

## Meta Data – Florida Soil Characterization Data

### Project Description:

The dataset encompasses about 1,300+ soil profiles and about 8,300+ soil horizon data collected across the State of Florida, U.S. There are 144 soil physical, chemical, biological, morphological, and taxonomic data included in this data set. These data represent the most comprehensive body of knowledge ever collected for Florida soils during ~1965 to 1996. Soil sampling locations were determined based on tacit knowledge of soil surveyors.

### Funding Sources:

Data collection and laboratory analysis: Accelerated Soil Survey Program (United States Department of Agriculture (USDA) - Natural Resources Conservation Service (NRCS) and Environmental Pedology Laboratory, Soil and Water Science Department, University of Florida.

Data mining (conversion of hardcopy data into digital format; georeferencing of sampling sites): Florida Department of Transportation (Principal Investigator: Dr. Sabine Grunwald). Project: "Soil and Environmental GIS Data to Support ETDM" Project No. 722184112.

### Quality:

The field and laboratory standards of Natural Resources Conservation Service and Soil and Water Science Department were followed. The data are provided without warranty to users.

### Contributors:

Principal Investigator - Florida Soil Characterization Data Mining Project	Dr. Sabine Grunwald, Soil & Water Science Department, University of Florida (UF)
Scientific Project Team :	Dr. W.G Harris, Soil & Water Science Department, University of Florida, and Mr. Wade Hurt, Natural Resources Conservation Service
Database Development :	Dr. S. A. Bloom, Soil and Water Science Department, UF
Data Assembly & GIS :	R.G. Rivero, V. Ramasundaram, M. Gao, B. Murphy, and K. Bloom
Data Collection : and Analysis	Staff of the Environmental Pedology Laboratory, Soil and Water Science Department, University of Florida in conjunction with the Natural Resources Conservation Service.

**Project Dates:** 01/1965 to 12/1996

**Project web site:** <http://flsoils.ifas.ufl.edu>

## Publications from this Project (that used data from this project)

Stone E.L., W.G. Harris, R.B. Brown and R.J. Kuehl. 1993. Carbon storage in Florida Spodosols. *Soil Sci. Soc. Am. J.* 57: 179–182.

Ross, C.W., S. Grunwald, D.B. Myers and X. Xiong. 2016. Land use, land use change and soil carbon sequestration in the St. Johns River Basin, Florida, USA. *Geoderma Reg.* 7, 19–28.  
doi:10.1016/j.geodrs.2015.12.001

Vasques G.M., S. Grunwald and D.B. Myers. 2012. Influence of the geographic extent and grain size on soil carbon models in Florida, USA. *J. of Geophys. Research – Biogeosciences* 117. G04004: 1-12.  
doi:10.1029/2012JG001982.

Vasques G.M., S. Grunwald and D.B. Myers. 2012. Associations between soil carbon and ecological landscape variables at escalating spatial scales in Florida, USA. *Landscape Ecology J.* 27: 355-367.  
doi:10.1007/s10980-011-9702-3.

Vasques G.M., S. Grunwald and W.G. Harris. 2010. Building a spectral library to estimate soil organic carbon in Florida. *J. Environ. Qual.* 39: 923-934.

Xiong X., S. Grunwald, D.B. Myers, C.W. Ross W.G. Harris and N.B. Comerford. 2014. Interaction effects of climate and land use/land cover change on soil organic carbon sequestration. *Science of Total Environment J.* 493: 974-982. <http://dx.doi.org/10.1016/j.scitotenv.2014.06.088>

## Description

### Purpose of sampling (what project, to answer what questions, etc.)

Name: Florida Soil Characterization Data

The dataset encompasses about 1,300+ soil profiles and about 8,300+ soil horizon data collected across the State of Florida, U.S. There are 144 soil physical, chemical, biological, morphological, and taxonomic data included in this data set. These data represent the most comprehensive body of knowledge ever collected for Florida soils during ~1965 to 1996. Soil sampling locations were determined based on tacit knowledge of soil surveyors.

### General sampling location

State(s): Florida

## Sample acquisition and processing

### Geo-referencing of Sampling Locations

Sites were sampled over decades and collection of site-specific information changed during the FL Soil Survey Program. Thus, to attach x and y coordinates to each site had to be adapted depending on available information:

1. The latitude and longitude as provided by the field team;

2. Soil maps and aerial photographs on which the sampling locations were marked, so characterization was simply a matter of coordinate conversion from the map coordinate system (township and ranges) to latitude and longitude; or
3. Utilization of the sample location description metadata to project the described point onto a township and range system from which the latitude and longitude could be found
4. Soil Survey Geographic Database (SSURGO), Natural Resources Conservation Service which allowed check-up between site-specific pedon data and soil map polygons

### Map Projection

The FLSC data coordinates are provided with North American Datum 1983 HARN (NAD83) and in Albers Conical Equal Area map. The data are reprojected to World Geodetic System 1984 (WGS84), and are presented in latitude and longitude.

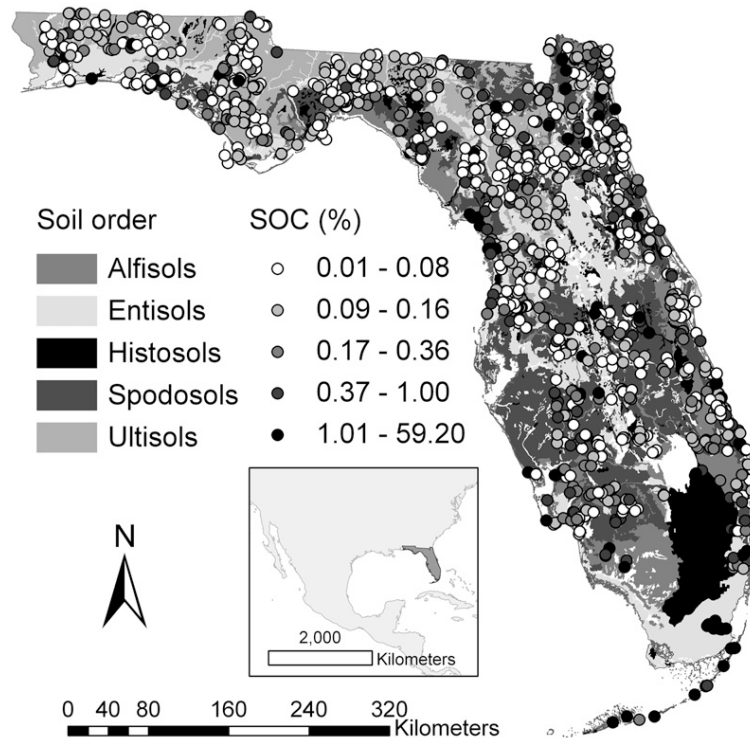


Fig. 1. Distribution of soil profiles and soil orders within the state of Florida. Soil orders were derived from the State Soil Geographic (STATSGO) database (Natural Resources Conservation Service, 2006); Mollisols, Inceptisols, and

**Data Description:**

Variable (column) Name	Previous Variable Name	Data Type	Units	Meta Data
<b>Core Fields</b>				
ID	SN	Number	-	Identification number. Unique number for each data record (ascending order: 1, 2, ..., n)
REPN	REPN	Number	-	Replicate number provided by the user, in the case of repeated measures or time series
LONG_WGS84	-	Number	Decimal degrees	X-coordinate in the World Geodetic System 1984 (WGS84) projection. <u>Map projection parameters:</u> Albers Conical Equal Area map projection: Albers False_Easting: 400000.00000000 False_Northing: 0.00000000 Central_Meridian: -84.00000000 Standard_Parallel_1: 24.00000000 Standard_Parallel_2: 31.50000000 Central_Parallel: 24.00000000 Linear Unit: Meter (1.000000) Geographic Coordinate System: GCS_North_American_1983_HARN Datum: D_North_American_1983_HARN Prime Meridian: 0
LAT_WGS84	-	Number	Decimal degrees	Y-coordinate in the World Geodetic System 1984 (WGS84) projection. <u>Map projection parameters:</u> Albers Conical Equal Area map projection: Albers False_Easting: 400000.00000000 False_Northing: 0.00000000 Central_Meridian: -84.00000000 Standard_Parallel_1: 24.00000000 Standard_Parallel_2: 31.50000000 Central_Parallel: 24.00000000 Linear Unit: Meter (1.000000) Geographic Coordinate System: GCS_North_American_1983_HARN Datum: D_North_American_1983_HARN Prime Meridian: 0
DATE	SAMPLEDATE (had to be reformatted to fit MM/DD/YYYY)	Date	(MM/DD/YYYY)	Date soil was described and sampled
TIME	< Added >	Time	(HH:MM:SS)	Time of soil observation (hours:minutes:seconds). Not collected in this project
ELEV	ELEV	Decimal	m	Altitude of soil surface above mean sea level. Not collected in this project
Z	Z	Decimal	m	Depth of measurement (Z) in cm; below the soil surface negative numbers. In this project instead of Z the upper and lower bounds of horizons were collected (compare

				variables Top_Depth and Bott_Depth). In this data base soil analytical measurements represent the soil sample collected between upper and lower horizon boundaries.
Ancillary Core Fields				
DATEOrig	< Missing >	String		Date soil was described and sampled
Day	< Missing >	Number		Day soil was sampled
Month	< Missing >	Number		Month soil was sampled
Year	< Missing >	Number		Year soil was sampled
Identification Code				
Pedon_ID	< Missing >	String		Pedon identification number; consists of the initial character 'S', followed by a two-digit code for the county (by alphabetical order of the counties of Florida), a dash, and a three-digit code representing the profile number (and therefore the sampling sequence) within that county.
Horizon_ID	HorzIndex	Number		A unique horizon index
Layer	Layer	Number		Number for each layer with 1 designating the top layer; and 2, 3, ....n layers counting down the soil profile
LAB_NUM	LAB_NUM	Number		Laboratory sample number. A four digit laboratory identification number that links this specific horizon to the results of the laboratory examination of the sample taken from this horizon
Comment	COMMENTS	String		Comments (soil sampling and/or laboratory analysis)
Described	DESCRIBED	String		Personnel who described and sampled the soil
Geographic Data				
Location	LOCATION	String		Description of sampling location (county in Florida and georeferencing of sites based on the Public Land Survey System – PLSS)
X_NAD83	X	Decimal	degrees	Geographic Coordinate - longitude in decimal degrees, North American Datum 1983 (NAD83)
Y_NAD83	Y	Decimal	degrees	Geographic Coordinate - latitude in decimal degrees, North American Datum 1983 (NAD83)
ALBERS_X	ALBERS_X	Decimal	m	X-coordinate in the Albers Equal Area Conic map projection. <a href="#">Map projection parameters:</a> Albers Conical Equal Area map projection: Albers False_Easting: 400000.00000000 False_Northing: 0.00000000 Central_Meridian: -84.00000000

				Standard_Parallel_1: 24.00000000 Standard_Parallel_2: 31.50000000 Central_Parallel: 24.00000000 Linear Unit: Meter (1.000000) Geographic Coordinate System: GCS_North_American_1983_HARN Datum: D_North_American_1983_HARN Prime Meridian: 0
ALBERS_Y	ALBERS_Y	Decimal	m	Y-coordinate in the Albers Equal Area Conic map projection. <a href="#">Map projection parameters:</a> Albers Conical Equal Area map projection: Albers False_Easting: 400000.00000000 False_Northing: 0.00000000 Central_Meridian: -84.00000000 Standard_Parallel_1: 24.00000000 Standard_Parallel_2: 31.50000000 Central_Parallel: 24.00000000 Linear Unit: Meter (1.000000) Geographic Coordinate System: GCS_North_American_1983_HARN Datum: D_North_American_1983_HARN Prime Meridian: 0
GeoRefComment	GEOREFCOMMENT	String		Comments on the process of georeferencing sampling points
GeoRefSource	GEOREFSOURCE	String		Source of georeferencing
County	< missing > Needed to be added back	String		County in Florida the soil sample was collected
<b>Soil Taxonomic Data</b>				
Soilname	SOILNAME	String	-	The scientific designation for the soil at the profile's location according U.S. Soil Taxonomy (time of sampling)
Classification	CLASSIFICATION	String	-	The current classification for the soil at the profile's location according U.S. Soil Taxonomy
Series	SERIES	String	-	Soil Series according to U.S. Soil Taxonomy
Order	ORDER	String	-	Soil Order according to U.S. Soil Taxonomy
Suborder	SUBORDER	String	-	Soil Suborder according to U.S. Soil Taxonomy
GreatGroup	GREATGROUP	String	-	Great Group according to U.S. Soil Taxonomy
Subgroup	SUBGROUP	String	-	Soil Subgroup according to U.S. Soil Taxonomy
Family	FAMILY	String	-	Family according to U.S. Soil Taxonomy
HName	HNAME	String	-	Horizon designation Capital letters designate A, B, E, C and R mineral master horizons; L and O organic master horizon. Lower letters designate specific features within master horizons: a: Highly decomposed organic material; b: buried genetic horizon; c: concretions or hard nonconcretionary

				<p>nodules; d: physical root restriction; e: organic material of intermediate decomposition; g: strong gleying; h: illuvial accumulation of organic matter; i: slightly decomposed organic material; k: accumulation of carbonates; m: cementation of induration; o: residual accumulation of sesquioxides; p: tillage or other cultivation disturbance; r: weathered or soft bedrock; s: illuvial accumulation of sesquioxides and organic matter; ss: presence of slickensides; t: accumulation of silicate clay; v: plinthite; w: development of color and structure. Arabic numerals are added as suffixes to the horizon designations to identify subdivisions within horizons (e.g. Bt1-Bt2 indicates two different Bt horizons). The convention for designating discontinuities is the use of Arabic numbers as prefixes to the horizon designation. By convention the top layer is not numbered, thus the second layer is designated 2 and subsequent lower layers 3, 4 and so on. Primes (') are used if two (or more) horizons in the same profile have the same horizon designation but be separated by an unlike horizon; the lower of the two horizons is then designated as prime (').</p>
HDescrip	HDESCRIPT (this field was cut off)	String	-	Description of the soil horizon by field crew
HDepth	HDEPTH	String	cm	Horizon depths with upper and lower boundaries in centimeter relative to the soil surface (depth Z = zero)
Top_Depth	TOP_DEP	Numbers	cm	Upper horizon boundary of soil observation relative to the soil surface (depth Z = zero)
Bott_Depth	BOTT_DEP	Numbers	cm	Bottom horizon boundary of soil observation relative to the soil surface (depth Z = zero)
<b>Soil Properties</b>				
Sand_VF	SAND_VF	Numbers	% wt	Very fine sand. It is the soil separate with 0.05 to 0.10 mm particle diameter. It is reported as a gravimetric percent on a <2 mm base.
Sand_F	SAND_F	Numbers	% wt	Fine sand. It is the soil separate with 0.10 to 0.25 mm diameter particles. It

				is reported as a gravimetric percent on a <2 mm base.
Sand_M	SAND_M	Numbers	% wt	Medium sand is the soil separate with 0.25 to 0.50 mm particle diameter. It is reported as a gravimetric percent on a <2 mm base.
Sand_C	SAND_C	Numbers	% wt	Coarse sand. It is the soil separate with 0.5 to 1.0 mm particle diameter. It is reported a gravimetric percent on a <2 mm base.
Sand_VC	SAND_VC	Numbers	% wt	Very coarse sand. It is the soil separate with 1.0 to 2.0 mm particle diameter. It is reported as a gravimetric percent on a <2 mm base.
Sand_T	SAND_TOT	Numbers	% wt	<p>Total sand derived from pipette method.</p> <p><u>Reagents</u> Hydrogen peroxide, 30% (H<sub>2</sub>O<sub>2</sub>); Sodium hexametaphosphate [(NaPO<sub>3</sub>)<sub>6</sub>.Na<sub>2</sub>O]; d make to volume (50% solution)</p> <p><u>Sample Preparation and Procedure</u> For samples containing &gt;1% organic carbon (surface soils and Bh horizons), remove organic carbon by oxidation with 30% H<sub>2</sub>O<sub>2</sub>. Weigh 100.0g soil into beakers, add approximately 200mL H<sub>2</sub>O, 25mL H<sub>2</sub>O<sub>2</sub> and place on the hot plate with low heat. It may be best to let them sit overnight to prevent foaming over. This is before putting them on the hot plate. Make subsequent additions of H<sub>2</sub>O<sub>2</sub> as necessary to remove excess H<sub>2</sub>O<sub>2</sub> and proceed as follows. (Note: Be sure to correct calculations based on %O.C.)</p> <p>Weigh 50g (&gt;30%clay) or 100g (&lt;30% clay) into 400mL beakers, add 100mL sodium hexametaphosphate, let stand overnight. Do same for oxidized samples. Carefully transfer samples to mixer cup and mix for 3 minutes. Then transfer sample carefully from cup to cylinder making sure sample is completely transferred; make to 1000mL with deionized water, stopper and shake, and place into water bath. Include a blank for each run.</p> <p>Important: Note time and water temperature. These elements are necessary to determine at what time and depth aliquots are to be taken. See table.</p> <p>Using 25mL automatic pipette, draw off aliquot at required time and depth and carefully dispense into numbered and weighed aluminum weighing dishes. Place these samples in drying oven overnight. Remove cylinders from water bath, decant silt and clay with repeated washing until only sand remains. Wash sands into 400mL beakers, decant water, and place in drying oven overnight.</p>



				<p>Remove the weighing dishes from oven and weigh. This is a quantitative measure of the clay fraction. Remove sands from the oven, completely transfer to a nest of sieves, and shake on Ro-tap for 3 minutes. Weigh <i>sand separates</i>. This is a quantitative measure of the total sand fraction. The silt fraction is obtained by difference.</p> <p><u>Calculations</u>  Percent sand = [(sand wt.)*100] divided by (sample wt.)  Percent clay = (boat wt. + clay wt + Na3PO4 – boat wt – blank wt)(40)(100) divided by (sample wt)  Percent silt = 100% - %clay - %sand</p> <p><u>Footnotes to Particle Size Differential Analysis Procedure</u>  1. Samples should be weighed to 50.0g +/- 0.1g. If a sample is over 50% clay a sample weight of 25.0 +/- 0.1g may work better.  2. Aluminum weighing boats should be weighed to three decimal places.  3. Experimental laboratory error should be approximately 5%. If results fall outside of this range, the sample should probably be run again.  4. Field data can vary as much as 20% and still give meaningful information.</p> <p><b>References</b>  Soil Survey Laboratory Methods Manual. August 1992. p.14. U.S. Department of Agriculture.</p>
Silt_T	SILT_TOT	Numbers	% wt	Total silt derived from pipette method [compare meta data Sand_T]
Clay_T	CLAY_TOT	Numbers	% wt	Total clay derived from pipette method [compare meta data Sand_T]
Texture_C	TEXT_C	String	-	Soil texture designations: COS or cos: Coarse sand; S or s: Sand; FS or fs: Fine sand; VFS or vfs: Very fine sand; LCOS or lcos: Loamy coarse sand; LS or ls: loamy sand; LFS or lfs: Loamy fine sand; LVFS or lvfs: Loamy very fine sand; COSL or cosl: Coarse sandy loam; SL or sl: Sandy loam; FSL or fsl: Fine sandy loam; VFSL or vfsl: Very fine sandy loam; L or l: Loam; SIL or sil: Silt loam; SI or si: Silt; SCL or scl: Sandy clay loam; CL or cl: Clay loam; SICL or sicl: Silty clay loam; SC or sc: Sandy clay;

				<p>SIC or sic: Silty clay;  C or c: Clay;  MK: Muck;  PEAT;  GR: Gravelly modifier of a specific texture. E.g. Gravelly sandy loam. Fragment range for gravelly modifier is 15 to 35%.  VGR: Very gravelly modifier. Fragment range for very gravelly modifier is 35 to 50%.</p>
MaxDepthSand	MAXDEPTHSAND	Number	cm	<p>Maximum depth of sand in a given soil profile.</p> <p><u>Procedure:</u> To determine the maximum depth of sand in any given profile requires:</p> <ul style="list-style-type: none"> <li>• that each horizon in the profile be categorized by using the sand, silt and clay values to place the horizon on the standard texture triangle; and</li> <li>• that the profile be scanned from the surface downwards horizon by horizon for membership in the 'sand' and 'loamy sand' categories. When a horizon is found not to fall into one of these two categories, the upper depth of that horizon was taken as the 'maximum depth of sand' in that profile. If all horizons sampled fell into the two categories, the value '999' was assigned and should be taken to mean that the maximum depth of sand was unknown but exceeded the maximum depth sampled. In all cases, the units associated with depth are centimeters.</li> </ul> <p>The categorization of a horizon required:</p> <ul style="list-style-type: none"> <li>• The development of an algorithm that can project a point based on the composition percentages into the triangle and, conversely, can convert a point in the triangle into an equivalent point in a Cartesian coordinate system;</li> <li>• The conversion of the vertices of the polygons in the triangle for all soil types into such a coordinate system;</li> <li>• The mapping of those coordinates into a graphic system such that each soil type was uniquely colored; and</li> <li>• The projection of a given horizon into that graphic system using the composition percentages to determine the color of the pixel at that location which, in turn, indicates the soil type.</li> </ul> <p>Values: 0-999 in cm; a 999 indicating unknown depth, and a 0 indicating no depth</p>
DepthRock	MinDEPTHROCK	Number	cm	<p>Depth to bed rock</p> <p><u>Process to derive property:</u> For a given profile, each horizon (starting at the surface) was scanned for the presence of 'R' or 'r' in the horizon's name. If found, the upper depth of that horizon was taken as the depth to bedrock in that profile.</p>

				Values: 0-999 in cm; a 999 indicating unknown depth, and a 0 indicating no depth
PH_1	PH_H2O	Number	pH is defined as a negative decimal logarithm of the hydrogen activity in a solution	<p><b>Water pH</b></p> <p><u>Procedure:</u> For 1:1 dilution add an equal weight of water to 20 or 30 g soil in a 50-ml beaker. Stir at regular intervals for about an hour. Measure pH of the soil suspension with a glass electrode, stilling well before immersing the electrodes in the suspension. Ratio 1:1.</p> <p>For most soils the pH values are: H<sub>2</sub>O&gt;CaCl<sub>2</sub>&gt;KCl</p> <p><u>Reference:</u> Soil Survey Laboratory Methods Manual. August 1992 or 1996. U.S. Department of Agriculture, Natural Resources Conservation Service, National Soil Survey Center.</p>
PH_2	PH_CACL2	Number	pH is defined as a negative decimal logarithm of the hydrogen activity in a solution	<p><b>CaCl<sub>2</sub> pH</b></p> <p>Same as in method "Water pH" except use 0.01 M CaCl<sub>2</sub>. Ratio 1:2.</p> <p><u>Reference:</u> Soil Survey Laboratory Methods Manual. August 1992 or 1996. U.S. Department of Agriculture, Natural Resources Conservation Service, National Soil Survey Center.</p>
PH_3	PH_KCL	Number	pH is defined as a negative decimal logarithm of the hydrogen activity in a solution	<p><b>KCl pH</b></p> <p>Same as in method "Water pH" except use N KCl instead of water. Ratio 1:1.</p> <p><u>Reference:</u> Soil Survey Laboratory Methods Manual. August 1992 or 1996. U.S. Department of Agriculture, Natural Resources Conservation Service, National Soil Survey Center.</p>
EC	ELECCOND	Number	MMHO/cm	<b>Electrical conductivity</b>
TP_1	TOT_PHOS	Number	ppm	<p><b>Total phosphorus</b></p> <p>An alkaline oxidation method for determination of Total Phosphorus in Soils By: W.A. Dick and M.A. Tabatabai</p> <p><u>Reagents:</u></p> <ul style="list-style-type: none"> <li>• Sodium Hypobromite Solution: Add 3mL of bromine slowly to 100mL of 2M NaOH.</li> <li>• Formic Acid: 90% (Fisher Scientific)</li> <li>• Sulfuric acid (5N): Add 145mL of concentrated H<sub>2</sub>SO<sub>4</sub>, AR quality, to about 700mL of H<sub>2</sub>O and dilute to 1 liter with H<sub>2</sub>O.</li> <li>• Ammonium Molybdate-Antimony Potassium Tartrate Solution (Reagent A) Dissolve 12g of ammonium molybdate (J.T. Baker Chemical Co.) in 100mL of H<sub>2</sub>O. Add both solutions to 1 liter of 5N H<sub>2</sub>SO<sub>4</sub>, dilute to 2 liters with H<sub>2</sub>O, and mix the solution thoroughly. Store this reagent in a Pyrex glass bottle in a dark, cool place.</li> <li>• Ascorbic Acid Solution (Reagent B) : Dissolve 1.056g of ascorbic acid (J.T.</li> </ul>

				<p>Baker Co.) in 200mL of Reagent A and mix the solution thoroughly. Prepare daily.</p> <ul style="list-style-type: none"> <li>• Standard Phosphate Solution: Dissolve 0.2195g of potassium dihydrogen phosphate (KH<sub>2</sub>PO<sub>4</sub>) in about 700mL of H<sub>2</sub>O, and dilute to 1 liter. This contains 50ppm of orthophosphate P per mL. Should be refrigerated.</li> <li>• 2M NaOH: Put 80g NaOH in a liter volumetric flask. Dissolve the NaOH and dilute with 2D H<sub>2</sub>O [double-distilled deionized water] to 1 liter.</li> </ul> <p><u>Procedure:</u></p> <ol style="list-style-type: none"> <li>1. ~.25g soil (&lt;60 or 100 mesh).</li> <li>2. Place soil in glass centrifuge tube.</li> <li>3. Add 3mL of sodium hypobromite solution. IMPORTANT: Prepare hypobromite solution immediately before use. Can be used after several hours.</li> <li>IMPORTANT: Add bromide slowly (approximately 0.5mL /min) and with constant stirring.</li> <li>4. Swirl tubes for a few seconds and then let stand for 5 minutes.</li> <li>5. Swirl again and place on sand bath (260-280 degrees C) for approximately 45 minutes. For first 30 minutes place gently into sand. Then push into sand (deep) for 15 minutes.</li> <li>6. Remove and allow to cool.</li> <li>7. Add 3mL of distilled H<sub>2</sub>O. Add 2mL of formic acid. Swirl gently.</li> <li>IMPORTANT: Make sure contents are in solution and not stuck to the sides or bottom of the tube.</li> <li>IMPORTANT: When swirling stopper the tubes. Be very careful. Gas will build up and the stopper may be "shot off". Release the stopper every few seconds to allow for the gas to escape.</li> <li>8. Add 25mL of 1.0N H<sub>2</sub>SO<sub>4</sub>. Stopper and shake carefully.</li> <li>9. Place tubes in the centrifuge at 3000rpm for 10 minutes.</li> <li>10. Aliquot 2mL from each tube into 25mL volumetric flask.</li> <li>11. Add 4mL of ascorbic acid solution. (Reagent B)</li> <li>12. Fill with distilled H<sub>2</sub>O to 25mL.</li> <li>13. Stopper and shake contents.</li> <li>14. After 30 minutes read on the Spec 20 at 720nm.</li> <li>15. Record absorbance.</li> </ol> <p><u>Reference:</u> Soil Survey Laboratory Methods Manual. August 1992. U.S. Department of Agriculture.</p>
C_1	ORG_C	Number	%	<p><b>Soil organic carbon</b> Walkley-Black for mineral soils and Loss on Ignition (LOI) for organic soils.</p> <p><u>Procedure:</u> Ball-mill one teaspoon of soil for 5 minutes in the ball-mill. Weigh out 0.250 (+/-) 0.001 g of</p>

			<p>soil into 250mL Erlenmeyer flasks. Add 10mL of potassium dichromate solution. Under the hood with the exhaust fan on, add 20mL concentrated sulfuric acid to each sample. (Be sure and wear a lab coat and safety glasses when adding the acid.) Let the samples cool for 30 minutes in the hood. Add about 200mL of water to each sample. Add 5 to 8 drops ferrous sulfate complex indicator to each sample. Titrate to a dark green end point with ferrous sulfate. Run two blanks first. Blanks should be within 0.1mL of each other. Samples run after the blanks should all be less than the blanks.</p> <p><u>Reagents:</u></p> <ul style="list-style-type: none"> <li>• Potassium dichromate (K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>)</li> <li>• Ferrous sulfate (FeSO<sub>4</sub>·6H<sub>2</sub>O)</li> <li>• Sulfuric acid (H<sub>2</sub>SO<sub>4</sub>)</li> <li>• 1, 10-Phenanthroline-ferrous sulfate complex</li> </ul> <p><u>Preparation of Reagents:</u></p> <ul style="list-style-type: none"> <li>• 1.0N Potassium dichromate Dissolve 49.04g per liter in deionized water using volumetric flask and make to volume.</li> <li>• 0.5N Ferrous sulfate Dissolve 138.30g plus 40mL concentrated sulfuric acid per liter in deionized water and make to volume.</li> <li>• Sample Preparation and Procedures Grind four ½-teaspoon scoops of soil in ball-mill for 3 minutes. Sample weight is based on estimated organic matter content as follows: 1.000g for light colored soils 0.500g for gray to brown soils 0.250g for most soils 0.100g for black soils</li> <li>• Weigh in duplicate, ground soil into 25mL Erlenmeyer flasks. Add exactly 10.0mL of 1.0N potassium dichromate and swirl gently to thoroughly wet soil. Place samples in fume hood. Carefully add 20mL concentrated sulfuric acid down the side of the flask into soil solution and swirl gently to thoroughly mix. Allow to stand for at least 1 hour. Include blanks which also serve as standards.</li> <li>• To digest samples, carefully add about 200mL water, washing sides of flasks. Add 5 drops of ferrous sulfate complex indicator to each flask and titrate with 0.5N ferrous sulfate. The endpoint is a sharp change from orange to green to reddish-brown.</li> </ul> <p><u>Sample Calculations:</u></p> <ul style="list-style-type: none"> <li>• Normality FeSO<sub>4</sub> = [(N K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>) (mL)] divided by (mL blank titer)</li> <li>• Percent organic carbon = {[(mL blank)-(mL sample titer)] divided by g of sample}(Norm. FeSO<sub>4</sub>)(0.3/0.77)</li> <li>• Note: Ferrous sulfate FeSO<sub>4</sub> has a valence of +2</li> <li>• 69.15g/L = 0.25 N</li> <li>• 138.30 g/L = 0.50 N</li> </ul>
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				<p><u>Reference:</u> Soil Survey Methods Manual. August 1992. U.S. Department of Agriculture.</p>
AL_1	KCL_AL	Number	Meq/100g	<p><b>Aluminum</b> Derived by: KCL extraction</p> <p><u>Reagents:</u> Potassium chloride (KCl)</p> <p><u>Preparation of Reagents:</u> 1.0N KCl: Dissolve 74.56g KCl per liter in deionized water and make to volume.</p> <p><u>Sample Preparations and Procedure:</u></p> <ul style="list-style-type: none"> <li>• Weigh, in duplicate, 10g soil into 125mL Erlenmeyer flasks. Include blanks. Add 50mL 1.0N KCl to each, swirl gently to thoroughly wet, cover and allow to stand overnight.</li> <li>• Attach appropriately numbered 125mL Erlenmeyer flasks equipped with Buchner funnels and Whatman No. 42 filter paper to vacuum manifold. Moisten filter paper and turn on vacuum to seal it. Swirl sample vigorously and pour into filter funnels using the vacuum to avoid dislodging the filter paper. Using vacuum as necessary, sequentially leach five 10mL aliquots of KCl through each sample and blanks.</li> <li>• Swirl each filter flask to mix and transfer about 30 mL to numbered plastic bottles. Refrigerate. Discard the remaining sample.</li> </ul> <p><u>Sample Calculations:</u></p> <ul style="list-style-type: none"> <li>• <math>\text{Meq}/100\text{g} = ((\text{sample ppm} * \text{sample dilution factor}) - (\text{blank ppm} * \text{Blank dilution factor})) * \text{elemental constant}</math></li> <li>• Elemental constant for Aluminum = <math>1/89.9 = 0.01112</math>.</li> </ul> <p><u>Reference:</u> Soil Survey Laboratory Methods Manual. August 1992. Pg. 193. U.S. Department of Agriculture.</p>
Ca_1	EXTR_CA	Number	Meq/100g	<p><b>Extractable Ca<sup>2+</sup></b></p> <p><u>Reagents:</u> Concentrated acetic acid (CH<sub>3</sub>COOH) Concentrated ammonium hydroxide (NH<sub>4</sub>OH)</p> <p><u>Preparation of Reagents:</u></p> <ul style="list-style-type: none"> <li>• 1.0N Ammonium acetate (pH 7.0)</li> <li>• Add 1224mL NH<sub>4</sub>OH (68mL/L) and 1026mL CH<sub>3</sub>COOH (57mL/L) to an 18 liter bottle containing approximately 10 liters of deionized water and make to volume. This should be done in the fume hood. Allow to cool and adjust to pH 7.0 with appropriate reagent while stirring continuously.</li> </ul> <p><u>Sample Preparation and Procedure:</u></p> <ul style="list-style-type: none"> <li>• Weigh, in duplicate, 10g of soil (5g for organics) into 125mL Erlenmeyer flasks.</li> </ul>

				<p>Add 20mL of ammonium acetate to each sample; include blanks. Swirl gently to thoroughly wet, stopper and allow to stand overnight.</p> <ul style="list-style-type: none"> <li>• Attach the appropriate number of 500mL filter flasks to the vacuum manifold and equip each with a Buchner funnel, moisten with deionized water, and turn on the vacuum. Open stopcock on each line to seal the paper to each funnel. Swirl flask vigorously and pour each sample into the appropriate funnel.</li> <li>• Using vacuum as necessary, draw the ammonium acetate completely through the soil. Leach an additional 80mL through the soil with sequential 20mL aliquots. Some soil may get through the filter paper; refilter these as necessary. Remove funnels, swirl filter flask to thoroughly mix, and pour about 30mL filtrate into numbered plastic bottles. Refrigerate. Discard the remaining sample.</li> </ul> <p><u>Calculations:</u></p> <ul style="list-style-type: none"> <li>• <math>\text{meq}/100\text{g} = [(\text{sample ppm} * \text{sample dilution factor}) - \text{blank ppm} * \text{blank dilution factor}] * \text{elemental constant}</math></li> <li>• Elemental constants:  Calcium <math>1/200 = 0.00500</math>  Magnesium <math>1/121.5 = 0.00823</math>  Sodium <math>1/230 = 0.00435</math>  Potassium <math>1/390 = 0.00256</math></li> </ul> <p><u>Additional Notes:</u>  Glassware and funnel should be rinsed with deionized water only, immediately upon completion of extractions.</p> <p><u>Reference:</u>  Soil Survey Methods Manual. August 1992. Pg. 345. U.S. Department of Agriculture.</p>
Mg_1	EXTR_MG	Number	Meq/100g	<p>Extractable Mg<sup>2+</sup></p> <p>Same extraction procedure as described under "Extractable Ca<sup>2+</sup>", but different calculation to derive Mg<sup>2+</sup></p>
Na_1	EXTR_NA	Number	Meq/100g	<p>Extractable Na<sup>+</sup></p> <p>Same extraction procedure as described under "Extractable Ca<sup>2+</sup>", but different calculation to derive Na<sup>+</sup></p>
K_1	EXTR_K	Number	Meq/100g	<p>Extractable K<sup>+</sup></p> <p>Same extraction procedure as described under "Extractable Ca<sup>2+</sup>", but different calculation to derive K<sup>+</sup></p>
TBase	TOT_Base	Number	Meq/100g	<p>Total extractable bases (Ca<sup>2+</sup>, Mg<sup>2+</sup>, K<sup>+</sup> and Na<sup>+</sup>)</p> <p>Sum of fields Ca, Mg, Na, and K.</p>
ExtractID	EXTRACID	Number	Meq/100g	<p>Extractable Acidity</p> <p><u>Reagents:</u></p>

				<ul style="list-style-type: none"> <li>• Barium chloride (BaCl<sub>2</sub>·2H<sub>2</sub>O)</li> <li>• Triethanolamine N(CH<sub>2</sub>CH<sub>2</sub>OH)<sub>3</sub></li> <li>• Hydrochloric acid (HCl)</li> <li>• Bromocresol green indicator</li> <li>• Mixed indicator (methyl-red and methylene blue)</li> <li>• Sodium carbonate anhydrous (Na<sub>2</sub>CO<sub>3</sub>)</li> </ul> <p><u>Preparation of Reagents:</u></p> <ul style="list-style-type: none"> <li>• Boil deionized water to remove dissolved carbon dioxide. This condition is reached when small, rapid bubbling ceases and large sporadic bubbling is observed. For 50 samples (capacity of shaker), boil 6 liters. Allow to cool to room temperature using carbon dioxide trap.</li> <li>• 0.5N Barium chloride and 0.2N triethanolamine (TEA) buffer solution In 14 liters boiled deionized water dissolve 1099.26g BaCl<sub>2</sub>·2H<sub>2</sub>O (61.07 g/L) using magnetic stirrer. Add 480.6mL TEA (26.7 mL/L) and 59.4mL concentrated HCl (3.3mL/L). Bring to 18 liter volume with boiled water. Adjust pH to 8.2 by adding concentrated HCl using burette and pH electrode.</li> <li>• 0.2N HCl Add 16.67mL concentrated HCl per liter deionized water using volumetric flask and make to volume.</li> <li>• 0.2N Sodium carbonate Add 21.20g anhydrous Na<sub>2</sub>CO<sub>3</sub> per liter deionized water using volumetric flask and make to volume. A supply of Na<sub>2</sub>CO<sub>3</sub> should be kept in the oven to maintain anhydrous condition.</li> <li>• Bromocresol green indicator Dissolve 0.1g bromocresol green in 7.2mL 0.02N NaOH and dilute to 250mL with deionized water.</li> <li>• Mixed indicator (methyl-red and methylene blue) Dissolve 1.250g methyl red and 0.825g methylene blue in 1 liter 90% ethanol.</li> </ul> <p><u>Sample Preparation and Procedure:</u></p> <ul style="list-style-type: none"> <li>• Sample weight is based on estimated potential acidity. Refer to KCl pH values for each sample: 10.0g for pH less than or equal to 4 15.0g for pH from 4 to 5 25.0g for pH greater than 5</li> <li>• Weigh samples, in duplicate, into 250mL Erlenmeyer flasks. Include duplicate blanks. Add 100mL buffer solution to each sample, swirl gently to ensure thorough wetting of the sample. Stopper tightly, load into shaker, and shake vigorously for 2 hours. Remove from shaker and allow to settle overnight.</li> <li>• Draw off 50mL of the solution using a pipette and a squeeze bulb (Safety Pipettor). A sliding scale (AMINCO) holding the pipette attached to a lab stand is useful for this endpoint. Drain the 50mL aliquot</li> </ul>
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				<p>into 125mL Erlenmeyer flasks. Add 2 drops of bromcresol green and 8 drops of mixed indicator to each sample and blank.</p> <ul style="list-style-type: none"> <li>• Titrate samples with 0.2N HCl using lighted magnetic stirrer. The color changes from green to blue to purple. Some samples will go to a reddish-purple. The endpoint is reached when no detectable change in intensity of the color is observed.</li> <li>• Standardize the 0.2N HCl with 0.2000N Na<sub>2</sub>CO<sub>3</sub>. It is easier to use 0.200N NaOH standardized with 0.250N potassium hydrogen phthalate (51.058g potassium hydrogen phthalate per liter). Pipette 25mL sodium carbonate solution into four Erlenmeyer flasks. Bring to a gentle boil to remove dissolved carbon dioxide and sharpen endpoint. Cover and allow to cool. Add 4 drops of phenolphthalein and 4 drops bromcresol green to each. Titrate with 0.2N HCl to a faint yellow. The endpoint will be reached when no detectable change in intensity of the yellow is observed.</li> </ul> <p><u>Sample Calculations:</u></p> <ul style="list-style-type: none"> <li>• Normality of HCl = (0.2000N) (mL Na<sub>2</sub>CO<sub>3</sub>)/mL HCl)</li> <li>• Meq/100g = (mL blank – mL titer) (N HCl) (100 mL/150 mL) (100)/(g of sample)</li> </ul> <p><u>Additional Notes:</u> The above glassware is washed with soap and brush immediately after extraction. Excess buffer solution can be stored and used later.</p> <p><u>Reference:</u> Soil Survey Methods Manual. August 1992. Pg. 361. U.S. Department of Agriculture.</p>
CEC	CEC_SUM	Number	Meq/100g	<p><b>Cation exchange capacity</b></p> <p>Cation-exchange capacity is measured by the methods outlined in Soil Survey Investigations Report No. 42, <i>Soil Survey Laboratory Methods Manual, Version 4.0</i>, November 2004, USDA, NRCS. The ammonium acetate method gives the cation-exchange capacity value (CEC-7) for soils that have pH &gt;5.5 or contain soluble salts. This method uses a solution of one normal ammonium acetate buffered at pH 7.0 to provide the extracting index cation (NH<sub>4</sub><sup>+</sup>). Cation-exchange capacity is reported in centimoles per kilogram (cmol(+) kg<sup>-1</sup>), which are equivalent to milliequivalents per 100 grams (meq 100 g<sup>-1</sup>) of soil. If the pH is less than 5.5, use effective cation-exchange capacity</p>
BaseSat	BASE_SAT	Number	%	<p><b>Base saturation</b></p> <p>Base saturation is measured by the method outlined in Soil Survey Investigations Report No.42 , <i>Soil Survey Laboratory Methods Manual, Version 4.0</i>, November 2004, USDA, NRCS. The method is called “Sum of Cations”. It amounted to the sum of NH<sub>4</sub>OAc</p>

				extractable bases divided by their sum plus acidity extracted at pH8.2 by BaCl <sub>2</sub> triethanolamine. Multiplying by 100, this value is reported as percentage.
C_2	PYROCARB	Number	%	<p><b>Sodium Pyrophosphate Extractable Carbon</b></p> <p><u>Reagents:</u></p> <ul style="list-style-type: none"> <li>• Sodium pyrophosphate (Na<sub>4</sub>P<sub>2</sub>O<sub>7</sub>)</li> <li>• Superfloc</li> </ul> <p><u>Preparation:</u></p> <ul style="list-style-type: none"> <li>• 0.1M Sodium pyrophosphate: Dissolve 44.6g per liter in deionized water and make to volume.</li> <li>• 0.4% Superfloc: Dissolve 0.4g in 100mL of hot deionized water with vigorous and continuous stirring. Superfloc must be added very slowly to avoid clumping.</li> </ul> <p><u>Sample Preparation and Procedure:</u></p> <ul style="list-style-type: none"> <li>• Weigh, in duplicate, 2.000 (+/-) 0.002g soil into Erlenmeyer flasks; include blanks. Add 100mL 0.1M sodium pyrophosphate to each, stopper and load into shaker. Let shake for eight hours.</li> </ul> <p>Remove from shaker. Add 5 drops 0.4% superfloc to each flask and shake vigorously. Transfer about 45mL solution to centrifuge tubes. Fill all tubes to same volume to balance the load. Centrifuge at 2000rpm for 20 minutes.</p> <ul style="list-style-type: none"> <li>• Remove centrifuge tube; inspect supernatant for clarity. Recentrifuge as necessary if colloids remain suspended. Transfer clear supernatant to numbered plastic bottles. Refrigerate.</li> <li>• Centrifuge additional portion of each sample. Pipette 10mL of each into 500mL Erlenmeyer flasks. Evaporate to dryness at about 70 degrees C. Determine extractable carbon by Walkley-Black method.</li> </ul> <p><u>Sample Calculations:</u></p> <ul style="list-style-type: none"> <li>• Percent Fe or Al = [(sample ppm * total sample d.f.) - (blank ppm * total blank d.f.)] divided by 10,000</li> <li>• Percent pyrophosphate = [(mL blank pyrophosphate - mL sample) divided by weight of sample] * N Fe(NH<sub>4</sub>)<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub> * (0.3/0.77) organic carbon where the weight of sample is 0.200g.</li> <li>• Normality of Fe(NH<sub>4</sub>)<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>.6H<sub>2</sub>O = [(10mL)(1.0N K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>)] divided by mL blank NOTE: Use Fe(NH<sub>4</sub>)<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>.6H<sub>2</sub>O blank to standardize solution, not the pyrophosphate blank.</li> </ul> <p><u>References:</u> Soil Survey Laboratory Methods Manual. August 1992. p.162. U.S. Department of Agriculture.</p>

Fe_2	PYROFE	Number	%	Sodium Pyrophosphate Extractable Iron  Compare procedure described under "Sodium Pyrophosphate Extractable Carbon"
Al_2	PYROAL	Number	%	Sodium Pyrophosphate Extractable Aluminum  Compare procedure described under "Sodium Pyrophosphate Extractable Carbon"
Fe_3	C_D_FE	Number	%	Citrate-Dithionate-Bicarbonate Extraction for Iron  <u>Reagents:</u> <ul style="list-style-type: none"> <li>• Sodium Bicarbonate (NaHCO<sub>3</sub>), 1M</li> <li>• Sodium Citrate, 0.3M</li> <li>• Sodium hydrosulfite (Na<sub>2</sub>S<sub>2</sub>O<sub>4</sub>)</li> </ul> <u>Procedure:</u> Weigh 4g of soil (1g clay) into a 100-mL centrifuge tube. Add 40mL of 0.3M Na-citrate and 5mL of 1M NaHCO <sub>3</sub> . Bring temperature to 80°C in a water bath. Add 1g Na <sub>2</sub> S <sub>2</sub> O <sub>4</sub> , stir constantly for 1 minute and occasionally for 15 minutes. Centrifuge for 5 minutes at 1,600 to 2,200 rpm. Decant clear supernatant into 500 mL volumetric flask and make to volume.  <u>Reference:</u> Mehra, O.P. and M. L. Jackson. 1960. Iron oxide removal from soils and clays by a dithionite-citrate system buffered with sodium bicarbonate. Proc. 7th Natl. Conf. On Clay and Clay Minerals, pp. 317-327. Pergamon Press, New York.
Al_3	C_D_AL	Number	%	Citrate-Dithionate-Bicarbonate Extraction for Aluminum  Same procedure as described under field "Fe_3".
Landform	LANDFORM	String	Description	Description of landforms
Topo	SLOPE	String	Description	Description of topography (slope in percent or elevation in inches)
LCLU	VEGETATION	String	Description	Description of land cover and land use
Parent	PARENT	String	Description	Description of parent material
Drainage	DRAINAGE	String	Description	Description of drainage
HydricStatus	HYDRICSTATUS	String	Description	Hydric status of soils. Two options: Hydric or Nonhydric
Hydric_C	HYDRICRATIONALE	String	Code	Hydric status of soils. Two options: Hydric = NH Nonhydric = NN
DepthWat	INDIRECTWATERTABLE	Number	cm	Estimated long-term water table depth in soil profile.  Using the soil profile taxonomy for horizons the database was searched for the first horizon at which "gleying" occurs. Gleying being a redox

				<p>product of a soil having been waterlogged for an extended period of time. Gleying is commonly denoted as a lower-case "g" in a horizon description (i.e., Bg). The first horizon from the surface to contain a gleying indicator in its nomenclature suggests that waterlogging occurs at this depth. Note that some hydric soils might have a water table which comes to the surface of the soil, where the entire soil profile would be inundated with water.</p> <p>Values are reported in centimeters. A 999 indicates unknown depth, and a 0 indicates no depth</p>
KSat_0 BD_0 W_1by10 W_1by3 W_15BAR W_3pt5_0 W_20_0 W_30_0 W_45_0 W_60_0 W_80_0 W_150_0 W_200_0 AW_0	SATHYD0 B_DEN_0 W_1by10 W_1by3 W_15BAR W_3pt5_0 W_20_0 W_30_0 W_45_0 W_60_0 W_80_0 W_150_0 W_200_0 AVAIL_W	Number	Ksat_0 in cm/hr  BD_0 in g/cc  Water contents in Vol. %  AW in cm/cm	<b>Water release curve (Replicate 0)</b>  There are up to three replicate water release curves possible - but the number in any profile can vary from 0 to 3. The first curve is represented by first 14 parameters listed below. Note that actual suctions in this group are not identical to those in the subsequent two replicates.  The terminal two replicates have identical suctions and may have replicated values at 15 bar, i.e., there may be up to four such values in the two replicates and possibly 5 such values in any given profile. Any value from 0 to 5, however, is possible. We advise caution when using these data for hydraulic modeling since only a few erroneous or missing values can radically affect curve fittings. You should verify the plausibility of each release curve before utilization.  <u>Replicate 0:</u> <ul style="list-style-type: none"> <li>• KSat_0 = saturated hydraulic conductivity (cm/hr)</li> <li>• BD_0 = bulk density (g/cc)</li> <li>• W_1/10 = water content at 1/10 bar (Weight %)</li> <li>• W_1/3 = water content at 1/3 bar (Weight %)</li> <li>• W_15BAR = water content at 15 bar (Weight %)</li> <li>• W_3pt5_0 = water content at 3.5cm of suction (Vol %)</li> <li>• W_20_0 = water content at 20cm of suction (Vol %)</li> <li>• W_30_0 = water content at 30cm of suction (Vol %)</li> <li>• W_45_0 = water content at 45cm of suction (Vol %)</li> <li>• W_60_0 = water content at 60cm of suction (Vol %)</li> <li>• W_80_0 = water content at 80cm of suction (Vol %)</li> <li>• W_150_0 = water content at 150cm of suction (Vol %)</li> <li>• W_200_0 = water content at 200cm of suction (Vol %)</li> <li>• AW_0 = Available water content (cm/cm)</li> </ul>
Ksat_1	SATHYD1	Number	Ksat_0 in cm/hr	<b>Water release curve (Replicate 1)</b>

BD_1 W_3pt5_1 W_20_1 W_30_1 W_45_1 W_60_1 W_80_1 W_100_1 W_150_1 W_200_1 W_345_1 W_15B_1A W_15B_1B	B_DEN_1 W_3pt5_1 W_20_1 W_30_1 W_45_1 W_60_1 W_80_1 W_100_1 W_150_1 W_200_1 W_345_1 W_15B_1A W_15B_1B		BD_0 in g/cc  Water contents in Vol. %  AW in cm/cm	<p>There are up to three replicate water release curves possible - but the number in any profile can vary from 0 to 3. The first curve is represented by first 14 parameters. Note that actual suctions in this group are not identical to those in the subsequent two replicates.</p> <p>The terminal two replicates (numbered 1 and 2) have identical suctions and may have replicated values at 15 bar, i.e., there may be up to four such values in the two replicates and possibly 5 such values in any given profile. Any value from 0 to 5, however, is possible. We advise caution when using these data for hydraulic modeling since only a few erroneous or missing values can radically affect curve fittings. You should verify the plausibility of each release curve before utilization.</p> <p><u>Replicate 1:</u></p> <ul style="list-style-type: none"> <li>• PRIMDAT1 = marker for 1st replicate water release curve</li> <li>• KSat_1 = saturated hydraulic conductivity (cm/hr)</li> <li>• BD_1 = bulk density (g/cc)</li> <li>• W_3pt5_1 = water content at 3.5cm of suction (Vol %)</li> <li>• W_20_1 = water content at 20cm of suction (Vol %)</li> <li>• W_30_1 = water content at 30cm of suction (Vol %)</li> <li>• W_45_1 = water content at 45cm of suction (Vol %)</li> <li>• W_60_1 = water content at 60cm of suction (Vol %)</li> <li>• W_80_1 = water content at 80cm of suction (Vol %)</li> <li>• W_100_1 = water content at 100cm of suction (Vol %)</li> <li>• W_150_1 = water content at 150cm of suction (Vol %)</li> <li>• W_200_1 = water content at 200cm of suction (Vol %)</li> <li>• W_345_1 = water content at 345cm of suction (Vol %)</li> <li>• W_15B_1A = water content at 15 bar - replicate 1 (Weight %)</li> <li>• W_15B_1B = water content at 15 bar - replicate 2 (Weight %)</li> </ul>
Ksat_2 BD_2 W_3pt5_2 W_20_2 W_30_2 W_45_2 W_60_2 W_80_2 W_100_2 W_150_2 W_200_2 W_345_2 W_15B_2A	SATHYD2 B_DEN_2 W_3pt5_2 W_20_2 W_30_2 W_45_2 W_60_2 W_80_2 W_100_2 W_150_2 W_200_2 W_345_2 W_15B_2A	Number	Ksat_0 in cm/hr  BD_0 in g/cc  Water contents in Vol. %  AW in cm/cm	<p><b>Water release curve (Replicate 2)</b></p> <p>There are up to three replicate water release curves possible - but the number in any profile can vary from 0 to 3. The first curve is represented by first 14 parameters. Note that actual suctions in this group are not identical to those in the subsequent two replicates.</p> <p>The terminal two replicates (numbered 1 and 2) have identical suctions and may have replicated values at 15 bar, i.e., there may be up to four such values in the two replicates and possibly 5 such values in any given profile. Any value from 0 to 5, however, is possible. We advise caution when using these data for</p>

W_15B_2B	W_15B_2B			<p>hydraulic modeling since only a few erroneous or missing values can radically affect curve fittings. You should verify the plausibility of each release curve before utilization.</p> <p><u>Replicate 2:</u></p> <ul style="list-style-type: none"> <li>● PRIMDAT2 = marker for 1st replicate water release curve</li> <li>● KSat_2 = saturated hydraulic conductivity (cm/hr)</li> <li>● BD_2 = bulk density (g/cc)</li> <li>● W_3pt5_2 = water content at 3.5cm of suction (Vol %)</li> <li>● W_20_2 = water content at 20cm of suction (Vol %)</li> <li>● W_30_2 = water content at 30cm of suction (Vol %)</li> <li>● W_45_2 = water content at 45cm of suction (Vol %)</li> <li>● W_60_2 = water content at 60cm of suction (Vol %)</li> <li>● W_80_2 = water content at 80cm of suction (Vol %)</li> <li>● W_100_2 = water content at 100cm of suction (Vol %)</li> <li>● W_150_2 = water content at 150cm of suction (Vol %)</li> <li>● W_200_2 = water content at 200cm of suction (Vol %)</li> <li>● W_345_2 = water content at 345cm of suction (Vol %)</li> <li>● W_15B_2A = water content at 15 bar - replicate 1 (Weight %)</li> <li>● W_15B_2B = water content at 15 bar - replicate 2 (Weight %)</li> </ul>
SM_MIN	SM_MIN	Number	%	<p>Clay mineralogy (soil clay fraction &lt;0.002 mm)</p> <p>SM: Smectite, 2:1 expansible secondary phyllosilicate</p> <p><u>Note on clay mineralogy properties:</u> Mineralogy was determined only for selected horizons within a soil, and only for the clay (&lt;0.002-mm) fraction. The data are based on x-ray-diffraction analysis, and should be viewed as semi-quantitative. They can show relative depth- or geographic trends when expressed as ratios or indices; absolute percentages should be interpreted with caution. Iron oxide minerals, present in small amounts in most soils, were removed by pretreatment to enable effective dispersion of clay. Also, some common minerals tend to occur in amounts too small to be detected by x-ray diffraction.</p>
CH_MIN	CH_MIN	Number	%	<p>Clay mineralogy (soil clay fraction &lt;0.002 mm)</p> <p>CH: Chlorite clay minerals</p>
VM_MIN	VM_MIN	Number	%	<p>Clay mineralogy (soil clay fraction &lt;0.002 mm)</p> <p>VM: Vermiculite, 2:1 expansible</p>

				secondary phyllosilicate
MI_MIN	MI_MIN	Number	%	Clay mineralogy (soil clay fraction <0.002 mm) MI: Mica clay minerals
HIV_MIN	HIV_MIN	Number	%	Clay mineralogy (soil clay fraction <0.002 mm) HIV: Hydroxyinterlayered vermiculite; partially-expansible secondary phyllosilicate
KA_MIN	KA_MIN	Number	%	Clay mineralogy (soil clay fraction <0.002 mm) KA: Kaolinite, 1:1 non-expansible secondary phyllosilicate
GI_MIN	GI_MIN	Number	%	Clay mineralogy (soil clay fraction <0.002 mm) GI: Gibbsite, Aluminum hydroxide
QZ_MIN	QZ_MIN	Number	%	Clay mineralogy (soil clay fraction <0.002 mm) QZ: Quartz clay minerals
CL_MIN	CL_MIN	Number	%	Clay mineralogy (soil clay fraction <0.002 mm) CL: Calcite; calcium carbonate
FL_MIN	FL_MIN	Number	%	Clay mineralogy (soil clay fraction <0.002 mm) FL: Feldspar; primary tectosilicate with cations (mostly K in Florida) in structure
SE_MIN	SE_MIN	Number	%	Clay mineralogy (soil clay fraction <0.002 mm) SE: Sepiolite; Magnesium silicate
AM_MIN	AM_MIN	Number	%	Clay mineralogy (soil clay fraction <0.002 mm) AM: Amorphous
DL_MIN	DL_MIN	Number	%	Clay mineralogy (soil clay fraction <0.002 mm) DL: Dolomite; Calcium magnesium carbonate
IN_MIN	< missing >	Number	%	Clay mineralogy (soil clay fraction <0.002 mm) IN: Intergrade vermiculite-chlorite; now called "hydrox-interlayered vermiculite"
MaxDryDens	MAXDRYDE	Number	lbs/ cu ft	Engineering test data by Florida Department of Transportation  Maximum dry density
OptMoist	OPTMOIST	Number	%	Engineering test data by Florida Department of Transportation  Optimum moisture
MA_2p0	MAIt2pt0	Number	%	Engineering test data by Florida Department of Transportation

				Mechanical analysis: Percent of soil passing a sieve size of 2.0 mm
MA_Op42	MAItpt42	Number	%	Engineering test data by Florida Department of Transportation  Mechanical analysis: Percent of soil passing a sieve size of 0.42 mm
MA_Opt074	MAIt_pt074	Number	%	Engineering test data by Florida Department of Transportation  Mechanical analysis: Percent of soil passing a sieve size of 0.074 mm
MA_Opt05	MAItpt05	Number	%	Engineering test data by Florida Department of Transportation  Mechanical analysis: Percent of soil passing a sieve size of 0.05 mm
MA_Opt02	MAItpt02	Number	%	Engineering test data by Florida Department of Transportation  Mechanical analysis: Percent of soil passing a sieve size of 0.02 mm
MA_Opt005	MAItpt005	Number	%	Engineering test data by Florida Department of Transportation  Mechanical analysis: Percent of soil passing a sieve size of 0.005 mm
MA_Opt002	MAItpt002	Number	%	Engineering test data by Florida Department of Transportation  Mechanical analysis: Percent of soil passing a sieve size of 0.002 mm
ASSHOEC	AASHO_C	Number	%	Engineering test data by Florida Department of Transportation  American Association of State Highway Officials engineering classification
CaCO3_Eq	CACO3_EQ	Number	%	Engineering test data by Florida Department of Transportation  Calcium carbonate equivalent Acid neutralization  <u>Reagents and Apparatus:</u> <ul style="list-style-type: none"> <li>• 1 N HCl standardized</li> <li>• 1 N NaOH, standardized and protected from ai</li> <li>• Phenolphthalein indicator solution</li> <li>• 50 ml burette</li> <li>• 25 and 10 ml pipettes</li> <li>• 250 ml Erlenmeyer flasks with small watchglasses</li> </ul>



			<p><u>Procedure</u></p> <ol style="list-style-type: none"> <li>1. Weigh out two 5g samples of soil on top-loading balance and record to nearest hundredth of a gram, i.e. 5.00g. Use 2 grams if soil is known to be high in carbonates, 1g for limestone samples.</li> <li>2. Transfer the samples to 250mL Erlenmeyer flasks.</li> <li>3. With a pipette, add 25mL of previously standardized 1N HCl.</li> <li>4. Heat on a steam hot plate for 30 minutes. Cover with small watchglass to minimize HCl loss.</li> <li>5. Add approximately 100mL of distilled water.</li> <li>6. Heat to boiling and cool slightly.</li> <li>7. Add 3 drops of phenolphthalein indicator and titrate to a faint pink endpoint with previously standardized 1N NaOH.</li> <li>8. Calculate the percent CaCO<sub>3</sub> equivalent.</li> </ol> <p><u>Remarks (correspond to procedure number)</u></p> <ol style="list-style-type: none"> <li>1. It is a good idea to check this determination by doing it in duplicate.</li> <li>2. 1g of pure CaCO<sub>3</sub> would require 20meq of acid for neutralization. Ca(OH)<sub>2</sub> or CaO will require more.</li> <li>3. All reactive material should be neutralized in this time.</li> <li>4. The water is added merely to bring the solution to a convenient volume for titration.</li> <li>5. The solution is heated to drive off CO<sub>2</sub> which would give an erroneous endpoint.</li> <li>6. The pink color should persist 30 seconds at the endpoint after thorough swirling of the sample.</li> </ol> <p><u>Calculations</u></p> <ol style="list-style-type: none"> <li>1. (mL HCl added * N HCl) – (mL NaOH added * N NaOH) = meq HCl neutralized</li> <li>2. meq HCl neutralized * 100 = percent CaCO<sub>3</sub> equivalent 20 meq/g CaCO<sub>3</sub> * wt of soil</li> </ol>
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## Description of Data Mining Procedures to Retrieve Hardcopy Soil Characterization Data

The data included in the Florida Soils Characterization Database was collected by the Environmental Pedology Laboratory of the Soil Science Department, Institute of Food and Agricultural Sciences, University of Florida, in cooperation with the Soil Conservation Service (renamed to Natural Resources Conservation Service), U.S. Department of Agriculture. The data were originally presented as seven printed books. Material for several additional books were generated but never compiled and published. The research was partially supported by State Legislative appropriations (administered by the Department of Agriculture and Consumer Services), and supplemental funds contributed by the participating counties in support of the Florida Cooperative Soil Survey. The purpose was to “compile and preserve laboratory and morphological data resulting from soil survey and selected research activities in the State of Florida.”

Overview of hard copy material:

<b>Volume</b>	<b>Published in:</b>	<b>Covering:</b>	<b>Pages:</b>
Book 1	1974	1965 to mid-1973	294
Book 2	June 1978	1973 to mid-1975	336
Book 3	June 1981	mid-1975 to 1977	306
Book 4	December 1985	1977 to 1979	306
Book 5	June 1988	1979 to 1982	291
Book 6	November 1989	1982 to 1984	308
Book 7	November 1990	1984 to 1986	318
Reference Guide*	1992	1965 to 1986	43
Loose Leafs	unpublished	1986 to 1996	~300

\*Soil Series and County Indices

The cast of professors editing these books changed from year to year and book to book, as well as the cast of technicians, graduate students, and student assistants. All hardcopy data had to be scanned, proofread several times, and converted to XML (eXtensible Markup Language) format. Soil classification designations which had changed over the years due to modifications in the U.S. Soil Taxonomy were adapted.

Data were composed of: lab data, field observations, and meta data. Lab data are the analytical results from the soil testing lab. Field observations consisted of taxonomic classification of each sampling site into designated soil horizons. The meta data provide descriptions of sample locations, soil properties and classes, and units.

Each profile was assigned a unique integer identifier for each county. The combination of the county number (derived from the order in the list of alphabetically ordered county names) and the profile number provided a unique identification key. For example, the first profile from Alachua County would be assigned the identifier **SO1\_001**. Unfortunately, individual profiles were repeated in different volumes (report books) and given different identification codes. In some instances, different profiles were given the same identification code. The profile

sequences within a county might not be sequential or start at "1" and there were some discrepancies between the county code number and the identity of the county given in the meta data. All such errors and the resulting corrections are documented in the 'Comment' tags of each profile.

The process started with scanning the pages for each profile using OmniPage Pro 9. "Scan Image" was chosen to scan the original paper document, then "OCR and Proof" was chosen to capture the text from the scanned image. The obvious spelling and format errors were corrected and the document was saved as a Word file. To expedite the work, a utility program was run to coordinate OmniPro and Word and to auto-generate appropriate file names and folders for each profile scanned. If the lab data were not already in digital format, the data were entered manually. Subsequently, a person other than the original proof-reader would proofread the documents. After the second proof-reading, the data were transferred into a set of XML fields using an utility program. A series of scans of the data were then run to detect problems or ambiguities (such as confusion of units) and such errors were rectified. Simultaneously, Mr. Wade Hurt (of the Natural Resources Conservation Service, affiliated with the University of Florida, Soil and Water Science Department) hand-annotated the original volumes for changes in soil classifications and any other errors that he detected. Those annotations were then added to the XML fields. In an effort to 'leave fingerprints', we have opted to preserve the original entries along with the corrections. In the event of a correction, the original material was enclosed in curly brackets and the new material was inserted in square brackets. For example:

...grayish-brown (10YR 4/2) {loamy sand}[fine sand]; weak fine granular...  
in which "loamy sand" is to be replaced by "fine sand".

A number of fields were created to reflect the original location of the data (available upon request):

- BOOK\_NUMBER = The volume as listed above
- META\_PAGE = the page on which the metadata were found
- TABLE\_PAGE = the page on which the lab data were found
- COMMENT = any comment concerning the profile in general

### **Geo-referencing of Sampling Locations**

Sites were sampled over decades and collection of site-specific information changed during the FL Soil Survey Program. Thus, to attach x and y coordinates to each site had to be adapted depending on available information:

5. The latitude and longitude as provided by the field team;
6. Soil maps and aerial photographs on which the sampling locations were marked, so characterization was simply a matter of coordinate conversion from the map coordinate system (township and ranges) to latitude and longitude; or

7. Utilization of the sample location description metadata to project the described point onto a township and range system from which the latitude and longitude could be found
8. Soil Survey Geographic Database (SSURGO), Natural Resources Conservation Service which allowed check-up between site-specific pedon data and soil map polygons

A Visual Basic Florida Georeference Toolbar was coded to facilitate the delineation of geographic coordinates in ArcGIS.

### **Map Projection**

The FLSC data coordinates are provided with North American Datum 1983 HARN (NAD83) and in Albers Conical Equal Area map. The data are reprojected to World Geodetic System 1984 (WGS84), and are presented in latitude and longitude.