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Nevada Nuclear Waste Storage Investigations

A U.S. DOE PROJECT

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HYDROLOGY AND WATER RESOURCES OVERVIEW FOR THE NEVADA NUCLEAR WASTE STORAGE INVESTIGATIONS, NEVADA TEST SITE, NYE COUNTY, NEVADA: ANNOTATED BIBLIOGRAPHY

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HYDROLOGY AND WATER RESOURCES OVERVIEW FOR THE NEVADA NUCLEAR WASTE STORAGE INVESTIGATIONS, NEVADA TEST SITE, NYE COUNTY, NEVADA: ANNOTATED BIBLIOGRAPHY

by

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ABSTRACT

The literature available regarding hydrology and utilization of water resources in the southwestern Nevada Test Site area is reviewed. In the context of this annotated bibliography, hydrology is defined to include hydrometeorology, surface water resources, and groundwater resources. Water utilization includes water supply, demand and use; future supply, demand and use; and wastewater treatment and disposal.

The bibliography is arranged in alphabetical order and indexed with both technical key words and geographical key words.

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CHAPTER I

INTRODUCTION

Scope of Work

This annotated bibliography was compiled in support of the environmental studies task of the Nevada Nuclear Waste Storage Investigations (NNWSI). It addresses the literature available regarding the hydrology and utilization of water resources in the southwestern Nevada Test Site (NTS) area. In the context of this bibliography, hydrology is defined to include hydrometeorology, surface water resources, and groundwater resources. Water utilization includes water supply, demand and use; future supply, demand and use; and wastewater treatment and disposal. It is noted that the terminology, hydrology and water utilization, implicitly encompasses the concepts of both quantity and quality. The NNWSI study area includes: (a) within the NTS, the Nevada Research and Development Area (NRDA), and (b) contiguous to the NRDA, the areas defined by extension of the northern border of the NRDA west to the western edge of the Topapah Spring Northwest 7 1/2 minute topographic quadrangle, then east to the point where the southward extension of the southeastern boundary meets the southern edge of the Specter Range 7 1/2 minute topographic quadrangle (Figure 1). In addition to this area, literature regarding the hydrology and utilization of water resources in the vicinity of the Amargosa Desert, Ash Meadows, Death Valley, Beatty (Nye County, Nevada), Indian Springs (Clark County, Nevada), Pahrump (Nye County, Nevada), and Lathrop Wells (Nye County, Nevada) are also considered in this bibliography (Figure 2).

Literature Search Techniques

Because of the unique nature of the literature pertinent to this project, a variety of literature search techniques were used. Before the specific search techniques are detailed, it should be noted that the scope of this aspect of the project was broadened slightly to ensure that all relevant publications were located. This broadening was in the flash flood and groundwater subject areas. Specifically, all publications regarding flash floods in southern Nevada

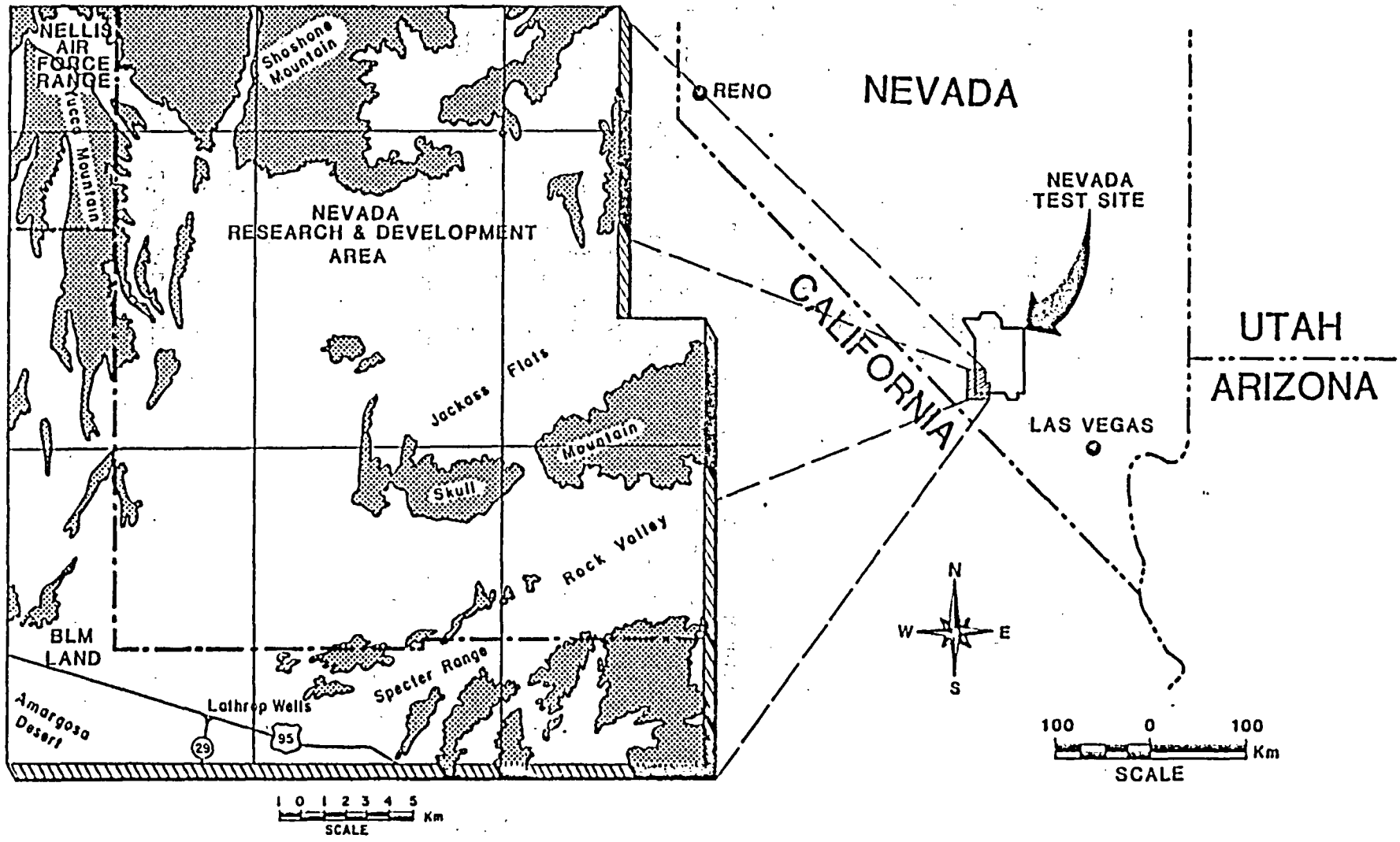

Figure 1. Nevada Nuclear Waste Storage Investigations Study Area.

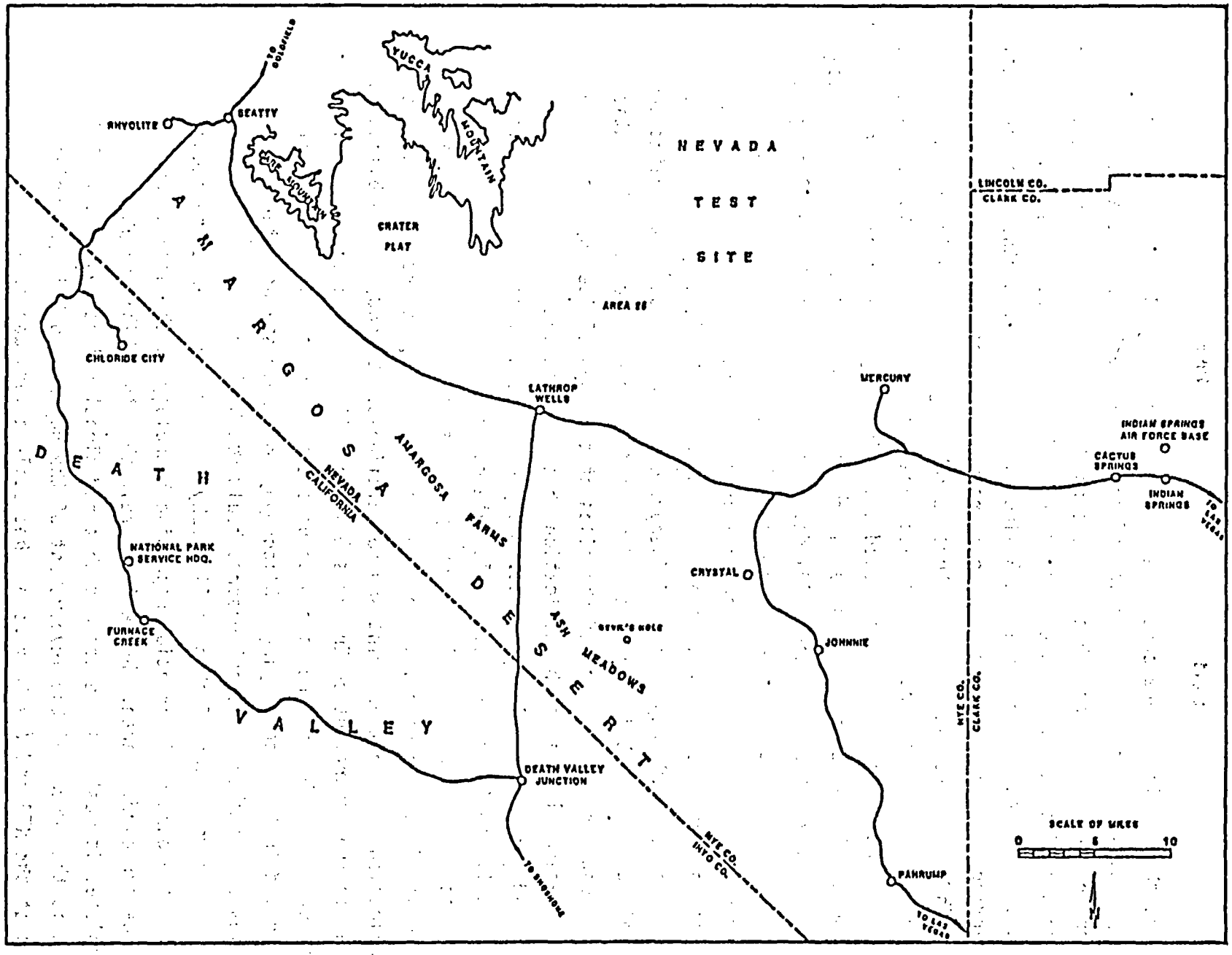

Figure 2. Hydrology Study Area.

and northern Arizona were considered relevant to the goals and objectives of the project. A cursory examination of the bibliography demonstrates that even given the broadened geographical area considered there are very few publications in this subject area. In the subject area of groundwater, the scope was broadened to include the entire NTS since it was felt that otherwise information regarding the local and regional aquifers might be lost.

The first step in the literature search program was the initiation of a computer search of the relevant subject areas and geographical locations through RECON at the Office of Arid Land Studies, University of Arizona, Tucson, Arizona. Although this search provided some information, most of the relevant literature is apparently not part of the RECON data base. The United States Geological Survey (USGS) indices to their various publications were searched along with the card catalogues of the following libraries: University of Nevada, Las Vegas; University of Nevada, Reno; U.S. Environmental Protection Agency, Las Vegas; and the U.S. Department of Energy, Las Vegas. Most of the citations contained in the bibliography came from these sources. Additional citations were found through a search of the files at the USGS office in Mercury, Nevada. The reference list in each publication which was located and reviewed was searched for additional references. Many of the citations in this bibliography are not listed in commonly available catalogs and indices.

The annotation of the literature presented another problem for the following reasons: First, since all literature was considered, regardless of age, some publications were out of print and not available. Second, some publications cited in the Department of Energy's Las Vegas library catalog were either classified or unavailable for reading without special permission. These publications are cited in the accompanying bibliography and their status noted. Third, copies of a number of recent reports could not be located.

The compilation of this bibliography was a major undertaking because of the vast amount of information regarding hydrology at the Nevada Test Site and in the surrounding area. While it is felt that this bibliography is reasonably complete, it must also be assumed that additional references exist. This situation is the result of the involvement of the numerous public and private contractors at the NTS and the many forms that publications can take.

Organization

The bibliography is organized in alphabetical order and the citation format is that recommended by the American Society of Civil Engineers. It should be noted that, in isolated cases, annotations were extracted from other annotated bibliographies and the actual publication was not examined by the authors.

Key Word Indices

In an attempt to aid the potential users of this volume, each citation was given a set of key words which described the technical subject area, and when appropriate, the geographical area discussed by the publication. In Table 15, the technical key words are defined as they are used in this volume. In Tables 16 and 17, the citation numbers of the bibliography, which follows, are indexed against the appropriate key words. It is hoped the reader will find this organization useful.

Table 1: Definitions of Key Words

Key Word	Definitions
Agencies	Reports that contain a list of agencies that are responsible for water resources management.
Agriculture	Reports that relate to the cultivation of plants and animals.
Irrigation	Reports on artificial watering of lands, with the goal of producing crops.
Soils	Reports that contain soil analyses, soil profiles, or other data pertaining to the condition of the soil.
Bibliography	Reports that are entirely, or contain, bibliographies of pertinent subjects.
Dictionary	Reports that define pertinent words and phrases.
Geology	Reports that deal with earth structures, rock types, rock composition, topography, historical geology, and surface and subsurface geologic features.
Geochemistry	Reports that contain chemcial analyses of soils and rocks.
Mineral Deposits	Reports that concern themselves with the exploration and mapping of mineral deposits.
Mineral Development	Reports on mines and mining operations in the study area.
Groundwater	Reports that deal with any facet of groundwater.

Groundwater Data	Reports that include well logs, lithographs, and reports on the permeability and porosity of the surrounding rock. Also included are reports that deal with tracer tests.
Groundwater Models	Reports that develop or use groundwater models, or explain their use.
Groundwater Quality	Reports that contain water quality analyses of groundwater.
Groundwater Saturated	Reports that deal specifically with the saturated zone, including aquifer location, characteristics, and yield.
Groundwater Unsaturated	Reports that deal with groundwater in the subsurface unsaturated zone.
Nuclear Tests	Reports that deal with the effects of nuclear tests on the hydrology and geology of the area.
Nuclear Wastes	Reports that contain studies on the safe storage of nuclear wastes. Most reports deal with potential Spent Unreprocessed Fuel Facilities (SURFF) sites.
Radionuclides	Reports on the storage and migration of radionuclides in the soil, and their transport in the groundwater.
Precipitation	Reports that list precipitation data, or contain precipitation analyses.
Pupfish	Reports that deal with, or include, sections on the Devil's Hole pupfish.
Surface Water	Reports which include sections on lakes, springs, and streams.

Floods	Reports that deal with floods, both prediction and frequency, damage, and control.
Streamflow	Reports on streamflow in the area, including USGS stream gauge records.
Surface Water Data	Reports that contain surface water levels and other data.
Surface Water Quality	Reports that contain water quality analyses of surface waters.
Urban Development	Reports that look into the possible town location, mostly near the Nevada Test Site.
Water Utilization	Reports that look at the uses, both present and future, of groundwater and surface water in the area.
Wastewater	Reports that deal with the creation and disposal of wastewater.

Table 2: Technical Key Word Index

Key Word	Citation Numbers
Agencies	230, 278
Agriculture	10, 13, 52, 60, 102, 176, 191, 196, 336, 339
Irrigation	23, 26, 60, 69, 99, 100, 120, 176, 193, 308, 336, 339
Soils	13, 44, 47, 102, 124, 149, 157, 186, 188, 195, 196, 197, 264, 266, 293, 322
Bibliography	16, 19, 47, 58, 59, 140, 141, 227, 252, 253, 254, 320
Dictionary	28
Geology	13, 21, 24, 47, 48, 49, 51, 52, 53, 54, 62, 63, 64, 75, 82, 86, 87, 88, 96, 98, 101, 107, 108, 109, 112, 122, 129, 132, 135, 137, 145, 149, 152, 154, 156, 157, 158, 160, 161, 169, 170, 171, 172, 178, 181, 190, 195, 196, 197, 200, 202, 204, 207, 208, 209, 210, 211, 212, 213, 217, 218, 220, 225, 229, 235, 237, 238, 239, 242, 243, 244, 246, 247, 255, 256, 257, 258, 260, 261, 264, 265, 266, 267, 275, 276, 281, 282, 289, 290, 291, 300, 301, 302, 306, 307, 321, 322, 330, 334
Geochemistry	47, 50, 75, 88, 154, 174, 181, 196, 197, 318, 331
Mineral Deposits	33, 48, 64, 82, 131, 155, 201, 244, 245
Mineral Development	33,48,82
Groundwater	13, 15, 17, 21, 23, 24, 25, 26, 30, 33, 34, 45, 46, 51, 52, 54, 55, 56, 65, 66, 67, 68, 69, 70, 75, 76, 77, 78, 79, 80, 81, 85, 86, 89, 101, 103, 104, 105, 106, 108, 114, 115, 118, 119, 120, 121, 132, 133, 134, 135, 136, 137, 138, 142, 143, 144, 147, 151, 153, 154, 156, 159, 162, 167, 168, 170, 173, 174, 177, 179, 186, 189, 190, 192, 193, 194, 199, 203, 204, 205, 206, 209, 210, 211, 212, 213, 214, 215, 216, 218, 219, 220, 221, 222, 223, 224, 226, 231, 232, 233, 234, 237, 238, 239, 240, 247, 248, 249, 250, 251, 255, 256, 259, 261, 268, 269, 270, 271, 272, 274, 275, 276, 279, 280, 281, 282, 285, 286, 287,

Table 2: Technical Key Word Index

Key Word	Citation Numbers
	288, 289, 290, 291, 294, 295, 296, 297, 299, 300, 301, 302, 304, 305, 306, 307, 308, 309, 310, 311, 315, 317, 318, 321, 323, 324, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 338, 340, 341, 344
Groundwater Data	7, 15, 17, 21, 25, 29, 30, 33, 34, 54, 55, 56, 57, 62, 74, 75, 76, 79, 80, 89, 90, 91, 92, 93, 94, 95, 96, 98, 99, 100, 111, 114, 116, 129, 130, 132, 136, 143, 179, 192, 193, 194, 207, 208, 215, 222, 223, 231, 232, 233, 240, 255, 261, 271, 281, 282, 289, 302, 303, 306, 310, 313, 314, 325, 342, 343
Groundwater Models	51, 65, 66, 67, 71, 85, 115, 116, 117, 143, 175, 183, 198, 210, 239, 251
Groundwater Quality	13, 17, 18, 22, 30, 58, 59, 68, 71, 74, 75, 77, 78, 79, 84, 86, 95, 106, 111, 112, 119, 133, 138, 151, 153, 183, 184, 211, 213, 222, 226, 232, 233, 248, 249, 250, 259, 268, 270, 279, 280, 283, 284, 287, 289, 308, 327, 335
Groundwater Saturated	13, 30, 45, 46, 56, 76, 101, 105, 107, 110, 132, 133, 134, 135, 136, 137, 138, 143, 144, 151, 154, 159, 168, 170, 173, 179, 198, 200, 203, 240, 250, 260, 269, 271, 285, 287, 288, 296, 297, 300, 301, 310
Groundwater Unsaturated	30, 70, 81, 107, 292, 293
Nuclear Tests	54, 71, 77, 78, 79, 84, 108, 112, 113, 134, 135, 140, 141, 142, 156, 183, 186, 187, 189, 195, 234, 256, 258, 264, 287, 294, 295, 296, 304

Table 2: Technical Key Word Index

Key Word	Citation Numbers
Nuclear Waste	45, 50, 73, 96, 109, 140, 141, 145, 160, 161, 175, 202, 221, 312, 316, 322, 328, 329
Radionuclides	45, 47, 50, 58, 59, 71, 73, 74, 75, 77, 79, 112, 113, 115, 124, 137, 149, 157, 177, 182, 183, 184, 186, 187, 188, 189, 241, 248, 249, 256, 291, 294, 295, 296, 319
Precipitation	1, 3, 8, 14, 31, 35, 37, 39, 41, 42, 43, 61, 123, 125, 126, 128, 139, 146, 148, 150, 162, 164, 165, 166, 180, 199, 206, 214, 220, 225, 228, 235, 262, 263, 270, 277, 293, 298, 305, 307, 311, 337
Pupfish	51, 69, 99, 100, 227, 338
Surface Water	61, 85, 101, 153, 169, 170, 174, 177, 182, 193, 199, 203, 205, 209, 211, 218, 219, 220, 225, 232, 241, 248, 259, 268, 269, 270, 286, 297, 302, 308, 309, 323, 332
Flood	1, 5, 6, 9, 11, 12, 38, 40, 72, 81, 83, 126, 127, 139, 180, 235, 236, 273, 337
Streamflow	4, 6, 32, 36, 72, 81, 123, 209, 258
Surface Water Data	4, 32, 36, 123
Surface Water Quality	4, 32, 36, 153, 259, 268, 270, 283, 284, 337
Urban Development	2, 63, 68, 326, 327

Table 2: Technical Key Word Index

Key Word	Citation Numbers
Water Utilization	10, 17, 20, 23, 26, 29, 48, 51, 52, 57, 60, 68, 104, 120, 154, 159, 176, 191, 213, 214, 230, 297, 302, 305, 326, 327, 338, 340, 341
Wastewater	20, 73, 239

Table 3: Geographical Key Words

Key Word	Citation Numbers
WESTERN UNITED STATES:	14, 37
California:	49, 302, 305, 309, 311, 331
Death Valley:	64, 131, 171, 172, 173, 174, 190, 220, 226, 242, 243, 246, 259, 274, 293, 309, 338
Mojave Desert:	64, 305, 309
Mesquite Valley:	23, 308
Idaho:	50
SOUTHWESTERN UNITED STATES	25, 61
Great Basin	8, 104, 163, 165, 167, 169, 225, 290, 330
Willow Beach, Arizona:	1
Nevada:	3, 4, 20, 31, 32, 33, 36, 42, 48, 49, 60, 88, 102, 123, 130, 150, 163, 164, 166, 176, 211, 224, 236, 269, 275, 286, 298, 311
Eldorado Canyon:	139
Central Nevada	89, 90, 91, 92, 93, 94, 97, 116, 119, 144, 206, 270, 277, 284, 302, 315, 342
Hot Creek Valley:	95, 97
Southern Nevada:	103, 105, 106, 127, 128, 144, 151, 155, 180, 203, 263, 302, 331, 332, 335, 337, 342
Clark County:	5, 6, 9, 11, 12, 63, 201, 272, 274, 327

Table 3: Geographical Key Words

Key Word	Citation Numbers
Indian Springs:	2, 213, 214, 215, 279, 280, 326
Las Vegas:	6, 12, 27, 38, 40, 44, 81, 158, 213, 214, 215, 272
Pahrump Valley:	10, 23, 173, 191, 205, 213, 214, 230, 238, 302, 308, 326, 336, 339
Nye County:	68, 69, 82
Amargosa Valley:	13, 26, 143, 152, 173, 174, 179, 206, 218, 220, 229, 237, 238, 244, 245, 268, 274, 280, 302, 307, 317, 323, 326
Ash Meadows:	51, 52, 69, 82, 87, 99, 100, 101, 120, 147, 173, 193, 199, 218, 229, 238, 274, 281, 302, 328, 329, 332
Bare Mountain	82
Devil's Hole:	69, 87, 120, 147, 193, 219, 338
Nevada Test Site:	7, 17, 29, 30, 45, 46, 58, 59, 62, 66, 70, 72, 73, 74, 75, 76, 77, 78, 79, 80, 84, 86, 96, 98, 107, 108, 111, 112, 115, 116, 117, 119, 122, 125, 129, 140, 141, 149, 156, 159, 161, 168, 175, 178, 181, 182, 186, 187, 188, 194, 195, 204, 207, 223, 229, 231, 232, 233, 248, 249, 255, 257, 262, 264, 266, 271, 279, 280, 282, 289, 294, 296, 299, 302, 303, 313, 314, 315, 324, 325, 326, 331, 333, 334, 340, 343, 344

Table 3: Geographical Key Words

Key Word	Citation Numbers
Area 5:	126, 128
Frenchman Flat:	149, 159, 321, 328, 329
Area 12:	62
Rainier Mesa:	53, 78, 79, 112, 168, 265, 300, 301, 318
Area 15:	197, 221
Area 18:	196
Area 25:	30, 262, 276
Jackass Flats:	45, 46, 72, 73, 98, 161, 217, 328, 329, 340, 341
Mercury:	222
Pahute Mesa:	15, 21, 54, 55, 56, 57, 168, 238, 265, 274, 317
Syncline Ridge:	96, 160, 312
Yucca Flat:	80, 84, 114, 138, 149, 159, 168, 234, 261, 265, 281, 304, 306, 321, 328, 329

CHAPTER II

ANNOTATED BIBLIOGRAPHY

1. _____, "Potential Flood Hazards at Willow Beach, Lake Mead National Recreational Area," Linsley, Kraeger and Associates, 527 Bayview Drive, Aptos, California, October 1980, 48 p.

   This report details an application of the concepts of probable maximum precipitation and a watershed model to Eldorado Canyon. The report discusses certain aspects of sediment transport and debris transport and delineates the floodplain in this location.

2. _____, "Indian Springs, Nevada - Comprehensive Land Use Plan," Clark County Department of Comprehensive Planning, Las Vegas, Nevada, May 1980.

   This report considers the present land use in Indian Springs, Nevada, and discusses the probable future land use. Although the report does not consider water resources specifically, it does briefly treat the environmental effects of growth.

3. _____, "Climatological Data, Nevada," 1961 Through 1980 Annual Summaries, National Oceanic and Atmospheric Administration, National Climatic Center, Ashville, North Carolina.

   These reports contain monthly temperature and rainfall data for weather stations in Nevada.

4. _____, "Water Resources Data for Nevada," NV-65 through 79-1, U.S. Geological Survey, Carson City, Nevada, 1965-1979.

   This series of reports contains the flow records for gauging stations, partial record stations, and miscellaneous sites within the State of Nevada. For convenience, records from pertinent gauges in other neighboring states are included. These reports also contain some water quality data.

5. _____, "Flood Hazard Study Las Vegas Wash and Tributaries, Clark County, Nevada," U.S. Department of Agriculture, Soil Conservation Service in cooperation with Clark County Commissioners, City of Las Vegas, City of North Las Vegas, Clark County Wastewater Agency, Clark County Conservation District and Nevada Water Resources Division, Reno, Nevada, February 1979, 33 p.

   A summary of technical data intended for use in making floodplain management decisions. In addition, it summarizes the factors which must be considered in floodplain management.

6. _____, "Flood Flow Frequency Analyses: Supplement to Las Vegas Wash Tributaries Flood Hazard Analyses, Clark County, Nevada," U.S.

Department of Agriculture, Soil Conservation Service, in cooperation with Clark County Conservation District, Reno, Nevada, July 1978, 19 p.

The report presents a summary of the techniques used and the results of the analyses that were performed for the Las Vegas Flood Hazard Analyses, City of North Las Vegas Flood Insurance Study and the City of Las Vegas Flood Insurance Study.

7. _____, "Groundwater Supply Survey - NTS Vicinity as Gathered by Interview with Interested Parties," Public Health Service, Las Vegas, Nevada, 1978, 196 p.

A compilation of data gathered by interview with interested parties. Data includes information on wells and springs located in airline distance from C.P. The information also includes depth to water table, depth of well, capacity rate of pumping, and population served. Distances from C.P. are grouped and vary from 0-10 miles up to those over 100 miles. Approximately 196 wells and springs are included.

8. _____, "Probable Maximum Precipitation Estimates, Colorado River and Great Basin Drainages," U.S. Department of Commerce, National Oceanic and Atmospheric Administration, and Department of Army, Corps of Engineers, Washington, DC, 1977.

9. _____, "History of Flooding, Clark County, Nevada, 1905-1975," Special Report, U.S. Department of Agriculture, Soil Conservation Service in cooperation with Clark County Conservation District and others, Reno, Nevada, 1977.

10. _____, "Progress Report #R115, Pahrump Field Laboratory," Max C. Fleischmann College of Agriculture, University of Nevada, Reno, Nevada, 1977.

The progress report shows the experimental activities of the laboratory personnel. Small field experiments were conducted using forages, small grain, cotton, and horticulture crops.

11. _____, "Flood Hazard Analyses Las Vegas Wash and Tributaries, Clark County, Nevada: History of Flooding," U.S. Department of Agriculture, Soil Conservation Service in cooperation with Clark County Conservation District, City and County Entities of Clark County, Nevada, and Nevada Division of Water Resources, Reno, Nevada, August 1977, 160 p.

The report is a comprehensive flood history of the Clark County area which defines areas where floods have occurred, an approximation of magnitude and other data relating to dates, times, and durations. This flood history was primarily based on an assembly of newspaper accounts starting in 1905. The report encompasses all county communities.

12. _____, "A Brief Appraisal of the July 3-4, 1975, Flash Flood in Las Vegas Valley, Nevada," Clark County Flood Control Division, Department of Public Works in cooperation with the U.S. Geological Survey, 1976.

13. _____, "Amargosa Project, California-Nevada, Concluding Report," U.S. Deparment of the Interior, Bureau of Reclamation, Lower Colorado Region, Boulder City, Nevada, 1975.

This report is an evaluation of the land and water resources of Amargosa Valley. Studies covered in this report include water quality analysis, recharge and movement studies, testing the physical and chemical properties of soils to determine their suitability for irrigated agriculture, geophysical surveying, drilling of a test well, and pump testing to evaluate aquifer characteristics.

14. _____, "Precipitation Frequency Atlas for the Western United States - NOAA Atlas 2," National Weather Service, Washington, DC, 1973.

An atlas consisting of 11 volumes for individual western states, including Nevada. Each volume contains precipitation - frequency maps for 6 and 24 hours durations for return periods from 2 to 100 years. Also included are methods and monograms for estimating values for durations other than 6 and 24 hours. In addition to the maps, each volume includes a historical review of precipitation - frequency studies, a discussion of the data handling and analysis method, a section on the use and interpretation of the maps, and a section outlining information pertinent to the precipitation - frequency regime in the individual states. There is also a discussion of the importance of snow in the precipitation - frequency analysis and formulas and monograms for obtaining values for 1-, 2-, 3-, and 12-hour durations.

15. _____, "Geologic and Hydrologic Effects Prediction and Effects Program, Almendro (U19V) Event, Pahute Mesa, Nevada Test Site," USGS 474-163, Special Studies-92, U.S. Geological Survey, Denver, Colorado, 1973, 38 p.

This report covers the predictions of the Almendro event scheduled for drill hole U19v on Pahute Mesa, Nevada Test Site. The hydraulic gradient in the U19v area is to the southwest. Static water level was estimated at 2,285 feet. The hydrologic effects of the event were expected to be similar to those produced by earlier explosions of intermediate and high yield at Pahute Mesa.

16. _____, "EPA Reports, Bibliography," EPA-LIB-73-01, Environmental Protection Agency, Washington, DC, 1973.

This bibliography contains citations, abstracts and author, corporate source, subject, contract and title indexes for all U.S. Environmental Protection Agency, and predecessor agencies reports contained in the NTIS collection as of April 1, 1973.

17. _____, "Proposed Networks for Radiological Monitoring of Groundwater in and Adjacent to the Nevada Test Site," U.S. Geological Survey, Denver, Colorado, March 1972, 6 p.

This report proposes a network of wells for monitoring radionuclide contamination of two groundwater systems. One system is recharged by areas on Pahute Mesa, western Rainier Mesa, and Buckboard Mesa (Areas 18, 19, and 20) and exits NTS under Forty-mile Canyon, Crater Flat, Beatty Wash, and Oasis Valley. Beatty and Lathrop Wells are the first places of major public use of water in this system. The second system is recharged in the eastern portions of Rainier Mesa, Shoshone Mountain, and Jackass Flats. This system discharges in Ash Meadows. This report recommends the installation of nine wells to be sampled monthly and twenty-six wells to be sampled quarterly.

18. _____, "Environmental Protection Research Catalog," EPA-ORM-72-1, Smithsonian Science Information Exhange, Inc., Washington, DC, 1972, 2 volumes.

This catalog gives description of research tasks such as air and water quality, solid waste management, pesticides, radiation, and noise.

19. _____, "Water Resources Research Catalog," WRSIC-72, Water Resources Scientific Information Center, Washington, DC, 1972, Volume 7, Part I, Part II.

These catalogs contain a description of research tasks, including nature of water, water cycle, water supply, and augmentation and conservation, water quality and quantity management, control and protection, water resources planning, resource data, engineering works, manpower, grants and facilities. Indexes include subject index, investigator index, contractor index, and supporting agency index.

20. _____, "Nevada Rural Communities Water And Wastewater Plan," Walter Engineering, Reno, Nevada; and Chilton Engineering, Elko, Nevada, 1972.

These reports documented the water supply and wastewater disposal systems for all the communities in Nevada with the exception of those located in Clark County.

21. _____, "Geologic and Hydrologic Effects of the Handley Event, Pahute Mesa, Nevada Test Site," Geological Survey 474-95, U.S. Geological Survey, Denver, Colorado, 1971, 71 p.

This report examines both the geologic and hydrologic effects of the Handley test. Surface fractures and measurements of ground deformation were reported. Groundwater pressure response to aquifers and water levels in open wells were measured following the event.

22. _____, "Water Contamination on Evaluation Program for AEC/NVOO/OEE," Teledyne Isotopes, Palo Alto, California, 1971, 31 p. (For official use only.)

23. _____, "Interim Report Inland Basins Projects, Nevada and California, Pahrump and Mesquite Valleys," U.S. Department of the Interior, Bureau of Reclamation, Boulder City, Nevada, October 1969, 70 p.

This report covers the land and water resources, present development, and potential requirements with regard to future irrigation, municipal and industrial developments in the Pahrump and Mesquite Valleys, Nevada and California. The study is particularly concerned with the management, conservation, and potential for the development of groundwater resources within these inland basins.

24. _____, "Report of Exploration Progress, Central Nevada, Period January 1, 1968 - April 1, 1969," Geological Survey 474-18, U.S. Geological Survey, Denver, Colorado, 1969, 35 p.

This report lists all holes drilled in central Nevada between January 1, 1968, and April 1, 1969, and includes the location, total depth, activity, or analyses performed, rock types, and general references and remarks about each hole specifically.

25. _____, "Groundwater Levels in the United States, 1961-1965 - Southwestern States," Water Supply Paper 1855, U.S. Geological Survey, Washington, DC, 1968, 125 p.

This report is a summary of the groundwater levels in the following states: Nevada, New Mexico, Arizona, and California for the years 1961 - 1965. This report contains no water quality data.

26. _____, "Inland Basins Project: Amargosa Project, Nevada-California," Reconnaissance Investigations, Interim Report, U.S. Department of the Interior, Bureau of Reclamation, Region 3, Boulder City, Nevada, 1968.

This reconnaissance report covers the investigation of the land and water resources, present development and potential requirements with regard to future irrigation and municipal and industrial developments in the Amargosa Valley. This study is particularly concerned with the management, conservation, and development of the water resources in this valley.

27. _____, "Published Soil Surveys, Las Vegas and Eldorado Valley Areas," Soil Conservation Service, Room 308, U.S. Post Office Building, Reno, Nevada, 89505, 1967.

This survey gives a brief description of the general nature of the area, i.e., water supply, industry, climate, etc. It describes how the survey was made, use and management of soils, engineering applications, descriptions of the soils, soil formation and classification, and physical and chemical data for selected soils.

28. _____, "Water Resources Thesaurus. A Vocabulary for Indexing and Retrieving the Literature of Water Resources Research and Development," Office of Water Resources Research, Washington, DC, 1966, 237 p.

The scope of this Thesaurus encompasses the broad research area of water resources such as the hydrologic cycle, supply and demand for water conservation and best use of available supplies of water methods for increasing such supplies and the economic, legal, social engineering, recreational, biological, geographical, and ecological aspects of water problems.

29. _____, "NTS Water Supply Study Areas 2, 8, 10, and 15," Holmes & Narver, Inc., Las Vegas, Nevada, April 1966, 15 p.

This report documents a survey made by Holmes & Narver of existing water production and distribution problems in Areas 2, 8, 10, and 15. This report makes recommendations for upgrading the present system to meet future demands in these areas.

30. _____, "Proposed Radioactive Wastewater Disposal to Settling and Infiltration Basins, Area 25, Nevada Test Site: Preliminary Safety Appraisal," HNSTR - 1229 - 140, Hazelton-Nuclear Science Corp., Palo Alto, California, March 1966, 21 p.

This report documents an evaluation of proposed waste-fluid infiltration basins from the viewpoint of radionuclide contamination of the underlying aquifers in Area 25. The report recommends that Well #6 be included in the regular NTS monitoring net and that additional exploratory drilling in the vicinity of the waste site be done to measure K_D.

31. _____, "Climatic Summary of the United States - Supplement for 1951 Through 1960, Nevada," Climatography of the United States, No. 86-22, U.S. Department of Commerce, Weather Bureau, Washington, DC, 1965, 41 p.

This report contains monthly temperature and rainfall data for weather stations in Nevada.

32. _____, "Surface Water Records of Nevada," U.S. Geological Survey, Carson City, Nevada, 1961-1964.

These records contain approximately the same information as Reference No. 4.

33. _____, "Mineral and Water Resources of Nevada," Bulletin 65, U.S. Geological Survey and Nevada Bureau of Mines, Mackay School of Mines, University of Nevada, Reno, Nevada, 1964, 313 p.

This report describes in a summary fashion, the mineral and water resources of Nevada. A section on economic geology describes the destribution of the metallic and nonmetallic mineral deposits both areally and with respect to the general geologic features. A section on mineral

exploration considers the commodities in Nevada which offer the greatest promise of new discoveries in the future. The water resources of the state are described in detail.

34. _____, "Groundwater Levels in the United States, 1956-1960 - Southwestern States," Water Supply Paper 1770, U.S. Geological Survey, Washington, DC, 1963, 160 p.

This report is a summary of the groundwater levels in the following states: Nevada, New Mexico, Arizona, and California for the years 1956-1960. This report contains no water quality data.

35. _____, "Rainfall Frequency Atlas of the United States," Technical Paper 40, U.S. Weather Bureau, Washington, DC, 1961, 115 p.

36. _____, "Surface Water Supply of the United States," U.S. Geological Survey Water Supply Papers, Part 9, Colorado River Basin, 1929-1961.

This series of reports have similar information as the two previous citations. Some of the reports contain data for five consecutive year intervals.

37. _____, "Generalized Estimates of Probable Maximum Precipitation for the United States West of the 105th Meridian for Areas to 400 Square Miles and Durations to 24 Hours," Technical Paper No. 38, U.S. Department of Commerce, Weather Bureau, Washington, DC, 1960, 66 p.

This report presents generalized estimates of probable maximum precipitation for areas from a point to 400 square miles and for durations up to 24 hours. The report also details what these values represent, how they should be used, and how accurate they are.

38. _____, "Report on Survey for Flood Control, Las Vegas Wash and Tributaries, Las Vegas and Vicinity, Nevada," U.S. Department of Army, Corps of Engineers, 1959.

39. _____, "Rainfall Intensities for Local Drainage Design in Western United States," Technical Report No. 28, U.S. Department of Commerce, Weather Bureau, Washington, DC, 1956.

40. _____, "Report on Flood of 13 June 1955, Las Vegas and Vicinity," U.S. Department of Army, Corps of Engineers, August 1955.

41. _____, "Rainfall Intensities for Local Drainage Design in the United States, Part I," Technical Paper No. 24, U.S. Department of Commerce, Weather Bureau, Washington, DC, 1953.

42. _____, "Climatic Summary of the United States - Supplement for 1931 Through 1952, Nevada," Climatography of the United States, No. 11-22, U.S. Department of Commerce, Weather Bureau, Washington, DC, 27 p.

This report contains monthly temperature and rainfall data for various weather stations in Nevada.

43. _____, "Maximum Recorded Precipitation in the United States for 5 Minutes to 24 Hours at 207 First Order Stations," Technical Paper No. 2, U.S. Department of Commerce, Weather Bureau, Washington, DC, 1947.

44. _____, "Published Soil Surveys, Las Vegas Valley Area," Soil Conservation Service, Room 308, U.S. Post Office Building, Reno, Nevada, 89505, 1923. (Out of Print.)

45. Abrahams, J. H. Jr., "Movement of Water and Radionuclides in a Tile Field Waste Disposal System at Jackass Flats, Nevada Test Site: Infiltration Studies, October 1959 through December 1960," University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico, 1963.

46. Abrahams, J. J. Jr., "Movement of Water and Radionuclides in a Tile Field Waste Disposal System at Jackass Flats, Nevada Test Site: Construction and Preliminary Testing, June 1958 through August 1959," University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico, 1963.

47. Ames, L. L. and Dhanpat, Rai, "Radionuclide Interactions with Soil and Rock Media; Volume 1: Processes Influencing Radionuclide Mobility and Retention; Element Chemistry and Geochemistry; Conclusions and Evaluations; Volume 2 - Part A and B: Annotated Bibliography," EPA 520/6-78-007A,B,C, Battelle Pacific Northwest Labs, Richland, Washington, 1978.

Volume 1: The interactions of 19 radionuclides with soil, and rock media in the literature to 1977 were reviewed. Included is a brief summary of natural soil and rock distributions, chemistry, solid and solution equilibria and laboratory and field absorption and irrigation results.

Volume 2: The purpose of this bibliography is to abstract the information on radionuclide-soil/rock interactions available in the literature. Authors are listed alphabetically. Information for this report was obtained from various journals, books, past bibliographies, scientific reports, and abstracting services.

48. Baker, Arthur III, Archbold, N. L. and Stoll, W. J., "Forecasts for the Future - Minerals," Bulletin 82, Nevada Bureau of Mines and Geology, Mackay School of Mines, University of Nevada, Reno, 1972, 223 p.

This report was originally prepared as a component of the State of Nevada water planning effort. It provides estimates of the water needs of the mineral industry in Nevada. It also considers the topics of future mineral industry employment, the minerals available in Nevada, the competitive position of these minerals in relation to other deposits and future mineral production. In addressing these topics, the report discusses the geology of the state, and the economics and technology of the mineral industry.

49. Ball, S. H., "A Geologic Reconnaissance in Southwestern Nevada and Eastern California," Geological Survey Bulletin 308, U.S. Geological Survey, Washington, DC, 1907, 218 p.

Describes the geology of titled area, such as the stratigraphy, historical, structural, and economic phases of geology. It includes brief statements about hydrology, climate, vegetation, and general culture of the area.

50. Barraclough, J. T., et al, "Hydrology of the Solid Waste Burial Ground, as Related to the Potential Migration of Radionuclides, Idaho National Engineering laboratory," Geological Survey IDO-22056, U.S. Geological Survey, Idaho Falls, Idaho, 1976, 183 p.

This report describes the results of a study made in 1970-1974 to evaluate the geohydrologic and geochemical controls on the subsurface migration of radionuclides from pits and trenches in the Idaho National Engineering Laboratory solid waste burial ground, and to determine the existence and extent of radionuclide migration, if any, from the burial ground.

51. Bateman, R. L., Mindling, A. L. and Naff, R. L., "Development and Management of Groundwater in Relation to Preservation of Desert Pupfish in Ash Meadows, Southern Nevada," 42017, Desert Research nstitute, Water Resources Center, Reno, Nevada, February 1974, 39 p.

This report describes the use of a numerical groundwater model of the Ash Meadows area of Southwestern Nevada to evaluate the effects of various groundwater development alternatives. The response of groundwater levels in the region is critical because of the existence of certain species of rare desert pupfish which inhabit springs in the area. The results of this modeling effort indicate that an annual volume of 6,000 acre feet can be pumped without adversely affecting water levels in this area. A larger annual pumping volume could be sustained under certain conditions.

52. Bateman, R. L., Mindling, A. L., Naff, R. L., and Joung, J. M., "Development and Management of Groundwater and Related Environmental Factors in Arid Alluvial and Carbonate Basins in Southern Nevada," 41018, Desert Research Institute, Water Resources Center, Reno, Nevada, January 1972, 43 p.

The principal objective of this study was to determine if a viable farming operation in Ash Meadows can continue while at the same time maintaining the natural habitat of the desert pupfish. Four areas of research are considered: 1) development of a groundwater model for the area, 2) evaluation of the recent geologic history of Ash Meadows, 3) a study of the agricultural engineering aspects of the farming operation, and 4) compilation of existing data on groundwater and surface water rights. This is a progress report.

53. Benson, L. V., "Mass Transport in Vitric Tuffs of Rainier Mesa, Nye County, Nevada," 45010, Desert Research Institute, Water Resources Center, Reno, Nevada, October 1976, 38 p.

Chemical and physical analyses of reactant and product phases found in subaerially-exposed vitric tuffs of Rainier Mesa, Nevada, indicate that diagenetic alteration is occurring today.

54. Blankennagel, R. K., "Geophysical Logging and Hydraulic Testing, Pahute Mesa, Nevada Test Site," Groundwater, Volume 6, No. 4, 1968, pp. 24-31.

The USGS used various geophysical logs and hydraulic testing techniques in studies related to underground nuclear explosions at NTS which are described in this paper. Interpretations of logging techniques depend on factors such as rock characteristics, drilling methods, and objectives of the hydraulic investigations.

55. Blankennagel, R. K., "Hydraulic Testing Techniques of Deep Drill Holes at Pahute Mesa, Nevada Test Site," Geological Survey Open File Report, U.S. Geological Survey, Washington, DC, 1967, 50 p.

This report describes testing techniques used by the USGS to obtain hydrologic data in deep holes drilled in Pahute Mesa, NTS. Qualitative data on hydrologic conditions in the borehole are obtained from electric, caliper, temperature, and fluid resistivity logs. Quantitative data in boreholes are obtained from radioactive tracer and spinner surveys. Pumping tests are made to measure the combined yield of the various aquifers.

56. Blankennagel, R. K. and Weir, J. E., Jr., "Geohydrology of the Eastern Pahute Mesa, Nevada Test Site, Nye County, Nevada," Geological Survey Professional Paper 712-B, U.S. Geological Survey, Washington, DC, 1973, 35 p.

Volcanic rocks underlie Pahute Mesa and tests have shown them capable of transmitting water. Most of the groundwater movement occurs through interconnecting fault and joint systems. Depth of water ranges from 1,952 to 2,350 feet below surface. Pump tests indicate that transmissivities range from 1,400 to 140,000 gallons per day per foot. The groundwater beneath Pahute Mesa moves southwestward and southward toward Amargosa Desert through Oasis Valley, Crater Flat, and western Jackass Flats. The flow of groundwater is estimated to be 8,000 acre feet per year. Groundwater velocity has estimates as much as two orders of magnitude - 5 to 250 feet per year with a reasonable estimate of less than 15 feet per year.

57. Blankennagel, R. K. and Weir, J. E., Jr., "Summary of Groundwater Data pertinent to Underground Construction and to Water Supply Development, Pahute Mesa, Nevada Test Site," Special Studies Technical Letter I-27, Supplement 2, U.S. Geological Survey, Washington, DC, 1966, 25 p. (For official use only.)

58. Borg, I. Y., et al, "Information Pertinent to the Migration of Radionuclides in Groundwater at the Nevada Test Site: Part I - Review and Analysis of Existing Information," UCRL-52078 Part 1, University of California, Lawrence Livermore Laboratory, Livermore, California, May 1976, 216 p.

This report is a comprehensive and detailed review of the knowledge regarding the migration of radionuclides of groundwater at the NTS. The conclusions reached in this report are: 1) insufficient data are available to state with certainty that radioactivity will never be carried off NTS; 2) migration at levels above the maximum permissable concentration to existing wells and springs is considered unlikely; 3) if off-site migration occurs, it will be from the southwestern margins of Pahute Mesa; 4) tritium is the isotope of primary concern; and 5) predictions of migration both within and without the NTS area are hampered by a lack of values for fundamental parameters in the transport equations.

59. Borg, I. Y., et al, "Information Pertinent to the Migration of Radionuclides in Groundwater at the Nevada Test Site: Part 2 - Annotated Bibliography," UCRL - 52078 - Part 2, University of California, Lawrence Livermore Laboratory, Livermore, California, August 1976, 112 p.

An annotated bibliography of subjects concerning migration of radionuclides in groundwater. An index based on key words is included.

60. Bourns, C. T., "Irrigated Lands of Nevada," Max C. Fleischmann College of Agriculture, Report No. 29, University of Nevada, Reno, Nevada, 1966.

This map-report shows the locations, approximate extent, and shape of irrigated land. This map compiled from large scale maps of various portions of the state upon which irrigated areas were drawn, presents the irrigated acreage when the water supply is ample and includes the wild flooded pasture and meadow lands.

61. Brakenridge, G. R., "Evidence for a Cold, Dry Full Glacial Climate in the American Southwest," Quaternary Research, Volume 9, 1978, pages 22-40.

This paper examines the validity of the assumption that annual precipitation was significantly greater in glacial climates of the American southwest. Evidence is presented that 1) both summers and winters at all elevations were much cooler, 2) the pluvial lakes were caused by lower evaporation rates without increased rainfall, and 3) the telescoping of vegetation zones is the expected results of cooler but not wetter full-glacial climates.

62. Byers, F. M., Jr., "Porosity, Density, and Water Content Data on Tuff of the Oak Springs Formation from the U12e Tunnel System, Nevada Test Site, Nye County, Nevada," Geological Survey Open File Report TEI-811, U.S. Geological Survey, Washington, DC, 1961, 27 p.

This report summarizes the porosity, density, and water content data on about 200 tuff specimens from the tunnel beds which compose the lower member of the Oak Spring formation of Miocene or younger age at the U12e tunnel, Rainier Mesa, NTS.

63. Byers, F. M. and Cummings, D., "Geology of Area Around Groundwater Test Well 10 at Possible AEC Townsite, Clark County, Nevada," Geological Survey TL-NTS-29, U.S. Geological Survey, Denver, Colorado, 1962.

64. Campbell, M. R., "Reconnaissance of the Borax Deposits of Death Valley and Mojave Desert," Geological Survey Bulletin 200, U.S. Geological Survey, Washington, DC, 1902, 20 p.

65. Carnahan, C. L., "Water Table Mapping User's Manual," NVO-1253-8, Desert Research Institute, University of Nevada, Reno, Nevada, 1976, 85 p.

Procedures are given for use of an empirical water table mapping routine utilizing the CDC 6400 computer located at the University of Nevada's Systems Computer Center. Detailed instructions are provided for the program sequences to be used in initial simulation of a water table and in updating an existing simulation.

66. Carnahan, C. L. and Fenske, P. R., "An empirical Method for Simulation of Water Tables by Digital Computers," Desert Research Institute, Reno, Nevada, September, 1975, 29 p.

An empirical method is described for computing a matrix of water table elevations from a matrix of topographic elevations and a set of observed water elevation control points which may be distributed randomly over the area of interest. The method has been applied to the Nevada Test Site and the Hot Creek Valley areas in Nevada.

67. Carnahan, C. L. and Fenske, P. R., "Digital Computer Simulation of Water Table," NVO-1229-173, Teledyne - Isotopes, Palo Alto, California, 1971.

This report describes the method used to simulate water tables on a digital computer. It discusses the possible deficiencies in the method. Computer program functions are described and code listings are given.

68. Carpenter, E., "Groundwater in Southeastern Nevada," Geological Survey Water Supply Paper 365, U.S. Geological Survey, Washington, DC, 1915, 86 p.

Discusses the water supplies in the valleys of Southeastern Nevada. Area of coverage is about 17,000 square miles, including parts of Clark and Nye Counties. Uses and sources of water in the area are mentioned by location, also the quantity and quality of the source water. General development of the area and the water needs are covered.

69. Carson, R. L., "Water Resources Data Collected in the Devil's Hole Area, Nye County, Nevada 1976-1977," Geological Survey Open File Report 79-742,

U.S. Geological Survey, Federal Building, Carson City, Nevada, 89701, 1979, 23 p.

This report presents water data collected in Devil's Hole and vicinity from July 1976 through June 1979 for the purpose of observing the effects of irrigation pumping on the pool level in Devil's Hole, Nye County, Nevada. The pool contains the endangered species of pupfish, Cyprinodon diabolis. The report presents changes in water level and springflow in graphic form and tabulates electric energy consumed by irrigation wells as an index of the pumpage.

70. Case, C., "Constitutive Relations for Flow of Water in the Unsaturated Zone," Desert Research Institute, Reno, Nevada, June 1977, 14 p.

The study of the flow of water and the concomitant transport of radionuclides in the unsaturated zone of the Nevada Test Site has necessitated a detailed review of unsaturated flow theory. The report introduces the terminology and concepts of a more precisely formulated theory of unsaturated flow than has appeared in the literature thus far. The results here add to the precision of the equations for flow in the unsaturated zone.

71. Charnell, R. L., et al., "Hydrologic Redistribution of Radionuclides Around a Nuclear Crater," NVO-1229-87, Isotopes, Inc., Palo Alto, California, 1967, 46 p.

This report describes a model for redistribution of radionuclides around a nuclear excavated crater. The model relies on simplifications to allow analysis of the entire hydrologic system around the crater. The model in its present form is general and may be applied to many nuclear cratering detonations.

72. Christensen, R. C. and Spahr, N. E., "Flood Potential of Topopah Wash and Tributaries, Eastern Part of Jackass Flats, Nevada Test Site, Southern Nevada," Geological Survey Open File Report 80-163, U.S. Geological Survey, Lakewood, Colorado, 1980, 22 p.

A site specific analysis of the hazards resulting from flash floods having return periods of 100 and 500 years and the maximum potential flood. The method uses a regression type watershed model coupled with a standard hydraulic analysis of the ephemeral channels.

73. Church, B. W., "Predicted Behavior of Radiocontaminants in NRDS Soils," Report 42-3, Pan American World Airways, Inc., Nuclear Rocket Development Station Project, 1969.

The so-called R-MAD tile drain field was used for about 10 years to dispose of water containing mixed fission products from the Nuclear Rocket Development Stations, Jackass Flats, NTS. Though most of the radioactivity in the wastewater was on solid particles, some was in solution. A number of borehole samples were taken at various depths in the tile drain

field. Analysis of certain isotopes shows the downward movement of the radioactivity to be about 2.5 m. The data suggest that some lateral and upward movement of the wastewater from the tile line occurs. Tile lines are buried 60 to 90 cm below the surface.

74. Claassen, H. C., "Water Quality and Physical Characteristics of Nevada Test Site Water Supply Wells," Geological Survey 474-158, U.S. Geological Survey, Lakewood, Colorado, 1973, 145 p.

This report presents complete tabulations of chemical analyses of water from wells at NTS. Complete trace elements analyses for water from the wells are given. The water tapped by most of the wells had not undergone significant changes in quality. Water level data indicate some local lowering of the water table in the vicinity of the wells on Frenchman and Yucca Flats. The levels of activity observed do not constitute a hazard to water users at NTS.

75. Claassen, H. C., "Water Quality and Physical Characteristics of Nevada Test Site Water Supply Wells," U.S. Geological Survey, Denver, Colorado, 1972, 92 p.

The chemical, radiochemical, and hydraulic data obtained by the USGS for water supply wells on NTS are summarized. Time variations in these parameters are discussed. For each well included, a schematic of the well construction and a summary of the lithology.

76. Claassen, H. C. and Cordes, E. H., "Two-well Recirculating Tracer Test in Fractured Carbonate Rock, Nevada," Hydro. Sci. Bulletin, Vol. 20, No.3, September 1975, pp. 367-382.

Analysis of the results of a two-well recirculating tracer test in the fractured lower carbonate aquifer, about 27 km southwest of Mercury, Nevada, resulted in evaluating the dispersivity of the aquifer and estimates of average groundwater flow velocity. The dispersivity is estimated to be 15 m and the flow velocity estimates are stated to range from .14 to 3.4 m/day.

77. Clebsch, A., Jr., "Tritium Age of Groundwater at the Nevada Test Site, Nye County, Nevada," Geological Survey Professional Paper 424-C, U.S. Geological Survey, Washington, DC, 1961, pp. C122-C125.

Discusses tritium levels in groundwater aquifers. In a perched aquifer, the resident time for tritium is much shorter than in main aquifers. Tritium levels have increased since the testing of hydrogen bombs, and is used in determining the resident time of water in aquifers tapped by supply wells.

78. Clebsch, A., Jr., "Groundwater in the Oak Spring Formation and Hydrologic Effects of Underground Nuclear Explosions at the Nevada Test Site," Geological Survey TEI-759, U.S. Geological Survey, Washington, DC., 1960, 29 p.

Describes in general terms the hydrologic effects of three events. The perched groundwater of Rainier Mesa is described. Water from Oak Spring is a sodium-silica-bicarbonate with less than 300 ppm TDS. Springs in the lower part of the formation discharge from faults or joints. Natural activity levels of water from the Rainier and Logan-Blanca tunnels are tabulated.

79. Clebsch, A., Jr. and Barker, F. B., "Analyses of Groundwater from Rainier Mesa, Nevada Test Site, Nevada," Geological Survey Open File Report TEI-763, U.S. Geological Survey, Washington, DC 1960, 22 p.

This report assesses the procedures and data obtained from sampling of groundwater collected from wells, springs, and tunnel workings. The sampling is to determine chemical quality and establish background levels of radioactivity and explosion-produced levels of radioactivity in the water.

80. Clebsch, A., Jr. and Winograd, I. J., "Groundwater," in A Summary Interpretation of Geologic, Hydrologic and Geophysical Data for Yucca Valley, Nevada Test Site, Nye County, Nevada, Geological Survey Open File Report TEI-358, V.R. Wilmarth et al, U.S. Geological Survey, Washington, DC, 1959, pp. 36-49.

81. Cooley, R. L., Fiero, G. W., Jr., Lattman, L. H. and Mindling, A. L., "Influence of Surface and Near-Surface Caliche Distribution on Infiltration Characteristics and Flooding, Las Vegas Area, Nevada," Report No. 21, Desert Research Institute, Center for Water Resources Research, Las Vegas, Nevada, 1973, 41 p.

The study was conducted on the Red Rock Canyon fan to determine calcium carbonate deposition on the fan as this affects infiltration and runoff, to investigate engineering projects designed for flood control, to obtain geomorphic and hydrologic information, and to help local agencies currently planning flood control projects.

82. Cornwall, H. R., "Geology and Mineral Deposits of Southern Nye County, Nevada," Bulletin 77, Nevada Bureau of Mines and Geology, Mackay School of Mines, University of Nevada, Reno, 1972.

This report surveys the geology and mineral resources of Southern Nye County. In this report, it is noted that the Bare Mountain Mining District produces fluorspar, mercury, volcanic cinder, ceramic silica, pumicite, gold, and silver. The fluorspar produced from this area is valued at more than $2 million. In the Ash Meadows district, bentonite, valued at $3 million, has been produced. In fact, Ash Meadows has the largest production of any clay district in Nevada.

83. Crippen, J. R. and Bue, C. D., "Maximum Flood Flows in the Conterminous United States," Water Supply Paper 1887, U.S. Geological Survey, Washington, DC, 1977, 52 p.

Peak flood flows from thousands of sites in the United States were studied to assist in estimating maximum potential flood flows. Outstanding floods were plotted on graphs and computed curves indicated floods may occur 2 to 3 times greater than those known for most streams.

84. Crow, N. B., "First Observations of Tritium in Groundwater Outside Chimneys of Underground Nuclear Explosions, Yucca Flat, Nevada Test Site," UCRL-52073, University of California, Lawrence Livermore Laboratory, Livermore, California, May 1976, 36 p.

This is a report on high levels of tritium found in groundwater in the vicinity of hole U2aw. A mechanism which would account for the movement of tritium in this instance is hypothesized.

85. Cunningham, A. B., "Modeling and Analysis of Hydraulic Interchange of Surface and Groundwater," Desert Research Institute, University of Nevada, Reno, Nevada, 1977, 89 p.

A technique for modeling the hydraulic interchange between surface and groundwater in an unconfined aquifer-river system has been developed. Modeling procedure consists of simultaneous solution of the Saint Venant equations for one dimensional open channel flow and the Boussinesq equations descriptive of two dimensional transient groundwater flow coupled by an expression for flow through a channel wetted perimeter. Gerlerkin finite element technique was utilized in the numerical solution algorithm.

86. Davis, S. N., et al., "Hydrologic and Geologic Evaluation, Nevada Test Site," HNS-30, Hazelton-Nuclear Science Corp., Palo Alto, California, 1963, 25 p.

This is an interim report on the hazards of groundwater contamination at NTS and the surrounding area. Because of a lack of data at the time this report was written, the primary emphasis of the report is on the geographic position and geologic environment rather than contaminants. A number of recommendations regarding additional studies are made.

87. Denny, C. S. and Drewes, H., "Geology of the Ash Meadows Quadrangle, Nevada-California," Geological Survey Bulletin 1181-L, U.S. Geological Survey, Washington, DC, 1965, p. L1-L56.

This paper describes rock types according to geologic age. The geologic structure of the Funeral Mountains, Devil's Hole Area, and the Resting Spring Range are mentioned. The geomorphology of the area is described.

88. Dickey, D. D. and Monk, E. F., "Determining Density and Porosity of Tuff Containing Zeolites," Geological Survey Professional Paper 475-B, U.S. Geological Survey, Washington, DC, 1963, pp. B169-B170.

This report notes that standard methods of density and porosity determination do not give reliable results for certain zeolitized tuffs which

are found in Southern Nevada. This report suggests a method which can be used.

89. Dinwiddie, G. A., "Hydraulic Testing of Wells in Central Nevada," Geological Survey 474-80, U.S. Geological Survey, Denver, Colorado, 1970, 110 p.

This report summarizes the results of hydraulic testing of six exploratory holes. Lithologic descriptions of penetrated formations are given as well as hydraulic conditions of each hole. The hole numbers are as follows: UCe-11, UCe-16, UCe-17, UCe-18, HTH-1, and UCe-10.

90. Dinwiddie, G. A., "Hydraulic Testing and Sampling of Hole Ue-1 in Central Nevada," Geological Survey 474-77, U.S. Geological Survey, Denver, Colorado, 1970, 25 p.

The report described the hydraulic testing and results of the tests on hole Ue-1. Injection and recovery tests were run on sampled intervals.

91. Dinwiddie, G. A., "Hydraulic Testing of Well HTH-2 in Central Nevada," Geological Survey 474-23, U.S. Geological Survey, Denver, Colorado, 1969, 33 p. (For Official Use Only.)

92. Dinwiddie, G. A., "Hydraulic Testing of Well HTH-3 in Central Nevada," Geological Survey 474-34, U.S. Geological Survey, Denver, Colorado, 1969, 23 p. (For Official Use Only.)

93. Dinwiddie, G. A., "Hydraulic Testing of Well HTH-4 in Central Nevada," Geological Survey 474-31, U.S. Geological Survey, Denver, Colorado, 1969, 20 p. (For Official Use Only.)

94. Dinwiddie, G. A., "Hydraulic Testing of Well HTH-5 in Central Nevada," Geological Survey 474-39, U.S. Geological Survey, Denver, Colorado, 1969, 14 p. (For Official Use Only.)

95. Dinwiddie, G. A., "Analysis of Hydraulic Tests in Hot Creek Valley, Nevada," USGS 474-82, U.S. Geological Survey, Denver, Colorado, 1968.

This report presents an analysis of data obtained during hydraulic tests in exploratory holes, Hot Creek Valley, Nevada. The analysis consists of determining hydrostatic head distribution in the vertical section, distribution of water quality, transmissivity, hydraulic conductivity, velocity of groundwater movement, and inflow to a theoretical chamber.

96. Dinwiddie, G. A. and Weir, J. E., Jr., "Summary of Hydraulic Tests and Hydrologic Data for Holes UE16d and UE16f, Syncline Ridge Area, Nevada Test Site," Geological Survey 474, U.S. Geological Survey, Denver, Colorado, 1979, 25 p.

This report summarizes the geohydrologic information obtained from two exploratory holes. Hydraulic heads increased with depth indicating a

potential for upward flow. The test holes were designed to determine the hydraulic characteristics of the Eleana Formation as a possible repository for radioactive waste in an argillite formation.

97. Dinwiddie, G. A. and L. J. Schroder, "Summary of Hydraulic Testing in and Chemical Analyses of Water Samples From Deep Exploratory Holes in Little Fish Lake, Monitor, Hot Creek, and Little Smoky Valleys, Nevada," USGS 474-90, U.S. Geological Survey Denver, Colorado, 1971.

This report summarizes hydraulic-test data obtained in deep exploratory holes in central Nevada. The tests determine transmissivity, conductivity, storage coefficient, velocity of groundwater movement, and chemical quality of water in the boreholes.

98. Doyle, A. C. and Meyer, G. L., "Summary of Hydraulic Data and Abridged Lithologic Log of Groundwater Test Well 6 (J-13), Jackass Flats, Nevada Test Site, Nye County, Nevada," Technical Letter NTS-50, U.S. Geological Survey, Washington, DC, April 26, 1963.

This technical letter summarizes the results of drilling groundwater test Well 6 (J-13), and presents a lithologic log, water sample analysis, construction information, and hydraulic data. The well is one of several drilled to explore the hydrologic conditions at the Nevada Test Site.

99. Dudley, W. W., Jr., and Larson, J. D., "Effect of Irrigation Pumping on Desert Pupfish Habitats in Ash Meadows, Nye County, Nevada," Geological Survey Professional Paper 927, U.S. Geological Survey, Washington, DC, 1976, 52 p.

The primary objective is to establish the degree to which controllable causes have lowered the water level in Devil's Hole and decreased flow in springs in Ash Meadows. A small pool in Devil's Hole, and numerous springs in the adjacent desert contain rare fish species of the genus Cyprinodon. The Devil's Hole pupfish, C. diabolis, feed and reproduce on a rock ledge which is nearly exposed due to recent irrigation pumping. The report covers correlation of pumping histories with the stage in Devil's Hole, allowing identification of several wells that effect the pool level. The report includes hydraulic testing, long-term water-level monitoring, water quality and geologic data as an aid in defining principal flow paths and hydraulic interconnections in the area.

100. Dudley, W. W., Jr. and Larson, J. D., "Effect of Irrigation Pumping on Desert Pupfish Habitats in Ash Meadows, Nye County, Nevada," Geological Survey Open File Report 74-188, U.S. Geological Survey, Washington, DC, 1974, 142 p.

101. Dudley, W. W. and Larson, J. D., "Geologic Controls on Spring Locations, Ash Meadows, Nye County, Nevada," Geologic Society of America, Cordilleran Section, Annual Meeting Program, No. 167, 1974.

102. Dunn, L. E., "Fertility Levels of Nevada Soils," Max C. Fleischmann College of Agriculture, Report No. T7, University of Nevada, Reno, Nevada, 1967.

A survey of soil fertility conditions in Nevada with reference to organic matter, nitrogen, phosphorous, and potassium is given. Soil and plant analysis and greenhouse tests were used on measurement methods of fertility levels. Sulfur, iron, copper, zinc, manganese, and boron were not found to be deficient for horticultural and some other crops.

103. Eakin, T. E., "Regional Groundwater System in Southeastern Nevada (abst.)," Journal National Water Well Association, Volume 3, No. 1, 1965, 48 p.

104. Eakin, T. E., Price, D. and Harrill, J. R., "Summary Appraisals of the Nations Groundwater Resources - Great Basin Region," Geological Survey Professional Paper P-813-G, U.S. Geological Survey, Washington, DC, 1976, pp. G1-G37.

Groundwater withdrawals were 1.1 million acre-feet in the Great Basin, 1970. Appraisal indicates groundwater resources could sustain an annual 2.6 million acre-feet pumpage. Few areas of the Great Basin have been studied and if large development occurs, more hydrologic and related data will be needed.

105. Eakin, T. E. and Winograd, I. J., "Interbasin Movement of Groundwater in South-Central Nevada - Some Implications," Abstracts of Geological Society of America, Spec. Paper 82, 1964, 52 p.

106. Eakin, T. E., Schoff, S. L., and Cohen, P., "Regional Hydrology of a Part of Southern Nevada - A Reconnaissance," Geological Survey Open File Report TEI-833, U.S. Geological Survey, Washington, DC 1963, 40 p.

The groundwater hydrology is reviewed on the basis of data that are generally limited. Data suggest that groundwater moves generally south or southwestward through the region. Estimates of recharge decrease markedly from north to south. Among valleys that may discharge by interbasin movement of groundwater are Yucca, Frenchman, Cactus, Go'd Stonewall Flats, and Emigrant Valley. Part of the sodium-bicarbonate waters and the altered waters now found in the Amargosa Desert could have moved to the Amargosa basin from localities to the north and northeast. The calcium-magnesium-bicarbonate waters that occur in Pahrump and Las Vegas Valleys are probably derived from the Spring Mountains. Potential water table gradients suggest that groundwater may be able to move into the Nevada Test Site from the northeast, north or northwest and exit to the southwest. Las Vegas Valley is an unlikely discharge area for groundwater from Nevada Test Site, even though water level in the discharge area southeast of Las Vegas are about 700 feet lower than the Test Site. This indicated difference in altitude fails to take into account the water levels at the intermediate locations are higher than those at the Test Site - about 60 feet at Tule Springs.

107. Eberle, W. R. and Bigelow, R. C., "Electrical Dispersion Characteristics of Selected Rock and Soil Samples from the Nevada Test Site," Geological Survey 474-162, U.S. Geological Survey, Denver, Colorado, 1973, 50 p.

Laboratory measurements of the resistivity and dielectric constant of alluvium soils, tuffs, rhyolite, and other rock types were made at decade intervals of frequency from 100 HZ too 100 MHZ. Water contents ranged from .3 percent by volume for partially saturated dolomite to 30.9 percent by weight for a fully saturated tuff. This report gives test results in table and graph plot form.

108. Eckel, E. B., "Nevada Test Site," Memoir 110, The Geological Society of America, Inc., 3300 Penrose Place, Boulder, Colorado, 80301, 1968, 290 p.

Describes results of 12 years of geological research on the Nevada Test Site. The primary purpose of the studies was to aid and advise the U.S. Atomic Energy Commission in all phases of its testing of nuclear devices. An enormous amount of knowledge was gained about the complex geologic an hydrologic conditions that exist in and near the Nevada Test Site. The complex volcanic and sedimentary stratigraphy, structure, and geologic history of this part of the Basin and Range Province are described. The deep fills in intermountain basins and the groundwater in them are in three dimensions, and geologic maps have been prepared and described in the text.

109. Ekren, E. B., et al, "Geologic and Hydrologic Considerations for Various Concepts of High-Level Radioactive Waste Disposal in Conterminous United States," Geological Survey Open File Report, U.S. Geological Survey, Washington, DC, 1974, 219 p.

110. Essington, E. H., "Evaluation and Selection of Tracers for Field Measurements of Coefficient of Dispersion," Contract AT (29-2)-22, Teledyne Isotopes, Palo Alto, California, 1971, 27 p.

A field study was designed to determine the degree of dispersion in a saturated desert alluvial aquifer. A group of tracers with properties consistent with conditions and restrictions required for the field site were selected. Three traces, I^-, HTO and CO^{60}-CDTA were chosen for use in the field study.

111. Essington, E. H. and Meyer, G. L. "Groundwater Monitoring at Nevada Test Site," Teledyne-Isotopes, Las Vegas, Nevada, December, 1971.

This is a data report/summary of the groundwater monitoring program at NTS.

112. Essington, E. H. and Sharp, J. V. A., "Some Aspects of Groundwater Solution Chemistry, Underground Nuclear Explosion Zones, Nevada Test Site," Hazelton-Nuclear Science Corporation, Palo Alto, California, 1968, 11 p.

This is a report of leaching experiments on Tertiary tuff from Rainier Mesa which was formed into radioactive glass to determine the possibility of transferring radioactivity to the groundwater. The results indicate that groundwater in a silicate rock testing media may dissolve sufficient radioactivity from explosion glass to be of concern.

113. Essington, E. H., Nishita, H., and Steen, A. J., "Release and Movement of Radionuclides in Soils Contaminated with Fallout Material from an Underground Thermonuclear Detonation," Health Physics, 11, 1965, pp. 689-698.

Fallout material from an underground thermonuclear detonation was analyzed to determine the presence of several longer lived radionuclides. In suspension studies, chelating agents as compared to water generally increased the amount of soluble radionuclides, but the effect was small. The effect of water and a chelating agent on the movement of radionuclides in the soil columns was also studied.

114. Fenske, P. R., "Interaquifer Leakage Through Uncased Borehole Penetrations, Yucca Valley, Nevada Test Site," 45013, Desert Research Institute, Water Resources Center, Reno, Nevada, May 1978, 10 p.

A method of calculating groundwater leakage rate into the carbonate aquifer through uncased boreholes is presented. Aquifer parameters were estimated on the basis of a few measured values. The appropriate basic equations are the straight line solutions of the radial flow equations.

115. Fenske, P. R., "Prediction of Radionuclide Migration in Groundwater," in Technical Discussions of Off-Site Safety Programs for Underground Nuclear Detonations, USAEC NVO-40, Rev. 2, CH. 7, Isotopes, Inc., Palo Alto, California, 1969, pp. 69-82.

This paper deals with alteration of flow lines due to permeability changes in the vicinity of a chimney. Radioactive contaminant transport equations are given. A tritium problem at NTS is calculated on the basis of various models and approximations.

116. Fenske, P. R. and Carnahan, C. L., "Water Table and Related Maps for Nevada Test Site and Central Nevada Test Area," 45009, Desert Research Institute, Water Resources Center, Reno, Nevada, April 1976, 18 p.

Water table maps, water table gradient maps, and depth-to-water maps have been constructed for the Nevada Test Site and the Central Nevada Test Area by Empirical simulation using a digital computer. This report presents maps constructed during May 1975, a listing of the water level control points, and a brief description of the empirical mapping technique.

117. Fenske, P. R. and Charnell, R. L., "Infill of Nuclear Rubble Chimneys by Groundwater," NVO-1229-171, Teledyne - Isotopes, Palo Alto, California, 1971.

This paper presents the results of a theoretical analysis of the ground in-fill rate of rubble chimneys. Changes in hydraulic conductivity have the greatest effect on in-fill. The theory has not been validated. Inflow at Bilby, Nevada Test Site, where reentry was through the top of chimneys, was used to fit model.

118. Ferris, J. G., et al., "Theory of Aquifer Tests," Water Supply Paper 1536E, U.S. Geological Survey, Denver, Colorado, 1962, 106 p.

This report surveys developments in fluid mechanics that apply to groundwater hydrology. It discusses the origin, occurrence, and motion of underground water in relation to the development of terminology and analytic expression for selected flow systems. It describes the underlying assumptions necessary for mathematical treatment of these flow systems, with particular reference to the way in which the assumptions limit the validity of the treatment.

119. Fiero, G. W., et al., "Use of Hydrochemistry for Interpreting Groundwater Flow Systems in Central Nevada," Geological Survey, U.S. Geological Survey, Denver, Colorado, 1974, 44 p.

This is a study of the suitability of central Nevada sites for nuclear testing. Chemistry of groundwater is used to determine paths of flow. All chemical data were put together to describe flow patterns in central Nevada. There is no indication that this method has been applied to Nevada Test Site in great detail.

120. Fiero, G. W. and Maxey, G. B., "Hydrogeology of Devil's Hole Area, Ash Meadows, Nevada," University of Nevada, Reno, Desert Research Institute, 1970, 26 p.

The groundwater discharging from major springs in Ash Meadows and the water level of the pool in Devil's Hole is an inherent part of a regional carbonate groundwater flow system.

Groundwater movement and the location of the major springs is controlled in part by major faults. Water from the carbonate aquifer recharges most of the overlying alluvial aquifer. Heavy groundwater withdrawals by pumping wells show a good correlation with water level decline in Devil's Hole.

121. Fiero, G. W., and Maxey, G. B., "Groundwater Flow Systems and Underground Nuclear Testing," Paper SPE-2944, Society of Petroleum Engineers, 1970.

A general description of perturbation of the water table by nuclear explosions. Some of the references on groundwater flow in small basins or flow as influenced by variations in permeability may be of interest.

122. Flanigan, V. J., "A Slingram Survey on the Nevada Test Site - Part of an Integrated Geologic-Geophysical Study of Site Evaluation for Nuclear Waste Disposal, "Geological Survey Open File Report 79-277, U.S. Department of Energy, Grand Junction, Colorado, 81501, 1979, 34 p.

123. Fordham, J. and Stidd, C. K., "Location of Hydrologic Gauges in Nevada and the Adjacent Sierra Nevada," Project Report No. 4, Center for Water Resources Research, Desert Research Institute, Reno, Nevada, March 1967, 175 p.

A comprehensive listing of stream. precipitation, snow, and weather gauges in Nevada and the adjacent Sierra Nevada Range. The tabulated information includes station name, location (longitude, latitude, elevation), length of record and in some cases, the physical location of the record.

124. Fowler, E. B., Gilbert, R. O., and Essington, E. H., "Sampling of Soils for Radioactivity: Philosophy, Experience, and Results," in Engelmann, R.J. and Sehmel G.A., Coordinators, Atmosphere - Surface Exchange and Gaseous Pollutants (1974), Conf., 740921, NTIS, Springfield, Virginia, 22151, 1976, pp. 709-726.

This paper presents information on the philosophy and development of methods used in the Nevada Applied Ecology Group's program to define plutonium levels in the soils. The program required interaction of experts in sampling, sample preparation, analyses, and data interpretation.

125. French, R. H., discussion of "Design hyetographs for Small Drainage Structures," by B. C. Yen and V. T. Chow, Journal of the Hydraulics Division, American Society of Civil Engineers, Volume 106, No. HY6, Proc. Paper 15452, June 1981.

This paper used precipitation data from the Nevada Test Site to discuss the triangular hyetograph hypothesis of Yen and Chow. The discusser notes that in some cases, the summer storms typical of the Nevada Test Site area cannot be accurately described by the author's hypothesis.

126. French, R. H., "Interim Report on Flash Floods, Area 5 - Nevada Test Site," Publication No. 45019, Water Resources Center, Desert Research Institute, Las Vegas, Nevada, September, 1980, 23 p.

This report summarizes the progress made during the first year of effort in studying flash floods in the vicinity of the low-level waste management site in Area 5 of the Nevada Test Site.

127. French, R. H., "Flash Flood Models for Southern Nevada," Proceedings of the Fourth Conference on Hydrometeorology, American Meteorological Society, Boston, Massachusetts, in press.

This paper discusses several flash flood models which have been used in the southern Nevada area. A methodology for studying and modeling flash floods is also presented.

128. French, R. J., "Analysis of Southern Nevada Precipitation for Engineering Design," Preceedings of the Fourth Conference on Hydrometeorology, American Meteorological Society, Boston, Massachusetts, in press.

A discussion of the precipitation in the southern Nevada area. Intensity-duration relationships are derived for two stations: Well 5B on the Nevada Test Site and McCarran International Airport in Las Vegas.

129. Friesen, H. N., "Hydrologic Data Storage and Retrieval System," NVO-1253-2, Desert Research Institute, University of Nevada, Reno, Nevada, 1972, 21 p.

Hydrologic Data has been collected from various USAEC test sites and a computerized system for storage and retrieval of this data has been implemented as an aid to geologic and hydraulic investigations. The system has been designed with emphasis placed on ease of user retrieval. A diversified set of statistical routines has been included in the system to provide the user with a wide choice of postretrieval data manipulation.

130. Friesen, H. N. and Brekke, J. C., "Hydrologic Data Bank Contents," 45015, Desert Research Institute, Water Resources Center, Reno, Nevada, March 1978, 40 p.

The USDOE/NV Hydrologic Data Storage and Retrieval System is composed of data files and computer programs for the manipulation of these files. This publication presents the names assigned to the data files and details the file contents.

131. Gale, H. S., "Prospecting for Potash in Death Valley, California," Geological Survey Bulletin 540-N, U.S. Geological Survey, Washington, DC, 1914, pp. 407-415.

This report describes the accumulation of vast saline deposits in Death Valley and the possibility of the segregation of potash. It lists log descriptions of four bore holes.

132. Garber, M. S., "A Method for Estimating Effective Porosity in a Rubble Chimney Formed by an Underground Nuclear Explosion," Geological Survey Professional Paper 750-C, U.S. Geological Survey, Washington, DC, 1971, pp. C207-C209.

A rubble chimney was dewatered at the time of the explosion and took five years to refill. Pump test during infill of the chimney caused interruption in the rise of the water level. A method was devised for estimating the effective porosity and was determined to be between 1.5 and 7.9 percent.

133. Garber, M. S., "Hydraulic Test and Quality of Water Data from Hole V-3cnPs#2, Bibly Site, Nevada Test Site," USGS-474-105, U.S. Geological Survey, Denver, Colorado, 1971, 81 p.

This paper is a data compilation. Water level drawdown and recovery data for several pumping tests are given. Radiochemical analyses of pumped water are presented.

134. Garber, M. S., "Large Rise and Following Decline of Water Level in Well 7 Area 3, Nevada Test Site, An Effect from Aardvark Underground Nuclear Explosion," Technical Letter Yucca - 48, U.S. Geological Survey, Denver, Colorado, 1963.

A rise of at least 17 m in the water level in test Well 7, followed by a slow decline of the water level, was observed after the Aardvark event. Several mechanisms to explain the observed water level fluctuation are advanced.

135. Garber, M. S. and Wollitz, L. E., "Measuring Underground-Explosion Effects in Surrounding Aquifers," Groundwater, Volume 7, No. 4, 1969, pp. 3-7.

Underground detonations may produce observable effects in surrounding aquifers and wells. The nature and durations of the effect at an observation point depends on several factors such as energy released, geologic environment, position of buried explosive device in relation to the saturated zone, aquifer characteristics, and distance from point of detonation. Specialized techniques were developed to make these measurements.

136. Garber, M. S. and Koopman, F. C., "Methods of Measuring Water Levels in Deep Wells," U.S. Geological Survey Water Resources, Inv., Book 8, Chapter A1, U.S. Geological Survey, Washington, DC, 1968, 23 p.

137. Garber, M. S. and Johnston, R. H., "A Summary of Lithologic Data, Aquifer Tests, and Construction of Hydraulic Test Well U3cn-5, Nevada Test Site," Technical Letter NTS-200, USGS, Denver, Colorado, 1967.

The well was drilled into Paleozoic rock about 122 m from Bilby emplacement hole. Examination of cores from this well at interval 670.6 to 711.7 m revealed the occurrence of radionuclides in preexisting joints. The authors point to shot-time injections of activity into the joints as the mechanism of its emplacement rather than long-term transport in groundwater flow.

138. Garber, M. S. and Thordarson, W., "Groundwater Test Well C, Nevada Test Site, Nye County, Nevada," Geological Survey Open File Report TEI-818, U.S. Geological Survey, Washington, DC., 1962, 79 p.

A summary of data regarding a pump test of a groundwater well in Yucca Flat. The specific capacity of the well was estimated to be 450 gallons per minute per foot of drawdown. It is noted that water from this well

is of the sodium bicarbonate type with a relatively high percentage of calcium and sulfate.

139. Glancy, P. G. and Harmsen, L., "A Hydrologic Assessment of the September 14, 1974, Flood in Eldorado Canyon, Nevada," Geological Survey Professional Paper 930, U.S. Geological Survey, Washington, DC, 1975, 28 p.

Details the storm intensity and destruction of life and property resulting from a peak discharge of 76,000 cubic feet per second from the 22.9 square mile drainage area of Eldorado Canyon. The type and volume of sediment deposited at the mouth of the canyon are described. The report discusses the precipitation event which caused the flood and the possibility of future floods.

140. Glanzman, V. M., "Bibliography of Reports by U.S. Geological Survey Personnel Pertaining to Underground Nuclear Testing and Radioactive Waste Disposal at the Nevada Test Site, and Radioactive Waste Disposal at the Wipp Site, New Mexico, January 1, 1979, to December 31, 1979," Geological Survey Open File Report USGS-OFR-80-817, U.S. Geological Survey, Denver, Colorado, 1980, 22 p.

This bibliography presents reports released to the public. Reports include information on underground nuclear testing, waste management projects at NTS and radioactive waste projects at the Waste Isolation Pilot Plant Site, New Mexico. It also contains an author and subject index.

141. Glanzman, V. M., "Bibliography of Reports by U.S. Geological Survey Personnel on the Nevada Test Site and Related Subjects, July 1, 1977, to December 31, 1978, with Author and Subject Indexes," Geological Survey 474-306, U.S. Geological Survey, Denver, Colorado, 1979, 27 p.

The bibliography presents reports released to the public. Reports include information on underground nuclear testing, waste management projects at the Test Site and related subjects. It also contains an author and subject index.

142. Gonzalez, D. D., Warren, C. T., and Washington, C. L., "Water Levels and Spring Discharges for Selected Wells and Springs in Nevada," USGS - 474-171, NTIS, Springfield, Virginia, 22151, 1966-1969, 69 p.

Surface water and groundwater data are collected from selected wells and springs in Nevada. Data presented are for the period 1966-1969 and were collected from groundwater wells, gauging stations, miscellaneous sites, and four hot spring sites. The data collection network is to evaluate possible effects of nuclear explosions on the hydrology of springs and wells.

143. Grove D. B., "U.S. Geological Survey Tracer Study, Amargosa Desert, Nye County, Nevada - Part II: An Analysis of the Flow Field of a Discharging-Recharging Pair of Wells," U.S. Geological Survey, Denver, Colorado, 1971, 56 p.

Two transport models, plug flow and dispersed flow, are presented to evaluate the flow field between a discharging-recharging pair of wells. A numerical solution for the plug-flow model resulted in a plot of dimensionless groups that allow prediction of travel times between wells along streamlines. A numerical solution for the dispersed flow model allows evaluation of the porosity and dispersivity of the aquifer. The technique is applicable for pulse tracer injection and recirculation.

144. Grove, D. B., Rubin, M., Hanshaw, B. B, and Beetem, W. A., "Carbon-14 Dates of Groundwater from a Paleozoic Carbonate Aquifer, South-Central Nevada," Geological Survey Professional Paper 650-C, U.S. Geological Survey, Washington, DC, 1969, pp. C215-C218.

Radiocarbon determinations were used to estimate the ages of groundwater from the Paleozoic aquifer underlying the Nevada Test Site and adjacent areas. Good correlation exists between carbon-14 and hydraulic interpretations, but irregularities in the aquifer prohibit predictions of groundwater velocities or flow patterns.

145. Hagstrum, J. T., et al., "Interpretation of Geophysical Well-Log Measurements in Drill Hole Ue25a-1, Nevada Test Site, Radioactive Waste Program," Geological Survey Open File Report, 80-941, U.S. Geological Survey, Denver, Colorado, 1980, 30 p.

This report describes the exploration hole drilled to investigate the suitability of pyroclastic deposits as storage sites for radioactive wastes. Studies have been conducted to investigate the stratigraphy, structure, mineralogy, petrology, and physical properties of tuff units encountered in the drill hole.

146. Hales, J. E., Jr., "Southwestern United States Summer Monsoon Source - Gulf of Mexico or Pacific Ocean?," Journal of Applied Meteorology, Volume 13, 1974, pp. 331-342.

147. Hanes, W. T., "Water Resources Data Collected in the Devil's Hole Area, Ash Meadows, Nevada, 1975-1976," Geological Survey Open File Report 76-797, U.S. Geological Survey, Federal Building, Carson City, Nevada, 89701, 1976, 16 p.

148. Hansen, E. M., "Moisture Source for Three Extreme Local Rainfalls in the Southern Intermountain Region," Hydrometeorological Report 26, National Weather Service, Washington, DC, 1975, 57 p.

149. Hansen, D. S., "Tritium Movement in the Unsaturated Zone, Nevada Test Site," thesis presented to the University of Nevada at Reno in 1978 in

partial fulfillment of the requirements for the degree of Master of Science.

Tritium movement in three different geomorphic settings at the Nevada Test Site was examined. Two bunched soil samples were collected from high fan, midfan and playa sediments in Yucca and Frenchman Flats.

150. Hardman, G., "Nevada Precipitation and Acreages of Land by Rainfall Zones," Mimeo. Rept. and Map, Nevada University of Agriculture Exp. Station, 1936, 10 p.

151. Hardman, G. and Miller, M. R., "The Quality of Waters of Southeastern Nevada Drainage Basins and Water Resources," Nevada University Agriculture Expt. Station, Bulletin 1-62, 1934, 136 p.

152. Healy, D. L. and Miller, C. H., "Gravity Survey of the Amargosa Desert Area of Nevada and California," Geological Survey Open File Report 474-136, U.S. Geological Survey, Washington, DC, 1971, 32 p.

This survey consisted of approximately 1,800 observations within a 2,400 square mile area of the Amargosa Desert. The survey provides information regarding basin-fill geology and buried normal faults. Analyses of two-dimensional geologic cross sections indicate valley fill ranges in thickness from several hundred to more than 7,000 feet with the thickest fill between Lathrop Wells and Death Valley Junction and in Mount Shador basin.

153. Hem, J. D., "Study and Interpretation of the Chemical Characteristics of Natural Water, Second Edition," Geological Survey GS-WSP-1473, U.S. Geological Survey, Reston, Virginia, 1970, 363 p.

This paper discusses various attributes of natural water with special emphasis on its chemical nature. It also discusses different types of analyses used to characterize natural water.

154. Hess, J. W. and Mifflin, M. D., "A Feasibility Study of Water Production from Deep Carbonate Aquifers in Nevada," 41054, Desert Research Institute, Water Resources Center, Las Vegas, Nevada, September 1978, 125 p.

This report is the first phase of a new program of study of the water supply potential of deep carbonate aquifers in southern and eastern Nevada. This initial work was designed to assemble and interpret existing geologic, geophysical, hydrologic, and geochemical information for development of a water supply from these areas.

155. Hewett, D. F., et al., "Mineral Resources of the Region Around Boulder Dam," Geological Survey Bulletin 871, U.S. Geological Survey, Washington, DC, 1936, 197 p.

This report details metalliferous and nonmetalliferous resources in the area around Boulder Dam. It indicates that the region contains a wide

range of commercially valuable minerals. It lists the minerals available in the area by county.

156. Higgins, G. H., "Evaluation of the Groundwater Contamination Hazard from Underground Nuclear Explosions," J. Geophys, Res. 64 (10), 1969, pp. 1509-1519.

This is a general review of the important relationships governing transport of activity from the site of an underground nuclear explosion. As recited, these are 1) unleachability of glasses formed, 2) ion exchange processes within surrounding rocks, and 3) nature of flow or perturbation of normal groundwater flow around a nuclear explosion.

157. Holly, D. E., Gainasso, N. L., and Essington, E. H., "Hydrodynamic Transport of Radionuclides: One-Dimensional Cases with Two-Dimensional Approximation," NVO-1229-179, Teledyne Isotopes, Palo Alto, California, 1971.

One-dimensional mathematical model of the transport and hydrodynamic dispersion of radionuclides in granular media are described. The analytical solution is limited to a homogeneous aquifer. A method is presented to obtain an approximate two-dimensional solution.

158. Holzer, T. L., "Documentation of Potential for Surface Faulting Related to Groundwater Withdrawal in Las Vegas Valley, Nevada," Geological Survey Open File Report, U.S. Geological Survey, Menlo Park, California, 1978, 12 p.

This report discusses the possible relationships of groundwater withdrawals to fault-offset of the land surfaces and the hazards of land development.

159. Hood, J. S., "Water Wells in Frenchman and Yucca Valleys, Nevada Test Site, Nye County, Nevada," Geological Survey Open File Report TEI-788, U.S. Geological Survey, Washington, DC, 1961, 59 p.

This report summarizes pump test information on three wells which provide the water supply for the NTS. Two of the wells are located in Frenchman Valley and one well in Yucca Valley. It is noted that the water levels in Frenchman Valley have declined no more than 6 feet as a result of pumping, but the water level in the well in Yucca Valley has declined about 31 feet.

160. Hoover, D. L., and Morrison, J. N., "Geology of the Syncline Ridge Area Related to Nuclear Waste Disposal, Nevada Test Site, Nye County, Nevada," Geological Survey Open File Report 80-942, U.S. Geological Survey, Denver, Colorado, 1980, 70 p.

This report describes a geologic formation in the Syncline Ridge area as a possible nuclear waste repository site. An argillite unit of the Eleana Formation appeared to have properties that are within acceptable limits for a repository.

161. Hoover, D. L., Eckel, E. B., and Ohl, J. P., "Potential Sites for a Spent Unreprocessed Fuel Facility, Southwestern Part of the Nevada Test Site," Geological Survey Open File Report 78-269, Nevada Bureau of Mines and Geology, University of Nevada, Reno, Nevada, 89507, 1978, 20 p.

This report describes the geology of the Jackass Flats area. It gives the guidelines for a Spent Unreprocessed Fuel Facility (SURFF) site selection. It recommends a detailed study of areas that are within the flats for a possible SURFF site.

162. Horton, R. E., "Analysis of Runoff Plot Experiments with Varying Infiltration Capacity," Trans. Amer. Geophys. Union, Part IV, 1939, p 693.

163. Houghton, J. G., "Supplement to Nevada Weather Watch Special Publication No. 1: Sources of Climatic Data in Nevada," Nevada Weather Watch, Reno, Nevada, May 1979, 26 p.

A supplement and updating of the following publication by Houghton, J. G., 1977.

164. Houghton, J. G., "Sources of Climatic Data in Nevada," Special Publication No. 1, Nevada Weather Watch, Reno, Nevada, 1977, 40 p.

A summary of climatic data available for Nevada. The weather elements measured in Nevada include temperature, precipitation, atmospheric moisture, sunshine, air quality, wind and air pressure. A list of data sources is also included.

165. Houghton, J. G., "Characteristics of Rainfall in the Great Basin," Desert Research Institute, Reno, Nevada, 1969, 205 p.

This report seeks to explain the characteristics of rainfall in the Great Basin in terms of climatic controls and develop statistical methods for estimating the long-term rainfall regime at stations with incomplete records. The parameters of the rainfall regime include monthly and annual totals, frequency of rainy days, variability, and precipitation effectiveness in terms of natural vegetation. The important climatic factors include synoptic and site factors.

166. Houghton, J. G., "Determination of Mean Monthly Rainfall and Frequency of Daily Runs from a Short Period of Record at Nevada Stations," unpublished research paper, Desert Research Institute, Reno, Nevada, 1966.

167. Houghton, S. G., "A Trace of Desert Waters, the Great Basin Story," Western Lands and Waters, Series X, Arthur H. Clark, Co., Glendale, California, 1976, 287 p.

168. Houser, F. N., "A Summary of Information and Ideas Regarding Sinks and Collapse, NTS," USGS-474-41, U.S. Geological Survey, Denver, Colorado, 1970.

Unpublished data are given on velocity of groundwater movement at the NTS. In Yucca Flat, it is 180 m/year; for Pahute Mesa, it is 60 m/year. There is a description of perched water at Rainier Mesa and Climax Stock. Rubble size and distribution in various chimneys are reviewed.

169. Hubbs, C. L. and Miller, R. R., "The Zoological Evidence: Correlation Between Fish Distribution and Hydrographic History in the Desert Basins of Western United States. In: The Great Basin with Emphasis on Glacial and Postglacial Time," Bulletin, University of Utah, 38(20), Biol. Series 10(7):17-166, 1948.

170. Hughes, J. L., "Some Aspects of the Hydrogeology of the Spring Mountains and Pahrump Valley, Nevada, and Environs as Determined by Spring Evaluation," thesis presented to the University of Nevada at Reno, Nevada, in 1966, in partial fulfillment of the requirements for Degree of Masters.

All available data pertaining to springs in the Spring Mountains and environs have been obtained and evaluated. Analysis of the geology indicates that nearly all springs are controlled by impermeable fault contacts or exposure of cavernous systems in limestone due to faulting or erosion. It has been concluded from this investigation that nearly all springs discharge from a local groundwater system.

171. Hunt, C. B., "Death Valley: Geology, Ecology, Archeology," University of California Press, 1975, 234 p.

172. Hunt, C. B. and Mabey, D. R., "Stratigraphy and Structure, Death Valley, California," Geological Survey Professional Paper 494-A, U.S. Geological Survey, Washington, DC, 1966, 138 p.

This paper details the geology of the Death Valley basin. Stratigraphy by geologic age is thoroughly described. The structural setting and features are presented with a stage sequence of events building the structures. Hydrologic characteristics of Death Valley are not discussed.

173. Hunt, C. B., Robinson, T. W., Bowles, W. A., and Washburn, A. L., "Hydrologic Basin, Death Valley, California," Geological Survey Professional Paper 494-B, U.S. Geological Survey, Washington, DC, 1966, 138 p.

Three types of valley fill in Death Valley are important to the hydrology described. Groundwater in Death Valley is augmented by groundwater entering the basin along faults from neighboring basins, especially Pahrump Valley by way of Ash Meadows. Pahrump Valley is the source of large springs in the Amargosa Desert. Four types of springs in Death Valley are described.

174. Hunt, C. B. and Robinson, T. W., "Possible Interbasin Circulation of Groundwater in the Southern Part of the Great Basin," in Short Papers in the Geological Sciences, Geological Professional Paper 400-B, U.S. Geological Survey, Washington, DC, 1960, pp. B273-B274.

An hypothesis that water may flow along fault fissures and discharge as springs along fault zones on the north and east sides of Death Valley is presented. This is supported by geochemical studies of the spring waters. The springs on the north end of Death Valley are similar to the spring waters in Mesquite Flat, the next basin northwest. The spring waters on the east side are similar to those at Ash Meadows in the Amargosa Desert, the next basin to the east.

175. Imam, R. L., et al., "Sensitivity Study on the Parameters of the Regional Hydrology Model for the Nevada Nuclear Waste Storage Investigations," Sand. 79-1197C, Sandia Laboratories, Albuquerque, New Mexico, 1980, 31 p.

This is a report on the sensitivity of the various parameters in the 2-D regional aquifer models developed for the NNWSI program. The sensitivity analysis is used to 1) determine which input variables have a significant effect on the model output, 2) define their relative importance, and 3) ascertain the effect of input variable correlations on their rankings. The significance of the results is discussed with respect to the hydrology of the region.

176. Jensen, E. H., "Management of Irrigated Forages in Nevada," Max C. Fleischmann College of Agriculture, Report B29, University of Nevada, Reno, Nevada, 1971.

Information and recommendations regarding management of irrigated forages are presented. Consideration is given to management of both pasture and haylands. Recommendations are made for the production of high quality forage in each of the three major climate areas in the state with specific consideration given to the problems of primary importance to each climatic area.

177. Johnson, J. O. and Edwards, K. W., "Determination of Strontium-90 in Water," USGS Water Supply Paper 1696-E, AEC Hydrology Office, Denver Federal Center, Colorado, 1967, 301 p.

A method is described for the determination of Strontium-90 in waters free of Strontium-89 or for determination of gross radiostrontium activity as Strontium-90. The method is suitable for use on natural samples and other aqueous systems without high concentrations of organic substance.

178. Johnson, M. S. and Hibbard, D. E., "Geology of the Atomic Energy Nevada Proving Grounds Area," Geological Survey Bulletin 1021-K, U.S. Geological Survey, Washington, DC, 1957, pp. 333-384.

This report is a complete geological description of the Nevada Test Site. It is of interest primarily as background information for hydrological studies.

179. Johnston, R. H., "Exploratory Drilling, Tracer Well Construction and Testing and Preliminary Findings, Part 1 of Geological Survey Tracer

Study, Amargosa Desert, Nye County, Nevada," USGS-474-98, U.S. Geological Survey, Washington, DC, 1968, 64 p.

The Part 1 tracer study is designed to determine velocity of groundwater movement through carbonate rocks underlying the NTS and the Amargosa Desert.

The site is underlain by lake deposits, alluvium, and basalt, and at greater depths by carbonate rocks. The site is a part of several hydraulically interconnected valleys. Carbonate rocks constitute a drain connecting the valleys and the discharge area in the desert. The water level potential is higher in the carbonate rocks than in the overlaying alluvium; however, the head differential is less than 1 foot. Three exploratory holes, three tracer holes, and one sample hole were drilled at the site. The tracer and sample holes were used for hydraulic testing of aquifer constants and tracer experiments.

180. Katzer, P. A., Glancy, P. A., and Harmsen, L., "A Brief Hydrologic Appraisal of the July 3-4, 1975 Flash Flood in Las Vegas Valley, Nevada," Geological Survey Open File Report 76-100, U.S. Geological Survey, Federal Building, Carson City, Nevada, 89701, 1976, 47 p.

181. Kaufman, W. J., "Groundwater Study Program: An Appraisal of the Distribution Coefficient for Estimating Underground Movement of Radioisotopes," HNS-1229-21, Hazleton-Nuclear Science Corp., Palo Alto, California, 1963, 23 p.

The selectivity coefficient (e.g., K, Sr, Ca), which is an equilibrium constant or a mass-action constant, is defined. It is related to the preference of one cation over another in an exchange reaction. K_d's for NTS tuff from hole T12b#2 are given. A resume is given of K_d (137Cs) data in the literature. This is an elementary discussion of the use of K_d's in predicting migration.

182. Klein, W. L. and Brechbill, R. A., "Preliminary Radiation Surveillance of an Aquatic System near the Nevada Test Site, June - July, 1967," SWRHL-65r, NTIS, Springfield, Virginia, 22151, 1972, 23 p.

Results of a three month radiation surveillance study of an aquatic system in upper Pahranagat Lake near the Nevada Test Site are presented. Radionuclide concentrations were found to be insignificant in water, aquatic plant, and fish samples. Sediment samples had detectable levels of some radioisotopes.

183. Knox, J. B., "Water Quality in Flooded Nuclear Craters," UCRL-50531, California University, Livermore, Lawrence Radiation Laboratory, 1968, 23 p.

This paper gives a simple model for transport of radioactive ions. It concerns itself mostly with the movement of tritium in and around a nuclear crater.

184. Knox, J. B., "Water Quality in Flooded Craters Produced by Nuclear Excavation," UCID-4741, Lawrence Radiation Laboratory, Livermore, California, 1964, 46 p.

This study examines the water quality in flooded craters produced by nuclear explosions in detail. The paper discusses the life history of tritiated water which initially occupies the fall-back area of the crater that is flooded. Procedures of water management and crop plantings on the lip which controls the tritiated water in the lip area are discussed.

185. Kohler, M. A., Nordenson, T. J., and Baker, D. R., "Evaporation Maps for the United States," Technical Paper 37, U.S. Weather Bureau, 1959, 13 p.

186. Koranda, J. J., Martin, J. R., and Wikkerink, R. W., "Leaching of Radionuclides at Sedan Crater," in Radionuclides in the Environment, Advances in Chemistry Series, Number 93, American Chemical Society, 1155 16th Street, N.W., Washington, DC, 20036, 1970, pp. 97-117.

This distribution of tritium and long-lived gamma radioactivity was studied in crater ejecta from the Sedan Test. Tritium concentrations were determined in soil water extracted from crater ejecta samples taken from the surface to 6 feet, and distances of 3,000 feet from the crater from 1966-1968. Tritium distribution was modified by postshot environmental effects, especially by rainfall leaching. Maximum tritium concentrations were found below the strata in which they were deposited. Gamma radionuclides exhibited limited movement in the crater ejecta strata or in preshot soil covered by Sedan ejecta.

187. Koranda, J. J. and Martin, J. R., "The Persistence of Radionuclides at Sites of Nuclear Detonations," in (Shore, B., and Hatch, F.) Biological Implications of the Nuclear Age, Conf-69030, TIC, Oak Ridge, Tennessee, 37839, 1969, pp. 159-187.

A study of the persistence of radioisotopes at nuclear detonation sites is important for evaluating future engineering uses of nuclear explosions such as the excavation of canals and harbors. Information on the distribution of radioisotopes at detonation sites where earth has been moved to create craters or trenches was studied and the uptake of certain radioisotopes by plants and animals in the areas was examined. Sedan event data on tritium concentrations in crater fallback, crater soil water, tissue water of plants growing on ejecta are presented. Five years after the shot, tritium was found to be the most abundant radioisotope in ejecta or in any biological system in the area.

188. Kreiger, H. L., "The Measurement of Long-lived Activation Products in Soil by Gamma Spectroscopy," Health Physics II, 1965, pp. 653-658.

Soil samples collected at the site of the 1957 balloon-type tests in Nevada have been periodically analyzed to determine specific nuclides and to observe changes in spectrum configurations from decay of short-lived gamma activities. Repeated acid leaching removed only about 70 percent

of the activities of the nuclides present, indicating a strong attachment of certain nuclides to the soil.

189. Kruger, P., "Hydrologic Transport of Radionuclides from Nuclear Craters and Quarries," NCG-TR-30, Army Engineering Nuclear Cratering Group, Livermore, California, 1970, 123 p.

This report presents a review of the literature related to the development of numerical and experimental methods for prediction of the hydrologic transport of radionuclides with specific applications to nuclear excavation and quarrying. The report reviews the possibility of using radioactive and activable tracer methods for experimental study of hydrologic transport under field conditions.

190. Kunkel, F., "A Geohydrologic Reconnaissance of the Saratoga Spring Area, Death Valley National Monument, California," U.S. Geological Survey Open File Report, 1966, 27 p.

191. Kwawu, F. E. and Ching, C. T. K., "Economic Impact in the Pahrump Valley," Max C. Fleischmann College of Agriculture, University of Nevada, Reno, Nevada, 1978.

192. Lakeotes, C.D., and Friesen, H. N., "Hydrologic Data Bank Users Guide," NVO-1253-5, Desert Research Institute, University of Nevada, Reno, Nevada, 1974, 22 p.

The AEC/NV Hydrologic Data Storage and Retrieval System is composed of data files and computer programs for the manipulation of these files. This bulletin presents the names assigned to data files, outlines the file contents and documents the procedures for retrieving desired data.

193. Larson, J. D., "Water Resources Data Collected in the Devil's Hole Area, Nevada 1972-1973," Geological Survey Open File Report 74-330, U.S. Geological Survey, Federal Building, Carson City, Nevada, 89701, 1974, 14 p.

Data collected from July 1972 to June 1973 were used to observe the effects of groundwater withdrawals for irrigation on the water level in Devil's Hole and the flow from major springs in the Ash Meadows area. Recorders were used to monitor water levels in Devil's Hole, three observation wells, and flow from five springs. Power consumption was monitored at six irrigation wells to estimate the amount of water pumped. All data are summarized in tables and graphs.

194. Leap, D. I., Waddell, R. K., and Thordarson, W., "Hydrologic Data Base for Solute Transport Model of Nevada Test Site and Vicinity," U.S. Geological Survey, 1979, in press.

195. Leavitt, V. D., "Soil Surveys of Five Plutonium Contaminated Areas on the Test Range Complex in Nevada," NERE-LV-539-28, Environmental Monitoring and Support Laboratory, Environmental Protection Agency, Las Vegas, NV 89114, 1974, 84 p.

Soils in five areas located on the Test Range Complex, Nye County, Nevada, are described. All of the areas have at one time been sites of above ground safety tests. The areas are contaminated with plutonium and are therefore, the object of investigations regarding the movement of plutonium in the environment. Most surface soils have a gravelly texture and are typically classified as sandy loam. The majority of surveyed land is either floodplain or alluvial fan with deep soils having well-developed profiles and platy structure. Soils are alkaline with ph from 7.0 to 9.0.

196. Leavitt, V. D., "Soil Survey of Area 18, Nevada Test Site," SWRHL-74r, Environmental Monitoring and Support Laboratory, Environmental Protection Agency, Las Vegas, NV 89114, 1970, 119 p.

A soil survey of Area 18, in the northwest part of the Nevada Test Site, was undertaken to obtain information on the soil and vegetation being grazed by the USAEC beef herd. Twenty soil series descriptions, including both physical and chemical analyses, were written and included on soil maps of the area.

197. Leavitt, V. D. and Mason, B. J., "Soil Survey of Area 15, Nevada Test Site," SWRHL-106r, Environmental Monitoring and Support Laboratory, Environmental Protection Agency, Las Vegas, NV 89114, 1971, 46 p.

The results of a soil survey of the area around the Environmental Protection Agency Experimental Dairy Farm located in Area 15 of the Nevada Test Site are reported. Four soil series were identified. Descriptions of these series are included along with physical and chemical analyses of representative samples of the soils.

198. Levy, H. B., "On Evaluating the Hazard of Groundwater Contamination by Radioactivity from an Underground Explosion," Report UCRL-51278, Lawrence Livermore Laboratory, Livermore, California, 1972.

A general discussion of factors affecting the radioactive contamination of groundwater and transport of radioactivity through the groundwater system. Mathematical development of models gives approximate calculations for estimating transport rates.

199. Loeltz, O. J., "Source of Water Issuing from Springs in Ash Meadow Valley, Nye County, Nevada (abs)," Geological Society of America Bulletin, Volume 71, No. 12, Part 2, 1960, pp. 1,917-1,918.

An abstract of a paper submitted for the Geological Society of America meeting in Denver, Colorado, October 31, 1960. The author claims that the source of much of the spring discharge in Ash Meadows is precipitation on the west slope of the Spring Mountains.

200. Lohman, S. W., "Groundwater Hydraulics," USGS Professional Paper 708, U.S. Geological Survey, Denver, Colorado, 1972, 70 p.

This paper details all the principles of groundwater hydraulics which is concerned with the natural or induced movement of water through permeable rock formations. A brief review of the divisions of subsurface water and some of the fundamental properties of aquifers are given.

201. Longwell, C. R., Pampeyan, E. G., Bowyer, B., and Roberts, R. J., "Geology and Mineral Deposits of Clark County," Bulletin 62, Nevada Bureau of Mines, Reno, Nevada, 1965, 218 p.

This report describes the mineral resources of Clark County. The principal metallic resources include gold, silver, copper, and manganese, while the principal nonmetallic resources include gypsum, limestone, dolomite, silica sand, and sand and gravel. Most of the mineral resources noted in this report are not in the vicinity of the Nevada Test Site.

202. Love, J. D., and Hoover, L., "A Summary of the Geology of Sedimentary Basins of the United States with Reference to the Disposal of Radioactive Wastes," Geological Survey TEI-768, U.S. Geological Survey, Washington, DC, 1960, 89 p.

This report describes approximately 60 areas in the United States considered as potential waste disposal sites. Their location, gross geologic features, and material resources are summarized.

203. Lyle, D. A., "The Springs of Southern Nevada," American Naturalist, Volume 12, 1878, pp. 18-27.

204. Lynch, E. J., Davis, S. N., and Postle, G. L., "Transport of Radionuclides by Groundwater: Some Theoretical Aspects," HNS-1229-61, Hazelton-Nuclear Science Corp., Palo Alto, California, 1964.

This paper is a theoretical discussion of hydrology-related groundwater movement problems particularly as they pertain to fractured rock at the NTS.

205. Malmberg, G. T., "Hydrology of the Valley-Fill and Carbonate Rock Reservoirs, Pahrump Valley, Nevada-California," Geological Survey Water Supply Paper 1832, U.S. Geological Survey, Washington, DC, 1967, 47 p.

This is the second appraisal of the Pahrump Valley Water Supply. Estimated recharge is 22,000 acre-feet. After the development of wells, natural springs began to decline or go dry. Between 1959 and 1962, estimated storage depletion was 45,000 acre-feet. Water levels are dropping as water is being pumped, but the chemical quality is satisfactory for domestic use. Irrigation water recycling, in time, could deteriorate water quality.

206. Malmberg, G. T., and Eakin, T. E., "Groundwater Appraisal of Sacrobatus Flat and Oasis Valley, Nye and Esmeralda Counties, Nevada," Groundwater Resources, Reconn. Ser. Rept. 10, Nevada State Engineer, 1962, 39 p.

This report describes the groundwater recharge and discharge of Sacrobatus Flats and Oasis Valley. It is estimated that the annual recharge and discharge from Oasis Valley is on the order of 2,000 acre-feet. 250 ac/ft is derived from precipitation within the basin and 1,800 ac/ft from underflow from Gold Flat. Discharge from the valley is by evapotranspiration and underflow to the Amargosa Desert. Sacrobatus Flat gets its recharge from underflow from Stonewall and Gold Flats and precipitation. Discharge from Scarobatus Flat is through evapotranspiration and underflow and underflow out of the basin to Grapevine Canyon. This groundwater reservoir is on the order of 3,500 ac/ft annually.

207. Manger, G. E., "The Best Value of Porosity of Lapilli Tuff from the Nevada Test Site," Geological Survey Professional Paper 525-B, U.S. Geological Survey, Washington, DC, 1965, pp. B146-B150.

This report documents experiments done to determine the porosity of lapilli tuff from Nevada Test Site. Although this report is of marginal interest, it does indicate some of the problems in obtaining values of porosity for rock types found on the Nevada Test Site.

208. Manger, G. E., "Porosity and Bulk Density, Dry and Saturated, of Sedimentary Rocks," Geological Survey Open File Report TEI-820, U.S. Geological Survey, Washington, DC, 1962, 10 p.

This report gives the aspects of measurements of porosity and bulk density in dry and saturated sedimentary rocks. Tables with this data are given on stratigraphic units in various parts of the United States and a few foreign countries.

209. Maxey, G. B., "Hydrology of Desert Basins," 49017, Desert Research Institute, Water Resources Center, Reno, Nevada, September 1968, 13 p.

This report presents the idea that topographically high areas underlain by crystalline and highly indurated clastic rocks are well watered with many small springs and perennial streams. In cavernous carbonate terrains, the mountains are dry with few small springs near the base of the mountains and large springs in the valleys. This implies high water tables with marked groundwater divides corresponding to topographic divides and relatively flat water tables in carbonate terrains with groundwater divides not controlled by topography.

210. Maxey, G. B., "Hydrogeology of Desert Basins," Groundwater 6, 10-22, 1968.

A discussion of hydrologic systems is presented in this report. Hydrologic systems in arid lands normally include a recharge area in mountains and a discharge area in the lowlands often with an intermediate area of lateral flow between recharge and discharge areas. This system is often modified by local geologic climatic and physiographic factors. Most water-supply contamination and disposal problems arise from a combination of features superimposed on this system by concentrations of populations

and agricultural activity in the discharge areas. Most of the data are available from the lowlands. A conceptual model of optimal groundwater reservoir development illustrates how to determine optimum use of storage and perennial yield provided the use to which the water is to be put and the time of withdrawals are unknown.

211. Maxey, G. B. and Mifflin, M. D., "Occurrence and Movement of Groundwater in Carbonate Rock of Nevada," in Moore, G. W., ed., Limestone Hydrology-a Symposium with Discussion, Natl. Speleol. Soc. Bull., Volume 28, No. 3, 1966, pp. 141-157.

This report discusses the carbonate rocks that underlie large parts of eastern and southern Nevada that are important aquifers. Two general classifications of groundwater flow systems can be made: 1) local flow systems characterized by small drainage areas, short flow paths, extensive interbasin flow, large spring discharge fluctuations, and low temperature water with low concentrations of Na, K, Cl, and SO_4, and 2) regional flow systems with large drainage areas, long flow paths, common interbasin flow, steady spring discharge, and higher temperature water with higher concentrations of Na, K, Cl, and SO_4. This investigation includes hydrologic approaches such as water budget studies, water potential studies and water-chemistry studies.

212. Maxey, G. B., and Farvolden, R. N., "Hydrogeologic Factors in Problems of Contamination in Arid Lands," Groundwater, Volume 2, No. 4, 1965.

This report describes an ideal hydrologic system for arid lands with respect to water supply contamination and disposal problems. Suitability of hydrogeologic units for any function of operations involving water supply or waste disposal depends primarily on their position within the hydrologic system and secondarily on physical properties.

213. Maxey, G. B. and Jameson, C. H., "Geology and Water Resources of Las Vegas, Pahrump, and Indian Springs Valleys, Clark and Nye Counties, Nevada," Water Resources Bulletin 5, Nevada Department of Conservation and Natural Resources, Carson City, Nevada, 1948, 43 p.

This report describes the general nature of the three valleys, the geology and water bearing properties of the rock formations, the effects of geologic structures on the movement of groundwater, and a summary of the geologic history. It details the valleys' groundwater systems, such as water levels, recharge, discharge, and water quality.

214. Maxey, G. B. and Robinson, T. W., "Groundwater in Las Vegas, Pahrump, and Indian Springs Valleys, Nevada (a summary)," Water Resources Bulletin 6, Nevada Department of Conservation and Natural Resources, Carson City, Nevada, 1947, 23 p.

This summary gives a history of the use of the groundwater in the three valleys. It states the only source of groundwater for the valleys is from precipitation in the Spring and Sheep Mountains. Declines in the

groundwater levels have occurred in the Las Vegas Valley. Indian Springs Valley has little water level changes. Small declines have occurred in Pahrump Valley.

215. Maxey, G. B. and Jameson, C. H., "Well Data in Las Vegas and Indian Springs Valleys, Nevada," Water Resources Bulletin 4, Nevada Department of Conservation and Natural Resources, Carson City, Nevada, 1946.

This data report includes all available data on 570 wells in the Las Vegas Valley collected by the Geological Survey and the Office of the State Engineer as of 4/30/46. In addition, data on 15 wells in Indian Springs Valley are included. The data is organized in tables.

216. McGuinness, C. L., "The Role of Groundwater in the National Water Situation," Geological Survey GS-WSP-1800, U.S. Geological Survey, Washington, DC, 1963, 1,121 p.

This report outlines briefly the principles of water occurrence and describes the water situations as of 1960-61, with emphasis on the occurrence of groundwater and the status of development and accompanying problems. The United States is divided into ten major groundwater regions. The groundwater situation is also described on a state-to-state basis.

217. McKay, E. J., "Hydrothermal Alteration in the Calico Hills, Jackass Flats Quadrangle, Nevada Test Site," NTS-43, U.S. Geological Survey, Denver, Colorado, March 1963, 6 p.

The report presents the geology of the Calico Hills area. Geologic mapping of the Calico Hills has outlined areas of extensive hydrothermal alterations and areas of intrusive porphyritic rhyolites that indicate a large igneous body beneath the Calico Hills dome. Knowledge of this igneous body and collapsed structure in the area will be important in the interpretation of aeromagnetic and gravity data related to subsurface study.

218. Mehringer, P. J., Jr., and Warren, C. N., "Marsh, Dune and Archaeological Chronology, Ash Meadows, Amargosa Desert, Nevada, In: Holocene Environment Change in the Great Basin," R. Elson (ed.), Nevada Archaeol. Surv., Res. Pap. 6, 1976.

219. Mehringer, P. J., Jr., and Haynes, C. V., Jr., "Water Level Fluctuations, Devil's Hole, Nevada," Report-Desert Research Institute, University of Nevada System, Reno, Nevada, 1972, 12 p.

220. Mendenhall, W. C., "Some Desert Watering Places in Southeastern California and Southwestern Nevada," Water Supply Paper 224, U.S. Geological Survey, Washington, DC, 1909, 98 p.

This paper describes the physical features of the subject area, climate, water supply, hints of desert travel, main traveling routes, irrigation, and artesian waters, and a description of springs. Approximately 68,000

square miles are covered by the paper, including Death Valley, Amargosa Desert drainage area and other areas of interest.

221. Meyer, G. L. and Nork, W. E., "Preliminary Groundwater Contamination Evaluation - Radioactive Waste Disposal Pit at USPNS Experimental Farm, Area 15, Nevada Test Site," NVO-1229-150, Teledyne-Isotopes, Las Vegas, NV, August, 1970, 6 p.

A report regarding the feasibility of using an infiltration pit for the disposal of wastes at the EPA farm. It is concluded that the site located is satisfactory.

222. Meyer, G. L. and Smith, R. E., "Summary of Hydraulic Data, Quality of Water, and Lithologic Log for Army Well 1, Mercury Valley, Nye County, Nevada," Geological Survey Technical Letter NTS-71, U.S. Geological Survey, Denver, Colorado, 1964, 14 p.

This report summarizes construction data, hydrologic data, and a lithologic log as a result of deepening Army Well 1. Potential water supply and water levels and quality of water are included.

223. Meyer, G. L. and Young, R. A., "Summary of Hydraulic Data and Abridged Log for Groundwater Test Well 3, Frenchman Flat, Nevada Test Site, Nevada," Geological Survey Technical Letter - NTS-30, 1962, 6 p.

This technical letter summarizes the results of drilling groundwater test well 3, and presents a lithologic log, water sample analysis, construction information, and hydraulic data. The well is one of several drilled to explore the hydrologic conditions at the Nevada Test Site.

224. Mifflin, M. D., "Delineation of Groundwater Flow Systems in Nevada," Technical Report No. 4, Desert Research Institute, Reno, Nevada, 1968, 107 p.

This report presents available hydrologic and geologic information has been considered with flow systems theory in an attempt to delineate groundwater flow systems in Nevada. Definition of sink areas, source areas, and configuration of flow within the flow system has been the primary objective of the study. The one hundred thirty six recognized flow systems in Nevada have been separated into two groups based on configurations of flow. Presence, or absence of important interbasin flow has been used as a criterion.

225. Mifflin, M. D. and Wheat, M., "Pluvial Lakes and Estimated Pluvial Climates of Nevada," Bulletin 94, Nevada Bureau of Mines and Geology, Reno, Nevada, 1979, 57 p.

The objective of this study was to evaluate past pluvial paleoclimates of the Nevada portion of the Great Basin. The search for shoreline evidence has yielded recognition of 53 pluvial lakes of Lahontan Age. The authors feel the lakes would have been maintained if the average annual mean

temperature was 5°F lower than today and if the annual mean precipitation was 68 percent over modern precipitation.

226. Miller, G. A., "Appraisal of the Water Resources of Death Valley, California-Nevada," Geological Survey Open File Report 77-728, U.S. Geological Survey, Federal Building, Sacramento, California, 95825, 1977, 124 p.

The recharge and discharge of the hydrologic system of Death Valley is presented to be a steady state condition. Recharge to groundwater is from interbasin underflow and from local precipitation. Some of the water discharges from evapotranspiration. Typically, the water beneath the valley floor contains between 3,000 and 5,000 milligrams per liter of dissolved solids. Wastes from most of the springs and seeps in the mountains contains a few hundred to several hundred milligrams per liter of dissolved solids. Present sites in the valley used by man are supplied by springs, with the exception of Stove Pipe Wells hotel area.

227. Miller, R. R., Soltz, and Sanchez, D. L., "Fishes and Aquatic Resources of the Death Valley System, California-Nevada, 1878-1976," A Bibliography, U.S. Department of Interior, National Park Service, Western Region, San Francisco, California, 1977, 27 p.

A nonannotated bibliography with the primary subject being the desert pupfish. Some geologic and hydrologic references are cited.

228. Mockhus, V., "Use of Storm and Watershed Characteristics in Synthetic Hydrograph Analysis and Applications," U.S. Soil Conservation Service, Department of Agriculture, 1957.

229. Moench, R. H., "Structural Geology of the Southern Part of the Amargosa Desert and Vicinity," USGS-474-253, U.S. Geological Survey, Denver, Colorado, March, 1965, 21 p.

This report describes what is known and has been inferred about the distribution and structure of Precambrian and Paleozoic rock units in the area that is considered to be most critical with respect to interbasin groundwater flow from the NTS. This appears to be a critical piece of research in examining the groundwater in Ash Meadows and the Amargosa region.

230. Mooney, M., Langenbacher, W., Radtke, H., Miller, W., and Ching, C., "Pahrump Valley, Nevada, Resource Atlas," Max C. Fleischmann College of Agriculture, MS 68, University of Nevada, Reno, Nevada, 1980.

Data are presented to cover natural and human resources. It includes some discussion about the economic characteristics and the public services.

231. Moore, J. E., "Selected Logs and Drilling Records of Wells and Test Holes Drilled at the Nevada Test Site Prior to 1960," Geological Survey Open File Report TEI-804, U.S. Geological Survey, Washington, DC, 1962, 54 p.

This report is a compilation of lithologic logs, drillers logs, drilling records, and hydrologic data on 18 wells and test holes drilled in the NTS and surrounding area prior to 1960. All these holes except Gravity high 1 and 2 were drilled for hydrologic information.

232. Moore, J. E., "Records of Wells, Test Holes, and Springs in the Nevada Test Site and Surrounding Area," Geological Survey Open File Report TEI-781, U.S. Geological Survey, Washington, DC, 1961, 22 p.

This report discusses the wells, test holes, and springs of the NTS and surrounding area. Since November 1957, the U.S. Geological Survey has been collecting and compiling all available information on the source, occurrence, quality, quantity, temperature, and other aspects of the groundwater resources of the NTS and the surrounding area. This report summarizes the basic information that has been collected on 49 wells and test holes from this area along with information on 9 springs.

233. Moore, J.E., et al., "Groundwater Test Well 2, Nevada Test Site, Nye County, Nevada," Geological Survey Open File Report TEI-836, U.S. Geological Survey, Washington, DC, 1963, 73 p.

The report concludes that groundwater test well 2 was drilled to a depth of 3,422 feet. Water in the test well occurs in both tuff and carbonate rocks. The highest and lowest water levels were measured in the tuff and the carbonate rocks. Pump test data and a water quality analysis were recorded. The well was finished to develop water from the carbonate rock aquifer.

234. Moore, J.E. and Garber, M.S., "Groundwater Test Well B, Nevada Test Site, Nye County, Nevada," Geological Survey Open File Report TEI-808, U.S. Geological Survey, Washington, DC, 1962, 39 p.

This report describes the lithology penetrated by drilling and the aquifer characteristics. The purpose of this is to determine if the groundwater beneath the Test Site has become contaminated due to nuclear detonations and to observe groundwater hydrology of the Nevada Test Site, especially beneath Yucca Flat.

235. Moore, D. O., "Estimating Mean Runoff in Ungauged Semiarid Areas," Water Resources Bulletin 36, Nevada Department of Conservation and Natural Resources, Carson City, Nevada, 1968, pp. 36-39.

This paper describes a method of estimating runoff in ungauged, semiarid regions based on watershed elevation and a limited number of streamflow records under the requirement that the region is hydrologically homogeneous. Relations of this type are affected by local variations in geology, precipitation, land slopes and land use. Two methods for adjusting the base relations for these variations in both perennial and ephemeral streams are presented.

236. Moosburner, Otto, "Flood Investigations in Nevada Through 1977 Water Year," Geological Survey Open File Report 78-610, U.S. Geological Survey, Federal Building, Carson City, Nevada, 89701, 1978, 94 p.

237. Naff, R. L. "Hydrogeology of the Southern Part of the Amargosa Desert in Nevada," M. S. Thesis, University of Nevada, Reno, Nevada, 1973.

238. Naff, R. L., Maxey, G. B. and Kaufmann, R. F., "Interbasin Groundwater Flow in Southern Nevada," 49050, Desert Research Institute, Water Resources Center, Reno, Nevada, March 1974.

This report reviews current ideas on the sources of groundwater flow to the Amargosa Desert area. It is pointed out that little is known of the impact of thrust faults on groundwater occurrence and movement in the region. The Amargosa Desert is indicated to be a sink for three regional groundwater flow systems (Pahute Mesa, Ash Meadows, Pahrump) discharging about 2.89 x 10^7 m^3 year within the basin and 6.76 x 10^7 m^3 year as underflow to other areas.

239. Nelson, R. W., "A Sequence for Predicting Waste Transport by Groundwater," AEC Report BNWL-63, Battelle Northwest Laboratories, Richland, Washington, 1965, 12 p.

This paper describes a sequence for analyzing the effects of groundwater flow on waste transport in natural soils. The desired result is to predict accurately the concentration of wastes entering streams, rivers, or other potable waters. The sequence of the analysis is performed by three computer programs. The sequence logically falls into three broad categories: (1) determination of the flow system invariants in the region of interest, (2) prediction of the new groundwater potential distribution and (3) utilization of the new potential to enable waste transport predictions.

240. Nelson, R. W., and Reisenauer, A. E., "Application of Radioactive Tracers in Scientific Groundwater Hydrology," Radioisotopes in Hydrology, International Atomic Energy Agency, Vienna, 1963.

241. Nevin, R. L., et al., "Redistribution of Radiocontaminants by Surface Water Flows,: HNS-1229-46, Hazelton-Nuclear Science Corp., Palo Alto, California, 1964.

The purpose of this study was to investigate the processes of transport and accumulation of radioactive material, and to evaluate the capability for accurate hazard appraisals with present knowledge. It was concluded that widely distributed deposits of contaminated particulate material could be accumulated by the processes of erosion and sedimentation and create long-term continuing sources of contamination of water supplies.

242. Noble, L. F., "Structural Features of the Virgin Spring Area, Death Valley, California," Geological Society of America Bulletin, Vol. 52, No. 1, 1941, pp. 941-1,000.

243. Noble, L. F., "Rock Formations of Death Valley, California," Science, New, Ser. Vol. 80, 1934, pp. 173-178.

244. Noble, L. F., "Note on a Colemanite Deposit Near Shoshone, California, with a Sketch of the Geology of a Part of the Amargosa Valley," Geological Survey Bulletin 785-D, U.S. Geological Survey, Washington, DC, 1926, pp. 63-73.

245. Noble, L. F. and Mansfield, G. R., "Nitrate Deposits in the Amargosa Region, Southeastern California," Geological Survey Bulletin 724, U.S. Geological Survey, Washington, D.C., 1922, 99 p.

Nitrate deposits in the Amargosa region are blanket deposits that occur in a layer of caliche about 5-inches thick. The deposits lie about 9 inches below the surface. The soil above and the bedrock below have only small amounts of nitrates. The caliche averages less than 2.5 percent sodium nitrate. The available quantity of nitrate is small and production cost too high for commercial production of this nitrate deposit in the Amargosa region.

246. Noble, L. F., and Wright, L. A., "Geology of the Central and Southern Death Valley Region, California," in Jahns, R. H., ed., Geology of Southern California, California Division of Mines Bulletin 170, 1954, pp. 143-160.

This report describes rock types, structural elements, and topographic features of the central and southern portions of Death Valley. Hydrologic data are not discussed.

247. Noble, D. C., "Ground Water Leaching of Sodium From Quickly Cooled Volcanic Rocks (Abst.)," Amer. Mineralogist, 1965, Vol. 50, Nos. 1-2, p. 289.

A very brief discussion on the susceptibility of groundwater leaching of Na_2O from quick-cooled silicic volcanic rocks, K_2O usually is not leached, possibly because of the large size of the potassium ion.

248. Nork, W. E., "Groundwater Resources and the Safe Conduct of Underground Nuclear Testing," PaltR-1229-176, Teledyne-Isotopes, Palo Alto, California, 1968, 20 p.

This report is a study of radioactive migration in groundwater after an underground nuclear detonation occurs. The purpose of the study is to predict the migration history of the radionuclides in groundwater. Attention is paid to all known wells and springs located near or along the path of the radionuclide transport, and predictions are made of the time required to reach and flow past the wells and springs. When no wells exist along the flow path, predictions are less specific.

249. Nork, W. E., Forslow, E. J. and Essington, E. H, "Radioactivity in Water, Central Nevada Test Site Area," NVO-1229-175, Isotopes, Inc., Palo Alto, California, 1971.

Data are given on the radioactivity of preshot and postshot from eight well and spring sampling points. From April 1967 to December 1970, activity was monitored, and the distribution coefficient was measured on cores for ^{45}Cs + ^{85}Sr and ^{137}Cs using groundwater.

250. Nowlin, O. J., "A Groundwater Quality Monitoring Program for Nevada," Geological Survey Open-File Report 78-768, U.S. Geological Survey, Federal Building, Carson City, Nevada 89701, 1978, 170 p.

251. Oberlander, P. L., "Development of a Quasi Three-Dimensional Groundwater Model for a Portion of the Nevada Test Site," 45014, Desert Research Institute, Water Resources Center, Reno, Nevada, January 1979, 67 p.

Computer groundwater models do not account for water movement in the lateral extent normal to the model. An empirical correction matrix has been devised that will partially adjust a two-dimensional model for flow in the third dimension. In an isotopic and homogeneous medium, the correction matrix averages a 4.9 percent difference in potential values.

252. Ohl, J. P., "Bibliography of Reports by U.S. Geological Survey Personnel on the Nevada Test Site and Related Subjects, July 1, 1976, to June 30, 1977, with Author and Subject Indexes," Geological Survey, U.S. Geological Survey, Denver, Colorado, 1977, 26 p.

253. Ohl, J. P., "Bibliography of Published Reports by U.S. Geological Survey Personnel on the Geology and Hydrology of the Central Nevada Test Area, Nye County, Nevada, 1968-First Quarter-1973," Geological Survey, U.S. Geological Survey, Denver, Colorado, 1973, 11 p.

254. Ohl, J. P., "Bibliography of Published Reports by U.S. Geological Survey Personnel on the Geology and Hydrology of the Nevada Test Site," USGS-474-88, U.S. Geological Survey, Denver, Colorado, 1970, 64 p.

Listed in this unannotated bibliography are published reports on the geology and hydrology of the NTS by USGS scientists. Reports on related subjects made thru investigations at the NTS are also listed. The list is in alphabetic order by senior author's surname. A cross index of all junior authors is interalphabetized.

255. Orkild, P. P. and Jenkins, E. C., "Report of Exploration Progress, Pahute Mesa, Period July 31, 1966 - January 31, 1968," U.S. Geological Survey Report 474-239, 1970, 67 p.

This report contains lithologic logs for 80 exploratory emplacement and proposed drill holes on Pahute Mesa, Nevada Test Site. They show the rocks penetrated are Miocene age or younger. The deepest hole drilled, UE20f, bottomed at 13,686 feet in pre-Silent Canyon rocks.

256. Piper, A. M., "Potential Applications of Nuclear Explosives in Development and Management of Water Resources-Preliminary Canvass of the Groundwater Environment," U.S. Geological Survey TEI-873, 1968, 173 p.

This report is comprised of two parts. The first part seeks to canvass groundwater situations within the U.S. in which nuclear detonation appears potentially advantageous as a tool for water management. The second part examines the restrictions on practicable detonation, including: (1) the uncertainty in predicting geometry and dimensions of a rubble chimney; (2) intensity of ground motion and air blast which determine removal distance from a population center; (3) initial concentrations of radionuclides introduced into the groundwater; and (4) economic and legal considerations.

257. Piper, A. M., "Geologic, Hydrologic, and Thermal Features of the Sites: Operations Windstorm and Jangle, Project 1(8)a. Operation Jangle, Nevada Proving Grounds, October-November, 1975," WT-343, Geological Survey, Portland, Oregon, 1952, 67 p.

258. Piper, A. M. and Stead, F. W., "Potential Applications of Nuclear Explosions in Development and Management of Water Resources-Principles," Geological Survey Open File Report TEI-857, U.S. Geological Survey, Washington, DC, 1965, 128 p.

This appraisal seeks to determine if nuclear detonations offer advantages in the development and management of water resources. These advantages being changes which the detonations might produce in the natural environment of water, specifically by modifying stream channels, and the transmissibility of rock strata underground.

259. Pistrang, M. A. and Kunkel, F., "A Brief Geologic and Hydrologic Reconnaissance of the Furnance Creek Wash Area, Death Valley, National Monument, California," Geological Survey Water Supply Paper 1779-Y, U.S. Geological Survey, Washington, DC, 1964, 35 p.

This report describes a reconnaissance level survey of the groundwater in the Furnace Creek area of Death Valley. Spring locations, discharges and quality are tabulated, and a number of hypotheses regarding the source of this water are advanced.

260. Price, C. E., "'Granite' Exploration Hole, Area 15, Nevada Test Site, Nye County, Nevada-Interim Report, Part B, Hydrologic Data," U.S. Geological Survey Open File Report TEM-836B, 1960, 20 p.

Listed in this report are observations of fluid loss during drilling and measurements of water-level recovery after bailing. The decline after water injection indicates two zones in the granite that are more permeable than the rest of the rock. The hole is entirely above the regional water table. Circulation of air through the hole suggest fairly extensive unsaturated openings between 1,175 and 1,200 feet.

261. Price, C. E., and Thordarson, W., "Groundwater Test Well A, Nevada Test Site, Nye County, Nevada," A Summary of Lithologic Data, Aquifer Tests and Construction, Geological Survey Open-File Report TEI-800, U.S. Geological Survey, Washington, DC, 1961, 59 p.

This report records the work done at groundwater test well A, which is one of six wells that were put down especially to ascertain the direction and rate of groundwater movement beneath Yucca Flat. Included are descriptions of the drilling, casing, development, geophysical logging of the well, and the bailing and pump test results.

262. Quiring, R. F., "Climatological Data Nevada Test Site and Nuclear Rocket Development Station," Report ERLTM-ARL 7, U.S. Department of Commerce Environmental Science Services Administration, NTIS, Springfield, Virginia 22151, 1968, 177 p.

Climatological data for the Nevada Test Site and Nuclear Rocket Development Station were compiled. The data and analyses are presented as samples from substantially different togopgraphic environments to show the salient features of the seasonal and diurnal variation of the wind and temperature near ground level and aloft. An evaluation of precipitation data for a 20-station network on the test site and a 5-year Climatological Summary for the continuously manned Yucca Weather Station is included.

263. Quiring, R. F., "Annual Precipitation Amount as a Function of Elevation in Nevada South of 38 1/2 Degrees Latitude," U.S. Weather Bureau Research Station, Las Vegas, Nevada 1965, 14 p.

The purpose of this paper is to show that the area of Nevada south of latitude 38 1/2 degrees can be divided into two zones with an indefinite transition between them. Also presented is a relationship between annual precipitation and elevation for each zone.

264. Rammey, E. M., et al., "Some Characteristics of Soil and Perennial Vegetation in Northern Mojave Desert Areas of the Nevada Test Site," USAEC Report UCLA 12-916, NTIS, Springfield, Virginia 22151, 1973, 340 p.

Data were compiled from several interrelated projects conducted at the Nevada Test Site. This was part of a team effort to obtain more information on soil and plant relationships in the desert ecosystem in order to better understand the impact of nuclear testing on the environment. Results from the chemical and physical characterization of soil profiles at 79 study sites located in northern Mojave Desert areas of the Nevada Test Site are included.

265. Ramspott, L. D. and Howard, N. W., "Average Properties of Nuclear Test Areas and Media at the USERDA Nevada Test Site," UCRL-51948, Lawrence Livermore Laboratory, Livermore, California, 1975, 37 p.

The data on the physical properties of the NTS accumulated since underground testing began, have been stored in the Lawrence Livermore Laboratory K-Division Test Effects Data Bank. This report briefly describes the principal test areas (Yucca Flat, Pahute Mesa, and Rainier Mesa) and media (alluvium, tuff, granite and Paleozoic rocks) at the NTS. Background information is given on the data base and the various methods used to measure geophysical parameters at the NTS are described.

266. Rickard, W. H. and Murdock, J. R., "Soil Moisture and Temperature Survey of a Desert Vegetation Mosaic," Ecology, 44, 1963, pp. 821-844.

This report presents soil data for the Nevada Test Site between March 4 and May 9, 1960. Soil temperatures and moisture measurements were made in seven plant habitats on the Nevada Test Site. Soil moisture was determined by gravimetric sampling, and temperatures were measured using the sucrose inversion technique. Cooler soil temperatures were not always associated with an increase in elevation. In some cases, topographic positions and soil properties influenced soil temperatures and available soil moisture more strongly than did elevation changes.

267. Robie, R. A., "Thermodynamic Properties of Minerals," Geological Survey TEI-816, U.S. Geological Survey, Washington, DC, 1962, 31 p.

A group of tables listing the thermodynamic properties of many elements and minerals.

268. Robinson, B. P., and Beetem, W. A., "Quality of Water in Aquifers of the Amargosa Desert and Vicinity, Nevada," USGS-474-215, U.S. Geological Survey, Denver, Colorado, 1975, 64 p.

This report studies the groundwater quality of the Amargosa Desert. Springs in the area of the Amargosa Desert represent the groundwater discharge from the groundwater moving in a general southward direction from the Nevada Test Site. Identification of water derived from sources in the Amargosa Desert aids in determining the quantity of water moving through, as well as the rate of groundwater moving in, the aquifer system at the Nevada Test Site. Water analyses of the area are presented.

269. Robinson, B. P., Young, R. A., and Beetem, W. A., "Water Levels and Spring Discharges for Selected Wells and Springs in Nevada, 1966-1967," IR:NTS-5, U.S. Geological Survey, Denver, Colorado, 1969, 24 p.

270. Robinson, B. P., Thordarson, W. and Beetem, W. A., "Hydrologic and Chemical Data for Wells, Springs, and Streams in Central Nevada, Tps. 1-21N. and Rs. 41-57E," Geological Survey TEI-871, U.S. Geological Survey, Washington, DC, 1967, 61 p.

This study reveals information from published and unpublished geologic, hydrologic, and chemical-quality data for ground and surface water in central Nevada. Analyses reveal that precipitation is closely related to altitude: as altitude increases so does precipitation. Also found are

hardness of 120 ppm and TDS 500 ppm of surface and groundwater in the area. The streams in the valleys only flow in response to snowmelt and flash flood storms. The major uses of groundwater are for irrigation and stock-watering, with domestic use being the third highest.

271. Robinson, B. P. and Beetem, W. A., "Chemical Data on Water From Supply Wells, Nevada Test Site," Technical Letter NTS-104, U.S. Geological Survey, Denver, Colorado, 1965, 41 p. (For official use only.)

272. Robinson, T. W., et al, "Water Levels and Artesian Pressures in Wells in Las Vegas Valley and Other Valleys in Nevada, 1913-45," Nevada Water Resources Bulletin 3, Nevada Department of Conservation and Natural Resources, Carson City, Nevada, 1947, 77 p.

This bulletin presents a compiled lsisting of water levels found in wells for the periods that the measurements were made. Main emphasis is placed on the wells located in Clark County. The tables list the well location, the water level, and the date the measurement was made.

273. Roeske, R. H., "Methods for Estimating the Magnitude and Floods in Arizona," Reports No. ADOT-RS-15-121, Arizona Department of Transportation, Phoenix, Arizona, September 1978, 82 p.

A method for flood estimation is presented. Regression equations for estimating flood magnitudes at ungauged sites for recurrence intervals of 2, 5, 10, 25, 50, 100, and 500 years were developed for six flood frequency regions in Arizona. The regression equations apply to streams that are not affected significantly by regulation, diversion, or urbanization.

274. Rush, F. E., "Regional Groundwater Systems in the Nevada Test Site Area, Nye, Lincoln, and Clark Counties, Nevada," Water Resources-Reconnaissance Series Report 54, U.S. Geological Survey, Denver, Colorado 80225, 1971, 25 p.

This report covers 16 hydrographic areas between Tonopah and Las Vegas, Nevada, centering about at the Nevada Test Site. Three types of groundwater reservoirs are identified. Three regional interbasin groundwater flow systems have been identified; Ash Meadows, Pahute Mesa, and Sacrobatus Flat, including Cactus Flat. Groundwater in the Ash Meadows system flows generally southward to Ash Meadows to discharge at springs, by evapotranspiration, and possibly by subsurface outflow across a fault barrier to the south end of the Pahute Mesa system in the Amargosa Desert. The Pahute Mesa system flows generally southward to discharge largely by evapotranspiration in the Amargosa Desert. Groundwater is believed to flow southwestward from Cactus Flat to Sacrobatus Flat where it is largely discharged by evapotranspiration. Some of the water in the first two systems may move southwestward as underflow to Death Valley through the carbonate rocks of the Funeral Range. Estimated recharge and discharge of the systems are discussed. Because virtually all the groundwater discharge is by subsurface outflow at considerable depth,

most groundwater development probably will be from groundwater in storage.

275. Rush, F. E., "Index of Hydrographic Areas in Nevada," Water Resources Information Series Report 6, Nevada Division of Water Resources, 1968, 37 p.

276. Sass, J. H., et al, "Analysis of Thermal Data from Drill Holes Ue25a-3 and Ue25-1, Calico Hills and Yucca Mountain, Nevada Test Site," Geological Survey Open File Report 80-826, U.S. Geological Survey, Menlo Park, California, 1980, 25 p.

Thermal data from two sites 20 km apart indicate heat flow both within and below the upper 800 meters is affected by hydrothermal convection. For hole Ue25a-1, the apparent heat flow above the water table is 54 m Wm^{-2} (approx. 1.3 HFU). Below the water table, the temperature profile indicates upward and downward movement within the hole and possibly within the formation. Hole Ue25a-3, Calico Mountain, is characterized by conductive heat flux averaging 135 mW/m^2 to a depth of 700 meters below which water appears to be moving downward. Between 735 and 750 meters, the hole intersects a nearly vertical fault along which water seems to be moving vertically downward. Variation in conductive heat flow over a 20 km distance suggests the presence of a more deeply seated hydrothermal corrective system.

277. Schaeffer, J. R., "Climatology of Tonopah Test Range, 1967," USAEC Report SC-M-68-522, NTIS, Springfield, Virginia 22151, 1968, 74 p.

The climatology of the Tonopah Test Range is described by climatic summaries of temperature, relative humidity, station pressure, precipitation and surface winds during 1967; summaries of the same elements based on seven-year averages covering the years 1961-1967; and summaries of upper winds based on the years 1961-1967.

278. Schamberger, H. A., "Activities of Agencies Concerned with Water and Related Resources of Nevada," Desert Research Institute, University of Nevada, Reno, Nevada, 1969, 123 p.

This report lists state agencies, federal agencies, and nonstatutory agencies related to Water Resources in Nevada. The activities and responsibilities of each of the agencies are given with a list of key personnel within the organization.

279. Schoff, S. L. and Moore, J. E., "Sodium as a Clue to Direction of Groundwater Movement, Nevada Test Site," Geological Survey Professional Paper 600-D, U.S. Geological Survey, Washington, DC, 1968, pp. D30-D33.

Sodium is the predominant cation in groundwater in volcanic aquifiers at the Nevada Test Site, but is nearly lacking in alluvial and carbonate aquifers in the Indian Springs Valley. The low sodium in the water of Indian Springs Valley shows that water has not migrated into the valley from the Nevada Test Site.

280. Schoff, S. L. and Moore, J. E., "Chemistry and Movement of Groundwater, Nevada Test Site," Geological Survey Open-File Report TEI-838, U.S. Geological Survey Washington, DC, 1964, 75 p.

On the basis of a study of groundwater chemistry, the authors conclude that the groundwater of the Nevada Test Site is moving into the Amargosa Desert but not into Indian Springs Valley. Only a fraction of the water reaching the Amargosa Desert is from the Test Site. Large contributions appear to be coming from the Spring Mountains and localities to the northwest.

281. Schoff, S. L, and Winograd, I. J., "Potential Aquifers in Carbonate Rocks, Nevada Test Site, Nevada," In Short Paper in Geology and Hydrology, Geological Survey Professional Paper 450-C, Art. 105, U.S. Geological Survey, Washington, DC, 1962, pp. C111-C113.

This report describes a pump test of a drill hole which penetrated the carbonate aquifer in Yucca Flat at the Nevada Test Site. This test yields some data regarding the permeability of this aquifer which underlies the Nevada Test Site and extends to at least Ash Meadows.

282. Schoff, S. L., and Winograd, I. J., "Hydrologic Significance of Six Core Holes in Carbonate Rocks of the Nevada Test Site," Geological Survey Open File Report TEI-787, U.S. Geological Survey, Washington, DC, 1961, 97 p.

This report summarizes the results from six core holes drilled into the carbonate rocks of the northern part of the NTS so far as they relate to groundwater hydrology. The report addressed the question as to whether the rocks contained any groundwater. It also explored the possibility that the carbonate rocks, if saturated, would be capable of transmitting large quantities of water to wells.

283. Schroder, L. J., "Determination of Tritium in Water," USGS-474-134, U.S. Geological Survey, Denver, Colorado, 1971, 22 p.

The USGS in Denver, Colorado, assays tritium concentrations of water using liquid scintillation techniques. 600 to 800 samples a year, with a detection level ranging from 150 to 400 tritium units, are analyzed. The methods and procedures used to analyze natural waters for tritium activity are described.

284. Schroder, L. J., Beetem, W. A. and Villasana, E., "Radiochemical Analyses of Water from Wells, Springs and Streams in Central Nevada," Geological Survey 474-97, U.S. Geological Survey, Denver, Colorado, 1971, 24 p.

This report presents the radiochemical data from the central Nevada study area, which included analyses of water samples for tritium, gross alpha and gross beta.

285. Schroder, M. C. and Jennings, A. R., "Laboratory Studies of the Radioactive Aquifers," UCRL-13074, University of California, Lawrence Radiation Laboratory, Livermore, California, 1963.

286. Scott, B. R., et al, "Nevada's Water Resources," Nevada Planning Report 3, 1971, 87 p.

287. Sharp, J. V. A., "Groundwater Contamination from Contained Underground Nuclear Explosions in Water-Saturated Media," Transactions of American Geophysical Union, Vol. 45, No. 1, March 1964.

288. Slitcher, C. S., "The Motions of Underground Waters," Water-Supply and Irrigation Papers, No. 67, U.S. Geological Survey, Washington, DC, 1902.

This paper describes the origin and extent of underground waters, surface zones of flow of groundwater and deep zones of flow of groundwater. The methods of getting these waters to the surface is also described. Asrtesian systems are also discussed.

289. Smith, R. E. and Doyle, A. C., "Summary of Hydraulic Data and Abridged Log for Groundwater Test Well 4, Indian Springs Valley, Clark County, Nevada," Geological Survey TL:NTS-36, U.S. Geological Survey, Denver, Colorado, 1962, 9 p.

This technical letter summarizes the results of drilling groundwater test well 4. The well is one of several drilled to explore hydrologic and geologic conditions in and around the NTS. Pump test results and a water sample analysis are included.

290. Snyder, C. T., "A Hydrologic Classification of Valleys in the Great Basin, Western United States," International Assoc. Sci. Hydrology Bulletin, Vol. 7, No. 3, 1962, pp. 53-59.

291. Sokol, D., "Radiohydrologic Surveillance Program at the Nevada Test Site," Teledyne-Isotopes, Las Vegas, Nevada, October 1968.

292. Stark, N., "Distillation-Condensation of Water and Nutrient Movement in a Desert Ecosystem," U.S. International Biological Program, Research Memo, RM 73-44, 1972 Progress Report, May 1973, 24 p.

The importance of distillation-condensation in the soil as a water and nutrient source for desert plants was studied. The study concentrated on Larrea Divaricata, Franseria Dumosa, and Atriplex Confertifolia vegetation on rocky, gravelly soils in Death Valley. Soils immediately beneath shrubs displayed a higher permeability than soils of shrub interspaces, despite a raised mound of soil at the base of each shrub. It is hypothesized that in addition to throughfall and stemflow, water supply is enhanced by microwatershed attributes of the surrounding soil surfaces. Variation in soil chemistry beneath the three species of shrubs is derived from pH values, water-holding capacity, cation exchange capacity, elemental content. The data suggest that the plant roots modify their

immediate chemical environment to increase nutrient concentrations and decrease potential toxicities. Methodology was inadequate to measure the quantity or quality of condensation water.

293. Stark, N., "Water Balance of Some Warm-Desert Plants in a Wet Year," Journal of Hydrology, Vol. 10, No. 2, University of Nevada, Reno, Nevada, February 1970, pp. 223-226.

Studies of the water balance on a hectare of gravelly wash in northern Death Valley showed that in an exceptionally wet year, the plants can obtain moisture from free soil water and the condensation of soil water vapor in March. In May, with higher soil temperature extremes, distillation and condensation in the 20 to 40 cm soil zone provided more than enough water to make up for the water loss from evapotranspiration. By June, the rate of water loss and other physiological processes were greatly decreased. Distillation and condensation in June did adequately supply transpiration water loss during a cloudy, cool period. Transpiration of the four dominant species based on grams of water lost per gram of dry weight varied from March through June by species. Internal water stress correlated closely with transpiration rates. Diurnal increase in internal moisture stress generally followed the decrease in transpiration rate in June. From March 10 through June 10, input was 2.6 G/SQ cm, evapotranspiration was 4.0 G/SQ cm, and soil moisture loss was 1.0 G/SQ cm. The difference between soil moisture loss and evapotranspiration losses was 0.4 G/SQ cm which is the result of measuring soil moisture outside of the root zone instead of within the root zone.

294. Stead,. F. W., "Groundwater Contamination. Peaceful Uses of Nuclear Explosives," University of Arizona Press, Tucson, Arizona, 1970, pp. 205-220.

A general description of the problem of groundwater contamination from underground nuclear explosives is presented. A brief discussion along with sample calculations is given on source terms and significant radionuclides and their movement in groundwater.

295. Stead, F. W., "Distribution in Groundwater of Radionuclides From Underground Nuclear Explosions," in Engineering with Nuclear Explosives, Third Plowshare Symposium Proc., April 21-23, 1964, U.S. Atomic Energy Comm. TID-7695, 1964, pp. 127-138.

This report describes the possibility of radionuclides entering into and moving with the groundwater in relation to the Plowshare Program. No postexplosion movement of radionuclides can, as yet, be demonstrated; however, waste disposal operations indicate that they can be transported considerable distances by groundwater flow.

296. Stead, F. W., "Tritium Distribution in Groundwater Around Large Underground Fusion Explosions," Science, Vol. 142, NO. 3596, 1963, pp. 1163-1165.

Tritium is released from underground nuclear fusion explosions in the Plowshare program. Tritium could become concentrated in nearby groundwaters, and as a possible contaminant, could be as important as long-lived fission products and induced radionuclides. The point is made that cratering explosions in dense rocks will result in greater tritium concentrations in groundwater than from explosions in less dense rocks.

297. Stearns, N. E., Stearns, H. T., and Waring, G. A., "Thermal Springs in the United States," Geological Survey Water Supply Paper 679-B, U.S. Geological Survey, Washington, DC, 1937, pp. 59-206.

298. Stidd, C. K., "The Use of Eigenvectors for Climatic Estimates," Preprint Series No. 36, Desert Research Institute, Reno, Nevada, July 1966, 27 p.

This report discusses an eigenvector method for estimating mean monthly precipitation at any point in Nevada. It is claimed that this method of interpolation is superior to the method of orthogonal polynomials and further that the first three eigenvectors account for 93 percent of the variance in the raw data. It is noted that the effect of station elevation is also considered. It is concluded that this method yields as reliable an estimate of the monthly average precipitation as could be obtained from an actual ten-year record.

299. Strausberg, S. I., "Estimating Distances to Hydrologic Boundaries from Discharging Well Data - Nevada Test Site," Hazelton-Nuclear Science Corporation, Palo Alto, California, May 1966, 8 p.

Estimates can be made of the distances to hydrologic boundaries by using water level measurements from pumping wells and by assuming in each case the possible range of the coefficient of storage. In a case where no boundary has been felt, the aerial extent or volume of rock affecting the drawdown pattern of a well can be estimated by assuming that a hypothetical boundary is just about to be felt at the time pumping stopped.

300. Thordarson, W. "Perched Groundwater in Zeolitized-Bedded Tuff, Rainier Mesa and Vicinity, Nevada Test Site," Geological Survey Open File Report TEI-862, U.S. Geological Survey, Washington, DC, 1965, 90 p.

This report describes occurrence, movement, and discharge of perched groundwater in tuffaceous rock that cap and underlie Rainier Mesa. Zeolitized tuff at the base of mesa, 183-244 m thick, controls recharge rate to paleozoic rocks. The fracture transmissivity is less than 10-100 gpd/ft and the interstitial permeability is less than .005 gpd/ft^2 and limits movement of waters. The only moving water is in fault zones near the top of zeolitized tuff. The vertical hydraulic gradient is .3-1.0 ft/ft.

301. Thordarson, W., "Occurrence, Movement and Discharge of Perched Groundwater in Bedded Tuff of the Oak Spring Group, Rainier Mesa and Vicinity, Nevada Test Site, Nye County, Nevada," U.S. Geological Survey TEI (in preparation), U.S. Geological Survey, Denver, Colorado, 1965.

302. Thordarson, W., and Robinson, B. P., "Wells and Springs in California and Nevada within 100 miles of the Point 37° 15'N, 116° 25'W on Nevada Test Site," USGS-474-85, U.S. Geological Survey, Denver, Colorado, 1971, 178 p.

This report furnishes available data on water wells and springs within a 100 mile radius of a specific location at the NTS. The well data provided includes well location, well depth, drilling data, major aquifer, land surface data, water level, yield, ownership, water use, and well use. The spring data includes location, name, aquifer, altitude, discharge, and water use.

303. Thordarson, W., Young, R. A., and Winograd, I. J., "Records of Wells and Test Holes in the Nevada Test Site and Vicinity (through December 1966)," Geological Survey Open File Report TEI-872, U.S. Geological Survey, Washington, DC, 1967, 26 p.

This report summarizes the hydrogeologic and construction data obtained from 119 test holes, wells, and emplacement holes at the NTS (through 1966). References to published reports for selected holes are noted. The report has value only to aid in detailed examination of the USGS hydrologic story for the Nevada Test Site.

304. Thordarson, W., Garber, M. S. and Walker, G. E., "Groundwater Test Well D, Nevada Test Site, Nye County, Nevada," Geological Survey Open File Report TEI-803, U.S. Geological Survey, Washington, DC, 1962, 58 p.

The report states that groundwater test well D is one of six wells that were drilled to find the direction and rate of groundwater movement beneath Yucca Flat. This test well was drilled to provide information on the possibility that the groundwater beneath the NTS, possibly contaminated by nuclear detonations, may carry radioactive fission products. A suite of geophysical logs, drilling operations, and aquifer tests are included.

305. Troxell, H. C. and Hofmann, W., "Hydrology of the Mohave Desert," in Jahns, R. H. ed., Geology of Southern California, California Division of Mines Bulletin 170, 1954, pp. 13-17.

This article discusses briefly the climate, precipitation extremes, runoff, groundwater, and water utilization in the California portion of the Mohave Desert.

306. Walker, G. E., "Groundwater in the Climax Stock, Nevada Test Site, Nye County, Nevada," Geological Survey Open File Report TEI-813, U.S. Geological Survey, Washington, DC, 1962, 48 p.

The Climax Stock is a granitic intrusive exposed in an area of about 1 square mile at the north end of Yucca Flat, near the northern boundary of the NTS. The AEC had test holes drilled in the rock to depths ranging from 705 to 2,001 feet. The evidence shows that groundwater is present

but only locally in isolated bodies or pockets where the rock is highly fractured. The report concluded it is unlikely that a dependable water supply could be developed by means of wells in the stock.

307. Walker, G. E. and Eakin, T. E., "Geology and Groundwater of the Amargosa Desert, Nevada-California," Reconnaissance Series Report No. 14, Nevada Department of Conservation and Natural Resources, Carson City, Nevada, 1963, 45 p.

This report covers the groundwater resources of the Amargosa Desert and considers the problem of the movement of water from areas beyond the surficial boundaries of the area. It concludes that only a small part of the groundwater is derived from the precipitation which falls on the land surface within the area; the majority of groundwater is a contribution from other areas and arrives by movement through underlying carbonate rocks. The report also covers pumping of wells and analyses of 28 samples of wells and springs in the area.

308. Waring, G. A., "Groundwater in Pahrump, Mesquite, and Ivanpah Valleys, Nevada and California," Water Supply Paper 450-C, U.S. Geological Survey, Washington, DC, 1921, pp 51-86.

This paper discusses the groundwater in the three valleys. Included in the discussion are springs, water table, quality of water, and irrigation. A listing of the springs and wells of the valleys is given.

309. Waring, G. A., "Springs of California," U.S. Geological Survey Water Supply Paper 338:1-410, 1915.

This paper discusses all of the spring locations in California. The paper states there are relatively few springs in the Mohave Desert and Death Valley that are worthy of noting, but their scarcity give them peculiar value. A listing of springs is given by county.

310. Webster, D. S., et al. "Two-Well Tracer Test in Fractured Crystalline Rock," Water Supply Paper 1544-I, U.S. Geological Survey, Washington, DC, 1970.

This paper is a report on the analysis of a two-year tracer test in which a pulse injection of tritium was made to move from an injection well to a pumping well. The results of the test agree with computations based on the assumption that flow was through a homogeneous medium consisting of numerous intersecting fractures.

311. Weedfall, R. O., "An Approach to the Development of Isohyetal Maps for the Nevada and California Deserts," U.S. Weather Bureau Research Station, Las Vegas, Nevada, 1963, 17 p.

The purpose of this study was to prepare seasonal isohyetal maps of the NTS and vicinity for hydrological use. Maps for five summer and seven winter months were prepared. The method used obtained normal rainfall

totals to construct the maps, except that summer months data for as many years as possible were averaged to determine a station's normal precipitation. This eliminated the effects of any large cloudbursts or unusually heavy storms.

312. Weir, J. E., Jr., and Hodson, J. N., "Geohydrology of the Hole UE-17a, Syncline Ridge Area, Nevada Test Site," Geological Survey-1543-4, U.S. Geological Survey, Denver, Colorado, 1979, 18 p.

This report covers the geohydrology of hole UE-17a as a possible repository for nuclear waste. The stratigraphy, occurrence of groundwater, static water level, and results of brief jetting tests are included in this document.

313. West, L. R., and Thordarson, W., "Summary of Hydraulic Data, Water Chemistry and Abridged Lithologic Log of Groundwater Test Well 8, Nye County, Nevada," Technical Letter NTS-47, 1963.

This technical letter summarizes the results of drilling groundwater test well 8, and presents a lithologic log, water sample analysis, construction information and hydraulic data. The well is one of several drilled to explore the hydrologic condition at the NTS.

314. West, L. R. and Garber, M.S., "Summary of Hydraulic Tests and Abridged Lithologic Log for Groundwater Test Well 5, Nye County, Nevada," Geological Survey TL:NTS-34, U.S. Geological Survey, Denver, Colorado, 1962, 7 p.

This letter summarizes the data obtained from drilling groundwater test well 5. Test well 5 is one of several wells drilled to explore hydrologic and geologic conditions at the NTS.

315. West, S. W. and Grover, D. B., "Hydrologic Considerations," Technical Discussions of Off-site Safety Programs for Underground Nuclear Detonations, U.S. Atomic Energy Commission, Washington, DC, 1969, p. 61-67.

A general description of hydrology and hydrochemical data at Nevada Test Site is given. Most of the groundwater flow at the NTS is in limestone and dolomite at .006-.6m/day. Discharge areas are given; 400 years is estimated as time necessary to reach them. There is some conjecture that flow may be locally high beneath Specter Range south of the NTS. Calculations at Pahute Mesa indicate a velocity of 15-760 m/year. The rate beneath Yucca Flat is 21.3 m/year based on 13_C and 14_C analyses. Central Nevada data are also given. Description of current USGS special studies include (1) effect of explosions on fluid pressure in aquifers, (2) permanent effects of explosions on hydraulic characteristics, etc., (3) tracer studies to define movement in central Nevada.

316. Westsik, J. H., Jr., and Turcotte, R. P., "Hydrothermal Reactions of Nuclear Waste Solids, A Preliminary Study," PNL-2759, Battelle Northwest, Richland, Washington, 1978, 31 p.

Pacific Northwest Laboratory has been studying the reaction of high-level waste glass in aqueous solutions at high temperatures. This document presents the results of initial studies of these hydrothermal glass reactions and a limited evaluation of supercalcine and other materials. The study concludes that virtually all solid materials show hydrothermal reactivity at temperatures between 250 and 350°C and that these extreme conditions are not desirable.

317. White, A. F., "Geochemistry of Groundwater Associated with Tuffaceous Rocks, Oasis Valley, Nevada: Hydrology of Nuclear Test Sites," Geological Survey GS-P-712E, U.S. Geological Survey, Washington, DC, 1979, 25 p.

This paper describes two principal aquifers. Regional similarities and trends in water chemistry indicate most of the recharge entering the Oasis Valley groundwater system is probably the result of groundwater inflow from Pahute Mesa, Gold Flat, and other areas to the north and east. Calculations show that about half the water recharged to Oasis Valley discharges through evapotranspiration and the rest by flow through alluvium southward toward the Amargosa Desert.

318. White, A. F., et al., "The Effect of Dissolution of Volcanic Glass on the Water Chemistry in a Tuffaceous Aquifer, Rainier Mesa, Nevada," Geological Survey GS-WSP-15350, U.S. Geological Survey, Reston, Virginia, 1980, 34 p.

The report describes the geochemistry of groundwater associated with the Tertiary tuffs within Rainier Mesa. Experimental results indicate glass dissolution is incongruent with the preferential release of sodium, calcium, and magnesium and the retention of potassium. Glass dissolution can be inferred as the controlling factor in determining water quality in many aquifer systems associated with tuffaceous rock in the western United States.

319. White, M. G. and Dunaway, P. B., "Studies of Environmental Plutonium and Other Transuranics in Desert Ecosystems," U.S. ERDA, NVO-159, NTIS, Springfield, Virginia.

320. White, R. M., "Annotated Bibliography of Weather Bureau Publications of Hydrometeorological Interest," Weather Bureau, Washington, DC, March 1965.

321. Wilmarth, V. R., et al., "A Summary Interpretation of Geologic, Hydrologic, and Geophysical Data for Yucca Valley, Nevada Test Site, Nye County, Nevada," TEI-358, U.S. Geological Survey, Washington, DC, January, 1959, 53 p.

The report summarizes an interpretation of the geology of Yucca Valley to depths of 2,300 feet below the surface, the characteristic features of groundwater in Yucca and Frenchman Valleys, and the seismic, gravity, and magnetic data for these valleys.

322. Winograd, I. J., "Radioactive Waste Storage in the Arid Zone," 55:884-894, EOS Transactions of the American Geophysical Union, 1974.

The pros and cons for use of thick unsaturated zones as repositories for solidified high-level wastes are discussed. Comparisons are made to high-level waste disposal in bedded salt deposits and deep caverns. The advantages of unsaturated zone storage include the potential for radioactive removal represented by arid zone soils and sediments.

323. Winograd, I. J., "Origin of Major Springs in the Amargosa Desert of Nevada and Death Valley of California," Ph.D. Dissertation, University of Arizona, Tucson, 1971, 170 p.

324. Winograd, I. J., "Noninstrumental Factors Affecting Measurement of Static Water Level in Deeply Buried Aquifers and Aquitards, Nevada Test Site," Groundwater, V. 8, No. 2, 1970, pp. 19-28.

This paper outlines the major problems affecting the measurement of static water levels of deeply buried aquifers and aquitards at the NTS. To obtain static water levels in deep wells at the test site, a variety of factors must be evaluated including drilling methods, density of drilling fluid, depth of hole at time of measurement, and hole deviation.

325. Winograd, I. J., "Pumping Test Data for Selected Wells, Nevada Test Site and Vicinity," Technical Letter NTS-116, U.S. Geological Survey, Washington, DC, April 1965. (For official use only.)

326. Winograd, I. J., "A Summary of the Groundwater Hydrology of the Area Between the Las Vegas Valley and the Amargosa Desert, Nevada, with Special Reference to the Effects of Possible New Withdrawals of Groundwater," September and October, Geological Survey Open File Report TEI-840, U.S. Geological Survey, Washington, DC, 1963, 79 p.

This report discusses potential townsites in three general areas, Indian Springs Valley, Amargosa Desert, and Pahrump Valley to facilitate operations at the Nevada Test Site. It describes the groundwater basins and the movements of groundwater that is supplying the water resource to the mentioned three general areas.

327. Winograd, I. J., "Availability and Permanence of a Groundwater Supply at the Proposed Townsite, Clark County, Nevada," Geological Survey TL:NTS-32, U.S. Geological Survey, Denver, Colorado, 1962, 11 p.

This letter discusses the occurrence of groundwater near a proposed townsite adjacent to U.S. Highway 95 in Clark County near the Nye County border. It discusses the quality, quantity, and number of wells needed to support a population of 10,000.

328. Winograd, I. J., "Interbasin Movement of Groundwater at the Nevada Test Site, Nevada," in Short Papers in Geology and Hydrology, Geological Survey Professional Paper 450-C, U.S. Geological Survey, Washington, DC, 1962, pp C108-C111.

This report hypothesizes that the carbonate aquifers underlying Yucca Flat, Frenchman Flat, and Jackass Flats are hydraulically connected through fracture of the carbonate rock. The report further suggests that at least some portion of the water discharged at Ash Meadows originates on the Nevada Test Site. The author recommends additional studies of this aquifer before radioactive wastes are stored in a repository at the Nevada Test Site.

329. Winograd, I. J. and Doty, G. C., "Paleohydrology of the Southern Great Basin, with Special Reference to Water Table Fluctuations Beneath the Nevada Test Site During the Late (?) Pleistocene," Geological Survey Open File Report 80-569, U.S. Geological Survey, Reston, Virginia, 1980, 91 p.

This report discusses the magnitude of the water table rise during the Pleistocene pluvial climates and the resultant shortening of the groundwater flow path and reduction in unsaturated zone thickness. The emphasis of this report is on the carbonate aquifer which underlies both the Nevada Test Site and the Ash Meadows area. The authors conclude that neither the cited rise in potentiometric level in this regional carbonate aquifer nor the shortened flow path during the Late (?) Pleistocene period preclude the utilization of the NTS as a repository for high-level or TRU wastes. It is noted that this work does not necessarily apply to the water table use within the Cenozoic aquifers of Frenchman, Yucca, Jackass Flats, or other valleys.

330. Winograd, I. J. and Pearson, F. J., Jr., "Major Carbon-14 Anomaly in a Regional Carbonate Aquifer: Possible Evidence for Megascale Channeling, Southern Great Basin," Water Resources Research, Vol. 12, No. 6, 1976, pp. 1125-1143.

331. Winograd, I. J. and Thordarson, W., "Hydrogeologic and Hydrochemical Framework, South-Central Great Basin, Nevada-California, with Special Reference to the Nevada Test Site," Geological Survey Professional Paper 712-C, U.S. Geological Survey, Washington, DC, 1975.

The purpose of this investigation was to (1) define the character and distribution of the major aquifers and aquitards, (2) identify and describe the principal areas of recharge to and discharge from the major aquifers, and (3) determine the rate and direction of groundwater movement within the aquifers and aquitards. Also evaluated was the rate of movement of various radionuclides from the vicinity of an underground nuclear detonation.

332. Winograd, I. J. and Friedman, I., "Deuterium as a Tracer of Regional Groundwater Flow, Southern Great Basin, Nevada-California," Geological Society of America Bulletin, Volume 83, No. 12, 1972, pp. 3691-3708.

Source area interpretations are given for water discharging from several major spring groups in southern Nevada. Samples collected from one recharge area and four discharge areas are given. An assumption for the use of deuterium is that its content remains constant during its residence time in the aquifer of interest. The date indicates that Ash Meadows springs are fed by a mixture of recharge derived from the Spring Mountains-Sheep Range uplands, 30 to 60 miles to the east, with underflow from Pahranagat Valley and vicinity 90 miles to the northeast. These suggested sources for Ash Meadows spring are in agreement with other studies conducted in the area.

333. Winograd, I. J., Thordarson, W. and Young, R. A., "Hydrology of the Nevada Test Site and Vicinity, Southeastern Nevada," U.S. Geological Survey, Denver, Colorado, August 1971, 429 p.

The occurrence and movement of groundwater in the NTS area is exhaustively described. Water chemistry data are presented and variations in water chemistry are interpreted as resulting from the influence of groundwater flow patterns. Groundwater flow velocity estimates are given for many NTS area locations. Transmissivity data are listed.

334. Winograd, I. J. and Thordarson, W., "Structural Control of Groundwater Movement in Miogeosynclinal Rocks of South-Central Nevada," in Eckel, E. B., ed., Nevada Test Site, Geological Society of America, Mem. 110, 1968, pp. 35-48.

This report describes these structural features at the Nevada Test Site and vicinity. Regional interbasin movement of groundwater in deformed miogeosynclinal carbonate rocks of eastern Great Basin has received attention in the literature since 1960. These regional carbonate aquifer systems, some of which may integrate as many as 13 intermontane basins, are compartmentalized by major structural features.

335. Winograd, I. J. and West, L. R., "Development of a Groundwater Supply Adjacent to U.S. Highway 95 Between Cactus Springs and Lathrop Wells, Clark and Nye Counties, Nevada - A summary Interpretation of Hydrologic Data and Some Recommendations," Geological Survey TL:NTS-26, U.S. Geological Survey, Denver, Colorado, 1962, 21 p.

The report represents a summation and interpretation of information bearing on the occurrence of aquifers, the depth to, and quality of the groundwater. Hydrologic analysis is reported only insofar as it bears on the exploration for groundwater.

336. Wise, J. D., "Pahrump Field Laboratory," Nevada Ranch and Home Review, Nevada Agricultural Experiment Station, Spring-Summer 1969, Vol. 4, No. 5, University of Nevada, Reno, Nevada, pp. 6-7.

The Pahrump Field Laboratory of the Nevada Agricultural Experiment Station was established to help solve agricultural problems in southern Nevada. Seventeen and one-half acres are for agricultural experiments,

and about 8 acres include a reservoir, tailing pond, roads, and farmstead. Local problems concerning irrigation, crop varieties, and new crops will be investigated. New land development, sodic soil reclamation by soil amendment, planting rates, plant species, cultivation practices, and weed control will be studied in field experiments. A superintendent technician, and 2 part-time horticulturists comprise the staff. There are 2 irrigation wells, and a 3-acre-foot reservoir, which supply over 1,200 gallons per minute through 3,500 feet of irrigation pipe. Five photographs show cotton and sorghum trials, the laboratory reservoir, climatological instrumentation, and furrow irrigation.

337. Woessner, W. W., "Reconnaissance Evaluation of Water Quality-Salinity Loading Relationships of Intermittent Flow Events in a Desert Environment, Las Vegas, Nevada," Water Resources Center, Desert Research Institute, Las Vegas, Nevada, September 1980, 116 p.

This report describes a study of water quality changes during a flash flood event. Estimates of the quantity of salt entering into Lake Mead during 1978 and 1979 and the increase in TDS are given. The amount of wind blown material entering the Lake Mead-Lake Mohave system was also studied.

338. Worts, G. F., Jr., "Effect of Groundwater Development on the Pool Level in Devil's Hole, Death Valley National Monument, Nye County, Nevada," Geological Survey Open File Report, U.S. Geological Survey, Washington, DC, 1963, 27 p.

339. York, C. R. and Rogers, L. F., "Integrating Livestock into the Cotton Producing Area of Pahrump Valley," University of Nevada, Max C. Fleischmann College of Agriculture, Report No. 37, 1968.

340. Young, R. A., "Water Supply for Nuclear Rocket Development Station at the Atomic Energy Commission's Nevada Test Site," Geological Survey Water Supply Paper 1983, U.S. Geological Survey, Washington, DC, 1972, 19 p.

The Nuclear Rocket Development Station in the Jackass Flats area of the Nevada Test Site covers approximately 123 square miles. In the area, the carbonate rock, which is a good water producer elsewhere, is too deep to be an economic water source in Jackass Flats. The only important water producing unit is a welded-tuff aquifer. Well J-12 is the only well in the area and is capable of suppling the present water needs. Quality and quantity of the water source is discussed. The well is on standby since the Nuclear Rocket Development Station has been deactivated.

341. Young, R. A., "Water Supply for the Nuclear Rocket Development Station at the U.S. Atomic Energy Commission's Nevada Test Site," U.S. Geological Survey, Denver, Colorado, 1969, 43 p.

342. Young, R. A., "Water Levels From Selected Wells in Central and Southern Nevada, January-September 1967," TL-NTS-198 Supp. 1, 2, and 3, 1967.

This report (and its 3 supplements for subsequent readings) presents daily noon water level measurements and the magnitude of water level fluctuations near times of nuclear detonations and earthquakes, for a specific period of months, of 2 dug and 11 drilled wells in central and southern Nevada.

343. Young, R. A., "Records of Wells and Test Holes Drilled at the Nevada Test Site and Vicinity Since 1960," Technical Letter: NTS-117, Federal Center, Denver, Colorado, 1965, 21 p.

This report updates the well record compiled by J. E. Moore in 1960. The compilation includes 63 wells and test holes drilled since 1960. The area for the additional well data inlcudes the Nevada Test Site, Jackass Flats, Mercury Valley, Indian Springs Valley, Three Lakes Valley, Pahute Mesa, and Gold Flat. Well data and chemical analyses are presented in table form.

344. Young, R. A., "Drilling and Well-Testing Problems in Investigations of Deep Aquifers at Nevada Test Site, Mercury, Nevada," Eleventh Symposium on Exploration Drilling, Colorado School of Mines Quarterly, Vol. 58, No. 4, 1963, p. 83-91.

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