West Virginia Water-Science Center Ground-Water Data Management Plan

INTRODUCTION

After ground-water data are collected, they often are processed using one or more procedures, such as the application of time or datum corrections or by applying water-quality or water-level review procedures, and then are stored in computerized or physical files. Descriptive information on data-collection sites, such as well construction data and location, also should be stored. The West Virginia Water Science Center Ground-Water Data Management Plan describes Center databases and data handling policy and procedures.

This document provides guidelines for the collection, processing, storage, and retrieval of ground-water data including water level data, water-quality analyses, water-use data, aquifer test data, and geophysical logs.

DATA MANAGEMENT POLICY

In general, data are most accessible and useful to the project chief and other Center employees, as well as to those outside the Center office, if they are stored in a computerized database. Storage in a single database also enables interpretations to be more easily verified and repeated. All water data collected as part of the routine data collection of the WRD, which are all ground-water data collected by basic data programs and Center projects (OGW Technical Memorandum 93.03), must be stored in computer files of the USGS National Water Information System (NWIS). In addition, “all data collected by others—such as cooperators, universities, or consultants—that are used to support published USGS documents and not published or archived elsewhere, shall be

placed in NWIS" (Hubbard, 1992). Exceptions to these requirements are spatial data coverages and other data for which appropriate database capabilities do not exist in NWIS.

All original data in paper form shall be placed in West Virginia Water Science Center file cabinets (presently located in the office of the Center Ground-Water Specialist). Original data are those data—from automated data-collection sites, laboratories, outside sources, and non-automated field observations—unmodified as collected or received, once put into conventional units (engineering units, generally with a decimal) (Hubbard, 1992). Original data in electronic form shall be stored in NWIS. All original data shall be preserved unmodified as collected or received. At the end of projects all project documents are to be archived, especially those which can not be easily archived in NWIS. Original GWSI coding sheets, results of approved aquifer tests, and borehole logs shall be stored in the district GWSI, borehole log, and aquifer test archives. Paper data are stored in the appropriate filing cabinets and electronic data are stored in the GWarchives folder on Igsancewfs003/users. Separate directories are present for the aquifer test (AQTESTARCHIVE), borehole log (LOGARCHIVE), ground-water model (GWMARCHIVE) archives and for the ground-water QA plan, data management plan, and technical procedure documents repository (QAPlanTechMemos).

Various Center personnel have been assigned the responsibility of managing Center databases. It is the responsibility of the project chiefs to coordinate their programs to the standards set forth by each database manager. The database managers and the Center ground-water and Water-Quality Specialists are responsible for providing comprehensive data management schemes and coordinating activities for ground-water projects. The

documentation of all new data management techniques is the responsibility of the database manager. This is to be accomplished through Open-file reports or memorandums distributed to all project chiefs in the Center.

The Center maintains and updates several national computer-data bases. National databases include the Ground-Water Site Inventory system (GWSI), the water-quality database (QWDATA), the Automated Data Processing system (ADAPS), and the Water Use Data System (AWUDS, and SWUDS), all parts of the National Water Information System (NWIS). Computer files of data and information are backed up and archived as part of standard Center computer operations.

WELL-NUMBERING SYSTEM

Along with the 15-digit station number used in GWSI, wells in West Virginia are also identified by the West Virginia Water-Science Center well number (also referred to as the UID). The UID is a unique number assigned to all wells in the West Virginia Water-Science Center GWSI database. The first four digits of the number specify the county (three letters followed by a hyphen) the well is located in (eg. Jef- for Jefferson County). The last four digits are a sequence number indicating the order the well was added to the database (eg. Jef-0147). The UID is stored in GWSI in the Station Name field (C012). For example, the UID for the twenty-ninth well added to the database in Berkeley County (county code Ber-) would be Ber-0029 in the database. This standard format shall be used as an identifier in ground-water reports published within the Center. A list of the county identifiers is attached to the end of this plan as appendix A.

GROUND-WATER DATA

Ground-water sites

GWSI

The Ground-Water Site Inventory (GWSI) file is part of the National Water Information System (NWIS) and was established to meet the need for storage of nationally standardized ground-water data, and to provide nationwide computer access to the stored data. The file contains inventory data about wells, springs, and other sources of ground water. Pertinent information includes: site identification and location, hydrogeologic characteristics, and well construction data. All wells that are part of the potentiometric or water-quality networks, or that are used for hydrologic investigations shall be entered into the GWSI database.

The GWSI paper file (maintained by the Center Ground-Water Specialist) contains documentation related to all sites in GWSI. The data and information for each well is filed individually according to UID in ascending order. Information in the central file should include the original GWSI coding form and for historical sites, a map of the well location. With the advent of DEMs and GIS, the West Virginia Water Science Center no longer requires a site map be archived for each site but relies on accurate location information collected to within a half second latitude and longitude using a GPS. The file may also include any other relevant data. Any updates to the site in GWSI should be accompanied by paper documentation in the paper GWSI file.

New sites

Steps to assure the quality of data entered into GWSI for new sites is described in the GWSI Processing Plan. The plan is designed to meet three main goals: (1) ensure that the information on available documentation gets entered correctly into GWSI, (2) check that the information meets official standards of accuracy and documentation, and (3) to ensure that the data are promptly entered into GWSI.

The steps in GWSI processing are:

- Well schedule preparation (project chief or his designee)
- Review
- Aquifer code verification
- Assignment of unique county id (UID)
- Keying and system checks
- Proofreading
- Site entry
- Spot check by Ground-Water Specialist
- Complete paperwork

The implementation of the GWSI processing plan is primarily carried out by the GWSI Database Manager or in his absence by the Center Ground-Water Specialist.

The "Well Schedule preparation" step is included to document the steps that projects submitting sites for GWSI entry should follow. Locations of wells should be determined in accordance with West Virginia Ground-water Technical Procedure Document 5 (GWPD 5). The USGS National Map internet website can be used to determine topographic setting and altitude if such data was not determined in the field. Geologic unit codes are assigned based on the 1968 West Virginia Geological Survey Geologic Map or appropriate updated maps and GIS layers provided by the WVGES or the USGS Geologic Discipline.

The purpose of the "Review" step is to verify that the site is not already in GWSI (or in process), to check the latitude and longitude against other information on the well record, to proofread the schedule against the available paperwork, and to search available databases for other information on the well. Maps are also prepared in this step to facilitate aquifer checking. Certain coded data are checked for consistency with Center policy (eg. use of site, use of water, types of logs, geologic unit codes, and station names and/or county unique identifiers).

"Aquifer code verification" is done at this point in the process for three reasons; (1) to avoid determining aquifer codes for wells that are already in the database, (2) the location of the well has been verified and a map can be prepared to facilitate checking, and (3) the well depth and other critical information on the well schedule has been proofed against the available documentation.

In the "Keying and system checks" step, NWIS system checks are utilized to check the logic of the information on the schedule. Automatic checking is utilized initially to avoid more costly detailed manual checking of this data.

The data that has been keyed for entry are checked against the coded schedule in the "Proofreading" step.

The "Site entry" step completes entry of the sites into GWSI, including any changes made during final review. Hard copies of the data entered are included in the GWSI paper files and simple reports for all sites added to GWSI in a batch are created and distributed to certain Center personnel.

All batches are submitted to the Ground-Water Specialist after they have been entered into the database for a "Spot Check". This check ensures that GWSI processing done by different members of the staff is done consistently. Approximately 5-10 percent of the sites will be checked against the original well schedule.

All GWSI data entry is to be conducted by the GWSI database Administrator or in special circumstances by his designee in consultation with the Center Ground-Water Specialist.

During all phases of the review, the GWSI staff will interact with the project chief that submitted the schedules to resolve any problems (for SWUDS sites this will be the Water-use Specialist). The Ground-Water Specialist will make final decisions on what gets entered based on the needs of the project and database considerations. The project chief will then sign off on the completed schedule once the final review has been completed to their satisfaction.

Site updates

Updates to GWSI are submitted by project personnel to the GWSI database manager. Any changes are checked according to the policies implemented for adding new sites to the database, as appropriate. All updates should be accompanied by signed paper documentation to be added to the GWSI paper files. The project chief will review any changes to the updates made by the GWSI database manager. All Center staff are required to assess whether an existing site is already in the database prior to establishing a new site. The GWSI database administrator will assure that the site is not duplicated within the database

Water-level data

Databases

GWSI

All non-continuous water-level data collected from projects and the water-level monitoring network wells must be entered into the GWSI database. It is preferable to enter water levels as depth to water below land surface; however, water levels may be entered directly as altitude of water level with approval of the Center Ground-Water Specialist.

Originals of the water-level measurement forms for project wells will be put in the GWSI paper files as the water levels are entered into GWSI. Project chiefs must review the data and computations and fill out the form at the bottom of the Synoptic water-level form or must enter the data on a multiple water-level form.

Intermittent water-level values collected as part of the water-level monitoring network will be entered into GWSI. Original data are archived in the ground-water network file currently housed in the surface-water records room. After the end of each water-year, all intermittent water-level data for the previous year are copied from the field forms and entered into GWSI by the GWSI database administrator. Tabling of the data for the annual report is done from the GWSI database using the SIMS software.

ADAPS

Continuous water-level data collected for the water-level networks and by ground-water projects must be stored in ADAPS. Necessary data corrections are checked by field

personnel upon return to office and entered into the ADAPS database. Before the data are marked “final”, all data collected by ground-water projects must be reviewed by the project chief and approved by the Center Ground-Water Specialist.

Data Processing

Water-level networks

All water-level data collected for the Water-Level Networks are entered into the GWSI and/or ADAPS databases and are published in the Center’s Annual report. Water-level measurements are taken during each field visit with either a steel tape or electric tape and entered on field forms and on a data download sheet at each well. These original field forms are filed, along with station descriptions, station analyses, primary computations, data correction worksheets, tally sheets, daily values tables, etc., are stored in the well network filing cabinet cabinet in the surface-water records room. For continuous recording sites, paper copies of primaries for the previous two water years are held in the file cabinet. Paper copies of data older than 2 years are archived in our historical water-level records file cabinet in the Dunbar Street warehouse. Within the file cabinet, wells are arranged alphabetically by county and then by local Identifier.

Continuous water-level data are reviewed by filed technicians after each field trip and at the end of each water year. As all well data is transmitted by satellite telemetry, the Center Ground-Water Specialist or others periodically review (on a daily basis) the incoming satellite data to check for errors or instrument problems. Wells are visited at regular intervals (usually 2 months) unless instrument problems are noticed as part of the daily review process. The recorders are serviced using the guidelines in the appropriate

technical procedure documents. Data are processed as soon as possible after each field trip so as to keep any problem data sets fresh in the field person's mind. The data are retrieved in two basic forms, electronic data logger (EDL) files and direct download via satellite telemetry. EDL files are downloaded and stored only for backup purposes; the satellite data is the primary record for the sites.

Data are reviewed after each field trip to ensure the accuracy of the database. Water-level measurements made in the field at the time of servicing the recorder are compared with the recorder setting. Datum corrections are applied based on the difference between steel tape or electric tape water-level measurements and recorder settings. Daily values "primaries" are examined and updated if necessary after each field visit.

A final review of the data takes place at the end of each water-year. The data are initially reviewed by project Hydrologic Technicians. The GWSI usually conducts a second review of the data prior to final preparation of manuscripts being prepared in SIMS. The Center Ground Water Specialist conducts a general review of the draft of each year's data and manuscripts prior to final approval for the SIMS generated annual report. The following tasks summarize the procedures used in the review at the end of the water-year:

- Unit- and daily-values hydrographs are plotted and examined.
- Primaries of daily and unit values are checked against field measurements and datum corrections are applied if needed.

- A station analysis is updated each year for each well.

- Station tally sheets, a running average of monthly water levels and historical/annual maximum and minimum values is updated for each well

Project Data

Data from submersible logger pressure transducers are only used for temporary installations only and are downloaded from instruments in the field to a laptop computer and then transferred to a desktop PC. Data are reformatted using DECODES, then put into ADAPS using the Input Standard Data Format option. These files are then processed in GWSI using the standard GWSI options 2, 3, and 4.

Project chiefs must review the data and computations and fill out the GWSI site coding form for new sites added to be added to the NWIS database. Coding form 9-1904A is used for documenting data for new surface-water or ground-water sites, form 9-1904B is used for documenting data for new springs, and form 9-1904D1 is used for documenting hydraulic data for new wells For synoptic water-levels, the data shall be entered onto the Center derived synoptic water-level form or form 9-1904E (multiple water-level form). It is preferable to enter the data into GWSI soon after the well is inventoried and/or water-levels are measured. The entry portion of the water-level form clearly identifies the measurement to be entered into GWSI. Checking the accuracy of the calculations is the responsibility of the project chief. Copies of the water-levels forms should be made and kept with the project data and the original forms will be submitted to the GWSI Database Administrator for data entry.

Aquifer and Slug tests

Aquifer tests conducted as part of projects are initially computed by the Project Chief and reviewed by the Center Ground-Water Specialist. The Center Ground-Water Specialist then prepares a submission package and sends it to the Regional Ground-Water Specialist for approval. Results of aquifer tests are not to published until approved by the Regional Ground-Water Specialist. The submission package and approval memo are then archived in the Center Aquifer Test Archive (submission requirements for aquifer and slug tests are describe in OGW Memo 94.02 and OGW Memo 09.01). Pertinent electronic data from pressure transducers, output from analytical modeling software, Excel spreadsheets, etc. are archived in the Centers aquifer test archive (GWarchives/AQTESTARCHIVE folder on Igsancewfs003/users). The aquifer-test file contains data and analyses for aquifer and slug tests.

The information required for the aquifer test archive and submission to the regional Ground-Water Specialist for review is:

Required Information
- UID of tested well
- Depth interval tested
- Aquifer tested
- Method of analysis
- Result (in standard units)

Supplemental Information
- Reference (where was the data published)
- Who did the test?
- When was the test done?
- Length of test

All paper copies of aquifer tests and slug tests, including historical archives, are stored in the aquifer test archive file cabinet located in the Ground-Water Specialists' office.

Borehole Geophysical Logs

Borehole logging data is handled in a similar fashion except that regional approval of the data is not required. Therefore, the data is processed by project staff, checked by the Project Chief, and approved for publication by the Center Ground-Water Specialist. Borehole log data is archived in the Centers borehole log archive (GWarchives/ LOGARCHIVE folder on Igsancewfs003/users). Older non-digital paper copies of geophysical logs collected by the USGS are stored in the geophysical log file cabinet housed in the Center Ground-Water Specialist's office.

Whenever possible, borehole log data shall be converted to ASCII format and stored in LOGARCHIVE. Data such as acoustic televeiewer, optical televiewer, and EM or heat pulse flow meter logs, that do not easily convert to ASCII format shall be stored in JPEG, PDF format or some other format that does not require the use of proprietary software. Guidelines specified in OGW memo 00.03 shall be used as a guide for proper archival of borehole log data. As new geophysical logs are acquired, updates will be made to the GWSI database indicating the logs are available.

Ground-Water Models

Ground-water models currently are only prepared by one individual within the West Virginia Water Science Center, the Center Ground-Water Specialist. All ground-water models including supporting data are archived in the Center ground-water model archive (GWarchives/GW_MODEL_ARCHIVE folder on Igsancewfs003/users). Ground-water models shall be archived according to guidelines specified in OGW memos Modeling reports and the proof of documentation of models in the Center model

archive are submitted to the Regional Ground-Water Specialist for regional approval prior to being submitted for final Director's approval.

Water-quality data

QWDATA

All water-quality data collected as part of Center water-quality collection programs are stored in the QWDATA portion of NWIS. All sites with QW data must be entered into GWSI. The "logging in" of samples and entry of field data are the responsibility of each project chief. USGS environmental water-quality data is stored in database 01 (DB01). Quality assurance data is stored in database 98 (DB98).

Data Processing

New data from the NWQL is processed to the main database (DB01) on Tuesday of each week by a cronjob; quality assurance data is automatically routed to the QA Database (DB98). Scripts are used to sort and break WATLIST and BADQW files according to their project accounting number and copies are reviewed by the Center Water-Quality Specialist then routed to appropriate project chiefs for their review. As causes for BADQW are corrected, the modified BADQW files are processed by the QWDATA database manager.

Project data

Quality assurance reviews and updates to the QWDATA are the responsibility of each project chief as is the short term storage of Analytical Service Reports (ASR), USGS standard field forms, and other sample related documents. After the life of project those documents are archived. Documents relating to sites are permanently maintained and available for reference by the GWSI Database Administrator. All data collected as part of the basic data program and some project data are published in the SIMS Annual Data Report, and the remaining project data are published in project specific reports. More information on the processing of water-quality data can be found in the Center Water-Quality Quality Assurance Plan.

Projects are responsible to maintain the QW paperwork for their sites, check data from the lab, request reruns, and verify the data. All data should be stored in the Center NWIS databases before publication. QW field sheets and analytical services request forms are stored in the water-quality filing cabinet in the Center Water-Quality Specialist's office.

Water-use data

Databases

The West Virginia Water-Science Center at times maintained two water-use databases: Site-Specific Water-Use Data System (SSWUDS) and Aggregated Water-Use Data System (AWUDS). Through 1995, SSWUDS was populated with site-specific withdrawal data. SSWUDS is no longer used within the West Virginia Water Science

Center (WSC) for compiling for the national report, "Estimated Use of Water in the United States." Results for West Virginia are stored in the AWUDS (locally in \\Igsancewfs001\Array_U\awuds). West Virginia WSC only uses AWUDS to present final results to the national compilation.

Water-use data was obtained from many sources (see Atkins, J.T., Jr., 2007, Water-use estimates for West Virginia, 2004: U.S. Geological Survey Open-File Report 2007-1038, 27p. http://pubs.usgs.gov/of/2007/1038 --In cooperation with West Virginia Department of Environmental Protection, Division of Water and Waste Management). Other than noted below, all significant sources are included in the archive. Data in Excel spreadsheets and ASCII files, processing instructions in AWK scripts, fortran programs, unix shell programs, SAS programs, etc. used to prepare data for entry into AWUDS are in an archive created locally at \\Igsancewfs001\Array_U\2005_WU_archive Although there are thousands of files in the archive, there were no manipulations or data entry without an audit trail in the archive.

The archive deliberately does not include original individual responses to the West Virginia DEP water-use questionnaire, as required by WVDEP:

> In 2004, the West Virginia Legislature passed Senate Bill 163, the Water Resources Protection Act, which tasked the West Virginia Department of Environmental Protection (WVDEP) to gather information regarding the quantity and use of surface water and ground water in the state. The WVDEP collected information from questionnaires completed by private and public water users and cooperated with the USGS to conduct this water-use study. This information, which remains the property of WVDEP, was used to improve the water-use estimates in this study.

The confidential questionnaire responses are not in the archive and are not on a network drive; and eventually, confidential questionnaire responses will not exist anywhere at West Virginia WSC.

Data Processing

Data on water users, withdrawal sites, and monthly withdrawal values are obtained on a five-year cycle from the West Virginia DEP, West Virginia Bureau for Public Health, West Virginia Public Service Commission and other sources. Related water-use data are also collected from the U.S. Bureau of the Census, U.S. Environmental Protection Safe-Drinking Water Inventory System (SDWIS), Department of Agriculture, U.S. Department of Agriculture, American Water Works Association, and other agencies.

Once all data needed for publication of the 5-year water-use compilation is obtained, the data is processed and entered into AWUDS. Quality assurance (QA) calculations and comparisons are part of the archive. There is also a final QA step in AWUDS.

Appendix A

The following county code identifiers are approved for use in assigning new ground-water sites (includes wells, springs, caves, mine addits, mine shafts, and other miscellaneous ground-water sites) to the GWSI database.

FIPS Code	County Name	C012 ID	FIPS Code	County Name	C012 ID
001	Barbour	Bar	003	Berkeley	Ber
005	Boone	Boo	007	Braxton	Brx
009	Brooke	Brk	011	Cabell	Cab
013	Calhoun	Cal	015	Clay	Cla
017	Doddridge	Dod	019	Fayette	Fay
021	Gilmer	Gil	023	Grant	Grt
025	Greenbrier	Grb	027	Hampshire	Hmp
029	Hancock	Hnc	031	Hardy	Hrd
033	Harrison	Har	035	Jackson	Jac
037	Jefferson	Jef	039	Kanawha	Kan
041	Lewis	Lew	043	Lincoln	Lin
045	Logan	Log	047	McDowell	Mcd
049	Marion	Mar	051	Marshall	Mal
053	Mason	Mas	055	Mercer	Mer
057	Mineral	Mil	059	Mingo	Mig
061	Monongalia	Mng	063	Monroe	Mnr
065	Morgan	Mrg	067	Nicholas	Nic
069	Ohio	Ohi	071	Pendleton	Pen
073	Pleasants	Ple	075	Pocahontas	Poc
077	Preston	Pre	079	Putnam	Put
081	Raleigh	Ral	083	Randolph	Ran
085	Ritchie	Rit	087	Roane	Roa
089	Summers	Sum	091	Taylor	Tay
093	Tucker	Tuc	095	Tyler	Tyl
097	Upshur	Ups	099	Wayne	Way
101	Webster	Web	103	Wetzel	Wet
105	Wirt	Wir	107	Wood	Woo
109	Wyoming	Wyo			