WATERSHED ANALYSIS TOOL FOR ENVIRONMENTAL REVIEW (WATER)

USER'S GUIDE

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WATER User's Guide

TABLE OF CONTENTS

DEDICATION

This project is dedicated to Les Strnad, a naturalist, planner, and visionary whose commitment to the people and ecology of Monterey Bay has been nothing less than extraordinary.

ACKNOWLEDGMENTS

The WATER project could never have been accomplished without the generous help of many people. I would like to thank the project sponsor, NOAA's Coastal Services Center, and Pace Wilber, the project's grant administrator, for their financial and moral support (and patience with the numerous extension requests). A special thanks is also extended to Jim Werle of AMBAG, whose selflessness and tireless effort in support of cooperative GIS have been a tremendous inspiration to me and others in the Monterey Bay region.

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I. DESCRIPTION

The Watershed Analysis Tool for Environmental Review (WATER) is basically a set of georeferenced resource data "layers" that can be viewed and manipulated using ESRI's ArcView 3.0 GIS software. The data layers were selected based on their applicability to management of polluted runoff.

More specifically, WATER consists of the following elements:

1.) a set of GIS data layers, satellite images, and scanned aerial photographs covering an area of the central California coastal region, georeferenced to the same coordinate system and stored on 4 CD-ROMs. (The data sets are listed in **Appendix A**, by disk and directory. They are indexed alphabetically in **Appendix B**.)

2.) ArcView 3.0 Project (.apr) files set up for displaying and querying some of the more complex data layers (such as those involving multiple, relationally-linked tables).

3.) ArcView 3.0 legend (.avl) files for some data sets (e.g., soils) where interpretation of classification schemes could be enhanced with pre-designed legends. (These pre-designed legends save considerable time in building new projects with WATER's data layers.)

4.) Several ArcView 3.0 Project (.apr) files set up for performing certain functions to data sets (such as changing projections or merging and clipping data layers) or to assist with changing directory structures within ArcView Project files (for example, when moving WATER's .apr files to your hard drive).

5.) Use notes, in the form of ASCII text files, found in the directories of many of the data layers, providing information about the source of the data and sometimes helpful hints about how to interpret the data.

6.) Metadata and source reference materials for many of the data layers, though not in the same format for each data set (see discussion in Section III below).

7.) Useful utility programs such as WinZip, G-Zip, and Untar for decompressing files;[1] as well as a PostScript viewer and a Microsoft Word viewer for reading some of the source materials that could not be converted easily into ASCII text files.

8.) A copy of ESRI's ArcExplorer program for those who do not have ArcView 3.0. (ArcExplorer is a "shareware" program that allows the user to view ArcView shapefiles and images, and to perform some queries, but does not have the capabilities of ArcView 3.0 to link tables or edit data sets.)

System Requirements

Since WATER is an ArcView 3.0-based application, the system requirements to use WATER are the same as what is required to run ArcView 3.0. Ideally, you will want a least a Pentium-class PC (or MacIntosh equivalent) with a fast CD player (if you are reading the files directly from the WATER CD-ROMs) and at least 16MB of RAM (32 or 64 MB are way better). If you are planning to download all of the data from the CD-ROMs onto your hard drive, you will

[1] Only WinZip is needed for a few of the larger data sets stored in compressed form on the WATER CD-ROMs; G-Zip and Untar are provided to assist the user in acquiring other data sets -- for example, from the World Wide Web -- which are often in compressed form.

need at least 2 Gigabytes of storage space. However, since few people will have 2 Gigs of free disk space on their computer, I've set up the CDs to make it as easy as possible to use the data directly from the CDs. That is why you will see identical copies of key "base map" layers (e.g., highways, streams, watersheds, USGS quad boundaries, etc.) on each CD. If your CD player is slower than 8X, reading the data directly off the CDs will be painfully slow, especially for the larger data sets and images. Luckily, the price of computer equipment has been falling, to where you can buy 16 MB of additional RAM for about $40, a 24X CD drive for $80, or a 2.5 GB hard drive for under $180, all of which you can install yourself. Do yourself a favor -- pop for the upgrades. The cost of upgrading is peanuts compared to the price of a copy of ArcView, and the time you save will easily pay for the equipment in a week.

Q: What if I don't have ArcView 3.0? A: There are several options for you:

1.) If you have ARC/INFO, then you can use ARC/INFO to view, query, and perform analyses on any of WATER's data sets and images.

2.) If you have an older version of ArcView (e.g., ArcView 2.1) you can build your own ArcView 2.1 projects with any of WATER's data layers that are in shapefile format (which is the vast majority), and you can import and link any of the tables that are in tab-delimited ASCII text (.txt) or dBASE IV (.dbf) format. You will not be able to load the pre-designed Project (.apr) files or the Legends (.avl files), since these were created in ArcView 3.0 and are not backward-compatible. Nor will you be able to view JPEG compressed images (.jpg files) because ArcView 2.1 cannot read compressed image files.

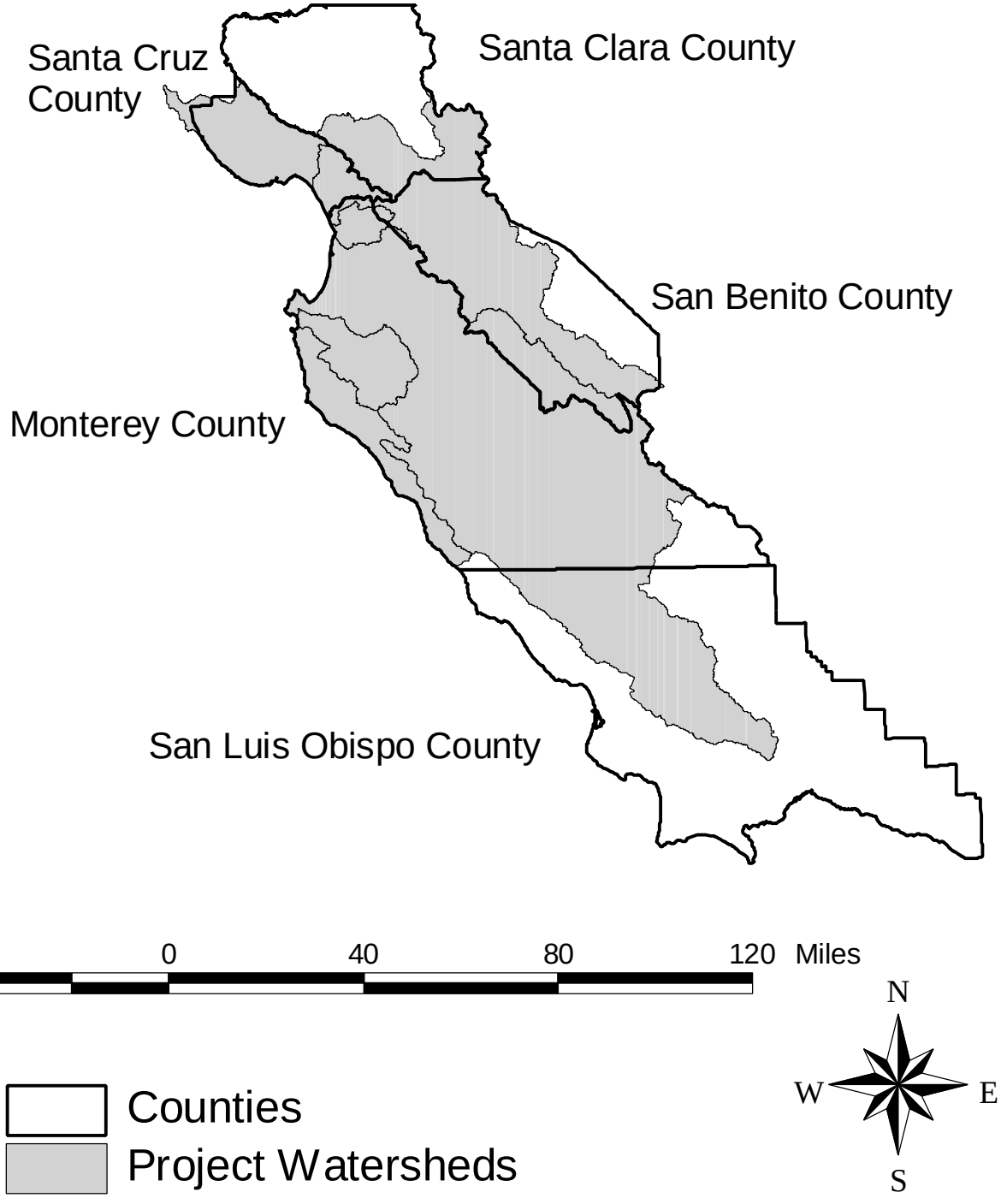
3.) You can use ESRI's ArcExplorer to view and query data layers. Though you cannot add or link related tables, nor edit data layers, you can do many of the simple functions that ArcView allows you to do. One caveat: ArcExplorer is a 32-bit program and will not run on Windows 3.1 or 3.11. You need to have Windows 95 or NT to run ArcExplorer. To install ArcExplorer, double-click the file called '**aesetup.exe**' in the Helpers\ESRI\ArcExplr\ directory on WATER's Disk #1 and follow the on-screen instructions.

4.) You may be able to access an interactive, fully functional GIS via the Internet on WATER's World Wide Web site. We are working with CSUMB to get this site up and running using ESRI's ArcView Internet Map Server, and hope the site will be functional by June of 1998.

II. GEOGRAPHIC EXTENT OF THE DATA

Figure 1 shows the geographic extent of the WATER "project area". Data collection for the project focused on the **watersheds of the Monterey Bay National Marine Sanctuary**. These include the coastal watersheds of northern Santa Cruz County (including the San Lorenzo), the Pajaro, Elkhorn and Watsonville Sloughs, the Salinas, Carmel Valley, and the coastal watersheds of Monterey County. However, at the request of the folks at the Regional Water Quality Control Board, I have often included all of the area within the Board's Region 3. In addition, many of the data sets were available by county and so extend beyond the project watershed boundaries. In such cases, I tried to get the data for the five counties shown in Figure 1: Santa Cruz, Santa Clara, Monterey, San Benito, and San Luis Obispo counties. Some data sets (e.g., Elkhorn Slough National Estuarine Research Reserve water quality sampling data) are, by their nature, limited to a particular sub-section of the project area, and some data sets (e.g., soils and National Wetlands Inventory data) were available for some areas but not others. Hopefully the missing pieces can be filled in as they are made available. In a few cases, data sets were provided which cover the entire state.

Figure 1:
WATER Project Area



III. PROJECTION / COORDINATE SYSTEM

All of the data layers on the WATER CD-ROMs use the following coordinate system and projection:

Projection:	Universal Transverse Mercator (UTM), Zone 10
Datum:	North American Datum (NAD)1983
Units:	Meters

Q: What if my existing data is in a different projection system (e.g., State Plane Zone 4, NAD 27, feet)? A: If your data is NOT stored in UTM-10-NAD83-meters format, then your native data layers cannot be directly overlaid with WATER's. A transformation is required: from your native projection system to WATER's or from WATER's to yours. If you have a GIS shop at your agency, then you will probably have ARC/INFO, MIPS, or some other software and the trained people who can explain and perform such transformations for you. If you're on your own, then you can use ArcView 3.0 to make the necessary transformations. An ArcView 3.0 project file is provided on WATER's Disk #1 for transforming either your native data to WATER's projection system and datum, or vise-versa. **Appendix C** of this Users Guide provides the necessary instructions. It's pretty easy but it takes time.

IV. METADATA

I tried to provide some level of metadata for most of the data layers in WATER. You can locate the metadata for any particular data layer on the CD-ROM in the same directory in which the data itself is located. In some cases, the originating agency provided me with FGDC-compliant metadata, which I passed on in the form of an ASCII text file. In other cases, more extensive information was provided in the form of user manuals or other documentation, which I passed on as well. Where no such materials were available, I have in many cases provided an ASCII text file with my own notes on the source of the data, information about the sub-directory structure or file names within a directory (used for data sets such as Census TIGER files that have multiple files), and other helpful hints about the data layer. (These files have either the same name as the data layer itself, but with a .txt file extension, or are named 'readme.txt', 'read1st.txt', or 'usenotes.txt'.) You will also notice that some data layers have no metadata at all. Hopefully these are the ones that are fairly easy to figure out.

I would like to have been able to organize the metadata into an FGDC-compliant catalog. Unfortunately, this was not possible given the resources available under this grant. Creating such a catalog for WATER will be something I hope to accomplish in 1998. I suggest you check the WATER Web site periodically for metadata updates.

Final note regarding metadata: Some of the metadata from original source agencies still refers to the projection system in which the data set was originally received. Obviously, this projection information is incorrect if the data was not already in WATER's projection system (UTM-Zone 10-NAD83-meters). Therefore ignore any references to projection systems and datums other than UTM-Zone 10-NAD83-meters.

File and Directory Naming Conventions Used in WATER:

1.) All of WATER's ArcView Project files refer to the data on the CD-ROMs as being located on drive E:. If you have a hard disk with available space assigned to the drive letter E:, I suggest you copy the data and Project files to your E: drive. That way, WATER's Project files will open without any changes. If you don't have an E: drive on your system, you can either re-assign the letter E to your CD drive, or copy WATER's Project files to your hard disk and rebuild them so they reference your CD drive using its current drive letter. (See **Appendix E** of this User's Guide for instructions.)

2.) Except for the image files, all of WATER's data layers are in ESRI's shapefile format. Under this format, a single data layer actually consists of three files: a .shp file, a .shx file, and a .dbf file. IT IS CRUCIAL THAT YOU KEEP THE THREE FILES TOGETHER WHEN YOU COPY OR MOVE THEM TO ANOTHER DIRECTORY OR DRIVE. Otherwise you will not be able to load the data layer.

3.) Most of WATER's image files are in JPEG-compressed format, and are designated with the .jpg file extension. The .jgw files you will see with the .jpg files are the ArcView World files -- these are used by ArcView to georeference the image files. IF YOU COPY OR MOVE AN IMAGE FILE, BE SURE TO COPY OR MOVE ITS CORRESPONDING .JGW FILE AS WELL. Otherwise you will lose the georeferencing for the image. (The only image files in WATER that are not georeferenced are the 1994 scanned aerial photos found on Disk #1 in the \Photos94 directory.)

4.) If you see '24' in the file or directory name (e.g., 'czb24k.shp'), that data layer was captured at a scale of 1:24,000 (i.e., digitized off of 7.5-minute quads).

5.) Generally, if you see '100' in the file or directory name, that data layer was captured at the 1:100,000 scale. (The exception is the 100 meter digital elevation model (DEM) hillshade layer found on WATER's Disk #1, which is based on a 100-meter grid.)

6.) If you see '500' in the file or directory name (e.g., 'czb500k.shp'), that data layer was captured at the 1:500,000 scale.

7.) If you see a '3' in the file name (e.g., 'precipr3.shp'), that data layer has been clipped to the boundaries of the Water Quality Control Board's Region 3 boundary.

8.) If you see 'ca' or 'cal' in the file or directory name (e.g., 'calcntys.shp'), that data layer covers the entire state. In such cases, there will almost always be another file of the same data clipped to a smaller geographic extent (typically the RWQCB Region 3 boundary).

9.) Wherever you see a subdirectory called BASINS within a data directory, that indicates a data layer which came from US EPA's BASINS CD. (Sometimes, data was available from more than one source, and there are interesting comparisons to be made by looking at what is supposed to be the same data coming from different sources. A good case in point is the NPDES permit data found in the \NPDES directory on Disk #2.)

10.) ArcView 3.0 can import tabular data in one of three forms: tab-delimited ASCII text (.txt) files, dBASE IV (.dbf) files, and ESRI's own INFO files (which are actually multiple files within a single directory). To keep things simple, I have used tab-delimited text files and .dbf files to store WATER's tabular data sets. (See the discussion in Section V below for an example of how tabular data sets are used in WATER.)

V. MISCELLANEOUS

A. Water Quality Data Sets in WATER

WATER contains the following water quality data sets for the central coast region (all found on Disk #2):

- Dept. of Fish & Game/State Water Resources Control Board Bay Toxics and Cleanup Program (July 1992 through December 1995);
- California State Mussel Watch Program (July 1977 through April 1995);
- Elkhorn Slough National Estuarine Research Reserve sampling program, administered by the Elkhorn Slough Foundation (November 1962 through February 1997);
- US EPA's STORET data base containing sampling data from many source agencies (October 1927 through November 1995);
- NPDES permit discharge sampling from US EPA Region 9's Permit Compliance System database (January 1987 through June 1997).

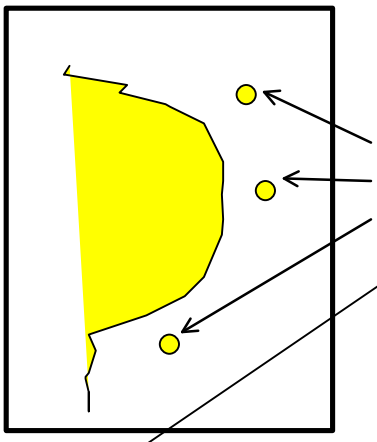
In the Monterey Bay region, as elsewhere, water quality data is stored in a wide variety of data structures or formats by the different agencies that collect the data. In WATER, I have tried to apply a somewhat consistent structure to the water quality data so that analysis across agencies and data sets would be easier. The structure I have chosen is shown in Figure 2. I chose it because it seems to make the best use of ArcView querying and table linking features.

As shown in Figure 2, the primary GIS layer for any of the water quality data sets is a shapefile consisting of points representing the sampling stations. The shapefile's attribute table will contain information about each sampling station (such as name, location, and elevation of the station). Each record in the attribute table corresponds to one sampling station. The actual water quality measurements are kept in a separate table, called 'samples.txt' or 'measures.dbf' or something similar (see Table 1 for applicable file names for each data set). Each record in the 'Samples' table represents the measured results of a single water quality parameter on a single date at a particular station (e.g., a dissolved oxygen measurement of 7.1 mg/liter found at the Back Bennet Slough station on October 19, 1988).

Within the ArcView project, the table of water quality measurements is "linked" to the sampling stations through a single "key" field, usually the station name or ID number. To make analysis using ArcView easier, a third table is also provided (usually called 'paramtrs.txt' or 'paramtrs.dbf' or similar), which contains a list of all the parameters found in the sampling data. If the tables are linked properly, having a separate parameters table allows the user to more quickly identify where a particular parameter has been measured simply by selecting that parameter in the parameters table. Sometimes a fourth table is included (called 'smplinfo.dbf' or similar) which contains information about a particular sampling collection, one during which more than one parameter was measured. For example, if a water sample was collected and then various parameters were measured from that sample, this table might contain information about tide stage, weather conditions, or time of day the sample was taken -- characteristics which apply to all of the parameters measured from that sample.

Figure 2: Typical Data Structure for Water Quality Data in WATER

Sampling Stations:



Attribute Table:

Station ID	Stn Name	Latitude	Longitude	Elevation	etc.-->
1	Pajaro R.	34.7649	-120.4432	120	
2	Elkhorn Sl.	34.6834	-120.4187	115	
3	Salinas R.	34.3491	-120.6328	45	

Station ID or name is the "key" field linking the Samples to the stations in the Attribute table.

Samples Table:

Station ID	Date (1)	Parameter Code	Parameter	Text Value (2)	Numeric Value	Units	Remarks
1	5/24/93	0145	Temp	18.9	18.9	Degrees C.	
1	5/24/93	0287	pH	8.23	8.23	pH units	
1	5/24/93	0486	NH3	<0.1	0.1	mg/l	less than
1	6/28/93	0145	Temp	19.5	19.5	Degrees C.	
2	5/24/93	0145	Temp	17.6	17.6	Degrees C.	
2	5/24/93	0486	NH3	>45	45	mg/l	greater than
3	6/28/93	0145	Temp	16.2	16.2	Degrees C.	
3	6/28/93	0287	pH	8.28	8.28	pH units	
3	6/28/93	0486	NH3	0.50	0.50	mg/l	

Samples table linked to Parameters table using 'Parameter Code' as key field.

Parameters Table:

Parameter Code	Parameter
0145	Temperature (deg. C)
0287	pH
0486	Nitrogen as NH3

Notes regarding Samples table:

(1) Sometimes the Date field will be included in more than one form in the Samples table. If the table file is stored in .dbf format, ArcView will display the date in a rather strange form that is easier for ArcView to sort by but difficult for us humans to read (for example, 10/09/93 shows up as 19931009). To make it easier to read the dates, a second date field may be included called 'TxtDate'. The standard text form is easier for us to read, but is not much good for sorting because the month and day come before the year. In some cases, separate fields for Day, Month, and Year have been included so that the data can be analyzed and graphed in different ways using ArcView (e.g., average for a particular month over a set of years).

(2) Two fields are provided for showing the results of sample analyses: a numeric Values field and a text Values field. In most cases, they will look the same. However, often analytical results are reported as 'less than' a particular amount (usually the limit of detection of the analytical method or instrument), or 'greater than' a particular amount (where the sample exceeded the instrument's calibrated range). The text field allows you to see what the originally reported value is. The numeric field allows you to conduct numeric analyses on the sample results (which you could not do with the text field). A 'Remark' or 'Qualifier' field is provided so you can decide what to do with the 'less than' or 'greater than' values (e.g., cut them from the data, assume they are the limit value, or apply some other multiple to those values before including them in a numeric analysis).

Each of WATER's water quality data sets have an ArcView 3.0 project file associated with it which contains the links for the relationships shown in Figure 2. Table 1 shows the file names associated with each of the water quality data sets. The links within each project file are set up to enable the user to quickly determine where any particular parameter has been measured. That is, when you highlight one or more parameters in the parameters table, ArcView will sort through the list of samples and then show you on the map all those stations where that parameter has been measured at some time in the past. It will also highlight all of the samples of that parameter in the Samples table. You could then, for example, run a query on the highlighted samples to select those which exceeded a particular value.

One can also link the tables in the reverse direction, and use ArcView to show all the parameters that have been measured at a particular station. **Appendix D** contains two exercises (similar to the one presented at the October, 1997 training session) to help you learn about different ways to link tables in ArcView. Different types of linking can answer different types of questions using the same data, and learning how to link tables in ArcView is one of the key skills to learn if you want to use the water quality data sets contained in WATER most effectively. If you have questions about how the tables in WATER's water quality data projects are linked, I suggest you go through the exercises in **Appendix D**.

B. US Census Bureau 1994 TIGER Files

The US Census Bureau has developed GIS files showing census tracts, block groups, and street segments, as well as streams, railroad lines and trails. An ArcView 3.0 Project file called **tiger.apr**, located in the \TIGER\ directory of Disk #1, shows these various themes for four counties: Santa Cruz, Monterey, San Benito, and San Luis Obispo Counties. Any of the TIGER street files (those shapefiles within the TIGER directory that end in 'st.shp') can be made into a street address look-up (a.k.a. "address-matching") theme. Instructions for adding such a layer to any ArcView 3.0 Project are provided in **Appendix G**.

C. Useful ArcView Extensions Included in WATER

The directory on WATER's Disk #1 called Helpers\ESRI\AVExtens\ contains a few ArcView 3.0 extensions that I have found useful, including:

⇒ a metadata extension (**Metadata.avx**) that assists with creating metadata that can be accessed directly from a Project in ArcView. This comes courtesy of NOAA's Coastal Services Center.

⇒ an extension called **Overview.avx** that creates a window in which you can see the entire extent of the themes in your Project view, even when you are zoomed in on a particular part of the view. This extension is very useful for keeping yourself oriented as you zoom in to take a close look at a small part of the geographic area covered by the Project. You can also move the zoomed area you are looking at in the View by moving a frame within the Overview window. WOW! This one's from ESRI.

⇒ an extension called **Prjctr.avx** that allows you to transform data from one coordinate system to another in ArcView. This one's also from ESRI.[2]

These extension files have to be copied to your C:\ESRI\AV_GIS30\ARCVIEW\EXT32 directory (or EXT16 directory if you are running Windows 3.1 or 3.11) before ArcView will recognize them. Once they are copied to the correct directory, they will appear in the list of available extensions that appears when you use the File...Extensions menu item from the main Project window of ArcView. To use them within an ArcView Project, simply check the box next to the applicable name in the Extensions selection window.

D. Duplicating/Sharing WATER's Data Sets

Most of the data on the WATER CD-ROMs is public domain data and has been obtained with the understanding that it would be distributed freely. **HOWEVER, THE REACH3 DATA SET FOUND IN THE STREAMS DIRECTORY ON EACH OF THE WATER CDs WAS INCLUDED ON THE CD-ROMS BY ACCIDENT AND IS A COPYRIGHTED DATA SET. PLEASE DO NOT USE OR DISTRIBUTE THE REACH3 DATA SET.**

You may distribute the other data layers freely except for the Reach3 data set noted above. All I ask is this: if you further distribute any data sets contained on the WATER CDs, please also distribute the metadata, user guides, and any other documentation from the CDs that will help the new user make proper use of the data, understand its limitations, and know who to contact with questions.

E. Spatial Accuracy of WATER's Data Sets

The spatial accuracy of WATER's data sets varies considerably from one data set to another, depending on the scale at which the information was captured. Most were digitized from 1:24,000 scale maps (i.e., USGS 7.5 minute quads). Some were captured at 1:100,000, a few at 1:500,000. More details about spatial accuracy may be found in documentation associated with individual data sets. The thing to know is that **THE SPATIAL ACCURACY OF WATER'S DATA SETS MAKES THEM APPROPRIATE FOR USE IN REGIONAL AND WATERSHED PLANNING EFFORTS, NOT FOR MAKING DECISIONS ABOUT INDIVIDUAL PIECES OF PROPERTY**.

In addition, it is important to know that only a few of the point data sets in WATER were derived from or verified using GPS. Most -- including most of the water quality sampling station locations and the NPDES discharge points -- were mapped from tables that contained latitude and longitude information. You will notice that some of the points are obviously not correct. This is probably because it is very difficult to notice an incorrect latitude or longitude when it is buried in a table of other numbers. However, once mapped, these errors become more obvious. One of the benefits of the WATER project will be the identification of incorrect locational information for some of these data sets. As more of us begin to use GIS, there will be increased pressure on all of our agencies to correct these problems.

[2] The process for re-projecting any of WATER's shapefile themes into your native projection (or your native data sets into WATER's projection) is described in **Appendix C**. The process for transforming a table with latitude/longitude coordinates into an ArcView shapefile that can be integrated into WATER is described in **Appendix F**.

F. Disclaimers

The data used to produce the WATER CD-ROMs came primarily from sources other than the Coastal Commission. Although reasonable efforts were made to assure that errors were not introduced during the transformation of data sets, **NO EFFORT WAS MADE TO VERIFY THE ACCURACY OF THE DATA ITSELF**. The Commission therefore makes no warranty as to the accuracy or usability of the data on the WATER CD-ROMs. By using the data from the WATER CD-ROMs, the user expressly accepts the data "as is" and assumes full responsibility for verifying the accuracy of the data and the appropriateness of its proposed application prior to making any decisions based on the data.

As noted above, the data on the WATER CD-ROMs is intended for use in regional and watershed planning. The spatial accuracy of the data is not great enough to be used as the basis for determinations regarding individual properties.

Some data sets (such as the soils data for Monterey County) are considered 'provisional' and may not have undergone final quality control certification from the source agency. Notice to this effect has been placed in documentation files associated with such data layers. When these data sets become available in their final, certified form, they will be placed on WATER's World Wide Web site. In the meanwhile, the user should read and heed whatever documentation may be available for a data set prior to its use.

Finally, I need to inform you that errors may have occurred during transformation of data from its native format and structure to that found on the WATER CDs. While considerable effort went into identifying and correcting such errors, some may have gone undetected.

G. Reporting Problems, Errors, or Bugs

If you encounter problems, errors, or bugs -- in the data, the CD-ROMs, or the documentation -- please bring them to my attention by writing to me at:

Helmut Gieben
California Coastal Commission
45 Fremont Street, Suite 2000
San Francisco, CA 94105

or e-mailing me at:

hgieben@slip.net

or calling me at:

(415) 904-5284

Please be as clear and specific as you can in your description of the problem. I will attempt to keep an updated list of know problems on WATER's World Wide Web site, along with any suggested work-arounds. If possible, I will post corrected data or documentation on the Web site.

VI. WHERE DO WE GO FROM HERE?

The WATER CDs represent a starting point. While I hope that the data sets are useful for your everyday work, I also know they won't be able to answer all of the questions you face or address all of your information needs. I hope that by bringing together so many pieces, WATER will help illuminate some of the gaps in our knowledge and encourage us to work together to address those gaps.

I propose the following tasks as follow-up to the distribution of the WATER CDs:

⇒ Completion of WATER's World Wide Web site. To include:

- downloadable copies of all of WATER's data sets (in compressed format);
- a thumbnail graphic of each data set;
- metadata and other documentation (when available) for each data set;
- a place to download or upload ArcView 3.0 Project files, legends, scripts, and other files pertaining to WATER's data sets;
- a list of known bugs, problems or errors in the data or documentation;
- a fully functional, interactive GIS featuring ESRI's ArcView Internet Map Server providing access to all of WATER's data layers;
- links to other GIS Web sites; and
- notices of training opportunities in regard to using WATER.

⇒ A quarterly WATER Newsletter with additional use tips, practice exercises, notification of bugs and errors, information about new or updated data sets available on the Web site, WATER training sessions, etc.

⇒ Development of a data dictionary or metadata catalog for WATER's data sets.

⇒ Development of a system for regularly updating WATER's data sets (e.g., monthly or quarterly collection of water quality sampling data and conversion to a uniform format and structure).

⇒ Identification and correction of incorrect locational information.

⇒ Development of new data sets or more spatially accurate versions of existing data sets.

⇒ A training program focused on using WATER to answer regional planning questions.

⇒ etc....

APPENDIX A:
List of WATER's Data Sets and Images, by Disk and Directory

WATER DISK #1: Hydrography, Habitats, DOQs, Soils, Street network, and other basics

Directory	Size	Contents
Coastln	4.09 MB	Shoreline (coastline) for the project area at 1:24k
Counties	2.60 MB	County boundaries (all CA counties at 1:2million; 5 project counties at 1:100k)
CZBdy	119 kB	Coastal Zone boundary at 1:500k and 1:24k
Dams	5 kB	Dam locations (based on Corps of Engineers 1980 data, via BASINS CD)
DOQs	256 MB	Digital Orthophoto Quads (North Santa Cruz County from USGS; North Monterey County and Salinas Valley from Monterey County Water Resources Agency)
Elkhabit	642 kB	Elkhorn Slough habitats, as mapped by Moss Landing Marine Labs
GAP	10.9 MB	Gap Analysis Project vegetation (land cover) data (from UCSB)
Grndwatr	968 kB	Goundwater basins as defined by Dept. of Water Resources
Helpers*	10.5 MB	Gzip, Untar, WinZip and other utilities useful for data extraction and conversion; also ESRI's ArcExplorer, and useful ArcView 3.0 utilities and extensions.
Highways	2.32 MB	Major State and Interstate highways
Hshades	22.9 MB	Shaded relief images (entire region from 100 meter DEM and available quads from USGS 20 meter DEMs)
NWI	8.54 MB	National Wetlands Inventory (all available for region in digital form -- mostly coastal quads)
Parcels	4.87 MB	Parcels for northern Monterey County and the Salinas Valley, as provided by the Monterey County Water Resources Agency
Photos94*	33.8 MB	1994 aerial photos of Elkhorn Slough indexed by flightline and frame centerpoint (not orthorectified)
Places	1.49 MB	USGS Placenames (useful for labeling maps)
Precip	20.7 MB	Precipitation contour maps for entire state and project region; and National Weather Service daily precip data for all stations in region
Quads	1.92 MB	Indexes for 1:250k, 1:100k, and 1:24k USGS quads
Soils	76.0 MB	Soils data for Monterey and Santa Cruz Counties
Streams	23.5 MB	US EPA Reach File 1 (via BASINS CD) and Reach File 3 streams
Strmflow*	35.2 MB	USGS stream gage stations and daily, monthly, annual flows
Tiger*	41.0 MB	Census TIGER files, including roads (useful for address matching)
TMImage*	53.0 MB	Thematic Mapper satellite image of region (from UCSB GAP project)
Veg	2.83 MB	Various vegetation layers (including CalVeg and hardwoods)
Wtrsheds	13.2 MB	Watersheds at various scales, including USGS Cataloging units, CalWater hydrologic units, hydrologic areas, and hydrologic subareas

* NOTE: Items with asterisks have ArcView 3.0 Project files associated with them.

APPENDIX A (continued)
List of WATER's Data Sets and Images, by Disk and Directory

WATER DISK #2: Water Quality Sampling data and Pollutant Source data

Directory	Size	Contents
Bayprot*	20.0 MB	Dept. of Fish & Game/State Water Resources Control Board Bay Toxics and Cleanup sampling data
CCCPrmts	1.97 MB	791 Geocoded Coastal Commission Permit Applications, 1986-1996, for the Elkhorn Slough area. (Approx. 65% of all CCC permit applications for the area).
CERCLA	1.92 kB	Comprehensive Environmental Response, Compensation, and Liability sites from the 1986 National Water Summary Report (U.S. Geological Survey, 1987)
Coastln	4.09 MB	Same as Disk #1, here as reference layer
Counties	266 kB	Same as Disk #1, here as reference layer
CritCstl	2.23 MB	Critical Coastal Areas (CZARA section 6217 watersheds)
CZBdy	119 kB	Same as Disk #1, here as reference layer
DrinkWtr	15.2 kB	Public water supply sites, from EPA database (via BASINS CD)
Fish_Adv	763 kB	1994 Fish Consumption Advisories (source: US EPA)
Grndwatr	968 kB	Same as Disk #1, here as reference layer
Highways	2.32 MB	Same as Disk #1, here as reference layer
IFD	42.4 MB	Industrial Facilities Discharge sites, from US EPA database (BASINS CD)
Mines	903 kB	Active, historic and inactive mines, from Cal. Dept. of Conservation Division of Mines and Geology mines database
Muslwtch*	7.84 MB	California State Mussel Watch sampling data (as of June, 1997)
NERRWatQ*	8.25 MB	Water quality sampling conducted by the Elkhorn Slough Foundation for Elkhorn Slough National Estuarine Research Reserve
Nit90	9.84 MB	Nitrogen fertilizer sales, by county, in 1990 (source: US EPA)
NPDES*	22.5 MB	NPDES permit data from three sources: US EPA Region 9 Permit Compliance System (PCS), Monterey Bay National Marine Sanctuary's Water Quality Protection Program, and US EPA's BASINS CD. (Interesting to compare data!)
NPL	961 kB	Superfund National Priority List (NPL) Sites (as points from BASINS CD and as polygons from US EPA)
Quads	1.21 MB	Same as Disk #1, here as reference layer
RCRA	18.5 kB	Point coverage of Resource Conservation and Recovery Act (RCRA) sites shown in the 1986 National Water Summary Report (USGS, 1987)
Sediment	10.6 MB	National Sediment Inventory data from BASINS CD
Slopes	110 MB	USGS 1:24k DEMs converted to slopes (6 classes: 0-5%, 6-10%, 11-15%, 16-30%, 31-50%, >50%). Zipped, by quad.
STORET*	332 MB	US EPA STORET water quality sampling data through 1994
Streams	23.5 MB	Same as Disk #1, here as reference layer
ToxicRel	47.3 kB	1992 Toxic Release Inventory sites (US EPA via BASINS CD)
Wtrsheds	13.2 MB	Same as Disk #1, here as reference layer

APPENDIX A (continued)
List of WATER's Data Sets and Images, by Disk and Directory

WATER DISK #3: Land Use data

Directory	Size	Contents
CCAP*	79 MB	Land cover for Santa Cruz and northern Monterey County interpreted from 1986 and 1993 Landsat TM images using NOAA Coastal Change Analysis Program (CCAP) protocol. Raster image for each year and one for 1986-93 changes. Also as shapefiles in zipped form.
Coastln	4.09 MB	Same as Disk #1, here as reference layer
Counties	2.60 MB	Same as Disk #1, here as reference layer
CZBdy	119 kB	Same as Disk #1, here as reference layer
ESRI	6.67 MB	ArcExplorer, useful ArcView 3.0 extensions, and some ArcView 3.0 projects set up for converting projection and datum of data layers, for merging and clipping themes, and for changing project directory references (used when moving data files between directories). Same as the ESRI files in the \Helpers\ESRI directory from Disk #1
Highways	2.32 MB	Same as Disk #1, here as reference layer
Landcovr	79.8 MB	Monterey and Santa Cruz County land cover delineated by Pacific Meridian for AMBAG from 1990 & 93 Landsat TM satellite images. In shapefile format.
Lndcvrtf	60.4 MB	Land cover for San Benito, Monterey and Santa Cruz Counties delineated by Pacific Meridian for AMBAG from 1990 & 93 satellite images. In raster format.
Lu8991	16.4 MB	Land use for Salinas Valley & N Monterey County in 1989/91 as mapped by California Dept. of Water Resources and digitized by Monterey County Water Resources Agency
LULC100k	9.17 MB	USGS Land Use Land Cover data mapped at the 1:100k scale. Represents late 1970's data; min. map unit = 10 acres in urban areas, 40 acres in non-urban.
LULC250k	20.1 MB	USGS Land Use Land Cover data mapped at the 1:250k scale. Represents late 1970's data.
Pesticid*	209 MB	Pesticide use data for 1995 from California Dept. of Pesticide Regulation (uses township/range/section for geolocating)
Quads	1.92 MB	Same as Disk #1, here as reference layer
Streams	23.5 MB	Same as Disk #1, here as reference layer
Wtrsheds	13.2 MB	Same as Disk #1, here as reference layer

APPENDIX A (continued)
List of WATER's Data Sets and Images, by Disk and Directory

WATER DISK #4: Topography data, BASINS, and MURP files

Directory	Size	Contents
BASINS*	78.4 MB	Contains all of the BASINS v.1 data sets for RWQCB Region 3, the BASINS ArcView project file, and associated documentation. NOTE: Some of the data sets on the BASINS CD could not be properly re-projected to UTM. To retain the integrity and operability of the full BASINS product, therefore, it is reproduced here in its original Albers projection. Data sets from this directory can therefore not be used directly with other WATER data. The BASINS data sets that could be converted to UTM have been included in other directories (and are noted as coming from the BASINS CD).
CCCPrmts	1.07 MB	Same as Disk #2, here as reference layer
Coastln	4.09 MB	Same as Disk #1, here as reference layer
Counties	2.60 MB	Same as Disk #1, here as reference layer
CZBdy	119 kB	Same as Disk #1, here as reference layer
DEM24k	428 MB	Topography files derived from USGS 1:24k digital elevation model (DEM) data. These include (in separate subdirectories): 1) Contours (elevation in meters, 10 or 20 meter intervals) Files represent individual quads, and are named accordingly. 2) Lattices (for use with ArcView Spatial Analyst). Grouped alphabetically, by quad name in subdirectories (see lattice.txt file in Lattices directory). 3) Slopes for two watersheds: Carmel Valley and Elkhorn Slough (categorized as 0-5%, 6-10%, 11-15%, 16-30%, 31-50%, and >50%). These are the same as the slope files on Disk #2, but the individual quads were joined and clipped to the watershed boundary. (These were done as tests to demonstrate ArcView 3.0's ability to merge and clip themes. Similar watershed slope maps could be created for other watersheds or sub-watersheds using the "utlities.apr" project found in the ESRI directory on Disk #3 (see WATER User Guide for detailed instructions).)
Highways	2.32 MB	Same as Disk #1, here as reference layer
MURP2*	9.77 MB	Data sets assembled for the Municipal Urban Runoff Program (MURP) demonstration project in the City of Monterey. Includes urban watersheds, stormwater structures, and potential sources of urban nonpoint source pollution.
Quads	1.92 MB	Same as Disk #1, here as reference layer
Streams	23.5 MB	Same as Disk #1, here as reference layer
Wtrsheds	13.2 MB	Same as Disk #1, here as reference layer

APPENDIX B:
Alphabetical Index to WATER's Data Sets and Images

APPENDIX C:
Using ArcView 3.0 To Transform a Theme From One Projection System And Datum To Another

The project file you will use is called **datum.apr** and is found in the **Helpers\ESRI** directory on **WATER Disk #1**. Here are the directions for performing a transformation from WATER's projection system and datum (UTM Zone 10, NAD 83, meters) to any other projection system and datum (the example uses State Plane Zone 4, NAD 83, feet).[3]

A. Setup.

1. Copy the file '**prjctr.avx**' (located on **WATER Disk #1**, in the **Helpers\ESRI\AVextens** directory) to the C:\ESRI\AV_GIS30\ARCVIEW\EXT32 directory on your hard drive
2. Copy the file '**datum.par**' (located on **WATER Disk #1**, in the **Helpers\ESRI** directory)to the C:\ESRI\ directory on your hard drive. (Datum.par is a parameter table that is used by datum.apr during transformation of data layers from one datum reference to another.)
3. Start ArcView 3.0 and open the file **datum.apr** (located on **WATER Disk #1**, in the **Helpers\ESRI** directory). If a window pops up saying "Where is C:\ ... datum.avx?", ignore it by clicking on the Cancel button.

B. Re-projecting the shapefiles to your native projection system.

4. Create a new View and add the theme(s) you want to transform (you can add them straight from the CD-ROM if you like). (To save time, you do not need to have the themes visible.)
5. Go to the View... Properties... menu item and in the View Properties window, for Map Units select the map units appropriate to WATER (i.e., 'meters'). Click OK to close the View Properties window.
6. Make the themes you want to convert active by holding the Shift key down while clicking on each theme's name.
7. Now click on the far right button on the upper toolbar, the one with the white arrow on a black circle with four dots around it. This will begin the re-projection script.
8. You will get a message box saying "Please select the input projection in the next dialog box." Click OK.
9. In the Projection Properties window, make sure the "Standard" radio button is clicked at the upper left, and for Category, choose "UTM". For Type:, select Zone 10. This allows the computer to know which projection the WATER data are currently in. Click OK.
10. When the computer asks for the output units, select the distance units of your native data sets as the output units (in our example, 'feet') and click OK.

[3] To perform the opposite conversion, follow the same steps, but reverse the selection of variables (i.e., use your native projection system and datum as input variables and UTM Zone 10 and NAD 1983 as output variables). Be sure to specify the correct map units (your native map units) under View Properties in step 5 before running the conversion.

11. The Projection Properties window will appear again, this time to allow you to specify the projection you want to convert INTO. Again, make sure the "Standard" radio button is clicked at the upper left. For Category, choose the appropriate projection (in our example, "State Plane --1983"), and for Type, choose the appropriate Zone (in our example, "California, Zone IV"). Click OK.

12. When asked if you want to recalculate area, perimeter, and length fields (if present) using meters, select Yes. To the question "Add projected shapefile(s) as theme(s) to a view?", click on Yes and select <New View> in the subsequent dialog box. Click OK

13. You will then be asked to save the re-projected shapefiles under new names. Give each one a new name and put them in the directory of your choice. (NOTE: If you save them to your hard drive with the same name and directory structure as on the CD-ROMs, it will be easier for you to transfer the ArcView Project files in WATER that reference these shapefiles.) (See **Appendix E** about rebuilding WATER's AV3.0 Project files after moving their referenced data files.) Click OK.

    For each theme, you will get the message at the bottom of your Project window saying "Exporting [file name]..." and the % completed bar will race across. A new view (View3) will open with the themes re-projected to your native projection system. You can now view the themes by clicking in the box to the left of the theme name.

14. Test the re-projected themes by adding a theme from your native data. Hopefully, it will overlay directly with the converted WATER data layers. If you do not see your native data set when you add it and make it visible, then the process probably did not work. Try again.

APPENDIX D:
Exercises for Understanding How To Link Tables in ArcView 3.0

Exercise 1. Finding water quality measures for a particular sampling station.

(Answers the question: "Show me all the parameters measured at this sampling station.")

NOTE: These exercises use a very large data set found on WATER Disk #2 -- the STORET data set. If your CD drive is slower than 8X, you will probably want to copy the entire STORET directory from WATER Disk #2 to your hard drive before running these exercises. (This will require approximately 332 Megabytes of free disk space). If you do this, then substitute the new location for the STORET files in steps 3, 7, and 8 below.

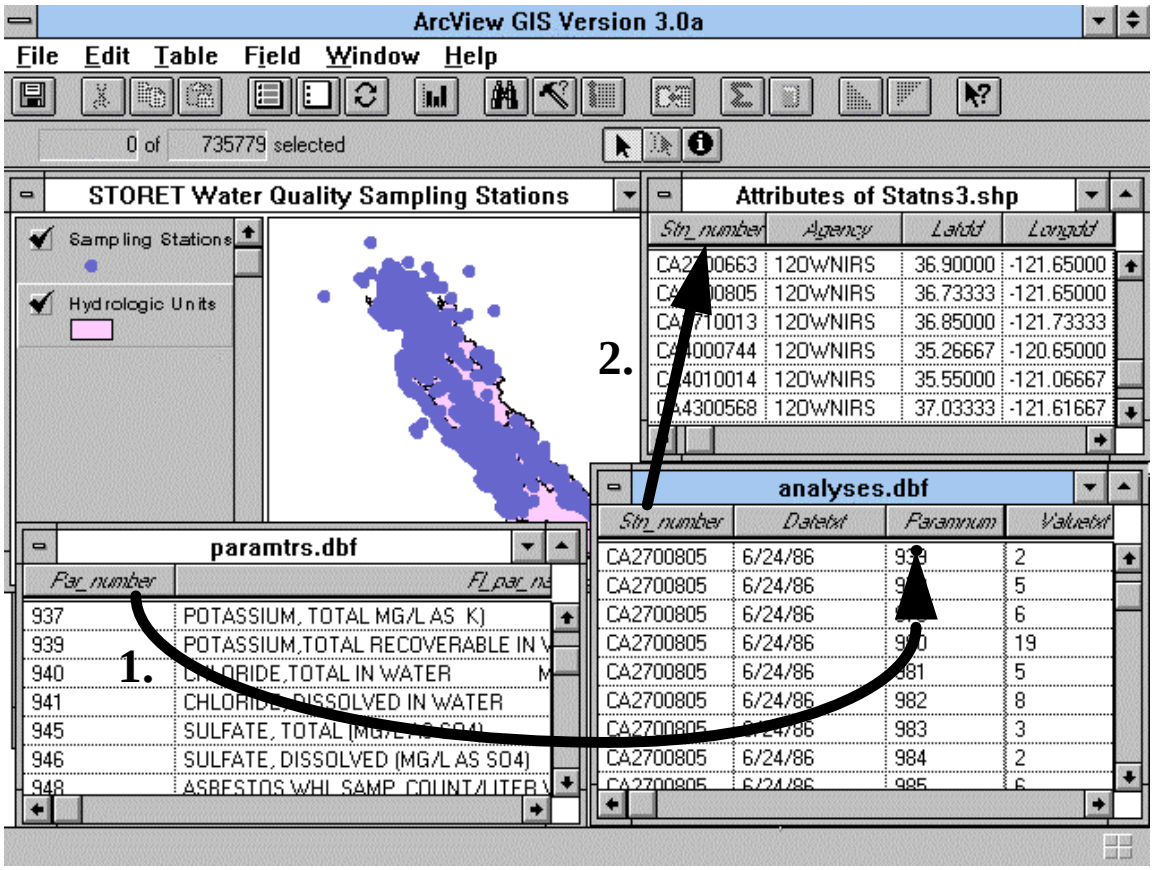
1. Open ArcView or create a new project using the File… New Project menu.
2. Create a new View by highlighting the Views icon and clicking on the 'New' button.
3. Add the STORET sampling stations theme by clicking on the Add Theme button (just under the Edit menu) or by using the View… Add Theme menu. The STORET file you are looking for is E:\Water2\Storet\stations.shp
4. Make the stations visible by putting a checkmark (clicking) in the box to the left of the theme name. (If your dots are in a light color (such as yellow) change the color of the dots by double-clicking on the theme name (which brings up the Legend Editor), then double-clicking on the dot symbol (which brings up the Palette window), finding the color palette by clicking on the button with the paintbrush on it, and choosing a darker color (e.g., red). Apply the change by clicking on the 'Apply' button in the Legend Editor window. Then get close the Palette and Legend Editor windows.)
5. Make the theme active by clicking on the area around the theme name.
6. Display the attribute table for the STORET stations by clicking on the Open Theme Table button (directly under the Theme menu) or using the Theme… Table menu. A separate window titled 'Attributes of Stations.dbf' will appear.
7. Next, add the table of STORET sampling data. To do this, go to the main project window, click on the Tables icon and then the 'Add' button. The table you are trying to add is E:\Water2\Storet\analyses.dbf. (If you can't find it, be sure you are in the correct directory and that List Files of Type: is set to "dBASE (.dbf).") The table will appear in a separate window on top.
8. Next, add the table of STORET parameters. To do this, return to the main project window, click on the Tables icon and then the 'Add' button, as in Step 7. This time, the table you are trying to add is E:\Water2\Storet\paramtrs.dbf. The new table will appear in a separate window.
9. Now you are ready to establish the links. Because links are directional, it is important to do the next steps in the correct sequence. First, organize your windows so you can see all 3 tables and the View window. (See figure at bottom of next page.) With the paramtrs.dbf window active, click on the gray field name box for the Par_number field. The light gray should become dark gray to let you know the field is active. Now activate the analyses.dbf window by clicking on it, and make the field called Paramnum active by clicking on the gray field name box where it says Paramnum. Now use the Table… Link menu to link the two tables. You might see an hourglass and a little blue bar racing

across the bottom of your project window to let you know it is 'indexing' the linking field. (Indexing speeds up searches.)

10. Now do the same between the Stn_number field in the analyses.dbf table and the Stn_number field in the Attributes of Stations.shp table. Be sure to click first on the Stn_number field in the analyses.dbf table, and last on the Stn_number field in the Attributes table. Use the Table… Link menu to link these two tables.

11. Now you are ready to answer the question "What parameters have been measured at this station?" To do so, select one or more of the sampling stations in the View using the Select Feature tool. (You may need to Zoom in to select a single point.) When you have selected a sampling point or set of points in the view, you will see the selected station(s) highlighted in the Stations Attributes table, and in the Analyses.dbf table, and in the paramtr.dbf table. All those highlighted in the paramtrs.dbf table are the parameters that have been measured at the selected sampling location(s). (If you don't see any rows highlighted in the paramtrs.dbf table, try selecting another point.)

12. Extra bonus points: You can **get all the highlighted parameters to come to the top of the paramtrs.dbf table** by making the paramtrs.dbf window active and then clicking on the 'promote' button (in the upper row of buttons just to the right of the binoculars and the hammer). You can **alphabetize them** by clicking on the Fl_par_nam ('full parameter name') field to activate that field and then clicking on the 'sort ascending' button (in the upper row of buttons, third from the right -- looks like a triangle on the button). To get the highlighted records back to the top, use the 'promote' button again.



Exercise 2. Finding all stations that sampled a given parameter.

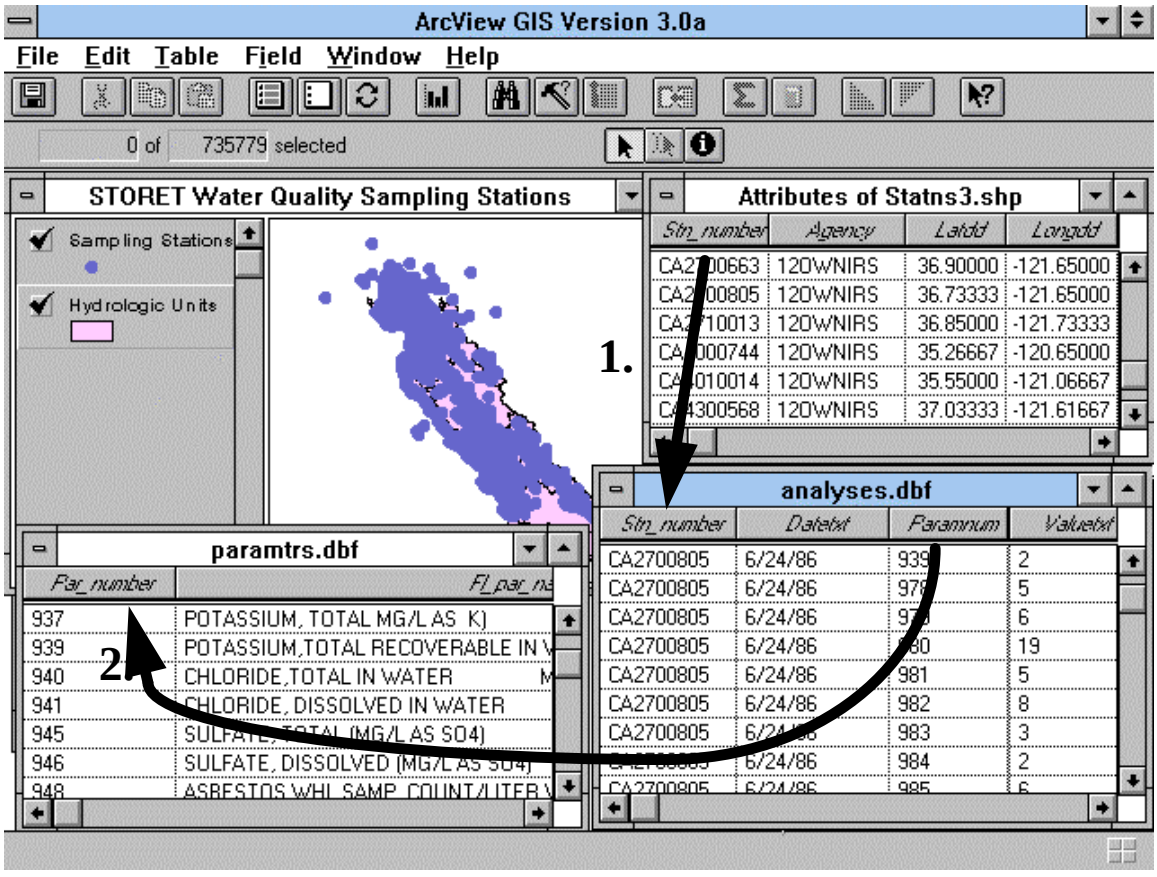
(Answers the question: "Show me all the stations where they have measured this parameter.")
(Incidentally, this is the configuration used in the Storet.apr Project.)

1. Using your project file from Exercise 1, we will demonstrate what happens if you link the tables using the same fields but in the opposite sequence. Begin by **clearing all the links** we created in Exercise 1. To do this, select each table in turn and use the Table… Remove All Links menu to remove all the links. (If the Remove All Links menu item is dimmed, that means that the active table has no links to remove.)

2. Now **make sure no records are selected in any of the tables** by using the Edit… Select None menu for each table. The highlighting should all go away.

3. Now establish links in the following sequence: First, click on the field **Paramnum** in the **analyses.dbf** table, then the **Par_number** field in the **paramtrs.dbf** table, then make the link using the Table… Link menu. Next, click on the **Stn_number** field in the **Attributes of Stations.shp** table, followed by the **Stn_number** field in the **analyses.dbf** table, and use the Table… Link menu to link the two tables. (See figure.)

Now if you **highlight a parameter in the paramtrs.dbf table** by clicking on it, it will send your message up the chain to the View, where you will see all of the points at which that parameter was sampled light up. (NOTE: give the computer some time to do this... it may take a while.) Is that cool or what? Now this is POWER!



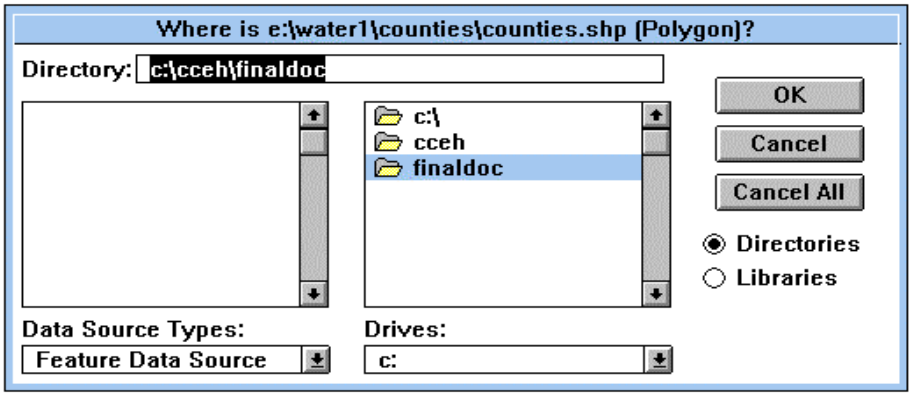
APPENDIX E:
Rebuilding an ArcView Project
If You Move Its Data Files

When you create an ArcView Project (.apr) file, you are really just creating a set of references to data files that exist elsewhere on your system, along with instructions on how you want those data files (or 'themes') to be displayed. This allows .apr files to be much smaller than if they actually contained copies of each data layer, thereby saving space on your hard disk. Instead of having multiple copies of a data layer, you have one copy that can be referenced by many ArcView Projects. Updating your Projects is also easier because all Project files that reference a given data layer will automatically be updated when the underlying data file is updated.

The drawback to this system is that if you ever move or rename a data file, or even just change the name of the directory or sub-directory it is in, you have to re-build all of the Project files that reference that data layer. Therefore, think very hard about what you want to name your data files, and also about the directory structure you will use to organize them. Then, AVOID MOVING OR RENAMING YOUR DATA FILES.[4]

Well, sometimes it's just not possible to avoid moving or renaming data files. One example is if you decide to copy WATER's data files to your hard disk, rather than reading them from the CD-ROMs. In that case, you have two options for re-building the Project file:

Method #1: Re-build the Project file the first time you use it, and then save the re-built Project. (Use this method if there are less than 10 data files referenced within the Project that have been moved or renamed.) Here's how: When you try to open the .apr file, ArcView will attempt to locate all of the data files referenced within the Project. When it gets to one it cannot find, a window will pop up asking you to provide the new location of the data file:



To re-build the Project, use the directory tree to locate the moved or renamed file and hit the OK button. Do this for each data file that was moved or renamed. After you have re-referenced all the data files and the Project opens, save it using the File...Save menu.

[4] Note that you can rename or move Project (.apr) files without worrying about having to rebuild them, since the references to data files within a Project file are absolute, not relative. The renamed or moved Project file will still refer to the correct locations for the data files as long as those data files were not also moved or renamed. When copying WATER's Project (.apr) files to your hard drive, you may have to rebuild them if your CD drive is anything other than the E: drive. This is because all of WATER's Projects assumed the CD drive is E:.

This will be the best method to use for re-building most of WATER's Project files. However, this can get really tedious if there are more than 10 data files that have to be re-referenced. For those Projects, I recommend Method #2.

Method #2: Use this method if there are more than 10 data files in the project that have been moved or renamed. For example, use this method to re-build any of the following Projects from the WATER CDs:

Disk #1:
Photos94.apr (in the WATER1\Photos94\ directory)
TIGER.apr (in the WATER1\TIGER\ directory)
Disk #2:
NPDES.apr (in the WATER2\NPDES\ directory)
Disk #4:
Region3.apr (in the WATER4\BASINS\apr\ directory)
MURP2.apr (in the WATER4\MURP\ directory)
MURPnew.apr (in the WATER4\MURP\ directory)

The method involves using a script within an ArcView Project file to change the file references within another ArcView Project file. It is basically a global 'Find and Replace' script applied to an ArcView Project. The script assumes you have already created the directory structure into which you are copying or moving the data files referenced in the Project file. This will be true if you have copied or moved the files already. If not, then you should create the new directory structure before continuing.

To use this method, start ArcView 3.0 and open the file **chgdir.apr** (located on **WATER Disk #1**, in the **Helpers\ESRI** directory). Follow the on-screen directions, paying particular attention to the fact that you must use the FORWARD SLASH ('/') rather than the BACKSLASH ('\') when referencing file locations and directory structures. The process involves identifying the Project file you wish to change, assigning a new name to the revised Project file, specifying the directory string to be replaced and the string to replace it with. ArcView reads through the entire Project file and replaces the first string with the second. When you open the new Project, it will reference the data files at the new location.

For example, lets say you wanted to move the Photos94 Project, its associated shapefiles and scanned aerial photos to your hard drive. You would:

1. Copy the entire Photos94 directory from WATER's Disk #1 to a directory on your C: drive (lets say we put it into a directory called C:\WATER).
2. Then you would start ArcView and open the chgdir.apr Project (right off the CD is fine -- **Disk #1**, in the **Helpers\ESRI** directory).
3. In the first dialog box, entitled 'Select File to Change', you would select the file called Photos94.apr to rebuild (you can use the one on Disk #1 (in the \WATER1\Photos94\ directory)).
4. In the next dialog box, save the file to your hard drive (in our example, to the C:\WATER directory) and use a new file name (e.g., Photos1.apr).

5. Where it says 'Enter string to replace:' type in the old directory structure for the Photos94 files, BUT USING FORWARD SLASHES RATHER THAN BACKSLASHES (i.e., 'E:/WATER1/Photos94') (don't enter the quote marks). Click OK.

6. Where it says 'Enter string to substitute:' type in the new directory structure where the data files are now located (in this example, 'C:/WATER/Photos94'). Click OK.

   You cursor will become an hourglass and you will see the word 'Searching...' and a '% completed' bar at the bottom of the ArcView window. When the process is complete, you will get a window telling you how many replacements were made. (That's how many manual re-references you avoided!)

7. Now open the new Project file and see if it worked. If there are still files for which you get the 'Where is...' window, then you can either manually locate them (method #1) or repeat this process (method #2) with any other file references still needing updating.

APPENDIX F:
Converting a Table With Latitude/Longitude Coordinates Into a WATER-Compatible ArcView Shapefile

The following discussion shows you how to use ArcView 3.0 to create a WATER-compatible point theme (in shapefile format) from a set of data with Latitude/Longitude coordinates. This would be the process to use if, for example, you had gotten GPS coordinates for a set of monitoring stations and you wanted to create a new data layer that would overlay directly onto any of WATER's existing data layers.

Before you can use this method, you will need to have your table in a format acceptable to ArcView. The most common form is either a **dBASE IV database file** (with the **.dbf** file extension), or a **tab-delimited ASCII text file** (with the **.txt** file extension). A tab-delimited text file is one in which the field names appear in the first row, separated by tabs, and each subsequent row represents one record of data (e.g., one monitoring station with a Latitude and a Longitude), with the fields also separated by tabs. Most word processing programs allow you to export or "Save As" a document in .txt format. Many database and spreadsheet programs also allow you to save tables as .txt or as dBASE IV files. Microsoft Access and Excel both allow you to save tables as .txt or .dbf files.

Within your data table you should have at least one field with Latitude and one field with Longitude, both in Decimal Degrees. (If you have Lat/Longs in Degrees Minutes and Seconds, see discussion below on how to convert to Decimal Degrees.)

A. Setup. (these steps are identical to those in Appendix C)

1. Copy the file 'prjctr.avx' (located on WATER Disk #1, in the Helpers\ESRI\AVextens directory) to the C:\ESRI\AV_GIS30\ARCVIEW\EXT32 directory on your hard drive
2. Copy the file 'datum.par' (located on WATER Disk #1, in the Helpers\ESRI\ directory)to the C:\ESRI\ directory on your hard drive. (Datum.par is a parameter table that is used by datum.apr during transformation of data layers from one datum reference to another.)
3. Start ArcView 3.0 and open the file datum.apr (located on WATER Disk #1, in the Helpers\ESRI\ directory). If a window pops up saying "Where is C:\ ... datum.avx?", ignore it by clicking on the Cancel button.

B. Importing the table with Latitude/Longitude coordinates.

4. Click on the Tables Icon, then the Add button
5. Locate the .dbf or .txt file that has your data and click OK. Your table will now appear in the ArcView project.

C. Creating a point theme.

6. Now click on the Views icon and hit the New button to create a new View.
7. Go to the View window and use the View... Add Event Theme... menu item to open the Add Event Them window.
8. In the Add Event Theme window, choose your data table from the droplist. For the X-field, select the Longitude field (or whatever you have named the field storing longitude

values in your table). For the Y-field, select the Latitude field (or whatever you have named the field storing latitude values in your table). Hit the OK button. You will be brought back to the View window, and your point theme will be waiting for you to activate.

9. Display the theme by clicking in the check box to the left of the theme name. See the points? If there appear to be only two points, then chances are you have some records where the Latitude and Longitude are listed as 0 -- one dot represents all the points for which Latitude and Longitude are listed as 0,0 and the other dot represents all of your other points stacked up on top of each other. To rectify this, go back to your .txt or .dbf file and make all 0s blank and start over.
10. Make the theme active by clicking on the theme name on the left side of the View window. You should see the area around the theme name appear raised.
11. Use the Theme... Convert to Shapefile.. menu item. Give your shapefile a name and save it wherever you can find it again in a minute. This will be a temporary file. When it asks you if you want to add the shapefile as theme to the view, click on 'Yes'. You will now see a second theme in your view. It sits right on top of your other view, so when both are on, you will only see the one furthest up on the list.
12. When you have assured yourself that the points are, in fact, in exactly the same location (trust me, they will be), then you can delete the original theme by clicking once on its name and choosing Edit... Delete Themes... and clicking Yes to the confirmation message.

D. Projecting the point theme.

13. Activate the new theme by clicking on its name.
14. Go to the View... Properties... menu item and in the View Properties window, for Map Units select "decimal degrees". Click OK to close the View Properties window.
15. Now click on the little blue planet button on the toolbar (it is located on the upper row of buttons, third from the far right, just to the left of the arrow with the question mark next to it). This runs you through the Datum transformation process.
16. When you push the blue planet button, a Convert Point Datum window pops up that asks you to choose the INPUT datum. Scroll down the list and select "NORTH AMERICAN 1927 - CONUS". (This is the datum most often used in our area when using Latitude & Longitude.) Click OK.
17. For the OUTPUT datum, select "NORTH AMERICAN 1983 - CONUS". (This is the datum used for the WATER project.) Click OK. You should see a % completed bar go across the bottom of your ArcView project window. (If not, then the process probably did not run properly because the Map Units were not set. If this is the case, then start over on a new View by reloading your temporary point shapefile into a new View and setting the Map Units to decimal degrees as described above, and continue.) If you saw a % completed bar trek across the bottom of your Project window, then you have successfully converted the datum.
18. Now, with the shapefile still active, click on the far right button on the upper toolbar, the one with the white arrow on a black circle with four dots around it. This will re-project your data points.

19. In the Projector! window, select "meters" as the output units and click OK.
20. In the Projection Properties window, make sure the "Standard" radio button is clicked at the upper left, and for Category, choose "UTM". For Type:, select Zone 10. Click OK.
21. When asked if you want to recalculate area, perimeter, and length fields (if present) using meters, you can select either Yes or No, it doesn't matter since there aren't any areas, perimeters, or lengths to calculate. You can click on No. To the question "Add projected shapefile(s) as theme(s) to a view?", click on Yes and select <New View> in the subsequent dialog box. Click OK
22. You will then be asked to save the re-projected shapefile with a new name. Give it a new name (this one won't be temporary) and put it in the directory of your choice. Click OK. You will get the message at the bottom of your Project window saying "exporting..." and the % completed bar will race across. A new view will open with your re-projected point theme.
23. View the new theme by clicking in the box to the left of the theme name.

THAT'S IT, YOU'RE DONE!

You can confirm that the re-projection worked by adding a theme from WATER's other data sets such as roads, counties, shoreline, or watersheds. Your point theme should line up with WATER's other data layers.

APPENDIX G:
Creating an Address Look-Up Theme in ArcView
Using Census TIGER Files

Census TIGER files are GIS street maps that have address ranges associated with each of the street segments. Thus, each city block represents a separate street segment, with a specific range of odd and even numbers on either side of the street (e.g., odd numbers between 301 and 399 on one side of the street and even numbers between 300 and 398 on the other side of the street).[5] ArcView 3.0 allows you to use TIGER files to build a data layer or 'theme' that can be used to look up street addresses. This is a very powerful capability

Follow these steps to add an address-matching layer to any ArcView 3.0 project:

1. Start ArcView and open the Project to which you wish to add address matching capabilities.

2. Open the View to which you wish to add address matching.

3. Add a TIGER Street shapefile as a theme to the View. The TIGER street files are located on WATER Disk #1 in the TIGER directory. Each county is in its own subdirectory. The street files all end in '...st.shp'. (Thus, for example, the TIGER street file for Monterey County is stored on Disk #1 as E:\WATER1\TIGER\Monterey\Montst.shp.)

4. Select and display the street theme.

5. From the **Theme** Menu, select **properties.**

6. In the left scroll area of the Properties Dialog Box, click on **Geocoding**. This changes the options available in the right side of the dialog box.

7. Select **US Streets** as the **Address Style.**

8. Click **OK**. This will allow you to build a geocoding index.

9. Click on the Button that looks like push-pin. This is the **Locate Address** icon.

10. Enter the address that you are looking for or select **Preferences** for more options.

11. A big dot should appear in your view if you match a valid address.

12. To clear the dot, click on the **Select Shape** tool (looks like an arrow), click on the dot, then press **delete.**

[5] TIGER files are not 100% complete. First of all, the files may not include new streets that were created in the past few years (WATER's TIGER files date back to 1994). Secondly, not all street segments have complete address numbers. The coverage and spatial accuracy of TIGER files tends to be better in urban areas than in rural areas because the street segments are shorter and the numbering in urban areas is more obvious.

APPENDIX H:
Merging and Clipping Themes
Using WATER's Utilitys.apr Project File

Example: Slopes within a Watershed

Some of WATER's data sets were too large to be delivered and used in one piece. Instead, such data sets were divided geographically into smaller chunks that could be assembled within an ArcView project for analysis covering larger areas such as watersheds. The topographic data (e.g., percent slopes) on WATER's CD-ROMs falls into this category. For example, the slope data for the region is divided into dozens of files, each of which represents one USGS 7.5 minute quad.

Because WATER was designed to facilitate watershed-based analysis, we thought it important to provide the user with the tools and directions needed to assemble the pieces of such data sets and "clip" them to a watershed boundary. That way, analyses (such as total acreages for various slope categories) can be performed on a single shapefile that represents the entire watershed, rather than working with dozens of individual files.

The process described here shows the user how to take the slope files as they are stored on the CD-ROMs, and combine them into one shapefile that is clipped to a watershed boundary. Parts of this process can be used with other data sets. For example, the steps in part E could be used to clip a land use layer to the watershed boundary. ArcView could then be used to calculate acreages for the different land uses within the watershed. Such land use acreages are used in polluted runoff models to predict pollutant loadings from the watershed.

Here's how to merge and clip WATER's percent slope data:

A. Copy PKZip for Windows to your hard drive.

Due to their large size, the slope shapefiles for WATER have been compressed using PKZip. If you do not already have a copy of PKZip on your computer, you will need to set up a copy from the WATER CD-ROMs. To do this, simply copy the entire directory called **WATER1\Helpers\Winzip** from **WATER Disk #1** to your C:\ drive.

B. Identify the USGS 7.5 minute (1:24,000 scale) quads you want to merge.

If you don't already know which quads you want to merge, the easiest way to identify the right ones is to use the watershed and quad boundary shapefiles found on any of the 4 WATER CDs.

Open ArcView, create a new View and add the theme called **'Waterqds.shp'** from the **Quads** directory on any of the WATER CDs. Overlay this with a watershed file from the **Wtrsheds** directory on any of the WATER CDs (e.g., **WATER2\wtrsheds\calwater\hydunits.shp**). You can now use the identify tool to see which quads you need to merge to cover your watershed.

Alternately, you can use the following process:

1. Make the watershed layer active by clicking on its name in the legend.
2. Select the watershed of interest using the Select Feature tool.

3. Now make the wtrquads theme active.
4. Use the Theme... Select by Theme menu item to select the quads that Intersect with the selected features of the watershed layer. The quads you need to merge will be the ones highlighted in the View.
5. To get a list of the quad names, open the attribute table using the Theme... Table menu item. Click on the Promote button to bring all the highlighted records to the top. The quad names appear in the last field of the attribute table called Task_Name. Make a note of the quad names.

C. Unzip the appropriate slope shapefiles from WATER Disk #2

Once you have identified the quads you want to merge, find and 'unzip' (uncompress) the appropriate slope shapefiles on **WATER Disk #2** in the **WATER2\Slopes** directory. The shapefiles are in PKZip compressed format, labeled **XXXXXXsp.zip**, where **XXXXXX** is an abbreviated version of the quad name, **sp** identifies it as a slope file, and **.zip** is the PKZip file extension indicating that it is a compressed file. In the case of Elkhorn Slough, for example, the files would be:

Prunedsp.zip (for Prunedale quad)
Mossldsp.zip (for Moss Landing quad)
Watsvisp.zip (for Watsonville quad)
Watsvwsp.zip (for Watsonville West quad)

(Note that because USGS 24k DEM files were not available for all quads in the WATER area, you may only get partial coverage of your watershed.)

You will need to unzip the compressed files onto your hard disk before ArcView will recognize them as themes.

To unzip the files:

1. Start PKZip for Windows by double-clicking on the file named **PKZipw.exe** in the Winzip directory you copied in Step A above.
2. Use File... Open menu.
3. Find the first zipped slope file you are looking for on **WATER Disk #2** in the **WATER2\Slopes** directory. Click the OK button. This will bring up a window showing you the three files for that shapefile.
4. Now use the Unzip... Extract Files menu item to open the Extract window.
5. Specify that **All files** are to be extracted to Disk into the C:\temp directory. Click the 'Extract' button. When the progress bar shows 100%, and you see the word "Done" in the Extract window, you have successfully uncompressed the file.
6. Now repeat steps 2-5 for the remaining quads.
7. When you have extracted all the files you need, exit PKZip for Windows.

D. Use the Utilitys.apr project to merge and clip the slope files.

1. Open the '**Utilitys.apr**' project from **WATER1\Helpers\ESRI** directory on **WATER Disk #1**.
2. Create a new View and add the slope themes you just extracted.
3. Add the watershed theme you used to identify the quads in step B above (for example, **WATER2\watershds\calwater\hydunits.shp**) and make it visible by checking the box in its legend.
4. If you want, make the slope themes visible to make sure they are the ones you want.
5. Use the Edit... Merge Themes... menu item.
6. When the Merge Themes window comes up, select the first slope shapefile from the droplist and click the 'OK' button.
7. Repeat step 6 for each of the other slope shapefiles you want to merge, clicking the 'OK' button after each selection.
8. After you select the last shapefile and click the 'OK' button, click the 'Cancel' button to end the selection process.
9. In the Output Merged Shapefile window, provide a name and a location to place the merged shapefile and click the 'OK' button. You will see the %-completed bar cycle through each shapefile it is merging.
10. When it is done merging the files, you will get a window asking whether you want to add the new shapefile to a View. Click on 'Yes', and, in the next window, specify the View you were just working in.
11. Make the new shapefile visible. You will see how the original slope shapefiles have now been merged into a single shapefile. Note that this procedure does not merge polygons across the boundaries of the original polygons -- it merely places them into a single shapefile.

E. Clip the merged shapefile to the watershed boundary.

1. Within the same View as you were using in step D, make the watershed theme (e.g., **hydunits.shp**) active. Use the Select Feature tool to select the watershed to which you want to clip the merged slopemap.
2. Use the Edit... Clip Theme menu item.
3. In the Clip Theme window, where it says "Which theme is the intersect theme?" choose the theme to be clipped (i.e., the merged slope theme) and click the 'OK' button.
4. In the next Clip Theme window, where it says "Which polygon theme is the clipping theme?" choose the watershed theme (i.e., **hydunits.shp**) and click the 'OK' button.
5. In the next window, specify a file name and location for the clipped theme, and click the 'OK' button.
6. The cursor will turn into an hourglass and a message will appear at the bottom of the ArcView window saying "Splitting Shapes...", with a %-completed bar.

7. When it is finished clipping the theme, you will see a window asking whether you want to add the new theme to a View. Click on 'Yes' and then select the View you were just working with.
8. Make the new theme visible. You should see the slope polygons clipped to the watershed boundary.
9. You can now display the slope categories using one of WATER's pre-designed legends if you want. To do so:
    a. Double-click the legend title for the new theme.
    b. When the Legend Editor window comes up, click on the 'Load...' button.
    c. In the next window, find the WATER2\Slopes directory on WATER Disk #2, select the file called slopes.avl and click the 'OK' button.
    d. When the Load Legend window appears, the Field should be Slope, and the All box should be checked. Click the 'OK' button.
    e. Then in the Legend Editor window, click the 'Apply' button. Close the Legend Editor.
    f. You now should see the merged slope layer with appropriate classes showing in different colors, clipped to the watershed boundary.