STAKEHOLDER SUMMATION

Recommendations
For Proposed Well Locations
In The Pahute Mesa Area
At The
Nevada Test Site

The Community Advisory Board for Nevada Test Site Programs

…Citizens Working Together on Environmental Issues

STAKEHOLDER SUMMATION

Community Advisory Board Underground Test Area Committee Recommendations for Proposed Wells in the Pahute Mesa Area at the Nevada Test Site

INTRODUCTION

Southern Nevada is a unique corner of the world made up of many extremes. Most people immediately associate Nevada with Las Vegas, a city in the state's largest metropolitan area -- an area with more than 1.8 million residents. But in reality, the most prominent feature of southern Nevada is the Mojave Desert. At first glance, it simply looks like miles of undisturbed rock, sage, and cactus – but it is dotted with residents in small towns, sprawling ranches, and a wide array of wildlife, including wild horses, bighorn sheep, burros, many species of birds, eagles, reptiles, and the endangered desert tortoise. The Mojave stretches from wide open plains to mountainous areas, with climate characterized by extreme variation in daily temperatures – and an average annual precipitation of less than 5 inches. Needless to say, water is an extremely valuable commodity that must be treasured and protected.

A major presence on the Mojave's landscape is the Nevada Test Site (NTS), which is located ~65 miles northwest of Las Vegas. At approximately 1,375 square miles, the NTS is larger than the state of Rhode Island and is one of the largest restricted-access areas in the United States. The NTS played a key role in our nation's defense by serving as the primary proving ground for both conventional and nuclear weapons testing. In fact, from 1951 to 1992, the United States government conducted 828 underground nuclear tests at the NTS – at depths ranging from ~90 to 4,800 feet beneath the desert's surface. More than 200, or roughly one-third of those tests occurred near or below the water table, which resulted in radioactive contamination of the groundwater at the NTS. The U.S. Department of Energy (DOE) began preliminary hydrologic research at the NTS in the 1970s; however, formalized groundwater studies were not begun until 1989 when the DOE funded its national Environmental Management (EM) program to address the legacy of the nuclear testing era. That same year, the NTS launched the Underground Test Area Project to begin an intensive groundwater studies program. Faced with the reality that no proven, cost-effective method currently exists for remediating deep, extensive groundwater contamination, DOE's Underground Test Area (UGTA) project team worked to develop an effective, long-term strategy to identify where radiological risks may exist in the groundwater, predict the movement of potentially contaminated groundwater, and define the extent of this migration. Ultimately, the information derived from these analyses will be used to establish a long-term monitoring network, consisting of new and existing wells both on and off the NTS.

The issue of groundwater contamination at the NTS has been a long-time concern of the Community Advisory Board for NTS Programs (CAB) – a nationally chartered DOE Site-Specific Advisory Board. Established in 1994, the CAB is a formal group of volunteer, non-partisan citizens organized to provide stakeholder feedback to the DOE's Nevada Site Office Environmental Management Program. Shortly after its formation, the CAB organized the CAB-UGTA Committee to focus on issues related to groundwater. Committee members kicked off their work with an intensive multi-year learning process. Members pored over lengthy technical documents, listened to numerous briefings by DOE scientists, and conferred with expert hydrologists, geologists, academia, and regulators. The CAB scheduled regular public meetings to discuss their findings and invite feedback from stakeholders. After many years of careful study, discussions, and stakeholder feedback related to the potential for contaminated groundwater to migrate beyond the NTS boundaries into private land, the CAB-UGTA Committee voiced strong concerns to the DOE regarding the UGTA project strategy. Both the CAB and members of the community were skeptical of an approach that relied so heavily on computer modeling and were extremely concerned that contaminants may ultimately move beyond the boundaries of the NTS before being detected.

BACKGROUND

In fiscal year 2000, the CAB dispatched a letter to the DOE requesting an independent peer review of the entire UGTA project strategy. After considering the concerns voiced by the CAB, the DOE agreed to fund the effort and also requested recommendations from the CAB for specific tasks that should be included in the peer review. To ensure the independence of the study, the DOE contracted with the Institute for Regulatory Science, who worked with the American Society of Mechanical Engineers to convene an independent peer review panel to study the strategy and provide their critique and recommendations. At the further request of the CAB, prior to beginning work, the peer review team traveled to Nevada in June 2001 to conduct a two-day public workshop designed to (1) listen to community concerns, and (2) provide a comprehensive overview of the proposed review to the public. Peer review team members also visited the NTS to see first hand the historical testing areas and their proximity to NTS boundaries, and to better understand the UGTA strategy.

The peer review was completed and distributed in November 2001. Subsequently, the CAB scheduled a public meeting in January 2002 to provide a forum for the peer review team to present their findings and to address any questions or comments from both CAB members and the community-at-large. Each member of the peer review team focused on specific areas of the report and fielded questions and comments to ensure that the audience fully understood the results as well as the recommendations for the path forward. In brief, the reviewing scientists found the strategy to be reasonable and appropriate; however, they noted some specific opportunities for enhancement, as follows:

- Improve the capability to detect changes in groundwater early enough for corrective action, which would improve public confidence.
- Ground-water flow paths must be understood in order to predict contaminant migration.
- Collect more data for northwest Pahute Mesa to reduce uncertainties
- It is crucial to identify water velocities
- Predictions must be validated with field data
- The proof-of-concept time period is too arbitrary—more flexibility is needed for the specific hydrogeologic setting

The report went on to specifically state:

> "The current implementation of the strategy requires improvements in its capability to detect movement of contaminants or changes in groundwater sufficiently early for corrective action…this approach does not adequately take advantage of the benefits that would accrue from a full commitment to monitoring activities as an integral part in earlier phases of the strategy…an early commitment to monitoring will provide improvements in public confidence in the corrective action strategy and greater acceptance of the combined modeling/monitoring approach."

See Appendix 2 for the Peer Review Recommendations

Over the next several months, DOE studied the peer review recommendations and began to modify the project strategy accordingly. Although the CAB was encouraged to see some changes reflected in the project, concerns still remained regarding location of data-gathering wells and the ability to predict contaminant migration. As a result, CAB-UGTA Committee members continued to study the peer review, evaluate the recommendations, and formulate further recommendations to DOE based upon the peer review findings. They additionally researched reports published from sources other than DOE; e.g., U.S. Geological Survey, universities, and the Nuclear Regulatory Commission. The CAB continued to focus on the subject at their public meetings. The CAB also conducted community workshops in rural southern Nevada to ensure that stakeholders were aware of their concerns and were provided every opportunity to have a voice in the process.

Based upon the level of interest and feedback from the CAB, in July 2002 the DOE invited the CAB to provide a specific recommendation for placement of a future well at a site that could potentially fill an existing data gap, add to the network of existing wells, and improve the chances of early detection of contaminants. Since that time, at the request of the CAB DOE has provided maps, reams of technical reports, briefings to the CAB and stakeholders on subjects ranging from computer modeling and data analysis to risk assessment (refer to Appendix 3 – Bibliography). Technical project managers met often with committee members, resulting in candid dialogue that has contributed to a better overall understanding of project intricacies. In turn, the CAB met with stakeholders in rural communities bordering the NTS, provided briefings to community groups on their work, and invited citizens to participate in their study.

Although the CAB-UGTA Committee was tasked with providing one well site, they concluded that, given the lack of data, a minimum of three wells would provide more beneficial information. As a result, on February 9, 2006, the CAB provided a formal recommendation delineating specific locations for three (3) additional wells to be drilled to: intercept possible contamination, determine the depth to groundwater, provide a clearer understanding of groundwater geochemistry, identify rock units, and provide results from single well pump tests. This report provides the details and rationale for the selected sites. (Additional technical details, including specific coordinates for the well locations is available on the CAB web site within the supporting technical documentation of this effort.)

GENERAL CONSIDERATIONS

Under the Federal Facilities Agreement and Consent Order (FFACO), the DOE is required to develop a plan (requiring review and approval by the Nevada Division of Environmental

Protection [NDEP]) to define underground contamination. In brief, the agreed-upon plan requires that a model be created to determine the underground contaminant boundary beneath the NTS, followed by a five-year testing program designed to validate the accuracy of model predictions. Once NDEP is satisfied that the extent of the contamination has been characterized, the state and DOE will negotiate and establish a compliance boundary, and monitoring wells will be placed to ensure that contamination does not cross that boundary. The projected time line to complete this process for the NTS is 2027.

Early in its deliberations and research, the CAB-UGTA Committee realized that the area's complex geology presents some unique challenges to understanding groundwater flow and designing groundwater models. They further realized that even three wells would do little to plug the data gaps that exist in the current groundwater models. However, strategically placed wells (in addition to the existing network of wells) would have a reasonable chance of providing some indication of radionuclide transport (movement of radioactive contamination) in a selected area and may possibly address the effects of some major geologic structures on the ground water flow in the area of concern. The final consideration was to identify the area that may pose the greatest chance of contamination to offsite resident water supplies. Therefore, a risk-based approach was taken to narrow and refine the area of primary concern.

Stakeholder comments indicate that their confidence in model results is limited and that one of their major concerns is the possibility of being surprised by finding contamination in their ground water supply. Therefore, being able to provide some indication of the species that can move in the groundwater, as well as the expected rate of movement, could serve to provide a better basis for monitoring wells in the area.

To date, except for an indication of plutonium transport and the anticipated movement of tritium, the understanding of which radionuclides may be present and moving in the groundwater, and their rate of movement, is very limited. In fact, even when the DOE completes contaminant transport models, the projections of radionuclide transport will (absent of some data that can be used for calibration) be very model-dependent and could be inaccurate.

Considering all the information gathered (as noted below under Geologic, Hydrologic, Geochemical, Structural, and Underground Nuclear Testing Considerations), the CAB-UGTA Committee narrowed its focus to the Pahute Mesa – Oasis Valley region. This decision was made due to two overarching concerns: the largest underground nuclear tests were conducted in the Pahute Mesa region, and the test located nearest to offsite residents was also conducted here.

GEOLOGIC CONSIDERATIONS

As noted earlier, the NTS comprises an area larger than the state of Rhode Island. In addition, due to earlier volcanic action and structural deformation, the region is dominated by a highly complex geology. Because of this complex geology and the large area (1,375 sq miles), the information collected from drill holes and tunnels is currently insufficient to define the parameters needed to predict groundwater and subsequent radionuclide movement.

In an attempt to better define some of the complex structures, various geophysical techniques have been used by the DOE. By using surface geology, drill hole geology, and

geophysical studies, the geologists at the NTS have constructed 3-dimensional drawings of probable rock types and structures in the subsurface. This data has been incorporated into a computer model creating a geologic framework for evaluating how the ground water moves under the NTS.

These geophysical studies have provided some valuable insights. One of the more interesting findings was a “bench” located between the Silent Canyon Caldera Complex (SCCC) and the Timber Mountain Caldera Complex (TMCC). The characteristics of this feature may be important to understanding ground water flow in the Pahute Mesa area.

HYDROLOGIC CONSIDERATIONS

The NTS is located within a region known as “The Great Basin”. The Great Basin has little or no surface water sources, and rainfall remains in the topographic basins (dry lakes or “playas”) until it sinks into the ground or is lost through evaporation. The total amount of rainfall received is relatively low (~5” per year) and it is not evenly distributed across the NTS. Higher elevations receive larger amounts of rainfall or snow than the intervening valleys and, as a result, contribute more recharge into the groundwater system.

Pahute Mesa is a plateau averaging more than 6,000 feet in elevation and receiving enough annual precipitation to introduce recharge into the groundwater system. At an average elevation of 3,000 - 4,000 feet, Oasis Valley is topographically down gradient (downhill) from Pahute Mesa. Its groundwater surface is also down gradient from Pahute Mesa. Oasis Valley is one of the major discharge areas within the regional groundwater system and is one of the few regions where groundwater rises to the surface and creates numerous springs.

GEOCHEMICAL CONSIDERATIONS

In the 1990s scientists studied the geochemistry of the groundwater in conjunction with the groundwater gradient (angle or slope) to predict the direction of groundwater flow, thus creating a “conceptual” model. Although there are few wells to define the path of groundwater flow, very strong geochemical evidence suggests that the groundwater flows from Pahute Mesa to Oasis Valley. Evidence is not clear on how fast the groundwater moves. This is one of the data gaps that creates concerns for the CAB-UGTA Committee.

Another concern is the fact that soluble (capable of being dissolved) radionuclides can migrate in groundwater. Some contaminants have an affinity for certain clay minerals, similar to those contained in altered volcanic rocks found at the test site. Therefore, even though some of the contaminants are leached into the groundwater at the nuclear test cavity site, some of these will be “filtered out” of solution as the molecules adhere to clay minerals. However, some radioactive contaminants that are not usually soluble have been found in wells at some distance from the original nuclear test area. UGTA scientists have learned that insoluble (not likely to dissolve) radionuclides can attach to very small mineral particles (called “colloids”), which can move through tiny interconnected fractures in the volcanic rocks.

STRUCTURAL CONSIDERATIONS

Predicting how groundwater moves is complicated by the interrelationship of rock type, rock configuration and structural disruptions. To further complicate things, layers of volcanic rocks may change in character laterally with distance from the volcanic center. In the extreme case, an aquifer unit (a rock unit in which groundwater can move) may become a confining unit (a unit of rock in which groundwater does not move). Aquifer layers (areas of ground containing moving groundwater) can be further disrupted by fault offset.

At the NTS, rock layers are broken by characteristic Basin and Range faulting which will tend to break up the water-bearing rock units into blocks. Water may or may not move across the separating faults. As a result, it's possible that groundwater movement beneath Pahute Mesa is controlled by fractured rocks and may be separated into distinct compartments by normal faults.

UNDERGROUND NUCLEAR TESTING CONSIDERATIONS

Rock fracturing can be created or enhanced by the detonation of underground nuclear tests. Nuclear testing releases a great deal of energy in a short period of time; vaporizes the rock in the immediate vicinity; and fractures the rock at greater distances away from the test. As the area begins to cool, the vaporized material condenses (along with much of the radioactive contaminants) and flows down the cavity wall to pool at the bottom into a substance known as "melt glass". Overlying rock fractures and falls into the cavity creating a "chimney" of rock fragments above the test. Initially, test energy pushes the groundwater outward, but over time it will likely flow back into the cavity area. There is a concern that this water may be able to dissolve radioactive contaminants from the cavity site and carry them out into the groundwater flow. Contaminants can also escape directly along rock fractures during the test in a process called "prompt injection".

THE CAB-UGTA COMMITTEE'S RECOMMENDATIONS

Taking into consideration the data gathered in their years of study, the uncertainties identified above, combined with continued interaction and dialogue with a wide array of technical experts, the CAB-UGTA Committee ultimately recommended sites for three wells to improve the ultimate objective of evaluating groundwater movement between Pahute Mesa and Oasis Valley. A synopsis of the three locations and purpose follows:

CAB Well #1

Sited to intersect a contaminant plume down-gradient from the Benham underground test, which was conducted in 1968. Existing Well #ER-20-5#1 is located ~4,290 feet south/southwest of the Benham test. This well encountered contamination, including insoluble radionuclides carried on colloids. Since groundwater migration is controlled by a variety of subsurface factors, it is not possible to know precisely how much farther contamination may have traveled since that time, but it could be in excess of 1,000 feet. If contamination is found at this well site, the data gathered may aid in determining the rate of migration and a better understanding of which radionuclide species are mobile.

CAB Well #2
Sited down-gradient from Well #1 and closer to the transition zone between the Silent Canyon Caldera and the Bench separating the Timber Mountain Caldera to the south. Considering the possible rate of groundwater migration, this location would be favorable for a sentinel well down-gradient of Benham contamination**.**

The deciding factors in the Committee's selection to site Wells #1 and #2 down gradient of the Pahute Mesa CAU were:

- The largest underground tests were at Pahute Mesa
- The steepest groundwater slope is between Pahute Mesa and Oasis Valley
- Closest private property to a test area is in Oasis Valley
- Geophysics indicates a possible fast path for groundwater migration
- The Peer Review noted that more data was needed in this area.

CAB Well #3
Sited for the two-fold task of testing the effect of the Thirsty Canyon Structure on groundwater flow in conjunction with the Bench between the two major calderas. The CAB does not believe that the hydrologic character of this structure has been adequately identified and believes that more work should be done in this area.

NOTE: This site proved to be problematic due to the proximity of the steep topography of Thirsty Canyon. After a thorough review of the area's topography, the CAB withdrew this site election pending further evaluation and study.

ADDITIONAL STAKEHOLDER CONCERNS

Although some stakeholder concerns were mentioned with the CAB recommendations, additional concerns have been expressed during public meetings or small group discussions, as follows:

Nye County Officials
Recognizing that the CAB-UGTA Committee had narrowed its focus to the Oasis Valley area, Nye County officials made it clear that their concerns covered a much larger area down gradient of the NTS. Although the CAB-UGTA Committee recognizes that there are additional data gaps around the NTS, they believe that the potential risk is relatively low and can be addressed in future studies. Nye County officials understand that contamination exists at the Nevada Test Site, but their frustration stems from not knowing how much and where it is located. Neither DOE nor NDEP are perceived as forthcoming with this information. County officials need to know this in order to plan safely for growth and development. They expressed frustration that after more than ten years of study, there are no maps of the extent of contaminated ground water.

Beatty, Nevada Residents
Some very specific monitoring questions were raised in Beatty. Residents want to know why springs and wells that <u>were</u> monitored <u>no longer are</u>. They want to know who is doing the monitoring and at which well. They also want a presentation on the

results of that monitoring. They believe the frequency of monitoring is inadequate for the risk involved. Concern was also expressed to the CAB over the long delay in the release of the monitoring data.

Monitoring vs. Characterization Activities

Initially the CAB misunderstood the organization of monitoring and characterization activities; down-gradient stakeholders also do not understand the differences in responsibility. The CAB-UGTA Committee feels that the separation of characterization and monitoring activities is an artificial distinction and counter productive to the goals of both. The CAB recognizes that the NNSA monitoring group does not fall under the EM hierarchy, but both are DOE programs and we feel their work would be accomplished more effectively if they were coordinated under unified leadership. As pointed out in the Peer Review Report, monitoring should be an integral and ongoing part of the characterization program.

Community Outreach / Information

The CAB also found that public knowledge about the monitoring program is both limited and skeptical. The CAB-UGTA Committee feels the message would be better received and understood if a DOE representative would present an annual briefing on monitoring results at the regular town board meetings in Pahrump, Beatty and Amargosa. This face-to-face exchange would be a starting point to build trust between contaminant monitors and potential contaminant receptors. The CAB believes the DOE is trying to address this issue, but not enough stakeholders are getting the message. This down-gradient stakeholder perception should not be ignored.

PATH FORWARD

The CAB held public meetings in Beatty (December 2005) and Pahrump (February 2006) to present the well site recommendations to the local stakeholders and to invite feedback.

Upon receipt of the CAB's letter of recommendation, Bill Wilborn, DOE's UGTA Project Manager, forwarded the information to members of the UGTA Technical Working Group for review and comment. Their comments were returned to the CAB-UGTA Committee and provided both positive and negative insights, which further enhanced the understanding of the complexities of the UGTA problem. However, none of the comments caused the CAB-UGTA Committee to change their priority for drilling the wells as initially recommended. Subsequent to the formal letter of recommendation and comments from the Technical Working Group, Mr. Wilborn expressed an interest in the CAB-UGTA Committee developing additional well-site recommendations. However, the UGTA project is not funded to drill additional wells until fiscal year 2009, so the CAB-UGTA Committee is continuing its studies of this issue and will consider additional sentinel well sites for recommendation to the UGTA project.

ACKNOWLEDGEMENTS

This well-siting project has shown the CAB that the DOE has, in fact, conducted a great deal of study of groundwater throughout the Pahute Mesa-Oasis Valley area. Half of the 40 wells that have been drilled for the UGTA project have been drilled on Pahute Mesa and in Oasis Valley.

DOE's willingness to fund an independent peer review to allow independent review of the UGTA strategy and provide recommended changes to the approach clearly reflects a willingness to consider alternatives and to share information with the public. As one of the Peer Review panelists noted about modeling "it is very easy to get trapped into thinking that the truth has been revealed to you when, in fact, you have been very good about coming up with a non-unique solution to the problem." This quote further reinforces their statement related to the need for additional data. The bottom line remains: stakeholders want sentinel wells to provide early warning of contaminant movement.

The CAB-UGTA Committee expresses its appreciation to the stakeholders for their comments and to the Environmental Management staff that have been so helpful and patient through all of our questions and requests. The UGTA project is a monumental task, and staff members have expended many hours toward the goal of gaining a better understanding of groundwater issues at the NTS. We have appreciated this opportunity to delve into the details of the program and have a deeper appreciation of the effort involved. The CAB-UGTA Committee looks forward to review of the subsequent phases of the UGTA project as they are developed.

APPENDICES

1. Well Table Guide and Well Table Spreadsheet
2. Feb 9, 2005 CAB Recommendation Letter to Steven Mellington
3. Bibliography of CAB-UGTA Committee Sources

How to Read the Table of Monitoring Data

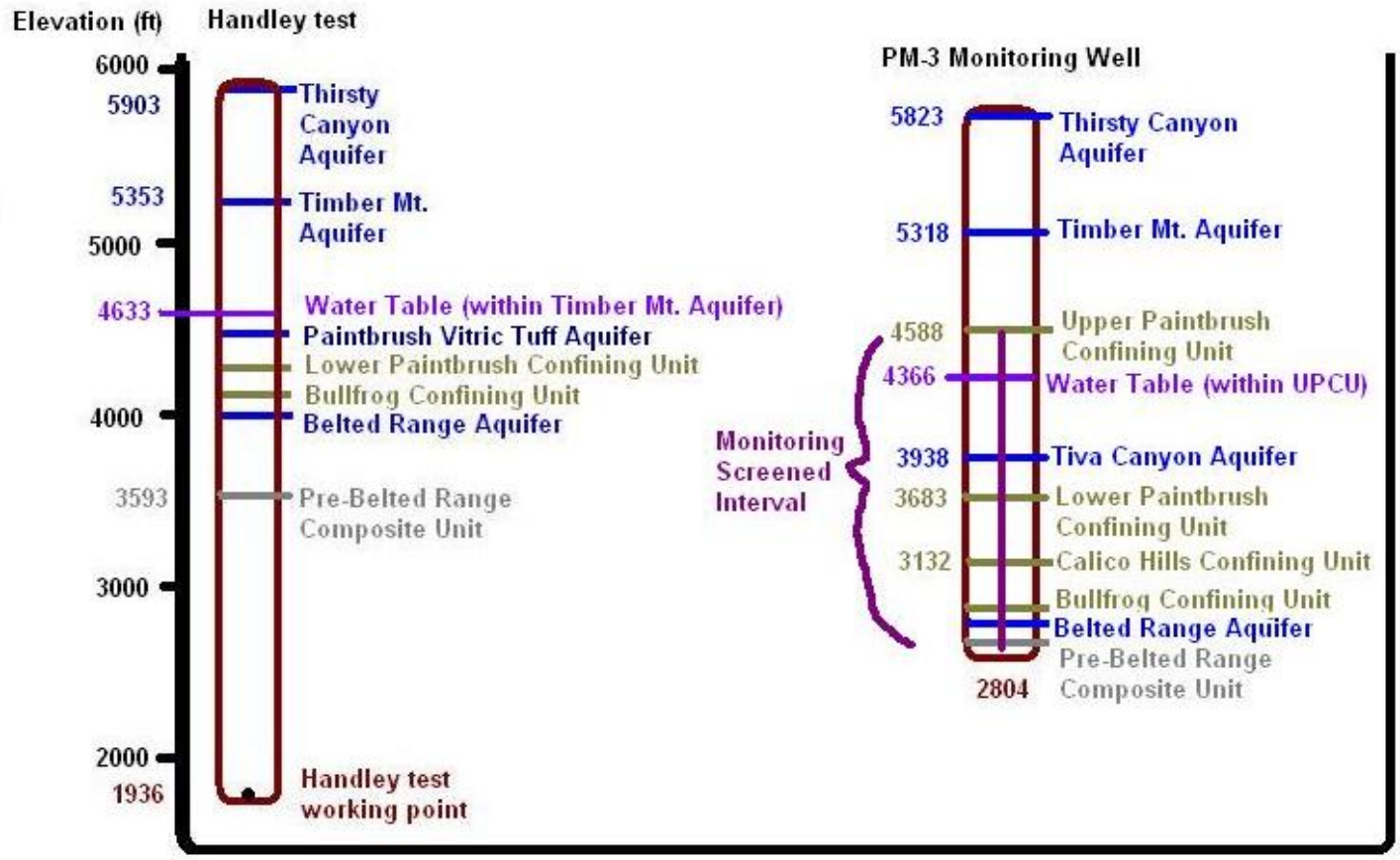
Columns represent nuclear tests with explosive yields greater than 200 kilotons (with names like Handley, Benham, and Boxcar) and nearby monitoring wells (with names like ER-EC-4, PM-3, U-20n PS#1).

The two columns on the left identify hydrostratigraphic units such as aquifers, confining units and composite units. The second column gives an abbreviation for that hydrostratigraphic unit's name (Calico Hills Confining Unit = CHCU). Each row represents one of these hydrostratigraphic units. Blue rows are aquifers, tan rows are confining units, and white rows are composite units.

Below the name of each monitoring well, the water table elevation (the top of the saturated zone) is given in feet (the number in violet). A purple horizontal line marks the top of the hydrostratigraphic unit within which the water table occurs. A vertical horizontal line identifies the screened interval (the range of depths from which water was collected for monitoring).

The elevation of the top of each hydrostratigraphic unit is given in feet. The top of the Timber Mountain Aquifer at Handley is 5,353 feet above sea level. Notice that at the nearby monitoring well PM-3, the top of the Timber Mountain Aquifer is slightly lower (5,318 feet). There is no number in this row for well PM-2, because this monitoring well does not intersect the Timber Mountain Aquifer.

The elevation of each nuclear test is the number in red, and the top of the hydrostratigraphic unit in which the test occurred is marked with a red horizontal line in that column.



Notice that the saturated Paintbrush Vitric Tuff Aquifer (this aquifer is water-saturated because it is located below the water table) at Handley is not intersected by the nearby well PM-3. This is important because contamination from the Handley explosion could be moving through any of the saturated aquifers in the test hole (shown at left), and one of these is not being monitored.

Nuclear Tests >200 kt

collar elevation (feet)		4759.6	5592	4072.8	4073		5903	6025.6	5823	5823	5823		6117	6337	6281	6257	6370	5604.4	6181	6241.8	6241.9		6534	6486	6474.8	6475.1	6466	6468
bottom elevation (feet)		1272.6	-3196	3892.8	3537			1025.6	2804	2804	2804							604.4	4116	3418.8	1947.9				3274.8			3200
elevation screened interval (feet)		3810.9-3538.7	3086-(-3196)	3922.8-3900.8	3567-3547		na	3727.7-3204.2	4350-2804	3951-3631	4444-4136		na	na	na	na	na	3976.0-3733.9	4241-4116	3941-3669	2810-2360		na	na	4037-3529	4040-1090	3985-3660	4197-3200
		2849.6-2506.6						2678-2265.2										3409.9-3097.7										
		1656.3-1354.8						1577.1-1276.2										2166.9-1793.6										
																		1183.9-700.9										
test elevation (feet)							1936						2118	2159	1681	3747	2545						4488	4275				
test yield (kilotons)							>1000						200-1000	500-1000	1150	200-1000	1300						200-1000	20-150				
		ER-EC-4	PM-2	ER-OV-01	ER-OV-06a		Handley	ER-EC-1	PM-3	PM-3-1	PM-3-2		Fontina	Colby	Benham	Tybo	Boxcar	ER-EC-6	ER-20-1	ER-20-5#1	ER-20-5#3		Pipkin	Bullion	ER-20-6#1	ER-20-6#2	ER-20-6#3	U20WW
Hydrostratigraphic Unit	Symbol			Semiannual	Semiannual		U-20m		Annual				U-20f	U-20aa	U-20c	U-20y	U-20i		Annual	Annual	Annual		U-20b	U-20bd	Annual	Annual	Biannual	Biannual
water elevation		4010.7	4733	4054.5	4057.6		4633	4167.6	4365.7	4365	4367		suspect		4183.9	4190.1		4178.4	4192.8	4186.7				4448	4446.9			4412
alluvial aquifer	AA																											
younger volcanics composite	YVCM	4759.6																										
Thirsty Canyon volcanic aquifer	TCVA	4709.6	5586				5903	6025.6	5823	5823	5823			6337	6281	6257	6370		6181	6241.8			6534	6486	6474.8	6475.1	6466	6468
detached volcanics composite	DVCM																											
detached volcanics aquifer	DVA																											
Fortymile Canyon composite	FCCM	3119.6		4072.8	4073																							
Fortymile Canyon aquifer	FCA																											
Timber Mountain composite	TMCM																											
Tannenbaum Hill lava flow aquifer	THLFA							5453.6										5604.4										
Tannenbaum Hill composite	THCM							4777.6										4656.4										
Timber Mountain aquifer	TMA	2837.6					5353	4500.6	5318	5318	5318		4627	5977	6061	6107	6070		5937	6069.8			6334	6084	6022.8	6025.1	6032	6176
subcaldera confining unit	SCVCU																											
Fluorspar Canyon confining unit	FCCU							4247.6										4254.4										
Windy Wash aquifer	WWA																											
Paintbrush composite	PCM																											
Paintbrush vitric-tuff aquifer	PVTA						4503						4612		5471	5757			5431	5783.8			5164					5178
Benham aquifer	BA							3975.6							5331	5617		4069.4	5127	5308.8								
Upper Paintbrush confining unit	UPCU							3438.6	4588	4588	4588		4277			5017		3480.4	4496	4806.8			4984	4876	4876.8	4879.1	4868	
Tiva Canyon aquifer	TCA							3329.6	3938	3938	3938		3572		4191	4697		3194.4	4343	4570.8								
Paintbrush lava flow aquifer	PLFA																											
Lower Paintbrush confining unit	LPCU						4213	3089.6	3683	3683	3683		3427		3821	4377		2889.4		4268.8				4396	4361			
Topopah Spring aquifer	TSA							2644.6							3681	4157		2474.4		4077.8	3650.9							
Yucca Mountain Crater Flat composite	YMCFCM																											
Calico Hills vitric tuff aquifer	CHVTA																											
Calico Hills vitric composite	CHVCM																											
Calico Hills zeolitic composite	CHZCM												3237	4827	3231		4940			3650.8	3281.9		4864	4366	4324.8	4388.1	4496	5034
Calico Hills confining unit	CHCU							2425.6	3132	3132	3132							2046.4										
Inlet aquifer	IA																											
Crater Flat composite	CFCM							1755.6						2847			2600	1644.4										
Crater Flat confining unit	CFCU																											
Kearsarge aquifer	KA																											
Bullfrog confining unit	BFCU						4138		2953	2953	2953																	
Belted Range aquifer	BRA		5226				4048		2873	2873	2873																	
pre-Belted Range composite	PBRCM		5046				3593		2823	2823	2823																	
Black Mountain intrusive confining unit	BMICU																											
Ammonian tanks intrusive confining unit	ATICU																											
Ranier Mesa intrusive confining unit	RMICU																											
Claim Canyon intrusive confining unit	CCICU																											
Calico Hills intrusive confining unit	CHICU																											
Silent Canyon intrusive confining unit	SCICU																											
Mesozoic granite confining unit	MGCU																											
lower carbonate aquifer- thrust plate	LCA3																											
lower clastic confining unit- thrust plate	LCCU1																											
upper clastic confining unit	UCCU																											
lower carbonate aquifer	LCA																											
lower clastic confining unit	LCCU																											

Handley Fault

Purse Fault

Boxcar Fault

Hydrostratigraphic unit where water table occurs

Hydrostratigraphic unit where test occurred

Screened interval for well

Sources:

USGS WRIR 98-4184

USGS WRIR 00-4014

DOE/NV/11718-706, A Hydrostratigraphic Model…

DOE/NV/11718-381, Completion Report ER-EC-1

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DOE/NV/11718-360, Completion Report ER-EC-6

Cheshire	UE-20n #1	U-20n PS#1	West Greeley Fault	Greeley	Kasseri	PM-1	East Greeley Fault	Estuary	Camembert	U19q PS#1d	U-19bh	ER-20-2#1	Inlet	East Estuary Fault	Mast	Muenster	Almendro Fault	Halfbeak	UE 19cWW	Almendro	U-19v PS#1	U-19v PS#1D	U-19v PS#2D	Pool	East Caldera boundary	ER-19-1-1	ER-19-1-2	ER-19-1-3	HTH-1	WW8
U-20n	3 yrs	3 yrs		U-20g	U-20z	Annual		U-19g	U-19q	1998	Annual	Annual	U-19f		U-19u	U-19e		U-19b	Biannual	U-19v	3 yrs			U-19p		not included			Annual	Qtr
3986	4419	4417		4452.9		4462.9		4670	4472		4675	4399							2339.7	4563	suspect					4350	suspect	5133		~4617
6477	6461	6461		6470	6509	6558		6734	6758	6739	6768	6670	6734		6873	6919		6791	7033	6876	6842	6842	6841	6899		6140	6140	6140	6156	5695
		3161				-1300					4620	4146							-1456		3005					2545	2545	2545	1950	196
na	4012-3212	4179-3627?		na	na	(-985)- (-1173)		na	na	2139-1998	6698-4620	4367-4146	na		na	na		na	4612- (-1456)	na	3224-3205	4534-3495	3749	na		2930-2580	3590-3402	4839-4718		4445-3915
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2648				2479	2359			3886	2458				4047		3883	2154		4102		3386				4014						
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February 9, 2005

Mr. Stephen A. Mellington
Acting Assistant Manager for Environmental Management
U.S. Department of Energy – Nevada Site Office
PO Box 98518
Las Vegas, NV 89193-8518

Subject: Community Advisory Board (CAB) for Nevada Test Site Programs Recommendations for Immediate Action: Locating Monitoring Wells for the Early Warning System for the Underground Test Area (UGTA)

Dear Mr. Mellington:

As you are aware, the CAB's Underground Test Area Committee (UGTA) has been carefully tracking the UGTA project over the past several years. The CAB's initial recommendations to the U.S. Department of Energy's Nevada Site Office (DOE/NSO) Environmental Management (EM) Program for a peer review of the UGTA strategy were adopted. As a result of our comments and feedback to the DOE on the peer review, Carl Gertz, former Assistant Manager for Environmental Management, requested that the CAB further review the project and provide recommendations for siting a future monitoring well at the Nevada Test Site (NTS). The CAB's UGTA Committee accepted that task, which has involved extensive review of DOE/NSO technical reports and maps, numerous meetings with DOE/NSO staff, and members of the UGTA Technical Working Group. To ensure that potentially affected stakeholders were aware of this effort, the CAB has conducted formal public information meetings in both Las Vegas and rural communities, participated in several meetings with Nye County representatives, sponsored informational groundwater workshops, and prepared and presented informational briefings to the town boards in the rural communities that would be most likely impacted if radionuclides were ever detected in groundwater outside the NTS boundaries.

As a result of our study and the stakeholder feedback received, we are recommending a series of three wells. We believe this network is vital to characterize the groundwater flow path toward the community we perceive as at highest risk.

The CAB has focused on the groundwater flowing west/southwest from the NTS, and its potential to carry contaminants from the 828 underground

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nuclear detonations that have occurred over the past 40 years. The tests of primary concern occurred in Western Pahute Mesa, closest to the NTS boundary, and in closest proximity to offsite Nye county residents.

The CAB has reviewed the various facets of the UGTA program to better understand the interrelationships that affect the prioritization of the UGTA project, including laws and regulations that govern the UGTA program, aimed at finding improvements or refinements which might better respond to stakeholder concerns while aiding DOE/NSO in their program goals.

As the UGTA committee sees it, the crux of the problem is this: the 828 nuclear detonations released approximately 132 million Curies of radioactivity (DOE/NSO 2001) during the 40 years of testing at the NTS, of which 60,860,000 Curies were released under Area 20 of the NTS. Many of these tests were conducted within the groundwater. The radioactive isotopes introduced into the groundwater include cesium-137, strontium 90, plutonium 239, americium 241, tritium 3H, and technecium-99. With this level of data, it is important that a process be in place to detect contamination, define its boundaries, and monitor its movement.

We believe there is a shortage of monitoring wells down gradient of this most important area of contamination beneath Area 20. After several years of study, there have been no maps produced to accurately depict the groundwater flow paths from that area. As a result, the UGTA Committee was compelled to focus their attention to this area.

Because the DOE/NSO is bound by the Federal Facility Agreement and Consent Order (FFACO) of 1996 (and subsequent agreements) negotiated between the NTS and the Nevada Division of Environmental Protection (NDEP), DOE has the responsibility for the understanding, management and monitoring of groundwater contamination from nuclear testing. Within the FFACO, a generic process is defined as the "UGTA Strategy" which contains the following parameters:

- Evaluate the extent of contamination to the groundwater due to nuclear testing;
- Develop five Corrective Action Units (CAUs) specific computer models; and
- Design a groundwater monitoring network.

The goals of the FFACO include the following:

- Provide protection of the public, workers, and the environment;
- Establish a long term groundwater monitoring network; and
- Develop groundwater flow models, which can be used to evaluate the effects of future changes in the system as a result of contaminant migration.

The FFACO mentions "protection of the public," but specifically lacks the protocol contained in the Federal Superfund Amendments and Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), which sets forth a process of requiring a risk-based assessment of contamination, transmission pathways, and prioritization of activities in assessing the risk to potential receptors of the contamination. Environmental media transmission pathway analysis is critical in this risk-based approach in CERCLA's

Remedial Investigation and Feasibility processes. Therefore, the CAB feels that the FFACO and DOE/NSO should include these most important tenets in prioritizing and funding their activities.

As a part of the CAB's careful review and assessment of the DOE/NSO progress in addressing groundwater issues, it also identified perceived deficiencies in the FFACO. Deficiencies seemed to range from a lack of a risk-based approach to a guidance in focus on a region with large data gaps. Therefore, in 2000 the CAB requested an external peer review of the UGTA program strategy.

Indeed, the external peer review panel provided the following feedback either in formalized written recommendations in the peer review report, or in dialogue at the public meeting convened to discuss the panel's findings:

- Improve the capability to detect changes in groundwater early enough for corrective action
- Groundwater flow paths must be understood in order to predict contaminant migration
- Predictions must be validated with field data
- Collect more data from Northwest Pahute Mesa
- Support the concept of "transition zone" monitoring in areas where water from a site merges with the larger flow paths (high probability of detection of contaminant)
- It is critical to identify water velocities

In a letter dated April 19, 2002, the CAB responded to the Peer Review report with the following recommendations:

- The DOE/NSO must demonstrate an early commitment to groundwater monitoring in this location
- More data is needed to reduce the uncertainties in Northwest Pahute Mesa
- It is imperative to understand groundwater flow paths in this area, and areas down gradient of Pahute Mesa
- DOE/NSO should consider siting sentinel wells in the transition zone flow paths
- Predictions must be validated by field data

From the Peer Review report, the CAB recognized that the most important area in the UGTA Program is the area down gradient of Pahute Mesa, where very few wells exist that could provide important data as well as to serve as an early warning system to protect the public. Currently there are seven offsite wells in this area (ER-EC-1, ER-EC-6, ER-EC-4, ER-EC-8, ER-EC-2A, ER-EC-5, and ER-EC-7). DOE obviously understands the importance of this area because it has placed half of all the UGTA wells drilled to date in the Pahute Mesa/Oasis Valley region. However, due to the large size of the area involved, their spatial locations still leave data gaps where no wells exist for detecting radionuclides. This critical area is the western part of upper Pahute Mesa.

It is this area, down gradient and southwest of Pahute Mesa, that is of immediate concern because it is directly up gradient of the residents of Oasis Valley, Beatty, and Amargosa. The CAB feels this area requires immediate investigation, collecting data that can only be obtained by drilling a series of wells that will likely intersect some part of a contaminant plume. From this well, water samples can be taken to

characterize groundwater geochemistry and to analyze for specific radionuclides. A single well pump test would provide valuable information about transmissivities and water level determination would give clues to groundwater flow direction. There is a compelling need for information on the groundwater in this area, where data can be obtained to help enhance the groundwater models, to decrease the large degree of uncertainties in this area, and serve as part of the early warning system.

The UGTA Committee also selected this area because it has the steepest groundwater gradient and closest proximity of underground testing to offsite receptors. One of the shots with the largest yield was the Benham test shot, which is within a couple of miles of the Test Site boundary. Fortunately, some groundwater tests have already been conducted in this area and these tests reveal that contamination clearly originating from the Benham test has migrated more than 4,000 feet to monitoring well ER-20-5#1. Therefore, another well sited down gradient of this well using the trend of structural fractures could provide valuable information on how much further this contamination has migrated.

The "system" of wells being recommended by the CAB is briefly described here. The CAB feels strongly that the DOE/NSO should advance a system of three wells down gradient of Pahute Mesa designed to collect highly important data including geology, water levels, geochemistry, and groundwater ages. The system should include one well that is sited to have a high probability of intercepting some contamination. These wells are described as follows:

Well 1:
Using existing data in conjunction with mapped structures (including surface crack maps), install the first well down gradient of the Tybo-Benham area south of ER-20-5#1. The exact distance from the Benham shot still needs to be determined, but the well should be close enough to intersect the contaminant plume. Properly designed, this well should produce data that would aid in determining contaminant progression. The wells should be deep enough to intersect the most important saturated aquifers. The proposed depth and more specific location of the well will be coordinated with DOE/NSO staff members, who are more knowledgeable of this area.

Well 2:
Install a second well down gradient of the first well, in the transition area between the Silent Canyon caldera and the potential barrier, the Timber Mountain bench area that was identified by geophysics and confirmed by UGTA drilling in 1999. Data gathered from this well could confirm direction of groundwater flow from the difference in the water levels as well as provide possible clues to the hydrologic character of the bench structure; i.e., groundwater barrier or conduit.

Well 3:
Install the third well at the junction of the potential barrier structure (the "bench") and a major fault identified by geophysics as a possible fast path into Oasis Valley. This well would complete a system to enhance our understanding of the groundwater flow direction. These three wells could show us how much further radionuclides have been transported beyond ER-20-5#1, the general direction of groundwater flow in that area and may also add to our understanding of the hydrologic characteristics of the bench; i.e., whether it is a barrier or conduit to groundwater flow. In our opinion, it is most important to understand the nature of

groundwater movement in this area. Typically, longer flow path routes result in a greater degree of potential attenuation of contaminants by adsorption, radioactive decay and dilution.

The resulting data would also strengthen the UGTA project's models, decrease the degree of uncertainty in one of the most important areas in the UGTA project, and satisfy a need to include the elements of risk and monitoring in the UGTA strategy. This is a compelling argument that is at the heart of our stakeholders' concerns, and would hopefully accelerate the potential for additional funding for the UGTA project well in advance of 2009.

The CAB's approach is further supported by the position of NDEP and the Peer Review. In the July 30, 2001, letter from the Nevada Division of Environmental Protection to the Department of Energy, it is stated that, "If CAU investigations consistently place monitoring wells where no contamination is found, additional wells may be required." In the CAB's recommendation letter to Mr. Gertz dated April 21, 2003, the CAB expressed its support for the Peer Review's stance that, "the need for near-field characterization … should not be understated or postponed until all the modeling is complete." The CAB also stated, in concert with the NDEP letter, "Without contaminant data in the downstream flow direction, the CAB does not see how modeling the location of the contaminant boundary will be valid in 2007." The Peer Review panel also acknowledged that identifying the direction of flow and velocity of movement of groundwater was crucial because sites with higher velocities need sentinel well emplacement early in the game.

A report detailing the background and process used to arrive at our conclusions will be forthcoming. We appreciate the opportunity to delve into the details of the UGTA characterization process. It has been a tremendous learning experience for the CAB and we recognize the superior support provided by DOE/NSO for this effort.

Sincerely,

Charles A. Phillips, Chair
Community Advisory Board
for Nevada Test Site Programs

cc: U.S. Senator John Ensign
U.S. Senator Harry Reid
U.S. Congresswoman Shelly Berkley
U.S. Congressman Jim Gibbons
U.S. Congressman Jon Porter
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K. Snyder, ERD, NNSA/NSO, Las Vegas, NV
C. Sanda, Stoller-Navarro JV
CAB Members

REFERENCES:

ASME, see American Society of Mechanical Engineers

BN, see Bechtel Nevada

DOE, see U.S. Department of Energy

DRI, see University of Nevada, Desert Research Institute

IT, see IT Corp. (International Technologies Corp.)

LANL, see Los Alamos National Laboratory

LLNL, see Lawrence Livermore National Laboratory

NNSA, see U.S. Department of Energy, National Nuclear Security Administration

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