National Cooperative Soil Survey Newsletter

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Editor's Note

Issues of this newsletter are available on the World Wide Web (http://soils.usda.gov/). Under Quick Access, click on NCSS, then on Newsletters, and then on the desired issue number.

You are invited to submit stories for this newsletter to Stanley Anderson, National Soil Survey Center, Lincoln, Nebraska. Phone—402-437-5357; FAX—402-437-5336; email—stan.anderson@nssc.nrcs.usda.gov.

Water Tables and Redoximorphic Features

By Craig Ditzler, National Leader, Soil Classification and Standards, National Soil Survey Center, Lincoln, Nebraska.

Over the years I have found that one of the things that people outside of Pedology find interesting about pedologists is our use of soil color, as expressed in redoximorphic features, to assess seasonal soil wetness. It's no problem when there is water in the hole and we say it is wet—anyone can see that—but when the soil is bone dry and we say it will likely be saturated next fall or spring, the pedologist may seem to be taking on the role of "water-witch" to someone untrained in reading the morphological clues. Over the years there have been a number of articles published in the literature detailing the biogeochemical processes responsible for the formation of redoximorphic features as well as studies correlating these redoximorphic features with soil wetness. A recent article published by researchers at North Carolina State University (He, X, M.J. Vepraskas, D.L. Lindbo, and R.W. Skaggs. 2003. A method to predict soil saturation frequency and duration from soil color. *Soil Sci. Soc. Am. J.* 67:961–969) has taken a significant step forward in helping us to interpret redoximorphic features in the soil.

The motivation for this study centered primarily on the hydrology component of the requirements for determining jurisdictional wetlands. To qualify, a site must be saturated to the surface for at least 5 percent of the growing season in at least 5 out of 10 years. Currently, there is no technology available that allows us to verify this condition with a single visit to a site. The morphology of the soil (presence or absence of redoximorphic features) helps us determine if the soil formed under conditions of wetness, but not the frequency or duration of the wetness. These researchers wanted to see if they could correlate the redoximorphic features at a site to the threshold hydrologic criteria for jurisdictional wetlands.

This research was conducted at a site on the Atlantic Coastal Plain near Greenville, North Carolina. A total of 13 plots were studied along 4 transects. Each transect represented a toposequence of soils from a moderately well drained Aquic Plaeudult to a very poorly drained Umbric Paleaquult. Water tables were monitored daily for 2½ years. Rainfall, redox potential, pH, and soil temperature were also monitored. Detailed morphological descriptions were made at each plot. From these data it was discovered that, for this site, an average of 21 days of continuous saturation was sufficient to reduce iron, indicating the presence of anaerobic conditions in the soil.

The observed water table and rainfall data were used to calibrate the soil hydrology model, DRAINMOD, for each plot so that the model could reproduce simulated water tables mirroring those observed over the 2½-year period. Once the hydrology model was calibrated, climate data covering the previous 40 years were used to simulate past water table fluctuations for each of the 13 plots. From this record, it was possible to determine the number of times each year that the soils were saturated for 21 or more consecutive days above the depths of 45, 60, 75, and 90 cm. It was also possible to determine the duration of each saturation event. This information (number and duration of events) was used to calculate what the authors call the “number of saturation events” (NSE), a value that integrates both the number of times the soil is saturated at a specific depth with the duration of the event. The NSE was then correlated to the percent of redoximorphic features for each of the four depths at each plot. These correlations were computed for redoximorphic depletions and redoximorphic concentrations separately and for both together. In addition, these relationships were studied for saturation events occurring within the growing season, outside the growing season, and for the whole year.

Results from this study demonstrated that the percent of redoximorphic features present in these soils is strongly related to the modeled saturation data. Redoximorphic depletions showed a stronger correlation than redoximorphic concentrations. As depth increases, it takes a higher NSE to result in a given percent of redoximorphic depletions. The authors display these relationships in simple linear graphs (one for each of the four depths) that can be used to estimate the expected number of saturation events each year based on the percent of redoximorphic depletions. For example, they showed that at a depth of 45 cm in these soils, 15 percent redoximorphic depletions suggests that about one saturation event of 21 to 41 days occurs each year. If there are only 5 percent redoximorphic depletions at this depth, one would expect only three events in a 10-year period.

These results are specific to the soils and general geographic area studied. Soils in other locations will exhibit different relationships. However, the methods demonstrated in this project could be employed at many other locations to determine how well the morphology reflects current hydrology. Some factors influencing the results would include carbon content, temperature, pH, and topography. In addition, it must be recognized that while the morphology of the soil reflects a long period of soil formation and development, the modeled pattern of soil saturation is limited to the available (much shorter) period of climatic records. It is likely that some locations would show weaker correlations than those reported in this study if the morphology of the soil reflects previous climatic conditions significantly different from those of today. While the authors did not address this issue, it seems that a poor correlation could be used as one form of evidence to support the concept of relict redoximorphic features. I hope the results from this study will encourage others to repeat this research in other locations.

Note: Another article in this issue of the NCSS Newsletter describes the National Agricultural Library and its online services. If you are a USDA employee, you can access the article described above through the DIGITOP section of the Web site by clicking on “journals” and then searching for “Soil Science Society of America Journal.” ■

The National Agricultural Library and You

By Craig Ditzler, National Leader, Soil Classification and Standards, National Soil Survey Center, Lincoln, Nebraska.

Did you know that the world’s foremost agricultural library is as close as your computer terminal? It’s true. The National Agricultural Library (NAL) was created in 1862 to serve USDA. Today, it is one of four national libraries (the others being the Library of Congress, the National Library of Medicine, and the National Library of Education). The NAL has a mission to increase the availability and utilization of agricultural information for researchers, educators, policymakers, consumers of agricultural products, and the public.

To make a cyber visit to NAL, point your browser to:

http://www.nal.usda.gov/

From the NAL homepage, you can explore several of the services offered. I’m just going to mention a few here. One of the first items you encounter on the site is AGRICOLA, NAL’s catalog and article citation service. With over 4 million bibliographic records, it is the world’s largest compilation of agricultural information. This powerful search engine allows you to use key words to search for books, journals, serials, reports, and other items. A simple “quick search” window is available as well as more advanced search capabilities involving multiple search term parameters. Search results can either be viewed on the screen or emailed to you. AGRICOLA is available to anyone with a computer terminal anywhere in the world.

If you are a USDA employee (and the NAL server recognizes your terminal as part of the USDA network of computers by its “usda.gov” address), you have additional access to services. Say, for example, that as a result of a search on AGRICOLA, you see a book you’d like to borrow. You can email a request, and NAL will mail the book to you and let you borrow it for 1 month. Or, if you want a copy of a journal article you’ve located, NAL will make a copy and fax it to you or (my preference) email it as a PDF attachment. More information about requesting items can be found by clicking on "request an item" on the tool bar at the top of many of the pages on the site or by clicking on "about NAL." Follow the directions carefully because there is a particular format your request should adhere to. I have had books mailed to me, as well as articles emailed to me, and have found the service to be very quick and reliable.

Another service available to USDA employees is the digital desktop library DIGITOP, which provides access to several thousand electronic full-text journals, newspapers, and other materials. I have used this service to obtain full-text PDF versions of articles published in *Geoderma*, *Soil and Tillage Research*, *Plant and Soil*, *Applied Soil Ecology*, *European Journal of Soil Science*, and the *Soil Science Society of America Journal*, as well as some others. Not all journals are available through DIGITOP, and only articles published in the last 10 years or so have been digitized, but if it's there, you can retrieve it immediately and at no charge to you or your office.

So remember, no matter where you are located, if you have access to a computer terminal, you can visit the world's foremost agricultural library, the USDA National Agricultural Library. ■

Thinking Spatially—Maps and the Rural Appraiser

By Bob Nielsen, Certified Professional Soil Scientist.

Maps and map products are tools of the appraisal trade and are themselves an important part of appraisal reports. Maps are used by appraisers to show the location, boundaries, and topography of a property. They are also used to compute the area of the property or to depict its soils, production potential, grazing capacity, and water resources. Yes, maps are useful tools, and they convey information to the reader of an appraisal report that would be difficult to express in narrative form. To take a liberty, "A map is worth 1,000 words." What maps, mapping tools, or map products should be included in appraisal reports? The answer is ——! Well, maybe the answer is not quite that vague, but it does very much depend on you and the value the map or map product adds to the appraisal process or your appraisal products.

The pitfall to be avoided is retrofitting a map or map product into the appraisal process and product without a clear understanding of what that map adds to the final analysis. For example, a topographical map contains a wealth of information that can be used to describe the geographical landscape of a property. This type of map is especially useful in areas of high relief but may not be as useful in describing level landscapes. Scale is another important consideration. Large-scale maps (1:250,000 or larger) work well when an appraisal project covers a large area, but they are of little value when a small farm or ranch is appraised. These are just a couple of examples of the considerations that need to be made before various maps or map products are selected for inclusion in an appraisal process or report. With this in mind, let's take a look at maps and map properties and some of the issues that may arise when maps are employed in the appraisal process.

Maps—An Overview

Maps provide us with a graphic representation of the world around us and show the relationships between one place and another. They provide us with a sense of direction and distance. There are two general types of maps. Physical or topographical maps emphasize physical features, such as land masses, rivers and other water bodies, mountains, soils, land use, and other geographical information. These types of maps also show major political subdivisions and transportation systems. Political and cadastre maps, on the other hand, emphasize political subdivisions and ownership. Maps of countries, states, cities, and counties are examples of political maps, while Public Land Survey System (PLSS) or land ownership maps are examples of cadastre maps. The maps may show major terrain features, such as major contour lines and water bodies.

Maps and map products fulfill many roles and provide the user with volumes of information. Consider a map (any map) and put a pencil to any spot within the map boundaries. That point represents a spot on the landscape that has many diverse properties (also known as attributes). These attributes include the point's geographical, physical, environmental, political, and economic characteristics. If the map is a topographical map, the attributes of the point are its elevation, geographical coordinates, or distance to the nearest road or town. Examples of attributes that would not be shown are ownership, when the property containing the point was last sold, the value of the property containing the point, and what soils are likely to be found at the point.

Anything that can be attributed to the point can be represented as a map attribute. One attribute of importance to the rural appraiser is a point's contribution of value to the subject or comparable property. This attribute can take many forms and includes the point's productivity index, grazing capacity, proximity to a major recreational area, etc.

Map—Characteristics[1]

Maps and map products have a specific set of characteristics that define the map, how it can be used, and what information is depicted. Three basic map characteristics define the map and are of concern to the rural appraiser. These characteristics are type, projection, and scale. Before digital maps and digital mapping products, cartographers set these map characteristics. These decisions were generally a compromise between the publication format and the information the cartographer was depicting. With the advent of digital maps and Geographic Information Systems (GIS), the user becomes the cartographer and must make some of the map publication decisions that were once made by the cartographers.

Given this shift in technology and the capability to manipulate a digital map, a basic understanding of map characteristics is necessary. Following is a brief discussion of each.

Type.—There are five basic types of map products that can be used by an appraiser. These are planimetric, topographic, quadrangle, and thematic line maps and image maps.

- *Planimetric maps* present political and cultural features but do not show relief. Examples of planimetric maps are state and county highway maps, cadastral (ownership) plats, and political boundary (county) maps.
- *Topographic maps* represent the shape and elevation of the terrain. Elevation and landscape features are represented by contour lines or shading. Contour lines are lines of equal elevation, and the contour interval is the elevation difference between contour lines. Generally, topographical maps are made at a scale of 1:24,000 with a contour interval of 5 to 10 feet (2 to 5 meters) on level terrain to 20 to 40 feet (6 to 12 meters) on steeper terrain. Map scales of 1:100,000 and 1:250,000 with contour intervals of 100 to 200 feet (30 to 60 meters) are available in some areas. Caution is required when maps of different scale and contour intervals are used because the smaller the map scale, the less precise and accurate the information presented.
- *Quadrangle maps* are special topographic maps that are 7.5 minutes of latitude (north and south) by 7.5 minutes of longitude (east and west). In some areas where a broader view and less detail are needed or useful, 15-minute quadrangles are available.
- *Thematic maps* emphasize a single topic, such as geology, soil, land use, and production indexes, and depict the extent, area, and distribution of the topic or subject.
- *Image maps*, unlike the preceding line maps, are prepared from aerial and satellite imagery and have an established scale and orientation. An orthophotograph is a special type of image map in which the geographically projected photograph has been corrected for displacement of terrain tip, tilt, and relief. This process creates an orthographically correct photo base on which distance, area, and direction can be measured accurately. Image and orthophotograph maps are becoming more readily available and are being used as base maps for line maps and other map products.

Projection.—Map projection is used to portray all or part of the round Earth on a flat surface. This portrayal cannot be done without some distortion. Every projection has its own set of advantages and disadvantages, and there is no "best" projection. Briefly, equivalent projection preserves size (areal extent) but may distort shape. Conformal projection preserves shape but distorts areal extent. The map maker must select the projection that best represents the data depicted and has the least amount of distortion. The following U.S. Geological Survey (USGS) Web site provides a good discussion and overview of various projections used to make maps:

http://mac.usgs.gov/mac/isb/pubs/MapProjections/projections.html

Map projection is one of those map technicalities that have been the concern of cartographers and map publishers. Historically, it has not been an issue that has been of concern to the user. It is becoming an issue for the user as more map products are published digitally and as GPS (Global Positioning Systems) and GIS (Geographical Information Systems) technologies are applied. Computerized mapping systems provide the user with the capability to merge and manipulate digital maps and aerial photographs and create new maps or map products. This potential allows the user to depict special features of the subject property or develop spatial analytical information. However, merging digital maps and aerial photographs gives poor

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[1] U.S. Department of Agriculture. 1990. Basic Photo Interpretation. Soil Conservation Service. Washington, DC. Chapter 6.

results or is impossible if the various map layers or images are of different projection. For instance, an appraiser using a GPS, which has the projection set to UTM NAD 83, has located points or boundary coordinates of the subject property. If those coordinates are then transferred to digital or hardcopy maps or aerial photographs with a different projection, the points or boundary tracts will appear misplaced. If the map or photograph is in UTM NAD 27 projection, the GPS data will appear to shift several hundred feet south and west of the original point or points. The mixing of projections can give the impression of error in either the map or the GPS readings when in truth the data are correct for both. It is the projection that is different.

Scale.—Map scale can be simply defined as the ratio of distance on a photograph or map to its corresponding distance on the ground. Map or photographic scale is a ratio expressed as 1:24,000, 1:12,000, or 1:250,000 or as an equivalence expression, such as 1 inch equals 2,000 feet. Although map scale is a fairly straightforward concept, it does constrain the amount of information depicted on the map.

For example, map publication scale is set by the publication format and is a compromise between the information presented and the physical size of the map publication. This compromise in turn affects the amount and precision of information depicted on the map product. A good illustration of this point is the NRCS soil survey report. When soil survey maps are published at a scale of 1:24,000, the smallest area of soil a soil scientist can depict is about 10 acres. However, if the publication scale is set at 1:12,000, soil scientists can depict areas of soil as small as 2.5 acres. In areas of high-intensity agriculture, such as the Corn Belt, the greater resolution provided by the 1:12,000 soil maps is an important planning and management resource used by farmers, farm managers, and agribusiness specialists. Conversely, in the grazing lands of the West, ranchers and rangeland managers are equally well served by the lesser resolution 1:24,000 soil maps.

The advent of digital maps and Geographic Information Systems (GIS) allows the user to exercise more control over map content and scale. In this context, the rural appraisers can change or tailor the maps or map products to meet their individual needs. Digital map scales can be changed by zooming in or out, and the result can be clipped and published in an appraisal report. The caveat is that current digital maps are based on their published predecessors and the information content has not changed. Zooming into or out of the area of interest on digital maps **does not increase or decrease the accuracy or precision of the information depicted.** The information presented is most reliable at the publication scale whether in hardcopy or digital format.

Map legend and metadata.—The map legend provides a number of important details about the map. Most often, the map legend of a hardcopy map includes the map name, the year published, the scale, the projection, and a distance scale. Digital spatial data and maps also have a legend that is technically referred to as metadata (data about data). Metadata is generally in a text file that accompanies a digital map or aerial photograph. This text file contains a description of the digital data and information normally found in a map's legend and along its margins. This information becomes important when digital maps are layered in GIS or other mapping technologies to ensure that the scale and projection of each map layer are compatible.

Summary

Maps and map products in the appraiser's toolbox can be an important part of the appraisal process and report. However, the appraiser must decide what maps or map products will improve the appraisal process and/or the appraisal report. The best map products and mapping technologies are not always obvious and will require some research and testing. Issues to be considered in the decision process are:

- Is the map to be used as an informational source or as an analytical tool?
- Is the map to be used to show the subject's location, define its boundaries, calculate its area, or represent its natural resources or agronomic capability?
- What is the format, digital or hardcopy?
- Are two or more maps to be used simultaneously?

Once the appraiser begins to answer these questions, the available options become more focused. Adding maps and map products to the appraisal process or report is a process and not an all-or-nothing proposition. As the appraisers become more familiar with mapping tools and products, they will discover more applications of the new technologies for their appraisal products.

There are several good reference Web sites that might be of assistance in considering maps and their role in the appraisal process:

http://mac.usgs.gov/isb/pubs/pubslists/fctsht.html
http://oddens.geog.uu.nl/index.html
http://members.aol.com/bowermanb/maps.html
http://www.maphistory.info/webtexts.html
http://www.maphistory.info/edson.html#intro ■

Not Your Typical Day in the Field

By Kent Sutcliffe, Soil Scientist, Natural Resources Conservation Service, Cedar City, Utah.

The August day started out in a normal way for members of the Grand Staircase-Escalante National Monument Soil Survey Team. Jay Skovlin, Soil Scientist, Kent Sutcliffe, Project Leader, and Suzanne Mayne, Range Specialist, packed up pit description equipment and digital cameras into Suzanne's new truck and headed east from Cedar City. The plan for the day was to locate and describe the type location of the Podo series and to determine if the climate of the type location properly reflects the classification of the series. Lucky for us, the type location is on a narrow strip of Dixie National Forest between Bryce Canyon National Park and the Grand Staircase-Escalante National Monument (GSENM). Although it is hard to take, we often hike through beautiful National Parks during work, in the name of data integrity.

Before the attendant at Bryce waved us on, she mentioned that there was a lost hiker in the area. Apparently, a woman had departed on a hike the previous morning and not returned in the evening. Since there is no water available in the park's backcountry, the possibility of disorientation and injury from dehydration is a real concern.

Since the Podo series type location is somewhat remote, we planned on doing an out-and-back hike from the rim of Bryce Canyon. The mileage would not be huge, but as anyone who has ever been to Bryce knows, the problem is in the 1,500 feet of elevation we would cover hiking down and back up. Although temperatures were quite mild, we were all soon sweating because of the need to keep a steady pace. After a half hour or so of hiking, we realized that at the rate we were going, we were not going to be able to make it to the type location and back by nightfall. We decided to make it a point-to-point hike. After visiting the type location, we would continue down the drainage to a pick-up point. Suzanne offered to hike back and drive her truck around to a small ranch at the end of the drainage. She would then leave the truck and hike up Willis Creek to meet us.

As Jay and I hiked quickly through the beautiful Claron Formation outcroppings, we could not help but notice the constant din of a helicopter. Although we could not see the helicopter from where we were, we assumed it was searching for the missing woman. It was making passes through adjacent drainages, but it never dropped into the area where we were hiking. We finally made it to the quarter section mentioned in the OSD and found the type location. It had taken longer to get there than we had expected, so we quickly dug a pit, took pictures, and made some additional site observations. While working there, we both thought we heard other voices, but it was hard to tell with the distant helicopter noise. Worried that Suzanne might be close, we hiked on down Ponderosa Canyon to its confluence with Willis Creek.

Once at the confluence of the two drainages, we drank some water and briefly rested. We decided to drop our packs, to ensure that Suzanne would stop and not continue hiking up Willis Creek while we continued our work. At this point, I was sure I was hearing someone yelling. Since the voice we were hearing did not sound like it belonged to Suzanne, we became a little more worried. About 100 yards down the trail, we found the lost woman! Jay and I looked at each other in disbelief.

She was lying under a ponderosa tree, digging small trenches radially out from the base of the tree. When we approached her, it took a minute for her to respond. Later we found out that she had been hallucinating and was not sure if we were real. After a few moments, she began talking with us and made clear what she needed: water. We dug through our bags and produced all of the water we had, including texturing water. We encouraged her to drink slowly, but she really did not want to hear that.

After she drank all of the water we had, she began to tell us about her experience. It was quite clear to Jay and me that she needed to get more fluids and electrolytes. She had attempted to eat earlier in the day, but her body had rejected the food. She appeared to us to be quite confused. She had dug the trenches in order to "trap water." She spoke of lakes in the area that she had drunk from in the past. Having hiked all through the area, we knew none existed. Even small ponds developed for wildlife and cattle were long since dry because of a drought. After drinking some water, she regained some strength. We told her that we had a vehicle a few miles away, and she was excited at the prospect of hiking to it and getting medical help. She must have had a surge of adrenaline, because once on the trail she was hiking really quickly. We figured she would not be able to maintain the pace for 3 miles, so we tried to slow her down a little. Sure enough, after just a few hundred yards, she started to falter and needed to rest.

Now completely out of water, Jay and I consulted with each other about what to do. We decided that I would run down and try to find Suzanne and bring the truck up the trail as far as possible. I ran down the trail, anticipating the appearance of Suzanne over every little knoll. What I did not know is that Suzanne was unable to find the key to get into the ranch. As a result, she had to park on the opposite end of the ranch, adding about another mile to her hike. Finally, I saw her and explained what had happened. I think if I had not been sweating so much and totally out of breath, she would not have believed me. I got the truck and headed up the trail, soon picking up Suzanne. We continued on, and she bristled at the sound of branches scraping her brand-new Chevy pickup. I reassured her that "they'll buff out." We finally arrived in the area where we had parted ways, but no one was there.

Jay immediately popped out of the woods, looking calm. His face wore an expression that seemed to say, "What's the big hurry?" He went on to explain that while we were gone, the helicopter had come over the ridge to search the Willis Creek drainage. Jay had been able to catch the attention of the helicopter crew by yelling and waving his sharpshooter shovel. After circling several times, the crew was able to land the helicopter and administer aid to the woman. After they offered us cold bottled water, we discovered that they were an interagency crew of fire and safety people. They had been searching for this person the whole day, in addition to several hours the previous evening. The information they had received from the family indicated that the woman had gotten lost several miles from where we found her. It was only out of frustration that the helicopter crew decided to search the Willis Creek drainage. The crew members were very thankful for our efforts. We packed up the truck and headed home, discussing our very unusual day in the field. ■

Optional and Required Parts of Soil Survey Publications

Excerpted from *Quality Improvement Rapid Response Team Soil Survey Publications Report*, August 2003, page 28.

Accessibility statement	Required
Cover	Required
"How To Use This Soil Survey"	Required
"Box" information and EEO statement	Required
Contents	Required
Foreword (or Preface)	Required
"General Nature of the Survey Area"	
Introductory information and locator map	Required
Climate tables and "Climate" section	Optional (link to WCC)
Other sections, such as "History," "Natural Resources," and "Transportation Facilities"	Optional
"How This Survey Was Made"	Required
"Survey Procedures"	Optional
"General Soil Map Units"	Optional (link to STATSGO)
Detailed soil map unit descriptions	Required
"Use and Management of the Soils" and interpretive tables	Required*
"Land Capability Classification"	Required
"Prime Farmland"	Required if relevant
"Soil Properties" and properties tables	
"Engineering Index Properties"	Required
"Physical Properties"	Required
"Chemical Properties"	Required
"Soil Features"	Required
"Water Features"	Required
"Physical and Chemical Analyses of Selected Soils"	Optional (link to NSSL data)
"Engineering Index Test Data	Optional
"Classification of the Soils" and classification table	Required
Series descriptions	Optional (link to OSDs)
"Formation of the Soils"	Optional
References	Required
Glossary	Required
General soil map	Optional (link to STATSGO)
Detailed soil maps	
Detailed map sheets	Required
"Index to Map Sheets"	Required
"Conventional and Special Symbols Legend"	Required
"Soil Legend"	Required
Photographs	Optional
Block diagrams and other drawings	Optional

* Required only for relevant uses (Cropland, pasture, woodland, range, wildlife habitat, recreation, and engineering uses are all optional, depending on relevancy.) ■

Example of a portable XRF meter with attachments for direct field soil sampling or analysis of prepared soil samples.

Positioning of portable XRF meter.

Prepared soil samples (dried and finely ground) packed into cells for analysis in the portable XRF meter.

National Soil Survey Center Tests XRF Meter

From "NRCS Technology News," April 2004.

Scientists at the National Soil Survey Center (NSSC) tested a portable X-ray fluorescence (XRF) meter as potential new technology for field soil surveys in urban and industrial areas. The suitability of portable XRF meters to supplement current laboratory methods to measure trace element contents in soils was evaluated. Trace element contents have long been important for accurate soil mapping in urban and industrial areas and for soil survey interpretations. Recent requests from state soils staffs have included soil contents of lead (Pb), arsenic (As), and selenium (Se).

This technology is useful in soil surveys for four major reasons:

- The rapid growth in urban soil surveys is expected to add more analyses to the workload of the Soil Survey Laboratory.
- Screening sites in the field before extensive sampling can lead to savings up to 60 percent on equipment and personnel and to reduced mapping time.
- Safety can be increased at urban sampling sites if soils are screened before employees are exposed to contaminated materials.
- Cooperators, such as the U.S. Environmental Protection Agency (including the Lead-Safe Yard Program), already use portable XRF meters in the field to identify sites with high risk from metals in soil and paint residue.

It is recommended that NRCS soil scientists and conservationists in urban areas attend the available training on portable XRF meters to increase their awareness and skill with tools used by cooperators. These general vendor training sessions can be followed by local onsite workshops and joint sampling trips for field training coordinated by NSSC scientists.

Portable XRF meters are affordable new technology for NRCS. These XRF meters can increase the safety and efficiency of soil surveys in urban and industrial areas while supplementing existing laboratory resources.

For more information, contact:

Joyce Scheyer
National Soil Survey Center
402-437-5698
joyce.scheyer@nssc.nrcs.usda.gov ■