DOE/RW-0583
QA:N/A

Office of Civilian Radioactive Waste Management

EVALUATION OF TECHNICAL IMPACT ON THE YUCCA MOUNTAIN PROJECT TECHNICAL BASIS RESULTING FROM ISSUES RAISED BY EMAILS OF FORMER PROJECT PARTICIPANTS

February 2006

This page intentionally left blank.

Table of Contents

Tables and Figures

Appendices

A. Selected USGS Emails (Redacted)

B. Infiltration Analysis Supporting the Technical Basis for the Site Recommendation
   - B-1. Infiltration Analysis Document Dependencies for the Site Recommendation
   - B-2. Relationships Between Component Models of the Total System Performance Assessment for the Site Recommendation

C. Software and Reports Associated With the USGS Infiltration Studies
   - C-1. Software Related to Infiltration and Requiring Review
   - C-2. Infiltration Related Reports Since 1996

D. Input/Output Data for Infiltration Studies
   - D-1. Input Data for ANL-NBS-HS-000032 REV 00
   - D-2. Output Data for ANL-NBS-HS-000032 REV 00
   - D-3. Input Data for ANL-NBS-HS-000032 REV 00 ICN 01
   - D-4. Output Data for ANL-NBS-HS-000032 REV 00 ICN 01
   - D-5. Input Data for ANL-NBS-HS-000032 REV 00 ICN 02
   - D-6. Output Data for ANL-NBS-HS-000032 REV 00 ICN 02
   - D-7. Input Data for MDL-NBS-HS-000023 REV 00
   - D-8. Output Data for MDL-NBS-HS-000023 REV 00

E. Listing of Data Submitted to the Technical Data Management System by USGS Personnel Who Exchanged the Emails

F. Borehole Data Records Associated with USGS Personnel Who Exchanged the Emails

G. Procedure Records Associated with USGS Personnel Who Exchanged the Emails

H. Corroborating Data Tables
   - H-1. Estimates of Recharge for Nevada Hydrographic Areas
   - H-2. Estimated Average Annual Precipitation, Evaporation, and Recharge Rates for the Columbia Plateau, Washington (pre-development conditions)
   - H-3. Recharge Estimates in West Texas, New Mexico, and Arizona

This page intentionally left blank.

EXECUTIVE SUMMARY

In late 2004, personnel reviewing archived emails for possible inclusion in the Department of Energy (DOE) Licensing Support Network discovered some emails authored by employees of U.S. Geological Survey (USGS) between 1998 and 2001 that suggested a lack of compliance with quality assurance requirements in work associated with the modeling of water infiltration at Yucca Mountain. Subsequent searches found emails through 2004. To assess the issues implied in the emails, DOE initiated the following:

- **An evaluation by the Office of Civilian Radioactive Waste Management (OCRWM) of the potential technical impacts.** This report presents the technical impact evaluation.

- **An evaluation by OCRWM of the programmatic (i.e., quality assurance-related) impacts.** That evaluation will be documented in a separate Root Cause Analysis and Extent of Condition Report.

- **An investigation by the DOE Office of Inspector General into potential misconduct by the individuals who exchanged the emails.** Additionally, the Department of Interior (parent agency of the USGS) Office of Inspector General is conducting an investigation into this issue.

The technical impact evaluation, documented in this report, focused on the primary work products developed by the USGS employees who exchanged the emails: nine net infiltration rate estimates developed through the computer modeling of climate and infiltration data and documented in a set of net infiltration maps presented in a 2000 report.[1] This evaluation looked specifically at whether these net infiltration rate estimates are independently corroborated, and considered the potential impacts of the emails on the technical basis supporting key OCRWM activities: the 2002 Site Recommendation and the Key Technical Issue agreements between the Nuclear Regulatory Commission (NRC) and OCRWM.

Key Findings

- **OCRWM considered the conceptual basis for the work done by the USGS employees who exchanged the emails.**

  The Yucca Mountain-specific infiltration model, along with investigational approaches and the development of a numerical model for infiltration, built upon a foundation of earlier scientific work. The water cycle and the physical processes that govern that cycle are widely documented and applied by hydrologists around the world.

[1] Civilian Radioactive Waste Management System Management and Operating Contractor (CRWMS M&O), 2000. *Simulation of Net Infiltration for Modern and Potential Future Climates*, ANL-NBS-HS-000032, Rev. 00, June 2000. RIS: MOL.20000801.0004.

- **OCRWM evaluated whether the net infiltration rate estimates developed by the USGS are corroborated by data derived independently by other parties.**

  The value of corroborating evidence is recognized by NRC[2] and other technical organizations. Comparisons with other data sets showed that the USGS net infiltration rate estimates are consistent with estimates for arid and semi-arid climates across the Western United States, with net infiltration being a small percentage of precipitation.

- **The net infiltration rate estimates and the conceptual models from which they were developed have been presented to a range of technical groups both affiliated and unaffiliated with the Yucca Mountain Project. This information was also published in scientific journals.**

- **In 2002, the Secretary of Energy recommended the Yucca Mountain site for development as a repository based on a number of technical and policy considerations. Estimates of net infiltration rates were used as input parameters to the models and analyses that were integrated into total system performance assessment modeling for the Site Recommendation.**

  The net infiltration rate estimates used in the total system performance assessment modeling for the Site Recommendation are consistent with and corroborated by several independent data sets.

- **As part of the NRC's interactions with OCRWM in anticipation of the submittal of a license application, the NRC developed a process to identify those areas where additional information was required to support a license application. OCRWM and NRC identified 293 Key Technical Issue agreements, five of which address physical processes or model approaches that either influence net infiltration rate estimates or are used to predict net infiltration rates at Yucca Mountain.**

  OCRWM and NRC have acknowledged in Quarterly Management Meeting discussions the possibility that the USGS email issue may affect certain agreements, including some already considered closed.

[2] U.S. Nuclear Regulatory Commission, 1988. NUREG 1298, *Qualification of Existing Data for High-Level Nuclear Waste Repositories,* February 1998. TIC: 200652.

1. INTRODUCTION

1.1 Background

In February 2002, in accordance with provisions of the Nuclear Waste Policy Act, Secretary of Energy Spencer Abraham provided to the President a recommendation that Yucca Mountain in Nevada be developed as a repository for the disposal of spent nuclear fuel and high-level radioactive waste.[3] The Site Recommendation was based on information prepared by the Department of Energy's (DOE) Office of Civilian Radioactive Waste Management (OCRWM). Following approval of the site by the President and subsequently by Congress, OCRWM has focused on preparation of a draft license application for submittal to the Nuclear Regulatory Commission (NRC). As part of the licensing process, NRC requires that DOE make available documentary material, as defined by NRC regulations,[4] that could be used in the licensing process. This documentary material will be made available in electronic format known as the Licensing Support Network.

In November 2004, DOE contractor personnel reviewing archived emails for possible inclusion in the DOE Licensing Support Network discovered some emails authored by employees of the U.S. Geological Survey (USGS) between 1998 and 2001 that suggested a lack of compliance with quality assurance requirements in work associated with the modeling of water infiltration at Yucca Mountain. Subsequent searches found additional emails of concern dating through 2004. The emails appeared to indicate a lack of compliance with quality assurance requirements that raised questions about the work done by the USGS employees who exchanged the emails. The quality assurance ramifications and programmatic impacts are being addressed separately and will be documented in a Root Cause Analysis and Extent of Condition Report.

This technical impact report was prepared to evaluate the potential impacts of the issues raised by the USGS emails on the *technical basis* – i.e., the documentation that describes the processes and primary components of the repository system that are relevant to the long-term performance of the repository. The technical basis supported the Site Recommendation and the information OCRWM provided to address the Key Technical Issue agreements, which are described below.

The Site Recommendation in 2002 relied on an assessment by Secretary Abraham, informed by years of scientific research and investigation, that the Yucca Mountain site was suitable for development as a repository, that compelling national interests existed in favor of developing a repository at that site, and that no countervailing arguments outweighed those interests. The Nuclear Waste Policy Act established numerous requirements that had to be satisfied before the Secretary could make a recommendation and defined a process for approval of the recommendation.

As part of the NRC's interactions with OCRWM in support of the Site Recommendation and prior to submittal of a license application, the NRC staff developed a process to identify those

[3]U.S. Department of Energy, 2002. *Recommendation by the Secretary of Energy Regarding the Suitability of the Yucca Mountain Site for a Repository Under the Nuclear Waste Policy Act of 1982,* February 2002*.*

[4] U.S. Nuclear Regulatory Commission, 2004. *10 CFR 2.1001, NRC Rules of Practice for Domestic Licensing Proceedings and Issuance of Orders: Definitions*. The Licensing Support Network is the electronic database that is the central storehouse for information that may be relevant to the license application for the Yucca Mountain Project.

areas where there likely would be additional technical information required for a license application. Through this process, OCRWM and NRC agreed upon 293 areas for additional work or documentation. These Key Technical Issue agreements[5] provided a mechanism for collecting the needed information. Five of the Key Technical Issue agreements between NRC and OCRWM relate to water infiltration.

1.2 Role of the USGS in Yucca Mountain Work

The USGS, created by Congress in 1879, is a science organization that focuses on the study of biology, geography, geology, geospatial information, and water. The USGS carries out large-scale, multi-disciplinary investigations that build the base of knowledge about the Earth. For several decades, the USGS has been involved with the challenge of spent nuclear fuel and high-level radioactive waste disposal in general, and Yucca Mountain in particular.

The USGS work on net infiltration was conducted by a team of scientists, technicians, and support personnel led by a Principal Investigator. Specific tasks within a study, such as sample collection, field and laboratory data measurements, and instrument maintenance and calibration, were performed by various members of the team. For example, in the infiltration studies, a long-term effort involved the collection of moisture logs in boreholes with neutron moisture meters. These data were collected by numerous scientists and technicians in the field and were submitted to the Technical Data Management System under the signature of either a data coordinator or principal investigator. In some cases, this data collection work was directed by the USGS employees that exchanged the emails; however, technical staff other than those involved in the email exchanges actually performed the data collection work. The USGS employees who exchanged the emails used the collected data to develop and execute the net infiltration model.

1.3 Scope of the Technical Impact Evaluation

In response to the discovery of the emails, OCRWM initiated this evaluation to determine the impact of the USGS email issue on the technical basis supporting the Site Recommendation and Key Technical Issue agreements with NRC. As part of this evaluation, OCRWM reviewed a more extensive collection of USGS emails to understand potential issues (as discussed further in Section 2), and identified the infiltration work that may be called into question (as described in Section 3 and presented in Appendices C-G). The evaluation of impacts on the technical basis is presented in Section 4, with additional corroborating data appearing in Appendix H. Section 5 applies the conclusions from Section 4 to key OCRWM activities.

[5] The complete list of Key Technical Issue agreements is presented in Appendix A of the NRC's *Integrated Issue Resolution Status Report,* NUREG-1762, Vol. 1, Rev. 01, April 2005.

2. ISSUES RAISED BY THE USGS EMAILS

During activities associated with placing documents into the Licensing Support Network, OCRWM contractor staff reviewed archived emails prepared by individuals who no longer had active OCRWM email accounts. Examples of the USGS employees' emails are provided in Appendix A. These emails, obtained from archival databases, have been retyped and reformatted and the names of individuals have been removed, but the content is otherwise exactly as written by the employees. The email content as presented in the appendix illustrates the apparent attitudes and behaviors that prompted the email reviewers to raise concerns.

Staff performing the email review raised concerns about emails that appeared to indicate a lack of compliance with quality assurance requirements and procedures. Many of the emails express frustration with, and a lack of appreciation for, quality assurance requirements. Because OCRWM's work must be documented in a manner that demonstrates compliance with quality assurance requirements and project procedures, these expressions raise potential issues related to quality assurance program controls and implementation. These process- and procedure-related issues, and the programmatic impacts of those issues, are the subject of a separate OCRWM evaluation, which will be documented in a Root Cause Analysis and Extent of Condition Report.

Some of the emails contain language giving the appearance of potential deliberate misconduct, as defined in federal regulations regarding waste, fraud, and abuse. Investigations of this potential misconduct are being conducted by the Inspectors General of the Department of the Interior and DOE and are beyond the scope of this report.

The USGS emails also raise concerns about potential weaknesses in technical documentation. This report focuses on the infiltration modeling work performed by the employees who exchanged the emails, and its potential impact on the technical basis that supported the Site Recommendation and Key Technical Issue agreements.

This page intentionally left blank.

3. TECHNICAL WORK THAT MIGHT BE CALLED INTO QUESTION

The USGS infiltration work and the products generated as a result of that work support the *technical basis* – i.e., studies and documents that describe the processes and primary components of the repository system that are relevant to the long-term performance of the repository. On the Yucca Mountain Project, the primary postclosure technical basis documents addressing the conceptual and numerical models and the types of data and software used in those models are called Analysis and Model Reports. The conceptual and numerical models are developed based on Yucca Mountain site-specific experiments and analyses as well as other relevant scientific work, and they progress as new information becomes available. Water infiltration data at Yucca Mountain have been collected both from field monitoring activities, such as borehole logging, and from laboratory investigations of rock and water samples. OCRWM also makes use of information from natural analogues – i.e., sites with similar or comparable conditions and processes – to corroborate site-specific information. Infiltration modeling uses data obtained from direct scientific measurement or generated by other models. The infiltration model results are used as inputs for other models. Each of the aspects of scientific modeling – the concepts, computer codes, and the various types of data – are managed using specific processes, procedures, and quality assurance controls.

For more than twenty years, OCRWM has been developing models with the support of the USGS to evaluate how water infiltrates into the soils and rocks at Yucca Mountain. Net infiltration rates are important because they contribute to the analysis of how much water could enter Yucca Mountain and potentially contact waste packages. Net infiltration is that portion of the water falling as precipitation that works its way below the root zone and cannot readily be evaporated or transpired by plants back into the atmosphere. Net infiltration is defined as a rate, i.e., volume of water per unit of area per unit of time, and is expressed as millimeters per year (mm/yr).

Net infiltration in arid and semi-arid regions is usually estimated based on other variables rather than determined from direct measurement. Most of the precipitation that falls at Yucca Mountain does not make its way to the water table; in a desert environment, most of the precipitation runs off, evaporates, or is used by plants (see Section 4 for a more detailed explanation of net infiltration as it relates to the Yucca Mountain Project).

The primary technical work in question is an Analysis and Model Report issued in June 2000[6] that presents nine net infiltration maps that were calculated using an infiltration model developed by the USGS employees who exchanged the emails. The nine net infiltration maps reflect estimates of the lower-bound, the mean, and the upper-bound net infiltration rate for each of three different climate states, one representing the present climate, and two others representing wetter climates in the future (monsoon and glacial-transition). The net infiltration rate estimates were developed from models that evaluate water infiltration at Yucca Mountain under three climate conditions. The estimates of net infiltration rate represented by the nine maps were used in the subsequent analyses of the unsaturated zone and in total system performance assessment modeling for the Site Recommendation, which integrated many features, events, and processes to

[6] CRWMS M&O, 2000. *Simulation of Net Infiltration for Modern and Potential Future Climates*, ANL-NBS-HS-000032, Rev. 00, June 2000. RIS: MOL.20000801.0004.

model long-term repository performance and assess the ability of the Yucca Mountain site to meet performance requirements set by the Environmental Protection Agency and NRC.

As noted, the principal product produced by the USGS employees is a report presenting nine net infiltration maps based on the infiltration model. However, to identify the broad range of work that could be called into question, OCRWM considered other technical basis documents to which the USGS employees who exchanged the emails contributed. While the emails refer to the June 2000 report[7] that was superseded by a November 2004 revision[8] prepared by others, the net infiltration rate estimates in the 2004 report still rely upon the work of the USGS employees that exchanged the emails.

The work that could be called into question falls into four categories:

1. The specific analysis, data, and software discussed in the emails and documented in *Simulation of Net Infiltration for Modern and Potential Future Climates*[9]

2. Subsequent analyses using the output of the USGS analysis, data, and software (e.g., infiltration uncertainty analysis, unsaturated zone flow analyses)

3. Other versions of the infiltration analyses[10] and other work to which the USGS employees who exchanged the emails contributed

4. The technical basis documentation that supported the Key Technical Issue agreements and Site Recommendation.

The diagrams in Appendix B illustrate the relationships between documents in categories 1 and 2 at the time of the Site Recommendation in 2002. Appendices C through G provide a list of work referred to in categories 3 and 4 above.

The list of USGS and other Yucca Mountain Project work associated with the employees who exchanged the emails, as presented in the appendices, is extensive. Among this work, the summary product that directly supports the technical basis is the set of nine net infiltration maps developed by USGS to show net infiltration rates under various potential future climate scenarios. For this reason, OCRWM's evaluation of technical impacts focused on assessing confidence in those net infiltration rates.

[7] CRWMS M&O, 2000. *Simulation of Net Infiltration for Modern and Potential Future Climates*, ANL-NBS-HS-000032, Rev. 00, June 2000. RIS: MOL.20000801.0004.
[8] Bechtel-SAIC Company LLC, 2004. *Simulation of Net Infiltration for Present-Day and Potential Future Climates*, MDL-NBS-HS-000023, Rev. 00, November 2004. RIS: DOC.20041109.0004.
[9] CRWMS M&O, 2000. *Simulation of Net Infiltration for Modern and Potential Future Climates*, ANL-NBS-HS-000032, Rev. 00, June 2000. RIS: MOL.20000801.0004.
[10] Bechtel-SAIC Company LLC, 2004. *Simulation of Net Infiltration for Present-Day and Potential Future Climates*, MDL-NBS-HS-000023, Rev. 00, November 2004. RIS: DOC.20041109.0004.

4. EVALUATION OF THE TECHNICAL BASIS

Establishing confidence in the net infiltration rate estimates published in the Analysis and Model Report entitled *Simulation of Net Infiltration for Modern and Potential Future Climates*[11] depends, in part, on whether there was a scientific basis for these estimates. This section reviews publications from the scientific literature and Yucca Mountain Project technical reports to evaluate the following three aspects of the infiltration studies that are important for determining if the net infiltration estimates can be considered technically adequate:

- The hydrologic processes and conceptual framework that form the bases for the studies of net infiltration at Yucca Mountain (Section 4.1)

- Estimates of net infiltration and groundwater recharge from the scientific literature, including technical reports that provide corroborative data for the USGS estimates (Section 4.2)

- The publication and presentation of the conceptual model and net infiltration rate estimates to technical peers and external organizations (Section 4.3).

4.1 Bases for Estimating Net Infiltration at Yucca Mountain

Net infiltration is the penetration of water through the ground surface to a depth where it can no longer be withdrawn readily by evaporation or transpiration by plants. The hydrologic processes that govern net infiltration are widely documented and applied around the world, and these processes are much the same as those that control groundwater recharge, or the amount of water that reaches the underlying water table. The key infiltration processes and a site-specific conceptual framework were established through study of the surrounding region, using hydrological principles published in the scientific literature. The average net infiltration rates resulting from the numerical model can therefore be compared with other data collected at Yucca Mountain and empirical estimates for groundwater recharge in arid and semi-arid climates.

4.1.1 Hydrologic Basis for Net Infiltration Rate Estimates at Yucca Mountain

The key elements of the water cycle at Yucca Mountain are precipitation (rain and snow falling on the ground), run-off and run-on of water across the land surface, redistribution, evapotranspiration (the combination of atmospheric evaporation and plant transpiration), and infiltration of water into the ground. Net infiltration is the penetration of water through the ground surface to a depth where it can no longer be withdrawn readily by evaporation or transpiration by plants.

Generally, precipitation at Yucca Mountain comes from two seasonal sources. During the winter months, storms from the Pacific Ocean crest the Sierra Nevada Mountains, bringing rain and snow to the Great Basin from the west and north. In the summer, moisture is drawn up from the Gulf of California, bringing rain in localized thunderstorms as the air heats over the desert.

[11] CRWMS M&O, 2000. *Simulation of Net Infiltration for Modern and Potential Future Climates*, ANL-NBS-HS-000032, Rev. 00, June 2000. RIS: MOL.20000801.0004.

The winter storms tend to be less intense than the summer storms and so are less likely to cause severe run-off. Also, evaporation is less intense during the winter when solar radiation and temperatures are lower. Precipitation is sensitive to topography, and more tends to fall on higher areas than on lower areas like the surrounding basin floors (Houghton, 1969).[12] Precipitation data for Yucca Mountain were collected at on-site meteorological stations and from the Nevada Test Site (National Oceanographic and Atmospheric Administration data).

Run-off in desert environments is ephemeral and at Yucca Mountain occurs only as a transient response to precipitation events. There are no permanent springs, creeks, or rivers at the Yucca Mountain site. When enough water falls to create run-off, it can be sudden and intense. The Great Basin desert is known for flash floods that start and end abruptly, carrying objects as large as boulders and cars when they do strike. During these events, large amounts of water can move rapidly away from upland areas like Yucca Mountain. Run-on occurs when water from higher areas accumulates in lower areas, which creates the potential for localized increases in infiltration.

Redistribution is defined here as the retention or diversion of water as it infiltrates below the surface. Redistribution is the main water cycle process in areas of the Yucca Mountain site where the soil above the bedrock is thicker than about five meters. The water storage capacity of such thick alluvial cover, as it would apply to a repository has been described by such authors as Winograd (1981)[13] and can be readily determined using established physical principles (Dane and Topp, 2002).[14] Because nearly all water infiltrating into deep soils and thick alluvium (sedimentary material deposited by a stream or running water) in vegetated arid and semi-arid areas is retained, in such areas net infiltration below the root zone is thought to be generally negligible. Thick alluvium effectively redistributes water and encourages the establishment of deep root zones. The combined effect of redistribution and water uptake by deep-rooted plants prevents water from becoming net infiltration.

Evapotranspiration consists of the water returned to the atmosphere by direct evaporation and transpiration (e.g., the water used by plants). It is a complex process and depends on factors such as solar radiation, air and soil temperatures, soil moisture content, air turbulence (e.g., wind), and the types and density of vegetation (e.g., amount of canopy cover, rooting depths, and leaf structure). Due to the complexity of this process, typical methods for calculating evapotranspiration include empirical correlations with climatic factors and energy budget approaches.[15] At Yucca Mountain, the empirical equation developed by Priestley and Taylor (1972)[16] has been applied.

Important aspects of the water cycle processes at Yucca Mountain include the temporal and spatial distribution of precipitation, run-off and run-on, redistribution, and evapotranspiration.

---

[12] Houghton, J.G., 1969. *Characteristics of Rainfall in the Great Basin*, Desert Research Institute, University of Nevada, Reno, Nevada, 205 pp. TIC: 234245.
[13] Winograd, I.J., 1981. "Radioactive waste disposal in thick unsaturated zones." *Science*, American Association for the Advancement of Science, vol. 212, no. 5402, June 26, 1981, 1457-1464. TIC: 217258.
[14] Dane, J.H. and Topp, G.C., 2002. *Methods of Soil Analysis: Part 4 – Physical Methods*, Soil Science Society of America, Madison, Wisconsin, 1,692 pp.
[15] Freeze, R. A. and Cherry, J. A., 1979. *Groundwater*, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 604 pp.
[16] Priestly, C.H.B. and Taylor, R.J., 1972. "On the assessment of surface heat flux and evaporation using large-scale parameters." *Monthly Weather Review*, vol. 100, no. 2, February 1972, 81-92.

Each of these processes have been studied extensively and the scientific literature describes methods for analyzing them.

4.1.2 Empirical Estimation of Net Infiltration

While the objective of this evaluation is to assess the adequacy of the net infiltration rate estimates prepared by the USGS employees who exchanged the emails, this evaluation recognizes that over long time periods net infiltration is considered essentially equivalent to groundwater recharge, which is a measure of water that has infiltrated from the land surface to the water table. While infiltration in arid and semi-arid climates is temporally and spatially variable due to intermittent precipitation that is sensitive to topography, long-term average net infiltration rates effectively measure the steady-state flow of water through the unsaturated zone (the zone of soil or rock below the ground surface and above the water table). Water movement through the unsaturated zone at Yucca Mountain is thought to be mainly vertical, and evaporative losses below the root zone are insignificant. Thus, the net infiltration estimates at Yucca Mountain correspond to the amount of water that moves deeper through the unsaturated zone and are comparable to estimates of the amount of water that would pass the land surface and reach the water table at other sites. Indeed, Scanlon and others (2002)[17] note that in many unsaturated zone studies, terms such as net infiltration are used to describe water movement below the root zone, and these are often equated to recharge.

Empirical relationships have been developed to estimate recharge as a function of average annual precipitation. Variability or uncertainty in the estimates of the larger components of the water cycle in arid and semi-arid climates (i.e., precipitation and evapotranspiration) can significantly affect values for net infiltration.

The Maxey-Eakin method[18] was specifically developed for estimating recharge to groundwater basins in Nevada by designating zones of average precipitation that were then balanced by trial-and-error with discharge estimates (see Table 4-1).

Table 4-1. Maxey-Eakin Empirical Relationship Between Precipitation and Recharge

Recharge Zone	Average Precipitation (mm/year)	Recharge (%)
1	0 to 203	0
2	203 to 304	3
3	305 to 380	7
4	381 to 507	15
5	508 and greater	25

[17] Scanlon, B.R., Healy, R.W., and Cook, P.G., 2002. “Choosing appropriate techniques for quantifying groundwater recharge.” *Hydrogeology Journal*, vol. 10, no. 1, February 2002, 18-39.
[18] Maxey, G.B. and Eakin, T.E., 1949. *Ground Water in White River Valley, White Pine, Nye, and Lincoln Counties, Nevada, Water Resources Bulletin No. 8*, State of Nevada, Office of the State Engineer, Carson City, Nevada, 61 pp. RIS: NNA.19870407.0319.

The Maxey-Eakin method has been used for more than 50 years and continues to be cited in the scientific literature. Maxey and Eakin themselves (1949) found that the results of their recharge method compared favorably with percentages determined in the Las Vegas Valley by means of precipitation gages maintained at different altitudes in the Spring Mountains. Watson and others (1976) subsequently evaluated the Maxey-Eakin method and found that it can be used as a reasonable approximation of recharge.[19] In 1994, Avon and Durbin[20] compared Maxey-Eakin estimates with independent estimates of recharge and concluded that "the Maxey-Eakin method provides fairly reliable estimates of recharge to ground-water basins in Nevada."

4.1.3 Conceptual Framework for Net Infiltration at Yucca Mountain

The concept of the unsaturated zone of arid regions as a potential environment for isolation of high-level radioactive waste was first advanced by Winograd (1974).[21] Winograd recognized that the deep water table in these regions is due to a combination of one or more factors, including moderate to high relief, aridity, relatively permeable rocks within the unsaturated zone, and regional aquifers with topographically low outlets.

A regional framework was established by Winograd and Thordarson (1975)[22] in *Hydrologic and Hydrochemical Framework, South-Central Great Basin, Nevada-California, with Special Reference to the Nevada Test Site*. This report documented that Yucca Mountain is part of the Ash Meadows groundwater basin in an area receiving 102 to 204 mm/yr average annual precipitation, depending on topography. The authors synthesized hydrogeologic, hydrochemical, and isotopic data to characterize the regional hydrostratigraphy and provide a basis for more detailed study of particular areas.

Winograd (1981)[23] summarized the advantages of using the thick unsaturated zones in the southwestern United States as potential environments for the disposal of solidified radioactive wastes. He identified that one of the chief advantages of arid, unsaturated environments was the small net infiltration of water. Using hydrogeologic data and interpretations presented in Winograd and Thordarson (1975), he calculated potential infiltration rates on the order of 2 mm/year through alluvium at the Nevada Test Site (at a lower elevation than Yucca Mountain) where average annual precipitation is about 120 mm/yr.

Roseboom (1983)[24] reviewed the attributes of disposal in desert areas with thick unsaturated zones. Roseboom noted that a layer of non-welded tuff could have the same lack of infiltration

[19] Watson, P., Sinclair, P., and Waggoner, R., 1976. "Quantitative evaluation of a method for estimating recharge to the desert basins of Nevada." *Journal of Hydrology*, vol. 31, 335-357. TIC: 216937.
[20] Avon, L. and Durbin, T. J., 1994. "Evaluation of the Maxey-Eakin method for estimating recharge to ground-water basins in Nevada." *Water Resources Bulletin*, American Water Resources Association, vol. 30, no. 1, February 1994, 99-111. TIC: 255352.
[21] Winograd, I. J., 1974. "Radioactive waste storage in the arid zone." *Transactions*, American Geophysical Union, vol. 5, no. 10, 884-894.
[22] Winograd, I.J. and Thordarson, W., 1975. *Hydrogeologic and Hydrochemical Framework, South-Central Great Basin, Nevada-California, with Special Reference to the Nevada Test Site*, U.S. Geological Survey Professional paper 712-C, Washington, DC, 137 pp. RIS: NNA.19870406.0201.
[23] Winograd, I.J., 1981. "Radioactive waste disposal in thick unsaturated zones." *Science*, American Association for the Advancement of Science, vol. 212, no. 5402, June 26, 1981,1457-1464. TIC: 217258.
[24] Roseboom, E. H., 1983. *Disposal of High-Level Nuclear Waste Above the Water Table in Arid Regions*, U.S. Geological Survey Circular 903, Washington, DC, 21 pp. RIS: HQS.19880517.2530.

that is believed to exist in thick soil layers in arid climates because such highly porous rocks would be natural capillary barriers to recharge. Roseboom also articulated the need to consider the potential consequences that future climatic changes could produce due to increased infiltration of water.

Scott and others (1983)[25] described in further detail the stratigraphic and structural character of the unsaturated tuffs at Yucca Mountain. They took the approach of describing a "physical-property stratigraphy" as opposed to a more traditional petrologic stratigraphy, thereby providing a physical basis for developing a conceptual hydrologic model. Their stratigraphic descriptions also included rock property data such as rock densities and porosities. They estimated that less than about 3 percent of annual precipitation enters the hydrologic system as recharge on a basin-wide average. Extrapolating from average annual precipitation rates in the Jackass Flats basin (to the east of Yucca Mountain and about 400 meters lower in elevation), Scott assumed precipitation at 200 mm/yr, meaning that net infiltration would be about 6 mm/yr.

To provide a basis for further study of Yucca Mountain, Montazer and Wilson (1984)[26] developed a conceptual model to describe the flow of fluid through the unsaturated zone at the site. They designated five hydrogeologic units and described the essential structural elements (e.g., major faults and hydraulic properties of the units), then proposed a hypothetical model for unsaturated zone flow. Among the major elements of this model, they recognized that infiltration is both spatially and temporally variable and identified fundamental processes that controlled net infiltration. They also reviewed various approaches that could be used to obtain estimates of net infiltration, including regional recharge techniques, water-budget studies, and analyses of geothermal heat flux. Estimating average annual precipitation at Yucca Mountain to be 150 mm/yr, they concluded that 0.5 to 4.5 mm/yr becomes net infiltration.

Based, in part, on Montazer & Wilson's work, DOE reported in the *Environmental Assessment, Yucca Mountain Site, Nevada Research and Development Area, Nevada*,[27] that 3 percent (4.5 mm/yr) or less of the 150 mm of annual precipitation reached the depth proposed for the repository (a value that remains within the range of the current net infiltration rate estimates of about 1 percent to about 6 percent; see Table 4-2 and discussion in Section 4.1.5, below). The 1986 *Environmental Assessment* described DOE's technical basis for nominating the Yucca Mountain site as suitable for site characterization, which included the low precipitation, deep water table, and closed groundwater basin. This decision represented the statutory step preceding the preparation of a site characterization plan and, subsequently, the Site Recommendation.

[25] Scott, R.B., Spengler, R.W., Diehl S., Lappin, A.R., and Chornack, M. P., 1983. "Geologic character of tuffs in the unsaturated zone at Yucca Mountain, Southern Nevada." In: Mercer, J.W., Rao, P.S.C., and Marine, I.W. (eds.), *Role of the Unsaturated Zone in Radioactive and Hazardous Waste Disposal*, Ann Arbor Science, Ann Arbor, Michigan, 289-335. TIC: 222524.

[26] Montazer, P. and Wilson, W. E., 1984. *Conceptual Hydrologic Model of Flow in the Unsaturated Zone, Yucca Mountain, Nevada*, U. S. Geological Survey Water-Resources Investigations Report 84-4345, Lakewood, Colorado, 55 pp. RIS: MOL.20030927.0200.

[27] U.S. Department of Energy, 1986. *Overview, Environmental Assessment, Yucca Mountain Site, Nevada Research and Development Area, Nevada*, DOE/RW-0079, May 1986. RIS: NNA.19890417.0168.

Table 4-2. Average Net Infiltration Rate Estimates for the Three Yucca Mountain Infiltration Cases[28]

Infiltration Case	Modern Climate			Monsoon Climate			Glacial-Transition Climate		
	Precip. (mm/yr)	Infil. (mm/yr)	I/P (%)	Precip. (mm/yr)	Infil. (mm/yr)	I/P (%)	Precip. (mm/yr)	Infil. (mm/yr)	I/P (%)
Minimum	185.8	1.2	0.6	188.5	3.6	1.9	201.0	2.2	1.1
Mean	188.5	3.6	1.9	300.5	8.6	2.9	316.1	13.4	4.2
Maximum	265.6	8.8	3.3	412.5	13.6	3.3	431.1	24.6	5.7

4.1.4 Estimates of Net Infiltration at Yucca Mountain

In the mid-1980s, DOE began site-specific activities that included intensive field data acquisition and laboratory studies. The development of numerical models for net infiltration began in the early 1990s.

The net infiltration rate estimates calculated for Yucca Mountain by the USGS are presented as nine net infiltration maps in the Analysis and Model Report entitled *Simulation of Net Infiltration for Modern and Potential Future Climates.*[29] These maps represent the minimum, mean, and maximum estimated values for each of three climate states. The first climate is the modern (or present-day) state observed at Yucca Mountain. The other two are potential future states, a monsoon climate and a glacial-transition climate that represent possible changes in precipitation and temperature over the next 10,000 years. The changes from one climate state to the next are progressive, and the infiltration estimates for successive climate states overlap to some extent. For example, the minimum estimates for the monsoon climate are the same as the mean values for the modern climate. This is reflected in the values reported in Table 4-2 and in the corresponding data points which coincide on the graphs in Figures 4-1 through 4-5.

The total system performance assessment models for the Site Recommendation incorporate the nine infiltration maps to determine the amount and distribution of water that flows through Yucca Mountain. The *Simulation of Net Infiltration* also presents tables of net infiltration estimates that represent averages of the values on each of the maps and these are presented in Table 4-2. For the comparisons with corroborating data, which are typically reported as basin-wide averages, this technical impact evaluation focuses on these average net infiltration estimates. The Yucca Mountain average net infiltration rate estimates range from about 1 percent to about 6 percent of average annual precipitation. This range is consistent with the representative values of 3 percent discussed above in Section 4.1.2. It is these percentages, portraying the relationship between net infiltration and precipitation, that provide the clearest points of comparison among the various types of data discussed below.

[28] CRWMS M&O, 2000. *Simulation of Net Infiltration for Modern and Potential Future Climates*, ANL-NBS-HS-000032, Rev. 00, June 2000. RIS: MOL.20000801.0004.
[29] CRWMS M&O, 2000. *Simulation of Net Infiltration for Modern and Potential Future Climates*, ANL-NBS-HS-000032, Rev. 00, June 2000. RIS: MOL.20000801.0004.

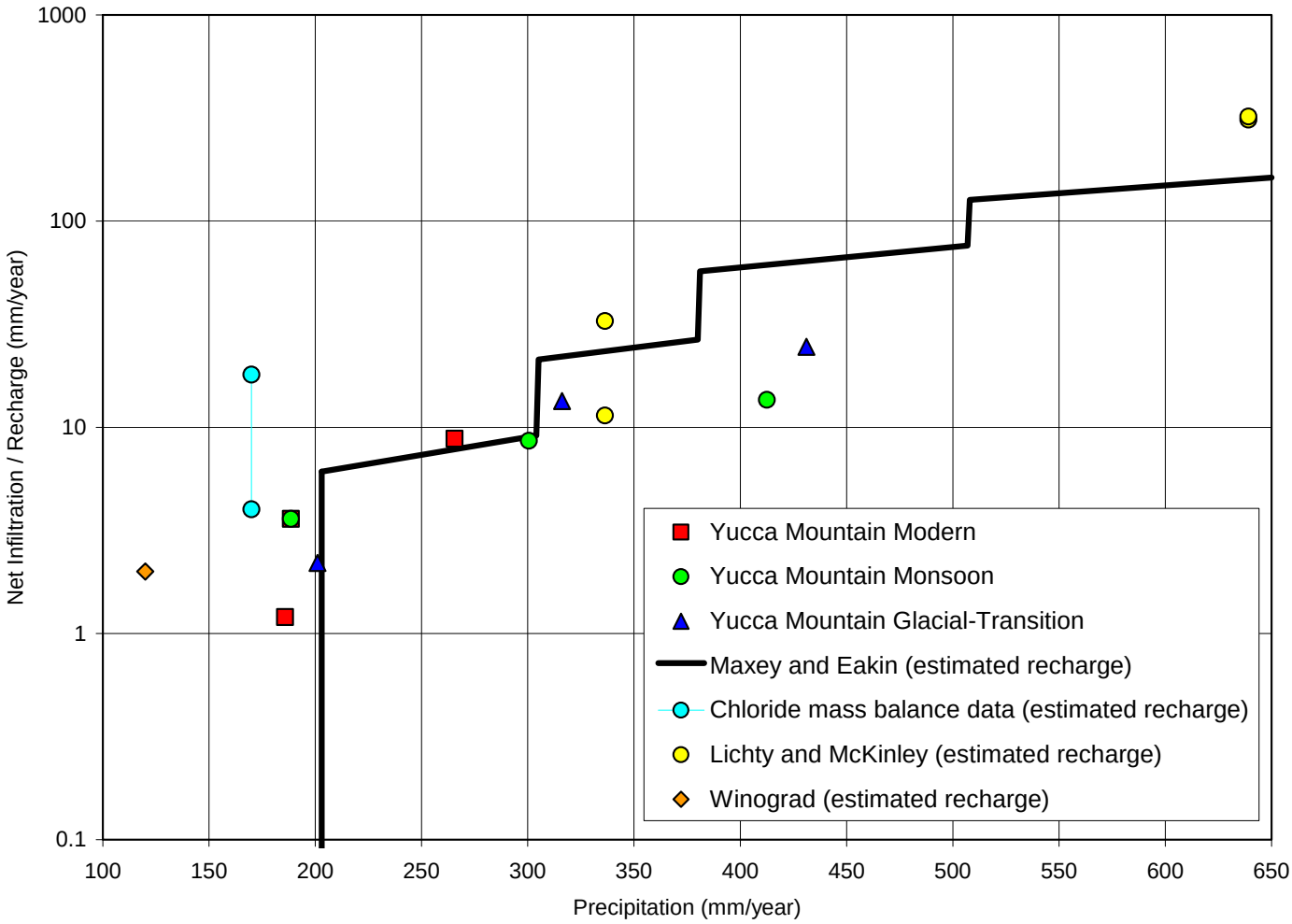


Figure 4-1. Comparison of the Net Infiltration Rate Estimates for Yucca Mountain With Other Estimates of Infiltration in the Vicinity of Yucca Mountain

Other types of data provide estimates of net infiltration at Yucca Mountain and are shown in Figure 4-1. This graph shows that the net infiltration rate estimates calculated by the USGS are generally consistent with other estimation methods, including the Maxey-Eakin method.[30] In both the Yucca Mountain estimates and the Maxey-Eakin method, not only does the amount of recharge increase with increasing precipitation, but the relative percentage of recharge increases as well.

The corroborating data presented in Figure 4-1 also include:

- Chloride Mass Balance Data (estimated recharge) – Estimates based on percentages of chloride ions present in sub-surface water can be related to water movement through a mass balance technique – a way of evaluating gain or loss of chemical concentrations as

[30] Maxey, G.B. and Eakin, T.E., 1949. *Ground Water in White River Valley, White Pine, Nye, and Lincoln Counties, Nevada, Water Resources Bulletin No. 8*, State of Nevada, Office of the State Engineer, Carson City, Nevada, 61 pp. RIS: NNA.19870407.0319.

water moves through a specific cross-sectional area. The chloride mass balance approach, which uses dissolved chloride concentrations, gives a net infiltration rate of 7 to 14 mm/yr plotted against an average precipitation rate of 170 mm/yr based on approximately 50 years of measurement.[31]

- Lichty and McKinley (estimated recharge) – Estimates of groundwater recharge rates were developed for analogue sites representative of paleoclimatic conditions during the Quaternary Period. For the site that was comparable with the glacial-transition climate at Yucca Mountain, the precipitation rate was 336 mm/yr with an estimated recharge rate between 11.1 and 32.8 mm/yr.[32] These results are consistent with Maxey-Eakin estimates and the Yucca Mountain estimate for the glacial-transition climate.

- Winograd (estimated recharge) – This estimate is drawn from Winograd (1981),[33] who calculated a net infiltration rate of 2 mm/yr from 120 mm/yr precipitation in alluvium at the Nevada Test Site, which is consistent with existing climate estimates for Yucca Mountain.

In addition to the corroborating data presented in Figure 4-1, other estimates of net infiltration for Yucca Mountain have been developed. These include:

- Calcite Abundance – Studies of calcite mineral coatings on rock fractures provide an indication of net infiltration rates, since these coatings form as infiltrating water evaporates. Model analyses indicate a range of net infiltration values from 2 to 20 mm/yr with a mean net infiltration rate of 5.92 mm/yr.[34]

- Perched Water Chemistry – Based on the presence of carbon-14 found in perched water (groundwater separated from an underlying body of groundwater by unsaturated rock) at Yucca Mountain, the net infiltration rate is estimated to be 8.2 mm/yr.[35]

The important processes controlling net infiltration are understood for arid and semi-arid sites like Yucca Mountain. The scientific literature provides documented and reviewed examples of relationships, equations, and empirical methods to represent these processes numerically. These methods were applied to the conceptual framework at Yucca Mountain as a basis for estimating net infiltration.

---

[31] CRWMS M&O, 2000. *Geochemical and Isotopic Constraints on Ground-Water Flow Directions, Mixing, and Recharge at Yucca Mountain, Nevada*, ANL-NBS-HS-000021, Rev. 00, August 2000. RIS: MOL.20000918.0287.
[32] Lichty, R.W., and McKinley, P.W., 1995. *Estimates of Ground-Water Recharge Rates for Two Small Basins in Central Nevada*, U.S. Geological Survey Water-Resources Investigation Report 94-4104, Denver, Colorado, 37 pp. RIS: MOL.19960924.0524.
[33] Winograd, I.J., 1981. "Radioactive waste disposal in thick unsaturated zones." *Science*, American Association for the Advancement of Science, vol. 212, no. 5402, June 26, 1981,1457-1464. TIC: 217258.
[34] Bechtel SAIC Company LLC, 2004. *UZ Flow Models and Submodels*, MDL-NBS-HS-000006 Rev. 02, October 2004. RIS: DOC.20041101.0004.
[35] Bagtzoglou, A.C., 2003. "Perched water bodies in arid environments and their role as hydrologic constraints for recharge rate estimation: Part 2, the case of Yucca Mountain*." Environmental Forensics*, vol. 4, 47-62.

4.2 Corroboration of Net Infiltration Rate Estimates

Corroboration of net infiltration rate estimates with other independently developed data is a primary means of providing confidence that the net infiltration rate estimates are suitable for their intended use. The use of corroborating data is supported by NRC. [36] In addition, the Nuclear Energy Agency (NEA) of the Organization for Economic Cooperation and Development (OECD) [37] evaluated the approaches and arguments that have been used to establish and communicate confidence in the safety and overall results of integrated performance assessment studies and advocated the broad use of existing data and data from natural analogues.

Because infiltration and groundwater recharge rates are of particular interest in arid and semi-arid regions, there exist significant independent data that can be used for corroboration. Within desert regions of the Western United States in particular, groundwater resource studies provide data representative of the Death Valley Region, the Nevada Test Site, and Yucca Mountain. These estimates of net infiltration and groundwater recharge have been independently produced by government agencies, consultants, and academic researchers using comparable or alternative analytical methods and are published in technical reports and scientific journals. As described in Section 4.1, these estimates provide corroboration of the net infiltration rate estimates at Yucca Mountain.

4.2.1 Estimates of Recharge for Nevada

The USGS (independent of the Yucca Mountain Project), in cooperation with the Nevada Division of Environmental Protection, compiled estimates of natural recharge from published sources in its report entitled *Ground-Water Pumpage and Artificial Recharge Estimates for Calendar Year 2000 and Average Annual Natural Recharge and Interbasin Flow by Hydrographic Area, Nevada* (Lopes and Evetts, 2004).[38] These estimates of average annual precipitation and recharge for each basin are provided in Table H-1, and the Nevada data are plotted with the Yucca Mountain average net infiltration rate estimates in Figure 4-2.

The Nevada data represent basin-wide averages for hydrographic areas throughout the state, and in many cases Lopes and Evetts (2004) report multiple precipitation/recharge values for a single hydrographic area. Precipitation estimates for a single area can vary by a factor of 2 and as much as 4; recharge estimates for a single area can vary by as much as a factor of 5. Multiple methods and data sources were used to estimate these values, which is the primary reason for reporting multiple values and the source of the variability. However, irrespective of data source or estimation method, recharge values reported by Lopes and Evetts typically remain between 3 and 10 percent of precipitation.

---

[36] U.S. Nuclear Regulatory Commission, 1988. NUREG 1298, *Qualification of Existing Data for High-Level Nuclear Waste Repositories*, February 1988. TIC: 200652.

[37] Nuclear Energy Agency, Organization for Economic Cooperation and Development, 2002. *Establishing and Communicating Confidence in the Safety of Deep Geologic Disposal, Approaches and Arguments*, Paris, France, 184 pp. TIC: 253065.

[38] Lopes, T.J. and Evetts, D.M., 2004. *Ground-Water Pumpage and Artificial Recharge Estimates for Calendar Year 2000 and Average Annual Natural Recharge and Interbasin Flow by Hydrographic Area, Nevada*, U.S. Geological Survey Scientific Investigations Report 2004-5239, Carson City, Nevada, 87 pp.

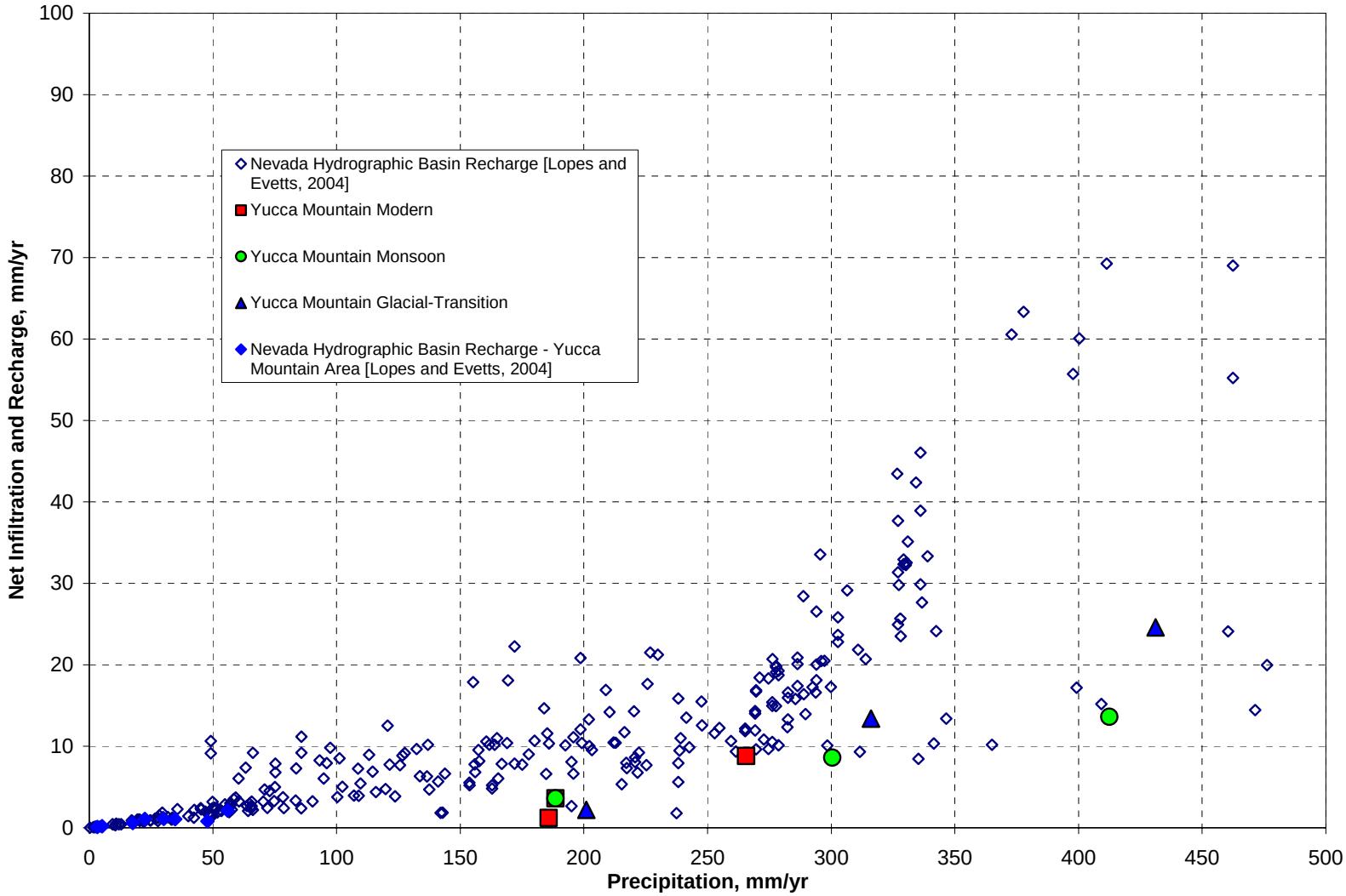


Figure 4-2. Comparison of Recharge Estimates for Nevada Hydrographic Areas With Yucca Mountain Net Infiltration Rate Estimates

The hydrographic areas closest to Yucca Mountain fall at the low end of the recharge scale (less than 10 mm/yr) and correspond closely to the net infiltration estimates for the modern climate at Yucca Mountain. The Yucca Mountain estimates for the monsoon and glacial transition climates are generally within the range for the wetter Nevada basins.

4.2.2 Estimates of Recharge for the Western United States

Net infiltration rate estimates for Yucca Mountain are consistent with similar results for arid regions of the Western United States. The range of precipitation and recharge rates includes analogues for the monsoon and glacial-transition climates postulated as future climate scenarios for Yucca Mountain.

Columbia Plateau, Washington Recharge Estimates

Lying in the rain shadow of the Cascade Mountains, the Columbia Plateau is similar to the Great Basin's position behind the Sierra Nevada Mountains. Data from the Columbia Plateau in Washington State are useful because they provide additional perspective on precipitation and recharge in wetter climates. Eastern Washington is cited in the *Future Climate Analysis*[39] Analysis and Model Report as an analogue for the glacial-transition climate.

Estimates of average ground-water recharge on the Columbia Plateau are documented in a USGS report entitled *Estimates Of Ground-Water Recharge To The Columbia Plateau Regional Aquifer System, Washington, Oregon, And Idaho, For Predevelopment And Current Land-Use Conditions.*[40] The deep-percolation model for estimating recharge used precipitation, temperature, streamflow, soils, land-use, and altitude data to compute transpiration, soil evaporation, snow accumulation, snowmelt, sublimation, and evaporation of intercepted moisture. Estimated annual average precipitation, evapotranspiration, and recharge rates for the various zones included in the Columbia Plateau study are shown in Appendix H, Table H-2.

The Columbia Plateau average precipitation rates that correspond to the precipitation rates at Yucca Mountain range from 167.9 to 464.3 mm/yr and are shown in Figure 4-3. The net infiltration rate estimates for Yucca Mountain for all three climate states are within the range of recharge rates estimated for the Columbia Plateau. For the average annual precipitation rates below 200 mm/yr, recharge rates range from 3.3 to 14.7 mm/yr or between 2 and 7.5 percent of precipitation. For the areas with precipitation corresponding to the glacial-transition climate (with average annual precipitation between 200 and 434 mm/yr), recharge rates range from 5.8 to 83.8 mm/yr or 6 to 18 percent of precipitation.

[39] CRWMS M&O, 2000. *Future Climate Analysis*, ANL-NBS-GS-000008, Rev. 00, March 2000. RIS: MOL.200000629.0907.

[40] Bauer, H.H. and Vaccaro, J.J., 1990. *Estimates Of Ground-Water Recharge To The Columbia Plateau Regional Aquifer System, Washington, Oregon, And Idaho, For Predevelopment And Current Land-Use Conditions*, U.S. Geological Survey Water-Resources Investigations Report 88-4108, Tacoma, Washington, 44 pp.

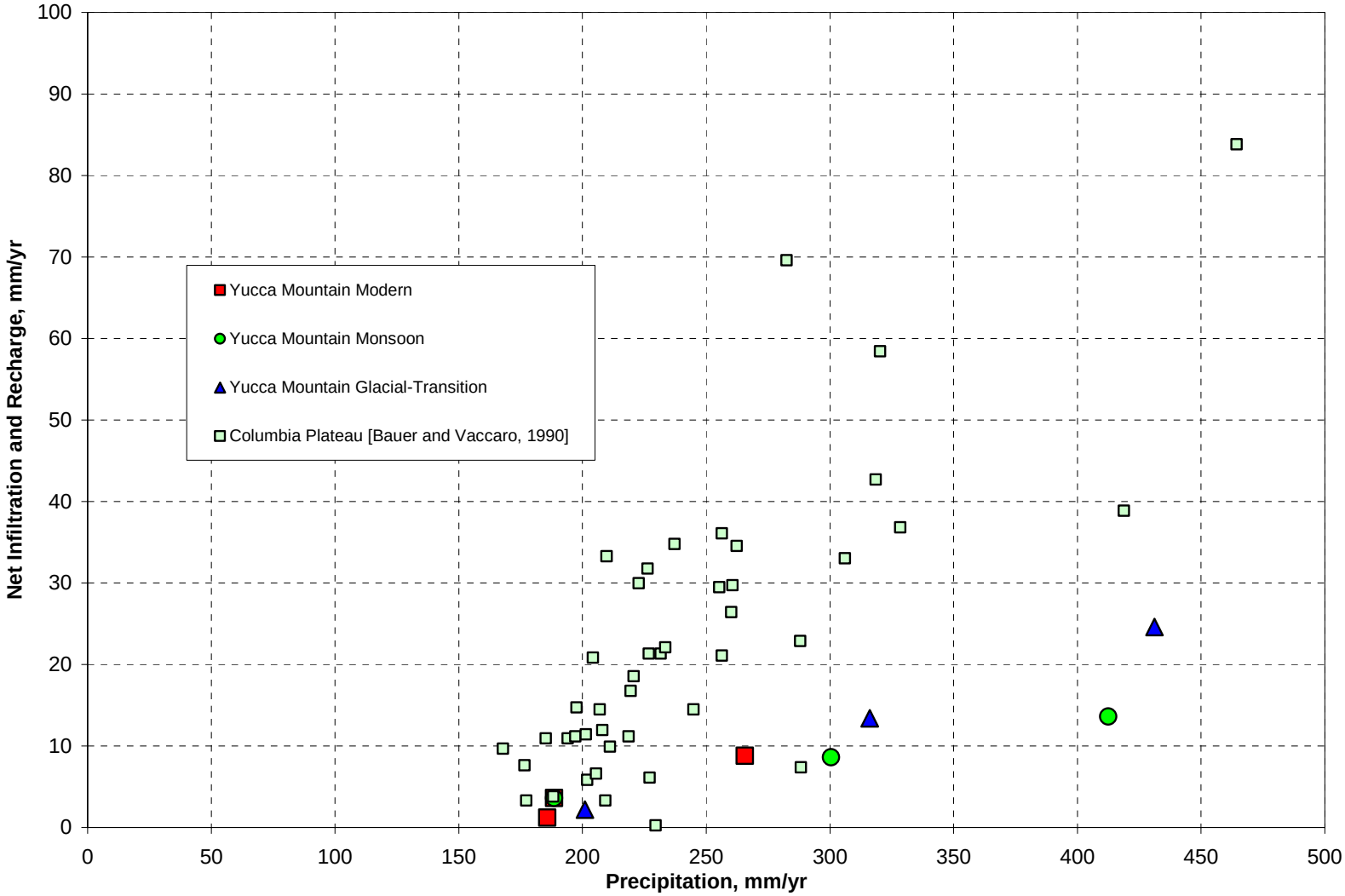


Figure 4-3: Comparison of Recharge Estimates for the Columbia Plateau With Yucca Mountain Net Infiltration Rate Estimates

Southwestern United States Recharge Estimates

Data from the Southwestern United States, including West Texas, New Mexico, and Arizona, are useful because this region includes sites identified as analogues for the monsoon climate (for example, Hobbs, New Mexico and Nogales, Arizona) in the *Future Climate Analysis*[41] Analysis and Model Report. Compiled estimates for groundwater recharge in various locations in West Texas, New Mexico, and Arizona, and recharge estimates for the Southwestern United States are compared with Yucca Mountain net infiltration rate estimates in Figure 4-4. Recharge rates for the Southwestern United States, as a fraction of precipitation, remain consistent with Yucca Mountain and are typically between less than 1 percent and 10 percent.

The data plotted in Figure 4-4 came from multiple published sources.[42,43,44,45,46,47,48,49,50,51,52,53] Details of these studies are provided in Appendix H, Table H-3.

[41] CRWMS M&O, 2000. *Future Climate Analysis*, ANL-NBS-GS-000008, Rev. 00, March 2000. RIS: MOL.200000629.0907.
[42] Boghici, R., 1999. *Changes in Groundwater Conditions in Parts of Trans-Pecos Texas, 1988-1998*, Texas Water Development Board Report 348, Austin, Texas, 29 pp.
[43] Coes, A.L. and Pool, D.R., 2005. *Ephemeral-Stream Channel and Basin-Floor Infiltration and Recharge in the Sierra Vista Subwatershed of the Upper San Pedro Basin, Southeastern Arizona*, U.S. Department of the Interior, U.S. Geological Survey Open File Report 2005-1023, Denver, Colorado, 67 pp.
[44] Gates, J.S., White, D.E., Stanley, W.D., and Ackerman, H.D., 1980. *Availability of Fresh and Slightly Saline Ground Water in the Basins of Westernmost Texas*, Texas Department of Water Resources, Austin, Texas, 108 pp.
[45] Scanlon, B.R., 1991. "Evaluation of moisture flux from chloride data in desert soils*." Journal of Hydrology*, vol. 128, pp. 137-156.
[46] Scanlon, B. R., Langford, R. P., and Goldsmith, R. S., 1999. "Relationship between geomorphic settings and unsaturated flow in an arid setting." *Water Resources Research*, American Geophysical Union, vol. 35, no. 4, April 1999, 983-999.
[47] Scanlon, B.R., Dutton, A., and Sophocleous, M., 2003. *Groundwater Recharge in Texas*, The University of Texas at Austin, Bureau of Economic Geology, Austin, Texas, 62 pp.
[48] S.S. Papadopulos & Associates, Inc., 2002. *Socorro-Sierra Planning Region Water Planning Study: Groundwater Resources in the Rio Grande and La Jencia Basins*, July 2002.
[49] Stephens, D.B. and Knowlton, R., 1986. "Soil water movement and recharge through sand at a semiarid site in New Mexico." *Water Resources Research*, vol. 22, no. 6, June 1986, 881-889.
[50] Wilson, J.L. and Guan, H., 2004. "Mountain-block hydrology and mountain-front recharge." In: Phillips, F.M., Hogan, J., and Scanlon, B. (eds.), *Groundwater Recharge in a Desert Environment: The Southwestern United States*, American Geophysical Union, Washington, D.C, 23 pp.
[51] Wood, W.W. and Sanford, W.E., 1995. "Chemical and isotopic methods for quantifying ground-water recharge in a regional, semiarid environment." *Ground Water*, National Groundwater Association, vol. 33, no. 3, May-June 1995, 458-468.
[52] Lopes, T.J. and Hoffman, J.P., 1997. *Geochemical Analyses of Ground-Water Ages, Recharge Rates, and Hydraulic Conductivity of the N Aquifer, Black Mesa Area, Arizona*, U.S. Geological Survey Water-Resources Investigations Report 96-4190, U. S. Geological Survey.
[53] Shurbaji, A.R. and Campbell, A.R.,1997. "Study of evaporation and recharge in desert soil using environmental tracers, New Mexico, USA," *Environmental Geology*, vol. 29, no. 3-4, 147-151.

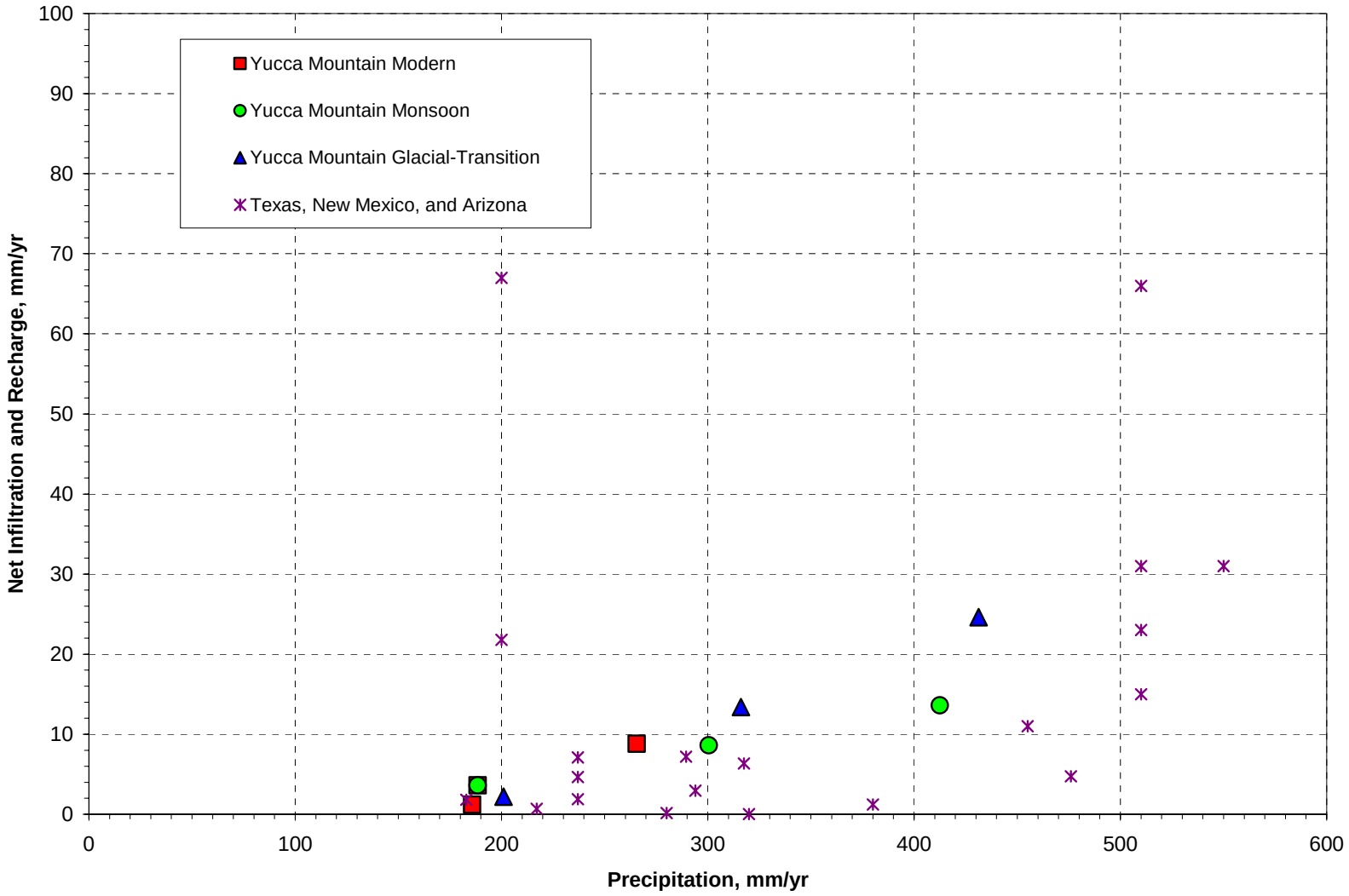


Figure 4-4. Comparison of Recharge Estimates for the Southwestern United States (Texas, New Mexico, and Arizona) With Yucca Mountain Net Infiltration Rate Estimates

4.3 Presentation and Publication of the Conceptual Model for Net Infiltration

Peer review processes have been applied to the Yucca Mountain Project since its inception. The essential attributes of peer and professional review result from publication in peer-reviewed journals, discussions with technical peers in formal and informal settings, and presentation of results to external experts and oversight groups. External publication and presentation serve not only to communicate the progress of scientific research, but also to provide independent scrutiny by the larger scientific community. This scrutiny provided an opportunity for research to be validated or challenged by review and comment.

4.3.1 Peer-Reviewed Publication

In 2001and 2002, project scientists from the USGS, Lawrence Berkeley National Laboratory, and Los Alamos National Laboratory collaborated on three articles in peer-reviewed journals summarizing the evolution and current state of understanding of the hydrology of Yucca Mountain. The *Journal of Hydrology*[54] article presented a retrospective of the evolution of conceptual models, and the *Reviews of Geophysics*[55] article focused more on the then-current understanding of Yucca Mountain's hydrology as it relates to the repository. Net infiltration was a prominent aspect of these publications. Average net infiltration rates of 5-10 mm/yr with an average annual precipitation of 170 mm/yr were reported in the first two of these articles, placing the net infiltration estimate for Yucca Mountain at 3 to 6 percent of average precipitation. The *Hydrogeology Journal*[56] article reported that spatially distributed net infiltration values average 5 mm/yr and that site-scale recharge estimate range from less than 1 to about 12 mm/yr, which would be about 1 percent to 7 percent of average precipitation.

The conceptual model described in the *Journal of Hydrology* article presented the processes governing net infiltration as the distribution and timing of precipitation, the physical properties of the surface soils and bedrock, and the components controlling evapotranspiration. Most net infiltration occurs from ridge tops and side slopes where the soils are thinner and the fractured bedrock allows rapid penetration. Net infiltration is negligible in deep soils and alluvium, except in large channels that are fed by large volumes of run-off during extreme precipitation events.

The *Reviews of Geophysics* article provided more detail on the results of hydrology investigations conducted to date. As these related to infiltration, the paper described the climate and precipitation patterns, the hydrologic setting of Yucca Mountain, vegetation, and geology. The process of surface infiltration was described in terms of the conceptual model and supporting (corroborating) data. The two most significant environmental factors controlling net infiltration at Yucca Mountain are precipitation and soil depth. This article also explained that

[54] Flint, A.L.; Flint, L.E.; Bodvarsson, G.S.; Kwicklis, E.M.; and Fabryka-Martin, J.M., 2001. "Evolution of the conceptual model of unsaturated zone hydrology at Yucca Mountain, Nevada." *Journal of Hydrology,* vol. 247, issues 1-2, 1-30. TIC: 250932.
[55] Flint, A.L.; Flint, L.E.; Kwicklis, E.M.; Bodvarsson, G.S.; and Fabryka-Martin, J.M., 2001. "Hydrology of Yucca Mountain, Nevada." *Reviews of Geophysics,* American Geophysical Union*,* vol. 39, no. 4, pp. 447-470. TIC: 254424.
[56] Flint, A.L., Flint, L.E., Kwicklis, E.M., Fabryka-Martin, J.T., and Bodvarsson, G.S., 2002. "Estimating recharge at Yucca Mountain, Nevada, USA: comparison of methods*." Hydrogeology Journal*, vol. 10, no. 1, pp. 180-204. TIC: 253752.

the spatially averaged, modeled net infiltration rate for the current climate scenario had been compared with estimates of recharge obtained from independent studies (including those discussed in Section 4.1.4, above). The authors of the article noted that a comparison of independent results increases confidence in the results of the model.

The *Hydrogeology Journal* article described the various recharge-estimation methods applied at Yucca Mountain, identifying the strengths and limitations of each approach. The methods applied at Yucca Mountain included water-balance techniques, calculations using Darcy's law, a soil physics method applied to neutron-hole water-content data, inverse modeling of thermal profiles, chloride mass balance, atmospheric radionuclides, and empirical approaches. The results of these methods are useful for defining upper boundary conditions, evaluating hydrologic parameter values, and calibrating and testing the models. The complex factors at Yucca Mountain (i.e., variable precipitation, topography, and soil depth; and a thick, layered, unsaturated zone with highly variable properties, including fractures and faults) result in spatially and temporally variable infiltration and recharge rates. However, the authors point out that, under steady-state conditions, net infiltration at the surface becomes recharge at the water table.

Taken together, these articles presented, in respected scientific journals, the net infiltration estimates for Yucca Mountain and the concepts, hydrologic processes and analytical methods underlying these estimates. Publication of this information made it publicly available for scrutiny by the larger scientific community.

4.3.2 Expert Elicitation

Expert elicitation is a formal, highly structured and documented process whereby expert judgments, usually of multiple experts, are obtained, typically to evaluate uncertainty. The uncertainty can be associated with the value of a parameter to be used in a model, the likelihood and frequency of various future events, or the relative merits of alternative conceptual models. Its use is accepted by the NRC and may be used in demonstrations of compliance with NRC's geologic disposal regulation. The conduct of expert elicitations for the OCRWM Program is guided by NUREG-1563, *Branch Technical Position on the Use of Expert Elicitation in the High-level Radioactive Waste Program.*[57]

The *Unsaturated Zone Flow Model Expert Elicitation Project* (Geomatrix, 1997)[58] was undertaken in 1997 with a panel of seven experts. The objective of the effort was to identify and assess the uncertainties associated with certain key components of the unsaturated zone flow system at Yucca Mountain. The panel reviewed the data inputs, modeling approaches, and results of the unsaturated zone flow model (termed the "unsaturated zone site-scale model") then being developed by Lawrence Berkeley National Laboratory and the USGS. Net infiltration, as the key input parameter to the unsaturated zone site-scale model, was one of the topics covered during the elicitation.

[57] U.S. Nuclear Regulatory Commission, 1996. NUREG-1563, *Branch Technical Position on the Use of Expert Elicitation in the High-level Radioactive Waste Program,* April 2005. RIS: MOL.20010919.0093.
[58] Geomatrix Consultants, Inc., 1997. *Unsaturated Zone Flow Model Expert Elicitation Project*, May 1997. RIS: MOL.19971009.0582.

During the course of the elicitation, one of the USGS employees who wrote the emails made presentations to the expert panel on the data collection efforts and the conceptual models employed to estimate the amount and spatial distribution of net infiltration. Although the experts concluded that the infiltration modeling did not account for some issues in spatial variability (for example, the potential for higher net infiltration rates in areas of thin alluvial cover), the panel generally accepted as reasonable the basic interpretations of the spatial distribution of net infiltration for Yucca Mountain. Another general conclusion by the experts was that infiltration is an episodic process linked to the occurrence of major storm events. Between episodic infiltration events, there is little to no net infiltration. During these intervening periods, evapotranspiration would preclude significant infiltration.

Further, five of the experts provided their own assessments of net infiltration for Yucca Mountain, with average values ranging from 3.9 mm/yr (2.3%, assuming 170 mm/yr average annual precipitation) to 11.3 mm/yr (6.6%), with an aggregate mean across the five experts of 8.7 mm/year (5.1%). The other two experts assessed percolation flux (the volume of water moving downward or laterally through the unsaturated zone in a given period), and thus net infiltration, on the basis of deeper subsurface data and reported mean values of 21.1 mm/yr (12.4%) and 7.4 mm/yr (4.4%). In general, these values compare favorably with the net infiltration model results for the modern climate, where net infiltration rates ranged from 1.2 mm/yr (about 1 percent) to 8.8 mm/yr (3.3%) (see Table 4-2).

As part of his efforts to provide net infiltration rate estimates, one of the panel members, Dr. Gaylon S. Campbell of Washington State University, requested and received the weather data (e.g., precipitation and temperature) used in the Yucca Mountain infiltration model in order to independently check the net infiltration rate values calculated by the USGS employees. Dr. Campbell generated a 50-year weather sequence for Yucca Mountain and used this data to independently model the components of the water movement at Yucca Mountain, including net infiltration rate. Dr. Campbell compared his results with those presented by the USGS employees and concluded that, "My model…produced similar net infiltration rate amounts, even though they are based on different assumptions." (Geomatrix, 1997).[59]

Another of the panel members, Dr. Shlomo P. Neuman of the University of Arizona, provided his own "back-of-the-envelope" calculations of percolation flux and velocity. Dr. Neuman preferred to concentrate on analyzing bulk mean annual percolation fluxes within the interior of Yucca Mountain, noting that net infiltration would constitute an upper bound to the percolation flux. From calculations based on rock properties data, Dr. Neuman estimated a lower bound of percolation flux of about 6 mm/yr. Based on measurement of moisture conditions within the Exploratory Studies Facility, he determined that 50 mm/yr can be considered an upper bound on percolation flux. He then calculated the geometric mean of these two bounds at approximately 17 mm/yr and concluded that this value constituted his best estimate of total ambient percolation flux through the repository horizon (Geomatrix, 1997).[60]

[59] Geomatrix Consultants, Inc., 1997. *Unsaturated Zone Flow Model Expert Elicitation Project*, May 1997. RIS: MOL.19971009.0582.
[60] Geomatrix Consultants, Inc., 1997. *Unsaturated Zone Flow Model Expert Elicitation Project*, May 1997. RIS: MOL.19971009.0582.

4.4 Technical Conclusions

This evaluation of the technical basis for the net infiltration rate estimates at Yucca Mountain:

- Reviewed the conceptual framework and theoretical basis for the development of a numerical model of net infiltration

- Surveyed corroborating infiltration and groundwater recharge data from Yucca Mountain, Nevada, and the Western United States

- Summarized the record of presentation and publication of the net infiltration rate estimates for technical peers and recognized experts.

From this evaluation, the following conclusions can be drawn:

1. The net infiltration rate estimates for Yucca Mountain are developed from a strong conceptual and hydrologic basis, including regional and site investigations dating back to the 1970s. The concepts, principles, and methods applied at Yucca Mountain are consistent with standard scientific practice as documented in the scientific literature.

2. Corroborating data on long-term net infiltration and groundwater recharge are publicly available in the scientific and technical literature. These data, surveyed for Nevada and the Western United States, are consistent with current estimates of net infiltration for Yucca Mountain, both under the modern climate and for potential future climate scenarios.

3. Data plots demonstrate that the net infiltration rate estimates for Yucca Mountain provide reasonable inputs to unsaturated zone flow modeling and the total system performance assessment modeling for the Site Recommendation. Figure 4-5 presents a compilation of all data discussed in this evaluation, showing that the Yucca Mountain net infiltration rate estimates are within the ranges of these data.

4. The net infiltration rate estimates and the conceptual models from which they were developed were published in peer-reviewed scientific journals and were the subject of an expert elicitation.

5. Net infiltration at Yucca Mountain is a small fraction of average annual precipitation, representing between about 1 percent and about 6 percent, meaning that, on average, between 1 and 10 mm/yr infiltrates into Yucca Mountain.

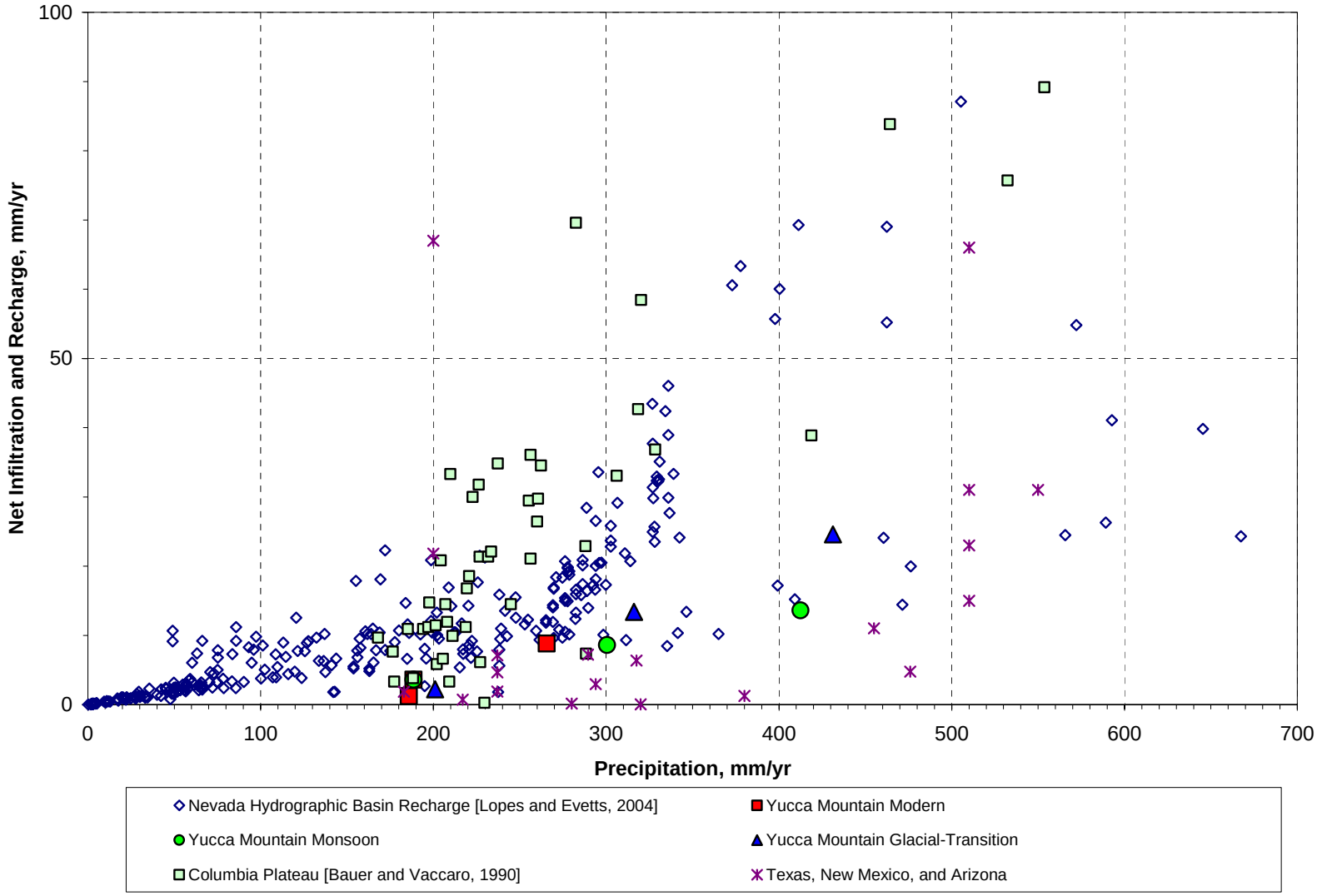


Figure 4-5: Net Infiltration Rate Estimates at Yucca Mountain and Recharge Estimates at Other Locations in the United States

This page intentionally left blank.

5. TECHNICAL IMPACT ON KEY OCRWM ACTIVITIES

The preceding section established that the USGS net infiltration rate estimates are corroborated by a significant body of published data and were the subject of internal and external presentations and discussions throughout their development. This section applies the conclusions presented in Section 4 to evaluate the technical basis supporting the Key Technical Issue agreements, Site Recommendation.

The Nuclear Waste Policy Act of 1982, as amended, defined a stepwise approach for repository development, establishing a series of milestones that include the Site Recommendation, application for a repository construction license, and a subsequent license amendment for authorization to operate the repository. In addressing its statutory responsibilities, OCRWM has taken an approach in which progressively more information is acquired to support each milestone.

Prior to the Site Recommendation, the NRC, as part of its interactions with OCRWM in anticipation of the submittal of a license application, developed a process to identify the areas where additional information or documentation would be required to support a license application. Technical exchanges between OCRWM and NRC resulted in 293 documented Key Technical Issue agreements, of which five address physical processes or model approaches that either influence net infiltration rate estimates or are used to predict net infiltration rate at Yucca Mountain. At the time of the Site Recommendation, all Key Technical Issue agreements between NRC and OCRWM were either closed or closed-pending, the latter designation meaning that the NRC believed that OCRWM's proposed approach, together with the agreement to provide additional information, acceptably addressed the issue. The Key Technical Issue agreement status provided the basis for NRC's "sufficiency letter," dated November 13, 2001, in accordance with provisions of the Nuclear Waste Policy Act.[61] That letter communicated NRC's conclusion that all technical issues were likely to be closed either through work submitted or commitments that OCRWM had made to submit additional work.

In making the Site Recommendation, Secretary of Energy Spencer Abraham relied upon, among other things, the status of the Key Technical Issue agreements, the NRC sufficiency letter, and the views of independent experts and of several scientific and technical organizations that had contributed to the technical work.[62] The Secretary based his recommendation on an assessment of the site's suitability informed by years of scientific investigations, the compelling national interests in favor of siting a repository there, and the absence of countervailing arguments that outweigh those national interests. The Secretary's determination that the site was suitable relied

[61] Section 114(a)(1)(E) of the Nuclear Waste Policy Act (42 U.S.C. 10134(a)(1)(E)) required the NRC to provide, as a prerequisite to DOE's site recommendation, preliminary comments on "the extent to which the at-depth site characterization analysis and waste form proposal for such site seem to be sufficient for inclusion in any application to be submitted by the Secretary for licensing of such site as a repository."

[62] A letter from the Director of the USGS stated, "the USGS believes that the scientific work performed to date supports a decision to recommend Yucca Mountain for development as a nuclear waste repository." The detailed technical information that accompanied Dr. Groat's letter directly addressed both net infiltration and the likely future climate at the site. (Letter, Charles G. Groat, Director of USGS, to DOE Under Secretary Robert G. Card, October 4, 2001.)

in part on total system performance assessment modeling for the Site Recommendation[63] of long-term repository performance, which incorporated the net infiltration rate estimates developed by USGS. As concluded in Section 4, the net infiltration rate estimates incorporated into the technical basis are consistent with independently derived data for Yucca Mountain and other arid and semi-arid regions in the United States.

The document entitled *Technical Basis Document No. 1: Climate and Infiltration*[64] places the responses to the Key Technical Issue agreements related to climate and infiltration within the context of overall conceptual understanding of unsaturated zone flow, explains their relationship to the postclosure safety analysis, and provides a discussion of the relevance of the agreements.

As OCRWM continues to prepare a license application, the status of the Key Technical Issue agreements will evolve. With respect to the agreements associated with net infiltration rate estimates, NRC has requested additional information on one agreement to address questions about how the methodology used to select the net infiltration maps addresses uncertainty. The other four infiltration-related Key Technical Issue agreements have been closed. OCRWM and NRC have acknowledged in their Quarterly Management Meeting discussions the possibility that the USGS email issue may affect certain agreements, including some already considered closed. Of the total 293 agreements, NRC has provided feedback on all but eight, and has stated that the NRC responses to these eight agreements would not be released pending resolution of the potential USGS email issue.

[63] CRWMS M&O, 2000. *Total System Performance Assessment for the Site Recommendation*, TDR-WIS-PA-000001, Rev. 00, ICN 01, December 2000. RIS: MOL.20001220.0045.

[64] Bechtel SAIC Company LLC, 2004. *Technical Basis Document No. 1: Climate and Infiltration*, Rev. 1, May 2004. RIS: MOL.20040804.0292. This is one in a series of documents prepared for each component of the Yucca Mountain repository system relevant to its design and postclosure performance. The information presented in these documents, along with associated references, forms an outline of the postclosure safety analysis that is being developed for the license application. These documents do not present the complete "technical basis," as this term is used in a more general sense in this technical impact evaluation report.

APPENDICES

This page intentionally left blank.

Appendix A: Selected USGS E-Mails (Redacted)

This appendix presents selected emails by USGS employees. They have been retyped and reformatted and the names of individuals have been removed, but the content is otherwise exactly as written by the employees.

This page intentionally left blank.

Date: 05/11/1998

Subject: UZ Flow (+climate+infiltration) section for TSPA-0A document

FYI. Still don't know quite how to handle the air temp glitch. I'm continuing to keep mum about this, but, from a scientific integrity standpoint, it is tempting to let the end users know exactly what was provided to them in terms of effectivley cooler future climate simulations. Problem is, I don't know how to do this without looking bad. If we can let it all pass without trying to attach DTN numbers to these results (the prefered choice), then I can forget about it and just concentrate on getting results out for the new model. If they (DOE) force us to put DTN's on these things, I would rather the truth come out sooner than later.
Don't need to respond to this, we can talk about it later.

Date: 06/18/1998

Subject: Re:

I'm finishing up the infil report (concentrating only on those items ____ originally requested me to look at … I talked this over with ____ yesterday). I've been meaning to send you a program that will convert the 6 regional strips you have back to the original *.inp file format, but I got sidetracked a little with the planning stuff. Let me finish infil and I will get you the code (I'm close to finishing it). I wanted to have these simulations running this week. But I also wanted you and ____ to look at what I'm using for effective permeabilities. I'm trying to clean up a worksheet I have so that you and ____ can understand it.

As far as FY99 modeling goes, there are several areas that we can always use help in; programming, GIS, and anyone capable of getting a simulation going, compiling the results, creating maps and graphs of the output, and helping me compile and update the climate database, streamflow records (along with any other calibration data), and the future climate stuff. You and I may be the only ones developing the model code, but even some part-time help from someone with programming skills would be a tremendous boost to keep things going (the small re-formatting program above is a great example), and to have software QA keep in step with model improvements. I don't know who this person would be, and there we have a dilema. At least we are making an effort to improve out GIS expertise.

As far as the Fortymile Wash stuff and the regional stuff goes; 1. We never seem to be certain about the funding level from _____ until the planning is over and done with ….. I wanted to have a backup to keep the regional effort going. 2. We are doing the same amount of work on the regional scale wether we get the money for Fortymile Wash or not, so why not try to get the money? All we have to do is a few extra simulations in Fortymile Wash. Its like we'll get paid twice for the same work (and I don't feel bad about this considering how little we're getting paid for the work this year ….. in my mind it will all even out in the end). 3. I'm still not convinced that there will not be another round of planning where we have to try to cut 50% of the funding we are asking for now. Then we can just get rid of the Fortymile Wash WP. Geeze … I spent too much time on this email … gotta go!

Date: 10/20/1998

Subject: Re: Additions to DRAFT—DOE Requests for Possible Fy99 Additions

This is a gamble but I'll take the OK and make them eat shit is the long run. They WILL NOT go into a license scenario with the model we have now, and particullarly with PA demanding changes. Don't sell out.

Date: 10/29/1998

Subject: Re: Design Features 23/24 – Period of Effectiveness

enjoyed the ranting and raving. We're trying to work with the engineers because thats where the funding's going. Leveling the top of the mountain seemed humorous but it gave me the chance to make some more cool figures. This little task is history now. Wait till they figure out that nothing I've provided them is QA. If they really want the stuff they'll have to pay to do it right.

Date: 12/17/98

Subject: Re: AP 3.10Q

FYI: The work plan PA has put together as a result of the meeting this week includes model hand-offs (TBVs documented using NLP 3-15s) which will all eventually be QA'd using AP 3.10Q (see attachment below). _____ is going to be the PA lead on the AP 3.10Q for the FY98 model. We're not sure how smoothly this is going to go but this is the approach. Like you've said all along, YMP has now reached a point where they need to have certain items work no matter what, and the infiltration maps are on that list. If USGS can't find a way to make it work, Sandia will (but for now they are definately counting on us to do the job). PA totally supports paying for a USGS report on the FY98 model, but they fully realize the problems we're having with the Director's approval thing.

I've had no response from ____ concerning my response to his request for an FY99 work plan using the close-out funds. PA has indicated that I can charge all my time this year to the 10506 account. There was also good indication this week that PA is willing to support us in FY00 to continue on with model validation and uncertainty work, and to deal with FEPs addressing the infiltration maps. The 110k provided to USGS was in direct response to the telecon and was specifically intended for infiltration modeling work. I can no longer wait for USGS to figure this out; I'm moving ahead according to the PA/Sandia work plan we put together this week.

What I really need now are some warm bodies to review the work I've been doing.

Like _____ said, "Live by the sword, die by the sword!".

Date: 12/18/1998

Subject: Re: AP 3.10Q

Wow! Thanks for this very thoughtful and philosophically charged wealth of advice. I here exactly what you say. YMP is looking for the fall guys, and we are high on the list. I got a strong feeling at the PA meeting that high level folks are starting to pay very close attention to who they will come after when things hit the fan. Who got how much funding at what time will all be long forgotten when the lawyers start challenging credibility of results. It was made clear that this will be like the OJ trial, where results are completely thrown out because of minor procedural flaws or personal attacks on credibility. As _____ told the lawyer who was there, YMP doesn't stand a snowball's chance in hell of making this work if that is the approach. As far as the 98 and 99 modeling, I'm starting the write-ups now. Much of this is already being covered in the NLPs and APs so I can kill 2 birds with the same stone. I much as I think Sandia may help us out with some things, I am going to be very careful that Sandia doesn't end up taking credit for our work.

Date: 12/17/98

Subject: Re: AP 3.10Q

I agree with your analysis. We only win if we get the final product out. I have to think through this carefully but where I'm headed is this. _____and I will make sure we get the 96 report done (you need to call _____ ASAP, just in case she needs input from you on Friday) . You, on the other hand, need to start the FY99 report, assuming the FY96 gets approved. You need to lay out the changes you've made to the model, how you've tested or calibrated those changes (stream gage, neutron (I've already started working on a new neutron hole analysis which I had hoped to finish this vacation but won't be done until later I'm sure)), what the results are, and what difference it makes. Do this for the site scale as your basis for the change to the model and as the basis of the report. Then start another report, which uses the first report, to lay out the regional model. Both report will address past and future climates. That's where I'm heading but I'm not there yet. We can discuss this tomorrow.

_____

The bottom line is forget about the money, we need a product or we're screwed and will take the blame. EVERYBODY will say they told us to go ahead without a plan or budget in place (even though ____ said no hires). This is now CYA and we had better be good at it. I seem to have let this one slip a little to much in an attempt to cover all our work (and get us the hell out of the long term problem of Yucca Mountain) but now it's clear that we have little to no choice. In all honestly I've never felt well managed or helped by the USGS YMP folks, in fact, as you know, I've often felt abandoned. This time it's no different, or worse, and we have to work together to get out of this one. I'm still overwhelmed trying to protect the rest of the program from the ravages of what's happening in Denver (funding, which we seem to be blamed for because we got funding) and the current HDP fiascoes in the ESF. That is to say we're not working on our own as we have for the past 12 years, now were being threatened (and carefully watched) by the people who use to simply ignore us. These are very dangerous time, both funding wise and professionally. Mark my words on this one, it will not be long before our technical credibility with be challenged in an attempt to discredit us and redirect funding!
Oh, by the way, you did a great job in response to _____ request. Bravo!!

(keep my last paragraph prvate or among friends, if you know who they are)

Date: 02/23/99

Subject: Re: NCR YMSCO-99-0002, ECRB-SYS-CS1900

Sure it's supposed to make you feel better! I gave a presentation to a small group of professional women at the local chapter of the Assoc. of Women Geoscientists a couple of weeks ago and the consensus was that I had by far the best job and they were all jealous. We do SCIENCE! And we analyse data and even do some cool esoteric stuff and get to think about hydrologic processes while we drink beer. This QA tracking crap is only half our lives, remember. The other half we actually do some cool stuff. Right? Right? Talk to a consultant and you'll get a new perspective. (I just deleted (yes, just pushed the delete key!) the email from _____ on some stupid software QA package I was supposed to submit for a stupid modeling analysis I did in 1995. Yeah, just try to get me to do it.) Go out and have some fun today, _____, I miss you!

_____

Date: 03/15/99

Subject: Re: Tiger Team Hell

This memo actually hits the nail on the head. You are exactly right: One, yes, we will do the work, Two, yes, screw the tiger team (I don't know how yet but I'll figure it out), Three, yes, destroy this memo!

_____

Date: 03/15/99

Subject: Re: Tiger Team Hell

_____

_____and I have been trying to figure out what's really coming at us with the tiger team effort. So far we've learned that they don't have a solid plan of action yet. I've formulated a "potential impact list" that is prioritized according to what work gets impacted 1st; 1. FY99 support to PA (includes all the workshop stuff), 2. regional recharge report, 3. site-scale infiltration modeling report. Some of the work the tt effort calls for was scheduled under 22001 QA anyway, but we started hearing rumors of things like re-doing all the QA work for the neutron logging data, which will stop us dead in the water.

Now I'm going to give you the inside scoop: I'm going to continue the regional modeling, even if it means ignoring direct orders from YMP management. I'm also going to be working on reports, even if it means ignoring direct orders from YMP management. _____ and I have a pretty clear vision of the type of work that needs to be done to stay alive for the long-haul, and it very definitely involves getting product out there for the users and the public to see. The Death Valley regional modeling work fits that bill. Screwing around with tiger teams does not. In the end, it's going to be the reports that move everything else forward. The tiger team efforts will just be vaporized.

So, the work may be slowed, but I will not let it stop. At this point, I am still working to the plan that we've all spent a significant amount of time on to make things happen for FY99. That's the insider scoop. The position we will take for the M&O planners may be much different. So delete this memo after you've read it.

_____

Date: 03/22/99

Subject: Re: Just Checking In

1. Software QA for the latest version of the model is coming along crappy. This is because there are some 11th hour changes taking place. The fall-back position is that the new models will be used only as supporting info for the developed data packages supporting the FY99 milestone report (we will use the 96 version of the infil code, which has been QA'd, to generate the final FY99 result.… this is mostly what _____ wants anyway).
2. Here's the minimum input data being used (both 96 and 99 version of model), which has for the most part already been QA'd:
1. Digital elevation data (data already QA'd)*
2. Geologic classification GIS map (already QA'd)*
3. Vegetation classification GIS map (already QA'd)*
4. Stream channel GIS map (already QA'd ?????)*
5. Daily precipitation data (already QA'd for 96 version of infil model…. I need to double check this. There's some important data from NTS precipitation stations in here that have always been a QA gray zone)
6. Soil property data (already QA'd)
7. Bedrock permeability (mostly already QA'd or available… I think)
* I'm trying to complete the northward expansion to match the new area of the SZ model. I'm not sure what the QA status is for the new GIS coverages for data sets 1-5.
Here's what I'm hoping to add to this, if all goes well:
1. USGS stream flow data: this is all available data …. no QA needed. (This is used for calibration)
2. NCDC (Earth-Info) daily climate data (precip, air temp, snow cover): also available data, no QA needed
3. Better soils data. If we use the STATSGO data, I don't think it needs to be QA'd
3. I've had my AP3.10Q training (doesn't mean I know what I'm supposed to do, but I have hard copies of everything).
4. Scientific notebook OK (not perfect, but I'm getting help from _____ in this department).
5. For now, I'm hiding out from all tiger teams, like some outlaw in a Spaghetti Western. We're heading underground with the real work. Tell _____ he was supposed to destroy that memo.

Date: 04/22/99

Subject: status of new climate net-infiltration modeling

I thought I'd give you a "heads up" on the progress of work I've been doing with the results you've provided. Model simulations have been in progress but about 3 weeks ago I found a small error in the model input that was generated using the EarthInfo data. The error was minor but would have created a QA nightmare so this was fixed and the simulations are being re-done (I'll send you a summary of the results when I get to this point).

I am about to submit a "developed datapackage" milestone consisting of the climate input files (7 files for the 7 sites you identified) that are being used by the net-infiltration model. The input files are basically re-formatted EarthInfo export files with a minor amount of parameter estimation occurring to fill small gaps in the record (even for the high ranking sites, there are gaps all over the place).

Here's the weird news; to get this milestone through QA, I must state that I have arbitrarily selected the analog sites. At first, I was going to include your email as supporting information in the data package, and discuss the work we did using the worksheets consisting of candidate sites, but since there is no DTN for your results the message I am getting from QA is that I can't use or refer to those results. In other words, I was trying to give you credit for your part in all this, as well as provide all info possible for the traceability of the analog climates, but this seems to create problems rather then solving them.

So for the record, the seven analog sites have been arbitrarily (randomly) selected. Hopefully these sites will by coincidence match sites you have identified.

———

P.S. please destroy this memo

Date: 04/22/99

Subject: Re: QA

Not a bad idea. I am now considering it. Ideally, one would assume that the more information you provide QA, the better the QA. In reality, it seems that the opposite is true. At any rate, its a damn shame to be wasting time with this sort of thing.

Date: 04/22/99

Subject: Re: QA

What if you just download the raw files from EarthInfo and say you used those? Do they need to know any more than that? You don't really need to do an analysis just say this is the data I used. Maybe that would work.

_____

Date: 04/22/99

Subject: QA

The QA bullshit grows deeper. I may need to say that I did everything by hand for the data package I am submitting that You and _____ reviewed. The program I wrote is not in the system and QA will be all over it like flies on &%#$. All references to _____ are being deleted.
Here's my question: When we go to start QA'ing the site-scale modeling work, will I get taken to the cleaners because I am not referencing either a tech procedure or a scientific notebook? In other words, would it be cost-effective to create a SN for the site-scale work and back-date the whole thing??
Can't wait to be far-far away from here!
_____

Date: 05/29/99

Subject: Re: _____met data and my two cents

_____

I totally support your philosophy. My main intent was to stir up the waters a bit; hopefully your argument will enlighten _____ and _____ to the general dilemma we face in the current YMP climate. I hope you don't think for a minute that I'm in agreement with the QA philosophy. The argument I am trying to initiate is this; if the precip data is used to shoot the infiltration modeling down, than YMP has set a precedent for shooting all the other process models down, and we are all just wasting out time with SR and LA. I think it would be good to get this all out in the open now before we waste any more time on YMP.

See you next week.

_____

Date: 05/28/99

Subject: Re: _____ met data and my two cents

I'm not sure we have to turn in the fy99 model results as Non-Q. The FY96 model results were Q and are waiting in the TDMS for directors approval on the report (which is Denver, hopefully being sent to the director and not another round of editing). The precipitation data we used in FY96 was also non Q, mostly the test site data but we determined that the model results themselves were Q because all the properties data was Q, the software was Q, the entire developed methodology for getting the rainfall data was Q. The precipitation was simply a set of boundary conditions or a single realization. Because any set of precipitation data can be used, real or stochastically generated, the results of the model can be fully traceable and therefore Q, although they are not necessarily the truth (as is the case for any model). The argument is that the model results are a realization of a single set of parameters and boundary conditions. If the model could only use exactly one set of data (precipitation in this case) then it would be of little value as a model. If your logic was right then you could never Q results of future climate simulations because the precipitation data is made up, you don't have a Q future. Same as never Qing transport model results of radionuclides that aren't even in the mountain yet! The results of our models have to be Q because everything was done according to a QA program in place and all the data collected to develop the physical model was done according to a QA program and the rainfall is simple a single realization. _____ uses made up cases and his results are all Q, sometime he just assumes the flux is 0.1 mm/yr everywhere and his results are fully accepted as Q because of the traceability of the model. Can everyone follow my logic? I really don't think this precipitation issue is that critical to the "Q" status of the model results as long as everything is traceable. I believe it is the methodology that makes a model Q, along with software and the basic properties. This issue is less well defined for the USGS as we are not the big modeling groups such as LANL, LLNL, and LBNL but I think we can easily defend our results as long as we get FY99 model Q'd. There, that's my thought. Now I can have beer and start my memorial day weekend.

Date: 11/15/99

Subject: Thanks for the cool refs

These references are pretty cool. Thanks for leaving them, it looks like usable stuff. Why can't I do this? What's my problem?
Well, maybe its that I'm just now getting the stupid data package off to the correct person. I re-sent it to _____, who responded from a laptop in Miami that I should just re-send it to _____, which I just did. Pretty soon the QA experts will want to know where the 4ja and Area 12 Mesa precip files came from. Here they are: Don't look at the last 4 lines. Those lines are a mystery that I believe somehow relate to the work _____ was doing in entering the 1994 data. These lines are not used by MARKOV (we stop at 9/30/94). I've deleted the lines from the "official" QA version of the files (which do have headers). In the end I keep track of 2 sets of files, the ones that will keep QA happy and the ones that were actually used.
The files are the output from the Paradox database that _____ and I had put together, which I still have but haven't looked at since 1996. So either the NTS data package has to look a lot like those files or I'm going to have start talking about the Paradox database when the QA questions start. My guess is that we do not want to deal with the Paradox database.
Here it is almost 2000, and I am still struggling with work done in 1995 and 1996.

_____
P.S. Let's make QA read those references too. Better yet, let's set asside a day for watershed training.

Date: 01/06/00

Subject: Re: AMR U0010

_____ called. Yes, this is really happening. _____ and _____ will help but it seems I am stuck going to LBNL on the 26th (_____ and _____ will also go for moral support). Responses to the LBNL comments are due on the 21st.

There is, of course, no scientific notebook for this work. All work is in the form of electronic files. I can show auditors input, output, and program files, but it is not clear to me how to show documentation of work in progress. They may be expecting to see something that at least looks like a scientific notebook documenting work in progress. I can start making something up but then the CA projects will need to go on hold.

If I continue placing _____ tasks as 1st priority for January, I will be ill prepared for the audit, and will likely get hammered. That's fine by me. I am far more concerned about the CA projects than I am about the AMR. But _____will be rather unhappy, and I will need help trying to figure out a good excuse why 100% of my time did not go into the audit without revealing the CA projects.

I am open for suggestions.

_____

Date: 02/17/00

Subject: finally the darn coordinates

I finally took the time to process your request. This required the use of TRANSFORM to look at the corners of the DEM, then a coordinate transformation using CORPSCON. Here are the results:
my picks using TRANSFORM
results obtained from CORPSCON
Please do not tell anyone how this was done because then we will need to get this whole thing through software QA!

_____

Date: 03/30/00

Subject: Installations

_____

The programs, of course, are all already installed otherwise the AMR would not exist. I don't have a clue when these programs were installed. So I've made up the dates and names (see red edits below). This is as good as its going to get. If they need more proof I will be happy to make up more stuff, as long as its not a video recording of the software being installed.

_____

Date: 01/19/01

Subject: INFIL CP1 documents

It makes me a little nervous to talk about lieing to the ITSMA in a DOE-available email so I'm using the USGS lotus notes instead. Now there's an interesting thought – me doing the testing. I'd like to have the opportunity but I don't see much chance as there would be the learning curve period and of course I'd want a help person/tutor – you available. Once I got the email from _____ regarding the timing of the comparison, I discussed the timing for the test with _____ I knew quite some time ago that it was not clear how this should be done. I asked for guidance (you may remember this) and was counseled to proceed as we have been doing…

The file dates needing to be changed might be a problem; however, I have opened a couple of the files (dw1 – ym1.v23 and one other) for the Q-d software run of one of the cmoparisons, and there are no visible printer-output dates. I have the files in two sets of folders, one for Comparison 1 and one for Comparison 2, and then have sub-folders for Q-d run files and Non-Q-d run files. Soon I will go through each of the Q-d files to check for dates to make sure there is nothing to prevent submittal of these when the time comes. Would you take a look at the lists below to make sure I have correctly indexed these files?

(See attached file: COMPARISON 1 LIST of FILES.doc)(See attached file: COMPARISON2 FILE LIST.doc)

In answer to the question about signatures, I changed the headers and footers on the CP1 documents to correlate with the signarture page dates we already have (4 December 2000 for all but the SAP, which has the 5 Dec date). The dates that show within the cover and signature pages (not the header and footer, but the date within the titles) can be different (earlier) because each document was initially drafted before the finalized document was issued. This is one of those details that is cumbersome but has to be right, and another good reason for having a checker to look things over.

Date: 1/18/01

Subject: Re: INFIL VTP

Good catch. XX is place holder. Change to “section 7.0 of ITP”. I expected more errors would surface, so I’m glad to hear you had the chance to double check everything before sending to CP1.

Do I now print out the signatures pages with the new dates, sign these, and overnight to _____?

Sounds like you need to lie to ITSMA about when the comparison test was performed, because I am not going to redo this. Someone will need to change all the file dates. Or I email you all the inputs and you can redo the test. Of course then you need to show what CPU was used on all the documents, and run the ITP.

Date: 02/20/01

Subject: Re: _____ effort for Infiltration for the Low-Temperature TSPA

I talked with _____ on the phone today. I told him we could be ready to send out 1st batch of results by the 26th, but not if this would look screwy because USGS can't start work until SN is in place. _____ strongly implied to me that he wants to stick by the rules, and we should not be conducting work until the SN is in place. But we can't finish the SN until _____ responds to _____'s questions. I will need to make the apparent schedule slip unless they can figure out the YMP-QA stupidities by COB today. If we don't let the schedule slip, they will catch on that it takes much less time to get the results out than what we say it takes.

Date: 5/29/02

Subject: Re: INFIL model inputs

Finally, here's my response to this email,

1. I do not believe that subsequent data from Alcove 1 and Pagany Wash are consistent with what was used in AMR model. However, part of the inconsistency relates to the resolution of a 30-meter grid in capturing the mapped geology, combined with the problem that only the surface geology was considered (the nonwelded tuff only showed up in the upper part of Pagany Wash, as far as what the model "saw" at 30-meter grid resolution).

2. Yes, higher values of ksat are being suggested.

3. I should be able to send you a USGS WRIR documenting the regional ksat values for lumped volcanics (arrived at by calibration of watershed models) within the next 3 to 6 months (report is now being readied for publication).

4. There is no reference or SN for the input distributions used in the uncertainty analysis. This was originally going to be documented in the uncertainty AMR but ending up in the infiltration AMR instead. The distributions are all qualitative (best guesses at that time, where guessing is defined as "what was considered reasonable"). The original input distributions were actually wider than what ended up in the analysis. The original output distribution was considered too wide once it was decided that the upper bound/lower bound climate results would be substituted as stand-ins for the actual upper bound/lower bound output distribution that PA ran as a step function (the upper bound climate would be carrying the highest weight in terms of occurrence probability). To correct this, I was asked to refine the input distributions (you can check with _____, _____, and _____ about this). I do remember changing the bedrock ksat distribution from lognormal +/- 2 orders of magnitude to +/- 1.5 orders of magnitude. I think most of the distributions were tweaked inward a bit. None of this was documented, and I may or may not still have a record of this in my own files (much of the record consisted of emails…..my earliest emails go only to about 2000, everything from 1999 has been deleted).

_____

Date: 6/29/04

Subject: Re: new model runs, 1980-95: dh1

____,

seems like you're making great progress with the runs. So I'm thinking we can leave the hourly time step to 1 hour?

When the 4ja runs are finished, we can do the direct comparison against the baseline modern climate. This will be a big moment!

I must admit that even though we're saying that we're calibrating using the neutron data and maybe the streamflow data, and the modern climate comparison is being done to validate the u0010 result, in reality the exact opposite is happening. I've selected a model that I'm hoping will provide a close match to the u0010 result, but still provides a good comparison to the neutron logs and streamflow records.

Date: 7/16/04

Subject: Re: another question from _____

_____,

you're making me laugh! HA HA HA HA

I'm ignoring your email for now.

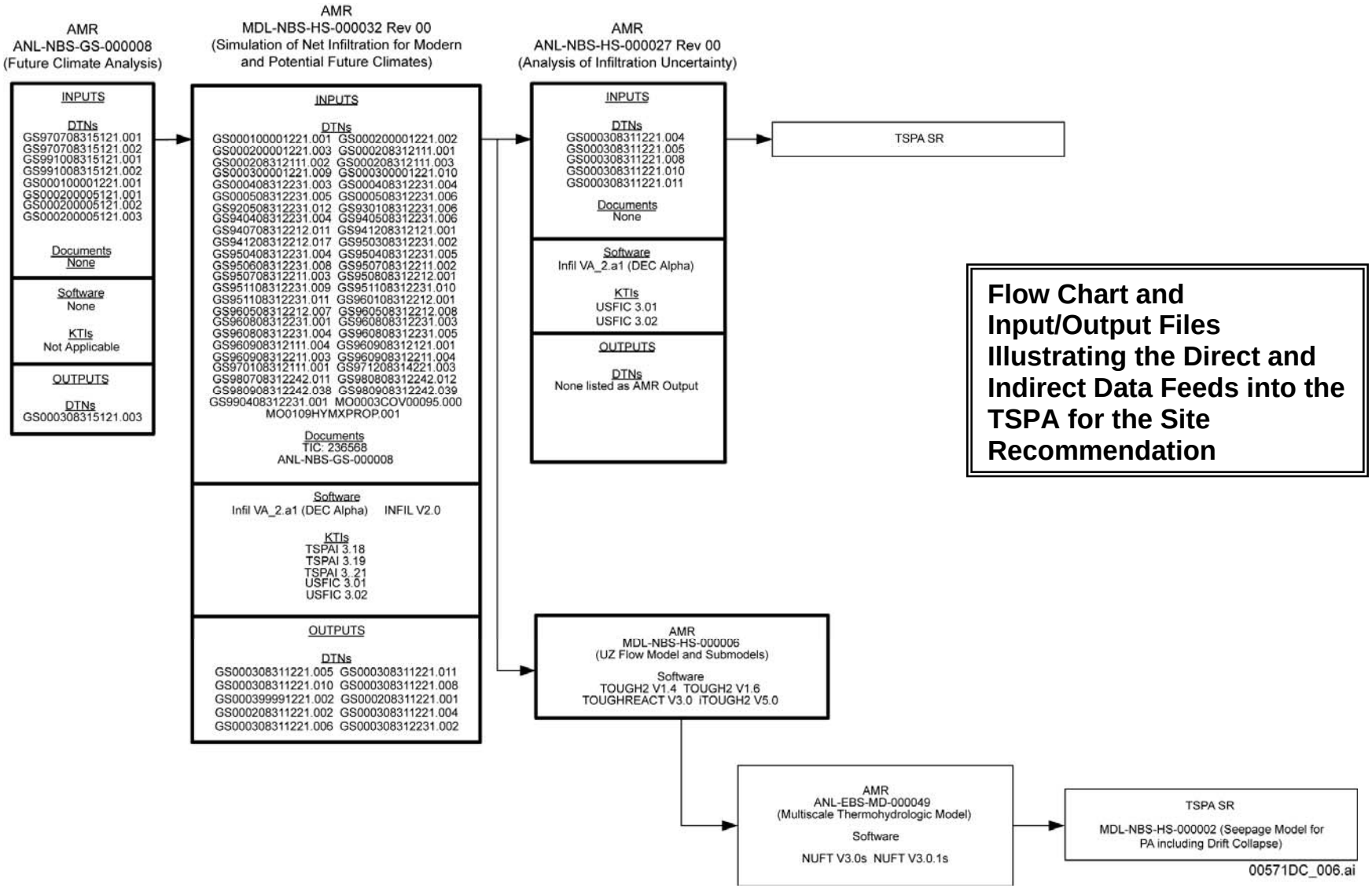
But I will take the time to say this: it requires code modification. I've decided I don't want YMP work bad enough to go there. Remember what I said: these guys are trying to put bandaids on a road kill. THEY DON'T GET IT!!!!!!!!

The more they start digging, the more dangerous it starts to get. There are many skeletons in the closet.

This page intentionally left blank.

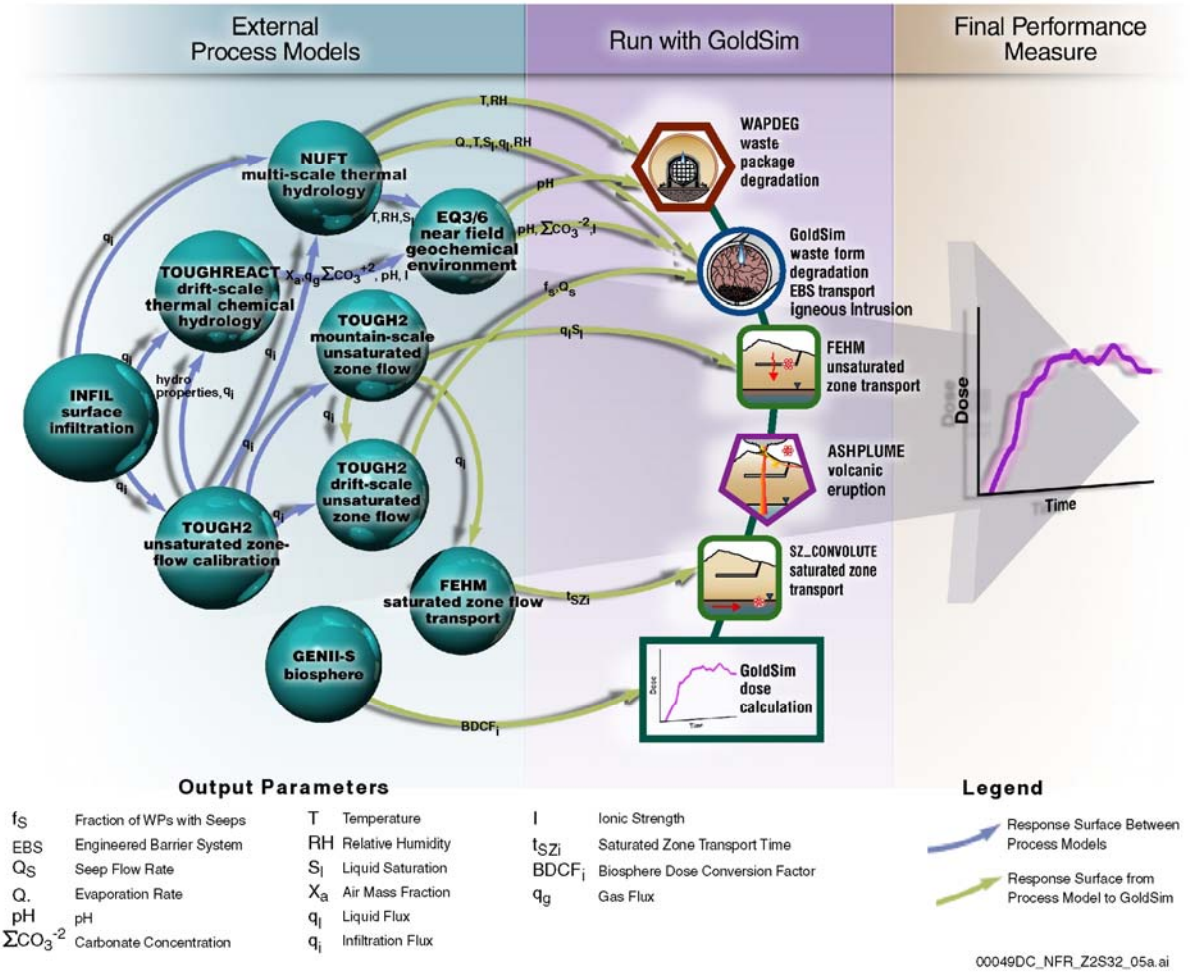
Appendix B: Infiltration Analysis Supporting the Technical Basis for the Site Recommendation

B-1. Infiltration Analysis Document Dependencies for the Site Recommendation



This page intentionally left blank.

B-2. Relationships Between Component Models of the Total System Performance Assessment for the Site Recommendation



This page intentionally left blank.

Appendix C: Software and Reports Associated With the USGS Infiltration Studies

C-1. Software Related to Infiltration and Requiring Review

Item No.	Software Name	Version	Software Tracking Number or Location in Document	Computer Type Used	Description
1	INFIL	2.0	10307-2.0-00	Pentium Pro PC, Windows NT 4.0 FORTRAN77	Simulates components of the water balance for watershed input domains supplied by WATSHD20, daily climate input, and model parameters included in the model control file. Outputs average annual rates for all components of the water balance, including net infiltration rates, for all grid cells located within the watershed-modeling domain.
2	INFIL	A_2.a1	10253-A_2.a1-00	COMPAQ Alpha, Operating System Open VMS AXP V7.2-1 FORTRAN 77	
3	MARKOV	1.0	10142-1.0-00	Pentium Pro PC, Windows NT 4.0 FORTRAN 77	Calculates monthly MARKOV chain probabilities for occurrence of daily precipitation and fits monthly exponential distribution coefficients to define the cumulative probability distribution function for the magnitude of daily precipitation. Uses daily precipitation records for input.
4	PPTSIM	1.0	10143-1.0-00	Pentium Pro PC, Windows NT 4.0 FORTRAN 77	Performs a stochastic simulation of daily precipitation using input probabilities and coefficients provided as output from MARKOV and a user defined prime seed.
5	BLOCKR7	1.0	Appendix D	Pentium Pro PC, Windows NT 4.0 FORTRAN77	Combines ARCINFO raster-grid export files (*30mlat.asc, 30mlong.asc, 30mslope.asc, 30maspct.asc, 30melev.asc, 30msoil.asc, 30mdpth.asc, 30mrock.asc, and 30mtopo.asc*) into a single column-formatted ASCII text file. Calculates 36 blocking ridge parameters for all grid locations using the raster-grid elevation data and adds the 36 columns to the output file (*30msite.inp*).
5	GEOMAP7	1.0	Appendix E	Pentium Pro PC, Windows NT 4.0 FORTRAN77	Updates the 1996 INFIL V1.0 geospatial input file (30msite.inp) to include the Day et al. (1998 [DIRS 101557]) central block geology map.
6	VEGCOV01	1.0	Appendix J	Pentium Pro PC, Windows NT 4.0 FORTRAN77	Performs a modification to bedrock saturated hydraulic conductivity provided as input to account for a north-south gradation in bedrock hydraulic conductivity.

C-1. Software Related to Infiltration and Requiring Review (continued)

Item No.	Software Name	Version	Software Tracking Number	Computer Type Used	Description
7	GEOMOD4	1.0	Appendix F	Pentium Pro PC, Windows NT 4.0 FORTRAN77	Defines an intermediate soil depth buffer zone between thin upland soils and thick alluvium using the mapped alluvium boundary and estimates the bedrock geology type underlying the buffer zone. Uses output from GEOMAP7 as input.
8	SOILMAP6	1.0	Appendix G	Pentium Pro PC, Windows NT 4.0 FORTRAN77	Estimates soil depths based on mapped soil depth classes and calculated ground surface slope included as input parameters in the geospatial parameter input file created as output from GEOMOD4.
9	SORTGRD1	1.0	Appendix H	Pentium Pro PC, Windows NT 4.0 FORTRAN77	Performs a bubble sort on the geospatial parameter input file based on elevation (sorts elevation from highest to lowest). The sorted file increases the efficiency of channel routing. Input is provided by SOILMAP6.
10	CHNNET16	1.0	Appendix I	Pentium Pro PC, Windows NT 4.0 FORTRAN77	Establishes the numerical channel network using elevations from the output file generated by SORTGRD1. Outputs a new file containing flow routing parameters for all grid cells. The new output file is used as input to WATSHD20.
11	WATSHD20	1.0	Appendix K	Pentium Pro PC, Windows NT 4.0 FORTRAN77	Extracts the watershed modeling domains based on a user defined watershed outflow point and input supplied from SORTGRD1 and CHNNET16. The output file is supplied directly as input to INFIL V2.0.
12	DAILY09	1.0	Appendix C	Pentium Pro PC, Windows NT 4.0 FORTRAN77	Reformats daily climate records exported from the EarthInfo database. Checks for data gaps and interpolates missing data if gaps are small or discards annual records if gaps are large.
13	MAPADD20	1.0	Appendix L	Pentium Pro PC, Windows NT 4.0 FORTRAN77	Compiles results obtained for individual watersheds into a single composite watershed-modeling domain, and calculates statistics for the composite watershed-modeling domain.
14	MAPSUM01	1.0	Appendix M	Pentium Pro PC, Windows NT 4.0 FORTRAN77	Calculates statistics for subareas within the composite watershed model domain. Uses results from MAPADD20 and a blanked SURFER grid as input. The blanked SURFER grid is created using the output from MAPADD20 and the boundary line of the subarea.

C-2. Infiltration Related Reports Since 1996

Document Identifier (DI #)	Version Number	Title	Accession Number	Originator
None (The 1996 INFIL v1 Report)	None	Draft: Conceptual And Numerical Model Of Infiltration For The Yucca Mountain Area, Nevada, U.S. Geological Survey Water Resources Investigation Report ##-### Denver, Colorado 1996 (C)	MOL.19970409.0087	Flint AL Hevesi JA Flint LE
ANL-NBS-HS-000032 (The June 2000 INFIL v2 Report)	REV 00	Simulation Of Net Infiltration For Modern And Potential Future Climates (DC #22943)	MOL.20000801.0004	Hevesi JA Hoxie D Flint A Craig R
ANL-NBS-HS-000032	REV 00 ICN 01	Simulation Of Net Infiltration For Modern And Potential Future Climates (DC #26921)	MOL.20010405.0002	Hevesi JA Hoxie D Flint A Craig R Dudley WW
ANL-NBS-HS-000032	REV 00 ICN 02	Simulation Of Net Infiltration For Modern And Potential Future Climates (DC #29616)	MOL.20011119.0334	Hevesi JA Houseworth J Craig R Scott W
ANL-NBS-HS-000032	REV 00 ICN 02 Errata 1	Simulation Of Net Infiltration For Modern And Potential Future Climates (DC #36171)	DOC.20031014.0004	Dana S Dixon PR Houseworth J
ANL-NBS-HS-000032	REV 00 ICN 02 Errata 2	Simulation Of Net Infiltration For Modern And Potential Future Climates (DC #36436)	DOC.20031015.0001	Harris S Dixon PR Wang J
MDL-NBS-HS-000023 (The December 2004, draft-LA Report using INFIL v2)	REV 00	Simulation Of Net Infiltration For Present-Day And Potential Future Climates (DC # 41583)	DOC.20041109.0004	Levitt DG Chaturvedi L Faybishenko B Zhang K Heaney J Liu HH Zhu M
ANL-NBS-HS-000027	REV 00	Analysis Of Infiltration Uncertainty (DC #22492)	MOL.20000525.0377	McCurley R Sanchez L Ho CK
ANL-NBS-HS-000027	REV 00 ICN 01	Analysis Of Infiltration Uncertainty (DC #35638)	DOC.20031030.0003	McCurley R Faybishenko B Gilkerson K Wang JSY Houseworth JE Dixon P

This page intentionally left blank.

Appendix D: Input/Output Data for Infiltration Studies

D-1. Input Data for ANL-NBS-HS-000032 REV 00, *Simulation of Net Infiltration for Modern and Potential Future Climates*

Data Tracking Number (DTN)	Description	Status
GS000100001221.001	EarthInfo, Inc. Western US Meteorologic Station Weather Data—NCDC Summary of Day (West 1) and NCDC Summary of Day (West 2).	Accepted Data
GS000200001221.002	Precipitation Data for Nevada Test Site, 1957-1994, from Air Resources Laboratory, from National Oceanographic and Atmospheric Administration (NOAA) Precipitation Data	Accepted Data
GS000200001221.003	NAD27 Datum of USGS Digital Elevation Model from Topopah Spring West and Busted Butte 7.5 Minute Quadrangles	Accepted Data
GS000208312111.001	Precipitation Data for May 3, 1989 through September 30, 1994 from Weather Stations 1 and 3, Yucca Mountain, Nevada	Qualified—Verification Level 2
GS000208312111.002	Air Temperature Data for Calendar Year 1992 from Weather Station 1 (Wx-1), Yucca Mountain, Nevada	Qualified
GS000208312111.003	Precipitation Data for July 17, 1987 through May 2, 1989 from Weather Stations 1 and 3, Yucca Mountain, Nevada	Qualified
GS000300001221.007	Empirical Equations from Campbell (1985) for Calculating Soil Properties from Texture Data	TBV-4258
GS000300001221.009	Evapotranspiration Coefficients	TBV-4259
GS000300001221.010	Preliminary Digital Geologic Map Database of the Nevada Test Site Area, Nevada by Sawyer and Wahl, 1995	TBV-4694
GS000308312231.001	Revised Physical Properties of Boreholes USW UZ-N17, USW UZ-N53, USW UZ-N55, USW SD-7, USW UZ-14, UE-25 UZ#16	TBV-4685
GS000408312231.003	Relative Humidity Calculated Porosity Measurements on Samples from Borehole USW SD-9 Used for Saturated Hydraulic Conductivity	Qualified
GS000408312231.004	Data for Core Dried in RH Oven and 105C Oven for USW UZ-N31, UZ-N32, UZ-N33, UZ-N34, UZ-N35, UZ-N38, UZ-N58, UZ-N59, UE-25 UZN#63 and USW UZ-N64; Data for Core Dried in 105C Oven Only for USW UZ-N11, UZ-N15, UZ-N16, UZ-N17, UZ-N27, UZ-N36 and UZ-N37	Qualified
GS920508312231.012	USW UZ-N54 and USW UZ-N55 Core Analysis: Bulk Density, Porosity, Particle Density and In Situ Saturation for Core Dried in 105C Oven	Qualified
GS930108312231.006	USW UZ-N53 Core Analysis: Bulk Density, Porosity, Particle Density, and In-Situ Saturation for Core Dried in 105C Oven	Qualified
GS940408312231.004	Core Analysis of Bulk Density, Porosity, Particle Density, and In-Situ Saturation for 3 Neutron Boreholes, USW UZ-N57, UZ-N61, and UZ-N62	Qualified
GS940508312231.006	Core Analysis of Bulk Density, Porosity, Particle Density and In Situ Saturation for Borehole UE-25 UZ#16	Qualified
GS940708312212.011	Volumetric Water Content from Neutron Moisture Meter Counts for 99 Boreholes from 5/3/89 or from the Time They Were Drilled Until 12/31/93	Qualified

D-1. Input Data for ANL-NBS-HS-000032 REV 00, *Simulation of Net Infiltration for Modern and Potential Future Climates* (continued)

Data Tracking Number (DTN)	Description	Status
GS941208312121.001	Surface-Water Discharge Data for the Yucca Mountain Area, Southern Nevada and Southern California, 1994 Water Year	Qualified—Verification Level 2
GS941208312212.017	Subsurface Water Content at Yucca Mountain, Nevada—Neutron Logging Data for 1/1/94 thru FY94	Qualified—Verification Level 2
GS950308312231.002	Laboratory Measurements of Core from USW SD-12 and Radial Boreholes	Qualified
GS950308312231.003	UE-25 UZ#16 Pycnometer Data	Qualified
GS950408312231.004	Physical Properties and Water Potentials of Core from Borehole USW SD-9	Qualified
GS950408312231.005	Physical Properties and Water Potentials of Core from Borehole USW UZ-14	Qualified—Verification Level 2
GS950608312231.007	Physical Properties and Water Content from Borehole USW NRG-6, 19 Mar 94 to 27 Mar 95	Qualified
GS950608312231.008	Moisture Retention Data from Boreholes USW UZ-N27 and UE-25 UZ#16	Qualified
GS950708312211.002	FY94 and FY95 Laboratory Measurements of Physical Properties of Surficial Materials at Yucca Mountain, Nevada	Qualified
GS950708312211.003	Fracture/Fault Properties for Fast Pathways Model	Qualified—Verification Level 2
GS950808312212.001	Volumetric Water Content Calculated from Field Calibration Equations Using Neutron Counts from 97 Boreholes at Yucca Mountain from 1 Oct 94 to 31 May 95	Qualified
GS951108312231.009	Physical Properties, Water Content, and Water Potential for Borehole USW SD-7	Qualified
GS951108312231.010	Physical Properties and Water Content for Borehole USW NRG-7/7A	Qualified
GS951108312231.011	Physical Properties, Water Content, and Water Potential for Borehole USW UZ-7A	Qualified
GS960108312111.001	Geostatistical Model for Estimating Precipitation and Recharge in the Yucca Mountain Region, Nevada–California	TBV-4684
GS960108312212.001	Volumetric Water Content Calculated from Field Calibration Equations Using Neutron Counts from 97 Boreholes at Yucca Mountain	Qualified
GS960508312212.007	Estimated Distribution of Geomorphic Surfaces and Depth to Bedrock for the Southern Half of the Topopah Spring NW 7.5 Minute Quadrangle and the Entire Busted Butte 7.5 Minute Quadrangle	Qualified—Verification Level 2
GS960508312212.008	Estimated Annual Shallow Infiltration at 84 Neutron Access Boreholes at Yucca Mountain, Nevada During the Water Years 1990 to 1995	Qualified—Verification Level 2
GS960808312231.001	Water Permeability and Relative Humidity Calculated Porosity for Boreholes UE-25 UZ-16 and USW UZ-N27	Qualified
GS960808312231.003	Moisture Retention Data for Samples from Boreholes USW SD-7, USW SD-9, USW SD-12 and UE-25 UZ#16	Qualified
GS960808312231.004	Physical Properties, Water Content and Water Potential for Samples from Lower Depths in Boreholes USW SD- 7 and USW SD-12	Qualified

D-1. Input Data for ANL-NBS-HS-000032 REV 00, *Simulation of Net Infiltration for Modern and Potential Future Climates* (continued)

Data Tracking Number (DTN)	Description	Status
GS960808312231.005	Water Permeability and Relative Humidity Calculated Porosity for Samples from Boreholes USW SD-7, USW SD-9, USW SD-12 and USW UZ-14	Qualified
GS960908312111.004	Relative Humidity, Temperature, Wind Speed, Wind Direction, Net Solar Radiation and Precipitation Data from Five Weather Stations in the Yucca Mountain Area for 1995 Water Year	Qualified—Verification Level 2
GS960908312121.001	Surface-Water Discharge Data for the Yucca Mountain Area, Southern Nevada and Southern California, 1995 Water Year	Qualified—Verification Level 2
GS960908312211.003	Conceptual and Numerical Model of Infiltration at Yucca Mountain, Nevada	Qualified—Verification Level 2
GS960908312211.004	Heat Dissipation Probe Data: Bleach Bone Ridge 3/95–11/95	Qualified
GS970108312111.001	FY96 Site Meteorology Data: Relative Humidity, Temperature, Wind Speed, Wind Direction, Net Solar Radiation and Barometric Pressure from Two Weather Stations in the Yucca Mountain Area, Oct. 1 – Dec. 3, 1995	Qualified—Verification Level 2
GS971208314221.003	Revised Bedrock Geologic Map of the Central Block Area, Yucca Mountain, Nevada	Qualified
GS980708312242.011	Physical Properties and Hydraulic Conductivity Measurements of Lexan-Sealed Samples from USW WT-24	Qualified
GS980808312242.012	Unsaturated Hydraulic Properties of Lexan-Sealed Samples From USW WT-24, Measured Using a Centrifuge	Qualified
GS980908312242.038	Physical Properties and Saturated Hydraulic Conductivity Measurements of Lexan-Sealed Samples from USW SD-6	Qualified
GS980908312242.039	Unsaturated Water Retention Data for Lexan-Sealed Samples from USW SD-6 Measured Using a Centrifuge	Qualified
GS990408312231.001	Saturated Hydraulic Conductivity of Core from SD-9, 2/27–3/27/95	Qualified
MO0003COV00095.000	Digital version of USGS 1:12,000 Geologic Map of Yucca Mountain by Scott and Bonk	Qualified

D-2. Output Data for ANL-NBS-HS-000032 REV 00, *Simulation of Net Infiltration for Modern and Potential Future Climates*

Data Tracking Number (DTN)	Description	Status
GS000308311221.005	Net Infiltration Modeling Results for 3 Climate Scenarios FY99	Qualified—Product Output
GS000308311221.011	Template Files for Uncertainty Analyses	Qualified—Product Output
GS000308311221.010	Preliminary Developed Daily Climate Data From Tule Lake, California Used for Infiltration Uncertainty Analysis	Qualified—Product Output
GS000308311221.008	Preliminary Estimates of Input Parameter Distributions Used for Infiltration Uncertainty Analysis	Qualified—Product Output
GS000399991221.002	Rainfall Runoff/Run-on 1999 Simulations	Qualified—Product Output
GS000208311221.001	Yucca Mountain 1980-1995 Developed Daily Precipitation Record	Qualified—Product Output
GS000208311221.002	Preliminary Developed Daily Climate Data for Potential Future Monsoon and Glacial-Transition Climates Using Records from Selected Analog Sites	Qualified—Product Output
GS000308311221.004	Preliminary Geospatial Input Data for Infil V2.0 FY99	Qualified—Product Output
GS000308311221.006	Merged USGS Digital Elevation Model from Topopah Spring West and Busted Butte 7.5' DEMS	Qualified—Product Output
GS000308312231.002	Developed Matrix Hydrologic Properties Information	Qualified—Product Output

D-3. Input Data for ANL-NBS-HS-000032 REV 00 ICN 01, *Simulation of Net Infiltration for Modern and Potential Future Climates*

Data Tracking Number (DTN)	Description	Status
GS000100001221.001	EarthInfo, Inc. Western US Meteorologic Station Weather Data—NCDC Summary of Day (West 1) and NCDC Summary of Day (West 2).	Accepted Data
GS000200001221.002	Precipitation Data for Nevada Test Site, 1957-1994, from Air Resources Laboratory, from National Oceanographic and Atmospheric Administration (NOAA) Precipitation Data	Accepted Data
GS000200001221.003	NAD27 Datum of USGS Digital Elevation Model from Topopah Spring West and Busted Butte 7.5 Minute Quadrangles	Accepted Data
GS000208312111.001	Precipitation Data for May 3, 1989 through September 30, 1994 from Weather Stations 1 and 3, Yucca Mountain, Nevada	Qualified—Verification Level 2
GS000208312111.002	Air Temperature Data for Calendar Year 1992 from Weather Station 1 (Wx-1), Yucca Mountain, Nevada	Qualified
GS000208312111.003	Precipitation Data for July 17, 1987 through May 2, 1989 from Weather Stations 1 and 3, Yucca Mountain, Nevada	Qualified
GS000300001221.009	Evapotranspiration Coefficients	Accepted Data
GS000300001221.010	Preliminary Digital Geologic Map Database of the Nevada Test Site Area, Nevada by Sawyer and Wahl, 1995	Accepted Data
GS000308312231.001	Revised Physical Properties of Boreholes USW UZ-N17, USW UZ-N53, USW UZ-N55, USW SD-7, USW UZ-14, UE-25 UZ#16	TBV-4685
GS000408312231.003	Relative Humidity Calculated Porosity Measurements on Samples from Borehole USW SD-9 Used for Saturated Hydraulic Conductivity	Qualified
GS000408312231.004	Data for Core Dried in RH Oven and 105C Oven for USW UZ-N31, UZ-N32, UZ-N33, UZ-N34, UZ-N35, UZ-N38, UZ-N58, UZ-N59, UE-25 UZN#63 and USW UZ-N64; Data for Core Dried in 105C Oven Only for USW UZ-N11, UZ-N15, UZ-N16, UZ-N17, UZ-N27, UZ-N36 and UZ-N37	Qualified
GS000508312231.005	UE-25 UZ#16 Pycnometer Data	Qualified
GS000508312231.006	Physical Properties and Water Content from Borehole USW NRG-6, 3/19/94 to 3/27/95	Qualified
GS920508312231.012	USW UZ-N54 and USW UZ-N55 Core Analysis: Bulk Density, Porosity, Particle Density and In Situ Saturation for Core Dried in 105C Oven	Qualified
GS930108312231.006	USW UZ-N53 Core Analysis: Bulk Density, Porosity, Particle Density, and In-Situ Saturation for Core Dried in 105C Oven	Qualified
GS940408312231.004	Core Analysis of Bulk Density, Porosity, Particle Density, and In-Situ Saturation for 3 Neutron Boreholes, USW UZ-N57, UZ-N61, and UZ-N62	Qualified
GS940508312231.006	Core Analysis of Bulk Density, Porosity, Particle Density and In Situ Saturation for Borehole UE-25 UZ#16	Qualified
GS940708312212.011	Volumetric Water Content from Neutron Moisture Meter Counts for 99 Boreholes from 5/3/89 or from the Time They Were Drilled Until 12/31/93	Qualified

D-3. Input Data for ANL-NBS-HS-000032 REV 00 ICN 01, *Simulation of Net Infiltration for Modern and Potential Future Climates* (continued)

Data Tracking Number (DTN)	Description	Status
GS941208312121.001	Surface-Water Discharge Data for the Yucca Mountain Area, Southern Nevada and Southern California, 1994 Water Year	Qualified—Verification Level 2
GS941208312212.017	Subsurface Water Content at Yucca Mountain, Nevada—Neutron Logging Data for 1/1/94 thru FY94	Qualified—Verification Level 2
GS950308312231.002	Laboratory Measurements of Core from USW SD-12 and Radial Boreholes	Qualified
GS950408312231.004	Physical Properties and Water Potentials of Core from Borehole USW SD-9	Qualified
GS950408312231.005	Physical Properties and Water Potentials of Core from Borehole USW UZ-14	Qualified—Verification Level 2
GS950608312231.008	Moisture Retention Data from Boreholes USW UZ-N27 and UE-25 UZ#16	Qualified
GS950708312211.002	FY94 and FY95 Laboratory Measurements of Physical Properties of Surficial Materials at Yucca Mountain, Nevada	Qualified
GS950708312211.003	Fracture/Fault Properties for Fast Pathways Model	Qualified—Verification Level 2
GS950808312212.001	Volumetric Water Content Calculated from Field Calibration Equations Using Neutron Counts from 97 Boreholes at Yucca Mountain from 1 Oct 94 to 31 May 95	Qualified
GS951108312231.009	Physical Properties, Water Content, and Water Potential for Borehole USW SD-7	Qualified
GS951108312231.010	Physical Properties and Water Content for Borehole USW NRG-7/7A	Qualified
GS951108312231.011	Physical Properties, Water Content, and Water Potential for Borehole USW UZ-7A	Qualified
GS960108312212.001	Volumetric Water Content Calculated from Field Calibration Equations Using Neutron Counts from 97 Boreholes at Yucca Mountain	Qualified
GS960508312212.007	Estimated Distribution of Geomorphic Surfaces and Depth to Bedrock for the Southern Half of the Topopah Spring NW 7.5 Minute Quadrangle and the Entire Busted Butte 7.5 Minute Quadrangle	Qualified—Verification Level 2
GS960508312212.008	Estimated Annual Shallow Infiltration at 84 Neutron Access Boreholes at Yucca Mountain, Nevada During the Water Years 1990 to 1995	Qualified—Verification Level 2
GS960808312231.001	Water Permeability and Relative Humidity Calculated Porosity for Boreholes UE-25 UZ-16 and USW UZ-N27	Qualified
GS960808312231.003	Moisture Retention Data for Samples from Boreholes USW SD-7, USW SD-9, USW SD-12 and UE-25 UZ#16	Qualified
GS960808312231.004	Physical Properties, Water Content and Water Potential for Samples from Lower Depths in Boreholes USW SD- 7 and USW SD-12	Qualified
GS960808312231.005	Water Permeability and Relative Humidity Calculated Porosity for Samples from Boreholes USW SD-7, USW SD-9, USW SD-12 and USW UZ-14	Qualified
GS960908312111.004	Relative Humidity, Temperature, Wind Speed, Wind Direction, Net Solar Radiation and Precipitation Data from Five Weather Stations in the Yucca Mountain Area for 1995 Water Year	Qualified—Verification Level 2

D-3. Input Data for ANL-NBS-HS-000032 REV 00 ICN 01, *Simulation of Net Infiltration for Modern and Potential Future Climates* (continued)

Data Tracking Number (DTN)	Description	Status
GS960908312121.001	Surface-Water Discharge Data for the Yucca Mountain Area, Southern Nevada and Southern California, 1995 Water Year	Qualified—Verification Level 2
GS960908312211.003	Conceptual and Numerical Model of Infiltration at Yucca Mountain, Nevada	Qualified—Verification Level 2
GS960908312211.004	Heat Dissipation Probe Data: Bleach Bone Ridge 3/95—11/95	Qualified
GS970108312111.001	FY96 Site Meteorology Data: Relative Humidity, Temperature, Wind Speed, Wind Direction, Net Solar Radiation and Barometric Pressure from Two Weather Stations in the Yucca Mountain Area, Oct. 1–Dec. 3, 1995	Qualified—Verification Level 2
GS971208314221.003	Revised Bedrock Geologic Map of the Central Block Area, Yucca Mountain, Nevada	Qualified
GS980708312242.011	Physical Properties and Hydraulic Conductivity Measurements of Lexan-Sealed Samples from USW WT-24	Qualified
GS980808312242.012	Unsaturated Hydraulic Properties of Lexan-Sealed Samples From USW WT-24, Measured Using a Centrifuge	Qualified
GS980908312242.038	Physical Properties and Saturated Hydraulic Conductivity Measurements of Lexan-Sealed Samples from USW SD-6	Qualified
GS980908312242.039	Unsaturated Water Retention Data for Lexan-Sealed Samples from USW SD-6 Measured Using a Centrifuge	Qualified
GS990408312231.001	Saturated Hydraulic Conductivity of Core from SD-9, 2/27–3/27/95	Qualified
MO0003COV00095.000	Coverage: Scotbons	Qualified

D-4. Output Data for ANL-NBS-HS-000032 REV 00 ICN 01, *Simulation of Net Infiltration for Modern and Potential Future Climates*

Data Tracking Number (DTN)	Description	Status
GS000308311221.005	Net Infiltration Modeling Results for 3 Climate Scenarios FY99	Qualified—Product Output
GS000308311221.011	Template Files for Uncertainty Analyses	Qualified—Product Output
GS000308311221.010	Preliminary Developed Daily Climate Data From Tule Lake, California Used for Infiltration Uncertainty Analysis	Qualified—Product Output
GS000308311221.008	Preliminary Estimates of Input Parameter Distributions Used for Infiltration Uncertainty Analysis	Qualified—Product Output
GS000399991221.002	Rainfall Runoff/Run-on 1999 Simulations	Qualified—Product Output
GS000208311221.001	Yucca Mountain 1980-1995 Developed Daily Precipitation Record	Qualified—Product Output
GS000208311221.002	Preliminary Developed Daily Climate Data for Potential Future Monsoon and Glacial-Transition Climates Using Records from Selected Analog Sites	Qualified—Product Output
GS000308311221.004	Preliminary Geospatial Input Data for Infil V2.0 FY99	Qualified—Product Output
GS000308311221.006	Merged USGS Digital Elevation Model from Topopah Spring West and Busted Butte 7.5' DEMS	Qualified—Product Output
GS000308312231.002	Developed Matrix Hydrologic Properties Information	Qualified—Product Output

D-5. Input Data for ANL-NBS-HS-000032 REV 00 ICN 02, *Simulation of Net Infiltration for Modern and Potential Future Climates*

Data Tracking Number (DTN)	Description	Status
GS000100001221.001	EarthInfo, Inc. Western US Meteorologic Station Weather Data—NCDC Summary of Day (West 1) and NCDC Summary of Day (West 2).	Accepted Data
GS000200001221.002	Precipitation Data for Nevada Test Site, 1957-1994, from Air Resources Laboratory, from National Oceanographic and Atmospheric Administration (NOAA) Precipitation Data	Accepted Data
GS000200001221.003	NAD27 Datum of USGS Digital Elevation Model from Topopah Spring West and Busted Butte 7.5 Minute Quadrangles	Accepted Data
GS000208312111.001	Precipitation Data for May 3, 1989 through September 30, 1994 from Weather Stations 1 and 3, Yucca Mountain, Nevada	Qualified—Verification Level 2
GS000208312111.002	Air Temperature Data for Calendar Year 1992 from Weather Station 1 (Wx-1), Yucca Mountain, Nevada	Qualified
GS000208312111.003	Precipitation Data for July 17, 1987 through May 2, 1989 from Weather Stations 1 and 3, Yucca Mountain, Nevada	Qualified
GS000300001221.009	Evapotranspiration Coefficients	Accepted Data
GS000300001221.010	Preliminary Digital Geologic Map Database of the Nevada Test Site Area, Nevada by Sawyer and Wahl, 1995	Accepted Data
GS000408312231.003	Relative Humidity Calculated Porosity Measurements on Samples from Borehole USW SD-9 Used for Saturated Hydraulic Conductivity	Qualified
GS000408312231.004	Data for Core Dried in RH Oven and 105C Oven for USW UZ-N31, UZ-N32, UZ-N33, UZ-N34, UZ-N35, UZ-N38, UZ-N58, UZ-N59, UE-25 UZN#63 and USW UZ-N64; Data for Core Dried in 105C Oven Only for USW UZ-N11, UZ-N15, UZ-N16, UZ-N17, UZ-N27, UZ-N36 and UZ-N37	Qualified
GS000508312231.005	UE-25 UZ#16 Pycnometer Data	Qualified
GS000508312231.006	Physical Properties and Water Content from Borehole USW NRG-6, 3/19/94 to 3/27/95	Qualified
GS920508312231.012	USW UZ-N54 and USW UZ-N55 Core Analysis: Bulk Density, Porosity, Particle Density and In Situ Saturation for Core Dried in 105C Oven	Qualified
GS930108312231.006	USW UZ-N53 Core Analysis: Bulk Density, Porosity, Particle Density, and In-Situ Saturation for Core Dried in 105C Oven	Qualified
GS940408312231.004	Core Analysis of Bulk Density, Porosity, Particle Density, and In-Situ Saturation for 3 Neutron Boreholes, USW UZ-N57, UZ-N61, and UZ-N62	Qualified
GS940508312231.006	Core Analysis of Bulk Density, Porosity, Particle Density and In Situ Saturation for Borehole UE-25 UZ#16	Qualified
GS940708312212.011	Volumetric Water Content from Neutron Moisture Meter Counts for 99 Boreholes from 5/3/89 or from the Time They Were Drilled Until 12/31/93	Qualified
GS941208312121.001	Surface-Water Discharge Data for the Yucca Mountain Area, Southern Nevada and Southern California, 1994 Water Year	Qualified—Verification Level 2

D-5. Input Data for ANL-NBS-HS-000032 REV 00 ICN 02, *Simulation of Net Infiltration for Modern and Potential Future Climates* (continued)

Data Tracking Number (DTN)	Description	Status
GS941208312212.017	Subsurface Water Content at Yucca Mountain, Nevada—Neutron Logging Data for 1/1/94 thru FY94	Qualified—Verification Level 2
GS950308312231.002	Laboratory Measurements of Core from USW SD-12 and Radial Boreholes	Qualified
GS950408312231.004	Physical Properties and Water Potentials of Core from Borehole USW SD-9	Qualified
GS950408312231.005	Physical Properties and Water Potentials of Core from Borehole USW UZ-14	Qualified—Verification Level 2
GS950608312231.008	Moisture Retention Data from Boreholes USW UZ-N27 and UE-25 UZ#16	Qualified
GS950708312211.002	FY94 and FY95 Laboratory Measurements of Physical Properties of Surficial Materials at Yucca Mountain, Nevada	Qualified
GS950708312211.003	Fracture/Fault Properties for Fast Pathways Model	Qualified—Verification Level 2
GS950808312212.001	Volumetric Water Content Calculated from Field Calibration Equations Using Neutron Counts from 97 Boreholes at Yucca Mountain from 1 Oct 94 to 31 May 95	Qualified
GS951108312231.009	Physical Properties, Water Content, and Water Potential for Borehole USW SD-7	Qualified
GS951108312231.010	Physical Properties and Water Content for Borehole USW NRG-7/7A	Qualified
GS951108312231.011	Physical Properties, Water Content, and Water Potential for Borehole USW UZ-7A	Qualified
GS960108312212.001	Volumetric Water Content Calculated from Field Calibration Equations Using Neutron Counts from 97 Boreholes at Yucca Mountain	Qualified
GS960508312212.007	Estimated Distribution of Geomorphic Surfaces and Depth to Bedrock for the Southern Half of the Topopah Spring NW 7.5 Minute Quadrangle and the Entire Busted Butte 7.5 Minute Quadrangle	Qualified—Verification Level 2
GS960508312212.008	Estimated Annual Shallow Infiltration at 84 Neutron Access Boreholes at Yucca Mountain, Nevada During the Water Years 1990 to 1995	Qualified—Verification Level 2
GS960808312231.001	Water Permeability and Relative Humidity Calculated Porosity for Boreholes UE-25 UZ-16 and USW UZ-N27	Qualified
GS960808312231.003	Moisture Retention Data for Samples from Boreholes USW SD-7, USW SD-9, USW SD-12 and UE-25 UZ#16	Qualified
GS960808312231.004	Physical Properties, Water Content and Water Potential for Samples from Lower Depths in Boreholes USW SD- 7 and USW SD-12	Qualified
GS960808312231.005	Water Permeability and Relative Humidity Calculated Porosity for Samples from Boreholes USW SD-7, USW SD-9, USW SD-12 and USW UZ-14	Qualified
GS960908312111.004	Relative Humidity, Temperature, Wind Speed, Wind Direction, Net Solar Radiation and Precipitation Data from Five Weather Stations in the Yucca Mountain Area for 1995 Water Year	Qualified—Verification Level 2
GS960908312121.001	Surface-Water Discharge Data for the Yucca Mountain Area, Southern Nevada and Southern California, 1995 Water Year	Qualified—Verification Level 2

D-5. Input Data for ANL-NBS-HS-000032 REV 00 ICN 02, *Simulation of Net Infiltration for Modern and Potential Future Climates* (continued)

Data Tracking Number (DTN)	Description	Status
GS960908312211.003	Conceptual and Numerical Model of Infiltration at Yucca Mountain, Nevada	Qualified—Verification Level 2
GS960908312211.004	Heat Dissipation Probe Data: Bleach Bone Ridge 3/95–11/95	Qualified
GS970108312111.001	FY96 Site Meteorology Data: Relative Humidity, Temperature, Wind Speed, Wind Direction, Net Solar Radiation and Barometric Pressure from Two Weather Stations in the Yucca Mountain Area, Oct. 1–Dec. 3, 1995	Qualified—Verification Level 2
GS971208314221.003	Revised Bedrock Geologic Map of the Central Block Area, Yucca Mountain, Nevada	Qualified
GS980708312242.011	Physical Properties and Hydraulic Conductivity Measurements of Lexan-Sealed Samples from USW WT-24	Qualified
GS980808312242.012	Unsaturated Hydraulic Properties of Lexan-Sealed Samples From USW WT-24, Measured Using a Centrifuge	Qualified
GS980908312242.038	Physical Properties and Saturated Hydraulic Conductivity Measurements of Lexan-Sealed Samples from USW SD-6	Qualified
GS980908312242.039	Unsaturated Water Retention Data for Lexan-Sealed Samples from USW SD-6 Measured Using a Centrifuge	Qualified
GS990408312231.001	Saturated Hydraulic Conductivity of Core from SD-9, 2/27–3/27/95	Qualified
MO0003COV00095.000	Coverage: Scotbons	Qualified
MO0109HYMXPROP.001	Matrix Hydrologic Properties Data	Qualified

D-6. Output Data for ANL-NBS-HS-000032 REV 00 ICN 02, *Simulation of Net Infiltration for Modern and Potential Future Climates*

Data Tracking Number (DTN)	Description	Status
GS000308311221.005	Net Infiltration Modeling Results for 3 Climate Scenarios FY99	Qualified—Product Output
GS000308311221.011	Template Files for Uncertainty Analyses	Qualified—Product Output
GS000308311221.010	Preliminary Developed Daily Climate Data From Tule Lake, California Used for Infiltration Uncertainty Analysis	Qualified—Product Output
GS000308311221.008	Preliminary Estimates of Input Parameter Distributions Used for Infiltration Uncertainty Analysis	Qualified—Product Output
GS000399991221.002	Rainfall Runoff/Run-on 1999 Simulations	Qualified—Product Output
GS000208311221.001	Yucca Mountain 1980-1995 Developed Daily Precipitation Record	Qualified—Product Output
GS000208311221.002	Preliminary Developed Daily Climate Data for Potential Future Monsoon and Glacial-Transition Climates Using Records from Selected Analog Sites	Qualified—Product Output
GS000308311221.004	Preliminary Geospatial Input Data for Infil V2.0 FY99	Qualified—Product Output
GS000308311221.006	Merged USGS Digital Elevation Model from Topopah Spring West and Busted Butte 7.5' DEMS	Qualified—Product Output

D-7. Input Data for MDL-NBS-HS-000023 REV 00, *Simulation of Net Infiltration for Present-Day and Potential Future Climates*

Data Tracking Number (DTN)	Description	Status
GS000100001221.001	EarthInfo, Inc. Western US Meteorologic Station Weather Data - NCDC Summary of Day (West 1) and NCDC Summary of Day (West 2).	Established Fact
GS000200001221.002	Precipitation Data for Nevada Test Site, 1957-1994, from Air Resources Laboratory, from National Oceanographic and Atmospheric Administration (NOAA) Precipitation Data	Established Fact
GS000200001221.003	NAD27 Datum of USGS Digital Elevation Model from Topopah Spring West and Busted Butte 7.5 Minute Quadrangles	Established Fact
GS000208312111.001	Precipitation Data for May 3, 1989 through September 30, 1994 from Weather Stations 1 and 3, Yucca Mountain, Nevada	Qualified
GS000208312111.002	Air Temperature Data for Calendar Year 1992 from Weather Station 1 (Wx-1), Yucca Mountain, Nevada	Qualified
GS000208312111.003	Precipitation Data for July 17, 1987 through May 2, 1989 from Weather Stations 1 and 3, Yucca Mountain, Nevada	Qualified
GS000300001221.009	Evapotranspiration Coefficients	Established Fact
GS000300001221.010	Preliminary Digital Geologic Map Database of the Nevada Test Site Area, Nevada by Sawyer and Wahl, 1995	Established Fact
GS000308315121.003	Meteorological Stations Selected to Represent Future Climate States at Yucca Mountain, Nevada	Qualified
GS000408312231.003	Relative Humidity Calculated Porosity Measurements on Samples from Borehole USW SD-9 Used for Saturated Hydraulic Conductivity	Qualified
GS000408312231.004	Data for Core Dried in RH Oven and 105C Oven for USW UZ-N31, UZ-N32, UZ-N33, UZ-N34, UZ-N35, UZ-N38, UZ-N58, UZ-N59, UE-25 UZN#63 and USW UZ-N64; Data for Core Dried in 105C Oven Only for USW UZ-N11, UZ-N15, UZ-N16, UZ-N17, UZ-N27, UZ-N36 and UZ-N37	Qualified
GS000508312231.005	UE-25 UZ#16 Pycnometer Data	Qualified
GS000508312231.006	Physical Properties and Water Content from Borehole USW NRG-6, 3/19/94 to 3/27/95	Qualified
GS000508312231.007	Physical Properties of Core Samples from Borehole USW UZ-14, from 03/09/94 to 07/11/94	Qualified
GS010408312111.001	Site Meteorology Data for Weather Stations UE-25 WX Stations 1 through 5, 10/1/94 - 10/1/95, Part II	Qualified
GS031208312211.001	FY95 Laboratory Measurements of Physical Properties of Surficial Material at Yucca Mountain, Part II	Qualified – Requires Verification
GS920508312231.012	USW UZ-N54 and USW UZ-N55 Core Analysis: Bulk Density, Porosity, Particle Density and In Situ Saturation for Core Dried in 105C Oven	Qualified
GS930108312231.006	USW UZ-N53 Core Analysis: Bulk Density, Porosity, Particle Density, and In-Situ Saturation for Core Dried in 105C Oven	Qualified

D-7. Input Data for MDL-NBS-HS-000023 REV 00, *Simulation of Net Infiltration for Present-Day and Potential Future Climates* (continued)

GS940408312231.004	Core Analysis of Bulk Density, Porosity, Particle Density, and In-Situ Saturation for 3 Neutron Boreholes, USW UZ-N57, UZ-N61, and UZ-N62	Qualified
GS940508312231.006	Core Analysis of Bulk Density, Porosity, Particle Density and In Situ Saturation for Borehole UE-25 UZ#16	Qualified
GS941208312121.001	Surface-Water Discharge Data for the Yucca Mountain Area, Southern Nevada and Southern California, 1994 Water Year	Qualified
GS950308312231.002	Laboratory Measurements of Core from USW SD-12 and Radial Boreholes	Qualified
GS950308312231.003	UE-25 UZ#16 Pycnometer Data	Qualified
GS950408312231.004	Physical Properties and Water Potentials of Core from Borehole USW SD-9	Qualified
GS950608312231.008	Moisture Retention Data from Boreholes USW UZ-N27 and UE-25 UZ#16	Qualified
GS950708312211.002	FY94 and FY95 Laboratory Measurements of Physical Properties of Surficial Materials at Yucca Mountain, Nevada	Qualified
GS950708312211.003	Fracture/Fault Properties for Fast Pathways Model	Qualified
GS951108312231.009	Physical Properties, Water Content, and Water Potential for Borehole USW SD-7	Qualified
GS951108312231.010	Physical Properties and Water Content for Borehole USW NRG-7/7A	Qualified
GS951108312231.011	Physical Properties, Water Content, and Water Potential for Borehole USW UZ-7A	Qualified
GS960108312211.002	Gravimetric and Volumetric Water Content and Rock Fragment Content of 31 Selected Sites at Yucca Mountain, NV: FY95 Laboratory Measurements of Physical Properties of Surficial Material at Yucca Mountain, Part III	Qualified
GS960508312212.007	Estimated Distribution of Geomorphic Surfaces and Depth to Bedrock for the Southern Half of the Topopah Spring NW 7.5 Minute Quadrangle and the Entire Busted Butte 7.5 Minute Quadrangle	Qualified
GS960808312231.001	Water Permeability and Relative Humidity Calculated Porosity for Boreholes UE-25 UZ-16 and USW UZ-N27	Qualified
GS960808312231.002	Relative Humidity Calculated Porosity Measurements on Samples from Borehole USW SD-9 Used for Saturated Hydraulic Conductivity	Qualified
GS960808312231.003	Moisture Retention Data for Samples from Boreholes USW SD-7, USW SD-9, USW SD-12 and UE-25 UZ#16	Qualified
GS960808312231.004	Physical Properties, Water Content and Water Potential for Samples from Lower Depths in Boreholes USW SD- 7 and USW SD-12	Qualified
GS960808312231.005	Water Permeability and Relative Humidity Calculated Porosity for Samples from Boreholes USW SD-7, USW SD-9, USW SD-12 and USW UZ-14	Qualified
GS960908312121.001	Surface-Water Discharge Data for the Yucca Mountain Area, Southern Nevada and Southern California, 1995 Water Year	Qualified
GS960908312211.003	Conceptual and Numerical Model of Infiltration at Yucca Mountain, Nevada	Qualified

D-7. Input Data for MDL-NBS-HS-000023 REV 00, *Simulation of Net Infiltration for Present-Day and Potential Future Climates* (continued)

GS970108312111.001	FY96 Site Meteorology Data: Relative Humidity, Temperature, Wind Speed, Wind Direction, Net Solar Radiation and Barometric Pressure from Two Weather Stations in the Yucca Mountain Area, Oct. 1 - Dec. 3, 1995	Qualified
GS971208314221.003	Revised Bedrock Geologic Map of the Central Block Area, Yucca Mountain, Nevada	Qualified
GS990408312231.001	Saturated Hydraulic Conductivity of Core from SD-9, 2/27 - 3/27/95	Qualified
MO0003COV00095.000	Coverage: Scotbons	Qualified
MO0109HYMXPROP.001	Matrix Hydrologic Properties Data	Qualified

D-8. Output Data for MDL-NBS-HS-000023 REV 00, *Simulation of Net Infiltration for Present-Day and Potential Future Climates*

Data Tracking Number (DTN)	Description	Status
GS000308311221.005	Net Infiltration Modeling Results for 3 Climate Scenarios FY99	Qualified—Product Output
GS000308311221.011	Template Files for Uncertainty Analyses	Qualified—Product Output
GS000308311221.010	Preliminary Developed Daily Climate Data From Tule Lake, California Used for Infiltration Uncertainty Analysis	Qualified—Product Output
GS000399991221.002	Rainfall Runoff/Run-on 1999 Simulations	Qualified—Product Output
GS000208311221.001	Yucca Mountain 1980-1995 Developed Daily Precipitation Record	Qualified—Product Output
GS000208311221.002	Preliminary Developed Daily Climate Data for Potential Future Monsoon and Glacial-Transition Climates Using Records from Selected Analog Sites	Qualified—Product Output
GS000308311221.004	Preliminary Geospatial Input Data for Infil V2.0 FY99	Qualified—Product Output
GS000308311221.006	Merged USGS Digital Elevation Model from Topopah Spring West and Busted Butte 7.5' DEMS	Qualified—Product Output
SN0407T0507804.001	Model Control Files For INFIL V A_2.A1, Submodel Denoted H104	Qualified—Product Output
SN0408T0507804.002	Model Control Files Of Streamflow Calibration For INFIL V 2.0, Submodel Denoted H104	Qualified—Product Output
SN0408T0507804.003	Output Flux Files Calculated Using INFIL V A_2.A1, Submodel Denoted H104	Qualified—Product Output
SN0408T0507804.004	Output Re-Calibration Files Calculated Using INFIL V A_2.A1 And INFIL V 2.0 (Daily Output Stream Flow Calibration Only) For The (2004) Submodel Denoted H104	Qualified—Product Output

Appendix E: Listing of Data Submitted to the Technical Data Management System by USGS Personnel Who Exchanged the Emails

Data Tracking Number (DTN)	Title	Status
GS940200012544.004	VERIFICATION OF A 1-DIMENSIONAL MODEL FOR PREDICTING SHALLOW INFILTRATION AT YUCCA MOUNTAIN.	Unqualified
GS950108312210.001	CLASS A PAN EVAPORATION DEPTH FOR 1/1/90 TO 9/30/94.	Unqualified – Prototype Data
GS000100001221.001	EARTHINFO, INC. WESTERN US METEOROLOGIC STATION WEATHER DATA - NCDC SUMMARY OF DAY (WEST 1) AND NCDC SUMMARY OF DAY (WEST 2).	Qualified – Established Fact
GS000200001221.002	PRECIPITATION DATA FOR NEVADA TEST SITE, 1957-1994, FROM AIR RESOURCES LABORATORY, FROM NATIONAL OCEANOGRAPHIC AND ATMOSPHERIC ADMINISTRATION (NOAA) PRECIPITATION DATA.	Qualified – Established Fact
GS000200001221.003	NAD27 DATUM USGS DIGITAL ELEVATION MODEL FROM TOPOPAH SPRING WEST AND BUSTED BUTTE 7.5 MINUTE QUADRANGLES.	Qualified – Established Fact
GS000200001221.005	DIGITAL VERSION OF GEOLOGIC MAP OF THE TOPOPAH SPRINGS QUADRANGLE, NYE COUNTY, NEVADA, GEOLOGICAL QUADRANGLE MAP GQ-444, BY CHRISTIANSEN, R.L. AND LIPMAN, P.W., 1965.	Unqualified – Preliminary Data
GS000208311221.001	YUCCA MOUNTAIN 1980-1995 DEVELOPED DAILY PRECIPITATION RECORD	Qualified – Product Output from ANL-NBS-HS-000032 (all versions) MDL-NBS-HS-000023 Rev 0
GS000208311221.002	DEVELOPED DAILY CLIMATE DATA FOR POTENTIAL FUTURE MONSOON AND GLACIAL TRANSITION CLIMATES USING RECORDS FROM SELECTED ANALOG SITES.	Qualified – Product Output from ANL-NBS-HS-000032 (all versions) MDL-NBS-HS-000023 Rev 0
GS000208311221.003	STOCHASTIC SIMULATIONS OF DAILY PRECIPITATION FOR STATIONS 4JA AND AREA 12MESA	Qualified – Product Output from ANL-NBS-HS-000032 (all versions)
GS000300001221.010	PRELIMINARY DIGITAL GEOLOGIC MAP DATABASE OF THE NEVADA TEST SITE AREA, NEVADA BY SAWYER AND WAHL, 1995	Qualified – Established Fact
GS000308311221.004	GEOSPATIAL INPUT DATA FOR INFIL V2.0 FY99	Qualified – Product Output from ANL-NBS-HS-000032 (all versions) MDL-NBS-HS-000023 Rev 0

Appendix E: Listing of Data Submitted to the Technical Data Management System by USGS Personnel Who Exchanged the Emails (continued)

Data Tracking Number (DTN)	Title	Status
GS000308311221.005	NET INFILTRATION MODELING RESULTS FOR 3 CLIMATE SCENARIOS FOR FY99.	Qualified – Product Output from ANL-NBS-HS-000032 (all versions) MDL-NBS-HS-000023 Rev 0
GS000308311221.006	MERGED USGS DIGITAL ELEVATION MODEL FROM TOPOPAH SPRING WEST AND BUSTED BUTTE 7.5' DEMS	Qualified – Product Output from ANL-NBS-HS-000032 (all versions) MDL-NBS-HS-000023 Rev 0
GS000308311221.008	ESTIMATES OF INPUT PARAMETER DISTRIBUTIONS USED FOR INFILTRATION UNCERTAINTY ANALYSIS	Qualified – Product Output from ANL-NBS-HS-000032 (all versions)
GS000308311221.010	DEVELOPED DAILY CLIMATE DATA FROM TULE LAKE, CALIFORNIA USED FOR INFILTRATION UNCERTAINTY ANALYSIS.	Qualified – Product Output from ANL-NBS-HS-000032 (all versions) MDL-NBS-HS-000023 Rev 0
GS000308311221.011	TEMPLATE FILES FOR UNCERTAINTY ANALYSIS	Qualified – Product Output from ANL-NBS-HS-000032 (all versions) MDL-NBS-HS-000023 Rev 0
GS000399991221.001	WATER POTENTIAL DATA FROM HEAT DISSIPATION PROBES IN ECRB HOLES FOR THE TOPOPAH SPRING LOWER NONLITHOPHYSAL, STATIONS 23+50 TO 25+85.7	Qualified
GS000399991221.002	RAINFALL/RUNOFF/RUN-ON 1999 SIMULATIONS	Qualified
GS010508311221.001	MEAN ANNUAL AIR TEMPERATURE USED FOR SIMULATION OF INFILTRATION FOR MODERN CLIMATE SCENARIO	Unqualified – Preliminary Data
GS010908312212.003	CLIMATE SCENARIO MODELING RESULTS FROM THE NET INFILTRATION MODEL INFILV2 FOR FY99 AND FY01 CONTAINING THE SOUTHERN EXTENSION OF THE POTENTIAL REPOSITORY	Unqualified – Preliminary Data
GS900908312211.001	GEOHYDROLOGIC AND DRILL-HOLE DATA FOR TEST WELL USW H-1, ADJACENT TO NEVADA TEST SITE, NYE COUNTY, NEVADA	Unqualified
GS900908312211.002	HYDROLOGIC, METEOROLOGICAL AND UNSATURATED-ZONE MOISTURE-CONTENT DATA, FRANKLIN LAKE PLAYA, INYO COUNTY, CALIFORNIA.	Unqualified
MO9101RIB00024.003	RIB ITEM#24/REV3: ENVIRONMENTAL CHARACTERISTICS: SEVERE WEATHER WIND CHARACTERISTICS.	Unqualified – Superseded by MO0101RIB00024.004

Appendix E: Listing of Data Submitted to the Technical Data Management System by USGS Personnel Who Exchanged the Emails (continued)

Data Tracking Number (DTN)	Title	Status
GS910808312212.001	GEOHYDROLOGIC DATA COLLECTED FROM SHALLOW NEUTRON-ACCESS BOREHOLES AND RESULTANT PRELIMINARY GEOHYDROLOGIC EVALUATIONS, YUCCA MOUNTAIN AREA, NYE COUNTY, NEVADA.	Unqualified
GS920108312211.001	LABORATORY AND FIELD MEASUREMENTS DONE ON SOIL/ALLUVIUM/COLLUVIUM SAMPLES TO DETERMINE PHYSICAL PROPERTIES AND FIELD GEOMORPHOLOGICAL OBSERVATIONS.	Unqualified
GS920108312212.004	DATA COLLECTED ON FIELD AND LAB EXPERIMENTS TO ASSESS SUITABILITY OF A COLLIMATED NEUTRON PROBE.	Unqualified
GS920108312231.001	CORE ANALYSES FOR VARIOUS WELLS IN NYE COUNTY.	Unqualified
GS920108312231.002	CORE ANALYSES FOR UZ-4 AND UZ-5 WELLS.	Unqualified
GS920108312231.003	ANALYSES FROM LABORATORY MEASUREMENTS OF CORE PHYSICAL AND HYDROLOGIC FLOW PROPERTIES OF VARIOUS WELLS IN NYE COUNTY.	Unqualified
GS920108312231.004	ANALYSES FOR LABORATORY MEASUREMENTS OF CORE PHYSICAL AND HYDROLOGIC FLOW PROPERTIES FOR VARIOUS WELLS IN NYE COUNTY.	Unqualified
GS920108312231.005	ANALYSES FOR LABORATORY MEASUREMENTS OF CORE PHYSICAL AND HYDROLOGIC FLOW PROPERTIES FOR VARIOUS WELLS IN NYE COUNTY.	Unqualified
GS920108312231.006	PRELIMINARY PERMEABILITY AND WATER-RETENTION DATA FOR NONWELDED AND BEDDED TUFF SAMPLES, YUCCA MOUNTAIN AREA, NYE COUNTY, NV.	Unqualified
GS920208312212.001	WEATHERSTATION DATA FOR YUCCA MOUNTAIN, NV FOR 1988 AND UP TO 5/2/89.	Unqualified
GS920208312212.002	WEATHERSTATION DATA FOR YUCCA MOUNTAIN, NV FOR 5/3/1989 TO 12/31/1989.	Qualified – Requires Data Verification
GS920208312212.003	PREDICTION OF ACTUAL SOLAR RADIATION USING MODELED CLEARSKY RADIATION AND AIR TEMPERATURE.	Unqualified
GS920508312231.010	COMPOSITE TRANSECT DATASET.	Unqualified
GS920508312231.011	USW GU-3 CORE ANALYSES.	Unqualified
GS920508312231.012	USW UZ-N54 AND USW UZ-N55 ANALYSIS, 105C OVEN-DRIED CORE	Qualified – Data Verified
GS920708312111.005	PRECIPITATION DEPTH, IN INCHES, COLLECTED USING A NETWORK OF NON-AUTOMATED, COLLECTOR-TYPE PLASTIC GAUGES.	Unqualified
GS920708312111.006	METEOROLOGICAL DATA CONSISTING OF WIND SPEED DIRECTION, AMBIENT AIR TEMPERATURE, RELATIVE HUMIDITY, NET SOLAR RADIATION, PRECIPITATION, AND BAROMETRIC PRESSURE.	Unqualified
GS921208312212.005	NEUTRON MOISTURE METER COUNTS FROM LOGS COLLECTED FROM 74 BOREHOLES AT YUCCA MOUNTAIN, NV, FROM THE TIME THEY WERE DRILLED UNTIL 5/2/89.	Unqualified

Appendix E: Listing of Data Submitted to the Technical Data Management System by USGS Personnel Who Exchanged the Emails (continued)

Data Tracking Number (DTN)	Title	Status
GS921208312212.006	NEUTRON MOISTURE METER COUNTS FROM LOGS COLLECTED FROM 74 BOREHOLES AT YUCCA MOUNTAIN NEVADA FROM 5/3/89 TO 9/30/91.	Qualified – Data Verified
GS921208312231.016	LABORATORY TEST RESULTS FOR CORE SAMPLES FROM TWO-DIMENSIONAL SHARDY BASE TRANSECT.	Unqualified
GS921208312231.017	INFLUENCE OF DETERMINISTIC GEOLOGIC TRENDS ON SPATIAL VARIABILITY OF HYDROLOGIC PROPERTIES OF VOLCANIC TUFF.	Unqualified
GS930108312111.001	METEOROLOGICAL DATA CONSISTING OF AMBIENT AIR TEMPERATURE AND NET SOLAR RADIATION.	Unqualified
GS930108312111.002	METEOROLOGICAL DATA COLLECTED AT FIVE WEATHER STATIONS PLUS FOUR ADDITIONAL PRECIP. SITES BETWEEN 10/1/91, AND 9/30/92.	Unqualified – Superseded by GS950208312111.001
GS930108312111.003	PRECIPITATION DEPTH, IN INCHES, FOR EVENTS BETWEEN 10/1/91 AND 9/30/92.	Unqualified
GS930108312111.004	PRECIPITATION DEPTH, IN INCHES, FOR EVENTS BETWEEN 10/1/92 AND 10/07/92, COLLECTED USING A NON-AUTOMATED, COLLECTOR-TYPE PLASTIC GAUGE AT UE-25 UZN #7.	Unqualified
GS930108312211.001	USE OF STATISTICALLY DISTINCT GENESIS-LITHOLOGY-QUALIFIER MAP UNITS FOR CLASSIFYING UPLAND SOILS AT YUCCA MOUNTAIN, NEVADA, BY GEOMORPHOLOGY AND PHYSICAL PROPERTIES AFFECTING INFILTRATION.	Unqualified
GS930108312212.001	THE INFLUENCE OF LONG-TERM CLIMATE CHANGE ON NET INFILTRATION AT YUCCA MOUNTAIN, NEVADA.	Unqualified
GS930108312212.004	THE INFLUENCE OF SEASONAL CLIMATIC VARIABILITY ON SHALLOW INFILTRATION AT YUCCA MOUNTAIN.	Unqualified – Superseded by GS940708312212.011
GS930108312231.001	MOISTURE RETENTION DATA COLLECTED ON COMPOSITE TRANSECT DATASET USING CHILLED-MIRROR PSYCHROMETER.	Unqualified
GS930108312231.006	USW UZ-N53 ANALYSIS, 105C OVEN-DRIED CORE	Qualified – Data Verified
GS930200012547.001	PHYSICAL AND FLOW PROPERTIES OF 100 CORE SAMPLES FROM CALICO HILLS AND TOPOPAH SPRING UNITS USED IN A STUDY ON THE EFFECTS OF HIGH TEMPERATURE ON HYDROLOGIC PROPERTIES OF VOLCANIC TUFF.	Unqualified
GS930208312232.008	CALCULATED SORPTIVITY VALUES FROM EXPERIMENTAL IMBIBITION DATA USING PHILIP'S SORPTIVITY EQUATION.	Unqualified
MO9303RIB00010.003	GEOLOGIC CHARACTERISTICS: ROCK MATRIX HYDROLOGIC CONDUCTIVITY.	Unqualified
MO9303RIB00023.003	RIB ITEM#23/REV3: ENVIRONMENTAL CHARACTERISTICS: AMBIENT ATMOSPHERIC CONDITIONS.	Unqualified
MO9303RIB00025.003	RIB ITEM#25/REV3: ENVIRONMENTAL CHARACTERISTICS: PRECIPITATION CHARACTERISTICS.	Unqualified – Superseded by MO9808RIB00025.004

Appendix E: Listing of Data Submitted to the Technical Data Management System by USGS Personnel Who Exchanged the Emails (continued)

Data Tracking Number (DTN)	Title	Status
GS930408312111.005	PRECIPITATION ESTIMATION IN MOUNTAINOUS TERRAIN USING MULTIVARIATE GEOSTATISTICS, PART II: ISOHYETAL MAPS.	Unqualified
GS930808312231.005	SPATIAL VARIABILITY IN HYDROLOGIC PROPERTIES OF A VOLCANIC TUFF.	Unqualified
GS940100012544.001	PHYSICAL PROPERTIES LABORATORY DATA OF CORE SAMPLES FROM OUTCROP ROCKS OF CALICO HILLS AND TOPOPAH SPRING GEOLOGIC FORMATIONS.	Unqualified
GS940100012544.002	WATER RETENTION DATA FROM SAMPLES USED FOR HIGH TEMPERATURE STUDY.	Unqualified
GS940100012544.003	HYDROLOGIC PROPERTY ALTERATIONS DUE TO ELEVATED TEMPERATURES AT YUCCA MOUNTAIN.	Unqualified
GS940108312111.001	PRECIPITATION QUANTITY (DEPTH) IN INCHES, FOR STORM EVENTS BETWEEN 10/1/92 AND 9/30/93.	Qualified – Requires Data Verification
GS940108312111.002	PRECIPITATION DATA.	Unqualified
GS940108312111.003	METEOROLOGICAL DATA FROM FIVE SITES.	Unqualified – Superseded by GS950208312111.001
GS940108312211.001	CHARACTERIZATION OF A DESERT SOIL SEQUENCE AT YUCCA MTN, NEVADA.	Unqualified
GS940108312211.002	GEOPHYSICAL LOGS FROM UE-25 UZN #85 AT YUCCA MOUNTAIN, NV.	Unqualified
GS940108312212.001	NEUTRON MOISTURE METER COUNTS COLLECTED FROM UE-29 UZN #91 AND UE-29 UZN #92 NEAR YUCCA MOUNTAIN, NEVADA, FROM 10/01/91 TO 09/30/93.	Unqualified
GS940108312212.003	NEUTRON MOISTURE METER COUNTS FROM LOGS COLLECTED FROM 99 BOREHOLES AT YUCCA MOUNTAIN FROM OCT. 1, 1991, OR FROM THE TIME THEY WERE DRILLED, UNTIL DEC. 31, 1993.	Qualified – Data Verified
GS940108312212.005	SPATIAL DISTRIBUTION OF POTENTIAL NEAR SURFACE MOISTURE AT YUCCA MOUNTAIN, NEVADA.	Unqualified – Superseded by GS940708312212.011
GS940108312212.006	SHALLOW INFILTRATION PROCESSES IN ARID WATERSHEDS AT YUCCA MOUNTAIN, NEVADA.	Unqualified – Superseded by GS940708312212.011
GS940108312213.001	NEUTRON MOISTURE METER COUNTS FOR THE PONDING AND REDISTRIBUTION EXPERIMENTS FROM LOGS COLLECTED AT UE-25 UZN #85 AT YUCCA MOUNTAIN.	Unqualified
GS940108312213.002	VOLUMETRIC WATER CONTENTS FROM NEUTRON MOISTURE METER COUNTS FROM LOGS COLLECTED AT UE-25 UZN #85 AT YUCCA MOUNTAIN, NV.	Unqualified
GS940108312213.003	SOIL DESCRIPTIONS, PARTICLE SIZE ANALYSIS, HYDRAULIC CONDUCTIVITY AND WATER RETENTION FOR PROFILE AT UE-25 UZN #85 YUCCA MOUNTAIN, NV.	Unqualified
GS940108312213.006	PULSE METER OUTFLOW MEASUREMENTS IN GALLONS AND LITERS OF WATER SUPPLIED TO A LARGE RING INFILTROMETER AT UE-25 UZN #85 AT YUCCA MOUNTAIN, NV.	Unqualified

Appendix E: Listing of Data Submitted to the Technical Data Management System by USGS Personnel Who Exchanged the Emails (continued)

Data Tracking Number (DTN)	Title	Status
GS940108312213.007	VOLUME OUTFLOW MEASUREMENTS (IN CM/HR) FROM SUPPLY TANKS FOR RING INFILTROMETER.	Unqualified
GS940108312213.008	CUMULATIVE INFILTRATION AND SURFACE FLUX VALUES CALCULATED AT SELECTED RING INFILTRATION EXPERIMENTAL LOCATIONS.	Unqualified
GS940108312213.010	MODELING A PONDED INFILTRATION EXPERIMENT AT YUCCA MOUNTAIN, NEVADA.	Unqualified
GS940108312231.001	PHYSICAL AND HYDROLOGIC PROPERTIES OF 686 SURFACE OUTCROP SAMPLES FROM 8 TRANSECTS.	Unqualified
GS940108312231.002	DATA FOR CORE DRIED IN RH OVEN AND 105C OVEN FOR USW UZ-N31, UZ-N32, UZ-N33, UZ-N34, UZ-N35, UZ-N38, UZ-N58, UZ-N59, UE-25 UZN#63 AND USW UZ-N64; DATA FOR CORE DRIED IN 105C OVEN ONLY FOR USW UZ-N11, UZ-N15, UZ-N16, UZ-N17, UZ-N27, UZ-N36 AND UZ-N37.	Unqualified – Superseded by GS000408312231.004
GS940108312231.003	PHYSICAL AND HYDROLOGIC PROPERTIES OF TOPOPAH SPRING TUFF USED FOR FRACTURE/MATRIX INTERACTION STUDY.	Unqualified
GS940208312111.004	A PRELIMINARY CHARACTERIZATION OF THE SPATIAL VARIABILITY OF PRECIPITATION AT YUCCA MOUNTAIN, NEVADA.	Unqualified
GS940308312211.003	SLOPE, ASPECT AND SURROUNDING TOPOGRAPHY ALONG THREE TRANSECTS AT WT-2 WASH (UNNAMED WASH IN THE VICINITY OF USW WT-2).	Unqualified
GS940308312211.004	TEMPORAL MEASUREMENTS OF GRAVIMETRIC WATER CONTENT AND WATER POTENTIAL AT EACH LOCATION ALONG THREE TRANSECTS AT (UN-NAMED) WT-2 WASH.	Unqualified
GS940308312211.005	PHYSICAL PROPERTIES FOR THE TOP 30 CM OF THE UNCONOLIDATED MATERIALS FOR (UN-NAMED) WT-2 WASH.	Unqualified
GS940308312211.006	BULK DENSITY, MASS WETNESS, AND VOLUMETRIC WATER CONTENTS FROM PAGANY WASH AREA.	Unqualified
GS940308312212.007	CALCULATED DAILY RADIATION LOAD FOR THE THREE TRANSECTS AT (UNNAMED) WT-2 WASH.	Unqualified
GS940308312213.007	WATER CONTENT AND WATER POTENTIAL FOR THE TOP FEW INCHES OF THE SURFICIAL MATERIALS AT A LOCATION CLOSE TO EACH OF 90 BOREHOLES IN THE YUCCA MOUNTAIN AREA.	Unqualified
GS940408312231.004	CORE ANALYSIS OF BULK DENSITY, POROSITY, PARTICLE DENSITY, AND IN-SITU SATURATION FOR 3 NEUTRON BOREHOLES, USW UZ-N57, UZ-N61, AND UZ-N62.	Qualified – Data Verified
GS940408312231.005	CURVE FITS FOR MOISTURE RETENTION DATA COLLECTED ON COMPOSITE TRANSECT DATASET.	Qualified – Data Verified
GS940508312231.006	CORE ANALYSIS OF BULK DENSITY, POROSITY, PARTICLE DENSITY AND IN SITU SATURATION FOR BOREHOLE UE-25 UZ#16.	Qualified – Data Verified
GS940508312231.007	LAB ANALYSES OF CORE FROM 10 NEUTRON HOLES USING RELATIVE HUMIDITY DRY WEIGHTS.	Unqualified

Appendix E: Listing of Data Submitted to the Technical Data Management System by USGS Personnel Who Exchanged the Emails (continued)

Data Tracking Number (DTN)	Title	Status
GS940708312212.010	VOLUMETRIC WATER CONTENT FROM NEUTRON MOISTURE METER COUNTS FOR 74 BOREHOLES FROM THE TIME THEY WERE DRILLED UNTIL 5/2/89.	Unqualified
GS940708312212.011	VOLUMETRIC WATER CONTENT FROM NEUTRON MOISTURE METER COUNTS FOR 99 BOREHOLES FROM 5/3/89 OR FROM THE TIME THEY WERE DRILLED UNTIL 12/31/93.	Qualified – Data Verified
GS940708312213.012	PRELIMINARY INFILTRATION DATA FOR UNCONSOLIDATED SURFACE MATERIALS.	Unqualified
GS940808312231.007	PHYSICAL & HYDROLOGIC PROPERTIES OF ROCK OUTCROP SAMPLES FROM A NONWELDED TO WELDED TUFF TRANSITIONS, YUCCA MOUNTAIN, NEVADA.	Unqualified
GS940808312231.008	PHYSICAL & HYDROLOGIC PROPERTIES OF ROCK OUTCROP SAMPLES AT YUCCA MOUNTAIN, NEVADA.	Unqualified
GS941008312212.014	SHALLOW INFILTRATION PROCESSES AT YUCCA MOUNTAIN, NEVADA -- NEUTRON LOGGING DATA 1984-93.	Unqualified
GS941008312212.015	GRAVIMETRIC WATER CONTENT AND WATER POTENTIAL COLLECTED FROM 43 SHALLOW NEUTRON-ACCESS BOREHOLES, YUCCA MOUNTAIN AREA, NYE COUNTY, NEVADA.	Unqualified
GS941108312212.016	PHYSICAL PROPERTIES OF CORE SAMPLES FROM BOREHOLES UE-25 UZN#10, USW UZ-N24, USW UZ-N46, USW UZ-N47, AND USW UZ-N98.	Unqualified
GS941108312213.014	NEUTRON COUNTS FOR 5 BOREHOLES USED IN THE UE-25 UZN#7 PONDING EXPERIMENT.	Qualified – Requires Data Verification
GS941208312111.006	FY94 SYNOPTIC/SITE METEOROLOGICAL DATA.	Unqualified
GS950208312111.001	METEOROLOGICAL DATA FOR YEARS 1987 - 94 FROM FIVE WEATHER STATIONS AT YUCCA MOUNTAIN, NEVADA.	Unqualified
GS950208312111.002	WEATHER STATION DATA FROM 9/12/90 TO 9/30/94	Unqualified – Superseded by GS950208312111.001
GS950308312213.001	FY94 BOREHOLE GEOPHYSICAL LOGGING GAMMA-GAMMA COUNTS.	Qualified – Requires Data Verification
GS950308312213.002	FY94 BOREHOLE ASSUMED DENSITY AND GEOPHYSICAL LOGGING CALIBRATION EQUATIONS.	Qualified – Requires Data Verification
GS950308312213.003	GRAVIMETRIC WATER CONTENT OF SELECTED SURFICIAL MATERIAL SAMPLES.	Qualified – Requires Data Verification
GS950308312213.004	CUMULATIVE INFILTRATION AND SURFACE FLUX RATES CONDUCTED IN FORTYMILE WASH AND NEAR UE-25 UZN#7.	Qualified – Data Verified
GS950708312111.003	FY94 SUMMARY OF PRECIPITATION DATA FROM THE NON-RECORDING GAGE NETWORK AT YUCCA MOUNTAIN, NEVADA.	Qualified – Data Verified
GS950708312211.002	FY94 AND FY95 LABORATORY MEASUREMENTS OF PHYSICAL PROPERTIES OF SURFICIAL MATERIALS AT YUCCA MOUNTAIN, NEVADA.	Qualified – Data Verified

Appendix E: Listing of Data Submitted to the Technical Data Management System by USGS Personnel Who Exchanged the Emails (continued)

Data Tracking Number (DTN)	Title	Status
GS950708312211.003	FRACTURE/FAULT PROPERTIES FOR FAST PATHWAYS MODEL.	Qualified – Data Verified
GS950808312212.001	VOLUMETRIC WATER CONTENT CALCULATED FROM FIELD CALIBRATION EQUATIONS USING NEUTRON COUNTS FROM 97 BOREHOLES AT YUCCA MOUNTAIN FROM 1 OCT 94 TO 31 MAY 95	Qualified – Data Verified
GS950908312211.004	LABORATORY MEASUREMENTS OF WATER RETENTION DATA, 1 OCT 94 TO 28 AUG 95.	Qualified – Requires Data Verification
GS951208312210.003	CLASS A PAN EVAPORATION DEPTH FOR 5/15/95 TO 9/22/95.	Unqualified
GS960108312111.001	GEOSTATISTICAL MODEL FOR ESTIMATING PRECIPITATION AND RECHARGE IN THE YUCCA MOUNTAIN REGION, NEVADA - CALIFORNIA.	Unqualified
GS960108312211.001	FY95 LABORATORY MEASUREMENTS OF PHYSICAL PROPERTIES OF SURFICIAL MATERIAL AT YUCCA MOUNTAIN, PART II.	Qualified – Data Verified
GS960108312211.002	GRAVIMETRIC AND VOLUMETRIC WATER CONTENT AND ROCK FRAGMENT CONTENT OF 31 SELECTED SITES AT YUCCA MOUNTAIN, NV: FY95 LABORATORY MEASUREMENTS OF PHYSICAL PROPERTIES OF SURFICIAL MATERIAL AT YUCCA MOUNTAIN, PART III.	Qualified – Data Verified
GS960108312212.001	VOLUMETRIC WATER CONTENT CALCULATED FROM FIELD CALIBRATION EQUATIONS USING NEUTRON COUNTS FROM 97 BOREHOLES AT YUCCA MOUNTAIN.	Qualified – Data Verified
GS960408312212.002	ESTIMATED ANNUAL SHALLOW INFILTRATION AT 61 NEUTRON ACCESS BOREHOLES AT YUCCA MOUNTAIN, NEVADA, DURING THE WATER YEARS 1985 TO 1989	Unqualified
GS960408312212.003	ESTIMATED ANNUAL PRECIPITATION AT 98 NEUTRON ACCESS BOREHOLES AT YUCCA MOUNTAIN, NEVADA, DURING THE YEARS 1985 TO 1995.	Unqualified
GS960408312212.004	ESTIMATED DISTRIBUTION OF ANNUAL PRECIPITATION AND SHALLOW INFILTRATION FOR THE SOUTHERN HALF OF THE TOPOPAH SPRING NW 7.5 MINUTE QUADRANGLE AND THE ENTIRE BUSTED BUTTE 7.5 MINUTE QUADRANGLE.	Unqualified
GS960408312212.005	PRELIMINARY SURFICIAL MATERIALS PROPERTIES MAP: SOILS OF THE YUCCA MOUNTAIN AREA, NEVADA.	Qualified – Data Verified
GS960508312111.002	DRAFT REPORT ENTITLED ANALYSIS OF REGIONAL PRECIPITATION AND SYNOPTIC-SCALE WEATHER PATTERNS DURING WATER YEARS 1992 AND 1993 FOR THE YUCCA MOUNTAIN REGION, NEVADA-CALIFORNIA.	Unqualified
GS960508312212.007	ESTIMATED DISTRIBUTION OF GEOMORPHIC SURFACES AND DEPTH TO BEDROCK FOR THE SOUTHERN HALF OF THE TOPOPAH SPRING NW 7.5 MINUTE QUADRANGLE AND THE ENTIRE BUSTED BUTTE 7.5 MINUTE QUADRANGLE.	Qualified – Data Verified
GS960508312212.008	ESTIMATED ANNUAL SHALLOW INFILTRATION AT 84 NEUTRON ACCESS BOREHOLES AT YUCCA MOUNTAIN, NEVADA DURING THE WATER YEARS 1990 TO 1995	Qualified – Requires Data Verification

Appendix E: Listing of Data Submitted to the Technical Data Management System by USGS Personnel Who Exchanged the Emails (continued)

Data Tracking Number (DTN)	Title	Status
GS960808312111.003	BAROMETRIC PRESSURE DATA COLLECTED AT WEATHER STATION 3, WATER YEAR 1995: FY95 METEOROLOGY DATA, PART 1.	Qualified – Requires Data Verification
GS960908312111.004	FY95 SITE METEOROLOGY DATA, PART II.	Qualified – Superseded by GS010408312111.001
GS960908312211.004	HEAT DISSIPATION PROBE DATA: BLEACH BONE RIDGE 3/95 - 11/95.	Qualified – Data Verified
GS960908312212.009	CUMULATIVE INFILTRATION AND SURFACE FLUX RATES CALCULATED ON RAW MILLIVOLT READINGS FOR FY95.	Qualified – Data Verified
GS960908312212.010	SHALLOW INFILTRATION.	Unqualified
GS970108312111.001	FY96 SITE METEOROLOGY DATA: RELATIVE HUMIDITY, TEMPERATURE, WIND SPEED, WIND DIRECTION, NET SOLAR RADIATION AND BAROMETRIC PRESSURE FROM TWO WEATHER STATIONS IN THE YUCCA MOUNTAIN AREA, OCT. 1 - DEC. 3, 1995.	Qualified – Data Verified
GS970108312111.002	PRECIPITATION DATA FROM THE NON-RECORDING GAGE NETWORK AT YUCCA MOUNTAIN, NV, FOR WATER YEAR 1995 (OCT 1, 1994 TO SEPT 30, 1995).	Qualified – Requires Data Verification
GS970208312242.001	MOISTURE MONITORING IN THE ESF, OCT. 1, 1996 THROUGH JAN. 31, 1997.	Qualified – Requires Data Verification, TBV# 5678
GS970308312111.003	PRECIPITATION RATE MEASUREMENTS FROM 11 LOCATIONS AT YUCCA MOUNTAIN, NV, OCT. 1, 1994 TO SEP. 30, 1996.	Qualified – Requires Data Verification
GS970708312242.002	MOISTURE MONITORING IN THE ESF, FEB. 1, 1997 THROUGH JULY 31, 1997.	Qualified – Requires Data Verification, TBV# 5679
GS970808312242.003	MEASUREMENT OF EVAPORATION FROM A FREE WATER SURFACE IN THE ESF NEAR ALCOVE 3, SEPTEMBER 9, 1996 TO JULY 24, 1997.	Qualified – Requires Data Verification
GS970908312242.004	MEASUREMENT OF NET RADIATION USING EPPLEY PRECISION SPECTRAL PYRANOMETERS (PSP) AND PRECISION INFRARED RADIOMETERS (PIR) IN SPLIT WASH.	Qualified – Requires Data Verification
GS970908312242.005	SOLAR RADIATION AND SOIL WATER POTENTIAL MEASURED ON A NORTH-FACING SLOPE AND ON A SOUTH-FACING SLOPE.	Qualified – Requires Data Verification
GS970908312242.007	HEAT DISSIPATION PROBE MEASUREMENTS IN ALCOVE 3 OF THE ESF.	Qualified – Requires Data Verification
GS970908312242.008	TIME DOMAIN REFLECTOMETRY MEASUREMENTS IN ALCOVE 3 OF THE ESF.	Qualified – Requires Data Verification
GS970908312242.009	TIME DOMAIN REFLECTOMETRY MEASUREMENTS IN THE SOUTH RAMP OF THE ESF AT STATION 67+00	Qualified – Requires Data Verification
GS970908312242.010	HEAT DISSIPATION PROBE MEASUREMENTS IN THE SOUTH RAMP OF THE ESF AT STATIONS 66+99, 67+21 AND 67+33	Qualified – Requires Data Verification
GS970908312242.011	TENSIOMETER MEASUREMENTS IN THE SOUTH RAMP OF THE ESF AT STATIONS 66+99, 67+21 AND 67+33.	Qualified – Requires Data Verification

Appendix E: Listing of Data Submitted to the Technical Data Management System by USGS Personnel Who Exchanged the Emails (continued)

Data Tracking Number (DTN)	Title	Status
GS970908312242.012	SOIL WATER POTENTIAL MEASURED AT 4 DEPTHS AT THE HEAD OF PAGANY WASH ON YUCCA MOUNTAIN FROM 12/1/95 TO 7/31/97.	Qualified – Requires Data Verification
GS980108312111.001	GEOSTATISTICAL ESTIMATES OF FUTURE RECHARGE FOR THE DEATH VALLEY BASIN.	Unqualified
GS980308312242.001	TIME DOMAIN REFLECTOMETRY MEASUREMENTS IN THE SOUTH RAMP OF THE ESF, AUGUST 1, 1997 TO JANUARY 4, 1998.	Qualified – Requires Data Verification
GS980308312242.002	HEAT DISSIPATION PROBE MEASUREMENTS IN THE SOUTH RAMP OF THE ESF, AUGUST 1, 1997 TO JANUARY 31, 1998.	Qualified – Requires Data Verification
GS980308312242.003	PHYSICAL PROPERTIES OF BOREHOLE SAMPLES FROM THE ESF SOUTH RAMP (ESF STATION 59+65 M TO ESF STATION 76+33 M).	Qualified – Requires Data Verification
GS980308312242.004	WATER POTENTIAL MEASUREMENTS USING THE FILTER PAPER TECHNIQUE FOR BOREHOLE SAMPLES FROM THE ESF NORTH RAMP (ESF STATION 7+27 M TO ESF STATION 10+70 M) AND THE ESF SOUTH RAMP (ESF STATION 59+65 M TO 76+33 M).	Qualified – Requires Data Verification
GS980308312242.005	PHYSICAL PROPERTIES OF LEXAN-SEALED BOREHOLE SAMPLES FROM THE PTN EXPOSURE IN THE ESF NORTH RAMP (ESF STATION 7+27 M TO ESF STATION 10+70 M).	Qualified – Data Verified
GS980308312242.006	PHYSICAL PROPERTIES OF SURFACE SAMPLES FROM THE PTN EXPOSURE IN THE ESF NORTH RAMP (ESF STATION 7+09 M TO ESF STATION 10+95 M).	Qualified – Requires Data Verification
GS980308312242.007	WATER POTENTIALS MEASURED WITH HEAT DISSIPATION PROBES IN EIGHT DRILL HOLES IN ESF ALCOVE 7 (SGDFA) FROM 12/09/97 TO 01/31/98 AND IN TWENTY-ONE DRILL HOLES IN NICHE 1 (ESF-NICHE3566) FROM 11/04/97 TO 01/31/98.	Qualified – Superseded by GS980908312242.022
GS980408312242.009	TEMPERATURE, RELATIVE HUMIDITY AND BAROMETRIC PRESSURE DATA FOR ESF-NICHE3566 (NICHE 1) AND ESF-NICHE3650 (NICHE 2) FROM 06/27/97 TO 01/31/98.	Qualified – Requires Data Verification
GS980808312242.016	PHYSICAL PROPERTIES OF SURFACE SAMPLES FROM ESF ALCOVE 7 (0+30 TO 2+00).	Qualified – Requires Data Verification
GS980808312242.017	EVAPOTRANSPIRATION MEASURED AT JACKASS FLATS BY THE EDDY CORRELATION TECHNIQUE	Unqualified
GS980908312242.018	PHYSICAL PROPERTIES OF BOREHOLE CORE SAMPLES FROM ESF-MD-NICHE3566#1, ESF-MD-NICHE3566#2, ESF-MD-NICHE3566#3A, ESF-MD-NICHE3566LT#1, ESF-MD-NICHE356LT#2, ESF-MD-NICHE3566LT#3, ESF-MD-NICHE3566LT#4, ESF-MD-NICHE3566LT#5, AND ESF-MD-NICHE3566LT#6.	Qualified – Requires Data Verification
GS980908312242.019	PHYSICAL PROPERTIES OF BOREHOLE CORE SAMPLES FROM ESF-MD-NICHE3107#1, ESF-MD-NICHE3107#2, ESF-MD-NICHE3107#3, ESF-MD-NICHE3107#4, ESF-MD-NICHE3107#5, ESF-MD-NICHE3107#6, AND ESF-MD-NICHE3107#7.	Qualified – Requires Data Verification

Appendix E: Listing of Data Submitted to the Technical Data Management System by USGS Personnel Who Exchanged the Emails (continued)

Data Tracking Number (DTN)	Title	Status
GS980908312242.020	PHYSICAL PROPERTIES OF BOREHOLE CORE SAMPLES FROM ESF-MD-NICHE3650#1, ESF-MD-NICHE3650#2, ESF-MD-NICHE3650#3, ESF-MD-NICHE3650#4, ESF-MD-NICHE3650#5, ESF-MD-NICHE3650#6, AND ESF-MD-NICHE3650#7.	Qualified – Requires Data Verification
GS980908312242.021	TEMPERATURE, RELATIVE HUMIDITY AND BAROMETRIC PRESSURE DATA FOR NICHE 1 (ESF-NICHE3566) AND NICHE 2 (ESF-NICHE3650) OF THE ESF FROM 02/01/98 TO 07/31/98.	Qualified – Requires Data Verification
GS980908312242.022	WATER POTENTIALS MEASURED WITH HEAT DISSIPATION PROBES IN TWENTY-ONE DRILL HOLES IN NICHE 1 (ESF-NICHE3566) FROM 11/04/97 TO 07/31/98.	Qualified – Requires Data Verification
GS980908312242.023	SOIL WATER POTENTIAL MEASURED AT 4 DEPTHS AT THE HEAD OF PAGANY WASH FROM 08/01/97 TO 7/31/98.	Qualified – Requires Data Verification
GS980908312242.024	MOISTURE MONITORING IN THE ESF, AUGUST 1, 1997 TO JULY 31, 1998.	Qualified – Requires Data Verification, TBV# 5680
GS980908312242.025	MEASUREMENT OF NET RADIATION USING EPPLEY PRECISION SPECTRAL PYRANOMETERS (PSP) AND PRECISION INFRARED RADIOMETERS (PIR) IN SPLIT WASH FROM 08/01/97 TO 07/31/98.	Qualified – Requires Data Verification
GS980908312242.026	PRECIPITATION MEASURED AT JACKASS FLATS FROM 06/03/97 TO 08/31/98 AND AT WT-2 WASH FROM 12/15/97 TO 08/31/98.	Qualified – Requires Data Verification
GS980908312242.028	PHYSICAL AND HYDROLOGIC PROPERTIES OF BOREHOLE CORE SAMPLES FROM ESF-SAD-GTB#1.	Qualified – Requires Data Verification
GS980908312242.029	PHYSICAL AND HYDROLOGIC PROPERTIES OF BOREHOLE CORE SAMPLES FROM ESF-NDR-MF#1, ESF-NDR-MF#2 AND ESF-NDR-MF#4 IN ALCOVE 6 OF THE ESF.	Qualified – Requires Data Verification
GS980908312242.030	PHYSICAL PROPERTIES OF BOREHOLE CORE SAMPLES FROM ESF-ECRB-SLANT#2.	Qualified – Requires Data Verification
GS980908312242.032	PHYSICAL AND HYDROLOGIC PROPERTIES OF BOREHOLE CORE SAMPLES AND WATER POTENTIAL MEASUREMENTS USING THE FILTER PAPER TECHNIQUE FOR BOREHOLE SAMPLES FROM ESF-LPCA-PTN#1 AND ESF-LPCA-PTN#2 IN ALCOVE 4.	Qualified – Requires Data Verification
GS980908312242.033	PHYSICAL AND HYDROLOGIC PROPERTIES OF BOREHOLE CORE SAMPLES AND WATER POTENTIAL MEASUREMENTS USING THE FILTER PAPER TECHNIQUE FOR BOREHOLE SAMPLES FROM ESF-UPCA-PTN#1 IN ALCOVE 3 OF THE ESF.	Qualified – Requires Data Verification
GS980908312242.034	PHYSICAL PROPERTIES OF BOREHOLE CORE SAMPLES AND WATER POTENTIAL MEASUREMENTS USING THE FILTER PAPER TECHNIQUE FOR BOREHOLE SAMPLES FROM ECRB-CWAT#1, ECRB-CWAT#2, AND ECRB-CWAT#3.	Qualified – Requires Data Verification
GS980908312242.035	MOISTURE MONITORING IN THE ECRB, 04/08/98 TO 07/31/98.	Qualified – Requires Data Verification

Appendix E: Listing of Data Submitted to the Technical Data Management System by USGS Personnel Who Exchanged the Emails (continued)

Data Tracking Number (DTN)	Title	Status
GS980908312242.036	WATER POTENTIALS MEASURED WITH HEAT DISSIPATION PROBES IN ECRB HOLES FROM 4/23/98 TO 7/31/98.	Qualified – Requires Data Verification
GS980908312242.037	WATER RETENTION DATA OF LEXAN-SEALED BOREHOLE SAMPLES AND SURFACE SAMPLES FROM ESF NORTH RAMP MOISTURE STUDY.	Qualified – Data Verified
GS980908312242.038	PHYSICAL PROPERTIES AND SATURATED HYDRAULIC CONDUCTIVITY MEASUREMENTS OF LEXAN-SEALED SAMPLES FROM USW SD-6.	Qualified – Data Verified
GS980908312242.039	UNSATURATED WATER RETENTION DATA FOR LEXAN-SEALED SAMPLES FROM USW SD-6 MEASURED USING A CENTRIFUGE.	Qualified – Data Verified
GS980908312242.040	PHYSICAL PROPERTIES AND SATURATED HYDRAULIC CONDUCTIVITY MEASUREMENTS OF CORE PLUGS FROM LEXAN-SEALED SAMPLES FROM BOREHOLES IN THE ESF NORTH RAMP.	Qualified – Data Verified
GS980908312242.041	PHYSICAL PROPERTIES AND SATURATED HYDRAULIC CONDUCTIVITY MEASUREMENTS OF CORE PLUGS FROM BOREHOLES USW SD-7, USW SD-9, USW SD-12, USW UZ-14, AND UE-25 UZ#16.	Qualified – Data Verified
GS990108312242.001	MOISTURE MONITORING IN THE ESF, 8/98 - 12/98	Qualified – Requires Data Verification, TBV# 5681
GS990108312242.002	TEMPERATURE AND RELATIVE HUMIDITY DATA FOR NICHE 1 (ESF-NICHE3566) AND NICHE 2 (ESF-NICHE3650) OF THE ESF FROM AUGUST 1, 1998 TO DECEMBER 12, 1998.	Unqualified
GS990108312242.004	TEMPERATURE, RELATIVE HUMIDITY, AND BAROMETRIC PRESSURE MEASURED AT ALCOVE 1 FROM 11/20/97 TO 12/12/98	Qualified – Requires Data Verification
GS990108312242.005	TEMPERATURE, RELATIVE HUMIDITY AND BAROMETRIC PRESSURE DATA FOR ALCOVE 7 OF THE ESF FROM 12/08/97 TO 12/12/98.	Unqualified
GS990108312242.006	PULSE FLOW METER DATA FOR THE ALCOVE 1 INFILTRATION EXPERIMENT FROM 03/08/98 TO 12/04/98.	Qualified – Requires Data Verification
GS990908312111.001	PRECIPITATION DATA, 1/19/99 - 7/31/99	Qualified – Requires Data Verification
GS990908312242.009	TEMPERATURE AND RELATIVE HUMIDITY FOR SURFACE AT ESF ALCOVE 1, 3/98 - 10/98	Qualified – Requires Data Verification
GS990908312242.010	MOISTURE MONITORING IN THE ECRB, 8/98 - 7/99	Qualified – Requires Data Verification
GS990908312242.011	MOISTURE MONITORING IN THE ESF, 12/98 - 7/99	Qualified – Requires Data Verification, TBV# 5682
GS000208312111.001	PRECIPITATION DATA FOR MAY 3, 1989 THROUGH SEPTEMBER 30, 1994 FROM WEATHER STATIONS 1 AND 3, YUCCA MOUNTAIN, NEVADA.	Qualified – Data Verified

Appendix E: Listing of Data Submitted to the Technical Data Management System by USGS Personnel Who Exchanged the Emails (continued)

Data Tracking Number (DTN)	Title	Status
GS000208312111.002	AIR TEMPERATURE DATA FOR CALENDAR YEAR 1992 FROM WEATHER STATION 1 (WX-1), YUCCA MOUNTAIN, NEVADA.	Qualified – Data Verified
GS000208312111.003	PRECIPITATION DATA FOR JULY 17, 1987 THROUGH MAY 2, 1989 FROM WEATHER STATIONS 1 AND 3, YUCCA MOUNTAIN, NEVADA	Qualified by Data Qualification Report: TDR-NBS-GS-000022
GS000208312242.001	TEMPERATURE AND RELATIVE HUMIDITY DATA FOR NICHE 1 (ESF-NICHE3566) AND NICHE 2 (ESF-NICHE3650) OF THE ESF FROM 12/13/98 TO 10/05/99	Unqualified
GS000300001221.007	EMPIRICAL EQUATIONS FROM CAMPBELL (1985) FOR CALCULATING SOIL PROPERTIES FROM TEXTURE DATA	Unqualified
GS000300001221.009	EVAPOTRANSPIRATION COEFFICIENTS	Qualified – Established Fact
GS000308312242.002	PHASE 1 OF WATER COLLECTION IN ALCOVE 1 FROM 05/05/98 TO 08/27/98.	Qualified – Requires Data Verification
GS000399991221.003	PRELIMINARY ALCOVE 1 INFILTRATION EXPERIMENT DATA	Qualified by Data Qualification Report: TDR-NBS-HS-000014
GS000399991221.004	PRELIMINARY DEVELOPED MATRIX PROPERTIES	Unqualified – Preliminary
GS000408312231.004	DATA FOR CORE DRIED IN RH OVEN AND 105C OVEN FOR USW UZ-N31, UZ-N32, UZ-N33, UZ-N34, UZ-N35, UZ-N38, UZ-N58, UZ-N59, UE-25 UZN#63 AND USW UZ-N64; DATA FOR CORE DRIED IN 105C OVEN ONLY FOR USW UZ-N11, UZ-N15, UZ-N16, UZ-N17, UZ-N27, UZ-N36 AND UZ-N37.	Qualified – Data Verified
GS000808312111.004	RAINFALL DATA COLLECTED WITH TIPPING BUCKET RAIN GAUGES IN THE AREA OF YUCCA MOUNTAIN COLLECTED FROM 8/1/99 TO 12/12/00.	Qualified
GS010408312111.001	SITE METEOROLOGY DATA FOR WEATHER STATIONS UE-25 WX STATIONS 1 THROUGH 5, 10/1/94 - 10/1/95, PART II.	Qualified – Data Verified
GS031208312211.001	FY95 LABORATORY MEASUREMENTS OF PHYSICAL PROPERTIES OF SURFICIAL MATERIAL AT YUCCA MOUNTAIN, PART II	Qualified – Requires Data Verification
GS940908312231.009	THE INFLUENCE OF SCALE ON CALCULATED SORPTIVITY VALUES FROM IMBIBITION EXPERIMENTS ON WELDED AND NON-WELDED TUFF.	Unqualified
GS940908312231.010	EVALUATION OF MEASUREMENT SCALE USING IMBIBITION EXPERIMENTS IN VOLCANIC TUFF.	Unqualified
GS950308312231.001	AIR PERMEABILITY FOR UE-25 UZ#16 AND RADIAL BOREHOLES	Qualified – Requires Data Verification
GS950308312231.002	LABORATORY MEASUREMENTS OF CORE FROM USW SD-12 AND RADIAL BOREHOLES	Qualified – Data Verified
GS950308312231.003	UE-25 UZ#16 PYCNOMETER DATA.	Qualified – Superseded by GS000508312231.005
GS950408312231.004	PHYSICAL PROPERTIES AND WATER POTENTIALS OF CORE FROM BOREHOLE USW SD-9.	Qualified – Data Verified

Appendix E: Listing of Data Submitted to the Technical Data Management System by USGS Personnel Who Exchanged the Emails (continued)

Data Tracking Number (DTN)	Title	Status
GS950408312231.005	PHYSICAL PROPERTIES AND WATER POTENTIALS OF CORE FROM BOREHOLE USW UZ-14	Unqualified – Superseded by GS000508312231.007 and GS020208312231.001
GS950608312231.006	WATER PERMEABILITY OF CORE FROM SD-9, 28 FEB 95 TO 17 APR 95.	Qualified – Superseded by GS990408312231.001
GS950608312231.007	PHYSICAL PROPERTIES AND WATER CONTENT FROM BOREHOLE USW NRG-6, FROM 3/19/94 TO 3/27/95.	Qualified – Superseded by GS000508312231.006
GS950608312231.008	MOISTURE RETENTION DATA FROM BOREHOLES USW UZ-N27 AND UE-25 UZ#16	Qualified – Data Verified
GS951108312231.009	PHYSICAL PROPERTIES, WATER CONTENT, AND WATER POTENTIAL FOR BOREHOLE USW SD-7.	Qualified – Data Verified
GS951108312231.010	PHYSICAL PROPERTIES AND WATER CONTENT FOR BOREHOLE USW NRG-7/7A.	Qualified – Data Verified
GS951108312231.011	PHYSICAL PROPERTIES, WATER CONTENT, AND WATER POTENTIAL FOR BOREHOLE USW UZ-7A.	Qualified – Data Verified
GS960808312231.001	WATER PERMEABILITY AND RELATIVE HUMIDITY CALCULATED POROSITY FOR BOREHOLES UE-25 UZ#16 AND USW UZ-N27.	Qualified – Data Verified
GS960808312231.002	RELATIVE HUMIDITY CALCULATED POROSITY MEASUREMENTS ON SAMPLES FROM BOREHOLE USW SD-9 USED FOR SATURATED HYDRAULIC CONDUCTIVITY.	Qualified – Superseded by GS000408312231.003
GS960808312231.003	MOISTURE RETENTION DATA FOR SAMPLES FROM BOREHOLES USW SD-7, USW SD-9, USW SD-12 AND UE-25 UZ#16.	Qualified – Data Verified
GS960808312231.004	PHYSICAL PROPERTIES, WATER CONTENT AND WATER POTENTIAL FOR SAMPLES FROM LOWER DEPTHS IN BOREHOLES USW SD-7 AND USW SD-12.	Qualified – Data Verified
GS960808312231.005	WATER PERMEABILITY AND RELATIVE HUMIDITY CALCULATED POROSITY FOR SAMPLES FROM BOREHOLES USW SD-7, USW SD-9, USW SD-12 AND USW UZ-14	Qualified – Data Verified
GS960908312211.003	CONCEPTUAL AND NUMERICAL MODELS OF INFILTRATION AT YUCCA MOUNTAIN, NEVADA.	Qualified – Data Verified
GS960908312231.004	CHARACTERIZATION OF HYDROGEOLOGIC UNITS USING MATRIX PROPERTIES AT YUCCA MOUNTAIN, NEVADA.	Unqualified
GS960908312231.006	PHYSICAL AND HYDROLOGIC PROPERTIES DETERMINED FROM ANALYSIS OF ROCK CORES, AND CORRELATION OF HYDROLOGIC PROPERTIES WITH PHYSICAL LITHOLOGIC PROPERTIES.	Unqualified
GS960908312231.007	BOREHOLE CORE SATURATIONS.	Unqualified
GS960908312231.008	PNEUMATIC PROPERTIES DETERMINED FROM ANALYSIS OF ROCK CORES.	Unqualified

Appendix E: Listing of Data Submitted to the Technical Data Management System by USGS Personnel Who Exchanged the Emails (continued)

Data Tracking Number (DTN)	Title	Status
GS961008312231.009	PHYSICAL PROPERTIES, WATER CONTENT AND WATER POTENTIAL FOR CORE SAMPLES FROM ESF ALCOVE BOREHOLES ESF-AL#2-HPF#1, ESF-BRFA-HPF#2, ESF-AL#3-RBT#1, ESF-AL#3-RBT#4 AND ESF-AL#4-RBT#1.	Qualified – Data Verified
GS970108312231.001	PHYSICAL PROPERTIES AND WATER CONTENT CALCULATED FROM RELATIVE HUMIDITY DRIED CORE SAMPLES FROM ESF ALCOVE BOREHOLES ESF-AL#2-HPF#1, ESF-BRFA-HPF#2, ESF-AL#3-RBT#1, ESF-AL#3-RBT#4, AND ESF-AL#4-RBT#1.	Qualified – Requires Data Verification
GS970108312231.002	PHYSICAL PROPERTIES OF SURFACE SAMPLES FROM THE ESF MAIN DRIFT (29+00 M TO 57+00 M).	Qualified – Requires Data Verification
GS970208312231.003	PHYSICAL PROPERTIES, WATER CONTENT AND WATER POTENTIAL ON SAMPLES FROM BOREHOLES ESF-NAD-GTB#1 AND ESF-NAD-GTB#1A FROM ALCOVE 6 IN THE ESF.	Qualified – Requires Data Verification
GS970708312231.004	PHYSICAL PROPERTIES OF SURFACE SAMPLES FROM THE ESF MAIN DRIFT	Qualified – Requires Data Verification
GS970808312231.005	PHYSICAL PROPERTIES OF CORE SAMPLES FROM ESF SOUTH RAMP BOREHOLES ESF-SR-MOISTSTDY#1 AND #2.	Qualified – Requires Data Verification
GS970908312242.006	PHYSICAL PROPERTIES OF BOREHOLE SAMPLES FROM THE PTN EXPOSURE IN THE ESF NORTH RAMP (ESF STATION 7+28 M TO STATION 10+71 M).	Qualified – Requires Data Verification
GS971008312231.006	PHYSICAL PROPERTIES AND SATURATED HYDRAULIC CONDUCTIVITY OF CORES FROM SURFACE SAMPLES FROM THE ESF MAIN DRIFT 29+00 M TO 57+00 M.	Qualified – Data Verified
GS980408312242.008	UNSATURATED HYDRAULIC PROPERTIES OF BOREHOLE SAMPLES FROM THE PTN EXPOSURE IN THE ESF NORTH RAMP (ESF STATION 7+27 M TO ESF STATION 10+70 M) MEASURED USING A CENTRIFUGE.	Qualified – Data Verified
GS980708312242.010	PHYSICAL PROPERTIES OF BOREHOLE CORE SAMPLES, AND WATER POTENTIAL MEASUREMENTS USING THE FILTER PAPER TECHNIQUE, FOR BOREHOLE SAMPLES FROM USW WT-24.	Qualified – Data Verified
GS980708312242.011	PHYSICAL PROPERTIES AND HYDRAULIC CONDUCTIVITY MEASUREMENTS OF LEXAN-SEALED SAMPLES FROM USW WT-24.	Qualified – Data Verified
GS980808312242.012	UNSATURATED HYDRAULIC PROPERTIES OF LEXAN-SEALED SAMPLES FROM USW WT-24.	Qualified – Data Verified
GS980808312242.013	UNSATURATED HYDRAULIC PARAMETERS DETERMINED FROM DIRECT AND INDIRECT METHODS.	Unqualified
GS980808312242.014	PHYSICAL PROPERTIES OF BOREHOLE CORE SAMPLES AND WATER POTENTIAL MEASUREMENTS USING THE FILTER PAPER TECHNIQUE FOR BOREHOLE SAMPLES FROM USW SD-6.	Qualified – Data Verified
GS980808312242.015	WATER RETENTION AND UNSATURATED HYDRAULIC CONDUCTIVITY MEASUREMENTS FOR VARIOUS SIZE FRACTIONS OF CRUSHED, SIEVED, WELDED TUFF SAMPLES MEASURED USING A CENTRIFUGE.	Qualified – Data Verified

Appendix E: Listing of Data Submitted to the Technical Data Management System by USGS Personnel Who Exchanged the Emails (continued)

Data Tracking Number (DTN)	Title	Status
GS990308312242.007	LABORATORY AND CENTRIFUGE MEASUREMENTS OF PHYSICAL AND HYDRAULIC PROPERTIES OF CORE SAMPLES FROM BUSTED BUTTE BOREHOLES UZTT-BB-INJ-1, UZTT-BB-INJ-3, UZTT-BB-INJ-4, UZTT-BB-INJ-6, UZTT-BB-COL-5 AND UZTT-BB-COL-8.	Qualified – Data Verified
GS990408312231.001	SATURATED HYDRAULIC CONDUCTIVITY OF CORE FROM SD-9, 2/27 - 3/27/95	Qualified – Data Verified
GS990708312242.008	PHYSICAL AND HYDRAULIC PROPERTIES OF CORE SAMPLES FROM BUSTED BUTTE BOREHOLES	Qualified – Data Verified
GS000308312231.001	REVISED PHYSICAL PROPERTIES OF BOREHOLES USW UZ-N17, USW UZ-N53, USW UZ-N55, USW SD-7, USW UZ-14, UE-25 UZ#16	Unqualified – Preliminary
GS000308312231.002	DEVELOPED MATRIX HYDROLOGIC PROPERTIES INFORMATION	Unqualified – Preliminary
GS000408312231.003	RELATIVE HUMIDITY CALCULATED POROSITY MEASUREMENTS ON SAMPLES FROM BOREHOLE USW SD-9 USED FOR SATURATED HYDRAULIC CONDUCTIVITY	Qualified – Data Verified
GS000408312242.004	PHYSICAL PROPERTIES OF BOREHOLE SAMPLES FROM THE ECRB (ECRB STATION 0+50 M TO ECRB STATION 25+00 M).	Unqualified – Superseded by GS030608312242.006
GS000508312231.005	UE-25 UZ#16 PYCNOMETER DATA	Qualified – Data Verified
GS000508312231.006	PHYSICAL PROPERTIES AND WATER CONTENT FROM BOREHOLE USW NRG-6, 3/19/94 TO 3/27/95.	Qualified – Data Verified
GS000508312231.007	PHYSICAL PROPERTIES OF CORE SAMPLES FROM BOREHOLE USW UZ-14, FROM 03/09/94 TO 07/11/94.	Qualified – Data Verified
GS010608312242.001	UNSATURATED HYDRAULIC CONDUCTIVITY AND MATRIC POTENTIAL IN BUSTED BUTTE VOLCANIC TUFF CORES	Qualified
GS020208312231.001	WATER POTENTIAL OF CORE FROM BOREHOLE USW UZ-14, FROM 03/09/94 TO 06/21/94.	Unqualified

Appendix F: Borehole Data Records Associated With USGS Personnel Who Exchanged the Emails

NOTE: There are a large number of records associated with borehole and sample specimen information that involves one of the subject USGS individuals. The Curatorial Sample Inventory & Tracking System (CSITS) identifies 13,050 specimen requests from a subject USGS individual. In addition, a search of RISweb produces the following table of 161 records. The search criteria were subject USGS individual last name in the author field and borehole in the title field.

Accession #	Type of Record	Title (161)
DRC.19960509.0022	REPORT	YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT BOREHOLE ACCESS REQUEST BOREHOLE UE-25 NRG-6 DATED MAY 2-3, 1994 (C)
DRC.19960509.0027	REPORT	YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT BOREHOLE STATUS/COMPLETION REPORT BOREHOLE UE-25 NRG-6 DATED MAY 2, 1994 (C)
DRC.19960520.0018	DATA	SMF SPECIMEN SHIPMENT PACKAGING LOG BOREHOLE USW SD-12 AND USW SD-7 (C)
DRC.19960520.0019	DATA	SMF SPECIMEN CUSTODY RECEIPT BOREHOLE USW SD-12 AND TRANSFER OF CUSTODY FORM (C)
DRC.19960718.0088	CORRESPONDENCE	CORE SAMPLES FROM BOREHOLE UE-25 NRG-4
DRC.19961022.0215	DATA	BOREHOLE ACCESS REQUEST FOR UE-25 UZ#5 GEOPHYSICAL LOGGING (C)
DRC.19961022.0216	REPORT	BOREHOLE COMPLETION REPORT FOR UE-25 UZ#5 (C)
DRC.19961022.0217	DATA	BOREHOLE ACCESS REQUEST FOR UE-25 UZ#4 GEOPHYSICAL LOGGING (C)
DRC.19961022.0218	REPORT	BOREHOLE COMPLETION REPORT FOR UE-25 UZ#4 (C)
DRC.19961022.0343	DATA REPORT	BOREHOLE ACCESS REQUEST AND COMPLETION REPORT USW UZN-93 TESTS PERFORMED AND GAS SAMPLING (C)
DRC.19961022.0344	DATA REPORT	BOREHOLE ACCESS REQUEST AND COMPLETION REPORT USW UZN-94 TESTS PERFORMED AND GAS SAMPLING (C)
DRC.19961022.0345	DATA REPORT	BOREHOLE ACCESS REQUEST AND COMPLETION REPORT USW UZN-95 TESTS PERFORMED AND GAS SAMPLING (C)
DRC.19970218.0014	DATA REVIEW	PROCEDURE OR INSTRUCTION SAMPLE OVERVIEW COMMITTEE SPECIMEN REMOVAL REQUEST FOR HYDROCHEMISTRY TESTS IN THE ESF/MATRIX HYDROLOGIC PROPERTIES TESTING WITH CONSOLIDATED FIELD PACKAGING INSTRUCTIONS FOR NORTHERN GHOST DANCE FAULT ACCESS DRIFT (ALCOVE #6) (GEOTHERMAL BOREHOLE) (C)
DRC.19970218.0020	DATA REVIEW	PROCEDURE OR INSTRUCTION SAMPLE OVERVIEW COMMITTEE SPECIMEN REMOVAL REQUEST FOR HYDROCHEMISTRY TESTS IN THE ESF-MATRIX HYDROLOGIC PROPERTIES TESTING WITH CONSOLIDATED FIELD PACKAGING INSTRUCTIONS FOR NORTHERN GHOST DANCE FAULT ACCESS DRIFT (ALCOVE #6) (GEOTHERMAL BOREHOLE) (C)
DRC.19970218.0021	DATA	SMF SPECIMEN REMOVAL LOG FOR BOREHOLE ESF-NAD-GTB#1A (C)

Appendix F: Borehole Data Records Associated With USGS Personnel Who Exchanged the Emails (continued)

Accession #	Type of Record	Title (161)
DRC.19970218.0022	DATA	SMF SPECIMEN SHIPMENT PACKAGING LOG FOR BOREHOLE ESF-NAD-GTB#1A (C)
DRC.19970218.0023	DATA	SMF SPECIMEN CUSTODY RECEIPT FOR BOREHOLE ESF-NAD-GTB#1A (C)
DRC.19970505.0044	DATA	SMF SPECIMEN SHIPMENT PACKAGING LOG FOR LORRAINE FLINT, OF USGS, PARENT BOREHOLE EF-BRFA-HPF#2 (C)
DRC.19970505.0045	DATA	SMF SPECIMEN CUSTODY RECEIPT FOR LORRAINE FLINT, OF USGS, PARENT BOREHOLE EF-BRFA-HPF#2 STANDARD CORE BOX (C)
DRC.19970818.0051	DATA	SMF SPECIMEN REMOVAL LOGS FOR BOREHOLE ESF-NDR-MF#1, #2 (C)
DRC.19970818.0052	DATA	SMF SPECIMEN SHIPMENT PACKAGING LOGS FOR BOREHOLE ESF-NDR-MF#1, #2 (C)
DRC.19970818.0053	DATA	SMF SPECIMEN CUSTODY RECEIPT LOGS FOR BOREHOLE ESF-NDR-MF#1, #2 (C)
DRC.19970818.0056	DATA	PROCEDURE OR INSTRUCTION SAMPLE OVERVIEW COMMITTEE SPECIMEN REMOVAL REQUEST FOR STUDY PLAN TITLED, HYDROCHEMISTRY TESTS IN THE ESF / MATRIX HYDROLOGIC PROPERTIES TESTING WITH CONSOLIDATED FIELD PACKAGING INSTRUCTIONS FOR SOUTHERN GHOST DANCE FAULT ACCESS DRIFT (ALCOVE #7) (GEOTHERMAL BOREHOLE), ESF-SAD-GTB#1 (C)
DRC.19970818.0057	DATA	SMF SPECIMEN REMOVAL LOGS FOR BOREHOLE ESF-SAD-GTB#1, (C)
DRC.19970818.0058	DATA	SMF SPECIMEN SHIPMENT PACKAGING LOGS FOR BOREHOLE ESF-SAD-GTB#1 (C)
DRC.19970818.0059	DATA	SMF SPECIMEN CUSTODY RECEIPT FOR BOREHOLE ESF-SAD-GTB#1 (C)
DRC.19970818.0063	DATA	SMF SPECIMEN REMOVAL LOGS FOR BOREHOLE ESF-MD-NICHE3566#2, #3A, #1, ESF-MD-NICHE3650#1, #2, #3, #4, #5, #6, #7, ESF-MD-NICHE3566LT#1, #5, (C)
DRC.19970818.0064	DATA	SMF SPECIMEN SHIPMENT PACKAGING LOGS FOR BOREHOLE ESF-MD-NICHE3566#1, #2, #3A, ESF-MD-NICHE3650#1, #2, #3, #4, #5, #6, #7, ESF-MD-NICHE3566LT#1, #5, (C)
DRC.19970818.0065	DATA	SMF SPECIMEN CUSTODY RECEIPT FOR BOREHOLE ESF-MD-NICHE3566#1, #2, #3A, ESF-MD-NICHE3650#1, #2, #3, #4, #5, #6, #7, ESF-MD-NICHE3566LT#1, #5, (C)
DRC.19970819.0004	PLAN	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR STUDY PLAN TITLED, HYDROCHEMISTRY TEST IN THE ESF / MATRIX HYDROLOGIC PROPERTIES TESTING FOR BOREHOLE ESF-SAD-GTB#1 WITH CONSOLIDATED FIELD PACKAGING INSTRUCTION FOR SOUTHERN GHOST DANCE FAULT ACCESS DRIFT (ALCOVE #7) (GEOTHERMAL BOREHOLE) (C)

Appendix F: Borehole Data Records Associated With USGS Personnel Who Exchanged the Emails (continued)

Accession #	Type of Record	Title (161)
DRC.19970819.0008	PLAN	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR STUDY PLAN TITLED, MATRIX PROPERTIES FOR BOREHOLE USW WT-24, WITH ATTACHED CONSOLIDATED FIELD PACKAGING INSTRUCTIONS FOR USW WT-24 (C)
DRC.19970819.0010	PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR MATRIX PROPERTIES FOR BOREHOLE ESF-MD-NICHE3566#1 AND FIELD PACKAGING INSTRUCTIONS (C)
DRC.19970821.0012	PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR EBS FIELD TESTS, FOR BOREHOLE ESF-HD-MPBX-14 (C)
DRC.19970923.0006	DATA	LORRIE FLINT FIELD APPROVAL FOR BOREHOLE ESF-SR-MOISTSTDY #3 (C)
DRC.19980929.0009	REVIEW PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR G. PATTERSON/L FLINT, STUDY PLAN TITLED: HYDROCHEMISTRY TESTS/MATRIX HYDROLOGIC PROPERTIES TESTING WITH CONSOLIDATED FIELD PACKAGING INSTRUCTIONS FOR NORTHERN GHOST DANCE FAULT DRILL/TEST ROOM (ALCOVE #6), FOR BOREHOLE ESF-NDR-MF#3 (C)
DRC.19980929.0010	REVIEW PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR G. PATTERSON/L FLINT, STUDY PLAN TITLED: HYDROCHEMISTRY TESTS/MATRIX HYDROLOGIC PROPERTIES TESTING WITH CONSOLIDATED FIELD PACKAGING INSTRUCTIONS FOR NORTHERN GHOST DANCE FAULT DRILL/TEST ROOM (ALCOVE #6) FOR BOREHOLE ESF-NDR-MF#4 (C)
DRC.19980929.0014	REVIEW	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR LORRIE FLINT FOR BOREHOLE ESF-ECRB-SLANT#1 (IN COMMENTS NO SPECIAL PACKAGING IS REQUIRED) (C)
DRC.19981026.0119	PACKAGE DATA	LORRAINE FLINT NON-BOREHOLE SPECIMEN SHIPMENT SPS RECORDS PACKAGE
DRC.19981116.0036	DATA	BOREHOLE ACCESS REQUESTS FOR PERIODIC LOGGING WITH HAND-HELD NEUTRON MOISTURE PROBE FOR STUDY PLAN TITLED INFILTRATION IN THE UNSATURATED ZONE WITH SIGNED DATE JANUARY 10, 1995 (C)
DRC.19981116.0037	DATA	BOREHOLE ACCESS REQUESTS FOR PERIODIC LOGGING WITH HAND-HELD NEUTRON MOISTURE PROBE FOR STUDY PLAN TITLED INFILTRATION IN THE UNSATURATED ZONE (C)
DRC.19981116.0038	DATA	BOREHOLE ACCESS REQUESTS FOR PERIODIC LOGGING WITH HAND-HELD NEUTRON MOISTURE PROBE FOR STUDY PLAN TITLED INFILTRATION IN THE UNSATURATED ZONE (C)
DRC.19981116.0039	DATA	BOREHOLE ACCESS REQUESTS FOR PERIODIC LOGGING WITH HAND-HELD NEUTRON MOISTURE PROBE FOR STUDY PLAN TITLED INFILTRATION IN THE UNSATURATED ZONE (C)

Appendix F: Borehole Data Records Associated With USGS Personnel Who Exchanged the Emails (continued)

Accession #	Type of Record	Title (161)
DRC.19981116.0040	DATA	BOREHOLE ACCESS REQUESTS FOR PERIODIC LOGGING WITH HAND-HELD NEUTRON MOISTURE PROBE FOR STUDY PLAN TITLED INFILTRATION IN THE UNSATURATED ZONE (C)
HQX.19890419.0104	PROCEDURE OR INSTRUCTION	USGS TECHNICAL PROCEDURE HP-12, METHOD FOR COLLECTION, PROCESSING, AND HANDLING OF DRILL CUTTINGS AND CORE FROM UNSATURATED-ZONE BOREHOLE AT THE WELL-SITE, NTS, REVISION 3 (C)
MOL.19940803.0066	AUDIT	YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT NONCONFORMANCE REPORT TEMPERATURES INSIDE CERTAIN SAMPLE CONTAINERS (ESF AL#1 BOREHOLE) EXCEEDED REQUIREMENTS BY ESF/LANL SAMPLE PLAN SP 92-20E, REVS. 1/14/94 AND 3/1/94, OR, A PERMANENT RECORD OF TEMPERATURE WAS NOT PRODUCED DUE TO INOPERABLE, NON CALIBRATED OR LACKING TEMPERATURE RECORDING EQUIPMENT, SCPB: 8.3.1.4.3 (C)
MOL.19940929.0001	PACKAGE TDIF DATA	YMP-USGS TABLE OF CONTENTS FOR TECHNICAL DATA RECORDS PACKAGE NEUTRON BOREHOLE DATA 1984 THROUGH 1993 DTN #GS921208312212.006, GS940108312212.003, GS940708312212.011, GS940708312212.010, GS921208312212.005 (DATA PACKAGE FOR ACTIVITY NUMBER 3GUI375M)(THIS HAS BEEN CORRECTED BY MOL.20000427.0069) (C)
MOL.19941222.0010	JOB PACKAGE DOCUMENT ADMINISTRATION	BOREHOLE ACCESS REQUEST UE-25 NRG# 2A AND 2B, DURATION OF ACCESS: 1 OR 2 DAYS, WIRELINE GEOPHYSICAL LOGGING OF BOREHOLE (C)
MOL.19950104.0224	PACKAGE DATA REVIEW	YMP-USGS TABLE OF CONTENTS FOR TECHNICAL DATA RECORDS PACKAGE MATRIX PROPERTY DATA THROUGH FY93 OF LABORATORY MEASUREMENTS ON 1" DIAMETER ROCK PLUGS FORM SURFACE OUTCROP TRANSECTS AND SUBSAMPLES FROM BOREHOLE USW GU-3 CORE (C)
MOL.19950105.0196	DATA	BOREHOLE ACCESS REQUEST UE-25 NRG-2A, 2B, ACTIVITY - WIRELINE GEOPHYSICAL LOGGING OF BOREHOLE (C)
MOL.19950131.0438	REPORT	IS THERE PERCHED WATER UNDER YUCCA MOUNTAIN IN BOREHOLE USW G-2?
MOL.19950414.0388	CORRESPONDENCE	CRITERIA LETTER FOR BOREHOLE WORK-OVERS, TESTING AND INSTRUMENTATION OF UE-25 UZ #4, UE-25 UZ #5, USW UZ-7, USW UZ-13, USW UZ-6S, USW NRG-6, AND USW SRG-4 BOREHOLES, YMSO, YUCCA MOUNTAIN, NEVADA
MOL.19960122.0203	TDIF	FY94 BOREHOLE ASSUMED DENSITY AND GEOPHYSICAL LOGGING CALIBRATION EQUATIONS. (PACKAGE ALSO CONTAINS CALIBRATION GAMMA-GAMMA COUNTS FROM WHICH THE EQUATIONS WERE DERIVED.)
MOL.19960524.0201	TDIF	TECHNICAL DATA INFORMATION FORM FOR PHYSICAL PROPERTIES, WATER CONTENT, AND WATER POTENTIAL FOR BOREHOLE USW SD-7 (C)
MOL.19960524.0206	TDIF	TECHNICAL DATA INFORMATION FORM FOR PHYSICAL PROPERTIES AND WATER CONTENT FOR BOREHOLE USW NRG-7/7A (C)

Appendix F: Borehole Data Records Associated With USGS Personnel Who Exchanged the Emails (continued)

Accession #	Type of Record	Title (161)
MOL.19960524.0211	TDIF	TECHNICAL DATA INFORMATION FORM FOR PHYSICAL PROPERTIES, WATER CONTENT, AND WATER POTENTIAL FOR BOREHOLE USW UZ-7A (C)
MOL.19960531.0082	PACKAGE DATA	YMP-USGS RECORDS PACKAGE FOR: MATRIX PROPERTY DATA THROUGH FY 93 OF LABORATORY MEASUREMENTS ON 1" DIAMETER ROCK PLUGS FROM SURFACE OUTCROP TRANSECTS AND SUBSAMPLES FROM BOREHOLE USW GU-3 CORE, SCPB: 8.3.1.2.2.3.1 (THIS IS A CORRECTION TO MOL.19950104.0224) (C)
MOL.19960702.0247	PUBLICATION REVIEW	VERIFICATION OF A 1-D HYDROLOGIC FLOW MODEL USING BOREHOLE CORE MEASUREMENTS IN VOLCANIC TUFF
MOL.19960924.0573	PUBLICATION	IS THERE PERCHED WATER UNDER YUCCA MOUNTAIN IN BOREHOLE USW G-2
MOL.19960924.0709	TDIF	PHYSICAL PROPERTIES AND WATER POTENTIALS OF CORE FROM BOREHOLE USW SD-9THIS RECORD IS CORRECTED BY MOL.20000316.0715 (C)
MOL.19960924.0712	TDIF	PHYSICAL PROPERTIES AND WATER POTENTIALS OF CORE FROM BOREHOLE USW UZ-14 (THIS RECORD HAS BEEN CORRECTED BY MOL.20030514.0127) (C)
MOL.19960924.0765	TDIF	PHYSICAL PROPERTIES AND WATER CONTENT FROM BOREHOLE USW NRG-6, MARCH 19, 1994 TO MARCH 27, 1995 (THIS RECORD HAS BEEN CORRECTED BY MOL.20000407.0098) (THIS RECORD IS CORRECTED BY MOL.20001113.0170) (C)
MOL.19960926.0180	PACKAGE TDIF DATA	YMP-USGS TABLE OF CONTENTS FOR TECHNICAL DATA RECORDS PACKAGE: FY95 WATER PERMEABILITY OF CORE FROM BOREHOLE SD-9, 28 FEBRUARY 1995 TO 17 APRIL 1995: DTN GS950608312231.006 (THIS PACKAGE SUPPORTS LEVEL 4 MILESTONE 3GUP292M) (THIS RECORD IS SUPPLEMENTED BY MOL.20000214.0171)(C)
MOL.19961118.0106	TDIF	PHYSICAL PROPERTIES AND WATER CONTENT FOR BOREHOLE USW NRG-7/7A, (THIS IS A CORRECTION TO MOL.19960524.0206) (C)
MOL.19961118.0108	TDIF	PHYSICAL PROPERTIES, WATER CONTENT, AND WATER POTENTIAL FOR BOREHOLE USW UZ-7A, (THIS IS A CORRECTION TO MOL.19960524.0211) (C)
MOL.19970224.0216	PUBLICATION	ABSTRACT ENTITLED COMPENSATING NEUTRON MOISTURE METER LOGS FOR BOREHOLE RUGOSITY BY KEVIN M ELLETT, JERRY W BULLARD, JOSEPH A HEVESI , AND ALAN L FLINT
MOL.19970224.0220	REPORT REVIEW	COMPENSATING NEUTRON MOISTURE-METER LOGS FOR BOREHOLE RUGOSITY, BY KEVIN M ELLETT, JERRY W BULLARD, JOSEPH A HEVESI, AND ALAN L FLINT (DRAFT - VERSION DATED AUGUST 30, 1995) (C)
MOL.19970224.0221	REVIEW	US DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY WATER RESOURCES DIVISION MANUSCRIPT ROUTING SHEET FOR ABSTRACT ENTITLED COMPENSATING NEUTRON MOISTURE METER LOGS FOR BOREHOLE RUGOSITY, BY KEVIN M ELLETT, JERRY W BULLARD, JOSEPH A HEVESI, AND ALAN L FLINT (C)

Appendix F: Borehole Data Records Associated With USGS Personnel Who Exchanged the Emails (continued)

Accession #	Type of Record	Title (161)
MOL.19970224.0222	REPORT REVIEW	TECHNICAL REVIEW FOR ABSTRACT ENTITLED COMPENSATING NEUTRON MOISTURE METER LOGS FOR BOREHOLE RUGOSITY, BY KEVIN M ELLETT, JERRY W BULLARD, JOSEPH A HEVESI, AND ALAN L FLINT (C)
MOL.19970626.0443	TDIF	RELATIVE HUMIDITY CALCULATED POROSITY MEASUREMENTS ON SAMPLES FROM BOREHOLE USW SD-9 USED FOR SATURATED HYDRAULIC CONDUCTIVITY (THIS RECORD HAS BEEN CORRECTED BY MOL.20000505.0055) (THIS HAS BEEN SUPPLEMENTED BY MOL.20000620.0014) (THIS RECORD IS CORRECTED BY MOL.20001113.0173) (C)
MOL.19970626.0444	NOTEBOOK	RELATIVE HUMIDITY CALCULATED POROSITY MEASUREMENTS ON SAMPLES FROM BOREHOLE USW SD-9 USED FOR SATURATED HYDRAULIC CONDUCTIVITY, COVER PAGE OF LABORATORY NOTEBOOK (C)
MOL.19970728.0207	DATA	SMF SPECIMEN REMOVAL LOG FOR BOREHOLE: 248 UE 25 NRG-3 (C)
MOL.19970728.0278	DATA	SMF SPECIMEN REMOVAL LOG ON BOREHOLE 202 USW US N54, 208 USW-UZN-16 AND 205 USW-UZN-37 (C)
MOL.19970729.0757	DATA	SMF SPECIMEN REMOVAL LOG, BOREHOLE 249 USW UZ-14, FEBRUARY 9, 1994 - AUGUST 25, 1995 (C)
MOL.19970729.0759	PROCUREMENT	SMF SPECIMEN CUSTODY RECEIPT, BOREHOLE USW UZ-14 (C)
MOL.19971218.0543	PUBLICATION	CORRELATION OF LITHOLOGIC FEATURES, HYDROGEOLOGIC PROPERTIES, AND BOREHOLE GEOPHYSICAL LOGS AT YUCCA MOUNTAIN, NEVADA
MOL.19971218.0547	PUBLICATION	CORRELATION OF LITHOLOGIC FEATURES, HYDROGEOLOGIC PROPERTIES, AND BOREHOLE GEOPHYSICAL LOGS AT YUCCA MOUNTAIN, NEVADA, BY DC BUESCH, RW SPENGLER, PH NELSON, AND LE FLINT
MOL.19971223.0133	CORRESPONDENCE REVIEW JOB PACKAGE DOCUMENT	USGS NEUTRON-ACCESS BOREHOLE PHASE 2, REVISION 4
MOL.19980102.0170	ADMINISTRATION	MANUSCRIPT ROUTING SHEET FOR REPORT ENTITLED "ASSESSMENT OF GEOPHYSICAL LOGS FROM BOREHOLE USW G-2, YUCCA MOUNTAIN, NEVADA" (C)
MOL.19980112.0163	CORRESPONDENCE	CORE SAMPLES FROM BOREHOLE UE-25 NRG-2A
MOL.19980202.0336	CORRESPONDENCE	PERSONAL COMMUNICATIONS RECORD: NEUTRON INFILTRATION BOREHOLE STUDIES FROM SURFACE (C)
MOL.19980219.0179	TDIF	PHYSICAL PROPERTIES OF BOREHOLE SAMPLES FROM THE ESF SOUTH RAMP BOREHOLES ESF-SR-MOISTSTDY #1 AND #2 (C)
MOL.19980223.0116	TDIF	PHYSICAL PROPERTIES OF BOREHOLE SAMPLES FROM THE PTN EXPOSURE IN THE ESF NORTH RAMP (ESF STATION 7+28 M TO ESF STATION 10+71 M)
MOL.19980406.0107	ADMINISTRATION	SMF SPECIMEN CUSTODY RECEIPT - NTS FIELD HYDROLOGY LAB, MERCURY, NV, SHIPMENT IDS': 0038, 0040, 0041, 0042, 0043 OF BOREHOLE NUMBER: USW UZ N55 (C)

Appendix F: Borehole Data Records Associated With USGS Personnel Who Exchanged the Emails (continued)

Accession #	Type of Record	Title (161)
MOL.19980513.0150	TDIF	WATER POTENTIAL MEASUREMENTS USING THE FILTER PAPER TECHNIQUE FOR BOREHOLE SAMPLES FROM THE ESF NORTH RAMP (ESF STATION 7+27 M TO ESF STATION 10+70 M) AND THE ESF SOUTH RAMP (ESF STATION 59+65 TO 76+33 M) DTN GS980308312242.004 (THIS RECORD HAS BEEN CORRECTED BY MOL.20000505.0057, MOL.20000526.0250 AND MOL.20000608.0172) (C)
MOL.19980513.0160	TDIF	PHYSICAL PROPERTIES OF BOREHOLE SAMPLES FROM THE ESF SOUTH RAMP (ESF STATION 59+65 M TO ESF STATION 76+33 M) - DTN GS980308312242.003 (C)
MOL.19980513.0165	TDIF	PHYSICAL PROPERTIES OF LEXAN-SEALED BOREHOLE SAMPLES FROM THE PTN EXPOSURE IN THE NORTH RAMP (ESF STATION 7+27 M TO ESF STATION 10+70 M) - DTN GS980308312242.005 (C)
MOL.19980528.0369	TDIF	UNSATURATED HYDRAULIC PROPERTIES OF BOREHOLE SAMPLES FROM THE PTN EXPOSURE IN THE ESF NORTH RAMP (ESF STATION 7+27 M TO ESF STATION 10+70 M) MEASURED USING A CENTRIFUGE - DTN GS980408312242.008 (C)
MOL.19980918.0390	TDIF	PHYSICAL PROPERTIES OF BOREHOLE CORE SAMPLES, AND WATER POTENTIAL MEASUREMENTS USING THE FILTER PAPER TECHNIQUE, FOR BOREHOLE SAMPLES FROM USW WT-24, "THIS HAS BEEN CORRECTED BY MOL.20000526.0246" (C)
MOL.19980924.0221	TDIF	PHYSICAL PROPERTIES OF BOREHOLE CORE SAMPLES AND WATER POTENTIAL MEASUREMENTS USING THE FILTER PAPER TECHNIQUE FOR BOREHOLE SAMPLES FROM USW SD-6, "THIS HAS BEEN CORRECTED BY MOL.20000526.0248" (C)
MOL.19980924.0222	DATA	YMP-USGS TECHNICAL DATA RECORD FOR PHYSICAL PROPERTIES OF BOREHOLE CORE SAMPLES AND WATER POTENTIAL MEASUREMENTS USING THE FILTER PAPER TECHNIQUE FOR BOREHOLE SAMPLES FROM USW SD-6 (C)
MOL.19980924.0223	DATA	DATA SUMMARY SHEET FOR PHYSICAL PROPERTIES OF BOREHOLE CORE SAMPLES AND WATER POTENTIAL MEASUREMENTS USING THE FILTER PAPER TECHNIQUE FOR BOREHOLE SAMPLES FROM USW SD-6 (C)
MOL.19980930.0173	TDIF	PHYSICAL PROPERTIES OF BOREHOLE CORE SAMPLES FROM ESF-MD-NICHE3566#1, ESF-MD-NICHE3566#2, ESF-MD-NICHE3566#3A, ESF-MD-NICHE3566LT#1, ESF-MD-NICHE3566LT#2, ESF-MD-NICHE3566LT#3, ESF-MD-NICHE3566LT#4, ESF-MD-NICHE3566LT#5, AND ESF-MD-NICHE3566LT#6
MOL.19980930.0174	DATA	TECHNICAL DATA RECORD: PHYSICAL PROPERTIES OF BOREHOLE CORE SAMPLES FROM ESF-MD-NICHE3566#1, ESF-MD-NICHE3566#2, ESF-MD-NICHE3566#3A, ESF-MD-NICHE3566LT#1, ESF-MD-NICHE3566LT#2, ESF-MD-NICHE3566LT#3, ESF-MD-NICHE3566LT#4, ESF-MD-NICHE3566LT#5, AND ESF-MD-NICHE3566LT#6 (C)

Appendix F: Borehole Data Records Associated With USGS Personnel Who Exchanged the Emails (continued)

Accession #	Type of Record	Title (161)
MOL.19981012.0761	TDIF	TECHNICAL DATA INFORMATION FOR PHYSICAL PROPERTIES OF BOREHOLE CORE SAMPLES FROM ESF-MD-NICHE3650#1, ESF-MD-NICHE3650#2, ESF-MD-NICHE3650#3, ESF-MD-NICHE3650#4, ESF-MD-NICHE3650#5, ESF-MD-NICHE3650#6, AND ESF-MD-NICHE3650#7 (C)
MOL.19981012.0762	DATA	TECHNICAL DATA RECORD - PHYSICAL PROPERTIES OF BOREHOLE CORE SAMPLES FROM ESF-MD-NICHE3650#1, ESF-MD-NICHE3650#2, ESF-MD-NICHE3650#3, ESF-MD-NICHE3650#4, ESF-MD-NICHE3650#5, ESF-MD-NICHE3650#6, AND ESF-MD-NICHE3650#7 (C)
MOL.19981012.0763	DATA	DATA SUMMARY SHEET - PHYSICAL PROPERTIES OF BOREHOLE CORE SAMPLES FROM ESF-MD-NICHE3650#1, ESF-MD-NICHE3650#2, ESF-MD-NICHE3650#3, ESF-MD-NICHE3650#4, ESF-MD-NICHE3650#5, ESF-MD-NICHE3650#6, AND ESF-MD-NICHE3650#7 (C)
MOL.19981012.0770	TDIF	TECHNICAL DATA INFORMATION FOR PHYSICAL PROPERTIES OF BOREHOLE CORE SAMPLES FROM ESF-MD-NICHE3107#1,ESF-MD-NICHE3107#2, ESF-MD-NICHE3107#3, ESF-MD-NICHE3107#4, ESF-MD-NICHE3107#5, ESF-MD-NICHE3107#6, AND ESF-MD-NICHE3107#7 (C)
MOL.19981012.0771	DATA	YMP-USGS TECHNICAL DATA RECORD FOR PHYSICAL PROPERTIES OF BOREHOLE CORE SAMPLES FROM ESF-MD-NICHE3107#1,ESF-MD-NICHE3107#2, ESF-MD-NICHE3107#3, ESF-MD-NICHE3107#4, ESF-MD-NICHE3107#5, ESF-MD-NICHE3107#6, AND ESF-MD-NICHE3107#7 (C)
MOL.19981012.0772	DATA	DATA SUMMARY SHEET FOR PHYSICAL PROPERTIES OF BOREHOLE CORE SAMPLES FROM ESF-MD-NICHE3107#1,ESF-MD-NICHE3107#2, ESF-MD-NICHE3107#3, ESF-MD-NICHE3107#4, ESF-MD-NICHE3107#5, ESF-MD-NICHE3107#6, AND ESF-MD-NICHE3107#7 (C)
MOL.19981110.0227	TDIF	PHYSICAL AND HYDROLOGIC PROPERTIES OF BOREHOLE CORE SAMPLES FROM 1997 TO ESF-SAD-GTB#1
MOL.19981110.0240	TDIF	PHYSICAL AND HYDROLOGIC PROPERTIES OF BOREHOLE CORE SAMPLES FROM ESF-NDR-MF#1, ESF-NDR-MF#2 AND ESF-NDR-MF#4 IN ALCOVE 6 OF THE ESF
MOL.19981110.0251	TDIF	PHYSICAL PROPERTIES OF BOREHOLE SAMPLES FROM ESF-ECRB-SLANT#2
MOL.19981110.0258	TDIF	PHYSICAL AND HYDROLOGIC PROPERTIES OF BOREHOLE CORE SAMPLES AND WATER POTENTIAL MEASUREMENTS USING THE FILTER PAPER TECHNIQUE FOR BOREHOLE SAMPLES FROM ESF-LPCA-PTN#1 AND ESF-LPCA-PTN#2 IN ALCOVE 4, "THIS HAS BEEN CORRECTED BY MOL.20000526.0252" (C)
MOL.19981110.0269	TDIF	PHYSICAL AND HYDROLOGIC PROPERTIES OF BOREHOLE CORE SAMPLES AND WATER POTENTIAL MEASUREMENTS USING THE FILTER PAPER TECHNIQUE FOR BOREHOLE SAMPLES FROM ESF-UPCA-PTN#1 IN ALCOVE 3 OF THE ESF, "THIS HAS BEEN CORRECTED BY MOL.20000526.0244" (C)

Appendix F: Borehole Data Records Associated With USGS Personnel Who Exchanged the Emails (continued)

Accession #	Type of Record	Title (161)
MOL.19981110.0278	TDIF	PHYSICAL PROPERTIES OF BOREHOLE CORE SAMPLES AND WATER POTENTIAL MEASUREMENTS USING THE FILTER PAPER TECHNIQUE FOR BOREHOLE SAMPLES FROM ECRB-CWAT#1, ECRB-CWAT#2 AND ECRB-CWAT#3 (THIS RECORD HAS BEEN CORRECTED BY MOL.20000505.0060) (THIS HAS BEEN CORRECTED BY MOL.20000526.0256) (C)
MOL.19981110.0355	TDIF	WATER RETENTION DATA OF LEXAN-SEALED BOREHOLE SAMPLES AND SURFACE SAMPLES FROM ESF NORTH RAMP MOISTURE STUDY MEASURED USING A CENTRIFUGE, "THIS HAS BEEN CORRECTED BY MOL.20000526.0258" (C)
MOL.19990419.0326	TDIF	BOREHOLE CORE SATURATIONS, BY LE FLINT -- SECTION 4.2.1.2 IN THE DRAFT REPORT, PAGES 139-143 IN THE PUBLICATION "HYDROGEOLOGY OF THE UNSATURATED ZONE, NORTH RAMP AREA OF THE EXPLORATORY STUDIES FACILITY, YUCCA MOUNTAIN, NEVADA," EDITED BY JP ROUSSEAU, EM KWICKLIS AND DC GILLIES, VA SUPPORTING DATA (THIS RECORD HAS BEEN CORRECTED BY MOL.20030311.0259) (C)
MOL.19991129.0469	ADMINISTRATION DATA CALIBRATION	YMP-USGS LIST OF SUPPORTING INFORMATION FOR SATURATED HYDRAULIC CONDUCTIVITY MEASUREMENTS ON SAMPLES FROM BOREHOLE USW SD-9 FOR DTN: GS990908312231.001, INCLUDING HARD COPIES OF DATA, DATA SUMMARY SHEETS, EQUIPMENT LIST AND CALIBRATION RECORDS, USGS TECHNICAL PROCEDURE HP-266, R0 (C)
MOL.20000214.0176	DATA	YMP-USGS TECHNICAL DATA RECORD FOR PHYSICAL PROPERTIES AND WATER POTENTIAL OF CORE FROM BOREHOLE USW SD-9 (C)
MOL.20000316.0715	TDIF	TECHNICAL DATA INFORMATION FORM FOR PHYSICAL PROPERTIES AND WATER POTENTIALS OF CORE FROM BOREHOLE USW SD-9 FOR DTN GS950408312231.004 FOR TDIF 304288 (THIS RECORD IS A CORRECTION TO MOL.19960924.0709) (C)
MOL.20000407.0098	TDIF	TECHNICAL DATA INFORMATION FORM FOR PHYSICAL PROPERTIES AND WATER CONTENT FROM BOREHOLE USW NRG-6, MARCH 19, 1994 TO MARCH 27 1995 (THIS RECORD CORRECTS MOL.19960924.0765) (C)
MOL.20000505.0055	TDIF	TECHNICAL DATA INFORMATION FORM FOR RELATIVE HUMIDITY CALCULATED POROSITY MEASUREMENTS ON SAMPLES FROM BOREHOLE USW SD-9 USED FOR SATURATED HYDRAULIC CONDUCTIVITY - DTN GS960808312231.002 TDIF 305621 (CORRECTION TO MOL.19970626.0443) (C)
MOL.20000505.0057	TDIF	TECHNICAL DATA INFORMATION FORM FOR WATER POTENTIAL MEASUREMENTS USING THE FILTER PAPER TECHNIQUE FOR BOREHOLE SAMPLES FROM THE ESF NORTH RAMP (ESF STATION 7+27 M TO ESF STATION 10+70 M) AND THE ESF SOUTH RAMP (ESF STATION 59+65 M TO 76+33 M) (CORRECTION TO 19980513.0150) (C)

Appendix F: Borehole Data Records Associated With USGS Personnel Who Exchanged the Emails (continued)

Accession #	Type of Record	Title (161)
MOL.20000505.0060	TDIF	TECHNICAL DATA INFORMATION FORM FOR PHYSICAL PROPERTIES OF BOREHOLE CORE SAMPLES AND WATER POTENTIAL MEASUREMENTS USING THE FILTER PAPER TECHNIQUE FOR BOREHOLE SAMPLES FROM ECRB-CWAT#1, ECRB-CWAT#2, AND ECRB-CWAT#3 - DTN GS980908312242.034 TDIF 307240 (CORRECTION TO MOL.19981110.0278) (C)
MOL.20000505.0073	TDIF	TECHNICAL DATA INFORMATION FORM FOR PHYSICAL PROPERTIES OF BOREHOLE SAMPLES FROM THE (ECRB STATION 0+50 M TO ECRB STATION 25+00 M) - DTN GS000408312242.004 TDIF 310475 (THIS RECORD HAS BEEN CORRECTED BY MOL.20030909.0383) (C)
MOL.20000505.0074	DATA	YMP-USGS TECHNICAL DATA RECORD - HARD COPY OF THE DATA FOR DATA PACKAGE FOR PHYSICAL PROPERTIES OF BOREHOLE SAMPLES FROM THE (ECRB STATION 0+50 M TO ECRB STATION 25+00 M) (C)
MOL.20000505.0075	DATA	DATA SUMMARY SHEET FOR PHYSICAL PROPERTIES OF BOREHOLE SAMPLES FROM THE (ECRB STATION 0+50 M TO ECRB STATION 25+00 M) (C)
MOL.20000505.0078	ADMINISTRATION	ITEMIZED LIST OF ITEMS PROVIDED TO THE REVIEWER/CHECKER FOR PHYSICAL PROPERTIES OF BOREHOLE SAMPLES FROM THE ECRB STATION 0+50 M TO ECRB STATION 25+00 M (C)
MOL.20000505.0079	DATA	YMP-USGS TECHNICAL DATA RECORD - SPREADSHEET OF COLLECTED ROW DATA FOR DATA PACKAGE FOR PHYSICAL PROPERTIES OF BOREHOLE SAMPLES FROM THE (ECRB STATION 0+50 M TO ECRB STATION 25+00 M) (C)
MOL.20000505.0080	DATA	YMP-USGS TECHNICAL DATA RECORD - GRAPHS OF THE DATA FOR DATA PACKAGE FOR PHYSICAL PROPERTIES OF BOREHOLE SAMPLES FROM THE (ECRB STATION 0+50 M TO ECRB STATION 25+00 M) (C)
MOL.20000526.0244	TDIF	TECHNICAL DATA INFORMATION FORM FOR PHYSICAL AND HYDROLOGIC PROPERTIES OF BOREHOLE OR SAMPLES AND WATER POTENTIAL MEASUREMENTS USING THE FILTER PAPER TECHNIQUE FOR BOREHOLE SAMPLES FROM ESF-UPCA-PTN#1 IN ALCOVE 3 OF THE ESF, "THIS CORRECTS MOL.19981110.0269" (C)
MOL.20000526.0246	TDIF	PHYSICAL PROPERTIES OF BOREHOLE CORE SAMPLES, AND WATER POTENTIAL MEASUREMENT USING THE FILTER PAPER TECHNIQUE, FOR BOREHOLE SAMPLE FROM USW WT-24, GS980708312242.010, "THIS CORRECTS MOL.19980918.0390" (C)
MOL.20000526.0248	TDIF	PHYSICAL PROPERTIES OF BOREHOLE CORE SAMPLES, AND WATER POTENTIAL MEASUREMENT USING THE FILTER PAPER TECHNIQUE FOR BOREHOLE SAMPLE FROM USW SD-6, GS980808312242.014, "THIS CORRECTS MOL.19980924.0221" (C)

Appendix F: Borehole Data Records Associated With USGS Personnel Who Exchanged the Emails (continued)

Accession #	Type of Record	Title (161)
MOL.20000526.0250	TDIF	WATER POTENTIAL MEASUREMENT USING THE FILTER PAPER TECHNIQUE FOR BOREHOLE SAMPLE FROM ESF NORTH RAMP (ESF STATION 7+27 M TO ESF STATION 10+70M) AND THE ESF SOUTH RAMP (ESF), GS980308312242.004, "THIS CORRECTS MOL.19980513.0150" (C)
MOL.20000526.0252	TDIF	PHYSICAL AND HYDROLOGIC PROPERTIES OF BOREHOLE CORE SAMPLES AND WATER POTENTIAL MEASUREMENT USING THE FILTER PAPER TECHNIQUE FOR BOREHOLE SAMPLES FROM ESF-LPCA-PTN#1 AND ESF-LPCA-PTN#2 IN ALCOVE 4, GS980308312242.004, "THIS CORRECTS MOL.19981110.0258" (C)
MOL.20000526.0256	TDIF	PHYSICAL PROPERTIES OF BOREHOLE CORE SAMPLES AND WATER POTENTIAL MEASUREMENTS USING THE FILTER PAPER TECHNIQUE FOR BOREHOLE SAMPLES FROM ECRB-CWAT#1, ECRB-CWAT#3, GS980908312242.034, "THIS CORRECTS MOL.19981110.0278" (C)
MOL.20000526.0258	TDIF	WATER RETENTION DATA OF LEXAN-SEALED BOREHOLE SAMPLES AND SURFACE SAMPLES FROM ESF NORTH RAMP MOISTURE STUDY, GS980908312242.037, "THIS CORRECTS MOL.19981110.0355" (C)
MOL.20000620.0014	TDIF	TECHNICAL DATA INFORMATION FORM FOR RELATIVE HUMIDITY CALCULATED POROSITY MEASUREMENTS ON SAMPLES FROM BOREHOLE USW SD-9 USED FOR SATURATED HYDRAULIC CONDUCTIVITY - DTN GS000408312231.003 TDIF 310387 (THIS IS A SUPPLEMENT TO MOL.19970626.0443) (C)
MOL.20001026.0105	TDIF	TECHNICAL DATA INFORMATION FORM (TDIF) 310623 FOR PHYSICAL PROPERTIES AND WATER CONTENT FROM BOREHOLE USW NRG-6, MARCH 19, 1994 TO MARCH 27, 1995, DATA TRACKING NUMBER (DTN) GS000508312231.006 (THIS RECORD IS CORRECTED BY MOL.20010214.0018) (C)
MOL.20001113.0170	TDIF	CORRECTION TO MOL.19960924.0765 - CORRECTED TECHNICAL DATA INFORMATION FORM (TDIF) #304427 FOR PHYSICAL PROPERTIES AND WATER CONTENT FROM BOREHOLE USW NRG-6, FROM MARCH 19, 1994 TO MARCH 27, 1995, DTN: GS950608312231.007 (THIS RECORD IS A CORRECTION TO MOL.19960924.0765) (C)
MOL.20001113.0173	TDIF	CORRECTION TO MOL.19970626.0443 - CORRECTED TECHNICAL DATA INFORMATION FORM (TDIF) #305621 FOR RELATIVE HUMIDITY CALCULATED POROSITY MEASUREMENTS ON SAMPLES FROM BOREHOLE USW SD-9 USED FOR SATURATED HYDRAULIC CONDUCTIVITY, FEBRUARY 28, 1995 TO APRIL 10, 1995, DTN: GS960808312231.002 (THIS RECORD IS A CORRECTION TO MOL.19970626.0443) (C)
MOL.20001115.0142	JOB PACKAGE	DOCUMENT YMP/WP/92-04, BOREHOLE SECURITY PROGRAM #1, REVISION 0 (CANCELLATION) (C)
MOL.20010125.0058	TDIF	TECHNICAL DATA INFORMATION FORM FOR TDIF NUMBER: 304427, DTN: GS950608312231.007, PHYSICAL PROPERTIES AND WATER CONTENT FROM BOREHOLE USW NRG-6, 19 MARCH 1994 TO 27 MARCH 1995 (C)

Appendix F: Borehole Data Records Associated With USGS Personnel Who Exchanged the Emails (continued)

Accession #	Type of Record	Title (161)
MOL.20010214.0018	TDIF	TECHNICAL DATA INFORMATION FORM NUMBER 310623, DTN: GS000508312231.006 FOR PHYSICAL PROPERTIES AND WATER CONTENT FROM BOREHOLE USW NRG-6, MARCH 19, 1994 TO MARCH 27, 1995 (THIS CORRECTS MOL.20001026.0105) (C)
MOL.20010530.0493	CORRESPONDENCE	E-MAIL: ECRB 6M BOREHOLE MONITORING (C)
MOL.20010613.0002	CORRESPONDENCEDATA	RETURN OF BOREHOLE SAMPLES
MOL.20010613.0261	DATA ADMINISTRATION	SMF SPECIMEN CUSTODY RECEIPT FOR SHIPMENT ID: 0108, TYPE WCSPEC, PARENT BOREHOLE: UE25 AND UZ-16 (C)
MOL.20010620.0119	CORRESPONDENCE	RETURN OF BOREHOLE SAMPLES (REMNANT DOCUMENTATION) (C)
MOL.20010625.0127	CORRESPONDENCE	DATA REMNANT DOCUMENTATION FOR THE RETURN OF BOREHOLE SAMPLES (C)
MOL.20020408.0367	PUBLICATION	CORRELATION OF LITHOLOGIC FEATURES, HYDROGEOLOGIC PROPERTIES, AND BOREHOLE GEOPHYSICAL LOGS AT YUCCA MOUNTAIN, NEVADA (C)
MOL.20030128.0150	ADMINISTRATION	BOREHOLE ACCESS REQUEST FOR BOREHOLE ID # USW AND UE-25 UZN 1 TO 99 (C)
MOL.20030514.0127	TDIF	TECHNICAL DATA INFORMATION FORM FOR: PHYSICAL WATER PROPERTIES AND WATER POTENTIALS OF CORE FROM BOREHOLE USW UZ-14 (THIS RECORD CORRECTS MOL.19960924.0712) (C)
MOL.20030615.0139	TDIF	TECHNICAL DATA INFORMATION FORM FOR GS000508312231.007 PHYSICAL PROPERTIES OF CORE SAMPLES FROM BOREHOLE USW UZ-14, FROM 03/09/94 TO 07/11/94 (THIS HAS BEEN CORRECTED BY MOL.20030702.0054) (C)
MOL.20030615.0141	DATA	SURROGATE RECORD FOR DATA PACKAGE: PHYSICAL PROPERTIES OF CORE SAMPLES FROM BOREHOLE USW UZ-14, FROM 03/09/94 TO 07/11/94
MOL.20030615.0142	DATA ADMINISTRATION	DATA SUMMARY SHEET FOR DATA PACKAGE: PHYSICAL PROPERTIES OF CORE SAMPLES FROM BOREHOLE USW UZ-14, FROM 03/09/94 TO 07/11/94
MOL.20030615.0145	DATA	SMF SPECIMEN SHIPMENT PACKAGING LOG, SMF SPECIMEN CUSTODY RECEIPT, AND FIELD SPECIMEN REMOVAL CHECKLIST FOR DATA PACKAGE: PHYSICAL PROPERTIES OF CORE SAMPLES FROM BOREHOLE USW UZ-14, FROM 03/09/94 TO 07/11/94
MOL.20030620.0009	TDIF	TECHNICAL DATA INFORMATION FORM FOR GS020208312231.001 WATER POTENTIAL OF CORE SAMPLES FROM BOREHOLE USW UZ-14, FROM 03/09/94 TO 06/21/94 (THIS HAS BEEN CORRECTED BY MOL.20030702.0056) (C)
MOL.20030620.0010	DATA	HARD COPY OF THE DATA FOR DATA PACKAGE: WATER POTENTIAL OF CORE SAMPLES FROM BOREHOLE USW UZ-14, FROM 03/09/94 TO 06/21/04
MOL.20030620.0011	DATA	SURROGATE RECORD FOR DATA PACKAGE: WATER POTENTIAL OF CORE SAMPLES FROM BOREHOLE USW UZ-14, FROM 03/09/94 TO 06/21/94

Appendix F: Borehole Data Records Associated With USGS Personnel Who Exchanged the Emails (continued)

Accession #	Type of Record	Title (161)
MOL.20030620.0012	DATA ADMINISTRATION	DATA SUMMARY SHEET FOR DATA PACKAGE: WATER POTENTIAL OF CORE SAMPLES FROM BOREHOLE USW UZ-14, FROM 03/09/94 TO 06/21/94
MOL.20030620.0015	DATA	WATER POTENTIAL CALCULATIONS FROM CX-2 MEASUREMENTS FOR DATA PACKAGE: WATER POTENTIAL OF CORE SAMPLES FROM BOREHOLE USW UZ-14, FROM 03/09/94 TO 06/21/94
MOL.20030702.0054	TDIF	TECHNICAL DATA INFORMATION FORM (TDIF) 310649, PHYSICAL PROPERTIES OF CORE BOREHOLE USW UZ-14, FROM MARCH 9, 1994 TO JULY 11, 1994, DTN: GS000508312231.007 (THIS IS A CORRECTION TO MOL.20030615.0139) (C)
MOL.20030702.0056	TDIF	TECHNICAL DATA INFORMATION FORM (TDIF) 312837, WATER POTENTIAL OF CORE FROM BOREHOLE USW UZ-14, FROM MARCH 9, 1994 TO JUNE 21, 1994, DTN: GS020208312231.001 (THIS IS A CORRECTION TO MOL.20030620.0009) (C)
MOL.20030909.0383	TDIF	TECHNICAL DATA INFORMATION FORM (TDIF) FOR PHYSICAL PROPERTIES OF BOREHOLE SAMPLES FROM THE ECRB (ECRB STATIONS 0+50 M TO ECRB STATION 25+00 M) (THIS RECORD CORRECTS MOL.20000505.0073) (C)
NNA.19900913.0119	PROCEDURE OR INSTRUCTION	SEALING NEUTRON ACCESS BOREHOLE CASINGS AT THE GROUND SURFACE
NNA.19920917.0023	PROCUREMENT	CRITERIA LETTER, USGS NEUTRON-ACCESS BOREHOLE PHASE 2, REVISION 4 (C)
NNA.19921030.0040	CORRESPONDENCE	RECORD OF VERBAL COMMUNICATION REGARDING REVISION OF TARGET DEPTH ON THE USW UZN-32 BOREHOLE (C)
NNA.19930301.0140	REVIEW	REVIEW COMMENT RECORD - RSN BOREHOLE SECURITY PROGRAMS 2 AND 3 (C)
NNA.19930527.0043	CORRESPONDENCE	CORE SAMPLES FROM BOREHOLE UE-25 NRG-2A
NNA.19931025.0054	REVIEW	ASSESSMENT OF GEOPHYSICAL LOGS FROM BOREHOLE USW G-2, YUCCA MOUNTAIN, NEVADA, BY NELSON AND SCHIMSCHALL (AUGUST 8, 1992 VERSION)
NNA.19940120.0181	CORRESPONDENCE JOB PACKAGE DOCUMENT	RECORD OF VERBAL COMMUNICATION, REVISION OF TARGET DEPTH ON THE USW UZN-31 BOREHOLE

This page intentionally left blank.

Appendix G: Procedure Records Associated With the USGS Personnel Who Exchanged the Emails

Accession #	Type of Record	Title (86)
DRC.19970218.0014	DATA REVIEW	PROCEDURE OR INSTRUCTION SAMPLE OVERVIEW COMMITTEE SPECIMEN REMOVAL REQUEST FOR HYDROCHEMISTRY TESTS IN THE ESF/MATRIX HYDROLOGIC PROPERTIES TESTING WITH CONSOLIDATED FIELD PACKAGING INSTRUCTIONS FOR NORTHERN GHOST DANCE FAULT ACCESS DRIFT (ALCOVE #6) (GEOTHERMAL BOREHOLE) (C)
DRC.19970218.0020	DATA REVIEW	PROCEDURE OR INSTRUCTION SAMPLE OVERVIEW COMMITTEE SPECIMEN REMOVAL REQUEST FOR HYDROCHEMISTRY TESTS IN THE ESF-MATRIX HYDROLOGIC PROPERTIES TESTING WITH CONSOLIDATED FIELD PACKAGING INSTRUCTIONS FOR NORTHERN GHOST DANCE FAULT ACCESS DRIFT (ALCOVE #6) (GEOTHERMAL BOREHOLE) (C)
DRC.19970505.0042	DATA PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE SPECIMEN REMOVAL REQUEST FOR STUDY PLAN TITLE HYDROCHEMISTRY TESTS IN THE ESF/MATRIX HYDROLOGIC PROPERTIES TESTING CONDUCTED BY USGS PERSONNEL, WITH ATTACHMENT FOR CORE SPECIMEN INFORMATION, CONSOLIDATED FIELD PACKAGING INSTRUCTIONS AND FIELD PACKAGING INSTRUCTIONS (C)
DRC.19970818.0056	DATA PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE SPECIMEN REMOVAL REQUEST FOR STUDY PLAN TITLED, HYDROCHEMISTRY TESTS IN THE ESF / MATRIX HYDROLOGIC PROPERTIES TESTING WITH CONSOLIDATED FIELD PACKAGING INSTRUCTIONS FOR SOUTHERN GHOST DANCE FAULT ACCESS DRIFT (ALCOVE #7) (GEOTHERMAL BOREHOLE), ESF-SAD-GTB#1 (C)
DRC.19970819.0010	PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR MATRIX PROPERTIES FOR BOREHOLE ESF-MD-NICHE3566#1 AND FIELD PACKAGING INSTRUCTIONS (C)
DRC.19970819.0012	PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR STUDY PLAN TITLED MATRIX PROPERTIES WITH FIELD PACKAGING INSTRUCTIONS (C)
DRC.19970819.0014	PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR STUDY PLAN TITLED MATRIX PROPERTIES (C)
DRC.19970819.0016	PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR STUDY PLAN TITLED MATRIX PROPERTIES (C)
DRC.19970819.0020	PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR STUDY PLAN TITLED MATRIX PROPERTIES (C)
DRC.19970819.0022	PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR STUDY PLAN TITLED MATRIX PROPERTIES (C)
DRC.19970819.0024	PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR STUDY PLAN TITLED MATRIX PROPERTIES (C)

Appendix G: Procedure Records Associated With the USGS Personnel Who Exchanged the Emails (continued)

Accession #	Type of Record	Title (86)
DRC.19970819.0028	PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR STUDY PLAN TITLED MATRIX PROPERTIES (C)
DRC.19970819.0030	PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR STUDY PLAN TITLED MATRIX PROPERTIES (C)
DRC.19970819.0032	PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR STUDY PLAN TITLED MATRIX PROPERTIES (C)
DRC.19970819.0034	PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR STUDY PLAN TITLED MATRIX PROPERTIES (C)
DRC.19970819.0036	PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR STUDY PLAN TITLED MATRIX PROPERTIES (C)
DRC.19970819.0038	PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR STUDY PLAN TITLED MATRIX PROPERTIES (C)
DRC.19970819.0040	PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR STUDY PLAN TITLED MATRIX PROPERTIES (C)
DRC.19970819.0042	PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR STUDY PLAN TITLED MATRIX PROPERTIES (C)
DRC.19970819.0046	PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR STUDY PLAN TITLED MATRIX PROPERTIES (C)
DRC.19970819.0048	PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR STUDY PLAN TITLED MATRIX PROPERTIES (C)
DRC.19970819.0050	PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR STUDY PLAN TITLED MATRIX PROPERTIES (C)
DRC.19970821.0012	PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR EBS FIELD TESTS, FOR BOREHOLE ESF-HD-MPBX-14 (C)
DRC.19970821.0016	PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR MATRIX PROPERTIES (C)
DRC.19970821.0018	PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR MATRIX PROPERTIES (C)
DRC.19970821.0020	PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR MATRIX PROPERTIES (ESF-MD-NICHE3566LT#5) (C)
DRC.19970821.0022	PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR MATRIX PROPERTIES (ESF-MD-NICHE3566LT#6) (C)
DRC.19970821.0027	PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR HYDROCHEMISTRY TESTS IN THE ESF/MATRIX HYDROLOGIC PROPERTIES TESTING (ESF-NDR-MF#1, ESF-NNDR-MF#2, ESF-NDR-MF#3) (C)
DRC.19970821.0031	PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR HYDROCHEMISTRY TESTS IN THE ESF/MATRIX HYDROLOGIC PROPERTIES TESTING (ESF-NDR-MF#1, ESF-NNDR-MF#2, ESF-NDR-MF#3) (C)

Appendix G: Procedure Records Associated With the USGS Personnel Who Exchanged the Emails (continued)

Accession #	Type of Record	Title (86)
DRC.19970821.0033	PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR HYDROCHEMISTRY TESTS IN THE ESF/MATRIX HYDROLOGIC PROPERTIES TESTING (ESF-NDR-MF#1, ESF-NNDR-MF#2, ESF-NDR-MF#3) (C)
DRC.19970821.0035	PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR HYDROCHEMISTRY TESTS IN THE ESF/MATRIX HYDROLOGIC PROPERTIES TESTING (ESF-NDR-MF#1, ESF-NNDR-MF#2, ESF-NDR-MF#3) (C)
DRC.19970821.0159	PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR MATRIX PROPERTIES (C)
DRC.19980929.0007	REVIEW PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR LORRIE FLINT STUDY PLAN TITLED: MATRIX PROPERTIES, WITH CONSOLIDATED FIELD PACKAGING INSTRUCTIONS FOR PTN LATERAL DIVERSION STUDY (ESF NORTH RAMP UPPER AND LOWER PAINTBRUSH CONTACT ALCOVES) (C)
DRC.19980929.0008	REVIEW PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR G. PATTERSON/L FLINT, STUDY PLAN TITLED: HYDROCHEMISTRY TESTS/MATRIX HYDROLOGIC PROPERTIES TESTING WITH CONSOLIDATED FIELD PACKAGING INSTRUCTIONS FOR SOUTHERN GHOST DANCE FAULT ACCESS DRIFT (ALCOVE #7) (C)
DRC.19980929.0009	REVIEW PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR G. PATTERSON/L FLINT, STUDY PLAN TITLED: HYDROCHEMISTRY TESTS/MATRIX HYDROLOGIC PROPERTIES TESTING WITH CONSOLIDATED FIELD PACKAGING INSTRUCTIONS FOR NORTHERN GHOST DANCE FAULT DRILL/TEST ROOM (ALCOVE #6), FOR BOREHOLE ESF-NDR-MF#3 (C)
DRC.19980929.0010	REVIEW PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR G. PATTERSON/L FLINT, STUDY PLAN TITLED: HYDROCHEMISTRY TESTS/MATRIX HYDROLOGIC PROPERTIES TESTING WITH CONSOLIDATED FIELD PACKAGING INSTRUCTIONS FOR NORTHERN GHOST DANCE FAULT DRILL/TEST ROOM (ALCOVE #6) FOR BOREHOLE ESF-NDR-MF#4 (C)
DRC.19980929.0011	REVIEW PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR LORRIE FLINT, STUDY PLANT TITLED: MATRIX PROPERTIES WITH CONSOLIDATED FIELD PACKAGING INSTRUCTIONS FOR ENHANCED CHARACTERIZATION OF THE REPOSITORY BLOCK (ECRB) (C)
DRC.19980929.0018	REVIEW PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR L. FLINT, STUDY PLAN TITLED: MATRIX PROPERTIES WITH CONSOLIDATED FIELD PACKAGING INSTRUCTIONS FOR ECRB CROSS DRIFT STUDY (SYSTEMATIC DRILLING) (C)
DRC.19980929.0023	PACKAGE PROCEDURE OR INSTRUCTION	REVIEW LORRIE FLINT FIELD PACKAGING APPROVAL FOR ESF-UPCA-PTN#1 RECORD PACKAGE
DRC.19980929.0027	PACKAGE PROCEDURE OR INSTRUCTION	REVIEW LORRIE FLINT FIELD PACKAGING APPROVAL FOR ECRB-CWAT#1 RECORD PACKAGE
DRC.19980929.0030	PACKAGE PROCEDURE OR INSTRUCTION	REVIEW LORRIE FLINT FIELD PACKAGING APPROVAL FOR ESF-ECRB-SLANT#1 RECORD PACKAGE

Appendix G: Procedure Records Associated With the USGS Personnel Who Exchanged the Emails (continued)

Accession #	Type of Record	Title (86)
DRC.19980929.0034	PACKAGE PROCEDURE OR INSTRUCTION	REVIEW L. FLINT FIELD PACKAGING APPROVAL FOR ECRB-SYS-CS50 RECORD PACKAGE
DRC.19981001.0014	REVIEW PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL WITH CONSOLIDATED FIELD PACKAGING INSTRUCTIONS FOR MOISTURE STUDIES/ECRB CROSS-DRIFT (LAUNCH CHAMBER) (C
HQX.19890419.0104	PROCEDURE OR INSTRUCTION	USGS TECHNICAL PROCEDURE HP-12, METHOD FOR COLLECTION, PROCESSING, AND HANDLING OF DRILL CUTTINGS AND CORE FROM UNSATURATED-ZONE BOREHOLE AT THE WELL-SITE, NTS, REVISION 3 (C)
MOL.19940929.0008	PROCEDURE OR INSTRUCTION	USGS TECHNICAL PROCEDURE DEVELOPMENT AND USE OF A CALIBRATION EQUATION FOR A HAND HELD NEUTRON MOISTURE METER (C)
MOL.19941024.0115	PROCEDURE OR INSTRUCTION	GEOPHYSICAL LOGGING USING GAMMA-GAMMA GEOPHYSICAL LOGGING PROBE
MOL.19941024.0118	PROCEDURE OR INSTRUCTION	USGS TECHNICAL PROCEDURE NWM-USGS-HP-275, R0, GEOPHYSICAL LOGGING USING NEUTRON-NEUTRON GEOPHYSICAL LOGGING PROBE
MOL.19960129.0168	PROCEDURE OR INSTRUCTION	TECHNICAL PROCEDURE YMP-USGS-HP-258,R0-M1 METHOD FOR DETERMINING THE PH OF A SAMPLE (EFFECTIVE DATE: JUNE 30, 1995) (C)
MOL.19960129.0174	PROCEDURE OR INSTRUCTION	TECHNICAL PROCEDURE # YMP-USGS-HP-263,R0-M1 PARTICLE SIZE ANALYSIS (EFFECTIVE DATE: JUNE 30, 1995) (C)
MOL.19960129.0179	PROCEDURE OR INSTRUCTION	TECHNICAL PROCEDURE # YMP-USGS-HP-229,R3-M1 DETERMINATION OF WATER CONTENT AND PHYSICAL PROPERTIES FOR LABORATORY ROCK SAMPLES (EFFECTIVE DATE: JUNE 30, 1995) (C)
MOL.19960129.0300	PROCEDURE OR INSTRUCTION	YMP-USGS-HP-97,R2 MEASUREMENT OF TEMPERATURE AND RELATIVE HUMIDITY USING A TEMPERATURE AND RELATIVE HUMIDITY PROBE (EFFECTIVE DATE MAY 17, 1995) (C)
MOL.19960129.0307	PROCEDURE OR INSTRUCTION	YMP-USGS-HP-284,R0 MEASUREMENT OF TEMPERATURE USING THERMOCOUPLES OR THERMISTORS (EFFECTIVE DATE JUNE 23, 1995) (C)
MOL.19960129.0340	PROCEDURE OR INSTRUCTION	YMP-USGS-HP-230,R0-M1, DETERMINATION OF WATER POTENTIAL USING THE DECAGON SC10-A THERMOCOUPLE PSYCHROMETER (EFFECTIVE DATE JUNE 30, 1995)
MOL.19960129.0343	PROCEDURE OR INSTRUCTION	YMP-USGS-HP-255,R0-M1, DETERMINATION OF WATER POTENTIAL USING THE DECAGON CX-2 WATER ACTIVITY SYSTEM (EFFECTIVE DATE JUNE 30, 1995) (C)
MOL.19960129.0346	PROCEDURE OR INSTRUCTION	YMP-USGS-HP-259,R0-M2, DETERMINATION OF BULK DENSITY USING AN IRREGULAR HOLE BULK DENSITY SAMPLER (EFFECTIVE DATE JUNE 30, 1995) (C)
MOL.19960129.0349	PROCEDURE OR INSTRUCTION	YMP-USGS-HP-265,R0-M2, CALCIUM CARBONATE EQUIVALENT ANALYSIS (EFFECTIVE DATE JUNE 30, 1995)
MOL.19960129.0352	PROCEDURE OR INSTRUCTION	YMP-USGS-HP-243,R0-M2, METHOD FOR MEASURING THE PARTICLE VOLUME AND/OR PARTICLE DENSITY OF ROCK OR SOIL SAMPLES USING THE MICROMERITICS ACCUPYC 1330 PYCNOMETER (EFFECTIVE DATE JUNE 30, 1995)
MOL.19960129.0355	PROCEDURE OR INSTRUCTION	YMP-USGS-HP-266,R0-M1, METHOD FOR MEASURING SATURATED HYDRAULIC CONDUCTIVITY AND AIR PERMEABILITY ON ROCK SAMPLES USING A LOW-PRESSURE HASSLER PERMEAMETER (EFFECTIVE DATE JUNE 30, 1995) (C)

Appendix G: Procedure Records Associated With the USGS Personnel Who Exchanged the Emails (continued)

Accession #	Type of Record	Title (86)
MOL.19990917.0362	PROCEDURE OR INSTRUCTION CHANGE CONTROL DOCUMENT	EXPEDITED MODIFICATION TO TECHNICAL PROCEDURE YMP-USGS-HP-266, R0 METHOD FOR MEASURING SATURATED HYDRAULIC CONDUCTIVITY AND AIR PERMEABILITY ON ROCK SAMPLES USING A HASSLER PERMEAMETER
MOL.19991108.0377	PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR MATRIX HYDROLOGIC PROPERTIES, CONSOLIDATED FIELD PACKAGING INSTRUCTIONS FOR PTN LATERAL DIVERSION STUDY (ESF NORTH RAMP) (SYSTEMATIC DRILLING) (C)
MOL.19991108.0379	PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR MATRIX HYDROLOGIC PROPERTIES/HYDROCHEMISTRY TESTING IN THE ESF, CONSOLIDATED FIELD PACKAGING INSTRUCTIONS FOR MOISTURE STUDIES IN THE ESF (ESF-FWP-96-004) DRIFT SCALE PERCOLATION NICHE STUDY (ESF MAIN RAMP NICHE #3 & #4) (C)
MOL.19991108.0381	PROCEDURE OR INSTRUCTION	SAMPLE OVERVIEW COMMITTEE FIELD PACKAGING APPROVAL FOR MATRIX PROPERTIES, CONSOLIDATED FIELD PACKAGING INSTRUCTIONS FOR MOISTURE STUDIES ESF NICHE 3 (BENEATH ALCOVE #8) (C)
MOL.20000331.0555	PROCEDURE OR INSTRUCTION	USGS TECHNICAL PROCEDURE HP-266, R0-M4, MODIFICATION TO YMP-USGS-HP-266, R0, METHOD FOR MEASURING SATURATED HYDRAULIC CONDUCTIVITY AND AIR PERMEABILITY ON ROCK SAMPLES USING A HASSLER PERMEAMETER (C)
MOL.20000425.0529	PROCEDURE OR INSTRUCTION	YMP-USGS TECHNICAL PROCEDURE RECORD MODIFICATION FOR HP-266, R0-M4: METHOD FOR MEASURING SATURATED HYDRAULIC CONDUCTIVITY AND AIR PERMEABILITY ON ROCK SAMPLES USING A HASSLER PERMEAMETER, (C)
MOL.20000425.0530	PROCEDURE OR INSTRUCTION	YMP-USGS TECHNICAL PROCEDURE RECORD EXPEDITED CHANGE HP-266, R0-M3: METHOD FOR MEASURING SATURATED HYDRAULIC CONDUCTIVITY AND AIR PERMEABILITY ON ROCK SAMPLES USING A HASSLER PERMEAMETER, (C)
MOL.20000427.0090	PROCEDURE OR INSTRUCTION	ADMINISTRATION CHANGE YMP-USGS-HP-263, REVISION 0 MODIFICATION 1 FOR PARTICLE-SIZE ANALYSIS (C)
MOL.20000526.0301	PROCEDURE OR INSTRUCTION	TECHNICAL PROCEDURE YMP-USGS-HP-263, RO-M1 FOR ADMINISTRATION CHANGE FOR HP-263, RO, PARTICLE-SIZE ANALYSIS (C)
NNA.19880531.0034	PROCEDURE OR INSTRUCTION	USGS TECHNICAL PROCEDURE (NWM-USGS-HP-179, REVISION 0) FIELD MEASUREMENT OF PRECIPITATION USING A TIPPING BUCKET RAIN GAGE, EFFECTIVE DATE: MAY 20, 1988 (APPROVED) (C)
NNA.19880628.0018	PROCEDURE OR INSTRUCTION	USGS TECHNICAL PROCEDURE HP-12 REVISION 3 METHOD FOR COLLECTION PROCESSING AND HANDLING OF DRILL CUTTINGS AND CORE FROM UNSATURATED-ZONE BOREHOLES AT THE WELL-SITE NEVADA TEST SITE (NTS) JUNE 08, 1988 (C)
NNA.19880628.0021	PROCEDURE OR INSTRUCTION	USGS TECHNICAL PROCEDURE HP-180 FIELD MEASUREMENT OF PRECIPITATION USING A PROPANE HEATED TIPPING BUCKET RAIN AND SNOW GAGE
NNA.19890421.0009	PROCEDURE OR INSTRUCTION	CRITERIA LETTER FOR PROTOTYPE EVALUATION OF THE EFFECTS OF WET AND DRY DRILLING FLUIDS ON THE IN SITU HYDROLOGIC CONDITIONS OF TUFFACEOUS ROCKS IN SUPPORT OF EXPLORATORY SHAFT HYDROLOGIC TESTING (C)

Appendix G: Procedure Records Associated With the USGS Personnel Who Exchanged the Emails (continued)

Accession #	Type of Record	Title (86)
NNA.19900913.0119	PROCEDURE OR INSTRUCTION	SEALING NEUTRON ACCESS BOREHOLE CASINGS AT THE GROUND SURFACE
NNA.19910905.0092	PROCEDURE OR INSTRUCTION	USGS TECHNICAL PROCEDURE HP-62, REV 6 - METHOD FOR MEASURING SUB-SURFACE MOISTURE CONTENT USING A NEUTRON MOISTURE METER (EFFECTIVE JULY 3, 1991) (C)
NNA.19911017.0057	PROCEDURE OR INSTRUCTION	IDENTIFICATION, MONITORING, AND SAMPLING OF PERCHED WATER ENCOUNTERED WHILE DRILLING NEUTRON-ACCESS BOREHOLES (EFFECTIVE SEPTEMBER 18, 1991) (C)
NNA.19911218.0008	PROCEDURE OR INSTRUCTION	USGS TECHNICAL PROCEDURE HP-229, REV 0, DETERMINATION OF WATER CONTENT AND PHYSICAL PROPERTIES FOR LABORATORY ROCK SAMPLES (EFFECTIVE NOVEMBER 4, 1991)
NNA.19920318.0027	PROCEDURE OR INSTRUCTION	DETERMINATION OF WATER POTENTIAL USING THE DECAGON SC10-A THERMOCOUPLE PSYCHROMETER (EFFECTIVE 111591)
NNA.19920902.0009	PROCEDURE OR INSTRUCTION	USGS TECHNICAL PROCEDURE HP-96 REVISION 1 MEASUREMENT OF WIND SPEED USING A MET-ONE INC, MODEL 014A WIND SPEED SENSOR (EFFECTIVE AUGUST 17, 1992) (C)
NNA.19930831.0013	PROCEDURE OR INSTRUCTION	DETERMINATION OF WATER POTENTIAL USING THE DECAGON CX-2 WATER ACTIVITY SYSTEM
NNA.19930915.0094	PROCEDURE OR INSTRUCTION	USGS TECHNICAL PROCEDURE HP-264 REVISION 0 FIELD MEASUREMENT OF PRECIPITATION USING NON-RECORDING RAIN GAGES (C)
NNA.19930923.0031	PROCEDURE OR INSTRUCTION	USGS TECHNICAL PROCEDURE HP-263, REVISION 0 PARTICLE-SIZE ANALYSIS (C)
NNA.19940321.0087	PROCEDURE OR INSTRUCTION	METHOD FOR MEASURING SATURATED HYDRAULIC CONDUCTIVITY AND AIR PERMEABILITY ON ROCK SAMPLES USING A LOW-PRESSURE HASSLER PERMEAMETER (PREPARED BY LORRAINE FLINT)
NNA.19940330.0034	PROCEDURE OR INSTRUCTION	MEASUREMENT OF TEMPERATURE AND RELATIVE HUMIDITY USING A CSI 207 TEMPERATURE AND RELATIVE HUMIDITY PROBE
MOL.20011023.0170	COMPUTER DOCUMENTATION PROCEDURE OR INSTRUCTION	USER'S MANUAL (UM) FOR INFIL V2.0; SDN: 10307-UM-2.0-00 (C)
NNA.19911017.0051	PROCEDURE OR INSTRUCTION	FIELD MEASUREMENT OF PRECIPITATION USING A TIPPING BUCKET RAIN GAGE (EFFECTIVE SEPTEMBER 9, 1991) (C)
NNA.19911017.0054	PROCEDURE OR INSTRUCTION	FIELD MEASUREMENT OF PRECIPITATION USING A PROPANE HEATED TIPPING BUCKET RAIN AND SNOW GAGE (EFFECTIVE DATE SEPTEMBER 12, 1991) (C)
NNA.19920608.0246	PROCEDURE OR INSTRUCTION	FIELD MEASUREMENT OF PRECIPITATION USING A TIPPING BUCKET RAIN GAGE (EFFECTIVE 041492)

Appendix H: Corroborating Data Tables

Table H-1. Estimates of Recharge for Nevada Hydrographic Areas[1]

Hydro-graphic Area Number	Hydrographic Area Name	Area of Hydro-graphic Area (acres)	Precipitation, acre-ft/yr	Recharge, acre-ft/yr	Precipitation, mm/yr	Recharge, mm/yr
1	Pueblo Valley	75520	48,300	2,000	194.9	8.07
2	Continental Lake Valley	136960	254,200	11,000	565.7	24.48
3	Gridley Lake Valley	124800	97,900	4,500	239.1	10.99
4	Virgin Valley	316160	230,000	7,000	221.7	6.75
5	Sage Hen Valley	14080	--	--		
6	Guano Valley	94080	206,000	7,500	667.4	24.30
7	Swan Lake Valley	144640	--	--		
8	Massacre Lake Valley	112640	88,200	3,500	238.7	9.47
9	Long Valley	277120	168,000	6,000	184.8	6.60
10	Macy Flat	17280	--	--		
11	Coleman Valley	32640	28,000	1,000	261.5	9.34
12	Mosquito Valley	20480	14,300	700	212.8	10.42
13	Warner Valley	52480	--	--		
14	Surprise Valley	136960	37,500	1,500	83.5	3.34
15	Boulder Valley	56320	50,400	2,000	272.8	10.82
16	Duck Lake Valley	341120	247,000	9,000	220.7	8.04
16		341120	243,000	8,900	217.1	7.95
17	Pilgrim Flat	7680	7,000	500	277.8	19.84
18	Painter Flat	19840	31,000	1,300	476.3	19.97
19	Dry Valley	24960	5,900	200	72.0	2.44
20	Sano Valley	7680	130	4	5.2	0.16
21	Smoke Creek Desert	627200	275,100	13,000	133.7	6.32
22	San Emidio Desert	195200	47,900	2,100	74.8	3.28
23	Granite Basin	5760	45,400	2,000	2402.4	105.83
24	Hualapai Flat	201600	62,700	4,000	94.8	6.05
		201600	106,200	7,000	160.6	10.58
25	High Rock Lake Valley	425600	435,000	13,000	311.5	9.31
26	Mud Meadow	316800	130,600	8,000	125.7	7.70
27	Summit Lake Valley	38400	42,700	4,200	338.9	33.34
28	Black Rock Desert	1394560	260,900	13,900	57.0	3.04

[1] In the graphs of infiltration and recharge in Section 4, data for sites where precipitation values exceed 500 mm/yr or average annual recharge exceeds 100 mm/yr were not plotted because those sites are not comparable to Yucca Mountain. However, these sites are included in Appendix H for completeness of record.

Table H-1. Estimates of Recharge for Nevada Hydrographic Areas (continued)

Hydro-graphic Area Number	Hydrographic Area Name	Area of Hydro-graphic Area (acres)	Precipitation, acre-ft/yr	Recharge, acre-ft/yr	Precipitation, mm/yr	Recharge, mm/yr
29	Pine Forest Valley	337920	197,000	10,000	177.7	9.02
30	Kings River Valley	264320	260,000	15,000	299.8	17.30
31	Desert Valley	673280	100,000	5,000	45.3	2.26
		673280	110,000	7,000	49.8	3.17
		673280	110,000	3,300	49.8	1.49
32	Silver State Valley	200320	35,000	1,400	53.3	2.13
33	Quinn River Valley	783360	880,000	62,000	342.4	24.12
34	Little Owyhee River Area	458240	357,000	2,700	237.5	1.80
35	South Fork Owyhee River Area	838400	1,004,000	28,000	365.0	10.18
36	Independence Valley	220800	--	10,000		
		220800	251,000	9,700	346.5	13.39
37	Owyhee River Area	341120	458,000	17,000	409.2	15.19
38	Bruneau River Area	328960	497,000	26,000	460.5	24.09
39	Jarbidge River Area	177920	334,000	32,000	572.2	54.82
40	Salmon Falls Creek Area	779520	1,021,000	44,000	399.2	17.20
41	Goose Creek Area	202240	198,000	6,700	298.4	10.10
42	Marys River Area	686720	--	--		
43	Starr Valley Area	212480	--	--		
44	North Fork Area	710400	--	--		
45	Lamoille Valley	164480	--	--		
46	South Fork Area	63360	98,000	3,000	471.4	14.43
47	Huntington Valley	503680	554,000	14,000	335.3	8.47
48	Dixie Creek-Tenmile Creek Area	250880	235,000	13,000	285.5	15.79
49	Elko Segment	200960	--	--		
50	Susie Creek Area	142720	147,000	9,700	313.9	20.72
51	Maggie Creek Area	253440	280,000	23,000	336.7	27.66

Table H-1. Estimates of Recharge for Nevada Hydrographic Areas (continued)

Hydro-graphic Area Number	Hydrographic Area Name	Area of Hydro-graphic Area (acres)	Precipitation, acre-ft/yr	Recharge, acre-ft/yr	Precipitation, mm/yr	Recharge, mm/yr
52	Marys Creek Area	39040	37,000	2,100	288.9	16.40
53	Pine Valley	641280	654,000	46,000	310.8	21.86
		641280	688,000	52,500	327.0	24.95
		641280	688,000	79,300	327.0	37.69
		641280	688,000	66,000	327.0	31.37
54	Crescent Valley	481280	200,000	14,000	126.7	8.87
		481280	446,000	25,200	282.5	15.96
		481280	446,000	26,200	282.5	16.59
		481280	446,000	21,000	282.5	13.30
55	Carico Lake Valley	240640	86,600	4,300	109.7	5.45
		240640	239,000	18,700	302.7	23.69
		240640	239,000	20,400	302.7	25.84
		240640	239,000	18,000	302.7	22.80
56	Upper Reese River Valley	728320	591,500	37,000	247.5	15.48
		728320	592,000	30,000	247.8	12.55
		728320	803,000	71,400	336.1	29.88
		728320	803,000	110,000	336.1	46.03
		728320	803,000	93,000	336.1	38.92
57	Antelope Valley	289280	240,000	11,000	252.9	11.59
		289280	279,000	17,200	294.0	18.12
		289280	279,000	25,200	294.0	26.55
		289280	279,000	19,000	294.0	20.02
58	Middle Reese River Valley	204160	142,000	7,000	212.0	10.45
		204160	186,000	12,800	277.7	19.11
		204160	186,000	13,200	277.7	19.71
		204160	186,000	10,000	277.7	14.93
59	Lower Reese River Valley	376320	341,000	18,500	276.2	14.98
		376320	341,000	19,000	276.2	15.39
		376320	341,000	13,000	276.2	10.53
60	Whirlwind Valley	60160	55,000	3,700	278.7	18.75
		60160	55,000	3,800	278.7	19.25
		60160	55,000	2,000	278.7	10.13
61	Boulder Flat	348160	291,000	14,000	254.8	12.26
		348160	308,000	19,100	269.6	16.72
		348160	308,000	19,300	269.6	16.90
		348160	308,000	11,000	269.6	9.63

Table H-1. Estimates of Recharge for Nevada Hydrographic Areas (continued)

Hydro-graphic Area Number	Hydrographic Area Name	Area of Hydro-graphic Area (acres)	Precipitation, acre-ft/yr	Recharge, acre-ft/yr	Precipitation, mm/yr	Recharge, mm/yr
62	Rock Creek Valley	284160	256,000	17,100	274.6	18.34
		284160	256,000	9,000	274.6	9.65
		284160	270,000	13,000	289.6	13.94
63	Willow Creek Valley	259200	279,000	20,000	328.1	23.52
		259200	280,000	27,500	329.3	32.34
		259200	280,000	28,000	329.3	32.93
64	Clovers Area	460800	401,000	17,900	265.2	11.84
		460800	401,000	18,400	265.2	12.17
		460800	401,000	13,000	265.2	8.60
65	Pumpernickel Valley	191360	169,000	8,800	269.2	14.02
		191360	169,000	9,000	269.2	14.34
		191360	169,000	7,500	269.2	11.95
66	Kelly Creek Area	192640	181,000	12,700	286.4	20.09
		192640	181,000	13,200	286.4	20.89
		192640	181,000	11,000	286.4	17.40
67	Little Humboldt Valley	624000	443,000	24,000	216.4	11.72
68	Hardscrabble Area	106880	115,000	9,000	328.0	25.67
69	Paradise Valley	384000	121,000	10,000	96.0	7.94
70	Winnemucca Segment	278400	--	--		
71	Grass Valley	332800	180,000	12,000	164.9	10.99
72	Imlay Area	493440	82,000	4,000	50.7	2.47
73	Lovelock Valley	406400	60,000	3,200	45.0	2.40
74	White Plains	104960	100	3	0.3	0.01
75	Bradys Hot Springs Area	113920	4,800	160	12.8	0.43
76	Fernley Area	76800	13,000	600	51.6	2.38
77	Fireball Valley	37120	6,000	200	49.3	1.64
78	Granite Springs Valley	618880	97,600	3,500	48.1	1.72
79	Kumiva Valley	213120	28,000	1,000	40.0	1.43
80	Winnemucca Lake Valley	237440	61,000	2,900	78.3	3.72
81	Pyramid Lake Valley	430080	100,000	6,600	70.9	4.68
82	Dodge Flat	58880	21,000	1,400	108.7	7.25
83	Tracy Segment	182400	121,000	6,000	202.2	10.03
84	Warm Springs Valley	158080	96,000	6,000	185.1	11.57

Table H-1. Estimates of Recharge for Nevada Hydrographic Areas (continued)

Hydro-graphic Area Number	Hydrographic Area Name	Area of Hydro-graphic Area (acres)	Precipitation, acre-ft/yr	Recharge, acre-ft/yr	Precipitation, mm/yr	Recharge, mm/yr
85	Spanish Springs Valley	48640	16,000	600	100.3	3.76
		48640	26,000	830	162.9	5.20
		48640	26,000	770	162.9	4.83
86	Sun Valley	6400	1,800	50	85.7	2.38
87	Truckee Meadows	129920	161,000	27,000	377.7	63.34
88	Pleasant Valley	24960	46,000	10,000	561.7	122.12
89	Washoe Valley	52480	87,000	15,000	505.3	87.12
90	Lake Tahoe Basin	88960	--	--		
91	Truckee CanyonSegment	53760	110,000	27,000	623.7	153.08
92	Lemmon Valley	59520	43,400	1,800	222.3	9.22
		59520	44,000	1,500	225.3	7.68
		59520	30,800	1,600	157.7	8.19
93	Antelope Valley	11520	9,000	300	238.1	7.94
94	Bedell Flat	33920	27,000	1,100	242.6	9.88
95	Dry Valley	51200	37,000	2,400	220.3	14.29
96	Newcomb Lake Valley	5760	4,500	300	238.1	15.88
97	Honey Lake Valley	123520	24,000	1,500	59.2	3.70
98	Skedaddle Creek Valley	27520	17,680	600	195.8	6.65
99	Red Rock Valley	37120	7,700	900	63.2	7.39
100	Cold Spring Valley	35200	18,000	900	155.9	7.79
101	Carson Desert	1396480	43,000	2,010	9.4	0.44
102	Churchill Valley	307200	32,000	1,300	31.8	1.29
103	Dayton Valley	236160	125,300	7,900	161.7	10.20
		236160	127,000	7,900	163.9	10.20
		236160	163,000	11,000	210.4	14.20
		236160	229,000	26,000	295.6	33.56
104	Eagle Valley	44160	58,000	8,700	400.3	60.05
		44160	--	5,600		
		44160	67,000	8,000	462.4	55.22
		44160	67,000	10,000	462.4	69.02
105	Carson Valley	268160	254,000	25,000	288.7	28.42
		268160	350,000	49,000	397.8	55.70

Table H-1. Estimates of Recharge for Nevada Hydrographic Areas (continued)

Hydro-graphic Area Number	Hydrographic Area Name	Area of Hydro-graphic Area (acres)	Precipitation, acre-ft/yr	Recharge, acre-ft/yr	Precipitation, mm/yr	Recharge, mm/yr
106	Antelope Valley	73600	66,700	5,000	276.2	20.71
107	Smith Valley	306560	210,000	17,000	208.8	16.90
108	Mason Valley	330240	32,000	2,000	29.5	1.85
109	East Walker Area	375040	191,000	22,000	155.2	17.88
110	Walker Lake Valley	864000	101,000	6,500	35.6	2.29
111	Alkali Valley	53120	32,400	1,800	185.9	10.33
112	Mono Valley	17280	16,000	700	282.2	12.35
113	Huntoon Valley	62080	22,200	800	109.0	3.93
114	Teels Marsh Valley	206720	38,400	1,300	56.6	1.92
115	Adobe Valley	9600	6,400	300	203.2	9.53
116	Queen Valley	41600	25,100	2,000	183.9	14.65
117	Fish Lake Valley	451840	255,000	33,000	172.0	22.26
		451840	251,000	26,800	169.3	18.08
118	Columbus Salt Marsh Valley	236800	13,300	700	17.1	0.90
119	Rhodes Salt Marsh Valley	127360	11,600	500	27.8	1.20
120	Garfield Flat	58880	9,400	300	48.7	1.55
121	Soda Spring Valley	240640	19,600	700	24.8	0.89
122	Gabbs Valley	817280	383,000	5,000	142.8	1.86
		817280	381,000	4,900	142.1	1.83
123	Rawhide Flats	145280	5,000	150	10.5	0.31
124	Fairview Valley	182400	16,600	500	27.7	0.84
		182400	74,000	2,300	123.7	3.84
125	Stingaree Valley	27520	--	--		
126	Cowkick Valley	70400	--	--		
127	Eastgate Valley Area	138240	--	--		
125,6,7	Sum of HAs 125, 126, 127	236160	94,100	6,000	121.5	7.74
		236160	171,000	6,700	220.7	8.65
128	Dixie Valley	833920	116,200	6,000	42.5	2.19
		833920	246,900	8,900	90.2	3.25
129	Buena Vista Valley	474880		10,000		
130	Pleasant Valley	182400	44,900	3,000	75.0	5.01
		182400	92,000	3,300	153.7	5.51
131	Buffalo Valley	322560	--	--		

Table H-1. Estimates of Recharge for Nevada Hydrographic Areas (continued)

Hydro-graphic Area Number	Hydrographic Area Name	Area of Hydro-graphic Area (acres)	Precipitation, acre-ft/yr	Recharge, acre-ft/yr	Precipitation, mm/yr	Recharge, mm/yr
132	Jersey Valley	90880	16,970	800	56.9	2.68
		90880	41,000	1,400	137.5	4.70
133	Edwards Creek Valley	266240	111,400	8,000	127.5	9.16
134	Smith Creek Valley	372480	119,000	12,000	97.4	9.82
		372480	92,000	9,600	75.3	7.86
		372480	92,000	8,300	75.3	6.79
135	Ione Valley	294400	90,000	8,000	93.2	8.28
136	Monte Cristo Valley	181760	12,200	500	20.5	0.84
137	Big Smoky Valley	1872640	741,000	77,000	120.6	12.53
		1872640	--	74,000		
138	Grass Valley	380800	211,000	13,000	168.9	10.41
139	Kobeh Valley	555520	110,000	11,000	60.4	6.04
140	Monitor Valley	664320	392,500	23,300	180.1	10.69
141	Ralston Valley	621440	340,000	16,000	166.8	7.85
		621440	115,000	5,000	56.4	2.45
142	Alkali Spring Valley	200320	2,800	100	4.3	0.15
143	Clayton Valley	355200	34,700	1,500	29.8	1.29
144	Lida Valley	342400	13,400	500	11.9	0.45
		342400	--	1,900		
145	Stonewall Flat	243840	1,900	100	2.4	0.13
		243840	--	800		
146	Sarcobatus Flat	519680	37,500	1,200	22.0	0.70
		519680	--	1,500		
147	Gold Flat	437760	94,000	3,800	65.4	2.65
		437760	--	6,600		
148	Cactus Flat	257920	15,000	600	17.7	0.71
		257920	--	3,100		
149	Stone Cabin Valley	630400	362,000	16,000	175.0	7.74
		630400	103,000	5,000	49.8	2.42
150	Little Fish Lake Valley	277760	181,000	11,000	198.6	12.07
		277760	236,430	9,700	259.4	10.64
151	Antelope Valley	284160	108,100	4,100	116.0	4.40

Table H-1. Estimates of Recharge for Nevada Hydrographic Areas (continued)

Hydro-graphic Area Number	Hydrographic Area Name	Area of Hydro-graphic Area (acres)	Precipitation, acre-ft/yr	Recharge, acre-ft/yr	Precipitation, mm/yr	Recharge, mm/yr
152	Stevens Basin	10880	8,500	200	238.1	5.60
153	Diamond Valley	481280	304,000	16,000	192.5	10.13
		481280	319,000	21,000	202.0	13.30
		481280	227,000	10,500	143.8	6.65
154	Newark Valley	512640	335,000	17,500	199.2	10.40
		512640	515,471	49,000	306.5	29.13
155	Little Smoky Valley	741120	140,000	5,400	57.6	2.22
		741120	523,359	13,000	215.2	5.35
156	Hot Creek Valley	663040	--	10,600		
		663040	153,000	7,000	70.3	3.22
		663040	424,067	5,800	194.9	2.67
157	Kawich Valley	224000	88,000	3,500	119.7	4.76
		224000	--	7,500		
158	Emigrant Valley	490880	75,720	3,204	47.0	1.99
		490880	--	13,000		
159	Yucca Flat	195200	19,300	700	30.1	1.09
		195200	--	1,900		
160	Frenchman Flat	296320	3,200	100	3.3	0.10
		296320	--	1,000		
161	Indian Springs Valley	419200	--	4,700		
		419200	115,000	10,000	83.6	7.27
		419200	--	8,200		
162	Pahrump Valley	504960	--	23,000		
		504960	--	20,200		
163	Mesquite Valley	151040	28,400	1,400	57.3	2.83
		151040	30,000	1,600	60.5	3.23
		151040	--	2,200		
164	Ivanpah Valley	208640	13,350	700	19.5	1.02
165	Jean Lake Valley	61440	2,200	100	10.9	0.50
166	Hidden Valley	21760	0	minor		
167	Eldorado Valley	339200	37,000	1,100	33.2	0.99
168	Three Lakes Valley	190720	41,100	2,000	65.7	3.20
		190720	--	1,200		
169	Tikapoo Valley	638720	115,000	6,000	54.9	2.86
		638720	--	9,800		

Table H-1. Estimates of Recharge for Nevada Hydrographic Areas (continued)

Hydro-graphic Area Number	Hydrographic Area Name	Area of Hydro-graphic Area (acres)	Precipitation, acre-ft/yr	Recharge, acre-ft/yr	Precipitation, mm/yr	Recharge, mm/yr
170	Penoyer Valley	448000	95,300	4,300	64.8	2.93
		448000	97,300	3,200	66.2	2.18
		448000	97,300	13,500	66.2	9.18
171	Coal Valley	294400	62,000	2,000	64.2	2.07
172	Garden Valley	315520	137,000	10,000	132.3	9.66
173A	Railroad Valley	385920	817,200	50,400	645.4	39.81
		385920	750,500	52,000	592.7	41.07
		385920	746,000	33,300	589.2	26.30
173B	Railroad Valley (Northern Part)	1375360	618,000	46,000	137.0	10.19
		1375360	616,000	28,400	136.5	6.29
		1375360	1,089,249	61,000	241.4	13.52
174	Jakes Valley	270080	--	13,000		
		270080	289,477	38,500	326.7	43.45
175	Long Valley	416640	297,000	10,000	217.3	7.32
		416640	452,367	48,000	330.9	35.12
176	Ruby Valley	642560	696,000	68,000	330.1	32.26
		642560	867,225	146,000	411.4	69.26
177	Clover Valley	296960	224,000	20,700	229.9	21.25
		296960	363,328	59,000	372.9	60.56
178	Butte Valley	646400	240,000	19,000	113.2	8.96
		646400	243,000	14,600	114.6	6.88
		646400	700,905	69,000	330.5	32.54
179	Steptoe Valley	1242880	810,000	85,000	198.6	20.85
		1242880	1,344,191	132,000	329.6	32.37
180	Cave Valley	231680	206,000	14,000	271.0	18.42
181	Dry Lake Valley	564480	118,000	5,000	63.7	2.70
182	Delamar Valley	245120	34,000	1,000	42.3	1.24
183	Lake Valley	356480	229,000	13,000	195.8	11.12
184	Spring Valley	1063040	791,000	75,000	226.8	21.50
		1063040	787,000	61,600	225.7	17.66
		1063040	1,141,444	104,000	327.3	29.82
185	Tippett Valley	220800	114,000	6,900	157.4	9.53
		220800	211,905	12,500	292.5	17.26
186	Antelope Valley	252800	117,000	4,700	141.1	5.67
		252800	246,551	17,000	297.3	20.50
187	Goshute Valley	610560	592,875	41,000	296.0	20.47
188	Independence Valley	359680	203,000	9,300	172.0	7.88
		359680	394,414	50,000	334.2	42.37

Table H-1. Estimates of Recharge for Nevada Hydrographic Areas (continued)

Hydro-graphic Area Number	Hydrographic Area Name	Area of Hydro-graphic Area (acres)	Precipitation, acre-ft/yr	Recharge, acre-ft/yr	Precipitation, mm/yr	Recharge, mm/yr
189	Thousand Springs Valley	925440	325,000	12,000	107.0	3.95
190	Grouse Creek Valley	35200	19,100	700	165.4	6.06
191	Pilot Creek Valley	208640	40,000	2,400	58.4	3.51
192	Great Salt Lake Desert	324480	77,600	4,800	72.9	4.51
193	Deep Creek Valley	133120	44,700	2,200	102.3	5.04
194	Pleasant Valley	48000	--	--		
195	Snake Valley	497280	--	--		
196	Hamlin Valley	264320	--	--		
197	Escalante Desert	67840	76,000	2,300	341.5	10.33
198	Dry Valley	72320	--	--		
199	Rose Valley	7680	--	--		
200	Eagle Valley	33280	--	--		
201	Spring Valley	183680	177,000	10,000	293.7	16.59
202	Patterson Valley	267520	137,000	6,000	156.1	6.84
203	Panaca Valley	213760	--	--		
204	Clover Valley	232960	--	--		
205	Lower Meadow Valley Wash	626560	--	--		
206	Kane Springs Valley	149760	10,000	500	20.4	1.02
207	White River Valley	1028480	--	40,000		
208	Pahroc Valley	325120	57,000	2,200	53.4	2.06
209	Pahranagat Valley	491520	43,000	1,800	26.7	1.12
210	Coyote Spring Valley	420480	39,000	2,100	28.3	1.52
211	Three Lakes Valley	199040	56,000	6,000	85.8	9.19
		199040	56,000	7,300	85.8	11.18
212	Las Vegas Valley	1000960	161,200	30,000	49.1	9.14
		1000960	161,200	35,000	49.1	10.66
		1000960	--	25,000		
		1000960	--	30,000		
		1000960	332,500	28,000	101.2	8.53
		1000960	--	33,000		

Table H-1. Estimates of Recharge for Nevada Hydrographic Areas (continued)

Hydro-graphic Area Number	Hydrographic Area Name	Area of Hydro-graphic Area (acres)	Precipitation, acre-ft/yr	Recharge, acre-ft/yr	Precipitation, mm/yr	Recharge, mm/yr
213	Colorado Valley	360320	5,800	200	4.9	0.17
214	Piute Valley	216320	55,800	1,700	78.6	2.40
215	Black Mountains Area	403200	2,200	70	1.7	0.05
216	Garnet Valley	99840	11,000	400	33.6	1.22
217	Hidden Valley	51200	11,000	400	65.5	2.38
218	California Wash	203520	2,000	60	3.0	0.09
219	Muddy River Springs Area	58240	--	--		
220	Lower Moapa Valley	161280	1,200	40	2.3	0.08
221	Tule Desert	122880	62,000	2,100	153.8	5.21
222	Virgin River Valley	580480	98,700	3,600	51.8	1.89
223	Gold Butte Area	341120	27,600	1,000	24.7	0.89
224	Greasewood Basin	69120	14,900	600	65.7	2.65
225	Mercury Valley	70400	5,200	250	22.5	1.08
226	Rock Valley	52480	900	30	5.2	0.17
225,226	Sum of HAs 225, 226	122880	--	400		
227	Fortymile Canyon	332160	61,000	2,300	56.0	2.11
		332160	--	700		
228	Oasis Valley	294400	33,500	1,000	34.7	1.04
		294400	--	3,000		
229	Crater Flat	116480	6,700	220	17.5	0.58
		116480	--	100		
230	Amargosa Desert	573440	90,000	1,500	47.8	0.80
		573440	--	400		
231	Grapevine Canyon	103680	1,070	50	3.1	0.15
232	Oriental Wash	116480	8,500	300	22.2	0.79

Table H-2: Estimated Average Annual Precipitation, Evaporation, and Recharge Rates for the Columbia Plateau, Washington (pre-development conditions)[2]

Zone #	Average Annual Precipitation (inch/yr)	Average Annual Evapo-transpiration (inch/yr)	Average Annual Recharge (inch/yr)	Average Annual Precipitation (mm/yr)	Average Annual Evapo-transpiration (mm/yr)	Average Annual Recharge (mm/yr)	Zone #	Average Annual Precipitation (inch/yr)	Average Annual Evapo-transpiration (inch/yr)	Average Annual Recharge (inch/yr)	Average Annual Precipitation (mm/yr)	Average Annual Evapo-transpiration (mm/yr)	Average Annual Recharge (mm/yr)
1	7.29	6.74	0.43	185.2	171.2	10.9	28	10.05	8.75	1.16	255.3	222.3	29.5
2	8.91	7.62	1.25	226.3	193.5	31.8	29	21.8	14.37	3.51	553.7	365.0	89.2
3	9.34	7.75	1.37	237.2	196.9	34.8	30	10.09	8.41	1.42	256.3	213.6	36.1
4	6.61	6.09	0.38	167.9	154.7	9.7	31	8.69	7.91	0.73	220.7	200.9	18.5
5	8.77	7.54	1.18	222.8	191.5	30.0	32	7.78	7.11	0.58	197.6	180.6	14.7
6	8.64	7.66	0.66	219.5	194.6	16.8	33	11.12	8.33	2.74	282.4	211.6	69.6
7	8.26	6.62	1.31	209.8	168.1	33.3	34	10.24	8.89	1.04	260.1	225.8	26.4
8	6.95	6.61	0.3	176.5	167.9	7.6	35	8.94	8.23	0.24	227.1	209.0	6.1
9	7.64	7.24	0.43	194.1	183.9	10.9	36	10.26	8.93	1.17	260.6	226.8	29.7
10	7.93	7.39	0.45	201.4	187.7	11.4	37	24.3	11.71	10.65	617.2	297.4	270.5
11	7.76	7.24	0.44	197.1	183.9	11.2	38	8.24	8.06	0.13	209.3	204.7	3.3
12	7.41	7.28	0.15	188.2	184.9	3.8	39	22.42	16.03	4.13	569.5	407.2	104.9
13	8.19	7.66	0.47	208.0	194.6	11.9	40	8.15	7.32	0.57	207.0	185.9	14.5
14	7.95	7.36	0.23	201.9	186.9	5.8	41	8.04	7.13	0.82	204.2	181.1	20.8
15	6.98	6.52	0.13	177.3	165.6	3.3	42	9.12	8.14	0.84	231.6	206.8	21.3
16	8.31	7.71	0.39	211.1	195.8	9.9	43	9.04	9.04	0.01	229.6	229.6	0.3
17	8.09	7.39	0.26	205.5	187.7	6.6	44	8.61	8.09	0.44	218.7	205.5	11.2
18	12.05	8.64	1.3	306.1	219.5	33.0	45	18.28	12.33	3.3	464.3	313.2	83.8
19	10.09	8.57	0.83	256.3	217.7	21.1	46	21.06	12.64	6.79	534.9	321.1	172.5
20	9.19	7.49	0.87	233.4	190.2	22.1	47	16.49	12.89	1.53	418.8	327.4	38.9
21	17.27	9.92	5.39	438.7	252.0	136.9	48	20.96	15.59	2.98	532.4	396.0	75.7
22	22.75	10.58	10.52	577.9	268.7	267.2	49	12.93	11.45	1.45	328.4	290.8	36.8
23	22.32	14.05	6.01	566.9	356.9	152.7	50	37.65	15.08	15.06	956.3	383.0	382.5

[2] In the graphs of infiltration and recharge in Section 4, data for sites where precipitation values exceed 500 mm/yr or average annual recharge exceeds 100 mm/yr were not plotted because those sites are not comparable to Yucca Mountain. However, these sites are included in Appendix H for completeness of record.

Table H-2: Estimated Average Annual Precipitation, Evaporation, and Recharge Rates for the Columbia Plateau, Washington (pre-development conditions) (continued)

Zone #	Average Annual Precipitation (inch/yr)	Average Annual Evapo-transpiration (inch/yr)	Average Annual Recharge (inch/yr)	Average Annual Precipitation (mm/yr)	Average Annual Evapo-transpiration (mm/yr)	Average Annual Recharge (mm/yr)	Zone #	Average Annual Precipitation (inch/yr)	Average Annual Evapo-transpiration (inch/yr)	Average Annual Recharge (inch/yr)	Average Annual Precipitation (mm/yr)	Average Annual Evapo-transpiration (mm/yr)	Average Annual Recharge (mm/yr)
24	9.64	9.19	0.57	244.9	233.4	14.5	51	11.35	11.15	0.29	288.3	283.2	7.4
25	10.33	8.92	1.36	262.4	226.6	34.5	52	11.34	10.01	0.9	288.0	254.3	22.9
26	12.61	10.24	2.3	320.3	260.1	58.4	53	8.93	8.03	0.84	226.8	204.0	21.3
27	12.54	10.24	1.68	318.5	260.1	42.7							

Table H-3: Recharge Estimates for West Texas, New Mexico, and Arizona[3]

West Texas-New Mexico-Arizona	Reference	Method(s)	Recharge		Precipitation	Notes
			mm/yr	*%*	*mm/yr*	
Chihuahuan Desert	Scanlon et al., 1999	Chloride mass balance method	0.02 – 0.05		320 (25-year record) 179 – 353 (for study period)	Inter-drainage areas. Higher in local depressions (1% of study area).
Chihuahuan Desert	Scanlon, 1991	Chloride mass balance method	0.03 – 0.27		280 (110-440 range)	10 soil profiles – recharge estimates for interstream areas. See Table 1 of reference for other studies.
Southern High Plains	Wood & Sanford, 1995 Wood et al., 1997	Chloride mass balance method	11	2	330 - 560	
Westernmost Texas	Gates et al., 1980 (Texas DWR report 256)	Water budget	6,000 acre feet per year (AFY); 2.5 mm/yr (N. Hueco) 7,000 AFY; (Presidio-Redford) 1,000 AFY ((Green River) 2,000 AFY (Red Light Draw)	All at 1%	183 (Ysleta) 294 (Pecos River) 476 (Davis Mtn.)	Regional study. See page 10 of reference for several sub-area recharge estimates.

[3] In the graphs of infiltration and recharge in Section 4, data for sites where precipitation values exceed 500 mm/yr or average annual recharge exceeds 100 mm/yr were not plotted because those sites are not comparable to Yucca Mountain. However, these sites are included in Appendix H for completeness of record.

Table H-3: Recharge Estimates in West Texas, New Mexico, and Arizona (continued)

West Texas-New Mexico-Arizona	Reference	Method(s)	Recharge		Precipitation	Notes
			mm/yr	*%*	*mm/yr*	
Trans-Pecos	Boghici, 1999 (Texas DWR report 348) Ashworth, 1990 (Texas DWR report 317)	Water level/water budget studies	67,800 AFY; 7.2 mm/yr (based on est. area of 4,500 sq. miles)	2 – 3%	241 – 338	Regional studies.
Socorro, New Mexico	Stephens & Knowlton, 1986	Field testing (soil probes, tensiometers, etc.)	7 – 36.6 37 – 97	3.9 – 20.4% 20.7 – 54.2%	200	Pressure head data. Water content data.
Rio Grande & La Jencia Basins, New Mexico	SPPA, 2002	Maxey-Eakin Hearne-Dewey Chloride mass balance method	7.1 4.3 - 5.0 1.7 - 2.1	3% 1.8-2.1% 0.7-0.9%	237 (Socorro, NM)	Water budget. Regression analysis. Chlorine-36 isotopes.
Eddy County, New Mexico	Shurbaji et al., 1995	Chloride mass balance method	0.5, 0.8, 2.4		380	3 boreholes.
Southeastern Arizona, Upper San Pedro Basin	Coes and Pool, 2005	Chloride mass balance method, tritium, stable isotopes	2 – 60		400 – 700	Basin Floor Infiltration.
Northeastern Arizona, Black Mesa	Lopes and Hoffmann, 1997	Geochemistry		1 – 3	178 - 457	Assumed percentage for input to analysis.
Sandia Mountains, Albuquerque Basin, New Mexico	Wilson and Guan, 2004	Precipitation – run-off regression	23	4.6	510	See Table 2 of reference.
		Empirical equations	66	13	510	
		Chloride mass balance method	31	6.1	510	
		Groundwater model, inverse calibration	132	26	510	
		Groundwater model, carbon-14 calibration	15	3	510	

This page intentionally left blank.