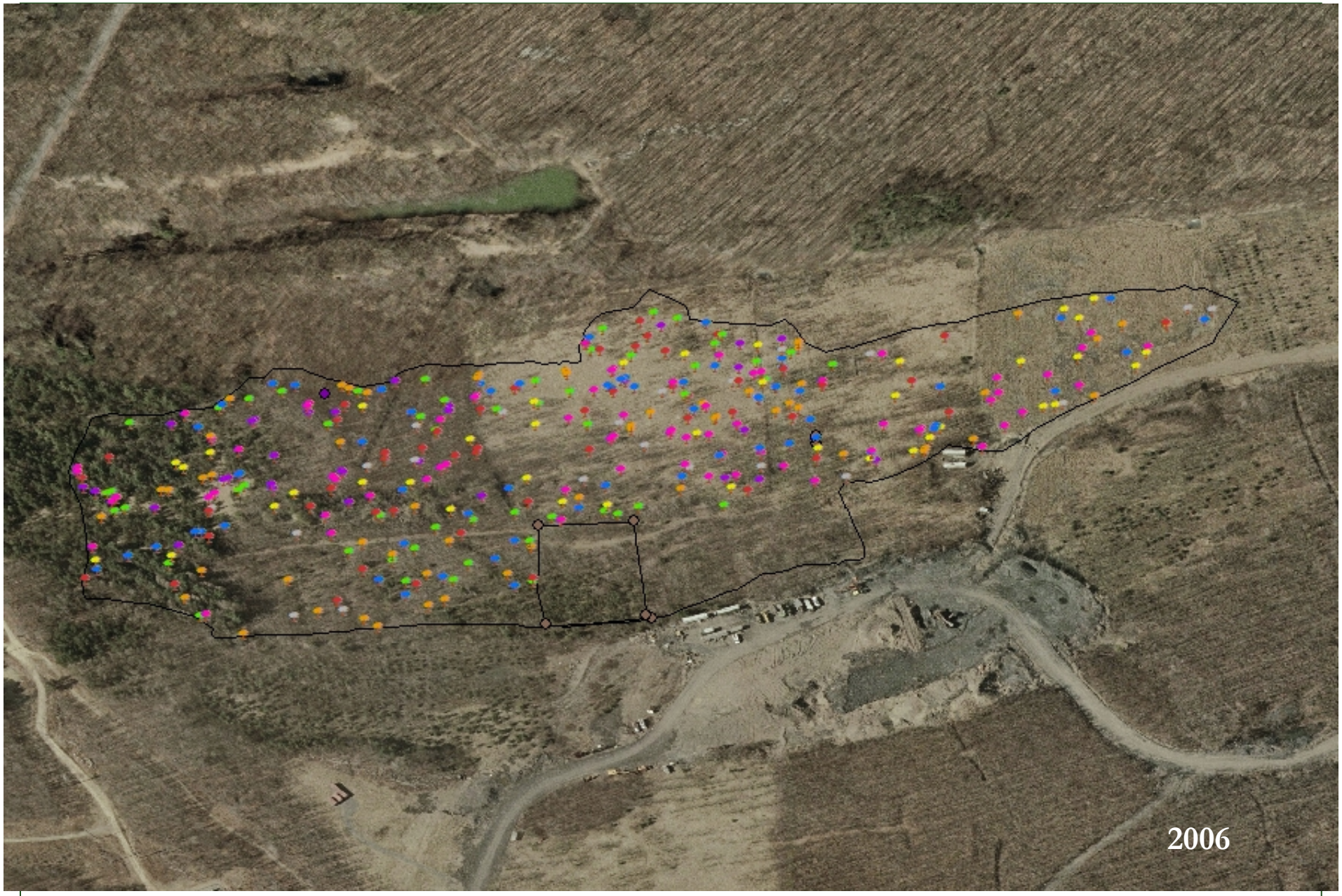
Tracking the Planting

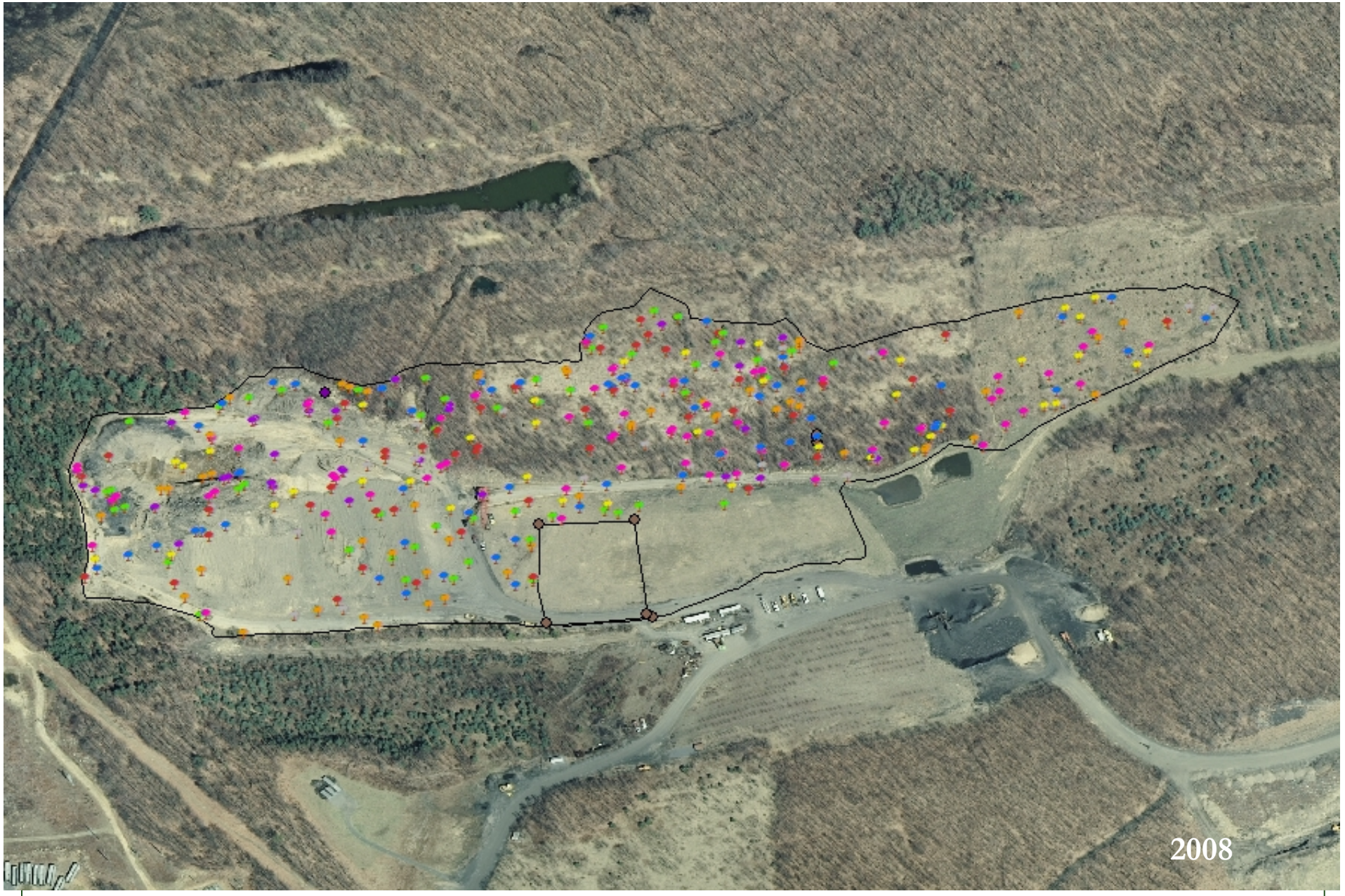
- It is important to randomize your chestnut planting
  - Often planting several sources of interest
  - Sources planted together may suffer from a local site issue or other geographically-oriented stressor (remember the activity?)
- Randomization also reduces site effect on performance
  - Genetic x Environment (G x E) interaction
  - Allows for a better snapshot of blight-resistance
  - Performance of an entire line not dependent on potential stress (or lack of stress) in one part of the planting

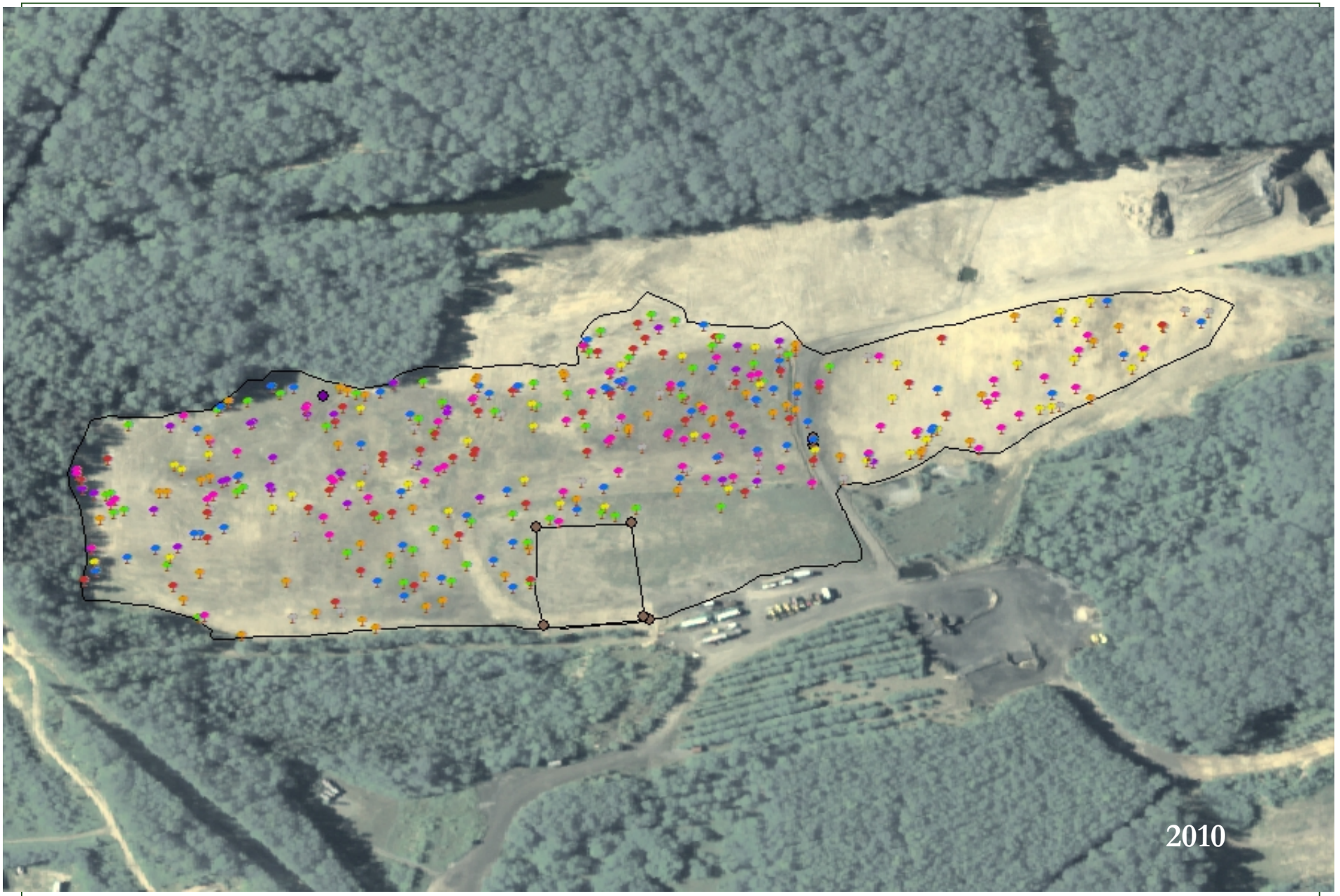
Tracking the Planting

- Chestnut plantings usually include several different crosses or species
  - Need a way to distinguish what goes where on the ground
  - Especially important with a large group of planters
- A color-coded layout works well
  - Plastic flags
  - Painted/colored stakes
- Can be done pre-planting or on planting day
  - If time to do prior to planting, this is a great prep task

http://www.forestry-suppliers.com/product_pages/View_Catalog_Page.asp?mi=1115&title=Plain+Vinyl+Stake+Wire+Flags#


2006


2008


2010

Tracking the Planting

- Beyond mapping, there is a need to track the planting over time
  - Yearly mortality, growth, performance, additional measures
- Work with Regional Science Coordinator to develop a format and set expectations for data collection
  - TreesDB in under development
    - Should be available "soon" to help track the trees in your planting

References

- Chestnut Growers Website
  - All presentations will be put here, and I will send out a link once they are posted.
- Fertilizing Woody Ornamentals
- Penn State Soil Analysis
  - http://www.aasl.psu.edu/SSFT.HTM
- NRCS Web Soil Survey
  - http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm
- Official Soil Series Descriptions (OSD)
  - https://soilseries.sc.egov.usda.gov/osdname.asp