Volume 1

Aquifer-Properties Data Compilation and Evaluation

Presentation to the Office of the Nevada State Engineer

Prepared by

SOUTHERN NEVADA
WATER AUTHORITY

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LIST OF ACRONYMS AND ABBREVIATIONS

bgs	below ground surface
DOE	U.S. Department of Energy
DST	Drill-Stem Test
DVRFS	Death Valley Regional Flow System
ft	foot (feet)
ft/day	feet per day
ft^2/day	square feet per day
gpm	gallons per minute
HGU	Hydrogeologic Unit
IT	IT Corporation
k	Intrinsic Permeability
K	Hydraulic Conductivity
m	meters
MX	Missile Experimental
NDWR	Nevada Division of Water Resources
NTS	Nevada Test Site
QEC	Questa Engineering Corporation
RMU	Regional Model Units
SNJV	Stoller-Navarro Joint Venture
SNWA	Southern Nevada Water Authority
Sy	Specific Yield
T	Transmissivity
UDWR	Utah Division of Water Rights
UGTA	Underground Test Area
USGS	U.S. Geological Survey
UTM	Universal Transverse Mercator

1.0 INTRODUCTION

This report describes aquifer property data analysis efforts conducted by the Southern Nevada Water Authority (SNWA) in support of the construction of conceptual and numerical groundwater flow models for Spring Valley and vicinity in Nevada. Figure 1-1 shows the location of Spring Valley and the region of interest to the hydraulic property data analysis. This region will be referred to as the "study area" in the remainder of this report.

1.1 Background

A groundwater flow model was developed to support the Spring Valley applications. The model area includes Spring Valley and neighboring basins including Snake and Hamlin Valley, Steptoe Valley, Tippet Valley, Lake Valley, Cave Valley, and the northern portion of Dry Lake Valley. The study area, model area and the points-of-diversion of the SNWA applications in Spring Valley are shown on Figure 1-2.

Estimates of hydraulic properties are an essential component of the conceptual groundwater flow model, and serve as the basis for the initial estimates in the numerical groundwater flow model.

1.2 Purpose and Objectives

Hydraulic properties include permeability and storage parameters of geologic units. Permeability parameters quantify the ability of fluids to flow through geologic media. Storage parameters, as their name indicates, provide a measure of the storage capabilities of the geologic media.

In general, the quantification of the permeability and storage parameters of a flow system is needed for several reasons: (1) It facilitates comparison of water-bearing geologic units; (2) it facilitates the identification of aquifers versus confining units; and (3) it is required in flux calculations using simple analytical or complex numerical models of groundwater flow.

The purpose of this report is to document the sources of hydraulic property information and develop a database of this information to be used in selecting modeling parameters.

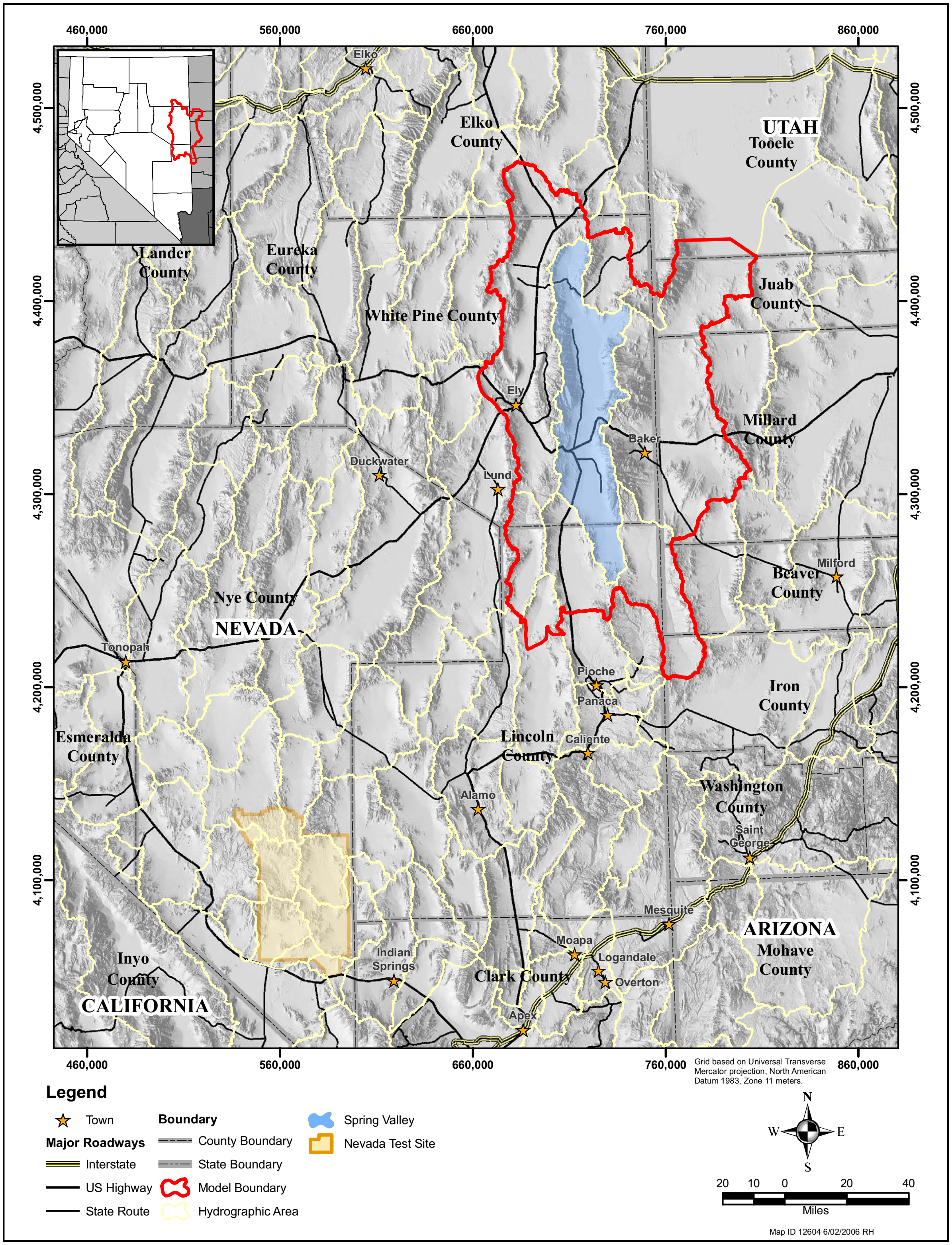

Figure 1-1
Location of Spring Valley and Aquifer Property Study Area

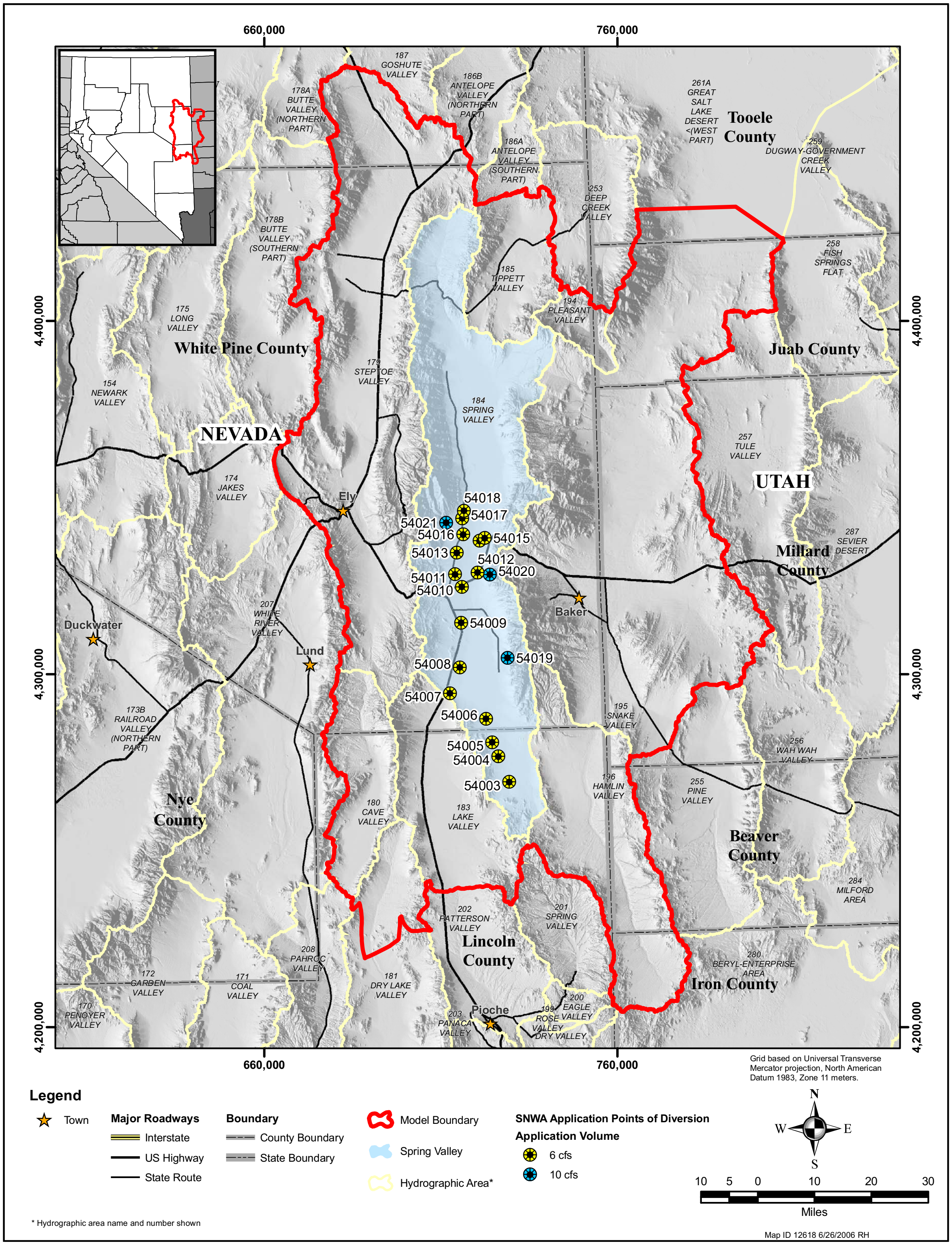

Figure 1-2
Location of Spring Valley Application Points of Diversion and Model Boundary

1.3 General Data Analysis Process

The general approach consists of the following steps:

1. Conduct a literature review of the hydraulic property data or other indicator data available for the study area.

2. Compile available hydraulic property data and related information.

3. Evaluate the quality of the data.

2.0 DATA

Descriptions of the data types, methods of measurement, available data, data reduction, and quality evaluation are described in this section.

2.1 Data Types

Data types of interest include (1) hydraulic properties such as permeability and storage derived directly from field or laboratory tests and (2) other types of data that may indirectly be used to estimate hydraulic properties or provide comparative estimates.

Permeability parameters may be expressed as intrinsic permeability (k), or transmissivity (T). Intrinsic permeability is a measure of the ability of a geologic unit to transmit fluids under a hydraulic or potential gradient and is independent of the resident fluid properties (Fetter, 1988). This parameter is usually applied in the evaluation of oil and gas wells, where fluid properties vary considerably. Hydraulic conductivity (K) is a measure of the ability of a geologic unit to transmit water and is a function of both the medium and the fluid (Fetter, 1988). Transmissivity is the rate at which water is transmitted through a unit width of an aquifer or confining bed under a unit hydraulic gradient and is a product of K and the thickness of the water-bearing geologic unit (Fetter, 1988). Hydraulic conductivity may vary with direction. Such variability is measured via anisotropy factors. Specific capacity is an expression of the productivity of a well and represents the well yield per unit of drawdown (Fetter, 1988) and may be used to derive estimates of T.

Storage parameters include the storativity and specific yield (Sy). The storage coefficient, also known as storativity, is the volume of water that an aquifer releases from or takes into storage per unit surface area of the aquifer per unit change in head (Fetter, 1988). The Sy is the ratio of water a rock or soil will yield by gravity drainage to the volume of rock or soil. The retained portion is called specific retention (Fetter, 1988).

Therefore, the types of data that may be used to estimate hydraulic properties are:

- K
- T
- Specific capacity
- Anisotropy factors
- Storage coefficient
- Sy

2.2 Methods of Measurements

Methods of aquifer-property measurement include direct methods to estimate the hydraulic properties and the use of other related data to estimate hydraulic properties in a quantitative or qualitative manner.

Methods of aquifer-property measurement include:

- Constant-rate pumping tests
- Slug tests
- Packer tests
- Step-drawdown tests
- Drill-stem tests (DST)
- Permeameter tests
- Specific capacity values which may be used to estimate transmissivities.

2.3 Description of Available Data

The study area for this task includes the model area Figure 1-1 and vicinity, and other nearby areas, which were added to the scope of the literature review effort due to the limited availability of site-specific data. These other areas have a similar hydrogeology and include the Death Valley Flow System, and other valleys located near the study area. The Death Valley Flow System has been the subject of several large projects including:

- Underground test areas (UGTA) on the Nevada Test Site (NTS)
- Yucca Mountain Project
- Nye County Early Warning Drilling Program
- SNWA Studies of Three Lakes Valley North and South and Tikaboo Valley North and South.

Brief descriptions of previous investigations conducted within the general study area that resulted in aquifer property data are summarized below.

2.3.1 Data Derived From Well Tests

Locations where well tests have been conducted within the study area are shown in Figure 2-1. Brief descriptions of the studies are provided in the following text.

Missile Experimental Well Studies

In the late 1970s and early 1980s, hydrogeologic investigations were completed for the Missile Experimental (MX) missile siting program. The data collected from MX Well Tests under the U.S. Air Force MX Siting Investigation/Water Resources Program are described in reports by Ertec Western, Inc. (1981a through c) and Bunch and Harrill (1984). The area of investigation for this project extends over Nevada and Utah. A number of wells were constructed and tested in 1980 and

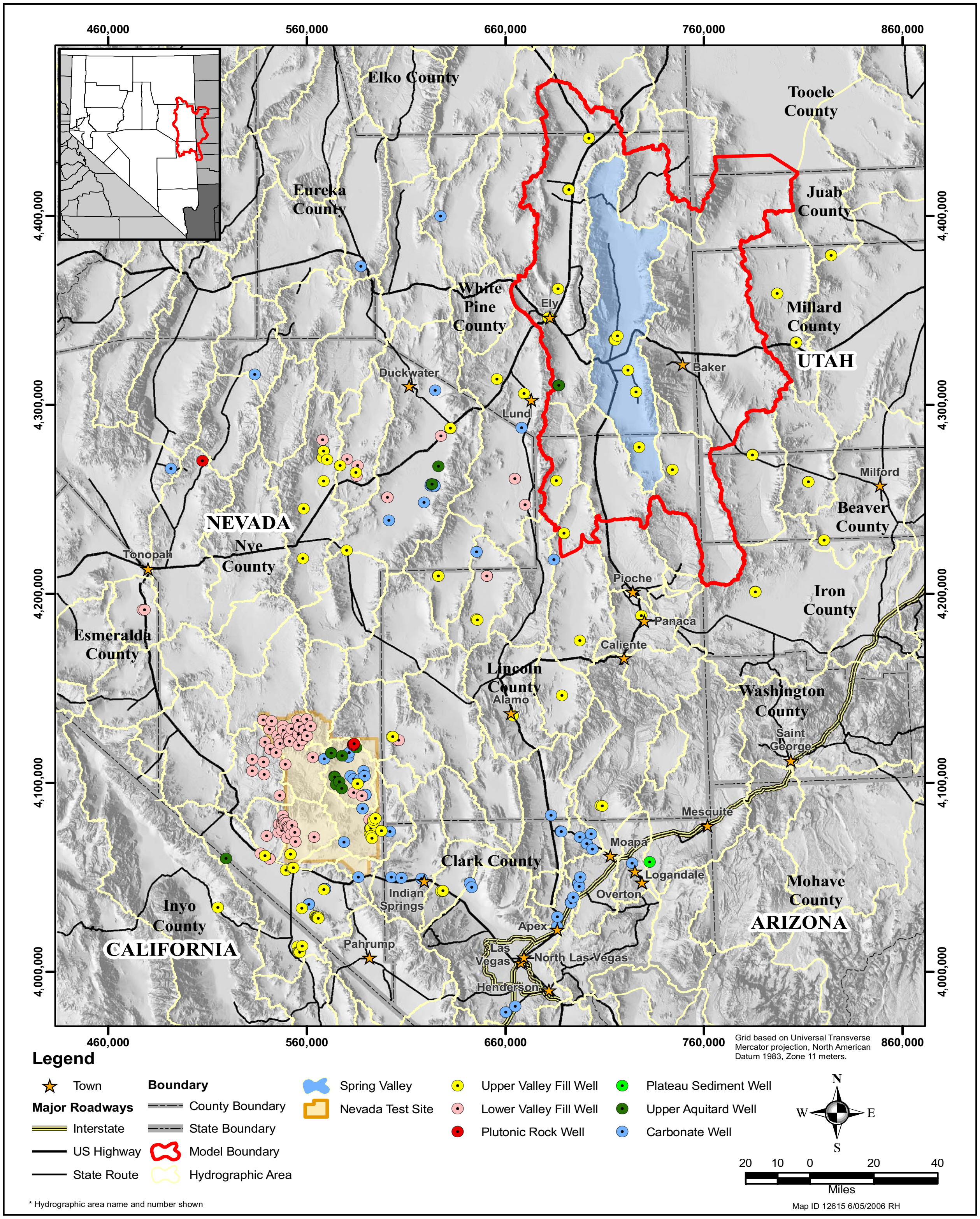

Figure 2-1
Locations of Aquifer Property Data by Regional Model Unit Excluding Upper Valley-Fill Driller's Log Data

1981, when the project was stopped. Most tests were single-well constant-rate tests that were conducted in the valley-fill aquifer with a few tests conducted in the carbonate aquifer. This data set is the largest site-specific dataset available.

White Pine Power Project

Reports by Leeds, Hill and Jewett, Inc. (1981; 1983) describe well tests conducted as part of the White Pine Power Project. This study was conducted in three phases and aquifer property data were derived from step-drawdown and pump tests. During Phase 2, several wells were installed and tested in the valley-fill and carbonate aquifers of Spring, Steptoe, and White River Valleys. During Phase 3, a few more wells were installed and tested in Spring and Steptoe Valleys.

Drill-Stem Tests

McKay and Kepper (1988) compiled, reviewed, and analyzed DST data collected from oil and gas wells in Nevada. Most of the wildcat wells reviewed are in the Railroad Valley and White River Valley Flow Systems. McKay and Kepper (1988) calculated transmissivities for 20 wells with complete DST records for the carbonate aquifer. They found that DST T values were smaller than those derived from aquifer tests by as much as three orders of magnitude.

Since the McKay and Kepper (1988) report, 80 more recent DSTs (1987 to 2003) have been conducted in Nevada. The data from these tests have neither been compiled nor analyzed as part of this study.

Death Valley Regional Flow System Studies

This section briefly describes each of the studies and data associated with the Death Valley Regional Flow System (DVRFS) or areas located within this flow system.

- Belcher et al. (2001): Belcher et al. (2001) compiled an extensive aquifer property dataset from existing databases and the literature to support the DVRFS model (Belcher, 2004). Although most of the locations of the data compiled by Belcher et al. (2001) fall within the DVRFS model area, some data locations are outside of the DVRFS model boundary. The dataset includes only “good quality” data as deemed by the authors of the report. Data of “lower quality” were not included in this dataset (Belcher et al., 2001).

- NTS Studies: An aquifer property dataset was developed to support the NTS Regional Model, an earlier model of the regional groundwater flow model for the DVRFS (IT Corporation [IT], 1996; 1997). This dataset contains much of the regional data available at the time of the study and each record in the dataset was assigned a qualification flag.

- In cooperation with the U.S. Geological Survey (USGS), the Stoller-Navarro Joint Venture (SNJV) compiled raw slug test data previously collected by the USGS for tests conducted on the NTS. Stoller-Navarro Joint Venture analyzed the data for environmental restoration studies of the Pahute Mesa UGTA and published the results in a report discussing hydrologic data for Pahute Mesa (SNJV, 2004c).

- To support the Nye County Early Warning Drilling Program associated with the Yucca Mountain Project, Questa Engineering Corporation (QEC) prepared several aquifer testing data analysis reports (QEC, 1999a through c; 2000a and b; 2001; 2002a through c; and 2003).
- Other NTS data consist of hydrologic data interpretation reports for wells or well clusters in the NTS and its vicinity conducted as part of the U.S. Department of Energy (DOE) Environmental Restoration Program (IT, 2002a through i; SNJV, 2004a, b, d, and e).

Other Studies

Other studies conducted within the region include localized hydrological investigations of Coyote Spring Valley, Moapa Valley, Lower Meadow Valley Wash, and Garnet Valley. These investigations provide data derived from step-drawdown and constant-rate tests for wells completed in valley-fill, carbonate, and volcanic rocks.

Another study included in the regional category is an extensive literature survey conducted by Maurer et al. (2004).

2.3.2 Data Derived From Driller's Logs

The Nevada Division of Water Resources (NDWR) maintains a database of driller’s logs for many wells in Nevada. This database is a source of extensive information. In addition to location and well construction information, driller's logs contain lithology and specific capacity data for some of the wells (NDWR, 2004). The Utah Division of Water Rights (UDWR) maintains similar information on their web site (UDWR, 2005). The specific capacity data is an additional source of estimates of transmissivities and hydraulic conductivities. Well locations for which driller's logs and specific capacity information are available are shown in Figure 2-2.

2.3.3 Porosity Data Source

An additional source of information that may be used to estimate storage properties is information on porosity. The porosity data were extracted from a single report. Plume (1996) compiled available porosity data to estimate upper bounds of storage coefficients for use in flow models developed under the USGS Regional Aquifer-System Analysis for the Great Basin Region. The dataset includes porosity data from American Stratigraphic Company logs of petroleum exploration wells drilled in the eastern Great Basin.

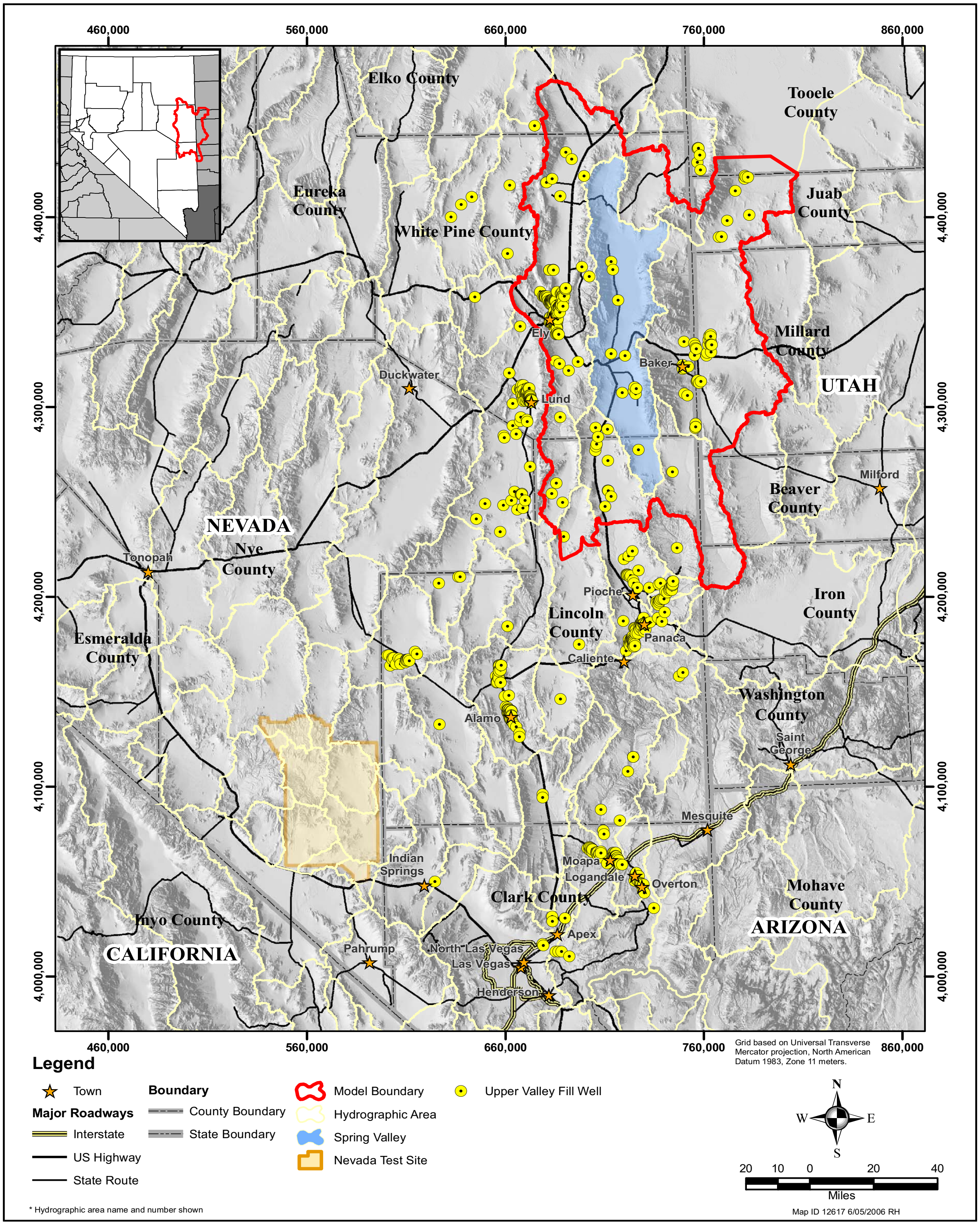

Figure 2-2
Locations of Upper Valley-Fill Driller's Log Data (NDWR, 2004; UDWR, 2005)

3.0 METHODOLOGY

The approach for the aquifer property data compilation and reduction is to compile the available aquifer property information for the region of the model area and reduce the data to a unified data structure, ultimately creating a database of the reduced data. The database can then be queried based on regional model unit (RMU) and the data can be analyzed to obtain estimates of the hydraulic properties needed for the numerical flow model.

3.1 Data Reduction

Data reduction for the well testing dataset began with the calculation of K estimates for the NDWR (2004) and UDWR (2005) specific capacity datasets. All of the individual datasets were then formatted into the same fields of information, and all values were converted to a standard set of units. This formatting and standardization process included mapping the hydrogeologic or lithologic information to a RMU (Attachment A). The RMUs in this model are a simplification of the geology, and therefore mapping was straightforward based on lithologic descriptions or previous studies hydrogeologic classifications. For example, alluvium is mapped as Upper Valley-Fill, and ash-flow tuffs are mapped as Lower Valley-Fill. Formatting also involved the standardization of site names and the creation of a site location table for unique locations. The individual datasets were then combined, and duplicate records were identified, flagged, and removed from the well testing dataset. Hydraulic conductivities for records with T and transmissive thickness information were then calculated. Finally, an aquifer property database was constructed from the resulting location and property tables (Attachment B). The porosity data from Plume (1996) was added to the database as a self-contained table.

3.2 Data Quality Evaluation

The following factors were considered in the data quality evaluation of each record of the combined dataset: record documentation, and test type and scale.

Record Documentation

This includes the documentation of the test itself and the data analysis used to derive the aquifer properties. A data documentation evaluation flag was applied to each record in the well testing dataset. The levels of documentation are described below:

- Level 1: Data containing detailed information about how the properties were determined, including information on test type, dates of testing, pumping or injection rates, radius or interwell distances, transmissive intervals, lithologic or stratigraphic descriptions, analytical method, and source. This level also includes all of the data from Belcher et al. (2001).

- Level 2: Data with all of the parameters listed in Level 1 but missing the dates of testing.

- Level 3: Data with most of the parameters listed in Level 1 but missing multiple fields of relevant information including dates, average pumping or injection rates, or radius or interwell distances. This level contains data in the fields that are missing in Level 4.

- Level 4: Data missing information on analytical method, test types, transmissive intervals. Also includes NDWR and UDWR Driller's Log information.

- Level 5: Data missing hydraulic parameter values or the information required to calculate the values. This information could not be used in this study.

Test Type and Scale

The scale of the test is extremely important when assessing the quality of the data for the intended purpose, especially for fractured hydrogeologic units (HGUs). The following test types may be grouped according to their scales from largest to smallest:

- Multiple-well constant-rate pumping tests
- Single-well constant-rate pumping tests
- Specific-capacity and DSTs
- Slug, packer, and step-drawdown tests
- Permeameter tests.

4.0 LIMITATIONS

General data limitations include:

- Limited data in project basins
- Limited tests from deep wells
- Limited number of multiple-well tests
- Limited number of long-term pumping tests
- Assumed thickness of the open interval and producing zones
- Bias above average K because many wells are screened preferentially across more productive zones (Belcher et al., 2002)
- Analytical methods used to solve for property data are based on aquifer assumptions
- Uneven distribution of the available data
- Test scale issues

The limitations described above have little effect on the purpose of this study, which is to provide ranges of aquifer properties to aid in the production of the Spring Valley regional groundwater flow model. The limitations may have an impact of the length of time required to prepare a calibrated groundwater model but will have little effect on the final calibrated model. If the data were available to reduce the number of limitations above, the values obtained would provide a better starting point for model calibration. However, the issues of bias above an average K, as well as the scaling of the data to a regional model, would still require further attention during calibration.

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Attachment A

Hydrogeologic Framework and Regional Model Units

A.1.0 HYDROGEOLOGIC FRAMEWORK

A detailed evaluation of the hydrogeology of the study area was conducted as part of this project and is described in an expert report titled "Geologic and Hydrogeologic Framework for the Spring Valley Area" (SNWA, 2006). Summary descriptions of the geology, structure, and hydrogeology were derived from that document and are presented in this section to support the analysis of aquifer property data.

The geology of the study area is dominated by a thick sequence of Paleozoic carbonates overlying Proterozoic to early Cambrian quartzites and shales above a Precambrian metamorphic core complex. Occasional shale and quartzite units are interbedded with the carbonates. Tertiary volcanic rocks are commonly found above the pre-Cenozoic sediments. These volcanic rocks have been erupted from several caldera complex centers and are generally accompanied by plutons. Preceding, intermixed with, and above the volcanic rocks are occasional sedimentary units, which are thicker to the south. These Cenozoic sediments include Oligocene to Miocene limestone and Oligocene to Holocene sands and gravels. The latest depositional episode was the creation of the valley fill within the basins of the region, as those basins were formed. This valley fill is dominated by sands and gravels, but also contains silts and clays deposited in basin playas.

The geologic framework of the study area was affected by three main structural events:

1. The Late Devonian to Late Mississippian Antler compressive deformation, which resulted in a number of thrust faults and created a highland to the northwest of the study area. Erosion of the highland resulted in Mississippian shales, sands, and gravels deposited within the study area.

2. The Late Jurassic to early Tertiary Sevier compressive deformation, which thrust western facies Paleozoic carbonates and related sediments over eastern facies continental and near shore sediments, most of which are Permian to Jurassic in age.

3. The Cenozoic basin-range extensional deformation. The extension began with the formation of detachment faults over uplifted areas, commonly areas of Jurassic and Tertiary plutons. These detachments continued during the volcanic episode of extension, where gaps created by extension allowed the intrusion of Tertiary magma that created the caldera complexes and Tertiary volcanics. Following the volcanic episode, the existing basin-range topography formed as the crust continued to stretch.

The third and most recent episode of deformation produced present-day topography and geologic features controlling groundwater flow.

Based on the geology and structure prevailing within the study area, the framework of the groundwater flow system was conceptualized as a set of groundwater flow compartments separated by the major structural features of the area. Flow compartment boundaries coincide with either known major structural features, barriers to flow inferred by water level data, or hydrographic area boundaries. The geologic units were grouped into HGUs based on a qualitative evaluation of their ability to transmit groundwater Table A.1-1. The HGUs were then grouped into simplified HGUs named RMUs. The RMUs are as follows:

- Upper Valley Fill (UVF): This unit consists mainly of unconsolidated sediments but also includes playa deposits, basalt and andesite, and mafic volcanic rocks. It is considered to be an aquifer over most of the study area. It may, however, be relatively impermeable in some areas.

- Lower Valley Fill (LVF): This unit consists mainly of volcanic rocks, but also includes older sediments below the volcanic rocks.

- Plateau Sediments (PS): This unit consists mainly of Permian to Mesozoic siliciclastic rocks and the Kaibab Limestone. It is considered to be an aquitard, as the Kaibab Limestone rarely forms sufficient openings to be an aquifer.

- Upper Carbonate Aquifer (UC): This unit consists of Permian and Pennsylvanian carbonate rocks and constitutes an aquifer where present.

- Upper Aquitard (UA): This unit consists of siliciclastic rocks of Mississippian age and is considered to be an aquitard.

- Lower Carbonate Aquifer (LC): This unit consists mainly of limestone and dolomite and includes some shale, sandstone, and quartzite. This unit constitutes a regional aquifer within the study area.

- Basement (BASE): This unit mainly consists of older siliciclastic rocks and high-grade metamorphic rocks. It is generally impermeable and forms the basement of the hydrogeologic framework of the flow system.

- Plutons (PLUT): This unit includes all intrusive rocks occurring within the study area.

The relationships between the RMUs and HGUs are presented in Table A.1-1.

Table A.1-1
Description of Hydrogeologic Units and Regional Model Units

Regional Model Unit	Regional Model Unit Description	Hydrogeologic Unit	Hydrogeologic Unit Description
UVF	Upper Valley Fill	QTb	Quaternary and Tertiary basalt - Quaternary and late Tertiary mafic volcanic rocks that are too thin to show on cross sections. These rocks are significant as a separate unit only where they are divided from the older volcanic rocks (Tv) by alluvium.
		QTs	Quaternary and Tertiary sediments - Includes sediments younger than the volcanic section, but may include older sediments where volcanic rocks are minor or nonexistent. Also includes playa deposits.
LVF	Lower Valley Fill	Tv	Tertiary volcanic rocks - Miocene to Eocene volcanic rocks.
		Tos	Older Tertiary sediments - Primarily created for the cross sections; includes the older Tertiary alluvial section below the volcanic section.
PLUT	Plutons	TJi	Tertiary to Jurassic intrusive rocks – includes all plutons.
PS	Plateau Sediments	KTRs	Cretaceous to Triassic siliciclastic rocks - Thicker where near the Colorado Plateau, and generally of low permeability. These units are more abundant in the southern part of the study area.
UC	Upper Carbonate Rocks	PIPc	Permian and Pennsylvanian carbonate rocks - Includes Ely Limestone, Bird Spring Formation, the Park City Group and other units. Includes Triassic carbonate rocks in the Butte Mountains, where these rocks are of limited extent. Also includes Permian red beds, undifferentiated.
UA	Upper Aquitard	Ms	Mississippian siliciclastic rocks - Includes Chainman Shale, Scotty Wash Quartzite, Diamond Peak Formation, Eleana Formation, and others. The Chainman Shale and Scotty Wash Quartzite are not differentiated in Lincoln County, except in the Egan and Schell Creek Ranges.
LC	Lower Carbonate Rocks	MOc	Mississippian to Ordovician carbonate rocks - Joana Limestone (Monte Cristo Formation) to Pogonip Group, also includes Chainman Shale in most of Lincoln and Clark County. The Pilot Shale and Eureka Quartzite are also included. Also included are the Guilmette Formation, Simonson Dolomite, Sevy Dolomite, and the Laketown Dolomite.
		Єc	Cambrian carbonate rocks - Includes the Bonanza King, Highland Peak, Lincoln Peak, and Pole Canyon Formations, and several units in western Utah.
BASE	Basement	ЄpЄs	Cambrian and Precambrian siliciclastic rocks - Includes the Wood Canyon Formation and the Prospect Mountain and Stirling Quartzites, and the Chisholm Shale, Lyndon Limestone, and Pioche Shale.
		pЄm	Precambrian metamorphic rocks - Precambrian X, Y, and Z high-grade metamorphic rocks, generally Late Proterozoic. It also includes the Johnnie Formation in the southern map area, and the weakly metamorphosed McCoy Creek and Trout Creek Groups in Schell Creek, Deep Creek, and Snake Ranges.

Source: Dixon, 2006

A.2.0 REFERENCES

Dixon, G.L., 2006, Personal communication to J. Watrus (Parsons) regarding Regional Modeling Units, 13 June. Las Vegas, NV.

SNWA, see Southern Nevada Water Authority.

Southern Nevada Water Authority, 2006, Geologic and Hydrogeologic Framework for the Spring Valley Area. Las Vegas, NV.

Attachment B

Aquifer Property Dataset

B.1.0 INTRODUCTION

This attachment contains summary information on the aquifer parameters datasets. The description of the datasets includes a summary of the data contents, the structure of the database, and directions on how to access the database.

B.2.0 DATA CONTENTS SUMMARY

The aquifer properties data is included as a Microsoft® Access database. The structure of the database will be described in Section B.3.0. The aquifer parameter table in the database contains information on K, T, Storage coefficient, and Sy determined from field and laboratory tests. This table contains 2,965 records for 1,155 different borehole locations.

B.3.0 DATABASE STRUCTURE

The aquifer property database has been constructed using Microsoft® Access 2003. The database contains five primary data tables and three domain tables.

B.3.1 Domain Tables

The aquifer property database contains three domain tables. The domain tables have been created for database documentation as well as to provide additional information on values within the primary data tables. The domain tables are:

- dmnCodes - Used for the description of codes used in the primary data tables
- dmnReferences - Used to provide complete reference information for the primary data provider of each record in the dataset
- dmnSources - Used to provide reference information for the original source of the data cited by the authors in the reference section.

B.3.2 Primary Data Tables

The aquifer property database contains five primary data tables: tblAQ_Prop_Sitefile, tblAQ_Properties, tblSpecificCapacity, tblLithology, and tblPorosity. The structure of each table is described below.

B.3.2.1 tblAQ_Prop_Sitefile

The tblAQ_Prop_Sitefile table contains information pertaining to the location of sites where aquifer parameter information has been included in this database. The fields in this table are described as follows:

- Site_ID - Unique site identifier for the location. When possible this is identical to the USGS Site Number. For NDWR specific data the Site_ID is a combination of “NDWR LOG #” and the Driller’s Log Number for a specific location. When the data does not fall into one of the previous categories the site is labeled with the hydrographic area number, Township, Range Section, and as many Quarter Sections as can be used to uniquely identify the location.

- Station_Name - Site name. This is typically a combination of hydrographic area number, Township, Range Section, and as many Quarter Sections as can be used to uniquely identify the location in combination with a common name for the location.

- Hydrographic_Area - Identifies the specific hydrographic area where the site is located. Colorado Plateau has been used for sites located in southeastern Utah.

- UTM83_Easting_(m) - This is the Universal Transverse Mercator (UTM) Easting of the location in meters (m). All of the coordinates are displayed as UTM Zone 11, North American Datum of 1983.

- UTM83_Northing_(m) - This is the UTM northing of the location in m. All of the coordinates are displayed as UTM Zone 11, North American Datum of 1983.

- LSE88_(ft) - This is the elevation, relative to sea level, of the land surface at the location in feet (ft).

- Hole_Depth_(ft) - This is the depth of the borehole in ft below ground surface (bgs).

- Well_Depth_(ft) - This is the depth of the completed well in ft bgs.

- Location_Source - Source of the location information.

- Comment - Any additional comments pertaining to the location information listed in this table.

B.3.2.2 tblAQ_Properties

The tblAQ_Properties table contains information on aquifer parameters including hydraulic conductivities, transmissivities, storativities, and Sy. The fields in this table are described as follows:

- Site_ID - Unique site identifier for the location. This field is linked to the Site_ID field in the tblAQ_Prop_Sitefile table.
- Observation Well Station Name - Site name. This field is identical to the Station_Name in the tblAQ_Prop_Sitefile table.
- Reference Station Name - The name of the site as listed in the reference for the data.
- Test Type - The type of test performed to acquire the hydraulic parameters.
- Date_Test_Started - The date the testing began.
- Date_Test_Started_Code - A code describing the Date_Test_Started date field as to whether it is accurate to the Y-Year, M-Month, D-Day, or Min-Minute. If the code specifies to the Minute then the hour and minute are placed in this field as well.
- Date_Test_Ended - The date the testing ended.
- Date_Test_Ended_Code - A code describing the Date_Test_Ended date field as to whether it is accurate to the Y-Year, M-Month, D-Day, or Min-Minute. If the code specifies to the Minute then the hour and minute are placed in this field as well.
- Avg_Pumping_or_Injection_Rate (gallons per minute [gpm]) - The average pumping or injection rate for this record (if applicable). The value is in gpm.
- Radius_or_Interwell_Distance (ft) - The radius of a well in a single well test or the distance between wells for a multiple well test. The distance is reported in ft.
- Pumped_or_Injection_Well - The reference name for the well being pumped or injected during a multi-well aquifer test.
- Transmissive_Interval_Top (ft) - The top of the transmissive interval in ft bgs.
- Transmissive_Interval_Bottom (ft) - The bottom of the transmissive interval in ft bgs.
- Transmissive_Thickness (ft) - The thickness of the transmissive interval calculated by subtracting the Transmissive_Interval_Top from the Transmissive_Interval_Bottom. The thickness is reported in ft.
- Stratigraphic_Unit - The stratigraphic unit or units found within the transmissive interval.

- Lithologic_Description - A description of the lithology or lithologies found within the transmissive interval.

- Welding (Ash-flow tuff) - A description of the degree of welding in volcanic tuff deposits.

- Alteration - The type of alteration occurring within the volcanic tuff.

- Fracturing - A description of the fracturing of volcanic tuffs.

- UGTA_HSU - The hydrostratigraphic unit identified in the DOE UGTA Project data. This information was used to map to SNWA's RMU.

- USGS_HGU - The HGU identified by the USGS for their data. This information was used to map to SNWA's RMU.

- SNWA_RMU - The RMU as defined by SNWA geologists.

- Analytical_Method - The method used to analyze the test data.

- Analyzed_Record (minutes) - The time duration of test data that was analyzed in minutes.

- Analyzed_Data - Description of what data was analyzed for the test results.

- Average_Hydraulic_Conductivity (ft/day) - The average K in ft/day. Applies only to where a reference is providing the average from multiple analyses.

- Horizontal_Hyd_Conductivity (ft/day) - The horizontal K in ft/day.

- Vertical_Hyd_Conductivity (ft/day) - The vertical K in ft/day.

- Transmissivity - The T in square feet per day (ft^2/day).

- Storativity - The storativity of the aquifer.

- Specific_Yield - The Sy of a formation.

- DDE_F - Data Documentation Evaluation Flag. This field contains an evaluation of how well documented the data in a given record is. Explanations of this field can be found in the text as well as in the codes table.

- Data Source - Link to the sources domain. Used to provide reference information for the original source of the data cited by the authors in the reference field.

- Reference - Link to the references domain. This field contains the primary reference information where the records data was obtained.

- Comments - Any additional comments for a given record.

B.3.2.3 tblSpecificCapacity

The tblSpecificCapacity table contains specific capacity information developed by Timothy J. Durbin, Inc. from NDWR and UDWR driller's logs. The fields in this table are described as follows:

- Well Log ID - The well log identifier as defined by NDWR or UDWR.
- Yield (Gallons per Minute) - The yield of the well as defined on the driller's log in gallons per minute.
- Drawdown (feet) - The drawdown in feet recorded on the driller's log.
- Top of Perforation (Feet) - The top of the perforated interval in ft bgs as recorded on the driller's log.
- Bottom of Perforation (Feet) - The bottom of the perforated interval in ft bgs as recorded on the driller's log.
- Static Water Level (Feet) - The static water level in ft-bgs as recorded on the driller's log.
- Hours Pumped - The number hours the well was pumped as recorded on the driller's log.
- Specific Capacity (Gallons per Minute per Foot Drawdown) - The specific capacity calculated for the well in gpm per foot of drawdown.
- Hydraulic Conductivity (Feet per Day) - The hydraulic conductivity calculated for the well in ft/day.

B.3.2.4 tblLithology

The tblLithology table contains lithologic information developed by Timothy J. Durbin, Inc. from NDWR and UDWR driller's logs. The fields in this table are described as follows:

- State - The state where the well log was obtained.
- Well Log ID - The well log identifier as defined by NDWR or UDWR.
- Lithology Code - Lithologic code that is related to lithology name.
- Lithology Name - A lithologic description of the interval.
- Base of Lithologic Unit - The depth of the basal contact of the unit in ft-bgs.

- UTM83_X - The easting coordinate of the well in Universal Transverse Mercator Projection, North American Datum of 1983 in meters.

- UTM83_Y - The northing coordinate of the well in Universal Transverse Mercator Projection, North American Datum of 1983 in meters.

- “X” = Questionable Well Log - This field was used by Timothy J. Durbin, Inc. as an identifier of a well log that was of uncertain value.

B.3.2.5 tblPorosity

The tblPorosity table is a standalone table that is not linked to the other tables within this database. It is simply being stored within the database for convenience. This table contains information on porosity from a single source (Plume, 1996). The fields in this table are described as follows:

- Report Well Number - The well number from the Plume (1996) report.

- Location - The township range and section information for the well number.

- Data Source - The source identified by Plume (1996) as either American Stratigraphic Company log number or Nevada State Department of Mineral Resources file numbers.

- Land Surface Altitude (feet) - The elevation of land surface in feet above mean sea level.

- Well Depth (feet) - Measured depth bgs of the well bore. Depth measurement is in feet.

- Top Depth (feet) - The top depth of the listed interval. Measured in ft bgs.

- Bottom Depth (feet) - The bottom depth of the listed interval. Measured in ft bgs.

- Lithology - Lithology of the rocks at the listed open interval, one of the following values:

  - Anhy - Anhydrite
  - Cgl - Conglomerate
  - Clyst - Claystone
  - Dol - Dolomite
  - Gvl - Gravel
  - LS - Limestone
  - Mrlst - Marlstone
  - Qtzt - Quartzite
  - Sd - Sand
  - Sh - Shale
  - Sltst - Siltstone
  - Volc - Volcanic Rocks.

- Minimum Porosity Percent - The minimum value of porosity for a given interval listed as a percentage.

- Maximum Porosity Percent - The maximum value of porosity for a given interval listed as a percentage.

- ? On Range - Indicates that the author has added a question mark to the range of porosity listed.

- Porosity Type - A code identifying the type of porosity measured, one of the following values:

  - E-Earthy - loosely aggregated particles
  - F-Fracture porosity
  - O-Oolitic porosity
  - P-Pinpoint porosity - isolated pores
  - U-Unknown
  - V-Vuggy
  - X- Intercrystalline

- Remarks - Any additional remarks for a given well.

B.4.0 ACCESS TO DATA

The aquifer property dataset may be accessed on the CD-ROM as a Microsoft® Access 2002 database. The individual tables within the database have also been saved as ASCII text files.

Access:

- AquiferProperty_062306.mdb

B.5.0 REFERENCES

Plume, R.W., 1996, Hydrogeologic Framework of the Great Basin Region of Nevada, Utah, and Adjacent States: U.S. Geological Survey Professional Paper 1409-B, 64 p.