OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
ANALYSIS/MODEL COVER SHEET
Complete Only Applicable Items

1. QA: QA
Page: 1 of: ~~3~~ 37 (initialed, 12-20-01)

2. ☒ Analysis — Check all that apply	**3.** ☐ Model — Check all that apply
Type of Analysis: ☐ Engineering; ☐ Performance Assessment; ☒ Scientific	Type of Model: ☐ Conceptual Model; ☐ Abstraction Model; ☐ Mathematical Model; ☐ System Model; ☐ Process Model
Intended Use of Analysis: ☐ Input to Calculation; ☒ Input to another Analysis or Model; ☒ Input to Technical Document; ☐ Input to other Technical Products	Intended Use of Model: ☐ Input to Calculation; ☐ Input to another Model or Analysis; ☐ Input to Technical Document; ☐ Input to other Technical Products
Describe use: Analyze available water-level altitudes to create a potentiometric surface map for use in the SZ site-scale flow and transport model.	Describe use:

4. Title:
Water-Level Data Analysis for the Saturated Zone Site-Scale Flow and Transport Model

5. Document Identifier (including Rev. No. and Change No., if applicable):
ANL-NBS-HS-000034 REV 01

6. Total Attachments:	7. Attachment Numbers - No. of Pages in Each:
1	I-31

	Printed Name	Signature	Date
8. Originator	Patrick Tucci	Patrick Tucci	12/20/01
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12. Remarks:
Approved AMR

OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
ANALYSIS/MODEL REVISION RECORD
Complete Only Applicable Items

2. Analysis or Model Title:

Water-Level Data Analysis for the Saturated Zone Site-Scale Flow and Transport Model

3. Document Identifier (including Rev. No. and Change No., if applicable):

ANL-NBS-HS-000034 REV 01

4. Revision/Change No.	5. Description of Revision/Change
REV 00	Initial Issue
REV 00/ICN 01	ICN to replace record accessioned as number MOL.20000609.0111 with Data Tracking Numbers and revise assumption text concerning this matter (Section 5.3). Update Section 8.2 to reflect current procedures, and update Sections 8.1 and 8.4 to reflect current DIRS references.
REV 01	This revision updates the water-level data with data from Nye County Early Warning Drilling Program wells and well USW WT-24. This AMR also includes a discussion of vertical head differences in the Yucca Mountain area, and a potentiometric-surface map that represents an alternate conceptual model from that presented in Rev00/ICN 01 of water levels north of Yucca Mountain. Additional text changes were made for the purpose of clarification or editorial correction. Note: Changes were too extensive to denote by a black vertical line in the margins.

CONTENTS

FIGURES

TABLES

ACRONYMS

ACC	Accession Number
AMR	Analysis/Model Report
AP	Administrative Procedure (DOE)
CD-ROM	compact disk – read-only memory
CRWMS M&O	Civilian Radioactive Waste Management System Management & Operating Contractor
DIRS	Document Input Reference System
DOE	Department of Energy
DTN	Data Tracking Number
EWDP	Early Warning Drilling Program
GIS	Geographic Information System
ID	identification
LHG	large hydraulic gradient
NWIS	National Water Information System
OCRWM	Office of Civilian Radioactive Waste Management
PI	Principal Investigator
QARD	Quality Assurance Requirements and Description
SZ	Saturated Zone
TDMS	Technical Data Management System
USGS	United States Geological Survey
UTM	Universal Transverse Mercator
YMP	Yucca Mountain Site Characterization Project

1. PURPOSE

This Analysis/Model Report (AMR) documents an updated analysis of water-level data performed to provide the saturated-zone, site-scale flow and transport model (CRWMS M&O 2000) with the configuration of the potentiometric surface, target water-level data, and hydraulic gradients for model calibration. The previous analysis was presented in ANL-NBS-HS-000034, Rev 00 ICN 01, Water-Level Data Analysis for the Saturated Zone Site-Scale Flow and Transport Model (USGS 2001). This analysis is designed to use updated water-level data as the basis for estimating water-level altitudes and the potentiometric surface in the SZ site-scale flow and transport model domain. The objectives of this revision are to develop computer files containing (1) water-level data within the model area (DTN: GS010908312332.002), (2) a table of known vertical head differences (DTN: GS010908312332.003), and (3) a potentiometric-surface map (DTN: GS010608312332.001) using an alternate concept from that presented in ANL-NBS-HS-000034, Rev 00 ICN 01 for the area north of Yucca Mountain. The updated water-level data include data obtained from the Nye County Early Warning Drilling Program (EWDP) and data from borehole USW WT-24. In addition to being utilized by the SZ site-scale flow and transport model, the water-level data and potentiometric-surface map contained within this report will be available to other government agencies and water users for ground-water management purposes. The potentiometric surface defines an upper boundary of the site-scale flow model, as well as provides information useful to estimation of the magnitude and direction of lateral ground-water flow within the flow system. Therefore, the analysis documented in this revision is important to SZ flow and transport calculations in support of total system performance assessment.

The source data associated with this analysis include water-level data from boreholes within, and from one borehole (UE-25 J-11) adjacent to, the SZ site-scale flow and transport model area. The SZ site-scale flow and transport model area (Figure 1-1) is between a Universal Transverse Mercator (UTM) Easting of 533,340 meters and 563,340 meters and a UTM Northing of 4,046,782 meters and 4,091,782 meters (Zone 11, North American Datum 1927). The following types of information were gathered: borehole site name/identification (ID), location, land-surface altitude, water-level altitude, data source, reliability of data, minimum and maximum water levels (range), and open interval monitored with the associated water-level altitude and type.

Development of the original, Rev 00, AMR was performed pursuant to AMR Development Plan TDP-NBS-HS-000099 (USGS 2000) in accordance with AP-2.13Q, *Technical Product Development Planning*. This revision, Rev 01, to the previous analysis was prepared as part of activities being conducted under Technical Work Plan, TWP-NBS-MD-00001, Rev 01, *Technical Work Plan for Saturated Zone Flow and Transport Modeling and Testing* (BSC 2001). The TWP was prepared in accordance with AP-2.21Q, *Quality Determinations and Planning for Scientific Engineering, and Regulatory Compliance Activities.* No deviations from the TWP were necessary to complete this revision of the AMR.

The scope of this revision includes:

- Compilation of available water-level data within the model area;
- Removal of duplicate measurements and sites;
- Tabulation of measurement precision, where known;
- Assessment of the general reliability of the data;
- Tabulation of the range in water levels for use in uncertainty analyses;
- Documentation of the applicable use of water levels (potentiometric-surface development and/or SZ site-scale flow and transport model calibration);
- Generation of the potentiometric-surface map representative of the early 1990s (the time period of the saturated-zone, regional-scale flow model (D'Agnese et al. 1997) that is used to provide boundary conditions to the SZ site-scale flow and transport model, CRWMS M&O 2000); and
- Generation of a table of known vertical head differences within the SZ site-scale flow and transport model area. These head differences provide additional calibration targets for the model.

In this analysis, the water-level data are used to generate a single representative potentiometric surface (Figure 6-1) for the SZ site-scale flow and transport model domain. This revision of the potentiometric surface represents an alternate concept from that presented in Rev 00 ICN 01 of this report (USGS 2001) of the northern part of Yucca Mountain, which has been termed the "large hydraulic gradient area" (Ervin et al., 1994, p. 7). This concept assumes that water levels in boreholes USW G-2 and UE-25 WT #6 represent perched conditions, and are not representative of the regional potentiometric surface.

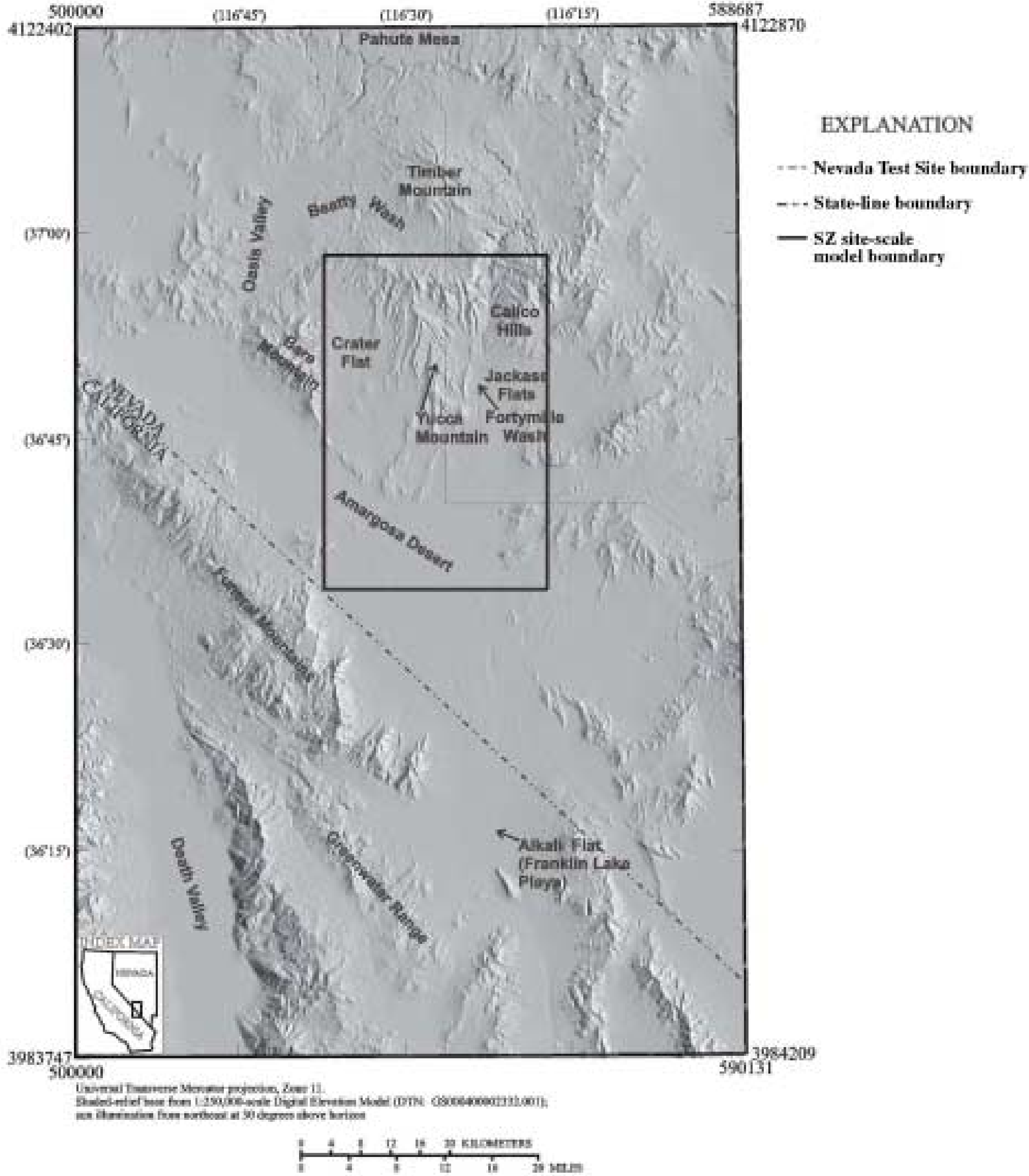

Figure 1-1 Location Map of the Study Area and Associated Geographic Features

2. QUALITY ASSURANCE

The activities documented in this revision were evaluated in accordance with AP-2.21Q, *Quality Determinations and Planning for Scientific, Engineering, and Regulatory Compliance Activities*, and were determined to be subject to the requirements of the U.S. DOE Office of Civilian Radioactive Waste Management (OCRWM) *Quality Assurance Requirements and Description* (QARD) (DOE 2000), pursuant to the Activity Evaluation prepared to support Technical Work Plan TWP-NBS-MD-000001 (BSC 2001). This revision has been prepared in accordance with procedure AP-3.10Q, *Analyses and Models.*

During development of this revision, all data were kept in the Principal Investigator's (PI) designated area on the H drive of the USGS server in Denver, Colorado. This directory is fully backed up weekly, with incremental backups 3 times a week, and is accessible only to the PI and the USGS computer site administrator. Additional backups were performed by the PI, on either floppy disk or CD-ROM. These data management activities comply with the guidance specified in AP-SV.1Q, *Control of the Electronic Management of Data*, and are documented in Scientific Notebook, SN-USGS-SCI-126-V1, Revision of Water-Level AMR (ANL-NBS-HS-000034, Rev 00/ICN 01) (Tucci 2001).

3. COMPUTER SOFTWARE AND MODEL USE

The water-level data were compiled and the potentiometric surface was constructed using Geographic Information System (GIS), spreadsheet, and digitizing software. No controlled software codes were used to synthesize the water-level data for the SZ site-scale flow and transport model. ARCINFO Version 7.2.1 was obtained from Software Configuration Management, was appropriate for the application, and was used only within its range of validation in accordance with the requirements of AP-SI.1Q, *Software Management*. PETROSYS, which was used in ANL-NBS-HS-000034, Rev 00 ICN 01 (USGS 2001) for gridding and contouring, was not used in this revision. The potentiometric surface shown on Figure 6-1 was hand-contoured, precluding the need for contouring software.

Table 3-1 Software Used to Support Analysis Activity

Software Name	Version	Software Tracking Number	Computer Platform, Operating System, Compiler	Description
ARCINFO	7.2.1	STN: 10033-7.2.1-01	Windows NT Workstation ver. 4.0. CPU ID#: 15409290306. Location: San Diego Projects Office, USGS/WRD, San Diego, CA	Plotting, coordinate transformation, and visualization of analysis results.

A brief description of how the software was used follows.

ARCINFO Version 7.2.1 (STN: 10033-7.2.1-01), published by Environmental Systems Research Institute, Inc., was used for plotting, coordinate transformation, and visualization of analysis results.

Microsoft Excel 97 SR-2 (exempt per AP-SI.1Q) was used to compile water-level data, and to compute average water levels using the "AVG" function of the software. Conversion of feet to meters was often done within Excel, by using the equation (meters = feet * 0.3048). These simple conversions were spot checked with hand calculations. The original Excel spreadsheets (inputs) were obtained from the Technical Data Management System (TDMS) (see Table 4-1). The calculated average water levels (outputs) are listed in Attachment I, Table I-1, and are contained in DTN: GS010908312332.002.

AutoCAD Map 2000, release 4 (exempt per AP-SI.1Q) was used to digitize the hand-drawn potentiometric contours. The output digitized contours were used as input to ARCINFO for plotting.

No model was used to support this analysis.

4. INPUTS

4.1 DATA AND PARAMETERS

The data used to construct the potentiometric surface and to define water levels in selected boreholes for flow-model calibration were developed from available measurements of water levels in boreholes throughout and adjacent to the SZ site-scale flow and transport model domain. These data, together with assessments of their accuracy and reliability, are presented in Tables I-1 through I-8 of Attachment I. In general these water-level measurements represent the configuration of the potentiometric surface in the upper part of the saturated zone, and no additional control is available from springs or other surface-water occurrences. Therefore, these data are considered to be appropriate for their intended use in defining the upper boundary and determining lateral hydraulic gradients for the SZ site-scale flow and transport model. Some water levels were obtained from deeper parts of the ground-water flow system, and these data provide information on vertical hydraulic gradients that are important for calibration of the SZ site-scale flow and transport model. Additional justification for the appropriateness of the data is documented in:

- Section 1 (Purpose), which describes the scope of the data used;
- Section 5.1 (Assumptions – Water-Level Data), which addresses assumptions concerning the use of the data;
- Section 6.1 (Analysis – Water-Level Data), which discusses the analysis of the water-level data; and
- Section 7.1 (Conclusion – Water-Level Data), which discusses potential errors and uncertainty.

All water-level data available for the SZ site-scale flow and transport model area were evaluated; however, some data were considered invalid. Data that were identified as invalid in ANL-NBS-HS-000034, Rev 00 ICN 01 (USGS (2001) are not used in this revised analysis. New data that were considered for use in this analysis were evaluated for validity and documented in scientific notebook SN-USGS-SCI-126-V1 (Tucci 2001), and the reasons for considering these new data to be invalid are described as follows. Based on observations of water-level data at Yucca Mountain, water levels generally fluctuate less than 1 m, and more often, less than 0.5 m (Graves et al. 1997). Exceptions occur if a nearby well is pumped or if water levels are affected by seismic events. Most of the data that were considered invalid in this analysis consisted of data obtained prior to development of the well, or were a result of known or suspected equipment failures. For example, water-level data are obtained from transducers, set in discrete zones isolated by packers, in wells NC-EWDP-1S, NC-EWDP-3S, and NC-EWDP-9SX. Transducers are known to be subject to drift, failure, or electronic problems. Packers occasionally will fail to seat properly, causing an incomplete isolation of a zone, or can leak and fail. Transducer data were considered to be invalid if they indicated either slow drifting of water levels or sharp spikes. Such phenomena could be valid, but they would have to occur in more than one zone in a well and in more than one well to be considered valid. Such corresponding changes in other zones or wells rarely occurred, so that the anomalous data were considered invalid.

Fault locations and traces (Figure 6-1; DTN: GS991208314221.001) were used as input data to construct the potentiometric-surface map. Ground-water flow may be affected by faults, which may act as barriers and/or conduits for flow. The locations of major faults in the SZ site-scale flow and transport model area were used to help guide the placement of potentiometric contours according to their assumed effect on ground-water flow (see Section 5.2).

Specific input data sets, and associated Data Tracking Numbers (DTNs), are listed in Table 4-1. The qualification status of these input sources can be found in the Document Input Reference System (DIRS).

Table 4-1 Input Data Sources

Data Description	Data Tracking Number
Digital Elevation Models Death Valley East Scale 1:250,000.	GS000400002332.001
Water-Level Measurements at UE-25 C #2 and C #3, 1989.	GS000408312312.001
Water-Level Altitude Data from the Periodic Network, January 1999 through March 1999.	GS000608312312.003
Revised Water-Level Altitude Data from the Periodic Network, First Quarter 1995.	GS000608312312.004
Water-Level Altitude Data, 1993.	GS000708312312.005
Ground-Water Altitudes from Manual Depth-to-Water Measurements at Various Boreholes November 1998 through December 1999.	GS000808312312.007
Geohydrology of Rocks Penetrated by Test Well UE-25p#1 (UE-25 p#1), Yucca Mountain Area, Nye County, Nevada.	GS920408312314.009
Geohydrologic Data and Test Results from Well J-13, Nevada Test Site, Nye County, Nevada.	GS930408312132.007
Water Levels in the Yucca Mountain Area, Nevada, 1990-91.	GS930408312312.015
Water Levels in Periodically Measured Wells in the Yucca Mountain Area, Nevada, 1981-87.	GS931008312312.025
Water-Level Altitude Data from the Periodic Network, Fourth Quarter, 1994.	GS950108312312.001
Potentiometric-Surface Map, 1993, Yucca Mountain and Vicinity, Nevada.	GS950508312312.005
28 Water-Level Measurements from the Periodic Network, Third Quarter, 1995 (7/1/95 - 9/30/95).	GS960208312312.003
Analysis of Water-Level Data in the Yucca Mountain Area, Nevada, 1985-1995.	GS960908312312.010
Water Level Altitude Data Collected at GEXA Well 4 and USW G-4.	GS970600012847.001
Water Levels in the Yucca Mountain Area, Nevada, 1996.	GS980308312312.004
Water-Level Altitude Data, April - June 1999.	GS990908312312.005
Water Level Data for Yucca Mountain Region and Amargosa Desert.	GS991100002330.001
Geologic Map of the Yucca Mountain Region.	GS991208314221.001
Water-Table-Altitude Data for Well USW G-4, Yucca Mountain Area, Nye County, Nevada.	MO0008WTRALTG4.000
Locations and Elevations for Selected Wells in the Yucca Mountain Region and Amargosa Desert from the USGS NWIS Database.	MO0011ELLOCAMD.000
Coverage: BORES3Q.	MO0103COV01031.000
Coverage: NCEWDPS. Submittal date: 07/18/2001.	MO0107COV01057.000
Water Level Data From Westbay Instrumented Borehole NC-EWDP1S.	MO0111DQRWLNYE.002
Water Level Data From Westbay Instrumented Borehole NC-EWDP-3S.	MO0111DQRWLNYE.003
Water Level Data From Westbay Instrumented Borehole NC-EWDP-9SX.	MO0111DQRWLNYE.004
Well Completion Diagram For Borehole NC-EWDP-4PA.	MO0112DQRWLNYE.005

Data Description	Data Tracking Number
Well Completion Diagram For Borehole NC-EWDP-4PB.	MO0112DQRWLNYE.006
Well Completion Diagram For Borehole NC-EWDP-7S.	MO0112DQRWLNYE.007
Well Completion Diagram For Borehole NC-EWDP-5SB.	MO0112DQRWLNYE.008
Well Completion Diagram For Borehole NC-EWDP-15P.	MO0112DQRWLNYE.009
Well Completion Diagram For Borehole NC-EWDP-12PA.	MO0112DQRWLNYE.010
Well Completion Diagram For Borehole NC-EWDP-9SX.	MO0112DQRWLNYE.011
Well Completion Diagram For Borehole NC-EWDP-12PB.	MO0112DQRWLNYE.012
Well Completion Diagram For Borehole NC-EWDP-12PC.	MO0112DQRWLNYE.013
Well Completion Diagram For Borehole NC-EWDP-19P.	MO0112DQRWLNYE.014
Well Completion Diagram For Borehole NC-EWDP-3S.	MO0112DQRWLNYE.015
Well Completion Diagram For Borehole NC-EWDP-3D.	MO0112DQRWLNYE.016
Well Completion Diagram For Borehole NC-EWDP-1DX.	MO0112DQRWLNYE.017
Well Completion Diagram For Borehole NC-EWDP-19D.	MO0112DQRWLNYE.018
Multi-Level Monitoring Port Depths In Nye County Boreholes NC-EWDP-1S, -3S AND -9SX.	MO0112DQRWLNYE.019
Water Level Depth Data For Nye County Boreholes NC-EWDP-2D AND -2DB.	MO0112DQRWLNYE.020
Multilevel Piezometer Casing Log For Borehole NC-EWDP-9SX.	MO0112DQRWLNYE.021
Multilevel Piezometer Casing Log For Borehole NC-EWDP-3S.	MO0112DQRWLNYE.022
Multilevel Piezometer Casing Log For Borehole NC-EWDP-1S.	MO0112DQRWLNYE.023
EWDP Phase I Manual Water Level Measurements.	MO0112DQRWLNYE.024
EWDP Phase II Manual Water Level Measurements.	MO0112DQRWLNYE.025
USW SD-7 Shift Drilling Summaries (1602.0'-2020.3'), Lithologic Logs (1600.0'-1925.0'), and Structure Logs (1632.0'-2020.3').	TM0000000SD7RS.003
USW SD-9 Shift Drilling Summaries, Structural Logs, and Lithological Logs.	TM0000000SD9RS.001
USW SD-12 Shift Drilling Summaries, Lithologic Logs, and Structure Logs from 1825.0'-2166.3'.	TM000000SD12RS.011

The locations of boreholes, the water-level altitudes in these boreholes, and the potentiometric contours are shown in Figure 6-1. The borehole data are provided in Attachment I.

4.2 CRITERIA

This revision addresses Subpart B, 10 CFR 63 (66 FR 55732). Subparts of the regulation that apply to this analysis activity are those pertaining to the characterization of the Yucca Mountain site (Subpart B, Section 63.15), the compilation of information regarding hydrology of the site in support of the License Application (Subpart B, Section 63.21(c)(1)(ii)), and the definition of hydrologic parameters and conceptual models used in performance assessment (Subpart E, Section 63.114(a)).

4.3 CODES AND STANDARDS

No codes or standards have been identified as applying to this analysis.

5. ASSUMPTIONS

5.1 WATER-LEVEL DATA

In the analysis presented in this report, several assumptions are made as described in the following subsections. The nature of these assumptions entails established hydrologic practices for the determination of water-level altitudes to be used in the construction of a potentiometric-surface map and requires no further confirmation.

1. Assumption: Averaging water levels from the 1980s to 1990s and 2000 provide water-level altitudes representative of conditions that existed in early 1990s. The SZ site-scale flow and transport model (CRWMS M&O 2000) uses ground-water fluxes from the Death Valley regional ground-water flow model (hereafter referred to as the regional model) (D'Agnese et al. 1997) as calibration targets. The simulated fluxes in the regional model represent average, assumed steady-state conditions from the early 1990's, not conditions for a specific year. Therefore, the water levels used to construct the potentiometric surface for the site-scale model must, to the extent allowed by data availability, represent conditions consistent with the regional model that used water-level data (altitudes) representing the early 1990s. Water levels in boreholes located at Yucca Mountain generally have not fluctuated by more than one meter during the time period from 1985 until 1995 (Graves et al. 1997). Some of the boreholes used in this analysis had no or very few water-level measurements taken during the 1980s and 1990s (Attachment I, Tables I-2 and I-4). For boreholes in this category, all available water-level altitudes, with the exception of anomalous ones noted in Attachment I, were used to calculate the mean water-level altitude (Attachment I, Table I-1). This is particularly true for boreholes located in the Amargosa Valley and Amargosa Desert (Figure 6-1). Boreholes listed in Attachment I, Table I-2 as unreliable ("U") or assumed perched ("P") are shown on Figure 6-1, but were not used to construct the potentiometric surface. This assumption is used in Section 6.1 and Attachment I, Table I-1.

2. Assumption: Mean water-level altitudes, even when influenced by ground-water withdrawal, represent water-level altitudes consistent with ground-water fluxes used in the SZ site-scale flow and transport model. Some boreholes in the model area are pumped for commercial and domestic water supplies. Water-level altitudes in these and adjacent boreholes could be influenced by the effects of pumping. This condition is especially true in the southern part of the SZ site-scale flow and transport model area. The mean water-level altitude, calculated by averaging available data, provides a datum point that is representative of the potentiometric surface for the time period being simulated. The rationale is that average-annual pumping values were used in the regional model (D'Agnese et al. 1997) and average water levels will, therefore, be consistent with the simulated conditions in the regional model. This assumption is used in Section 6.1 of this revision.

3. Assumption: Where measurement location (vertical) is unknown, the midpoint of the open interval or applicable packed-off interval is representative of the measurement location for SZ site-scale flow and transport modeling purposes. Most of the water levels used in this analysis are composite data, for a long open or screened interval. In open boreholes, the midpoint can be calculated as the mean of the altitude of the bottom of the borehole and the altitude of the

maximum water-level altitude. In packed-off intervals (screened intervals), the midpoint is calculated as the mean of the altitude of the bottom of the packed-off interval and the altitude of the top of the packed-off interval. Because this method is used for all boreholes that contributed water-level altitude data for this analysis, it provides a means for standardizing SZ measurement locations (Attachment I, Table I-5). This assumption is used throughout the revision.

4. Assumption: Water levels in boreholes USW G-2, UE-25 WT #6, and NC-EWDP-7S are perched. Water levels in boreholes USW G-2 and UE-25 WT #6, in the northern part of Yucca Mountain are assumed to represent perched conditions for the alternate concept of the large-hydraulic gradient area presented in this analysis. Czarnecki et al. (1997, p. 27) presents several lines of evidence to support this assumption. Water levels in borehole NC-EWDP-7S, in southern Crater Flat, are also assumed to represent perched conditions. The water levels for NC-EWDP-7S are anomalously high (Attachment I, Table I-1; Figure 6-1), and no other hydrogeologic explanation other than perched conditions is plausible for this location. This assumption is used in Section 6.2.

5. Assumption: Water levels in USW WT-24, at approximately 840 m above sea level, represent the regional potentiometric level. During drilling, a water-bearing fracture was encountered at about 760 m below land surface, and water rose in the borehole to an altitude of about 840 m above sea level. Drilling continued for another 104 m below the water-bearing fracture without any significant change in the water level (Graves 2001). Because the potentiometric level persisted as the borehole was considerably deepened, and because the water level remained relatively stable after completion of the well, the 840 m level is assumed to represent the regional potentiometric level and not a perched level. This assumption is used in Section 6.2.

5.2 POTENTIOMETRIC-SURFACE MAP

1. Assumption: It is assumed that the water level from the uppermost open interval from each borehole at each site, except those boreholes listed in Assumption 4 in Section 5.1, represents the potentiometric surface of the uppermost part of the saturated zone (i.e., the water table). Most boreholes have only one water-level measurement interval, however, several boreholes have two or more isolated measurement intervals (Attachment I, Table I-5). In most boreholes, the uppermost interval is where the water was first encountered in the borehole (excluding perched-water zones, where identified). The significance of this assumption is that the resulting configuration of the potentiometric surface helps to determine the magnitude and direction of lateral ground-water flow in the upper SZ, which is important in the evaluation of potential radionuclide transport down gradient from the potential repository. This assumption is used in Section 6.2.

2. Assumption: Faults may act as barriers and/or conduits for ground-water flow. The concept used in the placement of potentiometric contours (Section 6.2, Figure 6-1) is that ground-water flow across a fault or fault zone is impeded by the fault, and ground-water flow parallel to a fault or fault zone is not impeded. The concept that faults may act, alternatively, as barriers to or conduits for groundwater flow is pointed out by Freeze and Cherry (1979, p. 474). Within the saturated zone underlying Yucca Mountain, this assumption is further justified by the observations of Luckey et al. (1996, pp. 25 and 56) (1) that the Solitario Canyon fault along the

west side of Yucca Mountain is an apparent barrier to flow from west to east across the fault and (2) that, where fault zones are intersected by boreholes, these zones act as conduits for flow and produce much of the water entering the boreholes (Luckey et al. 1996, p. 37).

5.3 BOREHOLE LOCATIONS

1. Assumption: Borehole locations used in this analysis from DTN: MO0011ELLOCAMD.000 are sufficiently accurate for the intended purpose. Borehole coordinates and altitudes from YMP boreholes in DTN: MO0011ELLOCAMD.000 and in DTN: MO0103COV01031.000, which only contains YMP boreholes, were compared. Small differences in the northing and easting coordinates contained in the two records exist in most borehole locations. The altitudes of the boreholes in the two data sets were identical. Borehole altitude is the most critical component of the borehole location used for calculating the water-level altitude. Where there are differences in northing and easting coordinates, the differences are not large enough to adversely effect the location of the potentiometric-contour lines. This assumption is used throughout this revision.

6. ANALYSIS/MODEL

The water-level data and the resulting potentiometric-surface map provide important technical input for the development of the SZ site-scale flow and transport model. Saturated Zone Flow, though not a Principal Factor, may be considered in evaluating postclosure performance of the repository system and therefore may be taken into account in the postclosure safety case as identified within the Repository Safety Strategy (CRWMS M&O 2001). Consequently, inputs to this revision are determined to be related to "Other Factors" pursuant to the screening criteria outlined in AP-3.15Q, *Managing Technical Product Inputs.*

6.1 WATER-LEVEL DATA

The water-level data for the SZ site-scale flow and transport model were compiled from project data sources and U.S. Geological Survey (USGS) National Water Information System (NWIS) water-level data. This data set was updated using new (collected through December 2000) information from the Nye County Early Warning Drilling Program boreholes, data from borehole USW WT-24, and from geologic mapping within the model area (DTN: GS991208314221.001). Water-level information and analyses were compiled from the data sources listed in Table 4-1 of this revision. The results were assembled in tabular format for use as input to the SZ site-scale flow and transport model (see Attachment I).

Water-level information used in this analysis was derived from a variety of sources. The large areal extent of the SZ site-scale flow and transport model, and the long history of water-level data collection in this area, has resulted in similar (or in some cases duplicate) water-level information being contained in multiple data sources. If more than one site ID was found in NWIS for the same borehole, the site ID with the most measurements was used for calculating the average water-level altitude for the time period of interest. If location, land-surface altitude, or depth-to-water for a borehole were not available, the site was not used. NWIS data are stored as depth-to-water measurements, not as water-level altitude, and in English units as opposed to metric units. Conversion from depth-to-water to water-level altitude was accomplished by subtracting the depth-to-water measurement from the land-surface altitude of the measurement location (the borehole and surface altitude). The resulting water-level altitude was converted from feet to meters by multiplying by 0.3048.

Borehole information was examined to see if water levels potentially represented perched-water conditions. Professional judgment was used to determine whether water-level altitudes represented perched-water conditions, based on the following criteria: proximity to cold-water springs, proximity to recharge areas, steep or anomalous potentiometric surface slope, anomalous water-level altitudes, statistical water-level variability, water chemistry, pumping history, and hydrographs (O'Brien 1998). Potential perched-water levels identified during this analysis were flagged and identified as "suspected perched" or "assumed perched" (Attachment I, Tables I-2 and I-8). To prove perched-water occurrence unequivocally requires demonstrating partial saturation beneath a suspected perched-water body. The boreholes in question were either drilled using a water-based circulating fluid or were only completed a few tens of meters into the first zone of saturation. Unfortunately, partial saturation could not be proved or disproved unequivocally with the available data for the boreholes in question, USW G-2, USW G-1, UE-29 a #2, UE-25 a #3, USW UZ-N91, UE-25 WT #18, UE-25 WT #6 (O'Brien 1998), and NC-EWDP-7S (DTN: MO0112DQRWLNYE.007). In this analysis, however, water levels for wells USW G-1, UE-29 a #2, UE-25 a #3, USW UZ-N91, and UE-25 WT #18 are believed to not represent perched water areas. Water levels for these wells are consistent with the alternative concept of the large hydraulic gradient presented here and with the water level in USW WT-24.

6.1.1 Vertical Head Differences

Within the SZ site-scale flow and transport model area, 17 boreholes monitor, or have historically monitored, water levels in more than one vertical interval (Table 6-1). Water-level data from these boreholes allow for the calculation of the difference in potentiometric heads at each monitored interval. Both upward (head increases with depth) and downward (head decreases with depth) vertical gradients have been observed. Fewer downward gradients (5) are observed than upward gradients (12). Upward vertical head differences range from 0.1 m to almost 55 m, and downward vertical head differences range from 0.5 to 38 m. The monitored intervals were selected to either monitor water levels between different geologic units or between different permeable intervals within the same geologic unit.

Only two sites, UE-25 p #1, and NC-EWDP-2D/2DB, (Table 6-1), provide information on vertical gradients between volcanic rocks and the underlying Paleozoic carbonate rocks. At UE-25 p #1, water levels currently are monitored only in the carbonate aquifer; however, water-level data were obtained from within the volcanic rocks as the borehole was drilled and tested (DTN: GS920408312314.009). At this site water levels in the Paleozoic carbonate rocks are about 20 m higher than those in the overlying volcanic rocks. Borehole NC-EWDP-2DB penetrated Paleozoic carbonate rocks toward the bottom of the borehole (Spengler 2001). Water levels measured within that deep part of the borehole are about 8 m higher than levels measured in volcanic rocks penetrated by borehole NC-EWDP-2D.

Water levels monitored within the lower part of the volcanic-rock sequence at Yucca Mountain also are significantly higher than levels monitored in the upper part of the volcanics. Boreholes USW H-1 (tube 1) and USW H-3 (lower interval) both monitor water levels in the lower part of the volcanic-rock sequence, and upward gradients are observed at these boreholes with head differences of 54.7 m, and 28.9 m, respectively (Table 6-1). The gradient at USW H-3 is not completely known, because the water levels in the lower interval had been continuously rising before the packer that separates the upper and lower intervals failed in 1996.

An upward gradient is also observed between the alluvial deposits monitored in borehole NC-EWDP-19P and underlying volcanic rocks monitored in borehole NC-EWDP-19D (Table 6-1). The vertical head difference at this site is 5.3 m; however, levels reported for NC-EWDP-19D represent a composite water level for both alluvium and volcanics, so that the true head difference between those units is not completely known.

Downward gradients are also observed within the SZ site-scale flow and transport model area (Table 6-1). The largest downward gradient is observed between the deep and shallow monitored intervals at borehole NC-EWDP-1DX (head difference of 38 m). The depth to water at this site is very shallow (17 m), and within Tertiary spring deposits. Other downward gradients are much smaller in magnitude.

Five wells or well sites with more than 2 monitoring intervals (Table 6-1; well USW H-1, well USW H-6, well UE-25 J -13, site NC-EWDP-3D/NC-EWDP-3S, and well NC-EWDP-9SX) have head differences between the upper-most and lower-most monitored intervals and the intermediate intervals in which the gradients are both upwards and downwards. For example at well USW H-1, the head difference between the upper-most (tube 4) and next lower interval (tube 3) is –0.2 meters, indicating a small downward gradient; however, the head difference between tube 3 and the next lower interval (tube 2) is 5.3 meters, indicating an upward gradient. The significance of the mixed gradients at these sites on overall ground-water flow paths is not known at this time, because of the limited number of data points.

Table 6-1 Vertical Head Differences (Output DTN: GS010908312332.003)

WELL	OPEN INTERVAL (m below land surface)	POTENTIOMETRIC LEVEL (m above sea level)	HEAD DIFFERENCE deepest - shallowest intervals (m)	Source Data	REMARKS
USW H-1 tube 4	573-673	730.94	**54.7**	GS930408312312.015	1991 mean level, Luckey et al. 1996, table 3
USW H-1 tube 3	716-765	730.75		GS930408312312.015	1991 mean level, Luckey et al. 1996, table 3
USW H-1 tube 2	1097-1123	736.06		GS930408312312.015	1991 mean level, Luckey et al. 1996, table 3
USW H-1 tube 1	1783-1814	785.58		GS930408312312.015	1991 mean level, Luckey et al. 1996, table 3
USW H-3 upper	762-1114	731.19	**28.9**	GS980308312312.004	1996 mean level, Graves (1998, p. 59)
USW H-3 lower	1114-1219	760.07		GS980308312312.004	1996 mean level, Graves (1998, p. 59)
USW H-4 upper	525-1188	730.49	**0.1**	GS930408312312.015	1991 mean level, Luckey et al. 1996, table 3
USW H-4 lower	1188-1219	730.56		GS930408312312.015	1991 mean level, Luckey et al. 1996, table 3
USW H-5 upper	708-1091	775.43	**0.2**	GS930408312312.015	1991 mean level, Luckey et al. 1996, table 3
USW H-5 lower	1091-1219	775.65		GS930408312312.015	1991 mean level, Luckey et al. 1996, table 3
USW H-6 upper	533-752	775.99	**2.2**	GS930408312312.015	1991 mean level, Luckey et al. 1996, table 3
USW H-6 lower	752-1220	775.91		GS930408312312.015	1991 mean level, Luckey et al. 1996, table 3
USW H-6	1193-1220	778.18		GS931008312312.025	1/84-5/84 mean level, Luckey et al. 1996, table 3
UE-25 b #1 upper	488-1199	730.71	**-1.0**	GS930408312312.015	1991 mean level, Luckey et al. 1996, table 3
UE-25 b #1 lower	1199-1220	729.69		GS930408312312.015	1990-91 mean level
UE-25 p #1 (volcanic)	384-500	729.90	**21.4**	GS920408312314.009	Luckey et al. 1996, table 3
UE-25 p #1 (carbonate)	1297-1805	751.26		GS920408312314.009	Luckey et al. 1996, table 3
UE-25 c #3	692-753	730.22	**0.4**	GS930408312312.015	1990 mean level, Luckey et al. 1996, table 3
UE-25 c #3	753-914	730.64		GS930408312312.015	1990 mean level, Luckey et al. 1996, table 3
USW G-4	615-747	730.3	**-0.5**	MO0008WTRALTG4.000	Luckey et al. 1996, table 3
USW G-4	747-915	729.8		MO0008WTRALTG4.000	Luckey et al. 1996, table 3
UE-25 J -13 upper	282-451	728.8	**-0.8**	GS930408312132.007	Luckey et al. 1996, table 3
UE-25 J -13	471-502	728.9		GS930408312132.007	Luckey et al. 1996, table 3
UE-25 J -13	585-646	728.9		GS930408312132.007	Luckey et al. 1996, table 3
UE-25 J -13	820-1063	728.0		GS930408312132.007	Luckey et al. 1996, table 3

WELL	OPEN INTERVAL (m below land surface)	POTENTIOMETRIC LEVEL (m above sea level)	HEAD DIFFERENCE deepest - shallowest intervals (m)	Source Data	REMARKS
NC-EWDP-1DX (shallow)	WT-419	786.8	**-38.0**	MO0112DQRWLNYE.017, MO0112DQRWLNYE.024	5/99-2/00
NC-EWDP-1DX (deep)	658-683	748.8		MO0112DQRWLNYE.024 MO0112DQRWLNYE.017	8/99-2/00
NC-EWDP-2D (volcanic)	WT-493	706.1	**7.6**	MO0112DQRWLNYE.020, MO0112DQRWLNYE.024	1/99
NC-EWDP-2DB (carbonate)	820-937	713.7		MO0112DQRWLNYE.020, MO0112DQRWLNYE.025	11/15/00-11/22/00
NC-EWDP-3S probe 2	103-129	719.8	**-1.5**	MO0112DQRWLNYE.015, MO0112DQRWLNYE.019, MO0111DQRWLNYE.003, MO0112DQRWLNYE.022	5/06/99-12/06/00
NC-EWDP-3S probe 3	145-168	719.4		MO0112DQRWLNYE.015, MO0112DQRWLNYE.019, MO0111DQRWLNYE.003, MO0112DQRWLNYE.022	5/06/99-12/06/00
NC-EWDP-3D	WT-762	718.3		MO0112DQRWLNYE.024, MO0112DQRWLNYE.016	3/99-8/99
NC-EWDP-4PA	124-148	717.9	**5.7**	MO0112DQRWLNYE.025, MO0112DQRWLNYE.005	1/13/00-10/26/00
NC-EWDP-4PB	225-256	723.6		MO0112DQRWLNYE.025, MO0112DQRWLNYE.006	1/21/00-10/26/00
NC-EWDP-9SX probe 1	27-37	766.7	**0.1**	MO0112DQRWLNYE.011, MO0112DQRWLNYE.019, MO0111DQRWLNYE.004, MO0112DQRWLNYE.021	5/06/99-12/06/00
NC-EWDP-9SX probe 2	43-49	767.3		MO0112DQRWLNYE.011, MO0112DQRWLNYE.019, MO0111DQRWLNYE.004, MO0112DQRWLNYE.021	5/06/99-12/06/00
NC-EWDP-9SX probe 4	101-104	766.8		MO0112DQRWLNYE.011, MO0112DQRWLNYE.019, MO0111DQRWLNYE.004, MO0112DQRWLNYE.021	5/06/99-12/06/00
NC-EWDP-12PA	99-117	722.9	**2.2**	MO0112DQRWLNYE.025, MO0112DQRWLNYE.010	4/18/00-11/15/00

WELL	**OPEN INTERVAL** (m below land surface)	**POTENTIOMETRIC LEVEL** (m above sea level)	**HEAD DIFFERENCE** deepest - shallowest intervals (m)	**Source Data**	**REMARKS**
NC-EWDP-12PB	99-117	723.0		MO0112DQRWLNYE.025, MO0112DQRWLNYE.012	4/18/00-11/15/00
NC-EWDP-12PC	52-70	720.7		MO0112DQRWLNYE.025, MO0112DQRWLNYE.013	4/27/00-11/15/00
NC-EWDP-19P	109-140	707.5	**5.3**	MO0112DQRWLNYE.025, MO0112DQRWLNYE.014	3/13/00-6/17/00
NC-EWDP-19D	106-433	712.8		MO0112DQRWLNYE.025, MO0112DQRWLNYE.018	6/14/00-6/22/00

Negative value indicates downward gradient

6.2 POTENTIOMETRIC-SURFACE MAP

For SZ site-scale flow and transport model construction purposes, the potentiometric-surface map was created (Figure 6-1) from the water-level data listed in Attachment I, Table I-1. The potentiometric contours were hand drawn, rather than computer-generated as in Rev 00 ICN 01 of this report (USGS 2001). This hand contouring allowed the PI to locate the contours based on professional hydrologic judgement and experience. In accordance with the discussion in Section 5.2, the water-level altitude from the upper interval of each borehole from a site was assumed to represent the potentiometric surface. Under this assumption, only water-level altitudes representing the uppermost aquifer system, typically the volcanic or alluvial system, were used. Fault traces shown on Figure 6-1 represent the mapped surface expression of the faults.

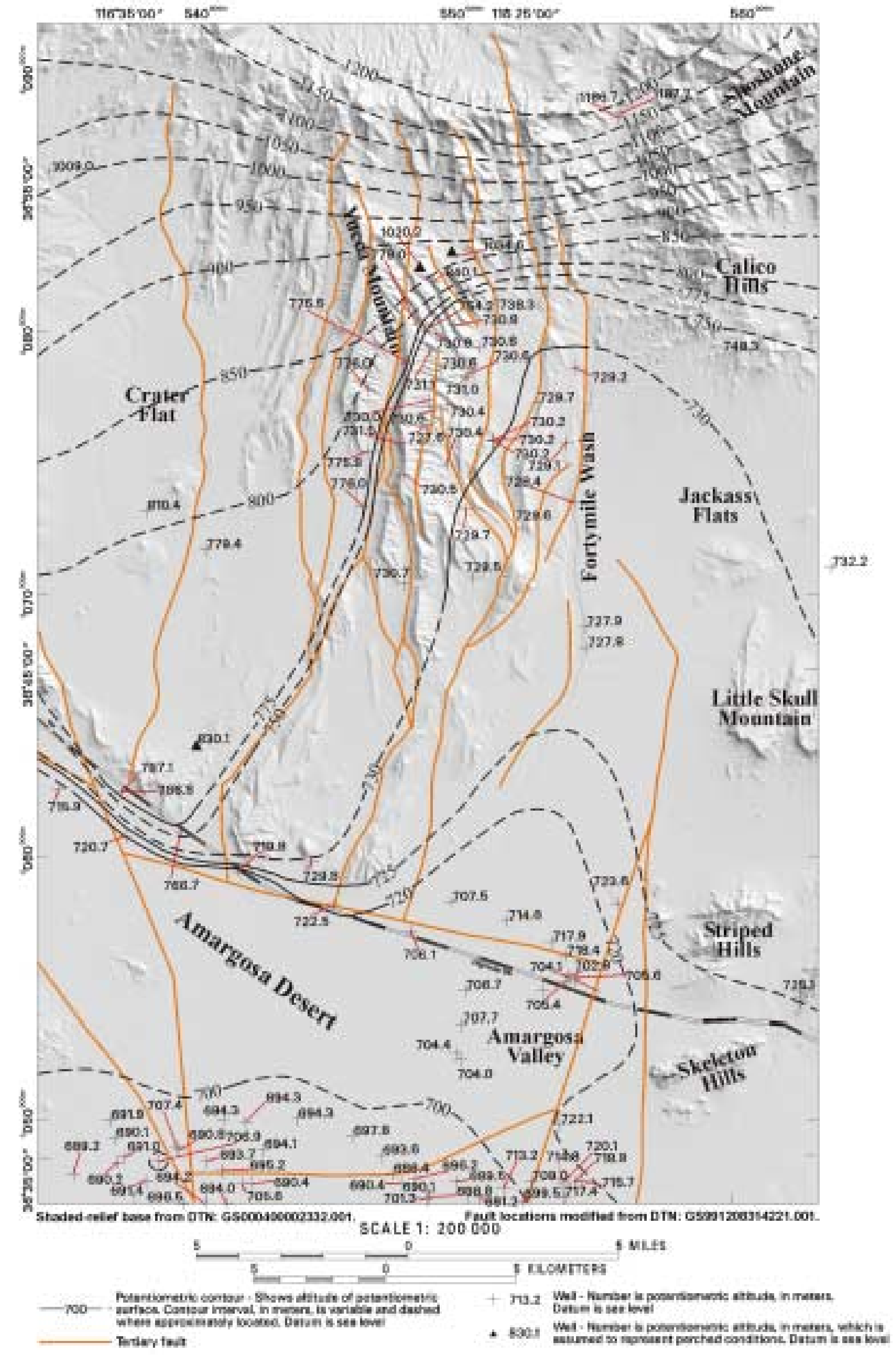

Figure 6-1 Potentiometric-Surface Map, Assuming Perched Conditions North of Yucca Mountain, in the SZ Site-Scale Flow and Transport Model Area (Output DTN: GS010608312332.001)

The distribution of water-level data and the complex geology in the SZ site-scale flow and transport model area allow for various interpretations of the configuration of the potentiometric surface (Luckey et al. 1996, pp. 21-26). Several potentiometric-surface maps (discussed below) have been developed that encompass Yucca Mountain and vicinity, including the SZ site-scale flow and transport model area and the regional model area. Examination of other potentiometric-surface maps that fully or partially cover the SZ site-scale flow and transport model area reveals no major differences in the shape of potentiometric-contour lines. This is not unexpected because similar, and in some cases the same, water-level data were used to create the potentiometric-contour lines; adhering to the rules that govern the construction of potentiometric contours, only a limited number of configurations of the water-level data are possible. The differences observed between existing potentiometric-surface maps and the one presented in this revision can be attributed to map scale, potentiometric-contour intervals, changing concepts of potential perched water and the regional potentiometric surface in the large hydraulic gradient area, and more and newer water-level data. The potentiometric-surface map created for this revision is an accurate interpretation based on the available water-level data, the geologic map of the Yucca Mountain region, the assumptions in Section 5, and the regional potentiometric surface.

This analysis differs from that reported in Rev 00 ICN 01 (USGS 2001, Figure 1-2) in several ways. The most significant difference is in the portrayal of the large hydraulic gradient (LHG) area north of Yucca Mountain. The concept that water levels in boreholes USW G-2 and UE-25 WT #6 are considered to represent perched conditions (Assumption 5.1.4), is used to create the potentiometric surface in this revision. By not using the data from those two boreholes the LHG is reduced from about 0.11 (Tucci and Burkhardt 1995, p. 9) to between 0.06 to 0.07, and the potentiometric contours are more widely spaced. Another significant difference is that potentiometric contours are no longer offset where they cross faults. Such offsets, which were shown in the map presented in Rev 00 ICN 01 (USGS 2001, Figure 1-2), would not be expected where the contours are perpendicular or nearly perpendicular to the fault trace. Direct evidence of offset, which would be provided by wells that straddle the fault, does not exist at Yucca Mountain. Faults were used, however, to help in the placement of contours that are oriented parallel or approximately parallel to faults. The concept used to represent the impact of faults on potentiometric contours is that ground-water flow across a fault (or fault zone) is impeded by the fault and ground-water flow parallel to a fault is not impeded by the fault. The basis for this representation is discussed in Section 5.2. The contour interval used in this analysis is somewhat different from Rev 00 ICN 01 (USGS (2001), which used a uniform contour interval of 25 m (USGS 2001, Figure 1-2). The contour interval used in Figure 6-1 is variable, in which the interval is 50 m for contours greater than 800 m, and 25 m for contours less than 800 m. Two additional contours, 730 and 720 are also included. The inclusion of those contours helps to visualize the effect of the fault along Highway 95 (Figure 6-1) , south of Yucca Mountain, on the ground-water flow system.

The potentiometric-surface map presented in Czarnecki et al. (1997, Figure 5) is identical in areal extent to the potentiometric-surface map developed for this revision (Figure 6-1). Examination of that potentiometric-surface map illustrates an alternative interpretation constructed from similar water-level data. Differences in the two maps occur at the boundaries of the maps, where there is little or no data; and where the potentiometric surface is influenced by major faults. The major difference in the shape of the potentiometric contours occurs in the northern and northwestern area of the maps. Czarnecki et al. (1997) suggest a closing of the contour lines to the north of the LHG, water-level altitudes as much as 150 meters shallower, and an east-west trend of the contours in southern Crater Flat. Other major differences occur south of Yucca Mountain, because Nye County EWDP data were not available to Czarnecki et al (1997).

Larger-scale potentiometric-surface maps (Ervin et al. 1994, plate 1; Tucci and Burkhardt 1995, Figure 4; Lehman and Brown 1996, Figure 16) cover only a small portion of the site-scale model area in the vicinity of Yucca Mountain. The potentiometric-surface map by Ervin et al. (1994, plate 1) has water-level contour intervals of 0.25 meters. That map does not attempt to contour the areas of the LHG or the moderate hydraulic gradient to the west of the Solitario Canyon fault, but the general shape of the potentiometric contours is similar to the map constructed for this revision (Figure 6-1). The potentiometric-surface map in Tucci and Burkhardt (1995, Figure 4) has contour intervals that are variable, from 0.50 meters to 20.00 meters. Comparing the same potentiometric contour (800-meter contour) on that map and the map constructed for this revision reveals a similarity in shape, although the gradient in the LHG area in the Tucci and Burkhardt (1995) map is larger that the gradient presented in this revision. The map by Lehman and Brown (1996, Figure 16) presents an alternate concept of ground-water flow at Yucca Mountain, in which faults and fracture zones act as very permeable conduits for flow. Although such features play an important role in the ground-water flow system at Yucca Mountain, the map is based on corrections to water levels that may not be valid due to the large open intervals in some of the wells (Graves et al. 1997, Appendix A). The map that Lehman and Brown present in their report (1996, Figure 16) is also somewhat spatially distorted, so that it cannot be directly compared to other potentiometric maps constructed for Yucca Mountain.

The regional potentiometric surface of the Death Valley region (D'Agnese et al. 1997, plate 1) is at a much smaller scale than the potentiometric-surface map in this revision. The contour interval used by D'Agnese et al. (1997, plate 1) is 100 meters, resulting in only a few contour lines intersecting the SZ site-scale flow and transport model area. As with the larger-scale potentiometric-surface maps, the same water-level contours that occur on D'Agnese et al. (1997, plate 1) and the potentiometric-surface map in this revision can be compared. This comparison reveals that the potentiometric contours on both maps are similar, although, because D'Agnese et al. (1997) assumes that water levels in USW G-2 and UE-25 WT #6 represent regional levels, the gradient in the LHG area is larger than the gradient presented in this revision.

Potentiometric data indicate a complex three-dimensional flow system. Luckey et al. (1996) discuss different gradients and interpretations of the SZ site-scale flow and transport model. Ground-water flow in the welded volcanic rocks occurs primarily in fractures and secondarily in the matrix of the rock (Luckey et al. 1996). Therefore, this flow system may result from the presence of faults and associated fracture zones occurring in the welded volcanic hydrogeologic units, rather than a system in which ground-water flow is through a porous medium. Depending upon where the potentiometric surface is located within the hydrostratigraphic sequence, it may be either confined or unconfined. Confined aquifers may exist where a relatively less permeable hydrogeologic unit, such as a clay bed or argillic volcanic unit, overlies a permeable hydrogeologic unit. An unconfined aquifer has no overlying, relatively less permeable, hydrogeologic unit.

Many of the boreholes used in this analysis only partially penetrate a single hydrogeologic unit. In boreholes that do penetrate more than one hydrogeologic unit, no attempt was made to distinguish water-level measurements associated with specific hydrogeologic units or fracture zones. The water-level altitudes in some boreholes represent composite heads from multiple hydrogeologic units and fractures zones. Generally, water levels in the uppermost saturated zone appear to represent a laterally continuous, well-connected aquifer system (Tucci and Burkhardt 1995, p. 7). Little impact on the potentiometric surface is expected from boreholes that are open at different depth intervals and to different hydrogeologic units.

Some of the major faults in the region are thought to affect water levels (Ervin et al. 1994; Tucci and Burkhardt 1995; Luckey et al. 1996; D'Agnese et al. 1997). As a result, several of these faults were selected to help interpret the water-level data used in the analysis (Figure 6-1). The selection was based on fault displacement of geologic units and extent of the fault, both laterally and vertically. The location of some of the major faults may explain the water-level altitudes in some of the boreholes and the resulting potentiometric-surface map. For example, an area termed the "moderate hydraulic gradient" is associated with the area adjacent to the Solitario Canyon fault, which is located along the west side of Yucca Mountain (approximately parallel to the 750-m and 775-m contours shown in Figure 6-1). Water-level altitudes to the west of the Solitario Canyon fault are more than 40 meters higher than those to the east (Ervin et al. 1994; Tucci and Burkhardt 1995). A moderate to large hydraulic gradient area southwest of Yucca Mountain also appears to be related to a fault that is approximately parallel to Highway 95 (Figure 6-1).

The potentiometric surface is characterized by four major regions that can be inferred from the potentiometric contours depicted in Figure 6-1:

(1) A small-gradient (0.0001 to 0.0004; Tucci and Burkhardt 1995, p. 9) area to the east and southeast of Yucca Mountain where water levels range from about 728 to 732 m. Gradients in the Amargosa Desert, south of Yucca Mountain are also small (0.001 to 0.0004; water levels ranging from about 720 to about 690 m);

(2) A moderate-gradient (0.02 to 0.04; Tucci and Burkhardt 1995, p. 9) area to the west of Yucca Mountain, where water levels range from about 740 to 800 m,

(3) A moderate- to large-gradient (0.01 to 0.05) area southwest of Yucca Mountain (along Highway 95 near southern Crater Flat), where water levels range from 720 to 775 m, and

(4) A large-gradient (0.06 to 0.07) area north of Yucca Mountain, where water levels range from about 738 to 1188 m. This gradient assumes that water levels in boreholes USW G-2 and UE-25 WT #6 represent perched conditions. The hydraulic gradient in the LHG area north of Yucca Mountain previously had been reported as about 0.11 (Tucci and Burkhardt 1995, p. 9).

The potentiometric surface presented in this analysis and in previously published reports generally implies a hydraulically, well-connected flow system within the uppermost saturated zone (Tucci and Burkhardt 1995) as discussed above.

A number of explanations have been proposed to explain the presence of the apparent LHG at the north end of Yucca Mountain. Explanations proposed for the LHG include:

1) Faults that contain nontransmissive fault gouge (Czarnecki and Waddell 1984);

2) Faults that juxtapose transmissive tuff against nontransmissive tuff (Czarnecki and Waddell 1984);

3) The presence of a less fractured lithologic unit (Czarnecki and Waddell 1984);

4) A change in the direction of the regional stress field and a resultant change in the intensity, interconnectedness, and orientation of open fractures on either side of the area with the LHG (Czarnecki and Waddell 1984); or

5) The apparent large gradient actually represents a disconnected, perched- or semi-perched-water body, so that the high water-level altitudes are caused by local hydraulic conditions and are not part of the regional saturated-zone flow system (Ervin et al. 1994).

Fridrich et al. (1994) suggest two hydrogeologic explanations for the LHG: (1) a highly permeable buried fault that drains water from the volcanic rock units into a deeper regional carbonate aquifer or (2) a buried fault that forms a 'spill-way' in the volcanic rocks. Their second explanation, in effect, juxtaposes transmissive tuff against non-transmissive tuff, and is therefore the same as (2) above. On a regional basis, other large hydraulic gradient areas are associated with a contact in the Paleozoic rocks between clastic, confining unit rocks and the regional carbonate aquifer; however, the cause and nature of the LHG near Yucca Mountain is not evident.

7. CONCLUSIONS

7.1 WATER-LEVEL DATA

Water-level altitudes in the SZ site-scale flow and transport model area range over 400 meters. The data distribution generally is very uneven, and the hydraulic character of the formations and the location of recharge areas, both of which influence the water level, are variable. As a result, water levels vary significantly over the SZ site-scale flow and transport model area.

Most of the water levels used in this analysis are composite levels in which water is produced from one or more hydrogeologic units or fracture zones as indicated in Attachment I, Table I-5, of this revision. Because of long open (uncased) or perforated/screened intervals, many boreholes intercept multiple permeable zones, resulting in a composite water-level altitude.

Potential errors in the potentiometric surface can result from the use of data from wells completed in potentially perched-water bodies, and from inaccuracies in the borehole site-location, land-surface altitude, water-level measurements, and water-level altitude calculation. Evaluation of methodology accuracy is documented in Attachment I, Tables I-6, I-7, and I-8. This information may be used to evaluate the representativeness of the water-level altitudes used in this analysis and to determine whether or not these altitudes represent the potentiometric surface of the upper saturated zone.

In addition to measurement uncertainties, the range in water levels for a borehole can be used in the determination of an uncertainty of a mean water level at that site. Pumping is included in the flux rates used in the regional model (D'Agnese et al. 1997); therefore water levels that may be influenced by pumping are included in the SZ site-scale flow and transport model (CRWMS M&O 2000). Because of the uncertainties in water levels discussed in the previous paragraph, the range in water-level altitudes and the possible causes of that variability should be taken into account during SZ site-scale flow and transport model calibration.

7.1.1 Vertical Head Differences

Vertical head differences, documented in Table 6-1, are variable throughout the SZ site-saturated zone model area. Of the 17 sites at which vertical gradients have been evaluated, most gradients (12) are upward, and fewer (5) are downward. No correlation is evident in the spatial location of boreholes and the location of upward or downward vertical gradients. The reason for this lack of spatial correlation probably is because of the wide variation in the monitored hydrogeologic units and depths of the monitored intervals. Gradients appear to be upward from the Paleozoic carbonate aquifer and from the deepest parts of the volcanic-rock aquifers, where potentiometric levels may be influenced by the underlying carbonates. A significant downward gradient exists at borehole NC-EWDP-1DX at a paleospring deposit south of Crater Flat. A slight downward gradient at borehole UE-25 J-13 may be indicative of recharge to the ground-water system along Fortymile Wash; however, the gradient is so small that it might only be an artifact of errors in water-level measurements.

7.2 POTENTIOMETRIC-SURFACE MAP

The potentiometric surface shown in Figure 6-1 provides a contour-map representation of the potentiometric surface from water-level data that were developed for this report and that are available from the TDMS under DTN: GS010608312332.001. This revised potentiometric surface presents an alternate concept of the LHG area north of Yucca Mountain to that presented in Rev 00 ICN 01 (USGS 2001). In this revision, water levels in boreholes USW G-2 and UE-25 WT #6 are assumed to represent perched conditions and not regional potentiometric levels. If perched conditions do not actually exist at those boreholes, and the water level in USW WT-24 also represents the regional potentiometric level, then the hydraulic gradient north of Yucca Mountain would be much greater than previously reported .

The potentiometric surface developed from the input data sets listed in Table 4-1 incorporates the potential errors and uncertainties identified in this revision. Hence, the accuracy of the potentiometric surface will vary spatially. In the potential repository area, the potentiometric surface may be characterized within one meter; however, in other areas within the SZ site-scale flow and transport model area the uncertainty in water levels is much greater because of lack of data in many areas. Areas where perched-water zones may exist, water-level drawdown associated with pumping in the Amargosa Valley, and the unknown effect of faults on water-level altitudes all add to the uncertainty of the accuracy of the potentiometric surface constructed using these data. The potentiometric surface presented herein does not strictly represent the water table, a concept reserved for the actual interface between the saturated and unsaturated zones. However, the potentiometric surface presented is probably a close and reasonable representation of the water table for the early 1990's (see Assumption 1 in Section 5.1).

Large portions of the SZ site-scale flow and transport model area contain no water-level data, and potentiometric contours drawn through those areas (indicated by dashed contours on Figure 6-1) are speculative and subject to other equally valid interpretations. Potential errors in the location of those contours will be represented in the site-scale SZ model as potential errors in the saturated thickness of the uppermost saturated unit or by a difference in which geologic unit constitutes the uppermost saturated unit.

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ATTACHMENT I

BOREHOLE DATA

TOTAL PAGES: 31

The following sections describe the information pertaining to terms used in Attachment I.

USGS Site Identification

Unique site identifications (IDs) are assigned to each borehole for which the USGS maintains water-level data. Boreholes that contain multiple monitoring zones are assigned a unique site ID for each of the different zones. The site IDs are different than the site ID for the entire borehole, but usually contain a portion of the borehole site ID. Where more than one site ID for a given borehole exists (multiple monitoring zones), the site ID for the entire borehole is used in Attachment I.

Site Name

The common borehole site name available for a given site was recorded.

CONTENTS

Table I-1 Easting, Northing, Land Surface Altitude, Mean Water-level Altitude (DTN: GS010908312332.002)

Easting and Northing

Coordinates for boreholes used in this analysis are from DTNs MO0011ELLOCAMD.000 (see Assumption 5.3), MO0103COV01031.000, and MO0107COV01057.000,. UTM easting and northing were calculated using ARCINFO PROJECT command. The latitude/longitude, or state plane coordinate, was projected into UTM (meters, Zone 11, North American Datum 1927) coordinates and rounded to the nearest meter.

Land-surface Altitude Above Sea Level (meters)

The land-surface altitudes for boreholes used in this analysis are from DTNs MO0011ELLOCAMD.000 (see Assumption 5.3), MO0107COV01057.000, and MO0103COV01031.000. The altitude was converted from feet to meters by the following formula, where necessary:

Altitude (ft) x 0.3048 (m/ft) = Altitude (m)

For example: 2401.52 ft x 0.3048 m/ft = 731.98 m

The altitude was subsequently rounded to the nearest tenth of a meter for use in this table.

Mean Water-level Altitude Above Sea Level (meters)

Mean water-level altitudes were calculated as time-averages over the period of available measurements. For the wells tabulated in Graves et al. (1997, Table 2, DTN: GS960908312312.010), monthly mean water-level altitudes computed from hourly transducer data and periodic manual water-level altitude measurements were used to compute the mean water-level altitude. The mean water level for each site not included in Graves et al. (1997, DTN: GS960908312312.010) was calculated based on the available record. An example calculation follows:

(730.98+731.07+731.09)/3 = 731.05

The altitude was subsequently rounded to the nearest tenth of a meter for use in this table.

In addition, the following exceptions were made when calculating the mean:

- NDOT well: Deleted the 1972 measurement (2,291.8 ft) from the calculation of the average. It is anomalously low and not representative of average conditions in the borehole.
- Donald O. Heath well: Deleted the 1961 measurement (2,342.0 ft) from the calculation of the average. It is anomalously high and not representative of average conditions in the borehole.
- William R. Monroe well: Deleted the 1958 measurement (2,362.0 ft) from the calculation of the average. It is anomalously high and not representative of average conditions in the borehole.
- Cooks West well: Deleted the 1963 measurement (2,324.6 ft) from the calculation of the average. It is anomalously low and not representative of average conditions in the borehole.
- Cooks East well: Deleted the 2 measurements of 2,333.8 ft (12/20/1961) and 2,335.3 ft(04/09/1991) from the calculation of the average. They are anomalously low and not representative of average conditions in the borehole.
- DeFir well: Used the data obtained after 1982 as being more representative of the calibration period.
- Airport well: Deleted the 1964 measurement (2,348.8 ft) from the calculation of the average. It is anomalously high and not representative of average conditions in the borehole.
- GEXA Well 4: Deleted 1991 measurement (3133.2 ft.) from the calculations of the average. It is anomalously low and not representative of average conditions in the borehole.
- Nye County EWDP boreholes: Water-level measurements made prior to development of the well were not used to calculate the mean. Additionally, water-level measurements obtained by transducers that were believed to be unreliable (based on comparison to measurements in other zones within the borehole and/or comparison to other boreholes) were not used. Those individual unreliable measurements consist of thousands of data points and are too numerous to list here.

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USGS Site ID	Site Name	Easting (UTM)	Northing (UTM)	Land-surface Altitude (m)	Mean Water-level Altitude (m)
365629116222602	UE-29 a #2	555753	4088351	1215.4	1187.7
365520116370301	GEXA Well 4	534069	4086110	1198.1	1009.0
365340116264601	UE-25 WT #6	549352	4083103	1314.8	1034.6
365322116273501	USW G-2	548143	4082542	1554.0	1020.2
365239116253401	UE-25 WT #16	551146	4081234	1210.9	738.3
365208116274001	USW UZ-14	548032	4080260	1348.9	779.0
365207116264201	UE-25 WT #18	549468	4080238	1336.4	730.8
365200116272901	USW G-1	548306	4080016	1325.9	754.2
365147116185301	UE-25 a #3	561084	4079697	1385.6	748.3
365140116260301	UE-25 WT #4	550439	4079412	1169.3	730.8
365116116233801	UE-25 WT #15	554034	4078694	1083.2	729.2
365114116270401	USW G-4	548933	4078602	1269.5	730.6
365105116262401	UE-25 a #1	549925	4078330	1199.2	731.0
365032116243501	UE-25 WT #14	552630	4077330	1076.4	729.7
365023116271801	USW WT-2	548595	4077028	1301.4	730.6
364947116254300	UE-25 c #1	550955	4075933	1130.6	730.2
364947116254501	UE-25 c #3	550930	4075902	1132.4	730.2
364947116254401	UE-25 c #2	550955	4075871	1132.2	730.2
364945116235001	UE-25 WT #13	553730	4075827	1032.5	729.1
364933116285701	USW WT- 7	546151	4075474	1196.9	775.8
364916116265601	USW WT- 1	549152	4074967	1201.4	730.4
364905116280101	USW G-3	547543	4074619	1480.6	730.5
364828116234001	UE-25 J -13	554017	4073517	1011.3	728.4
364825116290501	USW WT-10	545964	4073378	1123.4	776.0
364822116262601	UE-25 WT #17	549905	4073307	1124.0	729.7
365821116343701	USW VH-2	537738	4073214	974.5	810.4
364757116245801	UE-25 WT #3	552090	4072550	1030.0	729.6
364732116330701	USW VH-1	539976	4071714	963.5	779.4
364656116261601	UE-25 WT #12	550168	4070659	1074.7	729.5
364649116280201	USW WT-11	547542	4070428	1094.1	730.7
364554116232400	UE-25 J -12	554444	4068774	953.6	727.9
364528116232201	UE-25 JF #3	554498	4067974	944.4	727.8
364105116302601	Cind-R-Lite Well	544027	4059809	830.8	729.8
363907116235701	Ben Bossingham	553704	4056228	819.9	718.4
363836116234001	Fred Cobb	553808	4055459	811.4	702.8
363840116235000	Bob Whellock	553883	4055398	813.8	704.1
363840116234001	Louise Pereidra	554131	4055399	810.8	705.6
363840116233501	Joe Richards	554008	4055337	811.4	701.6
363835116234001	NDOT Well	553685	4055242	809.8	705.4
363742116263201	James H. Shaw	549863	4054911	795.5	706.7
363830116241401	Airport Well	552818	4054929	804.3	705.3
363815116175901	TW- 5	562604	4054686	931.5	725.1
363711116263701	Richard Washburn	549746	4053647	783.9	707.7
363621116263201	Richard Washburn	549679	4052322	774.2	704.4
363549116305001	Nye County Development Co	543481	4050069	742.2	694.3
363523116353701	Fred Wooldridge	536350	4050006	731.8	691.9
363525116325601	Fred J. Keefe	540673	4049994	735.2	694.3

USGS Site ID	Site Name	Easting (UTM)	Northing (UTM)	Land-surface Altitude (m)	Mean Water-level Altitude (m)
363519116322001	Leslie Nickels	541518	4049937	737.0	694.3
363540116240801	L. Mason	553471	4049848	771.1	722.1
363527116292501	Unknown	545596	4049403	744.0	697.8
363521116352501	Davidson Well	536552	4049329	730.1	690.1
363456116335501	Eugene J. Mankinen	538889	4049000	740.7	707.4
363454116314201	Donald O. Heath	542194	4048892	733.7	694.1
363503116351501	Elvis Kelley	536903	4048621	727.9	691.0
363503116284001	Manuel Rodela	546718	4048669	740.7	693.6
363436116342301	Charles C. DeFir Jr.	538196	4048442	740.7	706.9
363436116333201	William R. Monroe	540035	4048450	731.5	693.7
363434116354001	DeFir Well	536655	4048405	727.1	690.2
363438116324601	Edwin H. Mankinen	540608	4048083	727.9	695.2
363442116363301	Bill Strickland	534967	4047966	725.7	689.2
363440116282401	M. Meese	547120	4047963	731.5	686.4
363415116275101	Theo E. Selbach	547941	4047782	741.9	696.2
363407116342501	C.L. Caldwell	537727	4047670	723.3	691.4
363407116243501	Leonard Siegel	552390	4047685	762.0	709.0
363429116315901	James K. Pierce	541778	4047596	729.1	690.4
363405116321501	James K. Pierce	541381	4047563	740.7	705.6
363428116240301	Cooks West Well	553609	4047631	754.3	720.1
363428116234701	Cooks East Well	554006	4047633	755.2	718.9
363417116271801	Nye County Land Company	548466	4047261	740.7	690.1
363411116272901	Amargosa Town Complex	548492	4047077	739.1	688.8
363410116261101	Nye County Development Co	550431	4047057	743.7	691.2
363410116240301	Lewis C. Cook	553612	4047076	748.6	717.4
363410116240001	Lewis C. Cook	553687	4047077	749.8	714.8
363407116273301	Amargosa Valley Water	548393	4046953	737.9	701.3
363342116335701	Earl N. Selbach	539147	4046844	723.9	696.5
363340116332901	Lewis N. Dansby	539968	4046817	724.2	694.2
363342116325101	Edwin H. Mankinen	540788	4046821	724.2	694.0
363350116252101	Willard Johns	552097	4046882	746.8	699.5
365157116271202	USW H-1 tube 1	548727	4079926	1303.0	785.5
365157116271203	USW H-1 tube 2	548727	4079926	1303.0	736.0
365157116271204	USW H-1 tube 3	548727	4079926	1303.0	730.6
365157116271205	USW H-1 tube 4	548727	4079926	1303.0	730.8
365122116275502	USW H-5 upper	547668	4078841	1478.9	775.5
365122116275503	USW H-5 lower	547668	4078841	1478.9	775.6
365108116262302	UE-25 b #1 lower	549949	4078423	1200.7	729.7
365108116262303	UE-25 b #1 upper	549949	4078423	1200.7	730.6
365049116285502	USW H-6 upper	546188	4077816	1301.8	776.0
365049116285505	USW H-6 lower	546188	4077816	1301.8	775.9
365032116265402	USW H-4 upper	549188	4077309	1248.5	730.4
365032116265403	USW H-4 lower	549188	4077309	1248.5	730.5
364942116280002	USW H-3 upper	547562	4075759	1483.2	731.5
364942116280003	USW H-3 lower	547562	4075759	1483.2	755.9
364938116252102	UE-25 p #1 (Lwr Intrvl)	551501	4075659	1114.2	752.4
not available yet	USW SD-7	548384	4076499	1363.1	727.6
not available yet	USW SD-9	548550	4079256	1303.4	731.1

USGS Site ID	Site Name	Easting (UTM)	Northing (UTM)	Land-surface Altitude (m)	Mean Water-level Altitude (m)
not available yet	USW SD-12	548492	4077415	1323.7	730.0
364234116351501	NC-EWDP-1DX, deep zone	536768	4062502	803.6	748.8
364234116351501	NC-EWDP-1DX, shallow zone	536768	4062502	803.6	786.8
364233116351501	NC-EWDP-1S, probe 1	536771	4062498	803.8	787.1
364233116351501	NC-EWDP-1S, probe 2	536771	4062498	803.8	786.8
363940116275501	NC-EWDP-2DB	547800	4057195	801.3	713.7
363939116275401	NC-EWDP-2D	547744	4057164	801.2	706.1
364054116321401	NC-EWDP-3D	541273	4059444	799.4	718.3
364054116321301	NC-EWDP-3S, probe 2	541269	4059445	798.8	719.8
364054116321301	NC-EWDP-3S, probe 3	541269	4059445	798.8	719.4
364012116223401	NC-EWDP-5SB	555676	4058229	840.3	723.6
364145116334401	NC-EWDP-9SX, probe 1	539039	4061004	797.3	766.7
364145116334401	NC-EWDP-9SX, probe 2	539039	4061004	797.3	767.3
364145116334401	NC-EWDP-9SX, probe 4	539039	4061004	797.3	766.8
363951116252401	NC-Washburn-1X	551465	4057563	824.1	714.6
363925116241501	NC-EWDP-4PA	553167	4056766	823.0	717.9
363925116241401	NC-EWDP-4PB	553167	4056766	823.2	723.6
364332116332201	NC-EWDP-7S	539638	4064323	836.9	830.1
364137116351001	NC-EWDP-12PA	536951	4060814	774.7	722.9
364138116351001	NC-EWDP-12PB	536951	4060814	774.7	723.0
364139116351001	NC-EWDP-12PC	536951	4060814	774.5	720.7
364011116294901	NC-EWDP-15P	544848	4058158	786.9	722.5
364015116265301	NC-EWDP-19P	549329	4058292	819.2	707.5
364014116265301	NC-EWDP-19D	549317	4058270	819.2	712.8
365301116271301	USW WT-24	548697	4081909	1493.6	840.1
364706116170601	UE-25 J -11	563799	4071058	1049.5	732.2
364237116365401	BGMW-11	534386	4062600	787.9	715.9
363709116264601	Richard Washburn	549529	4052567	775.7	704.0
363409116233701	L. Cook	551348	4047432	755.9	713.2
363411116264701	Unknown	549532	4047668	745.2	689.5
363428116281201	Amargosa Water	547420	4047594	738.2	690.4
363429116233401	Lewis C. Cook	554329	4047666	755.3	715.7
363511116335101	Unknown	538989	4048877	729.4	690.8
365624116222901	USW UZ-N91	555680	4088196	1203.0	1186.7

Table I-2 Number of Data Points Used, Source, and Use

Number of Data Points Used

The number of data points used to determine the mean in Table I-1.

Source

The Data Tracking Number for the source from which the water-level data used to determine the mean (Table I-1) and minimum and maximum (Table I-4) water level altitude.

Use

The most appropriate use for each water level was identified as:
Potentiometric-surface map and calibration (WT)
Calibration (C)
Assumed to be perched (P). These water-level observations are not considered in construction of the potentiometric surface map nor considered as calibration points.
Unreliable (U) and therefore not used in the construction of the potentiometric-surface map. These water-level observations are not recommended for use in SZ site-scale model calibration.

A water-level measurement was identified as applicable for potentiometric-surface map construction if it was:
The water level from the upper interval (or only interval) from a borehole.
The water-level interval in the shallow (uppermost) aquifer system, typically the volcanic- or alluvial-aquifer system.

A water-level measurement was identified as unreliable on the basis of the criteria listed in Table I-3. In addition, the following boreholes contained in Attachment I were excluded from this analysis for the reasons stated below:

- Two Lewis C. Cook boreholes (ID numbers 363410116240001 and 363410116240301): The data for these boreholes consist of two water-level measurements in each borehole that span more than 20 years and differ by quite a bit. An average of the two values for each of these boreholes does not produce a water level that is representative of the early 1990's. The average is considered "Unreliable." There are other boreholes nearby that have reliable water levels that are sufficient for the SZ site-scale modeling.
- Fred Cobb well: Basically similar arguments apply as for the Lewis C. Cook boreholes. Water-level data from this borehole are not critical for model calibration because there are other boreholes nearby that have reliable water levels.
- Fred Woolridge well: Similar arguments apply as for the Lewis C. Cook boreholes. Water-level data from this borehole are not critical for model calibration because there are other boreholes nearby that have reliable water levels.

The remaining water-level data were labeled as suitable for calibration only. Calibration of the SZ site-scale model should be based on all water-level data except those labeled as unreliable (U).

USGS Site ID	Site Name	Number of Data Points Used	Source	Use
365629116222602	UE-29 a #2	208	GS991100002330.001	WT
365520116370301	GEXA Well 4	52	GS991100002330.001	WT
365340116264601	UE-25 WT #6	117	GS960908312312.010	P
365322116273501	USW G-2	28	GS960908312312.010	P
365239116253401	UE-25 WT #16	123	GS960908312312.010	WT
365208116274001	USW UZ-14	Estimate	GS950508312312.005	WT
365207116264201	UE-25 WT #18	38	GS960908312312.010	WT
365200116272901	USW G-1	1	GS991100002330.001	WT
365147116185301	UE-25 a #3	1	GS991100002330.001	WT
365140116260301	UE-25 WT #4	131	GS960908312312.010	WT
365116116233801	UE-25 WT #15	124	GS960908312312.010	WT
365114116270401	USW G-4	29	GS931008312312.025 GS970600012847.001 GS991100002330.001	WT
365105116262401	UE-25 a #1	40	GS991100002330.001	WT
365032116243501	UE-25 WT #14	135	GS960908312312.010	WT

USGS Site ID	Site Name	Number of Data Points Used	Source	Use
365023116271801	USW WT-2	106	GS960908312312.010	WT
364947116254300	UE-25 c #1	3	GS991100002330.001	WT
364947116254501	UE-25 c #3	8	GS960208312312.003 GS000608312312.004 GS000708312312.005 GS000408312312.001	WT
364947116254401	UE-25 c #2	10	GS930408312312.015 GS000608312312.004 GS000708312312.005 GS000408312312.001 GS950108312312.001	WT
364945116235001	UE-25 WT #13	118	GS960908312312.010	WT
364933116285701	USW WT- 7	113	GS960908312312.010	WT
364916116265601	USW WT- 1	128	GS960908312312.010	WT
364905116280101	USW G-3	113	GS960908312312.010	WT
364828116234001	UE-25 J -13	121	GS960908312312.010	WT
364825116290501	USW WT-10	132	GS960908312312.010	WT
364822116262601	UE-25 WT #17	117	GS960908312312.010	WT
365821116343701	USW VH-2	1	GS991100002330.001	WT
364757116245801	UE-25 WT #3	119	GS960908312312.010	WT
364732116330701	USW VH-1	147	GS960908312312.010	WT
364656116261601	UE-25 WT #12	123	GS960908312312.010	WT
364649116280201	USW WT-11	119	GS960908312312.010	WT
364554116232400	UE-25 J -12	100	GS960908312312.010	WT
364528116232201	UE-25 JF #3	234	GS991100002330.001	WT
364105116302601	Cind-R-Lite Well	62	GS991100002330.001	WT
363907116235701	Ben Bossingham	1	GS991100002330.001	U
363836116234001	Fred Cobb	2	GS991100002330.001	U
363840116235000	Bob Whellock	1	GS991100002330.001	U
363840116234001	Louise Pereidra	1	GS991100002330.001	U
363840116233501	Joe Richards	1	GS991100002330.001	U
363835116234001	NDOT Well	87	GS991100002330.001	WT
363742116263201	James H. Shaw	3	GS991100002330.001	WT
363830116241401	Airport Well	90	GS991100002330.001	WT
363815116175901	TW- 5	99	GS991100002330.001	WT
363711116263701	Richard Washburn	4	GS991100002330.001	U
363621116263201	Richard Washburn	1	GS991100002330.001	U
363549116305001	Nye County Development Co	3	GS991100002330.001	WT
363523116353701	Fred Wooldridge	3	GS991100002330.001	U
363525116325601	Fred J. Keefe	6	GS991100002330.001	WT
363519116322001	Leslie Nickels	4	GS991100002330.001	WT
363540116240801	L. Mason	22	GS991100002330.001	WT
363527116292501	Unknown	2	GS991100002330.001	WT
363521116352501	Davidson Well	63	GS991100002330.001	WT
363456116335501	Eugene J. Mankinen	4	GS991100002330.001	U
363454116314201	Donald O. Heath	4	GS991100002330.001	WT
363503116351501	Elvis Kelley	3	GS991100002330.001	WT
363503116284001	Manuel Rodela	2	GS991100002330.001	WT
363436116342301	Charles C. DeFir Jr.	5	GS991100002330.001	WT

USGS Site ID	Site Name	Number of Data Points Used	Source	Use
363436116333201	William R. Monroe	4	GS991100002330.001	WT
363434116354001	DeFir Well	19	GS991100002330.001	WT
363438116324601	Edwin H. Mankinen	4	GS991100002330.001	WT
363442116363301	Bill Strickland	1	GS991100002330.001	WT
363440116282401	M. Meese	1	GS991100002330.001	U
363415116275101	Theo E. Selbach	1	GS991100002330.001	U
363407116342501	C.L. Caldwell	3	GS991100002330.001	WT
363407116243501	Leonard Siegel	1	GS991100002330.001	U
363429116315901	James K. Pierce	3	GS991100002330.001	WT
363405116321501	James K. Pierce	2	GS991100002330.001	U
363428116240301	Cooks West Well	3	GS991100002330.001	WT
363428116234701	Cooks East Well	88	GS991100002330.001	WT
363417116271801	Nye County Land Company	2	GS991100002330.001	WT
363411116272901	Amargosa Town Complex	1	GS991100002330.001	WT
363410116261101	Nye County Development Co	1	GS991100002330.001	WT
363410116240301	Lewis C. Cook	2	GS991100002330.001	U
363410116240001	Lewis C. Cook	2	GS991100002330.001	U
363407116273301	Amargosa Valley Water	1	GS991100002330.001	WT
363342116335701	Earl N. Selbach	1	GS991100002330.001	U
363340116332901	Lewis N. Dansby	48	GS991100002330.001	WT
363342116325101	Edwin H. Mankinen	46	GS991100002330.001	WT
363350116252101	Willard Johns	2	GS991100002330.001	U
365157116271202	USW H-1 tube 1	101	GS960908312312.010	C
365157116271203	USW H-1 tube 2	75	GS960908312312.010	C
365157116271204	USW H-1 tube 3	108	GS960908312312.010	C
365157116271205	USW H-1 tube 4	124	GS960908312312.010	WT
365122116275502	USW H-5 upper	106	GS960908312312.010	WT
365122116275503	USW H-5 lower	54	GS960908312312.010	C
365108116262302	UE-25 b #1 lower	67	GS960908312312.010	C
365108116262303	UE-25 b #1 upper	99	GS960908312312.010	WT
365049116285502	USW H-6 upper	118	GS960908312312.010	WT
365049116285505	USW H-6 lower	79	GS960908312312.010	C
365032116265402	USW H-4 upper	128	GS960908312312.010	WT
365032116265403	USW H-4 lower	101	GS960908312312.010	C
364942116280002	USW H-3 upper	128	GS960908312312.010	WT
364942116280003	USW H-3 lower	59	GS980308312312.004	C
364938116252102	UE-25 p #1(Lwr Intrvl)	120	GS960908312312.010	C
not available	USW SD-7	1	TM0000000SD7RS.003	U
not available	USW SD-9	1	TM0000000SD9RS.001	WT
not available	USW SD-12	1	TM000000SD12RS.011	WT
364234116351501	NC-EWDP-1DX, shallow	14	MO0112DQRWLNYE.024 MO0112DQRWLNYE.017	WT
364234116351501	NC-EWDP-1DX, deep	13	MO0112DQRWLNYE.024 MO0112DQRWLNYE.012	C
364233116351501	NC-EWDP-1S, probe 1	26816	MO0112DQRWLNYE.019 MO0111DQRWLNYE.002 MO0112DQRWLNYE.023	WT

USGS Site ID	Site Name	Number of Data Points Used	Source	Use
364233116351501	NC-EWDP-1S, probe 2	18783	MO0112DQRWLNYE.019 MO0111DQRWLNYE.002 MO0112DQRWLNYE.023	C
363939116275401	NC-EWDP-2D	2	MO0112DQRWLNYE.024 MO0112DQRWLNYE.020	C
363940116275501	NC-EWDP-2DB	3	MO0112DQRWLNYE.025 MO0112DQRWLNYE.020	WT
364054116321401	NC-EWDP-3D	30	MO0112DQRWLNYE.025 MO0112DQRWLNYE.016	C
364054116321301	NC-EWDP-3S, probe 2	328170	MO0112DQRWLNYE.019 MO0112DQRWLNYE.015 MO0112DQRWLNYE.022 MO0111DQRWLNYE.003	WT
364054116321301	NC-EWDP-3S, probe 3	32124	MO0112DQRWLNYE.019 MO0112DQRWLNYE.015 MO0111DQRWLNYE.003 MO0112DQRWLNYE.022	C
363925116241501	NC-EWDP-4PA	14	MO0112DQRWLNYE.025 MO0112DQRWLNYE.005	WT
363925116241401	NC-EWDP-4PB	6	MO0112DQRWLNYE.025 MO0112DQRWLNYE.006	C
364012116223401	NC-EWDP-5SB	11	MO0112DQRWLNYE.025 MO0112DQRWLNYE.008	WT
364332116332201	NC-EWDP-7S	3	MO0112DQRWLNYE.025 MO0112DQRWLNYE.007	P
364145116334401	NC-EWDP-9SX, probe 1	29059	MO0112DQRWLNYE.019 MO0111DQRWLNYE.004 MO0112DQRWLNYE.021 MO0112DQRWLNYE.011	WT
364145116334401	NC-EWDP-9SX, probe 2	38706	MO0112DQRWLNYE.019 MO0111DQRWLNYE.004 MO0112DQRWLNYE.021 MO0112DQRWLNYE.011	C
364145116334401	NC-EWDP-9SX, probe 4	38560	MO0112DQRWLNYE.019 MO0111DQRWLNYE.004 MO0112DQRWLNYE.021 MO0112DQRWLNYE.011	C
364137116351001	NC-EWDP-12PA	25	MO0112DQRWLNYE.025 MO0112DQRWLNYE.010	C
364138116351001	NC-EWDP-12PB	25	MO0112DQRWLNYE.025 MO0112DQRWLNYE.012	C
364139116351001	NC-EWDP-12PC	26	MO0112DQRWLNYE.025 MO0112DQRWLNYE.013	WT
364011116294901	NC-EWDP-15P	12	MO0112DQRWLNYE.025 MO0112DQRWLNYE.009	WT
364015116265301	NC-EWDP-19P	9	MO0112DQRWLNYE.025 MO0112DQRWLNYE.014	WT
364014116265301	NC-EWDP-19D	5	MO0112DQRWLNYE.025 MO0112DQRWLNYE.018	C
365301116271301	USW WT-24	11	GS990908312312.005 GS000608312312.003 GS000808312312.007	WT
363951116252401	NC-Washburn-1X	59	MO0112DQRWLNYE.025	WT
364706116170601	UE-25 J -11	71	GS960908312312.010	WT
364237116365401	BGMW-11	51	GS991100002330.001	WT
363709116264601	Richard Washburn	1	GS991100002330.001	WT

USGS Site ID	Site Name	Number of Data Points Used	Source	Use
363409116233701	L. Cook	1	GS991100002330.001	U
363411116264701	Unknown	1	GS991100002330.001	WT
363428116281201	Amargosa Water	1	GS991100002330.001	WT
363429116233401	Lewis C. Cook	1	GS991100002330.001	WT
363511116335101	Unknown	1	GS991100002330.001	WT
365624116222901	USW UZ-N91	209	GS991100002330.001	WT

Table I-3 Reliability of Measurements

Reliability of Measurements

Using professional judgement, an assessment of the overall reliability of the average water-level data to represent 1990's water levels (Table I-1) was made. The following categories were assigned:
Best (average water level documented in Graves et al. 1997, DTN: GS960908312312.010)
Reliable (all others not identified in the other four categories)
Less Reliable (fewer than 5 water-level measurements) or (latest measurement made prior to 1980) or (only data point available within a 5 km radius.)
Unreliable (fewer than 5 measurements, all made prior to 1980)

USGS Site ID	Site Name	Reliability of Measurements
365629116222602	UE-29 a #2	Reliable
365520116370301	GEXA Well 4	Reliable
365340116264601	UE-25 WT #6	Best
365322116273501	USW G-2	Best
365239116253401	UE-25 WT #16	Best
365208116274001	USW UZ-14	Less Reliable (fewer than 5 measurements)
365207116264201	UE-25 WT #18	Best
365200116272901	USW G-1	Less Reliable (fewer than 5 measurements)
365147116185301	UE-25 a #3	Less Reliable (fewer than 5 measurements)
365140116260301	UE-25 WT #4	Best
365116116233801	UE-25 WT #15	Best
365114116270401	USW G-4	Reliable
365105116262401	UE-25 a #1	Reliable
365032116243501	UE-25 WT #14	Best
365023116271801	USW WT-2	Best
364947116254300	UE-25 c #1	Less Reliable (fewer than 5 measurements)
364947116254501	UE-25 c #3	Reliable
364947116254401	UE-25 c #2	Reliable
364945116235001	UE-25 WT #13	Best
364933116285701	USW WT- 7	Best
364916116265601	USW WT- 1	Best
364905116280101	USW G-3	Best
364828116234001	UE-25 J -13	Best
364825116290501	USW WT-10	Best
364822116262601	UE-25 WT #17	Best
365821116343701	USW VH-2	Less Reliable (fewer than 5 measurements)
364757116245801	UE-25 WT #3	Best
364732116330701	USW VH-1	Best
364656116261601	UE-25 WT #12	Best
364649116280201	USW WT-11	Best
364554116232400	UE-25 J -12	Best
364528116232201	UE-25 JF #3	Reliable
364105116302601	Cind-R-Lite Well	Reliable
363907116235701	Ben Bossingham	Unreliable (fewer than 5 measurements before 1980)
363836116234001	Fred Cobb	Unreliable (fewer than 5 measurements before 1980)
363840116235000	Bob Whellock	Unreliable (fewer than 5 measurements before 1980)
363840116234001	Louise Pereidra	Unreliable (fewer than 5 measurements before 1980)
363840116233501	Joe Richards	Unreliable (fewer than 5 measurements before 1980)
363835116234001	NDOT Well	Reliable

USGS Site ID	Site Name	Reliability of Measurements
363742116263201	James H. Shaw	Less Reliable (fewer than 5 measurements)
363830116241401	Airport Well	Reliable
363815116175901	TW- 5	Reliable
363711116263701	Richard Washburn	Unreliable (fewer than 5 measurements before 1980)
363621116263201	Richard Washburn	Unreliable (fewer than 5 measurements before 1980)
363549116305001	Nye County Development Co	Less Reliable (fewer than 5 measurements)
363523116353701	Fred Wooldridge	Unreliable (fewer than 5 measurements before 1980)
363525116325601	Fred J. Keefe	Reliable
363519116322001	Leslie Nickels	Less Reliable (fewer than 5 measurements)
363540116240801	L. Mason	Less Reliable (latest measurement prior to 1980)
363527116292501	Unknown	Less Reliable (fewer than 5 measurements)
363521116352501	Davidson Well	Reliable
363456116335501	Eugene J. Mankinen	Unreliable (fewer than 5 measurements before 1980)
363454116314201	Donald O. Heath	Reliable
363503116351501	Elvis Kelley	Less Reliable (fewer than 5 measurements)
363503116284001	Manuel Rodela	Less Reliable (fewer than 5 measurements)
363436116342301	Charles C. DeFir Jr.	Reliable
363436116333201	William R. Monroe	Reliable
363434116354001	DeFir Well	Reliable
363438116324601	Edwin H. Mankinen	Less Reliable (fewer than 5 measurements)
363442116363301	Bill Strickland	Less Reliable (fewer than 5 measurements)
363440116282401	M. Meese	Unreliable (fewer than 5 measurements before 1980)
363415116275101	Theo E. Selbach	Unreliable (fewer than 5 measurements before 1980)
363407116342501	C.L. Caldwell	Less Reliable (fewer than 5 measurements)
363407116243501	Leonard Siegel	Unreliable (fewer than 5 measurements before 1980)
363429116315901	James K. Pierce	Less Reliable (fewer than 5 measurements)
363405116321501	James K. Pierce	Unreliable (fewer than 5 measurements before 1980)
363428116240301	Cooks West Well	Less Reliable (fewer than 5 measurements)
363428116234701	Cooks East Well	Reliable
363417116271801	Nye County Land Company	Less Reliable (fewer than 5 measurements)
363411116272901	Amargosa Town Complex	Less Reliable (fewer than 5 measurements)
363410116261101	Nye County Development Co	Less Reliable (fewer than 5 measurements)
363410116240301	Lewis C. Cook	Unreliable (fewer than 5 measurements before 1980)
363410116240001	Lewis C. Cook	Unreliable (fewer than 5 measurements before 1980)
363407116273301	Amargosa Valley Water	Less Reliable (fewer than 5 measurements)
363342116335701	Earl N. Selbach	Unreliable (fewer than 5 measurements before 1980)
363340116332901	Lewis N. Dansby	Reliable
363342116325101	Edwin H. Mankinen	Less Reliable (latest measurement prior to 1980)
363350116252101	Willard Johns	Unreliable (fewer than 5 measurements before 1980)
365157116271202	USW H-1 tube 1	Best
365157116271203	USW H-1 tube 2	Best
365157116271204	USW H-1 tube 3	Best
365157116271205	USW H-1 tube 4	Best
365122116275502	USW H-5 upper	Best
365122116275503	USW H-5 lower	Best
365108116262302	UE-25 b #1 lower	Best
365108116262303	UE-25 b #1 upper	Best
365049116285502	USW H-6 upper	Best
365049116285505	USW H-6 lower	Best

USGS Site ID	Site Name	Reliability of Measurements
365032116265402	USW H-4 upper	Best
365032116265403	USW H-4 lower	Best
364942116280002	USW H-3 upper	Best
364942116280003	USW H-3 lower	Best
364938116252102	UE-25 p #1(Lwr Intrvl)	Best
not available yet	USW SD-7	Less Reliable (fewer than 5 measurements)
not available yet	USW SD-9	Less Reliable (fewer than 5 measurements)
not available yet	USW SD-12	Less Reliable (fewer than 5 measurements)
364234116351501	NC-EWDP-1DX, shallow	Reliable
364234116351501	NC-EWDP-1DX, deep	Reliable
364233116351501	NC-EWDP-1S, probe 1	Reliable
364233116351501	NC-EWDP-1S, probe 2	Reliable
363939116275401	NC-EWDP-2D	Less Reliable (fewer than 5 measurements)
363940116275501	NC-EWDP-2DB	Less Reliable (fewer than 5 measurements)
364054116321401	NC-EWDP-3D	Reliable
364054116321301	NC-EWDP-3S, probe 2	Reliable
364054116321301	NC-EWDP-3S, probe 3	Reliable
363925116241501	NC-EWDP-4PA	Reliable
363925116241401	NC-EWDP-4PB	Reliable
364012116223401	NC-EWDP-5SB	Reliable
364332116332201	NC-EWDP-7S	Less Reliable (fewer than 5 measurements)
364145116334401	NC-EWDP-9SX, probe 1	Reliable
364145116334401	NC-EWDP-9SX, probe 2	Reliable
364145116334401	NC-EWDP-9SX, probe 4	Reliable
364137116351001	NC-EWDP-12PA	Reliable
364138116351001	NC-EWDP-12PB	Reliable
364139116351001	NC-EWDP-12PC	Reliable
364011116294901	NC-EWDP-15P	Reliable
364015116265301	NC-EWDP-19P	Reliable
364014116265301	NC-EWDP-19D	Reliable
365301116271301	USW WT-24	Reliable
363951116252401	NC-Washburn-1X	Reliable
364706116170601	UE-25 J -11	Best
364237116365401	BGMW-11	Reliable
363709116264601	Richard Washburn	Less Reliable (fewer than 5 measurements)
363409116233701	L. Cook	Unreliable (fewer than 5 measurements before 1980)
363411116264701	Unknown	Less Reliable (fewer than 5 measurements)
363428116281201	Amargosa Water	Less Reliable (fewer than 5 measurements)
363429116233401	Lewis C. Cook	Less Reliable (fewer than 5 measurements)
363511116335101	Unknown	Less Reliable (fewer than 5 measurements)
365624116222901	USW UZ-N91	Reliable

Table I-4 Earliest Year of Measurement, Latest Year of Measurement, Minimum Water-level Altitude, and Maximum Water-level Altitude (DTN: GS010908312332.002)

Earliest Year of Measurement/Latest Year of Measurement

The earliest and latest year of reported measurement used in the calculation of the mean was determined and recorded. The data tabulated by Graves et al. (1997) were not checked for earlier or later measurements. The data reported in Graves et al. (1997) were collected for the water-level monitoring studies being conducted as part of Yucca Mountain site characterization activities and, as such, were collected after 1986 under an approved quality assurance program.

Minimum Water-level Altitude/Maximum Water-level Altitude (meters)

The smallest and largest water-level altitudes for the data used to calculate mean water-level altitude were compiled and tabulated. The altitude was converted from feet to meters by the following formula, where necessary:

Altitude (ft) x 0.3048 (m/ft) = Altitude (m)

The altitude was rounded to the nearest tenth of a meter.

USGS Site ID	Site Name	Earliest Year of Measurement	Latest Year of Measurement	Minimum Water-level Altitude (m)	Maximum Water-level Altitude (m)
365629116222602	UE-29 a #2	1985	1996	1186.2	1191.3
365520116370301	GEXA Well 4	1989	1996	995.3	1010.1
365340116264601	UE-25 WT #6	1985	1995	1033.3	1036.1
365322116273501	USW G-2	1992	1995	1019.6	1020.6
365239116253401	UE-25 WT #16	1985	1995	737.8	738.6
365208116274001	USW UZ-14	N/A	N/A	N/A	N/A
365207116264201	UE-25 WT #18	1991	1995	730.5	730.9
365200116272901	USW G-1	1982	1982	754.2	754.2
365147116185301	UE-25 a #3	1979	1979	748.3	748.3
365140116260301	UE-25 WT #4	1985	1995	730.3	731.2
365116116233801	UE-25 WT #15	1985	1995	729.0	729.4
365114116270401	USW G-4	1983	1990	730.0	730.9
365105116262401	UE-25 a #1	1982	1985	730.7	731.2
365032116243501	UE-25 WT #14	1985	1995	729.3	730.0
365023116271801	USW WT-2	1985	1995	730.1	730.8
364947116254300	UE-25 c #1	1983	1984	730.1	730.3
364947116254501	UE-25 c #3	1989	1995	730.1	730.3
364947116254401	UE-25 c #2	1989	1995	729.9	730.6
364945116235001	UE-25 WT #13	1985	1995	728.5	729.4
364933116285701	USW WT- 7	1985	1995	775.5	776.0
364916116265601	USW WT- 1	1985	1995	730.0	730.5
364905116280101	USW G-3	1985	1995	730.0	730.8
364828116234001	UE-25 J -13	1986	1995	728.3	728.7
364825116290501	USW WT-10	1985	1995	775.6	776.2
364822116262601	UE-25 WT #17	1985	1995	729.5	729.8
365821116343701	USW VH-2	1983	1983	810.4	810.4
364757116245801	UE-25 WT #3	1985	1995	729.4	729.9
364732116330701	USW VH-1	1985	1995	779.3	779.6
364656116261601	UE-25 WT #12	1985	1995	729.1	729.6
364649116280201	USW WT-11	1985	1995	730.2	730.8
364554116232400	UE-25 J -12	1989	1995	727.8	728.2
364528116232201	UE-25 JF #3	1992	1998	727.3	728.1

USGS Site ID	Site Name	Earliest Year of Measurement	Latest Year of Measurement	Minimum Water-level Altitude (m)	Maximum Water-level Altitude (m)
364105116302601	Cind-R-Lite Well	1992	1998	727.1	729.9
363907116235701	Ben Bossingham	1961	1961	718.4	718.4
363836116234001	Fred Cobb	1964	1990	700.1	705.4
363840116235000	Bob Whellock	1955	1955	704.1	704.1
363840116234001	Louise Pereidra	1952	1952	705.6	705.6
363840116233501	Joe Richards	1955	1955	701.6	701.6
363835116234001	NDOT Well	1991	1998	704.9	705.6
363742116263201	James H. Shaw	1953	1987	705.4	708.1
363830116241401	Airport Well	1987	1998	705.2	705.5
363815116175901	TW- 5	1962	1998	724.8	729.2
363711116263701	Richard Washburn	1958	1962	706.1	709.3
363621116263201	Richard Washburn	1958	1958	704.4	704.4
363549116305001	Nye County Development Co	1963	1987	691.3	695.9
363523116353701	Fred Wooldridge	1960	1984	688.4	694.0
363525116325601	Fred J. Keefe	1960	1987	691.4	696.3
363519116322001	Leslie Nickels	1962	1987	693.5	696.1
363540116240801	L. Mason	1963	1973	721.5	726.0
363527116292501	Unknown	1962	1987	696.9	698.7
363521116352501	Davidson Well	1963	1998	689.7	692.0
363456116335501	Eugene J. Mankinen	1961	1962	707.1	707.7
363454116314201	Donald O. Heath	1962	1987	693.2	696.2
363503116351501	Elvis Kelley	1984	1987	690.5	691.3
363503116284001	Manuel Rodela	1965	1987	692.2	694.9
363436116342301	Charles C. DeFir Jr.	1959	1987	705.3	708.8
363436116333201	William R. Monroe	1962	1987	691.5	696.0
363434116354001	DeFir Well	1987	1993	689.1	690.4
363438116324601	Edwin H. Mankinen	1961	1987	692.4	698.0
363442116363301	Bill Strickland	1982	1982	689.2	689.2
363440116282401	M. Meese	1962	1962	686.4	686.4
363415116275101	Theo E. Selbach	1958	1958	696.2	696.2
363407116342501	C.L. Caldwell	1958	1984	690.1	692.8
363407116243501	Leonard Siegel	1962	1962	709.0	709.0
363429116315901	James K. Pierce	1965	1987	689.5	692.1
363405116321501	James K. Pierce	1960	1962	704.7	706.6
363428116240301	Cooks West Well	1987	1991	719.6	720.4
363428116234701	Cooks East Well	1987	1998	717.7	720.3
363417116271801	Nye County Land Company	1962	1984	688.3	691.9
363411116272901	Amargosa Town Complex	1980	1980	688.8	688.8
363410116261101	Nye County Development Co	1987	1987	691.2	691.2
363410116240301	Lewis C. Cook	1966	1987	714.0	720.9
363410116240001	Lewis C. Cook	1962	1987	705.9	723.6
363407116273301	Amargosa Valley Water	1988	1988	701.3	701.3
363342116335701	Earl N. Selbach	1958	1958	696.5	696.5
363340116332901	Lewis N. Dansby	1954	1987	692.4	696.2
363342116325101	Edwin H. Mankinen	1955	1974	692.7	695.1
363350116252101	Willard Johns	1959	1962	698.5	700.4

USGS Site ID	Site Name	Earliest Year of Measurement	Latest Year of Measurement	Minimum Water-level Altitude (m)	Maximum Water-level Altitude (m)
365157116271202	USW H-1 tube 1	1985	1995	785.0	786.1
365157116271203	USW H-1 tube 2	1985	1995	735.7	736.3
365157116271204	USW H-1 tube 3	1985	1995	730.4	730.8
365157116271205	USW H-1 tube 4	1985	1995	730.5	731.0
365122116275502	USW H-5 upper	1985	1995	775.0	775.7
365122116275503	USW H-5 lower	1985	1995	775.0	775.9
365108116262302	UE-25 b #1 lower	1985	1995	728.5	730.3
365108116262303	UE-25 b #1 upper	1985	1995	730.5	730.8
365049116285502	USW H-6 upper	1985	1995	775.8	776.2
365049116285505	USW H-6 lower	1988	1995	775.7	776.1
365032116265402	USW H-4 upper	1985	1995	730.2	730.5
365032116265403	USW H-4 lower	1985	1995	730.2	730.8
364942116280002	USW H-3 upper	1985	1995	731.1	731.9
364942116280003	USW H-3 lower	1991	1996	747.4	760.3
364938116252102	UE-25 p #1(Lwr Intrvl)	1985	1995	751.9	752.7
not available yet	USW SD-7	1995	1995	727.6	727.6
not available yet	USW SD-9	1994	1994	731.1	731.1
not available yet	USW SD-12	1995	1995	730.0	730.0
364234116351501	NC-EWDP-1DX, shallow	1999	2000	786.7	786.8
364234116351501	NC-EWDP-1DX, deep	1999	2000	748.7	748.9
364233116351501	NC-EWDP-1S, probe 1	1999	2000	787.1	787.2
364233116351501	NC-EWDP-1S, probe 2	1999	2000	786.7	786.9
363939116275401	NC-EWDP-2D	1999	1999	706.1	706.2
363940116275501	NC-EWDP-2DB	2000	2000	712.3	713.7
364054116321401	NC-EWDP-3D	1999	2000	717.4	719.3
364054116321301	NC-EWDP-3S, probe 2	1999	2000	719.7	720.0
364054116321301	NC-EWDP-3S, probe 3	1999	2000	719.2	719.5
363925116241501	NC-EWDP-4PA	2000	2000	717.1	718.7
363925116241401	NC-EWDP-4PB	2000	2000	723.4	723.8
364012116223401	NC-EWDP-5SB	2000	2000	723.4	723.6
364332116332201	NC-EWDP-7S	2000	2000	829.9	830.2
364145116334401	NC-EWDP-9SX, probe 1	1999	2000	766.6	766.7
364145116334401	NC-EWDP-9SX, probe 2	1999	2000	767.2	767.4
364145116334401	NC-EWDP-9SX, probe 4	1999	2000	766.7	766.8
364137116351001	NC-EWDP-12PA	2000	2000	722.8	723.0
364138116351001	NC-EWDP-12PB	2000	2000	722.9	732.2
364139116351001	NC-EWDP-12PC	2000	2000	720.3	720.8
364011116294901	NC-EWDP-15P	2000	2000	722.4	722.6
364015116265301	NC-EWDP-19P	2000	2000	707.4	707.7
364014116265301	NC-EWDP-19D	2000	2000	712.6	712.9
365301116271301	USW WT-24	1999	1999	839.7	840.7
363951116252401	NC-Washburn-1X	1999	2000	714.4	714.7
364706116170601	UE-25 J -11	1989	1995	732.1	732.4
364237116365401	BGMW-11	1989	1999	715.5	716.2
363709116264601	Richard Washburn	1987	1987	704.0	704.0
363409116233701	L. Cook	1962	1962	713.2	713.2
363411116264701	Unknown	1987	1987	689.5	689.5
363428116281201	Amargosa Water	1987	1987	690.4	690.4

USGS Site ID	Site Name	Earliest Year of Measurement	Latest Year of Measurement	Minimum Water-level Altitude (m)	Maximum Water-level Altitude (m)
363429116233401	Lewis C. Cook	1987	1987	715.7	715.7
363511116335101	Unknown	1987	1987	690.8	690.8
365624116222901	USW UZ-N91	1986	1996	1185.6	1191.3

Table I-5 Top of Interval, Bottom of Interval, and Midpoint of Interval

Top of Interval/Bottom of Interval (meters)

Where available, the altitude of the top and bottom of screened or packed-off intervals were used. If the altitude of the screened or packed-off interval was not available, the borehole was treated as an open borehole. If the altitude of the bottom of a borehole interval was not available, the altitude of the base of the borehole was used for the bottom of the interval. Likewise, if the altitude of the top of a borehole interval was not available, the maximum water level was used for the altitude of the top of the interval. The altitudes were converted from feet to meters by the following formula:

$$\text{Altitude (ft)} \times 0.3048 \text{ (m/ft)} = \text{Altitude (m)}$$

The altitude was rounded to the nearest tenth of a meter.

Midpoint of Interval (meters)

Most of the water levels represent a composite water-level altitude for a borehole. Composite water-level altitudes refer to water levels derived from an open interval that may encompass one or more hydrogeologic units , in which any portion of the open interval may contribute to the water level. Because the altitude at which the hydraulic head measurement applies is uncertain, the midpoint of either the water column for open (uncased) boreholes or the midpoint of a screened or packed-off interval within the borehole is identified. The altitude of the midpoint of the interval was calculated by the following formula:

$$\text{Midpoint} = (\text{Top}+\text{Bottom})/2$$

The altitude was rounded to the nearest tenth of a meter.

Sources

Sources are tabulated in Table I-2

USGS Site ID	Site Name	Top of Interval (m)	Bottom of Interval (m)	Midpoint of Interval (m)
365629116222602	UE-29 a #2	1187.7	793.9	990.8
365520116370301	GEXA Well 4	1008.0	710.5	859.2
365340116264601	UE-25 WT #6	1034.6	931.8	983.2
365322116273501	USW G-2	1020.2	748.0	884.1
365239116253401	UE-25 WT #16	738.3	689.9	714.1
365208116274001	USW UZ-14	915.9	670.9	793.4
365207116264201	UE-25 WT #18	730.8	713.4	722.1
365200116272901	USW G-1	754.2	-502.9	125.7
365147116185301	UE-25 a #3	748.3	614.5	681.4
365140116260301	UE-25 WT #4	730.8	687.3	709.0
365116116233801	UE-25 WT #15	729.2	668.2	698.7
365114116270401	USW G-4	730.1	354.2	542.2
365105116262401	UE-25 a #1	731.0	436.9	584.0
365032116243501	UE-25 WT #14	729.7	677.4	703.6
365023116271801	USW WT-2	730.7	673.4	702.0
364947116254300	UE-25 c #1	730.3	216.2	473.2
364947116254501	UE-25 c #3	730.3	218.3	474.3
364947116254401	UE-25 c #2	730.2	376.3	553.2
364945116235001	UE-25 WT #13	729.1	678.5	703.8
364933116285701	USW WT- 7	775.8	705.9	740.9
364916116265601	USW WT- 1	730.4	686.4	708.4
364905116280101	USW G-3	688.6	-52.4	318.1
364828116234001	UE-25 J -13	707.7	1.8	354.8
364825116290501	USW WT-10	776.0	692.4	734.2
364822116262601	UE-25 WT #17	729.7	681.0	705.4

USGS Site ID	Site Name	Top of Interval (m)	Bottom of Interval (m)	Midpoint of Interval (m)
365821116343701	USW VH-2	810.5	-244.8	282.8
364757116245801	UE-25 WT #3	729.6	682.0	705.8
364732116330701	USW VH-1	779.4	201.5	490.5
364656116261601	UE-25 WT #12	729.5	675.7	702.6
364649116280201	USW WT-11	730.7	653.1	691.9
364554116232400	UE-25 J -12	712.6	606.6	659.6
364528116232201	UE-25 JF #3	727.8	597.5	662.7
364105116302601	Cind-R-Lite Well	729.8	690.6	710.2
363907116235701	Ben Bossingham	718.4	676.4	697.4
363836116234001	Fred Cobb	702.8	648.3	675.6
363840116235000	Bob Whellock	704.1	659.9	682.0
363840116234001	Louise Pereidra	705.6	690.4	698.0
363840116233501	Joe Richards	701.7	656.9	679.3
363835116234001	NDOT Well	705.3	658.9	682.1
363742116263201	James H. Shaw	706.7	621.8	664.3
363830116241401	Airport Well	705.5	567.5	636.5
363815116175901	TW- 5	725.1	652.3	688.7
363711116263701	Richard Washburn	707.7	632.2	669.9
363621116263201	Richard Washburn	704.4	646.2	675.3
363549116305001	Nye County Development Co	694.4	582.8	638.6
363523116353701	Fred Wooldridge	691.9	655.6	673.8
363525116325601	Fred J. Keefe	694.3	659.0	676.7
363519116322001	Leslie Nickels	694.4	615.1	654.7
363540116240801	L. Mason	722.1	676.4	699.2
363527116292501	Unknown	697.8	637.4	667.6
363521116352501	Davidson Well	690.2	653.9	672.0
363456116335501	Eugene J. Mankinen	707.4	649.9	678.6
363454116314201	Donald O. Heath	698.1	605.0	651.6
363503116351501	Elvis Kelley	691.0	679.1	685.1
363503116284001	Manuel Rodela	693.6	679.7	686.7
363436116342301	Charles C. DeFir Jr.	706.9	664.5	685.7
363436116333201	William R. Monroe	699.0	640.1	669.5
363434116354001	DeFir Well	691.3	650.9	671.1
363438116324601	Edwin H. Mankinen	695.2	630.3	662.8
363442116363301	Bill Strickland	689.2	664.8	677.0
363440116282401	M. Meese	686.4	642.8	664.6
363415116275101	Theo E. Selbach	696.2	650.5	673.3
363407116342501	C.L. Caldwell	691.4	617.5	654.5
363407116243501	Leonard Siegel	709.0	625.5	667.2
363429116315901	James K. Pierce	690.4	637.7	664.0
363405116321501	James K. Pierce	705.7	648.6	677.1
363428116240301	Cooks West Well	717.2	663.1	690.2
363428116234701	Cooks East Well	718.8	668.1	693.4
363417116271801	Nye County Land Company	690.1	740.7	715.4
363411116272901	Amargosa Town Complex	688.9	647.7	668.3
363410116261101	Nye County Development Co	691.2	539.5	615.4
363410116240301	Lewis C. Cook	717.4	687.7	702.5
363410116240001	Lewis C. Cook	714.8	662.7	688.7
363407116273301	Amargosa Valley Water	701.4	646.5	673.9

USGS Site ID	Site Name	Top of Interval (m)	Bottom of Interval (m)	Midpoint of Interval (m)
363342116335701	Earl N. Selbach	696.5	647.7	672.1
363340116332901	Lewis N. Dansby	694.2	635.2	664.7
363342116325101	Edwin H. Mankinen	694.0	678.5	686.2
363350116252101	Willard Johns	699.5	658.4	678.9
365157116271202	USW H-1 tube 1	-480.0	-511.0	-495.5
365157116271203	USW H-1 tube 2	206.0	180.0	193.0
365157116271204	USW H-1 tube 3	587.0	538.0	562.5
365157116271205	USW H-1 tube 4	731.0	630.0	680.5
365122116275502	USW H-5 upper	775.5	632.9	704.2
365122116275503	USW H-5 lower	632.9	259.9	446.4
365108116262302	UE-25 b #1 lower	1.7	-19.3	-8.8
365108116262303	UE-25 b #1 upper	730.7	1.7	366.2
365049116285502	USW H-6 upper	776.0	549.8	662.9
365049116285505	USW H-6 lower	549.8	81.8	315.8
365032116265402	USW H-4 upper	730.4	60.5	395.5
365032116265403	USW H-4 lower	60.5	29.5	45.0
364942116280002	USW H-3 upper	731.5	422.2	576.9
364942116280003	USW H-3 lower	422.2	264.2	343.2
364938116252102	UE-25 p #1(Lwr Intrvl)	-129.8	-690.8	-410.3
not available	USW SD-7	727.6	547.7	637.7
not available	USW SD-9	731.1	625.6	678.3
not available	USW SD-12	730.0	663.4	696.7
364234116351501	NC-EWDP-1DX, shallow	786.8	384.6	585.7
364234116351501	NC-EWDP-1DX, deep	145.6	120.6	133.1
364233116351501	NC-EWDP-1S, probe 1	754.8	748.8	751.8
364233116351501	NC-EWDP-1S, probe 2	739.8	721.8	730.8
363939116275401	NC-EWDP-2D	706.1	308.1	294.3
363940116275501	NC-EWDP-2DB	-18.7	-136	-77
364054116321401	NC-EWDP-3D	718.3	37.4	377.9
364054116321301	NC-EWDP-3S, probe 2	695.8	669.8	682.8
364054116321301	NC-EWDP-3S, probe 3	653.8	630.8	642.3
363925116241501	NC-EWDP-4PA	699.0	675.0	687.0
363925116241401	NC-EWDP-4PB	598.0	567.0	582.5
364012116223401	NC-EWDP-5SB	724.3	691.3	707.8
364332116332201	NC-EWDP-7S	828.4	824.7	826.6
364145116334401	NC-EWDP-9SX, probe 1	770.3	760.3	765.3
364145116334401	NC-EWDP-9SX, probe 2	754.3	748.3	751.3
364145116334401	NC-EWDP-9SX, probe 4	696.3	693.3	694.8
364137116351001	NC-EWDP-12PA	675.7	657.7	666.7
364138116351001	NC-EWDP-12PB	675.7	657.7	666.7
364139116351001	NC-EWDP-12PC	722.7	704.7	713.7
364011116294901	NC-EWDP-15P	725.9	707.9	716.9
364015116265301	NC-EWDP-19P	710.2	679.2	694.7
364014116265301	NC-EWDP-19D	713.2	386.2	549.7
365301116271301	USW WT-24	840.1	629.8	734.7
363951116252401	NC-Washburn-1X	696.1	677.8	687.0
364706116170601	UE-25 J -11	721.2	653.3	687.2
364237116365401	BGMW-11	715.9	631.0	673.4
363709116264601	Richard Washburn	704.1	775.7	739.9

USGS Site ID	Site Name	Top of Interval (m)	Bottom of Interval (m)	Midpoint of Interval (m)
363409116233701	L. Cook	713.3	695.0	704.1
363411116264701	Unknown	689.5	694.1	691.8
363428116281201	Amargosa Water	690.4	738.2	714.3
363429116233401	Lewis C. Cook	715.7	755.3	735.5
363511116335101	Unknown	690.8	729.4	710.1
365624116222901	USW UZ-N91	1186.8	1174.4	1180.6

Table I-6 Interval Description and Accuracy of Location

Interval Description
Where available, the interval type and description were compiled from the NWIS data files (DTN: GS991100002330.001), and from various Nye County datasets.

Accuracy of Location/Accuracy of Land-surface Altitude (meters)
Location and land-surface altitude accuracy, where available, were compiled from the NWIS data files (DTN: GS991100002330.001).

Sources
Sources are tabulated in Table I-2

USGS Site ID	Site Name	Interval Description	Accuracy of Location
365629116222602	UE-29 a #2	Open Hole, No Screen	+/- 1 second
365520116370301	GEXA Well 4	Perforated, Porous, or Slotted Casing	+/- 1 second
365340116264601	UE-25 WT #6	Wire-Wound Screen	+/- 10 seconds
365322116273501	USW G-2	Open Hole, No Screen	+/- 1 second
365239116253401	UE-25 WT #16	Wire-Wound Screen	+/- 1 second
365208116274001	USW UZ-14	Fractured Rock Openings	unknown
365207116264201	UE-25 WT #18	Wire-Wound Screen	+/- 1 second
365200116272901	USW G-1	Open Hole, No Screen	+/- 1 second
365147116185301	UE-25 a #3	Open Hole, No Screen	+/- 1 second
365140116260301	UE-25 WT #4	Wire-Wound Screen	+/- 1 second
365116116233801	UE-25 WT #15	Open Hole, No Screen	+/- 1 second
365114116270401	USW G-4	Open Hole, No Screen	+/- 1 second
365105116262401	UE-25 a #1	Unknown	+/- 1 second
365032116243501	UE-25 WT #14	Wire-Wound Screen	+/- 1 second
365023116271801	USW WT-2	Wire-Wound Screen	+/- 1 second
364947116254300	UE-25 c #1	Composite interval - entire saturated section	+/- 1 second
364947116254501	UE-25 c #3	Composite interval - entire saturated section	+/- 1 second
364947116254401	UE-25 c #2	Upper interval - above inflatable packer	+/- 1 second
364945116235001	UE-25 WT #13	Open Hole, No Screen	+/- 1 second
364933116285701	USW WT- 7	Wire-Wound Screen	+/- 1 second
364916116265601	USW WT- 1	Wire-Wound Screen	+/- 1 second
364905116280101	USW G-3	Open Hole, No Screen	+/- 1 second
364828116234001	UE-25 J -13	Open Hole, No Screen	+/- 1 second
364825116290501	USW WT-10	Wire-Wound Screen	+/- 1 second
364822116262601	UE-25 WT #17	Wire-Wound Screen	+/- 1 second
365821116343701	USW VH-2	Fractured Rock Openings	
364757116245801	UE-25 WT #3	Wire-Wound Screen	+/- 1 second
364732116330701	USW VH-1	Open Hole, No Screen	+/- 1 second
364656116261601	UE-25 WT #12	Wire-Wound Screen	+/- 1 second
364649116280201	USW WT-11	Wire-Wound Screen	+/- 1 second
364554116232400	UE-25 J -12	Perforated, Porous, or Slotted Casing	
364528116232201	UE-25 JF #3	Perforated, Porous, or Slotted Casing	+/- 1 second
364105116302601	Cind-R-Lite Well	Perforated, Porous, or Slotted Casing	+/- 1 second
363907116235701	Ben Bossingham	Perforated, Porous, or Slotted Casing	+/- 1 second
363836116234001	Fred Cobb	Perforated, Porous, or Slotted Casing	+/- 1 second
363840116235000	Bob Whellock	Perforated, Porous, or Slotted Casing	+/- 5 seconds

USGS Site ID	Site Name	Interval Description	Accuracy of Location
363840116234001	Louise Pereidra	Perforated, Porous, or Slotted Casing	+/- 1 minute
363840116233501	Joe Richards	Perforated, Porous, or Slotted Casing	+/- 1 second
363835116234001	NDOT Well	Perforated, Porous, or Slotted Casing	+/- 1 second
363742116263201	James H. Shaw	Perforated, Porous, or Slotted Casing	+/- 5 seconds
363830116241401	Airport Well	Perforated, Porous, or Slotted Casing	+/- 1 second
363815116175901	TW- 5	Open Hole, No Screen	+/- 1 second
363711116263701	Richard Washburn	Perforated, Porous, or Slotted Casing	+/- 5 seconds
363621116263201	Richard Washburn	Perforated, Porous, or Slotted Casing	+/- 5 seconds
363549116305001	Nye County Development Co	Perforated, Porous, or Slotted Casing	+/- 1 second
363523116353701	Fred Wooldridge	Perforated, Porous, or Slotted Casing	+/- 10 seconds
363525116325601	Fred J. Keefe	Perforated, Porous, or Slotted Casing	+/- 5 seconds
363519116322001	Leslie Nickels	Perforated, Porous, or Slotted Casing	+/- 5 seconds
363540116240801	L. Mason	Perforated, Porous, or Slotted Casing	+/- 10 seconds
363527116292501	Unknown	Unknown	+/- 5 seconds
363521116352501	Davidson Well	Perforated, Porous, or Slotted Casing	+/- 5 seconds
363456116335501	Eugene J. Mankinen	Perforated, Porous, or Slotted Casing	+/- 1 minute
363454116314201	Donald O. Heath	Perforated, Porous, or Slotted Casing	+/- 5 seconds
363503116351501	Elvis Kelley	Perforated, Porous, or Slotted Casing	+/- 5 seconds
363503116284001	Manuel Rodela	Perforated, Porous, or Slotted Casing	+/- 5 seconds
363436116342301	Charles C. DeFir Jr.	Perforated, Porous, or Slotted Casing	+/- 5 seconds
363436116333201	William R. Monroe	Perforated, Porous, or Slotted Casing	+/- 5 seconds
363434116354001	DeFir Well	Perforated, Porous, or Slotted Casing	+/- 5 seconds
363438116324601	Edwin H. Mankinen	Perforated, Porous, or Slotted Casing	+/- 5 seconds
363442116363301	Bill Strickland	Perforated, Porous, or Slotted Casing	+/- 1 second
363440116282401	M. Meese	Unknown	+/- 1 minute
363415116275101	Theo E. Selbach	Unknown	+/- 10 seconds
363407116342501	C.L. Caldwell	Perforated, Porous, or Slotted Casing	+/- 10 seconds
363407116243501	Leonard Siegel	Unknown	+/- 1 minute
363429116315901	James K. Pierce	Perforated, Porous, or Slotted Casing	+/- 1 second
363405116321501	James K. Pierce	Perforated, Porous, or Slotted Casing	+/- 10 seconds
363428116240301	Cooks West Well	Perforated, Porous, or Slotted Casing	+/- 5 seconds
363428116234701	Cooks East Well	Perforated, Porous, or Slotted Casing	+/- 5 seconds
363417116271801	Nye County Land Company	Unknown	+/- 1 minute
363411116272901	Amargosa Town Complex	Perforated, Porous, or Slotted Casing	+/- 1 second
363410116261101	Nye County Development Co	Perforated, Porous, or Slotted Casing	+/- 5 seconds
363410116240301	Lewis C. Cook	Perforated, Porous, or Slotted Casing	+/- 5 seconds
363410116240001	Lewis C. Cook	Perforated, Porous, or Slotted Casing	+/- 5 seconds
363407116273301	Amargosa Valley Water	Perforated, Porous, or Slotted Casing	+/- 1 second
363342116335701	Earl N. Selbach	Unknown	+/- 10 seconds
363340116332901	Lewis N. Dansby	Perforated, Porous, or Slotted Casing	+/- 5 seconds
363342116325101	Edwin H. Mankinen	Unknown	+/- 10 seconds
363350116252101	Willard Johns	Perforated, Porous, or Slotted Casing	+/- 10 seconds
365157116271202	USW H-1 tube 1	Tube 1 - deepest interval in piezometer	+/- 1 second
365157116271203	USW H-1 tube 2	Tube 2 - second deepest interval in piezometer	+/- 1 second
365157116271204	USW H-1 tube 3	Tube 3 - second shallowest interval in piezometer	+/- 1 second
365157116271205	USW H-1 tube 4	Tube 4 - shallowest interval in piezometer	+/- 1 second

USGS Site ID	Site Name	Interval Description	Accuracy of Location
365122116275502	USW H-5 upper	Upper interval - above inflatable packer	+/- 1 second
365122116275503	USW H-5 lower	Lower interval - below inflatable packer	+/- 1 second
365108116262302	UE-25 b #1 lower	Lower interval - below inflatable packer	+/- 1 second
365108116262303	UE-25 b #1 upper	Upper interval - above inflatable packer	+/- 1 second
365049116285502	USW H-6 upper	Upper interval - above inflatable packer	+/- 1 second
365049116285505	USW H-6 lower	Lower interval - below inflatable packer	+/- 1 second
365032116265402	USW H-4 upper	Upper interval - above inflatable packer	+/- 1 second
365032116265403	USW H-4 lower	Lower interval - below inflatable packer	+/- 1 second
364942116280002	USW H-3 upper	Upper interval - above inflatable packer	+/- 1 second
364942116280003	USW H-3 lower	Lower interval - below inflatable packer	+/- 1 second
364938116252102	UE-25 p #1(Lwr Intrvl)	Paleozoics units monitored	+/- 1 second
not available yet	USW SD-7	Fractured Rock Openings	unknown
not available yet	USW SD-9	Fractured Rock Openings	unknown
not available yet	USW SD-12	Fractured Rock Openings	unknown
364234116351501	NC-EWDP-1DX, shallow	Screen, above inflatable packer	unknown
364234116351501	NC-EWDP-1DX, deep	Screen, below inflatable packer	unknown
364233116351501	NC-EWDP-1S, probe 1	Screen, between inflatable packers	unknown
364233116351501	NC-EWDP-1S, probe 2	Screen, between inflatable packers	unknown
363939116275401	NC-EWDP-2D	Open Hole, No Screen	unknown
363940116275501	NC-EWDP-2DB	Open Hole, No Screen	unknown
364054116321401	NC-EWDP-3D	Open Hole, No Screen	unknown
364054116321301	NC-EWDP-3S, probe 2	Screen, between inflatable packers	unknown
364054116321301	NC-EWDP-3S, probe 3	Screen, between inflatable packers	unknown
363925116241501	NC-EWDP-4PA	Screen, above inflatable packer	unknown
363925116241401	NC-EWDP-4PB	Screen, below inflatable packer	unknown
364012116223401	NC-EWDP-5SB	Screen	unknown
364332116332201	NC-EWDP-7S	Screen	unknown
364145116334401	NC-EWDP-9SX, probe 1	Screen, between inflatable packers	unknown
364145116334401	NC-EWDP-9SX, probe 2	Screen, between inflatable packers	unknown
364145116334401	NC-EWDP-9SX, probe 4	Screen, below inflatable packer	unknown
364137116351001	NC-EWDP-12PA	Screen, between inflatable packers	unknown
364138116351001	NC-EWDP-12PB	Screen, between inflatable packers	unknown
364139116351001	NC-EWDP-12PC	Screen, between inflatable packers	unknown
364011116294901	NC-EWDP-15P	Screen	unknown
364015116265301	NC-EWDP-19P	Screen	unknown
364014116265301	NC-EWDP-19D	Screen, various intervals	unknown
365301116271301	USW WT-24	Open Hole, No Screen	unknown
363951116252401	NC-Washburn-1X	Screen	unknown
364706116170601	UE-25 J -11	Open Hole, No Screen	+/- 1 second
364237116365401	BGMW-11	Open Hole, No Screen	+/- 1 second
363709116264601	Richard Washburn	Unknown	+/- 1 second
363409116233701	L. Cook	Unknown	+/- 1 minute
363411116264701	Unknown	Unknown	+/- 5 seconds
363428116281201	Amargosa Water	Unknown	+/- 5 seconds
363429116233401	Lewis C. Cook	Unknown	+/- 5 seconds
363511116335101	Unknown	Unknown	+/- 1 second
365624116222901	USW UZ-N91	Open Hole, No Screen	unknown

Table I-7 Accuracy of Land-surface Altitude and Latest Water-level Measurement Method Description

Accuracy of Location/Accuracy of Land-surface Altitude (meters)

Location and land-surface altitude accuracy, where available, were compiled from the NWIS data files (DTN: GS991100002330.001).

Latest Water-level Measurement Method Description

Typical water-level measurement method was compiled from the NWIS data files (DTN: GS991100002330.001), and from the Nye County datasets listed in Table 4-1.

USGS Site ID	Site Name	Accuracy of Land-surface Altitude (m)	Latest Water-level Measurement Method Description
365629116222602	UE-29 a #2	0.1	Steel-tape measurement
365520116370301	GEXA Well 4	0.1	Electric-tape measurement
365340116264601	UE-25 WT #6	0.1	Steel-tape measurement
365322116273501	USW G-2	0.1	Electric-tape measurement
365239116253401	UE-25 WT #16	0.1	Steel-tape measurement
365208116274001	USW UZ-14	unknown	unknown
365207116264201	UE-25 WT #18	0.1	Steel-tape measurement
365200116272901	USW G-1	0.1	Unknown
365147116185301	UE-25 a #3	0.1	Reported, method not known
365140116260301	UE-25 WT #4	0.1	Steel-tape measurement
365116116233801	UE-25 WT #15	0.1	Steel-tape measurement
365114116270401	USW G-4	0.1	Manometer measurement
365105116262401	UE-25 a #1	0.1	Calibrated electric-tape measurement
365032116243501	UE-25 WT #14	0.1	Steel-tape measurement
365023116271801	USW WT-2	0.1	Steel-tape measurement
364947116254300	UE-25 c #1	0.1	Analog or graphic recorder
364947116254501	UE-25 c #3	0.1	Steel-tape measurement
364947116254401	UE-25 c #2	0.1	Reported, method not known
364945116235001	UE-25 WT #13	0.1	Steel-tape measurement
364933116285701	USW WT- 7	0.1	Manometer measurement
364916116265601	USW WT- 1	0.1	Electric-tape measurement
364905116280101	USW G-3	0.1	unknown
364828116234001	UE-25 J -13	0.1	Steel-tape measurement
364825116290501	USW WT-10	0.1	Electric-tape measurement
364822116262601	UE-25 WT #17	0.1	Steel-tape measurement
365821116343701	USW VH-2	unknown	unknown
364757116245801	UE-25 WT #3	0.1	Steel-tape measurement
364732116330701	USW VH-1	0.1	Steel-tape measurement
364656116261601	UE-25 WT #12	0.1	Steel-tape measurement
364649116280201	USW WT-11	0.1	Reported, method not known
364554116232400	UE-25 J -12	0.1	unknown
364528116232201	UE-25 JF #3	0.1	Unknown
364105116302601	Cind-R-Lite Well	0.1	Unknown
363907116235701	Ben Bossingham	1.0	Reported, method not known
363836116234001	Fred Cobb	0.5	Electric-tape measurement
363840116235000	Bob Whellock	3.0	Reported, method not known
363840116234001	Louise Pereidra	2.0	Reported, method not known
363840116233501	Joe Richards	0.5	Reported, method not known
363835116234001	NDOT Well	0.1	Steel-tape measurement

USGS Site ID	Site Name	Accuracy of Land-surface Altitude (m)	Latest Water-level Measurement Method Description
363742116263201	James H. Shaw	0.5	Steel-tape measurement
363830116241401	Airport Well	0.1	Calibrated electric-tape measurement
363815116175901	TW- 5	0.1	Electric-tape measurement
363711116263701	Richard Washburn	0.1	Steel-tape measurement
363621116263201	Richard Washburn	0.5	Reported, method not known
363549116305001	Nye County Development Co	2.0	Steel-tape measurement
363523116353701	Fred Wooldridge	0.5	unknown
363525116325601	Fred J. Keefe	0.5	Electric-tape measurement
363519116322001	Leslie Nickels	2.0	Steel-tape measurement
363540116240801	L. Mason	1.0	Unknown
363527116292501	Unknown	0.5	Electric-tape measurement
363521116352501	Davidson Well	0.5	Steel-tape measurement
363456116335501	Eugene J. Mankinen	0.5	Steel-tape measurement
363454116314201	Donald O. Heath	0.5	Steel-tape measurement
363503116351501	Elvis Kelley	0.5	Steel-tape measurement
363503116284001	Manuel Rodela	0.5	Steel-tape measurement
363436116342301	Charles C. DeFir Jr.	2.0	Electric-tape measurement
363436116333201	William R. Monroe	2.0	Steel-tape measurement
363434116354001	DeFir Well	0.1	Steel-tape measurement
363438116324601	Edwin H. Mankinen	0.5	Steel-tape measurement
363442116363301	Bill Strickland	0.5	Reported, method not known
363440116282401	M. Meese	0.1	unknown
363415116275101	Theo E. Selbach	0.5	Reported, method not known
363407116342501	C.L. Caldwell	2.0	unknown
363407116243501	Leonard Siegel	1.0	Steel-tape measurement
363429116315901	James K. Pierce	0.5	Steel-tape measurement
363405116321501	James K. Pierce	2.0	Steel-tape measurement
363428116240301	Cooks West Well	2.0	Steel-tape measurement
363428116234701	Cooks East Well	0.1	Calibrated electric-tape measurement
363417116271801	Nye County Land Company	0.1	unknown
363411116272901	Amargosa Town Complex	0.5	Reported, method not known
363410116261101	Nye County Development Co	0.5	Steel-tape measurement
363410116240301	Lewis C. Cook	0.5	Steel-tape measurement
363410116240001	Lewis C. Cook	1.0	Steel-tape measurement
363407116273301	Amargosa Valley Water	0.5	Reported, method not known
363342116335701	Earl N. Selbach	0.5	Reported, method not known
363340116332901	Lewis N. Dansby	2.0	Steel-tape measurement
363342116325101	Edwin H. Mankinen	2.0	Unknown
363350116252101	Willard Johns	0.5	Steel-tape measurement
365157116271202	USW H-1 tube 1	0.1	Steel-tape measurement
365157116271203	USW H-1 tube 2	0.1	Steel-tape measurement
365157116271204	USW H-1 tube 3	0.1	Steel-tape measurement
365157116271205	USW H-1 tube 4	0.1	Steel-tape measurement
365122116275502	USW H-5 upper	0.1	Steel-tape measurement
365122116275503	USW H-5 lower	0.1	Steel-tape measurement
365108116262302	UE-25 b #1 lower	0.1	Steel-tape measurement
365108116262303	UE-25 b #1 upper	0.1	Steel-tape measurement
365049116285502	USW H-6 upper	0.1	Steel-tape measurement
365049116285505	USW H-6 lower	0.1	unknown

USGS Site ID	Site Name	Accuracy of Land-surface Altitude (m)	Latest Water-level Measurement Method Description
365032116265402	USW H-4 upper	0.1	Unknown
365032116265403	USW H-4 lower	0.1	Steel-tape measurement
364942116280002	USW H-3 upper	0.1	Steel-tape measurement
364942116280003	USW H-3 lower	0.1	Calibrated electric-tape measurement
364938116252102	UE-25 p #1(Lwr Intrvl)	0.1	Steel-tape measurement
not available yet	USW SD-7	unknown	unknown
not available yet	USW SD-9	unknown	unknown
not available yet	USW SD-12	unknown	unknown
364234116351501	NC-EWDP-1DX, shallow	unknown	Calibrated electric-tape measurement
364234116351501	NC-EWDP-1DX, deep	unknown	Calibrated electric-tape measurement
364233116351501	NC-EWDP-1S, probe 1	unknown	Calibrated transducer
364233116351501	NC-EWDP-1S, probe 2	unknown	Calibrated transducer
363939116275401	NC-EWDP-2D	unknown	Calibrated electric-tape measurement
363940116275501	NC-EWDP-2DB	unknown	Calibrated electric-tape measurement
364054116321401	NC-EWDP-3D	unknown	Calibrated electric-tape measurement
364054116321301	NC-EWDP-3S, probe 2	unknown	Calibrated transducer
364054116321301	NC-EWDP-3S, probe 3	unknown	Calibrated transducer
363925116241501	NC-EWDP-4PA	unknown	Calibrated electric-tape measurement
363925116241401	NC-EWDP-4PB	unknown	Calibrated electric-tape measurement
364012116223401	NC-EWDP-5SB	unknown	Calibrated electric-tape measurement
364332116332201	NC-EWDP-7S	unknown	Calibrated electric-tape measurement
364145116334401	NC-EWDP-9SX, probe 1	unknown	Calibrated transducer
364145116334401	NC-EWDP-9SX, probe 2	unknown	Calibrated transducer
364145116334401	NC-EWDP-9SX, probe 4	unknown	Calibrated transducer
364137116351001	NC-EWDP-12PA	unknown	Calibrated electric-tape measurement
364138116351001	NC-EWDP-12PB	unknown	Calibrated electric-tape measurement
364139116351001	NC-EWDP-12PC	unknown	Calibrated electric-tape measurement
364011116294901	NC-EWDP-15P	unknown	Calibrated electric-tape measurement
364015116265301	NC-EWDP-19P	unknown	Calibrated electric-tape measurement
364014116265301	NC-EWDP-19D	unknown	Calibrated electric-tape measurement
365301116271301	USW WT-24	unknown	Steel-tape measurement
363951116252401	NC-Washburn-1X	unknown	Calibrated electric-tape measurement
364706116170601	UE-25 J -11	0.1	Calibrated electric-tape measurement
364237116365401	BGMW-11	0.5	Steel-tape measurement
363709116264601	Richard Washburn	0.5	Steel-tape measurement
363409116233701	L. Cook	0.1	Reported, method not known
363411116264701	Unknown	0.1	Steel-tape measurement
363428116281201	Amargosa Water	0.5	Steel-tape measurement
363429116233401	Lewis C. Cook	1.0	Steel-tape measurement
363511116335101	Unknown	0.5	Steel-tape measurement
365624116222901	USW UZ-N91	unknown	Steel-tape measurement

Table I-8 Water Level Measurement Accuracy and Perched?

Water-level Measurement Accuracy

Water-level altitude accuracy, where available, was compiled from the NWIS data files (DTN: GS991100002330.001).

Perched?

Potential perched-water levels identified during this analysis were flagged and identified as "Suspected perched" or "Assumed perched."

USGS Site ID	Site Name	Water Level Measurement Accuracy	Perched?
365629116222602	UE-29 a #2	Nearest 0.01 feet.	Suspected perched
365520116370301	GEXA Well 4	Nearest 0.01 feet.	
365340116264601	UE-25 WT #6	Nearest 0.01 feet.	Assumed perched
365322116273501	USW G-2	unknown	Assumed perched
365239116253401	UE-25 WT #16	Nearest 0.01 feet.	
365208116274001	USW UZ-14	unknown	
365207116264201	UE-25 WT #18	Nearest 0.01 feet.	Suspected perched
365200116272901	USW G-1	unknown	Suspected perched
365147116185301	UE-25 a #3	Nearest foot.	Suspected perched
365140116260301	UE-25 WT #4	Nearest 0.01 feet.	
365116116233801	UE-25 WT #15	Nearest 0.01 feet.	
365114116270401	USW G-4	Nearest 0.01 feet.	
365105116262401	UE-25 a #1	unknown	
365032116243501	UE-25 WT #14	Nearest 0.01 feet.	
365023116271801	USW WT-2	Nearest 0.01 feet.	
364947116254300	UE-25 c #1	Nearest 0.01 feet.	
364947116254501	UE-25 c #3	Nearest 0.01 feet.	
364947116254401	UE-25 c #2	Nearest foot.	
364945116235001	UE-25 WT #13	Nearest 0.01 feet.	
364933116285701	USW WT- 7	Nearest 0.01 feet.	
364916116265601	USW WT- 1	Nearest 0.1 feet.	
364905116280101	USW G-3	unknown	
364828116234001	UE-25 J -13	Nearest 0.01 feet.	
364825116290501	USW WT-10	Nearest foot.	
364822116262601	UE-25 WT #17	Nearest 0.01 feet.	
365821116343701	USW VH-2	unknown	
364757116245801	UE-25 WT #3	Nearest 0.01 feet.	
364732116330701	USW VH-1	Nearest 0.01 feet.	
364656116261601	UE-25 WT #12	Nearest 0.01 feet.	
364649116280201	USW WT-11	Nearest foot.	
364554116232400	UE-25 J -12	Nearest 0.01 feet.	
364528116232201	UE-25 JF #3	unknown	
364105116302601	Cind-R-Lite Well	Nearest 0.1 feet.	
363907116235701	Ben Bossingham	Nearest foot.	
363836116234001	Fred Cobb	Nearest 0.1 feet.	
363840116235000	Bob Whellock	Nearest foot.	
363840116234001	Louise Pereidra	Nearest foot.	
363840116233501	Joe Richards	Nearest foot.	
363835116234001	NDOT Well	Nearest 0.01 feet.	
363742116263201	James H. Shaw	Nearest 0.01 feet.	

USGS Site ID	Site Name	Water Level Measurement Accuracy	Perched?
363830116241401	Airport Well	Nearest 0.01 feet.	
363815116175901	TW- 5	Nearest 0.01 feet.	
363711116263701	Richard Washburn	Nearest 0.01 feet.	
363621116263201	Richard Washburn	Nearest foot.	
363549116305001	Nye County Development Co	Nearest 0.01 feet.	
363523116353701	Fred Wooldridge	Nearest 0.1 feet.	
363525116325601	Fred J. Keefe	Nearest 0.1 feet.	
363519116322001	Leslie Nickels	Nearest 0.01 feet.	
363540116240801	L. Mason	Nearest 0.01 feet.	
363527116292501	Unknown	Nearest 0.1 feet.	
363521116352501	Davidson Well	Nearest 0.01 feet.	
363456116335501	Eugene J. Mankinen	Nearest 0.01 feet.	
363454116314201	Donald O. Heath	Nearest 0.01 feet.	
363503116351501	Elvis Kelley	Nearest 0.01 feet.	
363503116284001	Manuel Rodela	Nearest 0.01 feet.	
363436116342301	Charles C. DeFir Jr.	Nearest 0.1 feet.	
363436116333201	William R. Monroe	Nearest 0.01 feet.	
363434116354001	DeFir Well	Nearest 0.01 feet.	
363438116324601	Edwin H. Mankinen	Nearest 0.01 feet.	
363442116363301	Bill Strickland	Nearest foot.	
363440116282401	M. Meese	Nearest 0.01 feet.	
363415116275101	Theo E. Selbach	Nearest foot.	
363407116342501	C.L. Caldwell	Nearest foot.	
363407116243501	Leonard Siegel	Nearest 0.01 feet.	
363429116315901	James K. Pierce	Nearest 0.01 feet.	
363405116321501	James K. Pierce	Nearest 0.01 feet.	
363428116240301	Cooks West Well	Nearest 0.01 feet.	
363428116234701	Cooks East Well	Nearest 0.01 feet.	
363417116271801	Nye County Land Company	Nearest 0.1 feet.	
363411116272901	Amargosa Town Complex	Nearest foot.	
363410116261101	Nye County Development Co	Nearest 0.01 feet.	
363410116240301	Lewis C. Cook	Nearest 0.01 feet.	
363410116240001	Lewis C. Cook	Nearest 0.01 feet.	
363407116273301	Amargosa Valley Water	Nearest foot.	
363342116335701	Earl N. Selbach	Nearest foot.	
363340116332901	Lewis N. Dansby	Nearest 0.01 feet.	
363342116325101	Edwin H. Mankinen	Nearest 0.01 feet.	
363350116252101	Willard Johns	Nearest 0.01 feet.	
365157116271202	USW H-1 tube 1	Nearest 0.01 feet.	
365157116271203	USW H-1 tube 2	Nearest 0.01 feet.	
365157116271204	USW H-1 tube 3	Nearest 0.01 feet.	
365157116271205	USW H-1 tube 4	Nearest 0.01 feet.	
365122116275502	USW H-5 upper	Nearest 0.01 feet.	
365122116275503	USW H-5 lower	Nearest 0.01 feet.	
365108116262302	UE-25 b #1 lower	Nearest 0.01 feet.	
365108116262303	UE-25 b #1 upper	Nearest 0.01 feet.	
365049116285502	USW H-6 upper	Nearest 0.01 feet.	
365049116285505	USW H-6 lower	unknown	
365032116265402	USW H-4 upper	unknown	

USGS Site ID	Site Name	Water Level Measurement Accuracy	Perched?
365032116265403	USW H-4 lower	Nearest 0.01 feet.	
364942116280002	USW H-3 upper	Nearest 0.01 feet.	
364942116280003	USW H-3 lower	unknown	
364938116252102	UE-25 p #1(Lwr Intrvl)	Nearest 0.01 feet.	
not available yet	USW SD-7	unknown	
not available yet	USW SD-9	unknown	
not available yet	USW SD-12	unknown	
364234116351501	NC-EWDP-1DX, shallow	unknown	
364234116351501	NC-EWDP-1DX, deep	unknown	
364233116351501	NC-EWDP-1S, probe 1	unknown	
364233116351501	NC-EWDP-1S, probe 2	unknown	
363939116275401	NC-EWDP-2D	unknown	
363940116275501	NC-EWDP-2DB	unknown	
364054116321401	NC-EWDP-3D	unknown	
364054116321301	NC-EWDP-3S, probe 2	unknown	
364054116321301	NC-EWDP-3S, probe 3	unknown	
363925116241501	NC-EWDP-4PA	unknown	
363925116241401	NC-EWDP-4PB	unknown	
364012116223401	NC-EWDP-5SB	unknown	
364332116332201	NC-EWDP-7S	unknown	Assumed perched
364145116334401	NC-EWDP-9SX, probe 1	unknown	
364145116334401	NC-EWDP-9SX, probe 2	unknown	
364145116334401	NC-EWDP-9SX, probe 4	unknown	
364137116351001	NC-EWDP-12PA	unknown	
364138116351001	NC-EWDP-12PB	unknown	
364139116351001	NC-EWDP-12PC	unknown	
364011116294901	NC-EWDP-15P	unknown	
364015116265301	NC-EWDP-19P	unknown	
364014116265301	NC-EWDP-19D	unknown	
365301116271301	USW WT-24	Nearest 0.01 feet.	
363951116252401	NC-Washburn-1X	unknown	
364706116170601	UE-25 J -11	Nearest 0.01 feet.	
364237116365401	BGMW-11	Nearest 0.01 feet.	
363709116264601	Richard Washburn	Nearest 0.01 feet.	
363409116233701	L. Cook	Nearest foot.	
363411116264701	Unknown	Nearest 0.01 feet.	
363428116281201	Amargosa Water	Nearest 0.01 feet.	
363429116233401	Lewis C. Cook	Nearest 0.01 feet.	
363511116335101	Unknown	Nearest 0.01 feet.	
365624116222901	USW UZ-N91	Nearest 0.01 feet.	Suspected perched