

8 GROUND-WATER RETRIEVAL/TABLING PROGRAM

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The Ground-Water Retrieval and Tabling program is a general-purpose retrieval and tabling program that accesses the Sitefile and all of the associated GWSI files.

8.1 Introduction

The Ground-Water Retrieval and Tabling program can be used to generate two types of general data tables, four types of water-level tables, or files suitable for input into other programs. This retrieval and tabling program allows the user to retrieve information from the USGS Sitefile and the associated Ground-Water Site-Inventory (GWSI). The first few times this program is used, ask for the detailed explanation (**V**erbose) to lead you through it. Later, you can select the minimum explanation (**T**erse) option to speed processing. When using this program with minimum explanations, further information can usually be obtained about program queries by entering a question mark (?) in response to a prompt.

The program requires the use of a number of temporary files. These are created in the current directory and are deleted when they are no longer needed. You must have sufficient space in the current directory to accommodate these files. If the program is interrupted, these files may remain, although they are usually deleted unless a severe problem has occurred.

8.2 Operation of retrieval software

From the main GWSI menu, select option 6 – Retrieval/Tables

8.2.1 Set-up Parameters

After you select the Retrieval/Tables option, the first query will ask you to identify your set-up parameters:

Enter set-up parameters (T/V,I/C/R,<CR>=TI):

Your answer to this query should be two letters to set how you want the retrieval program to operate. The default answer is TI. The first code will direct how the program presents queries throughout the operation of the retrieval program:

(T) Terse. Minimum explanation is provided. (default)

(V) Verbose. Detailed explanation is provided.

Specify **T** or **V** for the level of detail you require.

The second code will identify the type of input you will provide to the retrieval program:

- (I) Interactive.** You are prompted to provide all necessary data. (default)
- (C) Control file.** Required information is read from a control file created in a previous run of this program. You may override any option obtained from the control file. The control file (default name gw.ctrl) contains all of the program specifications and may be used to run a subsequent retrieval.
- (R) Resume after phantom/batch.** No file processing is required, but use this program to display/print output from the previously processed phantom/batch job.

For example, if you wish a detailed explanation and are processing interactively, enter **VI** or just **V**.

8.2.2 Root Path Name

After entering the setup parameters, you are prompted to enter a root path name:

Enter root path name (<CR>=gw):

The root path name is used to build default path names for the various files used and created during the retrieval. The default root name is **gw**, but you may enter a different root name. The program generates default path names by adding a suffix to the root name you specify. Whenever a new file is required in the program, you are prompted and given the choice of using the default path name or giving the file a different path name. For example, if completing a retrieval for the “Stillwater Project,” you might specify a root name of “Stillwater.” Pathnames beginning with Stillwater (e.g., Stillwater.ctrl, Stillwater.table) would be generated by the program if the default names are accepted.

8.2.3 Gross Selection of Sites

The next query you will need to answer is to select a method to identify a gross selection of sites:

Which field do you wish to use for gross selection of sites (1-11,<CR>=1)? ?

You must choose one of the following site file fields to be used for gross selection of sites --

- (1) Agency with site ID (C4&C1)
- (2) Country-State-County (C41&C7&C8)
- (3) Primary Aquifer (C714)
- (4) Hydrologic Unit (C20)
- (5) Water Use (C24)
- (6) Project Number (C5)
- (7) Drainage Basin (C801)
- (8) Use of Site (C23)
- (9) Station Name (C12)
- (10) Latitude range (C9)
- (11) Longitude range (C10)

You will later be given an opportunity to further qualify your selection by specifying a latitude-longitude boundary and/or by specifying tests to be performed on any GWSI fields.

1. Agency with site ID ([Sections 1.1 and 1.2](#)): You can enter up to 1,000 values or ranges. There are four options available for this selection:
 - S - Specify sites, one-by-one (may use partial site ID)
 - R - Specify range of site IDs (or partial IDs)
 - G - Specify range of site IDs based on "latitude" (columns 1-6) and "longitude" (columns 7-13) portions of the site ID
 - A - Specify that all sites are to be retrieved.As an option, you may select this field and provide an external file (default name gw.sites) that contains the agency code (columns 1-5) and the site ID (columns 6-20) of the sites to be retrieved. The entire agency-site ID must be included. If including only a partial site ID, append an asterisk (*) to the partial ID. This list may be generated from the program by asking for creation of a list of selected sites when the [processing parameters \(section 8.2.7\)](#) are specified.
2. Country-state-county code ([Sections 1.11, 1.12, 1.13](#)): You can enter up to 1,000 values.
3. Primary aquifer code ([Section 1.50](#)): You can enter up to 1,000 values. This is component C714 in the Sitefile and not component C93 in the geohydrologic file.
4. Hydrologic unit code number ([Section 1.27](#)): You can enter up to 1,000 values.
5. Water-use code ([Section 1.46](#)): You can enter up to 1,000 values.
6. Project number ([Section 1.7](#)): You can enter up to 1,000 values.
7. Drainage basin number ([Section 1.28](#)): You can enter up to 1,000 values.
8. Use-of-site code ([Section 1.43](#)): You can enter up to 1,000 values.
9. Station name (local well number) ([Section 1.8](#)): You can enter up to 1,000 values or partial values. As an option, select this field to provide an external file that contains the names (or partial names) of the sites to be retrieved (columns 1-24).
10. Latitude ([Section 1.14](#)): You can enter up to 1,000 ranges.
11. Longitude ([Section 1.15](#)): You can enter up to 1,000 ranges.

You will be given an opportunity later to further qualify or limit the number of sites that will be selected by the gross selection. Consistent data input and judicious use of the gross selection criteria can significantly reduce retrieval time. For example, if all sites have a properly coded project number and only sites for projects PROJ001 and PROJ008 are of interest, the size of the database is immediately reduced to include data for those two projects only.

Depending on your choice, the subsequent prompts will vary. Follow the prompts to complete your choice for the gross selection of sites.

8.2.4 Limitation for Site Selection

After completing the gross selection of site criteria, you will be required to answer a query about limiting your site selection:

Current limitations to site selection –

- (1) Polygon: Sites are not restricted by latitude-longitude polygon
- (2) Detail tests: Sites are not restricted by detail testing
- (3) Site types to be included: (SP) Spring
(GW) Ground water other than spring
- (4) Maximum number of sites to retrieve by gross select (0=no limit): 0
- (5) Max no sites to pass polygon, detail & type tests (0=no limit): 0
- (6) Maximum number of records to output for tabling (0=no limit): 0

Enter item number to change, R to re-list items or <CR> to continue:

1. Latitude-longitude polygon boundary of a geographic area.

The sites that pass the gross-selection criteria can be tested to see if they fall within a latitude-longitude polygon. The polygon is defined by up to 1000 latitude-longitude points. The points may begin on any vertex, but must be entered in a counter-clockwise order. The points may be entered from the terminal or from an existing file. The polygon file (default name gw.poly) defines the vertices of the latitude-longitude polygon. This may be an existing file or it may be created by the program. In addition, the program has the capability to generate a polygon approximating a circle of a given radius (miles) about a point. The points may be saved in a file for future use.

Note: Currently, the Polygon Retrieval function will not process latitude/longitude vertices entered with decimal seconds properly (e.g. 107 31 29.34), as might be generated by GIS. The software truncates the decimal part of seconds. When this occurs, duplicate latitude/longitude vertices may be created, which is not permitted, and may cause the Polygon Retrieval to fail.

After entering the polygon vertices, you are prompted whether or not any changes are needed to the selected polygon. The options are to **M** modify, **A** add, or **D** delete any one entry. A list of the vertices appears on the screen, and any vertex may be selected for the change. Only one vertex at a time may be changed. When the change has been made, the program prompts for the next change to the polygon. If no further changes are needed, enter an **N**; the program then continues to the next step.

2. Detail testing of values of most Site file or GWSI-related file fields.

Do you wish to specify any detail testing (Y/N,<CR>=Y)?

Enter test field/test string:

Enter operator:

Enter test value:

Enter connector to next test (Or/And/While) or <CR> if none:

Up to 20 detailed tests to further restrict selection of sites may be specified. These tests are performed after a site has passed the gross selection criteria and has passed the polygon criteria. A record included in the gross site selection and polygon tests failing the detailed tests will not be included in the output. Any field in the sitefile or any of the associated GWSI files may be selected for detail testing. Components used for detail testing need not be included in the output. A test consists of a component number, an operator, and a value. Available operators are:

EQ Equals	NE Not Equal
GT Greater than	LT Less than
GE Greater than or Equal to	LE Less than or Equal to
IN In range of	EX Outside range - for character strings only--
CN Contains	NC Does not contain

Test values are numbers, character strings, or components. Tests of character strings will search the entire length of the character string (maximum 20 characters). If trailing spaces are required, enclose the test value in single quotes ('). To use a component as a test value, enclose the component number in parentheses. For example, to test for water levels greater than well depth, use C237 GT (C28). To test data fields, enter the test value (date) in the form: yyyyymmdd. To test for missing fields, use -- for the test value. The only operators applicable to missing fields are **EQ** or **NE**.

An example of searching a character string field (C185) is shown below:

C185 CN LOG

This example would retrieve all records that contain the word 'log' in the miscellaneous remarks field (C185). This might be a search for all remarks that contain "DATA FROM DRILLER'S LOG" in this field.

If more than one test is made, the tests must be connected with **OR** or **AND**. For example, the following would ensure that well depth (C28) is not missing and is less than 100 feet:

C28 NE -- and C28 LT 100

Note: "and" connectors are evaluated before "or" connectors. For example, the following test:

C28 LT 100 or C28 GT 500 and C16 GT 4000

is equivalent to:

C28 LT 100 or (C28 GT 500 and C16 GT 4000)

and passes records with:

1. Depth of well less than 100 feet, or
2. Depth of well greater than 500 feet and altitude greater than 4000 feet.

To make the following test:

(C28 LT 100 or C28 GT 500) and C16 GT 4000

you have to use:

C28 LT 100 and C16 GT 4000 or C28 GT 500 and C16 GT 4000

The “while” connector is available for use in testing fields from related files. The “while” connector is similar to “and” except that “while” requires the tests be passed in the same occurrence of the related file. For example, the test:

C237 GT 100 and C235 GT 1984

is passed if any occurrence of C237 is greater than 100, and if any occurrence of C235 is greater than 1984. However, the test:

C237 GT 100 while C235 GT 1984

is passed only if the conditions are met in the same occurrence of the related file, i.e. if the depth is greater than 100 feet in a measurement made after 1984. Note that the fields in tests connected with “while” must be in a single related file, while the tests connected with “and” may include fields from the sitefile or any related files.

Detailed tests cannot be completed for owner name, owner address, owner phone number, contact name, contact address, or contact phone number. If such a test is attempted, the test will be disallowed and a message will be displayed. This functionality was removed for NWIS Release 4.3, Patch 2 to comply with the Privacy Act during a review of NWIS security issues.

If a detailed test is made on a field in one of the associated GWSI files (in which fields may occur a number of times for each site), you may specify whether the test must be passed for all occurrences of the field for a particular site or if one occurrence is sufficient.

The program prompts for the component number, the operator, and the test value. If the component for the site can occur more than once, it also prompts for the number of occurrences required.

3. Site Type.

Enter codes for site type to be included --
 If no type is specified, all types will be selected.
 Enter ? for list of types, or <CR> to end.
 Enter site code (SW/LK/ES/SS/SP/GW/ME/OF/DV/LA/AG/AS/PU/CO):

Site types available --
 (SW) Stream
 (LK) Lake or reservoir
 (ES) Estuary
 (SS) Specific Source
 (SP) Spring
 (GW) Ground water other than spring
 (ME) Meteorological
 (OF) Outfall
 (DV) Diversion
 (LA) Land application
 (AG) Aggregate ground water
 (AS) Aggregate surface water
 (PU) Place of use
 (CO) Coastal

Enter site code (SW/LK/ES/SS/SP/GW/ME/OF/DV/LA/AG/AS/PU/CO):

This option allows you to further restrict your retrieval by limiting the site types to be included based on the value of C802 ([Section 1.9](#)).

4. Maximum number of sites to retrieve by gross selection.

This option allows you to enter the maximum number of sites that the software should allow for the gross selection of sites before beginning the next test. The default entry is zero, which indicates no limit is included.

5. Maximum number of sites to pass polygon, detail & type tests.

This option allows you to enter the maximum number of sites that the software should allow for the polygon, detail, and site type tests before beginning the next test. The default entry is zero, which indicates no limit is included.

6. Maximum number of records to output for tabling.

This option allows you to enter the maximum number of records that the software should allow in the output for tabling. The default entry is zero, which indicates no limit is included.

8.2.5 Format of Output

The next set of information you will enter will describe the format of your output:

```
Specify format (1=Std, 2=Dump, 3=Subfile, 4=Special (<CR>=1): 3

The following output formats are available -

(1) Standard table with fields appearing horizontally across
the page while sites/records are listed vertically down the page.
Up to 25 pages(max 200 chars ea) of fields may be specified. You
may specify that certain fields appear on each page whenever more
than one page is required to list all the fields requested.

(2) Dump-format table in which selected fields for a single
site appear vertically down the page. This format is
advantageous for presenting the data for a site in a compact
form.

(3) Subfile format in which selected fields appear in a
machine-readable form in a file without column headings or spaces
between fields. This format is useful as input to other programs
for plotting, statistical analysis, etc. A table listing the
fields available in the subfile together with field locations and
field lengths is produced except for RDB files, which include the
information in the file header.

(4) Special formats, water levels.
```

The format you choose will determine the next set of queries you will see:

8.2.5.1 Standard Table Format

The standard table format allows you to include component numbers or other options for each column in the output. Fields to include on the output report must be specified. If more fields are specified than will fit on one page of a standard table, a multiple-page report (up to 20 pages) is created automatically. You may specify that certain fields appear on each page of a multi-page report. For example, you may wish to print Site IDs on each page. The width of any page may be limited by forcing a field to begin a new page. The location where fields will appear on the output is displayed as the field code is requested. The page and column location is displayed as "(Pg:xx,Col:xxx)".


```

Enter file name for output table (<CR>=gw.table):

Enter the title you wish to appear at the top of each page (upper/lower case) --
Title
GWSI RETRIEVAL/TABLING - NWIS-4.3.2-20030527   STANDARD FORMAT --

Define fields to be output --

  Enter field code or "WIDTH" to define page width, "SPACE" to force non-std
  spacing or "PAGE" to force next field on new page.  Enter <CR> to end.

(Pg:01,Col:001) - Enter field code/options: c4
(Pg:01,Col:009) - Enter field code/options: c1
(Pg:01,Col:026) - Enter field code/options:

Enter item number to change, R to re-list items or <CR> to continue:

```

A list of components is available in [Chapter 8 – Components Appendix](#). In addition to component numbers you can enter options for temporary fields ([Section 8.3.2](#)) or statistics codes ([Section 8.3.3](#)). After you have entered all the information you want to include in the output, you will be given the opportunity to review and modify your choices:

```

Current output format specifications --
(01) Table type: 1 (Standard)
(02) File name: gw.table
(03) Title:
(04) Print destination:
(05) Forms page length:      58
(06) Round numeric values on output? N
(07) Rounding exceptions: (none)
(08) Force upper case? N
(09) Page break field: (none)
(10) Fields to be output --
      C004 C001
(11) Output will not be sorted

Enter item number to change, R to re-list items or <CR> to continue:

```

The output file (default name gw.table) is generated by the program. The file may be printed from the program or printed later. At the end of the setup, any or all of the retrieval/tabling specifications may be selectively reviewed or reentered. See [Section 8.2.6](#) for details on each output option. The setup specifications may be saved in a control file. This file can then be used in a subsequent execution of this program. Future retrievals can be simplified by beginning with a similar retrieval/tabling execution. With this capability, you may generate one or more “canned” setups for recurring retrievals or for use as a pattern for typical retrievals or tables.

8.2.5.2 Dump Format

The dump format includes a row for each element of data for each site selected.

```
Specify format (1=Std, 2=Dump 3=Subfile, 4=Special (<CR>=1): 2
GWSI RETRIEVAL/TABLING - NWIS-4.3.2-20030527   FORMAT OF OUTPUT -
-

Enter file name for output table (<CR>=gw.table):

Enter the title you wish to appear at the top of each page
(upper/lower case) --

GWSI RETRIEVAL/TABLING - NWIS-4.3.2-20030527   DUMP FORMAT --

Which field set do you wish to use (1=Default, 2=Select, 3=All)?
```

You can select a default set of components, select individual components, or include all components in the dump format output.

The default set of components includes:

C001 C012 C013 C009 C010 C008 C093 C020 C024

If “Select” fields is chosen, the user will be prompted to enter selected fields that will be displayed in the vertical format of the dump type table. They may be entered individually. If a component number is preceded by an exclamation point (e.g., !C180), that field and all related fields will be included in the output. For example, if !C80 is entered for a component number, C80 (Casing material) and all related fields for casing will be included in the output. This selection will be included in the output specifications summary screen. This is opposite behavior to the “All” option below.

If “All” fields is selected, the user will be prompted to enter fields that are to be excluded from the table. They may be entered individually and if the user enters a component number preceded by an exclamation point (e.g. !C16), that field and all related fields will be excluded from the selection process. If, for example, !C16 (altitude of site) is typed in response to the prompt, then C16, which is part of the sitefile record, and all sitefile fields will be excluded from the selection. This is opposite behavior from the “Select” option above. The excluded fields will be indicated when the summary of output specifications is displayed.

After you make your component selection, you will be asked if you want fields with no data included in the output and whether you want to restrict output of related files:

```
Do you wish to print empty fields (Y/N,<CR>=N)?

Do you wish to restrict output of related files (Y/N,<CR>=N)?
```

Related Files:

Anything not found in the sitefile is found in a related GWSI file. Items in the sitefile are listed in [Chapter 2](#). You are queried about restricting the output of related files only if a component from a related file has been selected for output.

Note: Components in the Sitefile can occur only one time for the site [e.g., (C12)--local well number]. Components in the related GWSI file can occur multiple times for the site [e.g., (C79)--diameter of casing].

For restricting output from related files, the following operators can be used

EQ Equals	NE Not equal
GT Greater Than	LT Less Than
GE Greater than or Equal to	LE Less Than or Equal to
IN In range of	EX Outside range -- For character strings only
CN Contains	NC does Not contain

The “@” operator may be used to restrict selection of records to particular occurrences of a related file record for each site. The following “@” operators are available:

- @F Select the first n records for a site.**
- @L Select the last n records.**
- @N Select every nth record.**

If you choose one of these operators you will be prompted to enter “n.”

If you output a field from any of the related GWSI files, an opportunity is provided to specify the extent of the output from the related file by answering “Y” to the following prompt “Do you want to restrict the output of related files?”. If you answer “Y,” you are prompted to specify tests similar to those of the [detail tests \(Section 8.2.4\)](#) used in site selection.

At the end of the setup, any or all of the retrieval/tabling specifications may be selectively reviewed or reentered. See [section 8.2.6](#) for details on each output option. The setup specifications may be saved in a control file. This file can then be used in a subsequent execution of this program. Future retrievals can be simplified by beginning with a similar retrieval/tabling execution. With this capability, you may generate one or more “canned” setups for recurring retrievals or for use as a pattern for typical retrievals or tables.

8.2.5.3 Subfile Format

The subfile format includes components in a machine-readable form column headings or spaces between fields. This format is useful as input to other programs for plotting, statistical analysis, etc. In addition to the machine-readable output, a table listing the fields in the subfile, together with field locations and lengths, is produced. The prompts for the subfile format include naming the output file and entering a list of component

numbers. The output file (default name gw.subf) is generated by the program. The file may be printed from the program or printed later. A subfile format list (default name gw.subf.list) also can be generated. This file lists the location of each field in the file, along with its component number and description.

A list of components is available in [Chapter 8 – Components Appendix](#). In addition to component numbers you can enter options for temporary fields ([Section 8.3.2](#)) or statistics codes ([Section 8.3.3](#)).

RDB format can be retrieved using the subfile option. After selecting the subfile format and entering components to be included, then change option 3 in the output specifications for RDB format to “Y.”

```

Current output format specifications --
(01) Table type: 3 (Subfile)
(02) File name: gw.subf
(03) RDB format? Y
(04) Field list file name: gw.subf.list
(05) Print destination:
(06) Round numeric values on output? Y
(07) Rounding exceptions: (none)
(08) Rounding for component C237: by component C276
(09) Force upper case? N
(10) Right-justify numeric fields? Y
(11) Fields to be output --
      C004 C001 C012 C235 C237
(12) Output of related files is not restricted.
(13) Output will not be sorted.

Enter item number to change, R to re-list items, or to continue: 3

```

At the end of the setup, any or all of the retrieval/tabling specifications may be selectively reviewed or reentered. See [section 8.2.6](#) for details on each output option. The setup specifications may be saved in a control file. This file can then be used in a subsequent execution of this program. Future retrievals can be simplified by beginning with a similar retrieval/tabling execution. With this capability, you may generate one or more "canned" setups for recurring retrievals or for use as a pattern for typical retrievals or tables.

8.2.5.4 Special Table Format – Water Levels

After selecting option 4 from the format list, you will enter the output filename and the title to appear at the top of each page. The next query will require you to choose one of four types of water-level tables:

- (a) Daily water levels by year
- (b) Five-day water levels by year

- (c) Intermittent water levels by year
- (d) Intermittent water levels for multiple years

After selecting the type of water-level table for output, you will be queried for additional information including start year and ending year and heading formats:

```
Specify type water level table desired (1-4): 1

Enter year type (W/C/S,<CR>=W):
Enter start year (<CR>=first available):
Enter end year (<CR>=last available):

    Current alternate headings type: R
    Use the following headings for site description --
    SITE:[C001 ]
    LOCAL NUMBER:[C012 ]
Enter alternate headings type (N/R/A,<CR>=no change): ?
```

The heading options in the output table allow you to customize your water-level table:

- N -- None, use C270 if available.
- R -- Headings specified are to be used in place of C270 (may include C270).
- A -- Headings specified are to be used only if C270 is not available.

Site descriptions are normally obtained from observation well headings ([C270 - Chapter 2 - Section 7.9](#)). You may specify up to 20 lines of text/fields which are to be used instead of C270 or which are to be used if C270 data is not available. For each line you will need to enter 0-132 characters of text and/or one field. The field may either be C270 or any site file field. For example, you might specify:

```
Alternate headings type = "A",
"Site number:" for text and "C1" as field for line 1, and
"Local number:" for text and "C12" as field for line 2.
```

Then the following would be printed as headings whenever C270 is not available:

```
Site number: (contents of C1)
Local number: (contents of C12)
```

Note that either text or field data may be omitted from a line. For water-level tables types 3 and 4 also include an additional query:

```
Suppress status/method (Y/N,<CR>=N)?

NOTE: Specifying more water level groups than default
in next query requires print capability > 132 columns--
Enter number water level groups/line (1-09,<CR>=6):
```

The first query allows you to not include the water-level status or methods codes in the output with the water level results. An entry of “Y” will prevent these codes from appearing in the output.

The second query allows you to choose how many columns for water levels will appear on each line of output. The maximum number of columns is nine.

The final query is about restricting output of related files:

Do you wish to restrict output of related files (Y/N,<CR>=N)?

See the section about [Related Fields](#) in the Dump Format output above.

At the end of the setup, any or all of the retrieval/tabling specifications may be selectively reviewed or reentered. See [section 8.2.6](#) for details on each output option. The setup specifications may be saved in a control file. This file can then be used in a subsequent execution of this program. This allows the beginning of your retrieval/tabling design from a similar retrieval/tabling execution. With this capability, you may generate one or more “canned” setups for recurring retrievals or for use as a pattern for typical retrievals or tables.

8.2.6 Output Options

There are a number of options for the output tables or files. Some of these options are prompted for and others have supplied defaults. In either case, a table of the applicable options is displayed. You may change one or more of the following options:

1. Table Type. If this option is selected, the user will be sent back to the beginning of the Format of Output process to select the desired table type.
2. File name. The name of the output file can be changed.
3. Title. The title (up to 80 characters) may be changed. This option does not apply to subfiles.
4. Print destination. A printer other than the system default printer may be specified.
5. Print forms. Forms other than the default system forms may be specified.
6. Page length. The default page length is 58 lines, but this may be changed to any value between 10 and 160 lines to allow printing on various forms and devices.
7. Rounding of numeric fields. Rounding specifications for the entire retrieval are initially set by default. There are two types of default settings: (1) The program default is set to “N,” or (2) The district default, specified in `/usr/opt/nwis/support/gw.table.parms` file. The district default file is usually created to enforce a district standard for rounding. The default setting may be toggled by typing in the number for this field displayed in the “Output Format Specifications” at the prompt for changing an item on the specs and hitting `<Return>`. Rounding is applied according to data dictionary specifications for each component in the table when set to “Y.”

8. Rounding exceptions. You may specify one or more fields as exceptions to whatever rounding was selected in option (7) above. If you specify no rounding, you may also specify that one or more (up to 20) components be rounded. Similarly, if you select rounding, you may also specify up to 20 components where no rounding is applied.
9. Rounding for C16. Normally, site altitude (C16) is rounded according to the value of altitude accuracy (C18). You have the option of using the rounding specifications from the data dictionary for this component.
10. Rounding for C237. Normally, water levels (C237) are rounded according to the value of water-level accuracy (C276). This option uses the rounding specifications from the data dictionary for this component.
11. Force uppercase. You may force character field output in uppercase.
12. Right-justify numeric fields. Normally, numeric fields are printed with decimal points aligned. This option provides for right-justification of numeric fields.
13. Printing empty fields. Normally, empty fields are not printed in dump format. This option provides for forcing output of empty fields, and only applies to the dump format tables.
14. Years to process. This option applies to water-levels tables only, and provides for specifying the period to be tabled.
15. Start, end months. This option applies to water levels only and provides for specifying a partial year to be tabled. It also allows tabling of year types other than water year (the default) where the starting month is October and the ending month is September.
16. Number water-level groups per line. This option applies only to intermittent water levels. If page sizes narrower than 132 characters are required, this option provides for displaying fewer than the default number of groups.
17. Water-levels subtitle. This option allows the default subtitle, WATER LEVELS IN FEET BELOW LAND SURFACE, to be changed.
18. Print period-of-record summary. Normally, a period-of-record summary is not included on water-levels tables. This option provides for printing a summary for the entire period of record, even though only a partial period is being tabled.
19. Print record available line. Normally, a line indicating the period of record available is not printed. This option provides for printing such a line, and applies only to water levels.
20. Status types to include. Normally, summaries of water levels include all status types. This option provides for including only specific status types in summaries. For example, you may wish to include only static water-level measurements in summaries.
21. Field to table in water levels. Normally, water levels are tables of the values of component C237 (water level). This option provides for tabling some other field, such as elevation of water (a temporary field calculated from site altitude and water level).
22. Page break field. You may specify a field for which a page eject occurs whenever the value of the field changes. This option applies to type 1 and water-levels tables (except for daily tables).

23. Page break on site change. Normally, dump format tables are printed with one blank line separating sites. This option provides for forcing a page eject whenever the site changes. This option applies only to dump format tables.
24. Alternate headings. Normally, component C270 (observation well headings) is for describing sites for water-levels tables. This option provides for specifying combinations of literal text and component values used as site descriptions.
25. Limit related file output. Normally, all data available in the related files are tabled for each site selected. This option provides for limiting the tabling of related file output according to the values of the fields being tabled.
26. Permute related file output. Provides for tabling all possible combinations of fields when data are being tabled from more than one related file.
27. Sorting. Normally, tables and subfiles are output in the order that the data are available in the Sitefile and the related files. This option provides for sorting the output for up to 20 different fields, and in an ascending or a descending direction.

8.2.7 Processing Parameters

When all specifications are complete, the program asks for the processing parameters. There are five options for processing:

1. **(I)** Interactive. Control remains with the terminal.
2. **(P)** Phantom. Control of this retrieval reverts to a background process. The background process begins immediately with control of the terminal released to the user.
3. **(B)** Batch. A file is generated to be run later as a batch job. Instructions for this option are provided within the program.
4. **(R)** Review/modify the setup.
5. **(Q)** Quit. Terminate the retrieval.

The first processing option would be used for reasonably short retrievals. The second option would be used if the retrieval would take longer and the user needs the terminal, perhaps to begin another retrieval. Jobs that are completed either using the phantom or batch options will create two additional files. An input file (default name gw.cpl) and an output file (default name gw.como) are created. The input file controls the phantom or batch job while the output file records the results.

The third option is most useful for systems that are overloaded and when the retrieval is not needed immediately. A batch job has the least impact on other users and could even be run during the middle of the night. If you specify batch, further processing of your retrieval will not be done interactively. You will be prompted to specify names for files required for processing. When the batch job is complete, you may reenter this program to display or print the output. There are three additional options allowed at this time:

1. Control file generation
2. **(S)** Generation of a list of sites that passed all tests
3. **(@)** Selection of database number

The control file contains all of the specifications from this program execution. The control file could serve as a record of the retrieval specifications. It also can be used as a starting place for a later program execution. During the later program execution, any of the specifications can be changed. The control file is nice to have in case the retrieval/table is close to, but not exactly, what you wanted. The control file can then be used and specifications can be modified. A series of control files can be generated for typical retrievals done in the District. These control files then become “canned programs” that each user can modify to generate “tailored programs.”

The file containing the list of sites in a subsequent retrieval can be used for gross selection. A UNIX editor can be used later to add or delete sites from this file to get absolute control over those sites selected.

The database(s) to be processed can be specified by appending a string of database numbers preceded by @. For example, including @2 would indicate that database number 2 is to be processed, while including @2,4 would indicate that databases 2 and 4 are to be processed and @2-4,6 would indicate that databases 2, 3, 4, and 6 are to be processed. The default is @1.

The default for processing parameters is I@1, which indicates interactive processing of database 1. If, for example, you wish to process database 2 as a phantom job and create a file of the sites selected, you might respond PS@2.

8.3 Fields Available

All fields in the Sitefile and the associated GWSI files are available to this program. Fields are identified by component numbers. A list of valid components is available in [Chapter 8 – Components Appendix](#). Fields (components) are specified by entering the code Cxxx for the field desired. Enter M in place of C if the metric equivalent of the field is required. You need not enter leading zeros in field codes. Use the GWSI coding manual or the GWSI coding form to determine the component numbers; these are also found in the file named: /usr/opt/nwis/doc/data.dictionary. You can ask the program for a list of component numbers.

If you enter a field code with a prefix of ?, a field description is displayed. You are then asked to confirm the field before it is used. For example, if ?C28 is entered in response to the prompt “Enter field code:” the following is displayed:

```
That field is:  Depth of well
File:  Site File

Enter <Enter> to accept, "R" to reject
```

If <Enter> is pressed, the field is used. If R is entered, the field is not used and you are asked to enter another field code. A display of the fields available may be obtained any time a field code entry is requested. Enter + for a complete list or +Cxxx for a list of 20

components beginning with field **Cxxx**. A list of 20 components is displayed; choose to either continue the display of components or to resume normal processing.

8.3.1 Water-quality retrievals

The retrieval program makes it possible to table selected water-quality data that are stored in the water-quality database. The GWSI water-quality components include:

- C193 – Date and time of sample
- C195 – Aquifer Sampled
- C196 – Water-quality Parameter Code
- C197 – Value of QW Parameter Code
- C738 – QW Sample ID

For GWSI, the QW Parameter Codes are limited to:

- 00003 – Sample Depth
- 00010 – Water Temperature
- 00020 – Air Temperature
- 00095 – Conductance
- 00300 – Dissolved Oxygen
- 00400 – pH
- 00410 – Alk, Titr pH 4.5
- 00430 – Alk, Carbonate
- 00440 – Bicarbonate
- 00940 – Chloride

One way to display water-quality data in tables is by specifying the desired component numbers. An example of a standard table, where components C1, C738, C193, C195, C196, and C197 are specified at the prompts for output, is shown below:

<u>SITE-ID</u>	<u>SAMPLE RECORD NUMBER</u>	<u>DATE/TIME QUALITY PARAMETER MEASURED</u>	<u>AQUIFER SAMPLED</u>	<u>WATER-QUALITY PARAMETER CODE</u>	<u>VALUE OF WATER-QUALITY PARAMETER</u>
474251114385217	99003756	199006011200	111MTLG	00003	50
	99003756	199006011200	111MTLG	00010	15.5
	99003756	199006011200	111MTLG	00020	5.6
	99003756	199006011200	111MTLG	00300	32.1
	99003756	199006011200	111MTLG	00400	7.3

A more desirable way to display water-quality data may be to display all the parameters for one sample on a single line. The retrieval/tabling program provides the capability to temporarily restructure QW data in a horizontal format to display specified parameters for each sample by using the QDATE and QAQFR designation, followed by the desired water-quality parameters. The water-quality parameters will be displayed under descriptive column headings for the parameters. For example, by specifying C1,

QDATE, QAQFR, 00003, 00010, 00020, 00300, and 00400 at the prompts for output, the following table will result:

SITE-ID	DATE/TIME	AQUIFER	SAMPLE	WATER	AIR	OXYGEN,	PH
	QUALITY		DEPTH	TEMP	TEMP	DISSOLVED	(STANDARD
	PARAMETER	SAMPLED	(FEET)	(DEG C)	(DEG C)	(MG/L)	UNITS)
	MEASURED		(00003)	(00010)	(00020)	(00300)	(00400)
474251114385217	199006011200	111MTLG	50	15.5	5.6	32.1	7.3
	199012251800	111DDGP	75	1.4	4.5	55.3	7.1

NOTE: Do NOT combine QDATE/QAQFR designation with Water-Quality related components (C193, C195, C196, C197, and C738), or vice versa, when entering data output specifications, this will result in unpredictable table formats. For example, entering C1, C193, QDATE, 0010, 00020, C738 for data output specifications is NOT recommended.

8.3.2 Temporary Fields

Temporary fields are fields containing the results of mathematical operations on numeric GWSI fields, or the results of some logical process on character GWSI fields. Up to 20 temporary fields may be created.

Temporary fields are denoted as “T1,” “T2,” . . . “T999.” Temporary fields are entered at the prompt “Enter field code/options:” during specification of fields to be output; the user will be prompted for definition of the temporary field. Temporary fields may be used as any GWSI fields--for testing, output or sorting.

Numeric temporary fields contain the result of a sequence of operations on numeric constants and/or GWSI fields. The operations are defined using Reverse Polish Notation (RPN) that allows evaluation of algebraic expressions without regard for parentheses. Operations are entered as operands (numeric values or fields) and/or one of the operators:

- + Addition
- Subtraction
- * Multiplication
- / Division
- ^ Exponential

The current value of a term is modified according to the operation specified. If no operator is included, a new term is started. If no operand is included, the operation is applied using the last term computed and the current term. Any equation can be reduced to a sequence of these RPN operations. For example, to define a temporary field equal to site altitude (C16) less well depth (C28), you would specify the following sequence:

C16 C28-

To define the more complex (rather nonsensical) expression:

(C16-C28) + (C28-100)^.5

you would specify the following sequence of operations:

C16 C28- C28 100- .5^ +

Character temporary fields contain the result of a logical operation on a character GWSI field. The operations currently available are:

P - Partial field--extract a substring from a field.

S Sort key - create a sort key from any text field that contains township-range-section-qtr-seq in the specific format TTTRRRSSQQQNN (e.g. 09S40E36ADAB01). This temporary field may be used to sort the output and will arrange sites from North to South by township, and order sites from West to East by range within township. This sort key will only work if the input field is in the specified format (see example) and is used in the sort list in the table output specifications.

J - Julian day number--convert a date field to a 5-character day number referenced to a specified year.

D - Degree conversion--convert latitude or longitude in degrees-minutes-seconds to a 9-digit decimal degrees with 4 decimal places.

B--Replace field with database number.

The easiest way to set up a character temporary field is to specify the field desired when prompted for field/definition, then enter either **P**, **S**, **J**, **D**, or **B** when prompted for an operation code. The program will then prompt for any other required data. A special operator “=” is available for either character or numeric fields. This operator is used to retrieve a particular occurrence of a field in a related file. The temporary field is set to the value of the first operand in that occurrence of the related file where the value of the second operand is equal to the third operand, a constant. For example, if temporary fields T1 and T2 were defined as:

T1: C115 C706= WL

T2: C115 C706= QW

then T1 would be set to the value of C115 (network begin year) for that occurrence of the related file where C706 (data type) is equal to “WL.” Similarly, T2 would be equal to C115 where C706 is “QW.” A variation of this operation allows the first or last occurrence of a related file field to be retrieved. For example, the temporary field T1, could be defined as:

C190 C190= @L

Then, T1 would be set to the value of the last occurrence of C190. Conversely, the operand @F would specify that the first occurrence is to be retrieved. This temporary field would be useful for sorting on a related file field when data is being retrieved from multiple related files. Whenever a temporary field is defined using the “=” operator, that field is evaluated before output for the site begins. Thus, the temporary field can be used much as a Site file field.

8.3.3 Statistic Fields

You may specify that statistical computations be performed for any of the fields selected. The statistical options currently available are:

- C** - Count of non-missing occurrences
- T** - Sum of values
- H** - High (maximum) value
- L** - Low (minimum) value
- M** - Mean value
- S** - Standard deviation of values

The cxxx/ch1 form of field entry can be used when a field is requested for tabling under the type 1 table format. The cxxx is the component number and chl.. are the statistics requested for that component. For example, the entry:

C237/HL

would specify that maximum (**H**) and minimum (**L**) are to be calculated and reported for component C237.

Statistic fields contain a statistic of the values for one component in a related file field for one site. Statistic fields are specified as:

@.xxx
where
@. is the statistic desired, and
xxx is the component for which the statistic is computed.

The valid statistics are:

- C** - Count of occurrences
- T** - Total (sum) of occurrences
- H** - High (maximum) value
- L** - Low (minimum) value
- M** - Mean value
- S** - Standard deviation
- 1** - First value
- N** - Nth (last) valued

For example, the field specification @M237 would specify the mean value of component C237 (water level). **Note: Only non-missing values are included when evaluating the statistics. Statistic fields can be used just like Sitefile components for testing, reporting, or for arguments to temporary fields.**

8.4 Datum Conversions

Display of component values referenced to a datum may be converted to an alternate datum in the Standard Table format. When a component that is referenced to a horizontal or vertical datum is selected for display, the user will be prompted for the output format for all components referenced to the horizontal or vertical datum; once the output format is selected for the horizontal or vertical datum, that format is used for all related components. For example, if Option 2 is specified for component C9 (Latitude), the format specified in Option 2 is used for all other latitude and longitude fields. If the following field specifications for a standard table are entered, the table following the specifications would be output similar to the output below:

PAGE 1					
SITE-ID	ALTITUDE OF LAND SURFACE (FEET)	ALTITUDE DATUM (CODE)	LATITUDE (NAD1983) (DDMMSS)	LONGITUDE (NAD1983) (DDMMSS)	LATITUDE- LONGITUDE- CONVERTED FROM NAD1927
474251114385201	2878.57	NGVD29	474251	1143855	*
483318104105402	1977.00	NGVD29	483318	1041056	*
450937112393701	5237.00	NGVD29	450937	1123940	*
453107106110601	3020.00	NGVD29	453107	1061108	*

There are several components that are referenced to either a horizontal or vertical datum:

Component #	Description	Datum Type	Datum Component #
C009	Latitude (ddmmss)	Horizontal	C036
C909*	Latitude NAD83 (decimal degrees)	Horizontal	None
C010	Longitude (dddmmss)	Horizontal	C036
C910*	Longitude NAD83 (decimal degrees)	Horizontal	None
C016	Altitude of Land Surface	Vertical	C022
C325*	Altitude of Measuring Point	Vertical	C328
C242	Altitude of Water Surface	Vertical	C245

Note: *There is no provision to convert Altitude of Measuring Point (C325) to alternate datums or to force display of the MP Datum in tables; this will be provided with a future software release. However, water levels referenced to mean sea level (C242) when specified for display in special table format that have been calculated from MP Altitude (C325) and water level referenced to MP (C241) are converted correctly. Values included in output for decimal degrees of latitude and longitude (C909 and C910) will not be converted. Decimal degree output for these two components will only appear with NAD83 datum.

When a component that is referenced to a datum is selected for display in a table by the GW tabling program, the component value may be displayed as entered or converted to an alternate datum; in either case, the displayed value will be described as follows:

1. If the value is not to be converted, the datum associated with the component will automatically be included with the output.

2. If the value is converted from one datum to another, the value of the component will be converted and an indication of its having been converted will be displayed in the table. If the value is already stored in the specified datum, no processing will occur.

Datum conversions are performed using the North American Datum Conversion (NADCON) routines available from National Oceanic and Atmospheric Administration (NOAA). Horizontal conversions are performed between NAD27, which includes OLDAK, OLDPR, OLDHI, and OLDGUAM datums, and NAD83, provided that they fall within the latitude and longitude ranges accepted by NADCON. Vertical conversions are performed between NGVD29 and NAVD88 provided the corresponding coordinates fall within the latitude and longitude range of NADCON. The range for the NADCON vertical datum conversions are restricted to the “lower 48” states. If a requested datum conversion is not supported by NADCON, or the location of the datum is outside the range of NADCON, then the designation “NA” will be displayed in the table column indicating whether or not the value was converted. If “NA” is displayed, the value was not converted, and steps should be taken to ensure that the displayed value is not interpreted as a converted value.

Components may be converted from one datum to another for all table types except the dump format; data are displayed as entered in the dump format. When any component referenced to a datum is displayed in a table, the datum is displayed, and there is an indication of whether or not the displayed value has been converted from one datum to another.

There are three options for displaying components referenced to horizontal datums:

1. Output values as stored. Component C036, the latitude-longitude datum will be included automatically.
2. Output all values at NAD1927. Any NAD1983 values will be converted to NAD1927 and flagged as converted.
3. Output all values at NAD1983. Any NAD1927 values will be converted to NAD1983 and flagged as converted.

There are three options for displaying components referenced to vertical datums:

1. Output values as stored. Component C022, the altitude datum will be included automatically.
2. Output all values at NGVD1929. Any NAVD1988 values will be converted to NGVD1929 and flagged as converted.
3. Output all values at NAVD1988. Any NGVD1929 values will be converted to NAVD1988 and flagged as converted.

8.4.1 Subfile Table Format

Display of component values referenced to a datum may be converted to an alternate datum in the Subfile Table format. When a component that is referenced to a horizontal or vertical datum is selected for display, the user will be prompted for the output format for all components referenced to the horizontal or vertical datum. Once the output format is selected for the horizontal or vertical datum, that format is used for all related components. For example, if Option 2 is specified for component C9 (Latitude), the format specified in Option 2 is used for all other latitude and longitude fields. For example, if the following field specifications for a subfile table are made the table following the specifications would be output:

Field Specifications

```
Specify fields to be included in the subfile.  Enter <CR> to end --

Enter field code: c1
Enter field code: c16
Enter altitude datum correction option (1-3/?,<CR>=1): ?

You have selected output of altitude.  You must specify how
you wish to handle datum corrections.

You have 3 options:
(1) Output values as stored.  Component C022, the
    altitude datum will be included automatically.
(2) Output all values at NGVD1929.  Any NAVD1988 values will be
    converted to NGVD1929 and flagged as converted.
(3) Output all values at NAVD1988.  Any NGVD1929 values will be
    converted to NAVD1988 and flagged as converted.
Enter altitude datum correction option (1-3/?,<CR>=1): 3
Enter field code: c9
Enter datum correction option (1-3/?,<CR>=1): 1
Inserting X004  ...
Enter field code:
Inserting C036  ...
```

Subfile Table Output

```
474251114385201 2882.59      * 474251NAD27
483318104105402 1978.63      * 483318NAD27
450937112393701 5240.86      * 450937NAD27
453107106110601 3022.19      * 453107NAD27
```


8.4.2 Special Table Format

Water levels displayed in the Special Table Format may be displayed as an altitude by requiring the Field to Table in WL Format to be C242 (Altitude of Water Surface) in the Table Specifications. This can occur if water levels are entered as Altitude or Water Surface (C242), if water levels are entered as depth below land surface datum (C237) and the Altitude of the site (C16) in the sitefile is populated, or if water levels are entered as depth below MP (C241) and MP altitude (C325) is populated. Legacy data may not have the necessary collateral information available to display water levels as an altitude. If the “Field to Table in WL Format” is set to C242 the user will be prompted for which datum the water levels are to be displayed:

```
You have selected output of altitude of water surface (C242). You must
select a datum to be used for output values. You have 2 options:
  (2) Output values at NGVD1929.
  (3) Output values at NAVD1988.
Values will be converted as necessary.
Enter datum conversion option (2/3): 3
```

An example of table specifications and table output follow; user input is indicated by **bolded/underlined** response to prompts:

Field Specifications

```
Current output format specifications --
(01) Table type: 4 (Intermittent water levels, multiple years)
(02) File name: 4
(03) Title:
(04) Print destination:
(05) Forms page length: 58
(06) Round numeric values on output? Y
(07) Rounding exceptions: (none)
(08) Rounding for component C237: by component C276
(09) Force upper case? N
(10) Start year: 1980 End year: 1990
(11) Start month for tables: 10 End month: 09
(12) Suppress SM? N Number water level groups per line: 4
(13) WL sub-title: WATER LEVELS IN FEET BELOW LAND SURFACE DATUM
(14) Print period of record summary? N
(15) Field to table in WL format: C237 High extreme at low value? Y
(16) Page break field: (none)

Enter item number to change, R to re-list items or <CR> to continue: 15
Field to table (<CR>=C237)? C242
  You have selected output of altitude of water surface (C242). You must
  select a datum to be used for output values. You have 2 options:
    (2) Output values at NGVD1929.
    (3) Output values at NAVD1988.
  Values will be converted as necessary.
  Enter datum conversion option (2/3): 3
  Enter item number to change, R to re-list items or <CR> to continue:
```

Special Table Output

DATE: 07/06/01

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SITE: 474251114385201

LOCAL NUMBER: 23N24W34ADAA01

WATER SURFACE ELEVATION IN FEET (NAVD1988)

DATE	WATER LEVEL MS	DATE	WATER LEVEL MS	DATE	WATER LEVEL MS
MAR 12, 1980	2776.53 S	MAY 23, 1984	2774.45 S	JAN 13, 1988	2776.70 S
JUL 14	2777.73 S	JUN 22	2771.51 S	FEB 19	2777.12 S
OCT 09	2778.65 S	AUG 27	2769.68 S	APR 07	2777.96 S
JAN 15, 1981	2779.38 S	SEP 28	2769.76 S	MAY 23	2774.74 S
APR 10	2779.87 S	OCT 01	2770.75 S	JUN 29	2773.41 S
JUL 17	2778.79 S	NOV 27	2771.98 S	JUL 14	2771.80 S
JAN 06, 1982	2777.54 S	JAN 18, 1985	2772.27 S	AUG 19	2769.78 S
21	2777.70 S	23	2772.22 S	OCT 04	2770.67 S
FEB 02	2777.59 S	24	2772.22 S	11	2770.94 S
MAR 17	2778.05 S	MAR 20	2772.68 S	NOV 23	2773.40 S

Note: Datum used is displayed in table heading "WATER SURFACE ELEVATION IN FEET (NAVD1988)."