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Best Management Practices (BMP) Manual— Desk Reference:

Implementation and Effectiveness for Protection of Water Resources

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Best Management Practices (BMP) Manual—Desk Reference:

Implementation and Effectiveness for Protection of Water Resources

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Origin of the BMP Protocol Project

The BMP protocol project is a cooperative effort of the Forest Service, U.S. Department of Agriculture, and the Northeastern Area Association of State Foresters–Water Resources Committee (NAASF–WRC), Steven Koehn, Maryland State Forester, chairperson. The project has been funded by grants from the U.S. Forest Service and the U.S. Environmental Protection Agency (EPA).

The original concept and question sequence was developed by Roger Ryder and Tim Post of the Maine Forest Service in collaboration with David Welsch and Albert Todd of the U.S. Forest Service, Northeastern Area State and Private Forestry (NA S&PF). The NA S&PF proposed the method to the NAASF–WRC and the EPA for development as a potential regional protocol. After the withdrawal of the Maine Forest Service, David Welsch served as the project coordinator through the development, testing, and implementation of the project.

State forestry agencies from Delaware, Indiana, Maine, Maryland, Massachusetts, New Hampshire, New York, Ohio, Pennsylvania, Vermont, Virginia, West Virginia, and Wisconsin; the New York City Watershed Agricultural Council Forestry Program; and the U.S. Forest Service Northern Research Station and NA S&PF have collaborated in the development and testing of the BMP protocol.

Table of Contents

Chapter 1—Introduction

Section 319 of the Federal Water Pollution Control Act of 1972 (33 U.S.C. sec. 1251–1387), known as the Clean Water Act, defines the term *best management practice (BMP)* as a practice or measure that has been demonstrated to be successful in protecting the water resources of the United States from nonpoint source pollution. The BMP Protocol Project is an effort to develop a standard method for monitoring the use and effectiveness of best management practices commonly used in timber harvesting.

Background

The U.S. Environmental Protection Agency (EPA) was tasked with executing the Clean Water Act (CWA). Sections 208, 319, and 404 of the CWA require States to identify and quantify nonpoint sources of pollution as well as to develop and implement programs to address and lessen the amount of pollutants entering U.S. waters.

Forestry operations such as timber harvesting—or silvicultural activities as they are described in the CWA—are among the many activities regulated under sections 208, 319, and 404 of the CWA. Permits are required in order to conduct activities that may impact the waters of the United States. Although silvicultural activities are responsible for relatively small contributions to surface water pollution compared with other land uses, nonpoint source pollution resulting from silvicultural activities can result in the deterioration of water quality.

The CWA provides an exemption from the permitting requirement if appropriate BMPs are used and are effective in preventing adverse effects on the quality of water resources. The silvicultural exemption, as the clause is known, thus relieves silvicultural activities from the permitting requirement of the CWA if BMPs are used effectively. Monitoring is needed, however, to document the use and effectiveness of BMPs in forestry.

Over the years, litigation has attacked the silvicultural exemption, and the need to comply with Total Maximum Daily Loads has further reinforced the need for the effective use of BMPs. As a result, the EPA has been seeking BMP use and effectiveness data that are reliable and comparable among States as evidence of compliance with the provisions of the CWA.

Research studies have repeatedly shown that BMPs can be effective if applied correctly and in a timely manner.[1] To date, however, monitoring of effective BMP usage has often been sporadic, inconsistent, and largely anecdotal.

Purpose of the BMP Protocol

The specific purpose of the BMP protocol is to create an economical, standardized, and repeatable BMP monitoring process that is completely automated, from data gathering through report generation, in order to provide measured data, ease of use, and compatibility with State BMP programs.

The protocol was developed to meet the following needs:

- Document the use and effectiveness of BMPs in protecting water resources during forest harvesting operations.
- Document the degree of compliance with the Clean Water Act as well as the Coastal Zone Management Act and various State laws and regulations.
- Assess water resource protection based on the effectiveness of a collective set of BMPs rather than documenting the use of individual prescriptive methods or practices.
- Increase credibility through the measurement of results as opposed to observation and anecdotal assessments.
- Respond to public concerns regarding the potential effects of timber harvesting based on measured evidence.
- Identify opportunities for improvement in water resource protection by identifying causes of BMP failure.

[1] Kochenderfer, James N.; Hornbeck, James W. 1999. Contrasting timber harvesting operations illustrate the value of BMPs. In: Stringer, Jeffrey W.; Loftis, David L., eds. Proceedings, 12th central hardwood forest conference; 1999 February 28–March 2; Lexington, KY. Gen. Tech. Rep. SRS–24. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station: 128–136.

- Facilitate focused agency and industry BMP training programs by identifying problems with the implementation of individual practices.
- Identify opportunities to improve or simplify BMP practice specifications.
- Facilitate self assessment of water resource protection efforts by States, industry, and other forestry organizations, and encourage more frequent monitoring.
- Facilitate green certification.

Description of the BMP Protocol

The BMP protocol is an automated monitoring system with three functions: (1) data collection, (2) data analysis, and (3) report generation.

Data are collected using a branched question set designed to efficiently address those areas of the timber harvest with the greatest potential to impact water resources: water crossings; haul roads, log landings, and skid trails; chemical pollutants; buffer/filter strips; and wetlands.

The protocol question software was developed for use with commonly available software and hardware platforms. A variety of inexpensive pocket PC units or more costly GPS units can be used for field data collection. These field units use Windows Mobile software to link and upload data to a desktop computer. Microsoft Access, Excel, and Word—inexpensive software programs commonly available in forestry offices—are used to analyze the data and produce an automated data summary. GPS data recorded in the process permit analysis of any conceivable geographical unit.

Users can create customized reports suitable for different audiences by adding commentary and photos to the data summary to further explain results.

Features of the protocol include the following:

- State- or user-controlled statistical sample design
- Single field assessor–single visit sampling procedure
- Branched question set and data recorder program
- Computer-generated standard data summary
- Discrete georeferenced sample units
- Quality control resampling
- Analysis of potential site- and operator-associated risks by geographical area or individual timber sale
- State or user interpretation and report design
- Ability to design custom data queries

Organization of the BMP Manual

The documentation to accompany the BMP protocol software is contained in two volumes—a field guide and this desk reference. The two-volume set is informally referred to as the BMP manual.

This desk reference focuses on analyzing and summarizing the data that have been collected using the BMP Management Information System (BMP MIS). Chapter 3 covers installation of the BMP MIS software, running of the preprogrammed queries of the data, and generation of the standard data summaries. Chapter 4 addresses assembling the standard data summaries into a single Comprehensive Standard Data Summary. Chapter 5 contains instructions for creating custom queries and data summaries, which user's may want in order to address unique harvesting situations or activities. Chapter 6 covers the use of the spatial query tool to create subsets of the field data, based on GPS coordinates, to assess BMP effectiveness for specific geographical areas. The remaining chapters address such topics as statistical sample design, quality control, and recordkeeping.

The companion field guide contains the full text of the protocol questions and covers such topics as installing the field data collection software, training field personnel, and collecting data in the field.

Chapter 2—Best Management Practices Management Information System

Data collection using the BMP protocol is only the first step in determining BMP performance. The Best Management Practices Management Information System (BMP MIS) is a tool with which users can efficiently analyze and interpret a wide range of data from the BMP protocol and report on it to resource managers and the public. It consists of a set of electronic files that are used to organize, sort, and present the information in a set of standard data summaries. The standard data summaries, which report on individual focus areas, can then be combined into a Comprehensive Standard Data Summary of BMP performance. The BMP MIS also allows users to design custom queries to supplement the information in the standard data summaries.

The BMP MIS consists of the following components:

- This desk reference, which is a guide to using the BMP MIS to sort and query field data and present them in standard and custom data summaries.
- A CD containing the electronic files needed for processing BMP field data, as well as a set of sample files for use in practice exercises.

Requirements for the BMP MIS

The BMP MIS is designed to operate on hardware and software typically available in most government and industrial forestry offices in order to maximize efficiency and minimize additional cost. The following components are needed:

- Desktop (or laptop) computer with the following features:
    - ♦ USB port to connect to a pocket PC
    - ♦ 512 MB RAM
    - ♦ 1500 MHz processor
- Windows 2000 or Windows XP operating system
- Microsoft Office Professional 2003 software applications, including Access, Excel, and Word

You can confirm the specifications on your computer by opening My Computer on your desktop and right-clicking anywhere in that window. Select **Properties** from the menu. The **System Properties** box will open. The **General** tab lists the system specifications of the computer.

> **Important**: The BMP MIS was designed to work with the configuration specified. The BMP MIS will operate with different hardware-software configurations, but the screens may vary slightly from those shown in this manual. If using the 2002 version of Microsoft Word, download and install the Office XP Service Pack 3 from the Microsoft Web site.

Structure of the BMP MIS

The BMP MIS utilizes Microsoft Excel, Access, and Word to produce the standard data summaries that will form the basis of your reports. Each software application performs a specific function in the process (figure 2.1).

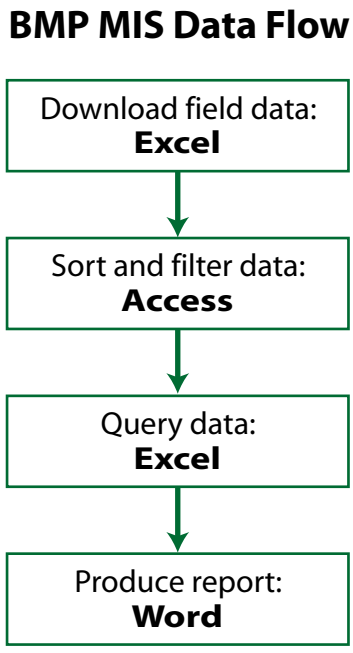


Figure 2.1. Different Microsoft programs are utilized in each step of the process, from downloading field data to producing a final report.

You received two different BMP MIS folders on the CD included with this BMP desk reference: **Sample BMP MIS** and **BMP MIS**. The **Sample BMP MIS** folder is provided for demonstration and training. The **BMP MIS** folder contains the files you will populate with your field data in order to generate reports. In each folder you will find the following:

- An Access database
- An Excel worksheet formatted for field data analysis
- Fifteen Word files containing standard data summary templates

In addition, the **Sample BMP MIS** folder contains an Excel file with sample field data.

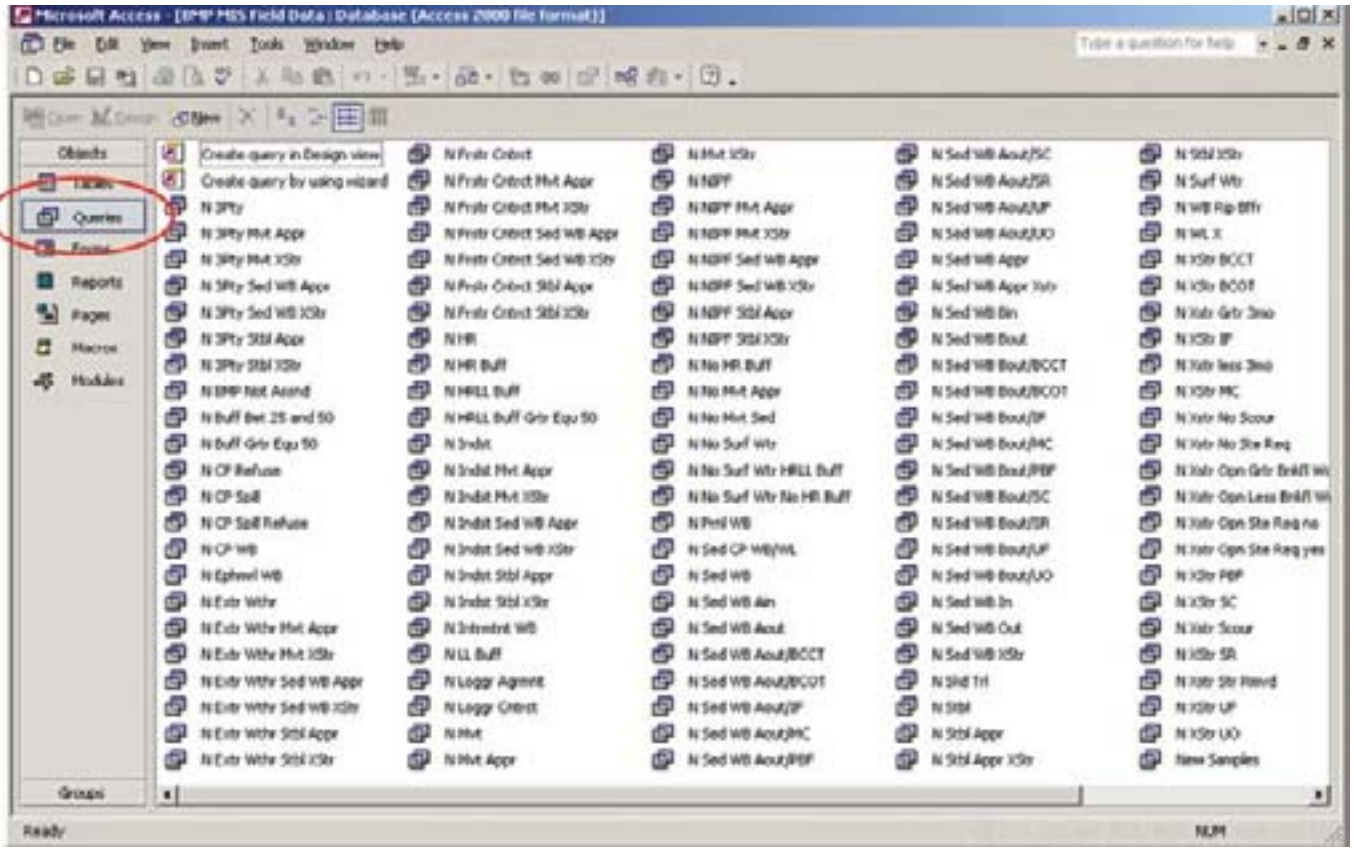
A description of how each Microsoft application is used to manage and query field data to create the standard data summaries is provided below.

Access Database

Data downloaded from the field data recorder are stored in an Excel worksheet. When sampling is complete, the worksheet will be imported into Access, where it becomes the primary database for BMP protocol data.

All data collected for your State or organization are stored in an Access table. From this table, the field data are sorted and filtered numerous ways.

The various sorts of the data in Access are referred to as queries. The goal of sorting data is to look at many different subsets of data that focus on specific *areas* in the sample unit, such as approaches to a surface water crossing or crossing structures, or specific *conditions*, such as soil movement or chemical pollutants. A number of queries have been defined in Access, as shown in the screen below. Each of the files shown is a subset of field data. The queries are named using abbreviations for the data they contain. A list of abbreviations used to name the queries can be found in appendix A; a list of the query names and descriptions is in appendix B.



Excel Worksheet

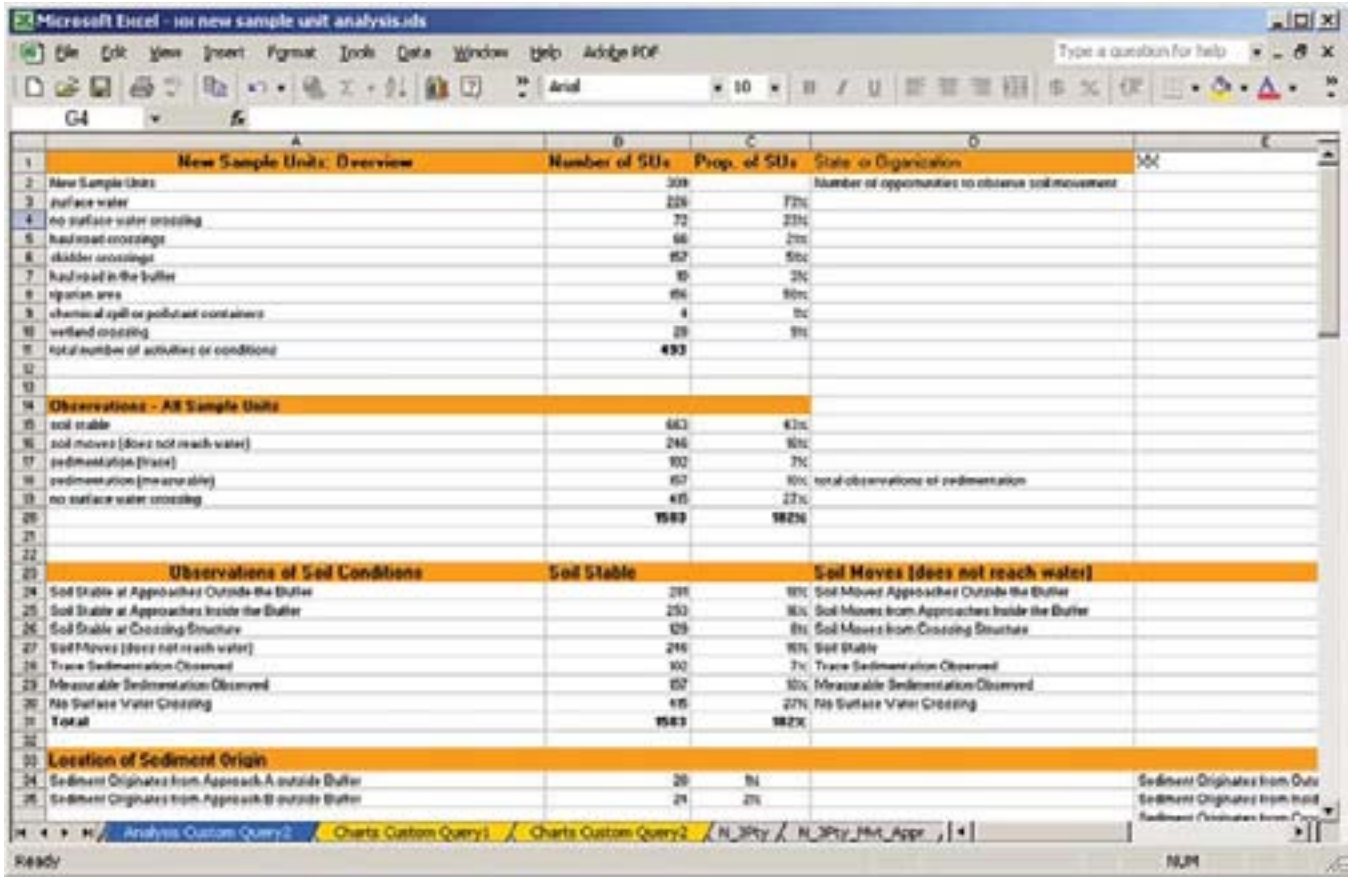
After data are sorted in Access as queries, each query is exported to a worksheet in an Excel file. This file contains worksheets that (1) contain copies of the Access data queries, (2) further query and analyze Access data, or (3) contain charts and graphs.

The Excel file organizes the data sorted in Access into one file, so that more specific queries can be applied to the field data. The goal in Excel is to use the Access queries to answer the questions that the protocol seeks to address, such as the following:

- Are there problems with soil movement on harvest units?
- What are the problems? Where and why are they happening?
- What is the use and effectiveness of BMPs?

Calculations are organized on worksheets by subject area, such as approaches to the water crossing, the crossing structure, chemical pollutants, and riparian area evaluation.

An example of an Excel worksheet from the analysis file is shown below. Charts, graphs, and other figures are compiled from these worksheets and stored in a separate worksheet by subject area. Figures and information from the Excel analysis file are exported to Word files and become components of the standard data summaries.



Word Document

The standard data summaries that report the results of the queries are formatted in Word. Fifteen standard data summary templates focusing on specific areas of the BMP protocol are included with the BMP MIS (appendix C). The standard data summaries present the data using text and charts; additional text, figures, and photographs may be inserted to tailor the reports to various audiences. The individual standard data summaries, such as the sample shown below, can also be combined into a Comprehensive Standard Data Summary.

While each software application has a specific job in the BMP MIS, it is important to understand that they work together to make analysis of field data possible and accessible to all participants using readily available software programs. The following chapters will guide you through the steps to set up and use the BMP MIS effectively to create a complete and comprehensive report from your field data.

Overview of Sample Units

309 new sample unites were sampled.

Number and Proportion of Sample Units by Feature

A sample unit is likely to have more than one of activity or condition recorded; therefore, the total of activities and conditions will exceed the number of sample units (e.g., **493** activities and conditions in **309** sample units).

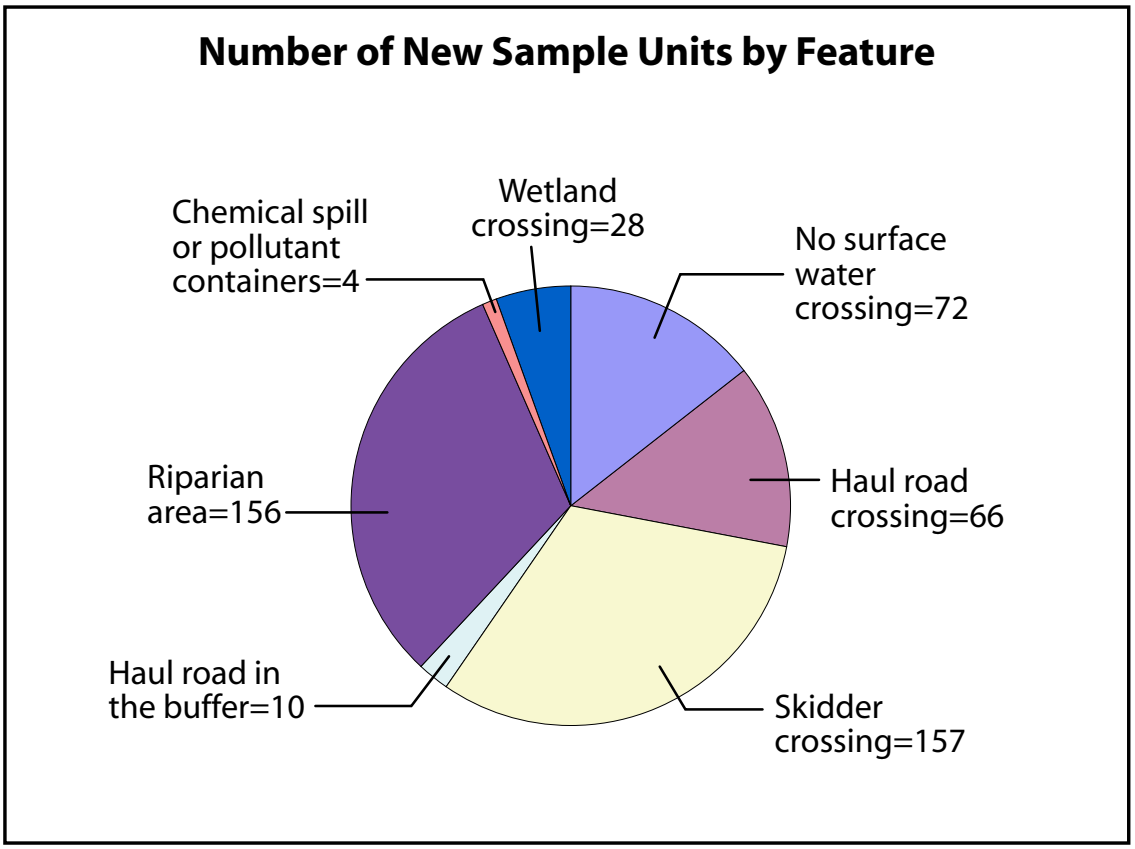


Figure X. (n=309)

Chapter 3—Installing and Using the BMP MIS

The CD provided with this desk reference includes several folders containing the electronic files you will need to process your field data. Two of the folders are referenced in this chapter: the **Sample BMP MIS** folder contains the files you will use in the practice exercises, and the **BMP MIS** folder contains files you will use to process the actual field data collected by your State or organization. This chapter guides you through the installation of the **Sample BMP MIS** folder onto your computer and illustrates how to use the files contained in it to generate standard data summaries. Instructions for compiling the standard data summaries into a Comprehensive Standard Data Summary are provided in chapter 4. After you have successfully completed the practice exercise using the files in the **Sample BMP MIS** folder, you will follow the same procedure for your actual field data using the files in the **BMP MIS** folder.

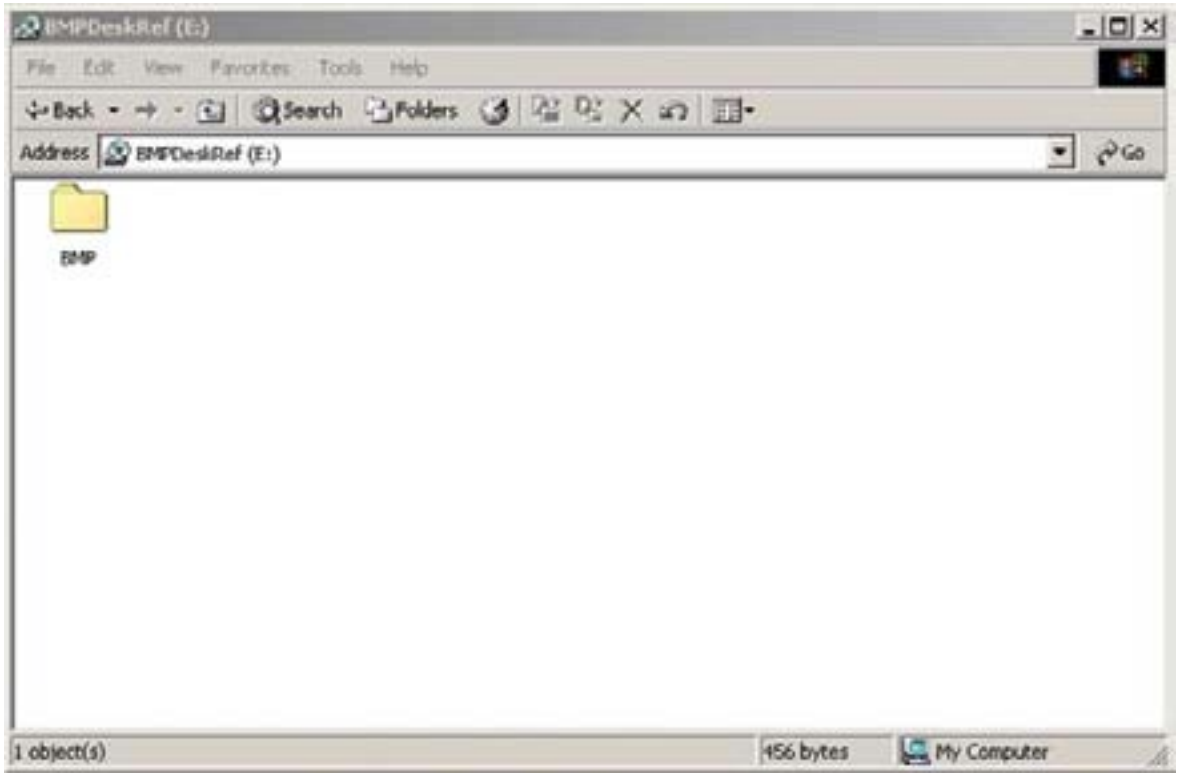
Throughout this chapter, text boxes contain instructions for using the BMP MIS with actual field data that differ from those for the Sample BMP MIS practice exercise (see example below).

> After completing the practice exercise using the **Sample BMP MIS** folder, use the same sequence of steps to copy the **BMP MIS** folder to your computer to analyze your actual field data. Rename the **BMP MIS** folder, using a unique name that represents the geographic area and the year in which the data were collected (e.g., BMP MIS Allagash 2007). Substitute **BMP MIS (name)** for **Sample BMP MIS** in the instructions in this chapter wherever applicable.

Copying the BMP Files to Your Computer

Step 3.1. Copy the BMP Folder to Your C Drive

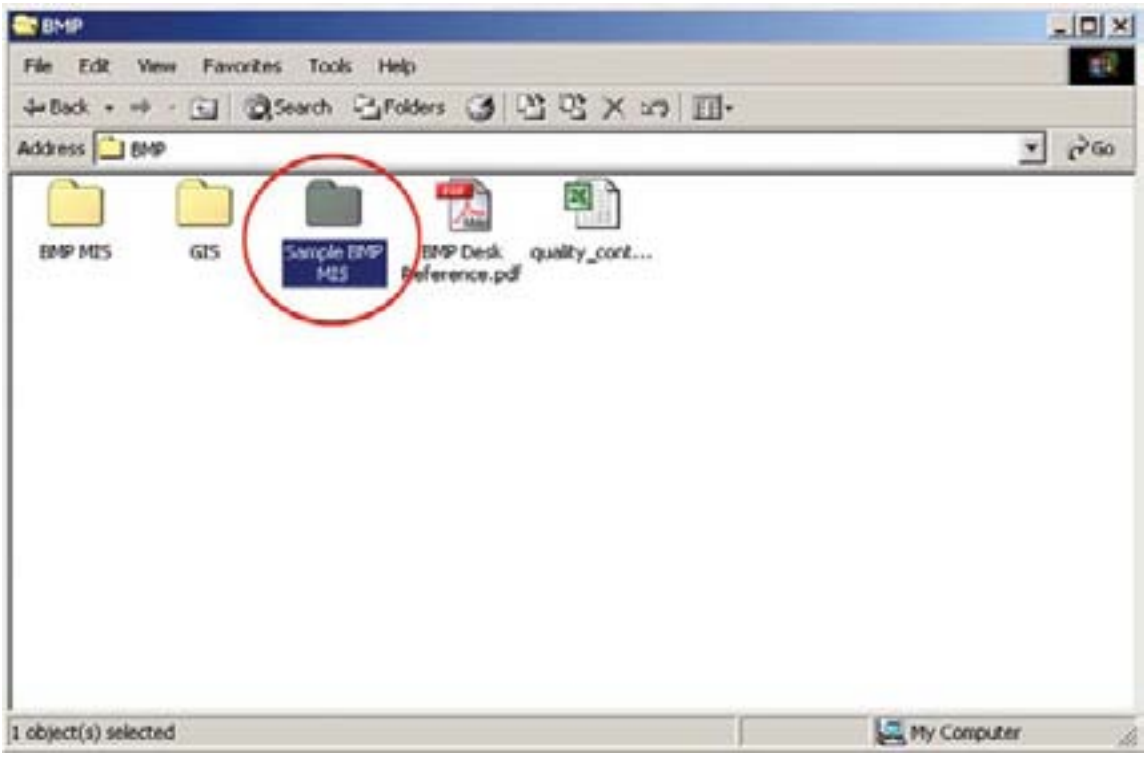
Insert the BMP desk reference CD into your computer's compact disc drive; the following window will open. Highlight the folder **BMP** and copy it to the C drive of your computer. **The files in the BMP folder must remain in this folder on the C drive!** You will be instructed to make copies of certain files and folders as necessary throughout the chapters of this document. Keep the original CD in a safe location.



Step 3.2. Make a Copy of the Sample BMP MIS Folder

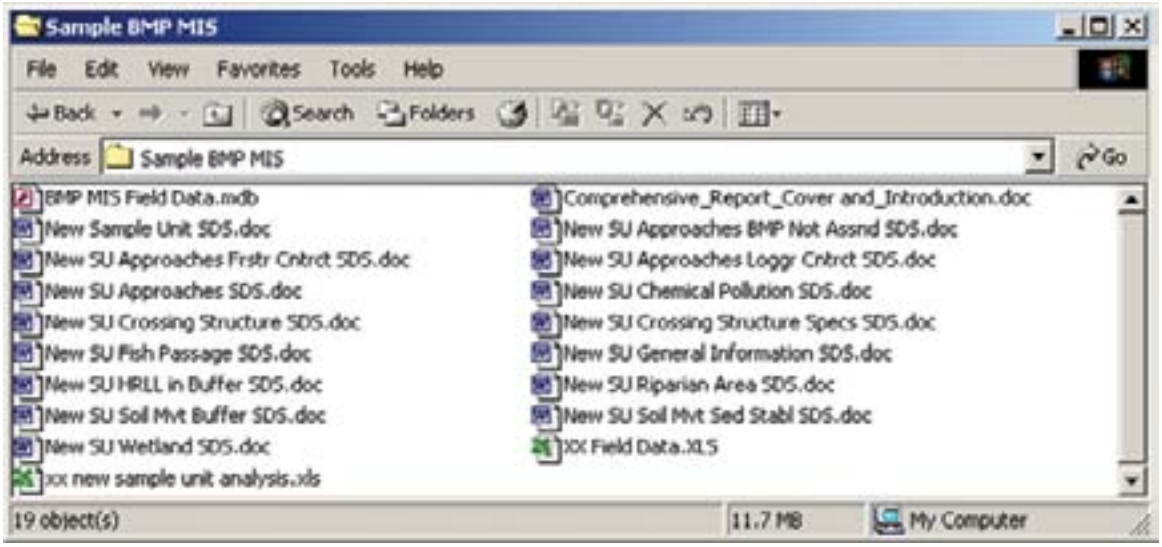
Navigate to the **BMP** folder you just copied onto your C drive and open it. Make a copy of the **Sample BMP MIS** folder and save it to a location of your choosing on your C drive (it should **not** be filed in the C:\BMP folder).

> When using the BMP MIS to process your actual field data, copy the **BMP MIS** folder and rename it as **BMP MIS (name)** in this step.



Step 3.3. View the Files in the Sample BMP MIS Folder

Navigate to the Sample **BMP MIS** folder you just copied onto your computer and double-click on it. The following window will open, listing the files contained in the folder.



This folder contains the following files:

- An Access database (**BMP MIS Field Data.mdb**)
- Two Excel worksheets: one containing sample field data (**XX Field Data.xls**) and one containing analysis of field data (**xx new sample unit analysis.xls**)
- Fifteen Word files containing standard data summary (SDS) templates
- A Word file containing the cover, introduction, and table of contents to the Comprehensive Standard Data Summary (**Comprehensive_Report_Cover_and_Introduction.doc)**

> Keep your field data Excel file for the same data collection period in the **BMP MIS (name)** folder along with the standard data summaries you will be creating in a later step. Continued use of the BMP protocol will result in several uniquely named BMP MIS folders; following this procedure will help you to keep track of the field data files, query files, and data summary files according to the geographic area and time periods in which the data were collected.

Importing Field Data Into Access

Data collected in the field are sorted and queried in Access. These sorts and queries are already defined in the Access file in the **Sample BMP MIS** folder; they simply need to be populated with your field data. In this section, you will practice importing a field data file to Access and creating a table using files in the **Sample BMP MIS** folder. Once the table is created, you will view the queries and export them to the Excel analysis file.

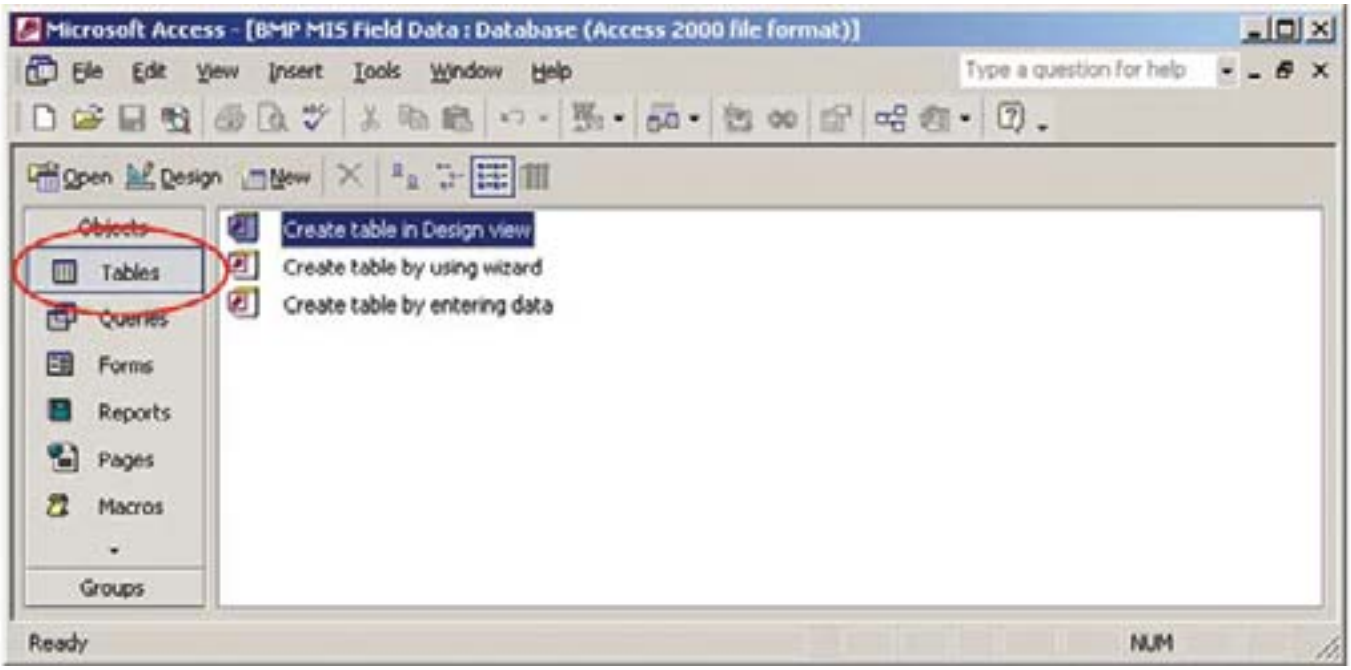
> When processing actual field data, you should finish collecting data in the field and upload the data to an Excel file before beginning this procedure (see the BMP field guide, appendix A for instructions on uploading field data to an Excel file). If you upload additional field data after following the steps outlined in this chapter to generate standard data summaries, you will have to repeat the entire process to include the new data in the standard data summaries.

Step 3.4. Open the Access Database File Using the Password

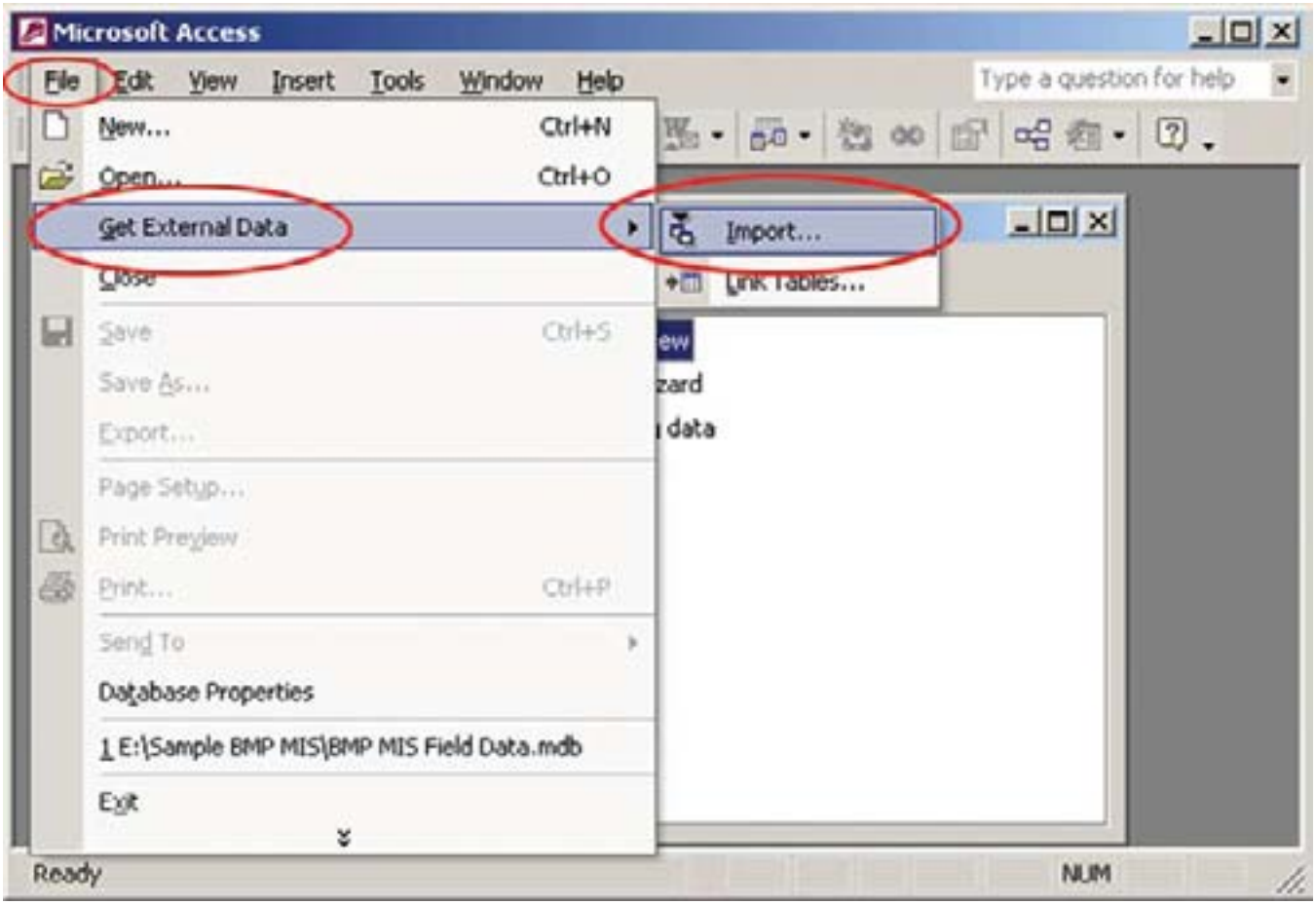
The Access database file in the **Sample BMP MIS** folder is password protected to ensure the security of field data. Double-click on the file **BMP MIS Field Data.mdb** to open it. A dialog box appears asking for the database password. The password is **BMP MIS** (it is case sensitive). Enter the password and select **OK** to open the database file.

Step 3.5. Import Field Data Into an Access Table

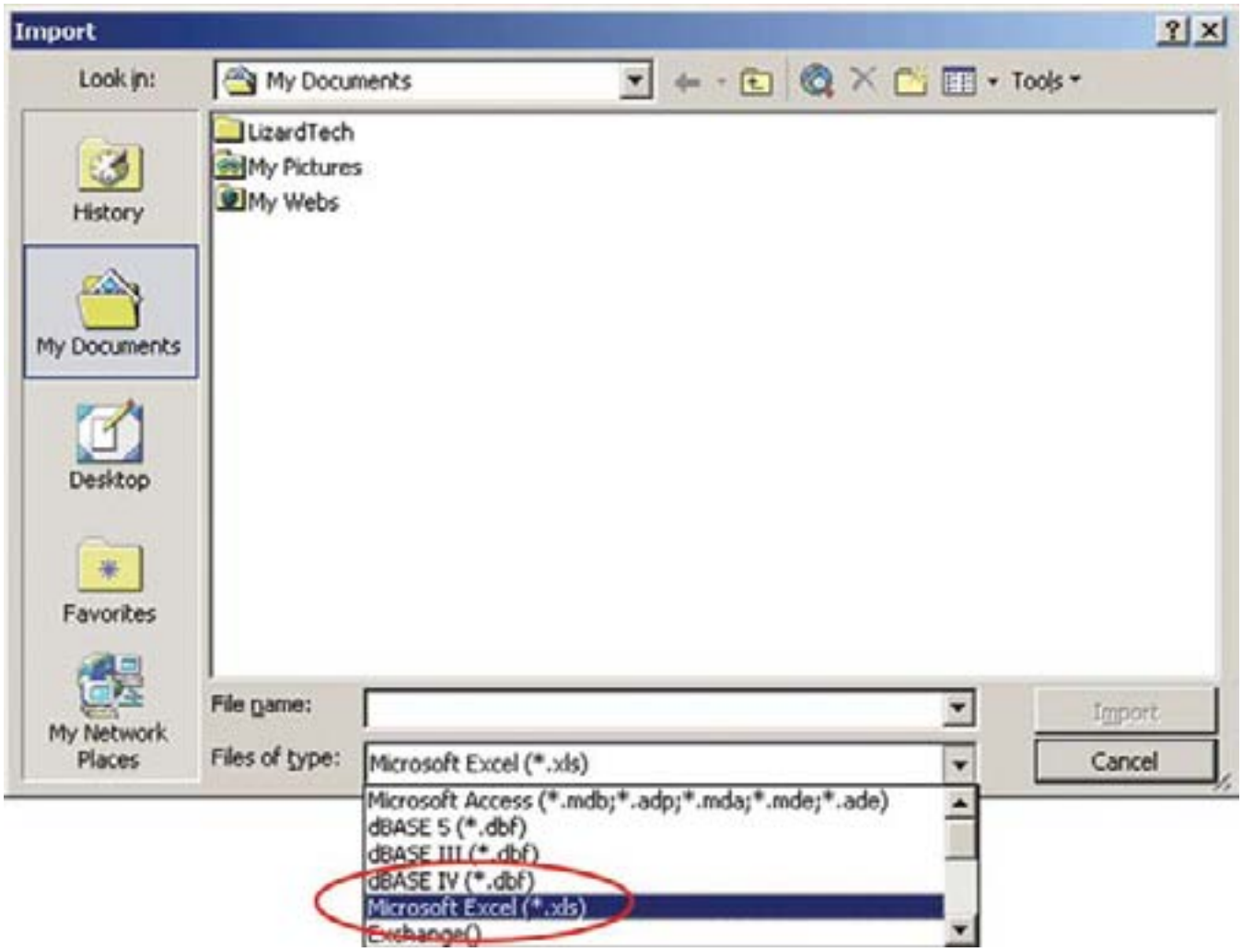
Using the menu on the left-hand side of the screen, under **Objects**, select **Tables**.



You will create a new table here using your Excel field data file. Select **File** on the main toolbar, then select **Get External Data** and **Import** from the drop-down menus.

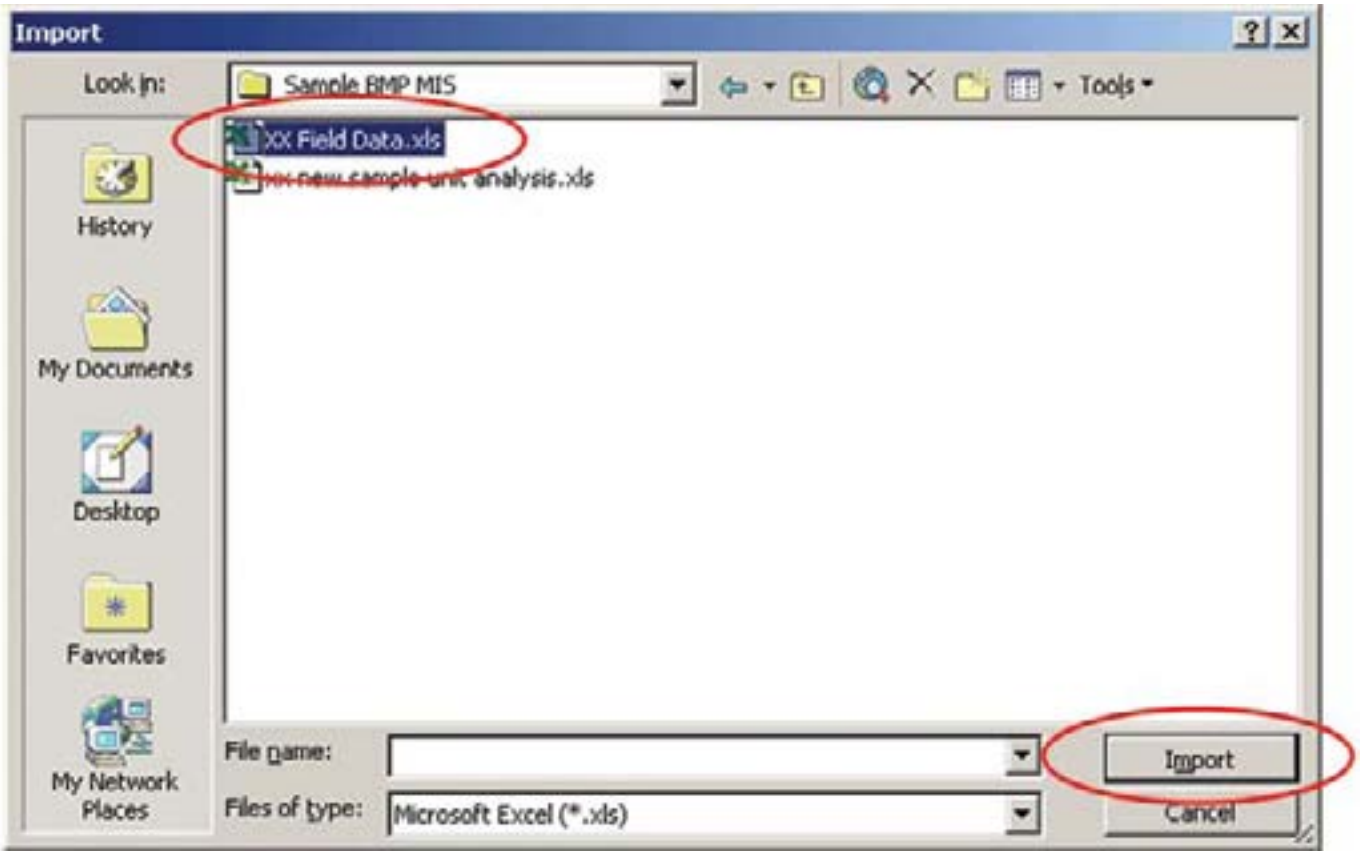


The **Import** window will open. Since the sample field data are stored in an Excel file, change the file type in the **Files of type** box at the bottom of the window to **Microsoft Excel (*.xls)**. Click on the down arrow and select this file type from the drop-down menu.

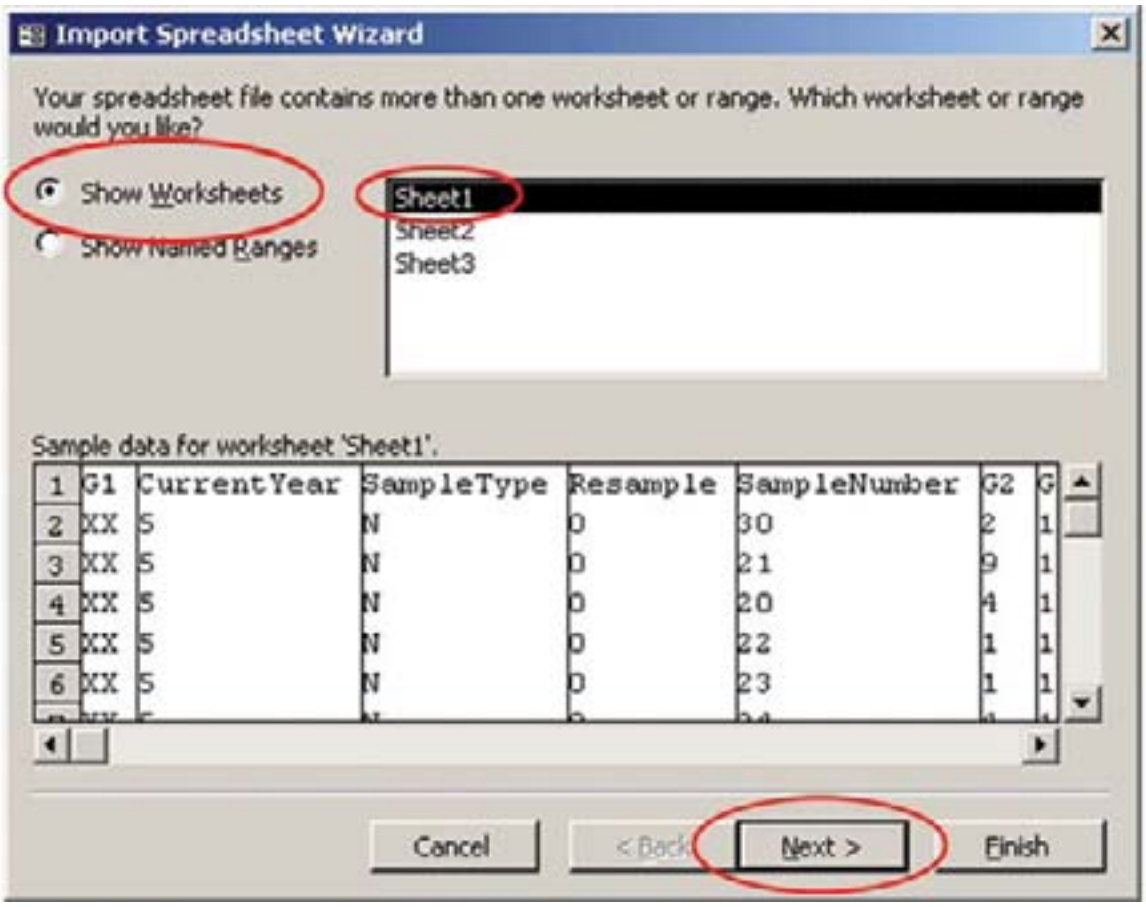


Navigate to the location of the Excel field data file. In this practice exercise, the sample field data file **XX Field Data.xls** is in the **Sample BMP MIS** folder. Select the file name to highlight it, then select **Import**.

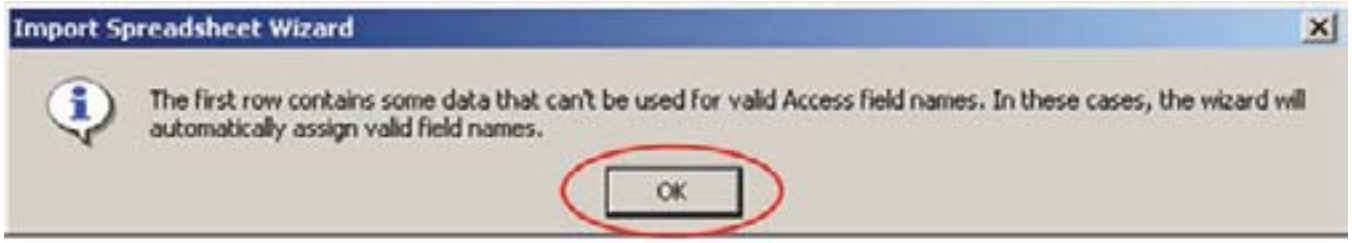
> When processing your actual field data, you will navigate to and import your Excel actual field data file. If you have not already done so, copy the actual field data file into the **BMP MIS (name)** folder you have created. When you have finished the steps outlined in this chapter, you will have the actual field data file, the query files, and the standard data summary files all in the **BMP MIS (name)** folder named for the geographic area and time period in which the data were collected.



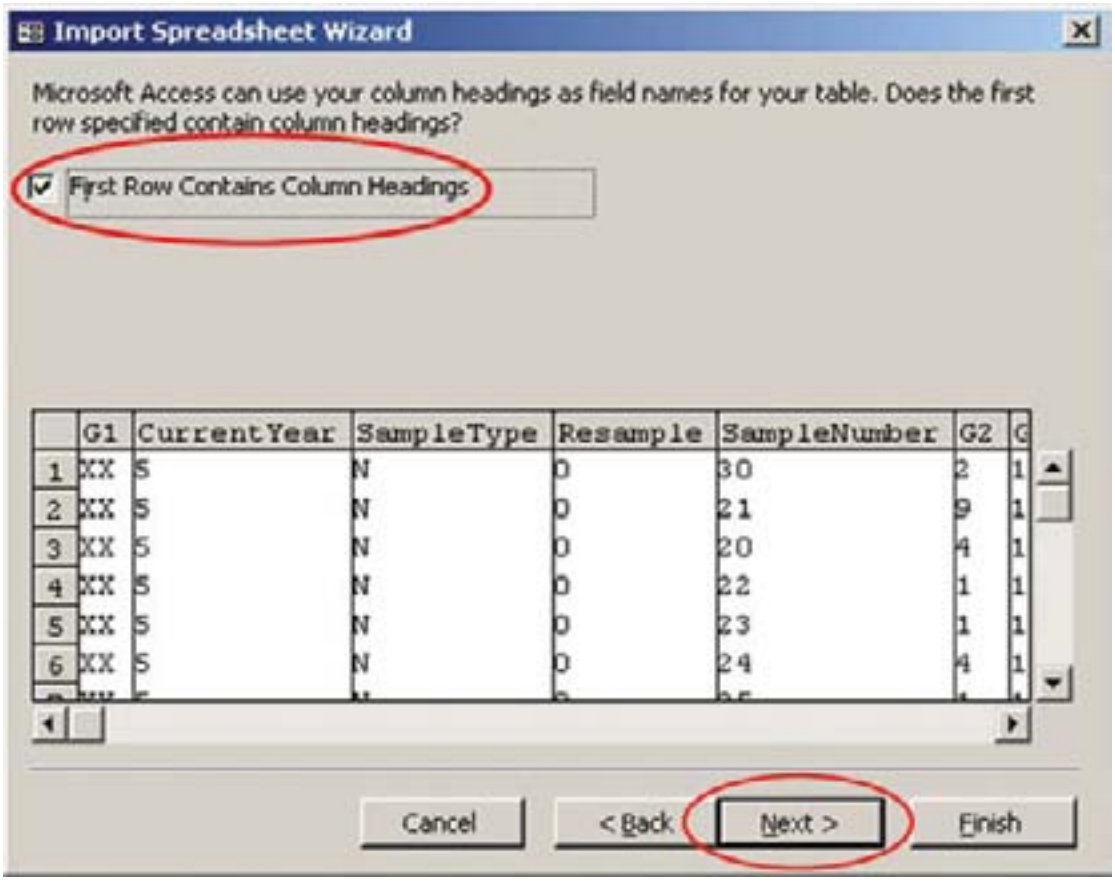
The **Import Spreadsheet Wizard** window will open. The first window will ask which worksheet or range you would like to import. Select **Show Worksheets**. Make sure that **Sheet1** is highlighted in the box. Select **Next**.



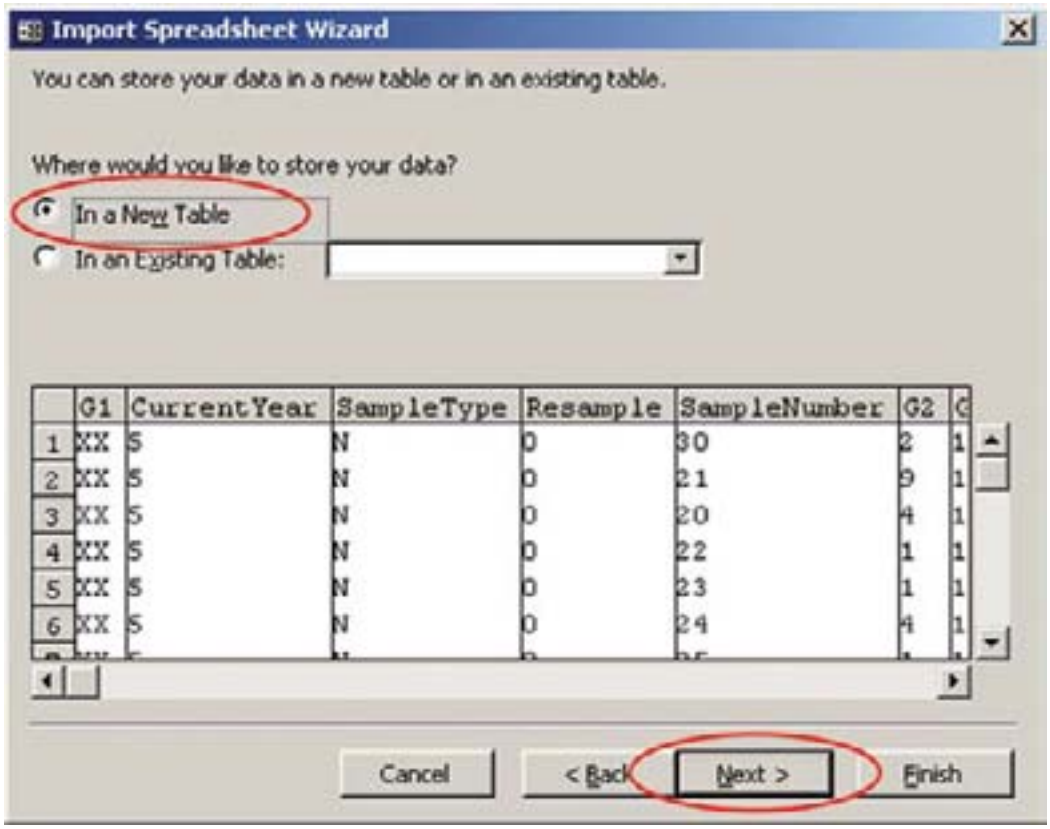
When the following dialog box appears, select **OK** to proceed to the next step. Access will simply assign field names, or column headings, to the field data.



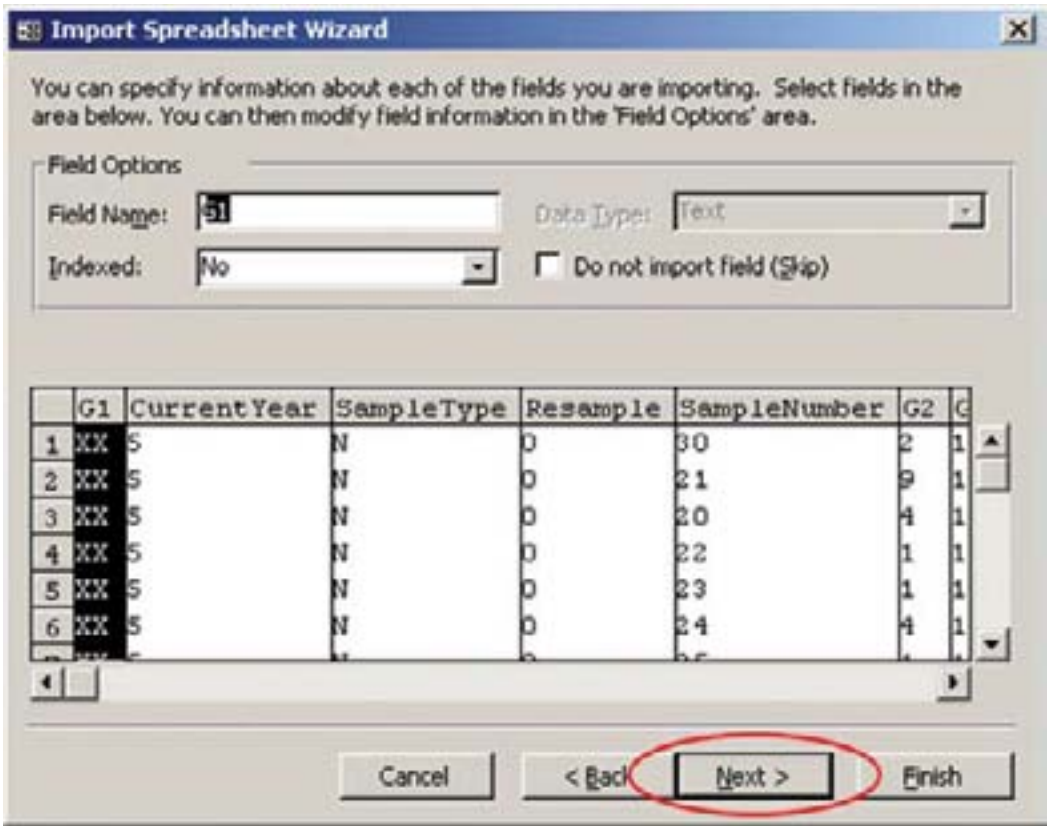
The next screen will ask if there are column headings on the table. Check **First Row Contains Column Headings** and select **Next**.



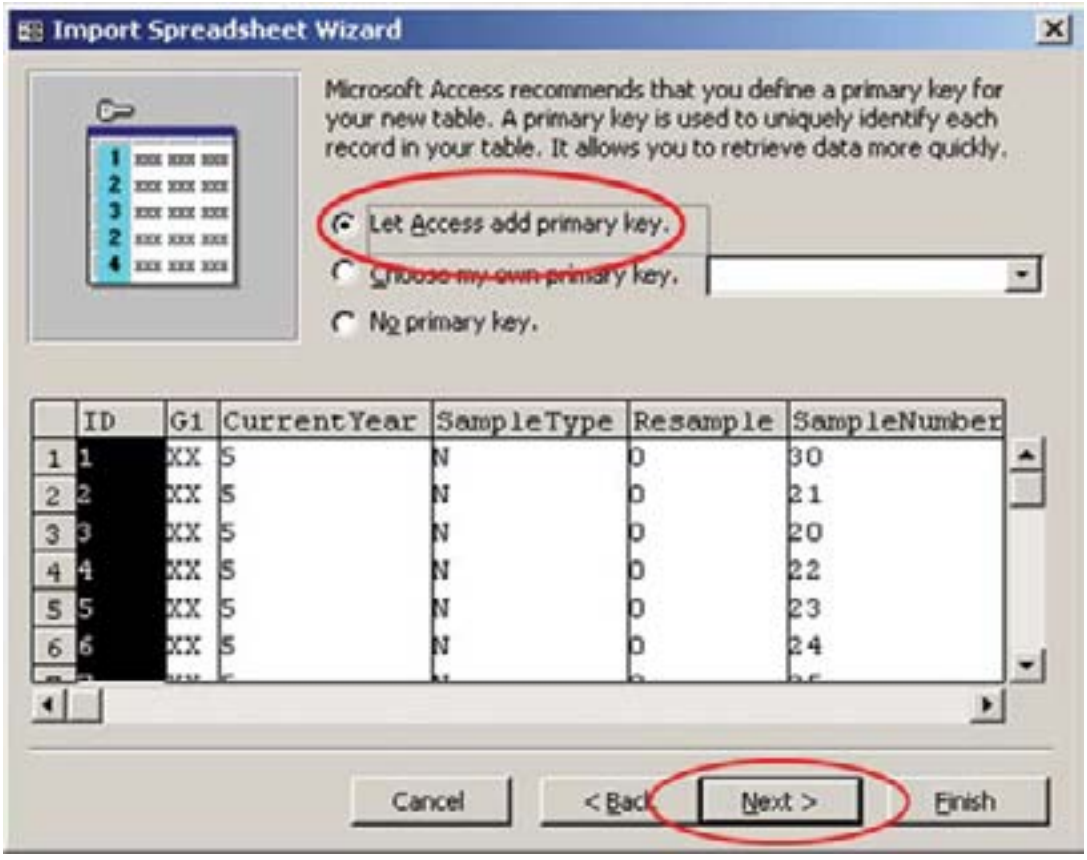
The next screen will ask where you would like to store your data. Select **In a New Table**, then select **Next**.



The next screen will ask you about field options. Select **Next** to advance past this window. **Do not enter any information here**.



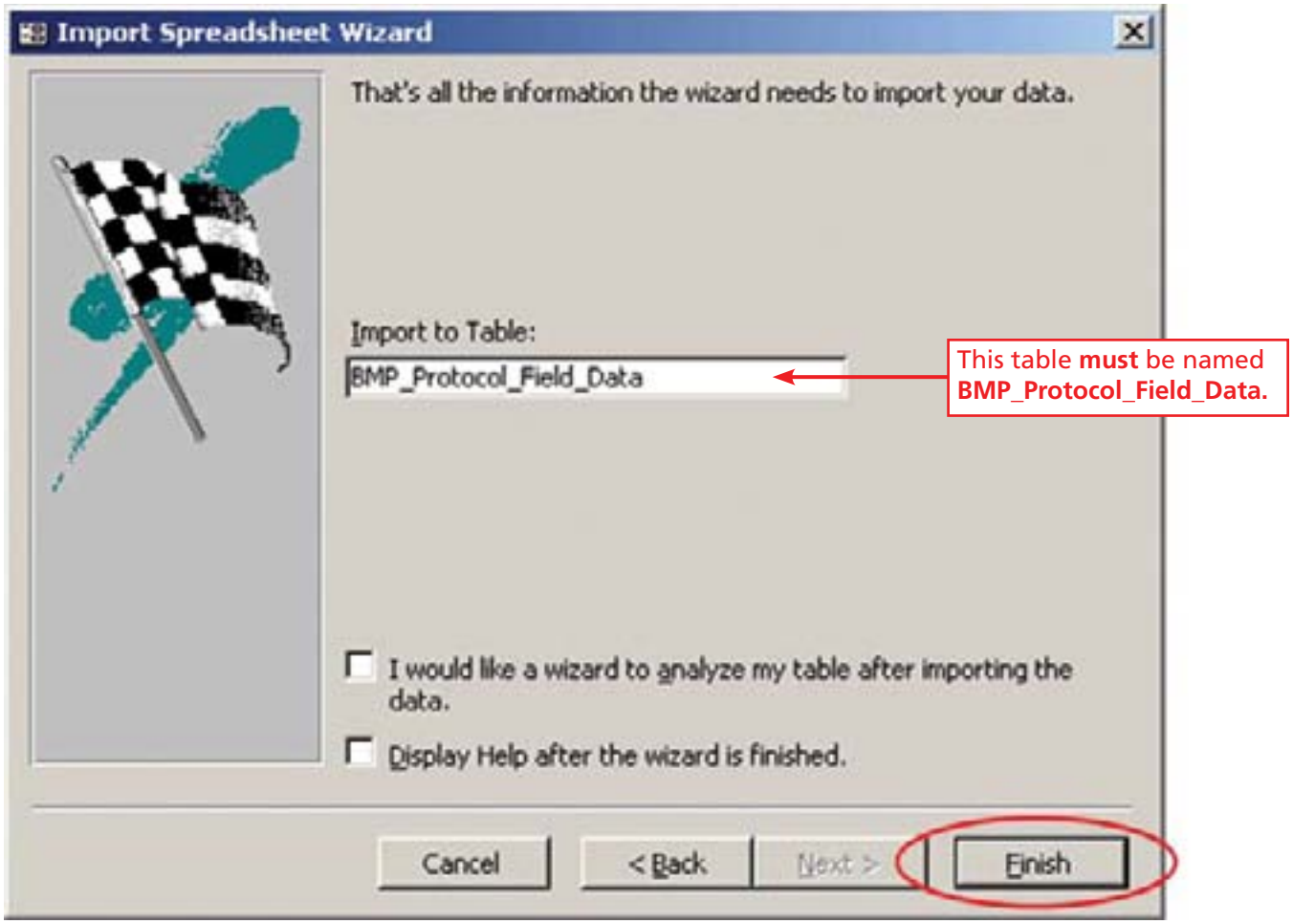
The next screen will ask about indexing the data table with a primary key. Select **Let Access add primary key**, then select **Next**.



The last screen in the **Import Spreadsheet Wizard** will ask you to name the table. The title of the worksheet appears as the default. Delete that table name and enter **BMP_Protocol_Field_Data**. Select **Finish**.

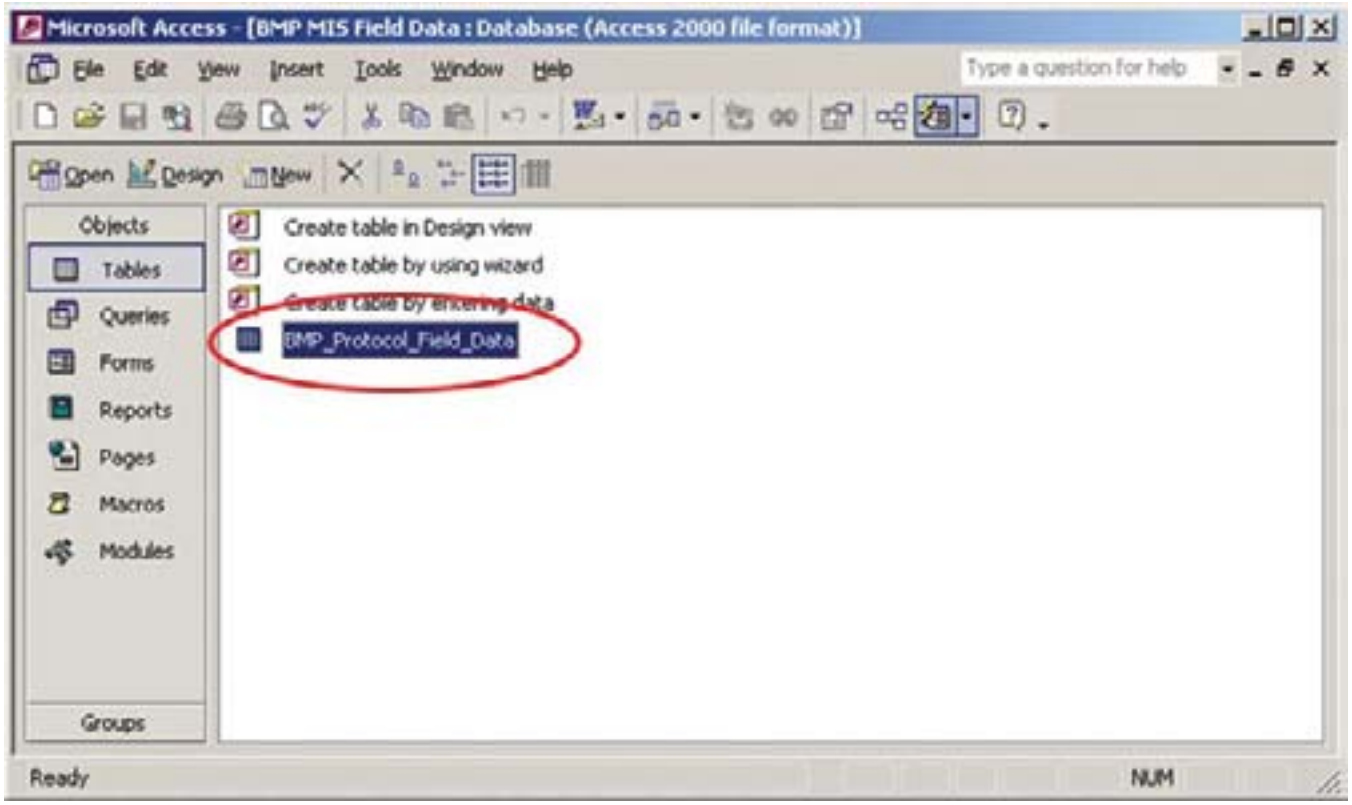
Important: The table **must** be named **BMP_Protocol_Field_Data**. Access queries will not work unless this name is used.

It is important to use the table name **BMP_Protocol_Field_Data** when you process your actual field data. The BMP MIS process will then produce a file called **BMP_Protocol_Field_Data.xls**. Each subsequent actual field data file will use this same file name; therefore, it is important that you create a new **BMP MIS (name)** folder for each geographic area and time period in which the data were collected. Place the actual field data file into this folder to keep it from being confused with actual field data files from other locations and time periods.



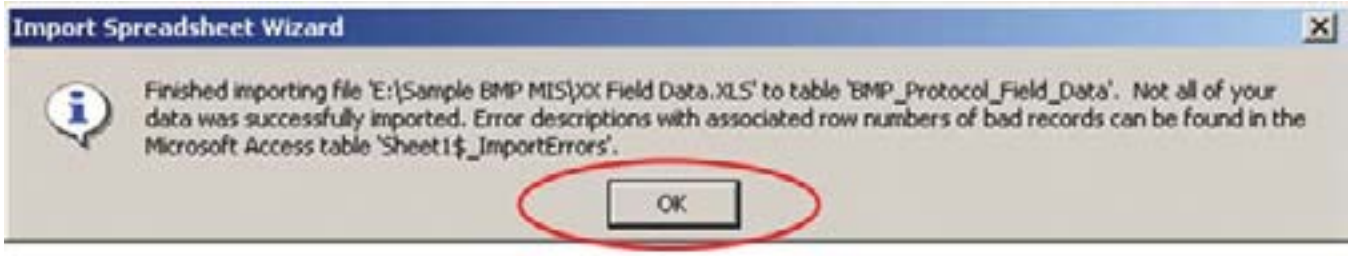
Access will import the field data from the Excel file and save them into the table **BMP_Protocol_Field_Data**. When the import is complete, the following dialog box will appear. Select **OK**.

You will be returned to Access. The new table will appear in the **Tables** window. If the field data table is imported successfully, proceed to step 3.7.

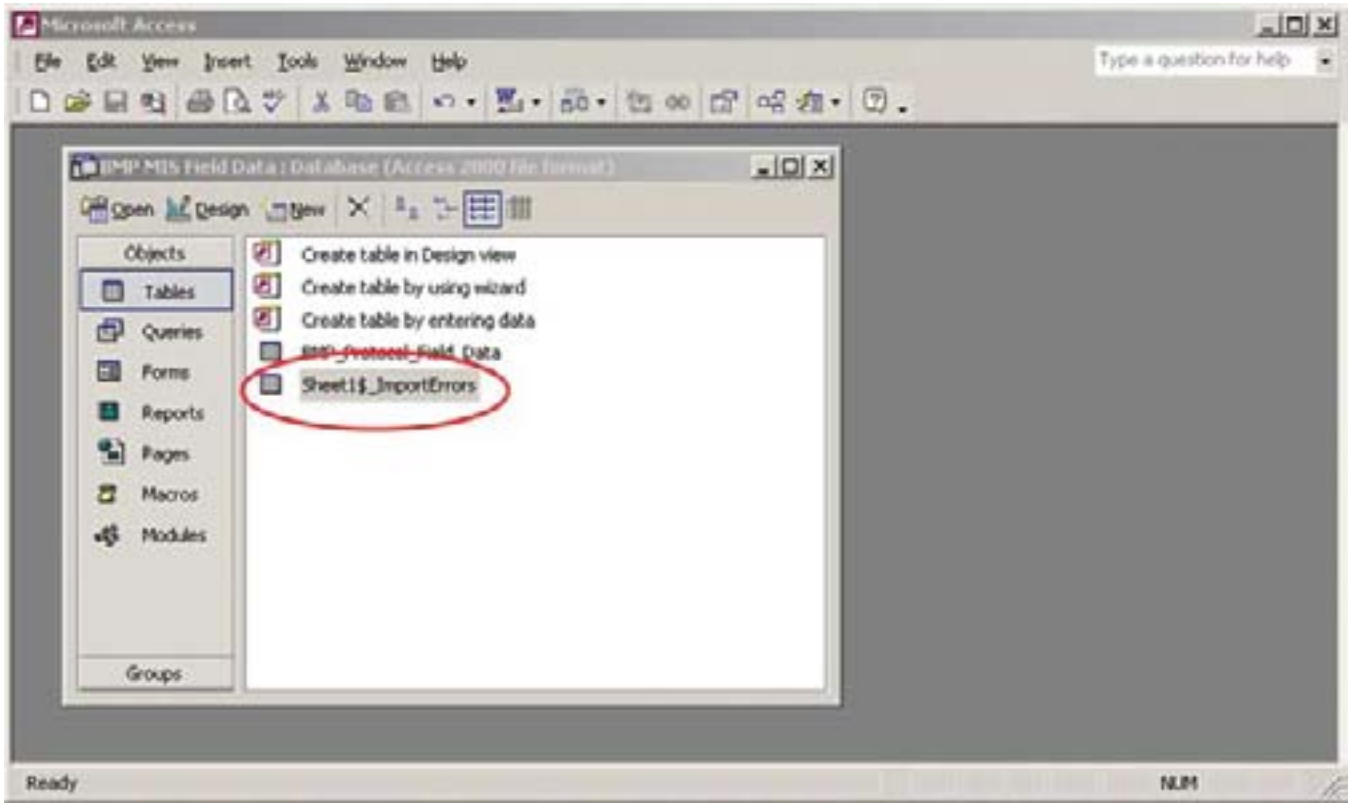


Step 3.6. Resolve Import Errors

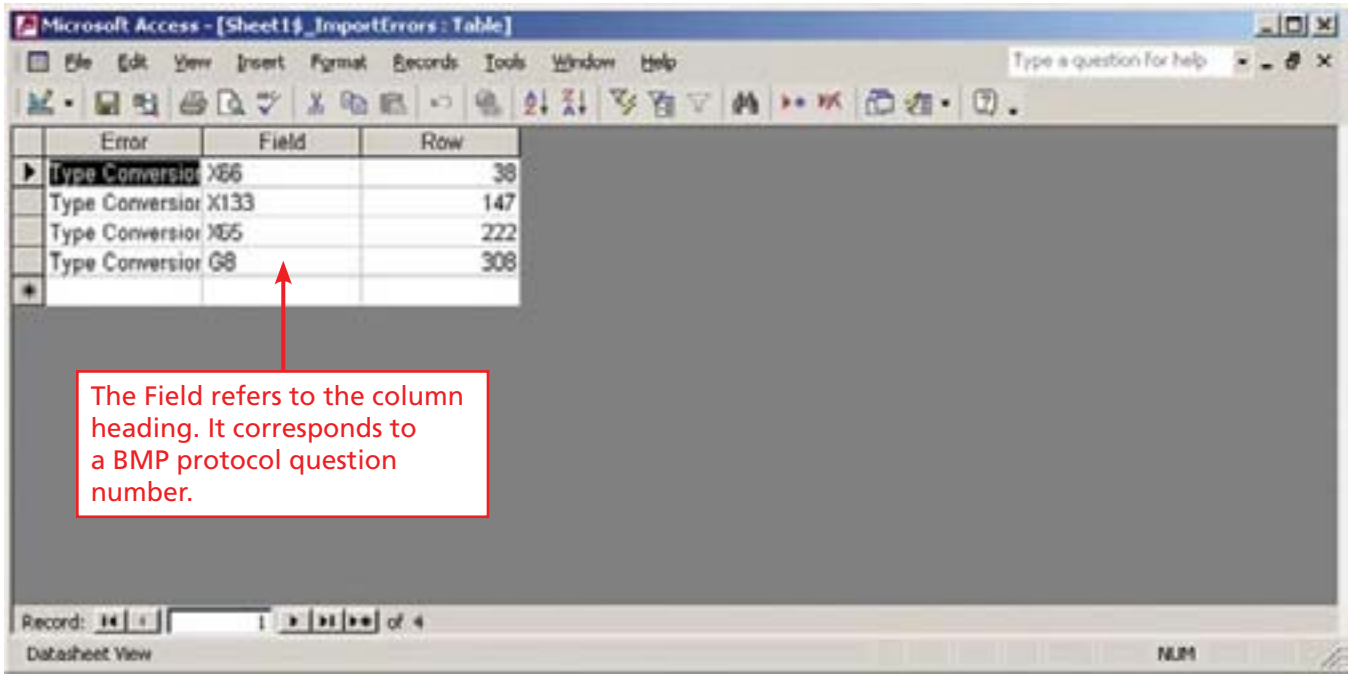
You may experience errors when importing data into Access. Errors usually result when there is unrecognizable data in a cell in the Excel file. This "bad" data may simply be a keystroke error made when collecting data in the field. If you have any import errors, the following dialog box will open when Access tries to complete the import process. Select **OK**.



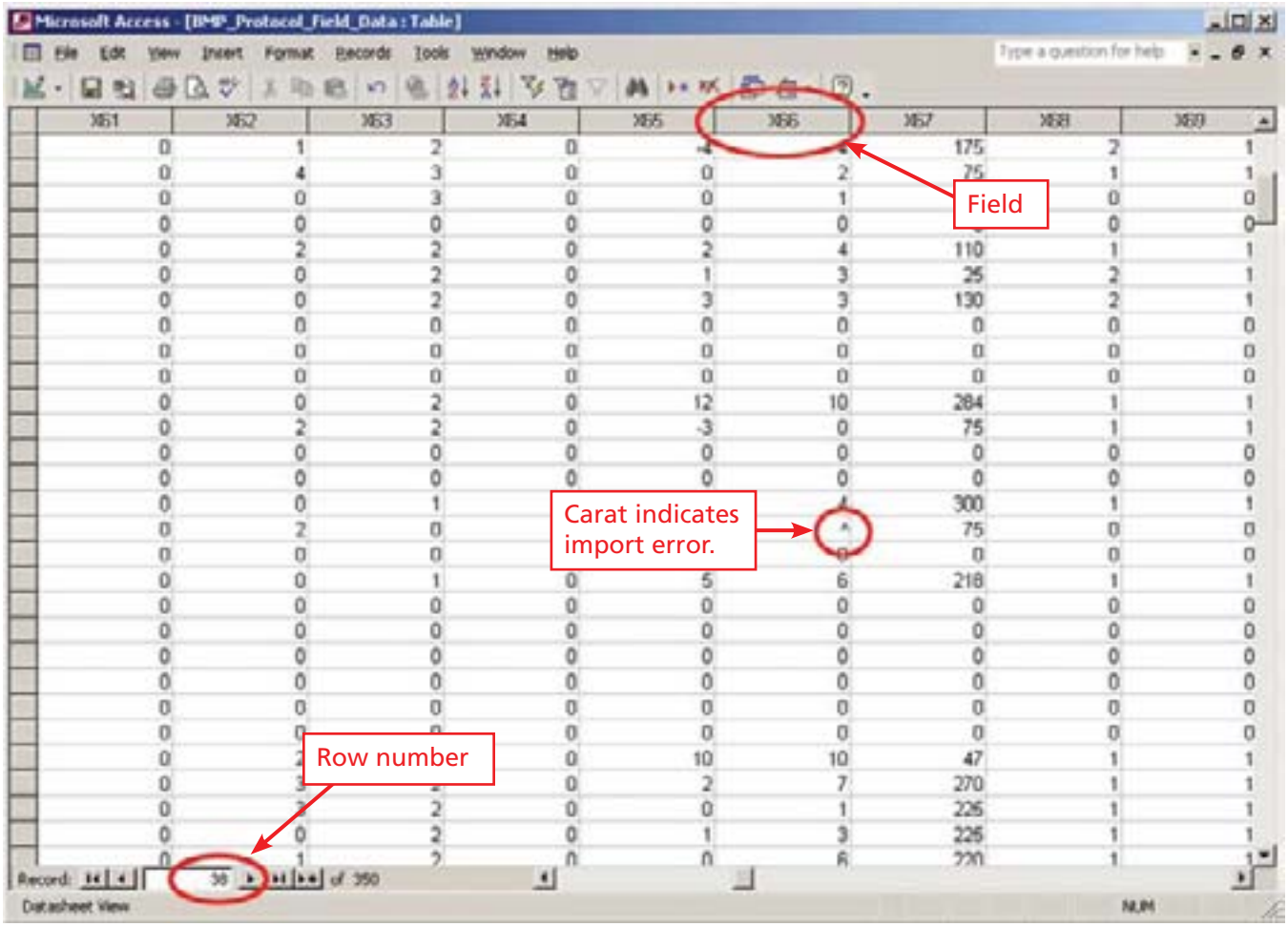
Access will save references to the errors in a table so that you may locate and correct them. To locate the errors in the **BMP_Protocol_Field_Data** table, open the **ImportErrors** table (in this practice exercise, it is called **Sheet1$_ImportErrors**) by double-clicking on the table name. (**Note**: The table name may vary depending on the input data file name, but the file name will always end in **_ImportErrors**.)



The **ImportErrors** table is a matrix describing the type of error, and the field (column heading) and row where it is located. The field name corresponds to the BMP protocol question number. A **Type Conversion** error means that Access does not recognize the data in the cell.



To correct the errors, open the **BMP_Protocol_Field_Data** table by double-clicking on the table name. Locate the cell at the intersection of the field (column) and row listed in the **ImportErrors** table. In this example, there is a caret (^) in the cell at the intersection of column X66 and row 38 indicating an import error.



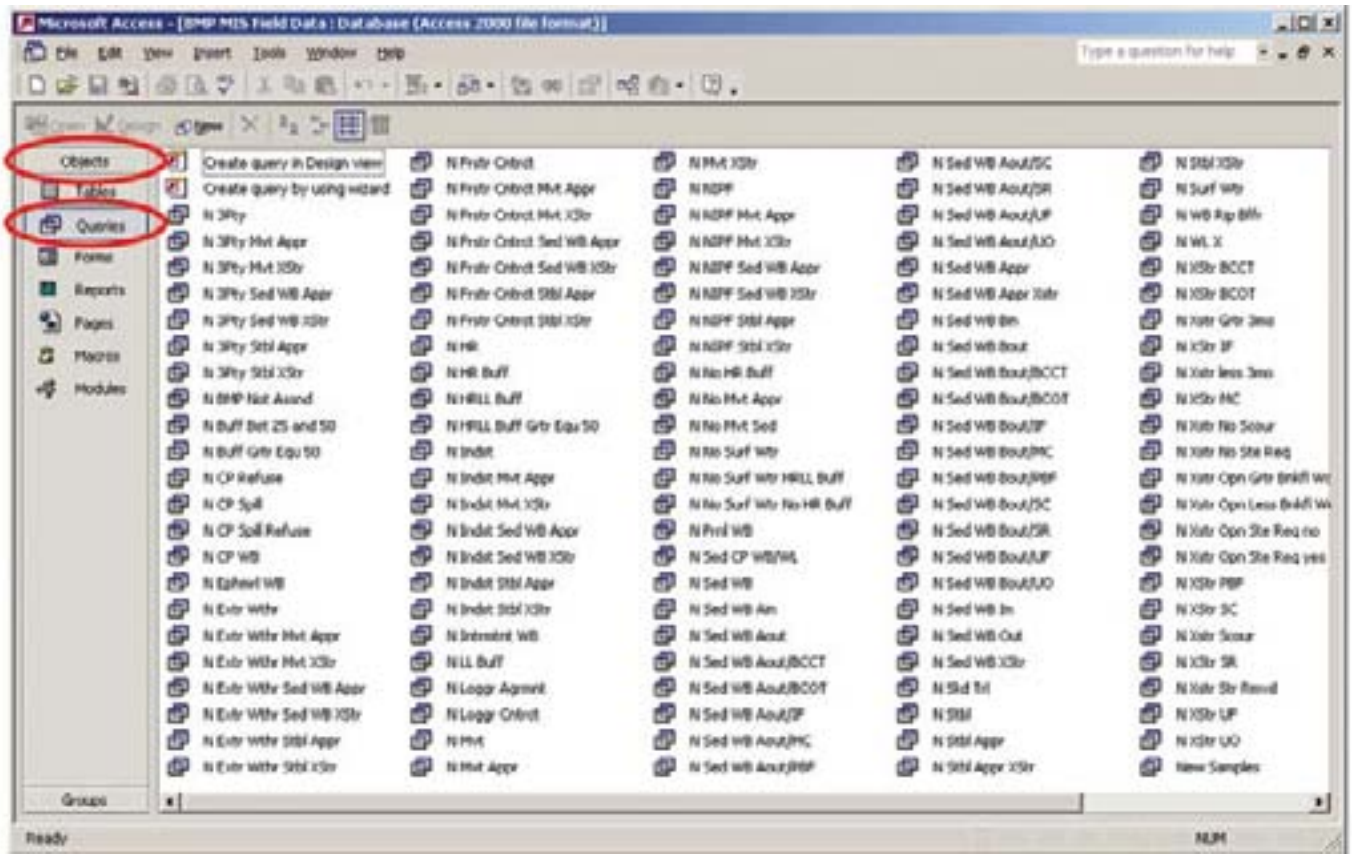
Correct the error to the best of your ability. It may help to look at the BMP field guide to determine what question X66 is asking. Check each cell reference in the **ImportErrors** table and correct the errors. When you have finished, close the **BMP_Protocol_Field_Data** table and continue with step 3.7.

Important: Correct all errors in the **BMP_Protocol_Field_Data** table before proceeding.

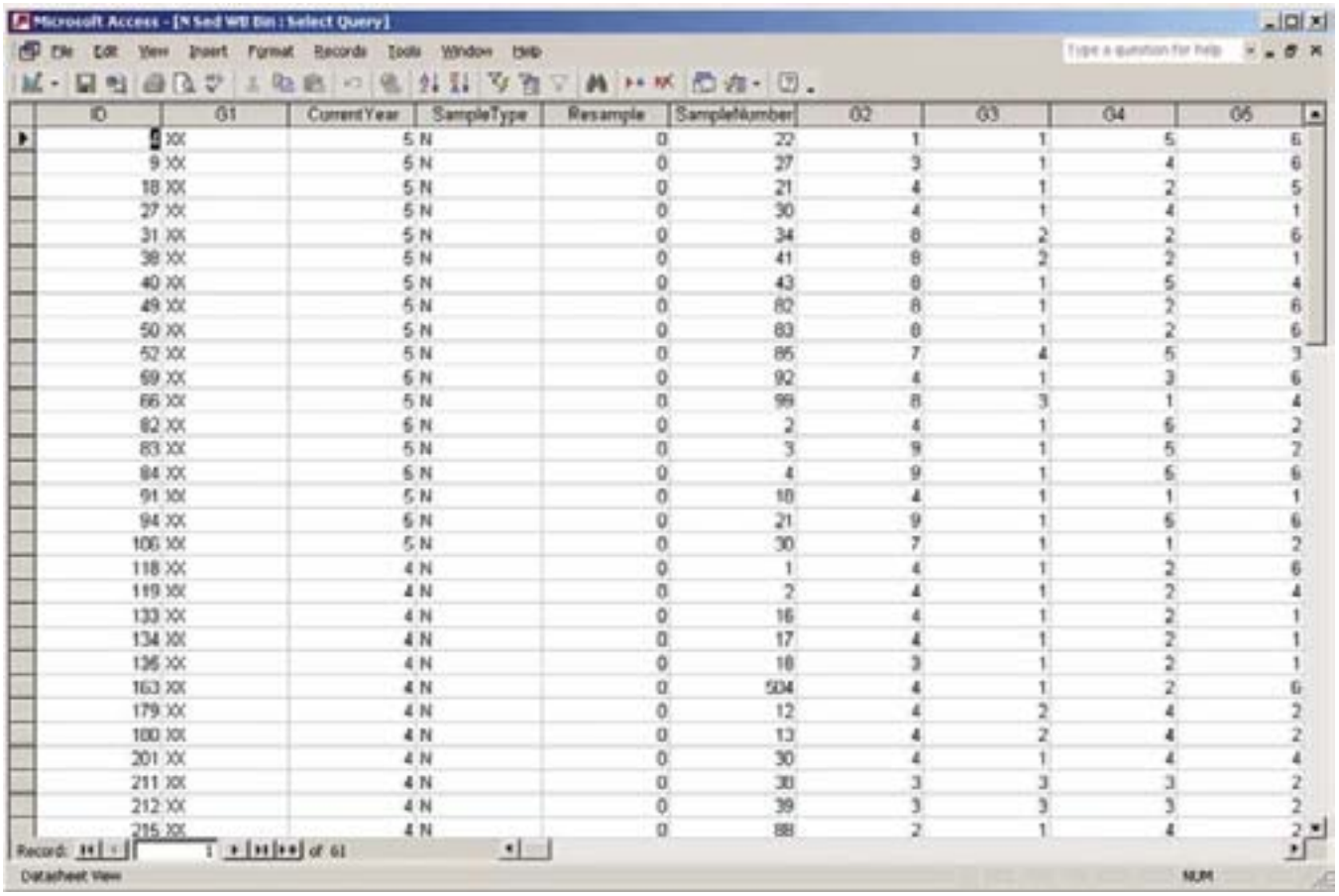
Step 3.7. Export Access Queries to the Excel Analysis File

The Access database file **BMP MIS Field Data.mdb** is populated with queries that sort and filter the field data in numerous ways. When you imported the sample field data into Access, the queries were automatically applied to the data.

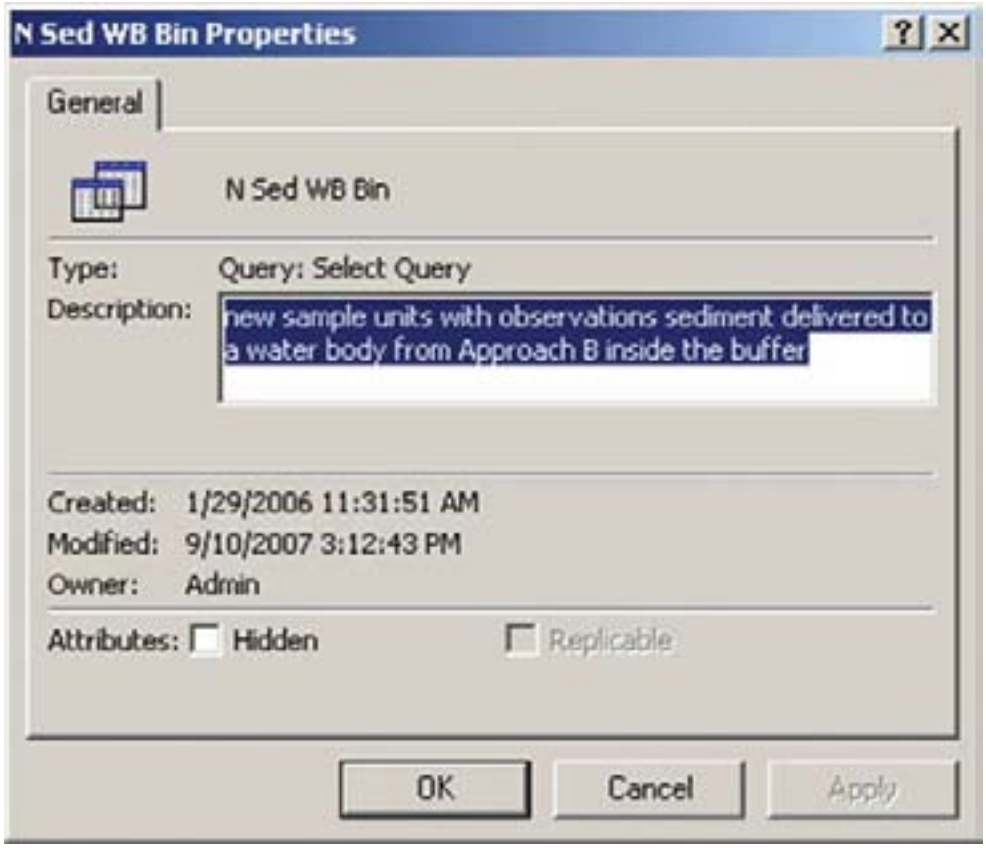
View the list of Access query files by selecting **Queries** under **Objects**. Each file is a separate query—a set of filtered and sorted field data.



Double-click on the query file **N Sed WB Bin** to view a query file, as shown below. Close the window when finished.

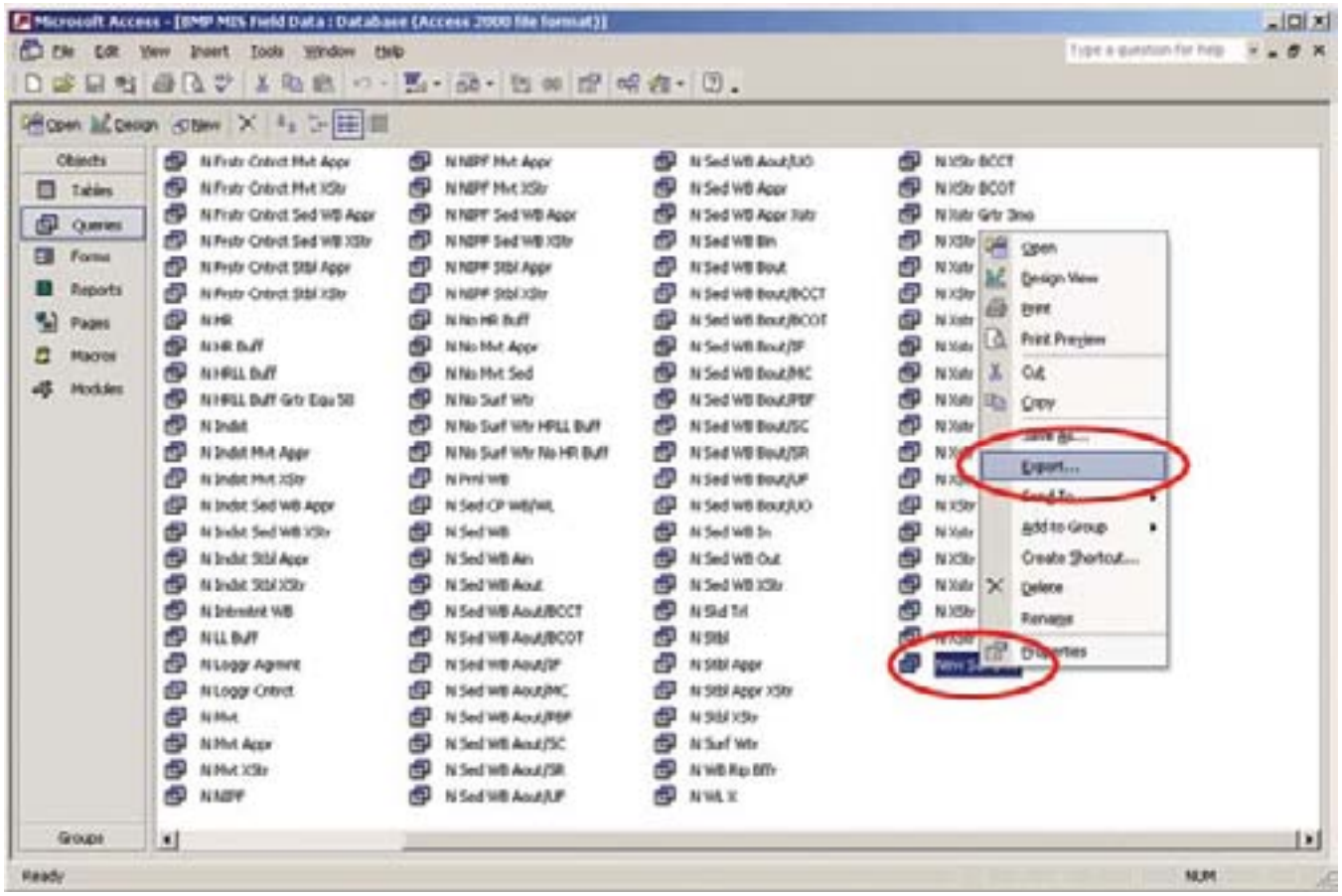


Each query is named according to the filtered data it contains. The list of abbreviations used to name the queries can be found in appendix A; a list of query names and descriptions is in appendix B. You may also find a description of each query by right-clicking on the query name in Access and selecting **Properties**. The following is an example of the **Properties** window of the query **N Sed WB Bin**, including the query description. Select **Cancel** to close the **Properties** window and return to the list of queries.

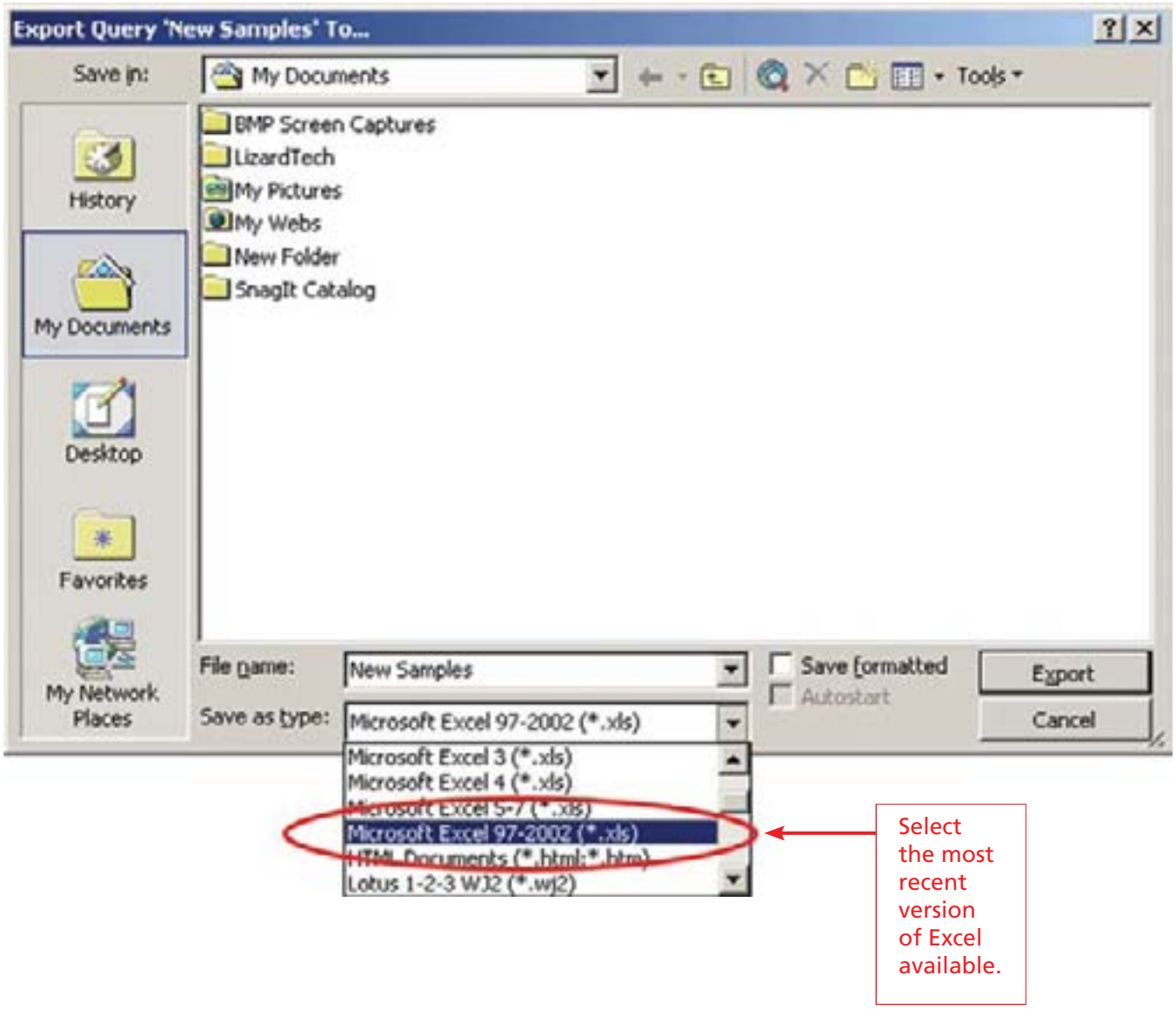


While Access queries sort field data in a variety of ways, data analysis occurs in Excel. The data that will be presented in the standard data summaries are linked to the Excel file in which the analysis occurs. The Access queries must be exported from Access to Excel before the summaries can be generated. **Each** query in the Access file must be exported individually. The instructions provided walk you through the step-by-step process for exporting one query using the sample files.

In this example, you will export the Access query **New Samples**, which contains data from all new sample units in the **Sample BMP MIS** folder. Right-click on the query **New Samples** and select **Export** from the drop-down menu.

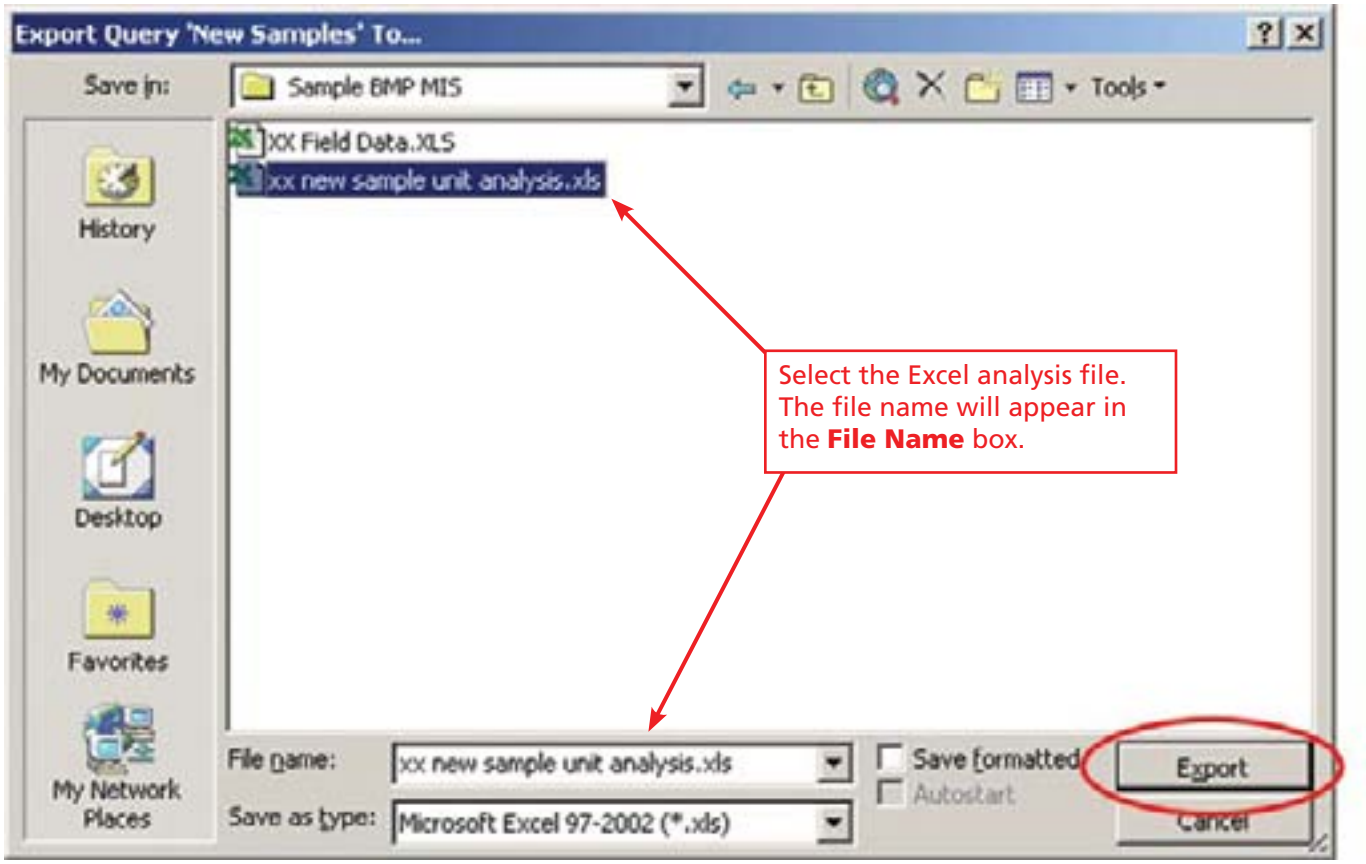


The **Export Query 'New Samples' To…** window will open. Select the type of file you are exporting the query to in the **Save as type** box at the bottom of the window. Click on the down arrow to open the drop-down menu and select the most recent version of **Microsoft Excel** available.



Navigate to the Excel file where the query will be exported. In the **Sample BMP MIS** folder, the Excel file is called **xx new sample unit analysis.xls**. Select this file name; the file name will also appear in the **File name** box at the bottom of the **Export Query 'New Samples' To…** window. Select **Export**.

> When working with your actual field data in the **BMP MIS (name)** folder, the Excel analysis file is named **new sample unit analysis.xls**.



Access will attempt to export the query to the Excel file you have selected. Because the Excel analysis file has an empty worksheet named for each Access query (the blank worksheet acts as a placeholder for your data), Access will display the following message as it attempts to export the query. Select **Yes**. Access will export the data and populate the Excel worksheet with the query of your field data.

Repeat this process with several other queries in order to become familiar with the process. When you are working with actual field data, it will be necessary to export **each** of the 118 Access queries to the Excel analysis file **individually** before proceeding to the next step. When all of the Access queries have been exported to Excel, close Access.

When working with your actual field data in the **BMP MIS (name)** folder, you must export **each** query file individually. The export process must be repeated for every one of the Access queries.

Analyzing Field Data in Excel

Once the Excel analysis file is populated with the Access queries, it will perform calculations based on the queries. In order for Excel to complete the calculations, you must open the Excel analysis file; the formulas in the worksheets will recalculate based on the queries you just exported to the Excel analysis file.

Step 3.8. Open the Excel Analysis File

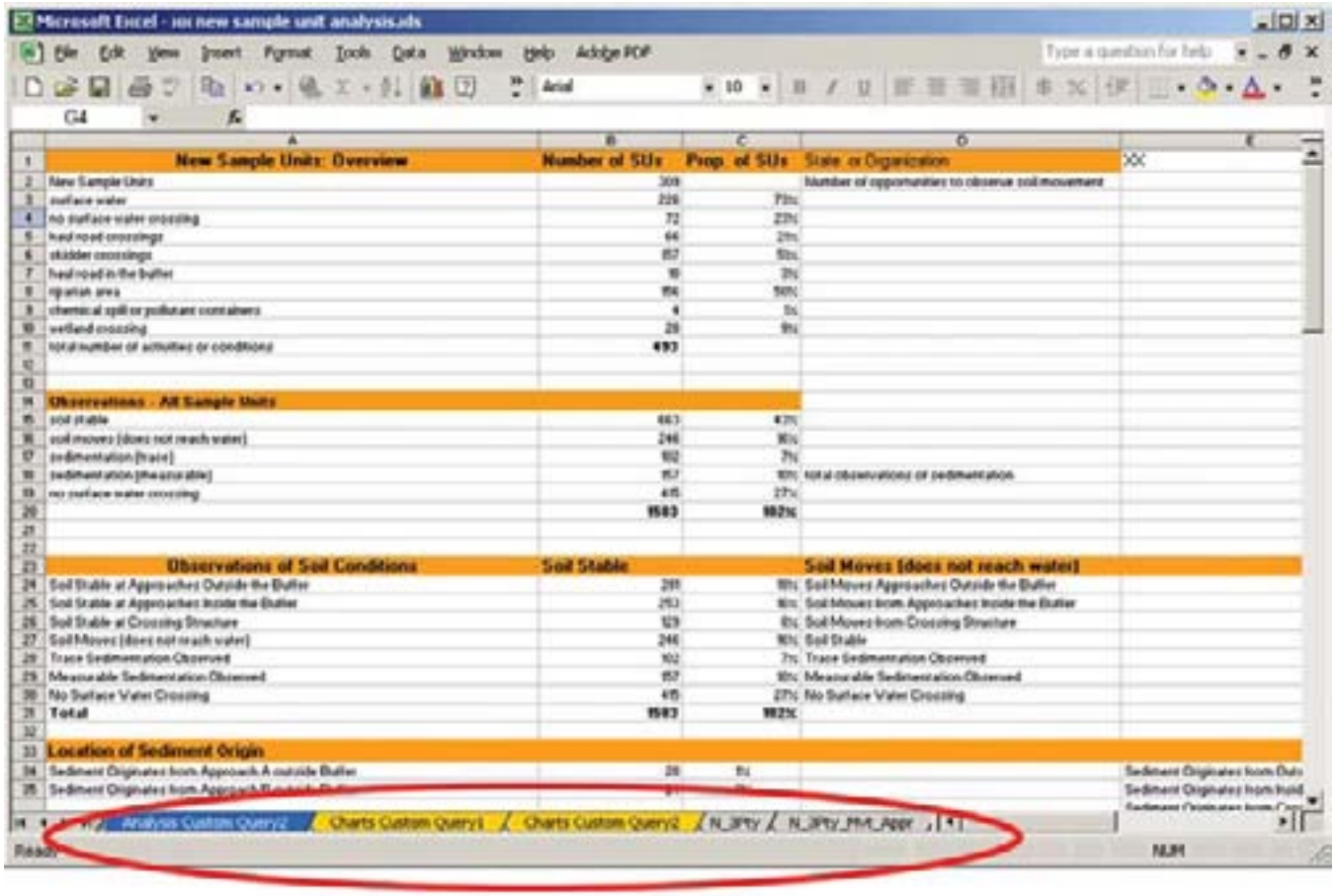
Open the Excel analysis file **xx new sample unit analysis.xls**.

> When you are working with your actual field data in the **BMP MIS (name)** folder, the Excel analysis file will be called **new sample unit analysis.xls**.

The file contains several worksheets, with color-coded tabs, presented in order as follows:

- Blue-tabbed worksheets analyze field data.
- Yellow-tabbed worksheets contain charts and graphs created from information in the field data analysis worksheets.
- White- or gray-tabbed worksheets are copies of the Access queries.

The Excel analysis file will appear as shown below when opened (note the tab colors at the bottom left of the screen).



Step 3.9. Review the Contents of the Excel Analysis File

Familiarize yourself with the organization of the Excel analysis file; the worksheets contain a great deal of information. Note that the Excel analysis worksheets are **not** the standard data summaries, which present the results in a clear and concise format and give the preparer the opportunity to further interpret and explain the findings.

Information in the analysis (blue-tabbed) and charts (yellow-tabbed) worksheets is linked to the standard data summaries, which are formatted in Word. Because the standard data summaries depend on accurate links to the Excel analysis file, the analysis and charts worksheets are protected—you can view information in the analysis and charts worksheets but cannot make changes to them. If you attempt to modify a protected worksheet, you will see the following error message.

Although Excel gives you the option to remove protection from the worksheet, **it is strongly recommended that worksheet protections remain intact**. Accidentally changing the analysis and chart worksheets may result in broken or undefined links in the standard data summaries. Select **OK** to continue.

Important: Do **not** remove protections from the Excel analysis or charts worksheets.

Step 3.10. Close the Excel Analysis File

Close the file **xx new sample unit analysis.xls** after viewing its contents. You will be asked if you wish to save changes to the file. Select **Yes** to save the calculations that Excel made on the analysis worksheets. Results of these calculations will be pulled into the standard data summaries as discussed in the next section.

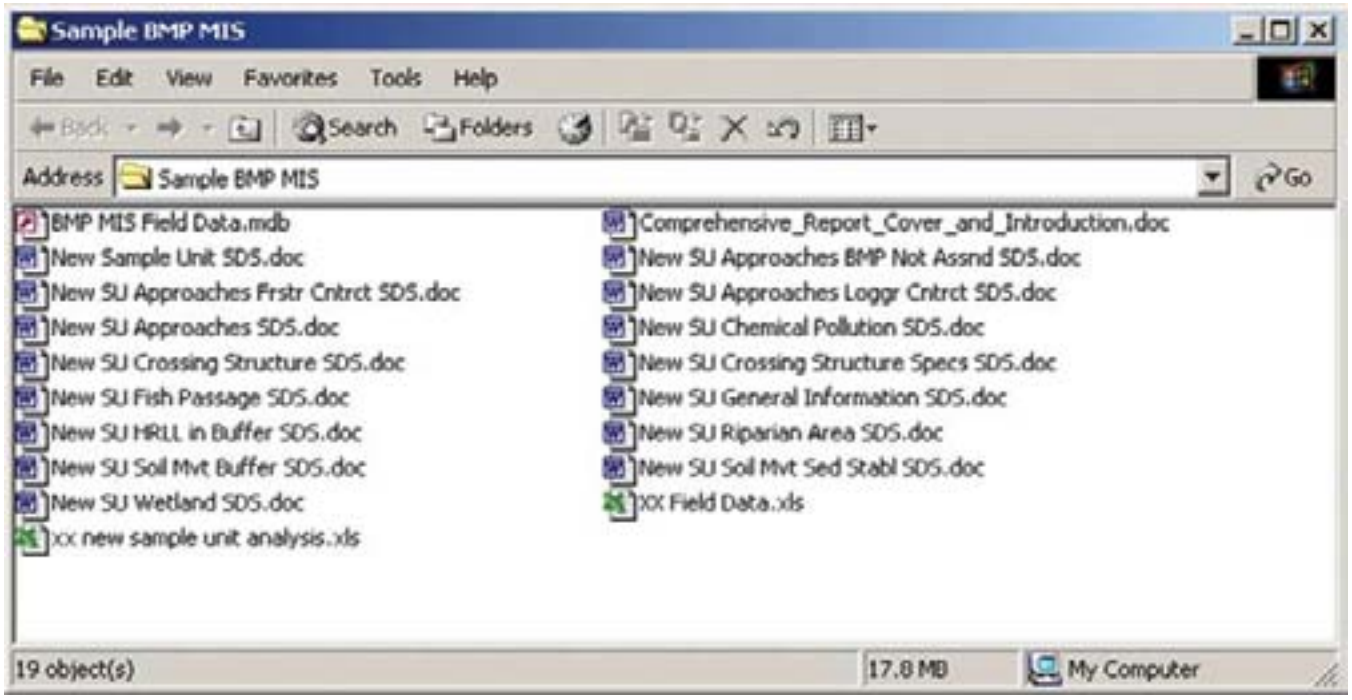
Generating Standard Data Summaries in Word

After the data has been extensively queried in Excel, the resulting information is presented in a series of standard data summaries (SDSs). The SDSs are organized to correspond to the focus areas in the BMP protocol, such as general information, approaches to a surface water crossing, crossing structures, and chemical pollutants. Each SDS may be used individually or combined with others to create a Comprehensive Standard Data Summary of your field data. A list and description of all the SDSs provided in the BMP MIS appear in appendix C.

In this part of the practice exercise, you will populate the SDSs with the newly calculated information from the Excel analysis file **xx new sample unit analysis.xls**. Chapter 4 discusses SDSs and the creation of a Comprehensive Standard Data Summary in greater detail.

Step 3.11. Open the SDS File and Update the Links

Open the **Sample BMP MIS** folder and review the SDS files it contains. All of the SDS files have the acronym SDS in the file name. In this example, you will work with the file **New Sample Unit SDS.doc**.



Double-click on the file **New Sample Unit SDS.doc** to open it. The following dialog box will appear.

As discussed previously, the information in the SDS files is linked to the Excel analysis file. Answering **Yes** directs the computer to seek out the Excel analysis file and update each piece of numeric information and each chart or graph in the SDS. Answering **No** simply opens the file and presents the information as it was last saved.

If you were to select **No**, the SDS would open but it would not update the links to data in the Excel analysis file. With no linked data, graphs and charts would be incomplete as shown below.

Overview of Sample Units

0 new sample units were sampled.

Number and Proportion of Sample Units by Feature

A sample unit is likely to have more than one of activity or condition recorded; therefore, the total of activities and conditions will exceed the number of sample units (e.g., **0** activities and conditions in **0** sample units).

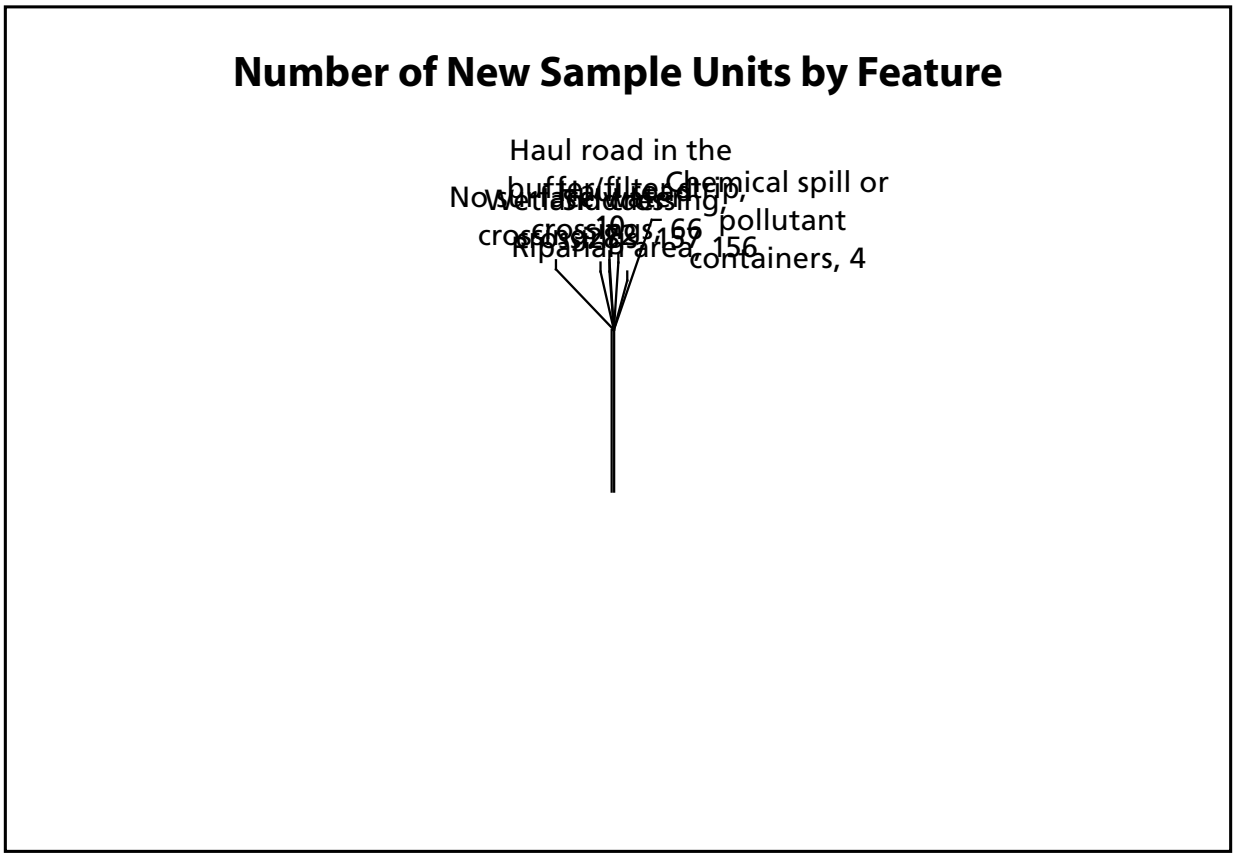


Figure X. (n=0)

If you select **Yes**, Word will update the links with the information you just exported into the Excel analysis file. The SDS template now contains current information.

Overview of Sample Units

309 new sample unites were sampled.

Number and Proportion of Sample Units by Feature

A sample unit is likely to have more than one of activity or condition recorded; therefore, the total of activities and conditions will exceed the number of sample units (e.g., **493** activities and conditions in **309** sample units).

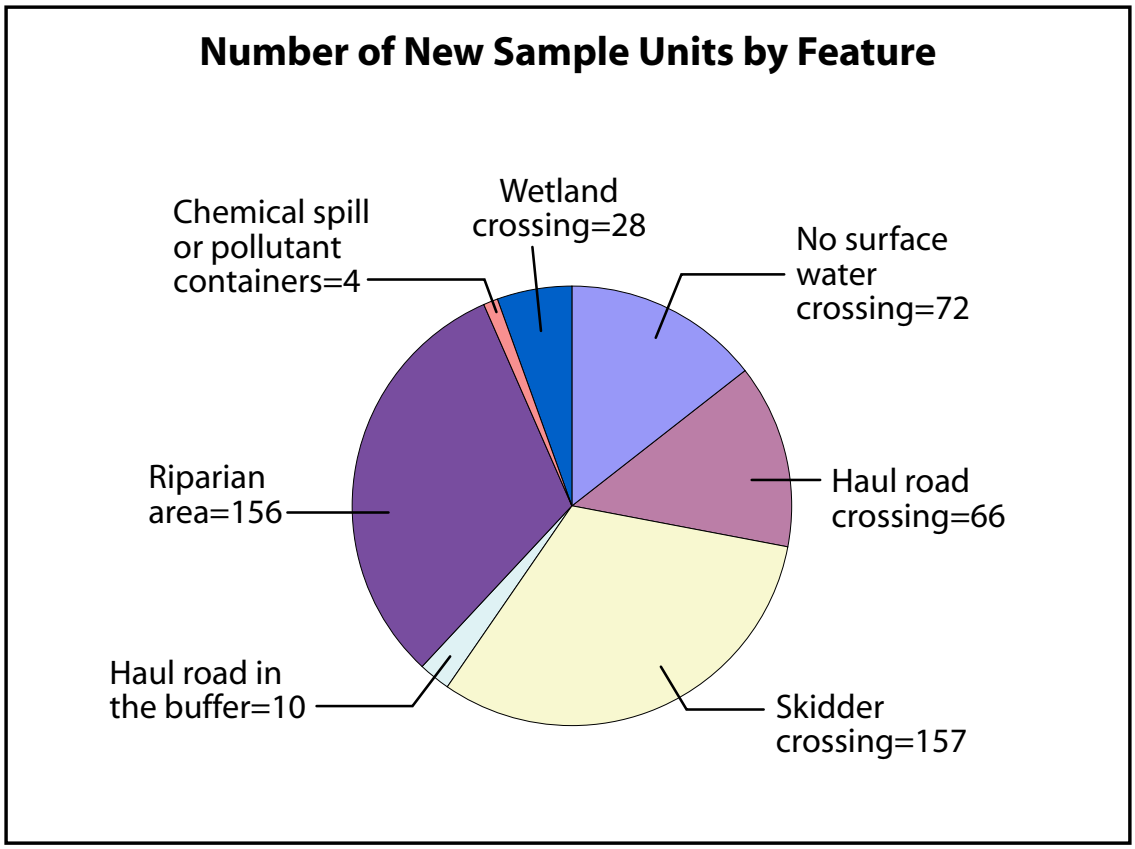


Figure X. (n=309)

After updating the links, save and close the file **New Sample Unit SDS.doc**. Do **not** change the file name.

Note: All file names should remain unchanged unless specifically instructed otherwise. As long as files are placed in a uniquely named folder (e.g., BMP MIS Allagash 2007), there will be no confusion with other similarly named files.

Step 3.12. Repeat the Process With the Remaining SDS Files

Open and update the links in **each** of the 15 SDS template files in the **Sample BMP MIS** folder. Becoming familiar with these steps will make generating the SDSs and creating a Comprehensive Standard Data Summary with actual field data much easier. Chapter 4 provides instruction and other information necessary for assembling the SDSs into a Comprehensive Standard Data Summary.

Processing Actual Field Data

After completing the entire practice exercise using the **Sample BMP MIS** folder, make a copy of the original **BMP MIS** folder and rename it **BMP MIS (name)**. Use the **BMP MIS (name)** folder to analyze your actual field data. Repeat the steps in this chapter, substituting **BMP MIS (name)** for **Sample BMP MIS** whenever necessary and following the instructions specific to the **BMP MIS (name)** folder.

Chapter 4—SDSs and Comprehensive Standard Data Summaries

The standard data summaries (SDSs) provided in the BMP MIS present the results of BMP performance in a concise and easy-to-read format. The SDSs are intended to be combined into a Comprehensive Standard Data Summary, but they may be used individually to assess BMP performance for individual focus areas. You may add explanations, interpretation, and additional supporting figures and photographs to generate complete and comprehensive reports tailored to various audiences. The reports may then be used to identify opportunities for improvement through additional planning, training, supervision, and enforcement, thus strengthening your State's or organization's capacity to address water quality problems related to forest management activities.

Structure of the Standard Data Summaries

Each of the 15 SDS template files provided in the BMP MIS is named for the focus area presented in the SDS. For example, the file **New SU Approaches SDS.doc** presents information regarding approaches to surface water crossings on new sample units. A description of each SDS file may be found by right-clicking on the file name and choosing **Properties** from the drop-down menu. Select the **Summary** tab at the top right of the **Properties** window. A description of the SDS is in the **Comments** field. An example of the **Properties** window for **New SU Approaches SDS.doc** appears below. A list and description of all the SDS template files available also appears in appendix C.

The SDSs are linked directly to the Excel analysis file. If data are changed or updated in the Access query and exported to the Excel analysis file, you have the opportunity to update the links automatically in the SDS file when the document is opened. The following dialog box appears when you open an SDS file. Selecting **Yes** directs the computer to seek out the linked information in the Excel analysis file and update the information in the SDS file.

A sample page from the SDS **New SU Approaches SDS.doc** is shown below. The highlighted elements are those linked to the Excel analysis file. The ability to update linked information in SDSs will be especially useful when creating custom queries, which is discussed in chapter 5.

Approaches to the Water Crossing

There are **4** opportunities to observe the occurrence of soil movement, sedimentation, or stabilization from the approaches to a surface water crossing. They are at Approach Area A–Outside the Buffer/Filter Strip, Approach Area A–Inside the Buffer/Filter Strip, Approach Area B–Inside the Buffer/Filter Strip, and Approach Area B–Outside the Buffer/Filter Strip. **Proportions are based on the total number of opportunities to make observations about soil conditions at the approaches.**

For the **309** new sample units, there are **1236** opportunities to observe soil conditions.

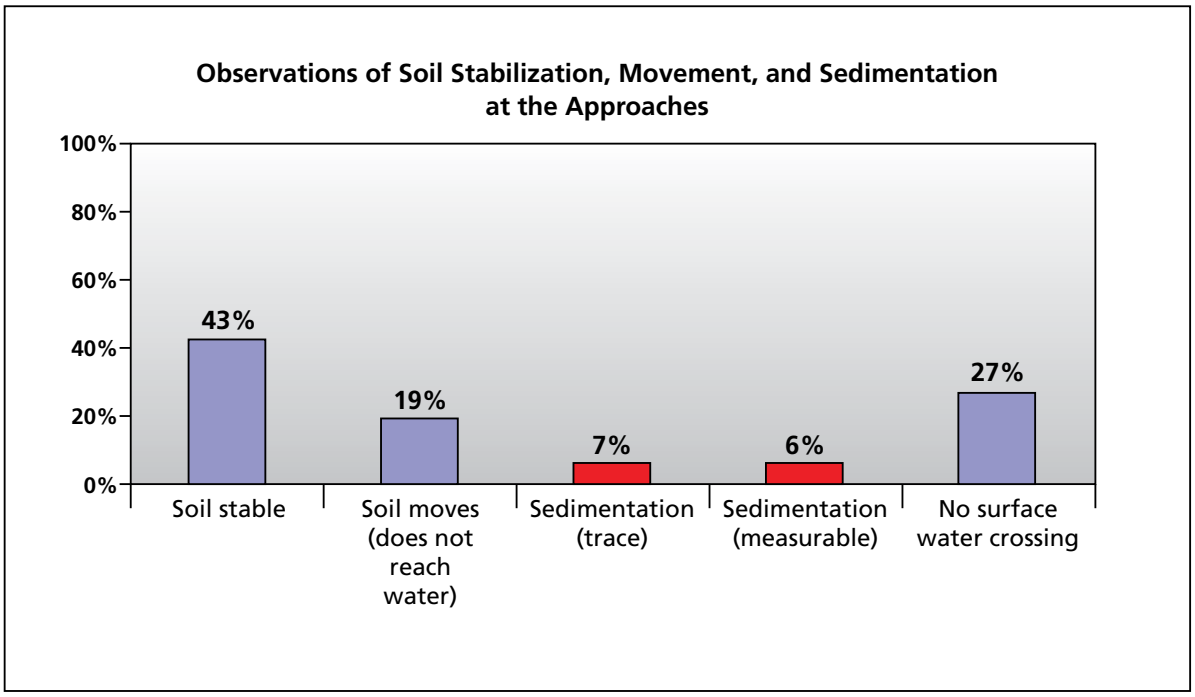


Figure X. Proportions are based on the total number of opportunities to observe soil conditions at the approaches (n=**1236**).

Discussion

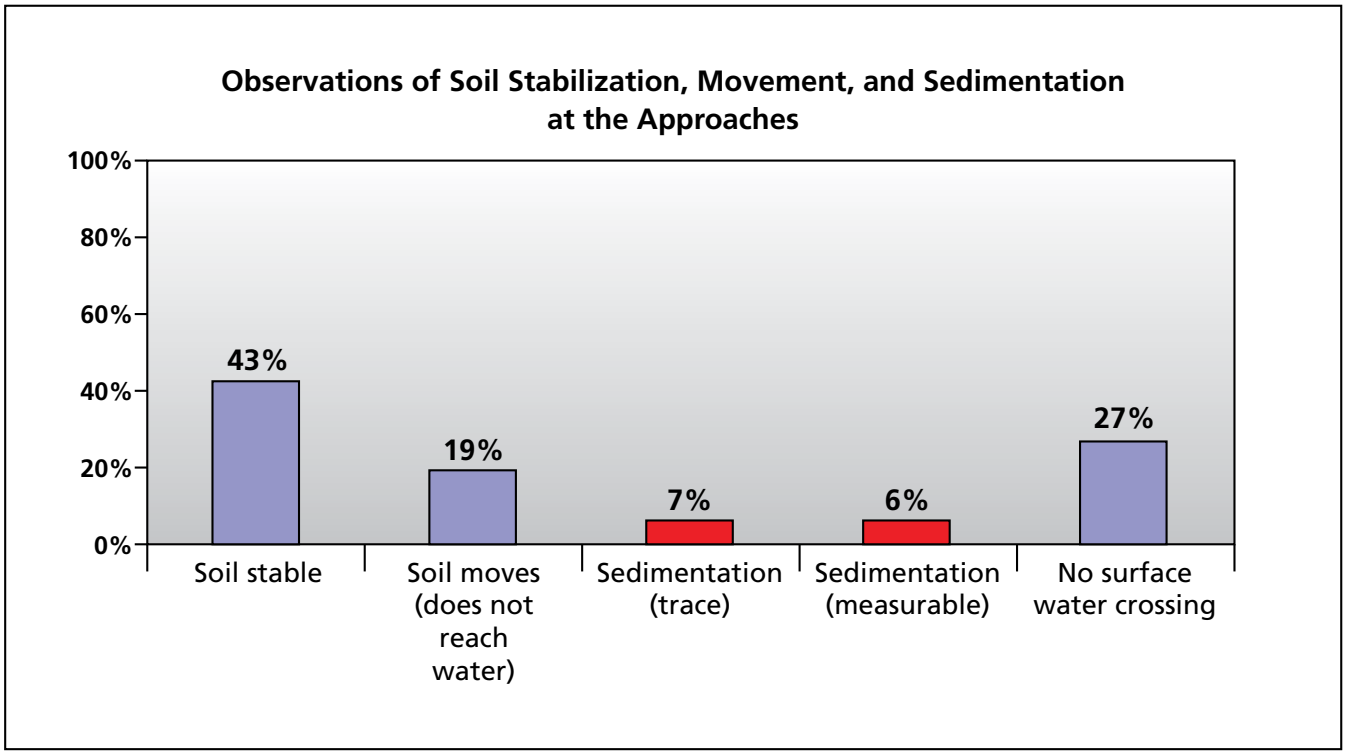
<OPTION: User may insert analysis, interpretation, and photographs here.>

As shown on the previous page, the SDSs begin with a brief description of the data presented and how the information was calculated, followed by results of the calculations and supporting figures. There are also placeholders in the SDS files where text and images can be inserted to explain, interpret, and analyze the information presented. The SDSs may be used alone or compiled into a Comprehensive Standard Data Summary evaluating a project's BMP performance.

Calculation of Proportions and the Presentation of Null Values

Where applicable, percentages presented in the SDSs are calculated on the total number of possibilities for a condition to occur based on the number of questions about that condition in the BMP protocol. For example, when evaluating the approaches to the surface water crossing, if there are 75 new sample units and 4 questions in the protocol where soil stabilization, movement, or sedimentation are evaluated, there are a total of 300 possible opportunities to make observations about soil conditions at the approaches (75 × 4 = 300). Those new sample units without a surface water crossing, and thus no approaches, are included as part of this total, as there are still four questions addressing conditions for these sample units. The number of opportunities to make observations about conditions at the approaches on sample units where approaches do not exist is a **null value**. **The null values are included in the SDSs to ensure that the percentages total 100 percent and the frequency of problems is accurately reported**.

The chart below shows the proportion of observations of soil stabilization, movement, and sedimentation at the approaches to a surface water crossing from a sample data set. There are 309 sample units in this data set, each with 4 questions assessing soil conditions at the approaches; therefore, there are 1,236 opportunities to observe soil conditions within this data set (n = 1,236). Although 83 sample units do not have a surface water crossing, there are still 332 opportunities to observe soil conditions on these sample units. Therefore, 332, or 27 percent, of the total number of possible observations of soil conditions are made on sample units without a surface water crossing.



You will see null values presented in many SDSs. They allow the reader to assess performance of the BMP protocol based on the total number of possible observations of a given condition, not as a proportion of a subset of the data.

Creating Comprehensive Standard Data Summaries

The 15 SDSs can be used individually or compiled into a Comprehensive Standard Data Summary. It is advisable to compile the completed set of SDSs into a Comprehensive Standard Data Summary summarizing performance on the entire protocol. A logical sequence for combining the SDSs into a Comprehensive Standard Data Summary is provided in appendix C. An example of a Comprehensive Standard Data Summary consisting of portions of all 15 SDSs is presented in appendix D.

There are two ways to compile a Comprehensive Standard Data Summary:

1. Print each SDS individually and assemble them into one report, or
2. Electronically combine the SDSs into a comprehensive report.

When SDSs are first combined into a Comprehensive Standard Data Summary, links to the Excel analysis file are maintained within the new document. **Since maintaining and updating links requires a significant amount of computer memory, it is recommended that you close all other computer programs or applications before compiling the Comprehensive Standard Data Summary**. If available computer memory becomes a problem when compiling the Comprehensive Standard Data Summary, create two or more smaller files instead of one large file.

> **Note**: Once the Comprehensive Standard Data Summary is compiled from the individual SDS files, the electronic links may be broken, which will greatly reduce the file size and facilitate e-mailing of the document. Breaking the electronic links is discussed later in this chapter.

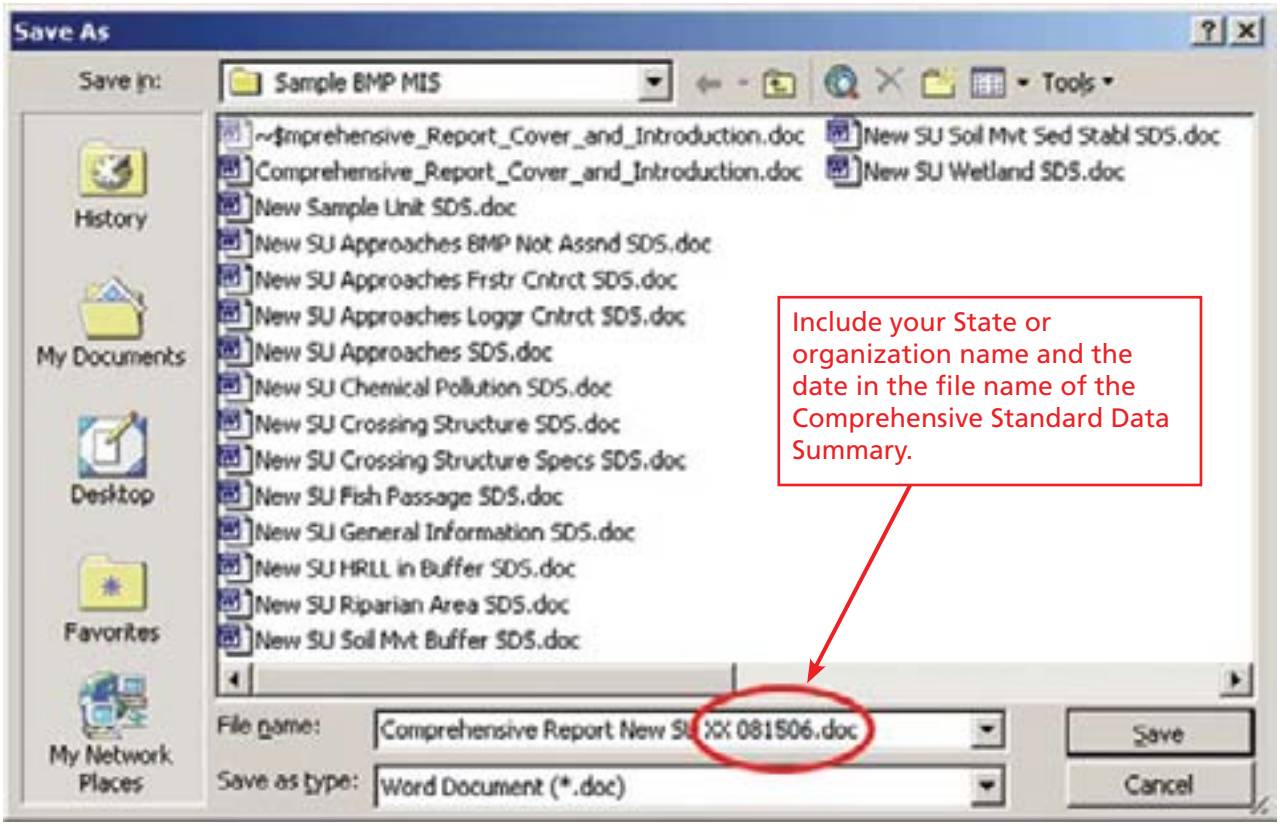
To assemble individual SDSs into one report, simply print out each SDS and attach the documents together. To create a Comprehensive Standard Data Summary within the BMP MIS, follow steps 4.1 through 4.4.

> As in chapter 3, the steps outlined in this chapter use the files in the **Sample BMP MIS** folder. Once you have completed the steps successfully using the **Sample BMP MIS** folder, repeat the process using the files in your **BMP MIS (name)** folder.

Step 4.1. Create the Comprehensive Standard Data Summary Document

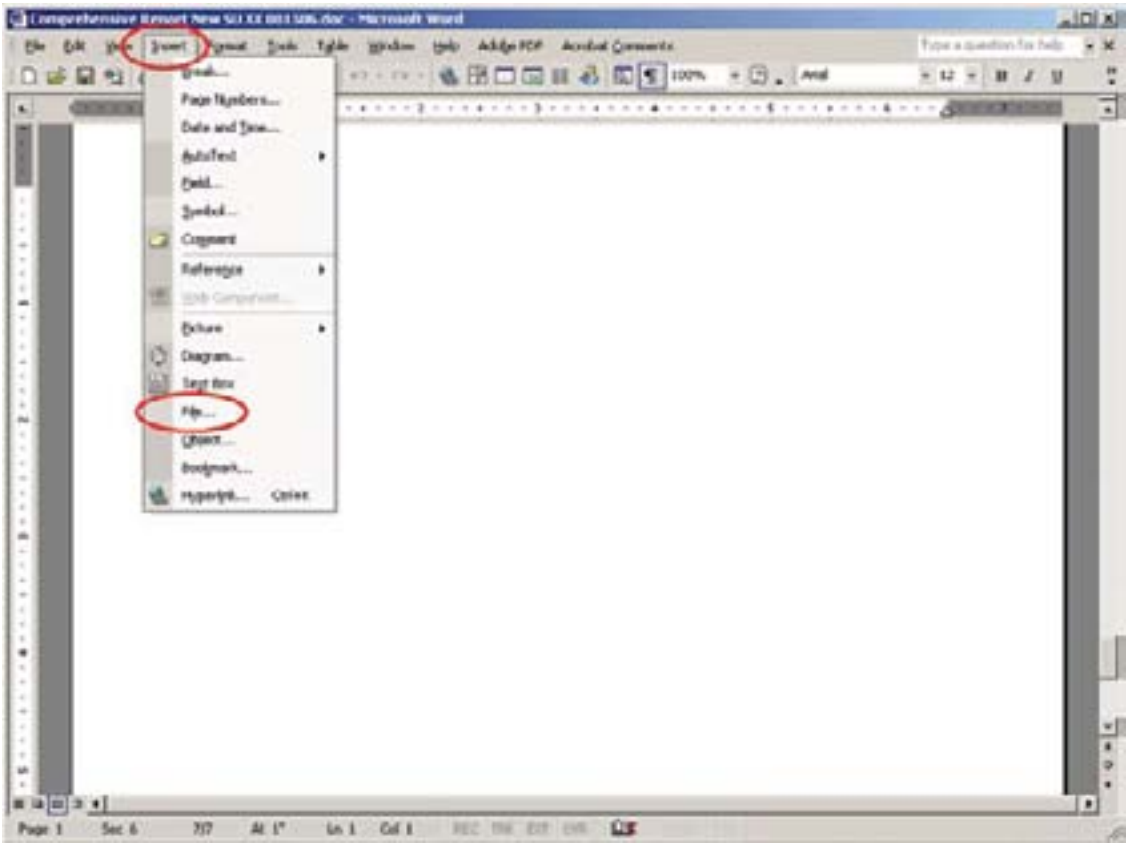
Navigate to the **Sample BMP MIS** folder. Open the file **Comprehensive_Report_Cover_and_Introduction.doc**. Select **File** from the main toolbar again and **Save As** from the drop-down menu.

When the **Save As** window appears, name the document using clear nomenclature that includes the State or organizational name or abbreviation and the date. In the sample screen shown on the following page, the new file has been named **Comprehensive Report New SU XX 081506.doc**. Similar nomenclature can be used, substituting the State or organization abbreviation for XX. The Comprehensive Standard Data Summary file **must** remain in the same folder as the Excel analysis file in order for the links to remain active and defined.

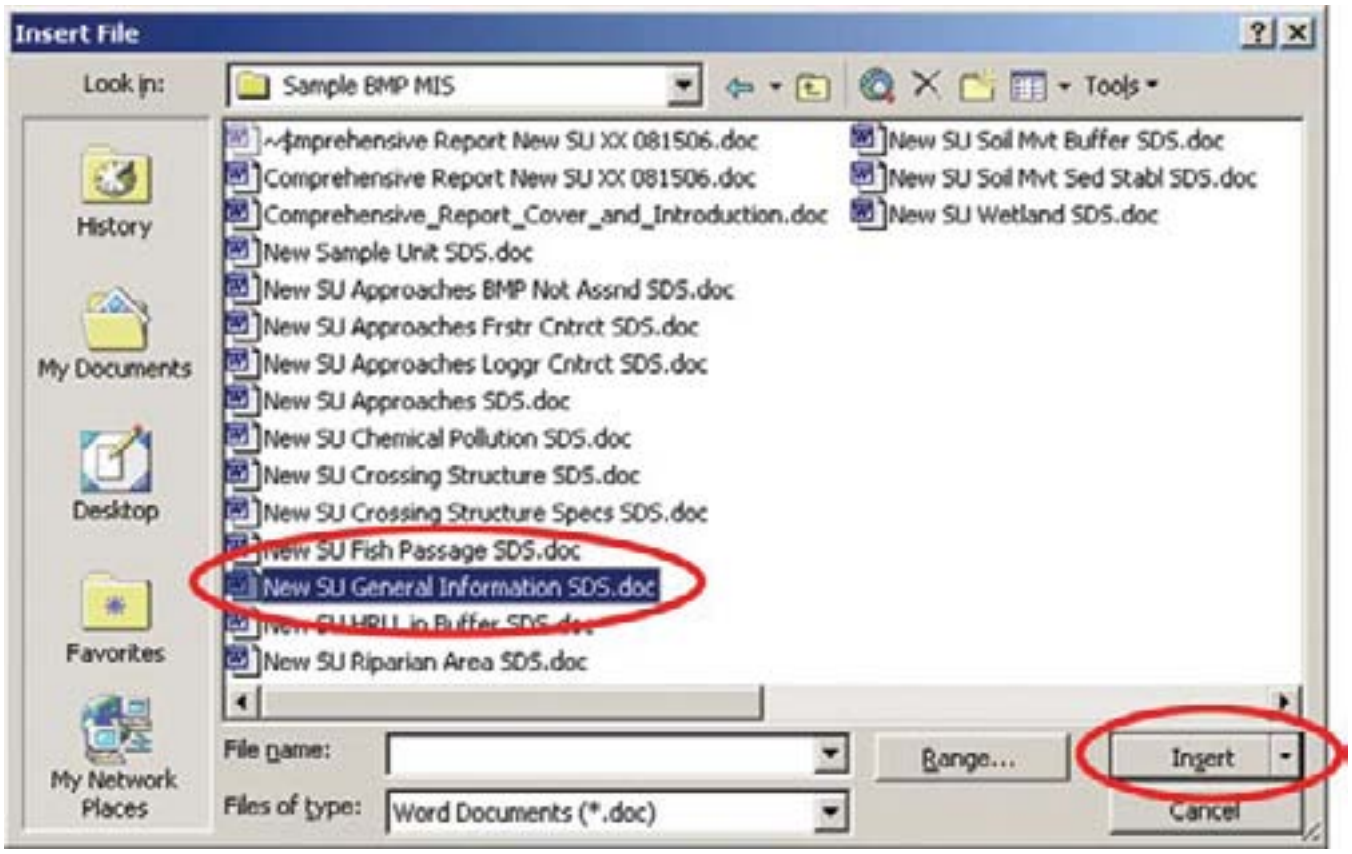


Step 4.2. Insert a File Into the New Document

Place your cursor at the very end of the document you just created. Select **Insert** from the main toolbar and **File** from the drop-down menu.



The **Insert File** window will open. Select the file **New SU General Information SDS.doc** to highlight it, then select **Insert**. The contents of the file will be copied into the Comprehensive Standard Data Summary file. The cursor will be left at the end of the inserted file.



Step 4.3. Insert the Remaining SDS Files Into the Document

Repeat step 4.2 for each SDS to be inserted into the Comprehensive Standard Data Summary. Appendix C includes the recommended sequence of SDSs, but you may choose what SDSs to include and in what order.

Step 4.4. Save the Comprehensive Standard Data Summary File

Once you have copied all of the desired SDS files into the Comprehensive Standard Data Summary, save the file before closing it. Maintain this file as your "master" Comprehensive Standard Data Summary. You may wish to augment the information presented with additional text or images (see the Adding Text and Images section in this chapter).

Breaking the Links

There are two important benefits to breaking the links with the Excel analysis file after the Comprehensive Standard Data Summary file is complete:

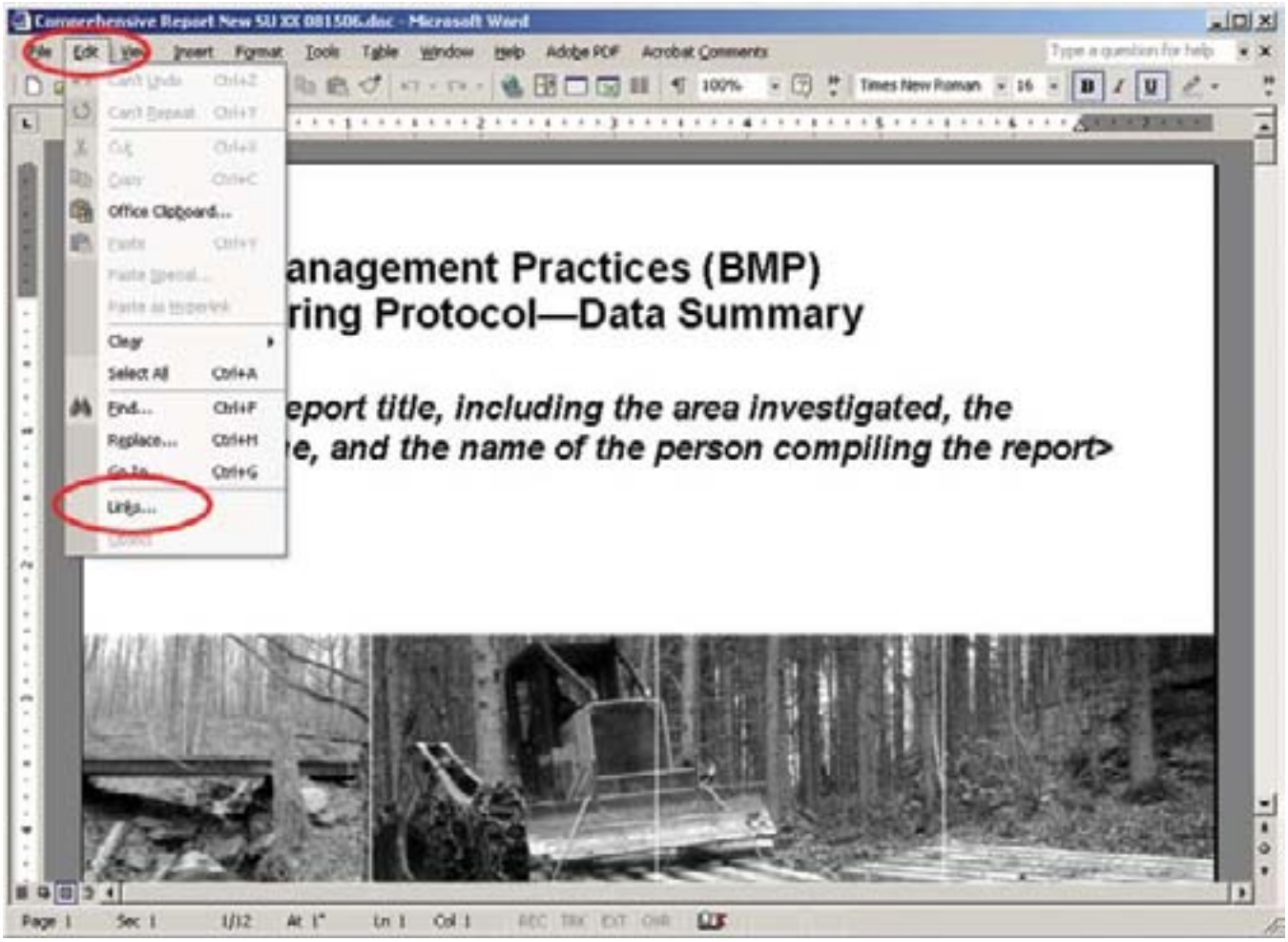
1. Files without links require less memory and storage space than those files maintaining links.
2. Files without links can be easily e-mailed because they are smaller and they can be sent without including the Excel analysis file. If the links were not broken and the Excel analysis file were not e-mailed along with the Comprehensive Standard Data Summary file, the recipient would encounter an error when opening the file.

The procedure for breaking the links affects only the document you are in when you break the links. Therefore, when you open the Comprehensive Standard Data Summary file and break the links, you break only the links to that file. Links between the query files and the SDS files are not affected. Once the links are broken, however, the procedure cannot be reversed. **Do NOT break the links with the Excel analysis file until the Comprehensive Standard Data Summary is COMPLETE, as this action cannot be undone**.

Once the Comprehensive Standard Data Summary is complete, it is advisable to break all links with the Excel analysis file to reduce the overall file size.

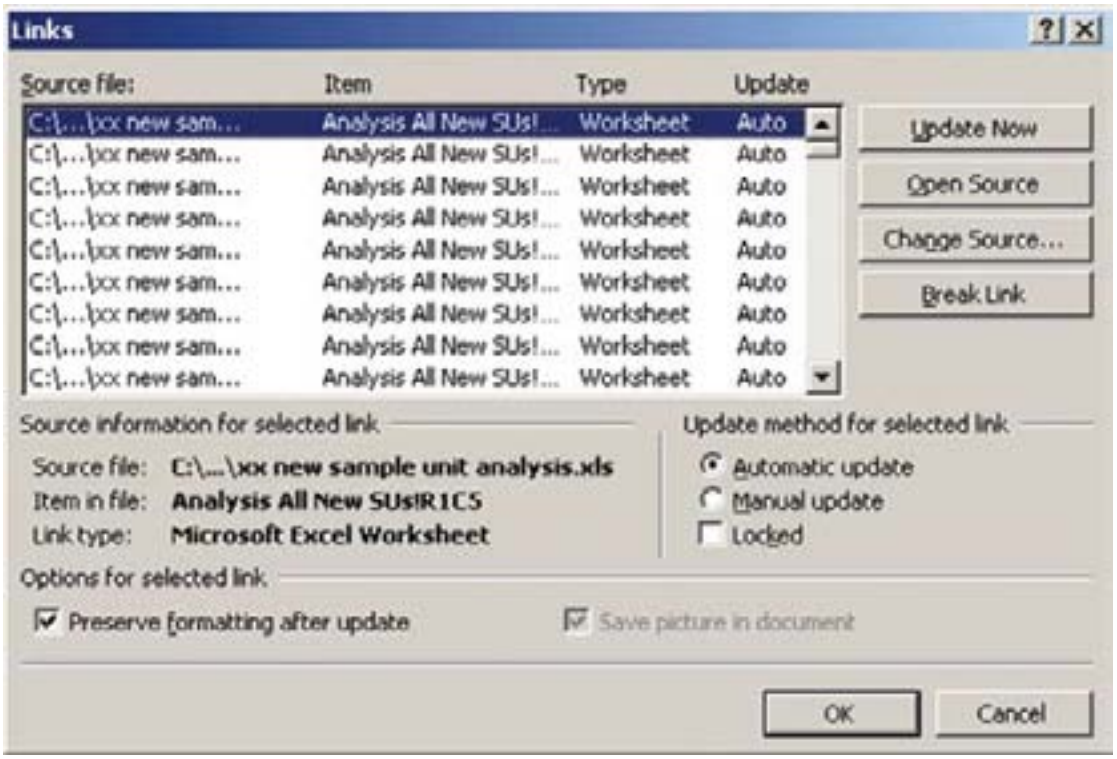
Step 4.5. Select the Links

Open the Comprehensive Standard Data Summary file. (It may take some time to open the file as Word updates the data links.) Select **Edit** from the main toolbar and **Links** from the drop-down menu.



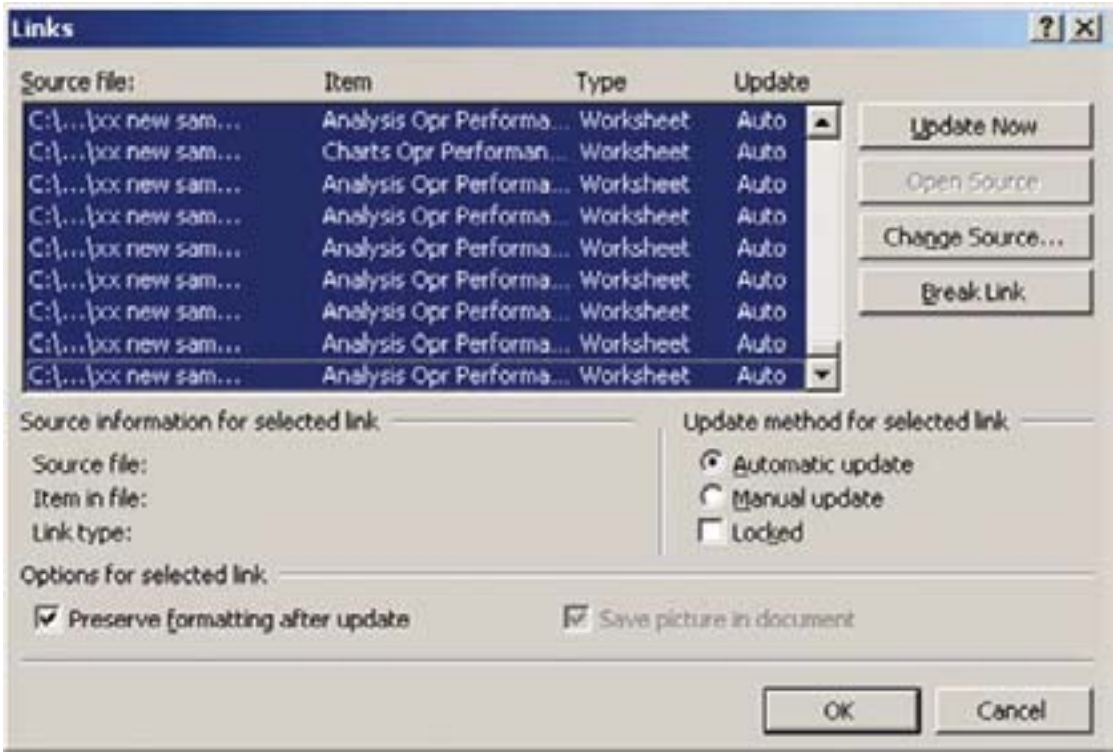
The **Links** window will open. Each piece of linked information in the Comprehensive Standard Data Summary will be listed.

Each line in this box is one piece of information linked to the Excel analysis file.



The first link will be highlighted. Select all of the links listed in the box by holding down the **Shift** key and pressing the **down-arrow key** until each link is highlighted.

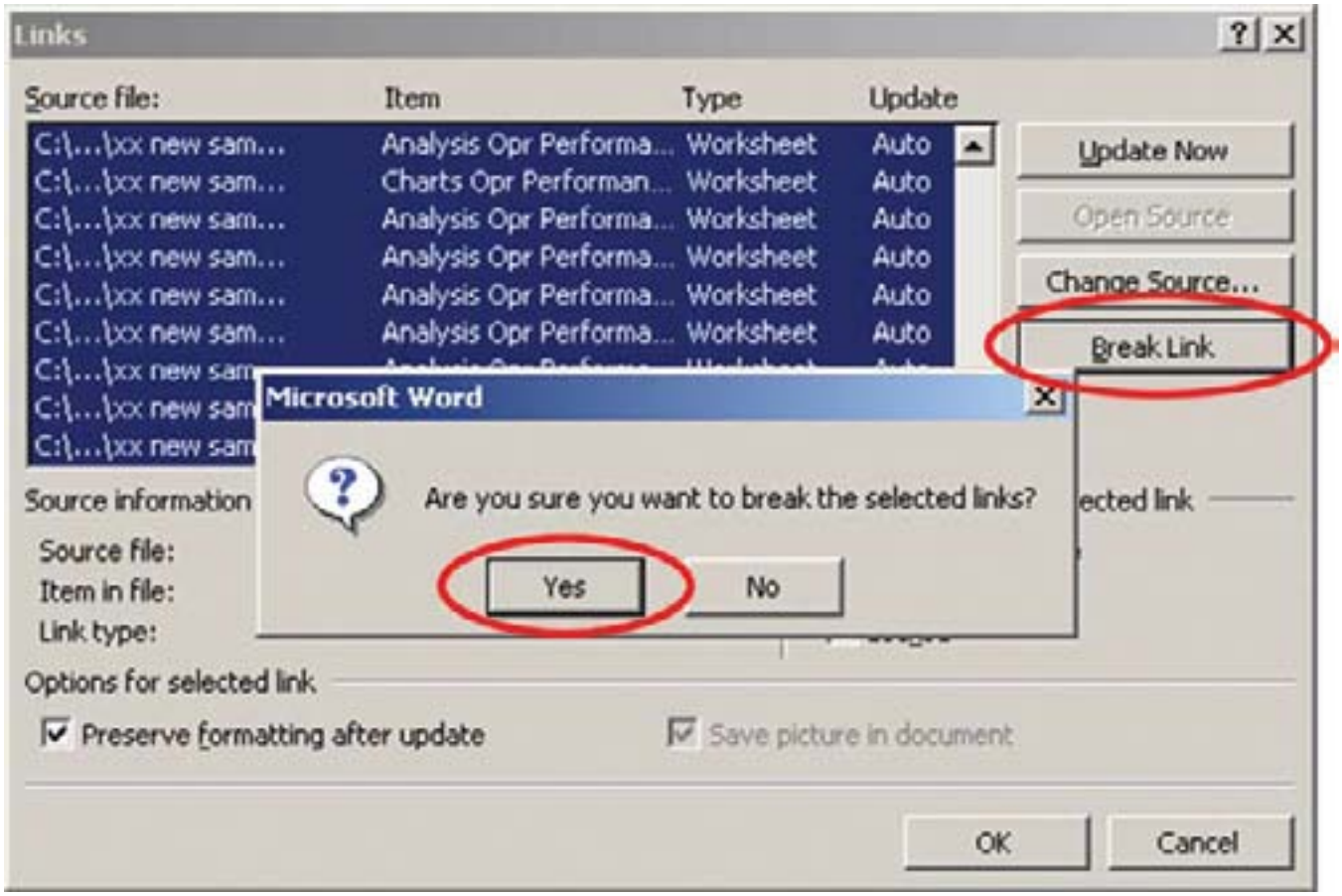
Highlight all links.



Step 4.6. Break the Links

When all of the links are highlighted, select **Break Link** to the right of the box. You will have an opportunity to cancel this action before the links are broken. A dialog box will open asking if you are sure you want to break the

links. Select **Yes** to break all of the links. The document is now a standard Word document with no active links to the Excel analysis file. It may be copied or moved to another file folder for archiving. Save the document before closing it.



Adding Text and Images

Text and images may be added to the individual SDSs or the Comprehensive Standard Data Summary. This feature allows you to explain, interpret, or analyze the information presented. You may want to customize the Comprehensive Standard Data Summary for different purposes or audiences, each with a different level of detail or emphasis. If so, save a copy of the Comprehensive Standard Data Summary and add or delete text and images as necessary for each use.

The SDS template files include placeholders in the body of the document for adding text and images. These placeholders will be copied into the Comprehensive Standard Data Summary and appear as follows:

Discussion

<OPTION: User may insert analysis, interpretation, and photographs here.>

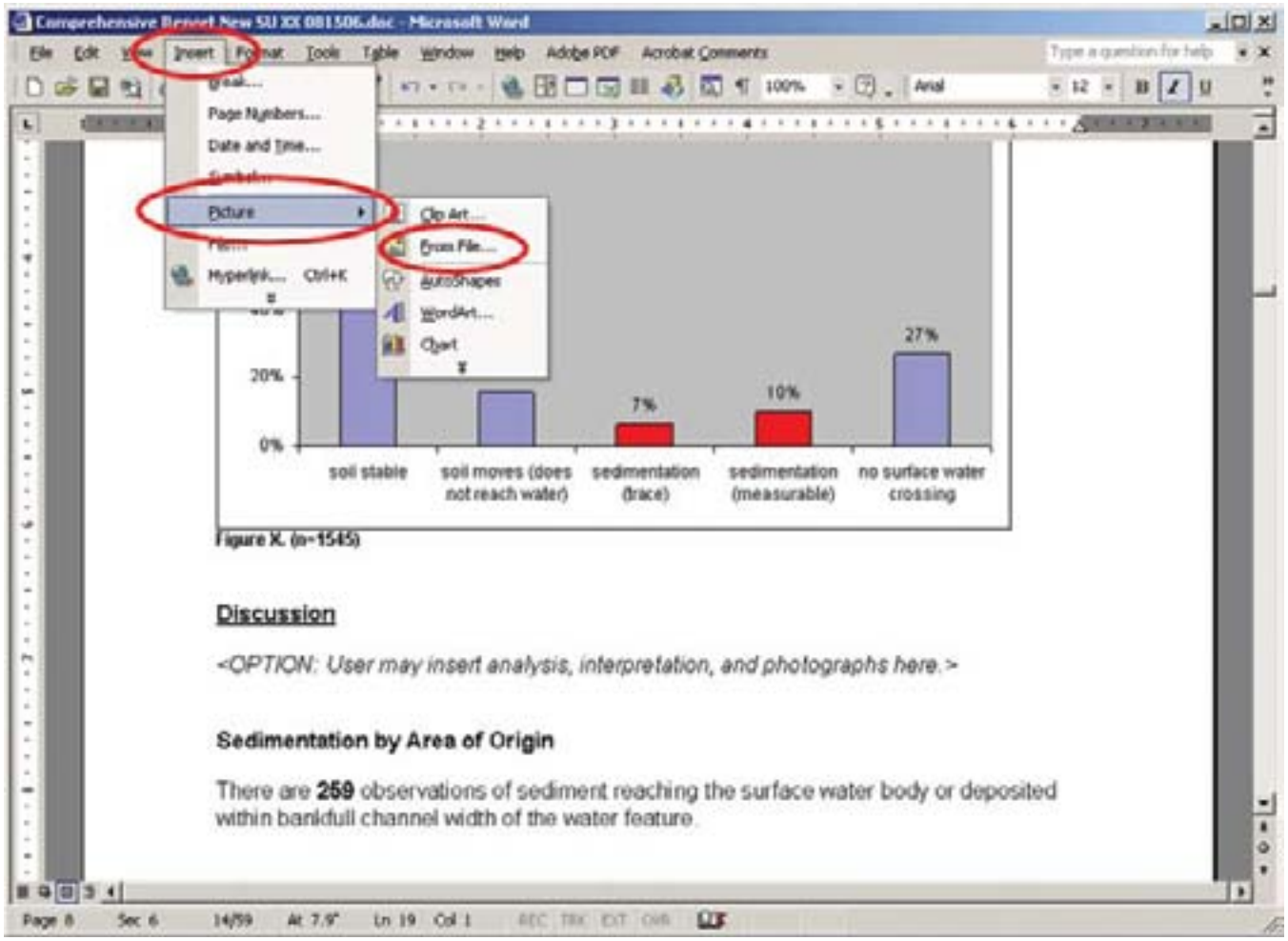
The location of these discussion sections is a suggestion only; because the Comprehensive Standard Data Summary file is a Word document, sections can be moved to wherever the report preparer wishes. Likewise, additional discussion sections may be added, or the discussion sections may be eliminated all together. Even without the discussion sections, the Comprehensive Standard Data Summary reports on BMP performance and effectiveness. The discussion sections do, however, offer the opportunity to add explanatory details.

Step 4.7. Add Text

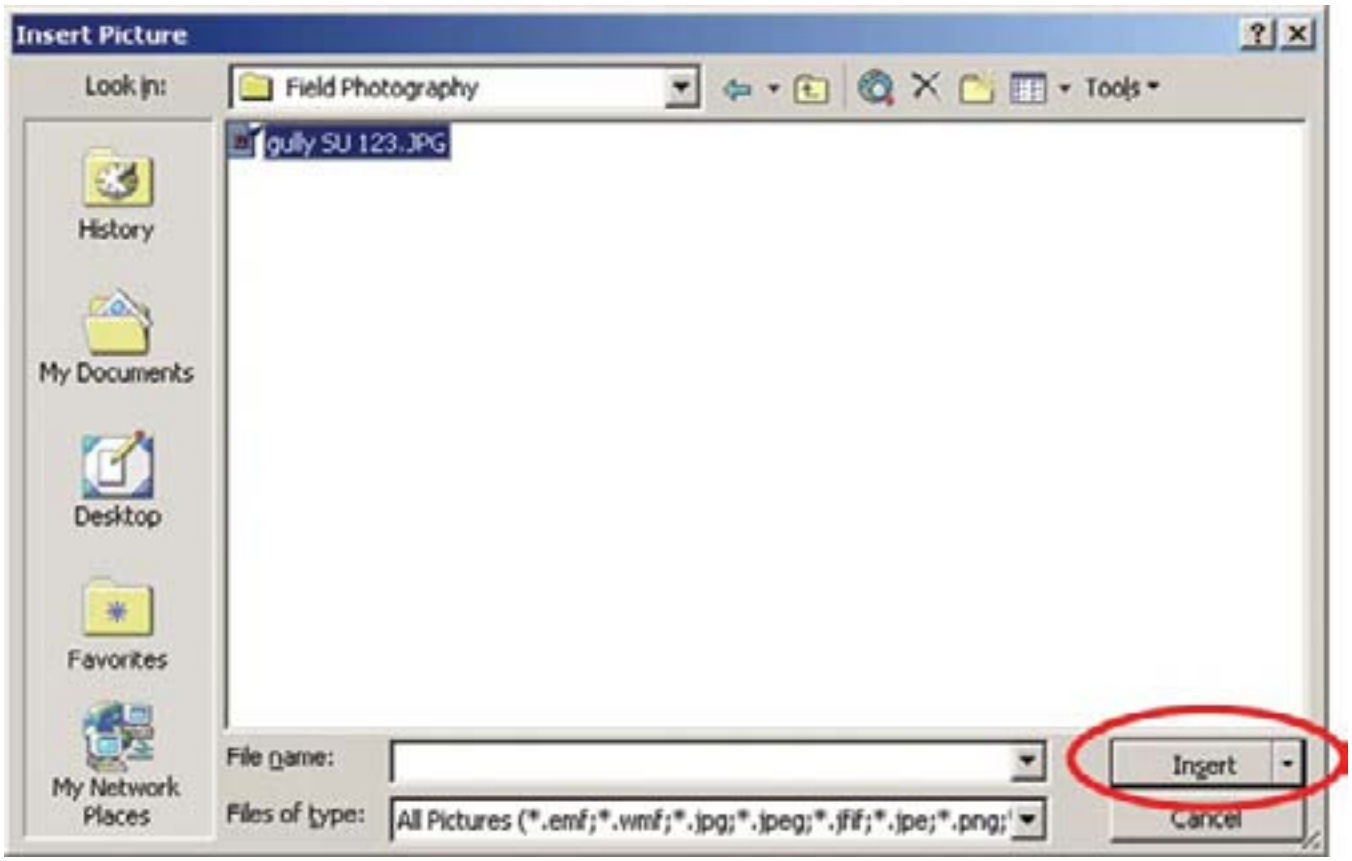
To add text into the Comprehensive Standard Data Summary, simply open the document, highlight the line "<OPTION: User may insert analysis, interpretation, and photographs here.>", and type your own text or copy text from another document. Save the document before closing it.

Step 4.8. Add Images

To add images such as digital photographs, place the cursor where you wish to insert an image into the Comprehensive Standard Data Summary. Select **Insert** from the main toolbar, then select **Picture** and **From File** from the drop-down menus.



When the **Insert Picture** window opens, navigate to the location of the file to be inserted. Select the file name in the **Insert Picture** window to highlight it and select **Insert** in the lower right-hand corner of the window. The image will be inserted into the document. Formatting options are available by right-clicking on the image and selecting **Format Picture** from the drop-down menu.



Repeat the process as necessary for additional images. Save the document before closing it.

Step 4.9. Remove Unused Placeholders

When the Comprehensive Standard Data Summary is complete and all desired text and images have been added, scan through the document and delete all unused discussion section placeholders. Save the document before closing it.

Finalizing the Comprehensive Standard Data Summary

Once the content of the Comprehensive Standard Data Summary is complete, it is recommended that you "clean up" some of the document formatting. The formatting of the SDSs was kept fairly simple for ease of use; as a result, some manual formatting is necessary. The items listed below are simply suggestions; you may customize the document however you prefer. See the example in appendix D.

- Insert the report title and other information suggested on the cover.
- Insert the number of sample units measured under the Data Summary heading on page ii. The number can be found under the General Information Feature heading.
- Update the Contents on page iii to reflect the SDSs you included and the order in which they appear.
- Insert page breaks where necessary to keep headings and data on the same page, or to start major headings on a right-facing page. Delete any unnecessary page breaks.

• Delete any text or graphics that are not needed for the purpose of your report, including unused placeholders.

• Number the figures and tables sequentially, or remove the figure and table identifiers.

• Once the document is complete, insert the page numbers of the major headings in the Contents on page iii.

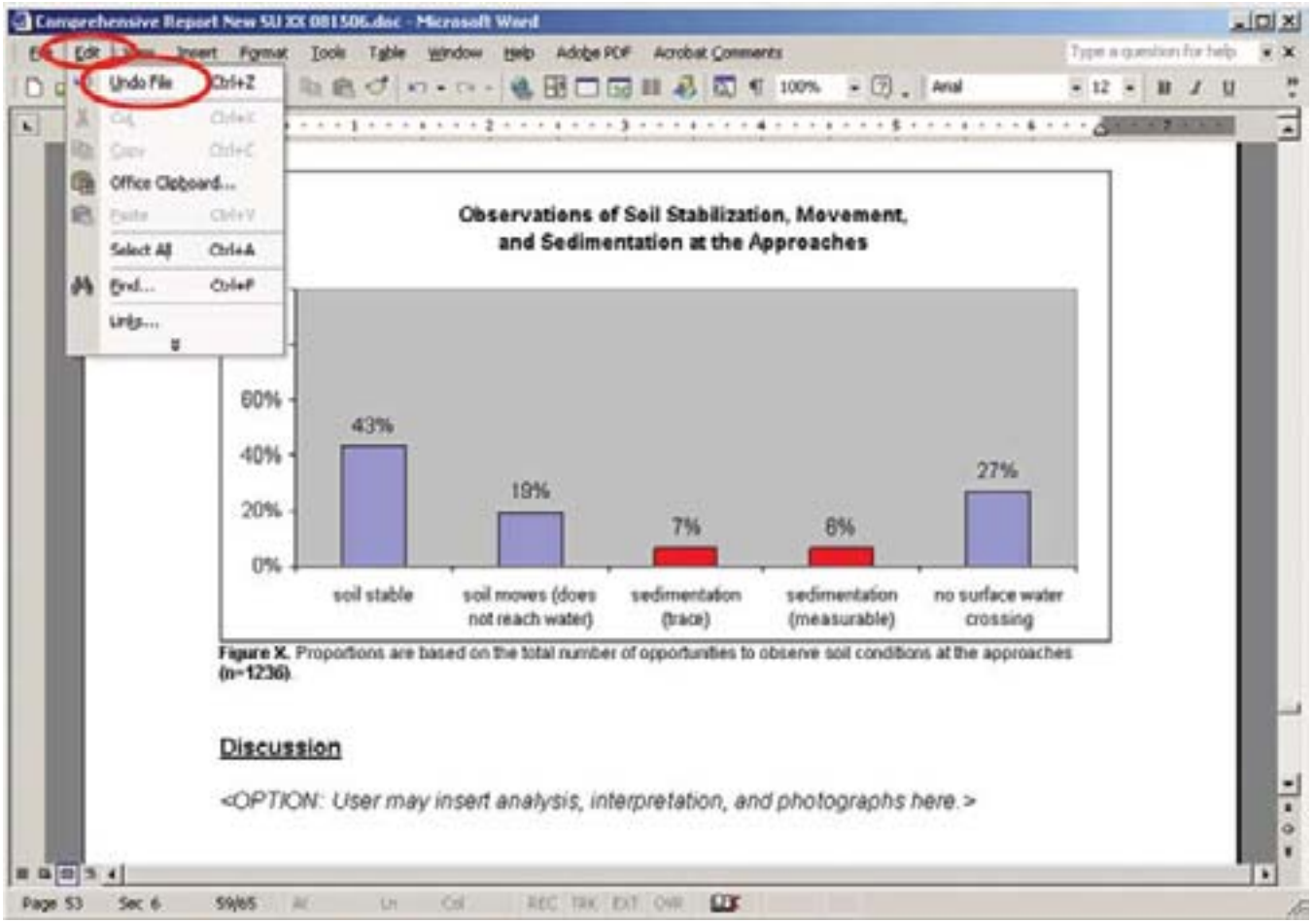
Tips for Troubleshooting

Here are some suggestions for managing common questions or problems.

Scenario 1: An SDS file is inserted into the Comprehensive Standard Data Summary in error.

Solution: You may immediately remove the SDS file most recently inserted into the Comprehensive Standard Data Summary by selecting **Edit** from the main toolbar and **Undo File** from the drop-down menu.

You may also delete an SDS (or text or an image from within an SDS) from within the Comprehensive Standard Data Summary by simply highlighting and deleting the material as you would in any other Word document.



Scenario 2: Error messages appear for some of the data in the SDS.

Solution: Some calculations in the Excel analysis file may return an error message, as in the sediment volume table shown on the following page. The error message simply means that no volume measurements were recorded for that condition. As a result, Excel will return an error message when it is not able to perform the mathematical operation in the formula.

In the example shown, Excel returned a **#DIV/0!** error in the average column because it is not possible to divide by zero. Similarly, the median calculation does not count zeros or empty cells because the formula in the Excel analysis file directs Excel to ignore these entries. Since there are no other entries greater than zero in that column, Excel returned a **#NUM!** error when the median value was calculated.

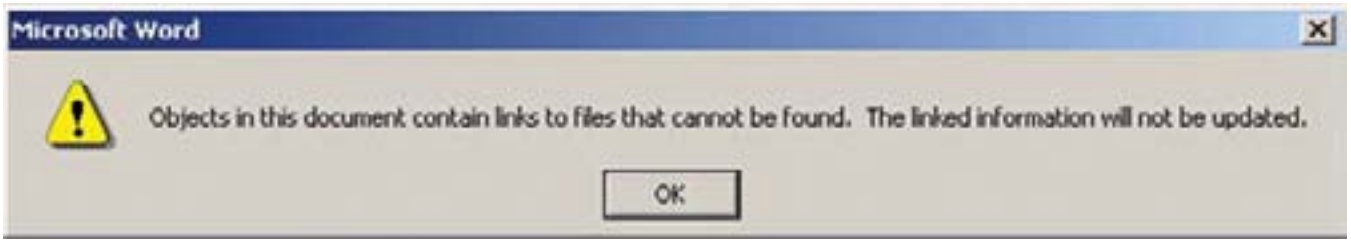
Once you have completed your Comprehensive Standard Data Summary and broken all of the links to the Excel analysis file, you may edit the error messages out of the tables. For example, you may substitute an "N/A" for not applicable where these error messages occur.

Table X. Quantities of Sedimentation by Crossing Structure Type

	Sediment Volumes (cubic feet)		
	Average	**Median**	**Maximum**
Unimproved ford	16	5	80
Improved/constructed ford	#DIV/0!	#NUM!	0
Pole/brush ford	116	9	600
Single culvert	27	4	123
Multiple culvert	6	4	15
Bridge/box culvert, closed top	59	12	200
Bridge/box culvert, open top	16	6	54
Structure removed	70	6	606
Unknown/other	76	76	150

Nonnumeric values indicate that no volume measurements were recorded.

Scenario 3: You have attached your Comprehensive Standard Data Summary to an e-mail and sent it. When the recipient opens the report and tries to update the links, the following error appears.



Solution: The Comprehensive Standard Data Summary is maintaining links to the Excel analysis file. Make sure that the links have been broken in your Comprehensive Standard Data Summary file before e-mailing it (see the Breaking the Links section in this chapter).

Chapter 5—Custom Queries and Data Summaries

The standard data summaries provided in the BMP MIS present the results of BMP performance by linking electronically to queries that sort information from the protocol data. Although several standard data summaries (SDSs) are provided, you may wish to focus on some of the protocol data in more detail. There are many possibilities for queries from your data; it would be impossible to address them all here. You may wish to create custom queries beyond the standard queries included with the protocol to more completely explore BMP performance. This chapter includes basic guidelines for creating custom queries in Access, writing formulas for higher level analysis in Excel, and creating your own custom SDSs.

In order to develop a custom query, the appropriate data must be filtered out of the field data in the Access database and exported to a worksheet in an Excel analysis file, where you can work on the data in more detail. A number of queries of field data already exist in the Access database; you can them use in creating additional SDSs. Standard data summaries are often based on several queries. **Some of the queries you need to create new SDSs may already exist in the Access database.** A list of the Access queries provided in the BMP MIS and their descriptions appear in appendix B. Review these existing queries carefully to determine if the subset of data you need has already been created. If the query you are looking for already exists, you can skip to the second section of this chapter (Exporting the Query to Excel). If you need to create a new query of field data in Access, begin with step 5.1.

The process of creating a new query, although not difficult, requires concentration and a lengthy written explanation. Since all queries are created using the same steps, this chapter will explain the creation of a single query. You can then follow the same process to create additional queries of your own choosing. Note that most SDSs utilize information from several queries, so it is important to check to appendix B to determine if the queries you need already exist.

> **Important**: This chapter uses data in the **Sample BMP MIS** folder to demonstrate building a simple query. It is recommended that you follow the steps outlined before attempting to design your own custom query. A query based on the criteria used—new sample units where a logger is responsible for BMP implementation by written contract (as part of the sale agreement)—already exists in the BMP MIS. The query will be given a slightly different name to differentiate it from the existing query.

Creating a Query in Access

Step 5.1. Gather the Documentation Needed

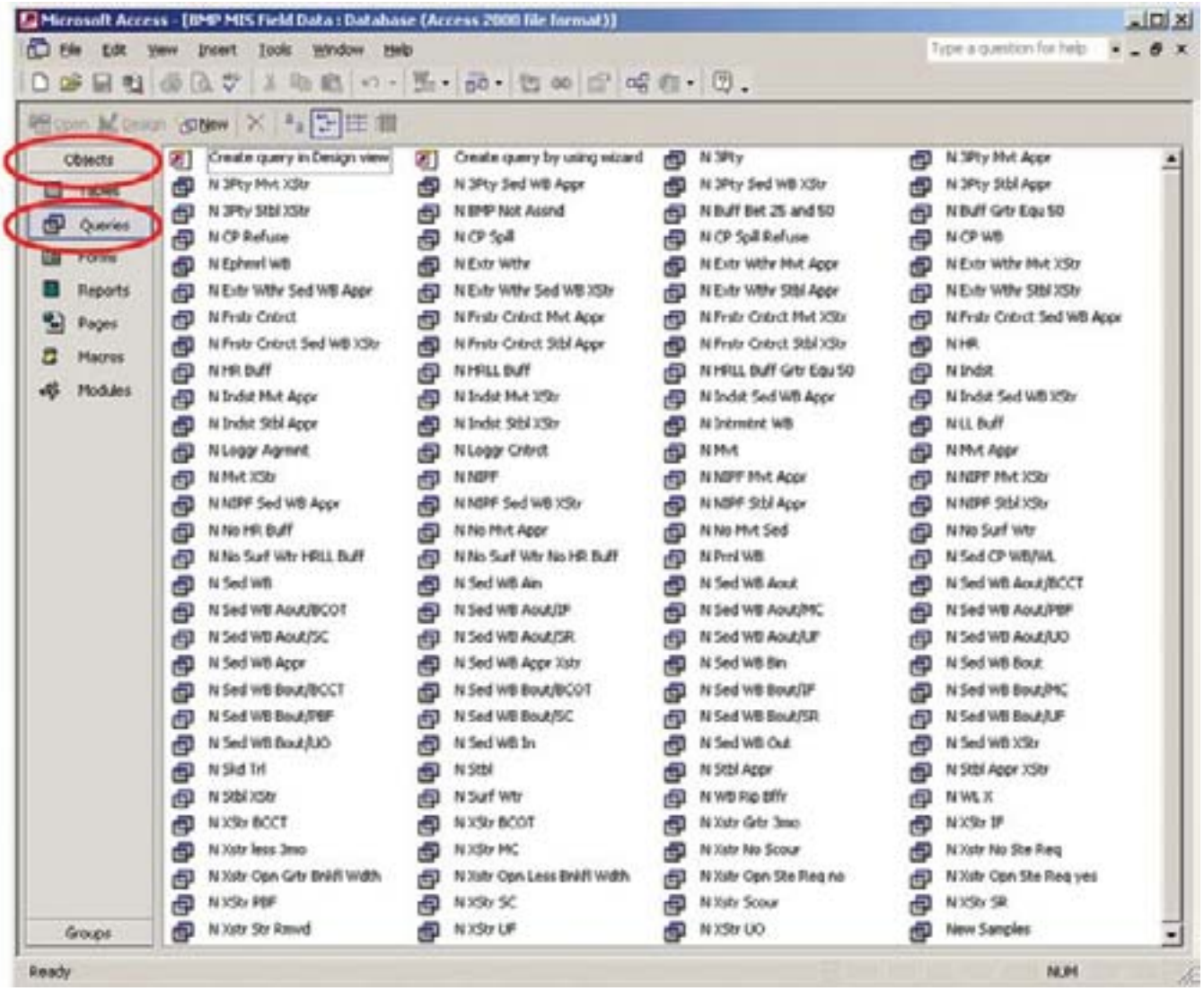
Before you begin designing a query in Access, be sure you have the following tools available:

- BMP field guide (the companion guide to this publication), which contains the complete text of all of the BMP protocol questions
- Map of the BMP protocol questions, which appears in appendix E of this desk reference

The question map breaks the BMP protocol into focus areas. It acts as a shorthand list of the subject of each question and a guide to the column in which each question appears in the Excel analysis file. The question map is extremely helpful when defining queries in Access and writing formulas to analyze queries in Excel.

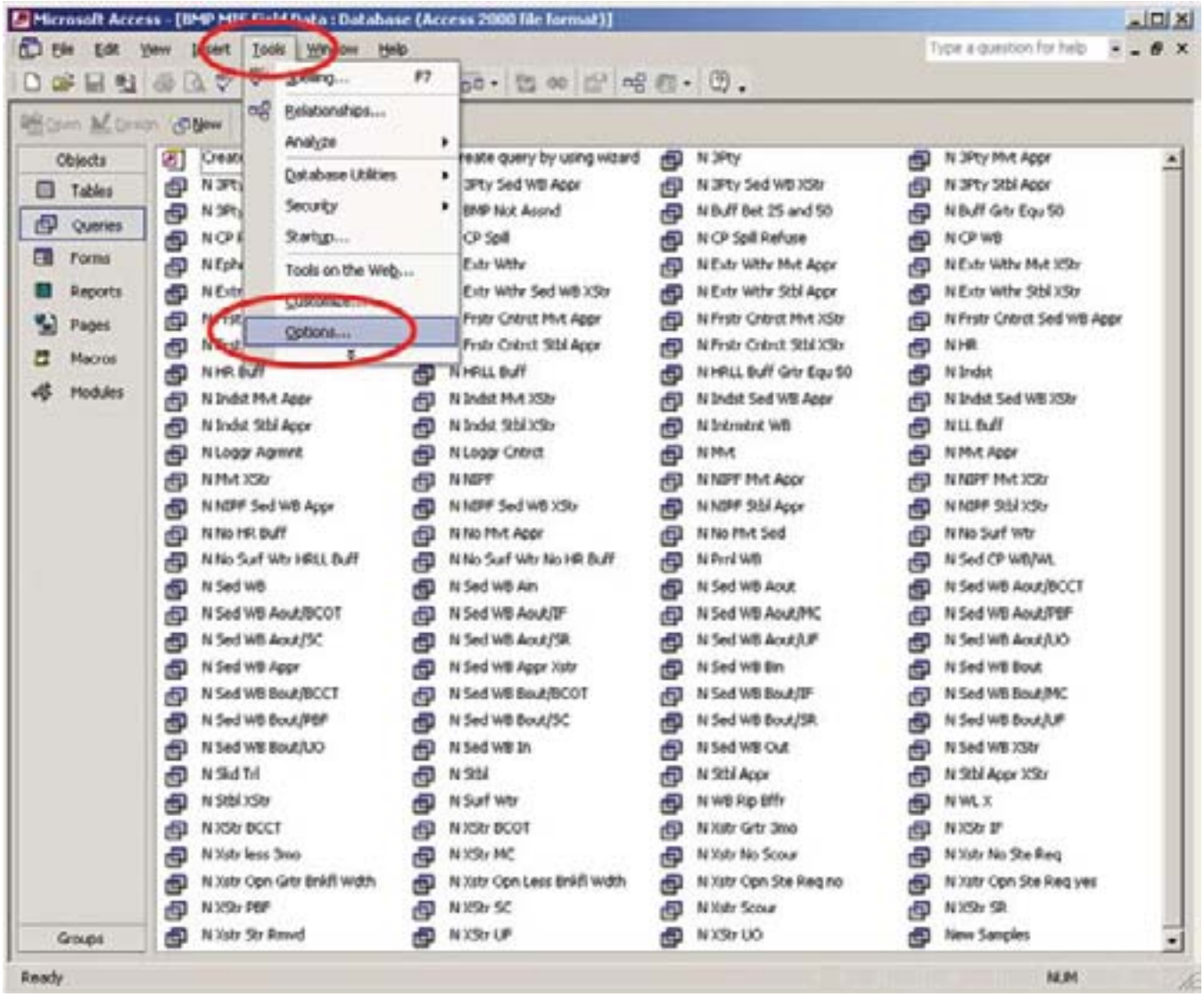
Step 5.2. Navigate to the Query Screen

Open the Access database (**BMP MIS Field Data.mdb**), using the password provided in chapter 3. On the left-hand side of the screen under **Objects**, select **Queries** to view the entire list of available queries.

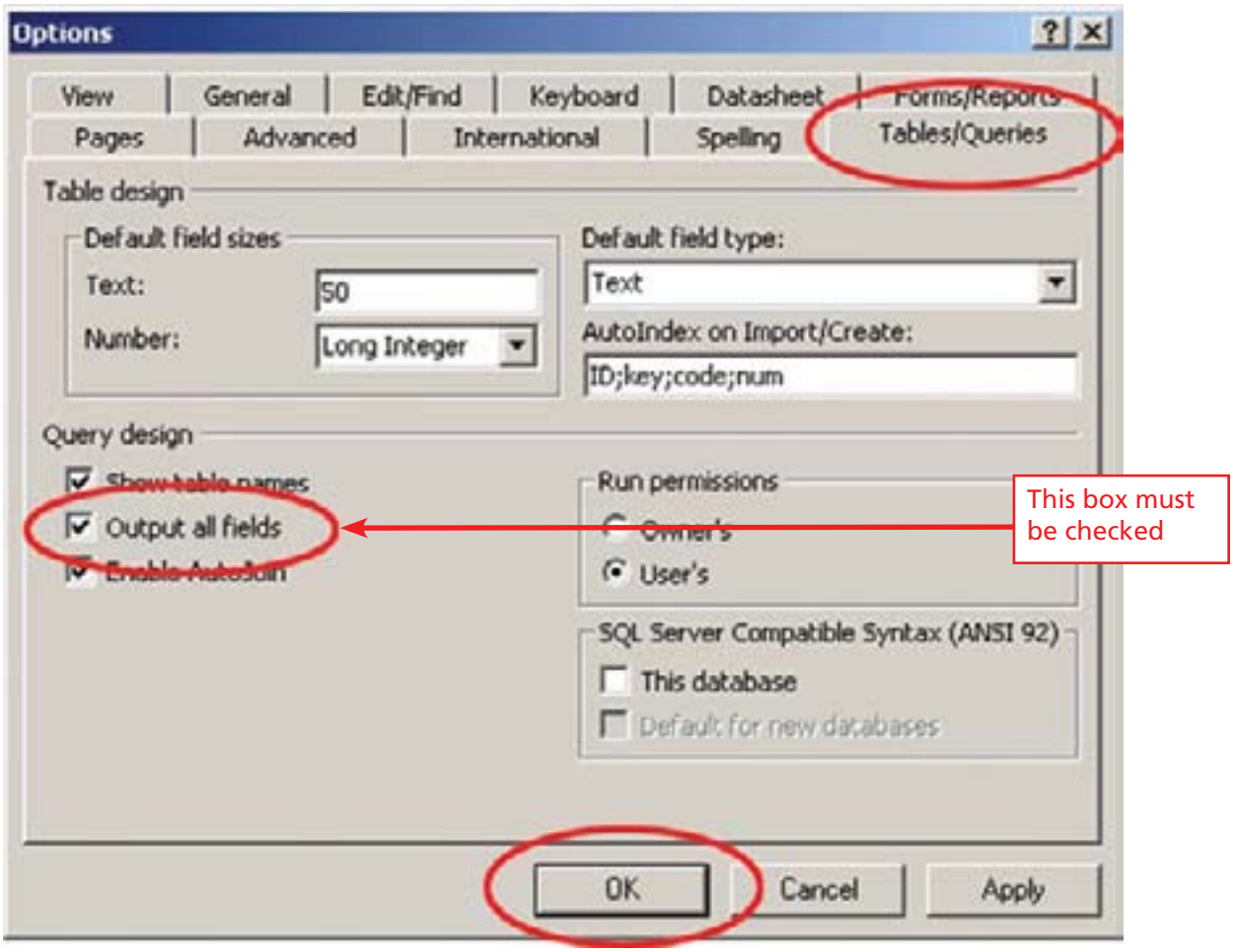


Step 5.3. Verify That Access Is Set to Return All Fields in a Query

Access filters information, but unless told to do otherwise, it will return only the fields defined as criteria. In the BMP MIS, Access must return **all** of the fields defined in the protocol. To ensure that all data points recorded for each sample unit are returned in the query, select **Tools** from the main toolbar and **Options** from the drop-down menu.

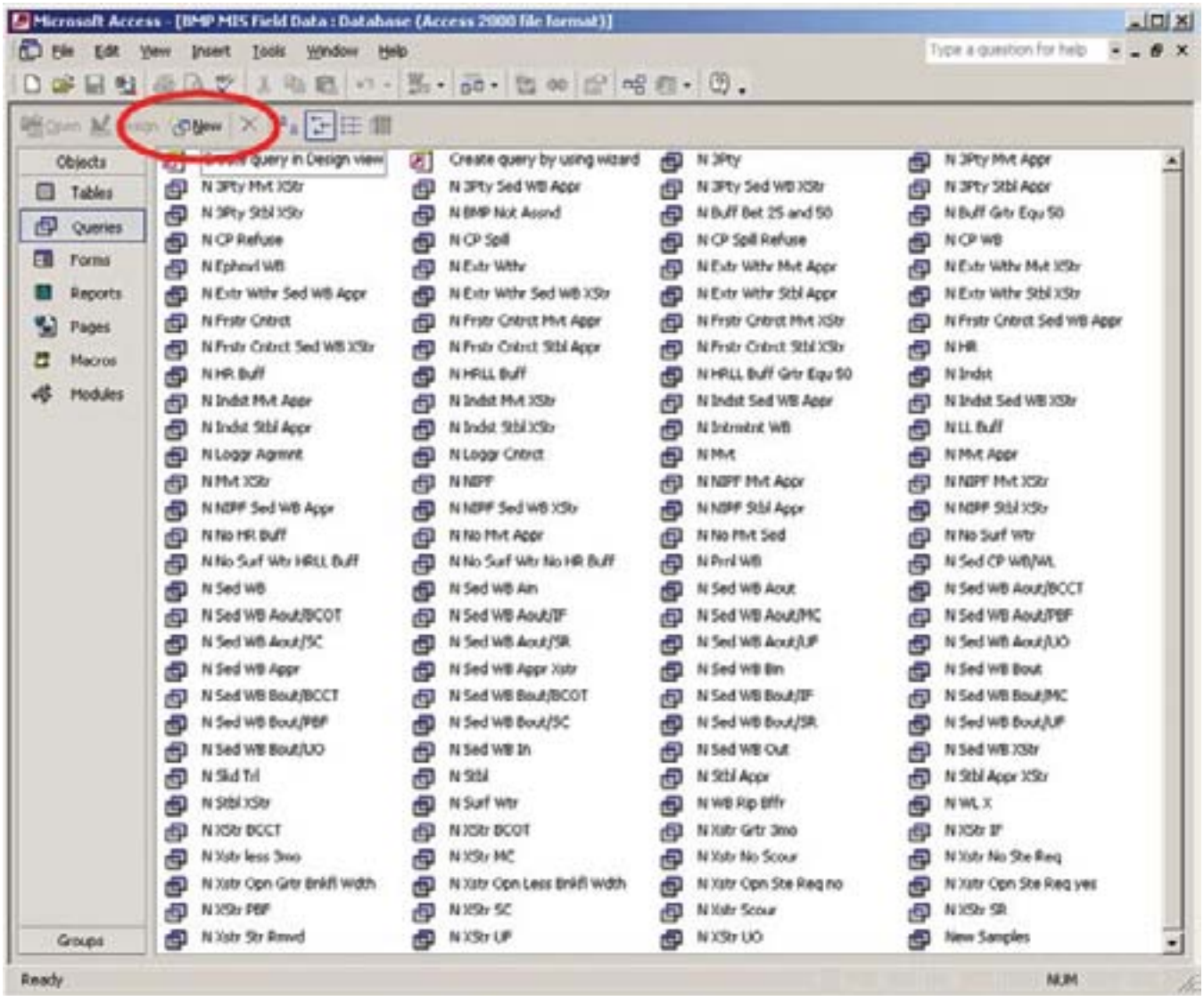


The **Options** window will open. Select the **Tables/Queries** tab. In the left-hand side of the window is the heading **Query design**. Make sure the **Output all fields** box is checked. Select **OK** to close the **Options** window.

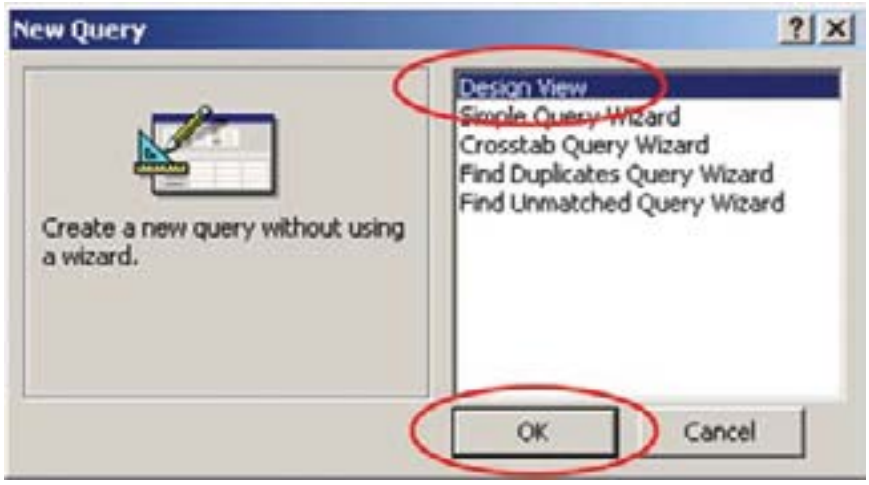


Step 5.4. Create a New Query

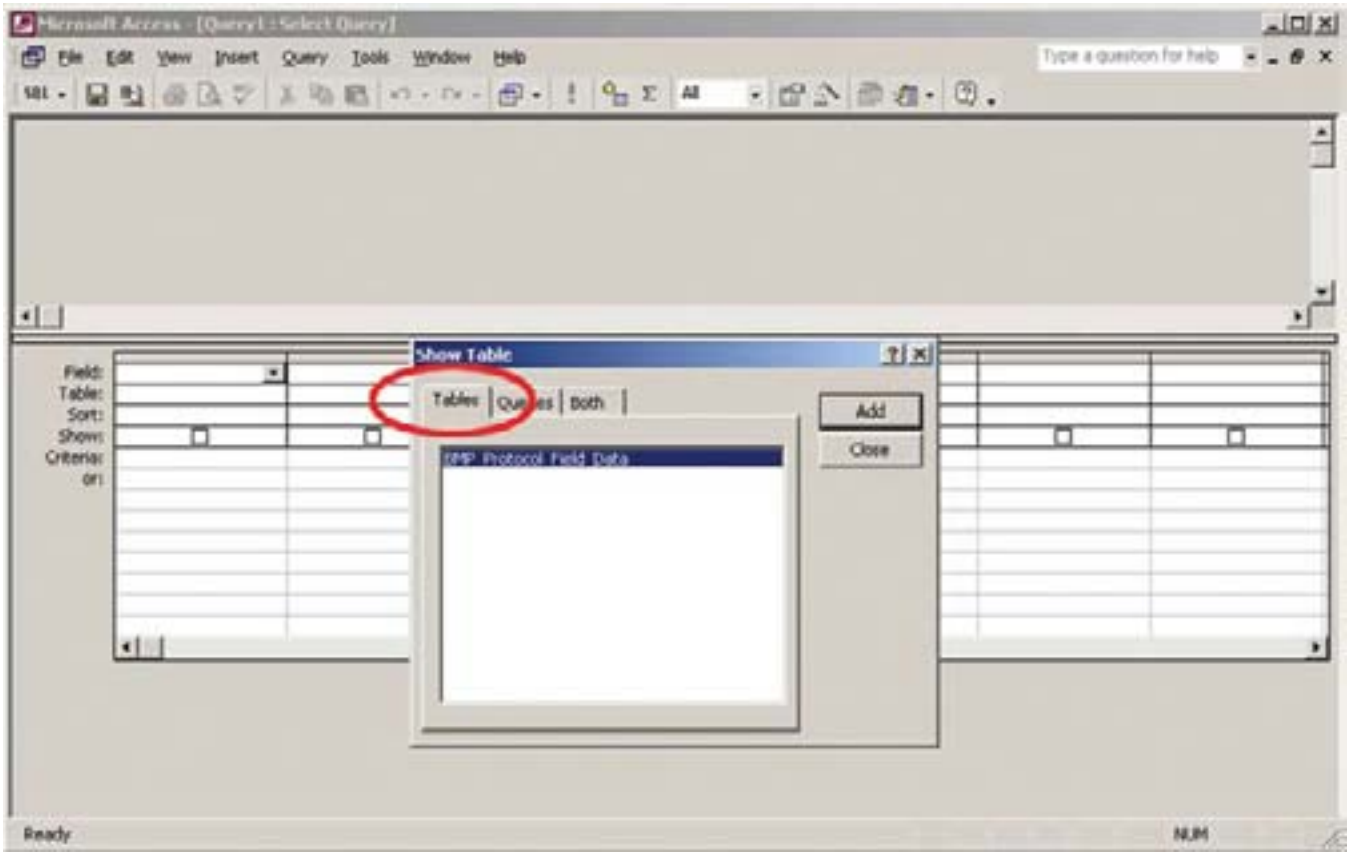
To begin creating a new query, select the **New** button on the Access toolbar (below the main toolbar).



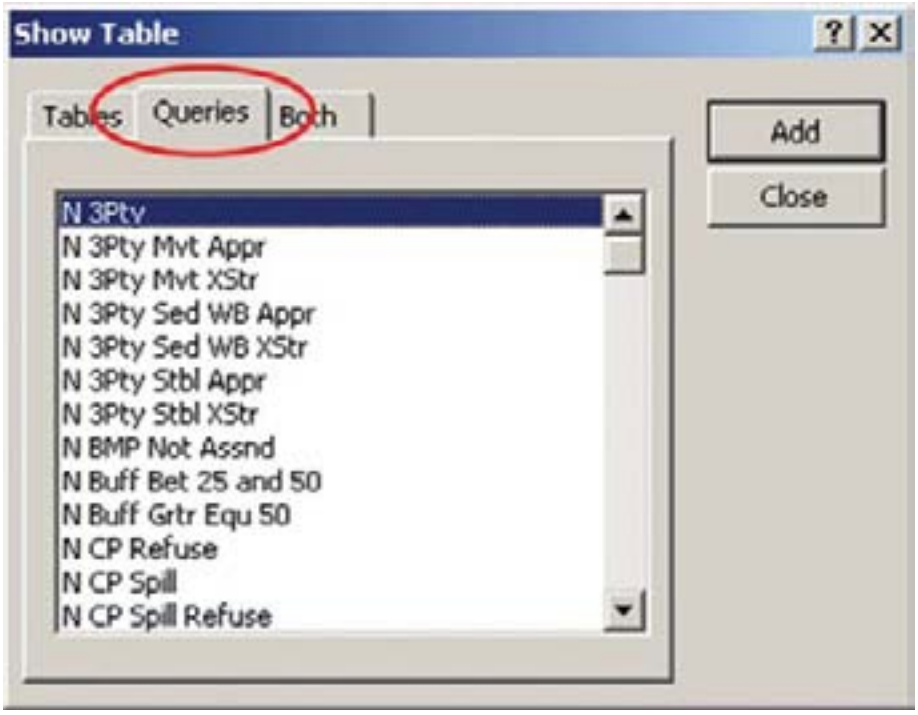
The **New Query** window will open. You will use **Design View** to create your query in Access. Highlight **Design View** and select **OK**.



The **Design View** of the new query will open, along with the **Show Table** window. The **Show Table** window lists the tables and queries on which the criteria in the new query can be based. The **Tables** tab lists the main database table where all field data are stored. As discussed in previous chapters, the table containing the field data must always be called **BMP_Protocol_Field_Data** in order for the queries to work properly.

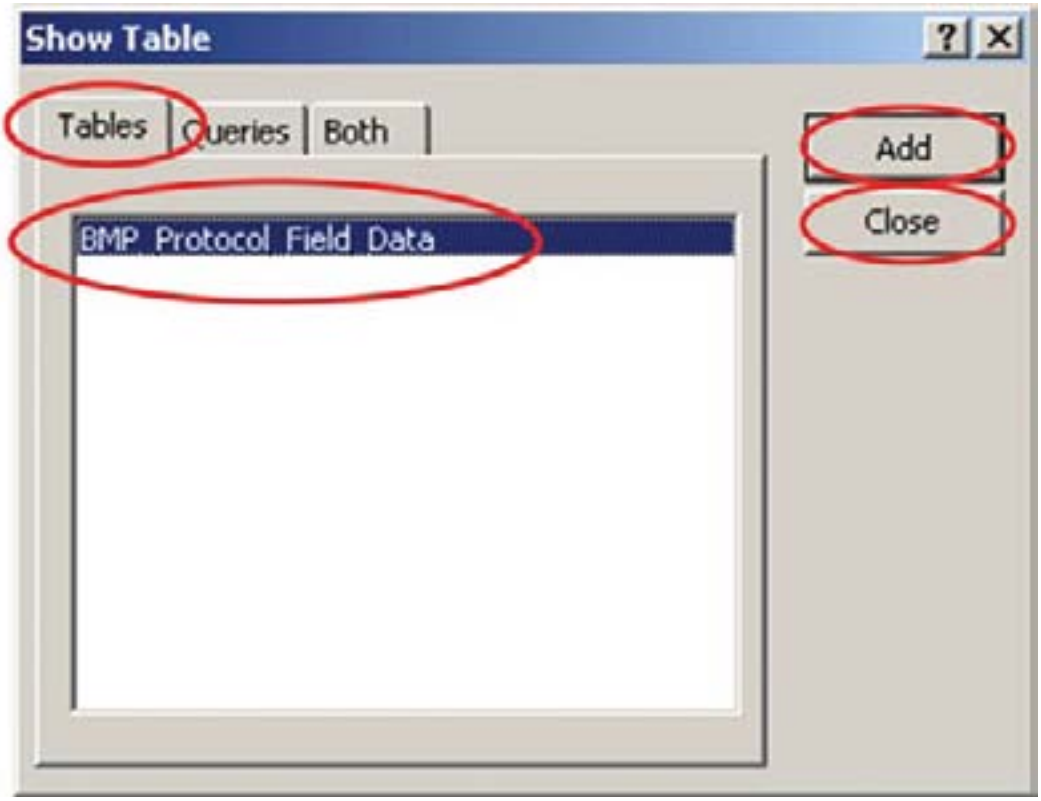


The **Queries** tab lists all of the queries already defined in Access.



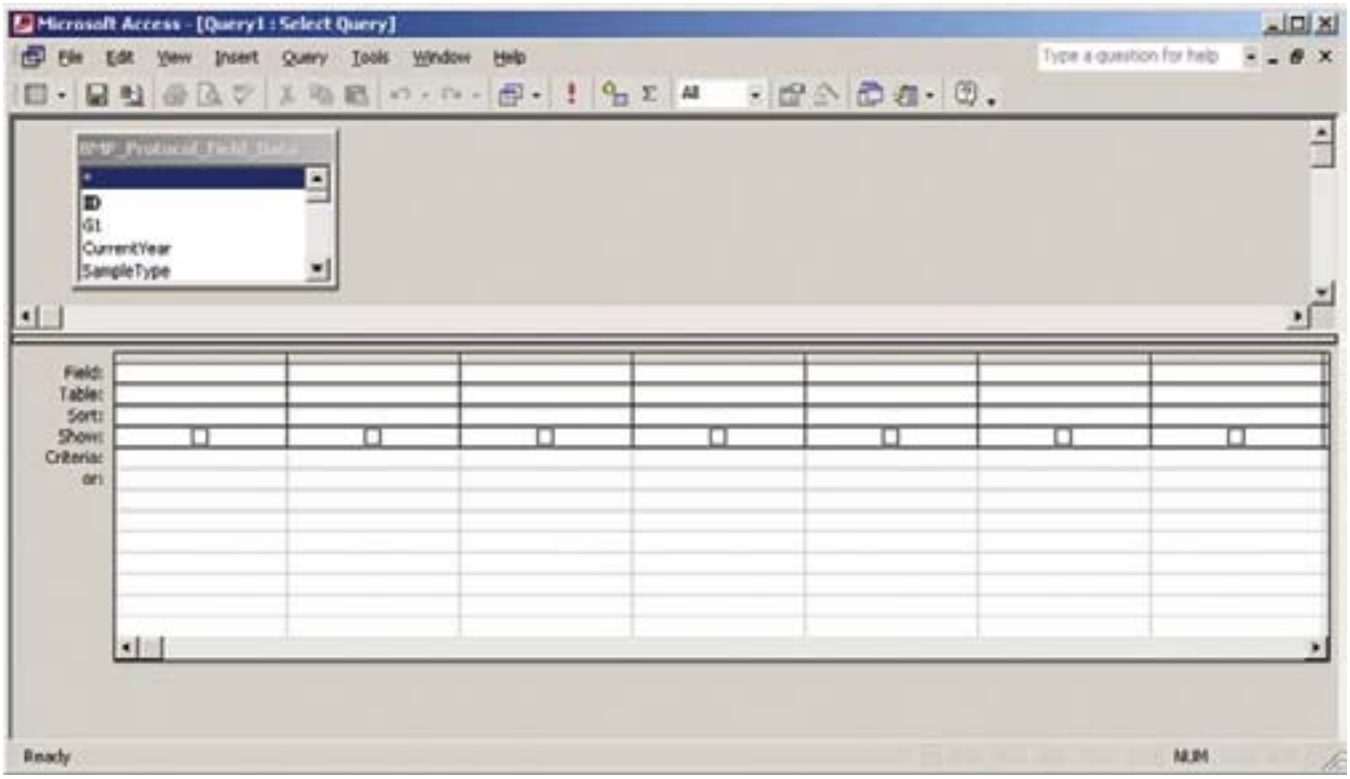
The **Both** tab lists both tables and queries together. The new query may be based on the entire field data table or on an existing query. If the new query is a subset of information in an existing query, the new query may be based on the existing query. For example, if the new query will return all new sample units that have evidence of sediment delivered to a water body, it may be based on the existing query **New Samples**, which returns all new sample units in the database. For the purposes of this exercise, the new query will be based on the table **BMP_Protocol_Field_Data**.

In the **Show Table** window, select the **Tables** tab, highlight the table **BMP_Protocol_Field_Data**, and select **Add**. The table will be added to the **Design View** screen. Select **Close**.



The next screen is divided into two parts:

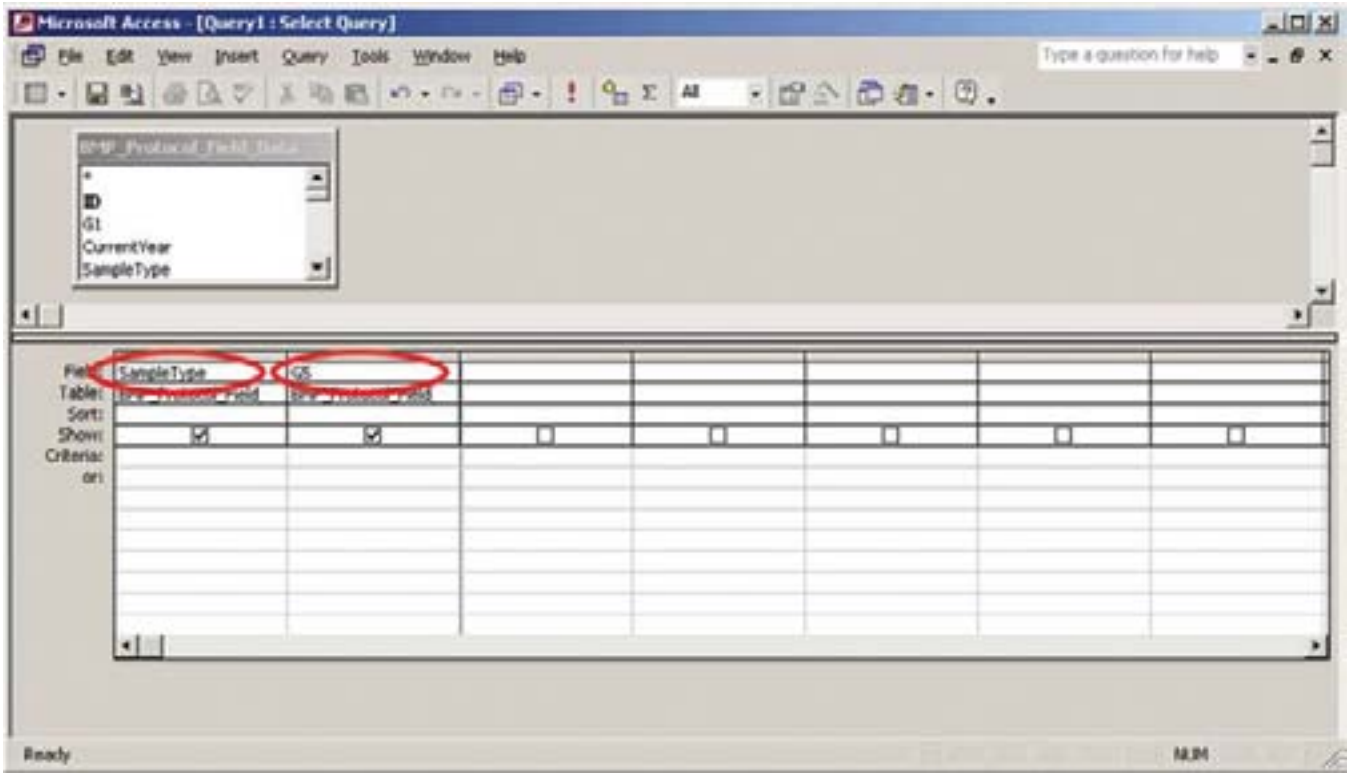
- The top of the screen contains a box with the table you just selected, **BMP_Protocol_Field_Data**. The fields that make up this table, which are also the question numbers from the BMP protocol, are listed in the box. You may increase the size of the box for easier viewing by clicking on its border and dragging it to the desired size.
- The bottom half of the screen is a blank table in which you will define the criteria for your new query.



Your query will be based on the following criteria: new sample units where a logger is responsible for BMP implementation by written contract. The question map in appendix E indicates that the limiting criteria are the questions **Sample Type** (under question **G1**) and **G5** (**BMP Responsibility Assigned**). You need to select these questions from the **BMP_Protocol_Field_Data** table and move them to the empty table at the bottom of the screen. There are three ways to accomplish this (choose one):

- Double-click on each question (**Sample Type** and **G5**) inside the **BMP_Protocol_Field_Data** table on the top the screen,
- Select the question inside the **BMP_Protocol_Field_Data** table on the top of the screen and drag it to an empty column below, or
- Select the empty **Field** cell in the empty table. A drop-down menu will appear with the field names from **BMP_Protocol_Field_Data**. Select the appropriate question (**Sample Type** and **G5**) from the drop-down list.

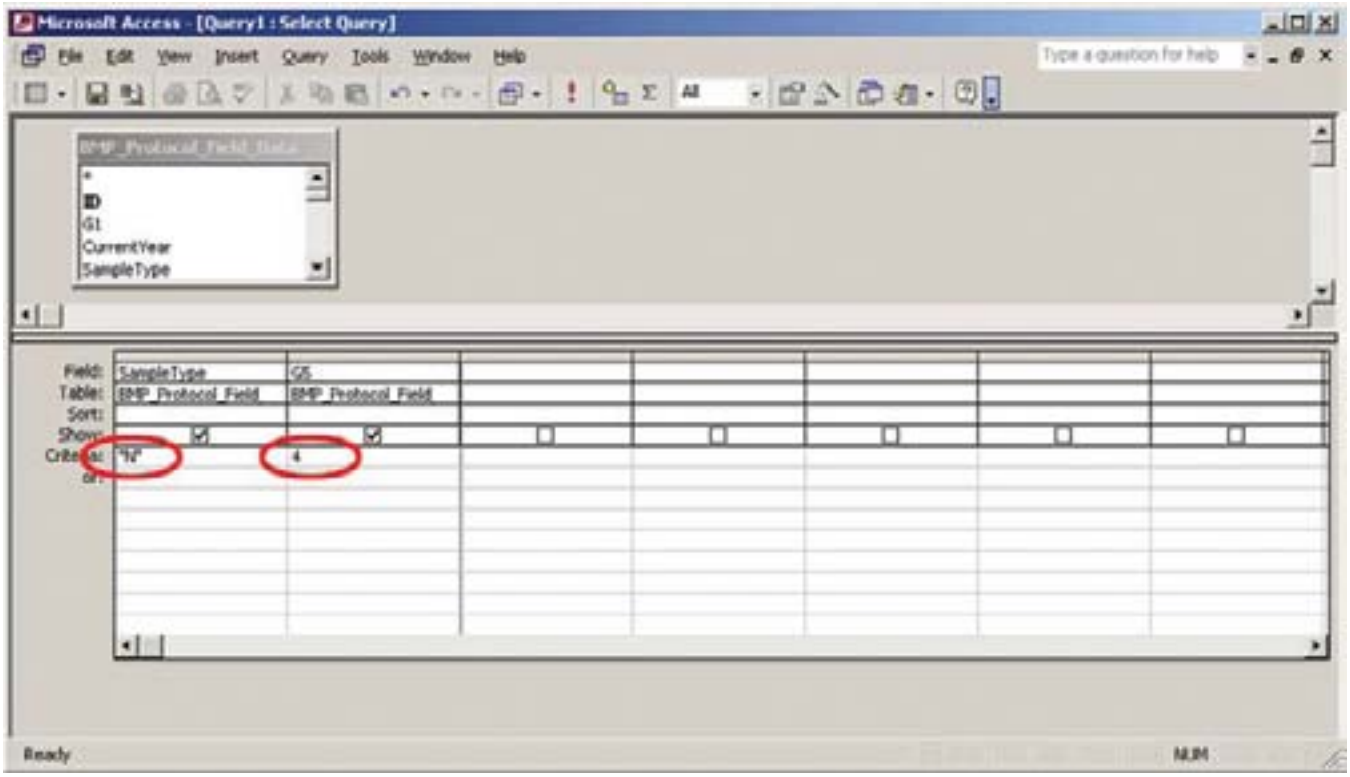
Use whichever method you prefer to move the two questions to the blank table, as shown below.



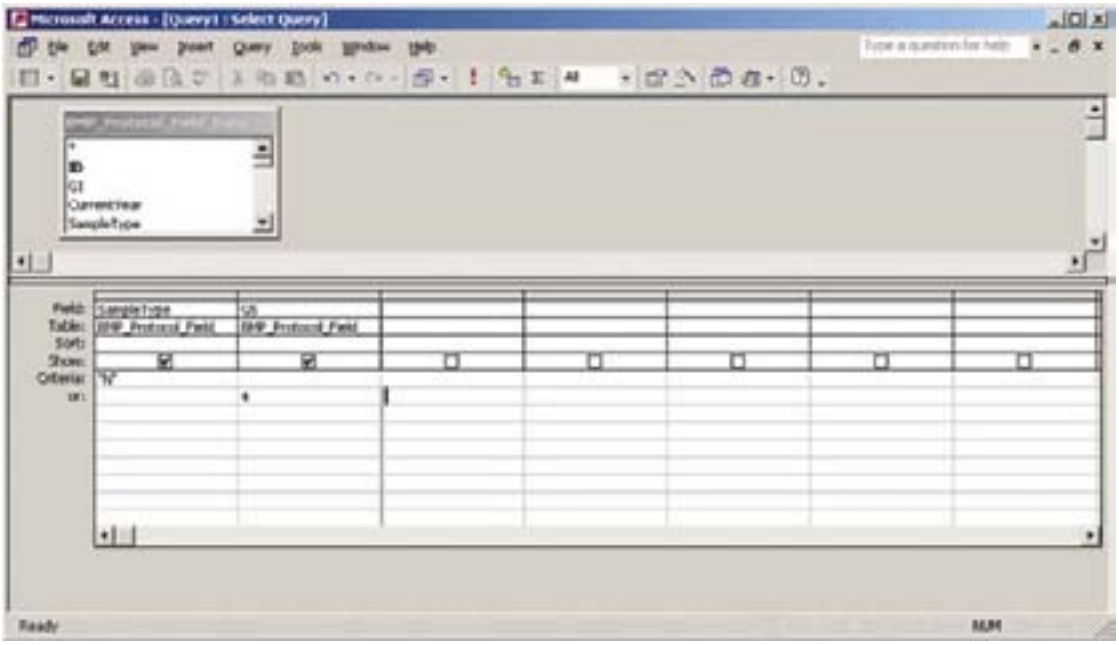
You have defined the fields to search, but not the criteria that will be used to filter those fields. That information will be entered in the **Criteria** row. The criteria must be defined **exactly** the same way they appear in the database. In order to view all new sample units where a logger is responsible for BMP implementation by written contract, the query must return all sample units that meet **both** of the selection criteria.

For **Sample Type**, all entries with the answer **N** (for new sample unit) meet the criteria of being new sample units. Enter **N** in the criteria cell in the column for **Sample Type**. It is important that the criteria **not** include sample units with the answer **Q** (for quality control sample), as these would be duplicates of new sample units already included in the selection criteria.

Question **G5** asks if responsibility for BMP implementation is assigned to a specific individual. Answer choice **4** indicates that responsibility for BMP implementation is assigned to the logger by written contract. Enter **4** in the criteria cell in the column for **G5**. The screen should appear as shown below.

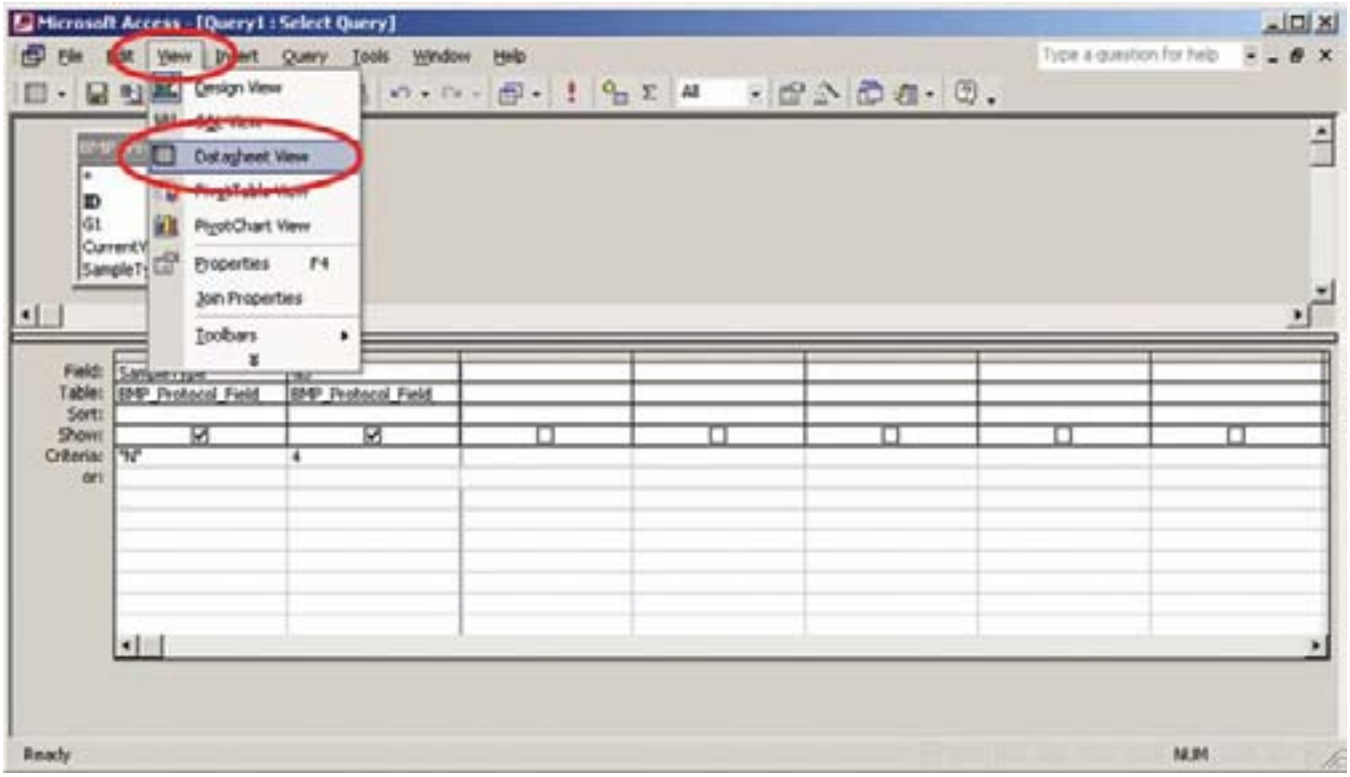


Important: Since the criteria are entered in the same row in the table, the sample units returned will meet **both** conditions. If you are searching on criteria that may meet **either** condition, enter the criteria on different rows. For example, the table below will return sample units that are **either** new **or** have a logging contractor responsible for BMP implementation by written contract as part of the sale agreement. The results of this query are very different.

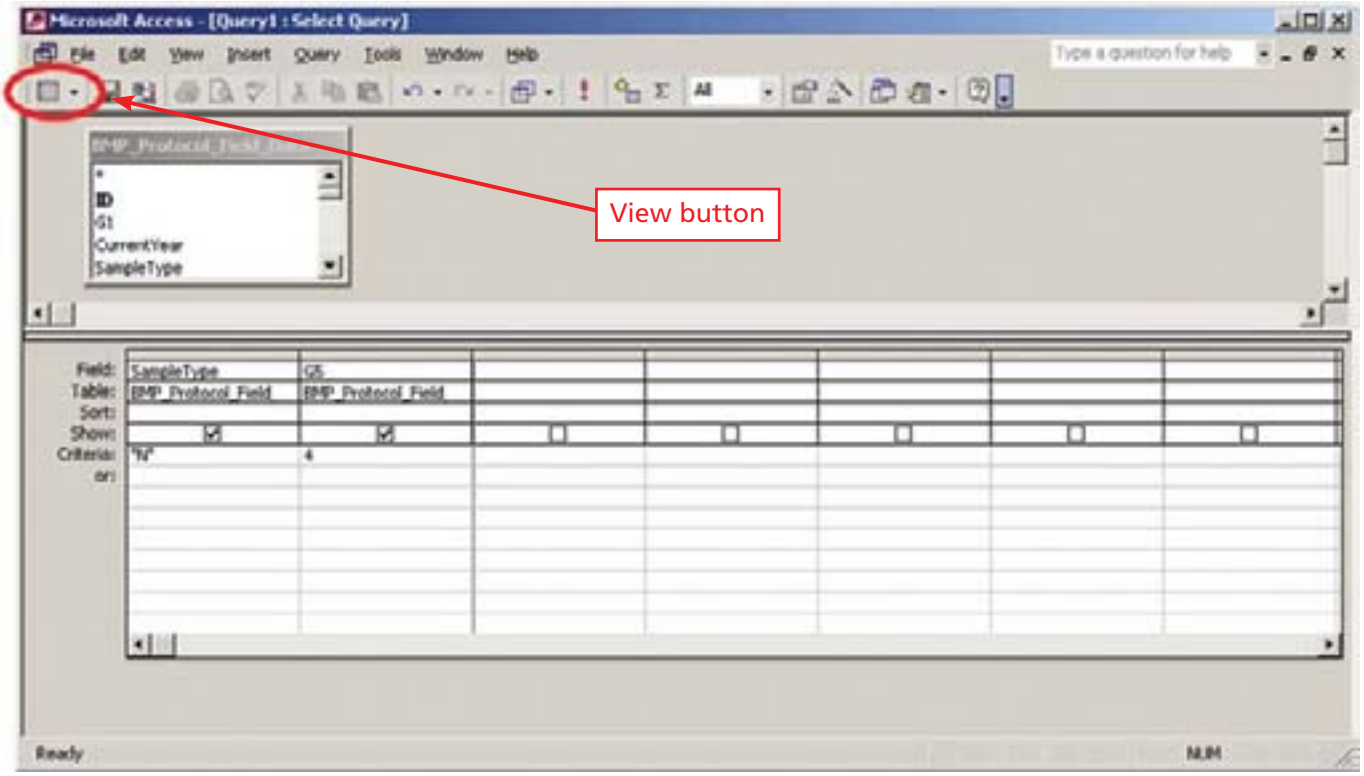


There are many ways to define criteria in Access. In the BMP MIS, the exact response to the question in the BMP protocol may often be entered as the limiting criteria. Some additional examples of ways to limit criteria appear in appendix F. It is also helpful to open the queries provided and switch to the Design View to see how the criteria were defined. It is best to keep Access queries as simple as possible and to use Excel to answer the more sophisticated questions that are based on the query.

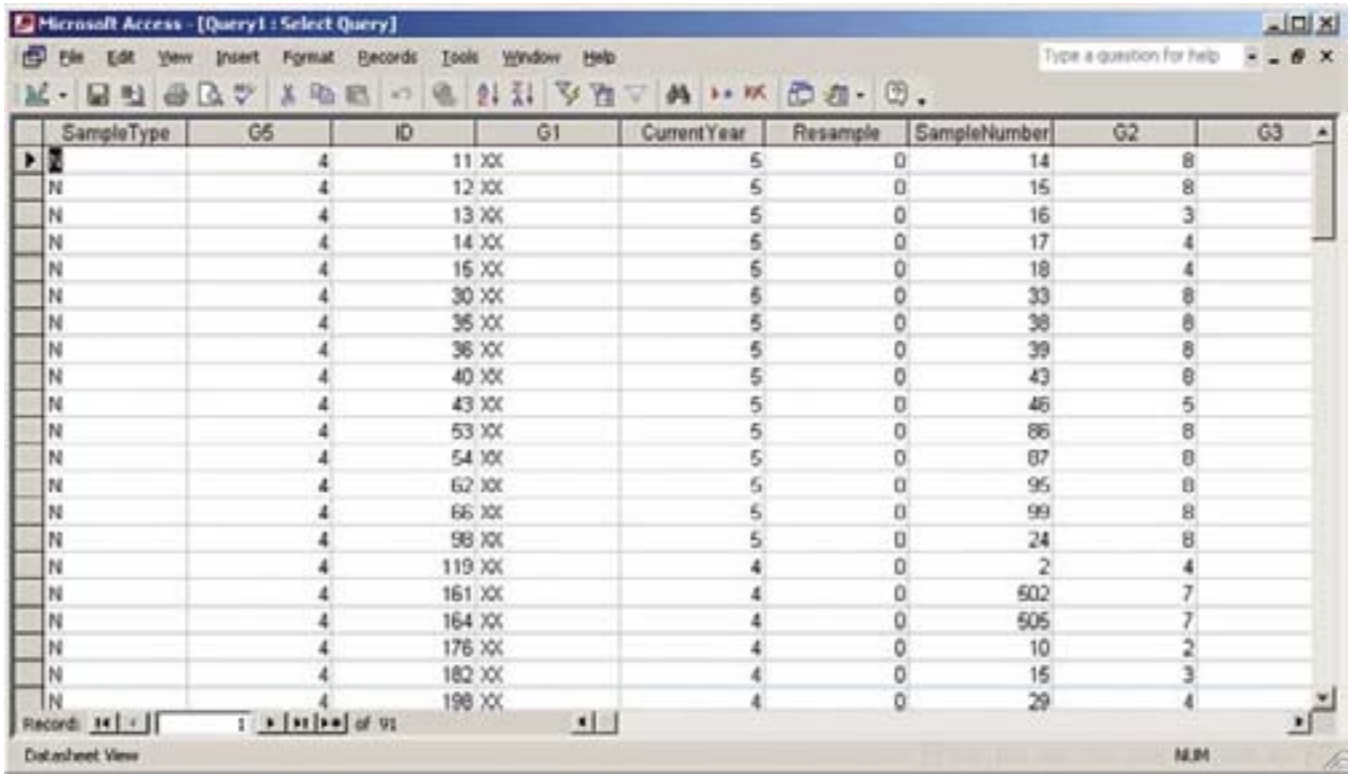
You may view the results of your new query by changing from the **Design View** to the **Datasheet View**. Select **View** on the main toolbar and **Datasheet View** from the drop-down menu.



An alternate method is to select the **View** button on the toolbar to toggle between the **Design View** and the **Datasheet View**.



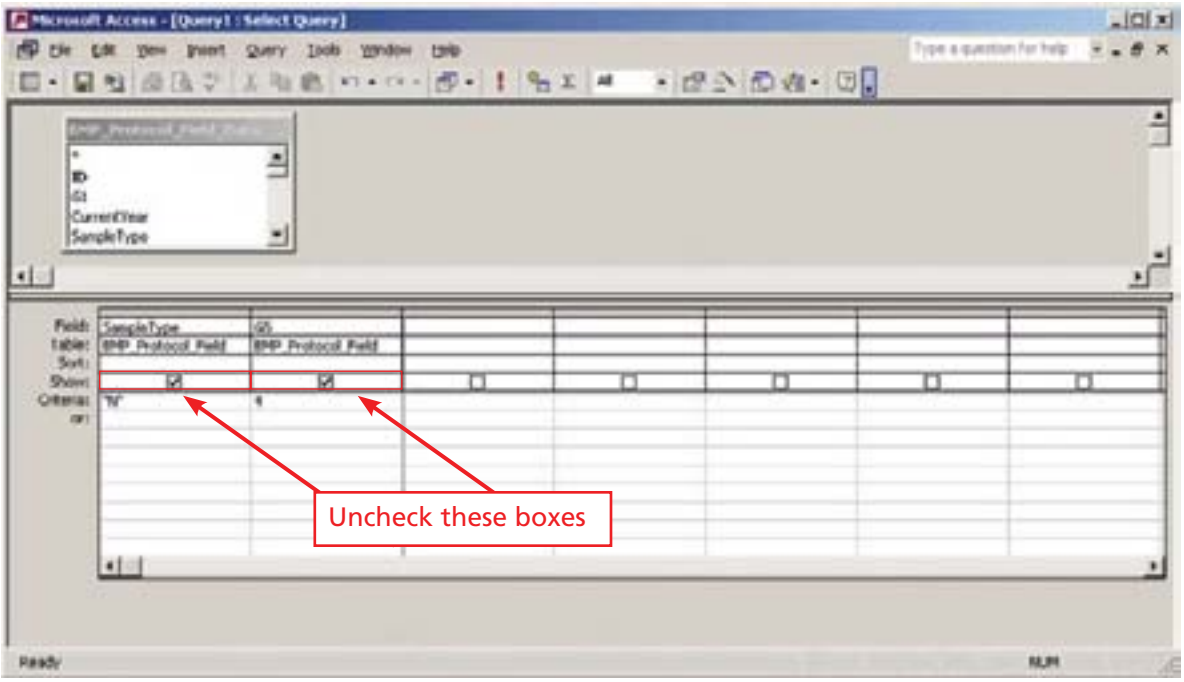
Access will return only sample units that meet the criteria you defined in the **Design View** table. The **Datasheet View** returned by this query appears as follows.



Switch back and forth between the **Datasheet View** and the **Design View** until you are comfortable with changing views. Make adjustments to the criteria in the **Design View**, if necessary, until the query returns the subset of data you need.

Note that in the **Datasheet View**, the fields used to define the criteria for the query (Sample Type and G5) have been moved to the first two columns of the datasheet. While it is useful to have those fields in this position to verify that the new query is sorting on the desired criteria, **you MUST move the columns back into their appropriate position—the order (column position) in which the question appears in the BMP protocol. Keeping the columns in the same order as they appear in the BMP protocol data file is critical to analyzing the data in Excel later in the process**.

To move the fields back to their appropriate column positions once you are satisfied with the new query, return to the **Design View** and uncheck the boxes for each field in the **Show** row in the table.



Return to the **Datasheet View**. The criteria fields no longer appear in the first two columns; they are back in their original column positions in the query.

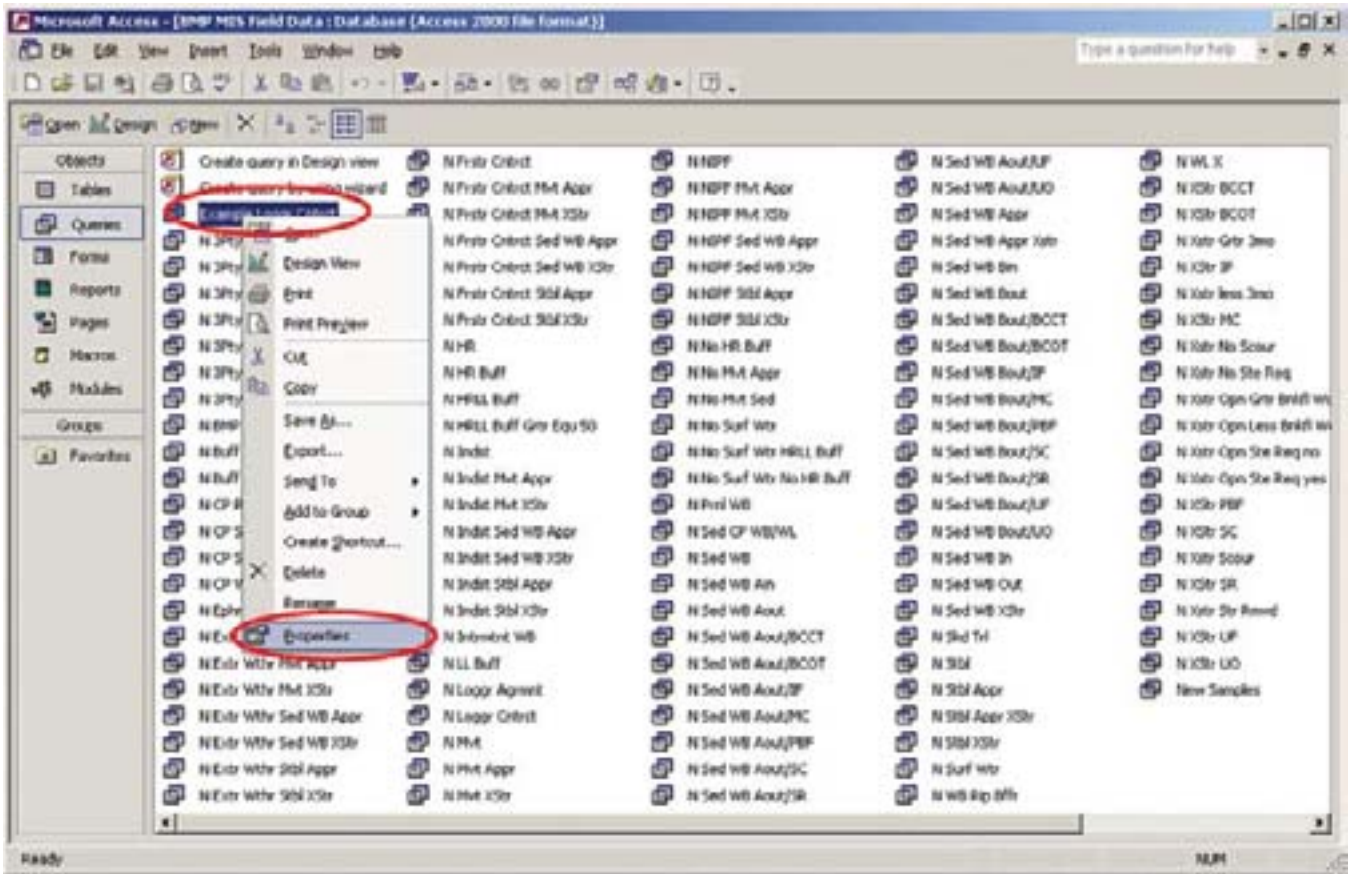
Save the new query by selecting **File** from the main toolbar and **Save As** from the drop-down menu. In the **Save As** window, enter the name of the new query. Whenever possible, use the abbreviations suggested in appendix A. **The query name cannot exceed 31 characters, including spaces.** This query will be saved as **Example Loggr Cntrct** to differentiate it from the existing query (N Loggr Cntrct).

Select **OK** to save the query. Close the query file by selecting **File** from the main toolbar and **Close** from the drop-down menu. You will be returned to the query screen. The new query will be listed in alphabetical order along with the other queries.

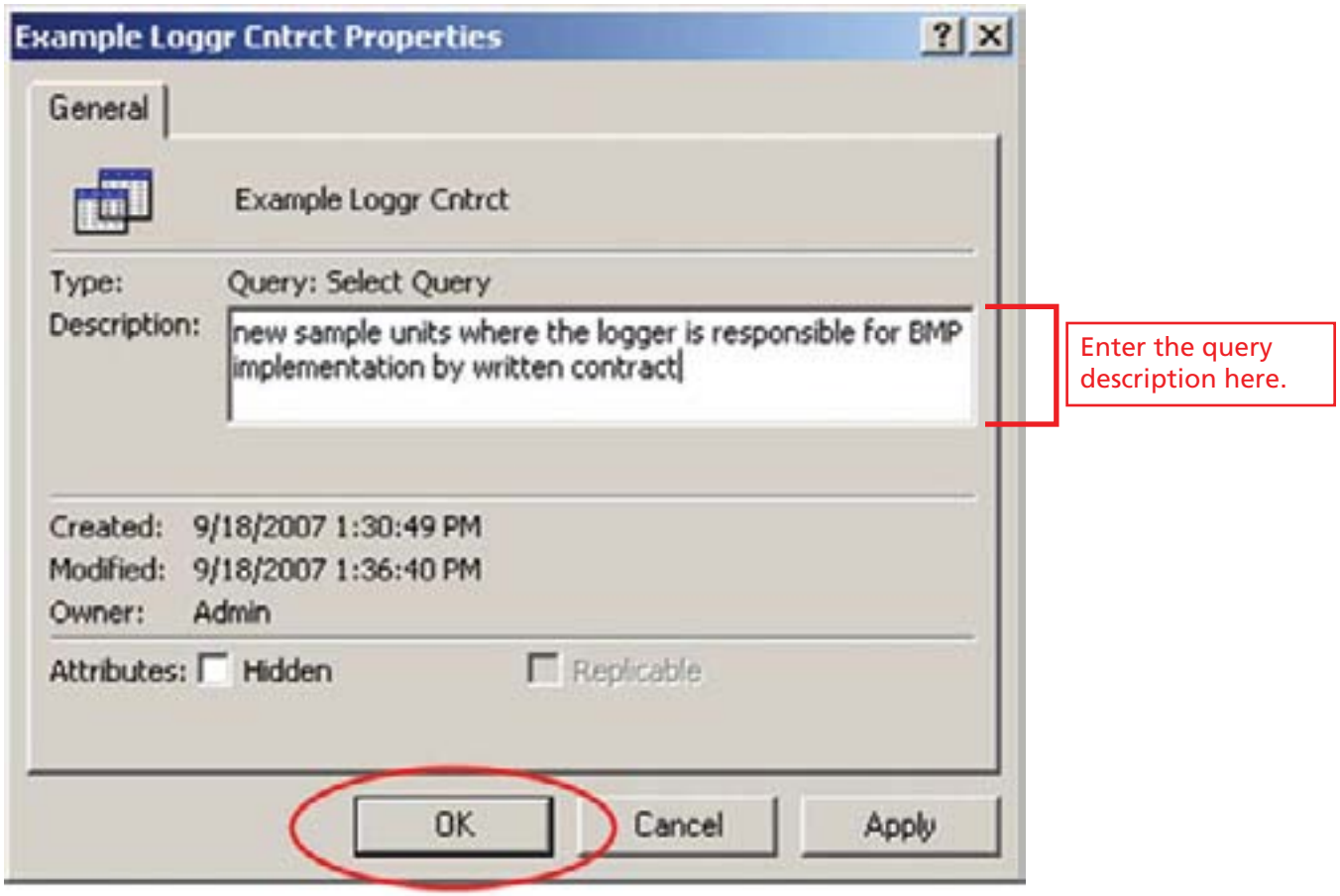
Step 5.5. Define the Contents of the New Query in Properties

Because the BMP MIS contains many Access queries, you should define the contents of the query in the description box in its Properties window. You may refer to the Properties window at any time to recall the query description.

In the **Queries** screen, right-click on the name of the new query and select **Properties** from the drop-down menu.



When the **Properties** window opens, enter a description for the query in the description box. Select **OK** to close the **Properties** window. The description will be saved. You may now export the new query to the Excel analysis file and work further on analyzing the BMP protocol field data (step 5.6).

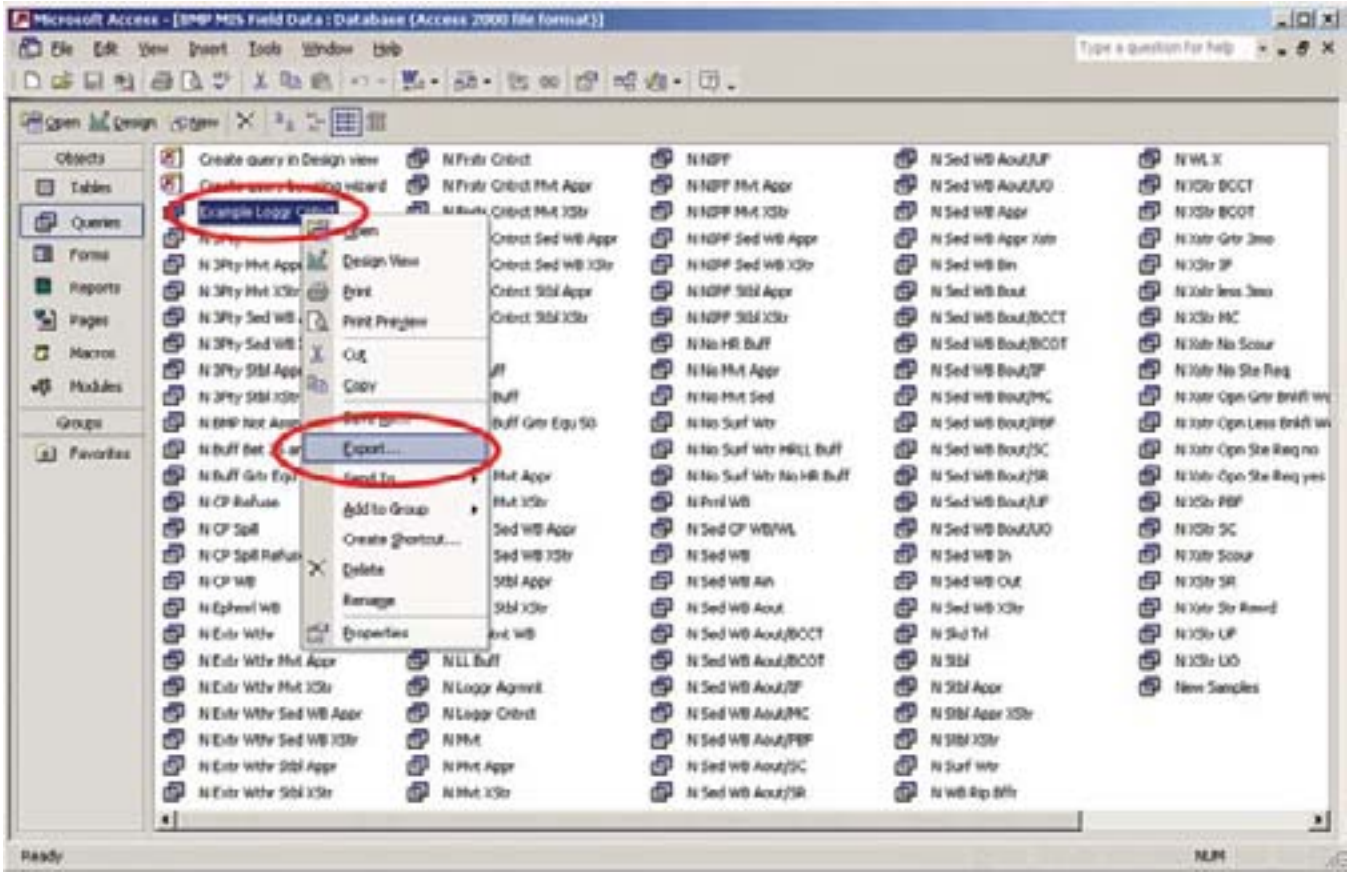


Exporting the Query to Excel

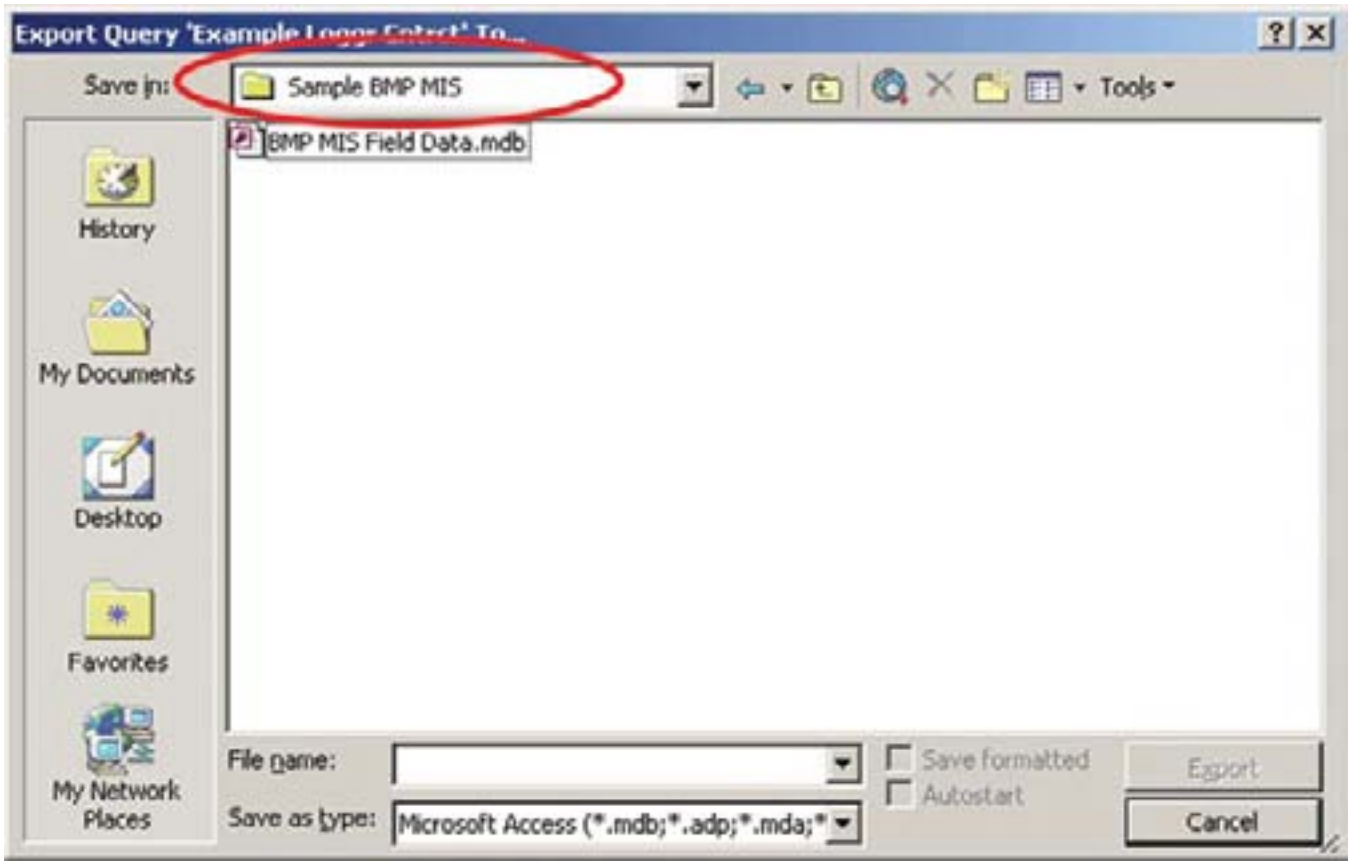
Once the query is defined in Access, you have a subset of field data available to work with. To further analyze the data in the new query, the data must be exported to the Excel analysis file.

Step 5.6. Select the Query to Be Exported

In the **Queries** screen, right-click on the new query **Example Loggr Cntrct** and select **Export** from the drop-down menu.



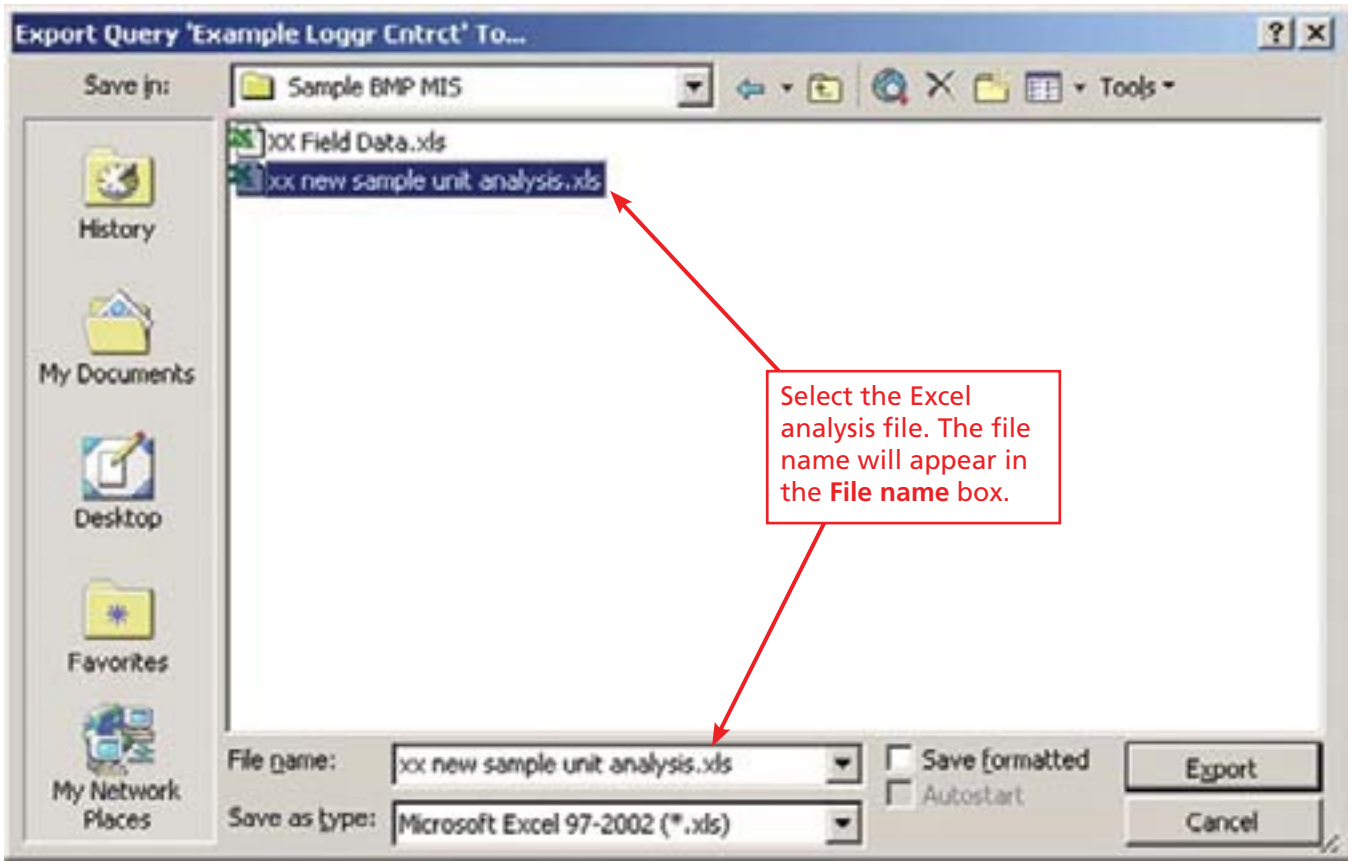
The **Export Query** window will open. Navigate to the **Sample BMP MIS** folder if you are not already there.



Step 5.7. Select the File Where the Query Will Be Exported

Because the query file is currently in Access, the files that appear in the **Export Query** window are Access files. However, you want to export the query to the Excel analysis file. To select that file, first choose **Excel** as the file type by clicking on the drop-down menu next to the **Save as type** box. There may be several versions of Excel listed; choose the latest version available on your computer.

After selecting Excel as the file type, the Excel files in the current folder will appear in the window. There will be two files in the **Sample BMP MIS** folder: one will contain field data and the other will be the BMP protocol data analysis file. Select the Excel analysis file **xx new sample unit analysis.xls**. The file name will appear in the **File name** box at the bottom of the window.



Step 5.8. Export the Query

Select **Export**. The query will be copied into the Excel analysis file.

Note: You may need to change the parameters of the custom query that you designed in Access to correct an error or change the criteria after it has been exported to Excel. If the query name has not changed (because the intention of the query is the same), repeat steps 5.6–5.8 to export the modified query to the Excel analysis file. It is neither necessary nor recommended that the previously exported data be deleted from the worksheet file first.

At step 5.8, after selecting **Export**, the following dialog box will open.

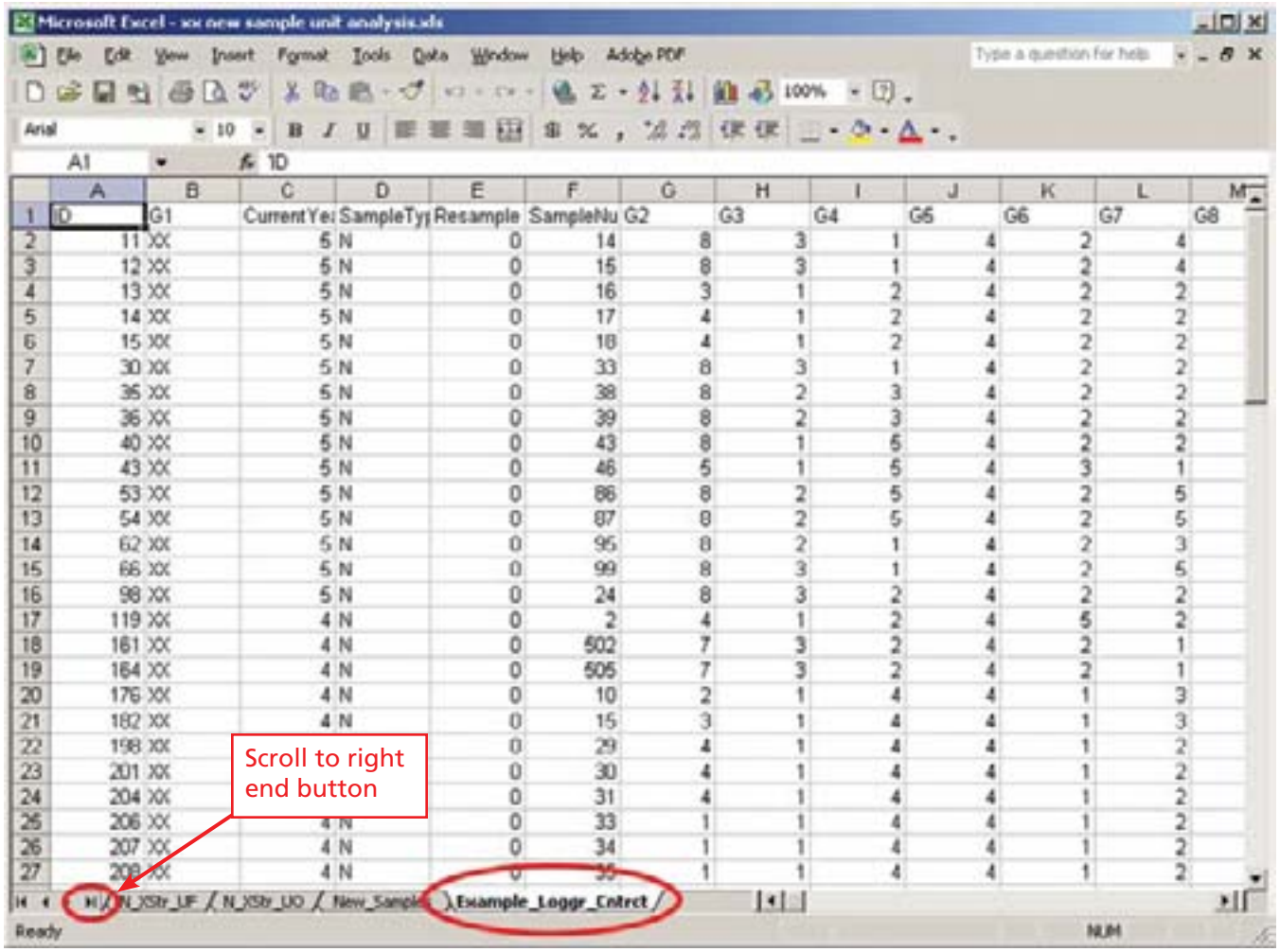
Select **Yes** to continue to export the query. The modified query will replace the old query in the Excel analysis file.

The query has been exported to the Excel analysis file onto its own worksheet titled **Example_Loggr_Cntrct**. Excel adds the underscores to the title to fill in the spaces in the query name. Close the Access file **BMP MIS Field Data.mdb**.

Step 5.9. Verify That the New Query Is in the Excel Analysis File

Open the Excel analysis file **xx new sample unit analysis.xls**. Along the bottom of the screen you will see the named worksheet tabs. The new worksheet **Example_Loggr_Cntrct** will be added as the last worksheet on the right. Scroll to the end of the list of worksheet tabs using the bottom scroll bar or click on the scroll to right end button.

Once the new query is in the Excel file, you may analyze the results of the query using Excel formulas and functions.



Analyzing Queried Data in the Excel Analysis File

The Excel analysis file will appear as shown above when opened. As described in chapter 3, it contains several worksheets, with color-coded tabs at the bottom left of the screen, presented in the following order.

- Blue-tabbed worksheets analyze field data.
- Yellow-tabbed worksheets contain charts and graphs created from information in the field data analysis worksheets.
- White- or gray-tabbed worksheets are copies of the Access queries.

The analysis and charts worksheets in the Excel analysis file are protected so that they cannot be modified easily. This prevents the accidental loss of data links to the standard data summaries. There are, however, unprotected worksheets in the Excel analysis file created specifically for your use in analyzing custom queries: **Analysis Custom Query1**, **Analysis Custom Query2**, **Charts Custom Query1**, and **Charts Custom Query2**. These worksheets are not protected, so you may add to and modify them as you create custom queries. You will create and save your new custom analyses and charts in these worksheets.

Select the worksheet tab **Analysis Custom Query1**, which contains a blank worksheet. You may begin analyzing the data resulting from your new query here. Excel has many functions, operators, and tools to use for this purpose. A list of the most useful general functions and operators used in Excel appears in appendix G.

For example, since the BMP protocol consists of primarily multiple-choice questions, the COUNT and COUNTIF functions are useful in counting the number of times a particular answer was chosen for a question.

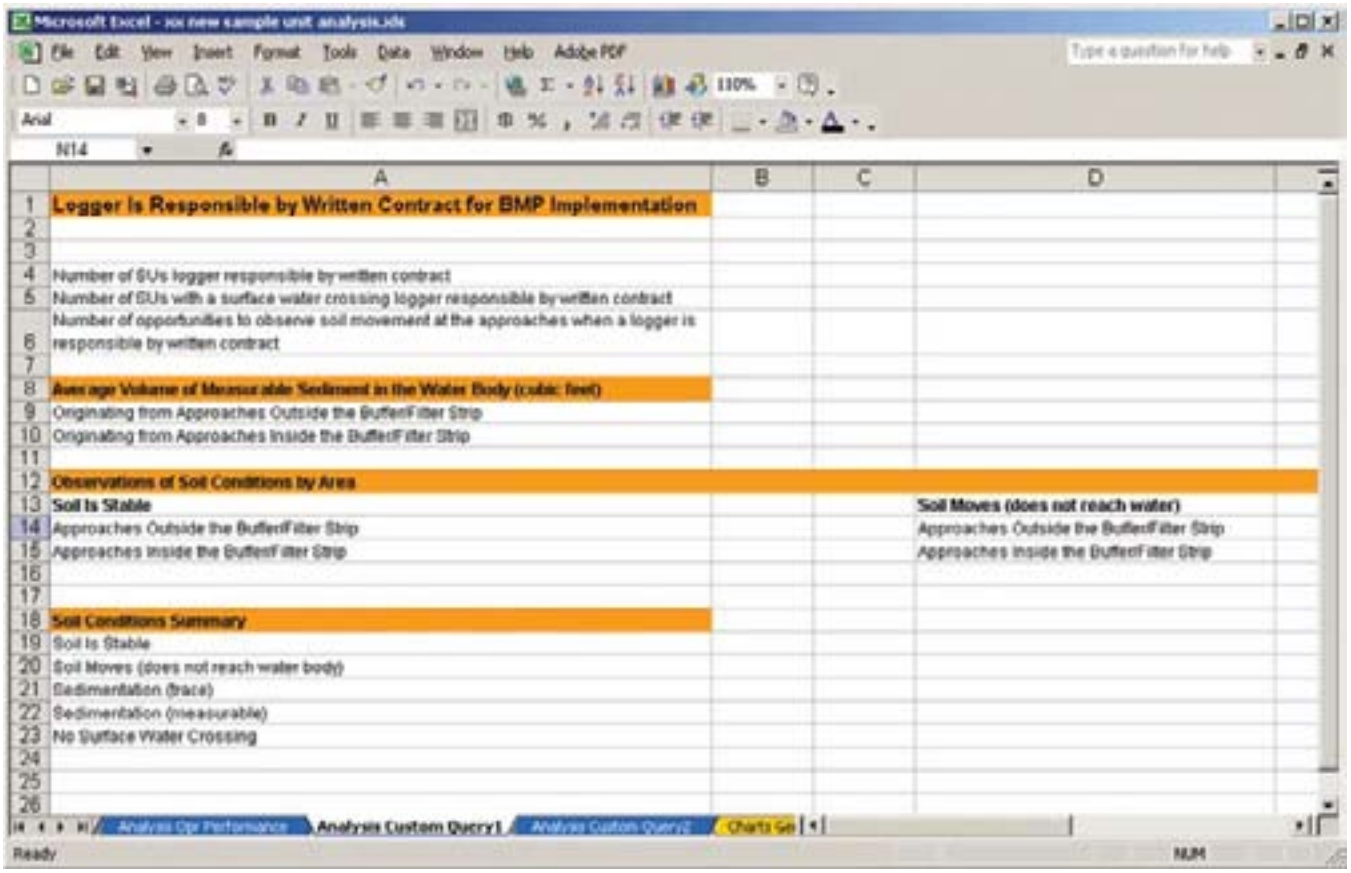
For this example, you will use the new query **Example_Loggr_Cntrct** to find out the following information regarding the approaches to surface water crossings:

- The number of new sample units where a logger is responsible for BMP implementation by written contract
- The number of these new sample units with a surface water crossing
- The number of opportunities to observe soil conditions at the approaches to surface water crossings on these sample units
- The number of observations for each of the following soil conditions: stable soil, soil movement, and sedimentation originating from the approaches to a surface water crossing on these new sample units
- The average volume of measurable sediment in the water body

Finally, you will create a chart illustrating the observations of each of these soil conditions on new sample units at the approaches to surface water crossings, and store the chart in the **Charts Custom Query1** worksheet.

Step 5.10. Set Up the Worksheet

Before beginning to analyze the data and write formulas, set up the **Analysis Custom Query 1** worksheet. The example below illustrates a worksheet that has been set up to present the information you will retrieve from the data. It includes a title to the section, as well as labels for the information you will isolate from the data. Other tabs in the Excel analysis file provide examples of completed worksheets. Set up your worksheet by inserting labels in cells and deciding which cells will be used to hold the formulas that will show the results of the calculations.



Setting up the worksheet first keeps the information organized and will make it easy to locate information when you are linking it to a new data summary.

Step 5.11. Perform the Calculations

The results that will appear in your custom worksheet are calculated from the field data using Excel functions and operators.

5.11a. Count the Number of Sample Units in the Query

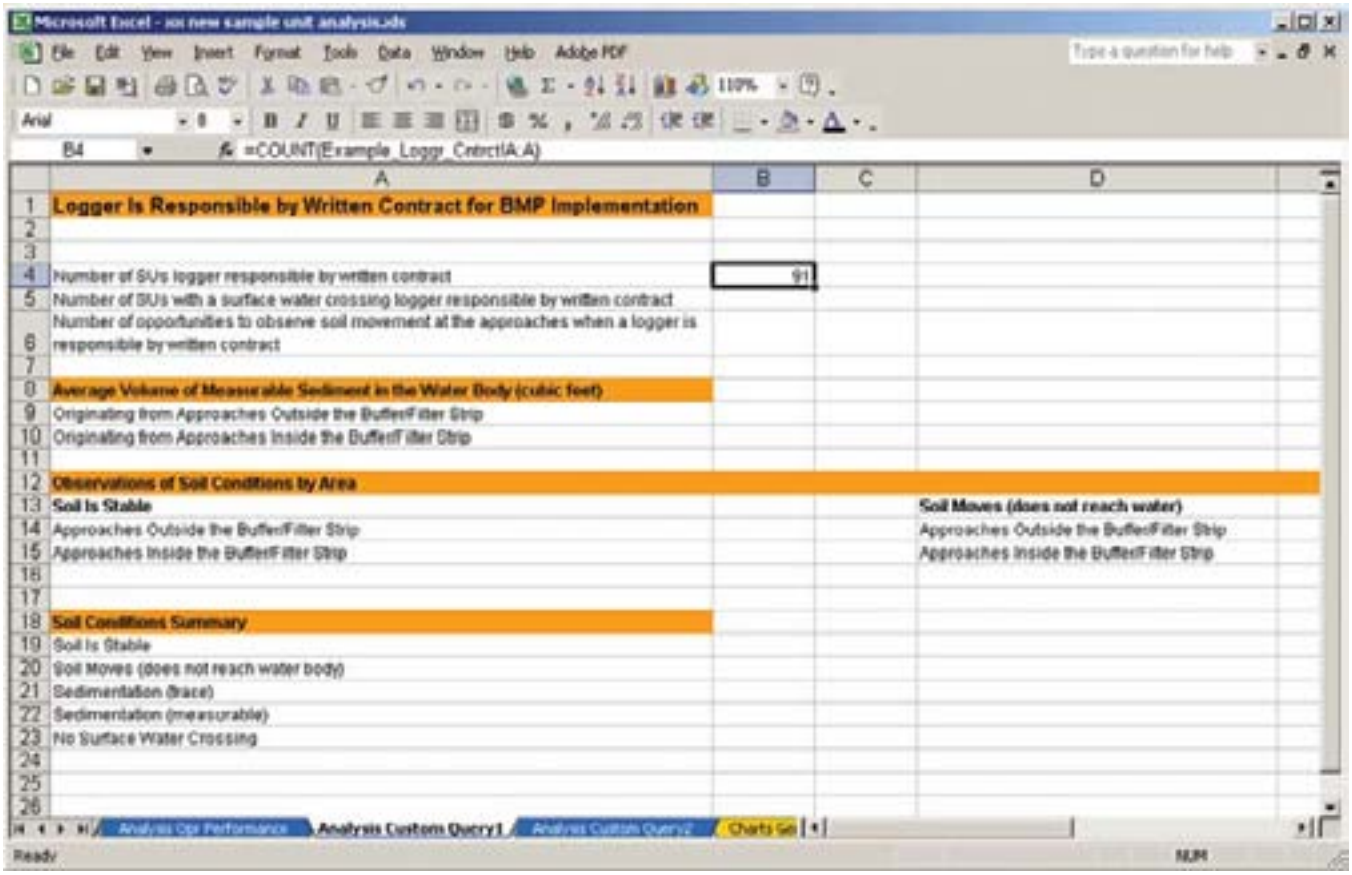
First, you will count the number of new sample units where the logger is responsible for BMP implementation by written contract. Since the query **Example_Loggr_Cntrct** has isolated all of the sample units that meet the criteria, you simply need to count the number of sample units in this query. The data description is entered in cell A4 in this example. Enter the following formula into cell B4, using the COUNT function:

=COUNT(Example_Loggr_Cntrct!A:A)

The formula directs Excel to count each cell in column A in the worksheet **Example_Loggr_Cntrct**.

The formula can be broken down into its individual parts: the equals sign tells Excel that a formula or calculation will follow; COUNT is the function, which counts all occurrences of the criteria specified; the information in parentheses is the criteria. The location of the data (i.e., the worksheet where the data are located) is followed by an exclamation point. **You will always need to enter the name of the worksheet where the data are located.** Finally, A:A directs Excel to count each row in the first column of the worksheet, column A. Each row corresponds to one sample unit that meets the criteria in the query **Example_Loggr_Cntrct**.

Press **Enter** after entering the formula into the cell. In this example, there are 91 sample units that meet the criteria.



5.11b. Calculate the Number of Sample Units With a Surface Water Crossing

Next, you will calculate the number of these new sample units with a surface water crossing. Refer to the question map in appendix E. Question X12 asks for the stream order or water body type at the crossing site. The question map indicates that the answers to question X12 are found in column Q in the query.

Question X12 reads as follows:

X12 Enter the answer code for the stream order or water body type at the crossing site. Although not ordinarily considered, if States wish to include ephemeral streams in the protocol, they will be coded zero-order (answer code 8).

1. First-order stream
2. Second-order stream
3. Third-order stream
4. Fourth-order stream or larger
5. Drainage ditch systems degrading and/or draining to natural surface waters
6. Pond or lake of Federal or State significance
7. Wetland or similar area of Federal or State significance
8. Zero-order (ephemeral stream)
9. No stream crossing in this sample unit (go to question HB137)
10. Stream crossing avoided by planning (go to question HB137)

To find out how many of the new sample units have a surface water crossing, you must find out how many responses to X12 in the query **Example_Loggr_Cntrct** contain an answer code **less than 9**. Total the number of responses that are less than 9 in column Q using the following formula:

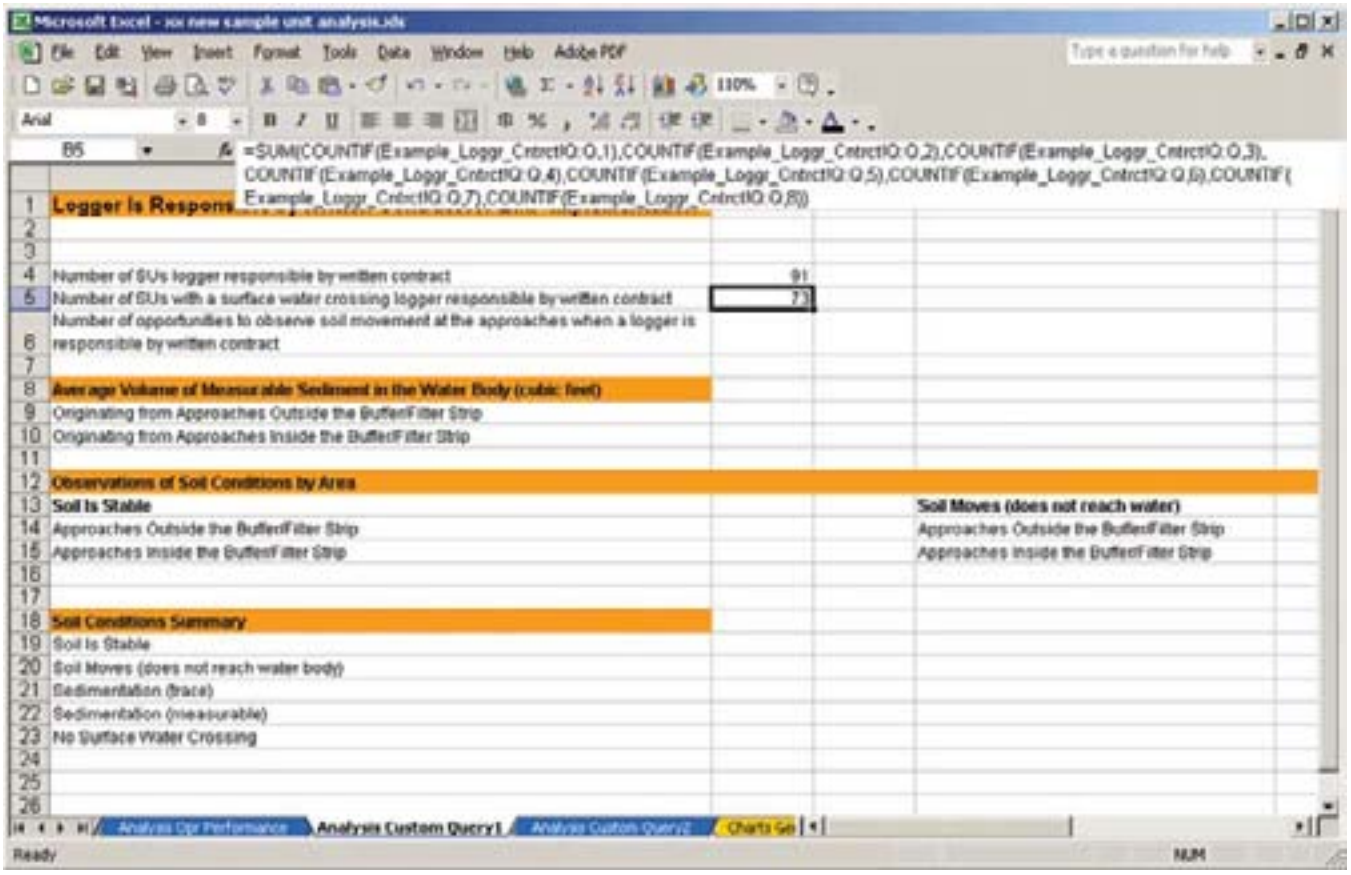
```
=SUM(COUNTIF(Example_Loggr_Cntrct!Q:Q,1),COUNTIF(Example_Loggr_Cntrct!Q:Q,2),
COUNTIF(Example_Loggr_Cntrct!Q:Q,3),COUNTIF(Example_Loggr_Cntrct!Q:Q,4),
COUNTIF(Example_Loggr_Cntrct!Q:Q,5),COUNTIF(Example_Loggr_Cntrct!Q:Q,6),
COUNTIF(Example_Loggr_Cntrct!Q:Q,7),COUNTIF(Example_Loggr_Cntrct!Q:Q,8))
```

Order of Operations Refresher

According to the rules of mathematics, mathematical syntax and operators must be placed in the following order:

1. Parentheses
2. Exponents
3. Multiplication and division
4. Addition and subtraction

This long formula simply directs Excel to sum the results of each of the COUNTIF statements in the parentheses. Excel follows the order of operations when calculating formulas and will calculate the results of each statement within parentheses before finally summing all of the answers together. The COUNTIF function is used because it counts the number of times a number or text meets a **specific condition**. In the above formula, it counts the number of times answer choices 1 through 8 occur in the **Example_Loggr_Cntrct** query. By summing the results of each COUNTIF statement, you have the answer to our question. There are 73 new sample units that meet these criteria.



Important: Zeros are automatically inserted in the spreadsheet in cells where protocol questions have not been answered. Use of the following formula, which counts all responses in column Q that are less than 9, will include any zeros for unanswered questions, producing in an **incorrect result**.

=COUNTIF(Example_Loggr_Cntrct!Q:Q,"<9")

5.11c. Calculate the Number of Opportunities to Observe Soil Conditions

Next, you will calculate the number of opportunities to observe soil conditions on the new sample units with a surface water crossing. This number will be important when calculating proportions of observations of soil conditions and causes of sedimentation in this subset of data. The question map in appendix E identifies the questions that assess soil movement or sedimentation for focus areas of the BMP protocol. Since this custom query is intended to deal only with sedimentation from **approaches to surface water crossings**, it can be determined by reading only those questions that address that issue.

Questions X22, X47, X91, and X116 address soil movement at surface water crossings:

X22 Approach Area A—Outside the Buffer/Filter Strip

X47 Approach Area A—Inside the Buffer/Filter Strip

X91 Approach Area B—Outside the Buffer/Filter Strip

X116 Approach Area B—Inside the Buffer/Filter Strip

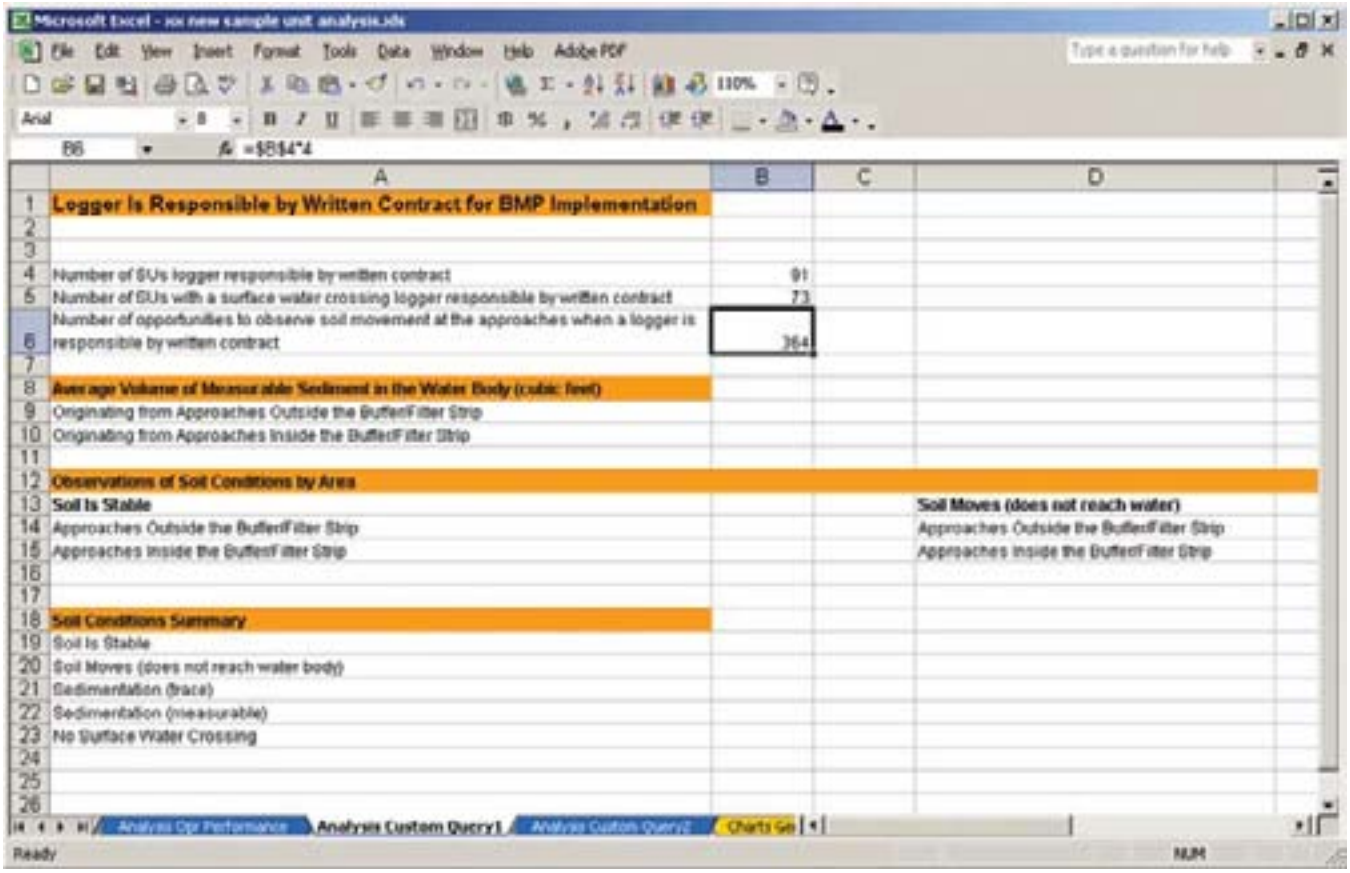
Therefore, there are only four opportunities to observe soil conditions at the **approaches to surface water crossings** in the BMP protocol.

To calculate the total number of opportunities to observe soil conditions at the approaches to the surface water crossing, multiply the total number of new sample units in the **Example_Loggr_Cntrct** query by 4 using the formula below.

=$B$4*4

Enter this formula in cell E4, immediately to the right of the description you entered in cell D4.

This formula refers to cell B4, which contains the number of sample units in the query **Example_Loggr_Cntrct**. The $ symbol is an absolute reference. When preceding a column or row reference with a $ symbol, you are instructing Excel to always look for the contents of that column or row. In this case, Excel will always multiply the contents of column B4 by 4 to calculate the total number of opportunities to observe soil conditions at the approaches to the surface water crossing. There are 364 opportunities.



5.11d. Calculate the Number of Observations of Each Soil Condition

Questions X22, X47, X91, and X116 are also used to calculate the number of observations of stable soil, soil movement, soil sedimentation (trace and measurable), and the number of sample units without a surface water crossing.

As indicated in your worksheet, you will first determine the number of samples in which soil is stable in Approach Areas A and B–**Outside** the Buffer/Filter Strip (questions X22 and X91). Answer code 5 indicates that soil is stabilized:

X22 Enter the answer code that best describes any soil movement in Approach Area A–Outside the Buffer/Filter Strip.

1. Trace amounts such as films or suspended sediments deposited in the water body or within the bankfull width of the channel (go to question X23)
2. Measurable amounts of sediment deposited in the water body or within the bankfull width of the channel (go to question X23)
3. Soil deposited inside the buffer/filter strip but did not reach the water body or within the bankfull width of the channel (go to question X31)
4. Soil moved in Approach Area A–Outside the Buffer/Filter Strip but did not reach the buffer/filter strip (go to question X37)
5. Soil is stabilized for Approach Area A–Outside the Buffer/Filter Strip (go to question X43)

X91 Enter the answer code that best describes any soil movement on Approach Area B–Outside the Buffer/Filter Strip

1. Trace amounts such as films or suspended sediments deposited in the water body or within the bankfull width of the channel (go to question X92)
2. Measurable amounts of sediment deposited in the water body or within the bankfull width of the channel (go to question X92)
3. Soil deposited inside the buffer/filter strip but did not reach the water body or within the bankfull width of the channel (go to question X100)
4. Soil moved in Approach Area B–Outside the Buffer/Filter Strip but did not reach the buffer/filter strip (go to question X106)
5. Soil is stabilized for Approach Area B–Outside the Buffer/Filter Strip (go to question X112)
6. Soil movement occurs in Approach Area B–Outside the Buffer/Filter Strip but has been recorded elsewhere in the protocol (go to question X113)

Therefore, you are interested in knowing how many times answer code 5 was recorded for questions X22 and X91 in the query **Example_Loggr_Cntrct**. You must add together the number of times this answer choice occurred for each question to get the total number of times stable soil was observed on Approach Areas A and B–Outside the Buffer/Filter Strip. According to the question map in appendix E, the answers to questions X22 and X91 appear in columns AA and CT in the query worksheet, respectively.

The following formula counts the number of times answer code 5 was chosen for each question and adds them together:

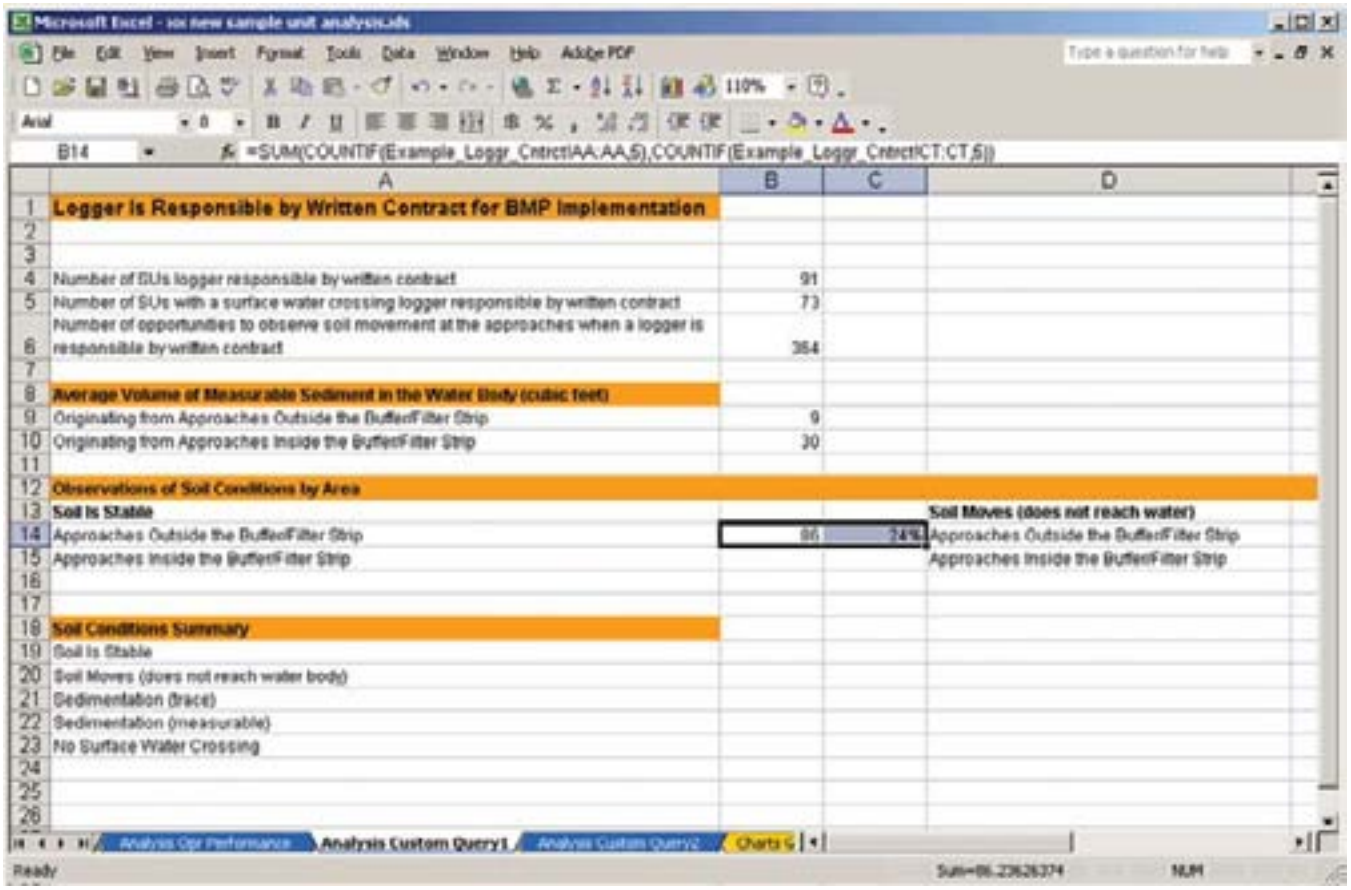
=SUM(COUNTIF(Example_Loggr_Cntrct!AA:AA,5), COUNTIF(Example_Loggr_Cntrct!CT:CT,5))

Enter this formula in cell B14, to the right of the cell containing the description.

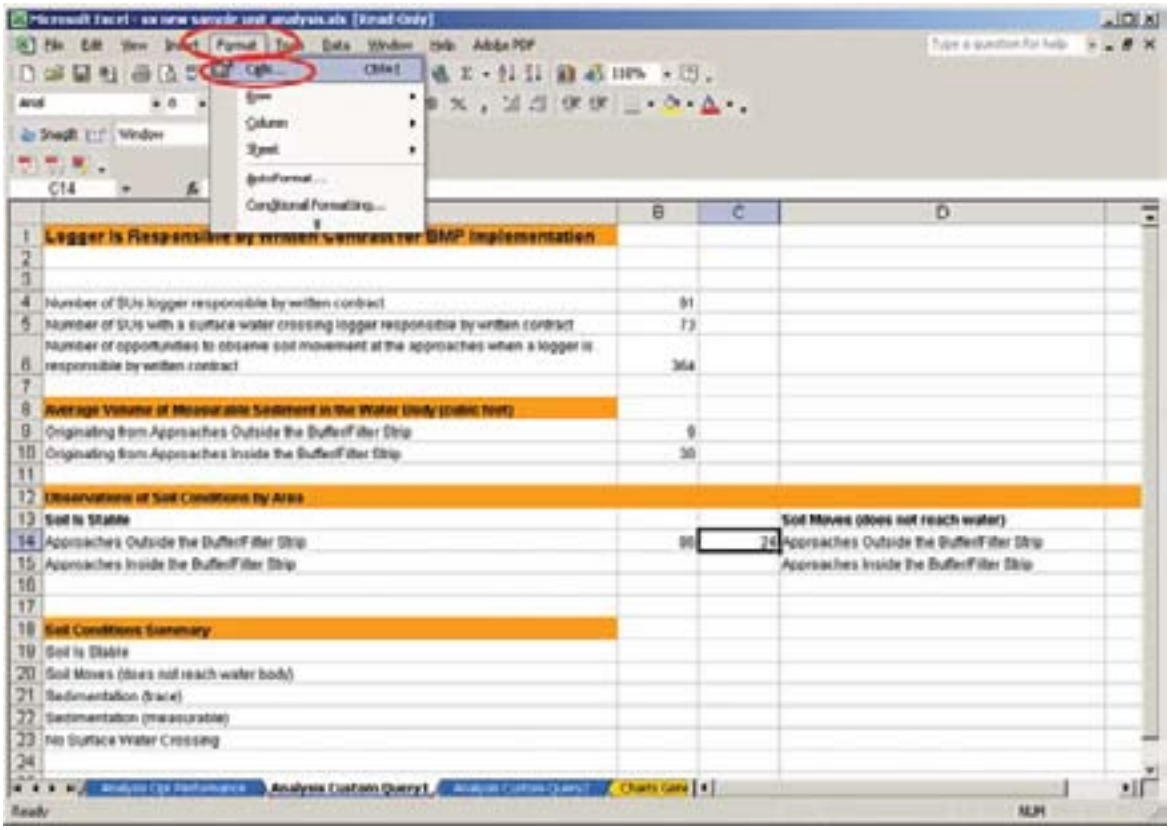
To calculate the **proportion** of the total number of observations that stable soil conditions were observed at Approach Areas A and B–Outside the Buffer/Filter Strip, simply divide the results of the formula by the total number of observations possible, using the formula below.

=B14/$B$6

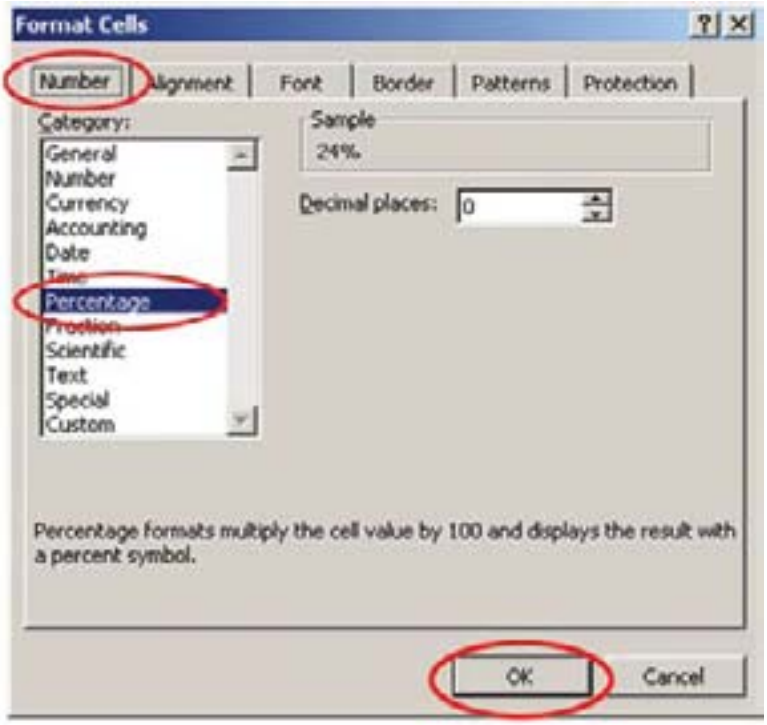
B14 is the cell where the number of observations of the condition is calculated and B6 is the cell where the total number of possible observations is calculated. Enter this formula in cell C14.



Note: Cells that calculate proportions must be formatted as a percentage. Click on the cell to highlight it, then select **Format** on the main toolbar and **Cells** from the drop-down menu.



The **Format Cells** window will open. On the **Number** tab, select **Percentage** in the **Category** window. Select **zero (0)** as the number of decimal places. Select **OK** to apply the formatting to the selected cell.



The same process should be followed for each of the other soil conditions. The formulas to calculate the number of observations of each condition and its proportion of the total possible number of observations appear in table 5.1.

Table 5.1. Formulas for calculating number of observations of each condition and its proportion of the total.

Condition	Number of occurrences	Proportion of total possible occurrences
No surface water crossing*	=$B$6-PRODUCT(B5,4)	=N14/$B$6
Approaches inside the buffer/filter strip		
Soil is stable	=SUM(COUNTIF(Example_Loggr_Cntrct!AZ:AZ,4), COUNTIF(Example_Loggr_Cntrct!DS:DS,4))	=B15/$B$6
Soil moves	=SUM(COUNTIF(Example_Loggr_Cntrct!AZ:AZ,3), COUNTIF(Example_Loggr_Cntrct!AZ:AZ,5), COUNTIF(Example_Loggr_Cntrct!DS:DS,3), COUNTIF(Example_Loggr_Cntrct!DS:DS,5))	=E15/$B$6
Sedimentation (trace)	=SUM(COUNTIF(Example_Loggr_Cntrct!AZ:AZ,1), COUNTIF(Example_Loggr_Cntrct!DS:DS,1))	=H15/$B$6
Sedimentation (measurable)	=SUM(COUNTIF(Example_Loggr_Cntrct!AZ:AZ,2), COUNTIF(Example_Loggr_Cntrct!DS:DS,2))	=K15/$B$6
Approaches outside the buffer/filter strip		
Soil is stable	=SUM(COUNTIF(Example_Loggr_Cntrct!AA:AA,5), COUNTIF(Example_Loggr_Cntrct!CT:CT,5))	=B14/$B$6
Soil moves	=SUM(COUNTIF(Example_Loggr_Cntrct!AA:AA,3), COUNTIF(Example_Loggr_Cntrct!AA:AA,4), COUNTIF(Example_Loggr_Cntrct!AA:AA,6), COUNTIF(Example_Loggr_Cntrct!CT:CT,3), COUNTIF(Example_Loggr_Cntrct!CT:CT,4), COUNTIF(Example_Loggr_Cntrct!CT:CT,6))	=E14/$B$6
Sedimentation (trace)	=SUM(COUNTIF(Example_Loggr_Cntrct!AA:AA,1), COUNTIF(Example_Loggr_Cntrct!CT:CT,1))	=H14/$B$6
Sedimentation (measurable)	=SUM(COUNTIF(Example_Loggr_Cntrct!AA:AA,2), COUNTIF(Example_Loggr_Cntrct!CT:CT,2))	=K14/$B$6

*The category "no surface water crossing" is required to account for opportunities for observations that will **not be observed** on sample units without a water crossing so that proportions equal 100 percent. It is a null value. See chapter 4 for a description of null values.

5.11e. Calculate the Average Volume of Measurable Sediment in the Water Body

The average volume of measurable sediment in the water body originating from outside and inside the buffer/filter strip can be calculated using an array function. An **array function** works on a range of cells (such as the range between HD2 and HE2000 expressed as HD2:HE2000) and is entered into an Excel worksheet with a **Ctrl + Shift + Enter** keystroke combination. Brackets {} are automatically placed around the formula after it is entered using this keystroke combination.

According to the question map in appendix E, evident sediment volumes originating from the approach areas outside the buffer/filter strip are recorded in questions X26 (column AE in the query) and X95 (column CX). Sediment volumes originating from the approach areas inside the buffer/filter strip are recorded in questions X51 (column BD) and X120 (column DW). **Sediment volume entries are duplicated in the database at the end of the protocol questions. Sediment volumes recorded in the BMP protocol are automatically copied to a contiguous block of columns at the end of the protocol in order to make volume calculations easier to write**.

According to the question map, columns HD and HE also contain the sediment volumes for the approach areas outside the buffer/filter strip, and columns HG and HH also contain the sediment volumes for the approach areas inside the buffer/filter strip.

To calculate the average of sediment evident in the water body originating from the approach area outside the buffer/filter strip, use the AVERAGE function. **You need to ignore all zero entries**. To do this, use a nested IF THEN statement within the formula to instruct Excel to ignore cells containing zero as an entry. The formula will look like this:

=AVERAGE((IF(Example_Loggr_Cntrct!HD2:HE2000>0,Example_Loggr_Cntrct!HD2:HE2000,"")))

The formula above contains an array (highlighted in yellow). Enter it in cell B9 using a **Ctrl + Shift + Enter** keystroke combination. Brackets will automatically be added at the beginning and the end of the formula.

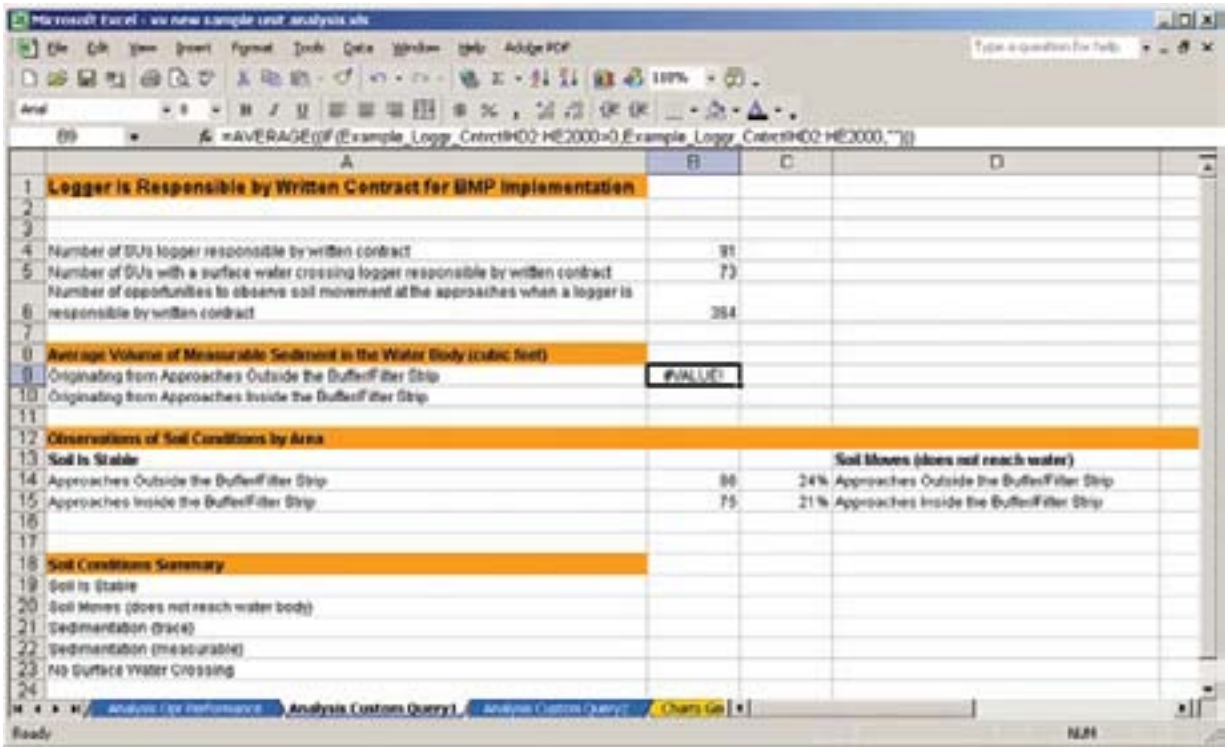
While this formula may appear complicated, it makes more sense when you look at the IF THEN statement first:

(IF(Example_Loggr_Cntrct!HD2:HE2000>0,Example_Loggr_Cntrct!HD2:HE2000,"")

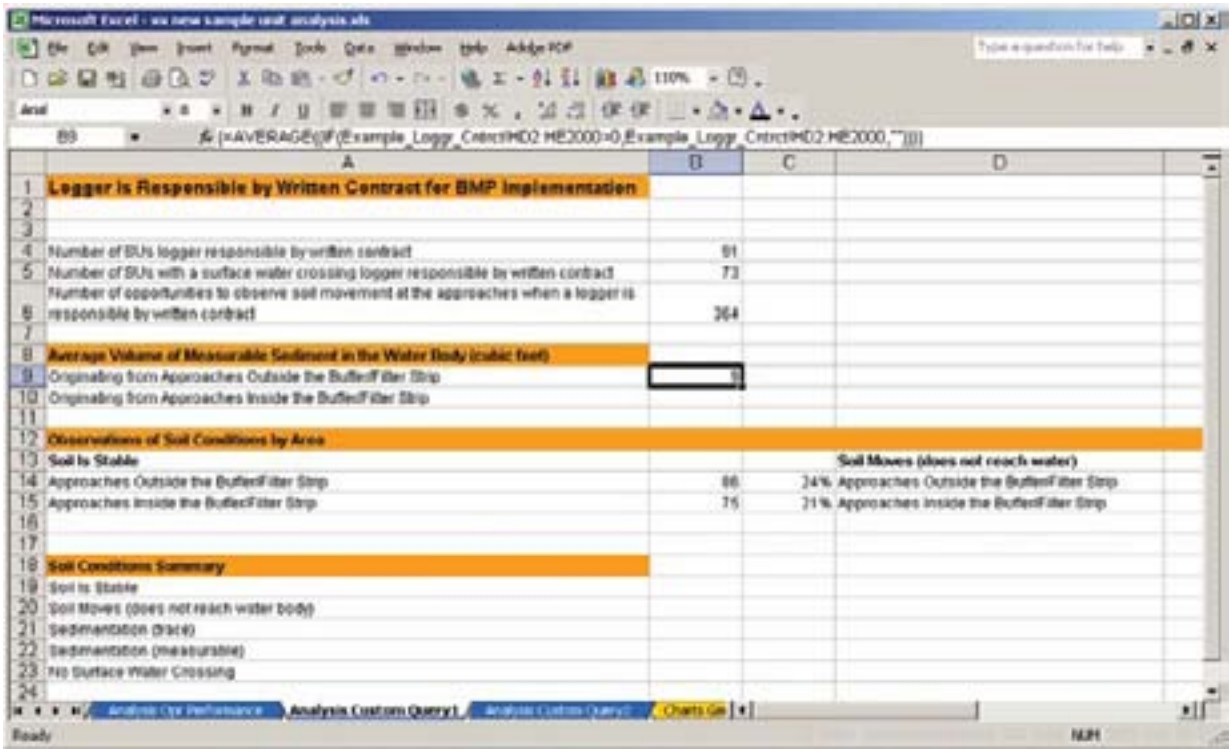
The syntax for an IF THEN statement is IF(condition,[value if true],[value if false]). The statement selects all of the cells on the worksheet **Example_Loggr_Cntrct** between cells HD2 and HE2000 that are greater than zero. The AVERAGE function is applied to those cells that are greater than zero. The twin quotes "" instruct Excel to return a blank cell if there are no entries in the range that are greater than zero. (**Note**: Since it is not possible to know how many sample units will be sampled by any individual project participant, the cell reference to row 2000 is an arbitrary number, which assumes that any project participant will not sample more than 2,000 units during any one sampling year.)

Remember: You must enter an array formula with a **Ctrl + Shift + Enter** keystroke combination.

Note the difference between the following two examples. In the first screen, the formula is entered with only an **Enter** keystroke, resulting in a #VALUE error.



In the second screen, the formula is entered with a **Ctrl + Shift + Enter** keystroke combination. The formula calculates the results accurately.



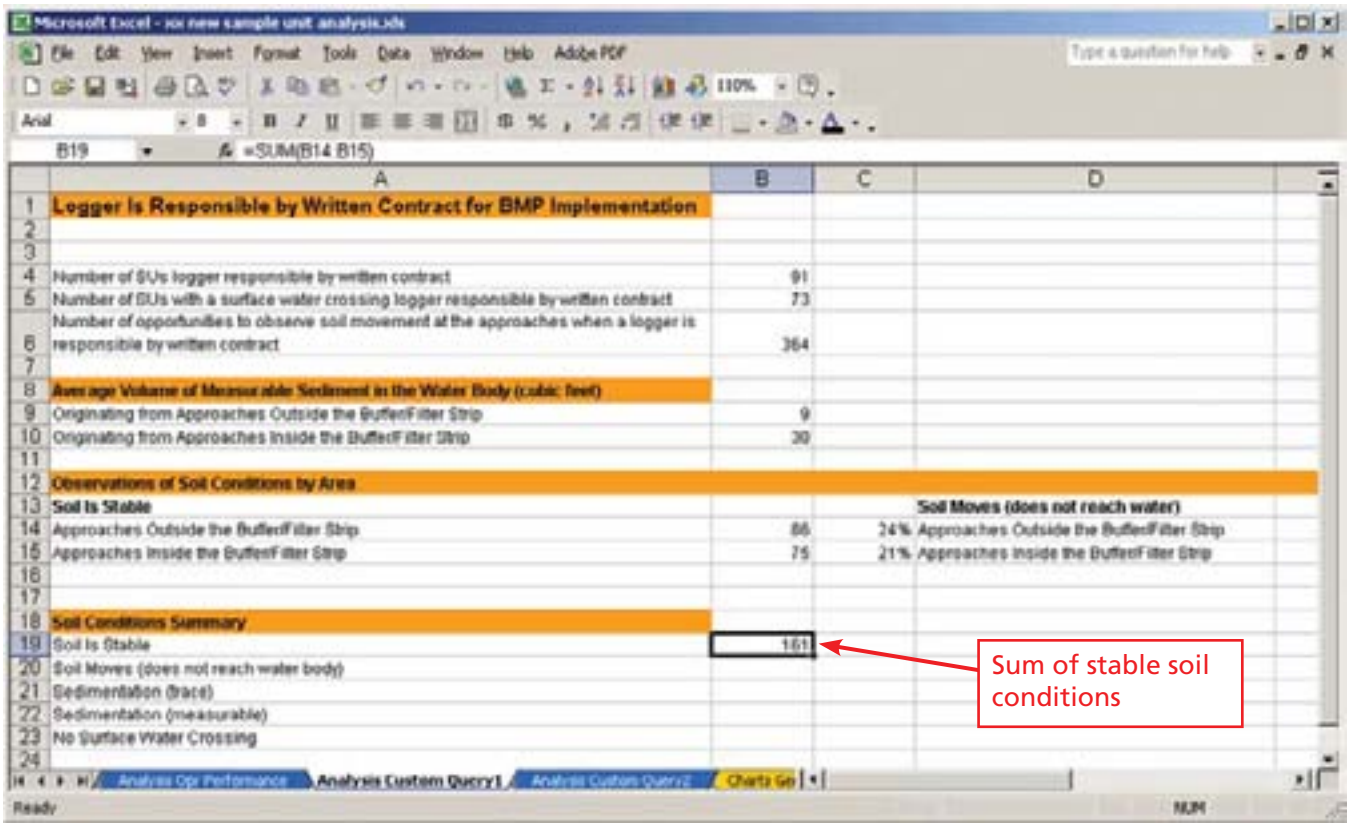
The same syntax can be applied to the formula calculating sediment volumes for the approach areas **inside** the buffer/filter strip. The only difference is the cell reference to the appropriate columns. Enter the following formula in cell B10 using a **Ctrl + Shift + Enter** keystroke:

=AVERAGE((IF(Example_Loggr_Cntrct!HG2:HH2000>0,Example_Loggr_Cntrct!HG2:HH2000,"")))

5.11f. Calculate the Soil Conditions Summary

Finally, you will use the information about the number of observations of soil conditions to summarize the conditions and create a chart, which you will later use in a custom SDS.

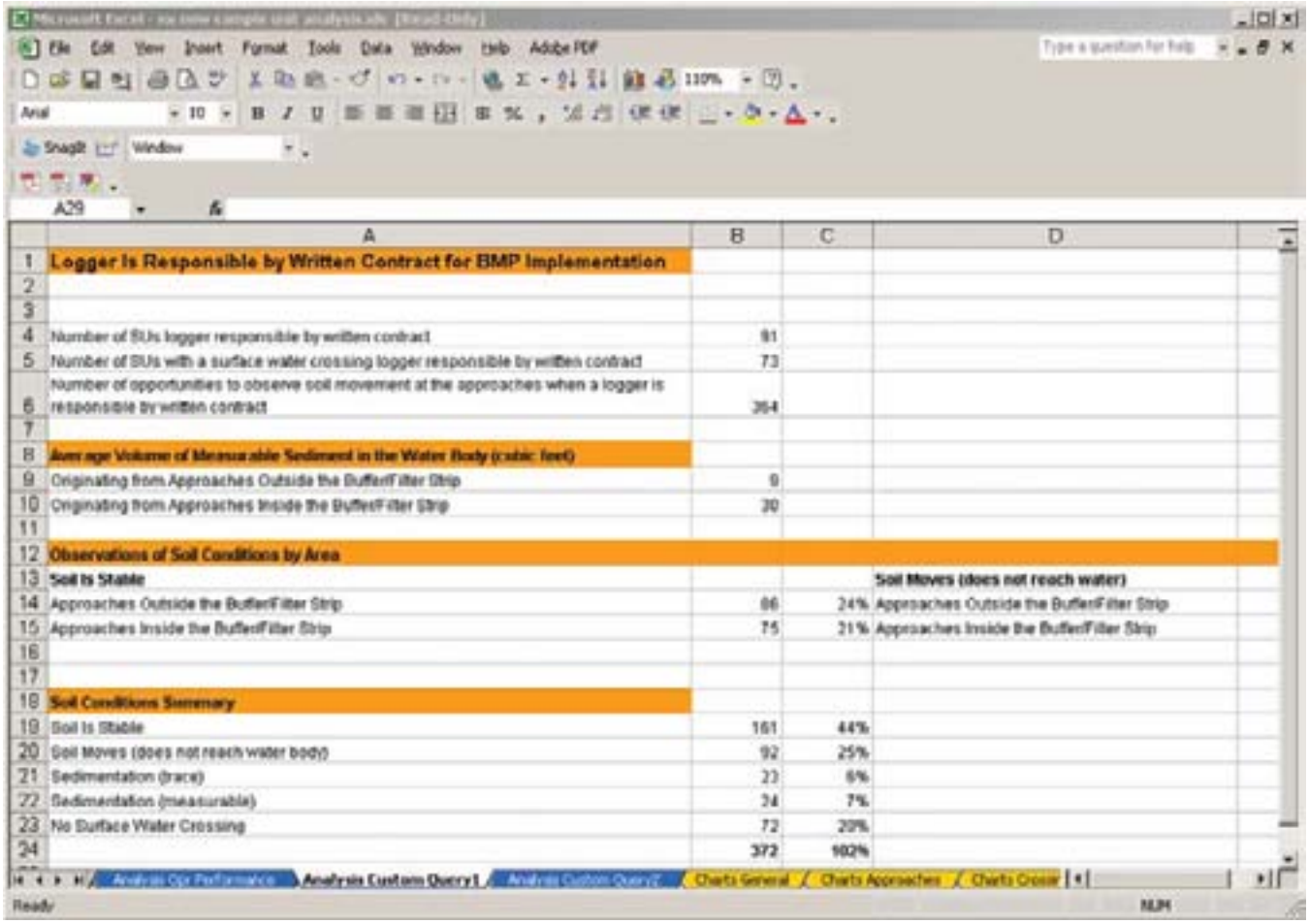
The following summary categories appear under the worksheet heading Soil Conditions Summary: Soil Is Stable, Soil Moves (does not reach water body), Sedimentation (trace), Sedimentation (measurable), and No Surface Water Crossing. You have already calculated the results for each condition inside and outside of the buffer/filter strip. Simply total the two results together in the Soil Conditions Summary section. For example, for the Soil Is Stable condition, sum cells B14 and B15 together using the formula =SUM(B14:B15). Place the formula in cell B19.



Repeat this process for each soil condition listed. For No Surface Water Crossing, simply enter the cell location preceded by an equal sign (=N14) since there is only one value.

Calculate the proportion of total observations by dividing each sum by the total number of opportunities to observe soil conditions, which is stored in cell B6. For example, to calculate the proportion of observations in which soil is stable, insert the formula =B19/$B6$ into cell C19.

The figures in bold (cells B24 and C24) are totals of the summary columns. Enter =SUM(B19:B23) in cell B24 and =B24/$B6$ in cell C24.



	A	B	C	D
1	**Logger Is Responsible by Written Contract for BMP Implementation**			
2				
3				
4	Number of SUs logger responsible by written contract	91		
5	Number of SUs with a surface water crossing logger responsible by written contract	73		
6	Number of opportunities to observe soil movement at the approaches when a logger is responsible by written contract	364		
7				
8	**Average Volume of Measurable Sediment in the Water Body (cubic feet)**			
9	Originating from Approaches Outside the BufferFilter Strip	0		
10	Originating from Approaches Inside the BufferFilter Strip	20		
11				
12	**Observations of Soil Conditions by Area**			
13	**Soil Is Stable**			**Soil Moves (does not reach water)**
14	Approaches Outside the BufferFilter Strip	86	24%	Approaches Outside the BufferFilter Strip
15	Approaches Inside the BufferFilter Strip	75	21%	Approaches Inside the BufferFilter Strip
16				
17				
18	**Soil Conditions Summary**			
19	Soil Is Stable	161	44%	
20	Soil Moves (does not reach water body)	92	25%	
21	Sedimentation (trace)	23	6%	
22	Sedimentation (measurable)	24	7%	
23	No Surface Water Crossing	72	20%	
24		372	102%	

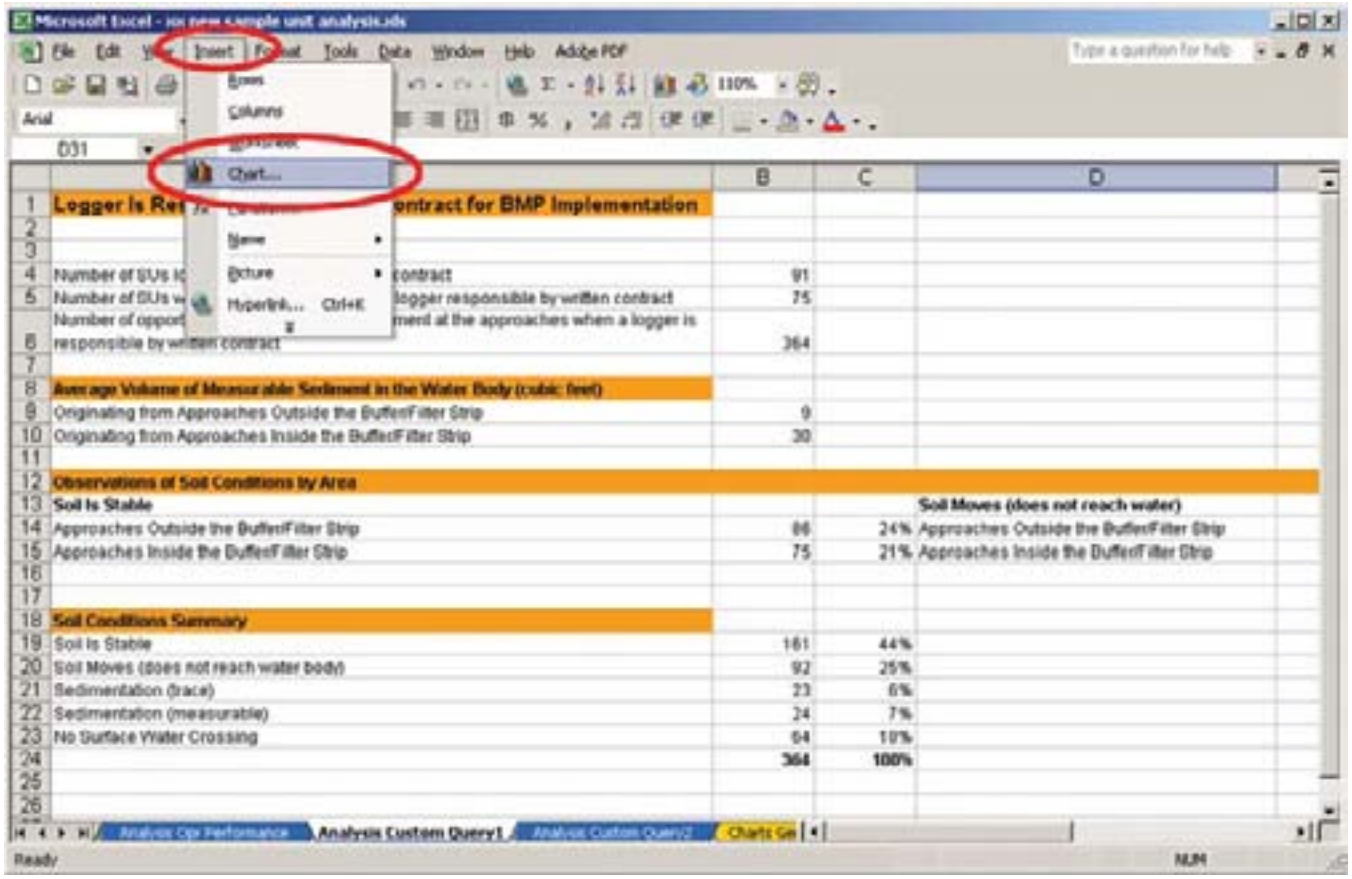
Inexperienced field personnel may inadvertently miss an entry or enter unnecessary additional data, resulting in calculations that do not equal 100 percent. The protocol leader should normally catch errors such as these during the quality control or data cleanup procedures that should be conducted as data are submitted. Small errors may result due to rounding, but larger errors should be resolved by reviewing the field data.

In this worksheet, the value in cell B24 should match the value in cell B6, and the value in cell C24 should equal 100 percent. The errors shown occur because zeros were automatically inserted in the data file for two sample units on which question X12 was not answered (see step 5.11b). This is an example of the type of error that can be detected and resolved as described above. Further graphics use the corrected data.

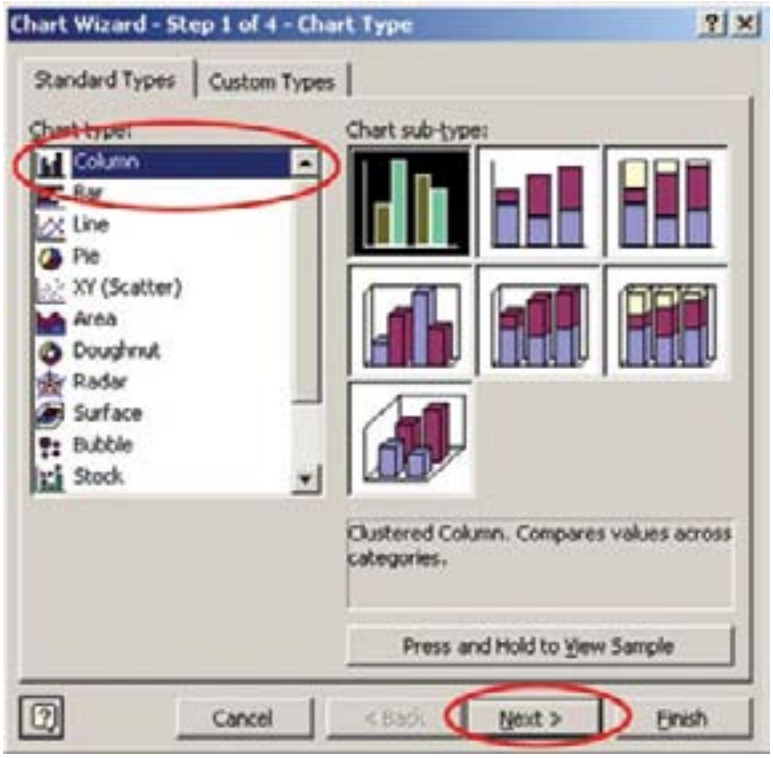
Step 5.12. Create a Chart

Finally, you will make a simple graph using the Excel Chart Wizard to illustrate the results and save it on the **Charts Custom Query1** worksheet.

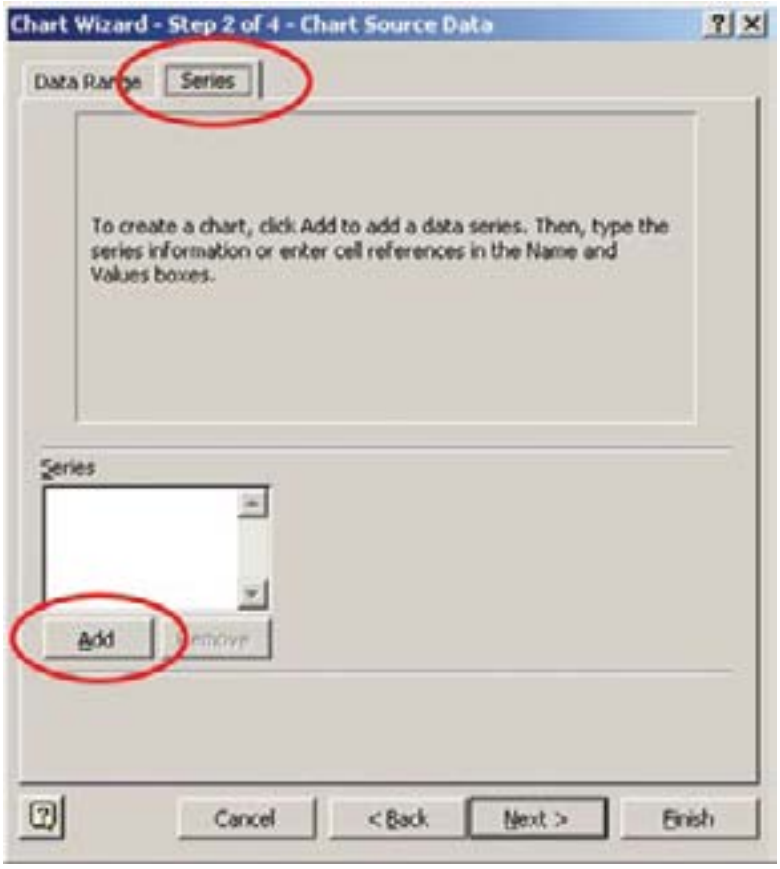
First, select **Insert** from the main toolbar and **Chart** from the drop-down menu.



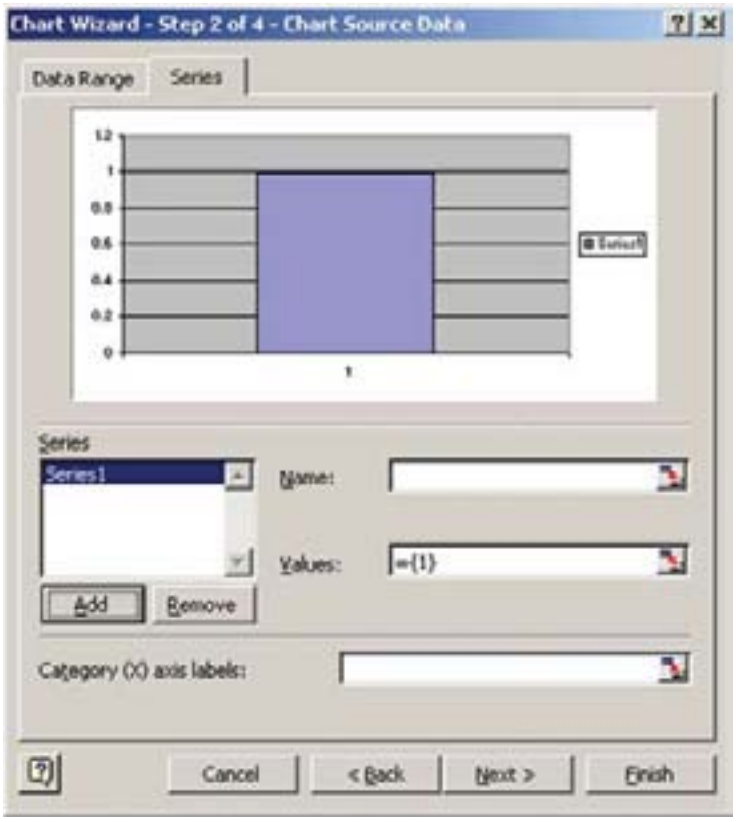
The **Chart Wizard** will open and guide you through four steps to create a chart. The first screen asks you to choose the type of chart you want. For this example, you will create a column chart. Select **Column** under **Standard Types** and select **Next**.



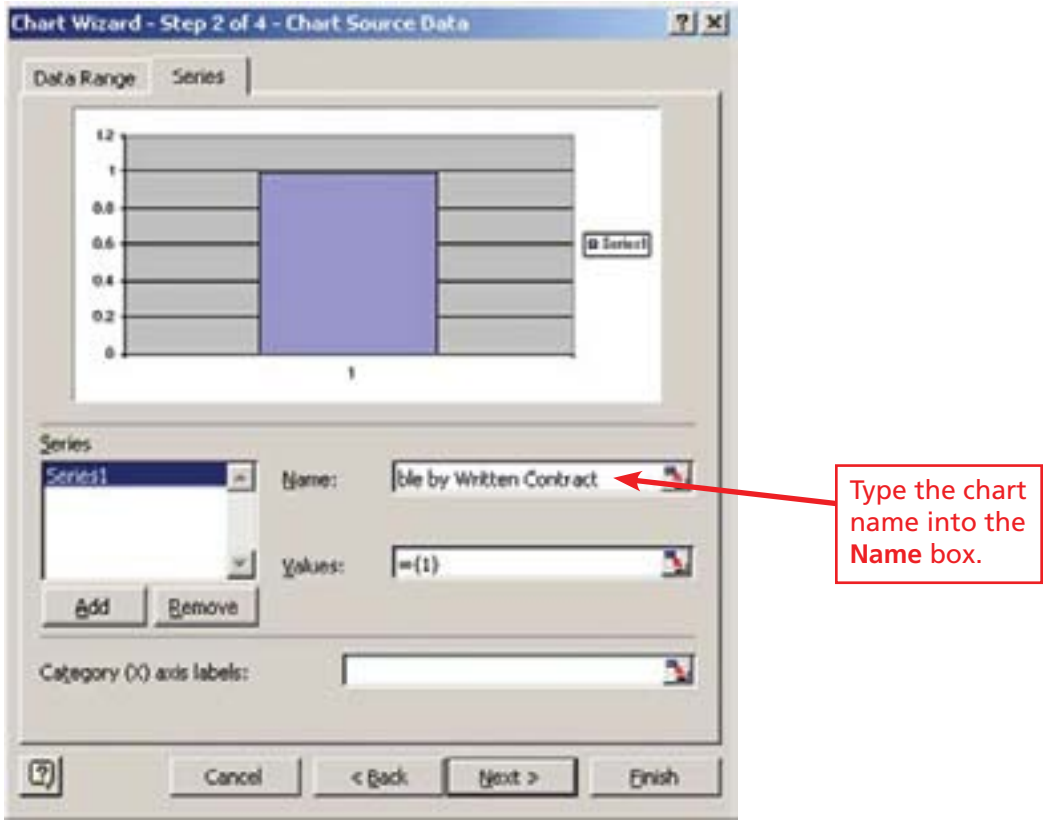
The next screen will ask for source data. Select the **Series** tab. Select **Add** to add a data series.



You then need to enter information on the data series. As you enter the information, the image of the chart at the top of the window will change.

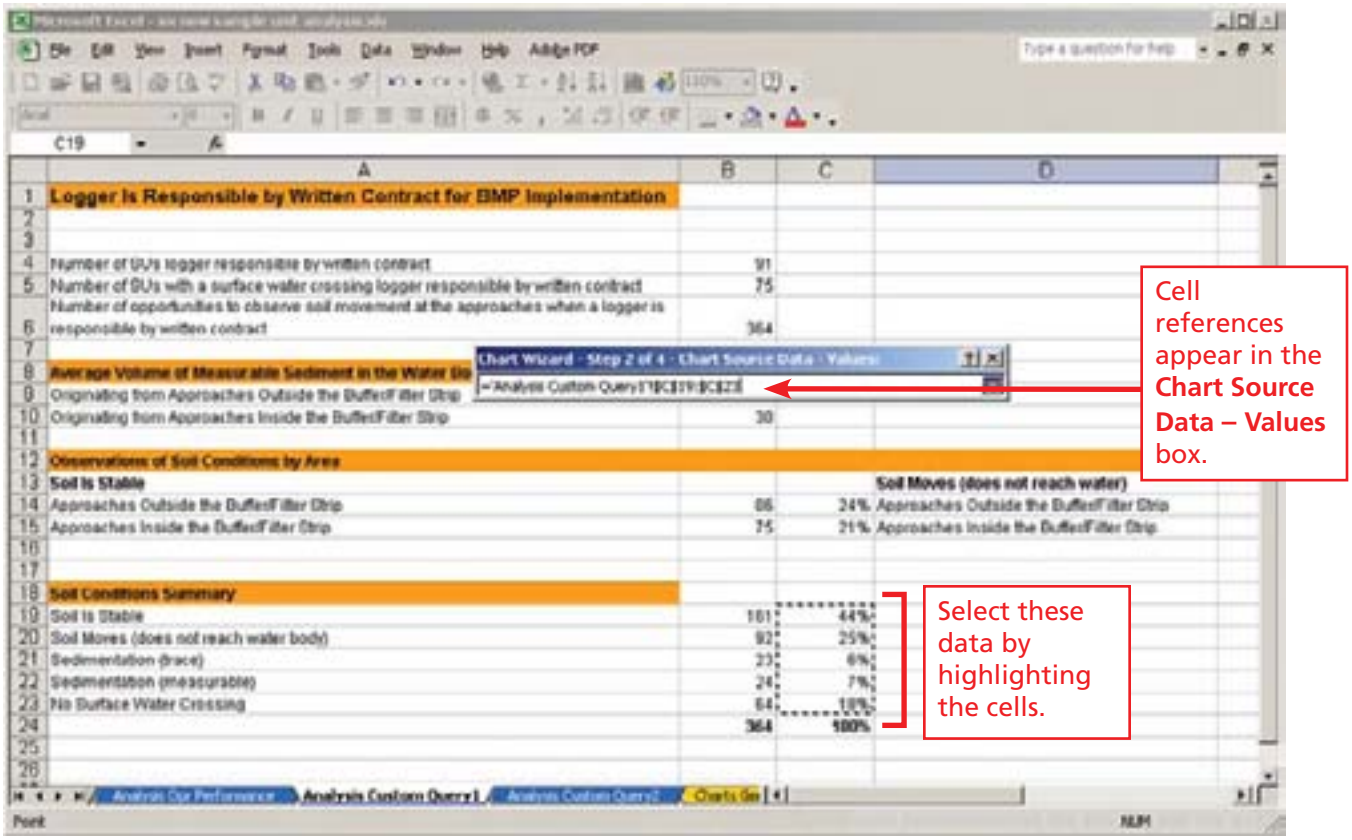


First enter the name of the data series. This one will be called **Proportion of Soil Conditions at the Approaches-Logger Responsible by Written Contract**. Type the name into the **Name** box.

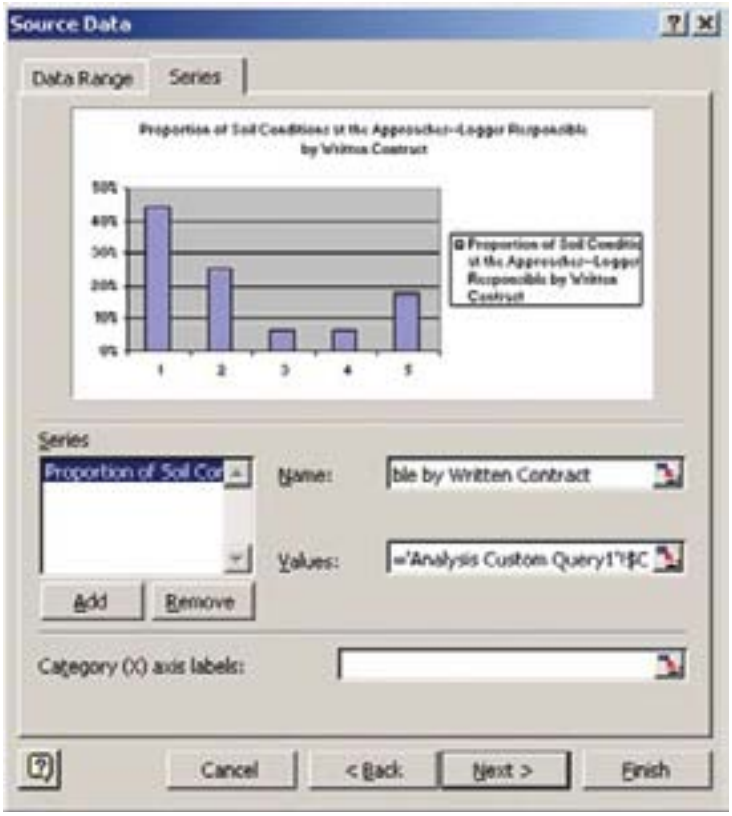


Next, enter the values in the data series. Click on the icon at the right of the **Values** box. It will collapse the **Source Data** window and display the worksheet you just created. You can simply highlight the data series to be included in the chart.

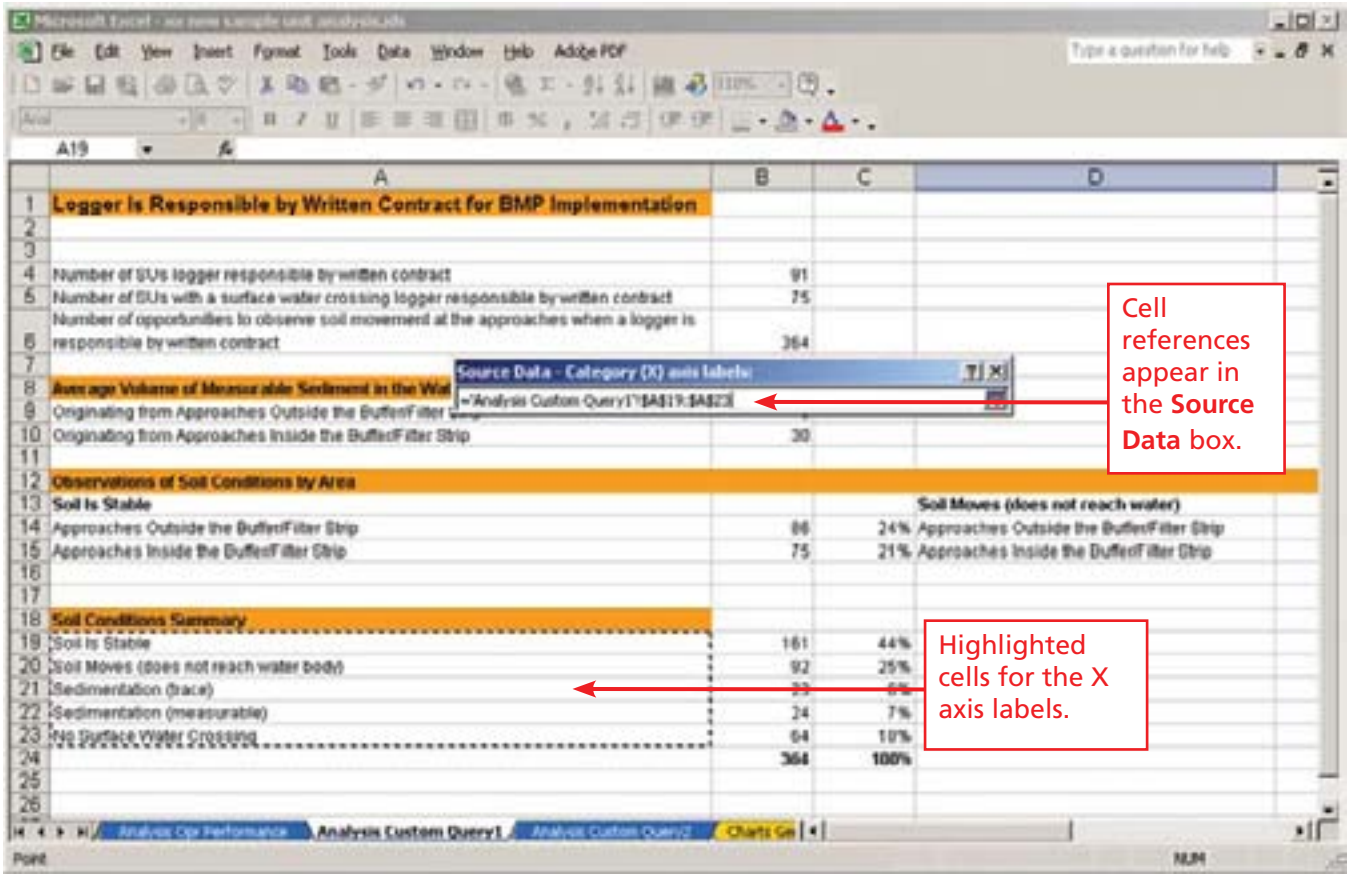
In this case, you are choosing the proportions of soil conditions observed at the approach areas to the surface water crossing. When you highlight the data series, the address of the cells chosen are written into the small **Chart Source Data – Values** box.



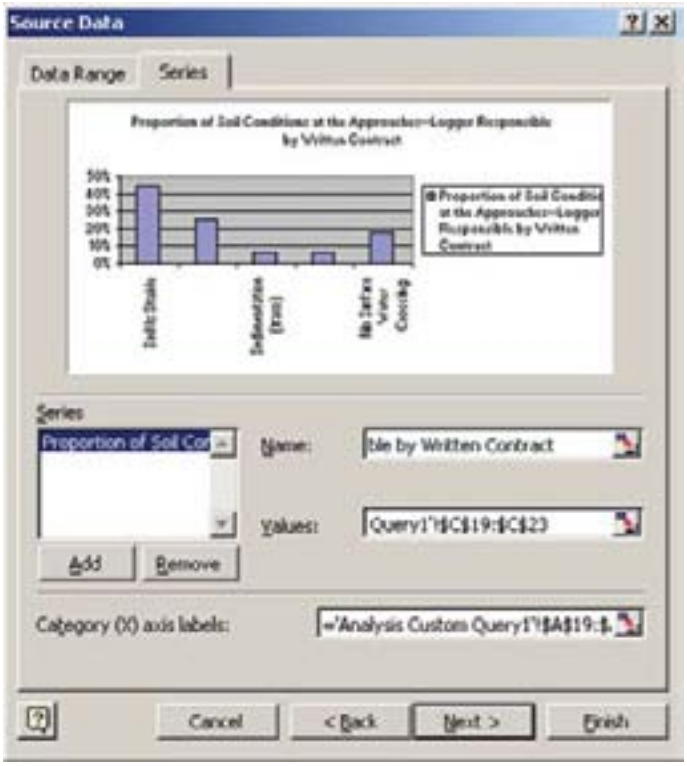
After highlighting the data series, click on the icon at the right of the **Chart Source Data – Values** box. It will expand the **Source Data** window, insert the selected data series in the **Values** box, and display the data series in the chart.



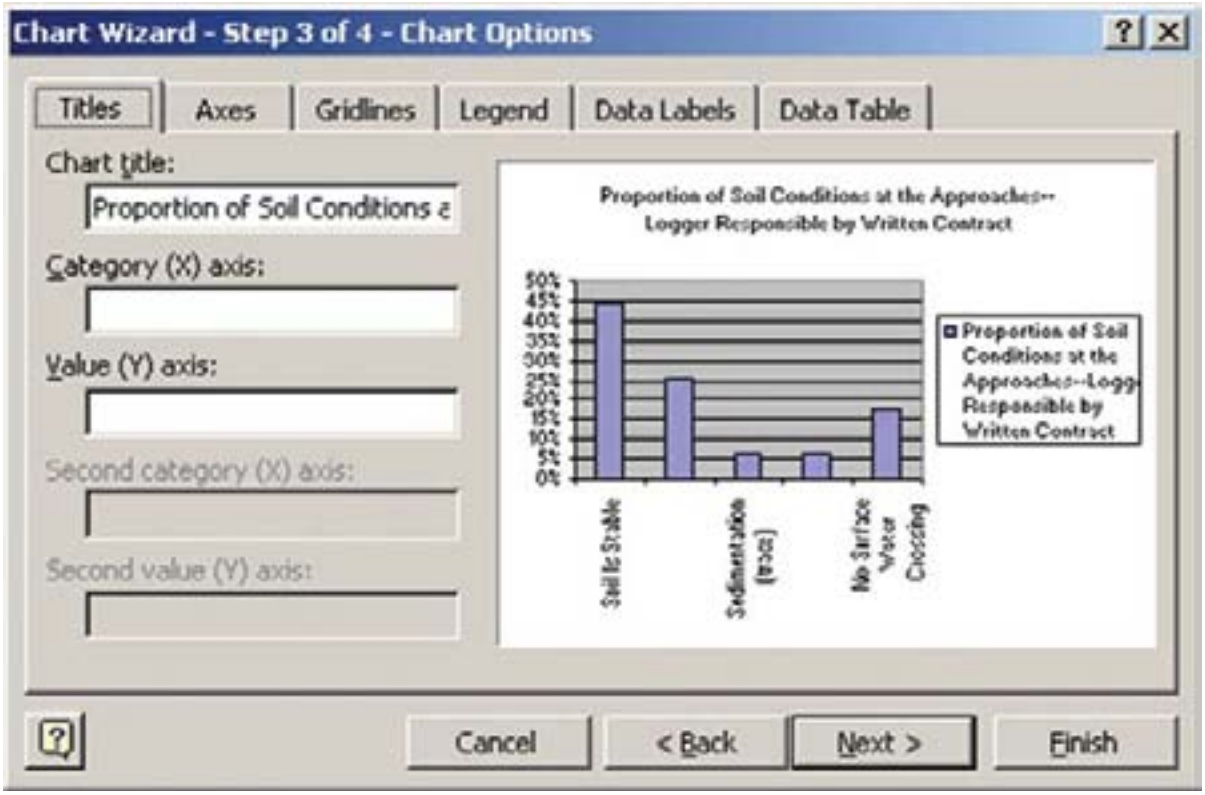
You must also select the **Category (X) axis labels** for the bars in the chart. Click on the icon at the right of the **Category (X) axis labels** box in the **Source Data** window. Select and highlight the X axis labels in the same way you selected the values for the data series.



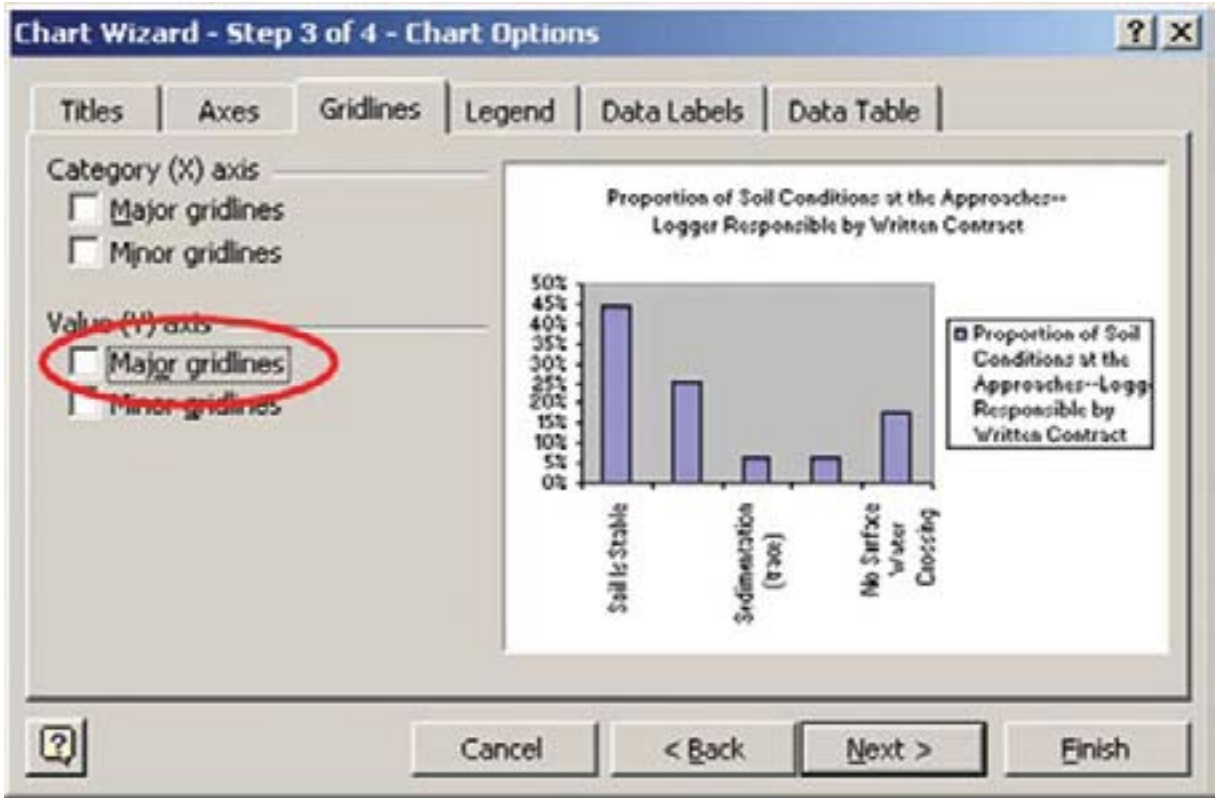
Click the icon again to return to the **Source Data** box, which will now contain a fairly complete image of the chart.



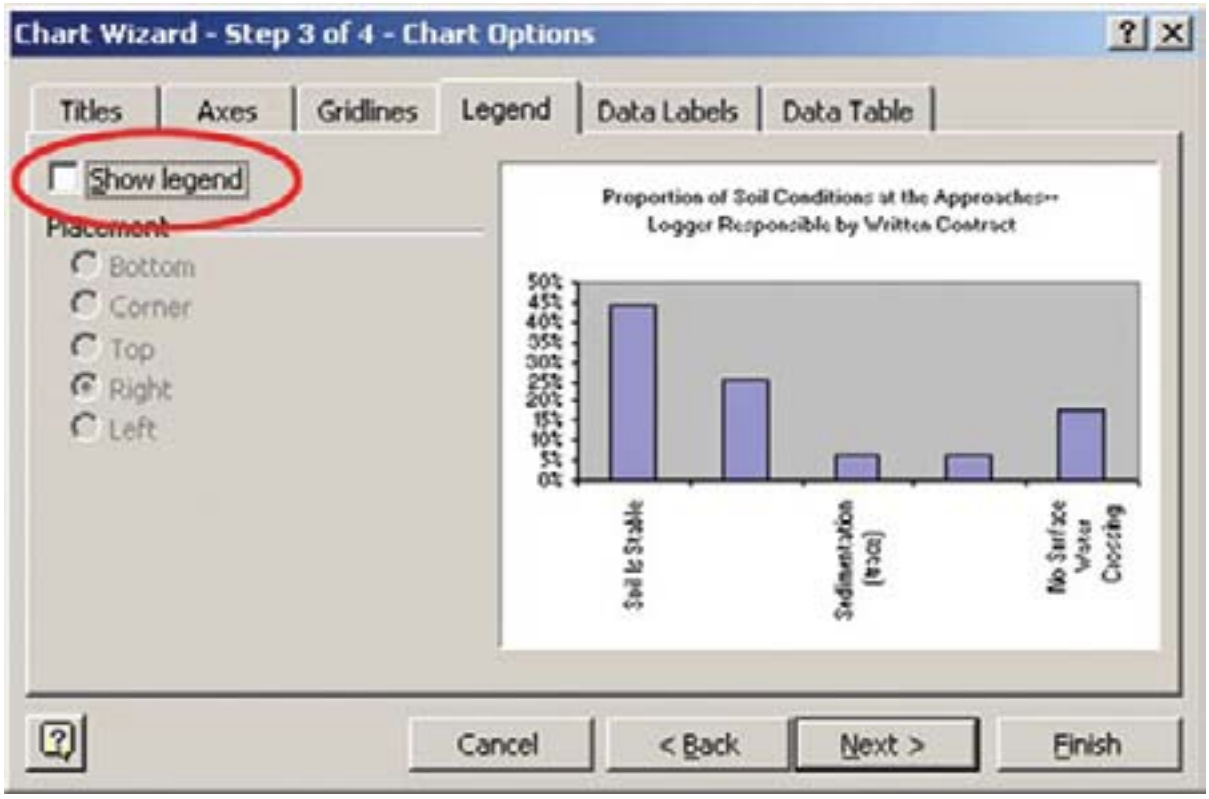
Select **Next** to advance to the third step in the Chart Wizard, **Chart Options**. Here you can customize the chart according to your preferences. Select the **Titles** tab. The chart name you entered in the previous step will appear in the **Chart title** box. You may change the chart title and label the X and Y axes if you so choose.



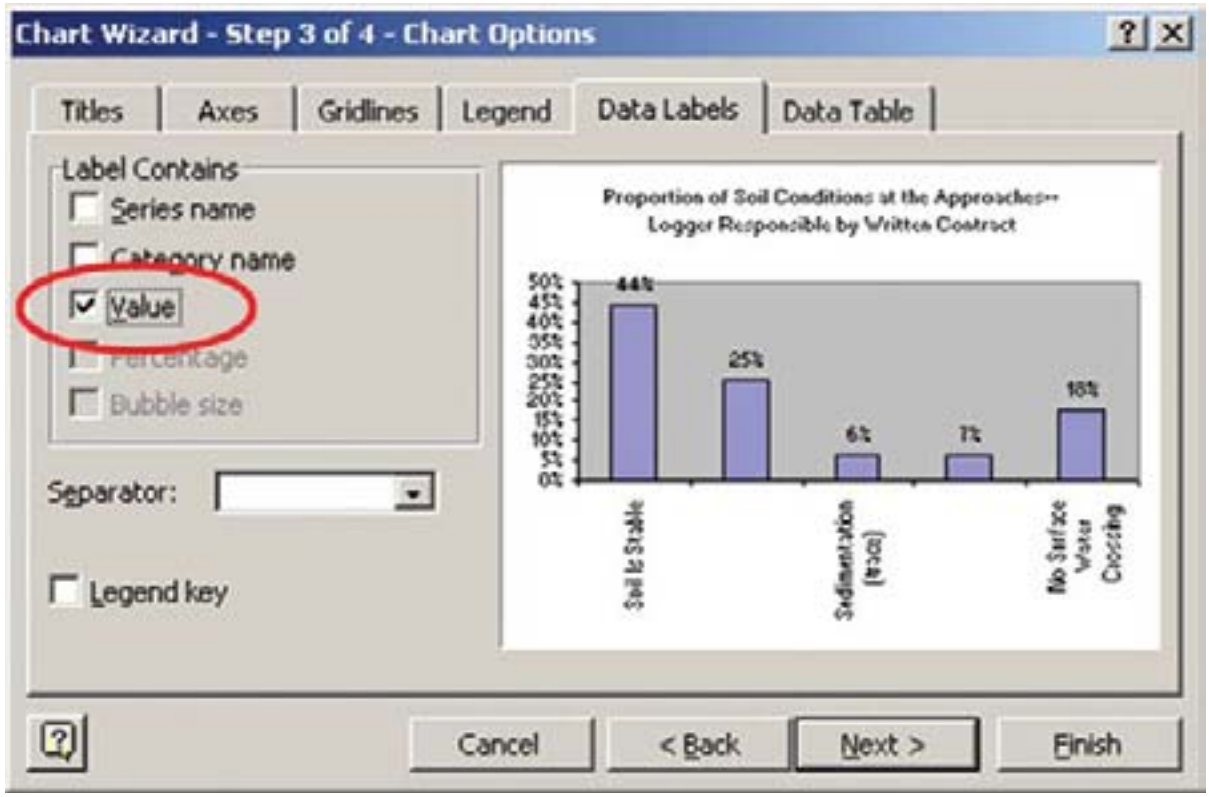
Select the **Gridlines** tab. The default setting is to show major gridlines on the **Value (Y) axis**. If you wish to remove the gridlines, uncheck the box. The change will be reflected in the sample table.



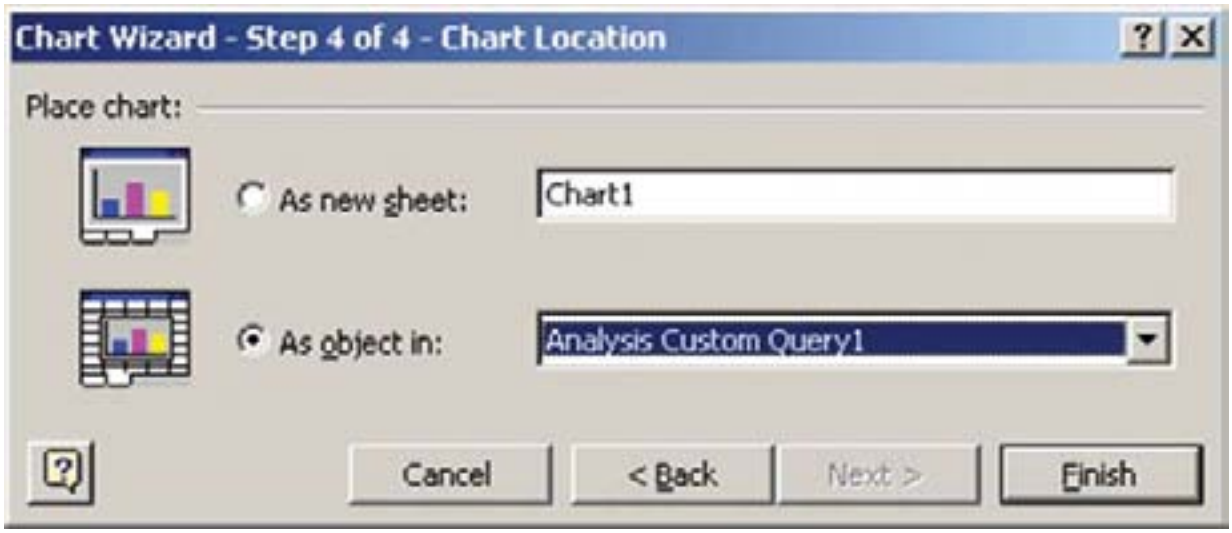
Select the **Legend** tab. Since there is only one data series on the chart, the legend is not necessary. To remove the legend, uncheck the **Show legend** box.



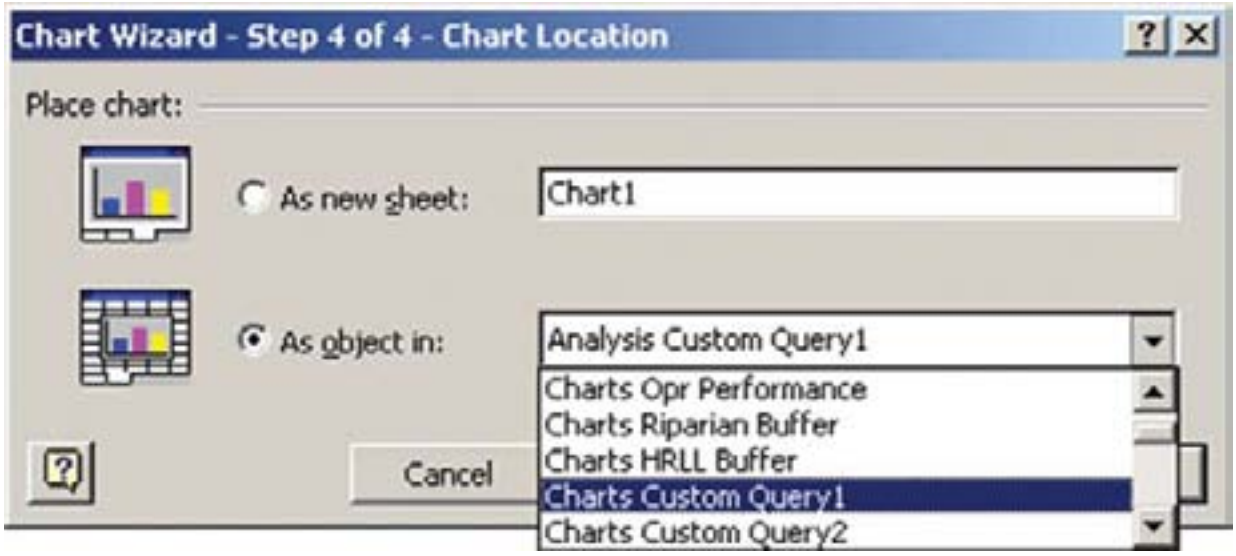
Select the **Data Labels** tab if you would like to label the data series on the chart. Under the **Label Contains** heading, check the **Value** box. The values of the data series will appear above the columns.



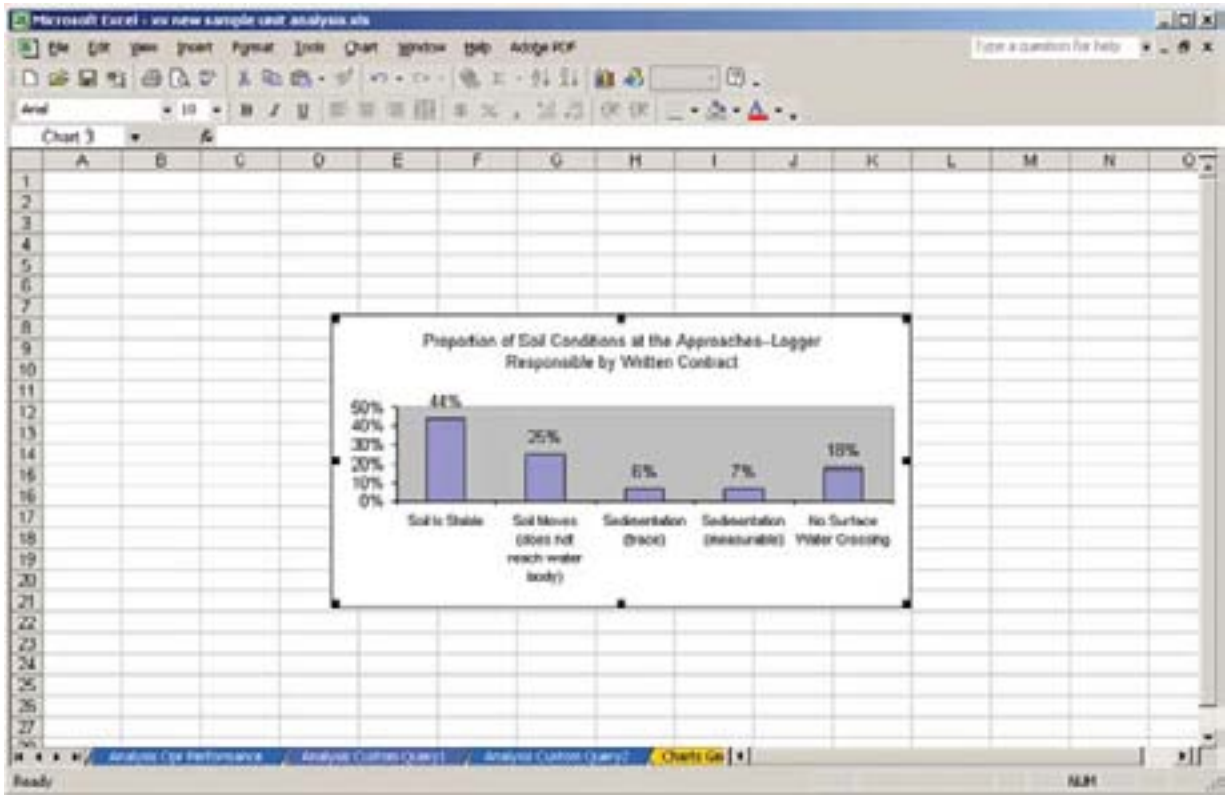
Select **Next** to proceed to the last step—selecting the location of the chart. The first option you will be given is to save the chart as an object in the current worksheet, **Analysis Custom Query1**.



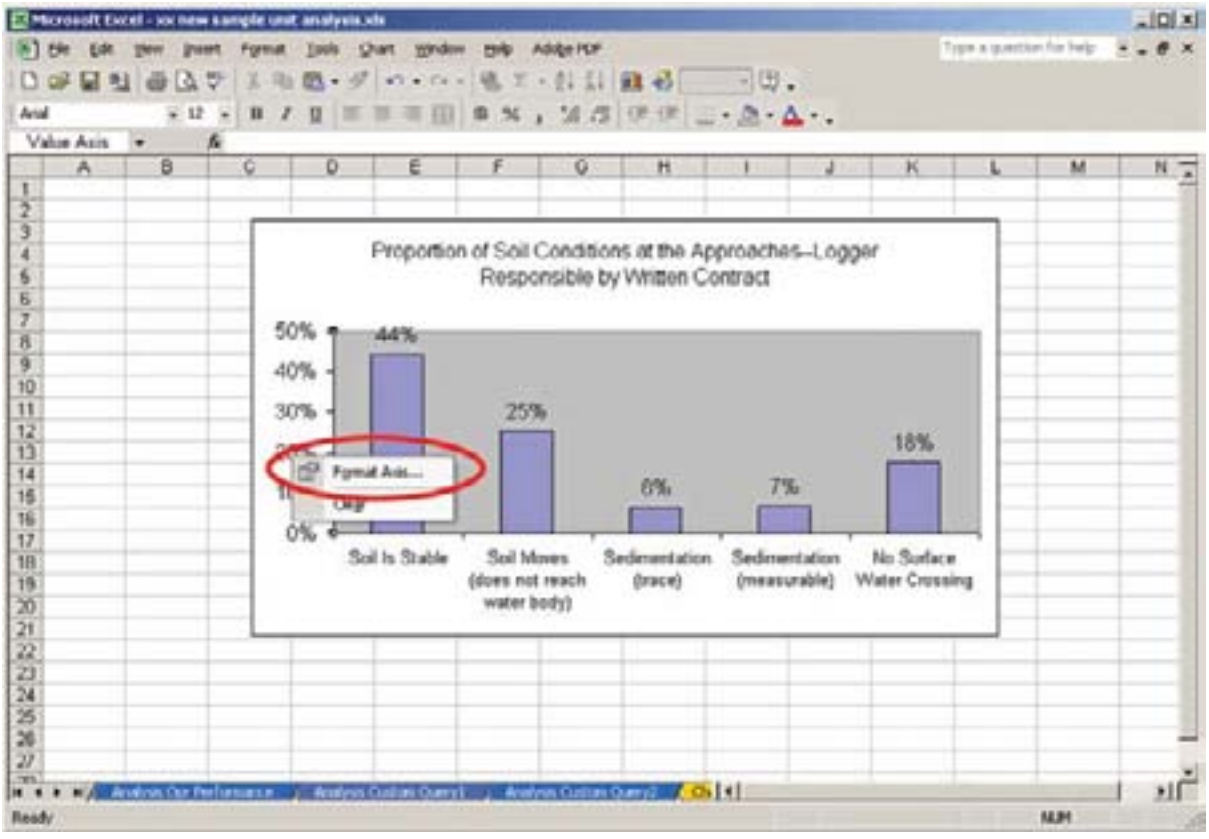
This chart should be saved as an object on the worksheet **Charts Custom Query1**. Click on the down arrow and select the worksheet name from the list.



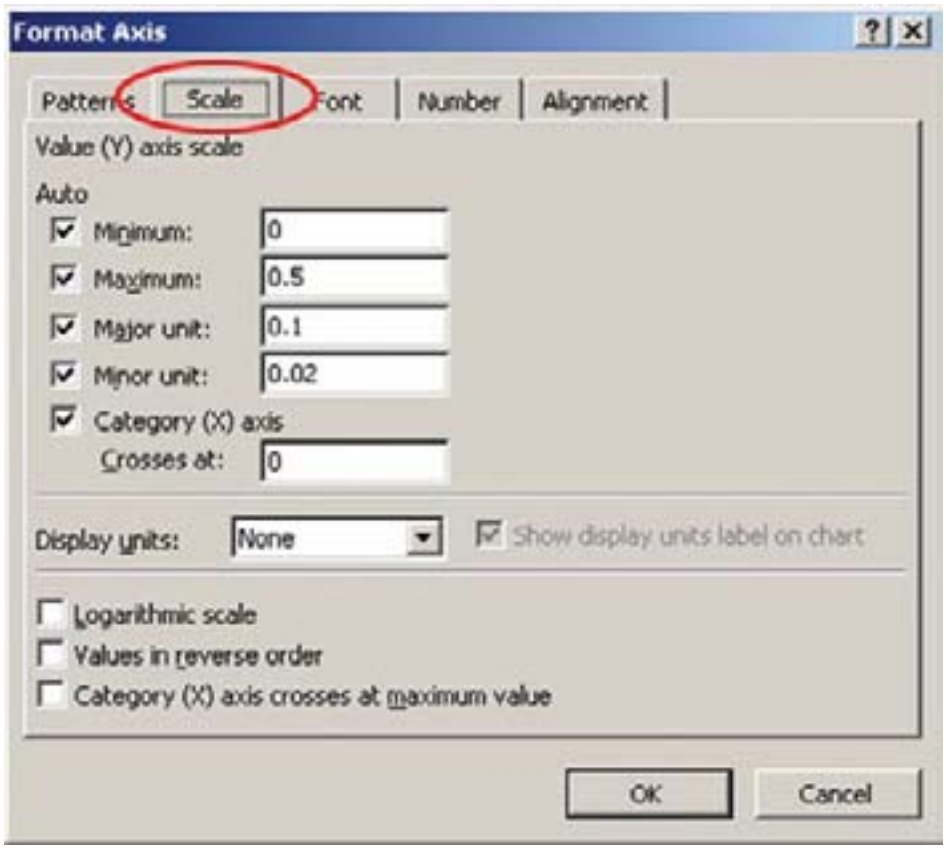
Select **Finish**. The chart will open in the **Charts Custom Query1** worksheet.



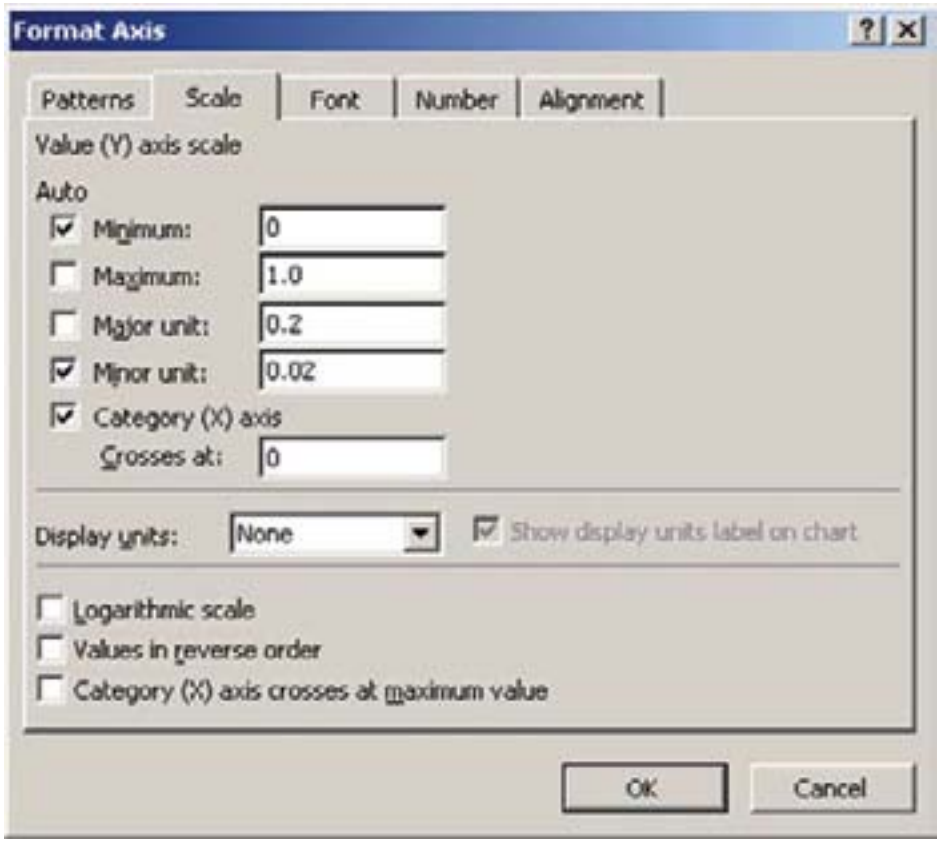
The completed chart can easily be formatted to make it consistent with other charts in the standard data summaries. For example, all the charts in BMP MIS are formatted to a scale of 100 percent on the Y axis. Change the scale on the new chart by right-clicking on the Y axis. Choose **Format Axis** from the drop-down menu.



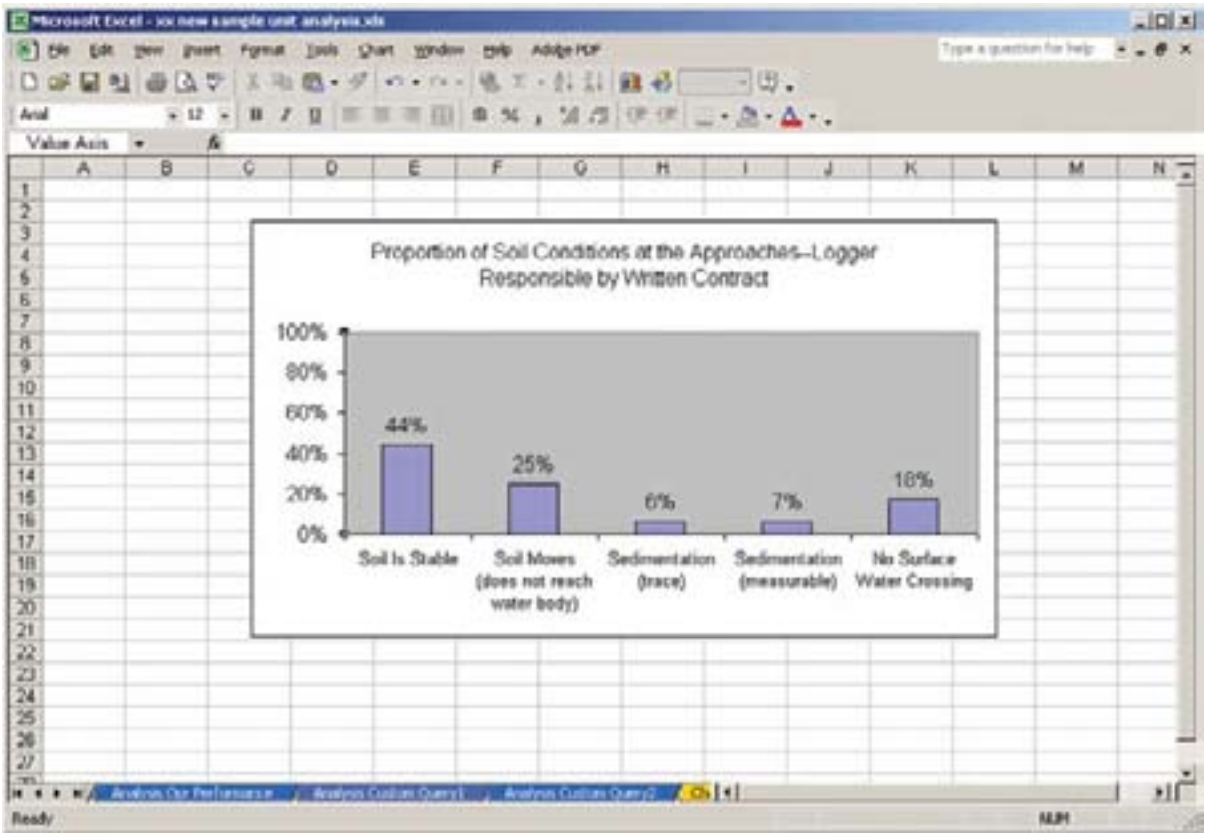
The **Format Axis** window will open. To adjust the scale of the axis, select the **Scale** tab.



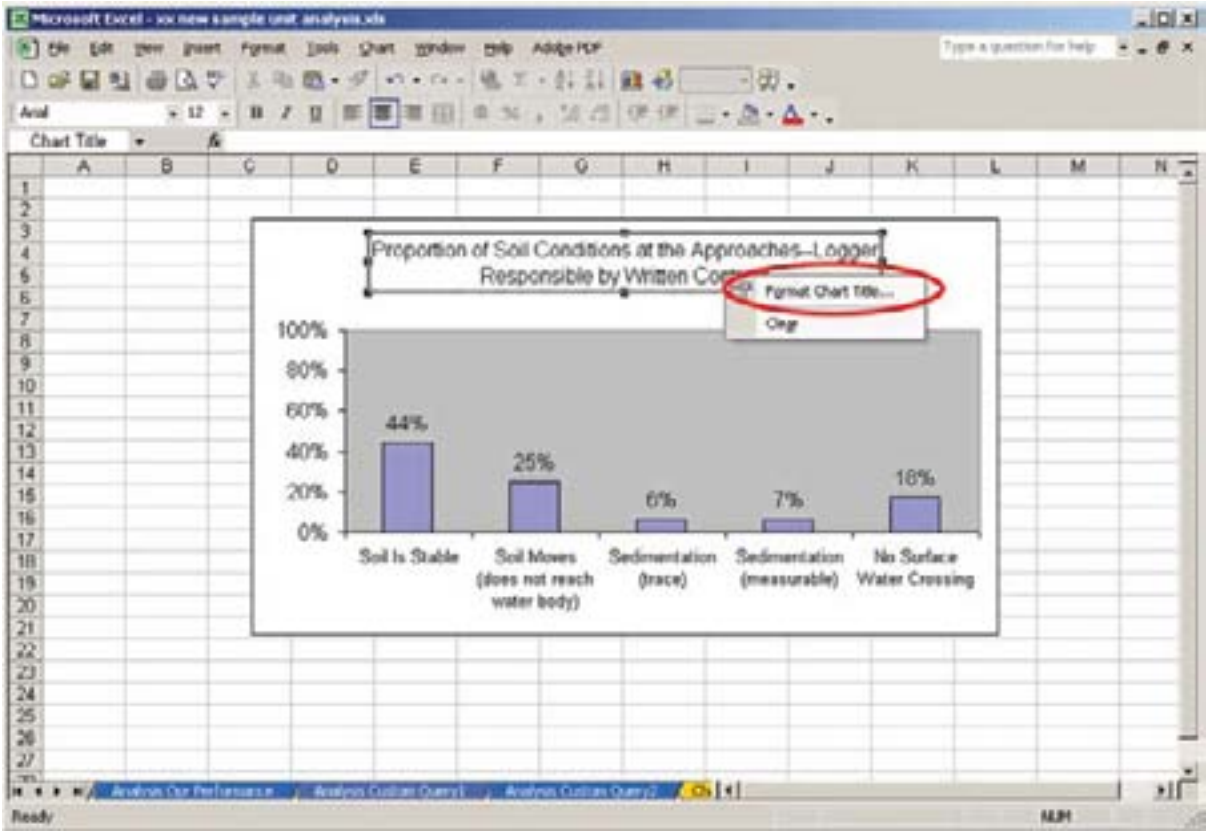
Change the **Maximum** setting to 1.0 and the **Major unit** setting to 0.2. When the new values are entered, the boxes to the left of those settings will uncheck, indicating that the auto setting has been overridden.



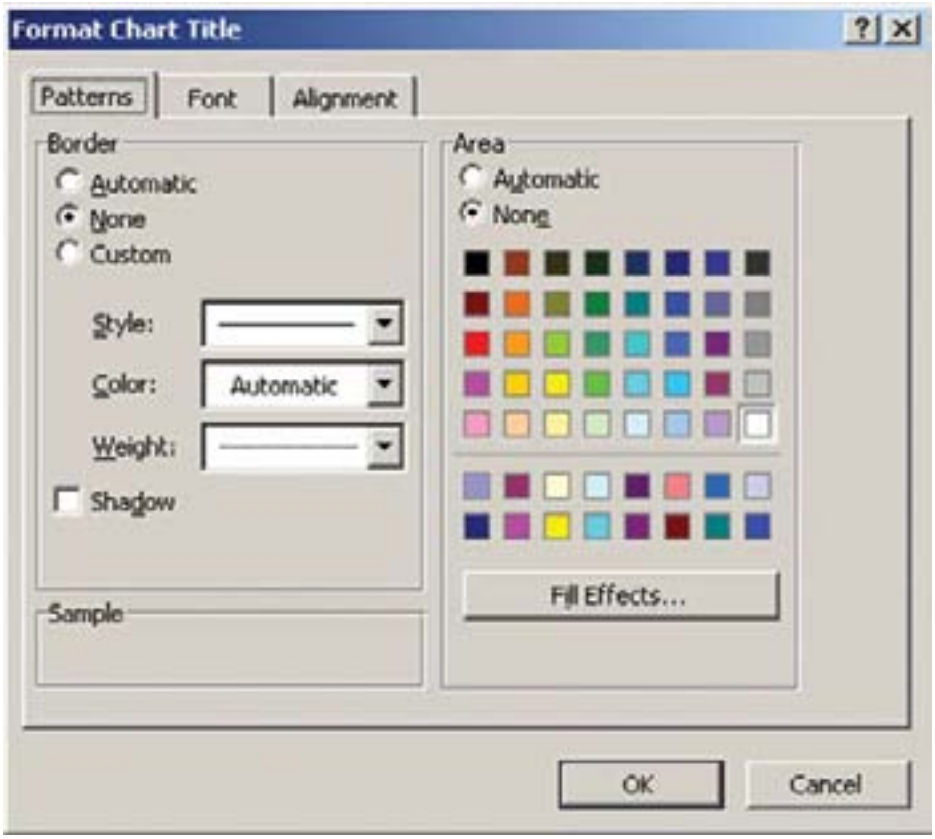
Select **OK** to see the chart adjusted to the new scale.



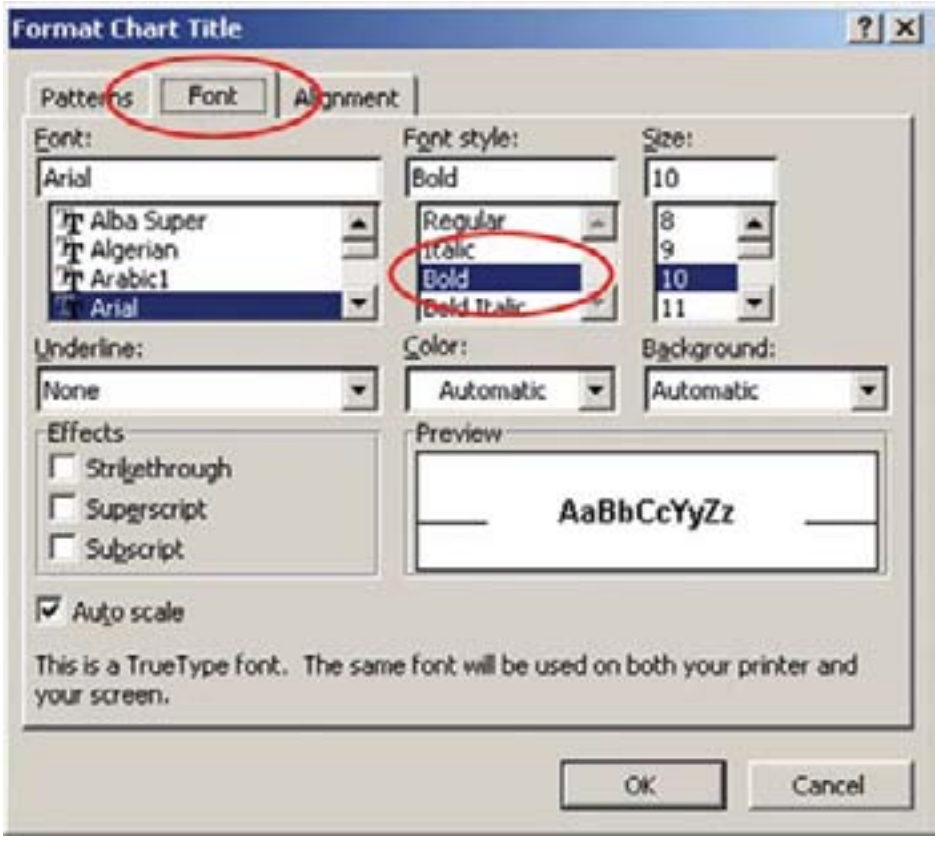
The title of the chart may look better in boldface. To select the chart title for formatting, click on the title to reveal the text box it is in, and right-click in the text box to open a drop-down menu.



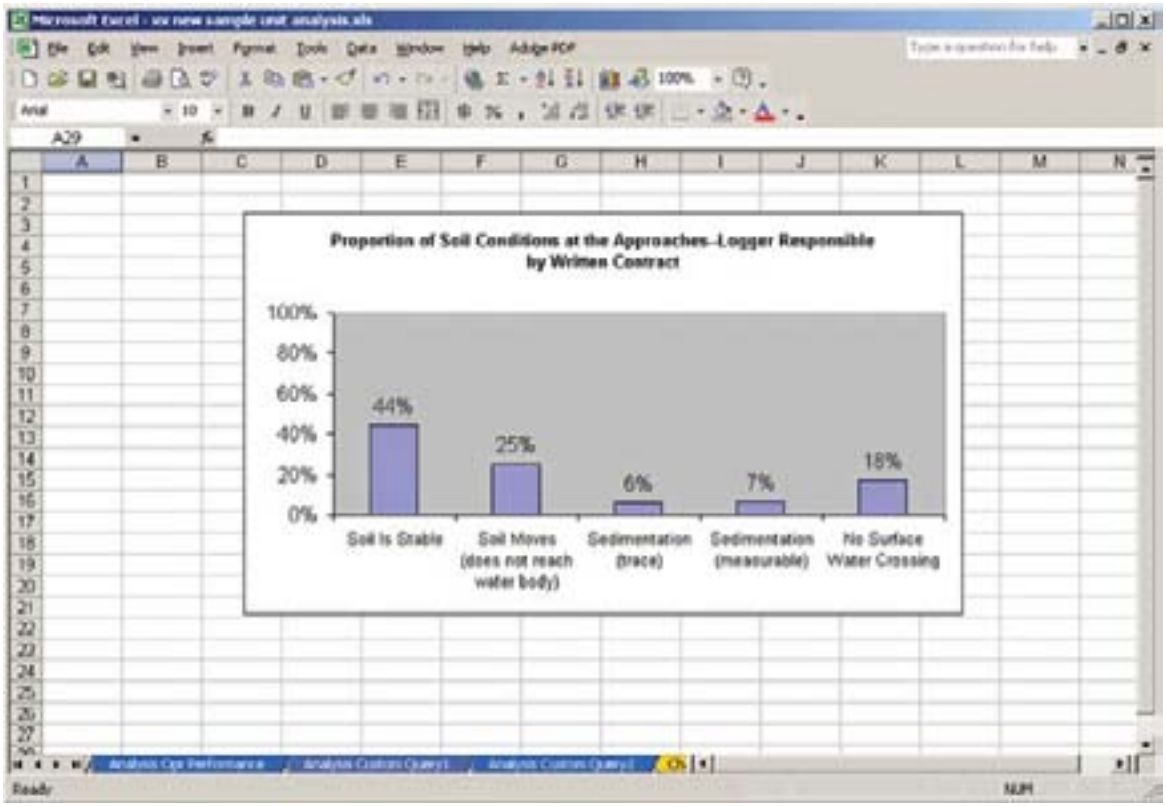
Select **Format Chart Title** to open the **Format Chart Title** window.



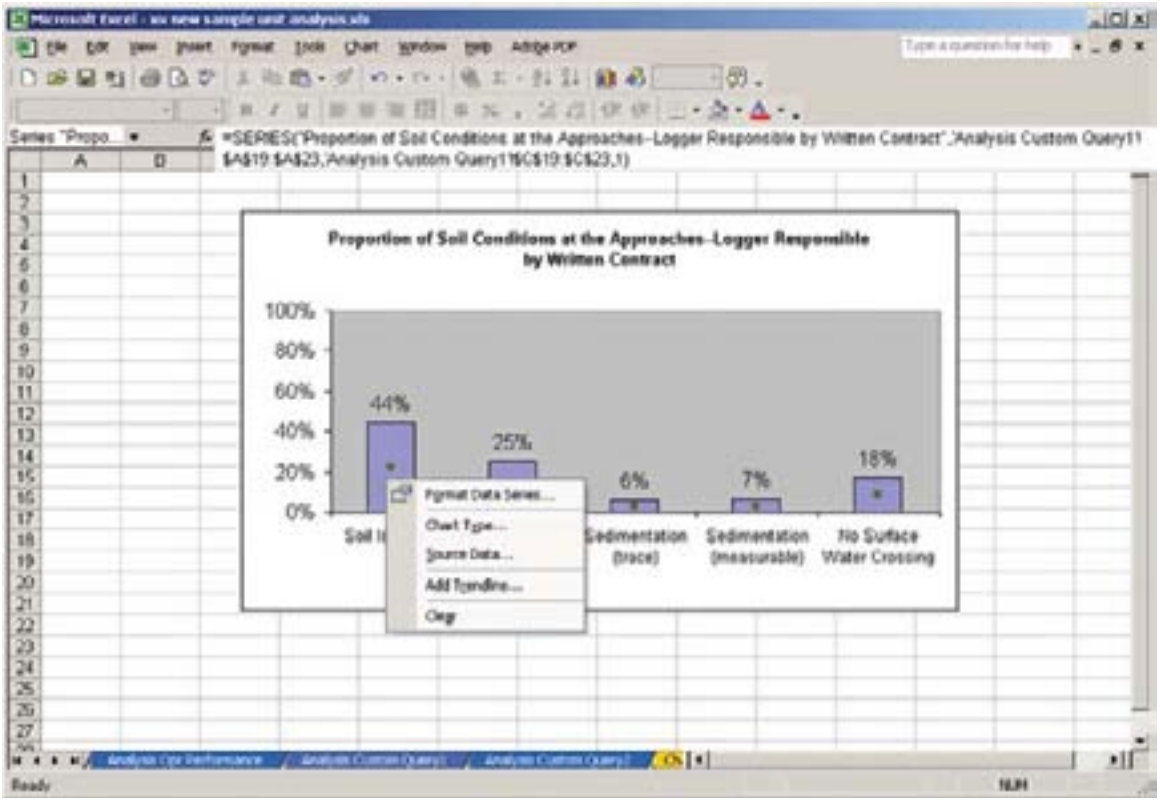
Select the **Font** tab to select a different font, font style, size, or effect. In this case, select **Bold** under the **Font style** menu.



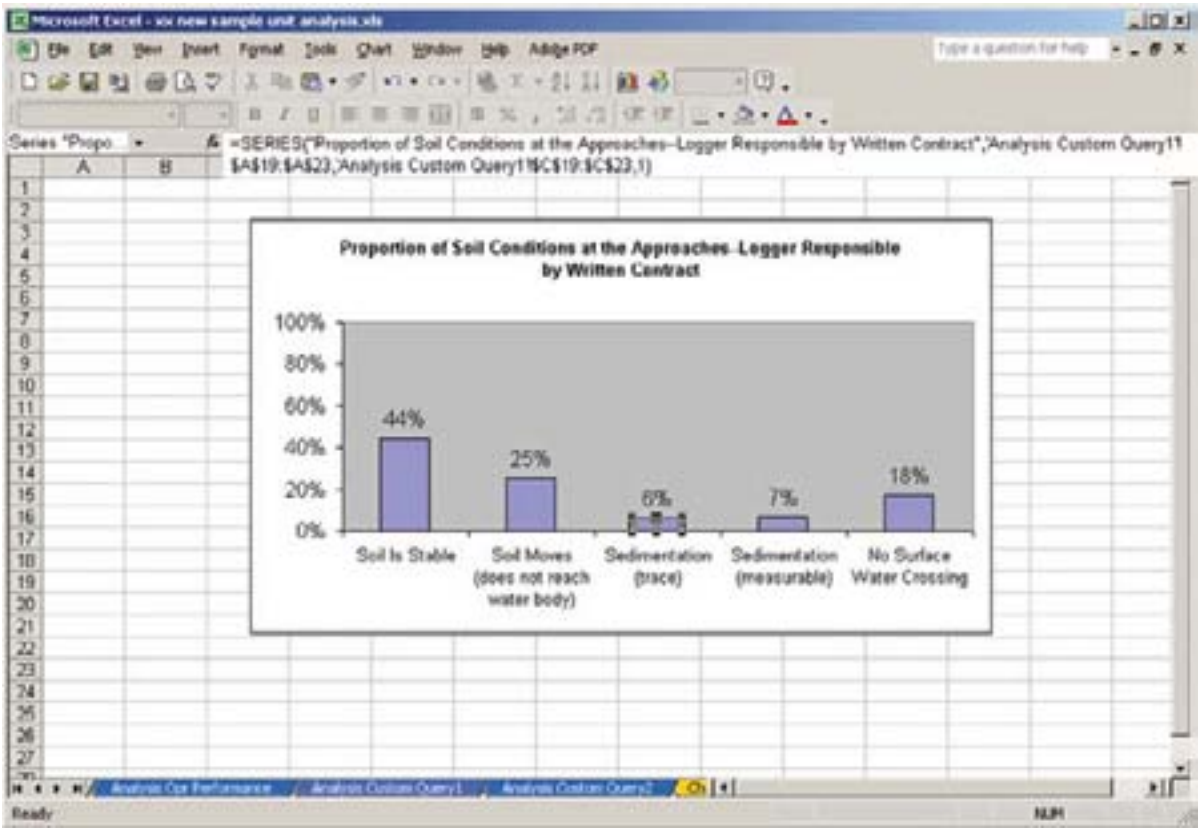
Select **OK** to apply the style.



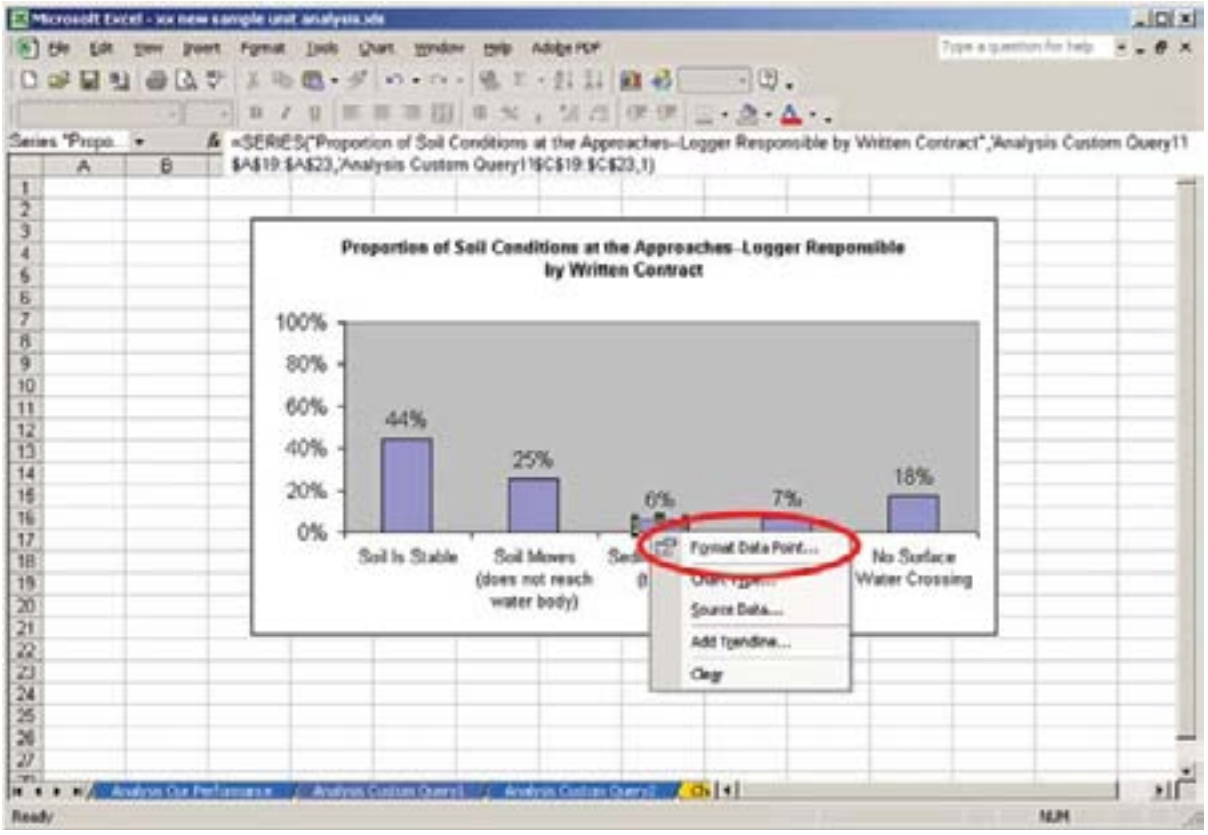
Finally, you may want to highlight conditions of concern (e.g., trace and measurable amounts of sediment observed in the water body). You can easily change the color of individual data points for emphasis. Place your cursor over the data point you wish to change and right-click once. The entire data series becomes highlighted with a small square on each point.



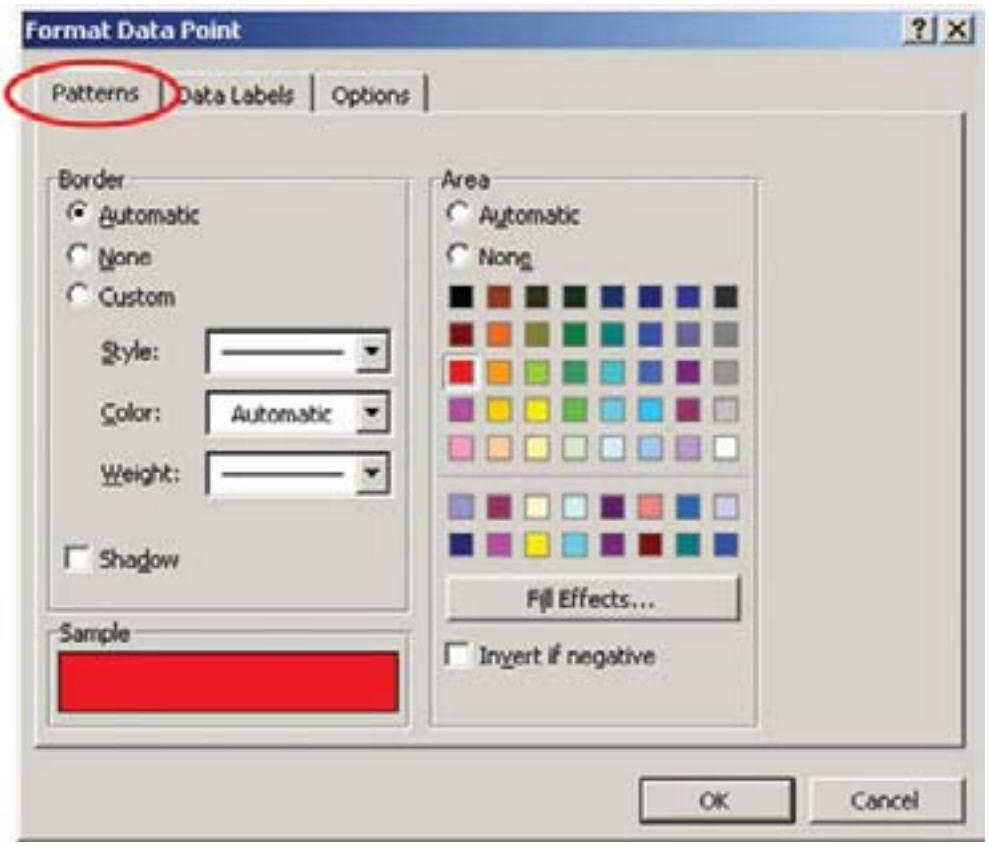
Left-click on the data point you wish to format to highlight it. In this example, the column for Sedimentation (trace) is highlighted.



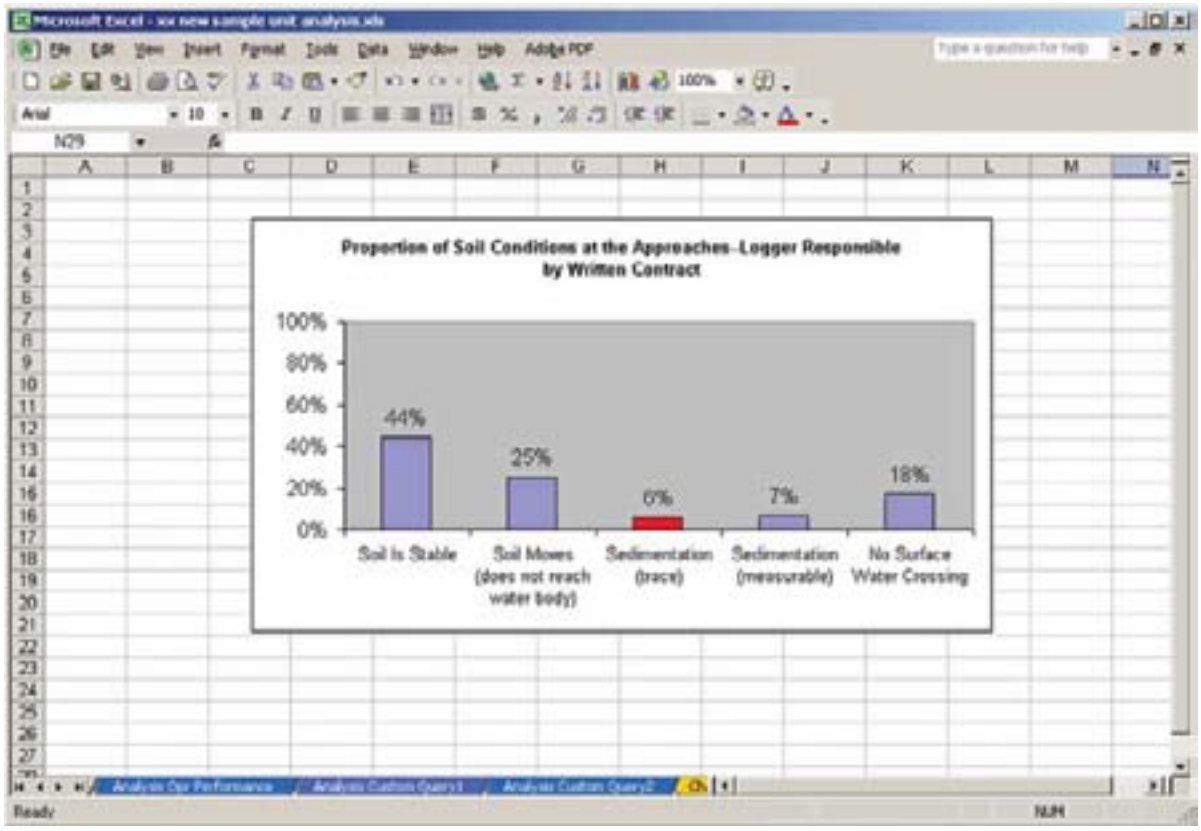
When the individual data point is highlighted, right-click and select **Format Data Point** from the drop-down menu.



Select the **Patterns** tab in the **Format Data Point** window. In the **Area** section, choose the color for the data point. The color you choose will appear in the **Sample** box in the lower left-hand corner of the window.



Select **OK** to apply the color choice to the data point.



When finished, save and close the Excel file.

There are many ways to format charts in Excel. Formatting choices should make the information presented clear and easy to read. This section presents one way to format the chart, but there are many more options than can be addressed here. In the beginning, trial and error is the best way to see the many options Excel offers for presenting information.

Creating a Custom SDS in Word

So far you have created a new query in Access, exported it to the Excel analysis file, analyzed data from the new query, and created a chart from the results. If you wish to present your work in new data summary or add it to an existing standard data summary, you need to know how to pull linked data from the Excel analysis file into a Word document. In this section, you will create a simple data summary, which will demonstrate how to link numbers and charts to a Word document.

Open the Excel analysis file before working on the new data summary. You need to have access to the information in the Excel file in order to create links in the Word document.

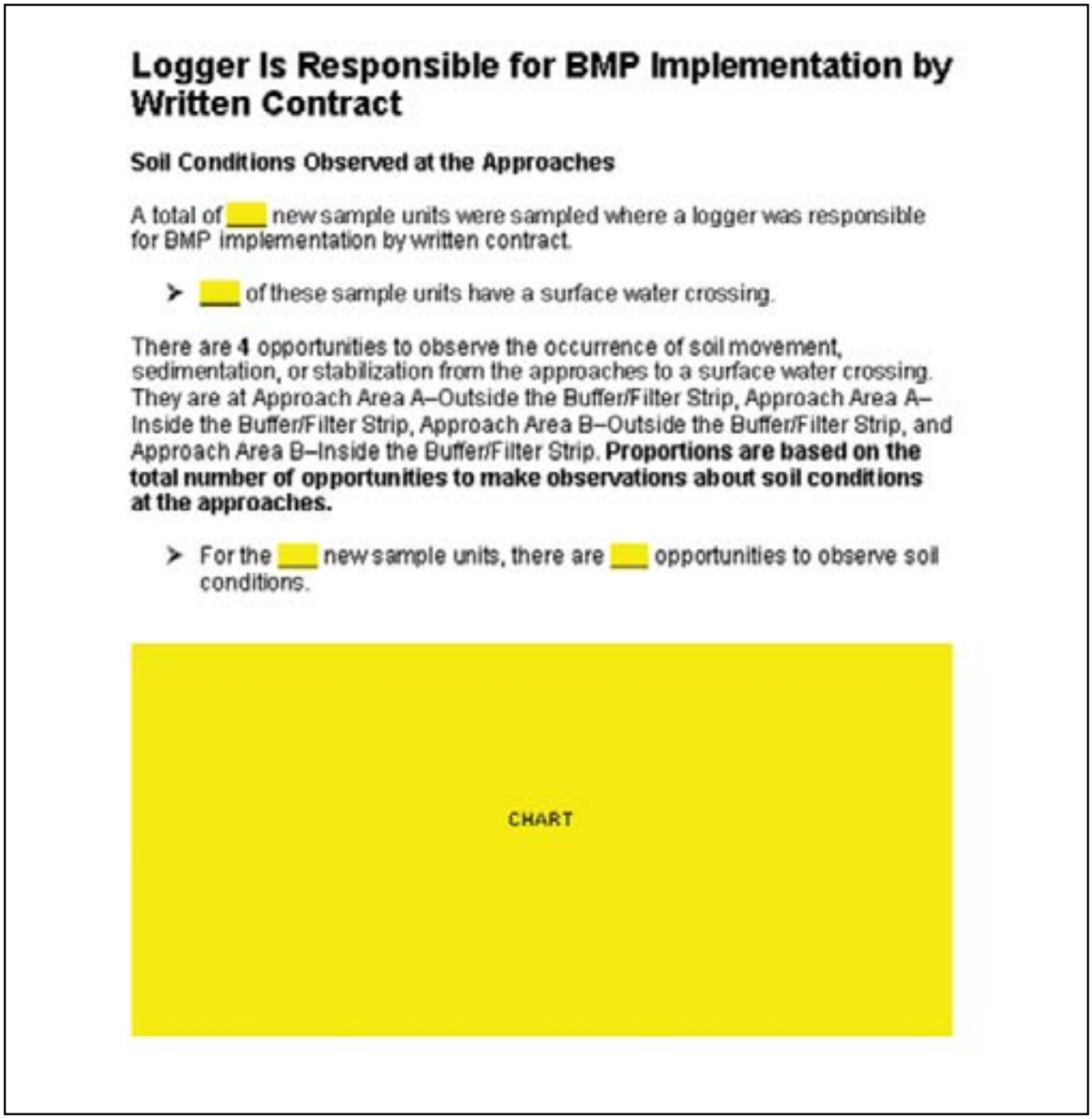
Step 5.13. Open and Name the New Word Document

Open a blank Word document and select **Save as** to name the file according to the contents of the report. In this example, the file is named **Example Approaches Loggr Cntrct SDS.doc**. Save the document in the **Sample BMP MIS** folder.

> When working with actual field data, remember to save the document in the **BMP MIS (name)** folder where the Excel analysis file is stored.

Step 5.14. Write the Report

Write the report as you would any other Word document, keeping in mind where you will locate the linked data. Highlighted areas were inserted in this example report to give some idea of how linked information from the Excel file might be used in a custom SDS. Although the format of the example follows other existing SDSs, you may format your report any way you choose.



Logger Is Responsible for BMP Implementation by Written Contract

Soil Conditions Observed at the Approaches

A total of ___ new sample units were sampled where a logger was responsible for BMP implementation by written contract.

- ___ of these sample units have a surface water crossing.

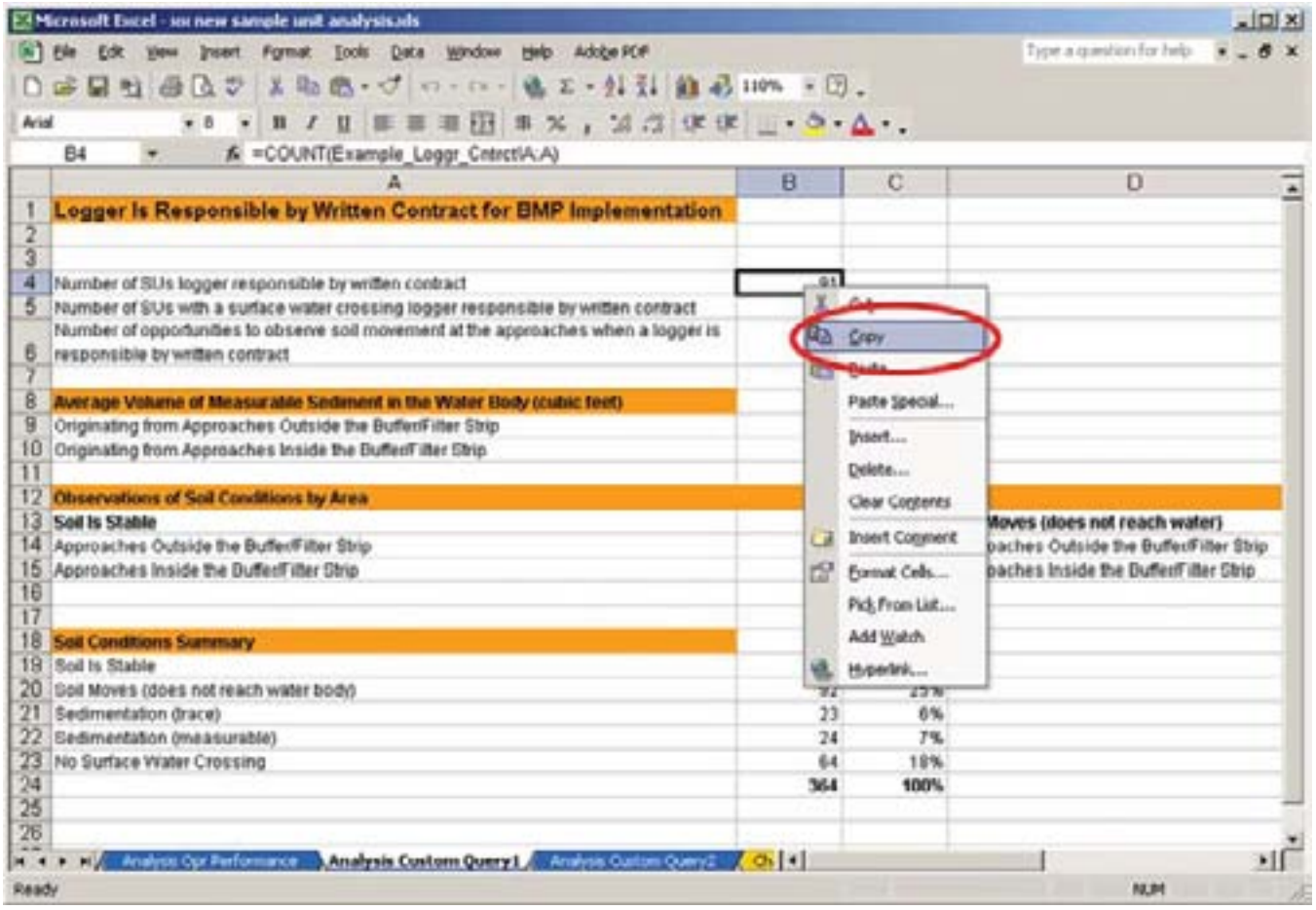
There are **4** opportunities to observe the occurrence of soil movement, sedimentation, or stabilization from the approaches to a surface water crossing. They are at Approach Area A–Outside the Buffer/Filter Strip, Approach Area A–Inside the Buffer/Filter Strip, Approach Area B–Outside the Buffer/Filter Strip, and Approach Area B–Inside the Buffer/Filter Strip. **Proportions are based on the total number of opportunities to make observations about soil conditions at the approaches.**

- For the ___ new sample units, there are ___ opportunities to observe soil conditions.

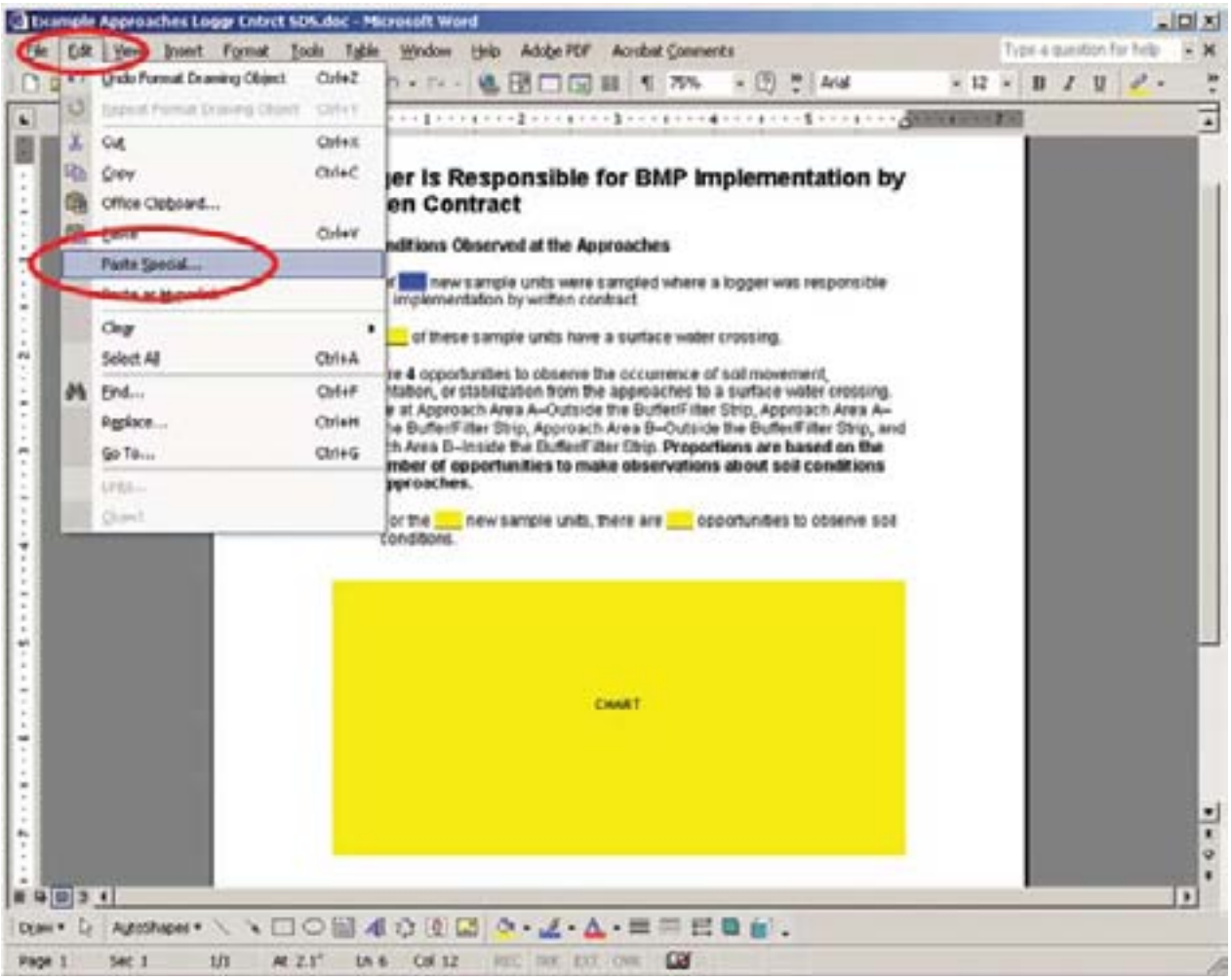
CHART

Step 5.15. Paste a Data Link Into the Word Document

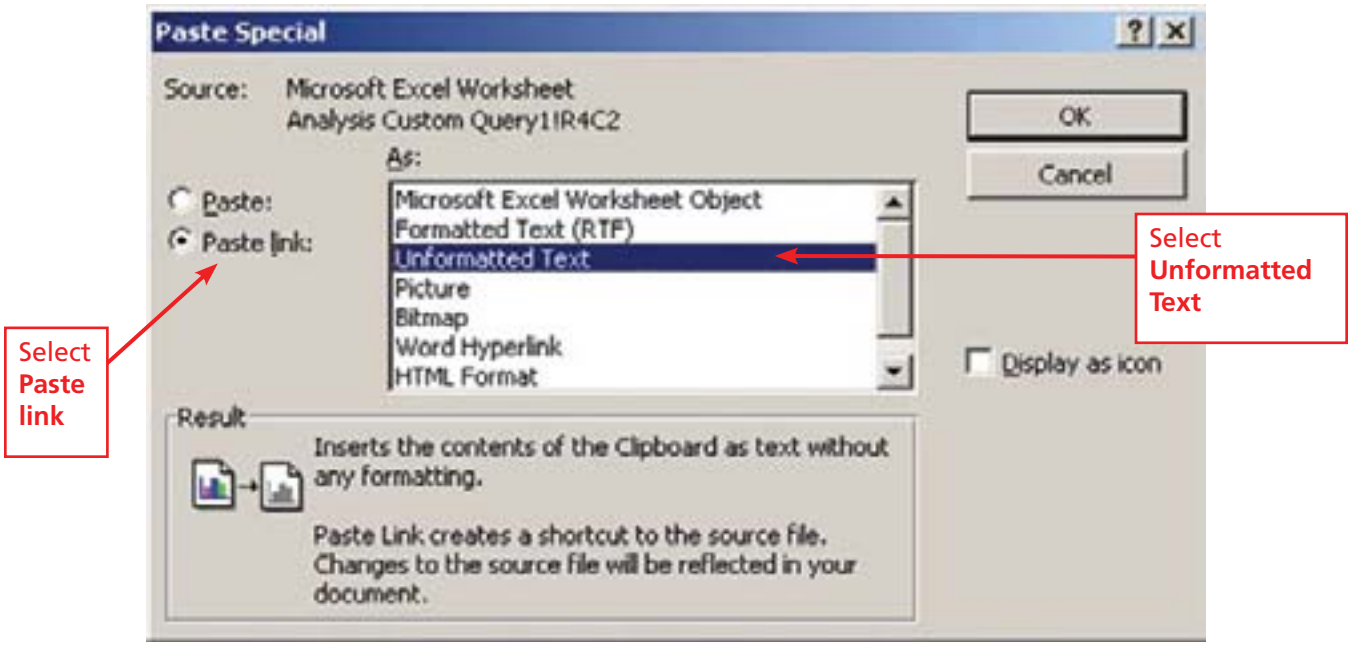
Return to the worksheet **Analysis Custom Query1** in the Excel analysis file. Right-click on the cell containing the data you wish to copy into the Word document. A drop-down menu will open. In the following example, cell B4, containing the total number of sample units, is selected. Select **Copy** from the drop-down menu. The cell border will be highlighted with a dashed line.



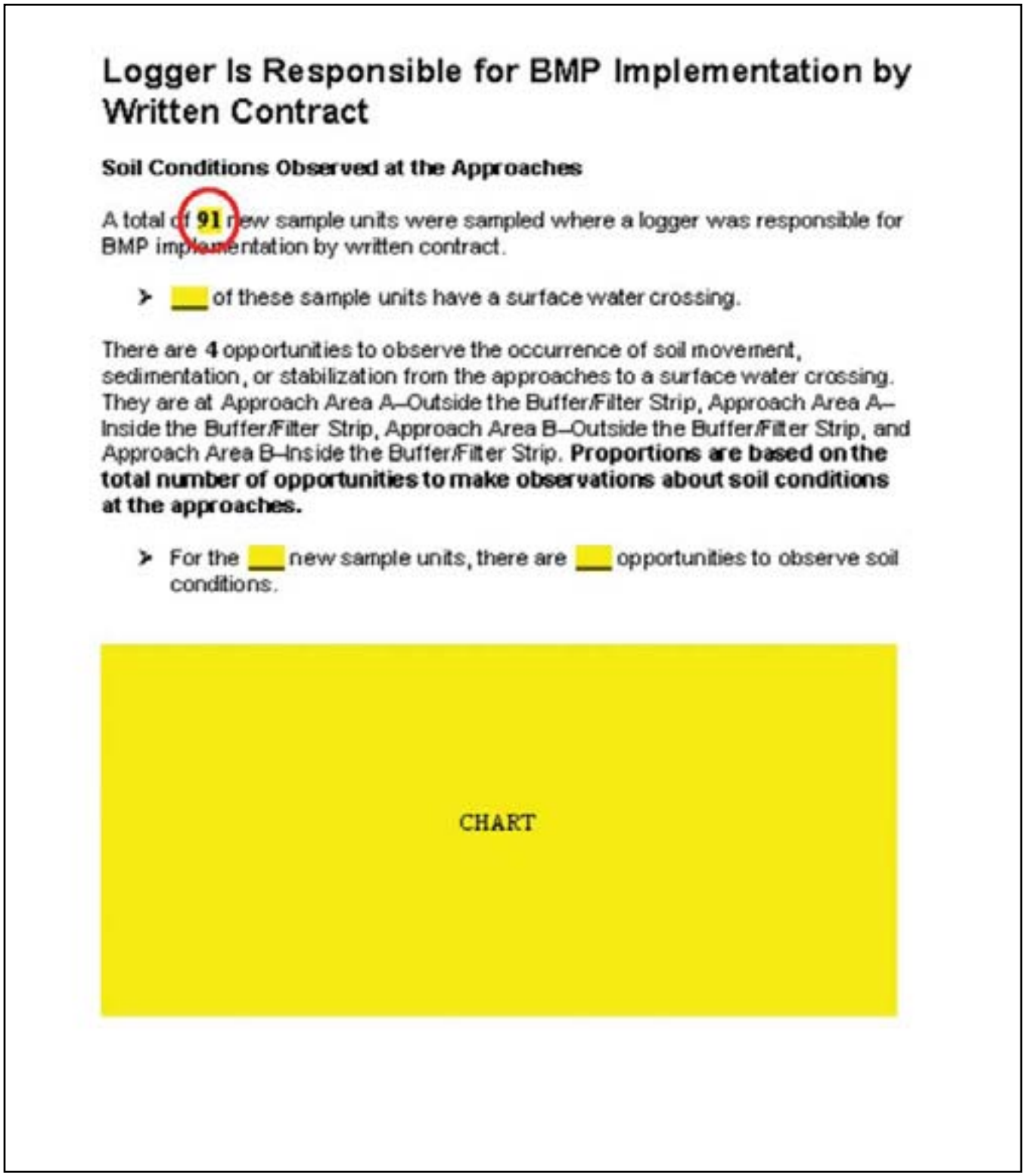
Return to the Word document and place your cursor in the location where you want the data to appear. Select **Edit** from the main toolbar and **Paste Special** from the drop-down menu.



The **Paste Special** window will open. Word defaults to the **Paste** option. Select the **Paste link** option on the left side of the window. In the **As:** box, select **Unformatted Text**.



By selecting **Unformatted Text**, only the data in the cell will be pasted into the Word document. You will be able to format the font, font size, and font style to match the rest of the document later. Select **OK**. The data from cell B4 is inserted into the Word document.



Logger Is Responsible for BMP Implementation by Written Contract

Soil Conditions Observed at the Approaches

A total of **91** new sample units were sampled where a logger was responsible for BMP implementation by written contract.

- ___ of these sample units have a surface water crossing.

There are **4** opportunities to observe the occurrence of soil movement, sedimentation, or stabilization from the approaches to a surface water crossing. They are at Approach Area A–Outside the Buffer/Filter Strip, Approach Area A–Inside the Buffer/Filter Strip, Approach Area B–Outside the Buffer/Filter Strip, and Approach Area B–Inside the Buffer/Filter Strip. **Proportions are based on the total number of opportunities to make observations about soil conditions at the approaches.**

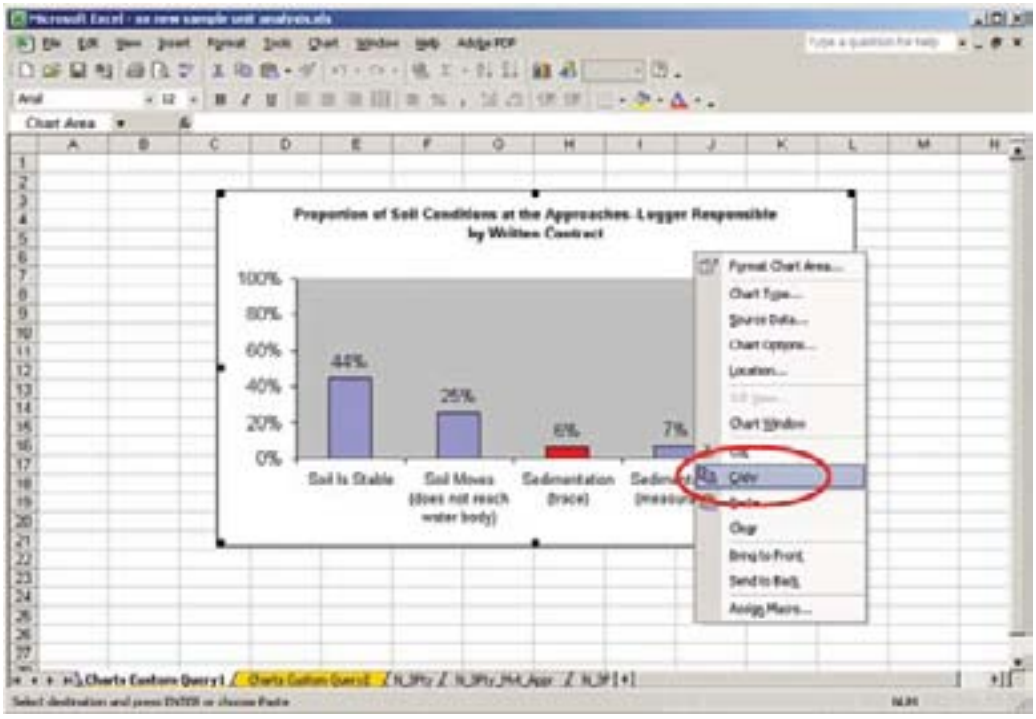
- For the ___ new sample units, there are ___ opportunities to observe soil conditions.

CHART

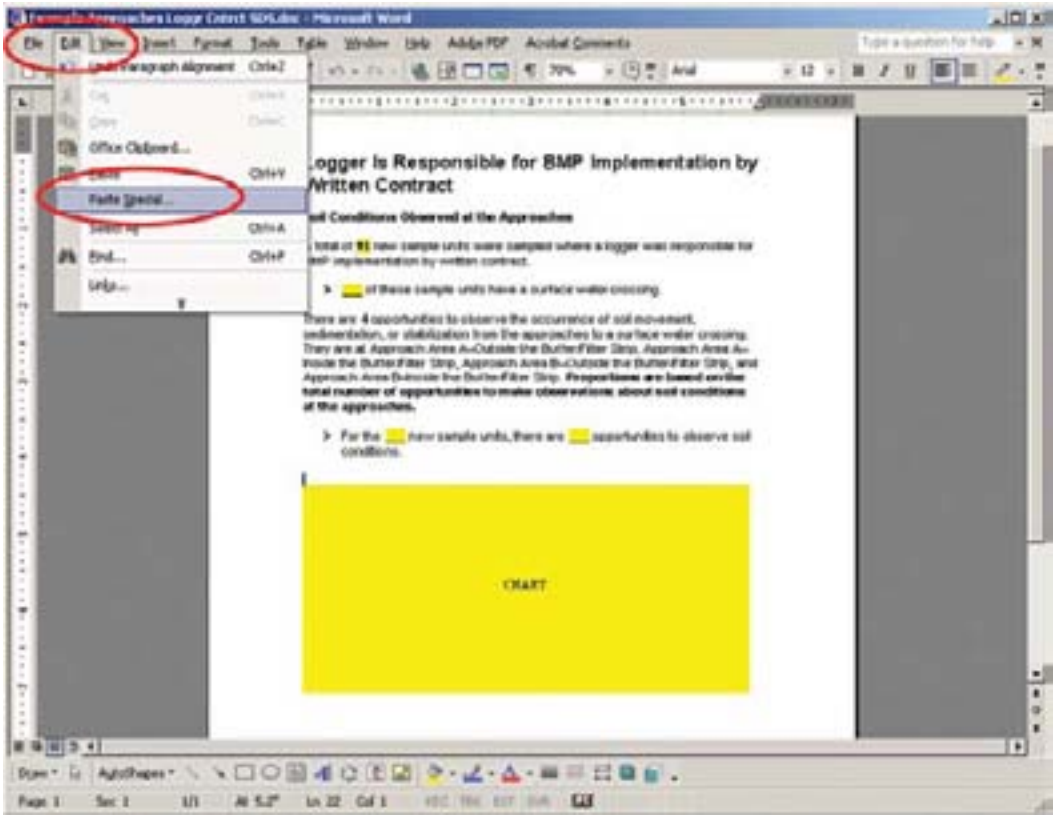
Repeat this process (step 5.15) for each data point you wish to include in the report.

Step 5.16. Paste a Chart Link Into the Word Document

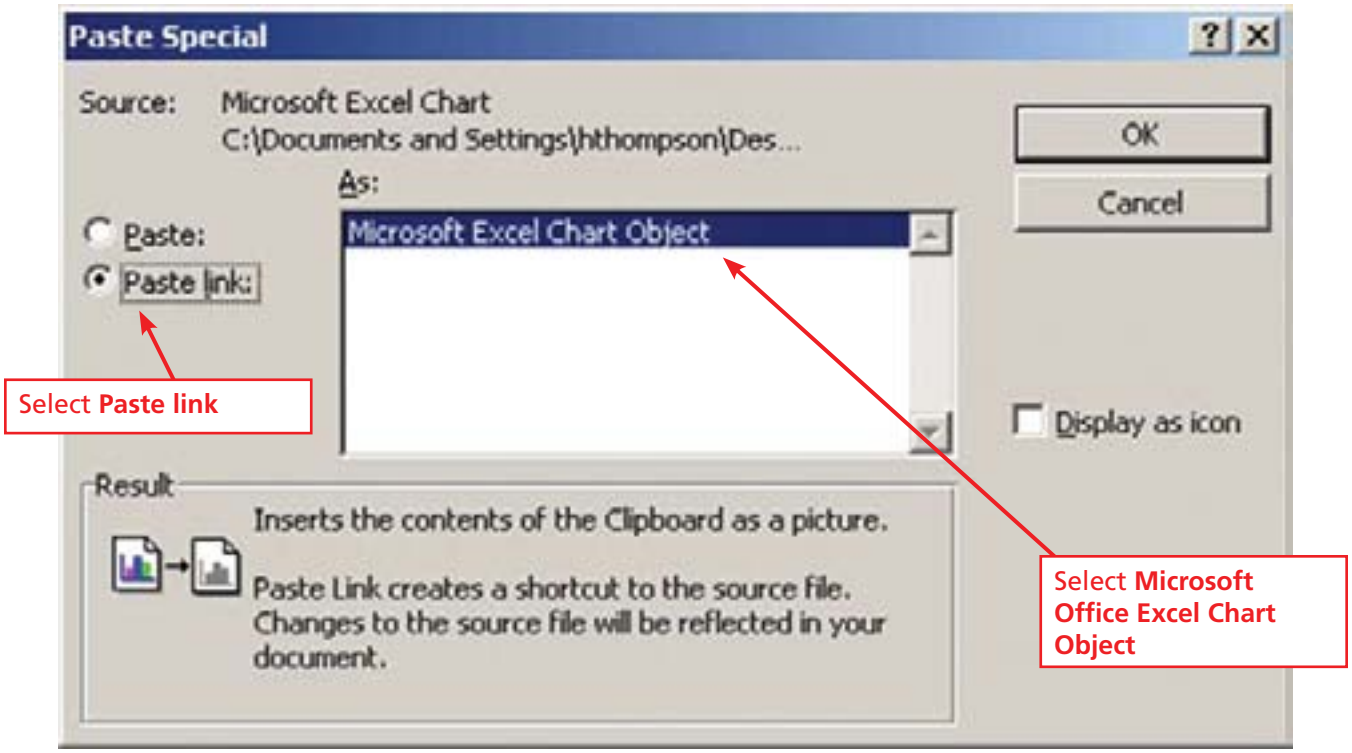
Navigate to the worksheet in the Excel analysis file containing the chart you wish to import into the Word document (in this example, it is **Charts Custom Query1**). Right-click on the chart and select **Copy** from the drop-down menu.



The chart border will be highlighted with a dashed line. Return to the Word document and place your cursor in the location where you want the chart to appear. Select **Edit** from the main toolbar and **Paste Special** from the drop-down menu.



The **Paste Special** window will open. Word defaults to the **Paste** option. Select the **Paste link** option. In the **As:** box, select **Microsoft Office Excel Chart Object**.



Select **OK**. The chart will be pasted into the Word document.

Repeat this process (step 5.16) for each chart you wish to include in the report.

The report now appears as follows; the yellow highlighted areas represent live links with the Excel analysis file. Save and close the file when finished.

Logger Is Responsible for BMP Implementation by Written Contract

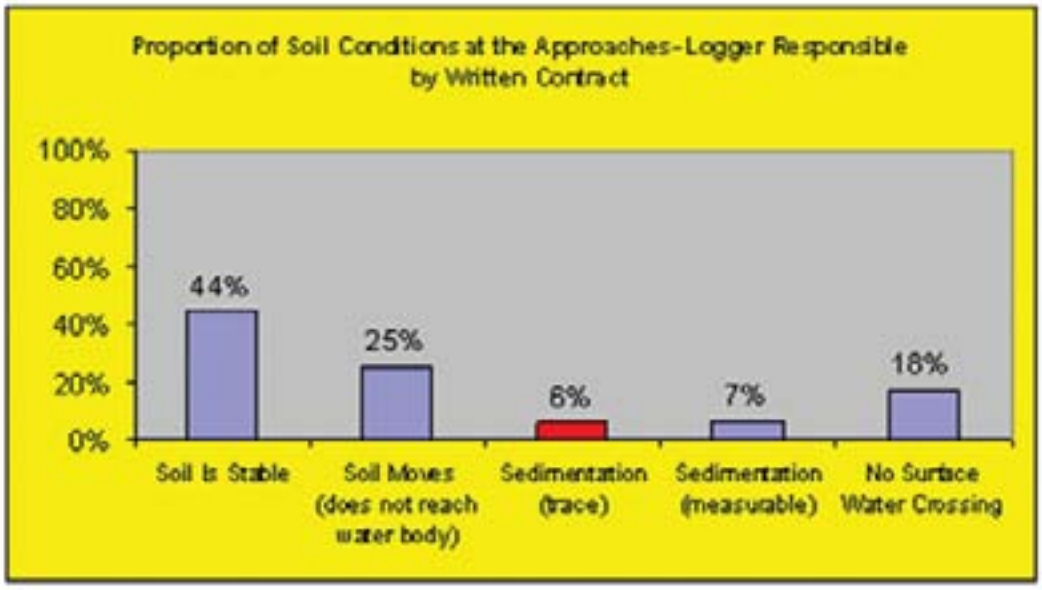
Soil Conditions Observed at the Approaches

A total of **91** new sample units were sampled where a logger was responsible for BMP implementation by written contract.

- **75** of these sample units have a surface water crossing.

There are **4** opportunities to observe the occurrence of soil movement, sedimentation, or stabilization from the approaches to a surface water crossing. They are at Approach Area A–Outside the Buffer/Filter Strip, Approach Area A–Inside the Buffer/Filter Strip, Approach Area B–Outside the Buffer/Filter Strip, and Approach Area B–Inside the Buffer/Filter Strip. **Proportions are based on the total number of opportunities to make observations about soil conditions at the approaches.**

- For the **91** new sample units, there are **364** opportunities to observe soil conditions.



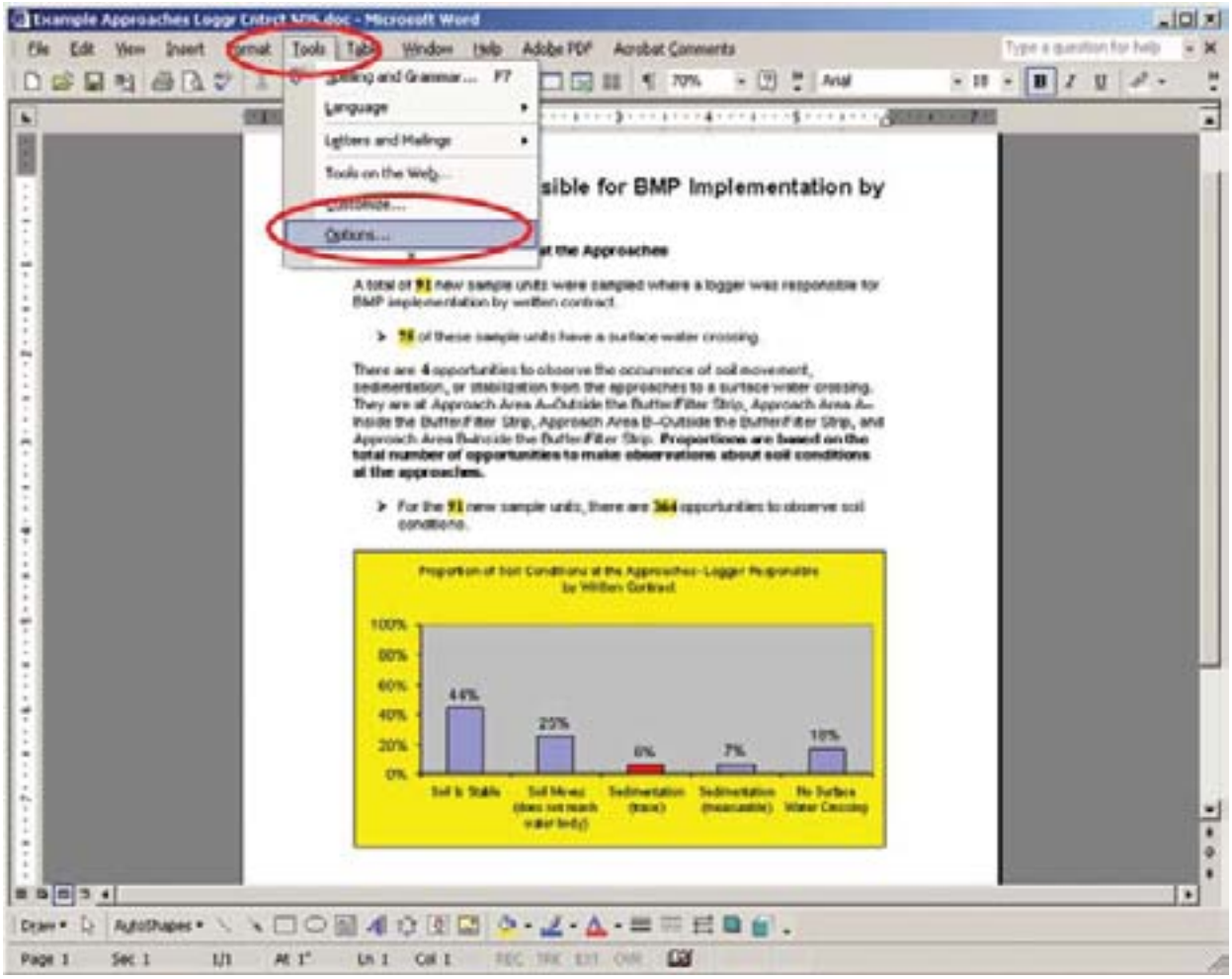
Important: Once you have established links in a Word document, you **cannot** move data in the source Excel worksheet. If you move data in the Excel worksheet, including adding or deleting rows or columns, the links in the Word document will be lost or different data will be pulled into the Word document inadvertently. Word will only look to the **original location** of the data when the link is established. Avoid rearranging the Custom Query worksheets in the Excel file after your data summary is complete. If links are broken or incorrect data is imported to the Word document unintentionally, you must reestablish the links in the Word document, following the instructions included in steps 5.15 and 5.16.

Step 5.17. Update the Links

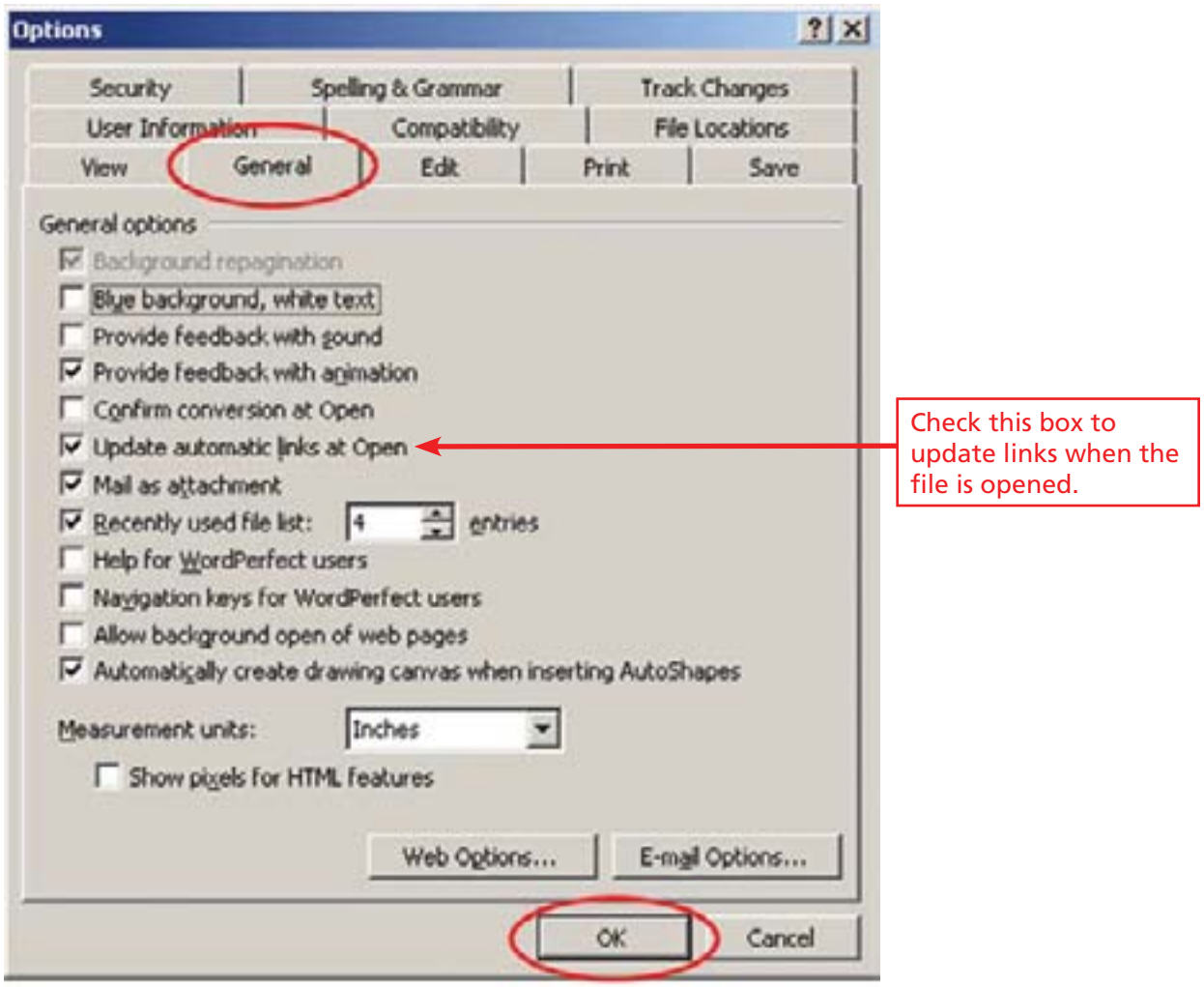
You have the option of having the links updated automatically when the Word document is opened, or you may update the links manually.

5.17a. Automatic Update

To set your links to update automatically when the Word document is opened, select **Tools** from the main toolbar and **Options** from the drop-down menu.



The **Options** window will open. Select the **General** tab. Check the box **Update automatic links at Open** (fifth item down) and select **OK**.



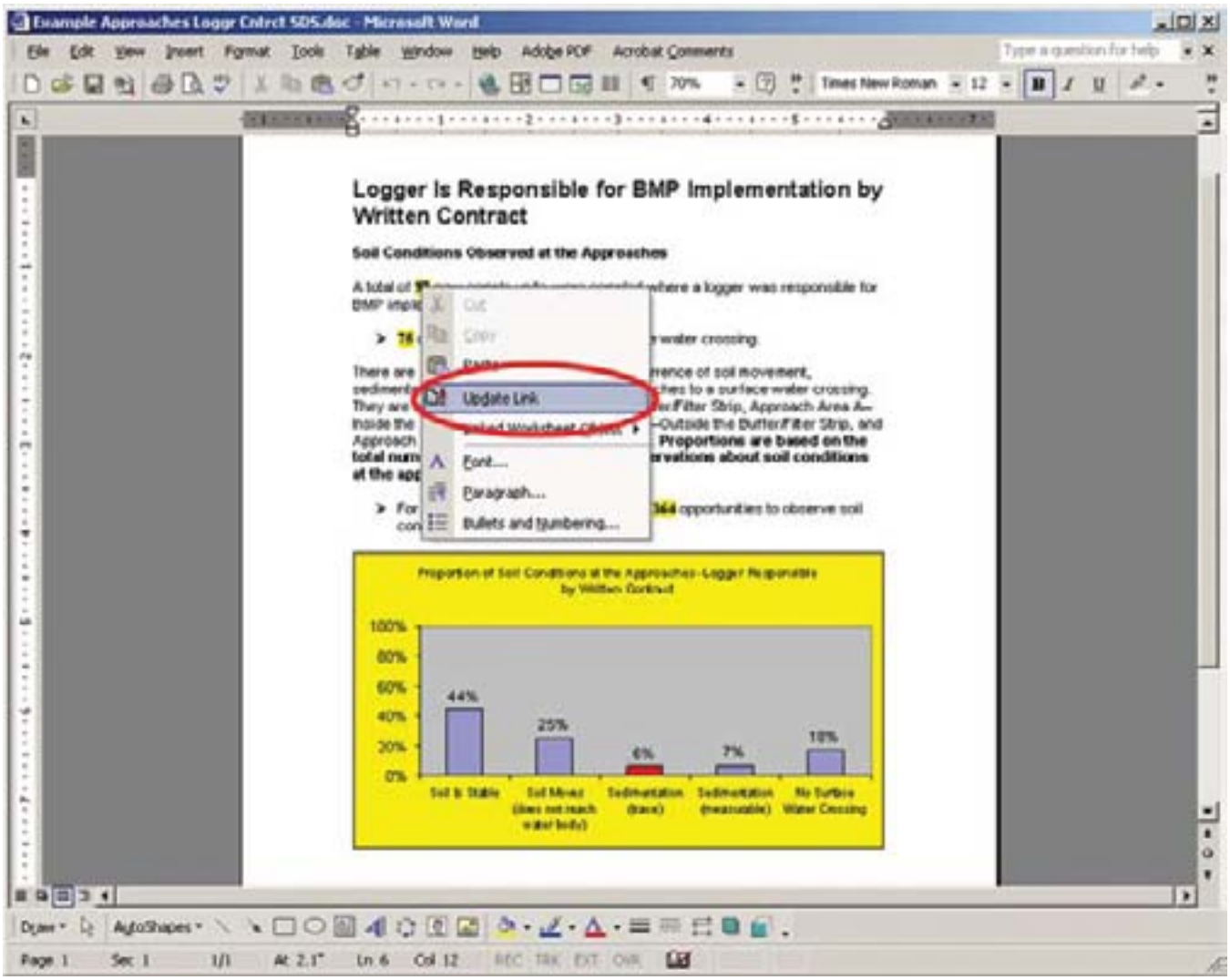
Word will prompt you to update the links each time you open the document with the following dialog box. Select **Yes ONLY if data have been changed or updated in the Excel analysis file**; otherwise, select **No**.

Important: It is **not** necessary to update links every time the document is opened. Update the links **only when data have been changed or updated in the Excel analysis file**.

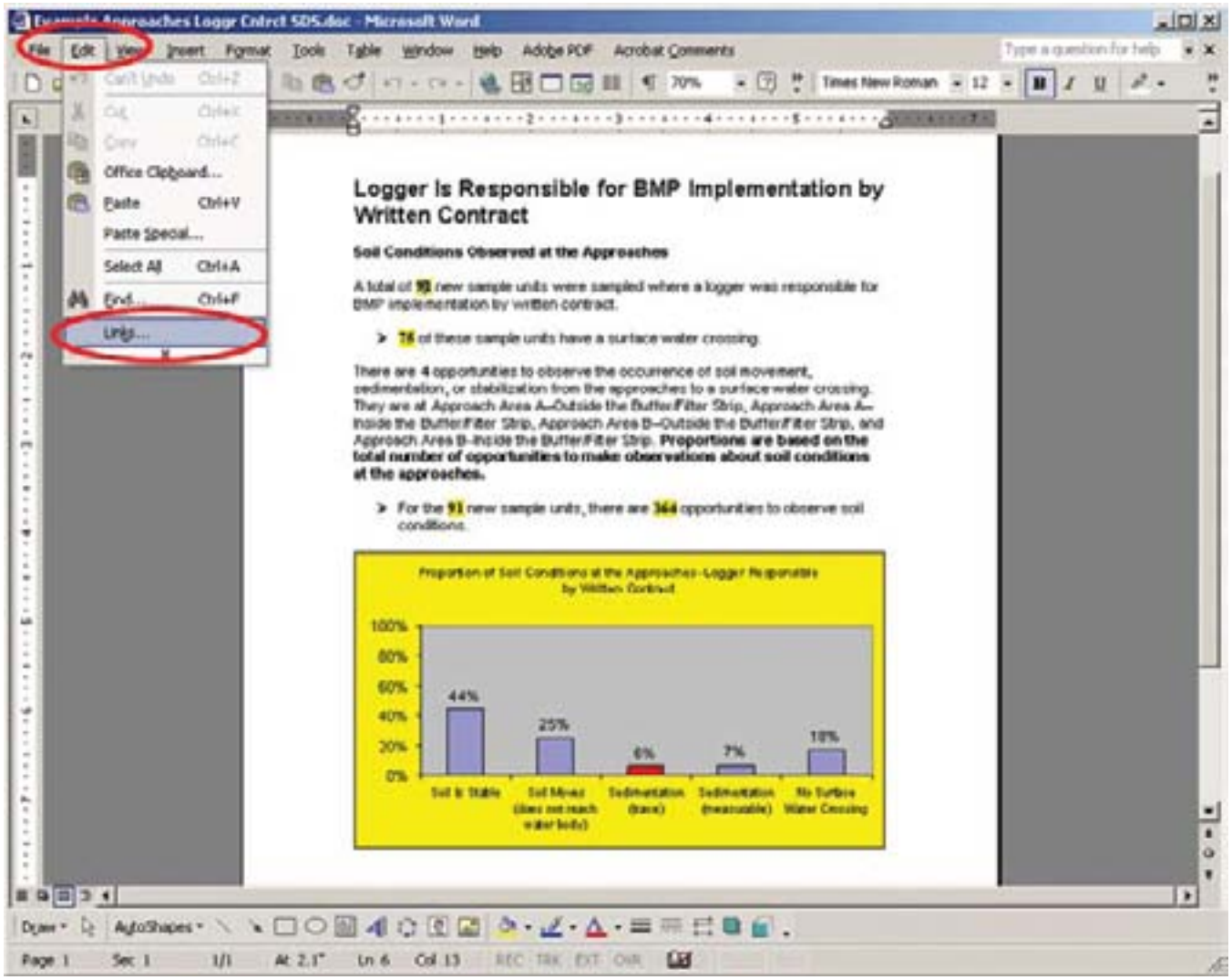
5.17b. Manual Update

If you wish to leave the update automatic links option off, you may still update links manually when working in the Word document. There are two ways to do this.

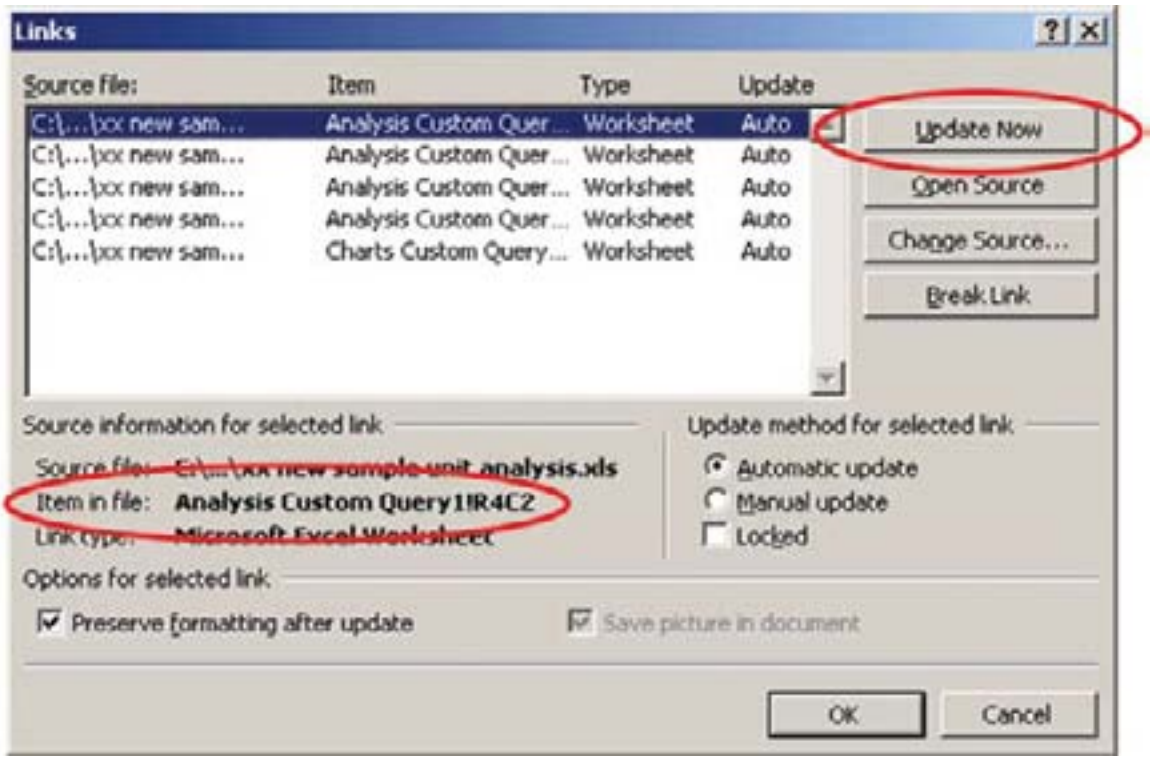
You may edit individual links by right-clicking on the linked data or chart, and selecting the **Update Link** option from the drop-down menu. When you choose this option, Word simply retrieves the data and updates the selected link. An alternate method is to highlight the linked information and press the **F9** key.



You may update a single link or multiple links by selecting **Edit** from the main toolbar and **Links** from the drop-down menu.

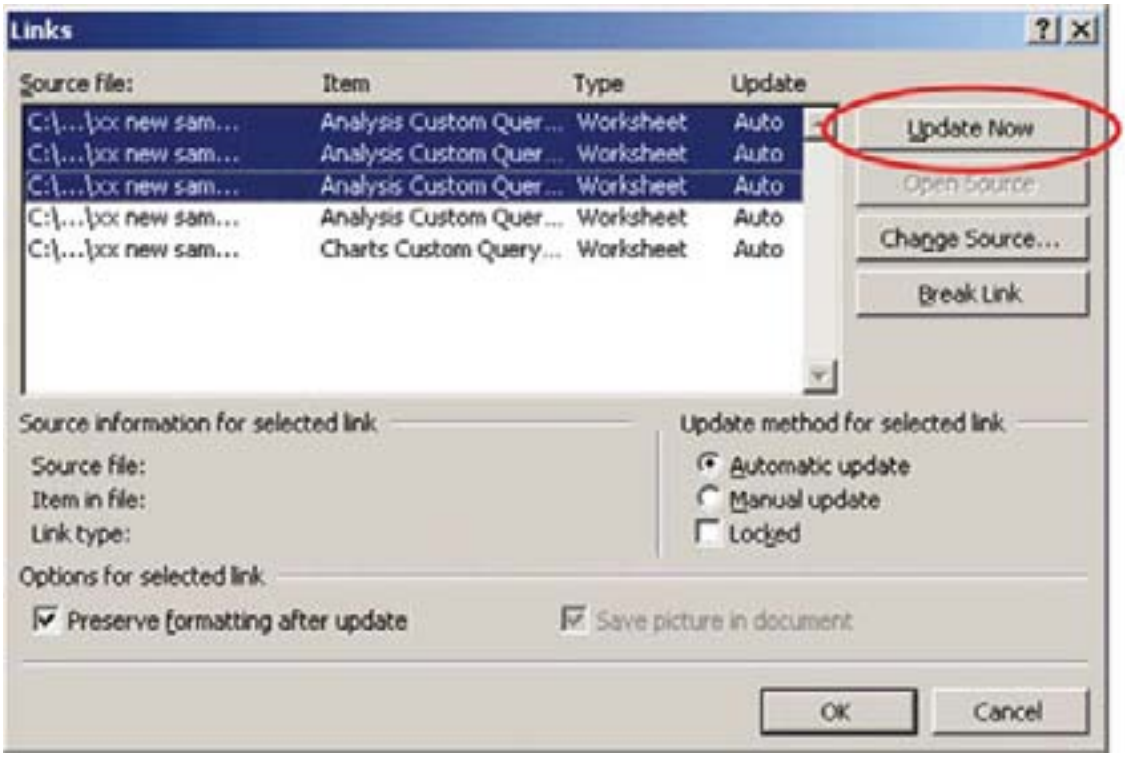


The **Links** window will open displaying a list of all the links in the document and the path to the linked file where the data are stored (the Excel analysis file). The location of the linked data appears in the **Item in file** entry. The worksheet name is followed by the cell address ("R" equal row and "C" equals column). To update a single link, highlight it and select the **Update Now** button.



To update several links at the same time, select the first link and hold down the **Shift** key and the **down arrow** key to highlight multiple links. Then select **Update Now**.

In the example below, the three links are selected for updating.



After updating is complete, select **OK** to close the **Links** window and continue working in the Word document.

You now have the basic information necessary to create and manage custom queries and data summaries. There are many possibilities for querying BMP protocol data.

> **Remember**: Although you are not required to experiment with the practice files provided in the **Sample BMP MIS** folder, we recommend you do so to become confident before working with actual field data.

Removing Worksheet Protections From the Excel Analysis File

Because information in the Excel analysis file is linked directly to the SDS templates, the analysis and charts worksheets in the file are **protected**, meaning you cannot edit or change the worksheet contents or layouts without removing the worksheet protections. The protections are intended to prevent losing the electronic links in the SDS template files or pulling the incorrect information into an SDS file.

This section includes instructions for removing the protections in the event that a change must be made on a protected worksheet. However, it is important to understand that **deleting cells, rows, or columns, or moving information in a worksheet in the Excel analysis file will result in problems with linked data in other locations.** Links in the SDS files can be reestablished following the instructions in steps 5.15 and 5.16. Although it is possible to reestablish links in the SDS file, this process can be time consuming and confusing; therefore, it is **not** recommended.

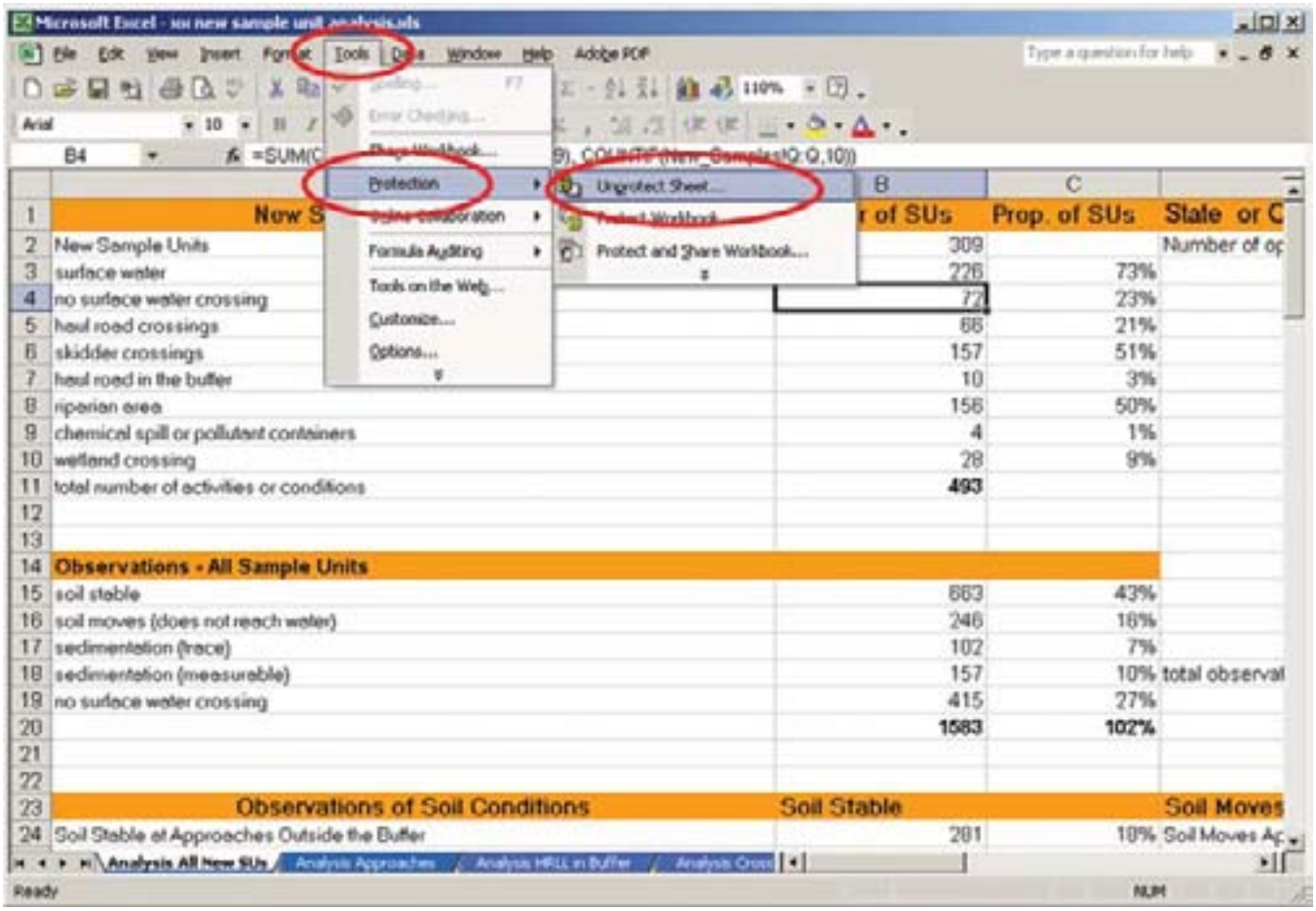
> **Important**: It is strongly recommended that you do **not** remove the worksheet protections.

Step 5.18. Remove the Worksheet Protections

If you attempt to change information in an analysis or charts worksheet in the Excel analysis file, you will see the following error message.

Select **OK** if it is necessary to make a change to the worksheet.

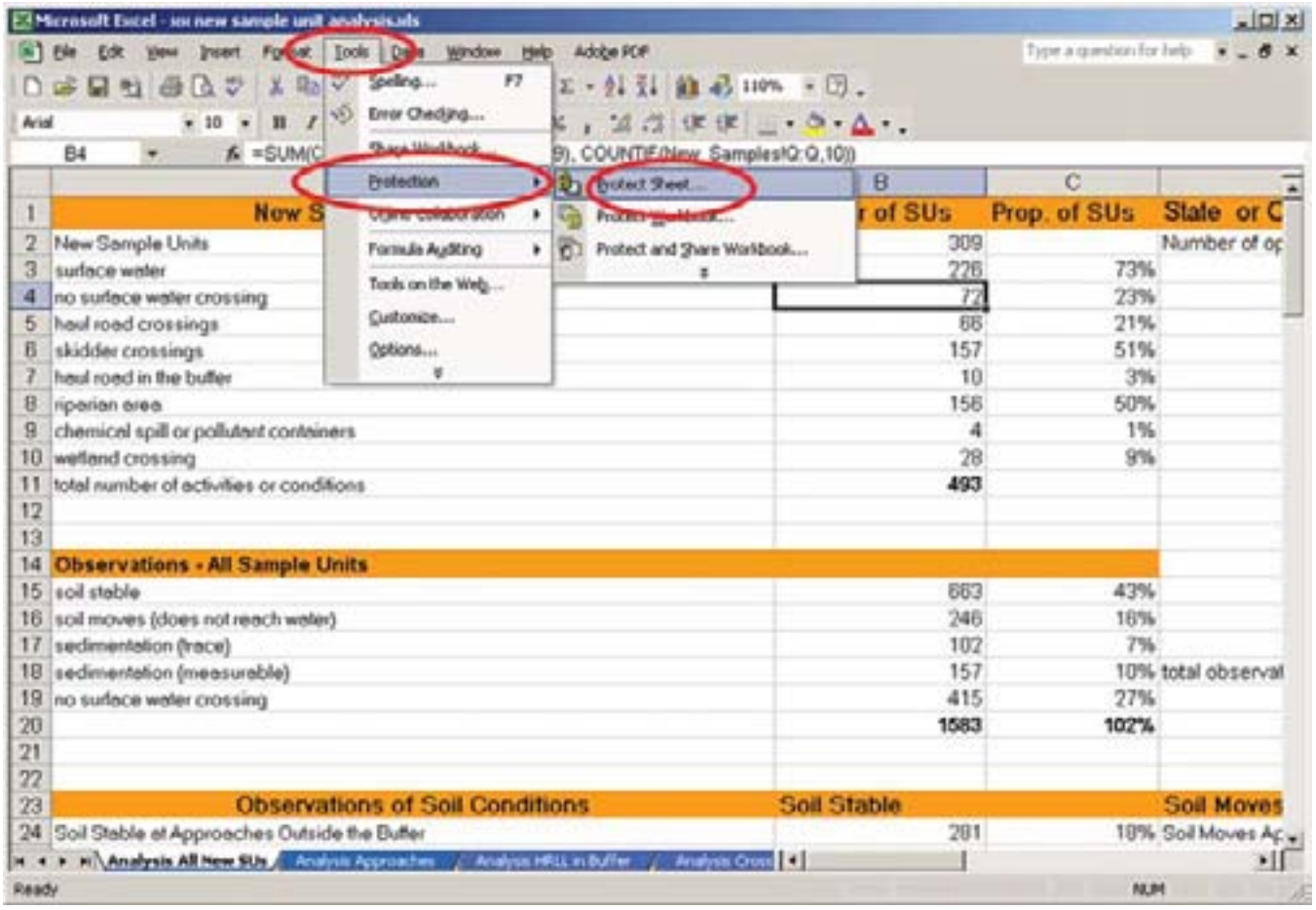
Select **Tools** from the main toolbar, and select **Protection** and **Unprotect Sheet** from the drop-down menus.



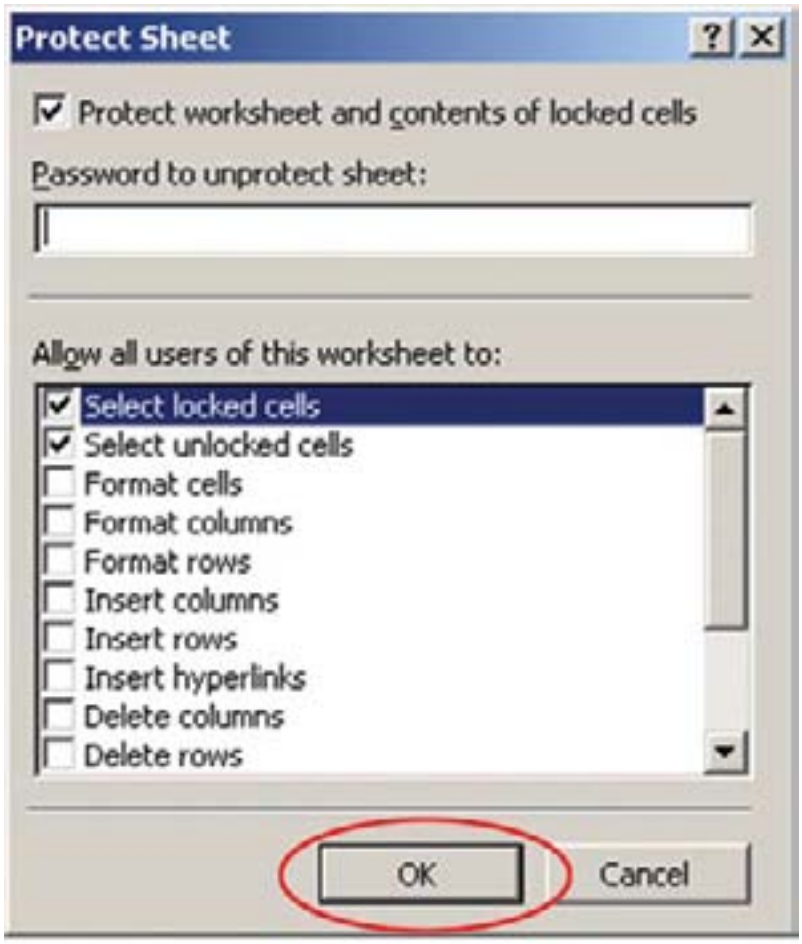
Note that although the worksheet is protected, **it is not password protected**. You will not be prompted for a password. Any necessary changes may be made at this time.

Step 5.19. Replace the Worksheet Protections

When edits are complete, it is important to replace the worksheet protections. Select **Tools** from the main toolbar, and select **Protection** and **Protect Sheet** from the drop-down menus.



The **Protect Sheet** window will open. Leave the selections at the default settings and select **OK**.



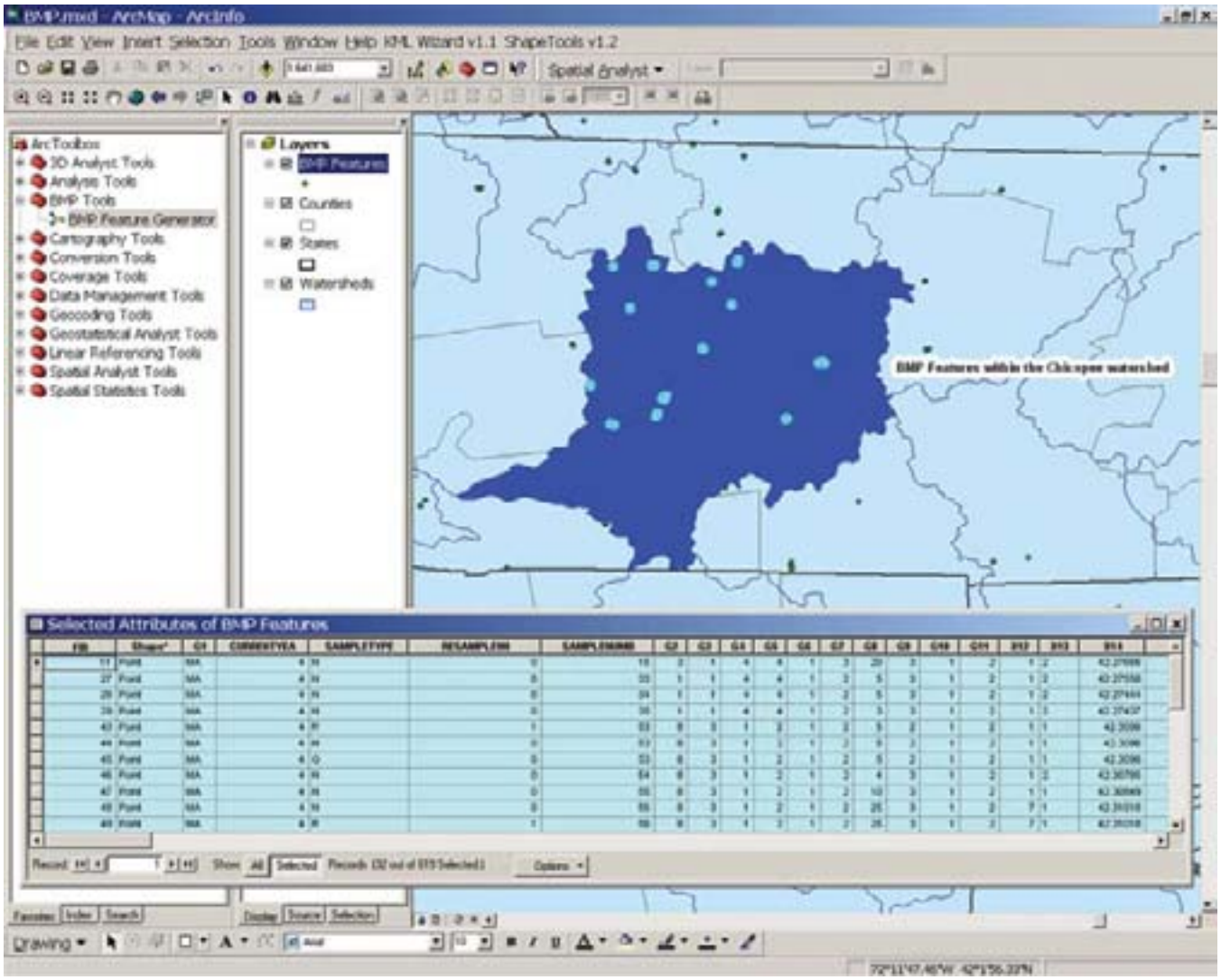
If you choose to add a password in order to unprotect the worksheet, you need to enter that password when attempting to unprotect that worksheet in the future. **It is strongly recommended that you do NOT enter a password to protect the worksheet.**

When changes are made in the Excel analysis file that may affect the links in the SDS templates, it is important to open the appropriate SDS file, update the links, and check the file carefully to be certain all links are correctly maintained. If the links are incorrect, follow the instructions in steps 5.15. and 5.16 to reestablish the links.

Chapter 6—Performing Spatial Queries

When evaluating BMP use and effectiveness, it is sometimes desirable to separate data based on various geographical units. For instance, you may want to evaluate only the BMP data occurring within a specific State, county, or watershed. You may do so by selecting BMP data samples, based on their GPS-derived coordinates. This procedure is known as a spatial query.

A Geographic Information System (GIS) may be used to perform custom spatial queries based on the relationships among BMP sample units and the features in other spatial datasets. The resulting data file may then be used with the BMP MIS in creating standard data summaries and a Comprehensive Standard Data Summary for the geographical area selected. The screen below shows a sample data file and map for the Chicopee watershed in Massachusetts.



This chapter provides instructions for using the BMP Feature Generator, a query tool created for use in conjunction with ESRI (Environmental Systems Research Institute) ArcMap GIS software. The BMP Feature Generator can be used to create a limited field data table, called a point shapefile, containing the data for sample units within a given geographic area from the records in your Excel field data file, which you created when you uploaded your field data to your desktop computer. For the purposes of this chapter, this file will be referred to as **BMP Field Data.xls**; you most likely will have assigned it a different name during the uploading process. **A copy of the BMP Feature Generator is included on the CD provided with the BMP desk reference. It must**

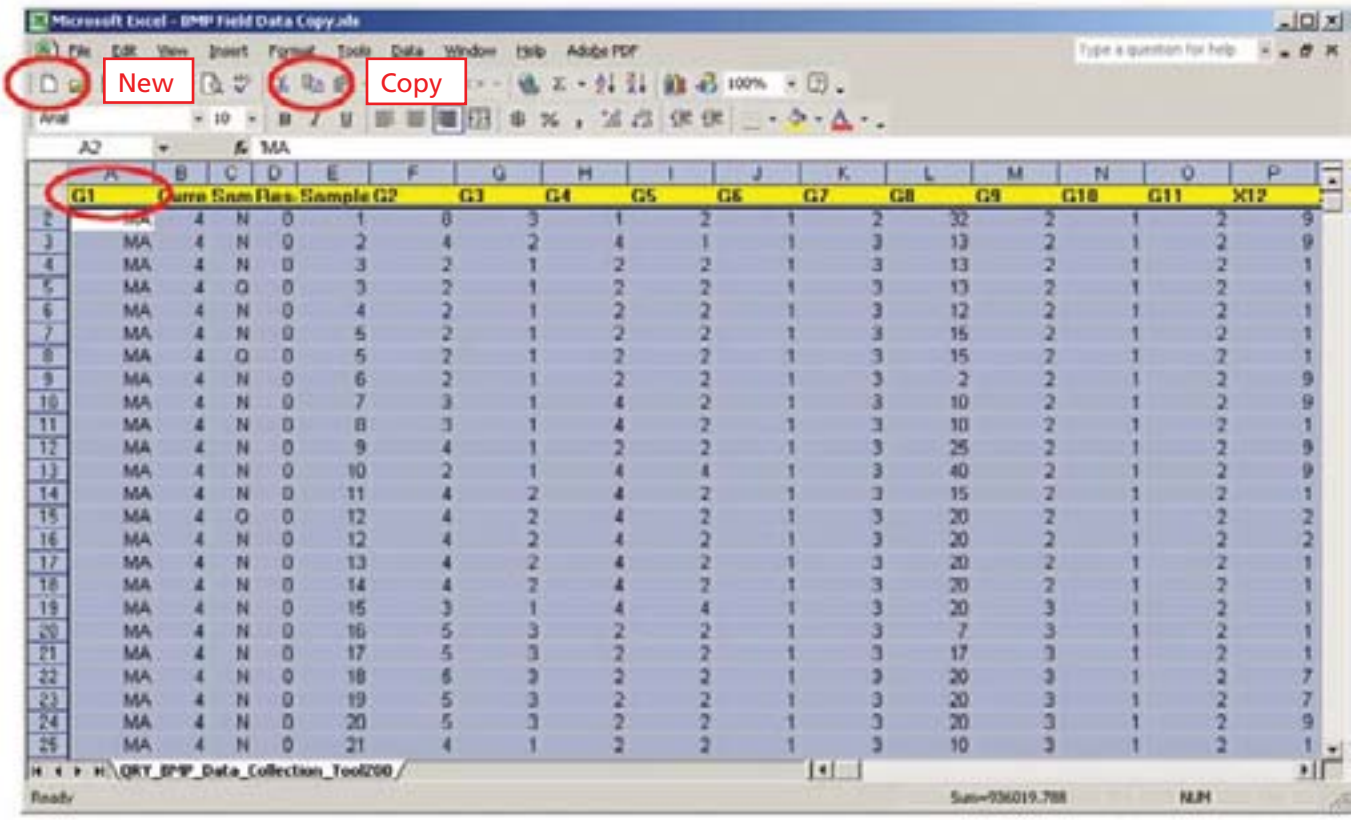
be copied onto your computer's C: drive (with the path C:\BMP\GIS) in order for it to work correctly. (If you followed the instructions in chapter 3, it should already be filed in the proper location.) Data files created using the BMP Feature Generator should be saved in a project folder (e.g., **BMP MIS (name)**) and used to generate SDSs for that project.

> Your Excel field data file is used to generate the standard data summaries and is password protected so that it will continue to work properly with the SDS generating files. To use the BMP Feature Generator, you must make an unprotected copy of your Excel field data file (**BMP Field Data.xls** in this example) and save it in the **C:\BMP\GIS** folder.

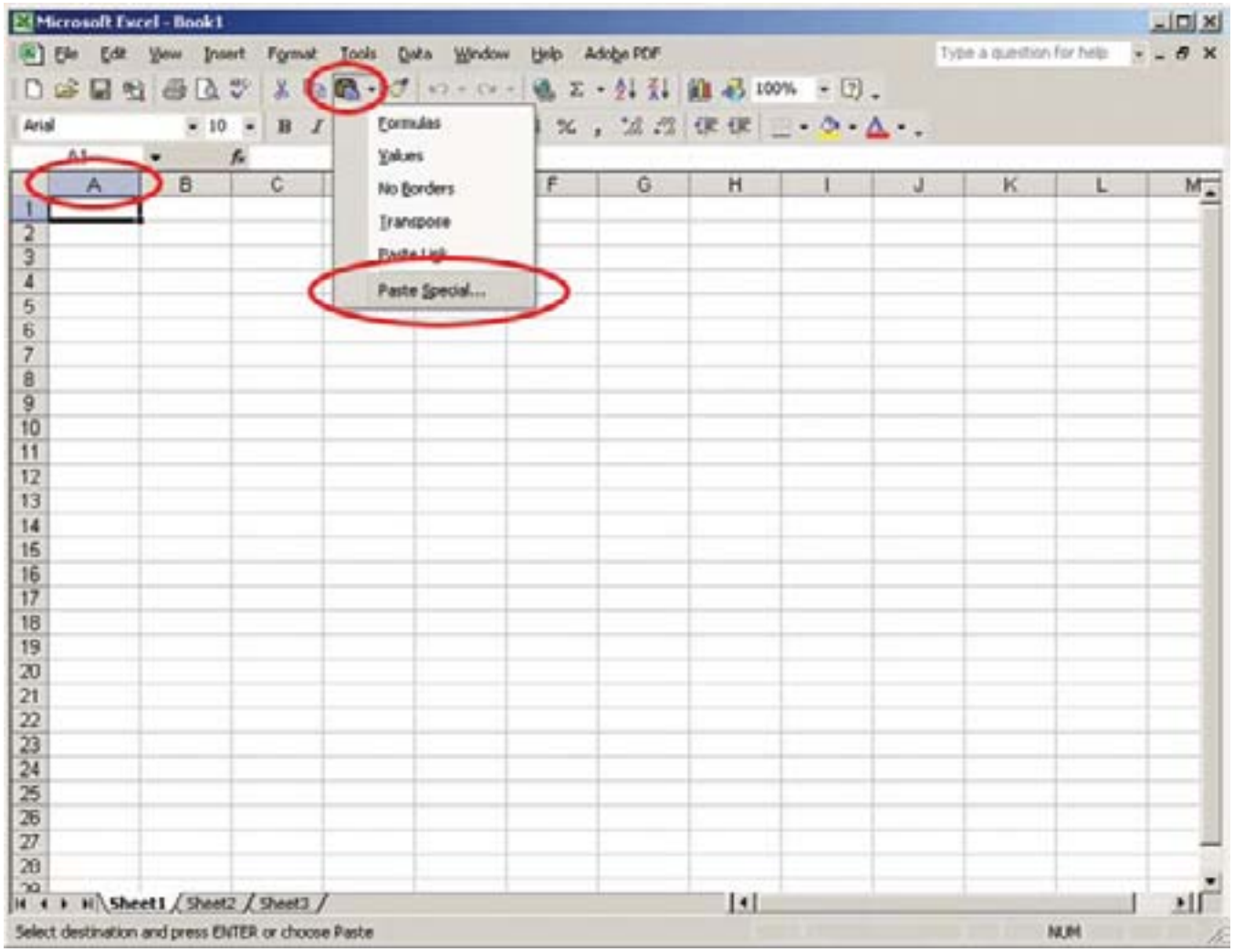
This chapter demonstrates the procedure for using the BMP Feature Generator to create a spatial query. Data for the Chicopee watershed in Massachusetts was used for instructional purposes, but no practice data file is included in the BMP MIS. You must use your own data to create spatial queries.

Step 6.1. Create a .dbf File From the .xls File

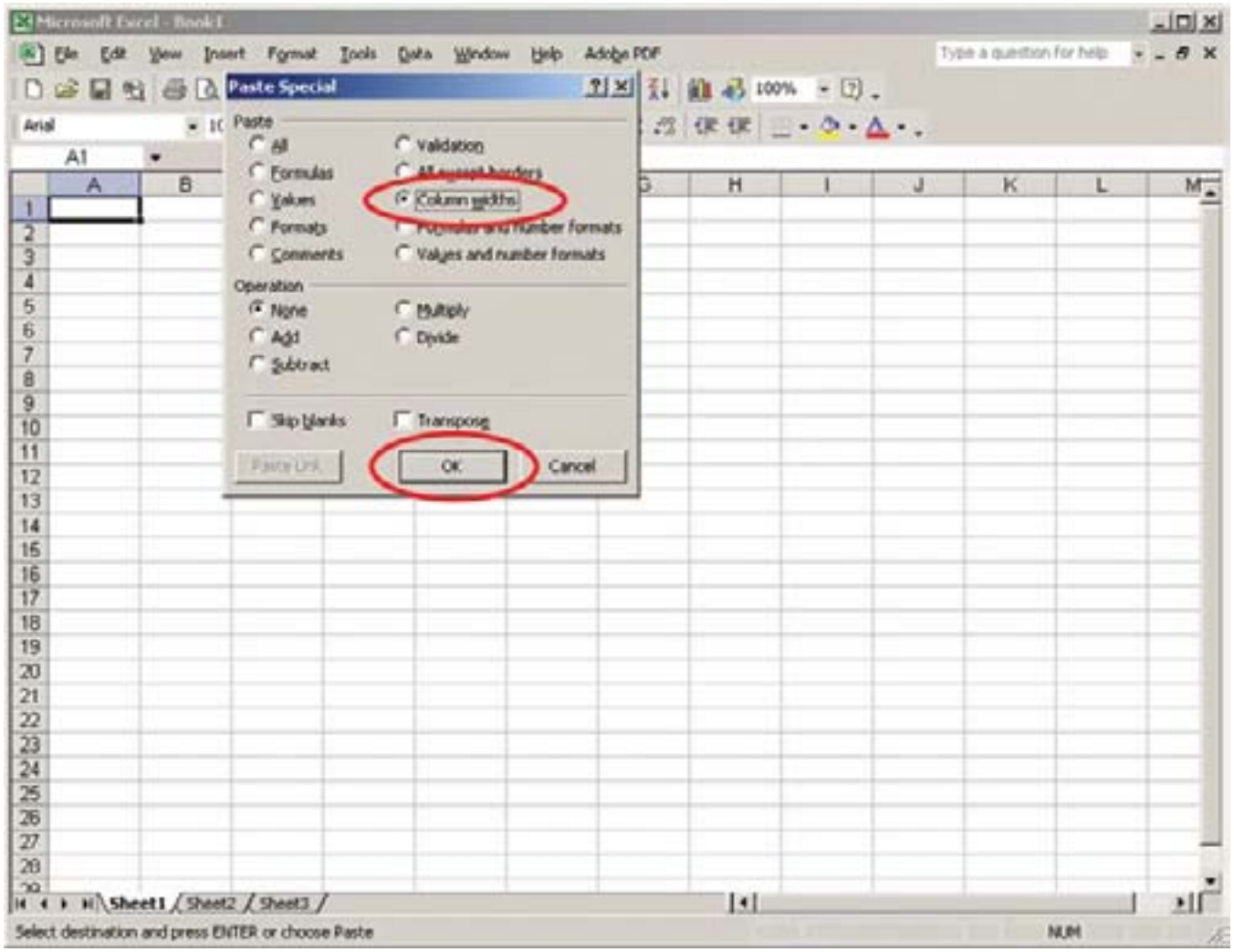
Navigate to the unprotected copy of your **BMP Field Data.xls** file in the **C:\BMP\GIS** folder and double-click on the file name to open it. Click on cell **A1** in the upper left-hand corner of the worksheet. Hold down the shift key and click on the lowest cell in the last column that contains data, at the extreme lower right of the worksheet (not shown on the screen capture). Check to see that the highlighted portion includes all columns and rows that contain data. Then select the **Copy** icon and the **New** icon on the toolbar at the top of the worksheet to open a new worksheet.



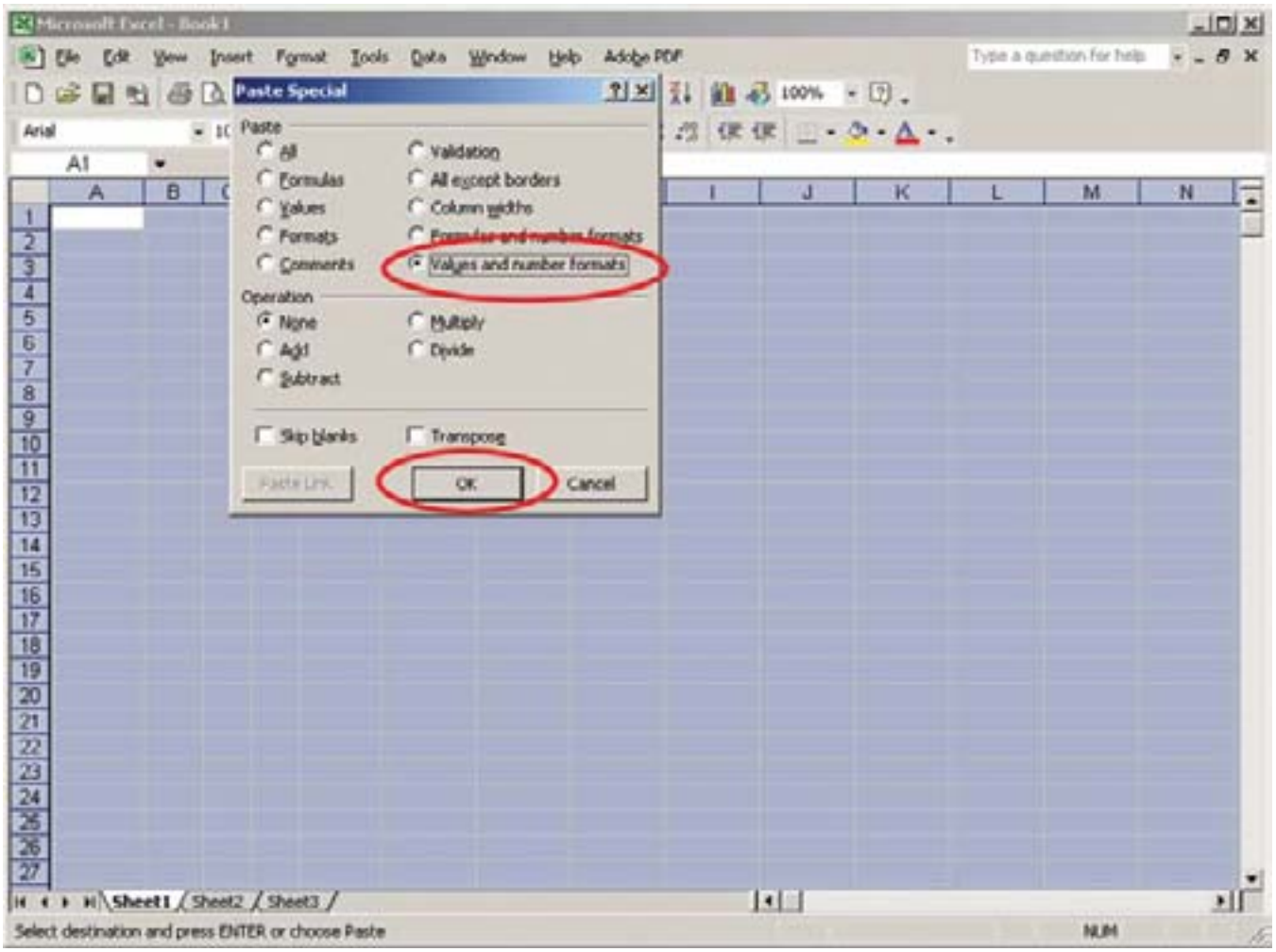
In the new worksheet, click on cell **A1**. Click the down arrow to the right of the **Paste** icon on the toolbar at the top of the worksheet. Select **Paste Special** from the drop-down menu.



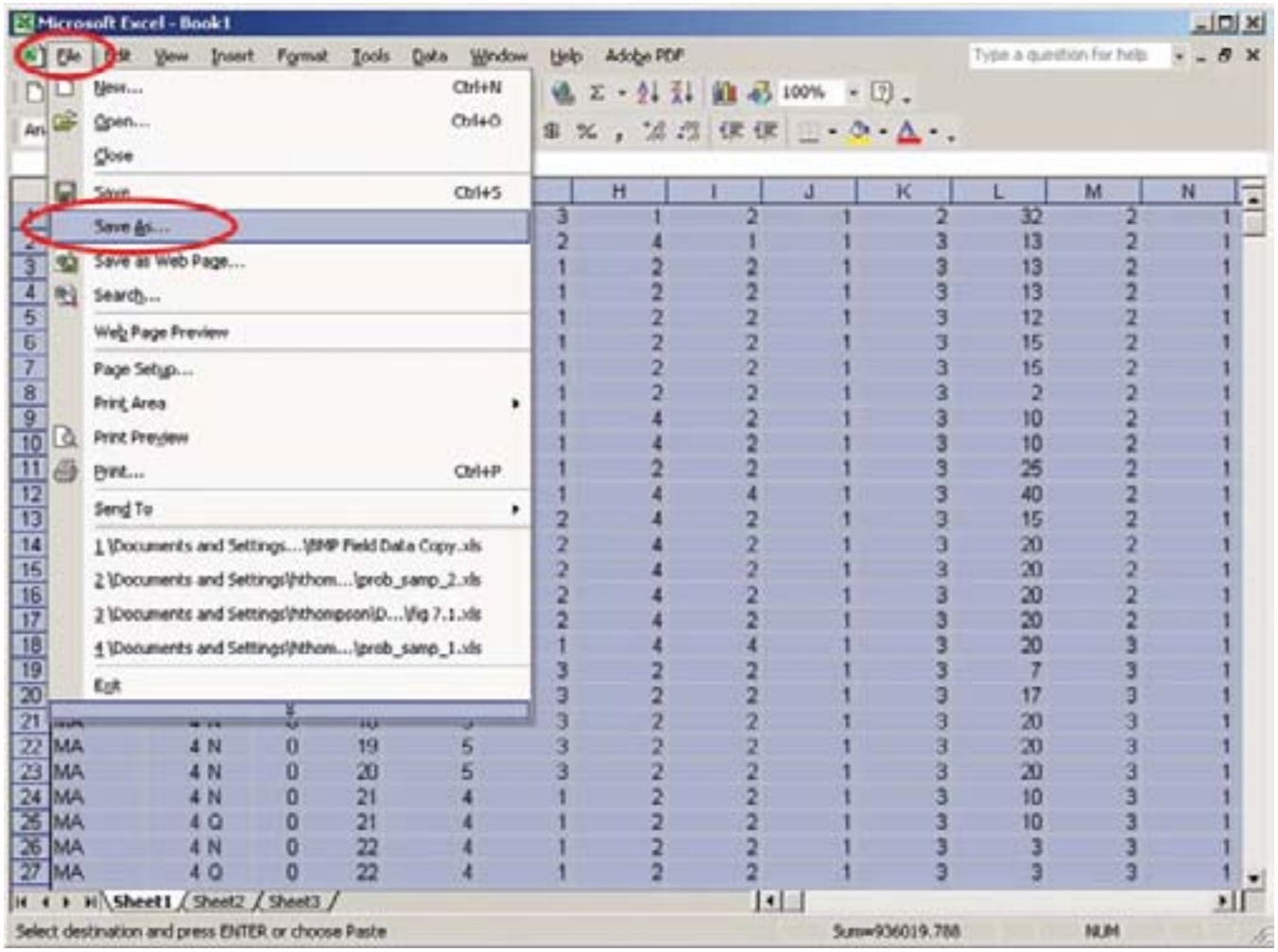
The **Paste Special** window will open. Check **Column widths** and select **OK**.



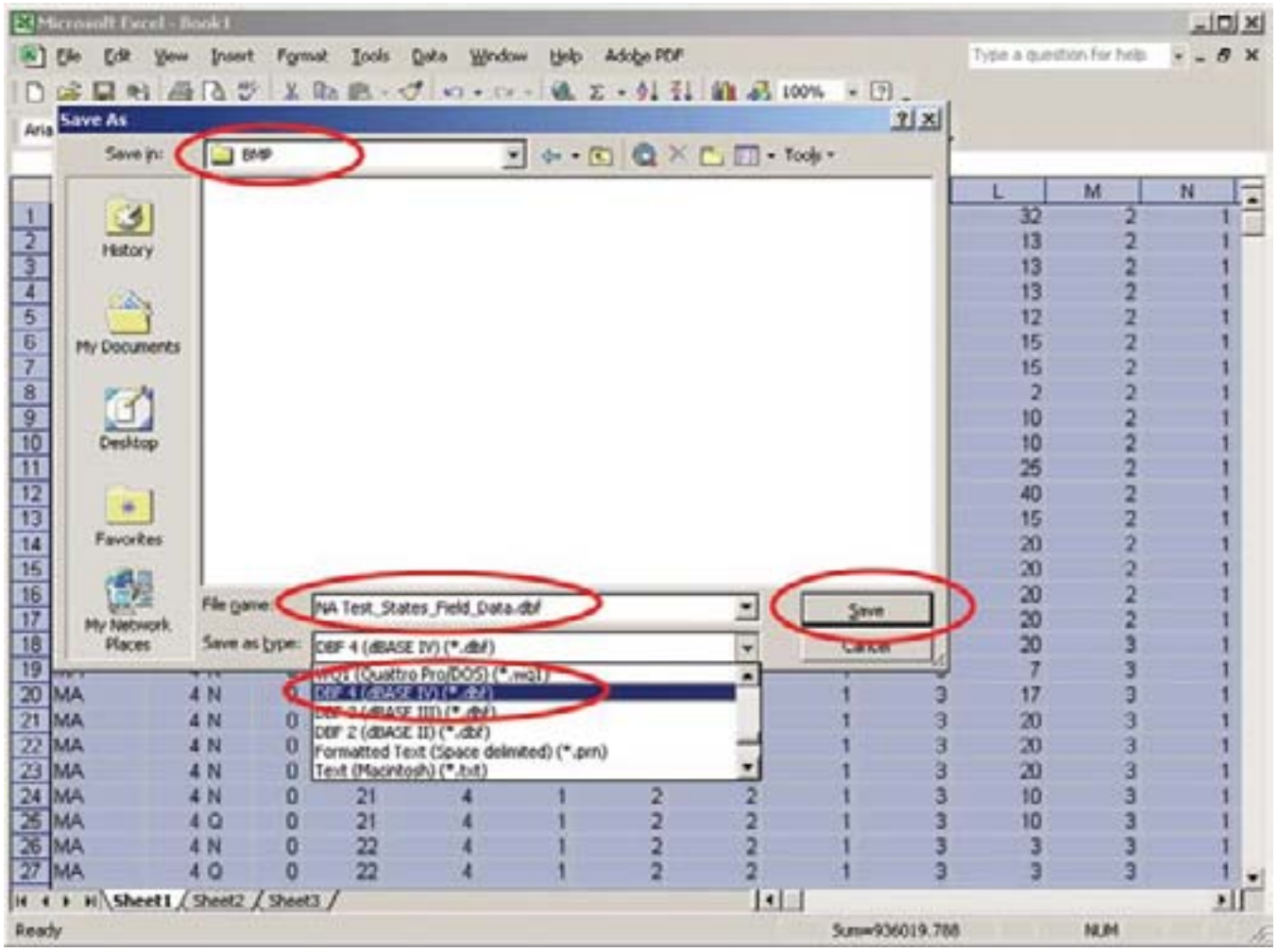
Click the down arrow to the right of the **Paste** icon on the toolbar again. Select **Paste Special** from the drop-down menu. Check **Values and number formats** and select **OK**.



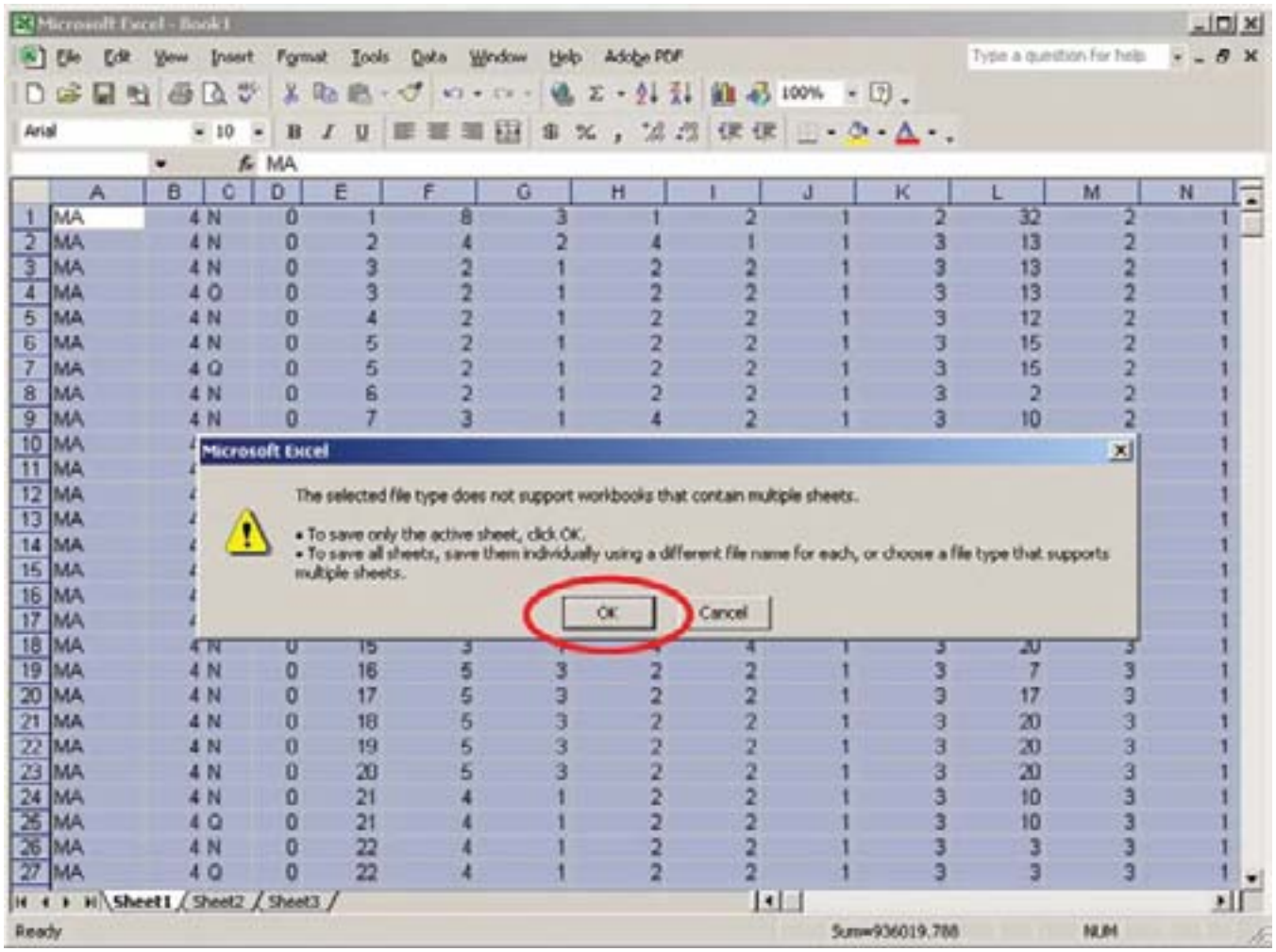
The data from your **BMP Field Data.xls** will be copied into the new worksheet in the correct format. Select **File** from the main toolbar and **Save As** from the drop-down menu.



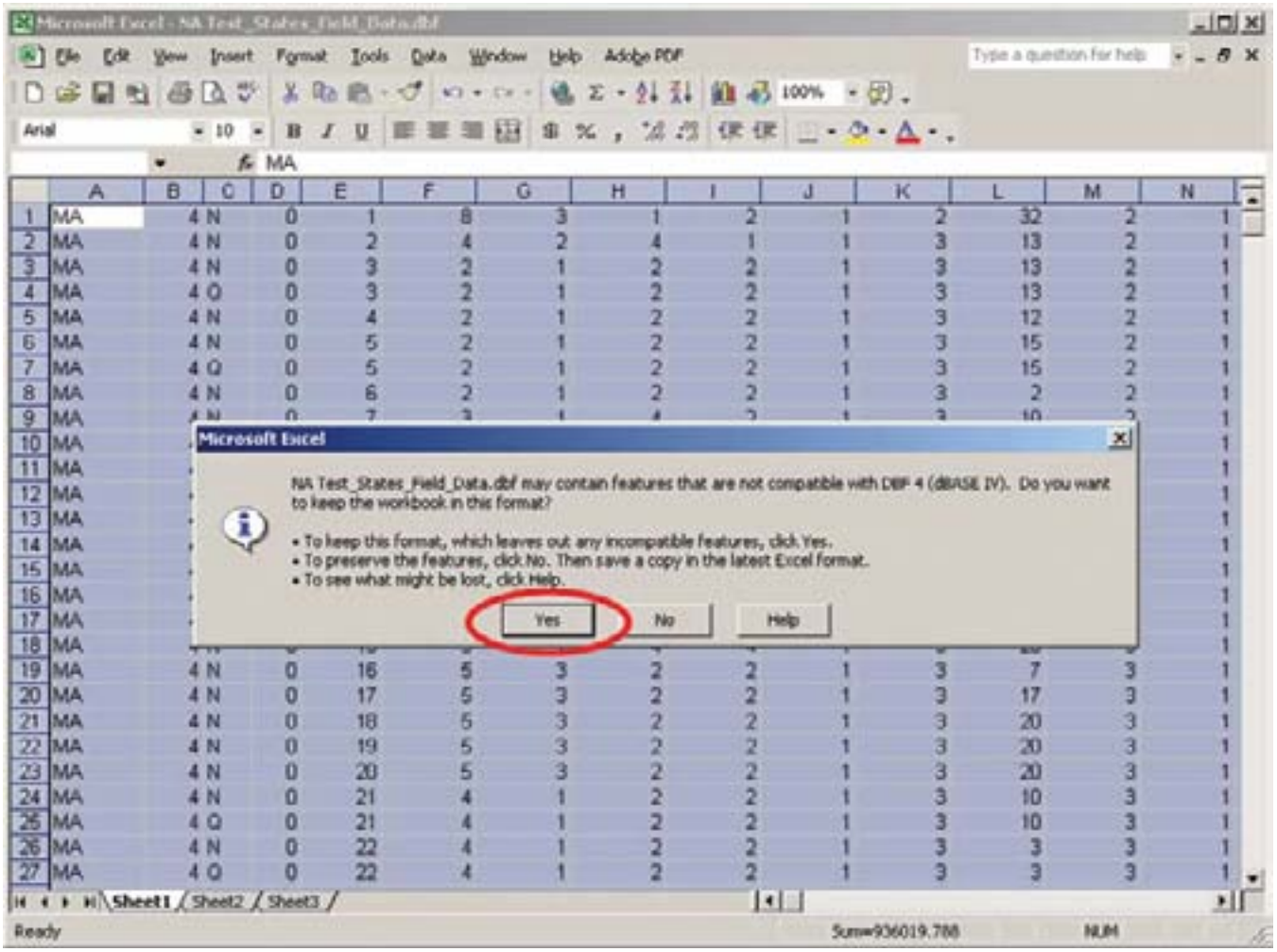
In the **Save As** window, save this interim file to the folder **C:\BMP**. In the **File name** box, enter a file name that describes the data (in this example, it is **NA Test_States_Field_Data**). In the **Save as type** box, select the most current .dbf format from the drop-down menu (in this example, it is **DBF 4 (dBASE IV)(*.dbf)**). Select **Save**. Later in the process, you will be instructed to move the final version of this file to a **BMP MIS (name)** folder, where it can be used to create standard data summaries.



Select **OK** in the window that opens to save the new worksheet as a .dbf file.



Select **Yes** in the next window that opens. Close the newly created .dbf file and the original Excel (.xls) file by selecting the red **X** in the upper right-hand corner of each file screen.

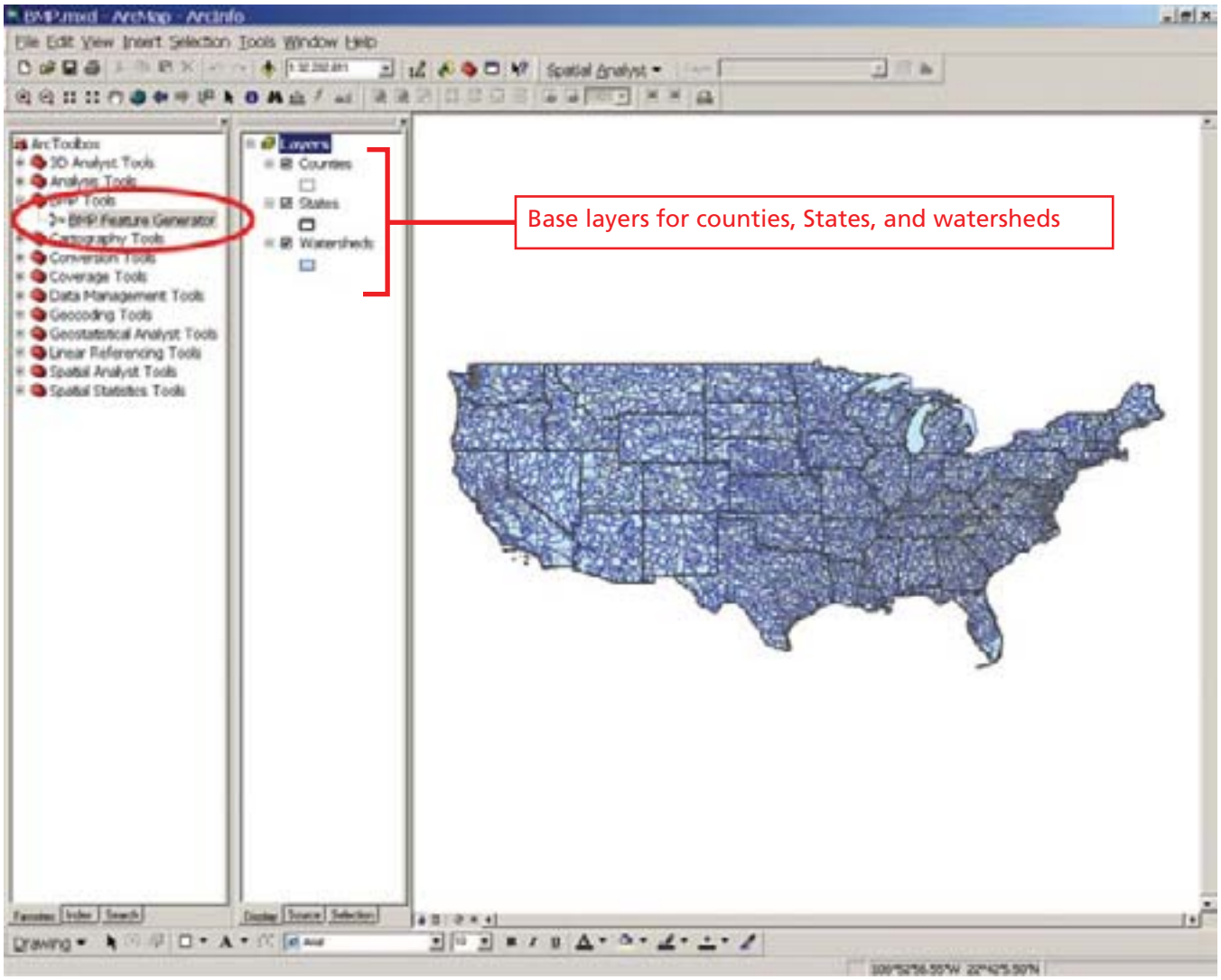


Note: The locations of the point features (sample units) in the output shapefile you are creating are based on the first GPS latitude-longitude coordinate pair encountered when reading from left to right in each row in the **BMP Field Data.xls** file.

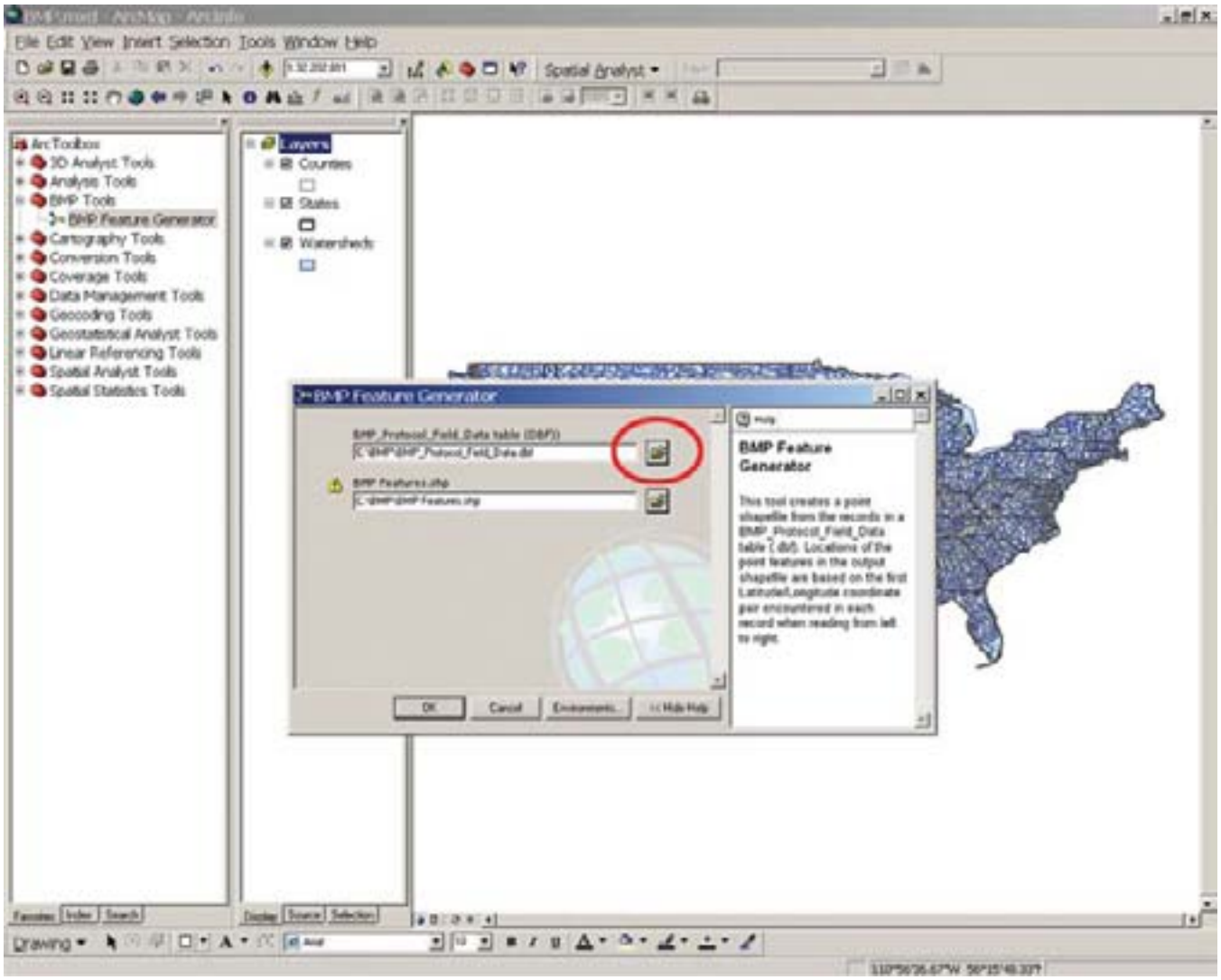
Latitude-longitude coordinate pairs may occur in columns X14 and X15 (water body crossing Approach Area A), HB138 and HB139 (haul road, log landing, or rutted, mineral soil skid trail inside the buffer/filter strip), CP171 and CP172 (chemical pollutants), or B177 and B178 (buffer/filter strip).

Step 6.2. Initiate the BMP Feature Generator Tool

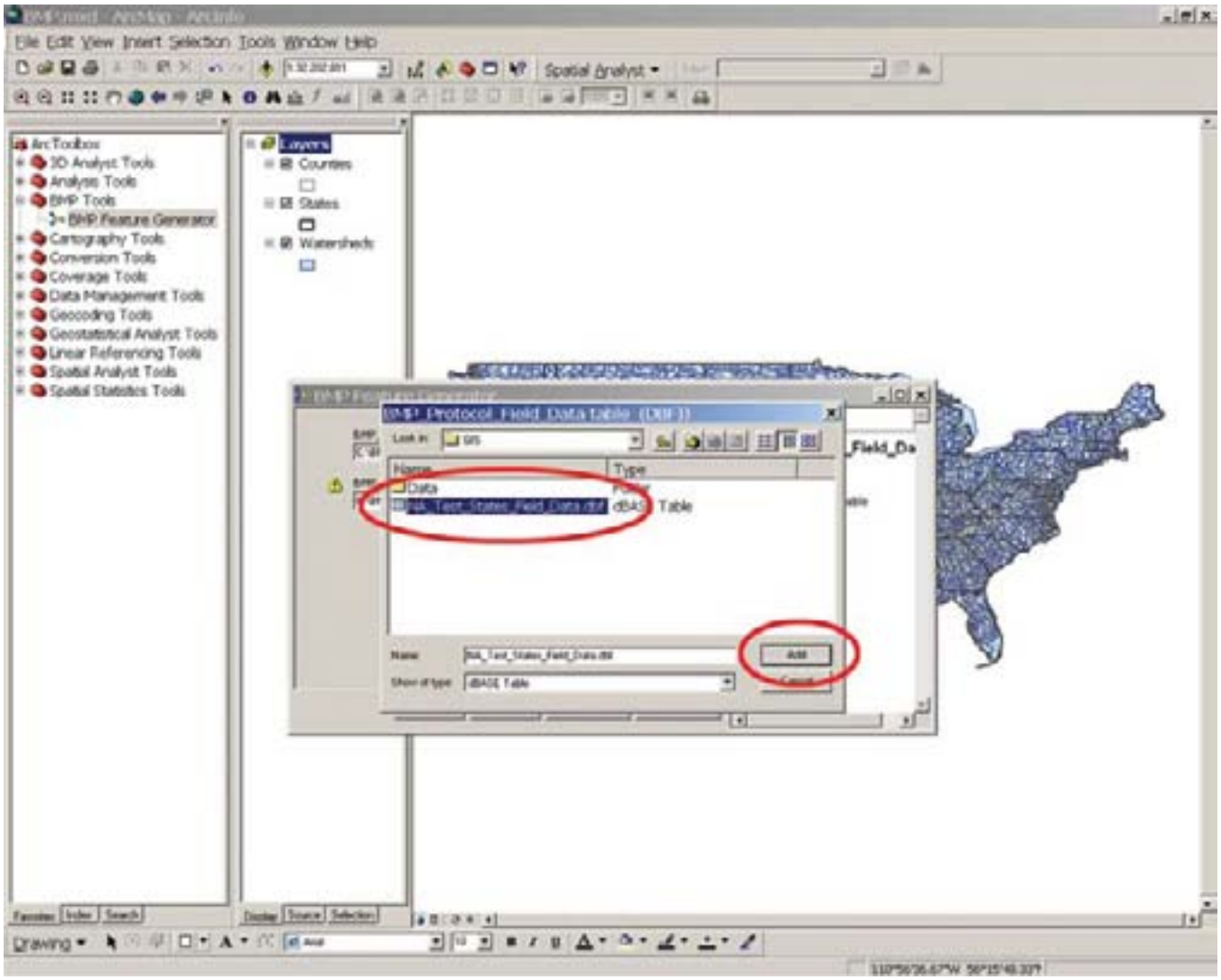
Navigate to the **GIS** folder in **C:\BMP** and open it. Double-click on the ArcMap project file **BMP.mxd** (C:\BMP\GIS\BMP.mxd) to open it. The **ArcMap-ArcInfo** window that opens should show base layers for counties, States, and watersheds. The ArcToolbox directory tree on the left-hand side of the screen should display the **BMP Feature Generator** under **BMP Tools**.



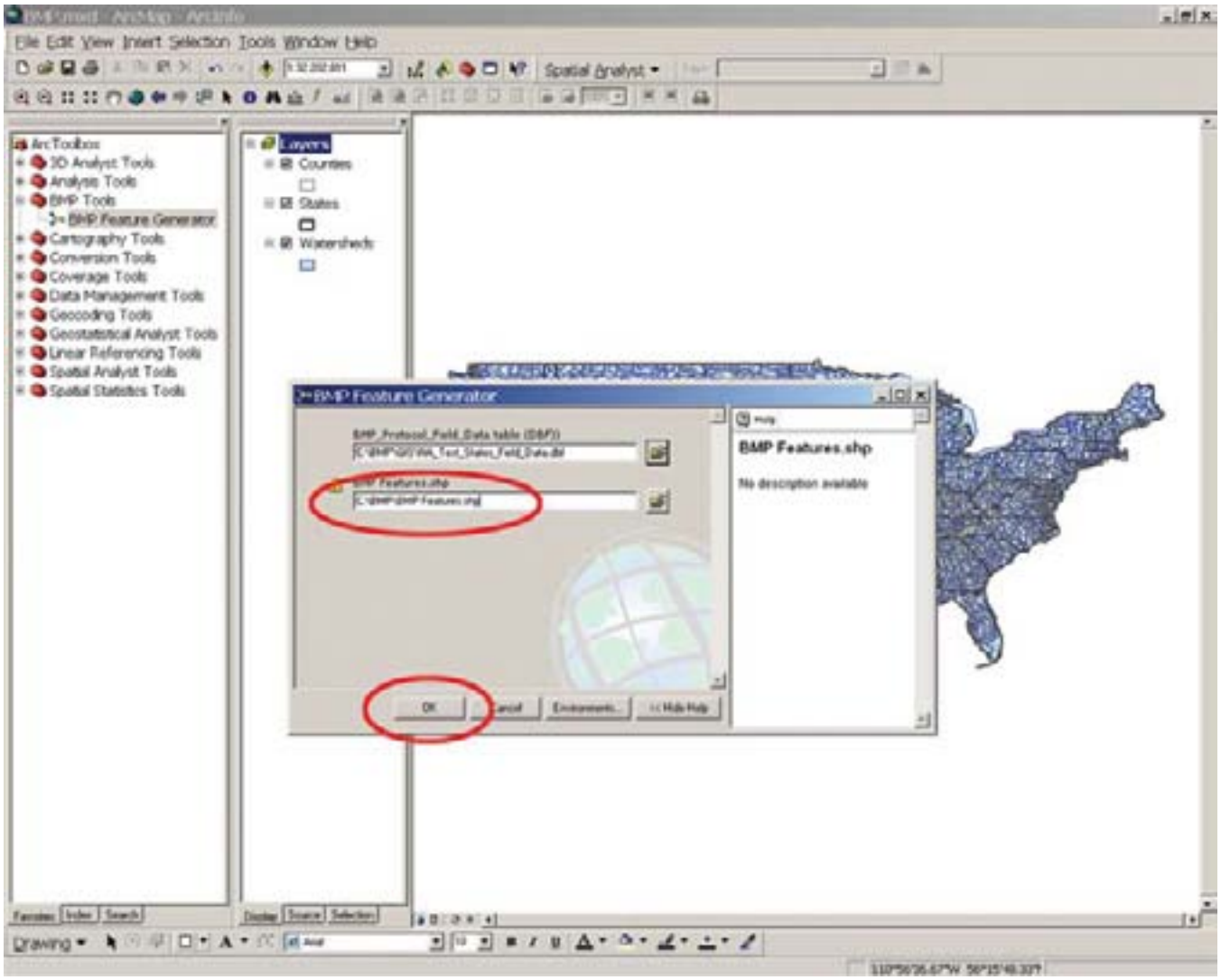
Double-click on the **BMP Feature Generator** in the ArcToolbox to open the **BMP Feature Generator** window and click the icon to the right of the top box.



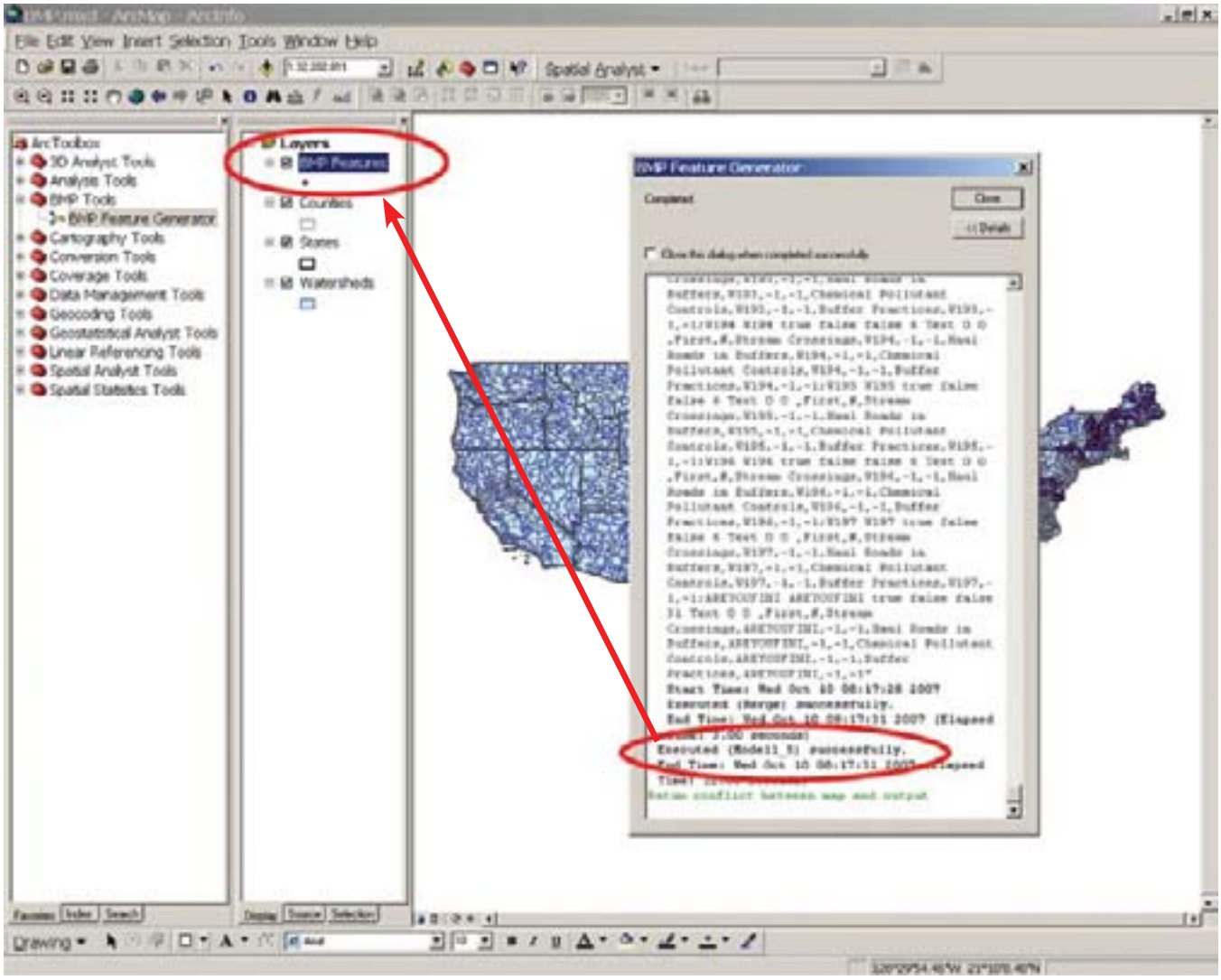
In the window that opens, navigate to the file name of the .dbf file that you just created from your **BMP Field Data.xls** file (in this example, it is **NA Test_States_Field_Data.dbf**). Highlight the file name and select **Add**.



In the lower box in the **BMP Feature Generator** window, replace the default file name with the name you wish to assign to the output shapefile. The .shp extension will be added automatically. (In this example, it has been named **C:\BMP\BMP Features**.) Select **OK**.

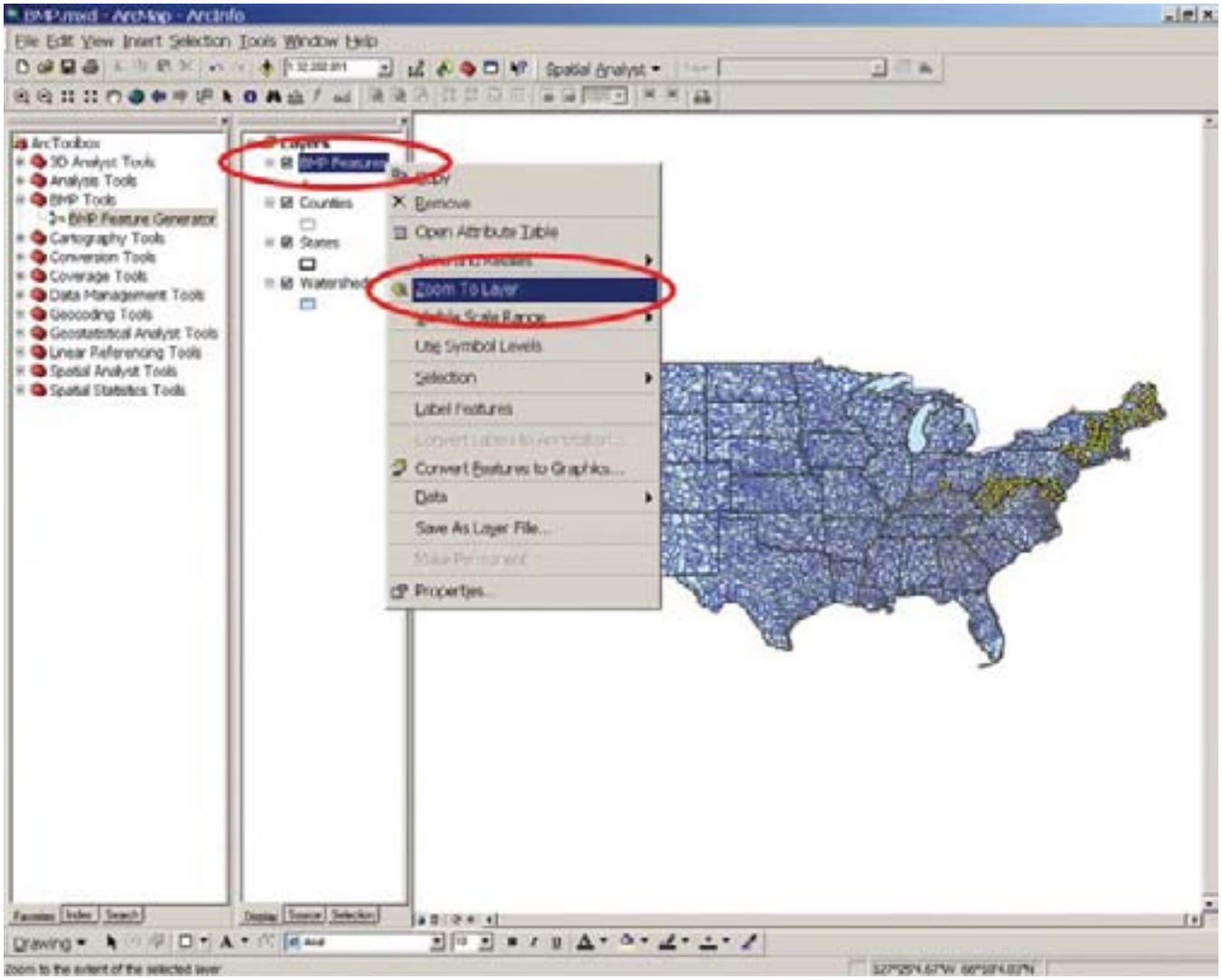


A window will open to indicate progress. When the tool executes successfully, a point shapefile depicting the locations of your BMP sample points will be displayed. The name of the shapefile you wish to create will be added to the ArcMap **Layers** window with the file name you assigned (**BMP Features**).



Step 6.3. View the Result and the Types of Information Available

Right-click on **BMP Features** under **Layers** and select **Zoom To Layer** from the drop-down menu. The map shown will zoom to only the States containing BMP sample points contained in the source point shapefile (in this example, **NA Test_States_Field_Data.dbf**).

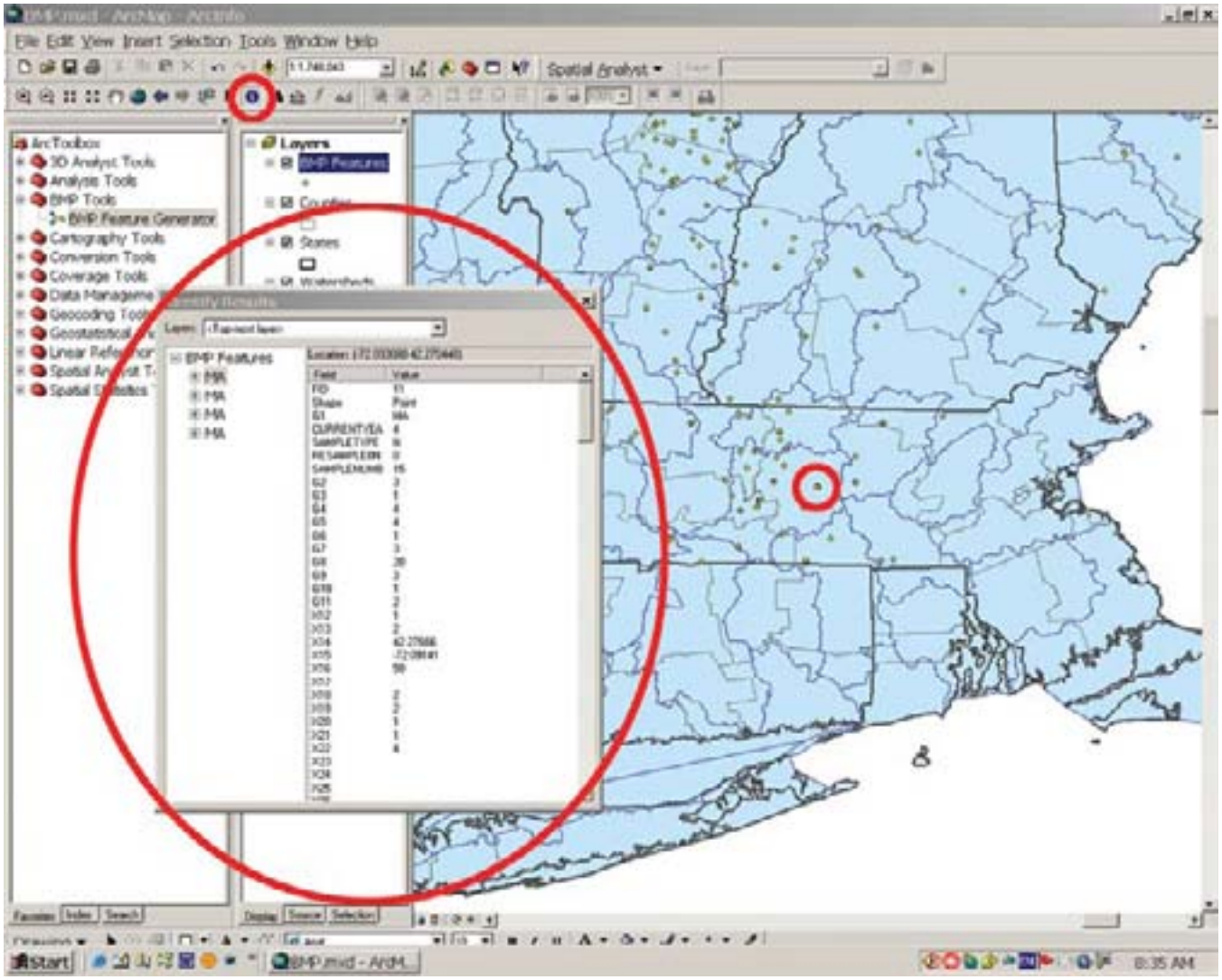


Alternatively, you may choose to zoom in manually using the **Zoom** icon on the toolbar.

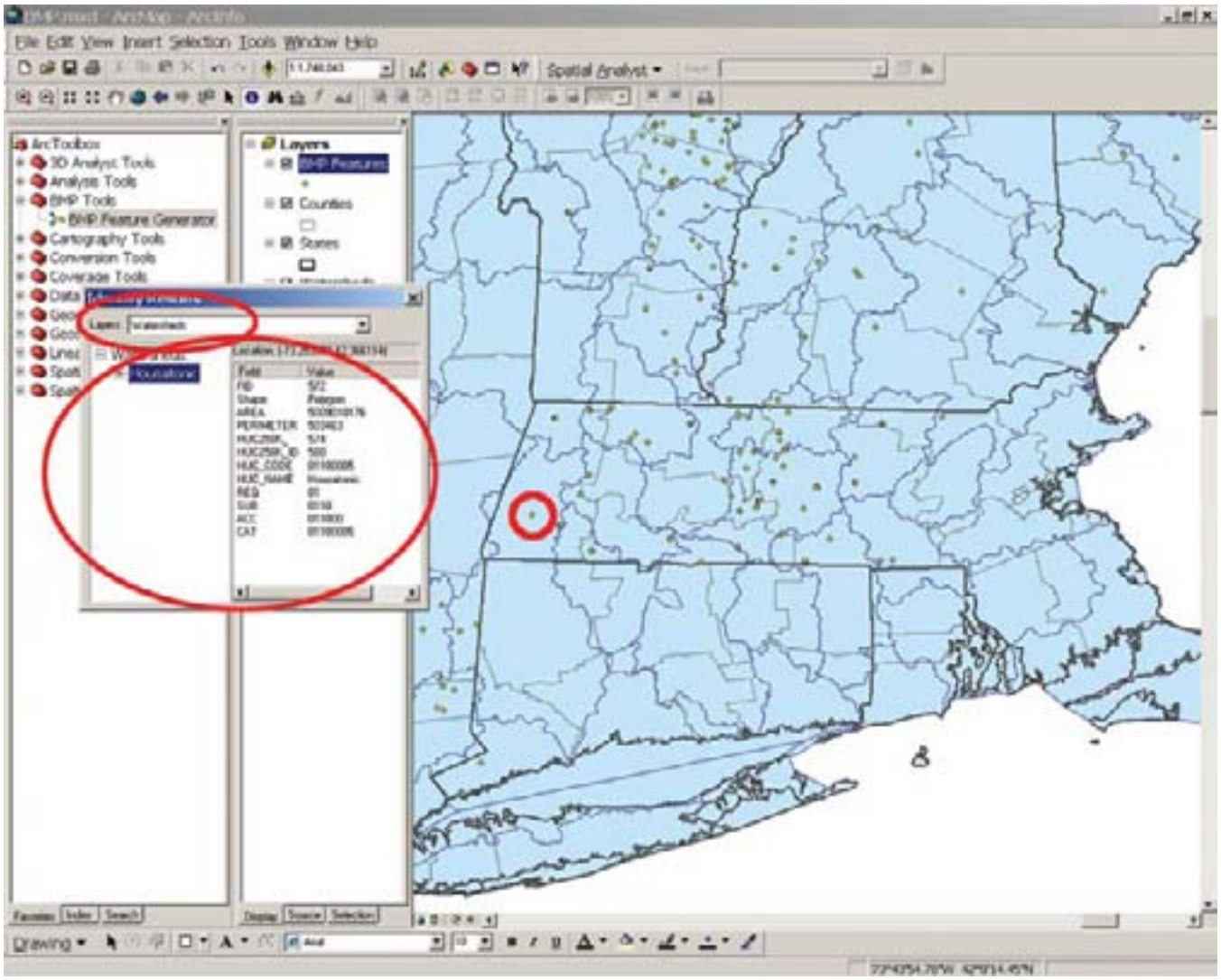
You may also find the **Identify** tool useful for selecting and viewing the attributes of features from any of the datasets.

You can control which of the layers' features are selected for identification by choosing from the drop-down list at the top of the **Identify Results** window, which opens when you click on a sample point using the **Identify** tool. **<Top-most layer>** is the default; it shows the BMP sample data for the point selected.

The map of sample units can be captured by pressing the **Print Screen** key. It can then be pasted into other products, such as PowerPoint presentations, BMP reports, or other publications.



You can view information on the watershed in which a specific data point occurs by clicking on the sample point. Then click on the down arrow to the right of the **Layers** box in the **Identify Results** window and select **Watersheds**. After viewing the information specific to the data point, return the **Layers** box to the default setting, **<Top-most layer>**.

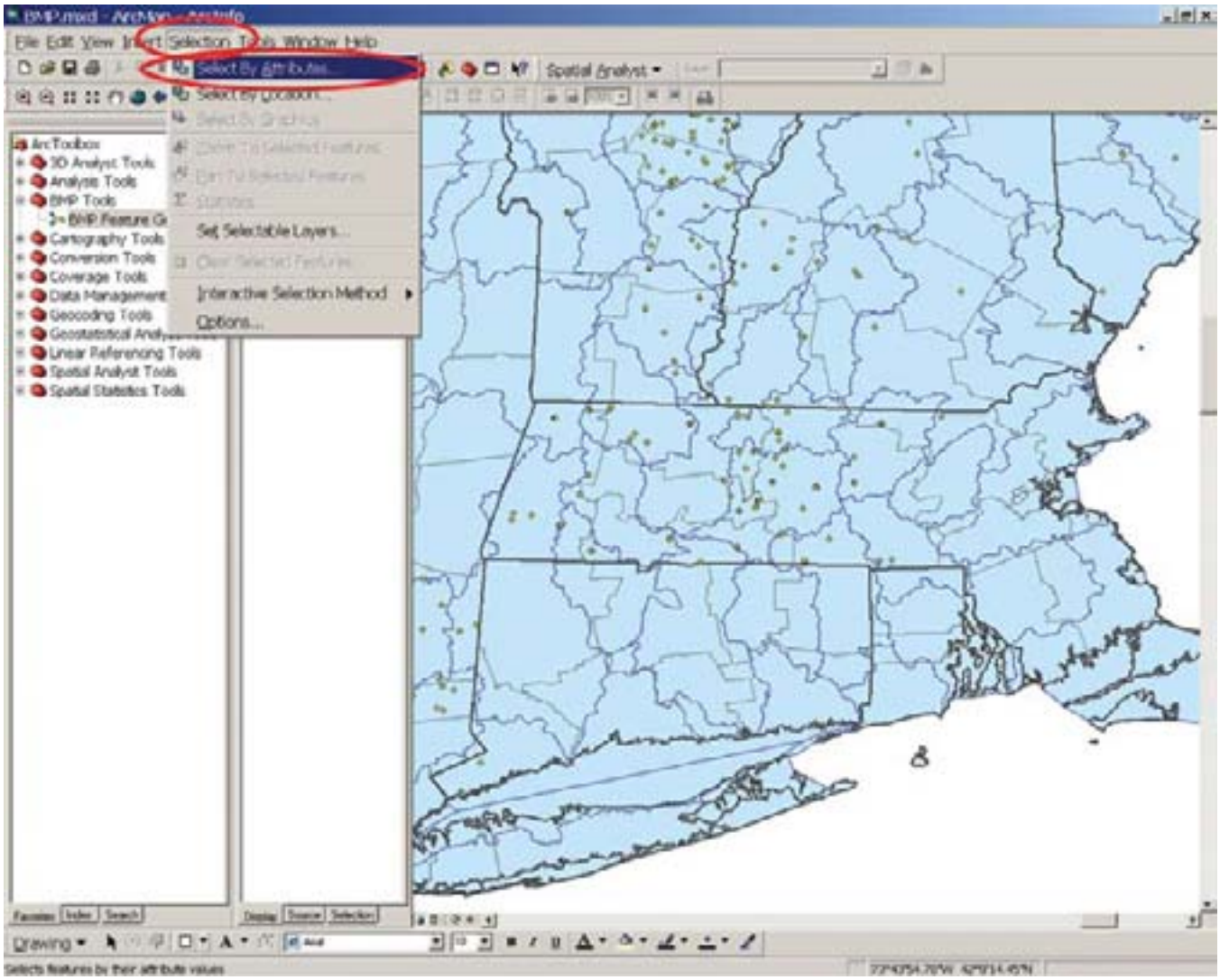


Step 6.4. Select Sample Data From Specific Geographic Areas

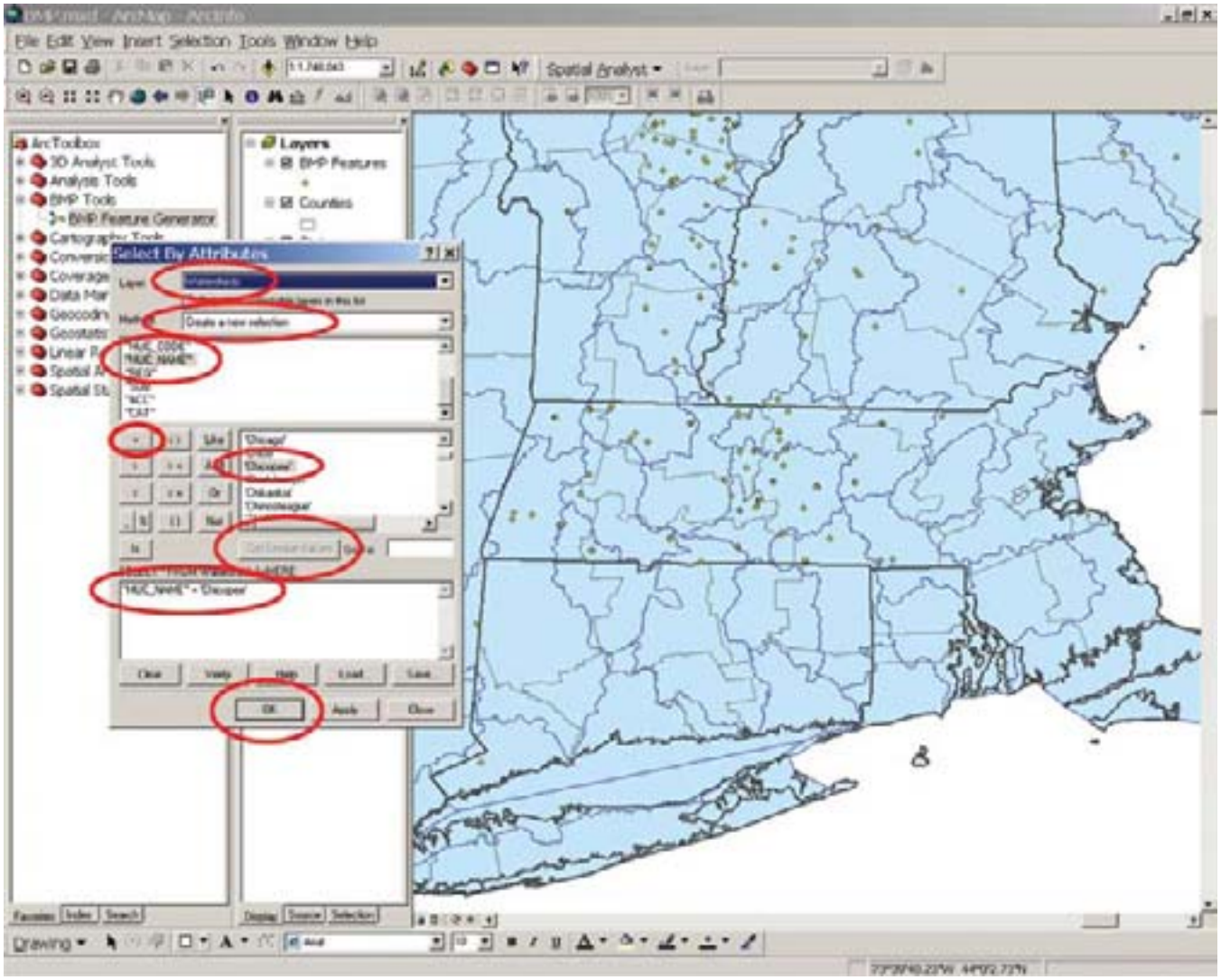
You can perform spatial queries based on the relationships among the BMP sample units and the features in other spatial datasets by using the **Select By Location** utility in ArcMap.

GIS datasets depicting shapes of the various watersheds are contained in files already programmed into the BMP Feature Generator and correspond to the U.S. Geological Survey eight-digit hydrologic unit codes (HUC). Standard GIS datasets for county and State boundaries are also incorporated into the tool. These datasets are automatically added to the ArcMap view when the **BMP.mxd** project file is opened.

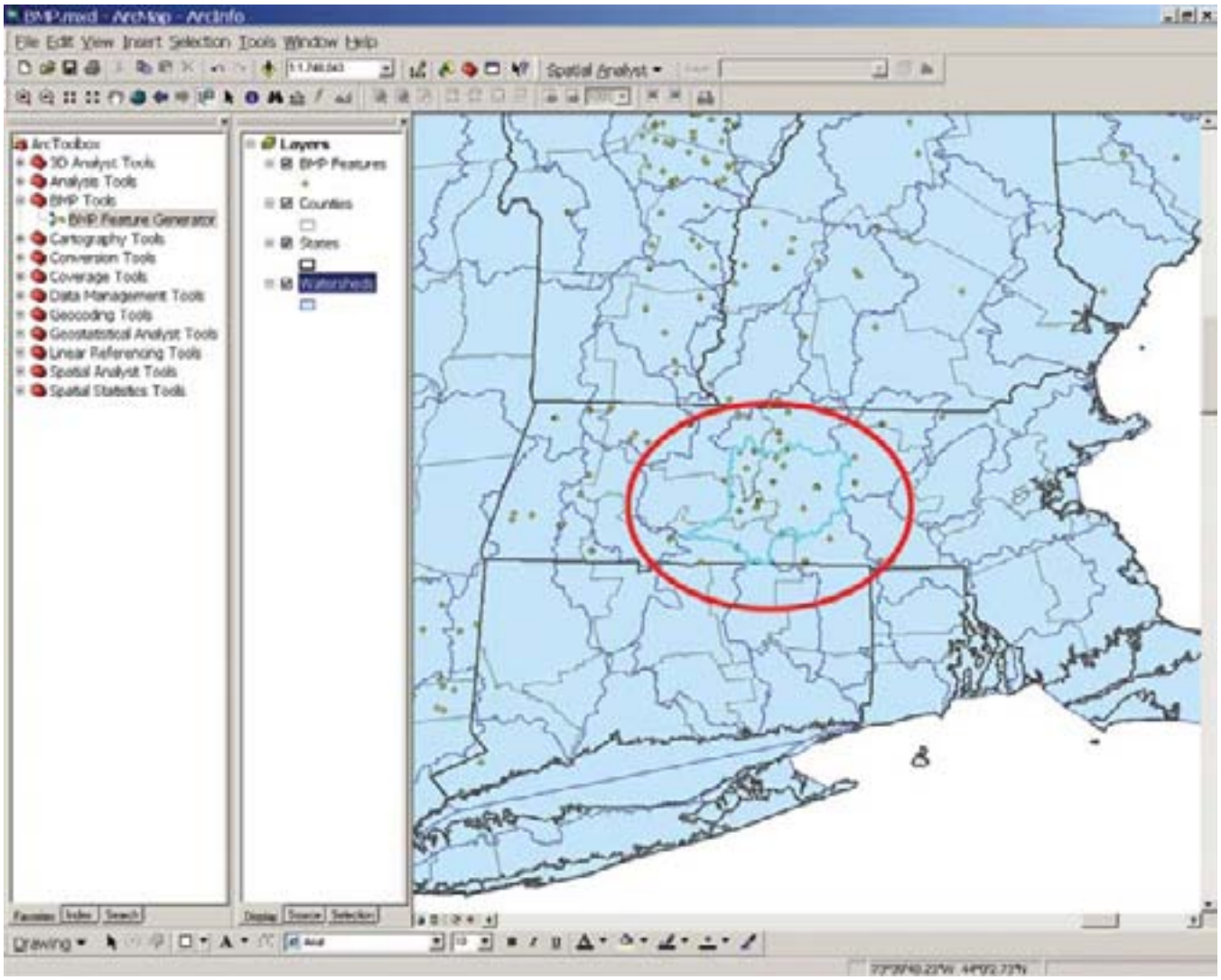
Select the **Selection** icon on the main toolbar and **Select By Attributes** from the drop-down menu.



The **Select By Attributes** window will open. Click the drop-down arrow to the right of the **Layer** box and select the name of the layer you wish to use, in this example **Watersheds**. In the **Method** box, select **Create a new selection** from the drop-down list. In the third box, scroll down and click on **HUC_NAME**. Click on the " = " button and the **Get Unique Values** button. In the fourth box, scroll down and then double-click on **Chicopee**. The selection statement in the last box should now read **"HUC_NAME"='Chicopee'**. Select **Apply** at the bottom of the window, and then select **OK**.



The **Select By Attributes** window will close and the selected watershed will now be highlighted in light blue.

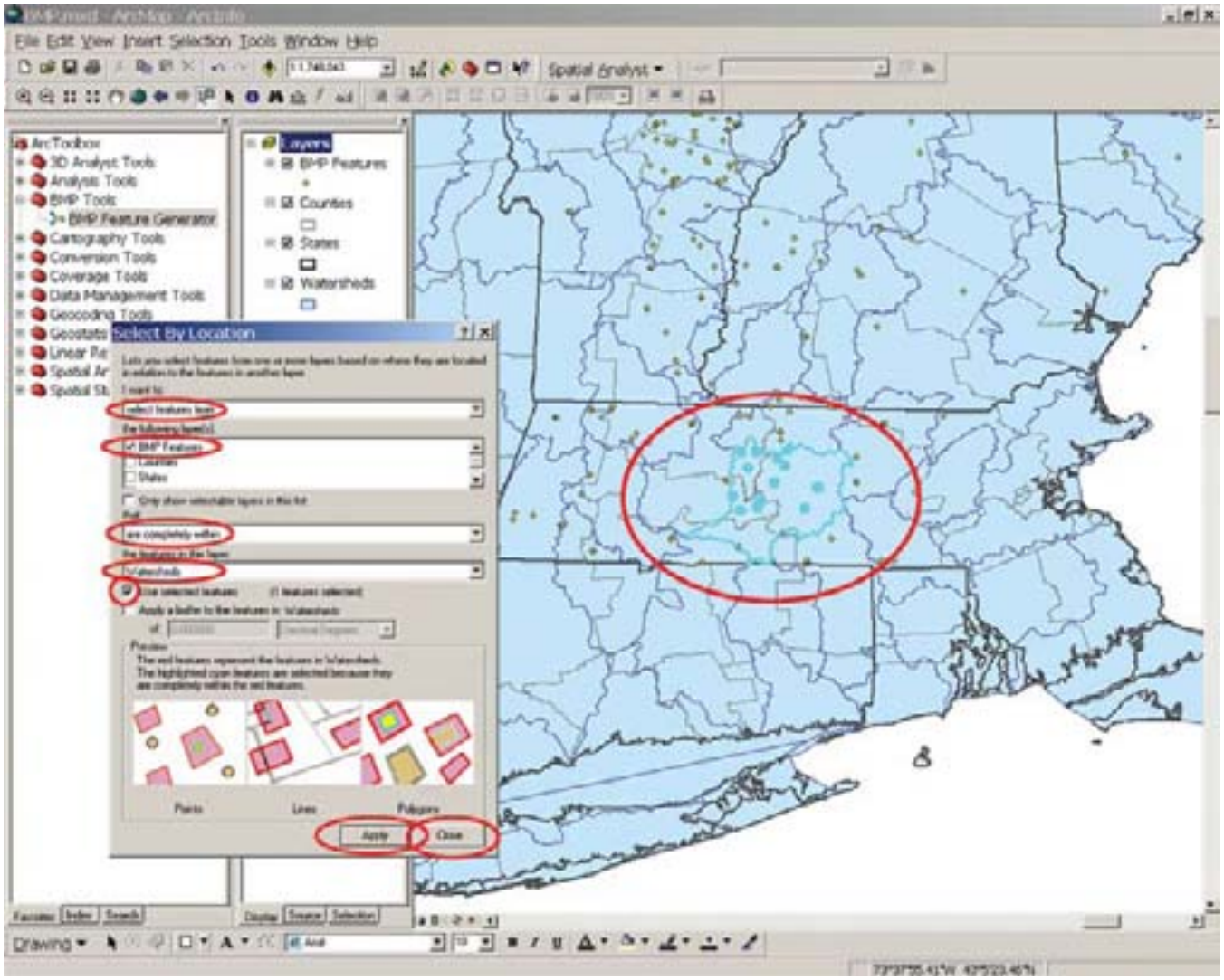


Note that several counties or watersheds could have been included in the data file being created by using the "OR" button in the selection statement in the **Select By Attributes** window. For example, the selection statement

"HUC_NAME"='Chicopee'OR"HUC_NAME"='Blackstone'

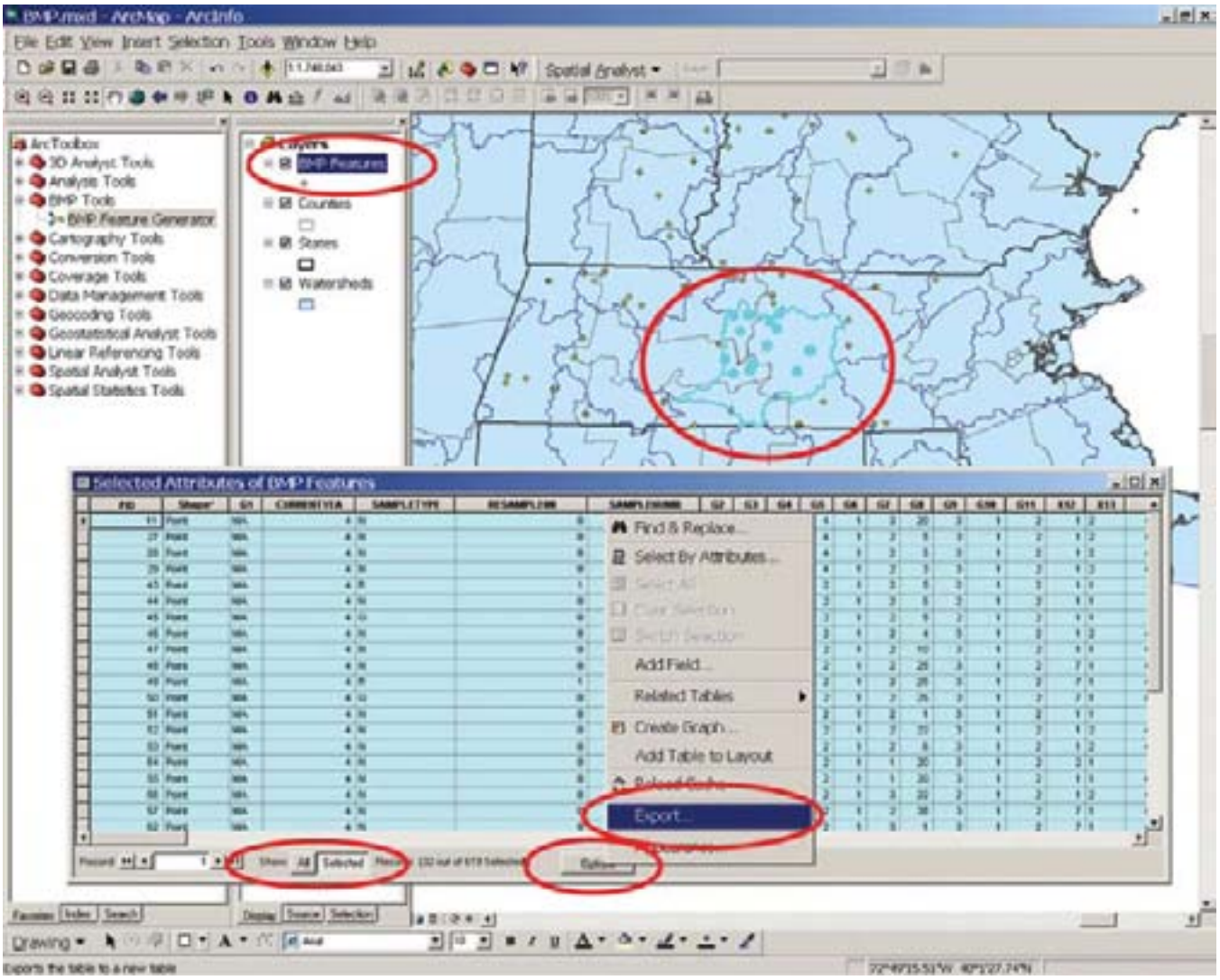
would yield a file containing sample data from both the Chicopee and Blackstone watersheds.

Select **Selection** from the main toolbar and **Select By Location** from the drop-down menu. The **Select By Location** window will open. In the **I want to** box, choose **select features from** from the drop-down menu. In the **the following layers** box, click on the check box next to the layer you created (in this example, **BMP Features**). In the **that** box, choose **are completely within** from the drop-down menu. In the **the features in this layer** box, select the **Watersheds** from the drop-down menu. Check the box next to **Use selected features**. Select **Apply** and then **Close**. The BMP features that fall within the Chicopee watershed will now be selected and highlighted in light blue.

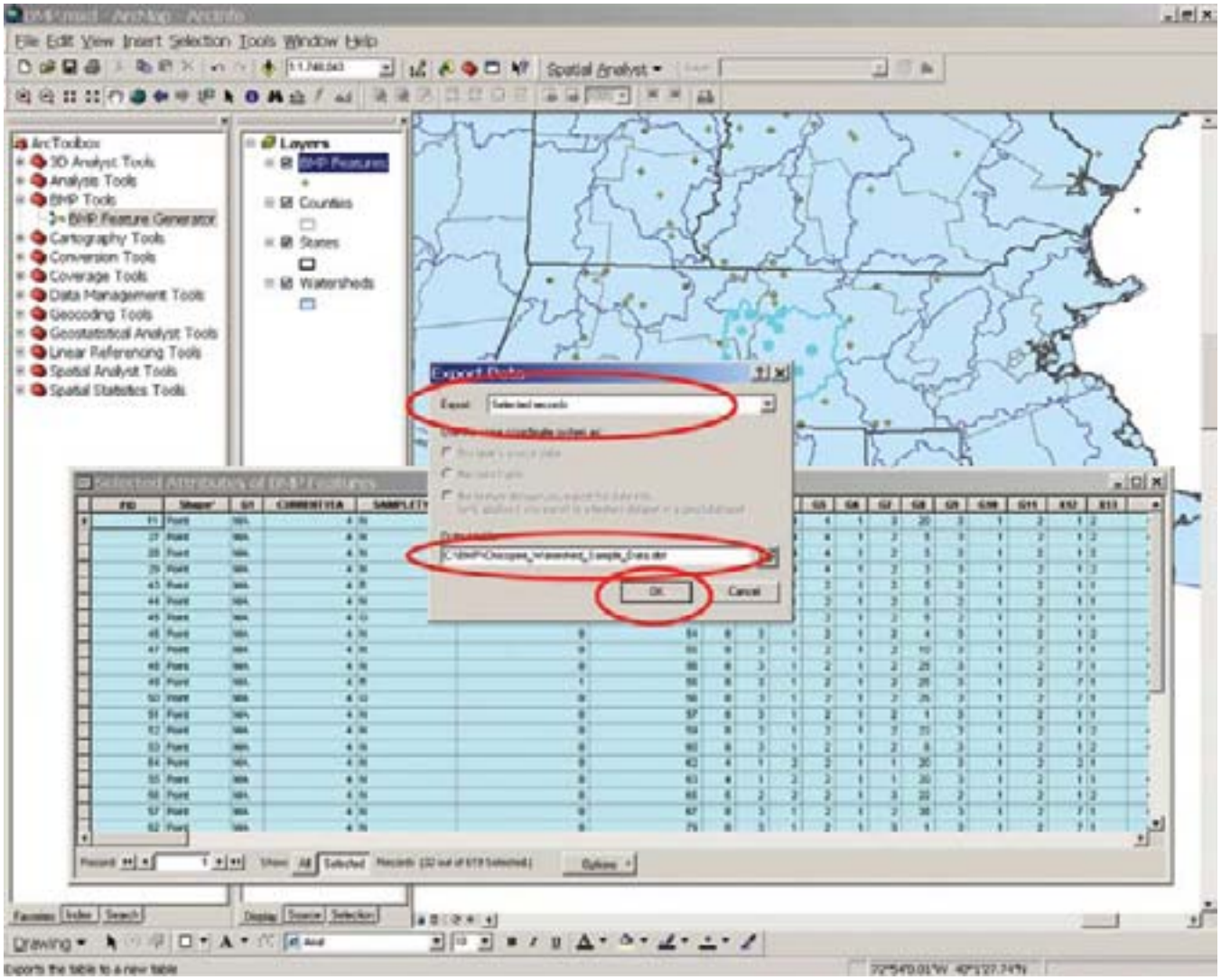


Step 6.5. Copy the Selected Data to a .dbf File

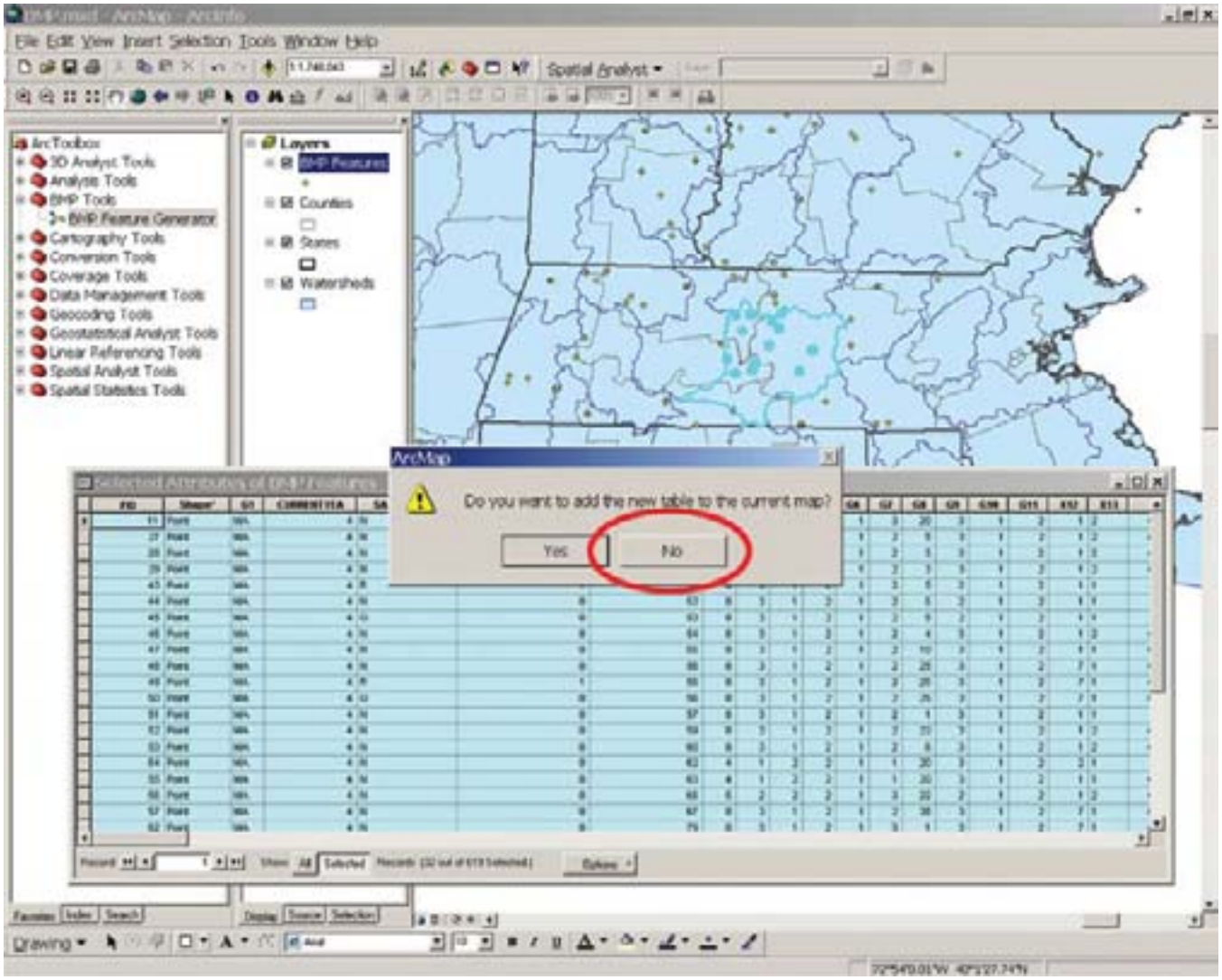
To save the selected records to a .dbf file that can then be opened in Access, where additional queries can be made, open the attribute table of the BMP data layer by right-clicking on the layer name under **Layers** (in this example, **BMP Features**), and selecting **Open Attribute Table** from the drop-down menu. The **Selected Attributes** window will open. Click the **Selected** button at the bottom of the window so that only those records that are selected are shown. Then select the **Options** button and select **Export** from the drop-down menu.



The **Export Data** window will open. In the **Export** box, select **Selected records** from the drop-down menu. In the **Output table** box, type the name you wish to assign to the data file or use the icon to the right of the box to navigate to the file location and type the name. (In this example it has been named **C:\BMP\Chicopee_ Watershed_Sample_Data.dbf** because it contains only the BMP samples from the Chicopee watershed.) Select **OK**.



In the **ArcMap** window that opens, select **No**.



The file will be saved in the folder you designated.

Step 6.6. Convert the .dbf File to an .xls File

Navigate to the folder containing the newly created .dbf file (in this example, **C:\BMP\Chicopee_Watershed_Sample_Data.dbf**), double-click the file name to open it, and, using the **Save as** function, save it as an Excel (.xls) file in a separate **BMP MIS (name)** folder (for example, **BMP MIS 07 Chicopee**). It may then be used to create standard data summaries and a Comprehensive Standard Data Summary for the Chicopee watershed using the BMP MIS procedure described in chapter 3.

Chapter 7—Sampling Design

This chapter provides guidance on sampling design for program managers and field foresters using the BMP protocol. State forestry agencies and other forest management organizations often have statisticians on staff and are encouraged to develop their own sampling strategy. Therefore, this chapter will be limited to suggestions intended to help overcome some of the sample design problems encountered during the testing phase of the protocol.

The authors give special thanks to Jeffrey Gove and Harry Valentine of the U.S. Forest Service, Northern Research Station for their assistance in the preparation of this chapter.

Timber Sales and Sample Units

Personnel, legal, and resource constraints render a complete assessment of all timber sale operations beyond the capabilities of most State forestry agencies and forest management organizations. As a result, it is highly unlikely that *all* timber sales can be visited; the assessment of BMP effectiveness must rely on a *sample* of timber sales. Although the BMP protocol records conditions found on discrete spatial components of timber sales called sample units (figure 7.1), the sample unit boundaries can be determined only by onsite inspection. The cost of onsite inspections makes it unlikely that the total number of potential sample units will be determined or that a full statistical analysis will be undertaken. Therefore, it is important that a representative and unbiased sample of logging sites be drawn to ensure that the results of the BMP monitoring protocol are conservative and provide accurate information to forest managers and regulating agencies, and to an increasingly concerned public, many of whom are unfamiliar with the principles of sound forest resource management.

Sample Unit Identification

Each timber sale is considered a sample site, containing a number of potential sample units. The sampling process begins with the compilation of a list of timber sales occurring within a given time period, usually 1 year. A random selection of timber sales, or sample sites, will be drawn from all of the timber sales in a State or other administrative unit, and one or more randomly chosen sample units within the selected timber sales will be measured based on the sample design. Detailed instructions on the identification of sample unit boundaries are provided in the BMP field guide.

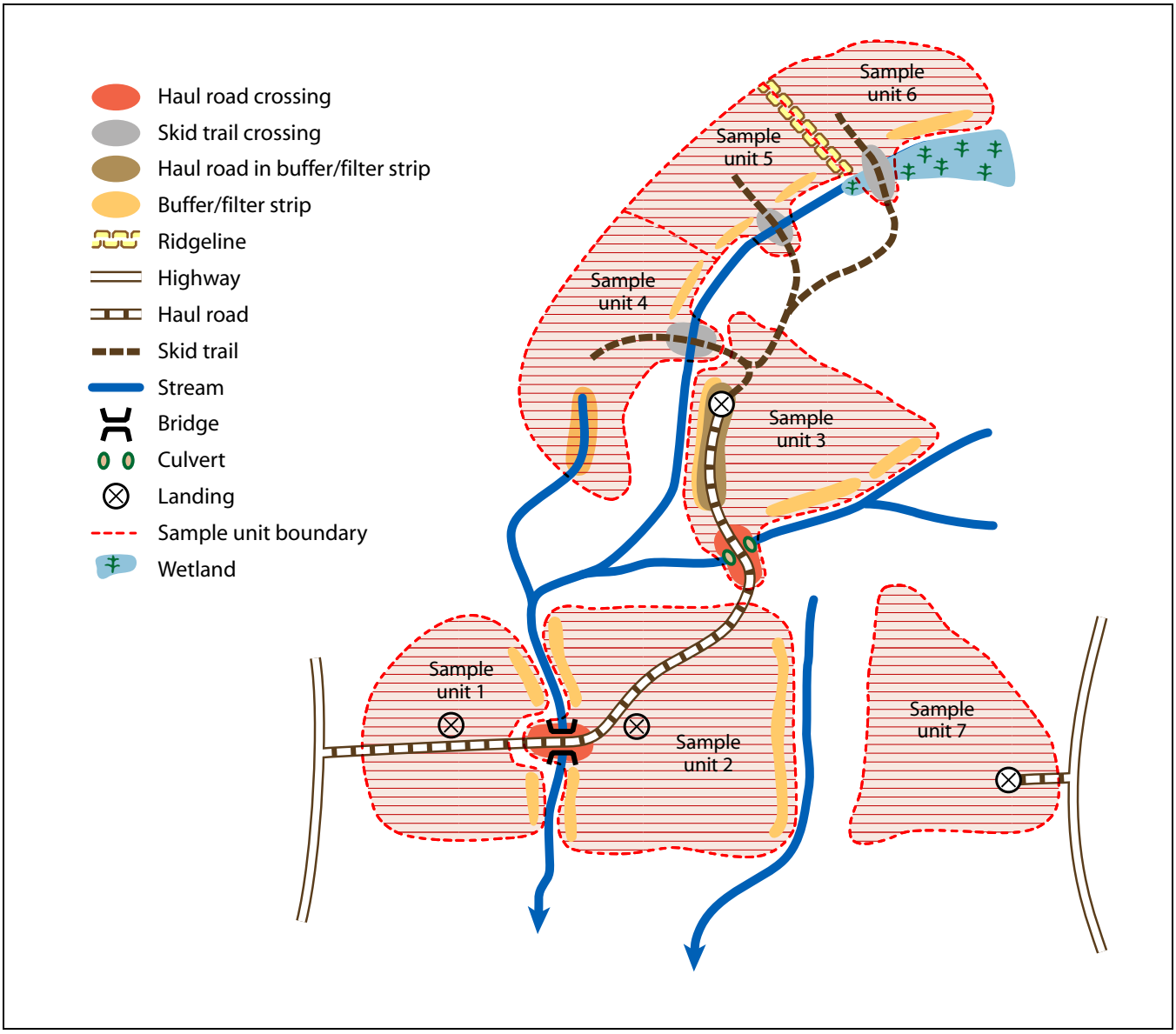


Figure 7.1. Sample units within a timber sale (sample site), as delineated by timber cutting boundaries, ownership boundaries, and water body crossing, are available for random selection as potential sample units.

Sample Design Using Probability Sampling

Probability sampling includes random sampling methods in which the probability or chance of selecting a given sample site is known in advance. If a given sample site can only be chosen once, the method is described as sampling without replacement. If a given sample site is returned to the list and thus has the potential to be chosen for sampling more than once, the method is known as sampling with replacement.

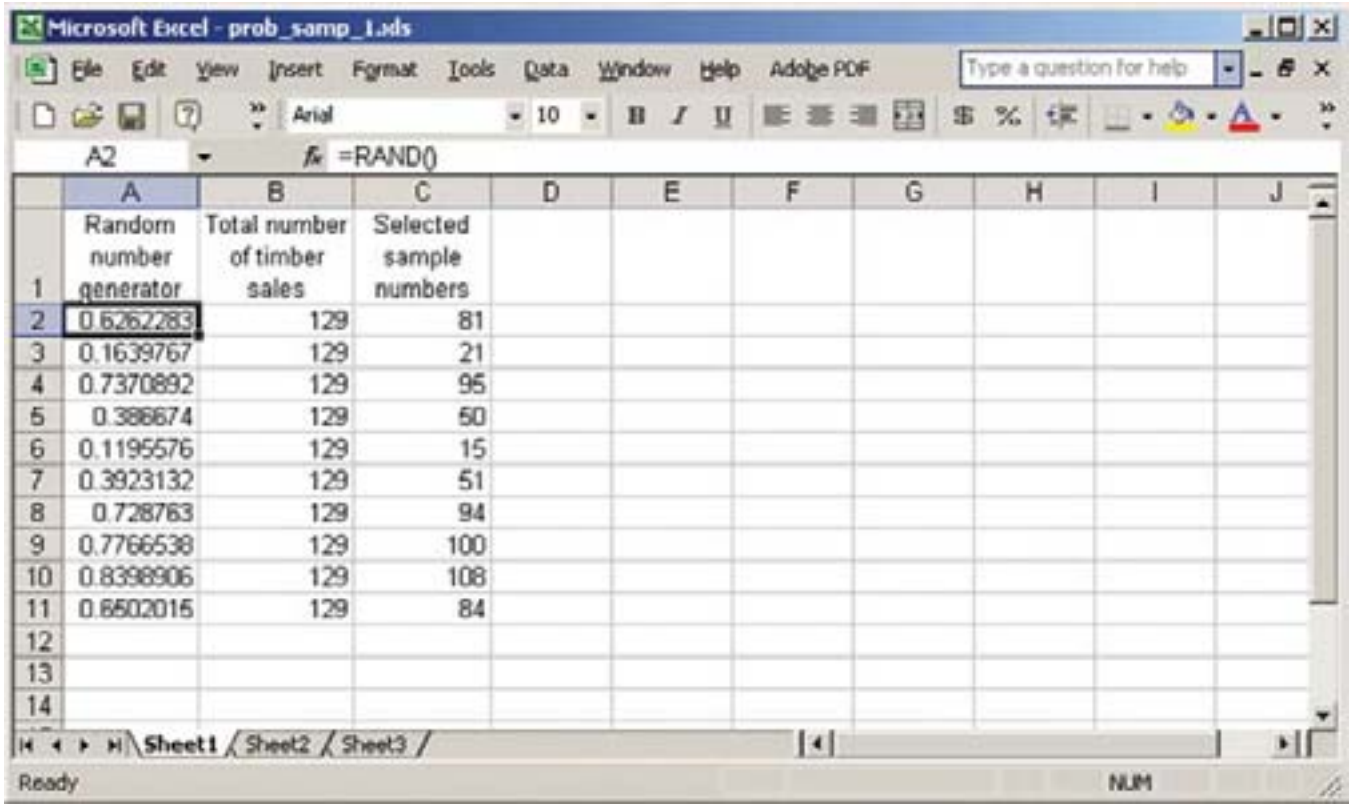
Random Sampling Without Replacement

Random sampling without replacement, also know as simple random sampling, is one of the simplest forms of probability sampling. It is appropriate in situations where the timber sales from which the sample is to be drawn have relatively similar characteristics. Every potential sampling site has an equal opportunity to be chosen once for measurement. As a result, it is a simple, reliable, and efficient method of choosing an unbiased sample.

In this method, a comprehensive list of all of the timber sales occurring within the area and timeframe to be sampled is developed from whatever data or information is available. The timber sales to be sampled are then selected at random from the list.

One way to select the sites to be sampled is to list the timber sales in any order and number them sequentially. Multiply the total number of timber sales by a randomly generated decimal and select the sale whose number is generated. Repeat the procedure until the desired number of sample sites has been selected.

The random number generator feature in Excel can be used for this process. The screen below shows the procedure for selecting 10 sample sites from a list of 129 timber sales. Open a blank Excel worksheet. Enter the function **=RAND()** in cell A2. Enter the number **129**, the total number of timber sales, in cell B2. Enter the formula **=A2*B2** in cell C2. Copy each entry into rows 3 through 11 of the same column. Format column C as a number with zero decimal places. The numbers in column C are generated by the formula and represent the timber sale numbers selected to be sampled. In this method, each timber sale is sampled only once. If a selected sample site is drawn again, the subsequent draw is discarded and an additional random draw is made until the desired total number of sample sites is drawn.



Another advantage of this method is that it represents a single random sample of the entire population of timber sales. Statistically sound subsets of the data can then be created to assess trends and other information.

Random Sampling With Replacement and Varying Probability

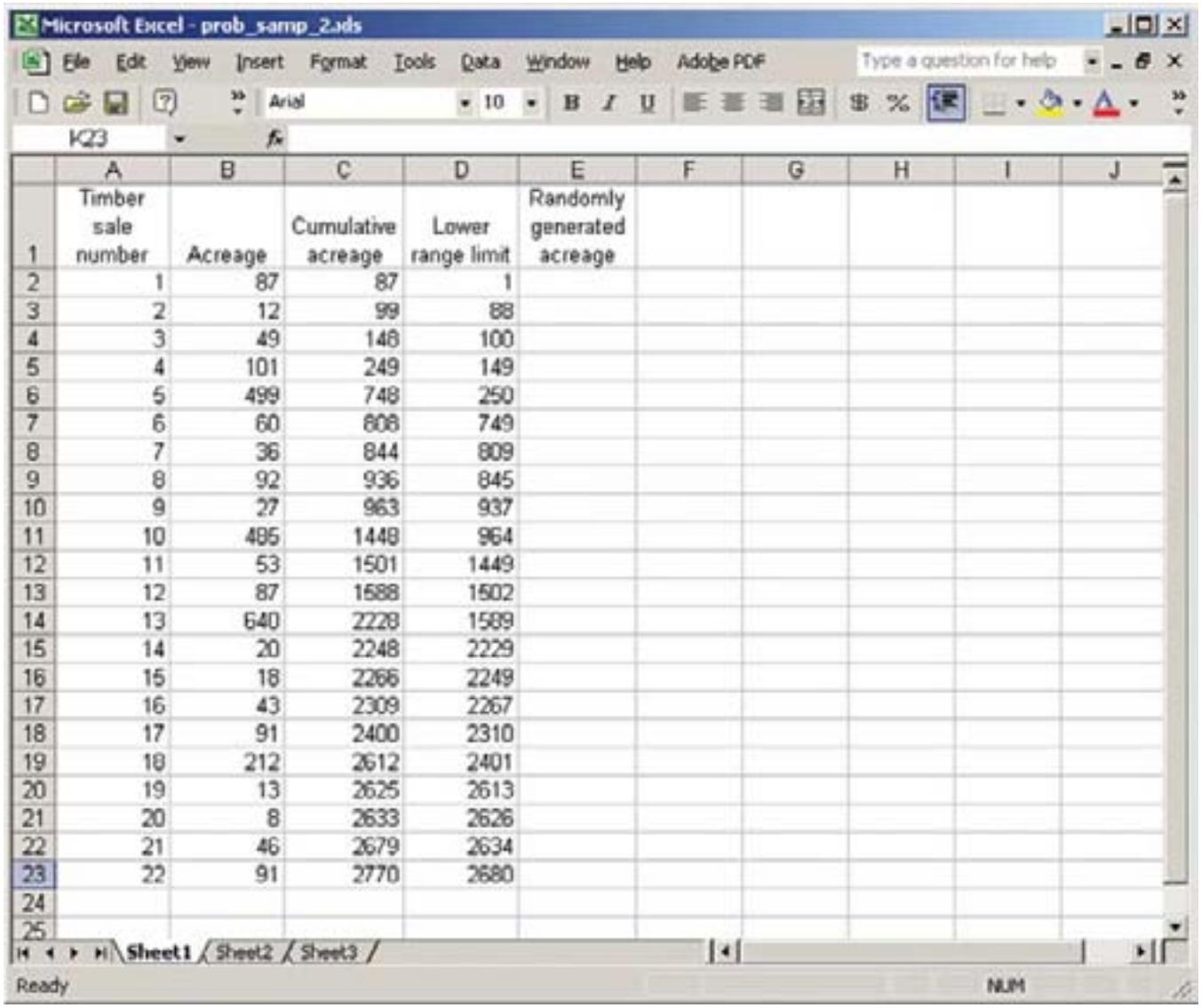
In random sampling with replacement and varying probability, also known as list sampling, the probability of a sample being selected increases with certain chosen characteristics (in this case, the acreage of the timber sale). Replacement means that a given site, once selected as a sample, remains in the list of potential sample sites and may be sampled more than once. Therefore, the larger the timber sale area, the more likely it is to be sampled and to be sampled more than once.

While only slightly more complicated than random sampling without replacement, random sampling with replacement and varying probability can be used to draw a single random sample while balancing the ratio of sample acreage to total harvest acreage where timber sales vary widely in total acreage. Statistically sound subsets of the data can then be created to assess trends and other information.

In a situation where the potential sample sites include a small number of large timber sales and a large number of smaller timber sales, this method can be used to obtain a more representative sample of conditions over the combined area of all the timber sales without resorting to stratification.

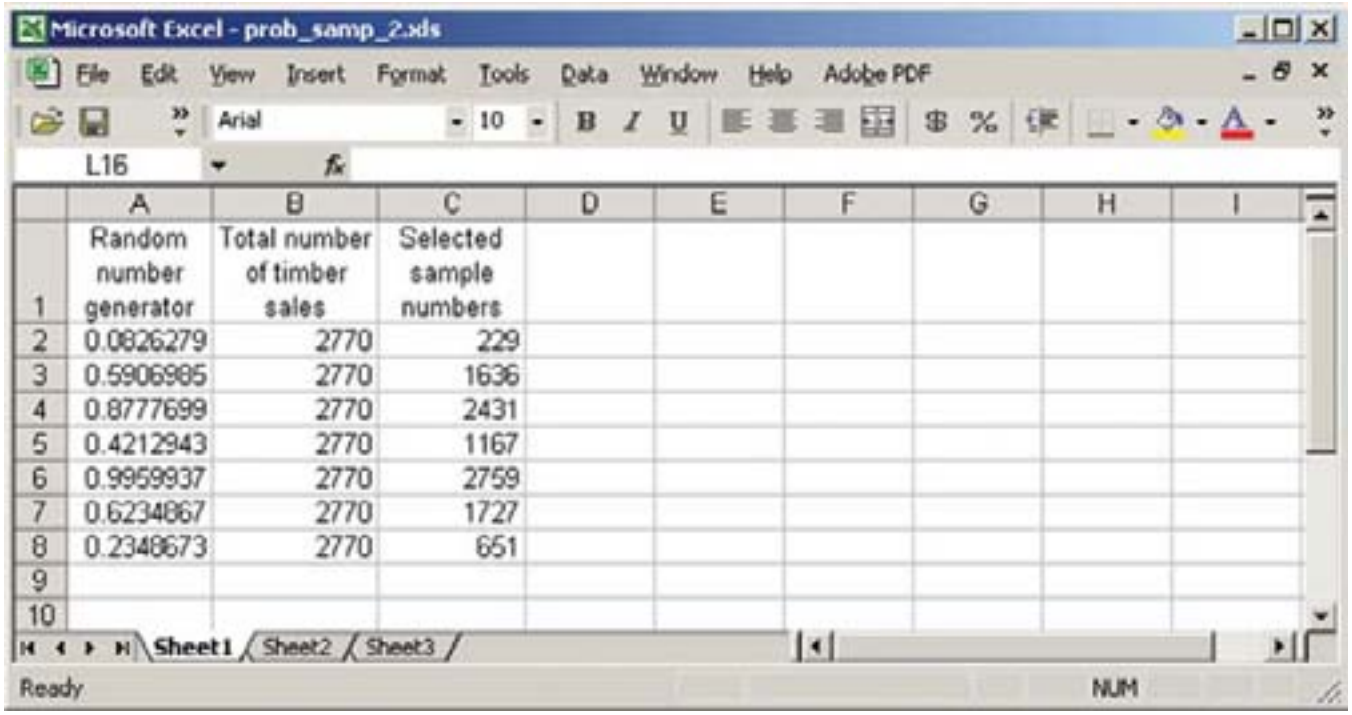
The process for selecting sample sites using this method involves listing the timber sales and calculating a cumulative total of each successive timber sale acreage. An acreage range is calculated for each timber sale based on the cumulative total and the size of the individual timber sale. A random acreage is generated between 1 and the total cumulative number of acres. This number will fall between the upper and lower acreage limit of one of the timber sales, designating it as a sale to be sampled. Thus the probability of being chosen for sampling increases with the size of the individual sale, and an individual sale may be chosen more than once.

The following screens demonstrate the process of selecting 7 sample sites from a list of 22 timber sales. Open a blank Excel worksheet. In column A, list the timber sale numbers. In column B, list the acreage of each timber sale. In column C, you will calculate the cumulative total of the acreage of the timber sales, resulting in a total acreage of all timber sales. In cell C2, enter the formula **=B2**. In cell C3, enter the formula **=C2+B3**. Copy this formula into the remaining cells in column C. In column D, you will calculate the lower limit of the acreage range of the timber sale in the same row. In cell D2, enter the number **1**. In cell D3, enter the formula **=C2+1**. Copy this formula into the remaining cells in column D.



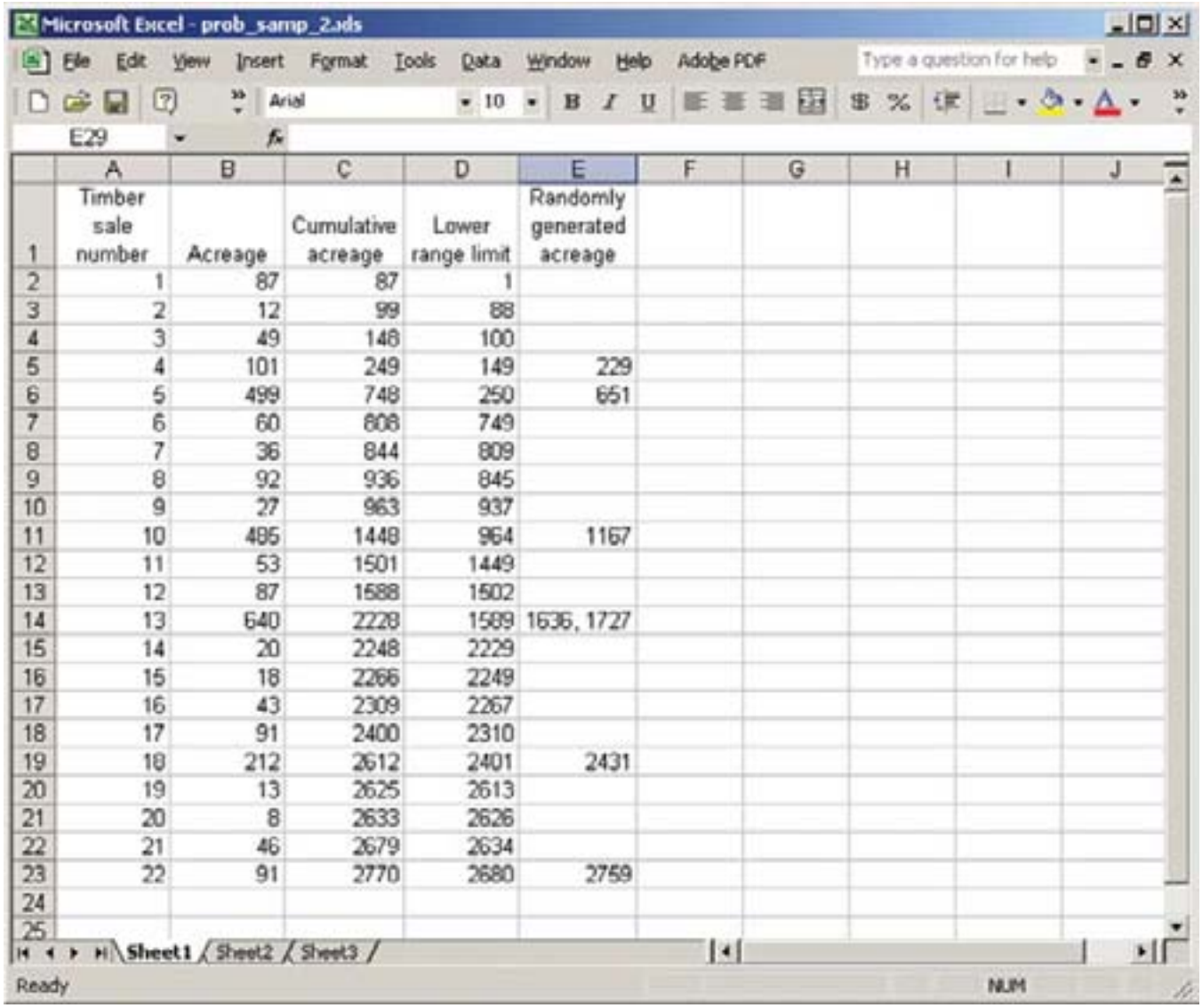
	A	B	C	D	E	F	G	H	I	J
1	Timber sale number	Acreage	Cumulative acreage	Lower range limit	Randomly generated acreage					
2	1	87	87	1						
3	2	12	99	88						
4	3	49	148	100						
5	4	101	249	149						
6	5	499	748	250						
7	6	60	808	749						
8	7	36	844	809						
9	8	92	936	845						
10	9	27	963	937						
11	10	485	1448	964						
12	11	53	1501	1449						
13	12	87	1588	1502						
14	13	640	2228	1589						
15	14	20	2248	2229						
16	15	18	2266	2249						
17	16	43	2309	2267						
18	17	91	2400	2310						
19	18	212	2612	2401						
20	19	13	2625	2613						
21	20	8	2633	2626						
22	21	46	2679	2634						
23	22	91	2770	2680						
24										
25										

The random acreages are calculated using the Excel random number generator. Open a second Excel worksheet. Enter the function **=RAND()** in cell A2. Enter the number **2770**, the total timber sale acreage (calculated in the previous worksheet), in cell B2. Enter the formula **=A2*B2** in cell C2. Copy each entry into rows 3 through 8 of the same column. Format column C as a number with zero decimal places. The numbers in column C are generated by the formula.



	A	B	C	D	E	F	G	H	I
1	Random number generator	Total number of timber sales	Selected sample numbers						
2	0.0826279	2770	229						
3	0.5906985	2770	1636						
4	0.8777699	2770	2431						
5	0.4212943	2770	1167						
6	0.9959937	2770	2759						
7	0.6234867	2770	1727						
8	0.2348673	2770	651						
9									
10									

A timber sale is chosen and sampled as often as one of the random acreages calculated in column C of the previous worksheet falls within the cumulative acreage range shown in columns C and D of the following worksheet. Enter the randomly generated acreages into the appropriate row in column E of the following worksheet. In this method, a given timber sale, large or small, may be selected for sampling any number of times.



	A	B	C	D	E	F	G	H	I	J
1	Timber sale number	Acreage	Cumulative acreage	Lower range limit	Randomly generated acreage					
2	1	87	87	1						
3	2	12	99	88						
4	3	49	148	100						
5	4	101	249	149	229					
6	5	499	748	250	651					
7	6	60	808	749						
8	7	36	844	809						
9	8	92	936	845						
10	9	27	963	937						
11	10	485	1448	964	1167					
12	11	53	1501	1449						
13	12	87	1588	1502						
14	13	640	2228	1589	1636, 1727					
15	14	20	2248	2229						
16	15	18	2266	2249						
17	16	43	2309	2267						
18	17	91	2400	2310						
19	18	212	2612	2401	2431					
20	19	13	2625	2613						
21	20	8	2633	2626						
22	21	46	2679	2634						
23	22	91	2770	2680	2759					
24										
25										

As a result of this method, two samples are drawn in sale area 13 and several samples are selected from smaller sales. Thus the balance in the ratio of sample acreage to timber sale acreage between the many small timber sales and the fewer larger timber sales is improved without introducing bias and without stratifying the sample.

As in random sampling without replacement, an advantage of this method is that it represents a single random sample of the entire population of timber sales. Statistically sound subsets of the data can then be created to assess trends and other information.

Random Sampling With Stratification

Sampling with stratification is somewhat more complicated and generally requires a greater number of samples. As a result, it is usually somewhat less efficient in terms of travel and staff time.

The decision to stratify a population, that is, dividing it into relatively homogeneous groups before samples are drawn, should only be done if a large variation in timber sale characteristics is clearly evident and would obscure important patterns and trends if ignored. For example, if a State contains a sector with very rough, mountainous terrain and another sector with very flat, wet terrain, two strata are more likely to provide an accurate picture of conditions than would a simple random sample drawn from across the entire State. Stratification, however, will likely require a larger sample size than other methods since an adequate number of samples (> 30) must be measured in each stratum, or group.

If, however, the variation in timber sales was substantial but could *not* be reliably isolated by stratification, then stratifying the population could be arbitrary and subjective, and lead to bias. Under these circumstances, random sampling without replacement or random sampling with replacement and varying probability might be more appropriate and yield more defensible results.

Sample Size

Maximizing the number of sample units is recommended since the predictive power of statistical analyses is directly proportional to sample size. Regardless of the sampling method chosen, a sufficient number of samples (≥ 30) must be obtained to avoid the statistical accuracy limitations inherent in a small sample. It is logical to assume that sample size should be increased as the total number of timber sales increases. Otherwise, the proportion or percentage of the population represented by the sample will be inadequate.

The variability of timber sales is another consideration. If early samples exhibit a wide variation in BMP implementation and performance, you may want to increase the sample size in order to accurately describe conditions statewide. Unfortunately, there are no rules of thumb for these adjustments in sample size. In most cases, sample size is limited by the resources that can be devoted to the project and, as a result, sample size usually falls short of the optimal number. Do your best with the resources available.

Examples From Protocol Testing

Very few States have a single database of all sites where timber sales occurred on an annual basis. As a result, the States that tested the BMP protocol used a variety of methods to identify an adequate number of timber sales as sample sites (table 7.1). Tax records, cutting plans or permits, soil and erosion control plans, highway entry permits, and forest management plans were all used as sources of timber sale data from which to draw a sample. In one case where no records existed, aerial reconnaissance was used to locate timber sales. Even after initial selection, some sample sites were removed from consideration because private landowners were unwilling to permit access. This introduces the possibility that landowners with concerns about the conduct of harvesting operations on their lands will deny access for monitoring, while confident landowners would permit monitoring, thus producing a favorable bias in the statewide results. One way to overcome this problem might be to grant landowners immunity from prosecution and fines for violations discovered during the sampling process if the problems are corrected within a reasonable timeframe.

In light of practical realities, some of the sampling and management strategies summarized in table 7.1 would need to be adjusted in order to be consistent with rigorous statistical theory and methods of avoiding bias.

Table 7.1. Summary of sampling and management strategies used by States and organizations in the BMP protocol pilot test.

State or organization	Method	Pros	Cons
DE	Samples were drawn by taking every fifth site from a list of erosion and sediment control permits. Sampling was assigned to State forestry personnel closest to the sites.	Comprehensive statewide list focused on nonpoint source pollution.	
IN	Five counties were drawn at random. Timber harvesting operations within the counties were located by aerial reconnaissance. Samples were collected on sites where permission to enter was granted.	Random sample of counties; census of timber harvesting operations.	Access denied by some private landowners.
MA	Sample included the first 80 sites in a random sort of the chapter 132 database for a 1-year period.	Comprehensive statewide database.	
MD	Samples were drawn for each physiographic provinces (shore, Piedmont, mountains) from a 3-year list of harvest permit notifications. First drawn were all sites with crossings.	Stratification to account for substantial physiographic and operational differences.	Focusing on sites with crossings makes it less likely that stable sites will be sampled.
ME	The State was divided into three regions with three landowner size categories in each. A random sample was drawn from Forest Operations Notification forms. Where landowner permission was granted, one sample was recorded on each of the small and medium landowner category operations and two on each of the large landowner category operations. Sampling was assigned to State forestry personnel closest to the sites.	Stratification to account for substantial physiographic and operational differences.	Perhaps too complex and stratified, with an arbitrary number of sample units on each site. Selection or omission of some samples to distribute workload.
NH	A total of 300 sites were drawn at random from intent to cut forms. Additional samples were drawn at random from Wetland Notification forms that included a stream crossing. All sites for which permission to enter was granted were sampled. Sampling was assigned to extension forestry personnel closest to the sites.	A large random sample from reliable statewide lists.	Access denied by some landowners.
New York City watershed area	Sites with crossings were solicited by letter from consulting foresters, State service foresters, and loggers. Additional sites were solicited from landowners attending forestry workshops. All sites for which permission was received were sampled.	Willingness to test protocol without any possibility of a convenient list from which to sample.	Less likely that poor sites will arise from solicitation of above-average participants.
VT	A sample unit was recorded on each Use Value Program parcel scheduled for review that included a timber sale, as well as on each State land timber sale. Sampling was assigned to State forestry personnel closest to the sites.	Subset of the population of timber harvesting operations statewide; allows evaluation of Use Value Program parcels and State lands in detail.	Sample and subsequent data analysis limited to Use Value Program parcels and State lands.
WV	A random sample was drawn from notification of intent to cut forms for a 1-year period. Sampling was assigned to State forestry personnel closest to the sites.	A large random sample from reliable statewide lists.	

Importance of Monitoring Over Time

One of the many reasons for consistency in sampling over time is the ability to detect and assess change. The importance of consistency in sampling and attention to detail can be seen in valuable, well-documented GIS and forest inventory databases. To realize the full value of the BMP protocol, States and organizations should repeat measurements at regular intervals, generally 1 to 5 years.

Regular and consistent monitoring is important for two reasons. First, if the sampling design is changed in subsequent years, the ability to compare the datasets, detect patterns and trends, and guide management efforts may be compromised. Second, if resources are allocated piecemeal with only a few samples taken every year versus, for example, 100 samples at 3-year intervals, it will probably be more difficult to gauge or detect changes associated with performance, training, or regulation.

Consider, for example, the range of variation in weather conditions during a 5-year period and its potential influence on BMP performance. Add changes in such things as equipment type, stumpage prices, and fuel prices, and the merits of a larger sample in one year on a regular interval become more apparent.

Recommendations

If the BMP protocol is to be successful in replacing older, subjective compliance measures as well as generating long-term support and credibility with the EPA, State regulatory agencies, nongovernmental organizations, and the public, it will need to produce straightforward and defensible results. To that end, conscientious sample design must precede the collection of field data. Adequate time and effort must be devoted to the task of balancing statistical principles with the practical realities of field and analytical work to ensure this goal is achieved. In addition to meaningful and useful assessments of State or organizational BMP programs, the ability to generate a regional overview to guide program development, information exchange, and technology transfer will be a valuable outcome.

Through it all, learn from experience, seek improvement, and be conservative when interpreting and applying monitoring results. Keep the following recommendations in mind:

1. Clearly and accurately list all of the timber sales to be considered.
2. Draw a sample from the list using a random process, such as one of the methods described here or one designed by statisticians from your organization.
3. Draw a sample of sufficient size (≥ 30), making it as large as possible given personnel and resource limitations.

In summary, a sample of timber harvesting operations for the BMP protocol should be drawn using sound sampling procedures from the most accurate and comprehensive list of timber sales that can be assembled to avoid the risk of bias.

Chapter 8—Quality Control

Quality control, in addition to sample design, is a significant factor in determining the value of data collected through a BMP monitoring program. Accuracy, precision, and verifiability of field data depend upon the care and consistency with which the field data are collected. Developing and maintaining high standards of quality requires

- Comprehensive training of field monitors, and
- Rigorous adherence to field procedures.

Regardless of sample design, errors in measurement or interpretation made in the collection of field data can inject bias, making it difficult to draw valid conclusions from the data. These errors have a direct bearing on the confidence that can be placed in the results of the BMP monitoring program and on the usefulness of the data to managers and regulators. Quality control, therefore, is a valuable and essential investment rather than a task that may be considered optional or unnecessary.

BMP Protocol Quality Control Principles

Responsibility for the quality control program must be assigned to an individual, preferably the State BMP Protocol Project Coordinator or project leader, early in the BMP monitoring program. The assigned individual should then be provided with the authority and resources necessary to organize and conduct the quality control program according to the principles outlined below.

- Ensure that the State coordinator or monitoring project leader has a thorough knowledge of the BMP monitoring protocol field procedures and BMP MIS.
- Establish required standards of accuracy and review them with field crews, emphasizing and reinforcing the importance accuracy and precision.
- Provide comprehensive training to all who will be involved with field data collection. Resist the temptation to provide just enough training to get people started, assuming that they will "figure it out as they go along" in the field. This approach fails to validate the effectiveness of the training and incurs the risk of changing standards and interpretation during the sampling process.
- Have field crews work in teams to increase the accuracy and consistency of BMP protocol application.
- Make a random selection of not less than 10 percent of the new sample plots **early in the field data collection phase** and remeasure them as quality control samples to detect and correct discrepancies in a timely manner.
- Repeat or refresh training on an annual basis or another appropriate interval based on sampling frequency.
- Verify or delete suspect data from the sample rather than risking contamination of the overall project results.

Quality control data collection and analysis should be completed as a part of each round of BMP monitoring in order to systematically compare data from new sample units with data from their respective quality control samples. This analysis helps determine how well different individuals independently evaluate the same site and can help to clearly identify the specific protocol questions that may require clarification or additional training for field personnel. The results of this quality control analysis should be documented and reported as part of the monitoring results.

Quality Control Results During Pilot Testing

Data quality is considered good when data recorded during a quality control review matches the data originally recorded by the field crew. Results for the pilot testing of the BMP protocol (2002–2006) showed that the quality control data directly matched the original sample data approximately 80 percent of the time when sample sites were visited independently within a short timeframe (table 8.1). This average of 80 percent accuracy is expected to improve as familiarity, training, and experience with the protocol increases.

Table 8.1. Number of quality control samples and percentage of questions with matching answers for States and organizations participating in the BMP protocol pilot test.

State or organization	Number of quality control plots	Percentage of questions with matching answers
Indiana	0	N/A
Maine	11	68
Maryland	6	78
Massachusetts	11	82
New Hampshire	4	81
New York City Watershed	9	78
Vermont	7	75
West Virginia	9	95

Quality Control Analysis

Reviewing quality control data against original field data by checking the answers to all 197 protocol questions in each sample is a time-consuming task. Some of the answers to protocol questions are very similar and call for a degree of judgment on the part of the reviewer to determine if the original and quality control data match. A significant number of protocol answers, however, may be verified by simple comparison of numerical data. An Excel worksheet has been developed to facilitate this process (see next section for detailed instructions on using the worksheet).

For most of the questions evaluated in the quality control analysis worksheet, the original field data and quality control data must match exactly. But for few of the questions, a tolerance level has been set to allow very minor differences to be recorded as a match. For example, if field personnel reported 125 feet as the total length of a ditch in answer to question X24 and a quality control reviewer recorded 132 feet, the answers would be considered a match because the difference is less than the 10 percent tolerance level set for that question.

Because erosion can lengthen rills and ditches over time, a tolerance level of 10 percent was used in the quality control analysis worksheet for linear measurements recorded in questions X24, X49, X93, X118, HB148, B186, B187, B188. Since some movement is often required for satellite reception, a tolerance level of .003 degrees was used for the GPS coordinates recorded in questions X14, X15, HB138, HB139, CP171, CP172, B177, and B178.

The following questions are included in the quality control analysis worksheet. The first appearance of a question number is in bold; subsequent appearances of the same question follow in normal type.

X12

X13, HB140, B173

X14, HB138, CP171, B177

X15, HB139, CP172, B178

X22, X47, X78, X91, X116, HB146

X23, X48, X80, X92, X117, HB147

X24, X49, X93, X118, HB148

X28, X34, X40, X53, X59, X83, X97, X103, X109, X122, X128, HB152, HB158

X32, X57, X101, X126, HB156

X38, X107

X71

X73

X74

X75

X76

X77

HB137

HB168

CP169

B179

B181

B186

B187

B188

B190

B191

W192

W196

Quality Control Analysis Worksheet

The quality control analysis worksheet file, **quality_control_worksheet.xls**, has been included on the CD accompanying this desk reference. This file is designed to work in conjunction with your original field data file and your quality control data file.

Navigate to the **quality_control_worksheet.xls** file and open it in Excel. The file has been password protected to prevent accidental alteration of the cell formulas. To unprotect the worksheet, select **Tools** from the main toolbar, and **Protection** and **Unprotect Sheet** from the drop-down menus. In the window that opens, type in the password "quality control" (in lower case). Make a copy of the worksheet under a different file name by selecting **File** from the main toolbar and **Save As** from the drop-down menu. Give the newly created file a name that identifies the project and date of the data (e.g., **qc (project name and date).xls**).

Return to the **quality_control_worksheet.xls** file and restore the password protection by selecting **Tools**, **Protection**, and **Protect Sheet**. Type in a password you can remember. Close the **quality_control_worksheet.xls** file.

You will copy rows of data from your original field data file and your quality control data file into the quality control analysis worksheet in pairs of rows, for example, placing original field data in row 2 and the corresponding quality control data in row 3. Original field data will be placed in rows 2, 8, 14, 20, 26, 32, 38, 44, and 50 and the respective quality control data in rows 3, 9, 15, 21, 27, 33, 39, 45, and 51. It is important to place the original field data and the quality control data in the correct rows in the quality control analysis worksheet in order for the formulas to work correctly. The worksheet will accommodate nine rows of original data along with nine rows of corresponding quality control data.

Navigate to and open your original field data file and the corresponding quality control data file. Open your newly created **qc (project name and date).xls** file. In your original field data file, click on the row number at the left end of the row containing the data to copy (e.g., row 2). Select the **Copy** icon on the main toolbar. Go to the **qc (project name and date).xls** file. Click on the row number at the left end of the row in which you wish to place the data and select the **Paste** icon. Continue filling the worksheet in this manner, first with the original field data file and then the quality control data file. Make sure to place the original field data in the correct rows with the respective quality control data in the rows immediately below.

The worksheet will place a TRUE or FALSE in the row below the data in the column of each question checked, indicating whether or not the data matched. The worksheet will then make the necessary calculations to indicate the percentage of questions that have matching answers.

The State coordinator or project leader can then use the results to assess the quality of data collection and the question areas in which additional training or clarification is needed.

Chapter 9—Recordkeeping and Data Security

Data gathered using the BMP protocol is used to evaluate the effectiveness of BMP implementation for your State or organization. Careful recordkeeping and the security of field data are essential to the integrity of any such project. The following are suggestions for managing records and securing data.

Recordkeeping

- Create a separate copy of the BMP MIS folder for each monitoring project undertaken. Give the folder a unique name that represents the geographic area and the year in which the data were collected (e.g., BMP MIS Allagash 2007). Save all field data and analysis files in this folder. It is important to keep all related data and reports for each project in the same unique folder for two reasons: (1) The BMP MIS will assign all field data files the same file name in order for the Access queries to work properly (see chapter 3). Keeping the field data files in their appropriate folder will ensure that the data remains accurate. (2) All files must be in the same folder in order to maintain the links between the source data and the data summaries.
- Ensure that the original BMP MIS folder and any subsequent BMP MIS project folders you create are part of a regular backup of your computer system. If you use a tape backup system in your office, be sure that all BMP MIS project folders are part of that scheduled backup.
- Copy the original BMP MIS folder onto a CD and store it in a safe place offsite. Information Technology professionals suggest keeping a copy of all important data offsite to would allow for data recovery in the event of a fire, flood, or other destructive event at the office.
- When you complete a Comprehensive Standard Data Summary, open the document file and break the links with the Excel analysis file. This will reduce the size of the file, making it easier to e-mail the file and requiring less memory to store it. Opening the Comprehensive Standard Data Summary and breaking the links from within it does not affect the links associated with other documents.

Data Security

Data security is essential to the reliability of the BMP protocol field data and data summaries. The integrity and defensibility of field data is the most important reason to take precautions and protect the security of your data.

- Allow only one person to correct errors. The fewer the people with the authority to make changes to protocol data, the more secure the data.
- Install and run the BMP MIS on a password-protected computer system. Require users to log into Windows with a password to gain access to the drive where the BMP MIS directories and files are located.
- Leave the default BMP MIS protections in place. The Access database as well as the Excel analysis file and Excel charts worksheets are password protected. **Do not remove these protections.** They guard against unauthorized access to data, and, in the case of Excel, protect the user from inadvertently losing data links.

Appendix A—Abbreviations

The following abbreviations are used in naming queries and standard data summaries in the BMP MIS.

Abbreviation	Definition
3mo	three months
3Pty	third party
Agrmnt	agreement
Ain	Approach Area A–Inside the Buffer/Filter Strip
Aout	Approach Area A–Outside the Buffer/Filter Strip
Appr	approach(es)
Assnd	assigned
BCCT	bridge culvert closed top
BCOT	bridge culvert open top
Bin	Approach Area B–Inside the Buffer/Filter Strip
BMP	best management practices
Bnkfl	bankfull
Bout	Approach Area B–Outside the Buffer/Filter Strip
Buff	buffer/filter strip
Cntrct	contract
CP	chemical pollutants
CP Spill	chemical spill
Ephmrl	ephemeral
Equ	equal
Extr Wthr	extreme weather
Frstr	forester
Grtr	greater
Grtr Equ	greater than or equal to
HR	haul road
IF	improved ford
Indst	industrial
Intrmtnt	intermittent
LL	log landing
Loggr	logger
MC	multiple culverts
Mvt	movement
N	new
NIPF	non-industrial private forest

Opn	open
PBF	pole/brush ford
Prnl	perennial
Rip Bffr	riparian buffer
SC	single culvert
Scour	scouring
Sed	sediment or sedimentation
Skd Trl	skid trail
Specs	specifications
SR	(crossing) structure removed
Stbl	stable
Ste Req	state requirement
Str Rmvd	opening spec undetermined due to structure removal
SU	sample unit
Surf	surface
UF	unimproved ford
UO	unknown/other
WB	water body
Wdth	width
WL	wetland
WL X	wetland crossing
Wthr	weather
Wtr	water
XStr	crossing structure

Appendix B—Queries

The following queries have been defined in the BMP MIS.

Query name	Description
N 3Pty	New sample units where forestry activity is certified by third-party agency
N 3Pty Mvt Appr	New sample units with surface water body concerns and observations of soil movement at the approaches; forest activity regulated by third-party certifying agency
N 3Pty Mvt XStr	New sample units with observation of soil movement from the crossing structure; forestry activity is certified by third-party agency
N 3Pty Sed WB Appr	New sample units with observations of sediment delivery to a water body from approaches; forestry activity is certified by a third-party agency
N 3Pty Sed WB XStr	New sample units with evidence of sediment delivery to the water body from the crossing structure; forestry activity is certified by third-party agency
N 3Pty Stbl Appr	New sample units with a surface water crossing and soil is stabilized at the approaches; third-party certifier is responsible for forest activity
N 3Pty Stbl XStr	New sample units with observations of stable soil at the crossing structure; forestry activity is certified by third-party agency
N BMP Not Assnd	New sample units where responsibility for BMP implementation has not been assigned
N Buff Bet 25 and 50	New sample units with a recommended buffer/filter strip width between 25 and 49 feet
N Buff Grtr Equ 50	New sample units with a recommended buffer/filter strip width greater than or equal to 50 feet
N CP Refuse	New sample units with observations of logging refuse
N CP Spill	New sample units with observations of chemical spill
N CP Spill Refuse	New sample units with evidence of both chemical spillage and pollutant containers
N CP WB	New sample units where chemical pollutants reached a water body
N Ephmrl WB	New sample units; crossing is ephemeral stream
N Extr Wthr	New sample units where an extreme weather-related event influenced results of evaluation
N Extr Wthr Mvt Appr	New sample units with observations of soil movement from the approaches and extreme weather occurrence likely to influence results of the sample

N Extr Wthr Mvt XStr	New sample units with observations of soil movement from the crossing structure and extreme weather likely to influence results of the sample
N Extr Wthr Sed WB Appr	New sample units with observations of sediment delivery to a water body from approaches and extreme weather likely to influence results of the sample
N Extr Wthr Sed WB XStr	New sample units with observations of sediment delivery to the water body from the crossing structure and extreme weather likely to influence results of the sample
N Extr Wthr Stbl Appr	New sample units where soil is stabilized at the approaches and extreme weather likely to influence results of the sample
N Extr Wthr Stbl XStr	New samples where soil is stable at the crossing structure and extreme weather likely to influence results of the sample
N Frstr Cntrct	New sample units where the forester is responsible for BMP implementation by written contract
N Frstr Cntrct Mvt Appr	New sample units with observations of soil movement from the approaches; forester is responsible for BMP implementation by written contract
N Frstr Cntrct Mvt XStr	New sample units with observations of soil movement from the crossing structure; forester is responsible for BMP implementation by written contract
N Frstr Cntrct Sed WB Appr	New sample units with observations of sediment delivered to a water body from approaches; forester is responsible for BMP implementation by written contract
N Frstr Cntrct Sed WB XStr	New sample units with observations of sediment delivery to a water body from the crossing structure; forester is responsible for BMP implementation by written contract
N Frstr Cntrct Stbl Appr	New sample units with soil stabilized at the approaches; forester is responsible for BMP implementation by written contract
N Frstr Cntrct Stbl XStr	New sample units with soil stabilized at the crossing structure; forester is responsible for BMP implementation by written contract
N HR	New sample units with a haul road associated with the crossing structure
N HR Buff	New sample units with a haul road in the buffer/filter strip; the haul road is NOT associated with another water body crossing
N HRLL Buff	New sample units with a haul road or log landing in the buffer/filter strip; the haul road or log landing is NOT associated with another water body crossing
N HRLL Buff Grtr Equ 50	New sample units with a haul road or log landing in the buffer/filter strip; the recommended buffer/filter strip width is greater than or equal to 50 feet
N Indst	New sample units belonging to an industrial forest landowner

N Indst Mvt Appr	New sample units with observations of soil movement at the approaches; industrial ownerships
N Indst Mvt XStr	New sample units with observations of soil movement from the crossing structure; industrial ownerships
N Indst Sed WB Appr	New sample units with observations of sediment delivered to the water body from the approaches; industrial ownerships
N Indst Sed WB XStr	New sample units with observations of sediment delivery to a water body from the crossing structure; industrial ownerships
N Indst Stbl Appr	New sample units where soil is stabilized at the approaches; industrial ownerships
N Indst Stbl XStr	New sample units where soil is stabilized at the crossing structure; industrial ownerships
N Intrmtnt WB	New sample units; crossing is intermittent stream or vernal pool
N LL Buff	New sample units with a log landing in the buffer/filter strip; the log landing is NOT associated with another water body crossing
N Loggr Agrmnt	New sample units where a logger is responsible for BMP implementation by oral agreement
N Loggr Cntrct	New sample units where a logger is responsible for BMP implementation by written contract
N Mvt	New sample units with observations of soil movement from the approaches, the crossing structure, a haul road or log landing in the buffer/filter strip, OR a wetland crossing
N Mvt Appr	New sample units with observations of soil movement from the approaches
N Mvt XStr	New sample units with observations of soil movement from the crossing structure
N NIPF	New sample units that are non-industrial private forest ownerships
N NIPF Mvt Appr	New sample units with observations of soil movement at the approaches; non-industrial private ownerships
N NIPF Mvt XStr	New sample units with observations of soil movement at the crossing structure; non-industrial private ownerships
N NIPF Sed WB Appr	New sample units with observations of sediment delivered to the water body from the approaches; non-industrial private ownerships
N NIPF Sed WB XStr	New sample units with observations of sediment delivery to a water body from the crossing structure; non-industrial private ownerships
N NIPF Stbl Appr	New sample units where soil is stabilized at the approaches; non-industrial private ownerships
N NIPF Stbl XStr	New sample units where soil is stabilized at the crossing structure; non-industrial private ownerships

N No HR Buff	New sample units with surface water crossings and no haul road or log landing in the buffer/filter strip
N No Mvt Appr	New samples with NO observations of soil movement or sediment delivered from the approaches; soil is stable at the approaches
N No Mvt Sed	New sample units with NO observations of soil movement or sediment delivered to a water body from the approaches, crossing structure, haul road or log landing in the buffer/filter strip, OR wetland crossing; soil is stable for all protocol questions
N No Surf Wtr	New sample units with no surface water crossings
N No Surf Wtr HRLL Buff	New sample units with no surface water crossing and a haul road or log landing in the buffer/filter strip
N No Surf Wtr No HR Buff	New sample units with no surface water concerns and no haul road in the buffer/filter strip
N Prnl WB	New sample units; crossing is perennial stream, lake, or wetland
N Sed CP WB/WL	New sample units with observations of sediment or chemical pollutants reaching a water body or wetland
N Sed WB	New sample units with observations of sediment delivered to a water body from the approaches, the crossing structure, a haul road or log landing in the buffer/filter strip, OR a wetland
N Sed WB Ain	New sample units with observations of sediment delivered to a water body from Approach Area A–Inside the Buffer/Filter Strip
N Sed WB Aout	New sample units with observations of sediment delivered to a water body from Approach Area A–Outside the Buffer/Filter Strip
N Sed WB Aout/BCCT	New sample units with observations of sediment delivered to a water body from Approach Area A–Outside the Buffer/Filter Strip; crossing structure is a bridge or box culvert with a closed top
N Sed WB Aout/BCOT	New sample units with observations of sediment delivered to a water body from Approach Area A–Outside the Buffer/Filter Strip; crossing structure is a bridge or box culvert with an open top
N Sed WB Aout/IF	New sample units with observations of sediment delivered to a water body from Approach Area A–Outside the Buffer/Filter Strip; crossing structure is an improved ford
N Sed WB Aout/MC	New sample units with observations of sediment delivered to a water body from Approach Area A–Outside the Buffer/Filter Strip; crossing structure is multiple culverts
N Sed WB Aout/PBF	New sample units with observations of sediment delivered to a water body from Approach Area A–Outside the Buffer/Filter Strip; crossing structure is a pole/brush ford
N Sed WB Aout/SC	New sample units with observations of sediment delivered to a water body from Approach Area A–Outside the Buffer/Filter Strip; crossing structure is a single culvert

N Sed WB Aout/SR	New sample units with observations of sediment delivered to a water body from Approach Area A–Outside the Buffer/Filter Strip; crossing structure removed
N Sed WB Aout/UF	New sample units with observations of sediment delivered to a water body from Approach Area A–Outside the Buffer/Filter Strip; crossing structure is an unimproved ford
N Sed WB Aout/UO	New sample units with observations of sediment delivered to a water body from Approach Area A–Outside the Buffer/Filter Strip; crossing structure is unknown/other
N Sed WB Appr	New sample units with observations of sediment delivery to a water body from the approaches to the surface water crossing
N Sed WB Appr Xstr	New sample units with observations of sediment delivered to a water body from the approaches or from the crossing structure
N Sed WB Bin	New sample units with observations of sediment delivered to a water body from Approach Area B–Inside the Buffer/Filter Strip
N Sed WB Bout	New sample units with observations of sediment delivered to a water body from Approach Area B–Outside the Buffer/Filter Strip
N Sed WB Bout/BCCT	New sample units with observations of sediment delivered to a water body from Approach Area B–Outside the Buffer/Filter Strip; crossing structure is a bridge or box culvert with a closed top
N Sed WB Bout/BCOT	New sample units with observations of sediment delivered to a water body from Approach Area B–Outside the Buffer/Filter Strip; crossing structure is a bridge or box culvert with an open top
N Sed WB Bout/IF	New sample units with observations of sediment delivered to a water body from Approach Area B–Outside the Buffer/Filter Strip; crossing structure is an improved ford
N Sed WB Bout/MC	New sample units with observations of sediment delivered to a water body from Approach Area B–Outside the Buffer/Filter Strip; crossing structure is multiple culverts
N Sed WB Bout/PBF	New sample units with observations of sediment delivered to a water body from Approach Area B–Outside the Buffer/Filter Strip; crossing structure is a pole/brush ford
N Sed WB Bout/SC	New sample units with observations of sediment delivered to a water body from Approach Area B–Outside the Buffer/Filter Strip; crossing structure is a single culvert
N Sed WB Bout/SR	New sample units with observations of sediment delivered to a water body from Approach Area B–Outside the Buffer/Filter Strip; crossing structure removed
N Sed WB Bout/UF	New sample units with observations of sediment delivered to a water body from Approach Area B–Outside the Buffer/Filter Strip; crossing structure is an unimproved ford

N Sed WB Bout/UO	New sample units with observations of sediment delivered to a water body from Approach Area B–Outside the Buffer/Filter Strip; crossing structure is unknown/other
N Sed WB In	New sample units with observations of sediment delivered to a water body from the approaches inside the buffer/filter strip
N Sed WB Out	New sample units with observations of sediment delivered to a water body from approaches outside the buffer/filter strip
N Sed WB XStr	New samples with evidence of sediment delivery to a water body from the crossing structure
N Skd Trl	New sample units with skid trails
N Stbl	New sample units with observations of stabilized soil at the approaches, the crossing structure, the haul road or log landing in the buffer/filter strip, OR the wetland crossing
N Stbl Appr	New sample units with observations of soil stabilized at the approaches
N Stbl Appr XStr	New sample units with observations of stable soil at the approaches or the crossing structure
N Stbl XStr	New sample units with observations of stable soil at the crossing structure
N Surf Wtr	New sample units with surface water crossings
N WB Rip Bffr	New sample units with perennial stream or lake, intermittent stream or vernal pool, or ephemeral stream adjacent to the buffer/filter strip
N WL X	New sample units with a wetland crossing
N XStr BCCT	New sample units with a bridge or box culvert with a closed top as crossing structure
N XStr BCOT	New sample units with a bridge or box culvert with an open top as crossing structure
N Xstr Grtr 3mo	New sample units with crossing structure to be in place greater than 3 months; fish or macroinvertebrates are present
N XStr IF	New sample units with an improved ford as crossing structure
N Xstr Less 3mo	New sample units with crossing structure to be in place less than 3 months; fish or macroinvertebrates are present
N XStr MC	New sample units with multiple culverts as crossing structure
N Xstr No Scour	New sample units with no evidence of stream down cutting or scouring within 100 feet of the outlet end of the crossing structure
N Xstr No Ste Req	New sample units with no State requirements for size of crossing structure opening
N Xstr Opn Grtr Bnkfl Wdth	New sample units with a crossing structure opening equal to or greater than pre-structure bankfull channel width

N Xstr Opn Less Bnkfl Wdth	New sample units with a crossing structure opening less than pre-structure bankfull channel width
N Xstr Opn Ste Req no	New sample units; size of crossing structure does not meet State requirements
N Xstr Opn Ste Req yes	New sample units; size of crossing structure meets State requirements
N XStr PBF	New sample units, crossing structure is a pole/brush ford
N XStr SC	New sample units, crossing structure is a single culvert
N Xstr Scour	New sample units with evidence of stream down cutting or scouring within 100 feet of the outlet end of the structure
N XStr SR	New sample units and crossing structure has been removed
N Xstr Str Rmvd	New sample units; unable to determine if crossing structure opening meets State requirements because structure removed
N XStr UF	New sample units; crossing structure is unimproved ford
N XStr UO	New sample units and crossing structure is unknown or other
New Samples	New sample units

Appendix C—Standard Data Summaries

Standard data summaries (SDSs) can be used alone or combined into a Comprehensive Standard Data Summary. Each Comprehensive Standard Data Summary should begin with the document **Comprehensive_Report_Cover_and_Introduction.doc**. The following is the recommended sequence for arranging the SDSs in the Comprehensive Standard Data Summary. A description of each SDS is also provided.

Overview Information

Name	Description
New SU General Information SDS.doc	Introductory information on the BMP protocol and summary data on the general information feature
New Sample Unit SDS.doc	Summary data on new sample units
New SU Soil Mvt Sed Stabl SDS.doc	Summary data on soil movement, sedimentation, and stabilization on new sample units

Data Summaries

Name	Description
New SU Approaches SDS.doc	Summary data on the approaches to surface water crossings on new sample units
New SU Crossing Structure SDS.doc	Summary data on the crossing structure feature on new sample units
New SU Crossing Structure Specs SDS.doc	Summary data on crossing structure specifications on new sample units
New SU Fish Passage SDS.doc	Summary data on fish passage questions on new sample units
New SU Soil Mvt Buffer SDS.doc	Summary data on soil movement within the buffer/filter strip on new sample units
New SU HRLL in Buffer SDS.doc	Summary data on haul roads and/or log landings in the buffer/filter strip on new sample units
New SU Riparian Area SDS.doc	Summary data on the riparian area feature on new sample units
New SU Chemical Pollution SDS.doc	Summary data on chemical pollution on new sample units
New SU Wetland SDS.doc	Summary data on wetland crossings on new sample units
New SU Approaches BMP Not Assnd SDS.doc	Summary data on the approaches where responsibility for BMP implementation has not been assigned as part of the timber sale agreement on new sample units
New SU Approaches Frstr Cntrct SDS.doc	Summary data on the approaches where a forester has been assigned responsibility for BMP implementation as part of the timber sale agreement on new sample units
New SU Approaches Loggr Cntrct SDS.doc	Summary data on the approaches where a logger has been assigned responsibility for BMP implementation as part of the timber sale agreement on new sample units

Appendix D—Example Comprehensive Standard Data Summary

See chapter 4 for the steps to follow in creating a Comprehensive Standard Data Summary using your data.

Example

Best Management Practices (BMP) Monitoring Protocol—Data Summary

<Insert report title, including the area investigated, the timeframe, and the name of the person compiling the report>

Example

The data in this document were generated using the procedures outlined in the two volumes of the **Best Management Practices (BMP) Monitoring Manual: Implementation and Effectiveness for Protection of Water Resources**:

Field Guide (NA–FR–02–06)

Desk Reference (NA–FR–02–07)

Both documents were published by:

United States
Department of Agriculture

Forest Service

Northeastern Area State and Private Forestry
11 Campus Boulevard, Suite 200
Newtown Square, PA 19073

Example

Introduction

The best management practices (BMP) protocol provides an efficient, economical, standardized, and repeatable BMP monitoring process that is automated from data gathering through the generation of a standard data summary. It uses commonly available software and inexpensive field data recording devices. It is compatible with existing State BMP programs and is available for use by forestry agencies, forest industry, and green certification organizations.

Further information, manuals, software programs, and training in the protocol procedures and report generation can be obtained from David Welsch or Albert Todd, U.S. Forest Service, Northeastern Area State and Private Forestry, Watershed Team.

Background

The BMP protocol project is a cooperative effort of the Forest Service, U.S. Department of Agriculture, and the Northeastern Area Association of State Foresters–Water Resources Committee (NAASF–WRC), Steven Koehn, Maryland State Forester, chairperson. The project has been funded by grants from the U.S. Forest Service and the U.S. Environmental Protection Agency (EPA).

The original concept and question sequence was developed by Roger Ryder and Tim Post of the Maine Forest Service in collaboration with David Welsch and Albert Todd of the U.S. Forest Service, Northeastern Area State and Private Forestry (NA S&PF). The NA S&PF proposed the method to the NAASF–WRC and the EPA for development as a potential regional protocol. After the withdrawal of the Maine Forest Service, David Welsch served as the project coordinator through the development, testing, and implementation of the project.

State forestry agencies from Delaware, Indiana, Maine, Maryland, Massachusetts, New Hampshire, New York, Ohio, Pennsylvania, Vermont, Virginia, West Virginia, and Wisconsin; the New York City Watershed Agricultural Council Forestry Program; and the U.S. Forest Service Northern Research Station and NA S&PF have collaborated in the development and testing of the BMP protocol.

Example

Data Summary

The information in this data summary was compiled from a sample data set using measurements from **309** sample units.

The data summary is a computer-generated set of graphs and charts summarizing the sample unit data in a standardized format to facilitate comparison with data collected from other times and differing geographical areas.

Each sample unit contains the potential for approximately 200 observations and includes a number of observations of some types of data. Proportions presented in the charts and graphs in the standard data summaries are based on the total number of possibilities for a condition to occur. Null observations are included in the calculations to ensure that the proportions total 100 percent and the frequency of problems is accurately reported.

The data collection procedure is described in the U.S. Forest Service publication *Best Management Practices (BMP) Monitoring Manual—Field Guide: Implementation and Effectiveness for Protection of Water Resources* (NA–FR–02–06), which includes the question set and instructions for making and recording the observations. Diagrams and definitions are also included.

Data summary generation, quality control, risk analysis, and statistical sample design information are described in *Best Management Practices (BMP) Monitoring Manual—Desk Reference: Implementation and Effectiveness for Protection of Water Resources* (NA–FR–02–07).

Example

Contents

Example

General Information Feature

This report presents the results of data gathered for the BMP protocol project on new sample units for the State of **XX**.

- A total of **309** new sample units were sampled.

Number of Samples Taken by Year

Year of Sample	Number of Samples
2003	0
2004	177
2005	132
2006	0
2007	0
2008	0
2009	0

Map of Monitored Area With Sample Units

<OPTION: User may insert figure showing monitored area and sample unit locations.>

Example

Ownership Category

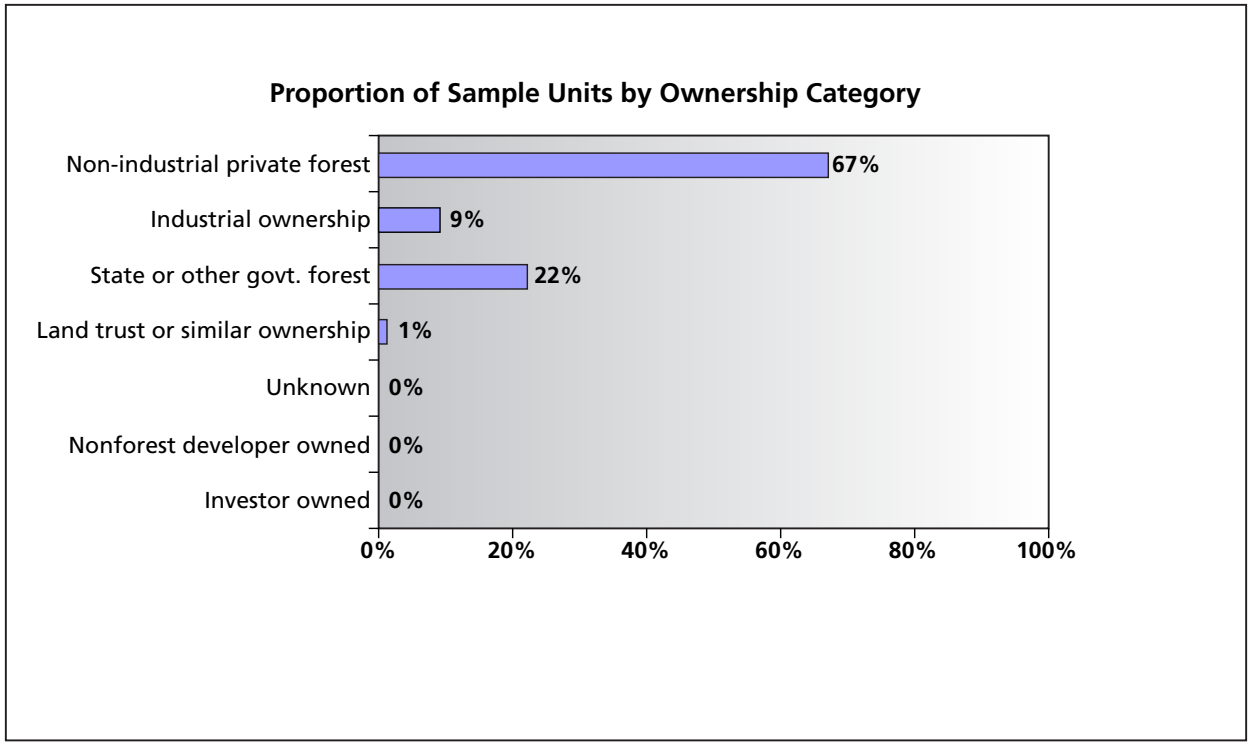


Figure 1. (n=309)

Example

Overview of Sample Units

309 new sample units were sampled.

Number and Proportion of Sample Units by Feature

A sample unit is likely to have more than one of activity or condition recorded; therefore, the total of activities and conditions will exceed the number of sample units (e.g., **493** activities and conditions in **309** sample units).

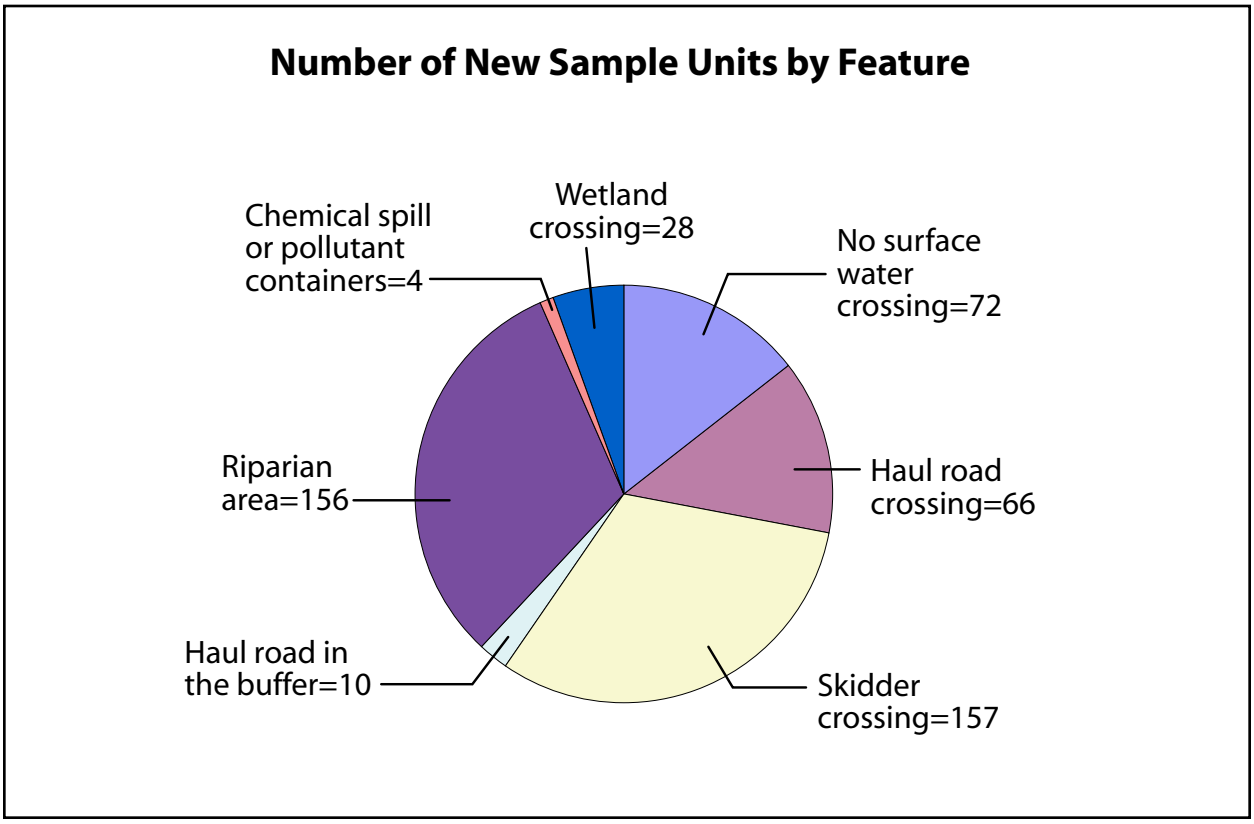


Figure 2. (n=309)

Example

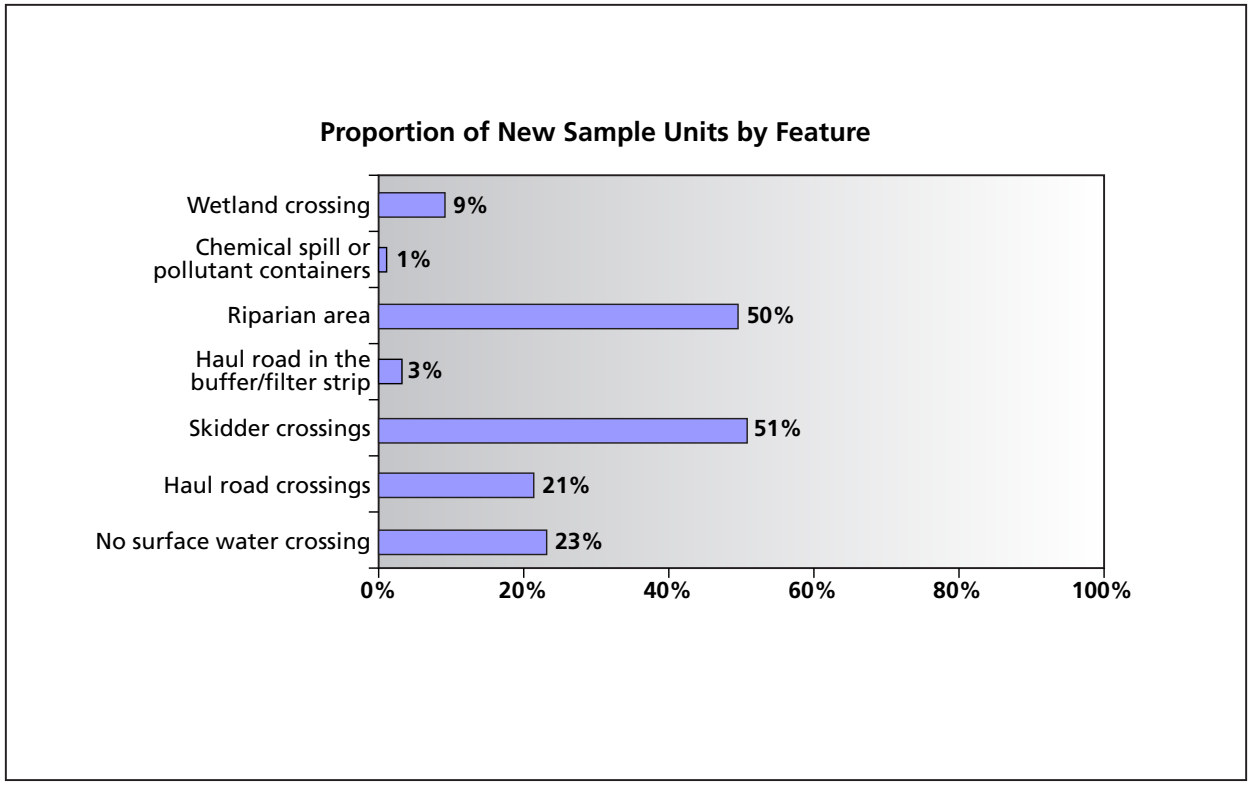


Figure 3. Sample units may qualify as more than one type; therefore, percentages may total more than 100 **(n=309)**.

Discussion

<OPTION: User may insert analysis, interpretation, and photographs here.>

Example

Soil Movement, Sedimentation, and Stabilization

There are **5** opportunities to observe the occurrence of soil movement, sedimentation, or stabilization for each sample unit. They are at Approach Area A–Outside the Buffer/Filter Strip, Approach Area A–Inside the Buffer/Filter Strip, the crossing structure, Approach Area B–Inside the Buffer/Filter Strip, and Approach Area B–Outside the Buffer/Filter Strip. **Proportions in this section are based on the total number of opportunities to make observations about soil conditions.**

For the **309** new sample units, there are **1545** opportunities to observe soil conditions.

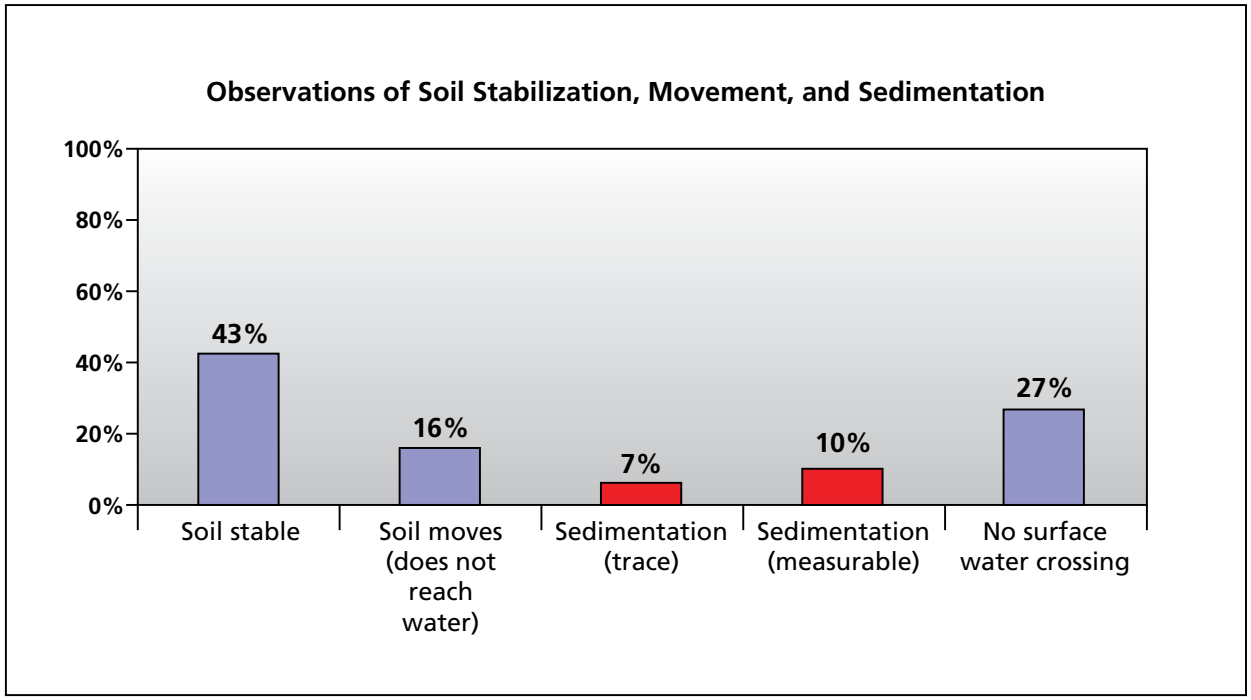


Figure 4. Proportions are based on the total number of opportunities to observe soil conditions in the protocol **(n=1545)**.

Example

Table 1. Quantities of Measurable Sedimentation by Area of Origin (cubic feet)

	Average	Median	Maximum
All areas			
Rill or gully	101	16	1485
Sediment evident in the water body	35	5	606
Approaches Outside the Buffer/Filter Strip			
Rill or gully	183	60	1485
Sediment evident in the water body	11	5	40
Approaches Inside the Buffer/Filter Strip			
Rill or gully	72	7	1250
Sediment evident in the water body	25	6	270
Crossing structures			
Rill or gully	N/A	N/A	N/A
Sediment evident in the water body	49	5	606

Nonnumeric values indicate that no volume measurements were recorded.

Note: Rill and gully volumes are measurements of the volume displaced from the rill or gully and may be larger than the volume actually entering the bankfull channel. Sediment evident in the water body is a measure of the sediment attributable to the logging activity and present in the channel when the observation is made; it cannot account for sediment washed away prior to observation. Thus, there is a high probability that the actual volume of sediment reaching the bankfull channel of the water body is between these two estimates.

Discussion

<OPTION: User may insert analysis, interpretation, and photographs here.>

Example

Approaches to the Water Crossing

There are **4** opportunities to observe the occurrence of soil movement, sedimentation, or stabilization from the approaches to a surface water crossing. They are at Approach Area A–Outside the Buffer/Filter Strip, Approach Area A–Inside the Buffer/Filter Strip, Approach Area B–Inside the Buffer/Filter Strip, and Approach Area B–Outside the Buffer/Filter Strip. **Proportions are based on the total number of opportunities to make observations about soil conditions at the approaches.**

For the **309** new sample units, there are **1236** opportunities to observe soil conditions.

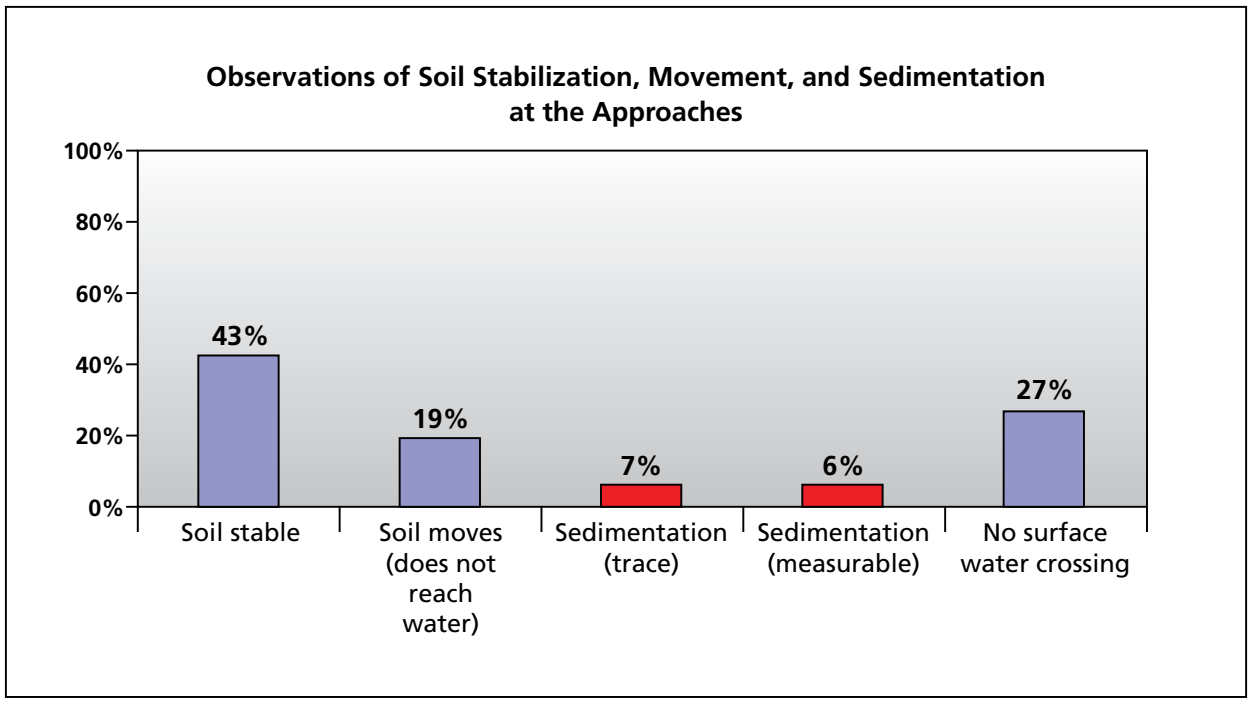


Figure 5. Proportions are based on the total number of opportunities to observe soil conditions at the approaches **(n=1236)**.

Discussion

<OPTION: User may insert analysis, interpretation, and photographs here.>

Example

Sediment From the Approaches

There are **83** observations of trace amounts of sediment reaching the surface water body or deposited within bankfull channel width of the water feature.

There are **77** observations of measurable amounts of sediment reaching the surface water body or deposited within bankfull channel width of the water feature.

The following table compares volumes of measurable amounts of sediment.

Table 2. Volume of Sedimentation (cubic feet)

	Approaches Outside the Buffer/Filter Strip		Approaches Inside the Buffer/ Filter Strip	
	Rill or gully	**Sediment evident in water body**	**Rill or gully**	**Sediment evident in water body**
Average	183	11	72	25
Median	60	5	7	6
Maximum	1485	40	1250	270

Table reflects the average, median, and maximum of sediment volumes 1 cubic foot or greater. Nonnumeric values indicate that no volume measurements were recorded.

Note: Rill and gully volumes are estimates of the volume displaced and may be larger than the volume actually entering the bankfull channel. Sediment evident in the water body is a measure of the sediment attributable to the logging activity and present in the channel at the point in time at which the observation is made; it cannot account for sediment washed away prior to observation. Thus, there is a high probability that the actual volume of sediment reaching the bankfull channel of the water body is between these two estimates.

Example

Crossing Structure

There is **1** opportunity to observe the occurrence of soil movement, sedimentation, or stabilization from the crossing structure. **Proportions are based on the total number of opportunities to make observations about soil conditions at the crossing structure.**

For the **309** new sample units, there are **309** opportunities to observe soil conditions at the crossing structure.

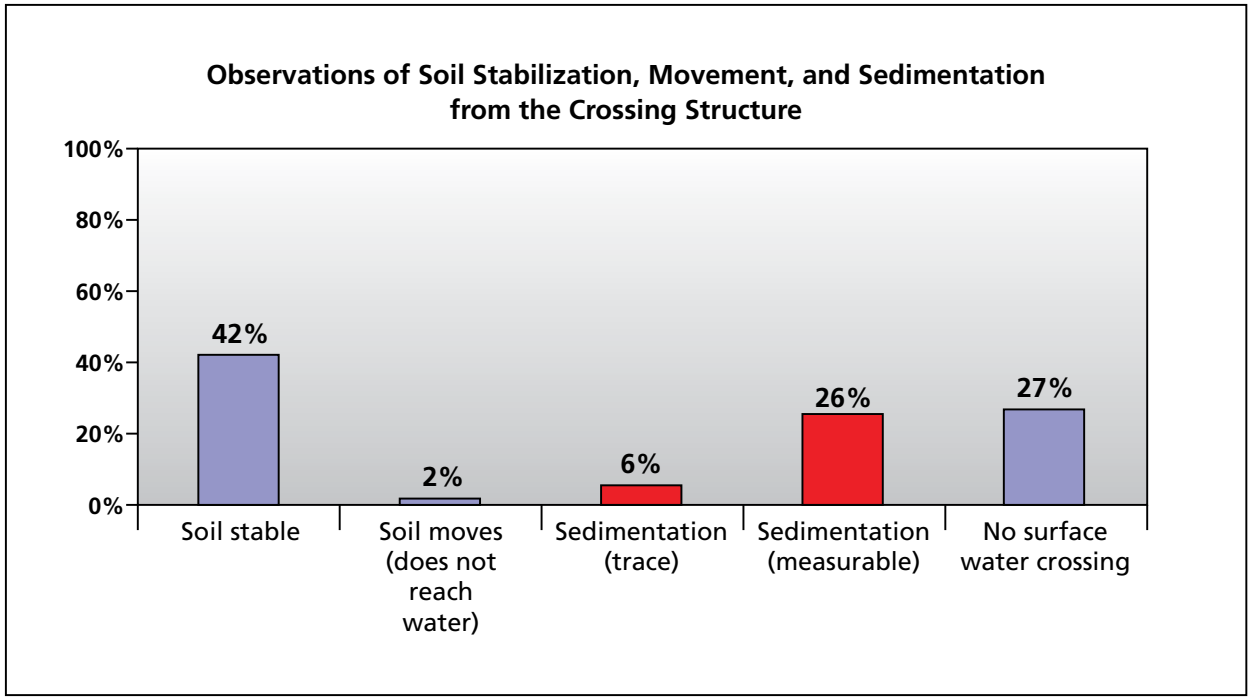


Figure 6. Proportions are based on the total number of opportunities to observe soil conditions at the crossing structure **(n=309)**.

Discussion

<OPTION: User may insert analysis, interpretation, photographs here.>

Sedimentation From the Crossing Structure

There are **19** observations of trace amounts of sediment reaching the surface water body or deposited within bankfull channel width of the water feature.

There are **80** observations of measurable amounts of sediment reaching the surface water body or deposited within bankfull channel width of the water feature.

Example

Table 3: Volume of Measurable Sediment Observed in the Water and Attributable to the Crossing Structure (cubic feet)

	Sediment evident in water body
Average	49
Median	5
Maximum	606

Nonnumeric values indicate that no volume measurements were recorded.

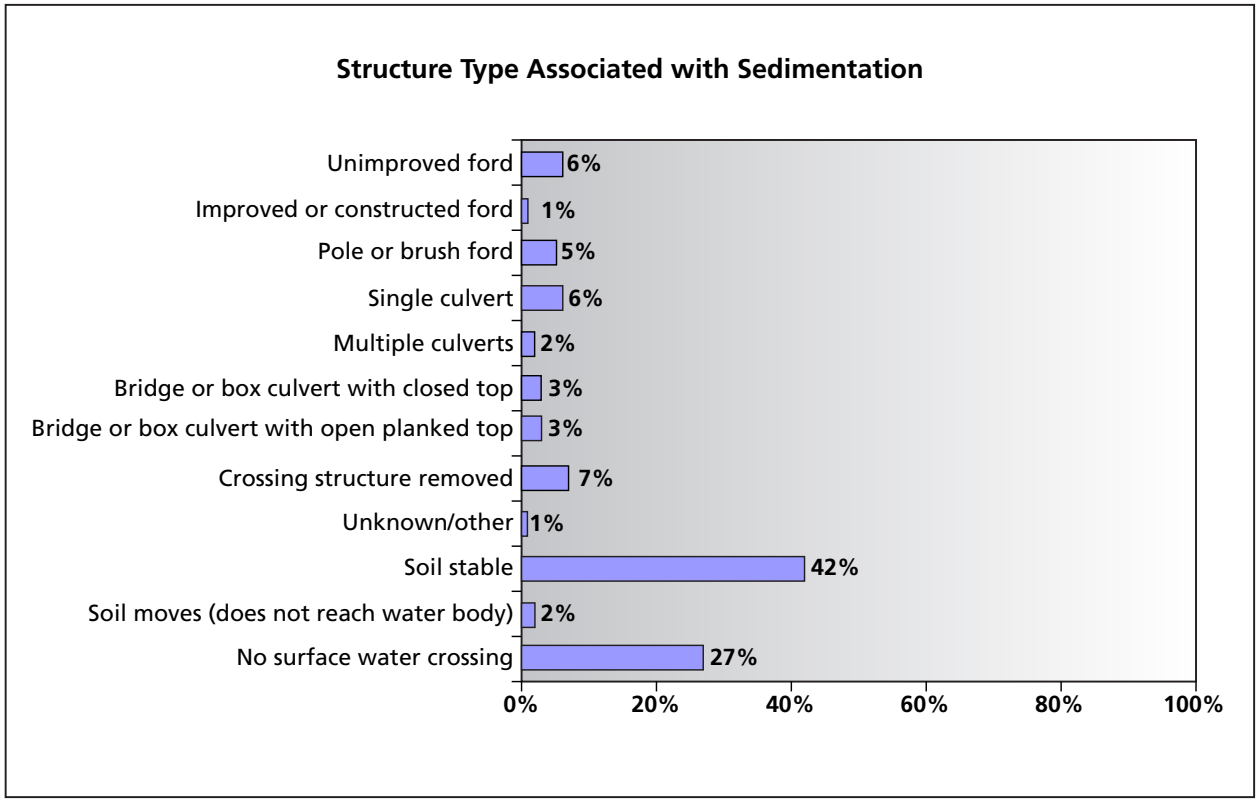


Figure 7. (n=309)

Example

Crossing Structure Specifications

A total of **309** new sample units were sampled.

- **226** sample units have surface water crossings.

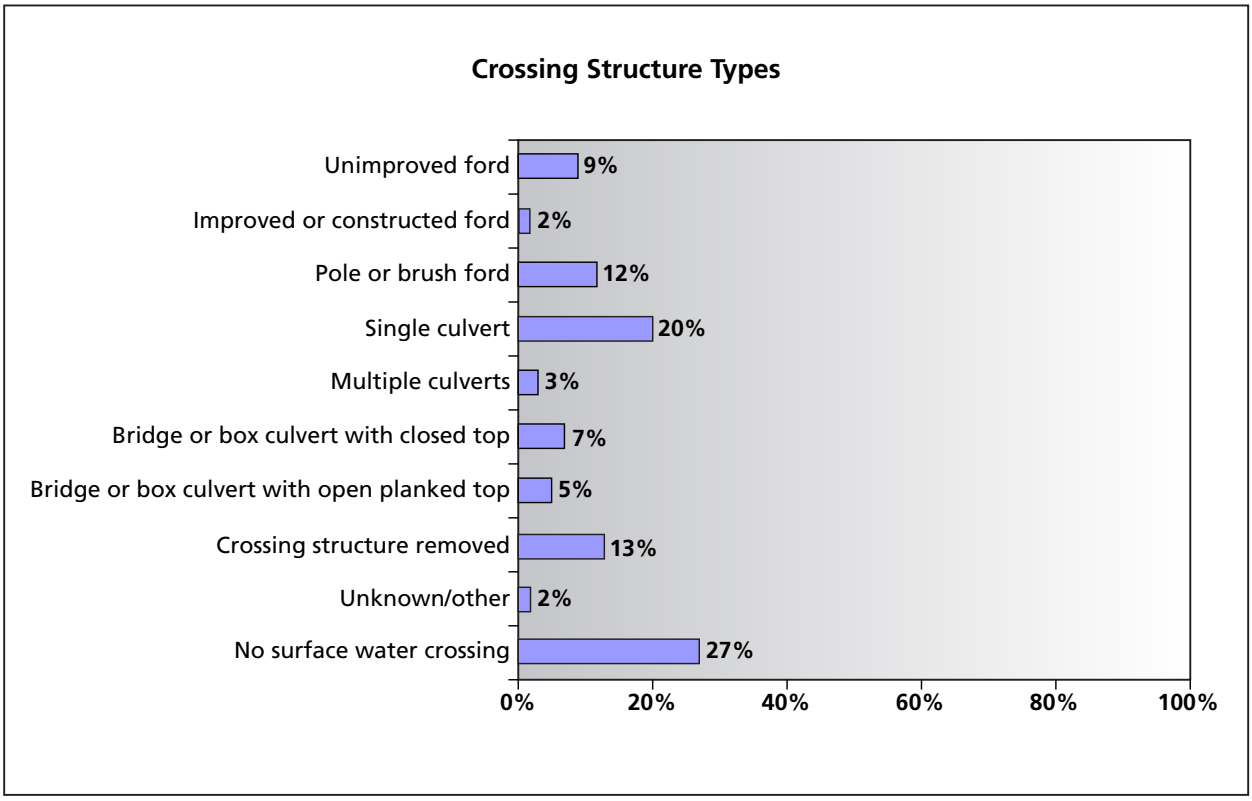


Figure 8. Proportions are based on the total possible number of crossing structures **(n=309)**.

Structure Type by Road Type

- There are **157** sample units with a skid trail at the water crossing.
- There are **66** sample units with a haul road at the water crossing.

Example

The following charts compare crossing structure types by road type at the water crossing.

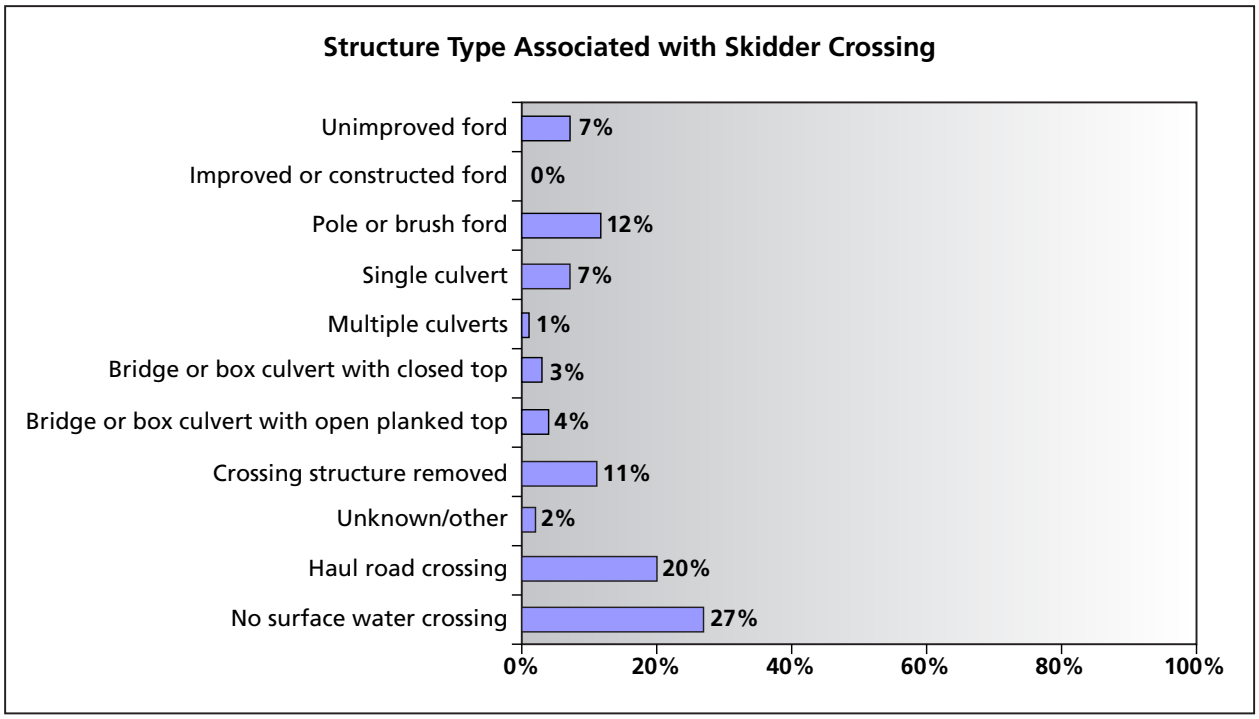


Figure 9. Proportions are based on the total possible number of crossing structures **(n=309)**.

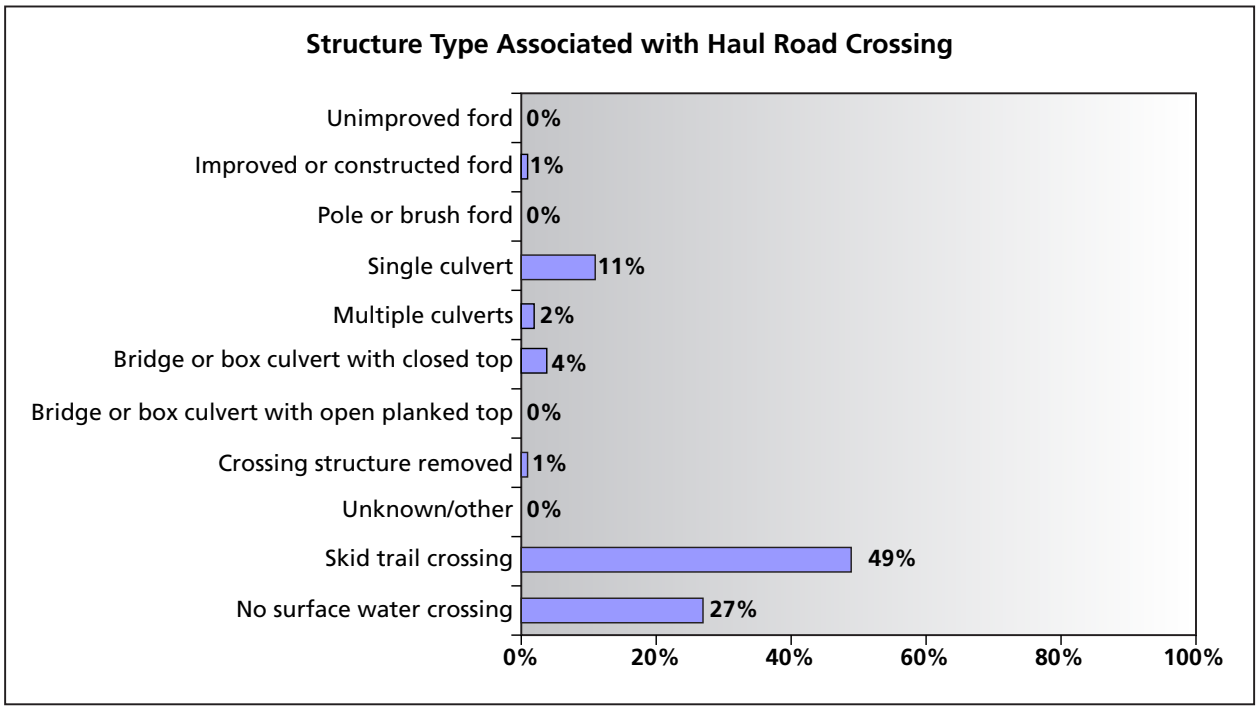


Figure 10. Proportions are based on the total possible number of crossing structures **(n=309)**.

Example

Fish Passage

Presence of Fish and Macro-Invertebrates

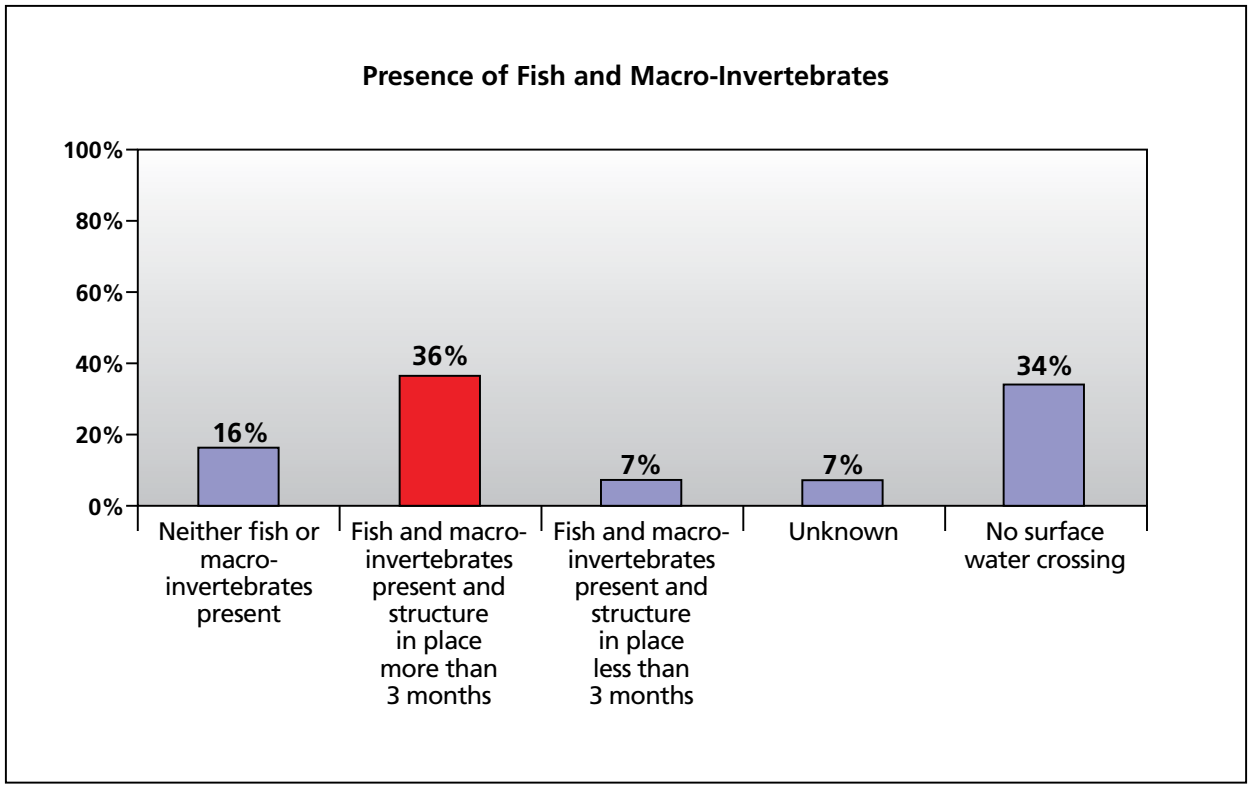


Figure 11. (n=309)

Example

Streambed Conditions When Fish and Macro-Invertebrates Are Present and Crossing Structure Is in Place More Than 3 Months

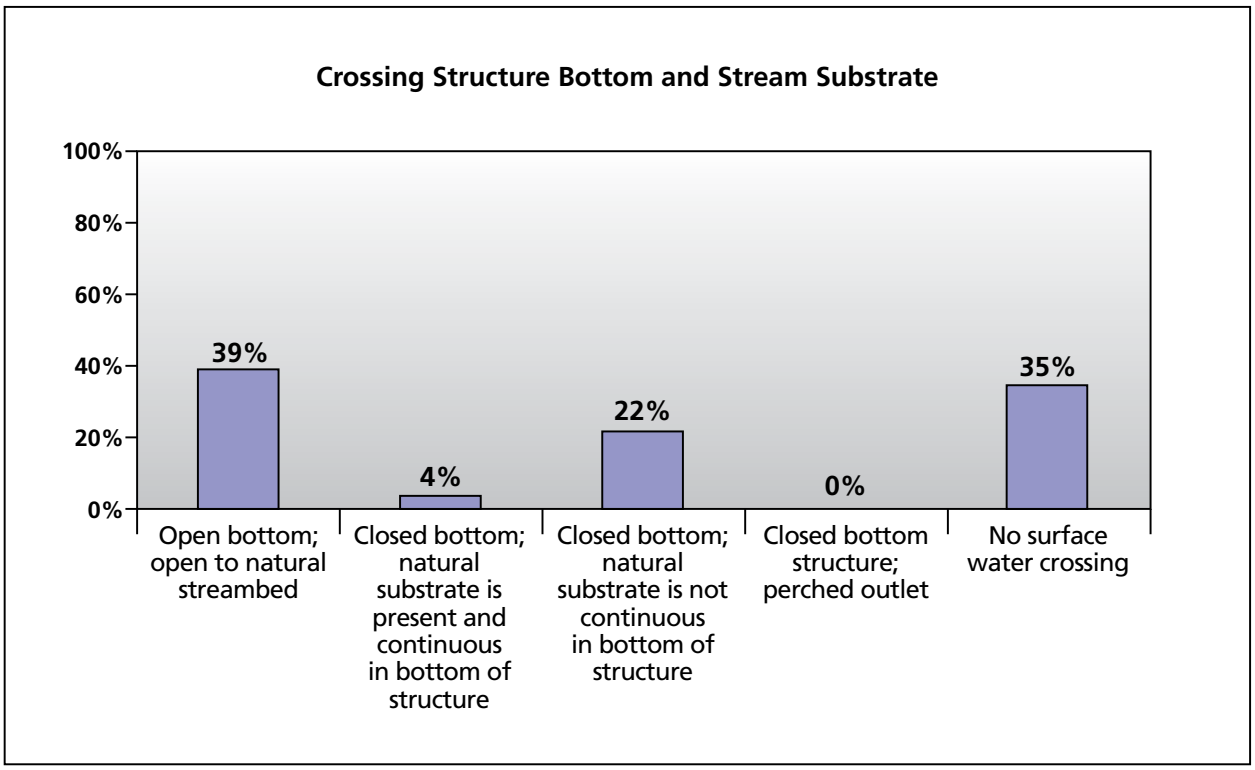


Figure 12. (n=309)

Discussion

<OPTION: User may insert analysis, interpretation, and photographs here.>

Example

Soil Movement Through the Buffer/Filter Strip (Soil Did Not Reach Surface Water Body)

Buffer/Filter Strip Width Is Between 25 and 49 Feet

Sample units in this section have a buffer/filter strip width between 25 and 49 feet.

- **16** sample units have a buffer/filter strip width between 25 and 49 feet.

There are **2** opportunities to observe the occurrence of soil movement through the buffer/filter strip. They are at Approach Area A–Inside the Buffer/Filter Strip and Approach Area B–Inside the Buffer/Filter Strip. **Proportions are based on the total number of opportunities to make observations about soil conditions at the approaches inside the buffer/filter strip.**

For the **16** new sample units, there are **32** opportunities to observe soil movement through the buffer/filter strip.

- There are **6** observations of soil movement through the buffer/filter strip that did not reach the surface water body.

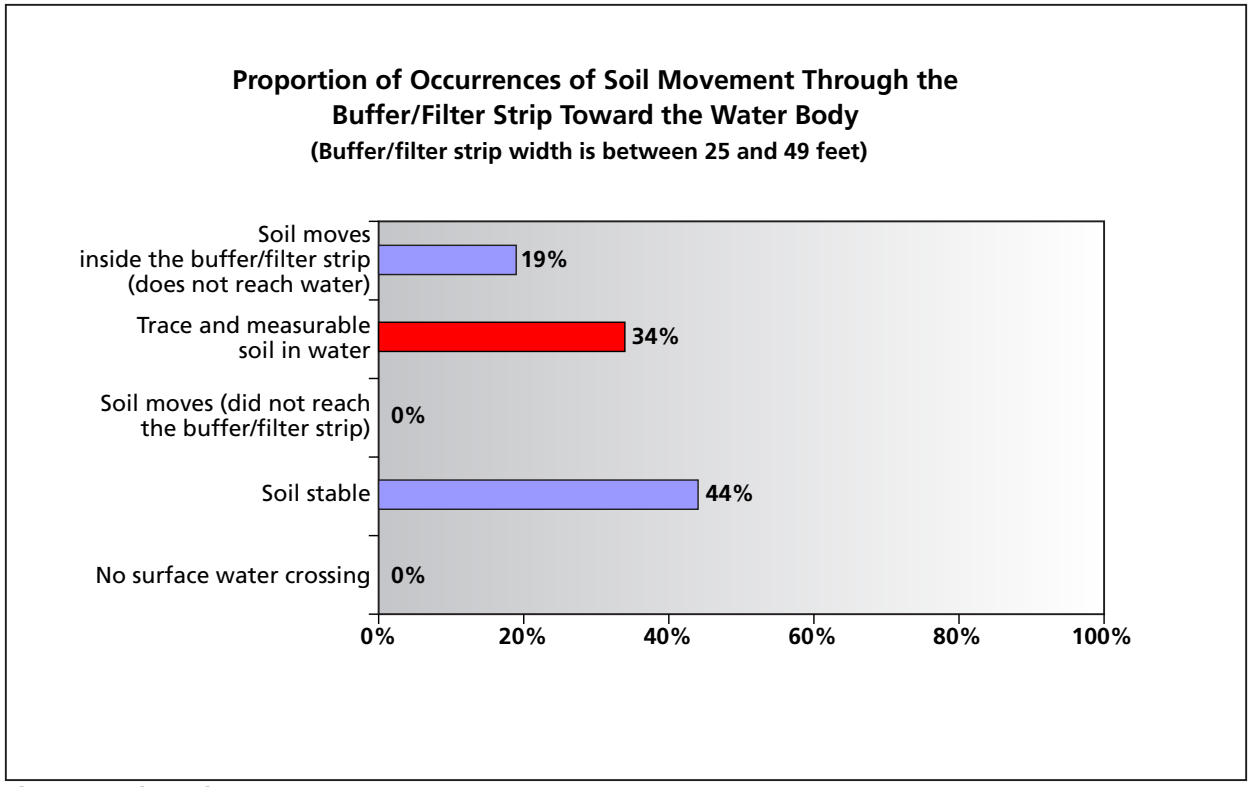


Figure 13. (n=32)

Example

Buffer/Filter Strip Width Is Greater Than or Equal to 50 Feet

Sample units in this section have a recommended buffer/filter strip width greater than or equal to 50 feet.

- **207** sample units have a recommended buffer/filter strip width greater than or equal to 50 feet.

There are **2** opportunities to observe the occurrence of soil movement through the buffer/filter strip. They are at Approach Area A–Inside the Buffer/Filter Strip and Approach Area B–Inside the Buffer/Filter Strip. **Proportions are based on the total number of opportunities to make observations about soil conditions at the approaches inside the buffer/filter strip.**

For the **207** new sample units, there are **414** opportunities to observe soil movement through the buffer/filter strip.

- There are **90** observations of soil movement through the buffer/filter strip that did not reach the surface water body.

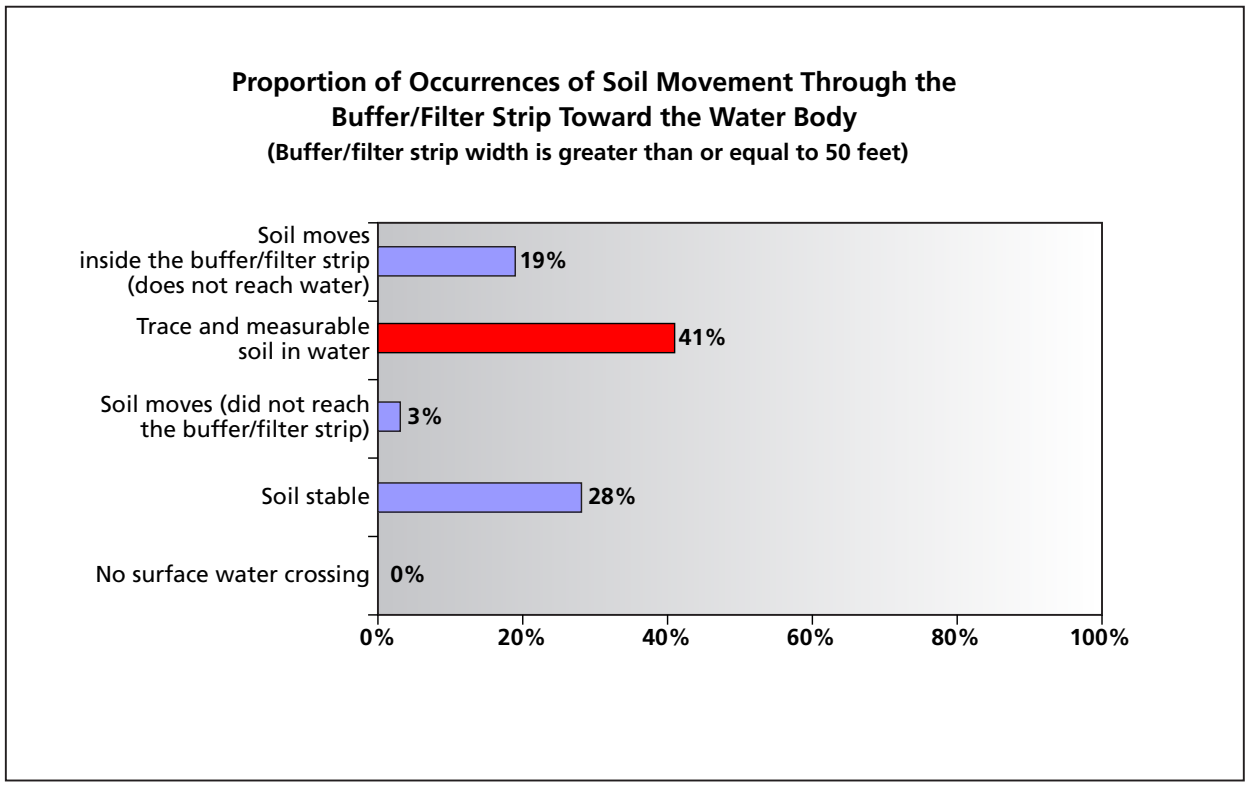


Figure 14. (n=414)

Example

Haul Road or Log Landing in the Buffer/Filter Strip

There is **1** opportunity to observe the occurrence of soil movement, sedimentation, or stabilization from the haul road or log landing inside the buffer/filter strip. **Proportions are based on the total number of opportunities to make observations about soil conditions at the haul road or log landing inside the buffer/filter strip.**

For the **309** new sample units, there are **309** opportunities to observe soil conditions at the haul road or log landing inside the buffer/filter strip.

- **10** sample units have a haul road or log landing located within the buffer/filter strip.

Soil Stabilization, Movement, and Sedimentation

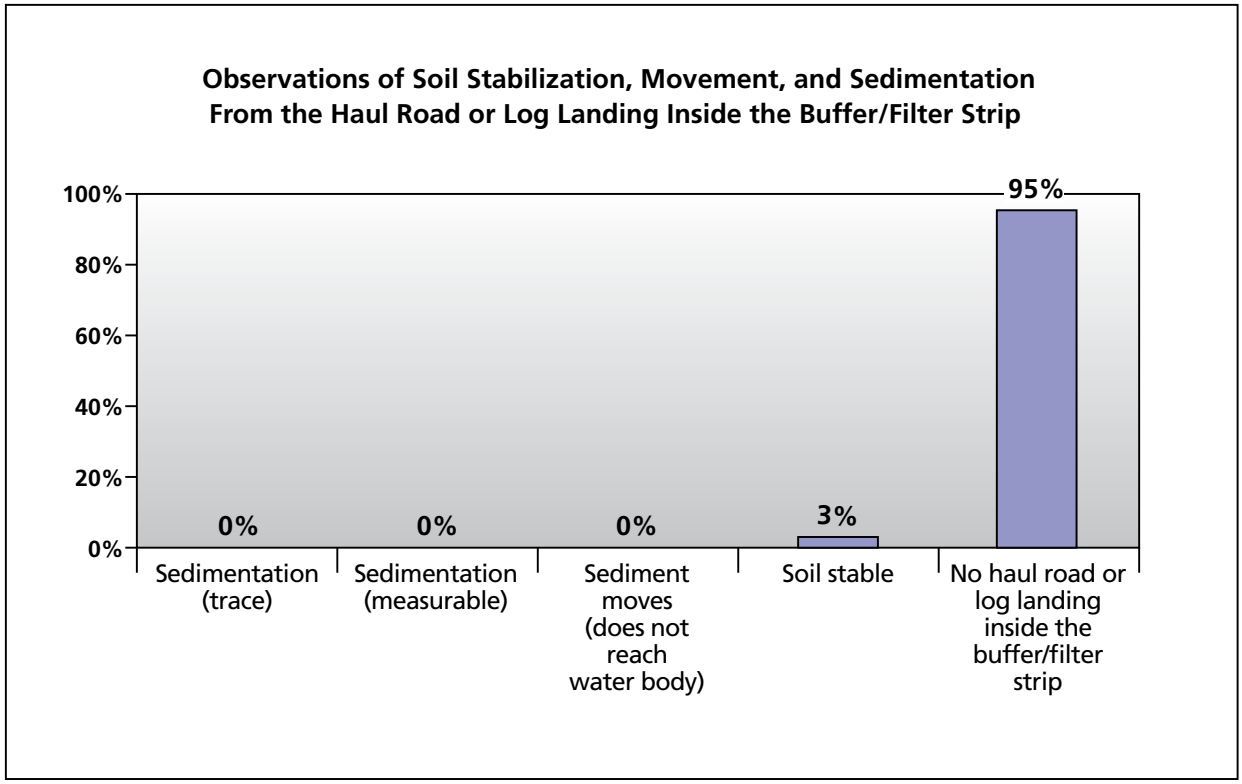


Figure 15. Proportions are based on the total number of opportunities to make observations about soil conditions at haul roads or log landings inside the buffer/filter strip **(n=309)**.

Discussion

<OPTION: User may insert analysis, interpretation, photographs here.>

Example

Sedimentation From the Haul Road or Log Landing in the Buffer/Filter Strip

There are **1** observations of trace amounts of sediment reaching the surface water body or deposited within bankfull width of the channel.

There are **0** observations of measurable amounts of sediment reaching the surface water body or deposited within bankfull width of the channel.

Soil Type in the Buffer/Filter Strip Where Sedimentation Was Observed

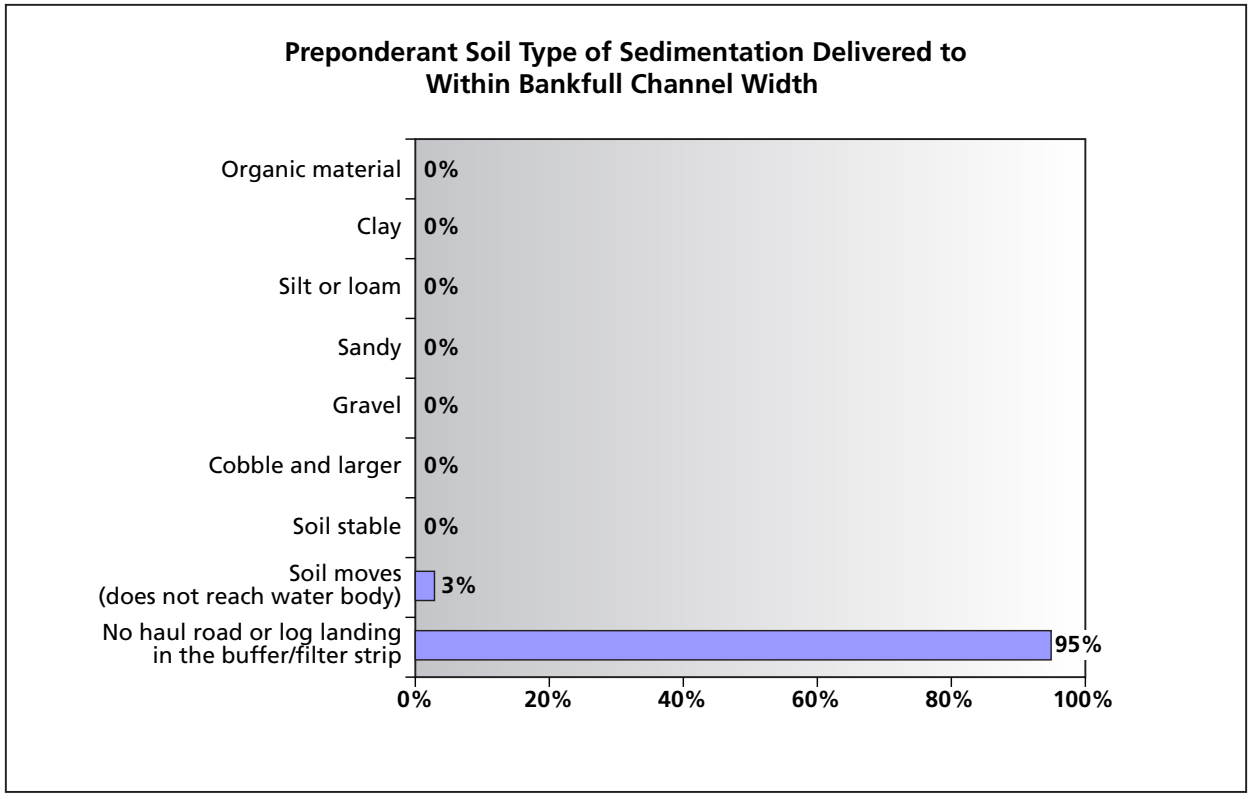


Figure 16. (n=309)

Table 4. Sediment Volumes (cubic feet)

	Calculated volume of soil removed from rill or gully terminating within bankfull channel width	Sediment evident in water body or within bankfull channel width
Average	6	36
Median	6	36
Maximum	6	36

Nonnumeric values indicate that no volume measurements were recorded.

Example

Riparian Area Analysis

A total of **156** sample units have a water body adjacent to the buffer/filter strip.

- **126** sample units have a recommended buffer/filter strip width greater than or equal to 50 feet.

Stream Order

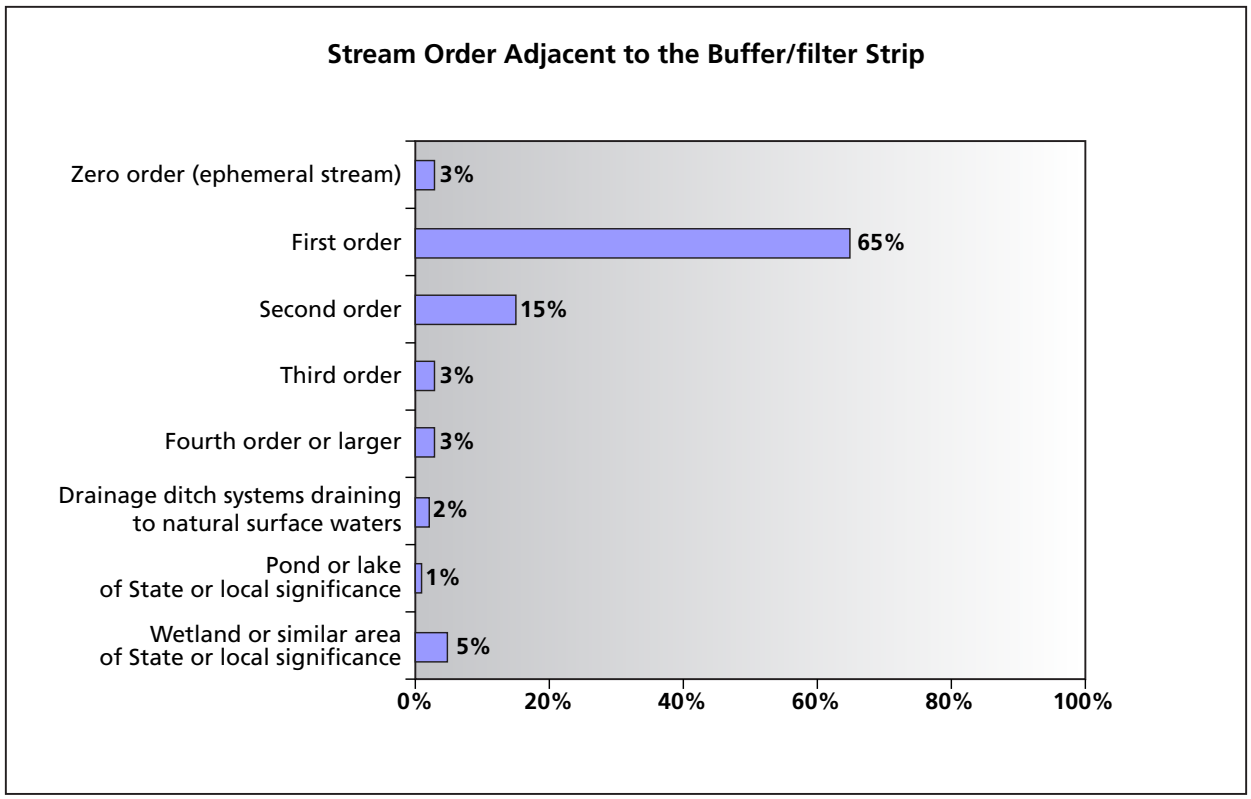


Figure 17. (n=156)

Example

Evaluation

- Total length of buffer/filter strip monitored (feet): 95,073

Sediment Delivery	
Total number of locations where sediment delivered to within bankfull width of the channel as a result of harvest operation	20
Number of locations per 1000 feet of buffer/filter strip monitored	0.210
Sediment Volume (cubic feet)	
Total volume of sediment currently evident within bankfull width of the channel resulting from harvest operations	199
Volume per 1000 feet of buffer/filter strip monitored	2.088
Rills, Gullies, Sediment Trails	
Total number of times rills, gullies, or sediment trails resulting from the harvest operation reach more than halfway across the buffer/filter strip	46
Rills, gullies, and sediment trails per 1000 feet of buffer/filter strip monitored	0.484
Naturally Occurring Large Woody Debris (LWD)	
Number of pieces of naturally occurring LWD in the water body	1582
Number of pieces of LWD per 1000 feet of buffer/filter strip monitored	16.640
Large Woody Debris (LWD) – Harvest Related	
Number of pieces of LWD occurring in the water body as a result of the harvest	970
Number of pieces of LWD per 1000 feet of buffer/filter strip monitored	10.203
Potential Erosion Channel	
Number of times a potential erosion channel has been gouged into the bank as a result of harvesting activities	15
Number of times per 1000 feet of buffer/filter strip monitored	0.158
Slash Volume (cubic feet)	
Less than 100 cubic feet per 1000 feet of buffer/filter strip monitored	0.810
Between 100 and 200 cubic feet per 1000 feet of buffer/filter strip monitored	0.126
More than 200 cubic feet per 1000 feet of buffer/filter strip monitored	0.095

Large woody debris (LWD) is defined as debris found within the bankfull width of the channel that is greater than 4 inches in diameter at the small end and either longer than the stream width or anchored to the bank by roots or other means.

Slash is defined as limbs, brush, tree tops, or similar relatively small woody logging debris that is left in the channel below bankfull elevation as a direct result of the current harvest.

Example

Shade Reduction/Basal Area Evaluation

Crown Closure (percent)	
Average	77
Minimum	1
Maximum	100
Basal Area (square feet)	
Average	95
Minimum	1
Maximum	212
Diameter of Largest Riparian Leave Tree	
Average	19
Median	18

Discussion

<OPTION: User may insert analysis, interpretation, photographs here.>

Example

Chemical Pollutants

309 new sample units were sampled.

Evidence of Potential Pollutants

- **9** sample units had evidence of lubricant, fuel, hydraulic fluid, and/or anti-freeze spillage resulting from harvest operations.
- **13** sample units had evidence of discarded batteries and/or other potential pollutant containers present.
- **4** sample units had evidence of chemical spills as well as discarded batteries and/or other potential pollutant containers present.

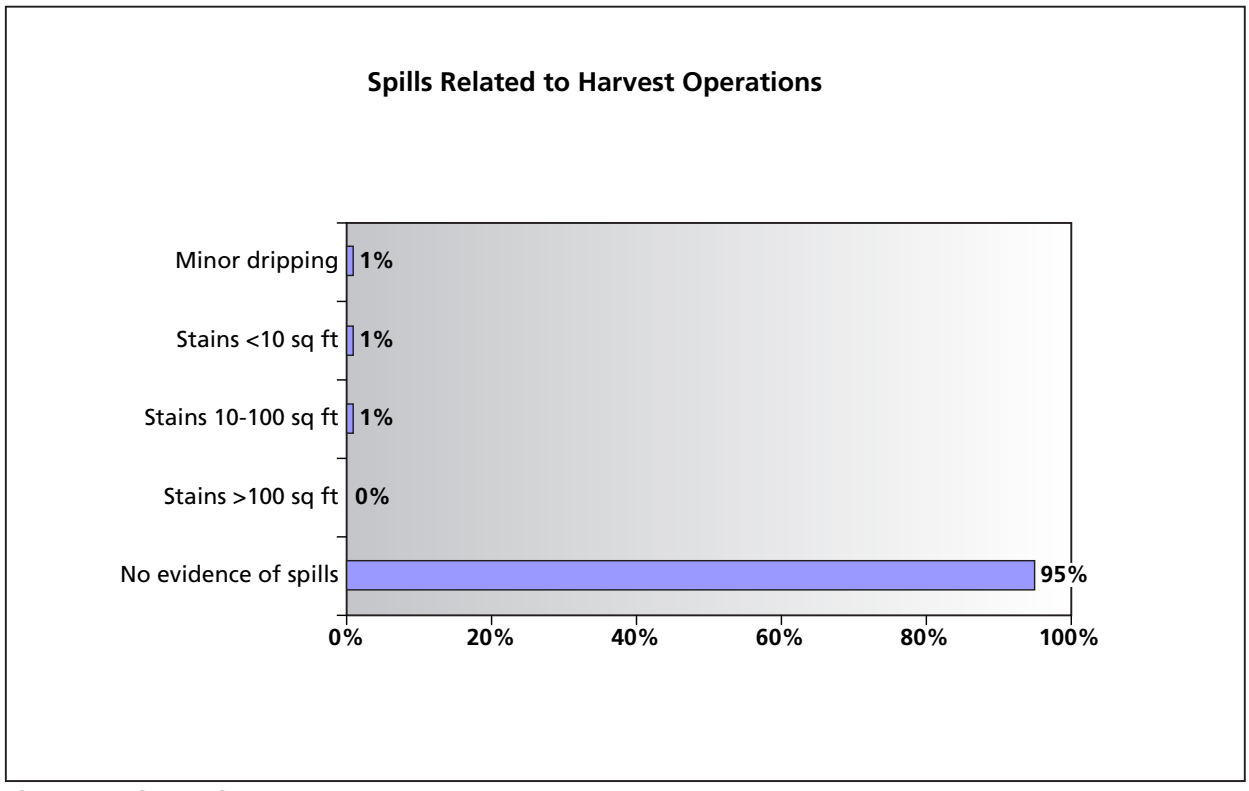


Figure 18. (n=309)

Example

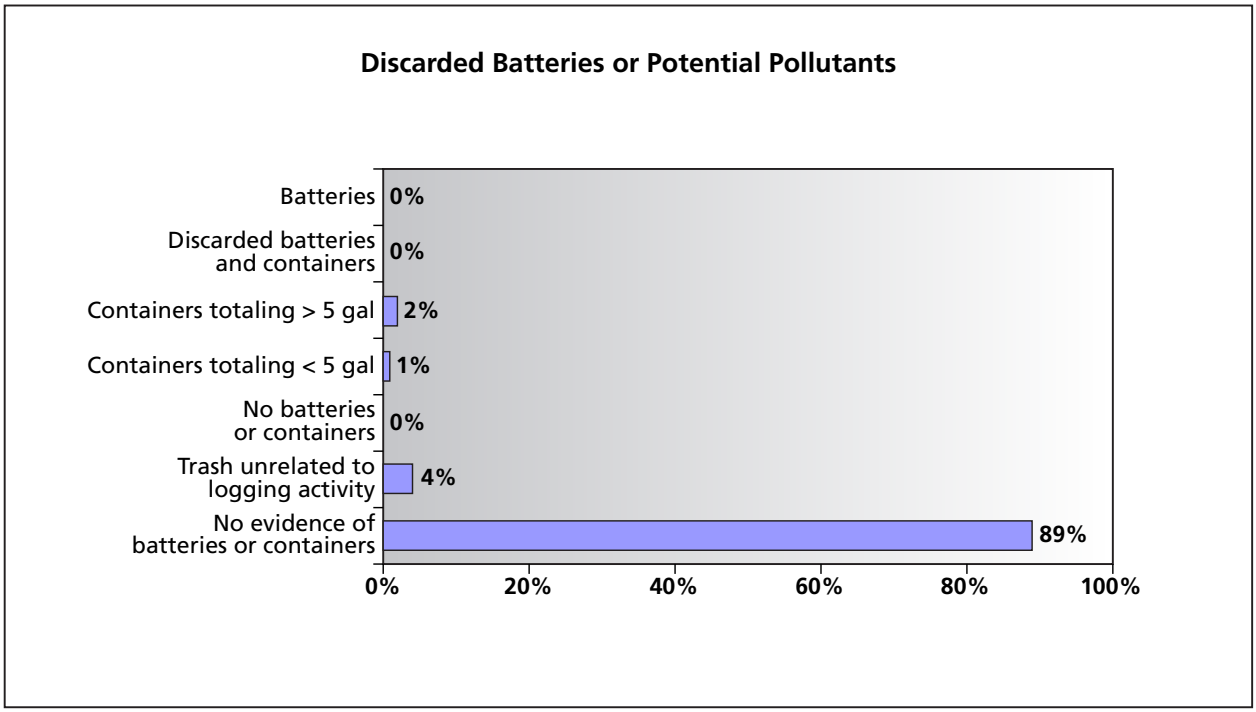


Figure 19. (n=309)

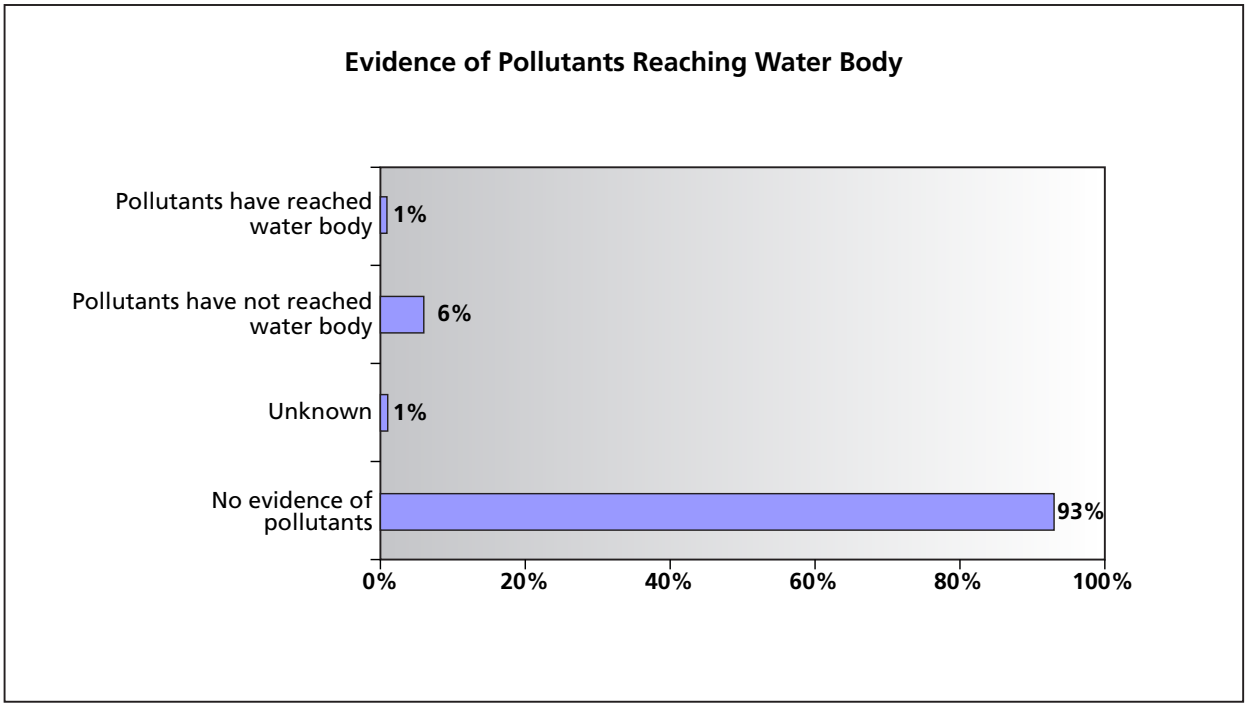


Figure 20. (n=309)

Example

Wetland Crossings

309 new sample units were sampled.

- **28** sample units have a wetland crossing.

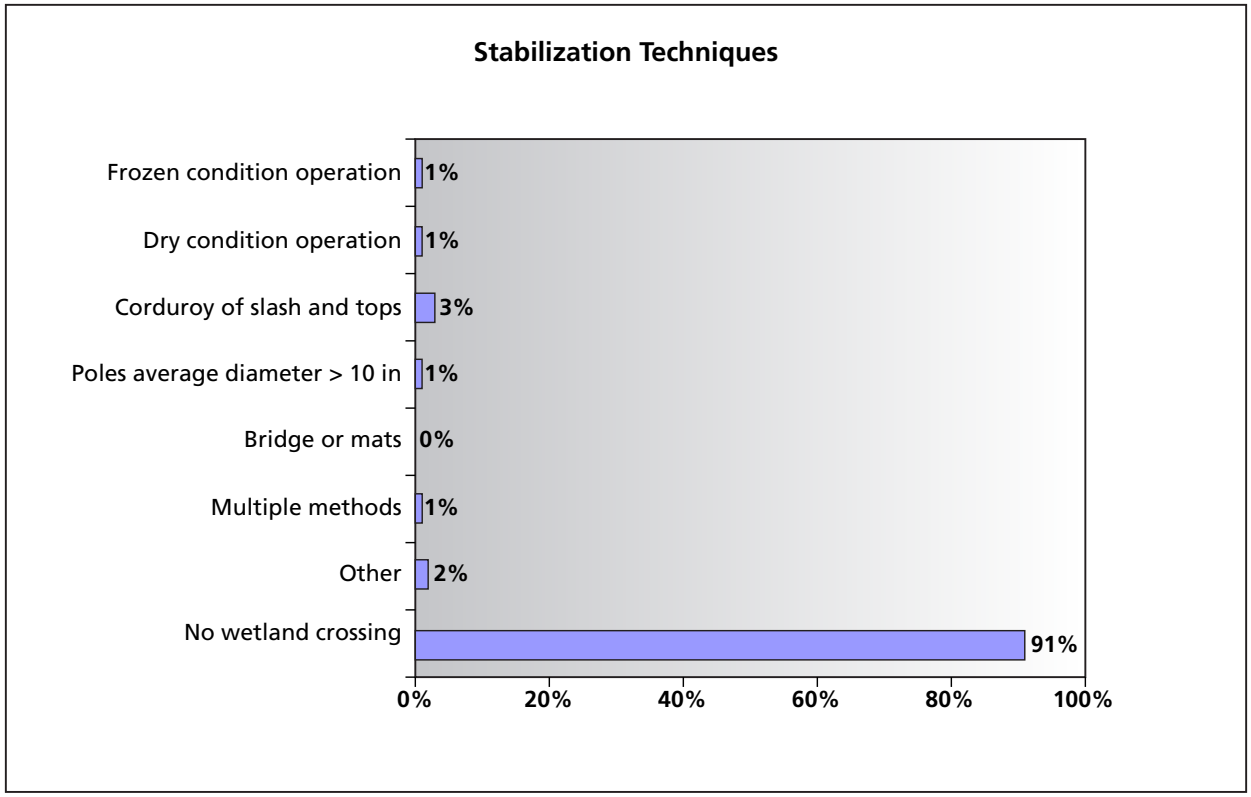


Figure 21. (n=309)

Table 5. Wetland Crossing Length From Upland to Upland

	Length (feet)
Average	217
Median	99
Maximum	999

Example

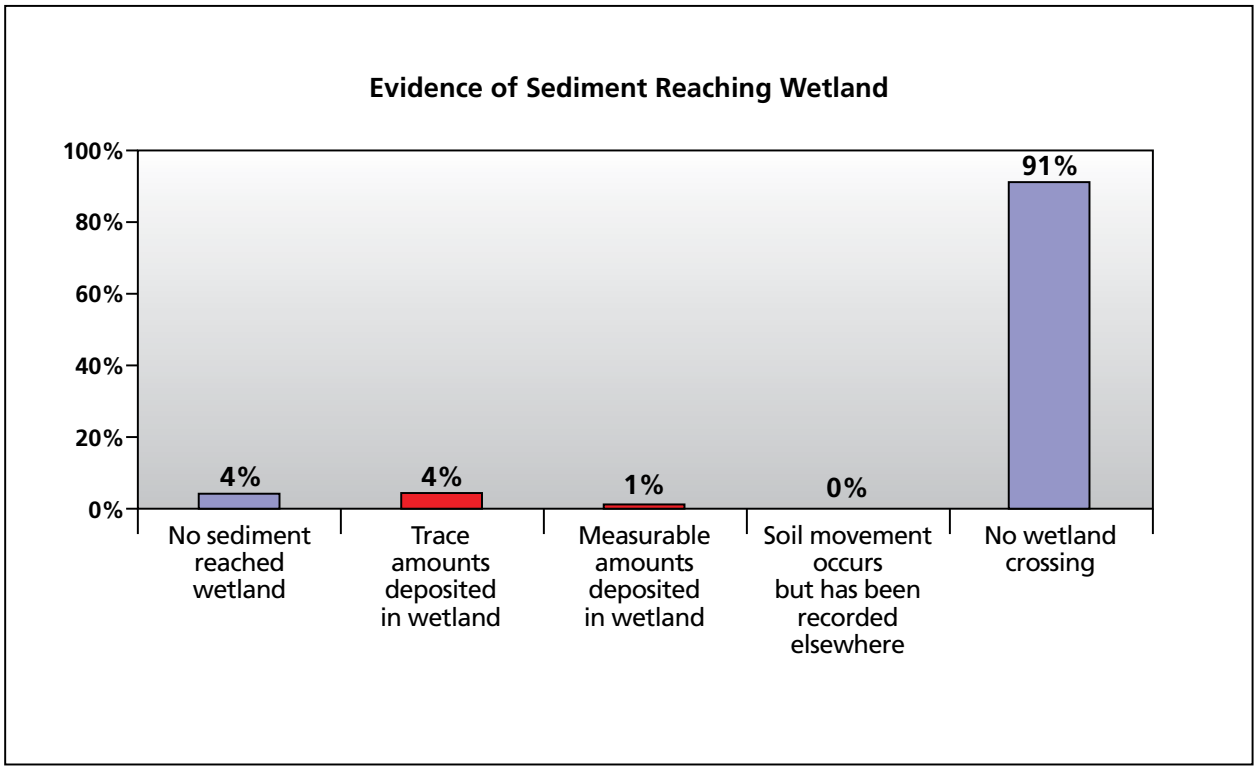


Figure 22. (n=309)

Table 6. Wetland Sedimentation Volume (cubic feet)

	Sediment Volume (cubic feet)
Average	21
Median	19
Maximum	45

Nonnumeric values indicate that no volume measurements were recorded.

Discussion

<OPTION: User may insert analysis, interpretation, and photographs here.>

Example

Responsibility for BMP Implementation Not Assigned

Soil Conditions Observed at the Approaches

A total of **29** new sample units were sampled where responsibility for BMP implementation was not assigned.

- **19** of these sample units have a surface water crossing.

There are **4** opportunities to observe the occurrence of soil movement, sedimentation, or stabilization from the approaches to a surface water crossing. They are at Approach Area A–Outside the Buffer/Filter Strip, Approach Area A–Inside the Buffer/Filter Strip, Approach Area B–Inside the Buffer/Filter Strip, and Approach Area B–Outside the Buffer/Filter Strip. **Proportions are based on the total number of opportunities to make observations about soil conditions at the approaches.**

- For the **29** new sample units, there are **116** opportunities to observe soil conditions.

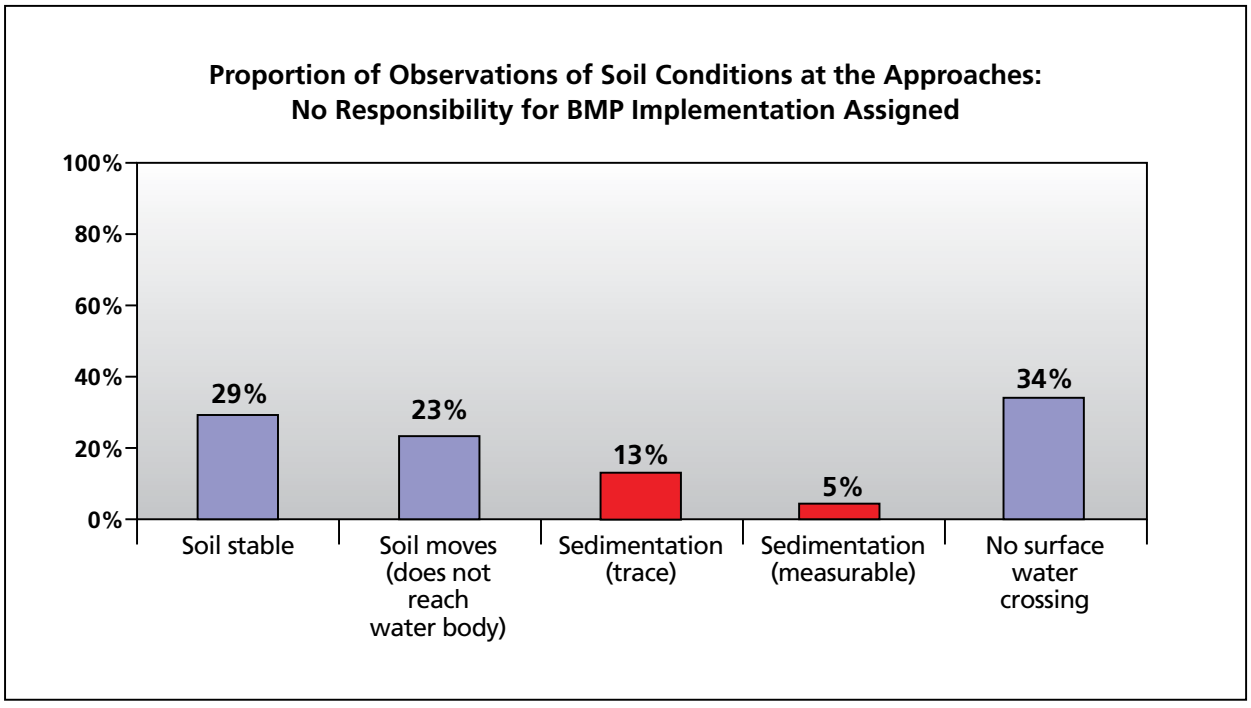


Figure 23. (n=116)

Example

Forester Is Responsible for BMP Implementation by Written Contract

Soil Conditions Observed at the Approaches

A total of **92** new sample units were sampled where a forester was responsible for BMP implementation by written contract.

- **65** of these sample units have a surface water crossing.

There are **4** opportunities to observe the occurrence of soil movement, sedimentation, or stabilization from the approaches to a surface water crossing. They are at Approach Area A–Outside the Buffer/Filter Strip, Approach Area A–Inside the Buffer/Filter Strip, Approach Area B–Inside the Buffer/Filter Strip, and Approach Area B–Outside the Buffer/Filter Strip. **Proportions are based on the total number of opportunities to make observations about soil conditions at the approaches.**

- For the **92** new sample units, there are **368** opportunities to observe soil conditions.

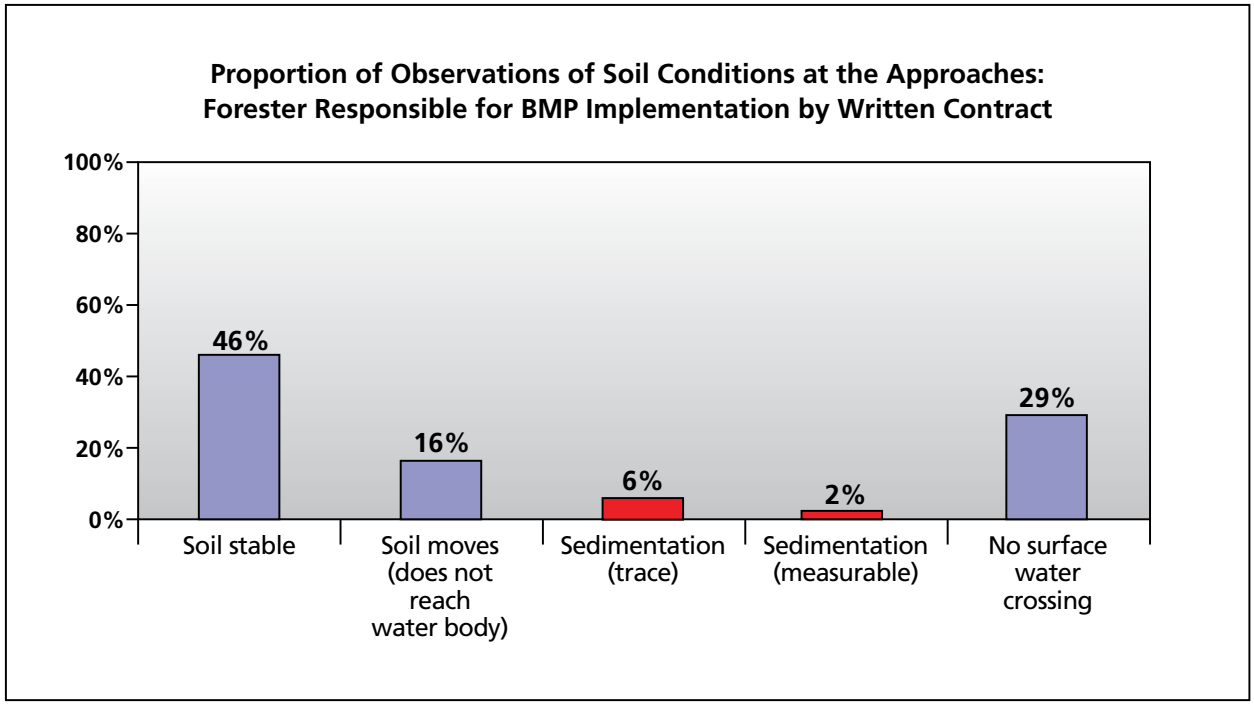


Figure 24. (n=368)

Example

Logger Is Responsible for BMP Implementation by Written Contract

Soil Conditions Observed at the Approaches

A total of **91** new sample units were sampled where a logger was responsible for BMP implementation by written contract.

- **73** of these sample units have a surface water crossing.

There are **4** opportunities to observe the occurrence of soil movement, sedimentation, or stabilization from the approaches to a surface water crossing. They are at Approach Area A–Outside the Buffer/Filter Strip, Approach Area A–Inside the Buffer/Filter Strip, Approach Area B–Inside the Buffer/Filter Strip, and Approach Area B–Outside the Buffer/Filter Strip. **Proportions are based on the total number of opportunities to make observations about soil conditions at the approaches.**

- For the **91** new sample units, there are **364** opportunities to observe soil conditions.

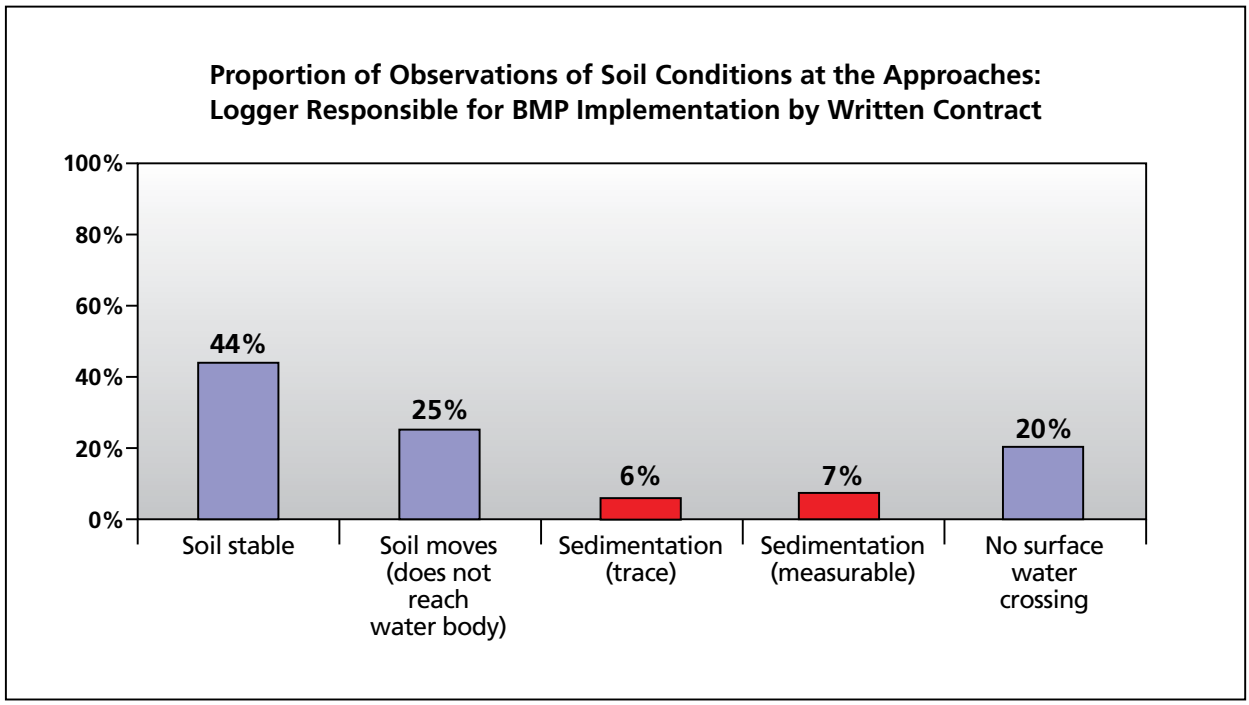


Figure 25. (n=364)

Appendix E—Question Map

In the Excel file containing data from the field, each column contains the answers to a specific BMP protocol question. The following table lists protocol questions by column location. The color coding by category matches that used in the Excel file. Columns GY through HN contain the results of calculations made on the protocol data.

A	Indexing key (inserted by Access)
General	
B	G1State
C	CurrentYear
D	SampleType
E	Resample?
F	SampleNumber
G	G2StatewideForestOwnership
H	G3LandownerCategory
I	G4OwnerProgramParticipant
J	G5BMPResponsibilityAssigned
K	G6LoggerProgramParticipant
L	G7HarvestStatus
M	G8AcresInSampleUnit
N	G9TypeOfHarvestSystem
O	G10InfluencingWeatherEvent
P	G11BMPsVolMandatory
Water Body Crossing Approach Area A	
Q	X12StreamOrderAtCrossingSite
R	X13WaterBodyTypeInNormalYr
S	X14GPSLatN999000000
T	X15GPSLongW999000000
U	X16StateBMPBufferWidthFt
V	X17ContractBufferWidthFt
Approach Area A–Outside the Buffer/Filter Strip	
W	X18RoadOrTrail
X	X19RoadTrailDescription
Y	X20BearingCapacityImprovments
Z	X21PrimaryAdjacentLandUse
AA	X22SoilMovementOutsideBuffer
AB	X23EvidenceSedimentReachedWater
AC	X24LengthFtOfRillGullyDitchOrRut
AD	X25MidPointXSectionSqIn

AE	X26SedimentInWaterCuFt
AF	X27PreponerantSedimentType
AG	X28SedimentAgainNextStorm
AH	X29SpecificSedimentationCause
AI	X30PrinciplesPracticesApplication
AJ	X31PercentSoilMovedThruBuffer
AK	X32EvidenceSedimentReachedBuffer
AL	X33PreponerantSedimentType
AM	X34SedimentAgainNextStorm
AN	X35SpecificSedimentationCause
AO	X36PrinciplesPracticesApplication
AP	X37DistanceTheSoilMovedFromPointOfOriginTowardBuffer
AQ	X38HowSedimentReachedWaterBody
AR	X39PreponerantSedimentType
AS	X40SedimentAgainNextStorm
AT	X41SpecificSedimentationCause
AU	X42PrinciplesPracticesApplication
AV	X43ApplicationOfBMPPrinciplesAndPractices
Approach Area A–Inside the Buffer/Filter Strip	
AW	X44HaulRoadOrSkidTrail
AX	X45BearingCapacityImprovement
AY	X46RoadTrailDescription
AZ	X47DescribeSoilMovement
BA	X48EvidenceSedimentReachedWater
BB	X49LengthFtOfRillGullyDitchOrRut
BC	X50MidPointXSectionSqIn
BD	X51SedimentInWaterCuFt
BE	X52PreponerantSedimentType
BF	X53SedimentAgainNextStorm
BG	X54SpecificSedimentationCause
BH	X55PrinciplesPracticesApplication
BI	X56PercentSoilMovedThruBuffer
BJ	X57HowSedimentReachedWaterBody
BK	X58PreponerantSedimentType
BL	X59SedimentAgainNextStorm
BM	X60SpecificSedimentationCause
BN	X61PrinciplesPracticesApplication
BO	X62ApplicationOfBMPPrinciplesAndPractices
BP	X63DominantHydrologicSoilType
BQ	X64SoilErodibilityFactorKNNN

BR	X65INSIDERoadGradient
BS	X66OUTSIDERoadGradient
BT	X67SlopeLengthFt
Crossing Structure	
BU	X68TrafficUseAtTheCrossing
BV	X69PrimaryPurposeOfCrossing
BW	X70RoadwayOwnership
BX	X71CrossingStructureDescription
BY	X72CrossingStructureVintage
BZ	X73InPlace3MoFishery
CA	X74BottomAndStreamSubstrate
CB	X75StuctureOpeningWidthFt
CC	X76OpeningMeetsBMPSpec
CD	X77Scouring100FtDownstream
CE	X78SoilOrFillMaterialMovement
CF	X79ActivityResultingInSedimentDeliveryFromCrossingStructure
CG	X80EvidenceSedimentReachedWater
CH	X81SedimentVolumeCuFt
CI	X82PreponerantSedimentType
CJ	X83SedimentAgainNextStorm
CK	X84PrinciplesPracticesApplication
CL	X85PrinciplesPracticesApplication
CM	X86BMPPrinciplesAndPracticesToTheCrossing
Water Body Crossing Approach Area B	
CN	X86.1StateBMPBufferWidthFt
CO	X86.2ContractBufferWidthFt
CP	X87HaulRoadSkidTrail
CQ	X88RoadTrailDescription
CR	X89BearingCapacityImprovement
CS	X90PrimaryAdjacentLandUse
CT	X91DescribeSoilMovement
Approach Area B–Outside the Buffer/Filter Strip	
CU	X92EvidenceSedimentReachedWater
CV	X93LengthOfRillGullyDitchOrRutFt
CW	X94MidPointXSectionSqIn
CX	X95SedimentInWaterCuFt
CY	X96PreponerantSedimentType
CZ	X97SedimentAgainNextStorm
DA	X98SpecificSedimentationCause

DB	X99PrinciplesPracticesApplication
DC	X100PercentSoilMovedThruBuffer
DD	X101HowSedimentReachedWaterBody
DE	X102PreponerantSedimentType
DF	X103SedimentAgainNextStorm
DG	X104SpecificSedimentationCause
DH	X105PrinciplesPracticesApplication
DI	X106FtSoilMovedTowardBuffer
DJ	X107HowSedimentReachedWaterBody
DK	X108PreponerantSedimentType
DL	X109SedimentAgainNextStorm
DM	X110SpecificSedimentationCause
DN	X111PrinciplesPracticesApplication
DO	X112ApplicationOfBMP
Approach Area B–Inside the Buffer/Filter Strip	
DP	X113HaulRoadOrSkidTrail
DQ	X114BearingCapacityImprovements
DR	X115RoadTrailDescription
DS	X116DescribleSoilMovement
DT	X117EvidenceSedimentReachedWater
DU	X118TotalLengthOfRillGullyDitchOrRutFt
DV	X119MidPointXSectionSqIn
DW	X120VolumeOfSedimentCuFt
DX	X121PreponerantSedimentType
DY	X122SedimentAgainNextStorm
DZ	X123SpecificSedimentationCause
EA	X124PrinciplesPracticesApplication
EB	X125PercentSoilMovedThruBuffer
EC	X126EvidenceSoilMovement
ED	X127PreponerantSedimentType
EE	X128SedimentAgainNextStorm
EF	X129SpecificSedimentationCause
EG	X130PrinciplesPracticesApplication
EH	X131BMPApplication
EI	X132DominantHydrologicSoil
EJ	X133SoilErodibilityFactorK
EK	X134INSIDERoadGradient
EL	X135OUTSIDERoadGradient
EM	X136SlopeLengthFt

Haul Road, Log Landing, or Rutted, Mineral Soil Skid Trail Inside the Buffer/Filter Strip	
EN	HB137HaulRdLogLndgInBuffer
EO	HB138GPSLatN999000000
EP	HB139GPSLongW999000000
EQ	HB140WaterBodyType
ER	HB141WaterBodyDescription
ES	HB142RecmndStripWitdthFt
ET	HB143BufferFilterStripWidthFt
EU	HB144BearingCapacityImprovements
EV	HB145RoadLandingDescription
EW	HB146DescribeSoilMovement
EX	HB147EvidenceSedimentReachedWater
EY	HB148LengthOfDitchGullyRillFt
EZ	HB149MidPointXSectionSqIn
FA	HB150VolumeOfSedimentCuFt
FB	HB151PreponerantSedimentType
FC	HB152SedimentAgainNextStorm
FD	HB153SpecificSedimentationCause
FE	HB154PrinciplesPracticesApplication
FF	HB155PercentSoilMovedTowardBuffer
FG	HB156HowSedimentReachedWaterBody
FH	HB157PreponderantSedimentType
FI	HB158SedimentAgainNextStorm
FJ	HB159SpecificSedimentationCause
FK	HB160PrinciplesPracticesApplication
FL	HB161BMPApplication
FM	HB162DominantHydrologicType
FN	HB163SoilErodibilityFactorKNNN
FO	HB164INSIDERdGradient
FP	HB165OUTSIDERdGradient
FQ	HB166SlopeLengthFt
Chemical Pollutants	
FR	CP167LoggingSpillage
FS	CP168DiscardedContainers
FT	CP169EvidenceReachWaterBody
FU	CP170Preponderant SoilType
FV	CP171GPSLatOfObservationsN999000000
FW	CP172GPSLongOfObservationsW999000000

Buffer/Filter Strip	
FX	B173WaterBodyType
FY	B174StreamOrder
FZ	B175StateRegulatedWaterBody
GA	B176WidthOfBufferFtRec
GB	B177GPSLatN999000000
GC	B178GPSLongW999000000
GD	B179TimesSedimentDelivered
GE	B180CumVolSedimentCuFt
GF	B181TimesReached12Way
GG	B182NaturalWoodyDebris
GH	B183HarvestWoodyDebris
GI	B184TimesBankGouged
GJ	B185VolumeOfSlash
GK	B186LengthOfBufferFt
GL	B187AvgShade
GM	B188AvgBasalArea
GN	B189AvgDiameterLargestTree
GO	B190ReductionInShade
GP	B191ShadeBAMeetsStateBMP
Wetland Crossing	
GQ_	W192CrossingStabilizationTechnique
GR	W193WetlandCrossingLengthFt
GS	W194AverageRuttingDepth
GT	W195RoadCrossDrainMethod
GU	W196SedimentReachesWetland
GV	W197DischargeVolumeCf
GW	AreYouFinishedWithThisEntry
GX	blank column
Columns Used for Calculations	
GY	Calculated volume of rill/gully Aout
GZ	Calculated volume of rill/gully Bout
HA	Calculated volume of rill/gully Ain
HB	Calculated volume of rill/gilly Bin
HC	Calculated volume of rill/gully HRLL
HD	Sediment volume evident in stream Aout
HE	Sediment volume evident in stream Bout
HF	Sediment volume evident in stream crossing structure
HG	Sediment volume evident in stream Ain

HH	Sediment volume evident in stream Bin
HI	Sediment volume evident in stream HRLL
HJ	Percent soil movement through buffer Aout
HK	Percent soil movement through buffer Bout
HL	Percent soil movement through buffer Ain
HM	Percent soil movement through buffer Bin
HN	Percent soil movement through buffer HRLL
State- or User-Defined Entries	
HO	S1 State- or user-defined entry
HP	S2 State- or user-defined entry
HQ	S3 State- or user-defined entry
HR	S4 State- or user-defined entry
HS	S5 State- or user-defined entry
HT	S6 State- or user-defined entry
HU	S7 State- or user-defined entry
HV	S8 State- or user-defined entry
HW	S9 State- or user-defined entry
HX	S10 State- or user-defined entry
HY	S11 State- or user-defined entry
HZ	S12 State- or user-defined entry
IA	S13 State- or user-defined entry
IB	S14 State- or user-defined entry
IC	S15 State- or user-defined entry
ID	S16 State- or user-defined entry
IE	S17 State- or user-defined entry
IF	S18 State- or user-defined entry
IG	S19 State- or user-defined entry
IH	S20 State- or user-defined entry

Appendix F—Access Query Expressions

Criteria Expressions

When entering text, dates, times, and numbers into criteria expressions, use the appropriate characters to indicate whether the criteria is text, a date, time, or numerical expression.

Data type	Expression
Text	"text"
Date	#16-Oct-04#
Time	#10:30am#
Number	5

Operators for Building Queries

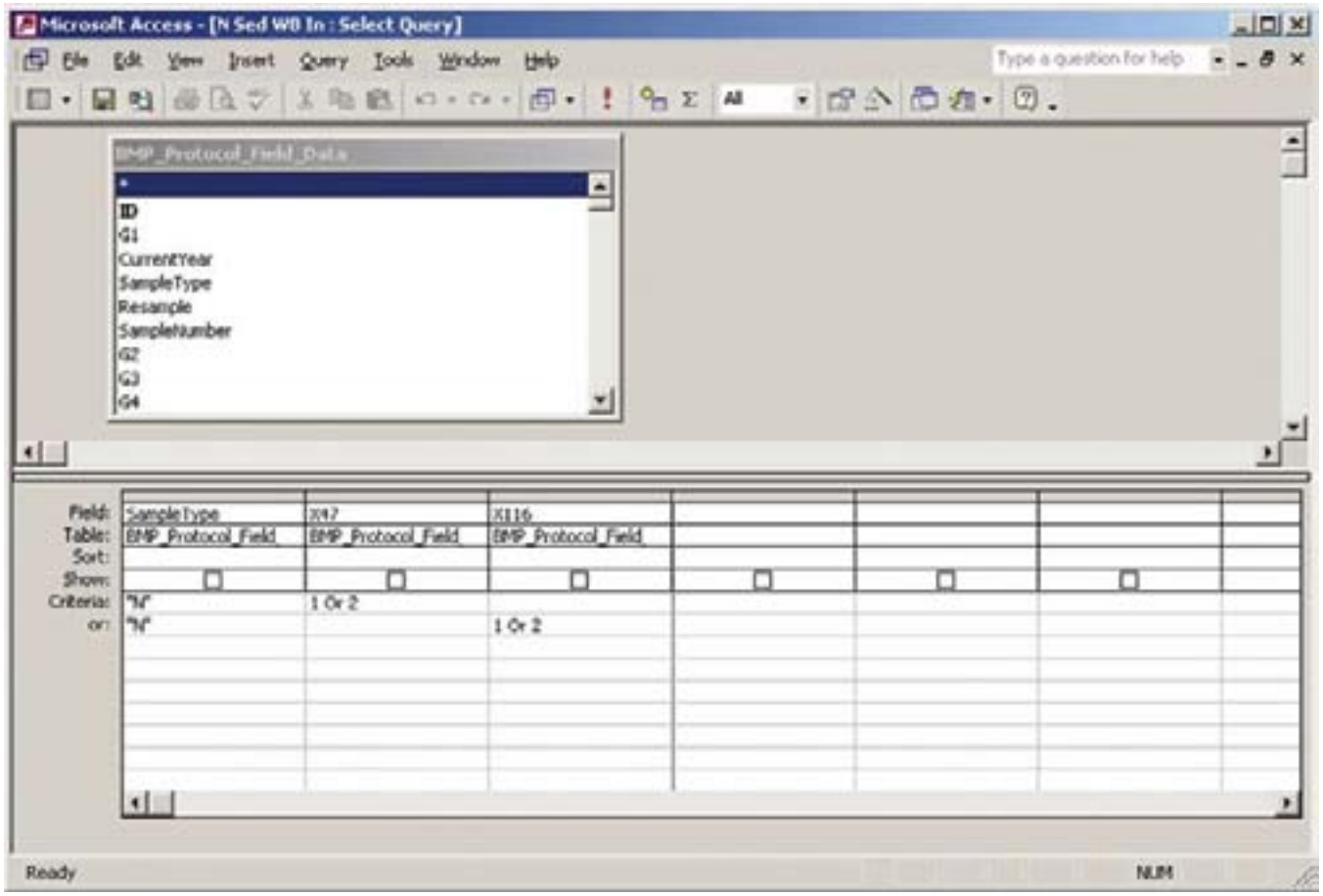
The following operators are useful when building queries in Access.

Operator	Function	Example
=	Finds values **equal to** a number, text, or date and time (note: "equal to" is understood if criteria is entered without the "=" operator).	The expression **=4** will select all cells with the number 4.
<>	Finds values **not equal to** a number, text, or date and time.	The expression **<>5** will select all cells that are not equal to 5.
<	Finds values **less than** the given value.	The expression **<5** will select all cells that have a value less than 5.
<=	Finds values **less than or equal to** the given value.	The expression **<=5** will select all cells that have a value less than or equal to 5.
>	Finds values **greater than** the given value.	The expression **>5** will select all cells that have a value greater than 5.
>=	Finds values **less than or equal to** the given value.	The expression **>=5** will select all cells that have a value greater than or equal to 5.
BETWEEN	Finds values **between or equal to** two values.	The expression **BETWEEN 1 AND 5** returns values between 1 and 5. (The expression **>=1and<=5** returns the same results).

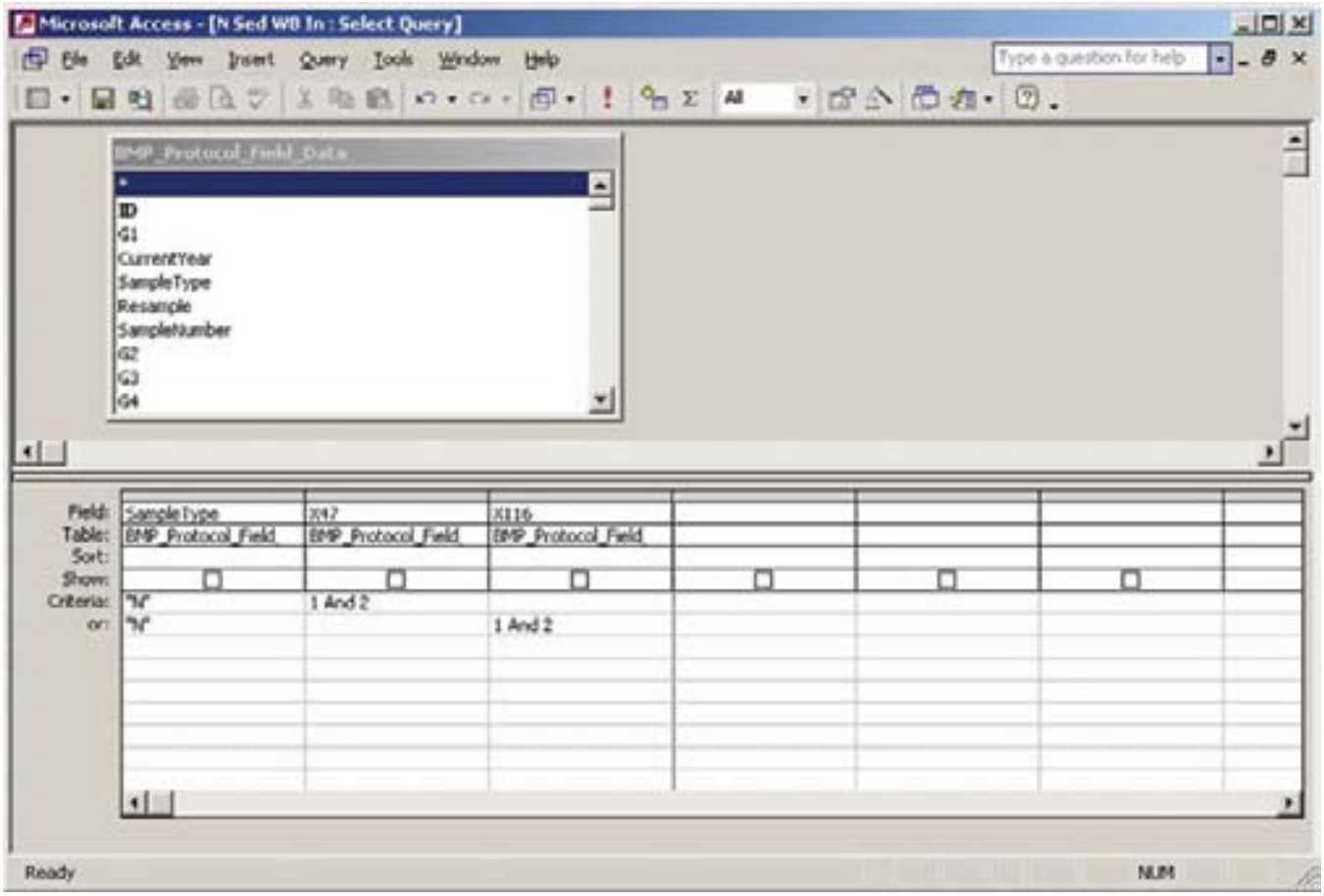
Specifying Multiple Criteria for a Single Field

You may use multiple criteria for a single field by using AND or OR in the criteria expression for that field.

For example, the query shown below is designed to return all sample units that meet *either* of the two following criteria: (1) contain **N** in the Sample Type column and have either **1** OR **2** as the answer to question X47, (2) contain **N** in the Sample Type column and have either a **1** OR **2** as answer to question X116. This query is searching for new sample units that have evidence of trace or measurable sedimentation from the approaches to the surface water crossing inside the buffer/filter strip.



The query shown below, however, is designed to return all sample units that meet either of the following criteria: (1) contain N in the Sample Type column and have both 1 AND 2 as the answer to question X47, (2) contain N in the Sample Type column and have both 1 AND 2 as the answer to question X116. Since there cannot be two answers to any question in the BMP protocol, no sample units will meet the criteria in this query.



Source: Simpson, Alan; Young, Margaret Levine; Barrows, Alison. 2003. Access 2003 all-in-one desk reference for dummies. Indianapolis, IN: Wiley Publishing, Inc. 840 p.

Appendix G—Excel Functions and Operators

The following functions and operators are useful for creating formulas in Excel.

Function	Description	Syntax
AVERAGE	Calculates the mean of a group of values	=AVERAGE(number1,number2,…)
COUNT	Counts the number of cells in a range that contains numbers	=COUNT(number1,number2,…)
COUNTIF	Counts the number of cells in a range that match a criteria	=COUNTIF(number1,number2,…)
IF	Tests for a true or false condition and returns one value or another value	=IF(logical_test,value_if_true,value_if_false)
MAX	Returns the largest value in a set of values	=MAX(number1,number2,…)
MEDIAN	Returns the median number in a set of numbers	=MEDIAN(number1,number2,…)
MIN	Returns the minimum value in a set of values	=MIN(number1,number2,…)
SUM	Calculates the sum of a group of values	=SUM(number1,number2,…)
SUMIF	Calculates a sum from a group of values, including only the values that meet a certain condition	=SUMIF(range,criteria,sum_range)

Logic operator	Description
=	Equals
>	Greater than
<	Less than
<>	Not equal to
>=	Greater than or equal to
<=	Less than or equal to

Source: Bluttman, Ken; Aitken, Peter G. 2005. Excel formulas and functions for dummies. Indianapolis, IN: Wiley Publishing, Inc. 402 p.