



NWIS Web Services Snapshot Tool: User Manual

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Software User Rights Notice

The software user rights notice is available at <http://water.usgs.gov/software/help/notice/>.

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Introduction

The NWIS Web Services Snapshot Tool (Figure 1) is an add-in that gives ESRI ArcMap¹ users the ability to query NWIS web services and download a “snapshot” of NWIS data from the web services to a geodatabase. A web service is a computer-to-computer protocol that allows for the direct sharing of information; the Snapshot Tool leverages a suite of web services made available by USGS to transfer user-requested water information from a remote NWIS web services database directly to a local geodatabase on your computer.

Once the local geodatabase is populated, the sites and measurements are immediately viewable on a map and in tables in the ESRI ArcMap software environment. Hence, the Snapshot add-In significantly reduces the time and expertise required to retrieve data via a method of requesting one or more tab-delimited text files from a website and then interpreting, mapping, and symbolizing the data in the text files.

Another feature of the Snapshot software is that it provides assistance in the selection and interpretation of database codes. NWIS has approximately 19,000 possible water characteristic or parameter codes. The Selection Tool in the Water Quality tab allows users to search and select from a list of approximately 4,700 characteristics. Potentially cryptic codes and field names are interpreted using geodatabase capabilities: The personal geodatabase provided with the installation files has built-in field aliases to decode database field names (parm_unt_tx becomes Result Unit of Measure, for example). The geodatabase also contains some coded value domains to decode abbreviations and codes in attribute tables ('00003' becomes 'MEAN' in the Daily Values table, for example).

The geodatabase has built-in relationships between sites and measurements taken at each site so users can run powerful queries, import tables and build new relationships with the NWIS data, and edit the data while maintaining the built-in relationships. After requesting data from web services and populating the geodatabase, ArcMap functions and tools may then be used to visualize, analyze, and export data to other analysis software. The data in the personal geodatabase can also be accessed by establishing an ODBC connection from a variety of software packages such as R, Matlab, Microsoft Excel, and Microsoft Access.

¹ Any use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Figure 1. Overview of the NWIS Web Services Snapshot Add-In.

The screenshot displays the ArcMap interface with the NWIS Snapshot Tool add-in. The tool's 'Layers' pane shows 'NWIS Sites' with sub-categories: Surface Water Sites (black triangle), Groundwater Sites (red circle), Springs Sites (blue circle), Atmospheric Sites (blue square), and Other Sites. The 'Display' section has radio buttons for 'All Sites', 'Active Sites', 'Real-time Sites', and 'Inactive Sites'. The 'Type of Site' section has checkboxes for 'Surface water Sites', 'Groundwater', 'Springs Sites', 'Atmospheric Sites', and 'Other Sites'. A 'Get Sites in Current Map Extent' button is visible.

An orange callout box with the text **1. Download sites in your study area.** points to the 'Type of Site' section.

The 'Identify' window shows a tree view for 'NWIS Sites' at 'Waller Ck at 38th St, Austin, TX'. A table of fields and values is displayed:

Field	Value
OBJECTID	28265
Result ID	1631630
Sample ID	1631630
Data Logger Line Name	
Detection Condition	
Parameter Name	pH
Method Specification	
Sample Fraction	Total
Result Status	Historical
Statistic Type	
Result Value Type	Actual
Result Weight Basis	
Result Time Basis	
Result Temperature Basis	
Result Particle Size Basis	
Result Lab Comment	20080221
Result Depth-Altitude Reference Point	
USGS Parameter Code	00400
Result Value	8.3
Result Unit of Measure	std units
Result Measure Qualifier Code	

An orange callout box with the text **2. Download data to a relational geodatabase.** points to the 'Identify' window.

The 'Select by Attributes' window shows a 'WHERE' clause: `[result_va] < 5`. Below the clause is a table of selected attributes:

Parameter Name	Result Value	Result Unit of Measure
pH	4.7	std units

An orange callout box with the text **3. Use ArcGIS to query, analyze, plot, edit, expand, visualize, and export your data.** points to the 'Select by Attributes' window.

Computer and Skill Requirements

To install the NWIS Web Services Snapshot Add-In, the computer must meet the following requirements:

- Microsoft .NET Framework version 3.5
- ESRI ArcMap 10.0
- An internet connection
- Basic familiarity with the National Water Information System (NWIS), Microsoft Windows, and the ArcGIS 10.0 environments.

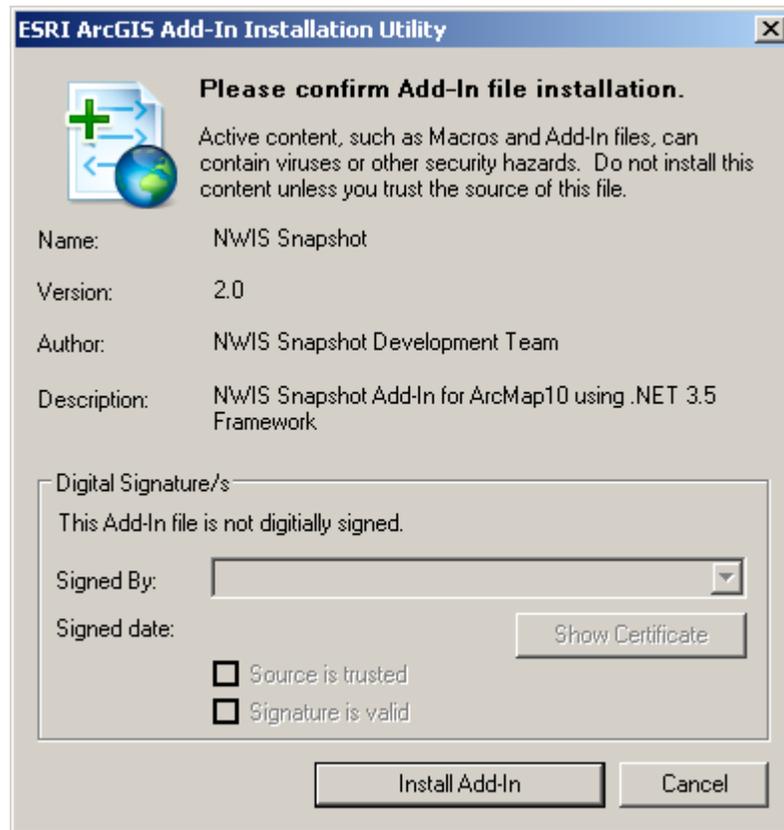
Installation

Installation of the NWIS Web Services Snapshot Tool requires both toolbar installation and ArcMap document set-up.

Toolbar installation

- Close **ArcMap 10** if it is open.
- Download and unzip the installation files from *<http://txpub.usgs.gov/snapshot>*
- In the installation directory, double-click the **Snapshot.esriAddin** file.
- An **ESRI ArcGIS Add-In Installation Utility** window should appear (Figure 2). Select the **Install Add-In** button.

Figure 2. ESRI ArcGIS Add-In Installation Utility window.



- Click **OK** in the **Installation succeeded** message box.
- Launch ArcMap 10.0.
- The Snapshot icon (Figure 3) may already appear somewhere in the ArcMap interface. If not, in the ArcMap **Customize** menu, select **Toolbars**. Select **NWIS Snapshot** from the list of Toolbars (Figure 4).

Figure 3. The NWIS Web Services Snapshot toolbar.

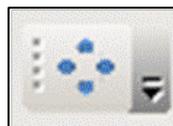
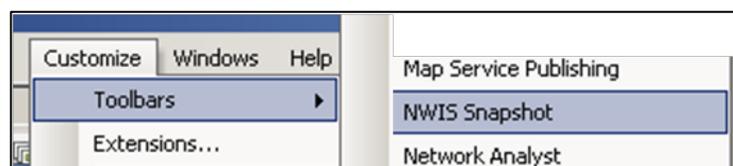


Figure 4. Select NWIS Snapshot from the list of toolbars.



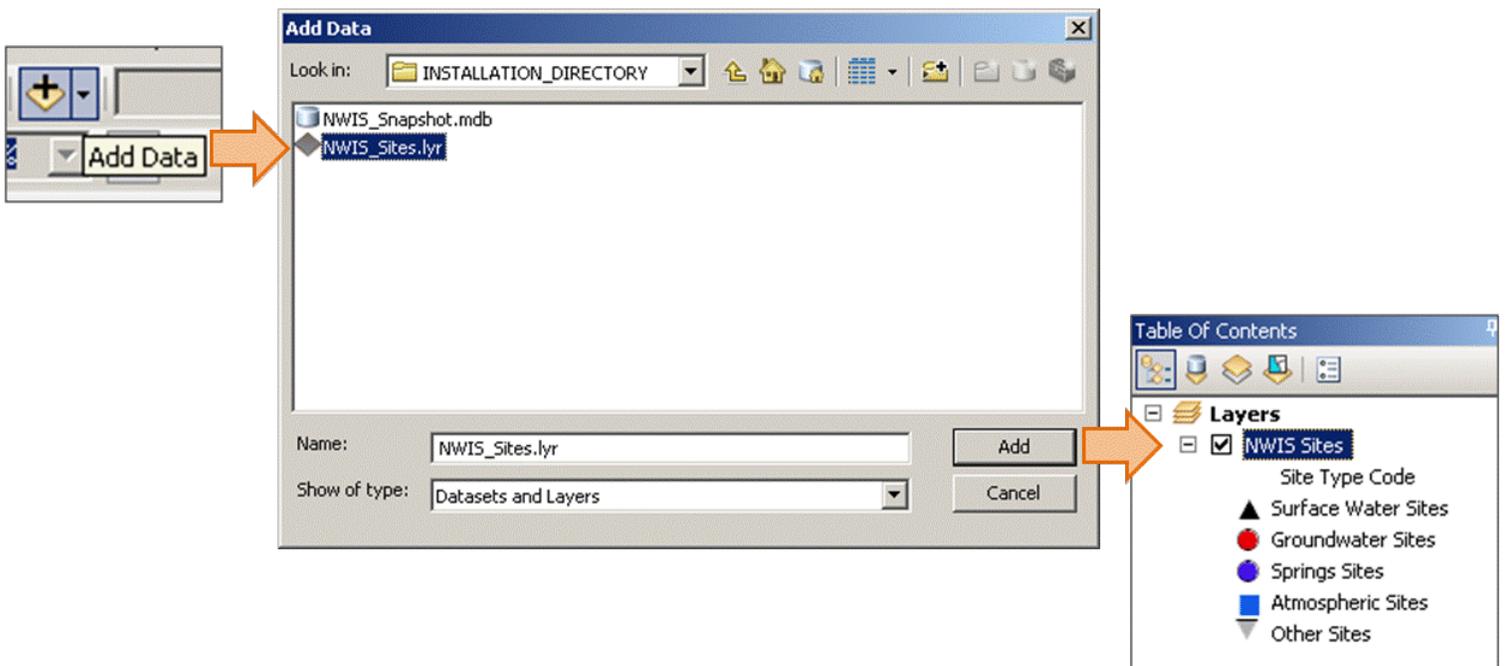
- Check to see that the Snapshot icon (Figure 3) is now visible.

Congratulations! You have successfully installed the NWIS Snapshot toolbar. You will launch the add-in using this toolbar after you have added the NWIS Sites layer file to the ArcMap document using the ArcMap document set-up steps.

ArcMap document set-up

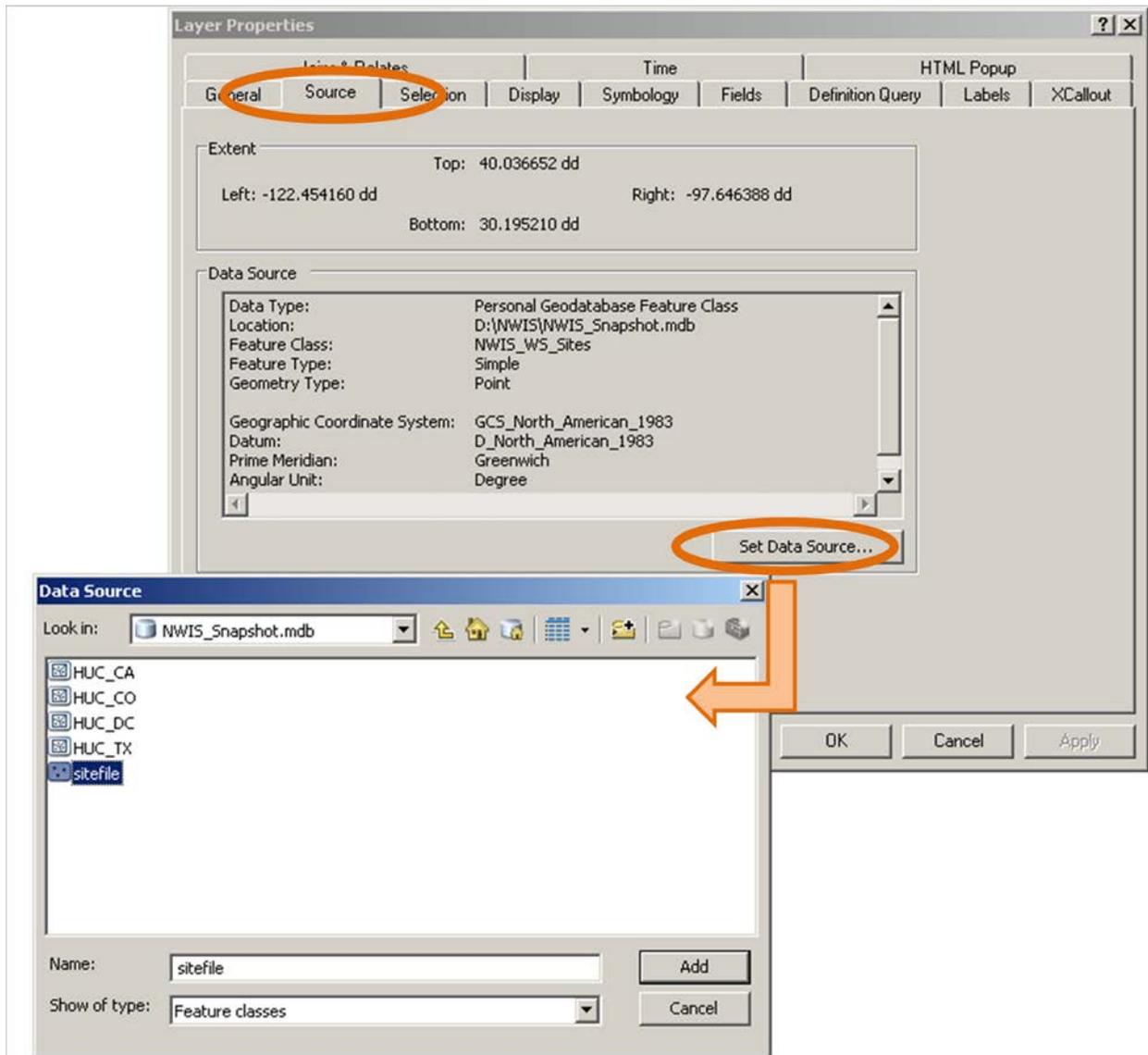
- Add the **NWIS_Sites.lyr** from the installation directory to an ArcMap document (Figure 5).

Figure 5. Add the NWIS_Sites.lyr file from the installation directory to the ArcMap document.



- Define the data source for the NWIS_Sites.lyr (Figure 6). To do this:
 - Right-click on the **NWIS Sites** layer in the ArcMap Table of Contents and select **Properties**.
 - In the **Source** tab of the Layer Properties window, select **Set Data Source...**
 - Navigate to the installation directory and **sitefile** in **NWIS_Snapshot.mdb** personal geodatabase. Click **Add**.
 - After the Data Source window closes, click the **Apply** button and then **OK** in the Source tab.

Figure 6. Update the data source of the NWIS_Sites.lyr file to point to the sitefile feature class.



Congratulations, you have successfully added the NWIS sites layer and linked it with the sitefile feature class in the Snapshot geodatabase. You are now ready to start using the Snapshot Tool to retrieve data from NWIS Web Services.

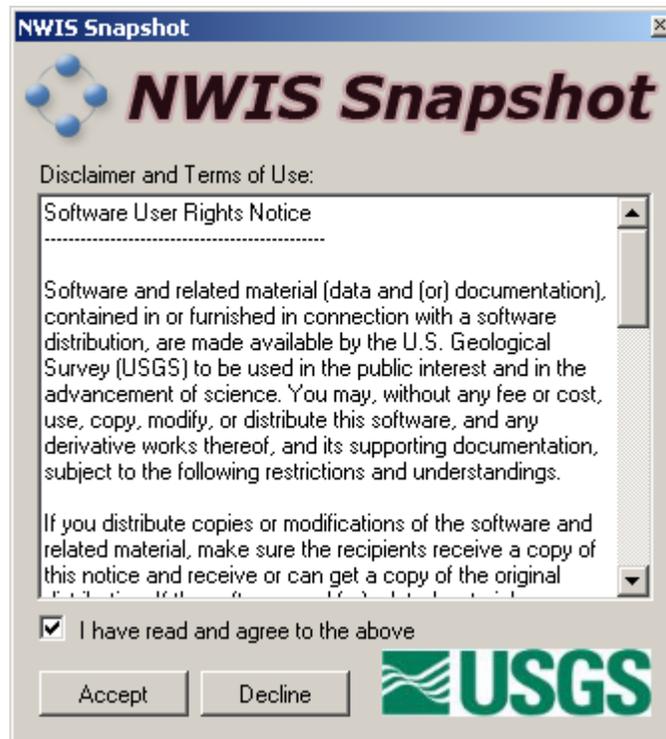
Program Execution and Interface

The following section explains how to launch the tool and use each tab of the NWIS Snapshot Tool interface to request web services data. It assumes you have installed the tool using instructions in the *Installation* section of this document.

Program Execution

- Launch the Snapshot using the add-in toolbar ().
- After reviewing the Software User Rights Notice, check the box next to *I have read and agree to the above* and click **Accept** (Figure 7).

Figure 7. Software User Rights Notice window.

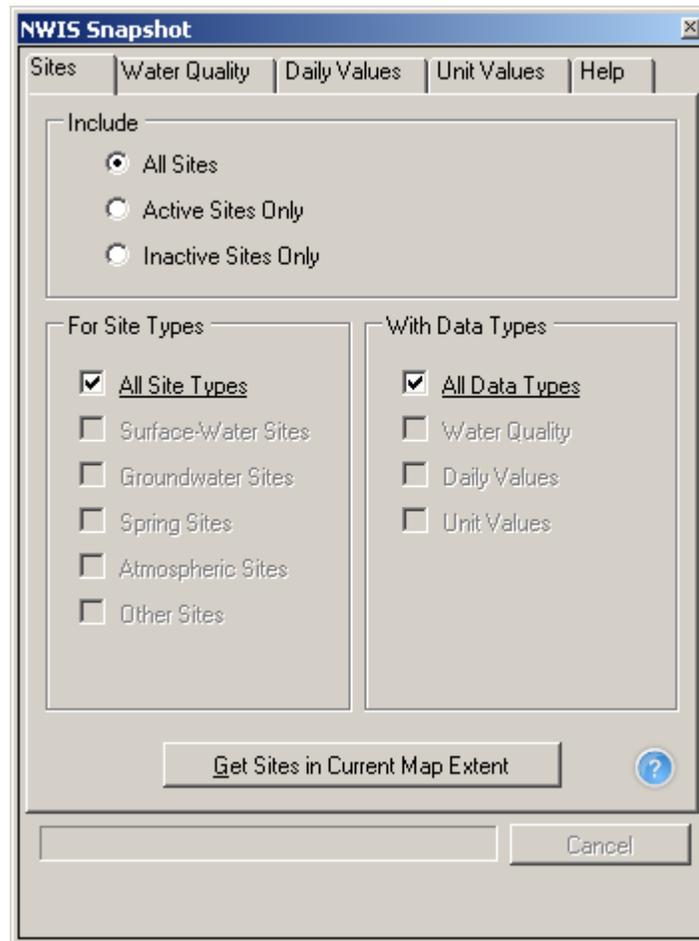


Program Interface

Sites Tab

Use the Sites tab (Figure 8) to retrieve data from the USGS Site Service.

Figure 8. The Sites tab.



1. Select a radio button in the **Display** frame to view points for sites categorized as **All**, **Active**, or **Inactive**.
2. Check one or more boxes in the **For Site Types** frame to download data for any combination of the following site categories: surface water, groundwater, springs, atmospheric sites, or other sites. The web service request is based on the NWIS Site Type Code (SITE_TP_CD). Table 1 shows the NWIS site type codes within each site category.

Table 1. NWIS Site Type Categories and Site Type Codes within each category.

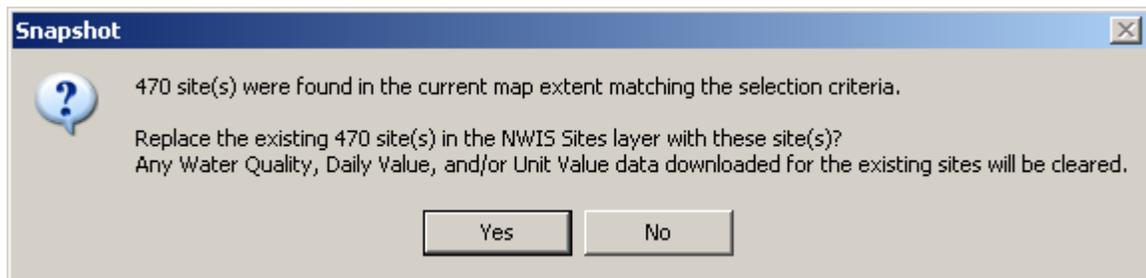
Site Category	Site Type Codes ²
Surface water	'ES','GL','LK','OC','OC-CO','ST','ST-CA','ST-DCH','ST-TS','WE'
Groundwater	'GW','GW-CR','GW-EX','GW-HZ','GW-IW','GW-MW','GW-TH','SB','SB-CV','SBGWD','SB-TSM','S B-UZ'

² Each Site Type Code is explained at http://nwis.waterdata.usgs.gov/nwis/help/?read_file=site_tp&format=table

Site Category	Site Type Codes ²
Springs	'SP'
Atmospheric	'AT'
Other	'AG','AS','AW','FA-CI','FA-CS','FA-DV','FA-FON','FA-GC','FA-LF','FA-OF','FAPV','FA-QC','FA-SEW','FA-SPS','FA-STC','FA-WDS','FA-WIW','FA-WU','FAWWD','LA','LA-EX','LA-OU','LA-SH','LA-SNK','LA-SR','SS'

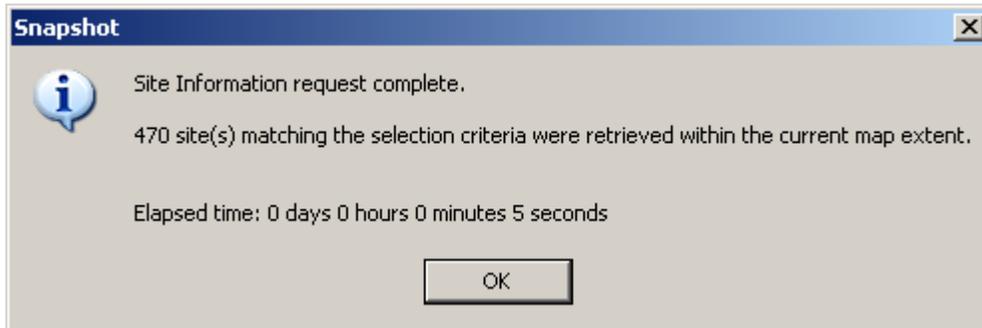
3. Use the options in the **With Data Types** frame to select sites that have water quality results, daily values or instantaneous values.
4. After the site and data types have been selected, submit a query to the NWIS Site Web Service by clicking **Get Sites in Current Map Extent** button.
5. A request confirmation window will appear. If a previous request has been made, all of the data in the **sitefile** table in the geodatabase will be replaced. Click Yes or No to confirm or cancel the request (Figure 9).

Figure 9. Confirm request to the NWIS Site Web Service.



6. A progress bar and data retrieval status will appear at the bottom of the user interface. An example of a data retrieval status message is "Site 304035097365001 added (470 of 470)." This means that information for NWIS site ID 304035097365001 has been added to the sitefile feature class attribute table and a point has been created in the sitefile feature class. This was the final site to be added: (470 of 470).
7. Next, a window summarizing the data retrieval will appear. Click OK after reviewing the summary.

Figure 10. Review summary of NWIS site information retrieval.



8. If site information is available, the Snapshot tool will populate the **sitefile** feature class (Figure A28) in NWIS_Snapshot.mdb. Another table that is populated with each request to a web service is the **Snapshot_DL_Date** table (Figure 11).

Figure 11. The date and time of each web service request are recorded in the Snapshot_DL_Date table.

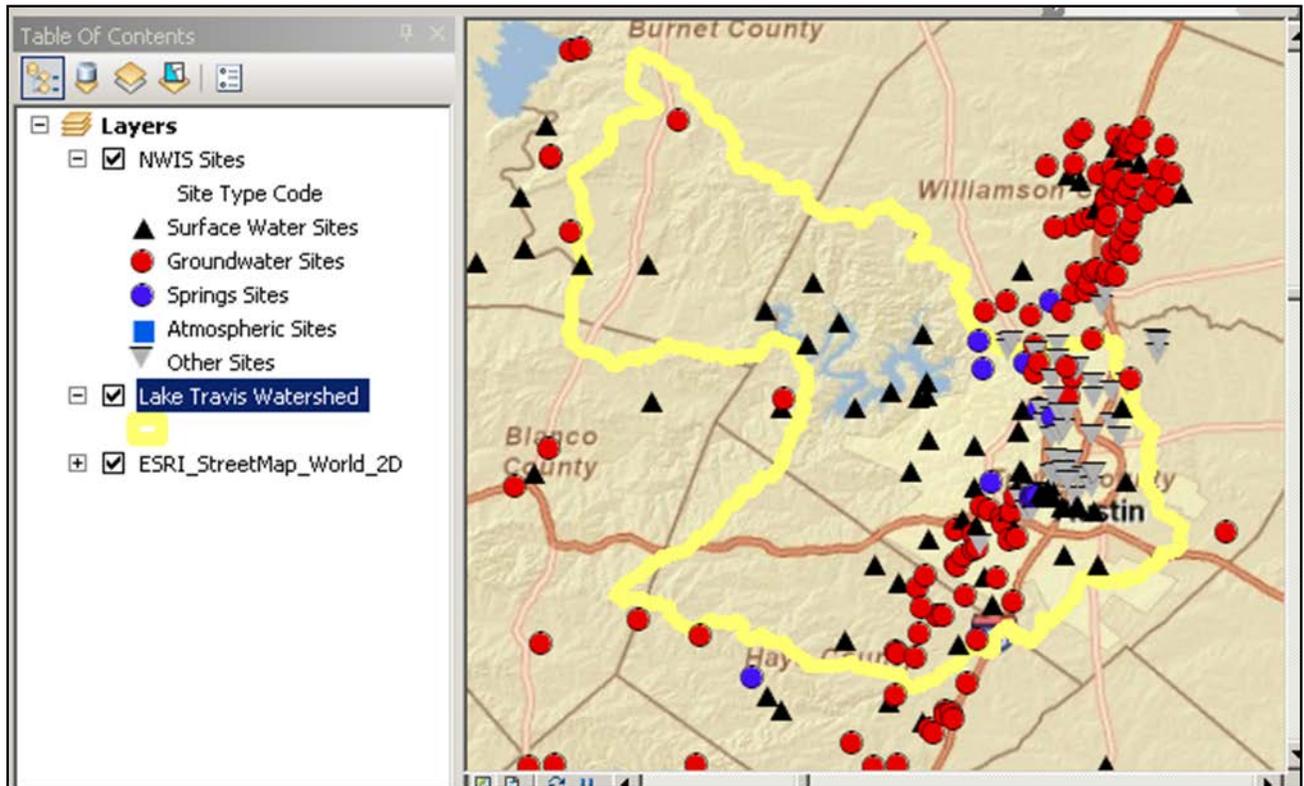
OBJECTID ^	Snapshot_Query	Snapshot_Date
1	Sites	6/5/2012 7:15:22 PM
2	Sites	6/5/2012 7:24:28 PM
3	Water Quality	6/5/2012 8:07:47 PM
4	Water Quality	6/5/2012 8:10:58 PM
5	Daily Values	6/5/2012 8:28:44 PM
6	Daily Values	6/5/2012 8:29:05 PM
7	Daily Values	6/5/2012 8:58:12 PM
8	Unit Values	6/5/2012 9:10:16 PM

Snapshot_DL_Date (0 out of 8 Selected)

Several factors influence the types of sites returned for a Sites query. One factor is the frequency of USGS water data collection for different categories of sites. For example, approximately 87% of the NWIS sites are groundwater sites but many are inactive.

Figure 12 illustrates sites retrieved from the USGS Site Service.

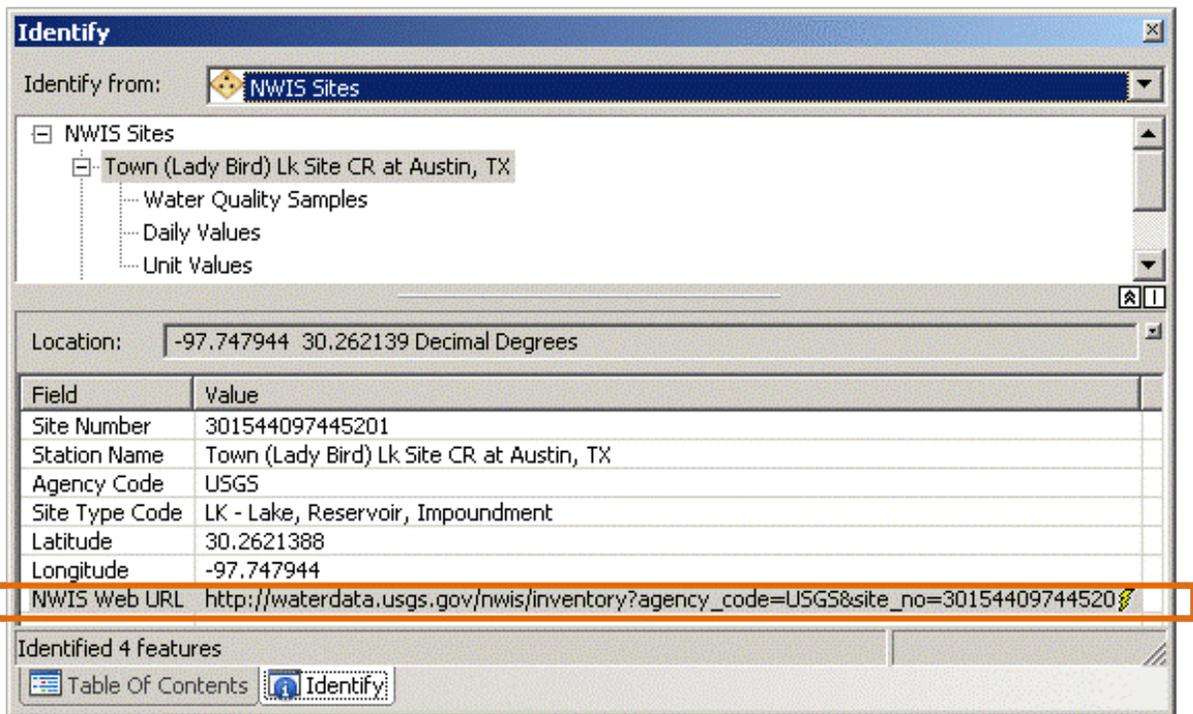
Figure 12. ArcMap window showing NWIS sites retrieved from web services.



Explore site information using the ArcMap Identify tool and USGS Water Data for the Nation website

- Select the **Identify** tool () and click on one or more of the sites for which you retrieved information from the NWIS Site Web Service. Examine the information. An example of Identify results is shown in Figure 13.

Figure 13. Example of results from the ArcMap Identify tool.



- Click the **NWIS Web URL** link in the Identify results window. This action should launch an Water Data for the Nation web page that may look similar to that shown in Figure 14. This page describes which types of data are available for a site and the time period of record.

Figure 14. The NWIS Web URL in the sitefile table points to the USGS Water Data for the Nation web page of each site.

USGS 301544097445201 Town (Lady Bird) Lk Site CR at Austin, TX

Available data for this site

Lake Site

DESCRIPTION:
Latitude 30°15'43.7", Longitude 97°44'52.6" NAD83
Travis County, Texas, Hydrologic Unit 12090205
Datum of gage: 0. feet above NGVD29.

AVAILABLE DATA:

Data Type	Begin Date	End Date	Count
Field/Lab water-quality samples	1975-02-03	2004-10-02	205

OPERATION:
Record for this site is maintained by the USGS Texas Water Science Center
Email questions about this site to [Texas Water Science Center Water-Data Inquiries](#)

Water Quality Tab

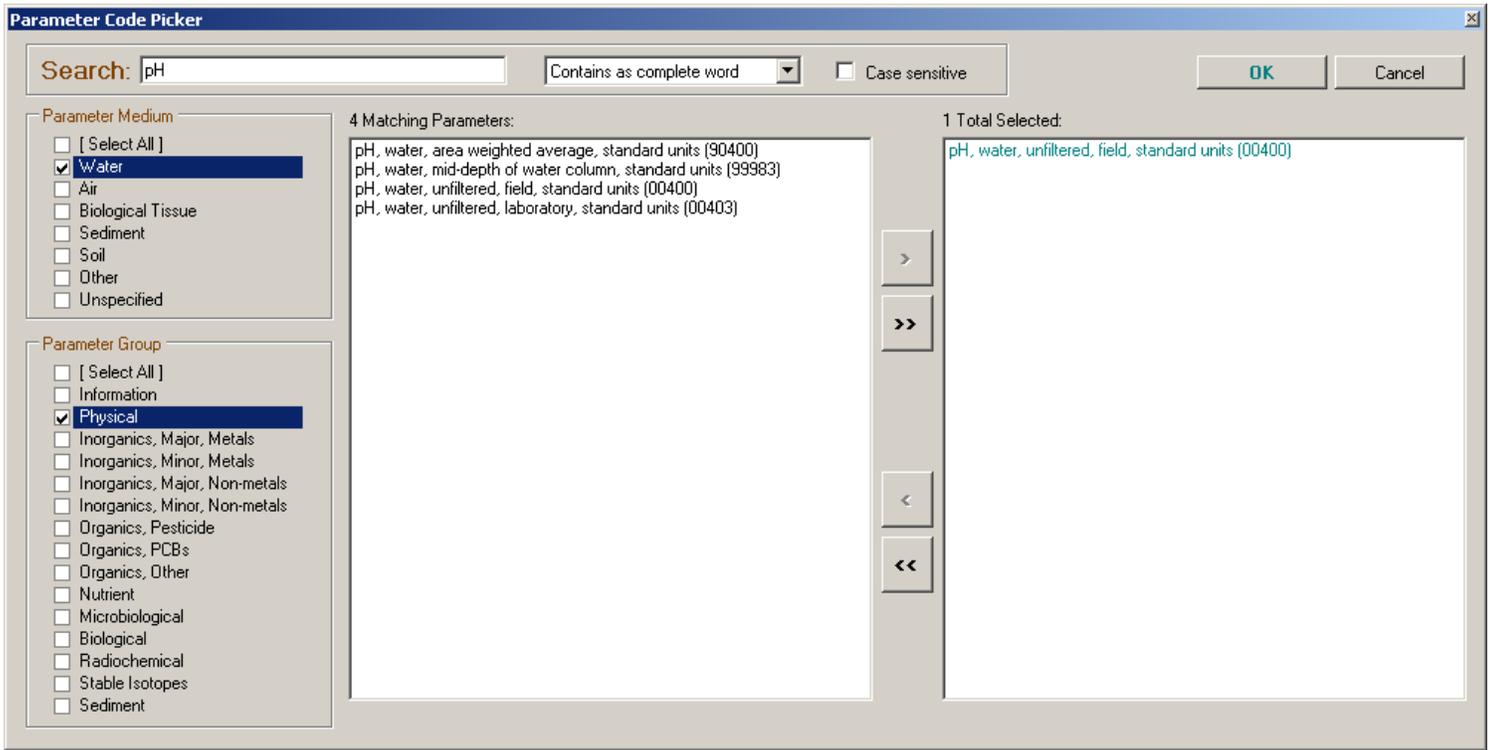
Use the Water Quality tab (Figure 15) to retrieve data from the Water Quality Data Portal (WQP).

Figure 15. The Water Quality tab.

The screenshot shows the 'NWIS Snapshot' dialog box with the 'Water Quality' tab selected. The dialog has four tabs: 'Sites', 'Water Quality', 'Daily Values', 'Unit Values', and 'Help'. The 'Water Quality' tab is active. It contains three main sections: 'Site Selection', 'Parameter Codes', and 'Date Range'. In the 'Site Selection' section, the radio button 'Request Data for Selected Sites' is selected. The 'Parameter Codes' section features a list box containing '00010', '00045', '00055', '00060', and '00065'. To the right of the list box are buttons for 'Selection Tool' and 'Top Ten', and a checkbox for 'All Parameter Codes' which is currently unchecked. The 'Date Range' section has 'Start Date' and 'End Date' dropdown menus, both showing '6/ 3/2012' and '6/ 5/2012' respectively, and a checkbox for 'All Available for Period of Record' which is unchecked. At the bottom of the dialog are buttons for 'Get Water Quality Data' and 'Cancel', along with a help icon (question mark in a circle).

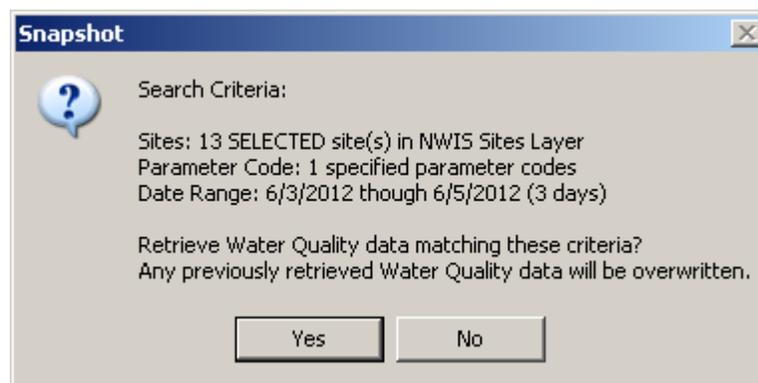
1. Select a radio button in the **Site Selection** frame to request data for all the displayed sites or only data for sites selected using standard ArcMap feature selection tools.
2. In the **Parameter Codes** frame, list USGS parameter codes for which you wish to retrieve data or check **All Parameter Codes** to request all available water quality data. When you type parameter codes into the Parameter Codes text box, enter a carriage return after each code. The top-ten most-frequently requested parameter codes are listed by default.
3. Click the **Selection Tool** button to open the **Parameter Code Picker**. Use the Parameter Code Picker to build a list of parameter codes (Figure 16). Parameters are also known as characteristics. Search by CAS number, USGS parameter code number, characteristic names, or *regular expression*. Click OK when you have selected the parameter or characteristic names of interest.

Figure 16. Use the Parameter Code Picker selection tool to build a list of one or more characteristics.



- Next, select a date range using the **Start Date** and **End Date** pickers or check the **All Available for Period of Record** checkbox. You may type the date directly into the Start Date and End Date boxes or click the downward arrow next to each date to bring up the **date picker**. In the date picker, select a month by clicking once on the month name and selecting a month from the month pop-up menu. Select a year by clicking once on the year and using the up/down arrows to select a year. Alternatively, scroll through months and years using the right/left arrow keys.
- Click the **Get Water Quality Data** button to submit a request to the NWIS Water Quality Web Service. A window summarizing your web services request will appear. Click Yes or No to proceed with or cancel the request.

Figure 17. Confirm request to the Water Quality Data Portal (WQP).



6. A progress bar and data request status message will appear. An example of a status message is Site 08155200: Querying web service. In this case the Snapshot Tool is submitting a request to the WQP for the USGS site with an ID number of 08155200. After the request is completed, a window summarizing the number of sites for which data was or was not returned. There is also a link to a download report. This download is an HTML file entitled “NWIS Water Quality Snapshot Report” (Figure 19). Web request errors are summarized in this report along with date ranges and counts of samples by site.

Figure 18. Review a summary of the WQP response.

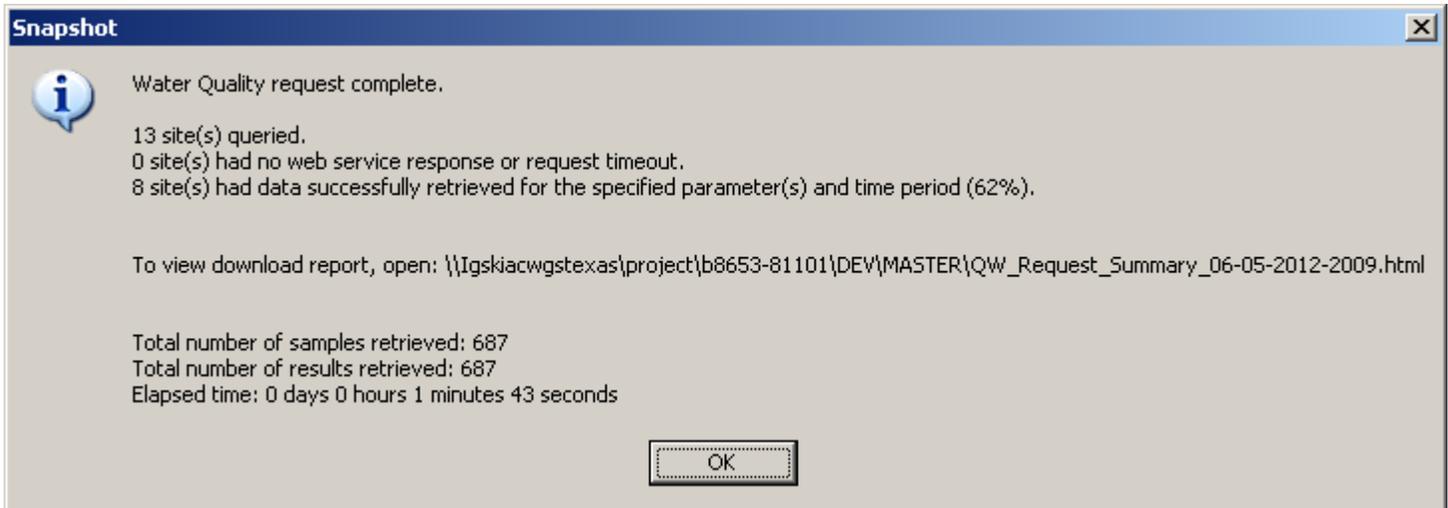


Figure 19. NWIS Water Quality Snapshot Report. Click on a “Request” link to view the original data or error message returned by the WQP.

NWIS Water Quality Snapshot Report

*Bad Request = Combination of Site and ParamCode is not found

Started: 9/2/2011 7:31:41 PM

Web Request Errors

Site	ParamCode	URL	Response
	&pCode=00400	Request	Good Data
	&pCode=00400	Request	Good Data
	&pCode=00400	Request	Good Data
	&pCode=00400	Request	Good Data
	&pCode=00400	Request	Good Data
	&pCode=00400	Request	Good Data
	&pCode=00400	Request	Good Data
	&pCode=00400	Request	Good Data
	&pCode=00400	Request	Good Data
	&pCode=00400	Request	Good Data

Sample Stats

Site	Min Date	Max Date	Sample Count
08154050	9/13/2005	9/13/2005	1
08154700	4/11/1978	5/12/2011	198
08155200	4/10/1978	1/9/2011	202
08155240	12/20/1988	1/16/2011	199
08155300	1/4/1979	4/27/2008	173
08155400	11/5/1969	3/20/2010	56
08156800	1/15/1975	5/12/2011	167
08158000	10/1/1967	8/19/1993	229
08158200	4/2/1976	1/28/1986	20
08158600	4/2/1976	6/22/2011	175
08158700	1/11/1974	1/9/2011	188
08158810	3/1/1978	6/9/2010	118
08158827	10/26/2004	5/29/2005	2
08158840	6/9/1983	4/17/2010	91

- If data are available, two geodatabase tables will be populated, qw_sample and qw_result. There is a one-to-many relationship from qw_sample to qw_result.

Querying the water quality results

Now that you have requested water quality data, you may query the results. The following example will help answer question: Which of the sites in my study area have pH values below a specified threshold?

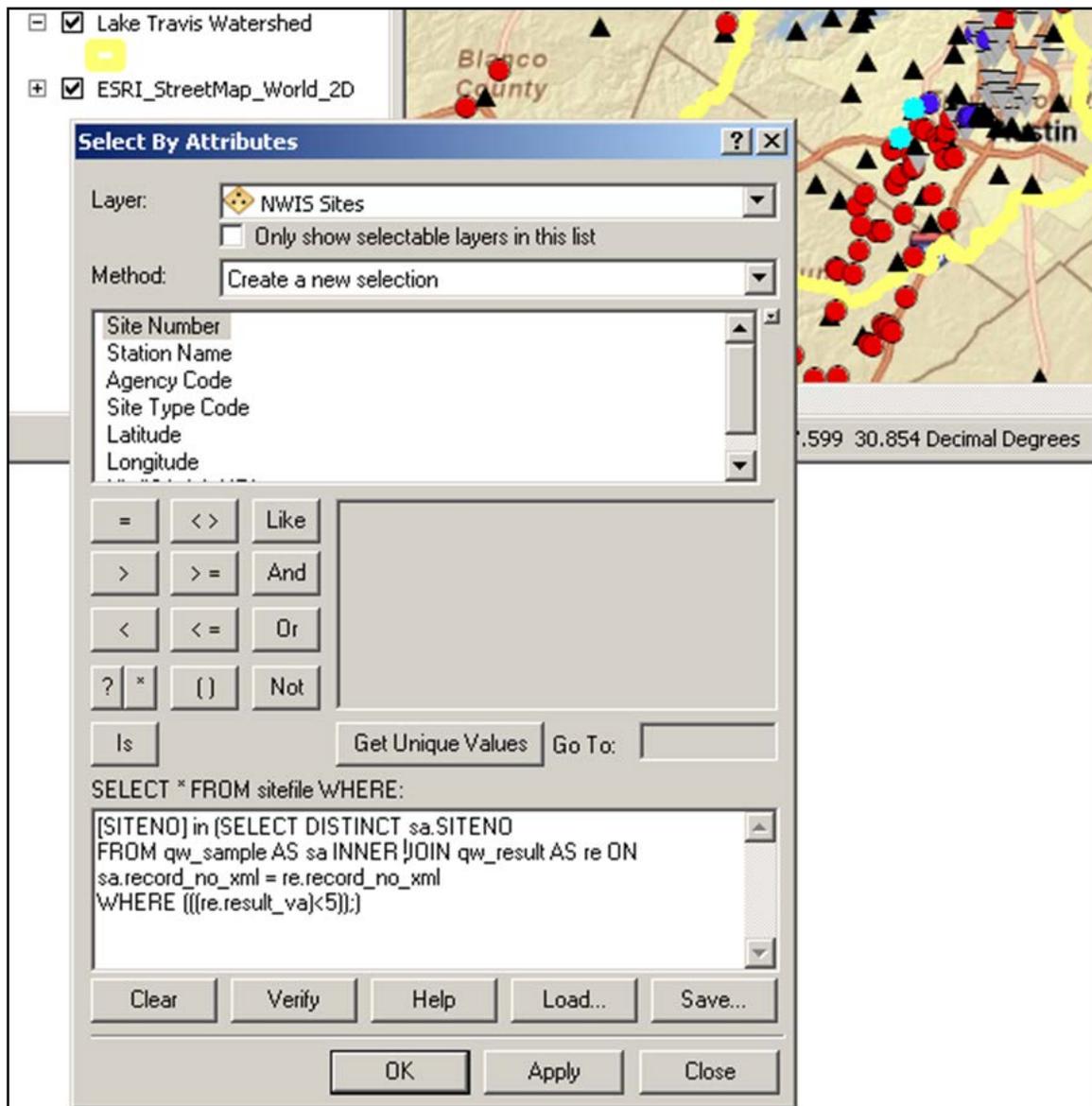
- From the main ArcMap menu, choose **Selection | Select by Attributes...**
- In the Select by Attributes window, make sure NWIS Sites is the selection layer (Figure 20).

- In the **SELECT * FROM sitefile WHERE:** box, you may enter this expression which will select all sites with a pH value less than 5:

```
[SITENO] in (SELECT DISTINCT sa.SITENO FROM qw_sample
AS sa INNER JOIN qw_result AS re ON sa.record_no_xml =
re.record_no_xml WHERE (((re.result_va)<5));)
```

- Choose **Verify** then **Apply** to check and run the query expression to select the sites. In Figure 20, executing the query reveals that two sites have pH values less than five.

Figure 20. Use a query expression in Select by Attributes to select sites based on water quality result value criteria.

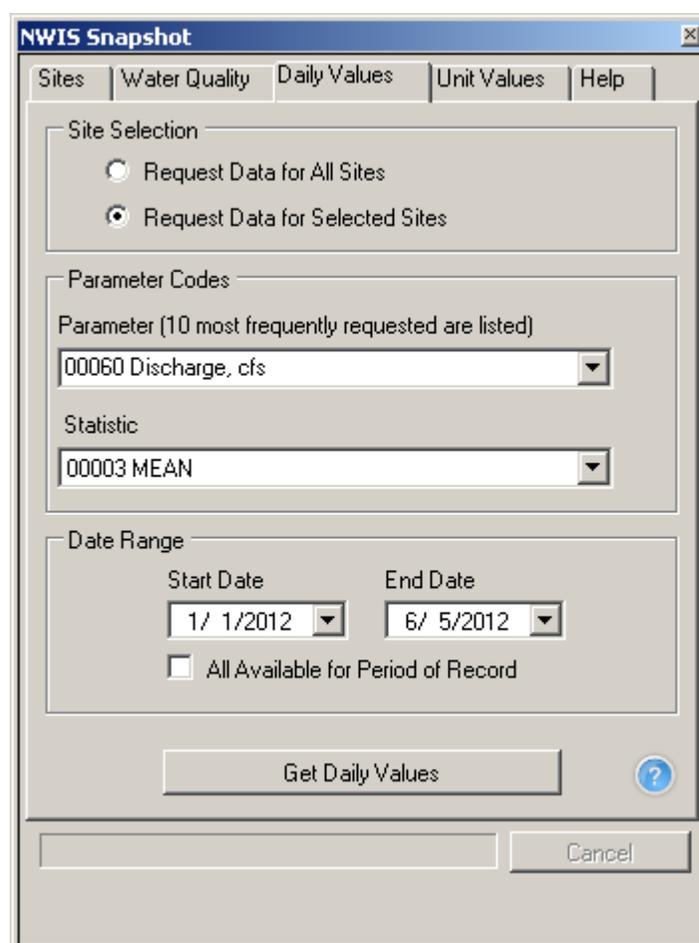


- Close the Select by Attributes window.

Daily Values Tab

Use the Daily Values tab (Figure 21) to download data from the USGS Daily Values Site Web Service. It is important to refine your search as much as possible due to the large quantity of data that may be returned. Ways to refine your search include selecting a subset of sites, reducing the spatial extent of the search area, and constraining the date range.

Figure 21. The Daily Values tab.



The image shows a software dialog box titled "NWIS Snapshot" with a tabbed interface. The "Daily Values" tab is selected. The dialog is divided into several sections: "Site Selection" with two radio buttons, "Parameter Codes" with two dropdown menus, and "Date Range" with two date dropdowns and a checkbox. At the bottom are "Get Daily Values" and "Cancel" buttons.

NWIS Snapshot

Sites | Water Quality | **Daily Values** | Unit Values | Help

Site Selection

Request Data for All Sites

Request Data for Selected Sites

Parameter Codes

Parameter (10 most frequently requested are listed)

00060 Discharge, cfs

Statistic

00003 MEAN

Date Range

Start Date: 1/ 1/2012

End Date: 6/ 5/2012

All Available for Period of Record

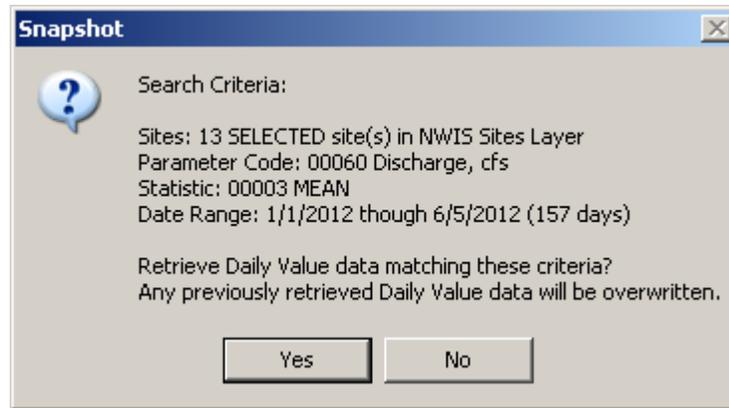
Get Daily Values

Cancel

1. Select a radio button in the **Site Selection** frame to request data for all the displayed sites or only data for sites selected using the standard ArcMap point feature selection tools.
2. The **Parameter Codes** frame has a dropdown box for specifying the NWIS Parameter code. The dropdown box allows the user to select from the ten most-frequently requested NWIS parameter codes. You can also manually enter a parameter code.
3. The **Codes** frame has a second dropdown box for specifying the NWIS Statistics code. Caution: It is possible for a user to select a statistic code that is not available for a given USGS parameter code. If no data is returned for your code combination, try selecting a different combination of parameter and statistic code.
4. Use the **Data Range** frame to select start and end dates.

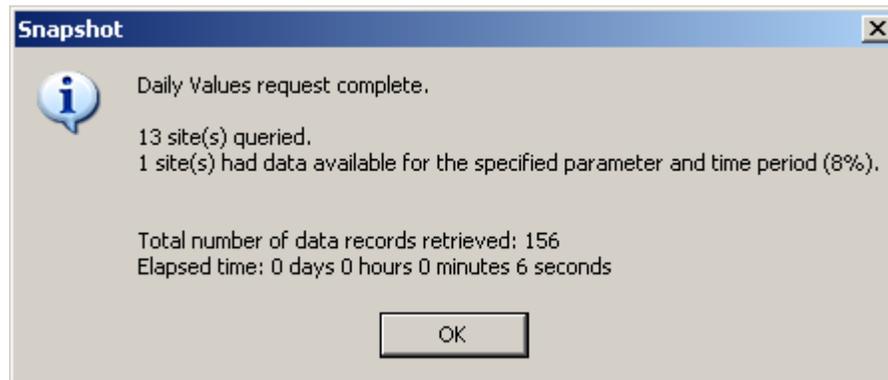
5. Click the **Get Daily Values** button to request data. A window summarizing the request to the NWIS Daily Values Web Service will appear (Figure 22). Click Yes or No to proceed with or cancel the request.

Figure 22. Confirm request to the NWIS Daily Values Web Service.



6. When the data request is complete, a window summarizing the results will appear (Figure 23). Click OK after reviewing this information.

Figure 23. Review a summary of NWIS Daily Values Web Service response.



7. If data are available, the query populates a geodatabase table called **dv_result** with the following data returned by the web service: the USGS site number, the parameter code (00065 = gage height, for example), the statistics code (00003 MEAN, for example), the date and time, the qualifiers (P=Provisional, for example) and the daily value.

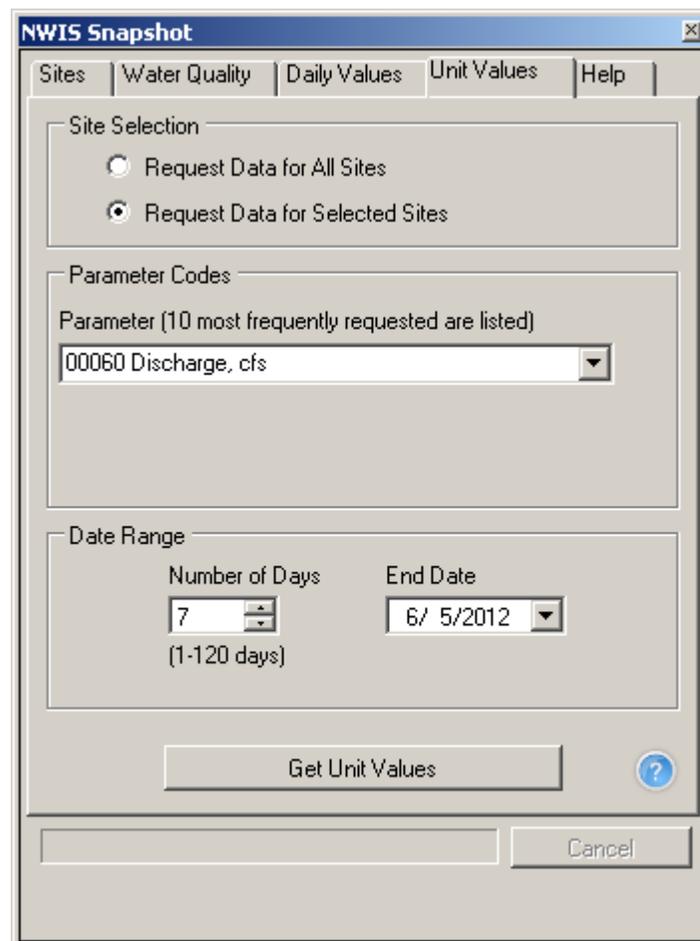
Viewing and summarizing daily values

View the Daily Values (dv_result) table in NWIS_Snapshot.mdb to see the output from the query. Tip: Review Adding and viewing tables in ArcMap for help. Optionally, use the ArcMap 10.0 Statistics and Create Graph functions to numerically and visually summarize the data you downloaded.

Unit Values Tab

Use the Unit Values tab (Figure 24) to download data from the USGS Instantaneous Values Web Service. An important tip in requesting data from the Unit Values Web Service is to refine your search as much as possible. Remember that unit values, also called instantaneous or real-time values, are recorded daily up to every 15 minutes which can result in a large amount of data and subsequently, a very long data request time. For example, selecting 30 days of data for just four sites yields more than 10,000 measurements.

Figure 24. The Unit Values tab.

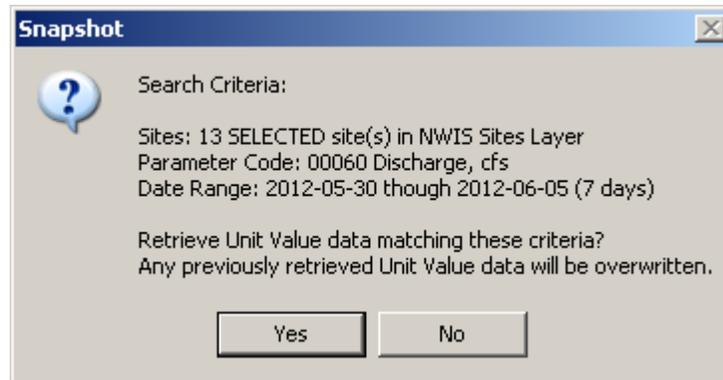


The screenshot shows the 'NWIS Snapshot' dialog box with the 'Unit Values' tab selected. The dialog has a title bar with a close button. Below the title bar are five tabs: 'Sites', 'Water Quality', 'Daily Values', 'Unit Values', and 'Help'. The 'Unit Values' tab is active. The dialog is divided into three main sections: 'Site Selection', 'Parameter Codes', and 'Date Range'. In the 'Site Selection' section, there are two radio buttons: 'Request Data for All Sites' (unselected) and 'Request Data for Selected Sites' (selected). The 'Parameter Codes' section has a label 'Parameter (10 most frequently requested are listed)' and a dropdown menu showing '00060 Discharge, cfs'. The 'Date Range' section has two sub-sections: 'Number of Days' with a spinner box set to '7' and a note '(1-120 days)', and 'End Date' with a dropdown menu set to '6/ 5/2012'. At the bottom of the dialog, there is a 'Get Unit Values' button, a help icon (a blue circle with a white question mark), and a 'Cancel' button.

1. Select a radio button in the **Site Selection** frame to request data for all the displayed sites or only data for sites selected using standard ArcMap point feature selection tools.
2. The **Parameter Codes** frame has a dropdown menu for specifying an NWIS Parameter code. The dropdown menu allows the user to select from the ten most-frequently requested NWIS Parameter codes. The user may also type a five-digit parameter code into this box. A description of parameter codes is available at <http://nwis.waterdata.usgs.gov/usa/nwis/pmcodes>.
3. Use the **Date Range** frame to select the number of days of data back from the present day.

4. Click the **Query NWIS Unit Values Web Service** button to submit a request for data. A window will appear summarizing the request to the NWIS Instantaneous Values Web Service. Click Yes or No to proceed with or cancel the request.

Figure 25. Confirm request to the NWIS Instantaneous Values Web Service.



5. After the request is complete, a window will appear summarizing the web service response results. If zero sites had data available for the specified parameter and time period, you may consider revising your request. Click OK after reviewing the response summary.

Figure 26. Summary of NWIS Instantaneous Values Web Service response.



6. If data are available, the unit values query populates a geodatabase table called **uv_result** with the following data: the USGS site number, the parameter code (00065 = gage height, for example), the date and time, the qualifiers (P=Provisional, for example) and the value.

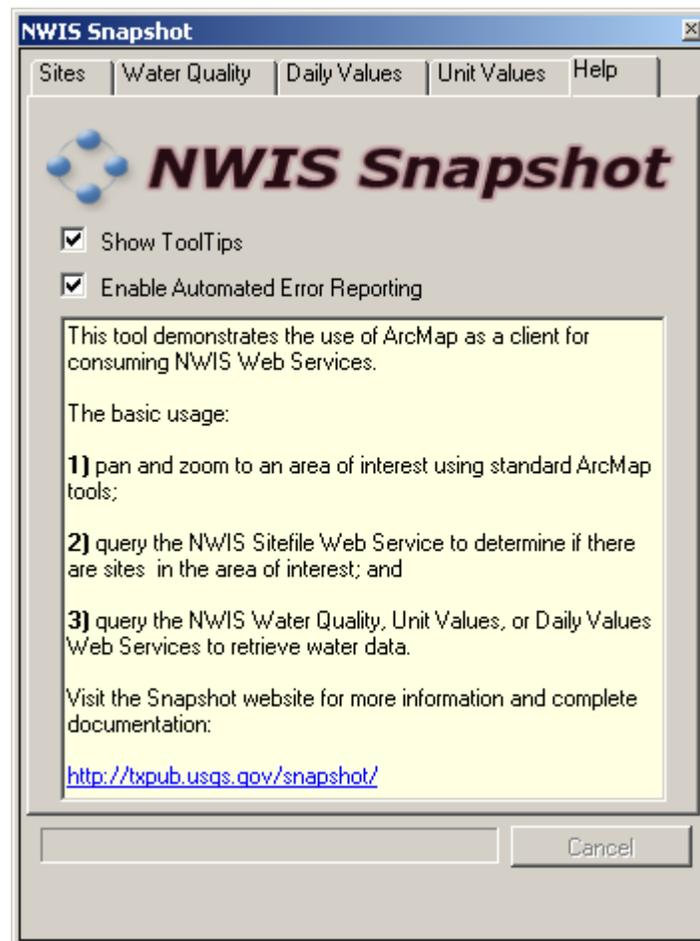
Viewing and summarizing instantaneous values

View the instantaneous values table (uv_result) table in NWIS_Snapshot.mdb to see the output from the query. Review *Adding and viewing tables in ArcMap* for help. Optionally, use the ArcMap 10.0 *Statistics* and *Create Graph* functions to numerically and visually summarize the data you downloaded.

Help Tab

The Help tab (Figure 27) outlines the basic tool usage, where to find information about NWIS web services, and provides a link to the software website.

Figure 27. The Help tab.



Uncheck **Show ToolTips** to turn off tool tips in the software.

Uncheck **Enable Automated Error Reporting** if you do not wish to have an error report sent to the software developers if an exception occurs during runtime.

Known issues and limitations

This section lists known issues with the NWIS Geodatabase Snapshot Tool or the data downloaded with the tool.

- It is important to note that each time a new query is run, all records are replaced in the corresponding geodatabase table. Any new data completely replaces the previously downloaded data. If you would like to retain the results of your queries, use ArcCatalog to make a copy of your geodatabase before running the tool again.
- The personal geodatabase has a size limit of 2 GB.
- The name “Snapshot” refers to a subset of a much larger database. Because the NWIS database contains over 1.5 million sites, it is not possible to download all sites and all data with a single query. You may use NWIS Mapper (<http://wdr.water.usgs.gov/nwisgmap/>) to explore NWIS site locations at a national scale. Use USGS websites such as WaterQuality Watch (<http://waterwatch.usgs.gov/wqwatch/>) and Water Watch (<http://waterwatch.usgs.gov/uvmap/>) to explore water data at a national scale.
- The Snapshot Tool works best for landscape-scale or local-scale data requests. Although there is no constraint on the spatial extent of the area for which site information may be requested, it is a best practice to constrain the area of interest and number of sites for a data request as much as possible because ArcMap does not perform optimally with very large data sets and because of the 2 GB size limit of the geodatabase. The source code may be modified by a trained developer to accommodate use of a file geodatabase or other type of database, however.
- If your network connection is down, this tool will not function properly. You can however work “off-line” once you have downloaded all the data to the geodatabase.
- The Snapshot Tool completely relies on the proper functioning of web services. If you plan to request data often from web services using the Snapshot tool, it is a good idea to subscribe to the USGS Water Data Notification Service (<http://waterdata.usgs.gov/nwis/help/help?form=email>) to receive updates about system events like down time or changes.
- The local system date and time on the computer running the Snapshot must be correct. At startup, Snapshot uses USGS Water Data for the Nation website to find the date and time and that is then compared to the user’s computer system date and time. The system time is accepted by the software if it is +/- 12 hours compared to the date and time on the USGS Water Data for the Nation website. If there is a larger discrepancy, a warning dialog pops up

notifying the user "The Snapshot tool requires requires an accurate computer system Date-Time for some of its features. Please verify your computer Date-Time and adjust if needed."

- The NWIS web services data retrieved by the current version of the Snapshot tool are only those available to the public, similar to that available via the USGS Water Data for the Nation website (<http://waterdata.usgs.gov/>). An example of an NWIS site for which data are not publicly available via web services or Water Data for the Nation is USGS 11455760, Suisun Bay near the Concord Naval Weapons Station in California. Further documentation on NWIS web services data is available at <http://waterservices.usgs.gov/>.
- sitefile table:** LAT and LONG are read as a strings and truncated to the first ten characters. In a spot check in the NWIS Texas database, the largest difference in LAT was -9.4131497263561E-08 and the largest difference in LONG was 9.42214271049124E-07.
- qw_sample table:** There are some occurrences where the Snapshot time is null but 1:00:00 AM is stored in NWIS QWDATA. This is an artifact of INGRES and Access and is not an error.
- qw_result table:** In order to be available on the Water Quality Web Service the NWIS parameter must have an SRSNAME (in other words, an equivalent in the EPA water quality database) in `nwis_parm_alias.parm_alias_cd`
- qw_result table:** The `project_cd` field might be different than what is stored in NWIS if parameter code 71999 is populated.
- qw_result table:** There may be a difference in water quality result values due to rounding. For example, in one example the NWIS value is 19800000 and the NWIS Web Services value is 20000000, with a resulting difference of 200000 between the two databases.
- qw_result table:** Result values are delivered as strings from the Water Quality Data Portal. To facilitate query and analysis of water quality result values, they are converted to numbers when being parsed and stored in the geodatabase. If the conversion from string to number fails, a value of -99999.99 is used. Examples of strings replaced by -99999.99 in the result value field are "1.2ice" or "dead fish in the water".
- Data from the NWIS GWSI (groundwater) database is not yet available via web services. It is possible to access some groundwater levels through some of the available web services. An example of data not available via web services is the following groundwater level measurement from a well in California in 1949:
http://nwis.waterdata.usgs.gov/usa/nwis/gwlevels/?site_no=381710122064901

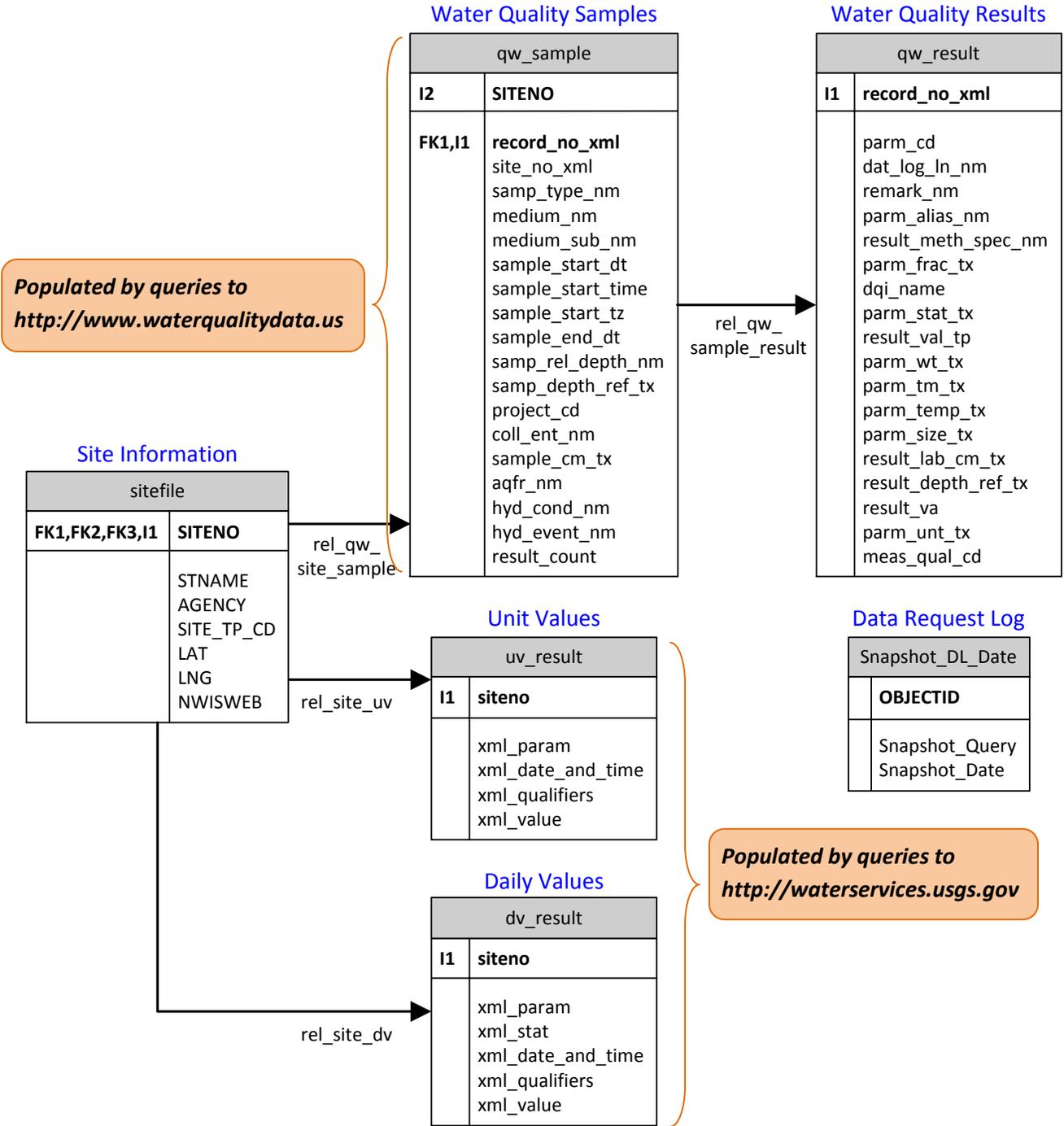
Appendix A: Geodatabase Schema

NWIS_Snapshot.mdb is an ESRI personal geodatabase in which downloaded NWIS web services data are stored. A personal geodatabase is a collection of geographic datasets of various types held in a Microsoft Access database.³ The geodatabase schema is shown in Figure A28. There are more tables in the geodatabase other than those shown here; however, the tables shown here are the primary data tables and are the most important ones to the end user.

The geodatabase NWIS_Snapshot.mdb is delivered with the Snapshot Tool installation files and populated by user-run NWIS web services queries. In Figure A28 FK means Foreign Key and I means Index. Key and index fields are used to link or relate geodatabase tables. Arrows represent relationships between tables. For example, rel_qw_sample_result is a relationship class stored in the geodatabase that links water quality samples with water quality results in a one-to-many relationship. Note that the relationships between tables only exist in the ArcGIS personal geodatabase environment.

³ Geodatabases are explained at <http://resources.arcgis.com/content/geodatabases/10.0/about>.

Figure A28. The NWIS Snapshot geodatabase schema.



Appendix B: Web Services

The NWIS Web Services Snapshot Tool interface contains four tabs for the user to specify parameters for requesting NWIS web services data and one “Help” tab with information about the Tool and how to submit feedback on it. Each tab in the user interface corresponds with a single web service from which data are downloaded. The tab names and corresponding web services are listed in Table 2.

Table 2. NWIS Snapshot Tool user interface components, web services, and geodatabase tables.

NWIS Snapshot tab name	Web service name	Web service reference URL	Geodatabase table populated by web service query ⁴	Data Description
Sites	USGS Site Service	<i>http://waterservices.usgs.gov/rest/Site-Test-Tool.html</i>	sitefile	“Important information about USGS hydrological sites as well as cooperator sites that it serves.” ⁵
Water Quality	Water Quality Portal	<i>http://www.waterqualitydata.us/webservices_documentation.html</i>	qw_sample, qw_result	“Data from the NWISWeb database. All publicly available data are not available through the web services at this time.” ... “[A]pproximately 92% of water-quality data [are] available from NWISWeb.” ⁶
Daily Values	Daily Values Web Service	<i>http://waterservices.usgs.gov/rest/DV-Test-Tool.html</i>	dv_result	“Daily values are summarized from time-series data for each day for the period of record and may represent the daily mean, median, maximum, minimum, and/or other derived value. Daily values include approved, quality-assured data that may be published, and more recent provisional data, whose accuracy has not been verified.” ⁸

⁴ The geodatabase schema is shown in Figure A28.

⁵ Quoted from *<http://waterservices.usgs.gov/>*. Accessed 11-15-2010.

⁶ Quoted from *<http://qwwebservices.usgs.gov/>*. Accessed 11-15-2010.

NWIS Snapshot tab name	Web service name	Web service reference URL	Geodatabase table populated by web service query ⁴	Data Description
Unit Values	Unit Values ⁷ Web Service	<i>http://waterservices.usgs.gov/rest/IV-Test-Tool.html</i>	uv_result	<p>“Real-time data are time-series (recorded at fixed intervals) data from automated equipment and represent the most current hydrologic conditions. Measurements are commonly recorded at 15- to 60-minute intervals and transmitted to the NWIS database every 1-4 hours. Real-time data are available online for 120 days.”⁸</p>

⁷ Also called Instantaneous or Real-Time Values.

⁸ Quoted from *<http://waterdata.usgs.gov/nwis/qw>*. Accessed 11-15-2010.