ENCLOSURE

Meeting Summary
NRC/DOE Technical Exchange
Future NRC and DOE Actions Related to the Adoption of the
Yucca Mountain Environmental Impact Statement
November 13, 2002

The U.S. Nuclear Regulatory Commission (NRC) and the U.S. Department of Energy (DOE) held a Technical Exchange on November 13, 2002, in Las, Vegas, Nevada. The purpose of this meeting was to discuss and identify future NRC and DOE actions related to the adoption of the "Environmental Impact Statement (EIS) for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada." In this Technical Exchange, the following major areas were discussed. (1) DOE's future steps of the EIS, (2) NRC's EIS adoption determination process, and (3) DOE identification and evaluation of new information, considerations or areas of additional analysis. The agenda, attendance list and briefing materials are provided as Attachments 1, 2 and 3, respectively. Highlights from the Technical Exchange are discussed below.

Opening Remarks

The meeting commenced with opening remarks by the NRC and DOE. The NRC expressed appreciation of DOE's preparation of the technical exchange and briefly discussed NRC's limited role regarding adoption of the EIS. DOE stated that its presentation would focus on the history and status of the EIS and DOE's environmental baseline review procedures prepared in accordance with the National Environmental Policy Act (NEPA) and the Nuclear Waste Policy Act (NWPA). From this Technical Exchange, DOE hoped to gain an understanding on how best to support the EIS adoption process for Yucca Mountain. DOE further noted that there would be opportunities for observers to comment during this Technical Exchange. However, DOE stated that the EIS is currently in litigation and that it would be inappropriate to discuss areas that are being challenged.

Summary/Status/Future Steps of EIS

The DOE staff presented a summary, status and future steps of the EIS. A brief history of the EIS was given. The processes involved with the draft EIS and the supplement to the draft EIS were explained. The staff reviewed the time line of the site recommendation and designation and the publication and distribution of the final EIS to the public. The major conclusions of the EIS, the preferred alternative and the areas changed from the publication of the draft EIS and supplement to the draft EIS were addressed. The staff explained the rationale for changes to the final EIS and the preparation of the Comment Response Document. The preferred alternative is to construct, operate and monitor, and eventually close a geologic repository at Yucca Mountain Mostly rail was identified as the preferred mode of transportation, both nationally and in Nevada. The staff provided future DOE actions for the EIS including the review of project activities using DOE environmental baseline review procedures and the support of the adoption of the EIS by the NRC.

The presentation was followed by a discussion period where the NRC staff directed questions to DOE on the status of developing transportation issues and identification of some of the changes made to the EIS. The DOE staff stated that a transportation strategy is currently being developed and provided an example of how DOE updated or changed the EIS.

NRC Environmental Impact Statement Adoption Determination Process

The NRC staff presented NRC's process for determining whether to adopt the EIS. The staff stated that NRC is an independent agency and that by law, the NRC shall regulate any potential geologic repository. Congress envisioned that DOE would prepare an EIS for a proposed repository at Yucca Mountain, and that the NRC would be able to adopt the EIS in whole or in part. The staff explained the adoption criteria for NRC's determination of whether or not it is practicable to adopt the EIS. The possible outcomes of NRC's determination process were explained. The staff stated that if the presiding officer and the Commission determine that it is practicable to adopt the EIS, the NRC responsibilities under NEPA would be satisfied and no further consideration would be required. Therefore, NRC's NEPA actions may be limited in scope. The NRC staff stated the decision on whether to adopt or supplement would be made 90 days after submittal of the license application.

There were no questions or comments from DOE with regard to NRC's presentation, but there were several questions from public observers. Public participants expressed concerns on transportation discussions in the EIS and the General Accounting Office Report on transportation, catastrophic meltdown in the spent fuel pool of a nuclear power plant, DOE quality assurance, transparency of the DOE and NRC interactions, NRC's comments on the EIS, and NRC's role to protect the public health, safety the and environment The NRC replied by explaining its independent role to protect public health, safety and the environment. The NRC explained that DOE is responsible for providing safety measures and that NRC would review those measures if DOE submitted a license application Also, the NRC stated that NRC provided comments on the final EIS to DOE in February 2002. In addition, while the NRC believes DOE has addressed its comments, more reviews may be needed, and they will have to be complete before submission of a potential license application. DOE requested a citation or copy of the General Accounting Office Report from the commenter, and neither was provided by the commenter.

Public participants also had concerns that DOE had not responded to the public's comments in the EIS. The DOE staff replied that DOE evaluated and identified comments in the transcript from the public meetings; however, some comments did not lend themselves to a response. An observer noted that DOE has not published a Record of Decision (ROD) and questioned how NRC could adopt such an EIS. The NRC staff explained that NRC's ROD is separate from any DOE ROD and further clarified that any NRC ROD would emerge from the Atomic Safety and Licensing Board's hearing process. Another observer questioned whether NRC had considered an assessment of water resource impacts of the geologic repository in preparing its comments on the EIS and provided a copy of the report, *Nye County Perspective: Potential Impacts Associated With the Long-Term Presence of a Nuclear Repository at Yucca Mountain, Nye County, Nevada, Water Resources Evaluation* (Attachment 4). The NRC staff stated that its review of the final EIS focused on DOE's response to NRC's previous comments. Another observer questioned NRC acceptance of the EIS while it is undergoing legal challenge. The NRC staff explained that NRC would make a determination at the time of its docketing decision on the license application on whether it can adopt the EIS in whole or in part for areas that are under legal challenge. If DOE submits a license application, NRC would review DOE's analyses for construction authorization and any additional changes in the EIS. Another observer questioned the capabilities of the barriers (e.g., waste containers and geologic isolation) to protect against the release of radiological contamination. The NRC staff stated that DOE must demonstrate the capabilities of the natural and engineered barriers and that this would be a part of NRC's safety review.

Identification and Evaluation of New Information, Considerations or Areas of Additional Analysis

The DOE staff presented the history of activities leading up to the EIS. The DOE staff discussed NRC's responsibility under NWPA and stated that NRC had commented on the draft EIS, supplement to the draft

EIS, and the final EIS. The DOE staff stated that DOE needs to ensure that adequate information is available to support the EIS adoption process for Yucca Mountain, and that DOE needs to determine if impacts that will result from a refined design are still consistent with the analysis in the final EIS.

The DOE's contractor presented the DOE environmental baseline review process. The procedure for implementing the process, includes: (1) a preliminary review to see if the proposed activity is covered in the environmental baseline or by a categorical exclusion; (2) a Level 1 Review to evaluate if the potential impacts are addressed in the environmental baseline; or (3) a Level 2 Review which determines whether the proposed activity represents a substantial change relevant to environmental concerns or might the preparation of additional environmental evaluations such as an environmental assessment or supplemental EIS or new EIS be advisable. The contractor stated that DOE would determine potential impacts on each environmental resource area as well as the cumulative impacts. Examples were provided on DOE's implementation of the procedures to assess ongoing proposed activities. The DOE's contractor staff concluded with a summary of the environmental baseline review process and emphasized DOE's responsibility to provide adequate environmental reviews of all its proposed activities.

The NRC staff posed several questions to DOE on the environmental baseline review process. The NRC staff noted that DOE's environmental baseline review procedure focuses on reviewing proposed activities and questioned how changes in the affected environment would be captured. The DOE staff explained that DOE separately analyzes changes in the affected environment on an annual basis. The NRC staff further asked if DOE would circulate any draft environmental assessments for public comments and if DOE would submit a cumulative analysis of all changes and its associated review if a license application is submitted. Regarding the opportunity for public participation on any environmental assessments, the DOE staff stated that this decision would need to be made by DOE management. In addition, DOE would consider providing a cumulative analysis for any changes from the issuance of the EIS to the submittal of any potential license application.

The NRC staff asked how changes in the total system performance assessment would be captured by DOE environmental reviews. For example, as understanding of drift collapse evolves, the dose from the repository may be affected. The DOE staff stated that DOE's environmental baseline review procedure includes reviewing these types of changes. The staff also stated that as the total system performance assessment model evolves, DOE may perform additional environmental reviews.

The NRC staff questioned the status of, format of, schedule for and availability of documentation (e.g., on the Internet or in the Licensing Support Network (LSN)) of additional DOE environmental reviews. Also, the NRC staff requested clarification on the content of the DOE semiannual environmental documentation review report. The DOE staff stated that these semiannual reports would be a summary of the environmental baseline reviews and that these documents may be requested through the appropriate channel. In addition, seven environmental reviews have been performed so far. Of these reviews, five have been approved and two are still undergoing review. The DOE staff took the action to investigate the availability of these reports in the LSN. The NRC staff stated the importance of NRC receiving these reports in a timely manner when they are available rather than as a total package at the time of any potential license application. The DOE staff replied that DOE would try to make information available to NRC regularly and early.

During the comment period for observers, some of the commenters focused on the effects of the repository on microorganisms, cumulative effects of the Nevada Test Site, effects of a phased repository, decommissioning costs if the proposed action is not approved, Inyo County (California) early drilling program, and similarities between the DOE environmental baseline review process and the NEPA scoping process and the need for public participation. The DOE acknowledged these comments and where

appropriate, noted that some of these issues are currently in litigation. Observers questioned the qualifications of the NRC staff and the process of licensing. The NRC expressed confidence in its abilities to effectively and efficiently review any potential license application from DOE. The NRC staff additionally explained that the two-step licensing process would consist of DOE submitting a license application to the NRC for authorization to construct a geologic repository. This would be followed by a DOE determination on whether to submit an amendment to the license application to request a license from NRC to receive and possess high-level radioactive waste. The NRC would conduct public hearings or offer opportunities for public hearings at each step of the process.

Closing Remarks

The NRC indicated that it was a beneficial technical exchange and reiterated NRC's limited role regarding adoption of DOE's final EIS. Although NRC provided comments to DOE on the final EIS in February 2002, additional NEPA analyses may be necessary and where appropriate, would allow for public participation. The need for a process transparent to the public was stressed. The NRC expressed concern regarding availability of DOE environmental baseline reviews. The NRC staff expects opportunities for monitoring the progress of any additional analysis. Further, it would be helpful for NRC to understand the nature of any changes well in advance of any potential license application This would facilitate NRC's decision of the final EIS. The NRC indicated that further technical exchanges may be scheduled as appropriate to provide transparency of DOE decisions on dispositioning new information, considerations or other changes that may need further evaluation by DOE prior to submitting a license application.

The DOE appreciated the opportunity to discuss the final EIS in this technical exchange. The DOE staff further noted that DOE was in the process of determining what information would be placed in the LSN and that process would consider the environmental baseline reports along with other potentially relevant information in compliance with the rules.

A representative from the State of Nevada provided comments on the need for DOE to appropriately document its additional analysis. The representative expressed concerns about appropriate documentation that may be showstoppers for an adoption decision and suggested DOE establish these as publicly available documents and their basis. These documents may be pertinent if a member of the public contests the adoption determination process.

1/13/03

Janet R. Schlueter, Chief Date
High-Level Waste Branch
Division of Waste Management
Office of Nuclear Materials Safety
and Safeguards
U.S. Nuclear Regulatory Commission

1/7/2003

Dennis R. Williams Date
Acting Deputy Director
Office of Licensing Application and Strategy
Office of Repository Development
U.S. Department of Energy

ATTACHMENT 1

Agenda
NRC/DOE Meeting
FUTURE NRC AND DOE ACTIONS
RELATED TO THE ADOPTION OF
YUCCA MOUNTAIN ENVIRONMENTAL IMPACT STATEMENT (EIS)
November 13, 2002
Conference Room 915
9960 Covington Cross Drive
Las Vegas, NV
Bridge # 702-295-6082

Wednesday November 13, 2002

9:00AM	-	9:15AM	PT	INTRODUCTION/OPENING REMARKS	NRC/DOE
9:15AM	-	9:30AM	PT	Summary/Status/Future Steps of EIS	DOE
9:30AM	-	9:40AM	PT	Discussion	NRC/DOE
9:40AM		9:50AM	PT	NRC Environmental Impact Statement Adoption Determination Process	NRC
9:50AM	-	10:00AM	PT	Discussion	DOE/NRC
10:00AM		10:15AM	PT	Comments	Observers
10:15AM	-	10:30AM	PT	BREAK	
10:30AM	-	11:15AM	PT	Identification and Evaluation of New Information or Considerations or Area of Additional Analyses	DOE
11:15AM	-	12:00PM	PT	Discussion	NRC/DOE
12:00PM		12:15PM	PT	Comments	Observers
12:15PM	-	12:30PM	PT	Closing Remarks	NRC/DOE
12:30PM			PT	ADJOURN	

ATTACHMENT 2

QA: N/A

Sign In Sheet
DOE/NRC Technical Exchange
FEIS
Las Vegas, NV
November 13, 2002

Name	Organization	Telephone
David Franklin	NNPP	702-295-2465
Mitzi Young	NRC	301-415-1523
Chester Poslusny	NRC	301 415-1341
Melanie Wong	NRC	301-415-6262
Gilbert Waldman	BSC	295-(702) 5014
PAT MACKIN	CNWRA	210.522.5054
Dan BECKMAN	BSC	702-295-4358
Lee Morton	BSC	702-295-6608
MYRLE RICE	INTERTECH Lincoln County	702 2636583
Jerry Selt	BSC	702-295-4136
TIM GUNTER	DOE	702-794-1343
[illegible]	CLARK COUNTY	702 455-5184
James Firth	US NRC	301-415-6628
Stacey FOX	US NRC	301 415 2462
Eileen Christensen	Nye County	702-240-2623
Binesh Tharakan	NRC	301 415 7138
Rod McCullum	NEI	202-739-8082
Shamica Walker	NRC	301-415-5142
DAVE LECHEL	LOCKHEED, M.	7058560537
Jack Parrott	NRC	702-794-5047
Veronica Cornell	MTS	702-794-1392

QA: N/A

Sign In Sheet
DOE/NRC Technical Exchange
FEIS
Las Vegas, NV
November 13, 2002

Name	Organization	Telephone
Eric Zwahlen	MTS/Golder Associates	702-794-5569
Dennis R. Williams	DOE/ORD	702-794-5526
Bob Braatbaum	MTS/Shaw	702 794-5424
Joseph Ziegler	DOE	702-794-5567
Jim Linnent	NSNFP	702-2950366
Steve Frishman	State of NV	775-687-5244
Paul Harrington	DOE	702-794-5415
Judy Treichel	NNWTF	702-248-1127
Linda Mathias	Mineral County Adv. Rep.	775-945-2485
Jim Pegues	City of Las Vegas	702 229-6562
George Hellstrom	DOE/ORD	702-794-1419
Janet Schlueter	NRC/HLW	301-415-7264
April Gil	DOE/ORD	702794-5578
Sally Perkins	Public	775-727-0883
Grant Hudson	P.O. Box 2598/Pahrump NV 89041	775-727-0866
Judith Espinoza		775-727-1119
Loreen Pitchford	Churchill County	775-971-0759
Mark Tynan	DOE	702 794 5457
James M. Williams	Nye County	303 386-2185
James Firth	NRC	301-415-6628
Jane Summerson	DOE	702 794 1493

ATTENDANCE LIST
NRC/DOE TECHNICAL EXCHANGE ON ENVIRONMENTAL IMPACT STATEMENT
T10A-1
NRC HEADQUARTERS
NOVEMBER 13, 2002

NAME	ORGANIZATION	TELEPHONE
RICHARD MAJOR	NRC/DCNW	(301) 415-7366
LARRY L. CAMPBELL	NRC/HLWB/NMSS	(301) 415-5000
Scott Flanders	NRC/DWM/EPAB	(301) 415-6717
Janet Kotra	NRC/DWM/HLWB	(301) 415-6674
Yen Chen	NRC/DWM	(301) 415-5615

ATTACHMENT 3

NRC Environmental Impact Statement Adoption Determination Process

Melanie Wong

Environmental and Performance Assessment Branch
U.S. Nuclear Regulatory Commission

November 13, 2002

NRC Role and Mission

- Independent Regulatory Agency
- Protect Public Health, Safety and Environment

Background

- NRC National Environmental Policy Act (NEPA) review may be limited under Law.
  - NRC required to adopt DOE's EIS "to the extent practicable."
  - To the extent NRC adopts, NEPA responsibilities are satisfied.

Background (continued)

- EIS must accompany license application.
- Docketing will be decided within 90 days of submission.
- NRC EIS adoption determination will be published in Notice of Docketing/Hearing.

On What Basis Would NRC Adopt DOE'S EIS?

- NRC must adopt the EIS unless:
  - Licensing action to be taken by Commission differs from the action proposed in the application in a way that may significantly affect the environment or
  - Significant and substantial new information or considerations make the EIS inadequate

Possible Outcomes of NRC's Adoption Determination Process

- Adopt
- Supplement
  - DOE
  - NRC

Public Opportunity for Participation

- Comments on Draft Supplement EIS (if issued)
- Contentions within 30 days after Notice of Docketing/Hearing
- Presiding Officer and Commission Review (Parties Only)

Summary

- NRC NEPA review limited by Law.
- Standards must be met for adoption.

U.S. Department of Energy
Office of Civilian Radioactive Waste Management

YUCCA MOUNTAIN PROJECT

Identification and Evaluation of New Information or Considerations or Area of Additional Analyses

Presented to:
Nuclear Regulatory Commission

Presented by:
Dr. Jane Summerson
Office of Repository Development
U.S. Department of Energy

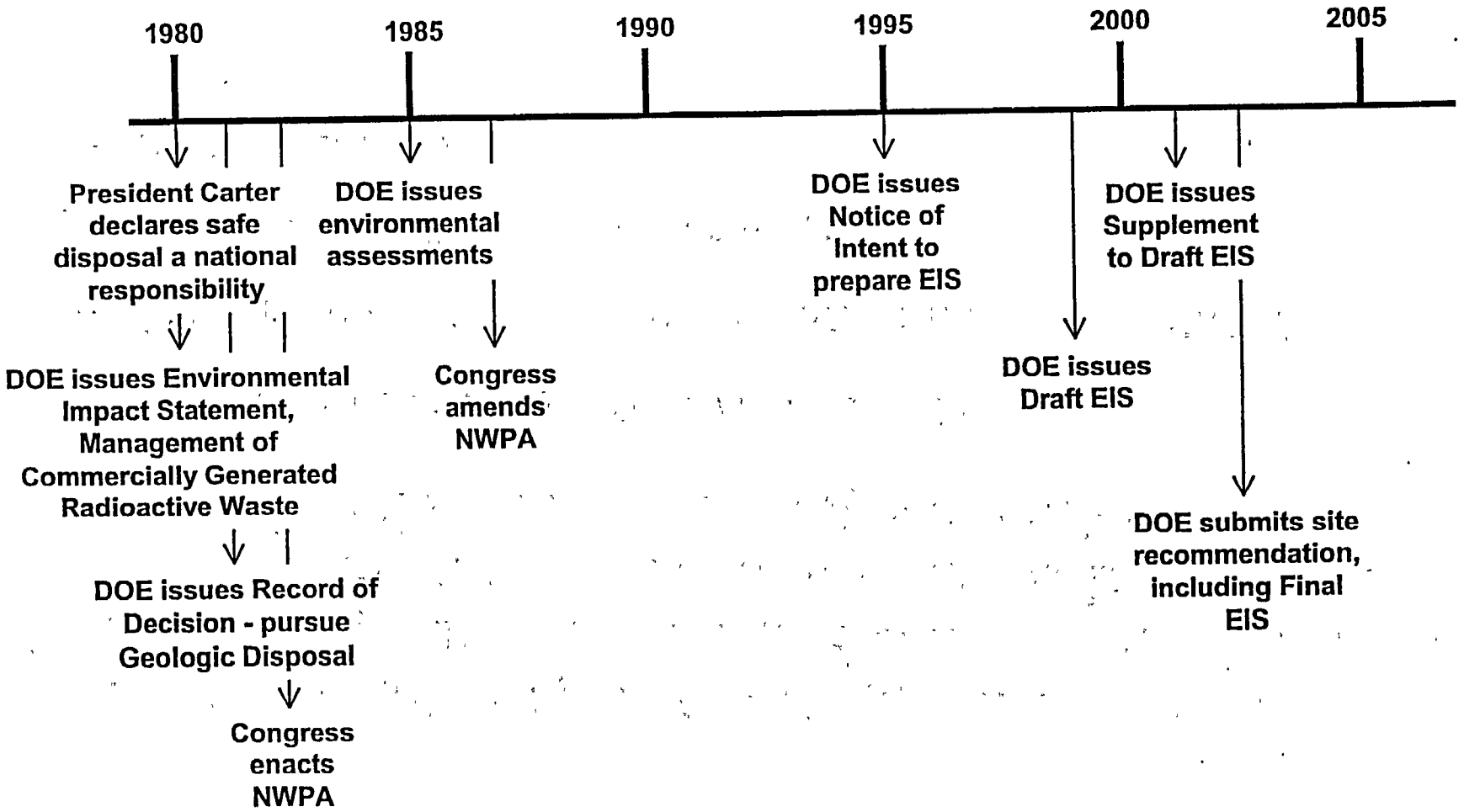
Lee Morton
Bechtel SAIC Company, LLC

November 13, 2002
Las Vegas, Nevada

Outline

- History of activities leading up the the Final Environmental Impact Statement (EIS)
- Activities supporting the Nuclear Regulatory Commission's (NRC) adoption of the Final EIS

Timeline Leading to the Final Environmental Impact Statement



Nuclear Waste Policy Act

- Nuclear Regulatory Commission shall, to the extent practicable, adopt the Final EIS in connection with the issuance of a construction authorization and license (Nuclear Waste Policy Act [NWPA])
- NRC reviewed and commented on
  - Draft Environmental Impact Statement (EIS) (1999)
  - Supplement to the Draft EIS (2001)
  - Final EIS (2002)

Supporting the Nuclear Regulatory Commission Adoption Process

- DOE needs to ensure up-to-date information is available related to environmental impacts to support the NRC's adoption of the Final EIS
- As design is refined for license application need to determine if impacts from the modified design are still consistent with those of the Final EIS (Environmental Baseline)
  - Final EIS was based on Site Recommendation design

Environmental Baseline Review Procedure

- Provides direction for reviewing proposed activities against the environmental baseline
  - Activity - new or change to existing action that could potentially result in impact to the public, the workers, or the environment
  - Environmental Baseline
    - Affected environment and potential environmental impacts identified in the Final EIS
    - Revised to reflect the environmental consequences of a new or changed activity, as appropriate

Environmental Baseline Review Process

Environmental baseline review mandated by applicable program procedures

Initiate Review	Review is required before activity may proceed early consultation is encouraged
Preliminary Review	Is the proposed activity in the environmental baseline? OR Does the proposed activity qualify as a categorical exclusion?
Level I Review	Are the potential environmental impacts from the proposed activity addressed in the environmental baseline?
Level II Review	Does the proposed activity represent a substantial change, significant new circumstances or information relevant to environmental concerns? OR Might the purposes of NEPA be furthered by preparation of an environmental assessment, supplemental EIS or new EIS

Environmental Resource Areas

- Land Use and Ownership
- Air Quality and Climate
- Geology
- Hydrology
- Biological Resources
- Cultural Resources
- Socioeconomics
- Health and Safety
- Noise and Vibration
- Aesthetics
- Utilities, Energy, Materials
- Waste and Hazardous Materials
- Environmental Justice
- Transportation
- Cumulative
- Long-Term Performance

Samples of Activities Reviewed Under Environmental Review Procedure

- Technical Baseline Change Proposal (BCP) to establish phased development of the design concept
  - Proposed activity was discussed in the Final EIS but not included as part of the proposed action for analysis, not a categorical exclusion - Level I review required
  - Environmental baseline review was approved subject to further evaluation once additional or greater details become available
  - BCP reviews provide an early warning of the need for future detailed reviews
- Nye County Early Warning Drilling Program Phase IV
  - Activity (and the need for expansion) included as part of the proposed action in the Final EIS and analyzed
  - Approved based on preliminary review

Summary

- Nuclear Regulatory Commission shall, to the extent practicable, adopt the Final EIS in connection with the issuance of a construction authorization and license (NWPA)
  - Final EIS
  - Supplemental environmental documentation
    - Environmental Baseline Reviews
    - Semi-annual Environmental Documentation Reviews
    - Environmental Assessments (if prepared)
    - Supplements to the Final EIS (if prepared)
- DOE is awaiting insight into NRC's adoption process so we can understand how best to support the process

Backup

Integration With Other Program Procedures

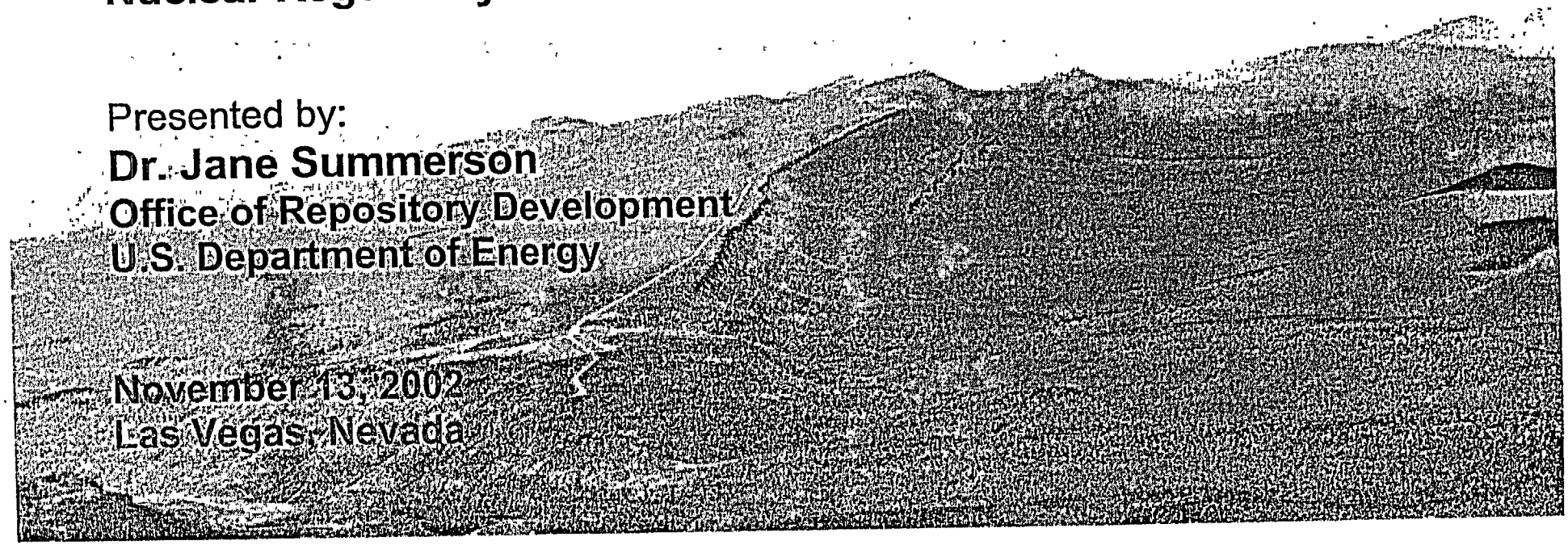
- To ensure compliance, this procedure is being integrated into other project procedures
- *Planning for Science Activities*
- *Testing Work Packages*
- *Integrated Planning, Baseline Change Proposal Preparation, and Baseline Change Control*
- *Review of Technical Products and Data*
- *Land Access and Environmental Compliance*
- *Work Request/Work Order Process*

U.S. Department of Energy
Office of Civilian Radioactive Waste Management

YUCCA MOUNTAIN PROJECT

Summary/Status/Future Steps of Environmental Impact Statement

Presented to:
Nuclear Regulatory Commission



Presented by:
Dr. Jane Summerson
Office of Repository Development
U.S. Department of Energy

November 13, 2002
Las Vegas, Nevada

Outline

- Status of Environmental Impact Statement (EIS)
- Final EIS - changes and conclusions
- Next steps

History of Environmental Impact Statement

- Draft EIS
  - August 13, 1999 - Environmental Protection Agency (EPA) Notice of Availability
  - 199-day public comment period with 21 public hearings
  - More than 11,000 comments
- Supplement to the Draft EIS
  - May 11, 2001 - EPA Notice of Availability
  - 45-day public comment period with 3 public hearings
  - More than 1,100 comments

History of Environmental Impact Statement

(Continued)

- February 14, 2002 - Secretary of Energy recommended the site as scientifically and technically suitable
  - Basis of recommendation included Final EIS

Site Designation

- February 15, 2002 - President recommended site to Congress
- April 8, 2002 - Governor of Nevada disapproved the site
- May 8, 2002 - House of Representatives voted to override the Governor
- July 9, 2002 - Senate voted to override the Governor
- July 23, 2002 - President signed joint resolution into law

Publication/Distribution

- Final EIS made available to the public on February 14, 2002 - internet and 38 reading rooms
- Final EIS distributed in October 2002
- EPA Notice of Availability on October 25, 2002

Major Conclusions from the Final Environmental Impact Statement

- Proposed action would cause small, short-term public health impacts, primarily due to transportation
  - Specific impacts at repository site would be very small
  - Transportation impacts associated mainly with nonradiological traffic fatalities and very low doses
- Long-term performance of proposed repository over 10,000 years would result in very low mean peak annual dose (0.00002 millirem)
- DOE does not expect the proposed repository to result in impacts to public health beyond prescribed standards

Final Environmental Impact Statement Areas of Change

- More information regarding potential impacts, particularly transportation impacts
- Use of representative fuel assembly in accident analyses
- Use of updated data, particularly population data
- More detailed discussion of perception-based impacts
- Use of updated computer models
- Editorial changes and corrections
- Addition of appendix on general transportation information
- Addition of U.S. Fish and Wildlife Service Biological Opinion
- Addition of Readers Guide

Why U.S. Department of Energy Introduced Changes

- Response to public comments, as appropriate
- Correct errors
  - Identified by DOE internal reviewers
  - Identified in public comments
- Provide new information or improved analyses

Comment Response Document Volume III

- DOE received more than 12,000 comments from letters, e-mails, and transcripts of public hearings
  - Comments received through August 31, 2001 were included in Final EIS
    - Comments received after August 31, 2001 were considered and evaluated - none raised new issues not already considered
- Similar comments were summarized
- DOE responded to all comments, either individual or summarized
- Some comments led DOE to change or update the EIS

Preferred Alternative

- Proposed Action identified as preferred alternative
  - Construct, operate and monitor, and eventually close a geologic repository at Yucca Mountain
- Mostly rail identified as preferred mode of transportation - nationally and in Nevada
  - Commercial sites without rail capability would ship by legal-weight truck

Next Steps

- On-going environmental baseline review of project activities
- Support adoption of the Final EIS by the Nuclear Regulatory Commission (NRC)

ATTACHMENT 4

November 21, 2002

Office of Nuclear Material Safety & Safeguards
Nuclear Regulatory Commission
Mail Stop: T7J8
Washington, D.C. 20555

Attention: Melanie Wong, Project Manager

Dear Ms. Wong:

It was a pleasure meeting you at the Summerlin DOE office on November 13, 2002, for the technical exchange between DOE and NRC. Per our discussion, I was hoping you could include the enclosed document, *Nye County Perspective: Potential Impacts Associated With the Long-Term Presence of a Nuclear Repository at Yucca Mountain, Nye County, Nevada, Water Resources Evaluation*, dated June 1999, in your minutes for that meeting. I must apologize for the delay in getting this document to your office, and I hope this delay will not cause you any undue stress.

Please feel free to contact either MaryEllen or me should you have any questions or require additional information regarding this matter.

Best regards,

B. Eileen Christensen

B. Eileen Christensen, C.E.M.

Enclosure

MaryEllen C. Giampaoli, Environmental Compliance Specialist
PO Box 127, Blue Diamond NV 89004 Phone (702) 875-4594 Fax (702) 875-3594 E-mail Megreg1159@aol.com

Nye County Perspective: Potential Impacts Associated With the Long-Term Presence of a Nuclear Repository at Yucca Mountain, Nye County, Nevada

Water Resources Evaluation

June 1999

Prepared by:

Thomas S Buqo
Consulting Hydrogeologist
Blue Diamond, Nevada

Prepared for:

Nye County
Nuclear Waste Repository Office
1210 East Basin Road
Suite 6
Pahrump, Nevada 89048

New file

Nye County Perspective:
Potential Impacts Associated With the
Long-Term Presence of a Nuclear Repository
at Yucca Mountain, Nye County, Nevada

Water Resources Evaluation

June 1999

Prepared by:

Thomas S Buqo
Consulting Hydrogeologist
Blue Diamond, Nevada

Prepared for:

Nye County
Nuclear Waste Repository Office
1210 East Basin Road
Suite 6
Pahrump, Nevada 89048

NYE COUNTY PERSPECTIVE: POTENTIAL IMPACTS ASSOCIATED WITH THE LONG-TERM PRESENCE OF A NUCLEAR WASTE REPOSITORY AT YUCCA MOUNTAIN NYE COUNTY, NEVADA

WATER RESOURCES EVALUATION

Table of Contents

NYE COUNTY PERSPECTIVE: POTENTIAL IMPACTS ASSOCIATED WITH THE LONG-TERM PRESENCE OF A NUCLEAR WASTE REPOSITORY AT YUCCA MOUNTAIN NYE COUNTY, NEVADA

WATER RESOURCES EVALUATION

Table of Contents

Tables and Figures

Tables

Figures

NYE COUNTY PERSPECTIVE: POTENTIAL IMPACTS ASSOCIATED WITH THE LONG-TERM PRESENCE OF A NUCLEAR WASTE REPOSITORY AT YUCCA MOUNTAIN NYE COUNTY, NEVADA

WATER RESOURCES EVALUATION

PURPOSE OF THIS DOCUMENT

The provisions of the National Environmental Policy Act of 1982 (NEPA), as constrained by the Nuclear Waste Policy Act, requires the U.S. Department of Energy (DOE) to prepare an Environmental Impact Statement (EIS). As part of the EIS, the DOE must identify and assess the impacts to water resources that will result from the disposal of spent nuclear fuel and high-level nuclear wastes at the proposed repository at Yucca Mountain. In written comments to DOE, and at formal scoping meetings, Nye County stated its concerns about the level of analysis that DOE will perform in assessing the potential impacts on the water resources of the region. The issues that were identified are briefly reiterated below:

1) The EIS must address the full array of impacts on the natural environment, including water quality and availability.

2) The standard of excellence that the EIS must meet is very high and the Record of Decision (ROD) could have far-reaching consequences for Nye County.

3) For reasons of health and safety alone, the science upon which the ROD is based must be of the highest quality and validity.

Additionally, Nye County transmitted written comments to DOE on the cumulative economic effects of restricted access land withdrawals, and stated the need for a thorough evaluation of the full array of potential environmental impacts on water quality and availability.

In the formal responses to comments related to hydrology and water resources, the DOE indicated that their planned NEPA analyses will focus on the effects of water on a repository. DOE further indicated that the impact of a compromised repository performance on the water resources of the region will then be assessed qualitatively. In this regard, the Summary of Public Scoping Comments (DOE, May 1997, p. 20) commits to describing the possible impacts to the repository of infiltration, climate change, elevated tritium concentrations, and the invasion of hot water from depth. Nye County notes that this approach, although necessary for assessing long-term repository performance, does not relate the impacts of repository performance to the *human environment*, as defined at 40 CFR 1508.4, and as required at 40 CFR 1502.3.

The Summary of Public Scoping Comments further commits to "qualitatively describe the potential impacts on water quality and water flow and springs and wells in the Alkali Flat-Furnace Creek Ranch groundwater basin" (DOE, 1997, p. 20). Such an approach fails to address the quantifiable impacts to water resources. Thus, the limited scope of the water resources assessment, as described in DOE documents to date, is unacceptable to Nye County and meets neither the intent nor the standards of NEPA. Nye County believes that the identification and analysis of the issues and impacts can, and must be performed in quantitative evaluations as required by the NEPA process.

The purpose of this document is to present Nye County's perspective of the impacts on water resources that will result from disposal of the nation's high-level radioactive wastes at the proposed repository at Yucca Mountain. It is not the intent of these analyses to find fault with DOE's NEPA process nor to attempt to use the NEPA process to oppose or obstruct a repository at Yucca Mountain. Rather, the intent is to provide a comprehensive and objective NEPA assessment of the impacts to water resources and to identify measures that can be taken to mitigate those impacts.

INTRODUCTION

This section presents general background information concerning the area that is the subject of this NEPA evaluation and the proposed action and alternatives that are to be covered in DOE's EIS. The approach used by Nye County in evaluating the impacts, the underlying assumptions, and the specific methodologies used are then presented and discussed.

General Location and Region of Influence

The general area considered in this evaluation includes Nye County, in its entirety, and the region around Nye County and Yucca Mountain. With respect to water resources, the region of potential influence includes all of the groundwater basins and flow systems which occur wholly, or in part in Nye County, however, for the purposes of this evaluation, only those basins that comprise the Death Valley flow system are considered as the region of influence. Figure 1 shows the location of Nye County, Yucca Mountain, and the region of influence.

Identification and Discussion of the Proposed Action and Alternatives

The proposed action is to construct, operate, and close a spent nuclear fuel and high-level radioactive waste repository at Yucca Mountain, located wholly in Nye County, Nevada. The proposed action will include both the transportation of 70,000 metric tonnes of wastes through Nye County and the emplacement of those wastes into the repository. The DOE has identified three alternatives to the proposed action based upon the thermal loading objectives: 1) a high thermal load; 2) an intermediate thermal load; and 3) a low thermal load.

The disposal of the nation's spent nuclear fuel and high level wastes at Yucca Mountain is one of the most significant federal actions ever undertaken, both in terms of cost and magnitude, and, more importantly, in the long-term implications for the health and safety of the present and future generations of Nye County residents. Nye County recognizes that permanent isolation of the wastes currently in storage at dozens of sites across the United States is an essential element of our nation's nuclear energy production. Nye County also recognizes that the disposal of these wastes at Yucca Mountain will reduce the threat to the water resources, and the public dependent upon those resources, at each of the power plants and other facilities where these wastes currently reside. However, these wastes, with a total activity of at least 14 billion curies, will most certainly render the water resources of Nye County vulnerable well into the future. As a consequence of this vulnerability, it is incumbent upon Nye County, the nation, and the decision makers to be fully aware of the long-term impacts of the proposed action upon the precious, and limited water resources of the County.

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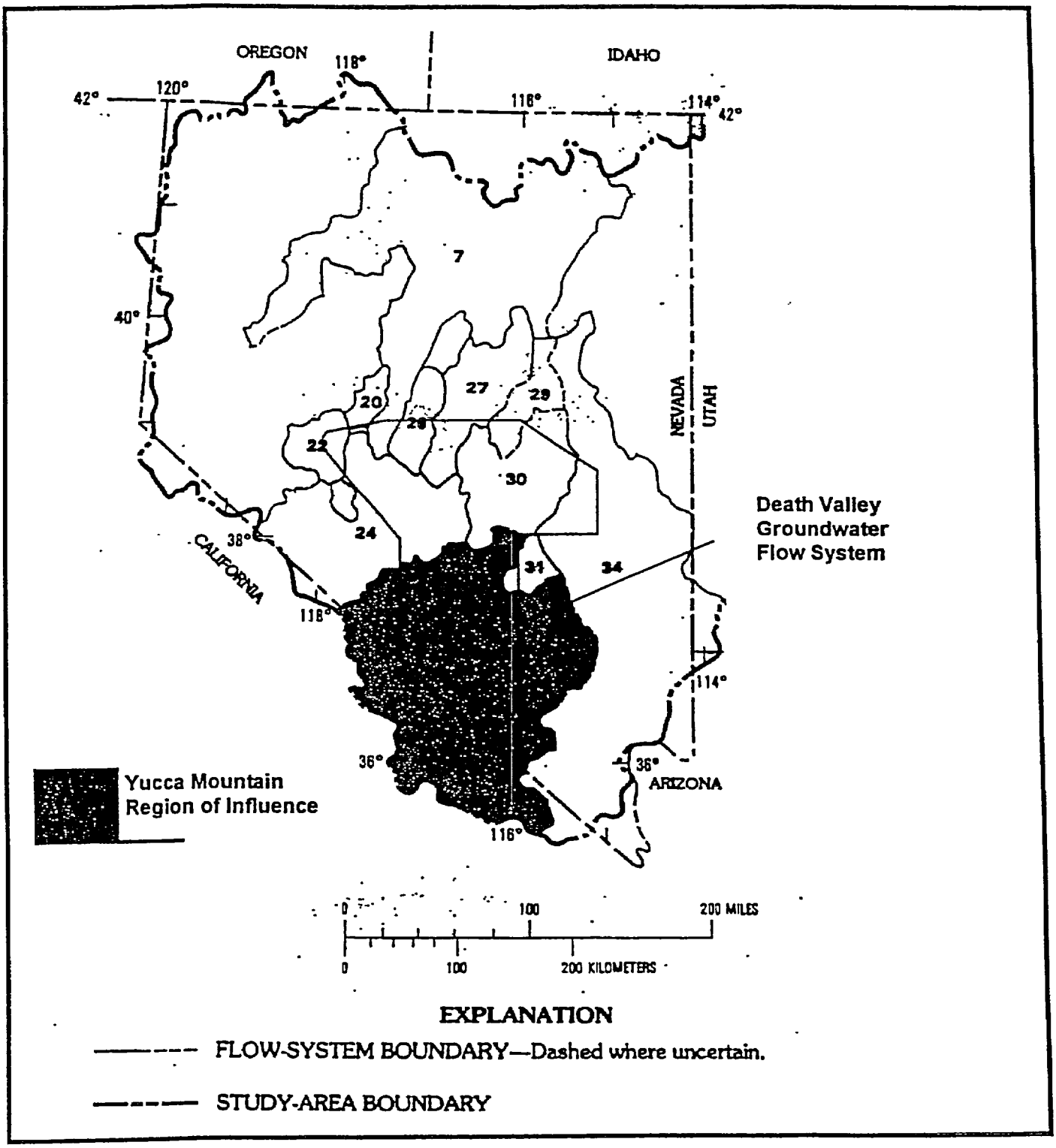

Figure 1. Region of Influence Used in this Evaluation

Methodology and Assumptions Used

The methods used in conducting this evaluation included a review of the available literature and data, consultations with government agencies, organizations, and the public, definition of the resource requirements, and impact evaluation. The specific methods employed, qualifications for data and information, and the techniques used in analyzing and evaluating impacts are identified and discussed in this section.

Literature and Data Review

A great deal of information has been published concerning the proposed repository and the water resources of the region and a great deal of unpublished agency data is available. The basic information needed for impact evaluation was obtained from published sources and consultations with water users, planners, and regulators. Where necessary, additional data was obtained from the files of the DOE, the U.S. Geological Survey, the Nevada Division of Water Resources (DWR), the Nevada Division of Water Planning (DWP), and public water supply system operators.

A review of the entire literature base related to Yucca Mountain was not conducted. Several thousand reference documents have been published that are relevant to the proposed repository and the hydrology, geology, and water resources of Nye County. The references that were selected for use in impact evaluation are listed in the References Cited section of this report, with full bibliographic citations. For the purposes of this evaluation, the information compiled from these sources was assumed to be factual and of sufficient accuracy to be of use.

Consultations

Consultations were conducted with a number of individual groups, agencies, organizations, and members of the public. Consultations were held with DWR, DWP, the Southern Nevada Water Authority, the Amargosa Conservation District, the Amargosa Valley Water Committee, the Beatty Water and Sanitation District, the Pahrump Regional Planning Commission, the U.S. Geological Survey, the National Park and Fish and Wildlife services, the U.S. Air Force, and the Bureau of Land Management. These consultations were aimed at defining future water requirements as well as actions that should be taken into consideration in the evaluation of the cumulative impacts over the reasonably foreseeable future.

Definition of Legal Water Availability and Use

The legal availability of water was established through the review of records on file with the DWR. Basin water right abstracts were obtained from DWR and were used as the basis for the values of perennial yield, committed water resources, and estimated water use that were used in impact evaluation. Nye County notes that there is considerable uncertainty associated with the perennial yield estimates that have been used for decades to guide water resource allocations in Nevada. However, as better estimates are not available, the published perennial yield values must be considered in this evaluation as the basis for defining legal water availability. There is little uncertainty concerning the committed water resources; the files of the DWR are current and accurately represent the quantities of water that have been appropriated and/or requested in each of the basins within the Nevada portions of the region of influence.

Water use data is based upon meter records for the Department of Energy and some of the water supply systems in Pahrump and Beatty, providing a reliable baseline. Water use data for other areas and users are

estimates. These estimates are less certain and are based upon either crude estimates, rudimentary records, or consumptive use estimates made by DWR as part of their annual water use inventories of selected basins in southern Nevada. Nonetheless, the estimates represent the best available data and are assumed to reasonably represent the existing water use in the region of influence.

Definition of Future Water Demand

Future water demand estimates are based upon census projections, published forecasts prepared by the NWRPO, DWP, and the U.S. Census Bureau, and consultations with existing and future water users in the region. Any projections of future population or water use are inexact. As a consequence. the future water demand projections used in this evaluation are considered approximate. Such uncertainty is not unique to this evaluation, however, and the estimates represent the best available data. It is assumed that the data and projections reasonably represent future water demand in the region of influence.

Impact Evaluation

The implementing regulations of NEPA at 40 CFR 1508.25 define the full range of actions, alternatives, and impacts that must be considered by an agency during the NEPA process. Specifically, the implementing regulations of NEPA at 40 CFR 1502 (a) and (b) require the agency EIS to include discussions of direct effects and their significance, as well as indirect effects and their significance. Nye County believes that the proposed repository at Yucca Mountain has the potential to result in both direct and indirect effects on the water resources of the region, and to contribute cumulatively to both categories of impacts. Furthermore, at some time in the (distant) future, the repository is assumed to fail. At that time, some portion of Nye County's water resources will be irretrievably lost to future generations representing an irreversible consequence of the proposed action. Thus, while the water requirements for constructing and operating the proposed repository are modest, the overall implications of siting the repository at Yucca Mountain are significant.

Direct short-term impacts would result from water withdrawals related to repository construction and operation. These short-term impacts would likely include a localized lowering of water levels and alteration of groundwater flow directions in the vicinity of water supply wells. Depending upon the actual quantities of groundwater to be used, the points of diversion, and the duration of pumping, other potential direct or indirect impacts may occur. These potential impacts may include increased pumping lifts and costs for other groundwater users in the region, reductions in spring flow rates, reductions in surface water flows, habitat destruction or alteration, and degradation of water quality.

Beyond these direct impacts, there are a number of *indirect impacts* that are likely to occur should a repository go forward at Yucca Mountain. The removal of large areas of land and the underlying water resources from future development; the effects of future groundwater contamination from the repository on resource availability; and the overall effects of water withdrawals and waste disposal at Yucca Mountain are examples of indirect impacts. Nye County believes these impacts have the potential to be more significant, in both magnitude and severity, than the direct impacts associated with providing water for construction and operation of a repository at Yucca Mountain. A major focus of this evaluation is on the indirect impacts on water resources as a result of the proposed action.

Additionally, impact evaluations must consider the impacts of the proposed action in several contexts when determining their significance. Although such impacts would clearly be insignificant to the nation as a whole,

in the context of the site-specific action proposed to occur in Nye County, such impacts could well be adverse and significant, over both short term and long term (40 CFR 1508.27).

Within the NEPA framework, perhaps the most important water supply issue for Nye County is the contribution of Yucca Mountain to the cumulative indirect impacts resulting from on-going and proposed federal and non-federal actions. Of extreme importance to Nye County is the analysis and discussion of *cumulative actions* as required at 40 CFR 1508.25 (a)(2). Similarly, Nye County places a special emphasis on the analysis required at 40 CFR 1508.25 (b)(3). This Section of the NEPA regulations requires that agencies consider, as an alternative, *mitigation measures that are not included in the proposed action*, and that the agencies will identify mitigation to address the potential impacts. Finally, as 40 CFR 1508.25(c)(3) requires agency consideration of *impacts that may be cumulative*, Nye County expects that the EIS will address the full range of impacts that may contribute to cumulative impacts to water resources. However, as the DOE and Nye County may have quite different perspectives with regard to water resources, the evaluation of cumulative impacts and the definition of mitigating measures are also major areas covered within this evaluation.

WATER RESOURCES BASELINE

Nye County has recently prepared a water resources baseline for the southern part of the County (Buqo 1996), and is currently preparing a county-wide water plan (Buqo, 1999, in preparation). This section provides a brief overview of the water resources of the region of influence.

Surface water resources are negligible and have been largely appropriated. Groundwater resources are significant. The demand for underground water rights has grown in recent years. The basins that comprise the Death Valley flow system have an estimated total recharge of about 148,000 acre feet per year (Pal Consultants, 1995, p. 63). According to the records of the Nevada Division of Water Resources, about 106,000 acre feet of vested, permitted, and/or certificated water rights are outstanding within the flow system. In addition to these recognized water rights, applications for 6,000 acre feet have been filed, largely for water in Pahrump Valley, Jackass Flats, and Oasis Valley. Reserved water right claims by the various federal agencies with stewardship over portions of Nye County are defined and discussed in a later section of this evaluation.

A number of basins within the region of influence have been designated by the Nevada State Engineer as requiring special management. Pahrump Valley has a sustained yield of 26,000 and groundwater rights totaling about 71,000 acre feet. Pahrump Valley has been designated as closed to further appropriations for irrigation. New appropriations may only be permitted for preferred uses such as mining or commercial water rights in areas not served by existing water purveyors. Much of Amargosa Desert, all of Sarcobatus Flat and Penoyer Valley, southern Indian Springs Valley and southwestern Oasis Valley have been designated but no specific administrative controls have been defined in the State Engineer's Orders.

Existing water use within the region of influence is concentrated in the agricultural and mining areas of Amargosa Desert and Penoyer Valley, and in the mixed urban and agricultural areas of Pahrump Valley. According to pumpage inventories by the Nevada Division of Water Resources, water use in 1997 totaled 12,441 acre feet in Penoyer Valley, 13,902 acre feet in Amargosa Desert, and 28,819 acre feet in Pahrump Valley. Water use in the other basins of the flow system is not inventoried. The U.S. Air Force used about 160 acre feet in Cactus Flat while the Department of Energy used less than 900 acre feet per year at the Nevada Test Site with withdrawals taken from Jackass Flats, Mercury Valley, Frenchman Flat, Yucca Flat, and Buckboard Mesa.

With the exception of radionuclide contamination at the Nevada Test Site, the water quality of the surface and groundwater resources in the region of influence is largely good. Elevated concentrations of fluoride, sulfate, and total dissolved solids occur in some areas of Oasis Valley and Amargosa Desert, and traces of naturally occurring uranium are known to be present in Oasis Valley and Crater Flat.

A number of water resources issues have been identified in Nye County. These issues include:

- Contamination from historic underground nuclear testing;
- Federal water rights and claimed reserved water rights;
- A projected water shortfall in Pahrump Valley due to increased urbanization; and
- The impacts of past present and reasonably forseeable future actions on the quantity, quality, and physical and legal availability of the water resources of the County.

Nye County has, and will continue to work with the various water right holders and water users in the County to resolve these, and other water resource related issues.

EFFECTS OF PAST AND PRESENT ACTIONS

In this section, the impacts on water resources as a result of past and present activities are defined and discussed. These observed and studied impacts serve in part as the basis for assessing the impacts of future actions. It is important to note that actions, within the context of this evaluation, include not only specific physical actions such as underground nuclear testing and groundwater use, but also the implementation of policies by the various agencies with stewardship over the vast majority of lands in Nye County and the region of influence. The rationale for including the impacts of policies within the region of influence may be found at 40 CFR 1508.18:

> (a) "Actions include new and continuing activities, including projects and programs entirely or partly financed, assisted, conducted, regulated, or approved by federal agencies; *new or revised agency rules, regulations, plans, policies, or procedures*; and legislative proposals....
>
> (b) Federal actions tend to fall within one of the following categories:
>
> > (1) *Adoption of official policy, such as rules, regulations*, and interpretations adopted pursuant to the Administrative Procedure Act, 5 U.S.C. 551 et seq.; treaties and international conventions or agreements; formal documents establishing an agency's policies which will result in or substantially alter agency programs.
> >
> > (2) *Adoption of formal plans, such as official documents prepared or approved by federal agencies which guide or prescribe alternative uses of federal resources, upon which future agency actions will be based*.
> >
> > (3) Adoption of programs, such as *a group of concerted actions to implement a specific policy or plan; systematic and connected agency decisions allocating agency resources to implement a specific statutory program or executive directive*;
> >
> > (4) Approval of specific projects, such as construction or management activities located in a defined geographic area. *Projects include actions approved by permit or other regulatory decision as well as federal and federally assisted activities*." (emphasis added)

Thus the evaluation of the impacts on the water resources of the region of influence as a result of past federal policies is clearly mandated by NEPA and is warranted as part of this evaluation. It is important to note however, that many of the previous Environmental Impact Statements and other NEPA documents prepared by federal agencies have not adequately addressed (and in most cases have completely ignored) the impacts of their policies and plans on the water resources of the region of influence. While these NEPA documents can be used for the basis of defining past and proposed actions, policies, and management directions, they cannot be used to define the impacts that result. Therefore, the definition of the impacts of past federal actions is a major element of this evaluation.

Past Actions

For the purposes of this NEPA evaluation, the past actions which have resulted in direct and indirect impacts on the water resources of Nye County can be segregated into two broad categories: 1) federal land use, land management, and policies; and 2) non-federal land use, management and policies. The federal land use management and policies category includes congressional mandates and the specific policies and actions of each

of the federal agencies which have jurisdiction over portions of Nye County including the U.S. Air Force, the U.S. Department of Energy, the U.S. Fish and Wildlife Service, the U.S. National Park Service, the U.S. Forest Service, and the Bureau of Land Management. The nonfederal actions include developments by the private sectors including mining and milling, agriculture, ranching and animal husbandry, and the developments in support of the general population, including water supplies for the towns and cities within the region of influence.

Federal Land Use, Land Management, and Policies

Past actions initiated by the federal government have defined today's water resource baseline in Nye County. In this section, the impacts of these actions on the water resources of Nye County are defined and discussed. An exhaustive treatment of all federal actions that have impacted the water resources of Nye County is not possible (a partial listing of the more important mandates is provided in Table 1). Therefore, an emphasis is placed upon the major actions which have resulted in the most significant impacts. These actions include a number of congressional mandates and specific actions taken by the various federal departments with stewardship over vast areas of Nye County, including the Departments of Energy, Defense, and Interior.

Congressional Mandates

The United States Congress legislated a number of acts that affected the development of the water resources of the western United States, Nevada, and Nye County. The earliest legislation, The Land Ordinance of 1785, initiated a federal policy of encouraging development by making lands available for settlement. This policy was to last for almost two centuries. The Harrison Land Law (1800) and the Graduation Act (1854), the Homestead Act (1862), the Timber Culture Act (1873), The Desert Land Act (1877), the Carey Act (1894), and the Enlarged Homestead Act (1909), all represented a national policy that encouraged the purchase and development of the vast lands owned by the federal government in the western United States.

Direct impacts upon Nevada and Nye County began to occur with the passage of the Homestead Act. Settlers wasted little time in obtaining land in Nye County under the provisions of this act. The first recorded settlement in Pahrump Valley was a ranch started by Mormon Charlie in the late 1860s (McCracken, 1990, p. 11). By 1875, there were two ranches and one farm in the valley and several hundred acres of land had been put under irrigation. Development in Amargosa Valley began in 1871 when Charles King started a ranching operation in Ash Meadows. McCracken (1992, p. 17) notes that by the late 1870s, most of the springs and seep areas from Beatty to Pahrump had been homesteaded. However, in the early 1880s, the decline in mining and the resulting loss of markets forced the abandonment of many of the original homesteads.

The Desert Land Act (1877) continued the federal policy of western development with significant direct impacts upon Nye County, however it was more than 70 years before these impacts were to occur. The Desert Land Act clearly defined Congress' intent to develop the west by restricting the act to the 11 western states and the Dakotas. Of particular note is Section 325 of the act:

> **§ 325. Resident citizenship of State as qualification for entry**
>
> ***Excepting in the State of Nevada,*** **no person shall be entitled to make entry of desert lands unless he be a resident citizen of the State or Territory in which the land sought to be entered is located.** [emphasis added]

Table 1. Congressional Mandates Regarding Land and Resource Uses

Land Entry and Agrarian Mandates	
Legislative Act (Popular Name)	**General Consequences**
Carey Land Act of 1894 Desert Land Act of 1877 Enlarged Homestead Act (1909) Forest Homestead Law of 1906 Homestead Act (1862) McCarran Act Pittman Act Public Land Sale Act (1964) Reclamation Law of 1902 Recreation Act of 1926 Recreation and Public Purposes Act of 1954 Stockraising Homestead Law of 1916 Taylor Grazing Act of 1934 Timber Culture Act (1873)	Opened the western states to development, encouraged agriculture, ranching, forestry, and animal husbandry. These acts resulted in the settling of the western states including Nevada. The Desert Land Act of 1977 was the most significant of these acts with respect to Nye County, especially with regard to the communities of Pahrump and Amargosa Valley in the southern part of the County.
Mining and Mineral Mandates	
Legislative Act (Popular Name)	**General Consequences**
Acquired Minerals Leasing Act (1947) General Mining Law of 1872 Lode Mining Law of 1866 Materials Act (1947) Mine Dewatering Act Mineral Lands Leasing Act Mineral Leasing Act (1920) Mineral Leasing Act Revision of 1960 Multiple Mineral Development Act of 1954 Placer Mining Law of 1870 Timber and Stone Law (1878)	Opened the public lands of the United States to mineral exploitation. These acts contributed significantly to the early development of Nevada and Nye County. The present communities of Tonopah (the County seat), Beatty, Gabbs, Manhattan, and Round Mountain are a result of the rich history of mining activities in Nye County.
Resource Protection, Management, and Preservation Mandates	
Legislative Act (Popular Name)	**General Consequences**
Endangered Species Act (1973) Federal Land Policy and Management Act (1976) Forest Management Act of 1897 General Public Land Reform Act of 1891 Multiple Surface Development Act (1955) National Environmental Policy Act (1970) National Historic Preservation Act (1966) National Wilderness Act (1964) Public Rangelands Improvement Act (1978) Surface Mining Control and Reclamation Act (1978) Wild and Free Roaming Horse and Burro Act (1971) Nuclear Waste Policy Act (1982), as amended California Desert Protection Act (1994)	These acts were aimed at the protection of environmental, cultural, and wildlife values, the restoration of previously disturbed areas, the establishment of a Timbisha Tribal Homeland, and the disposal of high-level nuclear waste in Nye County.

In total, the land policies of the United States clearly mandated that the arid, but arable lands of the western United States should be put into agricultural production. The citizenship provisions of the Desert Land Act targeted Nevada specifically for development. Beginning in the early 1950s and continuing until the late 1970s, numerous Desert Land Entries were patented in Nye County under the Desert Land Act.

As a direct result of these Congressional mandates, 446,000 acres of farmland had been developed in Nye County by 1964 (Nevada Division of Water Planning, 1994, p. 45). Irrigated pasture and harvested cropland peaked at 47,270 acres in 1965 and has ranged between 24,000 and 34,000 acres since that time (Nevada Division of Water Planning, 1996, p. 6-8). Agriculture remains the single largest user of water in Nye County with almost 80 percent of the total water used in the County going towards irrigation in 1995 (Nevada Division of Water Planning, 1998, p. 5).

Similarly, the minerals-related mandates resulted in the development of the mineral resources of the nation. The federal minerals policies have been major contributing factors in the development of the mining sector of the economies of the State of Nevada and Nye County. The mining sector has historically placed significant demands upon the water resources of the county and still accounted for almost 10 percent of the total water withdrawals from the county in 1995 (Nevada Division of Water Planning, 1998, p. 5). If the water used by the residents employed by the mining industry are taken into account along with the percentage of the service and government sectors associated with those residents, then the total water demand as a direct result of mining activities would represent an even greater proportion of the total demand.

Beginning in the second half of the 20th century, federal policies were dramatically changed to place an emphasis on environmental protection and preservation through the passage of such measures as the National Wilderness Act, Endangered Species Act, the National Environmental Policy Act, and the California Desert Protection Act. These acts also led to demonstrable impacts on the water resources, and associated socioeconomic values of Nye County. Direct impacts as a result of these mandates include the loss of agricultural lands and associated employment, an increase in the cost of appropriating and developing water supplies, and the elimination of large areas of Nye County from future groundwater development. Indirect impacts from these acts have resulted through the loss of tax revenues to both Nye County and the State of Nevada, potential mineral resource devaluation, and the opportunity costs.

U.S. Department of Energy Actions

The past actions taken by the DOE have had a profound and demonstrative impact on the water resources of the region of influence. First and foremost, of course, are the impacts that occurred as the result of nuclear weapons testing and experiments at the Nevada Test Site (NTS) and Tonopah Test Range (TTR). Secondly are the impacts that have resulted as a result of the withdrawal of the lands comprising the NTS. Thirdly are the impacts related to water use as part of Test Site operations and the Yucca Mountain Site Characterization Program. Future actions associated with the disposal of high-level waste at Yucca Mountain are discussed in a later section.

Impact of Mission Related Actions

The nuclear age dawned in Nye County in 1951 when President Harry S. Truman approved the establishment of the Nevada Proving Ground (renamed the Nevada Test Site in 1955). On January 11th of that year, the

nation conducted its first atmospheric test at this new facility, a one-kiloton device code-named Able, that was detonated 1,080 feet above Frenchman Flat (DOE, April 1993, p. 1). Between 1951 and 1992, 100 atmospheric and 828 underground nuclear weapons tests were conducted at the NTS (DOE, December 1994, p. vii). The nation's underground nuclear weapons testing program has left an indelible mark on the history, present conditions, and future of Nye County. Nye County has experienced, and continues to experience, the economic benefit of this federal facility. Nye County citizens are proud of their contribution to the defense of our nation as the situs jurisdiction for the Test Site. However, as an unavoidable consequence of the nation's testing program, there have been significant demonstrable impacts on the water resources of Nye County.

Direct Impacts

The effects of weapons testing and experiments at the NTS have been detailed in a number of previous documents, most notably Borg et al, (1976), Glasstone and Dolan (1977), ERDA (1977), and DOE (August 1996). The impacts of historic testing and experiments and other test site operations, relative to water resources, include:

- o Damage to the aquifers underlying the testing areas;
- o Groundwater and other subsurface contamination;
- o Lowering of water levels around NTS water supply wells; and
- o Disruption of groundwater flow paths and gradients.

Damage to Aquifers

Extensive physical disruption of the natural hydrologic system has occurred as a direct consequence of past weapons testing. The demonstrable impacts of an underground nuclear test on the physical environment are ground motion, disruption of the geologic media, surface subsidence, and contamination of the subsurface geologic media and surficial soils (DOE, August 1996, p. 4-81 and ERDA, 1977 pp. 4-1 to 4-6).

Ground motion from underground tests has resulted in surficial pressure ridges, displacement faults, and fracturing of the rocks overlying the testing areas (DOE, August 1996, p. 4-81). Vertical displacement of as much as 2 meters (8 feet) has occurred along faults in Yucca Flat and the volcanic rocks of Rainier Mesa have been fractured as a result of the loss of strength in the rocks in that area. These faults and fractures have increased the potential for downward migration of contamination from the surface and intermediate depth cavities to the water table.

Disruption of the deep geologic media and surface subsidence are a direct impact of historic underground testing. In the milliseconds after detonation of a nuclear device, the weapon and the surrounding rock are vaporized creating an underground spherical cavity. Within a few tenths of a second, the pressure within the cavity equalizes with the pressure in the overlying rock and the cavity reaches its maximum size. At the same time, the shock wave from the detonation travels outward from the cavity, crushing and fracturing the rock in the vicinity of the cavity. When the pressure caused by the explosion has decayed to the point where it can no longer support the overlying rock and soil, the cavity may collapse forming a chimney upward from the cavity. This process continues until either the cavity fills with rubble or the chimney reaches land surface and a subsidence crater forms, usually within a few hours after the detonation.

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Fracturing of the rocks in the vicinity of the cavity at each test has resulted in changes in the natural permeability of the rocks (DOE, August 1996, p. 4-84). These effects generally occur within 300 to 3,000 feet of the point of detonation, depending upon the yield of the weapon and the depth of emplacement. The shock wave and compressive forces from the tests increases the permeability near the cavity by creating more fractures. At greater distances from the cavity, the permeability may actually be permanently decreased because of the opening and closing of fractures. These detonation induced effects have altered the natural permeability and hence the transmissivity of the aquifers.

The magnitude and significance of the overall damage to the aquifers underlying the underground test areas at the NTS is not well understood. Laczniak et al (1996, p. 45) noted that because of the large number and close proximity of the underground tests in Yucca Flat, the aquifer damages from adjoining tests are probably cumulative. The consequences of these interactions between tests include increased hydraulic communication between aquifers, the creation of new pathways for groundwater flow, enhanced downward recharge from the surface, and an increase in the leachable surface area of melt glasses that formed immediately after detonations. These damages have severely impaired the ability of the aquifers under the testing areas to provide water supplies now, or in the future. As a result, the long-term productivity of the aquifers has been adversely impacted, and significantly so.

Groundwater and Other Subsurface Contamination

As noted in DOE (August 1996, p. 5-30), the groundwater under some portions of the NTS has been contaminated. Approximately 300 million curies of tritium and other fission and activation products were released into the deep subsurface environment. Of this total, an estimated 112 million curies were released below, or within 330 feet of the water table (DOE, August 1996, p. 4-129). The 1977 Final Environmental Impact Statement for the Nevada Test Site (Energy Research and Development Administration, September 1977, p. 9-1) did not identify this contamination of the water resources as an irreversible and irretrievable commitment of the resources; rather, it only identified the addition of new underground pockets of radioactivity and the formation of subsidence craters as such commitments. The 1996 Environmental Impact Statement for the Nevada Tests Site and Off-Site Locations in the State of Nevada, identifies any groundwater contamination in excess of U.S. Environmental Protection Agency drinking water standards as a result of future underground nuclear testing conducted in, or near the water table, as an irreversible and irretrievable resource loss (DOE, August 1996, p. 5-229).

Although the DOE Environmental Restoration Program has been evaluating the underground testing areas since before 1989, final definition of the extent and magnitude of the underground contamination and the selection of an appropriate remedy is not likely to occur for at least another decade. According to the provisions of the final Federal Facility Agreement and Consent Order with the State of Nevada, dated March 15, 1996, and the Underground Test Area Approach (unpublished DOE document dated January 26,1998), the full extent and magnitude of groundwater contamination may never be known. The strategy negotiated between DOE and the Nevada Division of Environmental Protection (NDEP) is based upon two principal assumptions: 1) The strategy can be achieved utilizing existing data and wells; and 2) the proposed remedial option is long-term groundwater monitoring. Thus, the final remedy may allow for continuing damages to the aquifer and water resources to occur.

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In lieu of defining the extent and magnitude of groundwater contamination through exploratory drilling, testing, and sampling programs, the results of existing regional and yet-to-be developed localized groundwater flow and transport models are being used as the basis for assessing the groundwater contamination. The location of underground nuclear weapons tests and the results of the regional model (DOE, 1997) are shown in Figures 2 and 3, respectively. As shown, underground testing was conducted across broad areas of the Test Site and the groundwater pathways down gradient from these testing areas extend into the populated areas of Amargosa Valley and ultimately, to Death Valley and the Franklin Lake Playa areas of California.

Beyond the weapons testing at the NTS, the facility has been used for radioactive waste disposal, nuclear rocket testing, and nuclear weapons related safety experiments. These activities have resulted in the contamination of the subsurface with about 10 million curies of radioactivity remaining as of January 1996 (DOE, August 1996, p. 4-6). What portion, if any, of this near-surface or shallow-depth contamination may be mobile and capable of reaching the water table has not yet been determined.

Lowering of water levels around NTS water supply wells

The DOE has historically operated 15 water wells situated at locations across the NTS. Water withdrawals and pumping and static water levels have been monitored at the NTS and have indicated that significant impacts have not occurred (DOE, August 1996, p. 5-29). Localized water-level declines and changes in flow directions in the vicinity of DOE water supply wells has occurred and will continue to occur in proportion to the level of water use needed to support Test Site operations. Overdraft has historically occurred on the NTS in the Yucca Flat hydrographic basin because of its limited perennial yield (700 acre feet per year). Future DOE withdrawals on the NTS are not expected to exceed the perennial yields of any of the source basins.

Disruption of groundwater flow paths and gradients

As a direct result of underground nuclear detonations, water levels in some parts of the NTS have been altered. Laczniak et al (1996, p. 45) note that in some portions of the Yucca Flat underground testing area, water levels are hundreds of feet higher than expected and that this phenomenon may likely be attributed to anomalously high pressures induced by nuclear weapons testing. As noted by these authors, the consequences of these changes in water levels and the corresponding change in flow paths and gradients have not been fully quantified and will complicate the numerical modeling of the area.

Indirect Impacts

Beyond the direct impacts discussed above, there are a number of indirect impacts that have affected the water resources of Nye County as a result of DOE actions related to the NTS.

Increased infiltration through the craters and collapse chimneys

Studies suggest that recharge through the surface deposits of the Yucca Flat and Pahute Mesa underground testing areas has probably been enhanced as an indirect result of historic testing operations. Laczniak et al (1996) reported that the formation of new fractures and collapse chimneys in the unsaturated zone above test locations may enhance the downward infiltration of water and the migration of contaminants. These authors

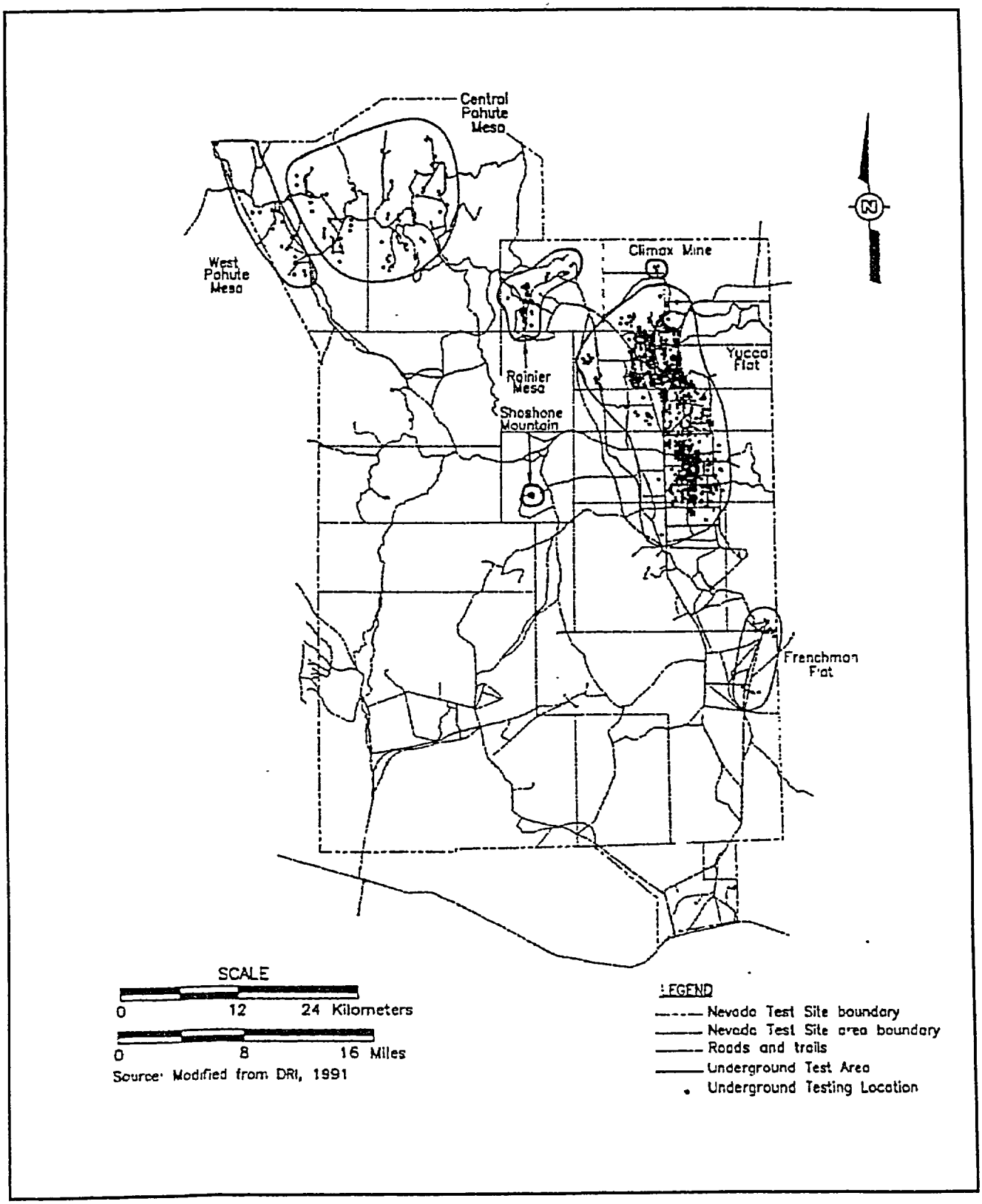

Figure 2 . Location of underground nuclear weapons tests and testing areas on the Nevada Test Site.

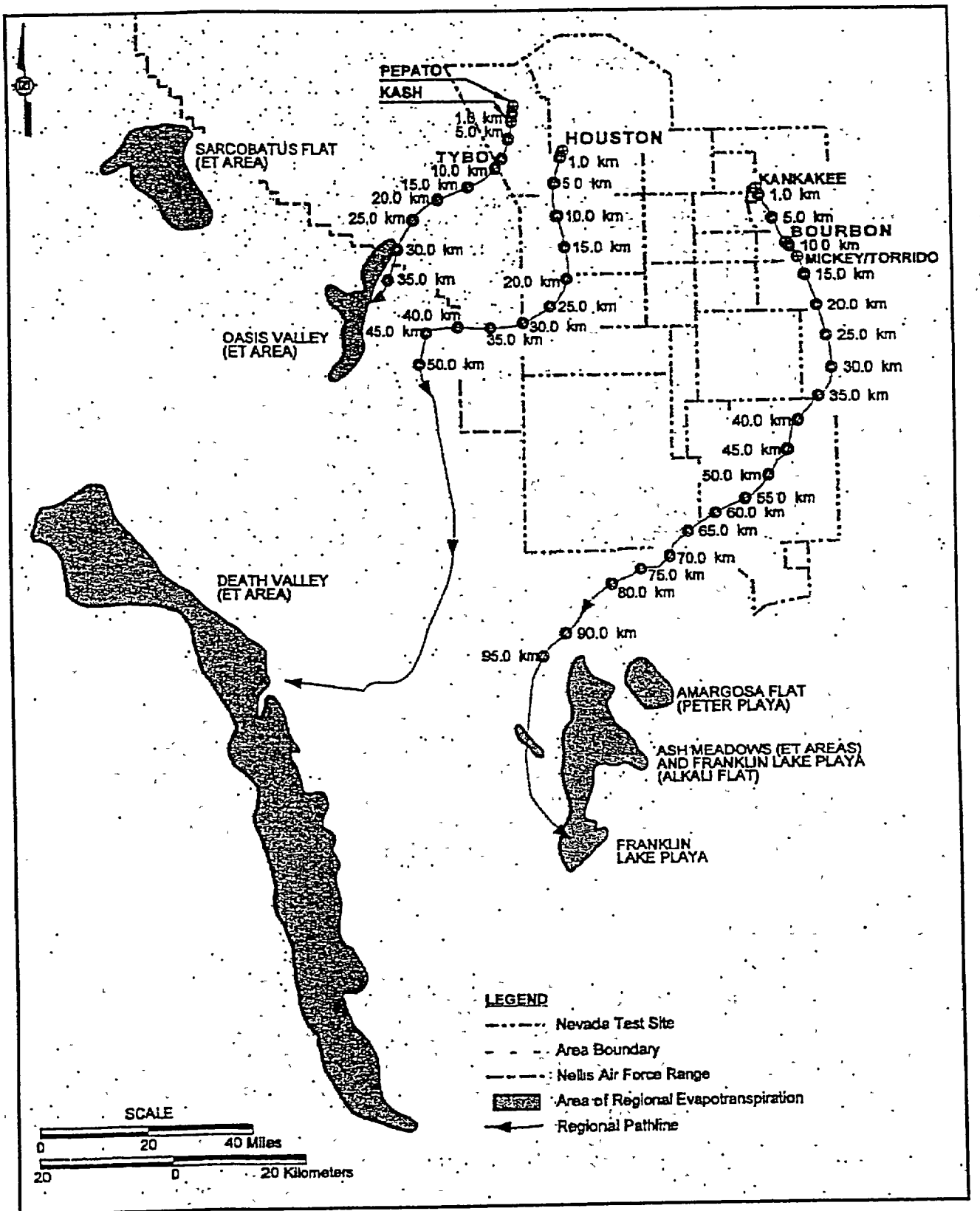

Figure 3. Groundwater flow paths down gradient of underground nuclear weapons testing areas.

further note that this type of enhancement may be more significant in areas where the subsidence craters retain runoff waters (a large area of the valley floor of Yucca Flat and a few locations on Pahute Mesa).

Loss of areas for water supply wells

As noted in DOE (August 1996, p. 4-131), groundwater contamination has rendered portions of the NTS unsuitable for groundwater development. More than 230 nuclear tests were conducted below or in close proximity (within 300 feet) of the water table. These tests resulted in the contamination of the groundwater with more than 60 radionuclides along with other contaminants introduced as part of the tests including fuels, detectors and tracers, rack and canister materials (most notably lead), organic compounds, and drilling and stemming materials (DOE, August 1996, pp. 4-126 to 4-132).

In the Nevada Test Site Resource Management Plan (DOE December, 1998, p. 11-5), the DOE states their assertion that "the contamination associated with nuclear tests is often localized near the test cavity, leaving the water above, below, and lateral to the test uncontaminated". This somewhat optimistic characterization might have merit if all of the contamination were truly isolated and not available for transport via dispersion and groundwater flow, however, the mobility of the contamination from underground testing at the NTS has already been established. According to DOE (August 1996, p. 4-130), there have been about a dozen instances of migration of radionuclides other than tritium, and tritium is thought to have migrated as much as several kilometers from some event locations. As a consequence, any groundwater withdrawals from areas above, below, or lateral to event cavities would be expected to induce the spread of contamination from the cavity and surrounding area toward any pumping wells whose capture zones include the test event location.

Because of the limitation presented by the occurrence of large areas of radioactive contamination, a significant area within Nye County can no longer be considered suitable for groundwater development. More than 250 square miles of the NTS have been used for underground testing. Because of the presence of significant quantities of contamination, the groundwater within the underground testing areas has effectively been lost to Nye County as a natural resource. Further, additional areas are no longer suitable for groundwater development because of their *proximity* to the contaminant sources and plumes in the underground testing areas. Insofar as the actual extent and magnitude of groundwater contamination under the NTS has not been, and may never be defined, the true extent of resource damages is not known at this time and may never be accurately known.

Impacts from Land Withdrawal

Beyond the direct impacts associated with underground weapons testing and other actions on the NTS, there are continuing impacts associated with the withdrawal of the lands that now comprise the facility. Under the various agency land withdrawals (Department of Energy and U.S. Air Force), a total of 1,350 square miles have been withdrawn from general use by the public. These withdrawals have effectively removed large areas of Nye County from consideration for future water resources development. There are areas on the NTS where groundwater resources are available and could be developed; however, their development by entities other than the DOE or DOD is perceived as inconsistent with the mission of the facility. Further, groundwater development could result in the *spread of contamination* into previously uncontaminated areas. Thus, successful development of the uncontaminated groundwater resources underlying the NTS is considered at best to be highly unlikely. As a consequence, the water resources that would otherwise be available to Nye County have been withdrawn.

Impacts from Non-Mission Related Water Use

Water withdrawals as part of the Yucca Mountain Site Characterization Program and the Kistler Aerospace activities have also affected the availability of water resources of Nye County. Adverse impacts associated with these actions include reductions in the quantity of water available for appropriation and the localized effects of increased water withdrawals from NTS wells and wells used to supply the Yucca Mountain characterization studies and other activities.

In addition to the direct impacts of non-mission related water use, there are the indirect impacts on water resources associated with employment at the NTS. Most NTS workers live off of the facility, predominantly in Clark County with a lesser number residing in Nye County. Worker employment on the NTS leads indirectly to an increased demand for water in Beatty, Amargosa Valley, Pahrump, and metropolitan Las Vegas.

U.S. Department of Defense Actions

The impacts of past Department of Defense actions in Nye County upon the water resources are primarily related to those activities conducted by the U.S. Air Force on the Nellis Air Force Range and the Tonopah Test Range. With respect to Yucca Mountain, only those impacts on the Nellis Air Force Range are of note. The impacts of Air Force actions were identified in the Renewal of the Nellis Air Force Range Land Withdrawal Draft Legislative Environmental Impact Statement (1998) and The Special Nevada Report (SAIC, 1991). The Special Nevada Report identified the impacts associated with actions taken by the U.S. Air Force, the U.S. Navy, and the U.S. Department of Energy in compliance with the Military Lands Withdrawal Act of 1986.

Impact of Mission Related Actions

The Las Vegas Bombing and Gunnery Range, now called the Nellis Air Force Range, was established on October 29, 1940 by President Roosevelt. In total, the range comprises more than three million acres of land between Tonopah and Las Vegas. The range is the nation's premier combat flying training area and its mission is critical to national security.

Direct Impacts

Actions taken at the Nellis Air Force Range have resulted in: the dispersal of more than 40,000 tons of explosion debris, residues, and contamination (depleted uranium, beryllium, and explosive products) on alluvial fans and playas; the disposal of solid wastes, paint products, solvents, batteries, and petroleum products in landfills, pits, and explosive ordnance disposal pits; leaks from underground storage tanks; and the consumption of water in support of mission related activities.

The U.S. Air Force (October 1986) provides limited information on disposal sites and Installation Restoration Program (IRP) sites on Nellis Air Force Range (NAFR) including the Tonopah Test Range (TTR). There are about 50 landfills located on the TTR and NAFR. A total of 24 IRP sites have been defined in Nye County with formal Site Inspections having been conducted for 13 sites at TTR and an unknown number of sites on NAFR. Information presented in U.S. Air Force (October 1986 p. 3-17) indicates that remedial actions were previously not required by the Nevada Division of Environmental Protection at any of the IRP sites in Nye County.

According to the Special Nevada Report (SAIC, 1991, p. 2-119), the dispersion of explosion debris may have resulted in the contamination of groundwater; however, the amount of groundwater that may have been contaminated as a result of these by-products is not known and cannot be estimated on the basis of existing studies. Similarly, insufficient studies have been done to allow the definition of contamination that may have resulted from land filling of wastes, the operation of explosive ordnance disposal facilities, or leaking tanks. According to the final contamination report for the proposed Nellis Land Withdrawal (U.S. Air Force, February 1997, Table 6-3), three sites in Nye County were found to have surficial soil contaminated with arsenic and beryllium. Subsequent evaluations reported by the U.S. Air Force (September 1998a, p. 3.6-15) indicate that contamination of surface soils is known to occur but the potential for groundwater contamination from this source is discounted because of the "low precipitation, high evaporation, generally low solubility of the contaminants of concern, and the considerable depth to groundwater across most of the range." This more recent study identified two categories of contamination on NAFR, ordnance residues and operations and maintenance spills, and concluded that there was little potential for the contaminants to migrate vertically downward to an aquifer (U.S. Air Force, September 1998a, p. 3.6-14).

Indirect Impacts

The indirect impact of U.S. Air Force mission-related actions in Nye County on the water resources is limited to an increase in the demand for water in the region. As for the DOE, the indirect impacts on water resources have been, and are associated with employment at the Air Force facilities. Most range workers live off the facility, predominantly in Clark County, with a lesser number residing in Nye County. Thus worker employment on the NTS leads indirectly to an increased demand for water in Tonopah and metropolitan Las Vegas.

Impacts from Land Withdrawal

As discussed for the land withdrawals that defined the NTS, there have been impacts associated with the withdrawal of the lands that now comprise the Nellis Air Force Range. These withdrawals have effectively removed large areas of Nye County from future development. There are areas on the range where groundwater resources could be developed, however, their development is inconsistent with the mission of the facility and such development is considered at best to be highly unlikely. As a consequence, the water resources that would otherwise be available to Nye County have been withdrawn as well as the land. In the Special Nevada Report, the analysis of the effects of the land withdrawals noted that:

> "The withdrawal of land from public access and/or the purchase of water rights by DOD and DOE has the greatest potential for effects on Nevada. ... The water resources associated with these lands could, if they exist and were available, play an important role in the continued growth of southern Nevada." (SAIC, 1991 p. 8-97).

Possible mitigating measures identified in the Special Nevada Report included the provision of access for water resources evaluation and development (if possible and consistent with mission requirements); assistance in water resources evaluation on withdrawn lands; the provision of rights-of-way for water transmission facilities where such action would not limit, constrain, or deny the purpose of the withdrawal; and considering opportunities to cooperate with local agencies to enhance water supply sources and programs.
/

Impacts from Water Appropriations and Use

The U.S. Air Force has 25 water rights in Nye County for springs and surface water sources totaling 485.07 acre feet (U.S. Air Force, September 1998b, pp. 26-30). The U.S. Air Force also has 15 groundwater appropriations in Nye County totaling 1,669.44 acre feet (U.S. Air Force, September 1998b, pp.15-17). The appropriations associated with the U.S. Air Force-related water withdrawals reduce the legal availability of water in the basins and flow systems in which they occur, and are additive to the appropriations of all water right owners in the region of influence.

Although the U.S. Air Force water right holdings in Nye County are appreciable, the actual quantity of water used is small. Between 1995 and 1997, metered water use at seven water supply wells in Nye County ranged from 129.2 to 159.51 acre feet per year. The impacts of water use in support of U.S. Air Force actions are limited and include the localized effects of water withdrawals in the vicinity of water supply wells. The existing network of active wells are all situated in areas located north and northwest of the Nevada Test Site except for Strager's Well located west of Yucca Mountain. These effects of these water withdrawals likely include a localized lowering of water levels in the immediate vicinity of the supply wells. The direct localized impacts associated with U.S. Air Force water withdrawals would probably not be additive to those of the Test Site or Yucca Mountain because of the distances between the individual water wells and the relatively minor quantities of water pumped.

U.S. Department of Interior Actions

Three separate Department of Interior agencies, the Bureau of Land Management, the National Park Service, and the Fish and Wildlife Service have stewardship of large tracts of land in Nye County. In this section, the impacts of the past and present actions and policies of these agencies, with respect to water resources, are described and discussed.

Bureau of Land Management

The Bureau of Land Management (BLM), through its Las Vegas District Office, has stewardship of 735,547 acres in southern Nye County (BLM, May 1998, p. 1-3). With respect to their land management practices and policies, a number of objectives and management directions have been identified. The FEIS for the Las Vegas District sets forth three management objectives for water resources. The first two are the maintenance of water quality and the maintenance or reduction of salt yields. These objectives have little potential for adversely impacting the water resources of Nye County. The third objective is to ensure availability of adequate water to meet management objectives including the recovery and/or re-establishment of Special Status Species. This objective has the potential to adversely impact water availability in the County.

Of particular note in the BLM's FEIS and Resource Management Plan is the first Management Direction aimed at meeting this objective:

> **"Determine water needs to meet management objectives. File for appropriative water rights on public and acquired lands in accordance with the State of Nevada water laws for water sources that are not federally reserved."** (BLM, May 1998, p. 2-9)

Management objectives and directions for other resource categories also have implications with respect to water resources. Under the category of fish, wildlife and special status species management, there are several

management directions that will impact the availability of water in the region. These directions include:

> **"Manage mesquite and acacia woodlands for their wildlife habitat values in... Amargosa Valley... Pahrump Valley** [and]... **Stewart Valley** [in Nye County] **and Stump Springs** [in the Clark County portions of Pahrump Valley] **or any other areas identified as being of significant wildlife value."**(BLM, May 1998, p. 2-17)

> **"Protect important resting/nesting habitat, such as riparian areas and mesquite/acacia woodlands. Do not allow projects that may adversely impact the water table supporting these plant communities."** [emphasis added] (BLM, May 1998, p. 2-17)

> **"Manage public lands adjacent to the Ash Meadows Area of Critical Environmental Concern ... to complement spring and aquatic habitat for special status species, including projects that may affect ground water levels or spring flows."** [emphasis added](BLM, May 1998, p. 2-18)

The BLM has designated 45,963 acres in Nye County as Areas of Critical Environmental Concern (ACEC). There are 6,891 acres in the Amargosa Mesquite ACEC in the Amargosa Flat area, 9,423 acres of private and BLM land within the Ash Meadows Wildlife Refuge, and 37,152 acres of BLM land around the refuge.

Impact of Resource Management Plan Related Actions

The present Resource Management Plan for the Las Vegas District includes a number of actions that have impacted, or will impact the water resources of Nye County. The direct and indirect impacts of the proposed acquisition of water rights, and actions taken to manage public lands for wildlife values are defined and discussed below. A subsequent section addresses the impacts of land disposal plans.

Direct Impact

The acquisition of water rights to support management directions will have a direct impact on the availability of water resources in Nye County. The Amargosa Desert and Pahrump Valley hydrographic basins have been designated as requiring additional groundwater management by the Nevada State Engineer. As a consequence, the BLM may not be able to administratively obtain the new water rights deemed necessary to meet management objectives that address those areas within Nye County and hence, may have to purchase and transfer existing water rights in the basins.

It is uncertain at this time if the BLM will claim a federally reserved water right for these areas, and if so, what quantity of water rights will be claimed. If water rights are purchased from willing owners and the water rights transferred to other areas, the quantity of legally available water in the basin available to non-federal uses will be reduced. Conversely, if the BLM claims federal reserved rights, then the overdraft conditions in Pahrump and the projected overdraft conditions for Amargosa Valley will be exacerbated as the federal reserved right would be additive to the over-appropriation of both basins.

The designation of large areas of Nye County as ACECs will also impact the water resources. Water that is appropriated, water rights that are purchased, and/or federal reserved water right claims for the protection of

the ACECs will result in a decrease in the amount of water available for other purposes within the Amargosa Desert and Pahrump Valley hydrographic basins. Actions taken via protests under Nevada Water Law, or other measures to disallow projects that might impact the ACECs, will result in higher costs for water, delays in water right applications (including change applications), and the cost borne by the applicants in responding to protests.

Indirect Impacts

Any actions that result in a decrease in the availability of water resources in southern Nye County will result in indirect impacts. The indirect impacts include an increase in the costs of water rights, a decrease in the taxes generated from lands that cannot be developed because of the lack of available water or the costs of that water, and a loss in the productivity of land that cannot be developed. Any water right protest actions aimed at protection of the ACECs will reduce the tax base available to Nye County. Because the BLM may seek to protect ACECs through protests of proposed adjacent land uses that the agency perceives could impact the water table, the actual footprint of the affected land extends beyond the designated boundaries of the ACECs.

Impacts from Land Disposal

Areas designated for disposal total 46,444 acres in Nye County (27,904 areas in Amargosa Valley, 3,772 acres at Lathrop Wells, and 14,786 acres in Pahrump Valley). The BLM's FEIS does not provide the acres of land designated for acquisition in Nye County but it appears that only the 9,423 acres of private land in the Ash Meadows Wildlife Refuge have been so designated. Thus a total of about 36,540 acres in Nye County would change from public domain to private property if land exchanges can be worked out and receive congressional approval. These land exchanges would result in indirect impacts on water availability. As noted by the BLM, land disposals would indirectly impact the water resources by providing land that may be developed, resulting in an increased growth rate and demand on an already taxed water supply (BLM, May 1998, p. 4-9). As noted in the BLM assessment, the additional water requirements could lead to further over-drafting of available groundwater and resultant water quality deterioration.

The BLM estimated that the land disposals in the Las Vegas Valley (in Clark County) would result in an increase in water demand of 3,193 acre feet per year based upon an annual disposal rate of 1,277 acres per year and an average water use figure of 2.5 acre feet per acre per year (BLM, May 1998, p. 4-9). No estimates were made of the increased demand in Nye County. Based upon this same method of estimation, the annual disposal rate in Nye County would be 1,395 acres per year in Amargosa Valley with a corresponding demand of 3,488 acre feet per year for water. Over the 20 year planning period, the total disposed land in Amargosa Valley (exclusive of Lathrop Wells) would be 27,904 acres. Even at a reduced water demand rate of 1.0 acre foot per acre, the demand for water would almost double in the Amargosa Desert hydrographic basin. Similarly, the annual disposal rate in Pahrump Valley would be 738 acres per year with a total disposal of 14,768 acres. At an assumed conservative demand rate of 1.0 acre foot per year per acre, the overdraft in Pahrump Valley would be significantly increased above projected levels.

For the land designated for disposal at Lathrop Wells (3,772 acres) the demand for water would be expected to increase along similar trends as above. However, as water to meet this demand could be obtained from one of three hydrographic basins, the impacts of a specific increase in demand cannot currently be defined. Should the source basin be Amargosa Desert, the impacts would be additive to those described above for land disposal in Amargosa Valley.

Impacts from Water Use

According to the records of the DWR, BLM water use in the vicinity of Yucca Mountain has been very small and limited to one water right in Amargosa Desert, three water rights in Jackass Flats for stock watering, and a single water well in Oasis Valley for quasi-municipal purposes. Thus the direct impacts of BLM water use are minimal.

National Park Service

The National Park Service has stewardship for the Death Valley National Park which includes two areas in Nevada: the "Nevada Triangle" (an area of about 171 square miles of which about 165 square miles are located in Nye County) and Devils Hole, an area of 40 acres located adjacent to the Ash Meadows National Wildlife Refuge. The status of the Death Valley National Park was changed by Congress on October 31, 1994 (through the California Desert Protection Act) from a National Monument to a National Park, and the area under Park Service stewardship was increased to about 3.3 million acres. This increase was limited to areas in California.

The mission of the Death Valley National Park is to protect significant desert features that provide world class scenic, scientific, and educational opportunities for visitors and academics to explore and study. The mission of the National Park Service is to conserve unimpaired the natural and cultural resources and values of the National Park System for the enjoyment, education, and inspiration of this and future generations.

Impact of Mission Related Actions

The National Park Service (NPS) recently released their Draft Environmental Impact Statement and General Management Plan for Death Valley National Park (NPS, September, 1998). The management objectives for this plan include a number of goals that have implications with respect to the water resources of Nye County. The objectives include the perpetuation of native plants, animals and ecosystems including rare and endangered species such as the Devils Hole pupfish, and the perpetuation and increase in water resource science and conservation. During the public scoping phase of their NEPA analysis, the NPS identified a number of water resource issues:

> **"Restoration of numerous springs is needed (e.g. Marl Spring) to make them suitable for wildlife.**
>
> **Consider the possible effects of BLM and NPS activities and regional developments (e.g. Stateline and Yucca Mountain) on water quality and quantity and vegetation.**
>
> **Address Department of the Interior leadership needed in resolving water issues, including adjudication.**
>
> **Address water resource issues (e.g. potential conflict of federal management objectives for Ash Meadows area)."** (NPS, September, 1998, p. 44).

Specific actions aimed at achieving management objectives and addressing these issues have been identified by the NPS and include:

Identify all water sources within the boundaries of the park;

Identify as a federally reserved water right all unappropriated water from any water source identified on federal lands within the boundaries of the park;

Share water source inventory data;

Vigorously defend federally reserved water rights through the state of California administrative process and in proceedings pursuant to Nevada Water Law that may authorize groundwater withdrawals that may impact water sources to which federally reserved or appropriated water rights are attached; and

Pursue acquisition of water rights within the park. (NPS, September 1998, pp. 61-62)

Since 1989, in response to concerns over the massive water right filings by the Las Vegas Valley Water District, the National Park Service has protested numerous water right applications within the Death Valley Flow System, which encompasses all of southern Nye County. The stated policy of the NPS is:

> **"...to follow state administrative procedures and to pursue negotiated settlements to protect its [NPS] water rights. Following State procedures, the NPS has protested numerous water appropriation applications. In many instances NPS reached settlement agreements with the applicants (for example, an agreement between NPS and the Department of Energy concerning water right applications of DOE)."** (NPS Water Resources Division, October 1997 p. 10-12)

In practice, the NPS has protested almost all water right applications in southern Nye County since 1989 that request more than 6 acre feet per year of appropriative right. The NPS actions taken to fulfill their management objectives have had, and continue to have, a number of demonstrable impacts upon the availability of water resources in Nye County.

As requested by the California Desert Protection Act of 1994, the National Park Service, Bureau of Land Management, Bureau of Indian Affairs, and the Timbisha Shoshone Tribe issued in April 1999 The Timbisha Shoshone Tribal Homeland, A Draft Secretarial Report to Congress to Establish a Permanent Tribal Land Base and Related Cooperative Activities. The recommendations in this draft report call for the federal government and the Timbisha Tribe to serve as partners in the area with the transfer of lands within Death Valley National Park and areas outside of the Park in both California and Nevada to be transferred to the tribe.

The demand for water associated with the tribal lands is poorly defined in the draft report, especially with regard to those lands in Nevada and Nye County. No demand for water is given for the proposed trust lands that are located just south of Nye County in the Amargosa Desert hydrographic basin, a basin that is shared between Nevada and California. For the proposed trust lands at Scotty's Junction, no water use estimate is provided. The demand for water at the proposed trust lands at Scotty's Junction would of course depend upon the number of residences, the numbers and types of business enterprises, and the magnitude of agricultural development.

Under the Winters decision of 1908, the United States Supreme Court held that the creation of a reservation by Congress included the implicit reservation along with the land, of sufficient water to fulfill the purposes of

the reservation. The Winters decree did not, however, quantify what those reserved water rights were, and it would take decades of conflict and litigation before the concept of "practicably irrigable acreage" was established by the U.S. Supreme Court in their 1963 decision regarding *Arizona v. California* (373 U.S. 546, 601).

In practice, the practicably irrigable acreage standard is used to quantify as a reserved right the amount of water need to irrigate all lands within a reservation that can be profitably put into agricultural production. In the case of the proposed tribal land in Sarcobatus Flat, the application of this standard would likely result in a claimed implied water right of 14,000 acre feet per year (based on an application rate of 5 acre feet per acre needed to cultivate 2,800 acres of land). This quantity of water would significantly exceed the published perennial yield value of 3,000 acre feet. It should also be noted that the fact that the perennial yield would be exceeded would neither limit the tribes claim to a large implied water right nor the quantity of water rights that would actually be recognized by the State of Nevada. In the case of the Las Vegas Valley Paiute Tribe, the State of Nevada recognized the tribes water rights in a basin that not only was over appropriated, but over pumped as well.

No estimate is given of water demand for the proposed trust lands near Lida, Nevada. Similarly, for the Lida Ranch, Lida, Nevada location, no estimated water demand is provided. The text states that the area would be used for residences, agriculture, and perhaps a tribal retreat.

The same issues discussed above for Death Valley, Death Valley Junction, and Scotty's Junction apply to the proposed tribal lands in Lida Valley. The perennial yield of only 350 acre feet per year is too small to support agriculture on a large scale however, there is nothing to prevent the Tribe from claiming a much larger water right and over drafting the groundwater basin.

Any water development and use by the Timbisha Tribe would add to the cumulative impacts of past, present, and reasonably foreseeable future actions on the water resources of Nye County. As such, all NEPA documentation prepared by the federal government regarding proposed actions in Nye County should include the proposed tribal lands as a reasonably foreseeable future action that should be included in any NEPA evaluations.

Direct Impacts

The direct impacts of NPS actions on the water resources of Nye County include the loss of agricultural jobs and productivity, a decrease in the water available for other uses in the region of influence, increased costs in water right acquisitions, increased operational costs, and a decrease in the rate of growth of the agricultural sector of the County's economy.

The past actions taken by the NPS to vigorously defend reserved water rights through administrative process and the seeking of judicial remedy have had a number of adverse impacts on Nye County. On June 7, 1976, the U.S. Supreme Court ruled that state permitted water withdrawals in the vicinity of Devils Hole must be limited to a level necessary to maintain water levels in Devils Hole above a determined level. This ruling followed the NPS appeal of a decision by the Nevada State Engineer to permit water withdrawals for irrigation purposes. As a consequence of the Court's ruling, the owners of the farm involved in the legal action were forced into bankruptcy resulting in the shutdown of a 12,000 acre ranch and the loss of more than 80 jobs with an annual payroll of more than $340,000.

The NPS claims a federally reserved water right for all unappropriated water from any source on federal wilderness and/or park areas. Although these rights have not been adjudicated, these claims add to the over-appropriation of the Amargosa Valley hydrographic basin. Any water rights that are reserved for federal uses in the region of influence reduces the quantity of water that is available for other uses by the public or local government entities.

In reaching settlements with water right applicants, the NPS has required that conditions regarding monitoring, annual duties, and the period of withdrawal be attached to the permit. Specific examples include the requirement that Bond Gold Bullfrog, Inc. and the DOE drill monitoring wells and monitor water levels and spring discharge rates. In other instance, the NPS has required that water right applicants significantly reduce either their requested diversion rates or annual duties, and/or their type of application (permanent versus temporary). Some water right applicants, including the DOE and U.S. Ecology, Inc., have had to haul water for their operations pending the resolution of NPS protests. The delays in water right permitting, the requirements for monitoring, and the need to haul water to sustain operations while NPS protest issues are resolved to the NPS's satisfaction, have increased the cost of water right acquisition in Nye County.

In some instances, the NPS has approved reductions in the scope of monitoring. In late 1997, after more than six years of monitoring, the NPS concurred with the DOE's request to reduce the scope of monitoring of water withdrawals for site characterization activities at Yucca Mountain.

Because of the increased costs of water appropriations for negotiations, protest hearings, monitoring requirements, and temporary water supplies, the profits from key economic sectors of Nye County have been reduced. Any time profits are reduced in the private sector, there is a corresponding reduction in the taxes generated from the affected operations.

It is difficult to quantify the cost impacts that have occurred as a direct result of the Park Service's water policies in the region of influence. The additive costs associated solely with the protest process can be appreciable. An applicant may spend several tens of thousands of dollars on consultants and legal fees for the preparation of monitoring plans, negotiations with the Park Service, and testimony at a protest hearing. If additional monitoring wells are required, as in the case of DOE (one well) and Bond Gold Bullfrog, Inc., (four wells) the cost can exceed $ 100,000. Other costs for monitoring have included the purchase of staff gages and spring discharge monitoring and recording equipment by the applicant for the Park Service in Death Valley. The additive costs of routine monitoring of water levels and springs varies depends upon the number of monitoring stations and the frequency of measurements but can also be several tens of thousands of dollars per year.

The costs of providing temporary water supplies until Park Service concerns have been resolved can also be appreciable. The costs to U.S. Ecology to haul water from Beatty to their facility (a distance of about 11 miles) were in excess of $ 5,000 per month. Similar costs were probably realized by the DOE.

Although the total costs that have resulted from the Park Service's policy cannot be readily estimated, it is obvious that the costs have not been insignificant, at least several hundreds of thousands of dollars and perhaps more.

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Indirect Impacts

The indirect impacts of past and present NPS actions, policies, and plans include increased water costs, decreased tax revenues, decreases in the long term productivity of private lands, and exacerbation of groundwater overdraft in Pahrump Valley. Because of delays in obtaining water rights because of potential NPS protests, some entities have opted to purchase existing water rights for their uses rather than obtain water rights through the Nevada appropriative process. The costs of water rights have steadily risen in southern Nevada over the last decade; a portion of this increase in cost can be attributed to NPS policies.

Because of NPS actions, it is no longer feasible to obtain and develop new water rights for lands in the vicinity of Devils Hole and it is more difficult and costly to obtain and develop new water rights in areas where the NPS feels that the development would impact park lands. As a consequence, there has been, and continues to be, a loss of the long-term productivity of the affected lands. Although the value of this loss of productivity cannot be estimated, the shut down of the Spring Meadows Ranch clearly demonstrates that the loss is appreciable both in terms of revenues and employment.

The NPS plans to establish a satellite office in Pahrump or elsewhere within the Death Valley flow system. The establishment of such an office will presumably result in a small incremental increase in the population of Pahrump with a corresponding incremental increase in the demand for water. Any action which increases the demand for water in Pahrump can be expected to increase the cost for water and exacerbate the existing overdraft situation in the basin.

Impacts from Land Withdrawal

The withdrawal of land for the Death Valley National Park has eliminated the potential for groundwater development from the withdrawn lands. Thus the water resources underlying an area of about 165 square miles in Nye County have been committed to the needs of the Park Service and are no longer available for development by Nye County, its residents, or business sectors. The quantity of water that has been committed has not been identified.

Recent actions suggest that the NPS may seek to expand Department of Interior controls over public and private lands in southern Nye County. The NPS - Western Region nominated all public lands adjacent to NPS Lands a Park Service Buffer Area of Critical Environmental Concern (BLM, May 1998, p. K-56). The BLM did not recommend that this ACEC nomination be designated citing the fact that "the area was not specific enough to allow for an analysis of the values, if any, of the 'buffer lands.'" Such designations, should they be pursued by the NPS in the future, would have the same types of impacts as those discussed for the BLM ACEC designations. However, based upon consultations with the National Park Service, there are no plans at present to nominate any areas as ACECs nor does the Park Service anticipate ever seeking buffer areas around Death Valley National Park (personal communication, Mr. Dick Martin, Superintendent, Death Valley National Park, Nov. 12, 1998).

Impacts from Water Use

Provisional data concerning historic water use at Death Valley National Park was made available by the National Park Service. Existing water uses include the Furnace Creek Ranch (a privately run hotel and golf

course), consumption by tourists and park staff, wildlife, and irrigation of non-native vegetation including lawns, salt cedars, and palm trees. Table 2 summarizes the water use at Death Valley National Park. Total water use for 1994 was estimated to be about 805 million gallons or 2,470 acre feet. These water use numbers are considered approximate as metered data is only available for some of the areas and for limited time periods.

Based on discussions with Park Service staff, the water use at the Furnace Creek Ranch hotel has been reduced since these 1994 estimates were made. Currently, this resort uses 38 to 39 million gallons per month or about 1,400 to 1,436 acre feet per year (personal communication, Mr. Mel Essington, National Park Service, November 1998).

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Table 2. 1994 Water Use at Death Valley National Park (Source: Provisional data from NPS files)

Water System	Average Annual Use (Million Gallons)	Average Annual Use (acre feet)	Comments
Cow Creek	58.400	179.2	unmetered
Furnace Creek	42.828	131.4	metered; broken in 1992
Wildrose	0.748	2.3	unmetered
Stovepipe Wells	0.131	0.4	meter removed 1993
Scotty's Castle	72.237	221.7	Sep 89-Apr 94 data
Grapevine	3.561	10.9	unknown type & period
Mesquite Campground	1.041	3.2	unmetered
Fred Harvey at Stovepipe Wells	1.280	3.9	Jan 90-Mar 94
Fred Harvey at Furnace Creek	611.971	1,878	Sep 89-Mar 94
Timbisha Village	12.572	38.6	Dec 91-Mar 94
Totals	804.768	2,470	

According to visitation data presented in the NPS's DEIS, the number of visitors to Death Valley National Park almost doubled between 1990 and 1997 from 691,000 to over 1,222,000. A corresponding increase in the demand for water has probably occurred, however, without more consistent meter data and more accurate estimates, this increase cannot be accurately estimated as part of this evaluation. The impacts of water use in Death Valley upon the up-gradient portions of the flow system, if any, have not been evaluated. As these uses are supplied primarily by springs, there probably are not any significant impacts on the water resources of Nye County. The impacts are likely limited to Death Valley and probably include reduced areas of habitat fed by springs and increased salinity of the groundwater.

Fish and Wildlife Service

The U.S. Fish and Wildlife Service has stewardship of the Ash Meadows National Wildlife Refuge, established in June of 1984. This refuge comprises more than 12,000 acres of spring-fed wetlands and alkaline desert uplands. The refuge provides habitat for numerous species including at least 26 plants and animals that only occur at Ash Meadows. In fact, the Ash Meadows National Wildlife Refuge has the greatest concentration of endemic species in the United States.

Impact of Past and Present Actions

To protect the groundwater sources that feed the springs and wetland areas of the refuge, the U.S. Fish and Wildlife Service acquired 54 permitted or certificated water rights in the Amargosa Desert hydrographic basin. These water rights, acquired in 1989, total about 12,573 acre feet per year making the U.S. Fish and Wildlife Service the single largest water right holder in the basin. The agency also holds water rights totaling less than 3 acre feet for stockwater at three springs in the basin.

Direct Impacts

The acquisition of water rights for wildlife purposes by the U.S. Fish and Wildlife Service has reduced the availability of water for other uses in the basin. The need to protect the wildlife values at Ash Meadows has also eliminated a large area up gradient from the refuge as a source of groundwater for other purposes.

The acquisition and use of water resources for wildlife purposes is based upon the assumption that wildlife values are higher than the value placed on agricultural productivity or residential development. In practice (at least in southern Nye County), it appears that this assumption is valid. Historic farming at Ash Meadows has ceased and plans for residential development were stopped when a conservation organization purchased the land so that the former agricultural lands would not be developed. Thus it has already been demonstrated that the wildlife values associated with Ash Meadows and Devils Hole are higher, in pure economic terms, than the values associated with other types of productivity. However, as noted by Montgomery and Pollack (1996) these values benefit society as a whole but the cost of the policy that provides these benefits falls on a small fraction of society, in the case of Ash Meadows, the economy of Nye County. The farmer in Amargosa Valley may not increase his productivity so that another individual, organization, or society in general may enjoy the benefit of the continued preservation of Ash Meadows.

Nye County both recognizes the need to preserve the important wildlife values at Ash Meadows and Devils Hole and is committed to working with the various federal and state agencies to protect these values. However, it must be noted that preservation is not without a price. In this instance, this price includes a loss of productivity and associated revenues to the County as well as the cost of purchasing the land for preservation. These losses are direct impacts of the federal policies aimed at protecting wildlife and habitat.

Indirect Impacts

The acquisition of water rights totaling more than one-half of the perennial yield of the Amargosa Desert hydrographic basin has resulted in an increased demand, and hence cost, for the remaining water rights in the basin. Because the basin is closed to additional appropriations for irrigation, there is a loss of present and future productivity from lands that are suitable for agriculture.

According to the Nevada Division of Water Resources (1973), the soils in the Amargosa Flat area, located a few miles up gradient (hydraulically) of Ash Meadows, have coarse surface textures and low water holding capacity in some areas and are wet and saline and/or alkali. Although the soils are classified as having severe to very severe limitations that reduce the choice of crops or require special practices and management, these soils support the entire agricultural production of Amargosa Valley. The agricultural productivity of the Amargosa Flat area will probably never be realized because groundwater withdrawals needed to bring the area under cultivation would likely impact the habitat at Ash Meadows.

Non-federal Land Use, Land Management, and Development

Impacts upon the water resources of Nye County from past and present actions have not been limited to those caused by federal actions. Each sector of Nye County's economy that requires water has had effects on the resources, both in terms of quantity and quality. In this section, the effects of these actions are defined and discussed. It is noted that the impacts identified are considered to be the indirect impacts of the congressional mandates discussed previously that encouraged mining, agriculture development, and the settlement of lands in Nye County. As noted by the Western Water Policy Review Advisory Commission (June 1998, Exec. Summary, p. xv), "*We must also recognize that the local economies have developed throughout the West as a result of government policies designed to encourage certain land and water uses. As those policies evolve, regardless of the reason, people and communities affected by such changes may need time and assistance to make a transition*".

Mining and Milling

The early histories of Nevada and Nye County were very much affected by the mining industry. Nye County has long experienced the "bust-and-boom" cycles associated with mining. Tonopah and Rhyolite are two prime examples of the rich history of mining in the region. Today, mining continues in Nye County with numerous mining operations located in the vicinity of Yucca Mountain. These operations include the Rayrock Mines, Inc., and Cathedral Gold operations in Crater Flat and the American Borate Company, IMV Nevada, and Barrick Bullfrog, Inc. operations in Amargosa Valley. According to Buqo (1996, p. 28), mining is the second largest non-federal water user in Amargosa Valley accounting for 2,571 acre feet of groundwater pumpage in 1995.

Direct Impacts

The direct impacts of mining and milling operations in southern Nye County include the localized lowering of water levels in the vicinity of dewatering or supply wells. Although mining operations have resulted in adverse impacts on water quality in some areas of Nevada, no reports of groundwater contamination at mines in southern Nye County have been documented. The Gabbs Mining District (in northwestern most Nye County) has been ranked as having the fourth highest potential for contributing to groundwater pollution in Nevada (Nevada Division of Environmental Protection, 1987, p. 17).

Because mining operations are temporary, the impacts on the water resources are also temporary. The Barrick Bullfrog Mine has performed limited dewatering at their property south of Beatty. Based upon the mine's records, the results of groundwater monitoring (conducted as a requirement of the resolution of water right

protests by the National Park Service) have demonstrated that the effects of this dewatering are localized. Water use by this operation, totaling about 1,800 acre feet per year, will cease in 2000 or 2001 as the mine is scheduled for closure.

Water use by other mining operations in Crater Flat and Amargosa Valley have resulted in localized impacts on water levels in the vicinity of production wells. Significant impacts from the use of water by the mining industry have not been identified.

Indirect Impacts

Although water use by the mining industry is temporary, there are long-term indirect impacts. Because of competition between the mining industry and federal uses, the cost for water rights has increased over time and will likely continue to increase.

Ranching, Agriculture, and Animal Husbandry

Ranching, agriculture, and animal husbandry operations in southern Nye County account for the majority of non-federal water use in Nye County. Because of recent water right forfeiture actions in the Amargosa Desert hydrographic basin, water rights for these purposes have been reduced significantly. However, the water use is still less than the total appropriative water rights that have been issued in the basin. As a direct result of the forfeiture actions and the development of new local markets, water use and agriculture has actually expanded during the period between 1990 and 1998. Because water right holders must "use or lose" their water rights, water use in the Amargosa Desert hydrographic basin is expected to continue to expand for the next five years or more, at which time the full appropriative water rights in the basin will have been put to beneficial use.

Historically, there have been two types of ranching operations in southern Nye County, grazing allotments, and irrigated pastureland operations. The water used for grazing allotments was typically derived from developed springs and low production water wells. The past and present impacts of water use on grazing allotments are not considered significant because of the small quantities of water used and their isolation. There are no active grazing allotments in southern Nye County; ranching operations are dependent upon irrigated pastures. About 16,200 acres of pasture were irrigated in Nye County in 1990 (DWR, 1996, p. 8).

Agriculture and animal husbandry have been an important part of Nye County's economy since the 1950s and have been far more stable than mining or activities on federal facilities. Forage crops, primarily alfalfa and sordan, are the main agricultural products. Other crops that are grown or have been grown include barley, wheat, cotton, pistachios, grapes, and vegetables. Nye County total farm marketings in 1995 were $13.2 million, higher than any previous year (DWR, 1998, unnumbered; and DWR, 1994, p. 51). Water withdrawals for irrigation accounted for 80 percent of all water use in Nye County in 1995 when a total of 60,233 acre feet were used (DWR, June 1998, p. 5). Although marketings are up, the total acreage under irrigation has dropped appreciably, from more than 47,000 acres in 1965 to less than 15,000 acres in 1995.

Direct Impacts

Water withdrawals for agricultural purposes have resulted in significant impacts on the water resources of southern Nye County. Direct impacts have included reductions in spring discharge rates in Pahrump Valley

and a lowering of the water table as much as 100 feet in some portions of the basin. Impacts in Amargosa Valley have resulted in the drawdown of water levels in areas of heavy water withdrawals. Kilroy (1991, p. 18) concluded that approximately 30 feet of water level drawdown occurred under the south central Amargosa Farms area between 1952 and 1987. This author noted that the water level decline was rapid during the 1970s but was less severe in the 1980s. Water level hydrographs and a water level change map presented by Kilroy (1991, Plate 3 and p. 44) indicate that a decline in water levels of ten feet or more occurred over an area of about 100 square miles but declines of more than 20 feet were limited to about 20 square miles and declines of more than 30 feet were limited to about 3 square miles.

Indirect Impacts

Indirect impacts that can be attributed to agricultural water withdrawals include increased pumping lifts and costs, the loss of native wildlife species and habitat, land subsidence, and possible water quality degradation.

With the lowering of water levels in Amargosa Valley and Pahrump Valley, more energy is needed to lift an equal volume of water. Thus, an increase in the cost of water production has occurred as an indirect impact. With continued overdraft of Pahrump Valley in excess of 10,000 acre feet per year (and expected to increase), some wells will ultimately have to be replaced with deeper wells, representing a future indirect impact.

The marked decline in spring discharge rates has resulted in the loss of several endemic fish species in Pahrump Valley. Natural habitat that was fed by some of the springs has been obliterated and has been significantly reduced or altered in other areas of the basin.

Although leveling data are lacking, probable subsidence in Pahrump was reported by Harrill (1986, p.42) with predicted impacts of more than 2 feet of subsidence as a indirect result of overdraft of the valley-fill aquifer in the basin. These predictions were based upon the results of a numerical model that also projected that continuous withdrawals of 40,000 acre feet per year from Pahrump Valley for a 65 year period would probably result in another 50 feet of water level decline in some portions of the basin. Water quality impacts from past pumping have not been reported but were also predicted by Harrill (1986, p. 51).

Low-Level Radioactive and Hazardous Waste Disposal

The low-level radioactive waste disposal site at Beatty, operated by U.S. Ecology, was the first commercial site of its type in the nation. The site was opened in 1962 and closed in 1992. During operation, the site received a total of almost 5 million cubic feet of wastes with a total radioactivity of 715,000 curies (DOE, November 1996, p. 4-13). According to information provided by the site operator, 95 percent of this total activity is from isotopes of cobalt, cesium, iron, hydrogen (tritium), nickel, plutonium, promethium, and strontium (Personal Communication, Mr. Zaki Naser, General Manager, U.S. Ecology, July 1998).

U.S. Ecology also has operated, and continues to operate, a hazardous waste disposal facility in accordance with a permit issued by the Nevada Division of Environmental Protection. This hazardous waste disposal facility employs 30 workers. This facility operates under a RCRA Part B permit and there have been no violations (Personal Communication, Mr. Douglas Greffin, Facilities Operations Manager, U.S. Ecology, October 1998). The current permit is in effect through 2008 but U.S. Ecology intends to review the permit and extend the lease if possible.

Direct Impacts

Liquid waste disposal in trenches and spills have resulted in contamination of the groundwater under portions of the facility. Tritium has been detected in the groundwater sampled from monitoring wells at the facility at activities below the action level of 2,000 pCi/L except in 1979, 1982, 1983, and 1984 when activities as high as 49,000 pCi/L (± 29,000 pCi/L) were detected. Although elevated above background levels, the tritium concentrations were below the maximum contaminant level of 90,000 pCi/L. Since July, 1984, only two samples tested positive for tritium (DOE, November 1996, p. 4-17).

Monitoring data for gross alpha and gross beta are also available for the facility (DOE, November 1996, p. 4-13). Gross alpha activities have exceeded the action level of 30.0 pCi/L at least seven times since 1962 and as recently as 1990. The groundwater contamination underlying portions of the facility is a direct adverse impact of waste disposal in southern Nye County. As active groundwater controls have not been required at the facility to remedy the contamination, it appears that the regulatory authorities with jurisdiction over the facility do not consider the contamination to be significant.

Presently water use at the facility is minor and water is trucked to the facility from Beatty. Records concerning historic water use could not be identified. The original water supply well, drilled in the late 1950s, was decommissioned in 1997 under threat of an order from the Nevada Division of Environmental Protection. This well was completed in both the upper and lower aquifers at the site and the well was decommissioned to protect the lower aquifer from contamination by the upper contaminated aquifer (ltr. dtd. 11 September 1997; NDEP to DWR, RE: Installation of a Supply Well at U.S. Ecology, 11 Miles South of Beatty, NV). In October 1997, U.S. Ecology filed for a water right and has been hauling water from Beatty by truck pending resolution of a December 1997 protest by the National Park Service and the drilling of a new supply well. To satisfy the Park Service's concerns, U.S. Ecology had to agree to: 1) limit their annual withdrawals to 4,300,000 million gallons (13.2 acre feet); 2) stipulate that the appropriation would expire in December 2008 unless the lease for the facility is extended; and 3) stipulate that the appropriation is non-transferrable. On May 22, 1998, the Park Service formally withdrew their protest. On July 7, 1998, the Nevada Division of Water Resources issued a water right permit to U.S. Ecology. In June of 1999, U.S. Ecology drilled a water supply well at their facility.

Indirect Impacts

The indirect impacts of non-federal low-level radioactive and hazardous waste disposal on the water resources of Nye County are not considered significant on their own but are, however, additive to the impacts of other actions, both federal and non-federal. As with the larger radiological source terms on the Nevada Test Site, there is the potential for continued releases of contamination to the groundwater as a result of natural recharge over the site. The temporary appropriation of water for operation of the facility does not result in a significant impact on water availability because of the small amount of water appropriated, the isolation of the site relative to other water users, and the short period of use.

Las Vegas Valley Water District Water Right Filings

In October 1989, the Las Vegas Valley Water District filed 146 water right applications for a total of 864,195 acre feet in the rural areas of Nye, Clark, Lincoln, and White Pine Counties. The District filed 32 applications in Nye County requesting 106,405 acre feet of temporary appropriations and 67,475 acre feet of permanent

appropriations for a total of 173,880 acre feet. Within Nye County, the District's applications have been limited to four hydrographic basins (Railroad Valley North and South, Garden, and Coal valleys). Applications for water rights in the Nye County portion of White River Valley and Hot Creek Valley were withdrawn.

The filing of these applications resulted in a considerable backlash not only from the affected counties, but from federal agencies including the National Park Service and U.S. Fish and Wildlife Service, environmental organizations, and private water right holders as well. Thousands of protests were filed on the Las Vegas Valley Water District's applications and to date, no water rights have been granted on any of the applications. Since the applications were originally filed, a number of them have been withdrawn and the water district has repeatedly reduced the quantity of water that is being considered for development. The most current Las Vegas Valley Water District projections indicate an anticipated maximum development of 180,000 acre feet per year (Personal Communication, Mr. Michael Johnson, Principal Hydrologist, LVVWD, November 1998).

Direct Impacts

The primary direct impacts of the Las Vegas Valley Water District's water right filings in Nye County have been fiscal in nature. Nye County has had to expend considerable resources in filing protests, coordinating strategies and plans with other affected counties (Lincoln and White Pine), and conducting independent studies of the District's proposed water withdrawals.

Another direct result of the Las Vegas Valley Water District's water right filings has been a change in National Park Service policy with regard to water right appropriations in southern Nevada. Prior to 1989, the Park Service seldom protested water right applications with the notable exception of the Devils Hole case previously discussed. After the Las Vegas Valley Water District's water right applications, the Park Service adopted a new policy of protesting all water right applications in the Death Valley and Colorado flow systems that are in excess of 6.0 acre feet per year. As will be discussed in the next section, the combination of the Water District's actions with the change in Park Service policy have resulted in significant impacts on the availability of water resources of Nye County.

Indirect Impacts

The combination of the Las Vegas Valley Water District's water right applications and the National Park Service's protests of those, and many subsequent applications, has resulted in a number of indirect impacts on Nye County. Any water right applicants in the valleys where the water district has filed applications must request permission from the Las Vegas Valley Water District so that the applicant can "move ahead" of the water district in the appropriation process. Typically, this means that the applicant must request that his Board of County Commissioners contact the water district and request that the district subordinate the Las Vegas Valley Water District applications. The water district then drafts up an agreement with the applicant that may contain conditions such as no municipal or industrial use in the future. The agreement is then submitted to the Board of Directors of the Las Vegas Valley Water District for approval.

If the applicant is requesting a diversion rate greater than 0.008 cubic feet per second or an annual duty in excess of 6.0 acre feet, then the National Park Service will protest the application. The applicant may then be required to reduce the requested extraction rate or duration and/or install a monitoring well or wells to induce

the Park Service to withdraw their protest. Of particular note is the fact that the National Park Service protest policy covers two entire flow systems comprising 64 individual hydrographic basins and more than 32,000 square miles. The Park Service policy has resulted in protests of water right applications in basins in which the Las Vegas Valley Water District has no applications including Amargosa Valley, Crater Flat, and Pahrump Valley in southern Nye County.

Additionally, The combination of the Las Vegas Valley Water District's water right filings and the National Park Service's policy has led to increased difficulty, time, and costs in obtaining water rights in the region of influence. Another indirect effect of the two agencies actions has been to constrain the growth of agriculture in Nye County as well as the other areas. Because the Amargosa Desert and Pahrump Valley hydrographic basins were closed to new appropriations for irrigation prior to 1989, the impacts on agriculture have been minimal in the southern part of the County.

Another indirect impact of the Las Vegas Valley Water District's water right filings has been increased water right applications by third parties. For example, speculators filed massive water right applications in Amargosa Valley and petitioned the State Engineer to forfeit unused water rights in the basin in the hope that the speculators could obtain new water rights and sell water or the rights to the Las Vegas Valley Water District. As a consequence, more than 12,000 acre feet of water rights were forfeited in the basin. This reduction in legally available water rights has contributed to the increased costs of water rights in Amargosa Valley.

Finally, the combined actions of the Water District and the Park Service have led to increased water use in Amargosa Valley and Pahrump Valley. Concerned land and water right owners have become quite aware of the fact that their water rights are subject to forfeiture if not used. As a consequence, groundwater withdrawals have increased as water right owners protect their water rights by pumping water for irrigation even in instances where market conditions may dictate otherwise. In short, a farmer will grow a crop at a loss if needed to protect their water rights if the value of those rights represents a significant asset. The increase in the value of water rights in southern Nevada over the last decade indicates that the farmer's decision is well based.

Urbanization in Pahrump and Amargosa Valley

Nye County is one of the fastest growing rural areas in the nation. The primary area of growth in the County is Pahrump. From a population of only a few hundred in 1965, Pahrump is now fast approaching 30,000 residents. Growth in Amargosa Valley has not been as dramatic but is still strong with a more than 30 percent increase in population between 1990 and 1995 (Buqo, 1996, p. 11). The rapid urbanization in southern Nye County has had both direct and indirect impacts on the water resources of the region of influence. In this section, those impacts are identified and discussed.

Direct Impacts

The primary direct impact of urbanization in southern Nye County has been an increase in water withdrawals in Pahrump and Amargosa Valley. According to inventory data on file with the Nevada Division of Water Resources, water use for domestic and quasi-municipal purposes in Pahrump (including Cal-Vada and the golf course) grew from 5,479 acre feet in 1990 to 12,096 acre feet in 1997, an increase of 121 percent. To date, about 7,000 domestic water supply wells have been drilled in Pahrump Valley and new wells continue to be

drilled at the rate of about 700 wells per year. As discussed previously, some portion of the increased demand for water has resulted as water right holders exercised those rights to avoid forfeiture.

In Amargosa Valley, quasi-municipal and domestic pumping increased from an estimated 135 acre feet in 1990 to 942 acre feet, almost a 600 percent increase. Much of the increase in Amargosa Valley during this period can be attributed to the construction of a hotel-casino with an RV park and golf course. To date, more than 750 water supply wells have been drilled in the Amargosa Desert hydrographic basin with more than 350 of these wells being used for domestic supplies.

Any increase in water withdrawals in Pahrump Valley, regardless of the type of use (agricultural versus quasi-municipal) results in a corresponding increase in the overdraft of the basin. While the additive effects of a single domestic well with a withdrawal rate of 1.0 acre feet per year are insignificant, the additive effects of 700 additional new wells each year could be significant and over the course of a decade, the impacts become unquestionably significant. The localized lowering of water levels during the pumping of domestic wells is most significant in areas where hundreds of domestic wells are present.

Indirect Impacts

Indirect impacts of urbanization in Pahrump and Amargosa Valley include increased water right costs and increased groundwater vulnerability to contaminant sources. The cost of water rights in Pahrump Valley has risen steadily through the 1990s and is expected to continue to rise through the foreseeable future. With time and the drilling of thousands of new domestic wells, water levels in the basin will likely begin to decline again. Ultimately, thousands of water wells in the basin will have to be deepened or replaced and subsidence over large areas of the basin is to be expected.

Increased groundwater vulnerability to contaminant sources has occurred because of the presence of thousands of domestic septic systems, and the presence of certain types of businesses and operations that represent point sources of contamination. This problem is by no means unique to southern Nye County.

IMPACT ANALYSIS

It is incumbent upon Nye County, as part of their participation in the NEPA process, to insure that the environmental consequences of high-level radioactive waste disposal at Yucca Mountain on the water resources of the county, and the water resources of the broader region are carefully evaluated. In considering the potential consequences, the Department of Energy must use the environmental analyses and recommendations made by Nye County because the County has both jurisdiction by law and special expertise. In this section, the impacts associated with the construction and operation of a high-level waste repository at Yucca Mountain are defined and discussed.

There is no question that the removal of high-level nuclear wastes from storage at the more than 80 operating reactors will result in a great deal of beneficial impacts to the environments where the reactors are located. There is also little question that the siting, construction, and operation of a high-level waste repository at Yucca Mountain has the potential to generate some level of beneficial impacts to Nye County, particularly socioeconomic benefits.

It must be noted however, that not all of the impacts associated with a repository will be beneficial. There will be adverse impacts and some of these impacts are likely to be significant. Thus Nye County is being placed in the unusual position of having to take the bad with the good so that other regions of the nation can realize the beneficial impacts of permanent waste isolation. Both the beneficial and adverse impacts associated with high-level waste disposal at Yucca Mountain will be additive to the impacts that have already been described from other federal actions in Nye County such as underground nuclear testing.

The proposed repository at Yucca Mountain has the potential to result in both direct and indirect impacts on the water resources of the region of influence, and cumulative impacts associated with both categories. Direct impacts may occur either in the short-term (10 years or less), the medium-term (10-52 years), the very long-term (52 to 300 years), or over geologic time. The indirect impacts will occur along similar time frames. With respect to cumulative impacts, three discrete scenarios are developed. These scenarios take into account the reasonably foreseeable future actions that are expected over the next 52 years i.e., through the year 2050.

The first scenario does not include waste disposal at Yucca Mountain and thus represents the "no action" alternative. Under this scenario, the cumulative impacts of past, present, and reasonably foreseeable future actions *exclusive of Yucca Mountain* are defined. This scenario provides the baseline of impacts for evaluation of the additive impacts of Yucca Mountain. The second scenario adds only the impacts of Yucca Mountain to the baseline impacts. The third scenario adds the impacts of Yucca Mountain to the baseline *and* the impacts of two sets of actions that may reasonably expected to be taken by the Las Vegas Valley Water District and the Department of Energy.

Direct Effects

Direct short-term impacts would result from water withdrawals related to repository construction and operation. These short-term impacts would likely include a localized lowering of water levels and alteration of groundwater flow directions in the vicinity of water supply wells. Depending upon the actual quantity of groundwater that is withdrawn, the proximity of the pumping wells to springs or surface water features, and the duration of pumping, other potential direct or indirect impacts may occur. These potential impacts may

include increased pumping lifts and costs for other groundwater users in the region, reductions in spring flow rates, reductions in surface water flows, habitat destruction or alteration, and degradation of water quality. The areas over which such impacts are likely to occur can be estimated by using standard analytical techniques for predicting drawdown in the vicinity of a pumping well and site-specific data concerning aquifer mechanics and the rates and duration of water supply wells used to meet Yucca Mountain resource requirements.

The quantities of water that will be used for repository construction, operation, and closure have not been definitively defined. The Yucca Mountain Site Characterization Plan provides preliminary estimates of a peak demand of 120 million gallons by the end of the seventh year of repository construction and a constant rate of 115 million gallons per year for the next 25 years (DOE 1988, p. 3-130). During operation, the demand for water has not been well defined. The Site Characterization Plan states that the minimum annual demand during the 23 years of repository operation would be about 2.5 million gallons per year but an estimate of peak demand was not provided. For the purposes of this evaluation, a groundwater withdrawal rate of 115 million gallons per year (353 acre feet per year) is assumed. This extraction rate equates to a continuous pumping rate of slightly under 220 gallons per minute.

The DOE Yucca Mountain Project Office (1991) evaluated the effects of continuous pumping of wells J-12 and J-13 which will likely supply some, if not all, of the water required for repository construction and operation. Based upon the hydraulic parameters provided in that document, the effect of long-term pumping can be estimated. After 25 years of continuous pumping at a rate of 220 gallons per minute, the drawdown at a distance of 10 feet from the well J-13 would be about 62 feet and the drawdown at a distance of 6 miles would be about 5.5 feet.

It should be noted that these estimates are based upon the Theis non-equilibrium equation which assumes that the aquifer is uniform and of infinite areal extent, there is no recharge from any source, the well fully penetrates the aquifer, and the water removed from storage is instantaneously released. For long-term pumping, the last two assumptions do not apply, however it is known that the aquifer is not uniform nor is it of infinite extent. Young (1972, p. 9) noted that there are discharge boundaries in the vicinity of J-13 that tend to increase the rate of drawdown that results from the long-term pumping of that well. The author (Young, 1972 p. 18) also noted that extensive dewatering of the welded tuff aquifer that supplies well J-13 will induce recharge from alluvial aquifers to the south (in Amargosa Valley). Any decrease in the naturally occurring subsurface discharge to the Amargosa Desert hydrographic basin would reduce the availability of water in Amargosa Valley and could exacerbate the effects of water withdrawals by users in that basin.

It should also be noted that well J-13 may not be used to supply all of the water necessary for the construction and operation of the repository. If a properly designed well field is used for water supply, the effects on water levels and the potential for reducing subsurface flow into Amargosa Valley would be reduced.

An evaluation of the potential effects of water withdrawals from water supply wells in Jackass Flats on the performance of a repository at Yucca Mountain is beyond the scope of this evaluation. Because of the uncertainties regarding the current configuration of the water table in southern Jackass Flats, additional data is needed before such an evaluation can be performed. Nye County is presently implementing an exploratory drilling program that will provide the necessary information. Based upon the analysis conducted as part of this evaluation and the previous study by Young (1972), it appears that water withdrawals in the vicinity of Yucca Mountain have the potential to alter groundwater flow directions and flow rates under, and in the vicinity of the proposed repository site.

Indirect Effects

Beyond the direct impacts, there are a number of indirect impacts that are likely to occur should a repository go forward at Yucca Mountain. The removal of large areas of land and underlying groundwater from future development, the effects of future groundwater contamination from the repository on resource availability, the rendering of Nye County's groundwater vulnerable to contamination, and stigma are examples of indirect impacts. The consequences of the indirect impacts are likely to be larger in magnitude and severity than the direct impacts associated with simply supplying a source of water for construction and operation of a repository at Yucca Mountain.

The land withdrawal associated with Yucca Mountain will effectively close a large area of Nye County from future water supply development. DOE (May 1986, p. 5-36) in their Environmental Assessment for Yucca Mountain, noted that locating a repository at Yucca Mountain would exclude any future exploitation of groundwater in the area immediately surrounding the repository. For every square mile of withdrawn land, recoverable groundwater will be lost as a natural resource and locations for high-volume, potable water supply wells will be excluded. Further, prime well sites in Jackass Flats, Rock Valley, and Amargosa Desert may no longer be suitable for water development because of their proximity to Yucca Mountain. As a consequence, the water resources underlying appreciably larger areas than the land withdrawal may be effectively lost. As with many of the federal land withdrawals, the footprint of impact may be much larger than the actual area of withdrawn land.

For site characterization, a total of 4,255.50 acres were withdrawn from mining and mineral leasing for 12 years (Federal Register, Vol. 55, No. 188, 25 Sep 1990, p. 39152). As noted by SAIC (December 1989, p. 7), this land withdrawal effectively restricts the development of wells on the withdrawn land until site characterization is completed. Although a final land withdrawal configuration has not been defined, it is assumed that any such withdrawal will be at least as large, and as restrictive, as the withdrawal obtained for site characterization. Thus it is assumed that a permanent land withdrawal for a repository would eliminate the entire length of Fortymile Wash between the southern boundary of the Nevada Test Site and the northen boundary of NTS Area 25. This area has been found to be suitable for the drilling and operation of large volume water supply wells such as J-12 and J-13. The loss of this area for future groundwater development is considered a significant adverse impact on Nye County's water resources.

The second major area of indirect impacts would occur in the event that the repository goes forward and there is a direct release of contamination from the repository. The results of the Total System Performance Analysis suggest that one or more canisters in a repository at Yucca Mountain will fail, that there will ultimately be a release of contaminants from the repository, the released contaminants will reach the groundwater, and a plume of contamination will migrate down gradient of the repository into the populated areas of Nye County. Such a release would, of course, represent a significant adverse impact on Nye County's water resources. Unless swift and comprehensive actions are taken to remedy such a release, an appreciable volume of the County's water resources would be vulnerable to the spread of a contaminant plume down gradient of Yucca Mountain. It is recognized that the results of the Total System Performance Analysis suggest that such a release is not likely for hundreds or even thousands of years. However, the analytic approach employed in those analyses has considerable uncertainty. At a minimum, the water resources of southern Nye County will be vulnerable to contamination for millennia, a significant adverse impact.

A third area of indirect impacts is the increased vulnerability of Nye County's drinking water supplies along the routes used for the transportation of wastes to the repository. Although the probability of a release of

radioactive wastes as a result of a transportation accident has been deemed small, not all types of accident scenarios have been investigated nor have the packages been evaluated for some scenarios. For example, rock falls could result in the destruction of both the transport vehicle and the waste packages and result in a release of radioactive contaminants. Should a release from this, or any other scenario, occur within the capture zone of a public water supply well, then the water supply system would be rendered vulnerable to contamination until such time as the remedy has been implemented.

Finally, there is the stigma that might ultimately result from the presence of a repository at Yucca Mountain. With respect to the water resources of Nye County, it is assumed that there will be no quantifiable stigma associated with Yucca Mountain until such time as a release of contamination has occurred. At the time that a release occurs, a stigma may be associated with the land and resources located down gradient of the facility in the path of the contamination. As noted by Buqo (1993), quantifying the stigma from a deep subsurface release of radioactive contamination is a subjective exercise unless it can be demonstrated that the highest and best use of the resource has been negated by the environmental damage.

It should be noted that stigma will be attached to the water resources on the basis of a release without regard to the actual level of contamination that may occur. That is, the value of land and appurtenant water rights will be reduced if any contamination is present under the land, regardless of whether or not the contamination exceeds some health based standard or criteria. This stigma will also apply to lands adjacent to areas with contamination in the subsurface.

Cumulative Direct Effects

Probably the most important water resource issues related to the indirect impacts of Yucca Mountain have to do with the cumulative adverse impacts of past, present, and reasonably foreseeable future actions in Nye County on the present and future availability of water resources in the region. While the water requirements for constructing and operating the proposed repository are modest, the overall implications of siting the repository at Yucca Mountain are significant. As a consequence, this discussion is related to the issue of cumulative impacts as a they apply to the supply of agricultural, mining, and quasi-municipal water supplies, and water needed to support wildlife and habitat.

Definition of Reasonably Foreseeable Future Action Scenarios

The "reasonably foreseeable future" is not defined in NEPA or in its implementing regulations. For the purpose of this evaluation, the reasonable foreseeable future is defined in accordance with the U.S. Bureau of Land Management (BLM) Guidelines for Assessing and Documenting Cumulative Impacts (April 1994). This guidance states:

> "The reasonably foreseeable action is not a worst-case scenario but a rational projection that combines known action and reasoned, defensible assumptions about future events and developments. It is not necessary (or desirable) to project reasonably foreseeable future actions on maximum development; rather they should be based on what is reasonable, using available and anticipated future technology and defensible economic projections." (as cited, pp. 24-25)

The BLM guidance suggests that Reasonably Foreseeable Future Actions Scenarios (RFFAS) be developed for the purposes of estimating long-term cumulative impacts. The RFFAS, according to this guidance, should be based upon existing planned actions as set forth in Resource Management Plans, actions that are likely to

occur on private, state and other federal land that may impact the same resources as the specific proposed action in question, and clearly documented assumptions (as cited, pp. 25-26). Based upon the available information and the assumptions summarized and discussed below, three RFFAS were developed for cumulative impact evaluation. The proposed actions for each scenario are summarized in Table 3a. For the purposes of this evaluation, the reasonably foreseeable future extends through the year 2050. The Resource Management Plans, Environmental Impact Statements, and other NEPA documents that were used to define the planned federal actions that may impact water resources within the region of influence during the reasonably foreseeable future are listed in Table 3b.

The proposed actions and management policies that have been adopted, or are proposed in these documents are considered in all three scenarios. It is assumed that withdrawals of National Park Service lands and military reservations will be maintained throughout the reasonably foreseeable future as will the lands under the stewardship of the Bureau of Land Management. Further, based upon consultations with the steward agencies, it is assumed that the resource management strategies set forth in the documents listed above will continue in the reasonably foreseeable future. The definition of the impacts upon water resources associated with these federal actions, policies, and management strategies are discussed in the section on the effects of past and present actions.

In addition to the federal actions defined and evaluated in these sources, there are a number of non-federal actions that must also be taken into account in evaluating the cumulative impacts on Nye County's water resources. These actions include Nye County's proposed Nevada Science and Technology Corridor, the Las Vegas Valley Water District's proposed water withdrawals in Clark and Nye County, expected growth in Pahrump, Amargosa Valley, and Beatty, the closure of the gold mine at Beatty, and actions associated economic development at the Nevada Test Site under the auspices of the Nevada Test Site Development Corporation (NTSDC). Information concerning these actions and proposed actions was obtained from published feasibility studies, consultations with the proponents, town boards, regional planning commissions, and information concerning water right applications on file with the DWR.

Uncertainty exists with respect to predicting future growth in Nye County, or almost anywhere for that matter. As a consequence, assumptions must be made concerning growth rates and water consumption. For the purposes of this evaluation, the following assumptions are made.

Assumption 1. Pahrump will experience a full build-out by the year 2050 and all water rights currently held within Pahrump Valley hydrographic basin will be put to beneficial use by that time. Based upon current Nye County projections, the total water demand in the year 2050 will be 84,000 acre feet per year, representing an overdraft of 65,000 acre feet per year on the groundwater resources of the basin. This assumption is included in the definition of all three scenarios.

Rationale

Nye County projections indicate that the population of Pahrump will approach 150,000 people by the year 2050 with a corresponding demand of 84,000 acre feet per year (Buqo, 1996). This projection was based upon a per capita consumption rate of 486 gallons per day and a reduction in agricultural water withdrawals of twenty per cent per decade. The projected demand of 84,000 acre feet per year is more than four times the established perennial yield of the basin and is more than three times the steady-state pumping rate of 26,000

Table 3a. Reasonably Foreseeable Future Acton Scenarios Use in NEPA Impact Evaluation			
Proposed or Existing Action or Assumption	Reasonably Foreseeable Future Action Scenario		
	Scenario 1	Scenario 2	Scenario 3
Overdraft in Pahrump Valley and Amargosa Desert; Full use of perennial yield of Jackass Flat and Rock Valley	X	X	X
No future development in Mercury Valley	X	X	X
BLM - Resource Management Plans	X	X	X
Death Valley National Park General Management Plan	X	X	X
Nellis Land Withdrawal	X	X	X
U.S. Forest Service Plans	X	X	X
DOE-NTS/ER monitoring only	X	X	
DOE-NTS/ER active groundwater controls			X
Las Vegas Valley Water District Full Development of Groundwater Resources in Clark County			X
High-Level Waste Repository at Yucca Mountain		X	X

NOTES: DOE-NTS/ER = Department of Energy Nevada Test Site Environmental Restoration Program - Scenarios 1 and 2 include only passive groundwater controls (monitoring and institutional controls). Scenario 3 includes active groundwater controls (plume control through capture and treatment or hydraulic barriers coupled with institutional controls). Establishment of a Timbisha Tribal Homeland in Nye County is not included since no water use estimates have been provided.

Table 3b. Federal Agency Documents Used In This Evaluation.	
Agency	NEPA Documentation
U.S. Department of Interior Bureau of Land Management	Proposed Las Vegas Resource Management Plan and Final Environmental Impact Statement (May 1998), Record of Decision (October 1998), and Implementation Plan (in preparation) Tonopah Resource Management Plan and Implementation Plan
U.S. Department of Interior National Park Service	Draft Environmental Impact Statement and General Management Plan, Death Valley National Park, California and Nevada (August, 1998)
U.S. Department of Energy Nevada Operations Office	Nevada Test Site, Resource Management Plan, Working Draft (May 21, 1998) Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (August 1996) and Record of Decision (December 1996) Draft Intermodal Transportation Environmental Assessment (September 1998) Final Waste Management Programmatic EIS (1997) and Record of Decision (in preparation)
U.S. Air Force	Renewal of the Nellis Air Force Range Land Withdrawal, Draft
U.S. Forest Service	Proposed Research Natural Area EA Roadless Area Plan and Forest Plan Revision

acre feet per year. The steady-state pumping rate was calculated by Harrill (1986, pp. 47-48) and used by the Nevada Division of Water Resources to take into account return flows from agriculture, domestic use, and public-supply and commercial use (Nevada Division of Water Resources, Supplemental Ruling on Remand, In The Matter of Application 51632, June 2, 1989, Peter G. Morros, State Engineer, Finding of Fact VI).

Assumption 2. Amargosa Valley will place all water rights currently held within the Amargosa Desert hydrographic basin to beneficial use by the year 2050. Based upon current Nye County projections, the total demand in the year 2050 will be at least 29,000 acre feet per year, representing an overdraft of at least 5,000 acre feet per year on the groundwater resources of the basin. This assumption is included in the definition of all three scenarios.

Rationale

It would be erroneous to assume that future water withdrawals in the region of influence will be limited to the published perennial yields or steady-state pumping rates of the source basins, as has been assumed by some investigators. The histories of water withdrawals in Pahrump Valley, Las Vegas Valley, and other basins in Nevada clearly demonstrate that water withdrawals within a given basin are not limited by the perennial yield. According to the estimates made by the Nevada Division of Water Resources, groundwater withdrawals in Pahrump Valley have exceeded the perennial yield of the basin every year since at least 1983. Water use in Pahrump is accelerating at present and the effects associated with full development of the existing water rights must be considered in a NEPA evaluation of the region of influence.

At present, the existing water rights in Amargosa Desert exceed the perennial yield of that basin. It is quite plausible that growth will accelerate and that all of these existing rights will be put to use within the next half-century. The agricultural production in the Amargosa Desert hydrographic basin is driven largely by market factors and concerns over water right forfeitures. The development of large scale dairy operations in the valley (Ponderosa Dairy) has provided a ready market for farmer's forage crops and increased the agricultural productivity. Beginning in 1995, water right forfeiture proceedings spurred an increase in water use in the basin. As a consequence of the increased agricultural production and the threat of additional forfeitures, water withdrawals have increased dramatically over the last seven years. As of the summer of 1998, new areas in Amargosa Valley were being prepared for irrigation in 1999 (as observed during Nevada Test Site Citizens Advisory Board Tour of Amargosa Valley on October 7, 1998), thus the demand for water is expected to increase significantly over the short-term.

Residential and business development in Amargosa Valley is also occurring. A small but thriving hotel and casino, RV park, and golf course has opened in the south end of the community and new businesses have been established. Residential development is occurring and subdivision and parceling activities reported by the Nye County Department of Planning indicate that new quasi-municipal and domestic wells will be drilled as these new lots are developed.

Current and future trends in the parceling and subdividing of land suggest that the drilling of domestic wells will accelerate in the near future in Amargosa Valley. Water withdrawals from domestic wells do not require a water appropriation under Nevada Water Law. Therefore, future withdrawals for domestic purposes will be additive to those projected on the basis of current water rights. Further, even in basins such as Amargosa Valley that have been designated as closed to additional water right appropriations for irrigation, new water rights may be granted for quasi-municipal and commercial purposes. These water rights would also be additive

to those currently appropriated within the basin. Therefore, an overdraft of the Amargosa Desert is to be expected within the reasonably foreseeable future. Because of planned federal land acquisitions and disposal and actions relative to water rights in the basin, it is premature to predict the full growth potential of the community of Amargosa Valley and hence the magnitude of overdraft. However, it is considered reasonable to assume that an overdraft of at least 5,000 acre feet per year will occur by the year 2050. This overdraft represents the full development of the 28,650 acre feet of water rights that have been granted and the demand for a very conservative estimate of 350 additional domestic wells at one acre foot per year per well.

Assumption 3. Because of current and future overdraft of Pahrump Valley, projected future overdraft of Amargosa Desert, and planned and reasonably foreseeable actions related to the development of the Nevada Science and Technology Corridor and the NTSDC, the entire perennial yields of the Jackass Flat and Rock Valley hydrographic basins will be put to beneficial use by the year 2050. This assumption is included in the definition of all three scenarios.

Rationale

With respect to the Nevada Science and Technology Corridor, the development of the proposed Nevada Science Museum and the Amargosa Valley Science and Technology Park are actions which are expected to occur in the reasonably foreseeable future. These actions will increase the demand for water in the hydrographic basins north of U.S. Highway 95 (Jackass Flats and Rock Valley). Minor increases in water demand that are already occurring as a result of NTSDC developments (e.g., Kistler Aerospace and Fluid Tech, Inc.) are expected to increase as future actions such as VentureStar, solar energy projects, and other developments occur. These basins are also under investigation as sources for supplemental water supplies to mitigate the projected overdrafts in Pahrump Valley and Amargosa Desert. Because of environmental concerns with respect to Mercury Valley and groundwater contamination from underground nuclear testing in Buckboard Mesa, Frenchman Flat, and Yucca Flat, the only two hydrographic basins in southern Nye County where unappropriated groundwater could be reasonably expected to be developed for supplemental supplies are Jackass Flats and Rock Valley. Therefore, it is assumed in this analysis that all of the legally available groundwater in these two basins will be appropriated and put to a beneficial use by the year 2050 in all scenarios.

Assumption 4. Because of growth in Clark County, all of the available water resources of the hydrographic basins in Clark County will be put to beneficial use by the year 2050. This assumption is included in the third scenario.

Rationale

On a more regional scale, a rigorous NEPA evaluation must also consider trends in water development in Clark County and their implications with respect to future water use. To provide water for the continued growth of metropolitan Las Vegas, the Southern Nevada Water Authority and Las Vegas Valley Water District have filed water right applications in basins up gradient of Nye County. The District has filed water right applications in Three Lakes Valley (north and south hydrographic basins) and Tikapoo Valley (north and south hydrographic basins). The quantities of water requested in the applications are in excess of the perennial yields of these basins. Recently (September, 1998), the Nevada Division of Lands filed three water right applications in Three Lakes Valley for a new prison. Pending resolution of protests related to these applications, it is not possible to determine at this time what future water developments will occur in the valleys located hydraulically

up gradient of Nye County. However, based upon the continued growth of metropolitan Las Vegas, it is considered reasonable to assume that all legally available water in Clark County will be appropriated and placed into beneficial use by the year 2050. However, as such development is not likely to occur until sometime after the year 2020, it is only included in one scenario.

Assumption 5. Because of wildlife concerns associated with Devils Hole and Ash Meadows, no additional significant water withdrawals beyond those of the DOE will occur in Mercury Valley or from the areas within the Amargosa Desert hydrographic basin that are situated hydraulically up gradient of these environmentally sensitive areas. This assumption is included in all three scenarios.

Rationale

Previous attempts to increase agricultural productivity near Devils Hole resulted in a lowering of water levels in this feature that raised concerns about the continued existence of the Devils Hole pupfish. Planned conversion of these agricultural lands to residential uses was also considered by some to be an unacceptable threat to the aquatic species at Ash Meadows and led to the purchase of this land for preservation. Because of concern that increased water production from up gradient areas would adversely impact the habitat at Devils Hole and Ash Meadows, it is considered highly unlikely that significant water withdrawals in the area will be permitted by the Nevada Division of Water Resources. However, the small quantities of water presently used for domestic and quasi-municipal purposes will continue to occur and may increase slightly over the next 51 years. Should the demand for water increase for some unforeseen future development, it is likely that water would be imported to the reason to avoid adverse impacts on Devils Hole and Ash Meadows.

Scenario 1 Baseline Cumulative Impacts

The baseline cumulative direct and indirect impacts on water resources expected as a result of past, present, and reasonably foreseeable future actions in are presented in Table 4. Table 4a lists the cumulative impacts from mission related activities along with those from the non-federal sector. Table 4b lists the cumulative impacts from the land withdrawals and designations, and Table 4c lists the cumulative impacts from water appropriations, water right claims, and water use by the federal agencies and private sector. These impacts represent the expected cumulative impacts of past and present actions by both federal agencies and private enterprises. The cumulative effect of these actions has already resulted in a number of significant cumulative impacts on water resources including injury through contamination, constraints on water development (both in terms of availability and the loss of locations for water wells), increased demands for water, overdraft, over appropriation, loss of long-term productivity, increases in the costs of water and water rights, loss of habitat, and decreases in tax revenues to the County.

Table 5 summarizes total water use in the region of influence and the predicted water use in the year 2050. According to the records of the Nevada Division of Water Resources, the combined pumping for agriculture, mining, and quasi-municipal purposes in Oasis Valley, Amargosa Desert, and Pahrump Valley now exceeds 40,000 acre feet per year. With federal water uses added to minor private uses in Indian Springs Valley, the total water use at present is approximately 59,000 acre feet per year. Projections made by Nye County indicate that this demand in Oasis Valley, Amargosa Desert, and Pahrump Valley will grow to more than 100,000 acre feet per year by the year 2050. Taking federal water use into account and the expected developments in Clark County, the projected total demand for water in the year 2050 is estimated to be approximately 141,000 acre feet. To accommodate this projected demand, it is considered very likely that every favorable location for obtaining potable groundwater in southern Nye County will be developed by the mid 21st century.

Table 4a Cumulative Impacts From Mission Related Activities - Scenario 1 - Baseline Cumulative Impacts				
Agency or Sector	**Actions**	**Direct Impacts**	**Indirect Impacts**	**Significance**
Department of Energy	Nevada Test Site Operations Past Actions Implement Resource Management Plan	Contamination of subsurface; Physical damage to aquifers; Water level perturbations; Increased recharge down chimneys.	Contamination of recharge; Removal of contaminated areas from future water development;	Significant resource injuries and constraints on water development
U.S. Air Force	Nellis Air Force Range Operations Past Actions	Surficial contamination; Water level perturbations.	Increased water demand in employment centers;	Not significant
Bureau of Land Management	Past Actions Implement Resource Management Plan	Reduced water availability; Increased over appropriation of Amargosa Valley; Restricted area for development; Increased water demand.	Increased water costs; Decreased tax revenues; Decreased long-term productivity of private lands; Decreased tax base growth; Increased overdraft of Pahrump Valley.	Significant increased demand for water and overdraft in Pahrump and over appropriation in Amargosa Valley.
National Park Service	Past Actions Implement General Management Plan	Reduced water availability; Increased over appropriation of Amargosa Valley; Restricted area for development; Increased appropriation time; Increased appropriation cost; Increased water demand.	Increased water costs; Decreased tax revenues; Decreased long-term productivity of private lands; Decreased tax base growth; Increased overdraft of Pahrump Valley.	Significant losses of long-term productivity of private lands, increases in costs of obtaining water rights, and decrease in tax revenues to County.
U.S. Fish & Wildlife Service	Past Actions	Reduced water availability; Increased over appropriation of Amargosa Valley; Decreased long-term productivity.	Increased water costs; Decreased tax revenues.	Significant losses of long-term productivity and tax revenues to County.
Non-federal Sector	Past Actions RFFAs Scenario 1	Overdraft of Pahrump Valley; Over appropriation of Amargosa Valley; Water levels declines; Increased appropriation time; Increased appropriation cost; Groundwater contamination.	Increased water costs; Loss of habitat and species; Increased pumping lifts; Decline of spring discharges; Potential subsidence; Increased water speculation.	Significant overdraft and loss of habitat and species in Pahrump Valley. Significant potential for over appropriation of flow system.

Table 4b. Cumulative Impacts From Land Withdrawals and Designations - Scenario 1 - Baseline Cumulative Impacts				
Agency	**Withdrawal or Designation**	**Direct Impacts**	**Indirect Impacts**	**Significance**
Department of Energy	Nevada Test Site Land Withdrawal (864,000 acres ±)	Restricted area for development.	Reduced water availability; Increased water costs.	Significant reduction in water availability
U.S. Air Force	Nellis Air Force Range Withdrawal (1,290,000 acres ±)	Restricted area for development.	Reduced water availability; Increased water costs.	Significant reduction in water availability
Bureau of Land Management	46,444 acres designated for disposal 45,963 acres designated as Areas of Critical Environmental Concern	Reduced water availability; Increased over appropriation of Amargosa and Pahrump Valleys; Restricted areas for development; Increased water demand.	Increased water costs; Decreased tax revenues; Decreased long-term productivity of private lands; Decreased tax base growth;	Significant increased demand for water and overdraft in Pahrump and increased demand in Amargosa Valley.
National Park Service	Death Valley National Park Land Withdrawals (106,961 acres)	Reduced water availability; Increased over appropriation of Amargosa Valley; Restricted area for development; Increased water demand.	Increased water costs; Decreased tax revenues; Decreased long-term productivity of private lands; Decreased tax base growth.	Significant losses of long-term productivity of private lands, and decreased tax revenues to County.
U.S. Fish & Wildlife Service	Ash Meadows National Wildlife Refuge (12,000+ acres in region of influence only; does not include Railroad Valley Wildlife Management Area or co-use of Nellis Air Force Range lands)	Reduced water availability; Increased over appropriation of Amargosa Valley; Decreased long-term productivity.	Increased water costs; Decreased tax revenues.	Significant losses of long-term productivity and tax revenues to County.
U.S. Department of Agriculture	Lands designated as National Forests (<1,000 acres in region of influence) (1,942,983 acres in all of Nye County)	None identified	None identified	Not significant
Total	Withdrawal of 2,261,000 acres ±; Designation of 59,000 acres ± for conservation, wildlife, or preservation; Designation of 46,444 acres for disposal.	Reduced water availability; Increased over appropriation of Amargosa and Pahrump Valleys; Restricted areas for development; Increased water demand.	Reduced water availability; Increased water costs; Decreased long-term productivity of private lands; Decreased tax revenues.	Significant reduction in water availability, increased demand for water and overdraft in Pahrump and increased demand in Amargosa Valley, losses of long-term productivity of private lands, and decreased tax revenues to County.

Table 4c. Cumulative Impacts From Groundwater Withdrawals - Scenario 1 - Baseline Cumulative Impacts				
Agency or Sector	**Water Right Appropriations**	**Claimed Reserved Rights**	**Estimated Peak Water Use and Year**	**Significance**
Department of Energy	353 acre feet	4,175 (interim claim per Draft Resource Management Plan)	4,175 (sum of 6 basins, peak years vary)	Claimed right exceeds perennial yield of Yucca Flat
U.S. Air Force	1,669.44 acre feet	None	159.51 acre feet	Not significant
Bureau of Land Management	Unknown	None	small	Not significant
National Park Service	none in Nye County	Claims unquantified federal reserved rights for all unappropriated water from any source on federal wilderness and/or park areas	Unknown, 2,470 acre feet average with 588 acre feet of federal use and 1,882 acre feet by non-federal users within Death Valley National Park	Unquantified claim for reserved rights may be significant; water use in National Park is not significant.
U.S. Fish & Wildlife Service	12,576 acre feet	None	24,000 (each year through evapotranspiration)	Significant water rights (more than 50% of perennial yield).
Total federal	> 15,000 acre feet	Unknown, at least 4,175 acre feet in Nye County.	> 30,804 acre feet	Significant water use and reduced water availability for other uses.
Total non-federal	Approximately 96,000 acre feet (does not include domestic wells)	None	Approximately 45,000 acre feet	Significant overdraft of Pahrump Valley
Total Cumulative	> 111,000	Unknown, > 4,175 acre feet	Approximately 76,000 acre feet	Significant overdraft of Pahrump Valley.

Table 5. Estimated 1997 Use and Projected 2050 Water Demand in of the Region of Influence.			
Basin and Basin Number	**Estimated Water Use and Year**	**Estimated Use - 2050**	**Significance**
Lida Valley (144)	unknown	no projections	No significance
Stonewall Flat (145)	none reported	no projections	No significance
Sarcobatus Flat (146)	25 acre feet (1997)	no projections	No significance
Gold Flat (147)	40 acre feet (1988)	25 acre feet	No significance
Cactus Flat (148) Stone Cabin (149)	107 acre feet (1997)	107 acre feet	No significance
Groom Lake Valley (158a)	no data	no projections	No significance
Papoose Lake Valley (158b)	no data	no projections	No significance
Yucca Flat (159)	194 acre feet (1996)	no projections	No significance
Frenchman Flat (160)	273 acre feet (1996)	no projections	No significance
Indian Springs Valley (161)	660 acre feet (1992)	725 acre feet	Exceeds perennial yield in 1992 and 2050
Pahrump Valley (162)	28,819 acre feet (1997)	84,000 acre feet	Exceeds perennial yield by >50% in 1992 and by > 440% in 2050
Three Lakes Valley South (211) Three Lakes Valley North (168)	350 acre feet (1992)	9,000 acre feet	Equals perennial yield by 2050
Mercury Valley (225)	339 acre feet (1993)	no projections	No significance
Rock Valley (226)	None	8,000 acre feet	Equals perennial yield by 2050
Jackass Flats (227a)	217 acre feet (1996)	4,000 acre feet	Equals perennial yield by 2050
Buckboard Mesa (227b)	248 acre feet (1996)	3,600 acre feet	Equals perennial yield by 2050
Oasis Valley (228)	718 acre feet (1996)	2,000 acre feet	Equals perennial yield by 2050
Crater Flat (229)	1,245 acre feet (1996)	900 acre feet	Exceeds perennial yield by 38% in 1992 but likely to decrease to perennial yield by 2050 with mine shut downs
Amargosa Desert (230)	26,478 acre feet (includes Fish & Wildlife appropriations)	29,000	Combined pumpage and evapotranspiration exceeds perennial yield by 58%.
TOTAL	59,000 ± acre feet	141,000 ± acre feet	Resources over developed by 2050.

Scenario 2. Baseline Plus Yucca Mountain

The adverse impacts of the land withdrawal associated with Yucca Mountain will be additive to: 1) the radiological burden already imposed on Nye County from underground nuclear weapons testing, its related tests and experiments, and radioactive waste disposal; 2) the federal land withdrawals associated with the Nevada Test Site, U.S. Air Force ranges and installations, and National Park lands; 3) the impacts that have resulted from federal policies aimed at preserving the environmentally sensitive areas at Devils Hole, Ash Meadows, Death Valley National Park, and other areas of critical environmental concern; and 4) the water resource use and management practices on both public and private lands in Nye County

Any contaminant releases from a repository at Yucca Mountain will be additive to the contamination that already exists. The results of preliminary modeling efforts conducted by the Department of Energy indicate that a plume of contaminated groundwater may form under, and down gradient of, Yucca Mountain after closure. The leakage of radioactive contamination, as predicted by these models, indicates that further losses of water resources may occur. The predicted area of contamination from Yucca Mountain overlaps contaminant pathways and predicted contaminant plumes leading from underground nuclear weapons testing areas on the Nevada Test Site. The impacts of contaminant releases from Yucca Mountain will be additive to those from the underground nuclear weapons testing areas and to those from other contaminant sources including waste disposal facilities. Because the amount of existing contamination on the Nevada Test Site is unknown, it is difficult to determine the cumulative losses of natural resources that will occur as a result of the co-mingling of contaminant plumes from different sources. However, it is possible to determine the significance of the potential for such losses by evaluating the total contamination and contaminant sources in terms of their radioactivity.

The cumulative activity of existing and future radioactive wastes and contamination within the region of influence is summarized in Table 6 and portrayed graphically in Figure 4. As shown, the baseline activity that is already presented in Nye County is on the order of 310 million curies. The disposal of wastes at Yucca Mountain would increase this activity by a considerable factor. Because of the decay rates of the specific radionuclides and their daughter isotopes and the uncertainty regarding when wastes would actually be entombed in the repository, it is not possible to accurately define the total radiological burden at this time. However, given that the wastes in their current form have a minimum total activity on the order of 14 billion curies, the wastes proposed for disposal will significantly increase Nye County's radiological burden.

Only a portion of the Yucca Mountain land withdrawal will be additive to the other federal land withdrawals associated with the Nevada Test Site, U.S. Air Force ranges and installations, and National Park lands. About one-half of the land to be withdrawn for Yucca Mountain is already withdrawn for portions of the Nevada Test Site and Nellis Air Force Range. Of the total withdrawal of 4,244.50 acres, approximately 2,000 acre will be additive. This additive portion includes prime water well locations in Crater Flat. The cumulative impact of the Yucca Mountain land withdrawal will further reduce the areas in which water resources can be developed to meet the long-term water shortfalls projected for southern Nye County. The cumulative loss of the majority of the Jackass Flats hydrographic basin and the most productive portions of the Crater Flat basin represent significant constraints on the development of the County's water supplies.

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Figure 4. Types and Depth Horizons of Radioactivity on the NTS and Yucca Mountain. Modified from US Department of Energy DOE\EIS 0243, August 1996, Environmental Impact Statement for the Nevada Test Site and Off Site Locations in the State of Nevada, Volume 1, page 4-7.

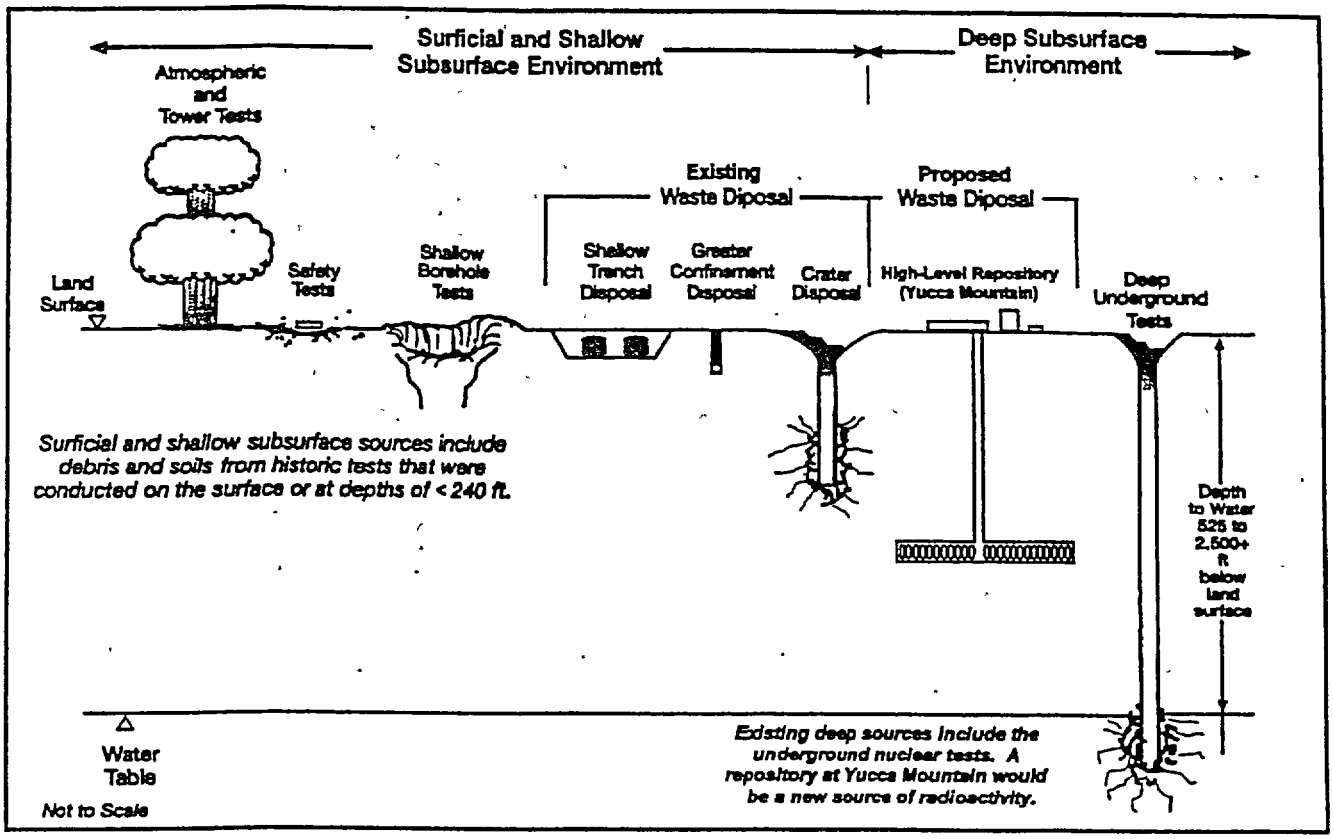

Table 6. Summary of Radioactivity in Southern Nye County, Nevada. Modified from US Department of Energy EIS for the NTS and Offsite Locations in the State of Nevada, Volume I, p. 4-6.

SOURCE OF RADIOACTIVITY	MAJOR KNOWN ISOTOPES OR WASTES	APPROXIMATE REMAINING ACTIVITY (curies)
Above Ground Tests	Americium, Cesium, Cobalt, Plutonium, Europium, Strontium	20
Safety Tests	Americium, Cesium, Cobalt, Plutonium, Strontium	35
Nuclear Rocket Tests	Cesium, Strontium	1
Shallow Borehole Tests	Americium, Cesium, Cobalt, Europium Plutonium, Strontium	2,000 at land surface unknown at depth
Shallow Land Disposal	Dry Packaged Low-Level & Mixed Wastes	500,000[a]
Crater Disposal	Bulk Contaminated Soils & Equipment	1250[a]
Greater Confinement Disposal	Tritium, Americium	9.3 million[a]
U.S. Ecology Beatty LLW Facility	Cobalt, Cesium, Iron, Tritium	710,000[b]
Deep Underground Tests	Tritium; Fission & Activation Products	Greater than 300 million
High-Level Waste Repository	Cesium, Plutonium, Strontium, Americium	Greater than 14 billion[c]

[a] Inventory at time of disposal (not corrected for decay). All other values are corrected for decay to January 1996.

[b] Total curies as of Dec. 31, 1992 per James L. Grant & Associates, Inc. December 21, 1993

[c] Summed from Sinnnock et al. (1987)

The construction and operation of a repository at Yucca Mountain will result in impacts that are additive to those that have resulted from federal policies aimed at preserving the environmentally sensitive areas at Devils Hole, Ash Meadows, and Death Valley National Park. The community of Amargosa Valley is situated *between* the DOE managed lands and those managed by the U.S. Fish and Wildlife Service and the National Park Service. In short, the federal government has adopted a policy of permissible pollution on the DOE lands up gradient of Amargosa Valley and absolute preservation of federal the lands down gradient of the community. Nye County is caught in the middle of these two conflicting policies. The County is faced with the formidable challenge of providing potable water supplies and water for agriculture and mining without inducing the flow of contamination off of DOE lands while maintaining in perpetuity the wildlife, habitat, and cultural values associated with the Department of Interior lands. The cumulative impact of these policies is significant, and as a result, it is considered very likely that Nye County may ultimately have to implement very costly water importation projects to provide its citizens with a safe supply of drinking water without adversely impacting areas designated for conservation or preservation.

Finally, the impacts of Yucca Mountain will be additive to the water resource use and management practices on both public and private lands in Nye County. Although the overall water use by Yucca Mountain is expected to be small (about 350 acre feet per year), this demand will be additive to those of the federal government. The demand for water to support federal policies regarding federally owned or managed lands must be met from the shared water resources that are available. As a consequence, any water that is committed to a federal action, such as Yucca Mountain, is not available for private uses in Nye County. Thus, although the water demand for Yucca Mountain is not large, the demand for water to support all federal actions is large and the cumulative effect of the federal demand for water is significant.

Scenario 3. Baseline Plus Yucca Mountain Plus Large-Scale Water Development

Scenario 3 includes the impacts of Scenario 2 with the additive impacts of large-scale groundwater withdrawals as part of remediation of the contamination at the Nevada Test Site and interbasin water transfers to metropolitan Las Vegas. Although not being actively considered at this time, it may become necessary to implement active groundwater controls to remediate the spread of contamination at the underground nuclear weapons testing areas on the Nevada Test Site. Examples of active controls include pump and treat systems (where contaminated water is pumped to the surface and evaporated or treated) and the creation of groundwater barriers such as hydraulic divides. Such controls, if implemented, will have two significant additive impacts: 1) the water withdrawals used to control contamination will increase the demand on the resources and further limit the water available for other purposes; and 2) groundwater flow paths and travel times may be significantly altered in the vicinity of Yucca Mountain, and the region as a whole.

Future water development in the Yucca Mountain region for non-federal purposes may also alter groundwater flow paths and travel times and could induce the flow of contaminated groundwater toward municipal well fields. As previously discussed, the Las Vegas Valley Water District has filed applications to withdraw as much water as can be permitted from basins located hydraulically up gradient of Nye County. In 1995, the U.S. Geological Survey published the results of numerical simulations of the proposed water withdrawals from rural areas in Clark, Lincoln, Nye, and White Pine counties. Although the modeling approach used is open to question, the results suggest that these water withdrawals, should they go forward, have the potential to dramatically alter the groundwater flow paths in the vicinity of Yucca Mountain. (See Schaefer and Harrill, 1995, US Geological Survey Water Resources Investigation 95-4173, pp. 26-27.) Even if the Southern Nevada

Water Authority does not go forward with its proposed regional water withdrawals, it is likely that the remaining water resources of the region will be developed within the next 50 years. Further, it is considered very likely that all of the remaining water in the region down gradient of Yucca Mountain will also be developed within the next 50 years.

Given the state-of-the-art of numerical modeling, it is not possible at this time to state what the cumulative impact of large-scale groundwater development for water supply and remediation would be. In other areas where such development has occurred (such as Pahrump Valley and Las Vegas Valley) large-scale water withdrawals have resulted in significant impacts including the lowering of water levels, the loss of springs and their associated habitat and wildlife values, subsidence, and potential water quality degradation. The development of the remaining water resources in southern Nye County will have to be carefully planned to avoid exacerbating the spread of contamination from the Nevada Test Site and the additive contamination that could result from a release from a repository. It may prove necessary to import water to the region because of the cumulative limitations imposed by the operation of a repository at Yucca Mountain and policies and management practices aimed at the protection of sensitive species and wildlife habitat.

Finally, given that the results of the performance assessment for a repository at Yucca Mountain indicate that a plume of radioactive contamination may spread down gradient from the site, it is possible that active groundwater controls may have to be implemented to remediate the pollutant plume. If active groundwater controls are employed, the impacts would be as discussed for remediation on the Nevada Test Site. These impacts would be additive to the other impacts under Scenario 3.

MITIGATION

Any of a number of actions may be taken to reduce, eliminate, or mitigate the adverse impacts on water resource availability that may occur as a result of siting a repository at Yucca Mountain. Alternative mitigating measures that could be taken, include the salvage of water from areas threatened with contamination, water supply replacement, and/or a relaxation of certain policies with respect to water allocations in Nye County. Nye County notes that the Department of Energy has committed to discussing mitigating measures in the EIS and Record of Decision including "impact compensation by replacing or providing substitute resources" (DOE, 1997b, p. 27).

Nye County is responsible for protecting the health, welfare, and economic well-being of the County and its residents. As all of Nye County's drinking water supplies are derived from groundwater sources, the protection of groundwater quality is of paramount importance. The siting of a high-level nuclear waste repository at Yucca Mountain, in conjunction with other federal actions, has the potential to result in both direct and indirect impacts on the quality of groundwater in the region. To provide an adequate level of drinking water protection, Nye County has identified the need to implement a strategy that comprises three basic components: wellhead protection; emergency response; and the development of alternate drinking water supplies.

Alternative Repository Design

Nye County is a proponent of design features which will provide greater confinement of the wastes and has developed the concept of a ventilated repository design. The results of preliminary evaluations done by Nye County's scientists suggest that a naturally vented repository would be safer and would likely exhibit fewer effects on the natural environment. Nye County has communicated their findings to the Department of Energy and the County's desire that this concept be given thorough consideration in the development of final repository designs.

Nye County is currently evaluating the concept of active groundwater controls as a means of operating a safer repository. In short, this concept consists of dewatering the aquifers under the Yucca Mountain area. Such an approach would: 1) increase the distance, and hence travel time, between the repository and the water table; 2) salvage groundwater that would otherwise be contaminated from repository releases; and 3) create an artificial sink under Yucca Mountain that would help to delay the migration of contamination should a release from the repository occur.

Wellhead Protection

The direct threats to water quality posed by high-level waste disposal at Yucca Mountain include possible transportation mishaps and potential releases of radioactive contaminants from the repository. To protect Nye County's drinking water supplies, the transportation corridors used for hauling the wastes and the areas down gradient of Yucca Mountain must have aggressive Wellhead Protection Programs that comply with the provisions of the Safe Drinking Water Act. The 1986 Amendments to the Safe Drinking Water Act mandated that such programs:

1. Develop management approaches to protect water supplies from contamination, including technical and financial assistance to water supply system owners and implementation of control measures, education, training, and demonstration projects;

2. Develop contingency plans for each public water supply system indicating the location and provision of alternate drinking water supplies to be used in the event of well or wellfield contamination;

3. Site new wells properly to minimize potential contamination and maximize yield; and

4. Ensure public participation in the Wellhead Protection Program.

High-level nuclear waste transportation through Nye County and disposal at Yucca Mountain represent potential contaminant sources that Nye County's water suppliers must take into account in meeting the requirements for a Wellhead Protection Program. To date, groundwater vulnerability assessments have been completed for some of the public water supply systems located down gradient of Yucca Mountain through an EPA grant administered by the Nevada Bureau of Health Protection Services. Only limited progress has been made toward meeting the full requirements of the Wellhead Protection Program. The individual public water supply systems in the County do not have the technical or financial capacity to meet the remaining requirements. Therefore, Nye County must be provided with financial and technical assistance to achieve the goals of the program. This assistance will be used to prepare a Groundwater Supply Contingency Plan, conduct compliance monitoring, and implement public education and technical assistance programs, and to collect data, prepare maps, and model drinking water supplies.

Further, Nye County must be given the authority to implement regulatory and management measures, such as the performance and operating controls and measures defined under the U.S. Environmental Protection Agency's technical guidance for Wellhead Protection Programs. These controls include:

> Specific permit or license standards (Nye County advocates radionuclide standards for groundwater that are protective of the County drinking water supplies both now and in the reasonably foreseeable future);
>
> Issuance of renewable, revocable operating permits in Wellhead Protection Areas to activities that use, handle, treat, or dispose of contaminating materials;
>
> The development of overlay zones that are protective of both recharge areas and individual water supply wells;
>
> Inspection and enforcement authority and the authority to impose waste specific impact fees, permit fees, fines/penalties, unit charges, access fees, and service fees, as necessary to provide the incentives for compliance with the Wellhead Protection Program.

Given the nature and magnitude of existing wastes and groundwater contamination in Nye County and planned and potential future waste steams that may be coming into the County, the need for an aggressive Wellhead Protection Program is clear. Nye County must be given the wherewithal to implement and manage this program.

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Emergency Response

Nye County notes that while the probability of a release from a transportation related incident has been judged to be slight, the County must be prepared to respond in the unlikely event that such an incident does occur. Financial and technical assistance must be provided to Nye County including personnel, training, and equipment so that the County can respond quickly and effectively to any incident within its boundaries and can assist other counties within the region.

Depending upon the final transportation modes and routes, several emergency response centers may be needed to provide an adequate level of protection. Nye County lacks the capital facilities to staff and equip such centers and maintain the degree of readiness needed to respond to an incident. Procedures and protocols for response actions including notifications to water users, the delivery of emergency water supplies, and containment and control of any releases, are lacking. Nye County has identified the need to plan and coordinate actions prior to, rather than in response to, an incident. Because of the magnitude and nature of the waste shipments that are being contemplated, Nye County must be given the capability to respond to any incidents. This same response capability must also be maintained in the area down gradient of Yucca Mountain after waste shipments have stopped.

Water Supply Replacement

Nye County notes that there are a myriad of scientific, socioeconomic, and health and safety issues and concerns with respect to waste disposal at Yucca Mountain and the protection of water supplies. The issues and concerns related to Yucca Mountain must be carefully evaluated in conjunction with the impacts of other federal actions and policies including underground nuclear testing, other waste disposal actions, and land and facility management practices. The results of Nye County's initial evaluations clearly point to the need for the development of alternative water supplies for the areas down gradient of Yucca Mountain.

The disposal of high-level wastes in a repository at Yucca Mountain will represent a threat to groundwater that, for all practical purposes, will last in perpetuity. Further, the technologies for remediating ground water contamination from a repository do not exist at present and may never be economically feasible. As a consequence, Nye County is faced with the fact that at some point in the future, the water resources needed to support the most populous portions of the county may be lost as a result of federal actions. An alternative supply of uncontaminated water must be available to meet current and projected future demands for drinking water.

Nye County has identified the importation of water from external sources as an alternative water supply source for the future. The costs associated with importing water are expected to be large but not prohibitive. Water rights must be secured, environmental clearances must be obtained, and a major water conveyance system must be built. Nye County does not have the financial capacity to fund a water importation project and must have assistance in developing an alternative source of safe drinking water.

A guarantee of safe water supplies for Nye County should be a lynchpin of any package of equity offsets. Given the magnitude and types of wastes considered for disposal at Yucca Mountain, and the cumulative impacts of past, present, and reasonably foreseeable future federal actions in Nye County, the need for alternate water supplies is clear.

Oversight

Nye County residents will be the population most affected by the impacts of waste disposal at Yucca Mountain. The maximally exposed individuals most at risk will be residents of the County. While national and state interests are concerned with protection of the *generic* public, only Nye County is focused on ensuring the health and safety of the people who will be most affected. The most fundamental protection that can be afforded to Nye County residents are those provided by rigorous performance standards and a national commitment to making licensing decisions based on the scientific merits of the site. However, *protection must not end with licensing.* Nye County must be assured that comprehensive monitoring will occur for as long as the wastes at Yucca Mountain pose a threat. Further, Nye County must be assured that those charged with monitoring have the institutional authority and the technical and financial resources need to provide long-term protection of the health and welfare of the County and its residents.

Continued Oversight Protections

The Nye County Nuclear Waste Repository Office NWRPO continues to serve an integral role in the process of assisting the nation in resolving the important issues related to disposal of spent fuels and other radioactive wastes. The NWRPO serves as a primary interface between the Nye County Board of County Commissioners, the affected public, and the United States. In this capacity, the NWRPO conducts independent scientific investigations, tracks and reviews Yucca Mountain related reports, and disseminates the results to the County, the scientific community, and the public. Continued funding must be made to extend the NWRPO's oversight activities throughout the life of an interim storage facility and/or a repository.

Monitoring and oversight provisions of Section 116(c) of the NWPA must be extended to include the life of an interim storage or repository facility. Through their planned Early Warning Drilling Program, Nye County will install a network of strategically located monitoring wells down gradient of Yucca Mountain. The costs of long-term monitoring of this network of wells are appreciable. Samples will have to be taken routinely for radiochemical analysis and wells may have to be replaced every fifty years or so. Nye County must receive assurances that the resources will be made available to conduct the monitoring and to maintain the monitoring network as long as necessary.

Regulatory Authority

Nye County notes that the future is uncertain especially when viewed in terms of the length of performance of a repository at Yucca Mountain. Nye County's responsibilities to protect the health and welfare of the County and its residents mandate that the County be able to exercise some level of control over the disposal of radioactive wastes. The interests of both Nye County and the United States may best be served by assisting Nye County in the development of local capacity to provide long-term institutional oversight of Yucca Mountain.

Through the creation of the Nye County Department of Natural Resources and Federal Facilities, Nye County has taken the first step in establishing such a capacity. Regulatory authority needs to be defined and delegated to the Department for long-term oversight.

Maintenance of Capability

Over the past 16 years, an appreciable amount of scientific data and understanding has been developed on the Yucca Mountain region and great deal of additional information will become available over the coming decades. Nye County believes that this information base must be carefully archived for use by future generations. Time will ultimately erode away at the "corporate knowledge" of Yucca Mountain unless steps are taken to preserve that knowledge. Nye County believes that the development of an Institute for Community Intergenerational Oversight of Nuclear Facilities would provide a meaningful mechanism to maintain the knowledge and capacity to make decisions many generations in the future.

An institute of this type would, as a matter of necessity, have to be located in Nye County. The mission of the institute would be to insure technical continuity during the 300 years until a decision on closure will be made. Nye County has noted with concern some of the original Yucca Mountain studies on the practicalities and realities of maintaining the long-term institutional controls necessary to prevent human intrusion. The endowment of an institute would provide for continued research related to the confinement of the nations nuclear wastes. The institute would also serve the public through education and public participation programs. Nye County believes that the proposed Nevada Science Museum could provide the important curatorial services needed for archiving of records and could also serve an integral role in the public education and participation programs. Endowment of an institute and funding of the proposed museum would not only represent an important part of the overall equity offsets package, it would also be instrumental in addressing the concerns over long-term institutional controls.

Uncertainty

Nye County has previously communicated their concerns to YMP on the emphasis being placed on model results in lieu of data as part of the Performance Assessment for Yucca Mountain. With respect to the accuracy and reliability of the data upon which the assessments are based, Nye County notes the published results of the formal Expert Elicitation process that was conducted concerning the performance assessment. These findings are consistent with Nye County's often stated observation that there is a lack of key data in areas located near Yucca Mountain and that modeling should not be used as a substitute for data in these areas. Nye County also notes the emphasis placed on the models by the Peer Review Panel who cautioned that in areas where public policy and public safety are at stake, the modeler must demonstrate the degree of correspondence between the model and the reality it seeks to represent, and that the limits of that correspondence must be delineated.

Any evaluations of water supply development should be based upon on two simple basic assumptions: 1) all of the available groundwater will be developed within the next century; and 2) groundwater overdraft will occur unless new sources of water are identified and imported into the region. Nye County's projections suggest that overdraft within the region will be on the order of 65,000 acre feet per year by the year 2050. It is plausible to assume that part of this overdraft will have to be made up from areas currently being underutilized, including the areas in the vicinity of Yucca Mountain.

The Department of Energy's Environmental Restoration Program may result in significant impacts on groundwater flow paths and travel times. If active groundwater controls are required, large-scale groundwater withdrawals may be needed to prevent the migration of contaminants released in the

underground testing areas on the Nevada Test Site. Any such controls could have a very large impact on Yucca Mountain and the water resources of the region as a whole.

Finally, Nye County has plans for the Nevada Science Museum and Gate 510 Business Park in the area north of the Lathrop Wells intersection. As these plans are implemented, water development could be initiated in early 1999 through the acquisition of water rights. It is plausible to assume that this area of Amargosa Valley will undergo dramatic changes once the museum becomes a reality. At that time, it is likely that significant growth will occur in this area with a corresponding demand for water. Present plans call for this demand to be met from water wells located north of Highway 95, in southernmost Jackass Flats.

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