

Prepared in cooperation with the
U.S. Department of Energy,
National Nuclear Security Administration Nevada Site Office,
Office of Environmental Management under Interagency Agreement,
DE-A152-01NV13944

Database of Ground-Water Levels in the Vicinity of Rainier Mesa, Nevada Test Site, Nye County, Nevada, 1957–2005

Data Series 190
Version 1.1, October 2007

**U.S. Department of the Interior
U.S. Geological Survey**

Database of Ground-Water Levels in the Vicinity of Rainier Mesa, Nevada Test Site, Nye County, Nevada, 1957–2005

By Joseph M. Fenelon

Prepared in cooperation with the
U.S. Department of Energy
National Nuclear Security Administration Nevada Site Office,
Office of Environmental Management under Interagency Agreement,
DE-A152-01NV13944

Data Series 190

**U.S. Department of the Interior
U.S. Geological Survey**

U.S. Department of the Interior
Dirk A. Kempthorne, Secretary

U.S. Geological Survey
P. Patrick Leahy, Acting Director

U.S. Geological Survey, Reston, Virginia: 2006

For sale by U.S. Geological Survey, Information Services
Box 25286, Denver Federal Center
Denver, CO 80225

For more information about the USGS and its products:
Telephone: 1-888-ASK-USGS
World Wide Web: <http://www.usgs.gov/>

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

Although this report is in the public domain, permission must be secured from the individual copyright owners to reproduce any copyrighted materials contained within this report.

Suggested citation:

Fenelon, J.M., 2006, Database of ground-water levels in the vicinity of Rainier Mesa, Nevada Test Site, Nye County, Nevada, 1957-2005: U.S. Geological Survey Data Series190, version 1.10, October 2007, 14 p.

Contents

Abstract	1
Introduction	1
Purpose and Scope	1
Water-Level Database	3
Acknowledgments	12
References Cited	12
Appendix 1. Water-Level Database for Rainier Mesa and Vicinity, Nevada Test Site, Nye County, Nevada, 1957–2005	13

Figures

Figure 1. Map showing boreholes and tunnel sites with water-level measurements, location of underground nuclear tests, and selected tunnels in the vicinity of Rainier Mesa, Nevada Test Site, Nye County, Nevada	2
Figure 2. Diagram showing relations among Microsoft® Access files in water-level database for Rainier Mesa area, Nevada Test Site, Nye County, Nevada	7
Figure 3. Example water-level output from Microsoft® Excel workbook	8

Tables

Table 1. Characteristics of sites with at least one water-level measurement through 2005 in the Rainier Mesa area, Nevada Test Site, Nye County, Nevada	3
Table 2. Summary of water-level measurements from sites in the Rainier Mesa area, Nevada Test Site, Nye County, Nevada	5
Table 3. Description of tables contained in the water-level database for the Rainier Mesa area, Nevada Test Site, Nye County, Nevada	9
Table 4. Description of general- and detailed-condition attributes assigned to water levels in Rainier Mesa area, Nevada Test Site, Nye County, Nevada	10

Conversion Factors and Datums

Multiply	By	To obtain
Length		
inch (in.)	2.54	centimeter (cm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
Volume		
gallon (gal)	3.785	liter (L)
Pressure		
pound per square inch (psi)	6.895	kilopascal (kPa)
Volumetric Rate		
gallon per minute (gal/min)	0.06309	liter per second (L/s)

Datums

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83) unless otherwise stated.

Vertical coordinate information is referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29).

Altitude, as used in this report, refers to its distance above the vertical datum.

Transmissivity: The standard unit for transmissivity is cubic foot per day per square foot times foot of aquifer thickness $[(\text{ft}^3/\text{d})/\text{ft}^2]\text{ft}$. In this report, the mathematically reduced form, foot squared per day (ft^2/d), is used for convenience.

Database of Ground-Water Levels in the Vicinity of Rainier Mesa, Nevada Test Site, Nye County, Nevada, 1957–2005

By Joseph M. Fenelon

Abstract

More than 1,200 water-level measurements from 1957 to 2005 in the Rainier Mesa area of the Nevada Test Site were quality assured and analyzed. Water levels were measured from 50 discrete intervals within 18 boreholes and from 4 tunnel sites. An interpretive database was constructed that describes water-level conditions for each water level measured in the Rainier Mesa area. Multiple attributes were assigned to each water-level measurement in the database to describe the hydrologic conditions at the time of measurement. General quality, temporal variability, regional significance, and hydrologic conditions are attributed for each water-level measurement. The database also includes hydrograph narratives that describe the water-level history of each well.

Introduction

Rainier Mesa is in the north-central part of the Nevada Test Site (NTS) in Nye County, southern Nevada ([fig. 1](#)). During 1957–92, 16 tunnels were mined in the Rainier Mesa area (U.S. Department of Energy, 2006). The five largest of these tunnel complexes (tunnels U-12b, U-12e, U-12g, U-12n, and U-12t) are shown in [figure 1](#). Sixty nuclear devices were detonated in the tunnels and two nuclear devices were detonated in vertical shafts in the Rainier Mesa area (U.S. Department of Energy, 2000).

The U.S. Department of Energy (DOE), National Nuclear Security Administration Nevada Site Office, under its Environmental Restoration Program, has a long-term program to investigate and remediate radionuclide contaminants generated on the NTS as a result of nuclear testing. As part of the program, DOE is evaluating what risk these contaminants may pose to the public. To help accomplish this objective, ground-water levels are being compiled and analyzed to better understand the ground-water flow system. This report is the fourth in a series of studies by the U.S. Geological Survey (USGS), in cooperation with DOE, to analyze and quality assure historic water-level measurements in areas of testing on the NTS (Fenelon, 2000; Bright and others, 2001; Fenelon, 2005).

Rainier Mesa is a volcanic plateau at an altitude of about 7,500 ft above sea level. It receives about 12.5 in. of precipitation annually (Air Resources Laboratory, Special Operations and Research Division, 2005). About 2,000 to 5,000 ft of Tertiary volcanic rocks, consisting primarily of bedded and welded tuffs, underlie Rainier Mesa (Thordarson, 1966, p. 14). The lower units consist of low-permeability bedded tuffs that impede the downward flow of recharge water from the overlying fractured welded tuffs, creating a perched ground-water system in the volcanic rocks (Thordarson, 1966, p. 32–33). The water-level altitude in the perched system is irregular but generally ranges from about 5,700 to 6,200 ft above sea level. Beneath the volcanic rocks on Rainier Mesa are Paleozoic carbonate rocks, Mesozoic granites, and Paleozoic and Precambrian quartzite and argillite. A regional water table is found in the Paleozoic carbonate rocks at an altitude from about 4,200 to 4,300 ft above sea level and at depths ranging from about 1,400 ft off of the mesa to as great as 3,100 ft on top of the mesa.

Purpose and Scope

This report documents and describes more than 1,200 water-level measurements made in the Rainier Mesa area from 1957 to 2005. Water levels were measured from 50 discrete intervals within 18 boreholes and from 4 tunnel sites. As part of the analysis, a systematic quality-assurance review of the USGS National Water Information System (NWIS) database was completed to remove or correct erroneous water-level data, and to add missing water-level measurements and well-site information. Well-completion data and borehole-lithologic descriptions were compiled from driller's logs, well completion reports, and other published and unpublished information.

An interpretive Microsoft® Access database of Rainier Mesa water-level measurements was constructed that consists of several components. First, each water-level measurement was assigned multiple attributes to describe the hydrologic condition at the time of measurement. Second, each well hydrograph has a written narrative, which consists of information and comments about the well and water-level data for the well. Third, water-level data and site information from the NWIS database were merged into the water-level database to provide supporting information for use in interpreting water-level measurements in the vicinity of Rainier Mesa.

Water-Level Database

The USGS collects and maintains water-level data for sites at the Nevada Test Site. As part of this data-collection program, current and historic water-level data are compiled, reviewed, and stored in the USGS NWIS database (<http://waterdata.usgs.gov/nv/nwis/nwis>). For the Rainier Mesa area,

the database contains about 1,000 water-level measurements from 50 discrete intervals within 18 boreholes. Additionally, about 200 water-level measurements of impounded tunnel water at four tunnel sites in Rainier Mesa (Charles Russell and others, Desert Research Institute, written commun., 2003) were compiled for this report but are not in the NWIS database. Water-level data for the 54 measurement sites ([fig. 1, table 1](#)) were collected periodically from 1957 to 2005.

Table 1. Characteristics of sites with at least one water-level measurement through 2005 in the Rainier Mesa area, Nevada Test Site, Nye County, Nevada.

[**Latitude and Longitude:** In decimal degrees; referenced to North American Datum of 1983 (NAD83). **Land-surface altitude:** Altitude relative to sea level. **Open interval:** Area of well that is open to aquifer and where, if saturated, ground water may enter well. Open interval consists of open borehole and (or) well screen, including gravel packs. Where multiple open intervals occur in a well, depths are in feet below land surface to top of uppermost interval and bottom of lowermost interval. **Contributing units:** Lithologic units contributing water to well. Multiple units for single well listed in order of their likely importance in contributing water to well. C, Paleozoic carbonate rock; P, Paleocolluvium; S, pre-Tertiary clastic rock; V, volcanic rocks (primary tuffs); X, igneous or metamorphic rocks; *, hole was dry and contributing unit listed is the unit at bottom of hole; queried (?) where uncertain]

U.S. Geological Survey local site name	U.S. Geological Survey site identification No. ¹	Nevada Test Site hole name ²	Latitude	Longitude	Land-surface altitude	Depth drilled	Open interval		Contributing units
							Depth to top	Depth to bottom	
							(feet)		
Dolomite Hill Hole	371106116112701	Mac Exploratory Co. #1 [Dolomite Hill]	37.185	116.192	6,399	1,200	24	1,200	C
ER-12-1 (1641-1846 ft)	371106116110401	ER-12-1	37.185	116.185	5,817	3,588	1,641	1,846	C,S
ER-12-1 (1641-3414 ft)	371106116110407	ER-12-1	37.185	116.185	5,817	3,588	1,641	3,414	C,S
ER-12-1 (1883-1940 ft)	371106116110405	ER-12-1	37.185	116.185	5,817	3,588	1,883	1,940	S
ER-12-1 (2449-2602 ft)	371106116110404	ER-12-1	37.185	116.185	5,817	3,588	2,449	2,602	S
ER-12-1 (2958-3212 ft)	371106116110403	ER-12-1	37.185	116.185	5,817	3,588	2,958	3,212	C
ER-12-1 (3309-3414 ft)	371106116110402	ER-12-1	37.185	116.185	5,817	3,588	3,309	3,414	C
ER-12-1 (brhl)	371106116110406	ER-12-1	37.185	116.185	5,817	3,588	1,474	3,588	C,S
ER-12-3 main	371142116125102	ER-12-3	37.195	116.215	7,385	4,908	2,445	4,908	C
ER-12-3 piezometer	371142116125101	ER-12-3	37.195	116.215	7,385	4,908	54	2,200	V
ER-12-4 main	371311116105902	ER-12-4	37.220	116.184	6,883	3,715	2,501	3,715	C
ER-12-4 piezometer	371311116105901	ER-12-4	37.220	116.184	6,883	3,715	56	2,225	V
ER-19-1-1 (deep)	371043116142101	ER-19-1	37.178	116.240	6,140	3,595	3,210	3,560	S
ER-19-1-2 (middle)	371043116142102	ER-19-1	37.178	116.240	6,140	3,595	2,550	2,738	V
ER-19-1-3 (shallow)	371043116142103	ER-19-1	37.178	116.240	6,140	3,595	1,301	1,422	V
Hagestad 1 (1600-1904 ft)	371113116125902	Hagestad #1	37.192	116.217	7,485	1,941	664	1,904	V,X
Hagestad 1 (1874-1904 ft)	371113116125901	Hagestad #1	37.192	116.217	7,485	1,941	664	1,904	X,V
TW- 1 (0- 560 ft)	370929116132301	USGS HTH #1	37.158	116.224	6,156	560	0	560	V
TW- 1 (0-1615 ft)	370929116132302	USGS HTH #1	37.158	116.224	6,156	1,615	0	1,615	V
TW- 1 (0-3731 ft)	370929116132305	USGS HTH #1	37.158	116.224	6,156	3,731	0	3,731	V,C
TW- 1 (1615-1840 ft)	370929116132303	USGS HTH #1	37.158	116.224	6,156	1,840	1,615	1,840	V
TW- 1 (1615-3300 ft)	370929116132307	USGS HTH #1	37.158	116.224	6,156	4,206	1,615	3,300	V
TW- 1 (1615-4206 ft)	370929116132311	USGS HTH #1	37.158	116.224	6,156	4,206	1,615	4,206	V,C
TW- 1 (3700-3731 ft)	370929116132304	USGS HTH #1	37.158	116.224	6,156	3,731	3,700	3,731	C
TW- 1 (3700-4206 ft)	370929116132309	USGS HTH #1	37.158	116.224	6,156	4,206	3,700	4,206	C
U -12e.03-1 (430 ft)	371122116122201	U-12e.03-1	37.189	116.207	7,545	1,825	1,404	1,825	V
U -12e.03-1 (682 ft)	371122116122202	U-12e.03-1	37.189	116.207	7,545	2,077	1,873	2,077	V
U -12e.03-1 (834 ft)	371122116122203	U-12e.03-1	37.189	116.207	7,545	2,229	2,096	2,229	C,P
U -12e.06-1 R/C	371052116125201	U-12e.06-1 R/C - Ex.	37.181	116.215	7,573	3,180	0	3,180	C
U -12e.M1 UG (1501 ft)	371106116123001	U-12e.M1 [UG Ex.]	37.185	116.209	7,539	2,881	2,234	2,881	C,V
U -12e.M1 UG (19 ft)	371106116123002	U-12e.M1 [UG Ex.]	37.185	116.209	7,539	1,399	1,389	1,399	V
U -12e.M1 UG (631 ft)	371106116123003	U-12e.M1 [UG Ex.]	37.185	116.209	7,539	2,011	1,389	2,011	V
U -12e.M1 UG (777 ft)	371106116123004	U-12e.M1 [UG Ex.]	37.185	116.209	7,539	2,157	1,389	2,157	V
U -12g.06 PS 1V	371028116123002	U-12g.06 PS #1V	37.174	116.209	7,626	1,474	826	1,474	V*(?)

4 Database of Ground-Water Levels in the Vicinity of Rainier Mesa, Nevada Test Site, Nye County, Nevada, 1957-2005

Table 1. Characteristics of sites with at least one water-level measurement through 2005 in the Rainier Mesa area, Nevada Test Site, Nye County, Nevada.—Continued

[**Latitude and Longitude:** In decimal degrees; referenced to North American Datum of 1983 (NAD83). **Land-surface altitude:** Altitude relative to sea level. **Open interval:** Area of well that is open to aquifer and where, if saturated, ground water may enter well. Open interval consists of open borehole and (or) well screen, including gravel packs. Where multiple open intervals occur in a well, depths are in feet below land surface to top of uppermost interval and bottom of lowermost interval. **Contributing units:** Lithologic units contributing water to well. Multiple units for single well listed in order of their likely importance in contributing water to well. C, Paleozoic carbonate rock; P, Paleocolluvium; S, pre-Tertiary clastic rock; V, volcanic rocks (primary tuffs); X, igneous or metamorphic rocks; *, hole was dry and contributing unit listed is the unit at bottom of hole; queried (?) where uncertain]

U.S. Geological Survey local site name	U.S. Geological Survey site identification No. ¹	Nevada Test Site hole name ²	Latitude	Longitude	Land-surface altitude	Depth drilled	Open interval		Contributing units
							Depth to top	Depth to bottom	
(feet)									
U -12n Ext. Drift GSP	999999999999903	U-12n Tunnel Extension Drift	37.204	116.197	6,700	--	--	--	V
U -12n Main Drift GSP	999999999999904	U-12n Tunnel Main Drift	37.203	116.198	6,700	--	--	--	V
U -12q	371153116134601	U-12q	37.198	116.230	7,413	2,144	6	2,144	V
U -12s (1480 ft)	371342116125102	U-12s	37.228	116.217	6,794	1,596	12	1,480	X,V
U -12s (1596 ft)	371342116125101	U-12s	37.228	116.217	6,794	1,596	12	1,596	X,V
U -12t Main Drift GSD	999999999999902	U-12t Tunnel Main Drift	37.217	116.172	6,370	--	--	--	V
U -12t Main Drift GSP	999999999999901	U-12t Tunnel Main Drift	37.218	116.173	6,575	--	--	--	V
U -12t.04 CH 1	371316116105001	U-12t.04 CH #1	37.221	116.181	6,796	1,187	60	1,187	(?)
UE-12n 15A	371226116125201	UE-12n #15A	37.207	116.215	7,369	1,934	700	1,934	V,X
UE-12t 6 (1378 ft)	371332116112801	UE-12t #6	37.225	116.192	6,907	1,378	23	1,378	V
UE-12t 6 (1461 ft)	371332116112802	UE-12t #6	37.225	116.192	6,907	1,461	23	1,461	V,X
UE-12t 7	371307116103801	UE-12t #7	37.230	116.183	6,961	1,692	20	1,692	(?)
WW- 8 (1770-2031 ft)	370956116172102	Water Well 8 [USGS HTH-8]	37.166	116.290	5,695	2,031	1,770	2,031	V
WW- 8 (2031-2053 ft)	370956116172105	Water Well 8 [USGS HTH-8]	37.166	116.290	5,695	3,009	2,031	2,053	V
WW- 8 (2053-2249 ft)	370956116172104	Water Well 8 [USGS HTH-8]	37.166	116.290	5,695	3,009	2,053	2,249	V
WW- 8 (30-1198 ft)	370956116172103	Water Well 8 [USGS HTH-8]	37.166	116.290	5,695	2,031	30	1,198	V
WW- 8 (30-1935 ft)	370956116172101	Water Well 8 [USGS HTH-8]	37.166	116.290	5,695	5,490	30	1,935	V
WW- 8 (3333-3429 ft)	370956116172106	Water Well 8 [USGS HTH-8]	37.166	116.290	5,695	4,088	3,333	3,429	V
WW- 8 (3428-3524 ft)	370956116172107	Water Well 8 [USGS HTH-8]	37.166	116.290	5,695	4,088	3,428	3,524	V
WW- 8 (5290-5490 ft)	370956116172108	Water Well 8 [USGS HTH-8]	37.166	116.290	5,695	5,490	5,290	5,490	P

¹The U.S. Geological Survey site identification is based on the latitude-longitude grid. Each site is identified by a unique 15-digit number. The first six digits denote degrees, minutes, and seconds of latitude; the next seven digits denote degrees, minutes, and seconds of longitude; and the last two digits are the sequence number of the well or test hole within the 1-second grid of latitude and longitude. The assigned number is retained as a permanent identifier even if a more precise latitude and longitude are later determined. To determine the geographic location of a well or test hole, the latitude and longitude coordinates should be used rather than the site identifier. Site identifications beginning with "99" are used in this report only and are not in the National Water Information System (NWIS).

²Official Nevada Test Site (NTS) hole names are assigned to test holes according to the type of hole drilled, site location (NTS area number), and sequence code for consecutive order in which the hole was drilled or redrilled. Most of the holes drilled on the NTS begin with the letter "U." Exploratory holes, drilled to assess material properties within a defined area, are designated with an "E" following the "U." The "U" or "UE" are followed by a dash (-), NTS area number, and sequence code (letters "a-z, aa-az, ba-bz, ..., za-zz"). The suffix "PS" indicates a postshot hole, the suffix "#" followed by a number indicates a satellite hole, and "HTH" indicates a hydrologic test hole. Exceptions to the standard naming convention are wells beginning with "ER," which indicates a well drilled for the Environmental Restoration Program.

Water-level data contained in the database and in this report were collected from multi-screen completion wells, from wells or boreholes with packers temporarily installed during or after drilling, and from open boreholes that may later have been deepened or completed into a well. In these situations, a unique site identification number and site name were established in the database for each discrete open interval where data were collected. In other situations, multiple piezometers, open at different intervals, were placed in a single borehole. In these cases, each piezometer is considered a site in the database. Site names from the same borehole are distinguished from each other by a parenthetical expression following the borehole name—for example: UE-12t 6 (1378 ft). A single number in the parenthetical expression refers to the depth of the well or borehole; two numbers separated by a dash refer to the depth of the top and bottom of the open interval in the well or borehole. For the purposes of this report, a discrete open interval where water levels were monitored may be referred to as a well or a site.

Periodic water-level measurements were made by the USGS or private contractors working at the NTS using calibrated electric-cable units (also known as iron-horse and wire-line devices), calibrated electric tapes, and less

commonly, a fluid-density geophysical log, float recorder, pressure gauge, or pressure transducer. Most water-level measurements prior to 1996 were made with an electric-cable unit (Garber and Koopman, 1968); whereas, more recent measurements typically were made using electric tapes. The tapes and cable units are calibrated annually at different water-level depths with a USGS 2,000-ft steel reference tape. At the time of measurement, a correction factor is applied to the depth-to-water reading based on the annual calibration. Recent (post-1995) measurements using electric tapes generally are more accurate (± 0.1 ft) than older measurements using electric-cable units or other methods (± 0.5 –1 ft).

A systematic quality-assurance review of data contained in the NWIS database from 1957 to 2005 for sites in the Rainier Mesa area was completed for this study. This included removing or correcting duplicate sites or erroneous water-level data, and adding missing water-level measurements and construction information. A summary of water-level measurements from the 54 sites is shown in [table 2](#). The earliest measurement was made in 1957 and 11 sites were measured in 2005. The deepest measured depth to water was 3,116 ft in well ER-12-3 main ([fig. 1](#)).

Table 2. Summary of water-level measurements from sites in the Rainier Mesa area, Nevada Test Site, Nye County, Nevada.

[**Number of measurements:** Includes measurements indicating well was dry or obstructed. **Minimum and maximum water level:** –, a measurement of the water surface was not made in the well because the well was dry or obstructed]

U.S. Geological Survey local site name	Period of record	Number of measurements	Water level	
			Minimum (shallowest)	Maximum (deepest)
(feet below land surface)				
Dolomite Hill Hole	1959–1960	11	1,110	1,130
ER-12-1 (1641-1846 ft)	1992–2005	90	1,450	1,542
ER-12-1 (1641-3414 ft)	1992	3	1,536	1,546
ER-12-1 (1883-1940 ft)	1992	1	1,480	1,480
ER-12-1 (2449-2602 ft)	1992	1	1,434	1,434
ER-12-1 (2958-3212 ft)	1992	1	2,779	2,779
ER-12-1 (3309-3414 ft)	1992	1	2,762	2,762
ER-12-1 (brhl)	1991	6	1,538	1,546
ER-12-3 main	2005	8	3,112	3,116
ER-12-3 piezometer	2005	9	1,245	1,250
ER-12-4 main	2005	9	2,566	2,654
ER-12-4 piezometer	2005	4	916	917
ER-19-1-1 (deep)	1994–2005	50	1,776	1,794
ER-19-1-2 (middle)	1994–2005	51	1,142	1,321
ER-19-1-3 (shallow)	1994–2005	60	1,005	1,008
Hagestad 1 (1600-1904 ft)	1958–1963	52	1,436	1,573
Hagestad 1 (1874-1904 ft)	1957–1958	14	1,359	1,930
TW- 1 (0- 560 ft)	1960	1	410	410
TW- 1 (0-1615 ft)	1960	2	415	416
TW- 1 (0-3731 ft)	1961–1962	4	1,026	1,032

6 Database of Ground-Water Levels in the Vicinity of Rainier Mesa, Nevada Test Site, Nye County, Nevada, 1957-2005

Table 2. Summary of water-level measurements from sites in the Rainier Mesa area, Nevada Test Site, Nye County, Nevada.—Continued.

[Number of measurements: Includes measurements indicating well was dry or obstructed. **Minimum and maximum water level:** –, a measurement of the water surface was not made in the well because the well was dry or obstructed]

U.S. Geological Survey local site name	Water level			
	Period of record	Number of measurements	Minimum (shallowest)	Maximum (deepest)
			(feet below land surface)	
TW- 1 (1615-1840 ft)	1961	2	1,023	1,024
TW- 1 (1615-3300 ft)	1962–1963	16	1,439	1,441
TW- 1 (1615-4206 ft)	1965–2005	112	1,461	2,081
TW- 1 (3700-3731 ft)	1961	1	1,984	1,984
TW- 1 (3700-4206 ft)	1962–1963	16	1,965	1,969
U -12e.03-1 (430 ft)	1959	1	1,378	1,378
U -12e.03-1 (682 ft)	1959	1	1,879	1,879
U -12e.03-1 (834 ft)	1959	1	2,105	2,105
U -12e.06-1 R/C	1962–1976	5	2,920	2,931
U -12e.M1 UG (1501 ft)	1960	3	2,832	2,865
U -12e.M1 UG (19 ft)	1959	1	1,379	1,379
U -12e.M1 UG (631 ft)	1959	1	1,354	1,354
U -12e.M1 UG (777 ft)	1959	1	1,434	1,434
U -12g.06 PS 1V	1980	1	–	–
U -12n Ext. Drift GSP	1994–2002	21	602	641
U -12n Main Drift GSP	1994–2002	23	603	643
U -12q	1962	3	1,814	1,831
U -12s (1480 ft)	1966–2005	396	910	958
U -12s (1596 ft)	1966	3	966	1,104
U -12t Main Drift GSD	1993–2002	32	662	758
U -12t Main Drift GSP	1993–2002	116	937	964
U -12t.04 CH 1	1982	3	875	884
UE-12n 15A	1988	5	1,326	1,331
UE-12t 6 (1378 ft)	1988	3	814	867
UE-12t 6 (1461 ft)	1988–2005	82	70	847
UE-12t 7	1988–1989	28	496	840
WW- 8 (1770-2031 ft)	1962	20	1,055	1,070
WW- 8 (2031-2053 ft)	1962	54	1,017	1,316
WW- 8 (2053-2249 ft)	1962	72	677	1,148
WW- 8 (30-1198 ft)	1962	57	997	1,070
WW- 8 (30-1935 ft)	1963–2000	11	1,068	1,083
WW- 8 (3333-3429 ft)	1962	25	1,062	1,098
WW- 8 (3428-3524 ft)	1962	47	1,057	1,308
WW- 8 (5290-5490 ft)	1962	37	1,101	1,434

An interpretive database using Microsoft® Access format was constructed that provides information on the external conditions influencing each water level measured in the Rainier Mesa area. The database contains site information for each well, well-construction records, borehole lithology, aquifer data, and water-level data (appendix 1). Information in this database was derived from data sets created for this study and data sets available from NWIS. All tables are linked by the USGS local site name and site identification number, a unique 15-digit number used to identify the site (table 1). Several of the tables also are linked by water-level date. The structure of the water-level database is shown in figure 2. An effort was made to maintain a database structure that is consistent with the structure of the NWIS database (U.S. Geological Survey,

2004). For example, the four well-construction tables from NWIS are preserved in the water-level database.

Hydrographs and site locations in Rainier Mesa are interactively presented with a Microsoft® Excel workbook. The workbook is designed to be an easy-to-use tool to understand the water-level history for any site in the Rainier Mesa area. It also can be used to filter water-level data by restricting the data to certain sites, dates, or hydrologic conditions.

An example page from the workbook (fig. 3) shows well UE-12t 6 (1378 ft), which was selected using the Excel built-in AutoFilter. Selected water-level information from the water-level database is shown for this well. Additionally, a short narrative is displayed that describes the well and hydrograph.

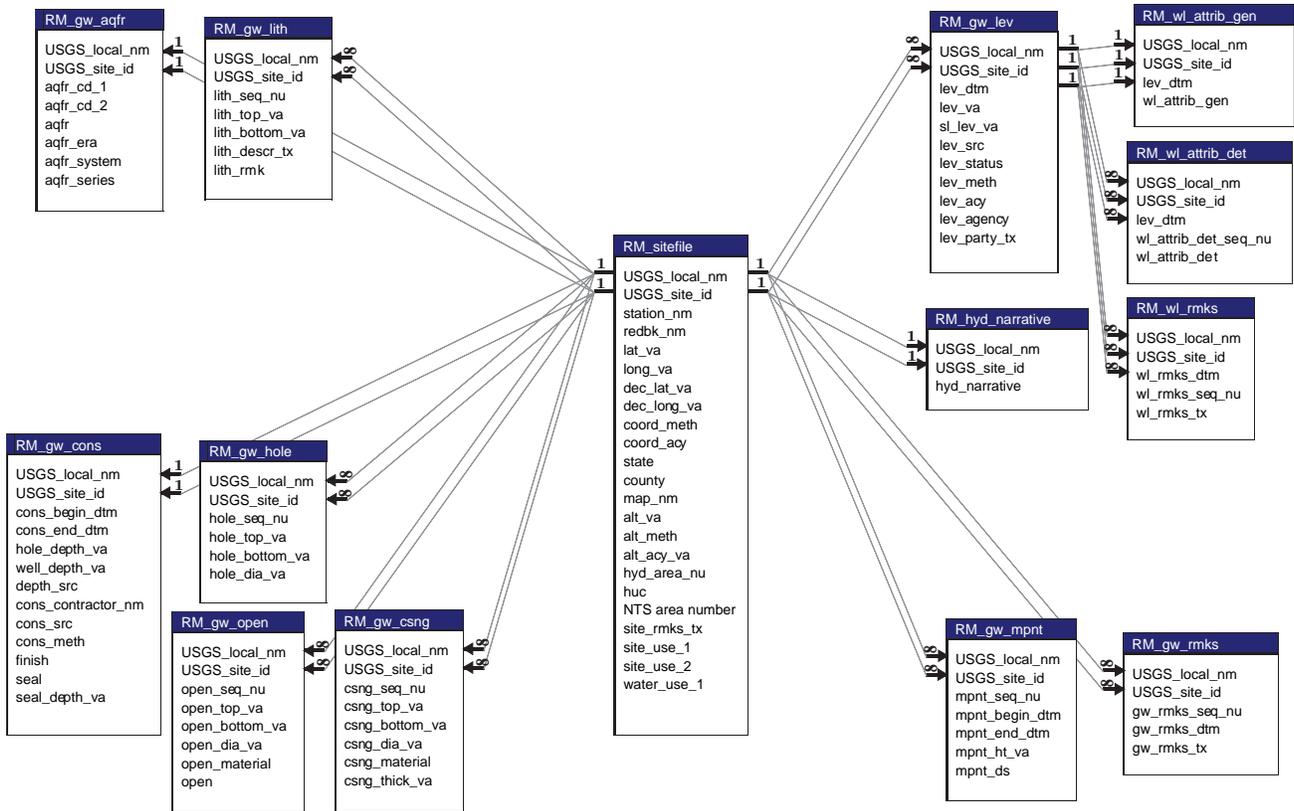


Figure 2. Relations among Microsoft® Access files in water-level database for Rainier Mesa area, Nevada Test Site, Nye County, Nevada.

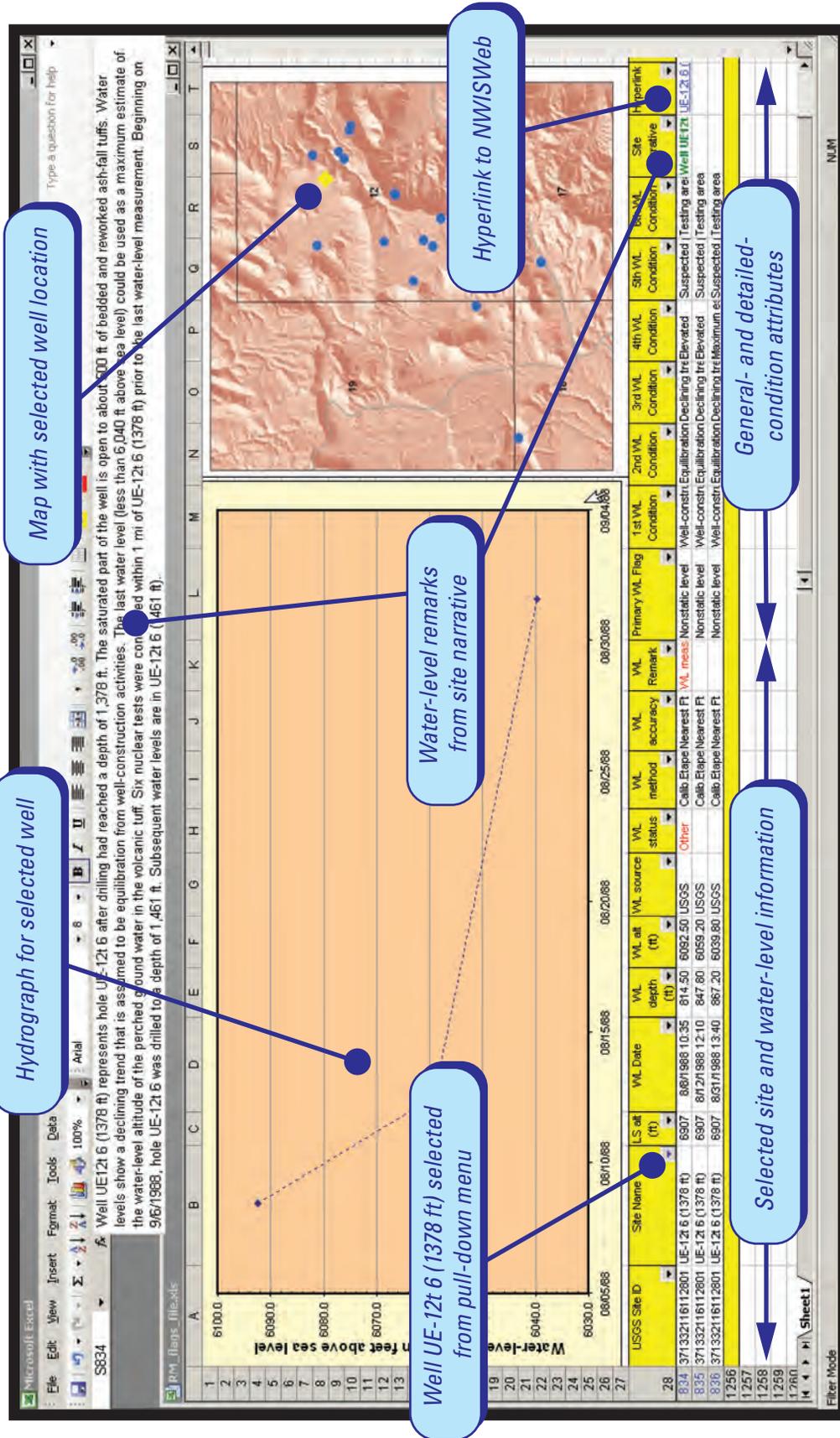


Figure 3. Example water-level output from Microsoft® Excel workbook.

Site, well-construction, and lithology information for the 54 Rainier Mesa water-level sites are stored in the water-level database ([appendix 1](#)). This information, which can be used to support interpretations of the water levels and water-level trends, is contained within nine tables in the water-level

database ([table 3](#)). Five additional tables in the database provide water-level information, including water-level data, hydrologic conditions of each water-level measurement, and a water-level history for each site ([table 3](#)).

Table 3. Description of tables contained in the water-level database for the Rainier Mesa area, Nevada Test Site, Nye County, Nevada.

Table name	Table grouping	Description	Remarks
RM_sitefile	Site information	U.S. Department of Energy name for hole; location coordinates; general location information (hydrographic area number, hydrologic unit code, and NTS area number); and land-surface altitude.	Basic information describing the site.
RM_gw_mpnt	Site information	Measuring-point information.	Only wells actively measured by USGS are included.
RM_gw_rmks	Site information	Miscellaneous remarks related to the site, well, or water-level data.	Remarks derived from a variety of sources including published reports, drilling records, or field notes.
RM_gw_cons	Well-construction information	Construction dates, hole and well depth, and construction method.	General construction information.
RM_gw_hole	Well-construction information	Hole diameters and intervals.	May have multiple entries for each site that describe unique intervals of hole.
RM_gw_csng	Well-construction information	Casing diameters and intervals.	May have multiple entries for each site that describe unique intervals of casing.
RM_gw_open	Well-construction information	Open-interval information.	May have multiple entries for each site, each describing a unique open interval. Open-intervals are defined by the diameter of the interval, the depths to the top and bottom of the interval, and the type of interval. The most common interval types are well screen and open hole. A typical site may have two open-interval entries in the database. One describes the screen or slotted interval and the other describes the open hole that surrounds the screen. The open-hole interval, which is commonly longer than and inclusive of the screened interval, may be sand or gravel packed or may be unfilled.
RM_gw_lith	Lithology information	Detailed lithologic descriptions of cuttings or cores.	The descriptions provided are original descriptions written by many different geologists and workers over the past 50 years and compiled primarily by H.R. Covington and D.B. Wood of the U.S. Geological Survey.
RM_gw_aqfr	Lithology information	Aquifers or lithologic units contributing water at each site.	The designations for aquifers or water-bearing units are lithostratigraphic based rather than hydrostratigraphic based, as is commonly used for the Nevada Test Site (Laczniak and others, 1996, table 1).
RM_gw_lev	Water-level information	Date, depth, source, status, method, and accuracy of water level.	Basic data pertaining to the water-level measurement. Water-level accuracy pertains to the depth-to-water measurement and not the water-level altitude.
RM_wl_rmks	Water-level information	Remarks related to specific water-level measurements.	
RM_wl_attrib_gen	Water-level information	General-condition attribute for each water level.	
RM_wl_attrib_det	Water-level information	Detailed-condition attributes for each water level.	
RM_hyd_narrative	Water-level information	Hydrograph narrative.	

10 Database of Ground-Water Levels in the Vicinity of Rainier Mesa, Nevada Test Site, Nye County, Nevada, 1957-2005

Water-level measurement source, method, accuracy, and hydrologic conditions at the time of the water-level measurement are attributed in the water-level database. Interpretations for individual water-level measurements and for the period of record for a site have been incorporated into the attributes. Abrupt water-level changes and long-term water-level declines are examples of typical hydrologic conditions that were interpreted. These interpretations are noted in the water-level remark, detailed hydrologic condition, or hydrograph narrative.

Hydrologic-condition attributes were used to describe the state of each water level that was measured at sites in the Rainier Mesa area. They also describe the external factors that may have affected the measured depths-to-water at each site. Hydrologic-condition attributes were categorized as either general or detailed (table 4). General-condition attributes describe the state of a water level. Examples are steady state, transient, and nonstatic level. Detailed-condition attributes can denote a factor affecting a water level, describe the effect that

a factor may have on a water level, or denote the uncertainty of a water-level interpretation. Factors affecting water levels include perched water, pumping, and recent well construction. Water-level effects include abrupt change, equilibration, and rising trend. One general-condition attribute and 0–6 detailed-condition attributes were assigned to each water-level measurement in the Rainier Mesa area.

The water-level history of each site is documented as a narrative. The narrative consists of comments or explanations about the site or about water-level data at the site. An interpretation of the hydrograph and its hydrologic significance is provided for most sites as part of the narrative. The narrative may include information about the open interval, testing done in the well, the well productivity, specific influences near the site that may have affected water levels, and other details that may provide additional information about the conditions affecting water-level data at the site. Basic information included in the narrative was derived from published reports or from USGS data files stored in Henderson, Nev.

Table 4. Description of general- and detailed-condition attributes assigned to water levels in Rainier Mesa area, Nevada Test Site, Nye County, Nevada.

[Number of water levels: Number of water levels in Rainier Mesa assigned with this attribute. Each water level was assigned only one general-condition attribute but may have multiple detailed-condition attributes]

Attribute name	Description	Number of water levels
General-condition attribute		
Localized conditions	Water level represents localized, typically transient, hydrologic conditions in aquifer (for example, nuclear-test effect or localized pumping).	4
None	Well is dry or obstructed or site was visited but water level was not measured.	3
Nonstatic level	Water level is affected by activities in the well such as aquifer testing, well construction, or pumping; water level does not represent conditions within the aquifer.	679
Steady state–LOCAL	Water level approximates predevelopment, steady-state, hydrologic conditions in a well that monitors a local-scale flow system, such as a perched aquifer. Water level is considered to be steady state relative to long-term (50–100 years) climatic conditions. Water-level changes occurring as a result of natural conditions are considered steady state for the purposes of this analysis.	39
Steady state–REGIONAL	Water level approximates predevelopment, steady-state hydrologic conditions in a well that monitors the regional ground-water flow system. The regional flow system is defined as the fully saturated part of the flow system. Water level is considered to be steady state relative to long-term (50–100 years) climatic conditions. Water-level changes occurring as a result of natural conditions are considered steady state for the purposes of this analysis.	189
Suspect	Water level is suspect or in error, and cannot be attributed to any known hydrologic cause.	277
Transient–LOCAL	Water level represents changes from pumping in a local-scale flow system, such as a perched aquifer.	27
Transient–REGIONAL	Water level represents changes from pumping in the regional ground-water flow system. The regional flow system is defined as the fully saturated part of the flow system.	9

Table 4. Description of general- and detailed-condition attributes assigned to water levels in Rainier Mesa area, Nevada Test Site, Nye County, Nevada.—Continued.

[Number of water levels: Number of water levels in Rainier Mesa assigned with this attribute. Each water level was assigned only one general-condition attribute but may have multiple detailed-condition attributes]

Attribute name	Description	Number of water levels
Detailed-condition attribute		
Abrupt change	Water level rapidly shifted or changed from previous measurements.	31
Anomalous–high	Water-level altitude is unusually high relative to other measurements at the site or at nearby sites.	2
Anomalous–low	Water-level altitude is unusually low relative to other measurements at the site or at nearby sites.	1
Consistent	Water level appears to be part of a reasonably consistent trend representative of general water-level conditions in the area.	176
Declining trend	Water level appears to be part of a discernible, overall downward trend. Possible causes include nearby pumping, decreased recharge, equilibration following drilling, or depressurization after a nuclear test.	329
Dry	Site was dry at time of measurement.	1
Elevated	Water level is elevated appreciably above the regional ground-water system, probably because of natural conditions.	733
Equilibration	Water level appears to be part of a discernible, overall trend that is approaching an equilibrium level, either higher or lower than the initial measurement. Equilibration commonly occurs following well construction, pumping, or nearby nuclear testing.	698
Erratic/unstable	Water level is erratic and unstable.	40
Injection/recovery	Water level appears to be affected by recent injection of water, mud, or other fluid into the well or hole.	182
Limited data	Water level is one of a limited number. Therefore, general-condition attribute assigned to water level is tentative.	30
Maximum estimate	Water level or depth to bottom of well (where well is dry) represents a maximum estimate of the equilibrated water-level altitude in the monitored hydrologic unit.	9
Minimum estimate	Water level represents a minimum estimate of the equilibrated water-level altitude in the monitored hydrologic unit.	3
Obstruction	Water-level measurement was attempted but could not be made because of an obstruction in the hole.	2
Packer test	Water level was measured during a packer test.	319
Pumping/recovery	Water level appears to be responding to current or past pumping at the site or at a nearby site. If water-level measurement is missing, well was pumping at time of measurement.	184
Questionable accuracy	Water level may be inaccurate because of poor measurement.	48
Rising trend	Water level appears to be part of a discernible, overall rising trend. Possible causes include a decrease in nearby pumping, equilibration following drilling, and above-normal precipitation.	602
Suspected perched water	Water level appears to represent perched-water conditions.	580
Suspected unsaturated	Water level is suspected to represent remnant fluid in well. Hole is believed to be unsaturated.	19
Testing area	Site located within 1 mile of one or more underground nuclear tests. Water level possibly is affected.	467
Tunnel effect	Water level may be affected by nearby tunneling.	223
Uncertain	General-condition attribute assigned to water level is tentative because of uncertainty in interpreting water level or hydrograph.	134
Undeveloped	Water level may not accurately represent hydrologic conditions because of insufficient or no well development.	138
Well-construction effect	Water level appears to be equilibrating from, or is suspected of being affected by, prior well-construction and(or) development activities.	156

Acknowledgments

This study was prepared in cooperation with the U.S. Department of Energy under Interagency Agreement DE-AI52-01NV13944. Thanks to David Wood (USGS) and coworkers for electronically compiling most of the borehole lithologic descriptions that are provided in the water-level database ([appendix 1](#)). Thanks also to Randell Laczniak (USGS) for general guidance in the interpretation of data.

References Cited

- Air Resources Laboratory, Special Operations and Research Division, 2005, Nevada Test Site (NTS) climatological rain gauge data: National Oceanic and Atmospheric Administration, accessed May 2005 at URL: <http://www.sord.nv.doe.gov/home_climate_rain.htm>.
- Bright, D.J., Watkins, S.A., and Lisle, B.A., 2001, Analysis of water levels in the Frenchman Flat area, Nevada Test Site: U.S. Geological Survey Water-Resources Investigations Report 00-4272, 43 p.
- Fenelon, J.M., 2000, Quality assurance and analysis of water levels in wells on Pahute Mesa and vicinity, Nevada Test Site, Nye County, Nevada: U.S. Geological Survey Water-Resources Investigations Report 00-4014, 68 p.
- Fenelon, J.M., 2005, Analysis of ground-water levels and associated trends in Yucca Flat, Nevada Test Site, Nye County, Nevada, 1951–2003: U.S. Geological Survey Scientific Investigations Report 2005-5175, 87 p.
- Garber, M.S., and Koopman, F.C., 1968, Methods of measuring water levels in deep wells: U.S. Geological Survey Techniques of Water-Resources Investigations, chap. A1, book 8, 23 p.
- Laczniak, R.J., Cole, J.C., Sawyer, D.A., and Trudeau, D.A., 1996, Summary of hydrogeologic controls on ground-water flow at the Nevada Test Site, Nye County, Nevada: U.S. Geological Survey Water-Resources Investigations Report 96-4109, 59 p.
- Rehfeldt, K., Drici, W., Lester, B., Sloop, D., Watrus, J., Beard, T., Sully, M., Fryer, W., and Benedict, C., 2004, Hydrologic data for the groundwater flow and contaminant transport model of Corrective Action Units 101 and 102—central and western Pahute Mesa, Nye County, Nevada: Stoller-Navarro Joint Venture Report S-N/99205–002, Shaw/13052-204, Revision No. 0, 422 p.
- Russell, C.E., Gillespie, David, Cole, J.C., Drellack, S.L., Prothro, L.B., Thompson, P.H., McCall, R.L., Pawloski, G.A., and Carlson, Richard, 1996, ER-12-1 completion report: Desert Research Institute Publication No. 45120, 158 p.
- Schoff, S.L., and Winograd, I.J., 1961, Hydrologic significance of six core holes in carbonate rocks of the Nevada Test Site: U.S. Geological Survey Open-File Report 61-152, 97 p.
- Thordarson, William, 1966, Perched ground water in zeolitized-bedded tuff, Rainier Mesa and vicinity, Nevada Test Site, Nevada: U.S. Geological Survey Open-File Report 66-130, 90 p.
- U.S. Department of Energy, 2000, United States nuclear tests, July 1945 through September 1992: U.S. Department of Energy, Nevada Operation Office, DOE/NV–209 (Rev. 15), 162 p.
- U.S. Department of Energy, 2006, Tunnel tests span 35 years of Nevada Test Site history: accessed May 2005 at URL <http://www.nv.doe.gov/library/publications/newsviews/tunnel.htm>.
- U.S. Geological Survey, 2004, User's manual for the National Water Information System of the U.S. Geological Survey: Ground-Water Site-Inventory System: U.S. Geological Survey Open-File Report 2004-1238, version 4.3, 275 p.

Appendix 1. Water-Level Database for Rainier Mesa and Vicinity, Nevada Test Site, Nye County, Nevada, 1957–2005

The database distributed with this report is in Microsoft® Access 2000 format. It contains 14 tables with hydrologic information for 54 sites in the Rainier Mesa area. The tables include information on water-level sites, well construction, borehole lithology, aquifers, and water levels. Descriptions of the types of information in the database tables are stored in the database in the table *field_descriptions*. A general description of each table can be read in the Access project window by opening the database, selecting “view,” and then

selecting “details.” Descriptions of each table column can be made to appear at the bottom of the database window screen by opening a table and moving the cursor to the column of interest.

A Microsoft® Excel workbook also is distributed with this report as an interface to the water-level database. Most of the water-level information from the database is provided in the spreadsheet. Different hydrographs from the Rainier Mesa area can be selected using Excel’s built-in AutoFilter.

This page intentionally left blank.

For more information concerning the research in this report, contact
Director, Nevada Water Science Center
U.S. Geological Survey
2730 N. Deer Run Road
Carson City, Nevada 89701
<http://nevada.usgs.gov/>

