Nevada
Environmental
Restoration
Project

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Annual Report
RCRA Post-Closure Monitoring
and Inspections for Corrective Action
Unit 91: Area 3 U-3fi Injection Well,
Nevada Test Site, Nevada
For the Period
October 2001 - October 2002

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Environmental Restoration
Division

National Nuclear Security Administration
Nevada Site Office

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**ANNUAL REPORT
RCRA POST-CLOSURE MONITORING
AND INSPECTIONS FOR
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Nevada Site Office
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NEVADA TEST SITE, NEVADA**

**FOR THE PERIOD
OCTOBER 2001 - OCTOBER 2002**

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TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS	viii
PROJECT SUMMARY	PS-1
1.0 INTRODUCTION	1
1.1 SCOPE AND OBJECTIVE	1
1.2 SITE HISTORY	1
1.3 SITE GEOLOGY AND HYDROLOGY	7
2.0 REGULATORY CRITERIA	9
2.1 BACKGROUND	9
2.2 SITE INSPECTION COMPLIANCE CRITERIA	10
2.3 SOIL MOISTURE MONITORING COMPLIANCE CRITERIA	11
3.0 SITE INSPECTIONS AND ANNUAL SUBSIDENCE SURVEY	13
3.1 INTRODUCTION	13
3.2 FINDINGS FROM THE SITE INSPECTIONS	13
3.3 ANNUAL SUBSIDENCE SURVEY	13
4.0 SOIL MOISTURE MONITORING	15
4.1 INTRODUCTION	15
4.2 OPERATING PROCEDURES	15
4.3 PRECIPITATION DATA	16
4.4 SOIL MOISTURE MONITORING RESULTS	18
4.4.1 Data Presentation	18
4.4.2 Discussion of Analytical Data Trends	24
4.4.2.1 January 2002 - First Quarter	24
4.4.2.2 April 2002 - Second Quarter	24
4.4.2.3 July 2002 - Third Quarter	25
4.4.2.4 October 2002 - Fourth Quarter	25
5.0 SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS	27
5.1 SUMMARY	27
5.2 CONCLUSIONS	27
5.3 RECOMMENDATIONS	28
6.0 REFERENCES	29

TABLE OF CONTENTS (Continued)

APPENDICES

APPENDIX A: POST-CLOSURE CARE INSPECTION CHECKLISTS

APPENDIX B: SUBSIDENCE SURVEY PLAT

APPENDIX C: PRECIPITATION RECORDS

FIGURES

FIGURE PS-1 - ER3-3 CUMULATIVE RESIDUAL NEUTRON COUNTS	PS-3
FIGURE PS-2 - ER3-3 BASELINE DIFFERENCE FIRST QUARTER	PS-5
FIGURE PS-3 - ER3-3 BASELINE DIFFERENCE SECOND QUARTER	PS-6
FIGURE PS-4 - ER3-3 BASELINE DIFFERENCE THIRD QUARTER	PS-7
FIGURE PS-5 - ER3-3 BASELINE DIFFERENCE FOURTH QUARTER	PS-8
FIGURE 1 - SITE LOCATION MAP U-3FI	2
FIGURE 2 - CROSS SECTION OF THE U-3FI WASTE DISPOSAL UNIT	3
FIGURE 3 - MONTHLY PRECIPITATION	17
FIGURE 4 - ER3-3 CUMULATIVE RESIDUAL NEUTRON COUNTS	19
FIGURE 5 - ER3-3 BASELINE DIFFERENCE FIRST QUARTER	20
FIGURE 6 - ER3-3 BASELINE DIFFERENCE SECOND QUARTER	21
FIGURE 7 - ER3-3 BASELINE DIFFERENCE THIRD QUARTER	22
FIGURE 8- ER3-3 BASELINE DIFFERENCE FOURTH QUARTER	23

TABLE OF CONTENTS (Continued)

TABLES

TABLE 1 - CHRONOLOGY OF THE AREA 3 U-3fi INJECTION WELL 6

TABLE 2 - SUBSIDENCE MONUMENT U-3fi COORDINATES AND ELEVATIONS 14

TABLE 3 - PRECIPITATION DATA FOR THE BUSTER JANGLE Y, METEOROLOGICAL
STATION BJY, AREA 3, NTS 16

ACRONYMS AND ABBREVIATIONS

bgs	below ground surface
BN	Bechtel Nevada
BJY	Buster Jangle Y
cm	centimeter(s)
DOE	U.S. Department of Energy
DOE/NV	U.S. Department of Energy, Nevada Operations Office
ft	foot (feet)
in	inch(es)
km	kilometer(s)
LANL	Los Alamos National Laboratory
m	meter(s)
mi	mile(s)
NDEP	Nevada Division of Environmental Protection
NTS	Nevada Test Site
RCRA	Resource Conservation and Recovery Act
REECo	Reynolds Electrical and Engineering Co, Inc.

PROJECT SUMMARY

INTRODUCTION

This annual monitoring and inspection report provides an analysis and summary for site inspections, meteorological information, and neutron soil moisture monitoring data obtained at the U-3fi Injection Well during the October 2001 to October 2002 period. The U-3fi Injection Well is located in Area 3 of the Nevada Test Site (NTS), Nye County, Nevada.

Inspections of the Area 3 U-3fi Injection Well are conducted to determine and document the physical condition of the concrete pad, facilities, and any unusual conditions that could impact the proper operation of the waste disposal unit closure.

The objective of the neutron logging is to monitor the soil moisture conditions along the 128-meter (m) (420-feet [ft]) ER3-3 monitoring well and detect changes that may be indicative of moisture movement in the regulated interval extending between 73 to 82 m (240 to 270 ft).

REGULATORY CRITERIA

Soil moisture compliance monitoring is done in compliance with the May 31, 1997, Class One Modification of the Nevada Division of Environmental Protection Permit for a Hazardous Waste Management Facility, Permit Number NEV HW009. The Class One Permit Modification incorporated the criteria presented in the October 1996 letter (U.S. Department of Energy, Nevada Operations Office [DOE/NV], 1996) requesting changes in the Resource Conservation and Recovery Act Industrial Sites Environmental Restoration Post-Closure Plan, Area 3 U-3fi Waste Unit, DOE/NV, 1995c.

The ER3-3 post-closure monitoring criteria requires notification to the Nevada Division of Environmental Protection (NDEP) if the residual raw neutron counts (Observed Raw Counts minus Baseline Raw Counts) exceeds the 200-count Action Level in the regulated interval extending between 73 to 82 m (240 to 270 ft) for two or more consecutive quarterly monitoring periods.

The ER3-3 post-closure monitoring criteria also requires notification to the NDEP if settling in the U-3fi borehole has occurred on a scale large enough to cause shearing of the lower portion of the ER3-3 monitoring well.

A directional survey is to be run in the ER3-3 access casing every five years to determine if subsidence is occurring the U-3fi emplacement borehole. The first survey was conducted in July 2000.

RESULTS OF INSPECTIONS AND THE MONITORING PROGRAM

Inspections

Site inspections are performed or conducted every six months to identify any significant changes to the unit requiring action. No significant concerns were noted.

Subsidence Survey

The subsidence survey for the October 2001 to October 2002 monitoring period was completed in July 2002 with a monument elevation of 1,230.833 m (4,038.165 ft) which indicated a subsidence of -0.457 centimeter (cm) (-0.180 inch [in]) relative to the baseline survey of September 1996, and a slight decrease in elevation of 0.030 cm (0.012 in) compared to the previous year, July 2001. While the survey results show a negative subsidence after the baseline survey, the magnitude of these changes is so small as to be at the survey instrument resolution level and it is not clear if they represent subsidence or measurement error. There is no clear evidence of any subsidence of the monument.

Precipitation

Precipitation data were collected from the National Weather Service Nuclear Support Office's CLINET Station Buster Jangle Y (BJY) located at 37° 03' 46" N, 116° 03' 09" W, in Area 3 of the NTS. This station is located approximately 4.8 kilometer (km) (3 miles [mi]) northwest of Well ER3-3. Precipitation records for this station for the period October 2001 through October 2002 are found in Appendix C and summarized in Table 3 and Figure 3 of Section 4.

The average annual precipitation over the period 1960 to 2002 at the BJO Station is 16.05 cm (6.32 in). The annual precipitation (January 2002 through December 2002) is 3.81 cm (1.50 in). The yearly precipitation for the current monitoring period, November 2001 through October 2002, is 3.94 cm (1.55 in). Drought conditions continued for the 2002 annual period, with rainfall approximately 75 percent below normal.

Soil Moisture Monitoring

The Cumulative Residual Neutron Counts graph (Figure PS-1) tracks changes over time from baseline conditions relative to the regulatory level of concern. The residual raw counts are calculated by subtracting the raw neutron count of each monitoring period from the first-year average neutron count (baseline). While the data are collected on a 0.3-m (1-ft) interval, the Cumulative Residual Neutron Count graph presents the residual count only every 1.5 m (5 ft) in the regulated interval between 73.2 to 82.3 m (240 to 270 ft). This interval corresponds to the point closest to the bottom of the U-3fi emplacement casing. The residual values are plotted as

residual raw counts vs date for each 1.5-m (5-ft) depth. The level of regulatory concern is indicated as a heavy line at the 200-count Action Level. Values exceeding this limit for two consecutive monitoring periods require notifying the NDEP as specified in the revised Post-Closure Plan.

The next four graphs (Figures PS-2 through PS-5) show the baseline difference for successive quarterly monitoring periods along the entire length of a neutron access tube relative to baseline conditions. These are calculated by subtracting the baseline (first-year average) raw neutron count from the current raw neutron count on a depth basis. The result of this subtraction is referred to as the residual raw count. The residual raw count is plotted with the actual raw neutron counts of both the current and baseline data vs depth from the top of the casing. A positive residual neutron count indicates conditions at that depth and point in time that are wetter than baseline conditions, while negative values indicate dryer conditions.

The Baseline Difference graphs provide detailed information on the overall performance of the entire unit.

The Cumulative Residual graph focuses only on cumulative trends relative to the regulatory level of concern and is used to determine regulatory compliance.

SUMMARY

- Inspections of the cover were done to identify any significant changes to the unit requiring action. No significant concerns were noted.
- The subsidence survey for the October 2001 to October 2002 monitoring period was completed in July 2002 with a monument elevation of 1,230.833 m (4,038.165 ft) which indicated a subsidence of -0.457 cm (-0.180 in) relative to the baseline survey of September 1996, and a slight decrease in elevation of 0.030 cm (0.012 in) compared to the previous year, July 2001. While the survey results show a negative subsidence after the baseline survey, the magnitude of these changes is small enough to be at the survey instrument resolution level; therefore, it is not clear if they represent subsidence or measurement error. There is no clear evidence of any subsidence of the monument.
- Visual inspections of the concrete cover indicate no evidence of subsidence.
- A single data point exceeded the residual 200 count level with a reading of 234.5 counts at a depth of 114.9 m (377 ft). This singular reading is attributed to a combination of counting statistics and an error caused by positioning of the logging tool in a steep gradient.
- The ER3-3 neutron moisture data obtained in 2002 are below the Action Level of 200 residual raw counts within the regulated interval.

CONCLUSIONS

- No significant concerns were observed during the site inspections over the period October 2001 through October 2002.
- There is no subsidence of the ER3-3 monument.
- The moisture content of the regulated interval between 73.2 to 82.3 m (240 to 270 ft) remains dry, stable and shows no signs of subsidence.
- Both the Baseline Difference and Cumulative Residual data indicate dry stable conditions for all quarterly monitoring periods. The Residual Raw Neutron Counts remain below the compliance Action Level of 200 counts within the regulated interval for period from October 2001 through October 2002.
- The closure is in compliance and performing as designed.

RECOMMENDATIONS

- Although not within a compliance interval or of regulatory concern, the drying trend observed in the bentonite seal and sloughed soils beneath the cement wellhead protection plug will continue to be monitored to determine if the void area is increasing.

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1.0 INTRODUCTION

1.1 SCOPE AND OBJECTIVE

This annual neutron soil moisture monitoring report provides an analysis and summary for site inspections, meteorological information, and neutron soil moisture monitoring data obtained at the Area 3 U-3fi Injection Well Unit. The U-3fi Injection Well is located in Area 3 of the Nevada Site (NTS), Nye County, Nevada. This report on the U-3fi Closure covers the period October 2001 to October 2002.

Inspections of the Area 3 U-3fi Injection Well are conducted to determine and document the physical condition of the covers, facilities, and any unusual conditions that could impact the proper operation of the waste disposal unit closure.

The objective of the neutron-logging program is to monitor the stability in soil moisture conditions along the 128 meters (m) (420 feet [ft]) of ER3-3 Well and detect changes that may be indicative of moisture movement in the regulated interval of 73.2 to 82.3 m (240 to 270 ft).

1.2 SITE HISTORY

The U-3fi Waste Disposal Unit is located in Area 3 at the NTS, Nye County, Nevada (Figure 1). The NTS is approximately 105 kilometers (km) (65 miles [mi]) northwest of Las Vegas, Nevada.

The U-3fi Waste Disposal Unit is an abandoned Los Alamos National Laboratory (LANL) emplacement hole (Figure 2). It was drilled by Reynolds Electrical and Engineering Co., Inc. (REECo) between March 27, 1967 and April 24, 1967, for emplacement of a nuclear explosive device. A detailed history of the emplacement hole drilling program is found in the U-3fi Waste Disposal Unit Closure Plan (U.S. Department of Energy, Nevada Operations Office [DOE/NV], 1995b). On April 11, 1967, the hole reached a depth of 256 m (841 ft) below the surface. Due to formation conditions, a thicker drilling foam was introduced into the hole to keep it open. Unfortunately, this did not work and the hole started caving in and the drill bit was trapped at a depth of 254.8 m (836 ft). A number of attempts to retrieve the drill bit all failed. The top of the collapsed emplacement hole was found at 73.2 m (240 ft) below ground surface. The hole was abandoned on April 24, 1967.

The U-3fi Waste Disposal Unit was established in 1970 as a disposal site for radiologically contaminated waste primarily for post-shot "high-grading" wash water, which was solidified with cement and drill cores (Tattro, 1989).

Figure 2
Cross Section of the U-3fi Waste Unit

The U-3fi Waste Disposal Unit primarily received core samples and solidified decontamination wastes. Core samples consisted of mixed fission and activation products from the solidification detonation debris/melt during post-shot drilling (U.S. Department of Energy [DOE], 1988). While under LANL control, only LANL solid drillback waste was disposed in the U-3fi Waste Disposal Unit. Control of the U-3fi Waste Disposal Unit was assumed in 1977 by the U.S. Atomic Energy Commission, predecessor of the Energy Research and Development Administration, now the DOE. At this time, four additional waste generators, Lawrence Livermore National Laboratory, Area 6 Decontamination Pad, Area 12 Tunnels, and LRY3 (an unspecified generator of weapons test program waste) began disposing their waste in the U-3fi Waste Disposal Unit.

Waste disposal record keeping for the U-3fi Waste Disposal Unit began in 1977. The database, established and maintained by REECO Defense Waste Management Department, currently the Bechtel Nevada (BN) Waste Management Project, has 102 entries between January 11, 1977 and November 28, 1988. Access to the U-3fi Waste Disposal Unit from 1977 to 1989 was through both REECO Radiation Safety and Wackenhut Services, Inc. Copies of the waste disposal documents are found in Appendix C of the Area 3 U-3fi Waste Unit Closure Plan (DOE/NV, 1995b).

According to waste disposal records, it is estimated that 86.34 curies (3,181 gigabecquerel) (1.7 kilograms [3.7 pounds]) of fission products from drilling activities were placed in the Waste Disposal Unit. Chromium from drilling mud and lead from pipe-lubricant, stemming, and shielding materials may also be present. Waste was placed from a depth of 54.9 m (180 ft) to approximately 73.2 m (240 ft) below ground surface (bgs).

Subsurface characterization activities began in November 1994 with the installation of the ODEX borehole ER3-3. The objectives of this study were to determine if constituents of concern were present in the subsurface and to assess the potential for migration of these constituents of concern from the waste zone to the surrounding formation.

The ER3-3 borehole is located 18.3 m (60 ft) south of U-3fi and drilled at a design angle of 6 degrees from the vertical in order to intercept the U-3fi emplacement borehole at approximately 183 m (600 ft) bgs. In practice, the emplacement borehole was intercepted at a depth of 125 m (410 ft) bgs due to drilling conditions that increased the borehole angle. The borehole reached a total depth of 130 m (425 ft) in February 1995.

Cuttings and core samples, recovered during drilling operations, were used to understand the geologic, lithologic, and hydrologic soil properties surrounding the U-3fi Waste Disposal Unit. The results of these studies are discussed in the U-3fi Post-Closure Plan (DOE/NV, 1995c).

The ER3-3 borehole was completed as a neutron-probe soil moisture monitoring well by removing the ODEX casing and stemming a single-wall steel casing in place with a sand backfill.

The monitoring well is located entirely within the vadose zone and extends from the surface to a depth of 128 m (420 ft). Its purpose is to provide post-closure monitoring for changes in soil moisture content that would indicate moisture migration in the vicinity of the waste and to detect subsidence of material in the U-3fi Borehole.

The Post-Closure Plan (DOE/NV, 1995c) was approved by the Nevada Division of Environmental Protection (NDEP) on August 28, 1995. The DOE/NV Project Manager authorized closure of the Waste Disposal Unit at that time.

On September 6, 1995, the stemming activities in U-3fi began with the placement of approximately 2.13 m (7 ft) of 20/40 sand and an expanding cement grout plug 4.6 m (15 ft) thick. Once this plug was allowed to set, the casing was filled with 32.6 m (107 ft) of NTS fine stemming sand and grouted with an expanding cement plug 13.7 m (45 ft) thick. On September 28, 1995, the U-3fi Waste Disposal Unit was declared closed.

Post-closure monitoring activities, detailed in the Post-Closure Plan (DOE/NV, 1995c), specified that a neutron monitoring program was to be based upon monitoring and reporting changes in absolute moisture content. The Action Level criteria for tracking and reporting to the NDEP was specified as the observance of a 5 percent relative increase in volumetric moisture content for two or more consecutive monitoring periods. As originally designed, the ER3-3 Well was to be used for obtaining raw neutron counts. This new specification would require a complicated and expensive compound calibration for determining absolute soil moisture content in the telescoping sand-packed borehole. In December 1995, representatives of NDEP, DOE/NV, and BN agreed that considering the 73.2-m (240-ft) depth of the regulated interval and the dry climatic conditions, no changes in moisture content would be expected. Therefore, the high cost of calibrating for the ER3-3 borehole geometry was not justified and a relatively simple program of monitoring for changes in raw counts would be sufficient as long as the alternative proposal was more conservative than the absolute Action Levels initially presented.

The first baseline neutron log from ER3-3 was obtained in July 1995. The first year of monitoring established the baseline conditions. The first quarterly monitoring was conducted in October 1996.

In September 1996, DOE/NV formally petitioned NDEP to change the Action Level to a 200-count change from baseline conditions in the 73.2 to 82.3-m (240 to 270-ft) regulated interval. This request was based on a statistical analysis of the expected rate of occurrence of false positives and false negatives in a 20-year period.

A Class One Modification to adjust the monitoring criteria in Section V of the Historic Resource Conservation and Recovery Act (RCRA) Units (NDEP, 1997) for the Area 3 U-3fi Injection Well was adopted on May 31, 1997.

Significant events for the U-3fi Waste Disposal Unit are summarized in Table 1.

TABLE 1 - CHRONOLOGY OF THE AREA 3 U-3fi INJECTION WELL

DATE	SIGNIFICANT EVENTS
1970	U-3fi Waste Disposal Unit established as disposal site for radiologically contaminated waste consisting of solidified post-shot wastewater and drill cores.
1989	Waste no longer accepted for disposal in U-3fi Waste Disposal Unit.
1994	Subsurface site characterization studies began in November 1994 with installation of Borehole ER3-3. Borehole was drilled 13.3 m (60 ft) south of U-3fi at an angle of 6° to a depth of 130 m (425 ft).
1995	<u>Resource Conservation and Recovery Act Industrial Site Environmental Restoration Closure Plan, Area 3 U-3fi Waste Unit</u> , draft issued June 1995 (DOE/NV, 1995b).
	<u>Resource Conservation and Recovery Act Industrial Sites Environmental Restoration Post-Closure Plan, Area 3 U-3fi Waste Unit</u> , issued August 1995 (DOE/NV, 1995c).
	First-year neutron baseline data set started in July.
	September 6, 1995 stemming and grouting activities begin in U-3fi Waste Disposal Unit.
	September 28, 1995 U-3fi Waste Disposal Unit was declared closed.
	<u>Area 3 U-3fi Waste Unit Resource Conservation and Recovery Act Closure Report</u> , issued November 1995 (DOE/NV, 1995a).
1996	DOE/NV petitions NDEP to change the Action Level to 200 counts above baseline conditions in the regulated interval.
	First quarterly monitoring began in October 1996.
1997	<u>First Annual Report RCRA Post-Closure Monitoring and Inspections for the U-3fi Waste Unit for the Period July 1995 - October 1996</u> , issued in January 1997 (DOE/NV, 1997).
	A Class One Modification to adjust the monitoring criteria in Section V of the Historic RCRA Units (Permit No. NEV HW009) for the U-3fi Injection Well was adopted on May 31, 1997.
	During first-quarter logging, the neutron logging tool #7074 separated from cable and was irreparably damaged in the fall. A backup instrument was calibrated to replace #7074.
2000	Required 5-year directional survey run on ER3-3 access casing. No subsidence of casing was indicated.

1.3 SITE GEOLOGY AND HYDROLOGY

The U-3fi Injection Well is located in the west central portion of Yucca Flat in Area 3 of the NTS, Nye County, Nevada (834004 N, 692900 E).

Yucca Flat is located within the Ash Meadows groundwater subbasin (Waddel, 1982). Regional groundwater flow is assumed to be south-southwest. Discharge occurs primarily in Ash Meadows, located approximately 80 km (50 mi) to the south-southwest.

The U-3fi emplacement hole extends to approximately 256 m (841 ft) and is hosted in Quaternary and Tertiary alluvial deposits which extend locally to about 274 m (900 ft). These deposits are variably cemented, moderately sorted sand and gravel derived from local hills. Beneath the alluvium, a Tertiary volcanic sequence extends from about 274 m (900 ft) to about 671 m (2,200 ft). These rocks form two hydrogeologic units: the welded tuff aquifer and the tuff-confining unit (Winograd et al., 1975). The water table beneath U-3fi occurs within the tuff-confining unit at approximately 488 m (1,600 ft). Underlying the volcanic sequence is the Lower Carbonate Aquifer, which is comprised of Paleozoic limestones and dolomites. These rocks are complexly faulted and form the primary groundwater transport path towards the Ash Meadows discharge point. The lower carbonate aquifer is estimated to be approximately 1,000 m (3,300 ft) thick beneath the U-3fi Waste Disposal Unit. Vertical migration of groundwater beneath U-3fi Waste Disposal Unit is controlled by the tuff-confining unit. Lateral (regional) migration is controlled by the lower carbonate aquifer.

Annual precipitation at Well ER6-1, located approximately 10 km (6.2 mi) south of the U-3fi Waste Disposal Unit, is 12.52 centimeters (cm) (4.93 inches [in]). Estimates of Potential Evapotranspiration obtained from characterization studies in Area 5 indicate Potential Evapotranspiration of about 157.5 cm/year (62 in/year), which is significantly higher than the mean annual precipitation. Recharge to the subsurface is believed to be nonexistent.

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2.0 REGULATORY CRITERIA

2.1 BACKGROUND

Section 4.0 of the Post-Closure Plan (DOE/NV, 1995c) specified a neutron monitoring program that is to be based upon monitoring and reporting changes in absolute volumetric soil moisture content. An action criteria for tracking and reporting to the NDEP was specified (Section 4.1.2) as the observance of a 5 percent relative increase in volumetric moisture content for more than two consecutive monitoring periods. Because the well was designed for obtaining raw neutron counts, this specification would have required a complicated and expensive compound calibration for determining absolute soil moisture content in the telescoping, sand-packed borehole. Implementation of this strategy would be both costly and problematic.

In a December, 1995 meeting with representatives from NDEP, DOE/NV, and BN, DOE/NV requested that the monitoring strategy be changed for two reasons. (1) The benefits of obtaining a compound calibration for absolute moisture content are offset by the high cost of calibrating for the ER3-3 hole geometry. (2) Considering the depth of the regulated interval and dry climatic conditions at the NTS, changes in moisture content are not expected. Therefore, a relatively simple program of monitoring for changes in raw neutron counts would be both conservative and sufficient. It was agreed that it is unnecessary to calibrate the neutron probe for the ER3-3 geometry, but that any alternative proposal must be more conservative than the absolute volumetric moisture content Action Levels initially presented. In addition, it was agreed to obtain up to 12 months of baseline neutron data and then propose an alternative monitoring plan to NDEP.

The proposed alternative to an absolute calibration was to use "statistically significant" changes in raw counts from the neutron tool to determine when an increase in moisture content occurred in the regulated interval.

The philosophy in using this approach is guided by two criteria:

- (1). Considering both the depth to the regulated interval and the arid site conditions, no change was expected due to surface rainfall events and infiltration. Therefore, any changes above the system noise level could be considered significant regardless of the change in absolute moisture content. Consequentially, calibration of the neutron gauge to local geometries and soil conditions would not be required.
- (2). Because the proposed monitoring is based on changes in raw counts, and not on the absolute moisture content, the criteria for setting an Action Level should be more conservative than what would be set when using an absolute soil moisture content.

Considering the above-stated criteria, a conservative choice for the Action Level would be “any statistically significant changes greater than some small multiple of the system noise level.” A statistical method called the Bootstrap (Bradley and Tibshirani, 1993) was run using the one-year baseline data set to provide the statistical character of the system noise and a 20-year acceptance rate of about 2 percent for both false positives and false negatives. The simulation was carried out to 2,000 years of quarterly monitoring (8,000 observations) in the 73.2 to 82.3-m (240 to 270-ft) regulated interval. For an acceptance rate of 2 percent, an Action Level of 200 count change from baseline conditions was found to meet the design criteria. Details of this process can be found in the first annual report (DOE/NV, 1997) and a letter discussing the technical basis (DOE/NV, 1996).

In October 1996, a formal proposal (DOE/NV, 1996) from DOE/NV was submitted to NDEP requesting that the post-closure monitoring activities be modified to reflect an Action Level based on a change in raw neutron counts of 200 counts in the regulated interval. NDEP approved this request on December 9, 1996 (NDEP, 1996).

A Class One Permit Modification incorporating the criteria provided in the December 1996 letter requesting changes in the Post-Closure Plan (DOE/NV, 1995c) was issued on May 31, 1997.

2.2 SITE INSPECTION COMPLIANCE CRITERIA

Prior to conducting a post-closure inspection, a review of design drawings, aerial photographs, and site maintenance records is performed to provide a basis for evaluating site conditions. The site inspection includes a walking inspection of the entire site within 304 m (1,000 ft) of the U-3fi Waste Disposal Unit and photo documentation. The Post-Closure Inspection Checklist (Appendix A) details items of concern under the following topics:

- Adjacent off-site features in the watershed areas up-slope of the unit, such as new roads and erosion channels
- Access roads, fences, gates, and signs
- Monuments and other permanent features
- U-3fi waste cover
- Site drainage features
- Monitoring Well ER3-3

2.3 SOIL MOISTURE MONITORING COMPLIANCE CRITERIA

Soil moisture compliance monitoring is performed following the May 31, 1997, Class One Modification of the NDEP permit for a Hazardous Waste Management Facility, Permit Number NEV HW009 (NDEP, 1997). The Class One Permit Modification incorporated the criteria presented in the December 1996 letter (DOE/NV, 1996) requesting changes in the Post-Closure Plan (DOE/NV, 1995c).

The ER3-3 post-closure monitoring criteria requires notification to the NDEP if the residual raw neutron counts (Observed Raw Counts minus Baseline Raw Counts) exceeds the 200-count Action Level in the regulated interval extending between 73.2 to 82.3 m (240 to 270 ft) for two or more consecutive quarterly monitoring periods. The post-closure monitoring criteria also requires notification to the NDEP if settling in the U-3fi Borehole has occurred on a scale large enough to cause shearing of the lower portion of the ER3-3 Monitoring Well. A borehole gyroscopic survey is conducted every five years to determine if the borehole casing is being subjected to stresses which may be indicative of subsidence within the U-3fi emplacement borehole.

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3.0 SITE INSPECTIONS AND ANNUAL SUBSIDENCE SURVEY

3.1 INTRODUCTION

To comply with the post-closure care requirements, formal site inspections have been conducted twice a year since the closure of the unit in September 1995. The inspections were completed to evaluate the performance and maintenance needs of the unit in accordance with the requirements of Title 40 Code of Federal Regulations §265.15 and the RCRA Part B Permit. A complete inspection package includes copies of the inspection checklist, field logbook notes, site photographs, and the inspector's current resume. Copies of the Post-Closure Care inspection checklist and associated field notes for March 2002 and September 2002 are found in Appendix A. Copies of site photographs and inspectors' resumes can be obtained by contacting the DOE/NV, Environmental Restoration Division.

3.2 FINDINGS FROM THE SITE INSPECTIONS

The site is in good condition. The vegetation that was observed growing on the soil cover during the September 2001 inspection had been removed by the March 2002 inspection. Minor hairline cracking was identified on the U3fi Waste Disposal Unit concrete pad and the ER3-3 Monitoring Well concrete pad during the March and September inspections; however, this cracking is not progressing and does not threaten the integrity of the concrete pads.

3.3 ANNUAL SUBSIDENCE SURVEY

A subsidence monument was installed in the cement plug on the U-3fi cover and surveyed on September 18, 1995. This monument provides elevation control to determine if subsidence of the cement plug or soil surrounding the U-3fi Waste Disposal Unit is occurring. The Subsidence Survey Plat is found in Appendix B.

On September 5, 1996, the first-year subsidence survey was conducted. It determined that the original survey was invalid because the survey had been run without a proper closure (DOE/NV, 1997). Because of this, the September 5, 1996 survey, with a control elevation of 1,230.84 m (4,038.18 ft), has been selected to represent the baseline elevation. All subsequent surveys will record subsidence relative to this datum.

A subsidence survey was completed on August 3, 1998, at the U-3fi monument. The elevation was recorded at 1,230.828 m (4,038.151 ft), which indicated a subsidence of 0.884 cm (0.029 ft) from the baseline control survey elevation of 1,230.84 m (4,038.18 ft) obtained on September 5, 1996. A confirmation survey was run on September 1, 1998. This survey recorded

a monument elevation of 1,230.831 m (4,038.159 ft), indicating a subsidence of 0.640 cm (0.021 ft). The survey had a closure error from the northwest corner monument of 0.579 cm (0.019 ft). Due to the small subsidence (approximately 0.640 cm [0.252 in]), it was unclear if this was a result of a previous survey error (incremental instrument error) or could be attributed to an actual subsidence of the monument itself. The average elevation (1,230.83 m [4,038.16 ft]) of the August 3, 1998 and the September 1, 1998 surveys was used for the 1998 monument elevation.

The subsidence survey for the October 2001 to October 2002 monitoring period was completed in July 2002 with a monument elevation of 1,230.833 m (4,038.165 ft), which indicated a subsidence of -0.457 cm (-0.180 in) relative to the baseline survey of September 1996, and a slight decrease in elevation of 0.030 cm (0.012 in) compared to the previous year, July 2001. While the survey results show a negative subsidence after the baseline survey, the magnitude of these changes is small enough to be at the survey instrument resolution level; therefore, it is not clear if they represent subsidence or measurement error. There is no clear evidence of any subsidence of the monument.

TABLE 2 - SUBSIDENCE MONUMENT U-3fi COORDINATES AND ELEVATIONS

SURVEY DATE	COORDINATES ^a		ELEVATION ^b TOP OF SM1 MONUMENT (Feet)	SUBSIDENCE (Feet)	
	NORTHING	EASTING			
September 18, 1995	N 834004.0	E 692900.3	(4,038.1) ^c	-	
September 5, 1996	N 834004.00	E 692900.35	4,038.18	-	
July 30, 1997	N 834004.00	E 692900.35	4,038.18	0.00	
August 3, 1998	N 834004.00	E 692900.35	4,038.151	-0.029	Avg. -0.025
September 1, 1998 ^d	N 834004.00	E 692900.35	4,038.159	-0.021	
July 12, 1999	N 834004.00	E 692900.35	4,038.16	-0.02	
July 31, 2000	N 834004.00	E 692900.35	4,038.168	-0.012	
July 23, 2001	N 834004.00	E 692900.35	4,038.166	-0.014	
July 8, 2002	N 834004.00	E 692900.35	4,038.165	-0.015	

^aAll coordinates based on the Nevada State Plane Grid, Central Zone - North American Datum of 1983 in feet.

^b All elevations based on the North American Vertical Datum of 1929 in feet.

^c Elevation cannot be proven due to failure to perform a proper closure on the original survey. September 5, 1996 survey will be used for the elevation control datum.

^d Re-run confirmation survey.

4.0 SOIL MOISTURE MONITORING

4.1 INTRODUCTION

The objective of the ER3-3 vadose zone monitoring program is to monitor the soil moisture condition in the 73.2 to 82.3-m (240 to 270-ft) regulated interval to provide an early warning of the potential for leachate migration from the U-3fi Waste Disposal Unit into the subsurface. In addition, the monitoring system is used to monitor changes indicative of subsurface subsidence within the U-3fi Waste Disposal Unit.

The ER3-3 monitoring system uses a portable neutron moisture-logging tool to determine changes in the moisture content in soils surrounding the neutron access tube which intercepts the U-3fi emplacement hole. By monitoring changes in soil moisture content, it is possible to detect the movement of wetting fronts in the soils surrounding the bottom of the U-3fi casing. The detection of changes in soil moisture content in this area provides an early warning of the potential movement of leachate from the U-3fi Waste Disposal Unit to the surrounding environment, indicating possible failure of the grout plug.

The ER3-3 borehole is located 18.3 m (60 ft) south of the U-3fi Waste Disposal Unit and drilled at a design angle of 6° from the vertical. The U-3fi emplacement borehole was intercepted at a depth of 125 m (410 ft) bgs, with a total depth of 129.5 m (425 ft). Logging is accomplished from the surface to only 128 m (420 ft) to avoid the possibility of getting the neutron probe stuck at the bottom of the access tube.

A Campbell Pacific Nuclear Hydroprobe (Model 503DR) containing a 50-millicurie (1.85-gigabecquerel) ²⁴¹Americium/Beryllium neutron source is used to obtain moisture logs in the access tube. The tool is operated without a soil moisture calibration, recording raw neutron counts in a 16-second window.

4.2 OPERATING PROCEDURES

Neutron-logging operations adhere to BN Organization Instruction OI-2152.105, "Environmental Restoration Neutron Moisture Logging" (BN, 1999). The logging procedure was modified so that the downhole tool can operate without a centralizer. This was done because the neutron access tube is inclined at a 6° angle. Field quality control operations require a daily standard count test to be run at the start and end of the day. Failure to pass this statistical test requires stopping operations, notifying the supervisor, and determining the cause.

Using this procedure, neutron logs are obtained by lowering the neutron tool to within 1.5 m (5 ft) of the bottom of the access tube. The raw neutron count is obtained using a 16-second count time at 0.3-m (1-ft) intervals along the length of the access tube. The data are recorded on field log sheets and stored in the data logger of the neutron probe as raw counts. The data logger is then downloaded to a personnel computer on a daily basis. Once the data have been reviewed, they are presented as two graphs: Cumulative Residual Neutron Counts and Baseline Difference. These graphs are discussed in Section 4.4.1, Data Presentation.

4.3 PRECIPITATION DATA

Precipitation data were collected from the National Weather Service Nuclear Support Office's CLINET Station Buster Jangle Y (BJY) located at 37° 03' 46" N, 116° 03' 09" W, in Area 3 of the NTS. This station is located approximately 4.8 km (3 mi) northwest of Well ER3-3. Precipitation records for this station for the period October 2001 through October 2002 are found in Appendix C and summarized in Table 3 and Figure 3.

The average annual precipitation over the period 1960 to 2002 at the BJY Station is 16.05 cm (6.32 in). The annual precipitation (January 2002 through December 2002) is 3.81 cm (1.50 in.). The yearly precipitation for the current monitoring period, November 2001 through October 2002, is 3.94 cm (1.55 in). Drought conditions continued through the 2002 annual period, with rainfall approximately 75% below normal.

TABLE 3. PRECIPITATION DATA FOR THE BUSTER JANGLE Y, METEOROLOGICAL STATION BJY, AREA 3, NTS

DATE	MONTHLY AVERAGE (1960-2002) inches ^a	MONTHLY CUMULATIVE inches ^a	YEARLY CUMULATIVE inches
October 2001	0.32	0.32	5.55
November 2001	0.50	0.25	5.80
December 2001	0.56	0.30	6.10
January 2002	0.85	0.04	0.04
February 2002	0.91	0.02	0.06
March 2002	0.78	0.13	0.19
April 2002	0.35	0.05	0.24
May 2002	0.36	0.00	0.24
June 2002	0.25	0.27	0.51
July 2002	0.50	0.10	0.61
August 2002	0.60	0.00	0.61
September 2002	0.35	0.11	0.72
October 2002	0.32	0.28	1.00

^a Source National Weather Service Nuclear Support Office

4.4 SOIL MOISTURE MONITORING RESULTS

4.4.1 Data Presentation

The Cumulative Residual Neutron Counts graph (Figure 4) tracks changes over time from baseline conditions relative to the regulatory level of concern (Action Level). The residual raw Counts are calculated by subtracting the first-year average neutron count (baseline) from the raw neutron count from each monitoring period. While the data are collected on a 0.3-m (1-ft) interval, the Cumulative Residual Neutron Count graph displays only the residual count every 1.5 m (5 ft) in the regulated interval between 73.2 to 82.3 m (240 to 270 ft). This corresponds to the point closest to the bottom of the U-3fi emplacement casing. The residual values are plotted as residual raw counts vs date for each 1.5-m (5-ft) depth (Figure 4). The level of regulatory concern is indicated as a heavy line at the 200 count Action Level. Values exceeding this limit for two consecutive monitoring periods require notifying the NDEP as specified in the Part B RCRA Permit (NDEP, 1997).

The next four graphs, Baseline Difference (Figures 5 through 8), show the changes occurring for the four quarterly monitoring periods along the entire length of a neutron access tube relative to baseline conditions. It is calculated by subtracting the baseline (first-year average) neutron count from the current raw neutron count on a depth basis. The result of this subtraction is referred to as the residual raw count. The residual raw count is plotted along with the actual raw neutron counts of both the current and baseline data vs depth from the top of the casing. A positive residual neutron count indicates conditions at that depth and point in time that are wetter than baseline conditions, while negative values indicate dryer conditions. Repeatability and instrumentation noise are approximately ± 100 counts. As a result, the residual graph has a noisy chaotic character due to the absence of any signal. The Baseline Difference graph provides detailed information on the overall performance of the entire unit, while the Cumulative Residual graph focuses only on cumulative trends relative to the regulatory level of concern at a specific depth and is used to make compliance decisions.

4.4.2 Discussion of Analytical Data Trends

The ER3-3 borehole is logged on a quarterly interval occurring in January, April, July, and October.

The Cumulative Residual Neutron Counts Graph (Figure 4) provides summary monitoring information over time with respect to the level of regulatory concern. The baseline data set, as indicated on the graph, was derived from the first ten months of data. Below the cumulative residual plot is the monthly cumulative precipitation obtained from the BJY Weather Station.

The Cumulative Residual Neutron Counts (Figure 4) in the regulated interval are plotted on a 0.3-m (5-ft) spacing, by date, and indicate dry conditions with no trends evident.

The moisture content of the regulated interval between 73.2 to 82.3 m (240 to 270 ft) remains dry and stable, and is below the compliance Action Level of 200 counts.

Performance along the entire neutron access tube is found in the Baseline Difference graphs (Figures 5 through 8). These graphs show the raw neutron counts obtained from both the baseline data set and the current quarterly monitoring period as well as the residual counts (Quarter - Baseline) on a 0.3-m (1-ft) interval. This presentation is useful to determine moisture changes occurring outside of the regulated interval as well as monitoring for subsidence. The 200 count Action Level and the extent of the regulated interval are labeled for reference.

4.4.2.1 January 2002-First Quarter

The January 2002 Baseline Difference graph is shown in Figure 5. Borehole conditions are observed to be dry and stable, with no trends or indications of subsidence evident in the data.

The area immediately beneath the cement plug shows an air gap with apparent "drying," probably due to the settling of the backfill in this area. This apparent drying trend extends from approximately 16.15 to 18.29 m (53 to 60 ft) in the January and subsequent monitoring quarters. No significant change is noted from the prior October 2001 monitoring period.

The moisture content of the regulated interval between 73.2 to 82.3 m (240 to 270 ft) remains dry and is below the compliance Action Level of 200 counts. There is no evidence of subsidence observed in the data.

4.4.2.2 April 2002-Second Quarter

The April 2002 Baseline Difference graph is shown in Figure 6. No changes are observed in the air gap beneath the cement plug. Borehole conditions are observed to be dry and stable, with no trends or indications of subsidence evident in the data.

The moisture content of the regulated interval between 73.2 to 82.3 m (240 to 270 ft) remains dry, stable, and is below the compliance Action Level of 200 counts with no indications of subsidence.

4.4.2.3 July 2002-Third Quarter

The July 2002 Baseline Difference graph is shown in Figure 7. The data logged in the third quarter indicates dry stable conditions over the length of the borehole with the exception of a single point reaching 234.5 counts at 114.9 m (377 ft) in depth. This reading is attributed to a combination of counting statistics and tool positioning error along an area that has a large change in counts over a short distance. This steep gradient resulted in a large change in the residual count from a small positioning error.

This neutron log also indicates dry stable conditions extending from 21 m (70 ft) to depth with no evidence of subsidence.

The moisture content of the regulated interval between 73.2 to 82.3 m (240 to 270 ft) remains dry and stable and shows no signs of subsidence.

4.4.2.4 October 2002-Fourth Quarter

The October 2002 Baseline Difference graph is shown in Figure 8. This neutron log also indicates dry and stable conditions extending from 21 m (70 ft) to depth, with no indications of subsidence.

The moisture content of the regulated interval between 73.2 to 82.3 m (240 to 270 ft) remains dry and stable, and is below the Compliance Action Level of 200 counts with no indications of subsidence.

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5.0 SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

5.1 SUMMARY

- Inspections of the cover were done to identify any significant changes to the unit requiring action. No significant concerns were noted.
- The subsidence survey for the October 2001 to October 2002 monitoring period was completed in July 2002 with a monument elevation of 1,230.833 m (4,038.165 ft) which indicated a subsidence of -0.457 cm (-0.180 in) relative to the baseline survey of September 1996, and a slight decrease in elevation of 0.030 cm (0.012 in) compared to the previous year, July 2001. While the survey results show a negative subsidence after the baseline survey, the magnitude of these changes is small enough to be at the survey instrument resolution level; therefore, it is not clear if they represent subsidence or measurement error. There is no clear evidence of any subsidence of the monument.
- Visual inspections of the concrete cover indicate no evidence of subsidence.
- A single data point exceeded the residual 200 count level with a reading of 234.5 counts at a depth of 114.9 m (377 ft). This singular reading is attributed to a combination of counting statistics and error due to positioning of the logging tool in a steep gradient.
- The ER3-3 neutron moisture data obtained in 2002 are below the Action Level of 200 residual raw counts within the regulated interval.

5.2 CONCLUSIONS

- No significant concerns were observed during the site inspections over the period October 2001 through October 2002.
- There is no subsidence of the ER3-3 monument.
- The moisture content of the regulated interval between 73.2 to 82.3 m (240 to 270 ft) remains dry, stable and shows no signs of subsidence.
- Both the Baseline Difference and Cumulative Residual data indicate dry stable conditions for all quarterly monitoring periods. The Residual Raw Neutron Counts remain below the compliance Action Level of 200 counts within the regulated interval for period from October 2001 through October 2002.
- The closure is in compliance and performing as designed.

5.3 RECOMMENDATIONS

Although not within a compliance interval or of regulatory concern, the drying trend observed in the bentonite seal and sloughed soils beneath the cement wellhead protection plug will continue to be monitored to determine if the void area is increasing.

6.0 REFERENCES

- Bechtel Nevada, 1999. Organization Instruction OI-2152.103, "Environmental Restoration Neutron Moisture Logging," December 1999.
- Bradley, E. and Tibshirani, R., 1993. An Introduction to the Bootstrap, Chapman & Hall.
- DOE, see U.S. Department of Energy.
- DOE/NV, see U.S. Department of Energy, Nevada Operations Office.
- NDEP, see Nevada Division of Environmental Protection.
- Nevada Division of Environmental Protection, 1996. Letter from P. J. Liebendorfer to S. A. Mellington, "Review of Revised Technical Basis for Setting the Action Level for Subsurface Monitoring of ER3-3 (U-3fi Waste Disposal Site CAU #91 {Site})," December 9, 1996.
- Nevada Division of Environmental Protection, 1997, Nevada Division of Environmental Protection Permit for a Hazardous Waste Management Facility, Permit Number NEV HW009, May 1997.
- Tattro, L. D., Los Alamos National Laboratory, August 4, 1989, Correspondence to Mr. Darrell M. Warren, Las Vegas, NV.
- U.S. Department of Energy, 1988. Environmental Survey Preliminary Report, Nevada Test Site, Mercury, Nevada, DOE/EH/OEU-ISP, Washington, D.C.
- U.S. Department of Energy, Nevada Operations Office, 1995a. Area 3 U3fi Waste Unit Resource Conservation and Recovery Act Closure Report, November 1995, Las Vegas, NV.
- U.S. Department of Energy, Nevada Operations Office, 1995b. Resource Conservation and Recovery Act Industrial Site Environmental Restoration Closure Plan, Area 3 U-3fi Waste Unit, DOE/NV-404, UC-700, Las Vegas, NV.
- U.S. Department of Energy, Nevada Operations Office, 1995c. Resource Conservation and Recovery Act Industrial Sites Environmental Restoration Post-Closure Plan, Area 3 U-3fi Waste Unit, DOE/NV-405, UC-700.
- U.S. Department of Energy, Nevada Operations Office, 1996. Letter from S. A. Mellington, DOE to P. J. Liebendorfer, NDEP, "Submittal of the Technical Basis for Setting the Action Level Criteria for Neutron Access Tube ER3-3, ER3-3 Baseline Data Set and Hydrologic Properties Report (CAU 91)", October 22, 1996, Las Vegas, NV.
- U.S. Department of Energy, Nevada Operations Office, 1997. First Annual Report RCRA Post-Closure Monitoring and Inspections for the U-3fi Waste Unit for the Period July 1995 - October 1996, DOE/NV 11718-089, UC-712, Las Vegas, NV.

- Waddell, R. K., 1982. Two-dimensional Steady-state Model of Groundwater Flow, Nevada Test Site and Vicinity, Nevada-California, U.S. Geologic Survey Water-Resources Investigations 82-4085, 72 p.
- Winograd, I. J., W. Thordarson, and R. A. Young, 1975. Hydrology of the Nevada Test Site and Vicinity, South Eastern Nevada, U.S. Department of the Interior, Geological Survey.

APPENDIX A

POST-CLOSURE CARE INSPECTION CHECKLISTS

Copies of site photographs available upon request.

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AREA 3, U-3fi POST-CLOSURE INSPECTION CHECKLIST

PAGE 1 OF 4

Inspection Start Date and Time: 3/14/2002 14:30

Reason for Inspection: Semi-annual

Responsible Agency: Bechtel Nevada, Environmental Restoration

Address: Nevada Test Site, Mercury, Nevada

Responsible Agency Official: Jeff Smith, Project Manager

Date of Last Post-Closure Inspection: 9/24/01 at 13:25

Reason for Last Post-Closure Inspection: Semi-annual

Chief Inspector: James Traynor Associate Scientist Environmental Restoration

Name	Title	Organization
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Assistant Inspector:

Name	Title	Organization
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A. GENERAL INSTRUCTIONS

1. All checklist items must be completed and detailed comments made to document the results of the site inspection. The completed checklist is part of the field record of the inspection. Additional pages should be used as necessary to ensure that a complete record is made. Attach the additional pages and number all pages upon completion of the inspection.
2. Inspectors are to provide an up-to-date resume or vitae for inclusion in the inspection report.
3. Any checklist line item marked by an inspector in a SHADED BOX, must be fully explained or an appropriate reference to previous reports provided. The purpose of this requirement is to provide a written explanation of inspector observations and the inspector's rationale for conclusions and recommendations. Explanations are to be placed on additional attachments and cross-referenced appropriately. Explanations, in addition to narrative, will take the form of sketches, measurements, annotated site maps.
4. The site inspection is a walking inspection of the entire site (i.e., the area within 1,000 feet of U-3fi and ER-3-3), including the perimeter and sufficient transects to be able to inspect the entire surface and all features specifically described in this checklist. Every monument, site marker, sign, monitoring well access, and erosion control marker will be inspected.
5. A standard set of color 35mm photographs is required. For this site, the standard set consists of 10 photographs (see instructions in Section D.6 of this checklist). In addition, all anomalous features or new features (such as changes in adjacent area land use) are to be photographed. A photo log entry will be made for each photograph taken.
6. Field notes taken to assist in completion of this checklist will become part of the inspection record. No form is specified for field notes, however, they must be legible and in sufficient detail to enable review by succeeding inspectors and the responsible agency.

B. PREPARATION (To be completed prior to site visit)

YES

NO

EXPLANATION

1. Post-Closure Permit reviewed.

X

2. Design basis documents reviewed.

X

3. Site as-built plans and site base map reviewed.

X

4. Previous inspection reports reviewed.

X

a. Were anomalies or trends detected on previous inspections?

X

LIGHT, HAIRLINE, RADIAL CRACKS IN PAD AND SEALANT IN CONCRETE EXPANSION JOINTS MISSING

b. Was maintenance performed?

X

RADIAL CRACK REPAIR NOT NECESSARY; SEALANT REPLACED

5. Site maintenance and repair records reviewed.

X

NO MAJOR REPAIRS PERFORMED

a. Has site repair resulted in a change from as-built conditions?

X

b. Are revised as-builts available that reflect repair changes?

X

NOT APPLICABLE

C. SITE INSPECTION PREPARATION

Assemble the following equipment, as needed, to conduct inspections

- a. Camera and film
- b. Binoculars
- c. Tape measure
- d. Optical ranging device
- e. Brunton compass
- f. Photo scales
- g. Erasable board
- h. Keys to locks
- i. Hand lens
- j. Clipboard
- k. Other miscellaneous support equipment

D. SITE INSPECTION (To be completed during inspection)

YES

NO

EXPLANATION

1. Adjacent off-site features within watershed areas upslope of U-3f Waste Unit.

- a. Have there been any changes in use of adjacent area?
- b. Are there any new roads or trails?
- c. Has there been a change in the position of nearby washes?
- d. Has there been lateral excursion or erosion/deposition of nearby washes?
- e. Are there new drainage channels?
- f. Other?

	X	
	X	
	X	
	X	
	X	
	X	

2. Access roads, fences, gates, and signs.

- a. Is there a break in the fence?
- b. Have any posts been damaged or their anchoring weakened?
- c. Is there evidence of erosion or digging beneath the fence?
- d. Does the gate show evidence of tampering or damage?
- e. Is there any evidence of human intrusion?
- f. Is there any evidence of large animal intrusion?
- g. Have any signs been damaged or removed?
(Number of signs replaced: _____)
- h. Are access roads passable?
- i. Other (include trash and debris in or around unit)?

	X	
	X	
	X	
	X	
	X	
	X	
	X	
X		
	X	

AREA 3, U-3fi POST-CLOSURE INSPECTION CHECKLIST (cont.)	YES	NO	EXPLANATION	PAGE 3 OF 4
3. Monuments and other permanent features				
a. Have the survey or boundary monuments been defaced or disturbed?		X		
b. Have the site markers been disturbed by man or natural processes?		X		
c. Do natural processes threaten to integrity of any monument or site marker?		X		
d. Other?		X		
4. U-3fi Waste Unit cover				
a. Is there evidence of settling?		X		
b. Is there cracking?	X		LIGHT, HAIRLINE, RADIAL CRACKS IN PAD	
c. Is there evidence of erosion around the cap (wind or water)?		X		
d. Is there evidence of animal burrowing?		X		
e. Other (vegetation, trash, debris, etc. within fenced area)?		X		
5. Site drainage features (within 1,000 feet of U-3fi).				
a. Is the drainage as describe in the site plans?	X			
b. Is there evidence of bank erosion?		X		
c. Is there evidence of channel erosion?		X		
d. Is there evidence of sedimentation?		X		
e. Is there channel obstruction?		X		
f. Is there any evidence that diversion channels (if present) are not performing their function?		X		
g. Other?		X		
6. Photo Instructions				
A total of 10 photographs are required to be taken during each inspection of the Area 3 U-3fi Waste Unit. Additional photos may also be taken. The required photographs shall be taken as follows:				
<ul style="list-style-type: none"> • Four (4) from the center of the U-3fi Waste Unit cap, one <u>in</u> each compass direction (i.e., N, S, E, W). • Four (4) of the U-3fi Waste Unit cap, one <u>from</u> each compass direction, • Two (2) of the ER-3-3 monitoring well surface completion with compass directions noted on the photo log. 				
7. Photo Documentation				
a. Have all photos required by the photo instructions been taken? (see last page of checklist)	X			
b. Has a photo log been prepared for each roll of film exposed?	X		SEE FIELD NOTES	
c. Number of roles exposed (<u>1</u>)				
d. Other?		X		

AREA 3, U-3fi POST-CLOSURE INSPECTION CHECKLIST (cont.)		YES	NO	EXPLANATION	PAGE 4 OF 4
8. Monitoring well ER-3-3 access					
a. Has the monitoring well access been disturbed by man or natural processes?		X			
b. Does any natural process threaten the integrity of the monitoring well access?		X			
c. Is the monitoring well access label plate intact and legible?	X				
d. Is the monitoring well access capped and properly secured?	X				
e. Other?		X			
E. FIELD CONCLUSIONS					
1. Is there an imminent hazard to the integrity of the U-3fi Waste Unit? (Immediate report required)		X			
Person/Agency to whom report made:					
2. Are more frequent inspections required?		X			
3. Are existing maintenance/repair actions satisfactory?	X				
4. Is other maintenance/repair necessary?		X			
5. Field conclusions/recommendations: Unit is in good working condition. Radial cracks in monument pad should be watched.					
E. CERTIFICATION					
I have conducted an inspection of the Area 3 U-3fi Waste Unit at the NTS in accordance with the procedures of the Post-Closure Permit (including the Post-Closure Plan) as recorded on this checklist, attached sheets, field notes, photo logs, and photographs.					
Chief Inspector's Signature
Title Associate Scientist		Printed Name James Traynor			
		Date 03/14/2002			

3/14/02

Members: Jim Tray

1430 Arrived onsite.

Weather: overcast, cold, windy

Adjacent offsite: Good.

Roads, fences, gates, & signs: Good.

Monuments: Good, light clacking in pad.

Cover: Good.

Site drainage: Good.

Monitoring Well: Good.

Photos

1	inside unit looking north (from center)	6	inside unit looking south (wellhead)
2	inside unit looking east	7	outside unit looking north
3	inside unit looking south (from center)	8	outside unit looking east
4	inside unit looking west	9	outside unit looking south
5	inside unit looking north (wellhead)	10	outside unit looking west

Conclusions/Recommendations: Light clacking in monument pad should be watched. Continue inspections as planned.

SIGNATURE

DATE

DISCLOSED TO AND UNDERSTOOD BY

DATE

WITNESS

DATE

**RESOURCE CONSERVATION AND RECOVERY ACT
AREA 3 U-3fi INJECTION WELL
POST-CLOSURE SITE INSPECTION
PHOTOGRAPH LOG**

Photo Number	Date	Description
1	3/14/2002	Inside unit looking north (from center of unit)
2	3/14/2002	Inside unit looking east
3	3/14/2002	Inside unit looking south (from center of unit)
4	3/14/2002	Inside unit looking west
5	3/14/2002	Inside unit, wellhead looking north
6	3/14/2002	Inside unit, wellhead looking south
7	3/14/2002	Outside unit looking north
8	3/14/2002	Outside unit looking east
9	3/14/2002	Outside unit looking south
10	3/14/2002	Outside unit looking west

AREA 3, U-3fi POST-CLOSURE INSPECTION CHECKLIST

PAGE 1 OF 4

Inspection Start Date and Time: 9/19/2002 at 1210

Reason for Inspection: Semi-annual

Responsible Agency: Bechtel Nevada, Environmental Restoration

Address: Nevada Test Site, Mercury, Nevada

Responsible Agency Official: Jeff Smith, Project Manager

Date of Last Post-Closure Inspection: 3/14/2002

Reason for Last Post-Closure Inspection: Semi-annual

Chief Inspector: James Traynor Associate Scientist Environmental Restoration

Name	Title	Organization
------	-------	--------------

Assistant Inspector:

Name	Title	Organization
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A. GENERAL INSTRUCTIONS

1. All checklist items must be completed and detailed comments made to document the results of the site inspection. The completed checklist is part of the field record of the inspection. Additional pages should be used as necessary to ensure that a complete record is made. Attach the additional pages and number all pages upon completion of the inspection.
2. Inspectors are to provide an up-to-date resume or vitae for inclusion in the inspection report.
3. Any checklist line item marked by an inspector in a SHADED BOX, must be fully explained or an appropriate reference to previous reports provided. The purpose of this requirement is to provide a written explanation of inspector observations and the inspector's rationale for conclusions and recommendations. Explanations are to be placed on additional attachments and cross-referenced appropriately. Explanations, in addition to narrative, will take the form of sketches, measurements, annotated site maps.
4. The site inspection is a walking inspection of the entire site (i.e., the area within 1,000 feet of U-3fi and ER-3-3), including the perimeter and sufficient transects to be able to inspect the entire surface and all features specifically described in this checklist. Every monument, site marker, sign, monitoring well access, and erosion control marker will be inspected.
5. A standard set of color 35mm photographs is required. For this site, the standard set consists of 10 photographs (see instructions in Section D.6 of this checklist). In addition, all anomalous features or new features (such as changes in adjacent area land use) are to be photographed. A photo log entry will be made for each photograph taken.
6. Field notes taken to assist in completion of this checklist will become part of the inspection record. No form is specified for field notes, however, they must be legible and in sufficient detail to enable review by succeeding inspectors and the responsible agency.

B. PREPARATION (To be completed prior to site visit)

YES	NO	EXPLANATION
-----	----	-------------

1. Post-Closure Permit reviewed.

X

2. Design basis documents reviewed.

X

3. Site as-built plans and site base map reviewed.

X

4. Previous inspection reports reviewed.

X

a. Were anomalies or trends detected on previous inspections?

X

LIGHT, HAIRLINE, RADIAL CRACKS IN PAD AND SEALANT IN CONCRETE EXPANSION JOINTS MISSING

b. Was maintenance performed?

X

RADIAL CRACK REPAIR NOT NECESSARY; SEALANT REPLACED

5. Site maintenance and repair records reviewed.

X

NO MAJOR REPAIRS PERFORMED

a. Has site repair resulted in a change from as-built conditions?

X

b. Are revised as-builts available that reflect repair changes?

X

NOT APPLICABLE

C. SITE INSPECTION PREPARATION

Assemble the following equipment, as needed, to conduct inspections

- a. Camera and film
- b. Binoculars
- c. Tape measure
- d. Optical ranging device
- e. Brunton compass
- f. Photo scales
- g. Erasable board
- h. Keys to locks
- i. Hand lens
- j. Clipboard
- k. Other miscellaneous support equipment

D. SITE INSPECTION (To be completed during inspection)

YES

NO

EXPLANATION

1. Adjacent off-site features within watershed areas upslope of U-3fi Waste Unit.

- a. Have there been any changes in use of adjacent area?
- b. Are there any new roads or trails?
- c. Has there been a change in the position of nearby washes?
- d. Has there been lateral excursion or erosion/deposition of nearby washes?
- e. Are there new drainage channels?
- f. Other?

	X	
	X	
	X	
	X	
	X	
	X	

2. Access roads, fences, gates, and signs.

- a. Is there a break in the fence?
- b. Have any posts been damaged or their anchoring weakened?
- c. Is there evidence of erosion or digging beneath the fence?
- d. Does the gate show evidence of tampering or damage?
- e. Is there any evidence of human intrusion?
- f. Is there any evidence of large animal intrusion?
- g. Have any signs been damaged or removed?
(Number of signs replaced: _____)
- h. Are access roads passable?
- i. Other (include trash and debris in or around unit)?

	X	
	X	
	X	
	X	
	X	
	X	
	X	
X		
	X	

AREA 3, U-3fi POST-CLOSURE INSPECTION CHECKLIST (cont.)	YES	NO	EXPLANATION	PAGE 3 OF 4
3. Monuments and other permanent features				
a. Have the survey or boundary monuments been defaced or disturbed?		X		
b. Have the site markers been disturbed by man or natural processes?		X		
c. Do natural processes threaten the integrity of any monument or site marker?		X		
d. Other?		X		
4. U-3fi Waste Unit cover				
a. Is there evidence of settling?		X		
b. Is there cracking?	X		LIGHT, HAIRLINE, RADIAL CRACKS IN PAD. NO CHANGE FROM PREVIOUS INSPECTIONS. RADIAL CRACKS DO NOT THREATEN THE INTEGRITY OF THE UNIT.	
c. Is there evidence of erosion around the cap (wind or water)?		X		
d. Is there evidence of animal burrowing?		X		
e. Other (vegetation, trash, debris, etc. within fenced area)?		X		
5. Site drainage features (within 1,000 feet of U-3fi).				
a. Is the drainage as describe in the site plans?	X			
b. Is there evidence of bank erosion?		X		
c. Is there evidence of channel erosion?		X		
d. Is there evidence of sedimentation?		X		
e. Is there channel obstruction?		X		
f. Is there any evidence that diversion channels (if present) are not performing their function?		X		
g. Other?		X		
6. Photo Instructions				
A total of 10 photographs are required to be taken during each inspection of the Area 3 U-3fi Waste Unit. Additional photos may also be taken. The required photographs shall be taken as follows:				
<ul style="list-style-type: none"> ● Four (4) from the center of the U-3fi Waste Unit cap, one <u>in</u> each compass direction (i.e., N, S, E, W), ● Four (4) of the U-3fi Waste Unit cap, one <u>from</u> each compass direction, ● Two (2) of the ER-3-3 monitoring well surface completion with compass directions noted on the photo log. 				
7. Photo Documentation				
a. Have all photos required by the photo instructions been taken? (see last page of checklist)	X			
b. Has a photo log been prepared for each roll of film exposed?	X		SEE FIELD NOTES	
c. Number of roles exposed (<u>1</u>)				
d. Other?		X		

AREA 3, U-3fi POST-CLOSURE INSPECTION CHECKLIST (cont.)		YES	NO	EXPLANATION	PAGE 4 OF 4
8. Monitoring well ER-3-3 access					
a. Has the monitoring well access been disturbed by man or natural processes?			X		
b. Does any natural process threaten the integrity of the monitoring well access?			X		
c. Is the monitoring well access label plate intact and legible?	X				
d. Is the monitoring well access capped and properly secured?	X				
e. Other?			X		
E. FIELD CONCLUSIONS					
1. Is there an imminent hazard to the integrity of the U-3fi Waste Unit? (Immediate report required)			X		
Person/Agency to whom report made:					
2. Are more frequent inspections required?			X		
3. Are existing maintenance/repair actions satisfactory?	X				
4. Is other maintenance/repair necessary?			X		
5. Field conclusions/recommendations: Unit is in good working condition. Radial cracking does not threaten the integrity of the unit.					
E. CERTIFICATION					
I have conducted an inspection of the Area 3 U-3fi Waste Unit at the NTS in accordance with the procedures of the Post-Closure Permit (including the Post-Closure Plan) as recorded on this checklist, attached sheets, field notes, photo logs, and photographs.					
Chief Inspector's Signature		Printed Name James Traynor			
Title Associate Scientist		Date 09/19/2002			

TITLE

PROJECT NO.

167

Work continued from Page _____

BOOK NO.

12¹⁰ Arrived onsite.

Members: J. Tra

Weather: warm + sunny

Adjacent offside: No change.

5

Access roads, fences, gates, & signs: Good

Monuments: Good

10

Cover: Good, radial cracking does not threaten integrity of unit.

Site drainage: Good.

15

Monitoring well: Good.

Conclusions/Recommendations: Site in good condition.

Photos:

Continue Semiannual
Inspections.

20

1 Inside unit looking north

2 Inside unit looking east

3 Inside unit looking south

4 Inside unit looking west

5 Well head looking north

6 Well head looking south

7 Outside looking north

25

8 Outside looking east

9 Outside looking south

10 Outside looking west

SIGNATURE

DATE

9/19/02

DISCLOSED TO AND UNDERSTOOD BY

DATE

WITNESS

DATE

**RESOURCE CONSERVATION AND RECOVERY ACT
AREA 3 U-3f INJECTION WELL
POST-CLOSURE SITE INSPECTION
PHOTOGRAPH LOG**

Photo Number	Date	Description
1	9/19/2002	Inside unit looking north (from center of unit)
2	9/19/2002	Inside unit looking east
3	9/19/2002	Inside unit looking south (from center of unit)
4	9/19/2002	Inside unit looking west
5	9/19/2002	Inside unit, wellhead looking north
6	9/19/2002	Inside unit, wellhead looking south
7	9/19/2002	Outside unit looking north
8	9/19/2002	Outside unit looking east
9	9/19/2002	Outside unit looking south
10	9/19/2002	Outside unit looking west

APPENDIX B

SUBSIDENCE SURVEY PLAT

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PLAN

SCALE: 1" = 20'

NUMERICAL TABLE

1	2	3	4	5	6	7
ELEV TOP MON SEPTEMBER 1996	ELEV TOP MON AUGUST 1997	ELEV TOP MON SEPTEMBER 1998	ELEV TOP MON JULY 1999	ELEV TOP MON JULY 2000	ELEV TOP MON JULY 2001	ELEV TOP MON JULY 2002
4038.18	4038.18	4038.18	4038.16	4038.17	4038.17	4038.17

PERFORM A PROPER CLOSURE ON THE ORIGINAL R THE ELEVATION CONTROL DATUM.

GRAPHIC SCALE

APPENDIX C

PRECIPITATION RECORDS

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NTS PRECIPITATION

October 2001

	A12	BJY	CS	DRA	A06	E Tu	4JA	LF2	MER	MV	40 Mi	PM1	PHS	RV	TS2	W5B	UCC
1												0.07					
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	
11																	
12																	
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15																	
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19																	
20																	
21																	
22																	
23																	
24																	
25																	
26																	
27																	
28																	
29																	
30	0.43	0.32	0.69	0.66	0.52	0.35	0.52	0.32	0.80	0.65	0.45	0.30	0.35	0.52	0.35	0.47	0.53
31																	
TOTAL	0.43	0.32	0.69	0.66	0.52	0.35	0.52	0.32	0.80	0.65	0.45	0.37	0.35	0.52	0.35	0.47	0.53

Area 12 Dip Stick Rain Gage Reading: 0.20 inches of precipitation from 10/02/00 to 11/01/00.

Data Tabulated By: *Raymond D. Dennis* 11/02/01

Data Quality Control: *Raymond D. Dennis* 11/02/01

Certified By: *Raymond D. Dennis* 11-02-01

NTS PRECIPITATION

November 2001

	A12	BJY	CS	DRA	A06	E Tu	4JA	LF2	MER	MV	40 Mi	PM1	PHS	RV	TS2	W5B	UC
1																	
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	
11																	
12	0.19	0.05	0.07	0.06	0.03	0.15	0.14	0.15	0.03	0.07	0.23	0.22	0.08	0.10	0.05	0.04	0.00
13	0.03	0.02	0.03	0.01		0.11	0.04	0.03	0.01	0.05	0.05	0.13		0.01	0.02		0.02
14																	
15																	
16																	
17																	
18																	
19																	
20																	
21																	
22																	
23																	
24	0.30	0.17	0.08	0.01	0.06	0.44	0.09	0.12	0.03	0.50	0.31	0.11	0.24	0.02	0.20	0.03	0.12
25		0.01		0.01				0.02		0.02			0.01		0.01		
26																	
27																	
28																	
29	0.05			T		0.05	0.05		0.05			0.03	0.02	0.29			
30			0.02		0.03			0.01			0.01					0.04	
TOTAL	0.57	0.25	0.20	0.09	0.12	0.75	0.32	0.33	0.12	0.64	0.60	0.49	0.35	0.42	0.28	0.11	0.17

Area 12 Dip Stick Rain Gage Reading: .60 inches of precipitation from 11/01/00 to 12/04/00.

Data Tabulated By: *Raymond D. Dennis* 12/05/01

Data Quality Control: *Raymond D. Dennis* 12/05/01

Certified By: *James C. Smith* 12-05-01

NTS PRECIPITATION

December 2001

	A12	BJY	CS	DRA	A06	E Tu	4JA	LF2	MER	MV	40 Mi	PM1	PHS	RV	TS2	W5B	UCC
1								0.02			0.01				0.01		
2	0.03							0.03						0.02	0.01		
3	0.25					0.07					0.03	0.34					
4						0.04					0.01	0.01					
5																	
6																	
7																	
8																	
9																	
10	0.02				0.02					0.01	0.01				0.02		
11	0.01			T		0.02						0.02					
12																	
13																	
14	0.28	0.23	0.18	0.17	0.08	0.27	0.14	0.25	0.07	0.15	0.29	0.17	0.17	0.10	0.33	0.20	0.15
15																	
16																	
17																	
18																	
19																	
20																	
21	0.06	0.02				0.03		0.03		0.02	0.02	0.02			0.02		
22																	
23	0.05					0.02						0.03					
24																	
25																	
26																	
27																	
28						0.01											
29	0.08	0.05	0.01	0.02	0.02	0.13	0.02	0.03		0.02	0.02	0.10	0.08	0.02	0.02	0.02	0.02
30	0.02		0.01		0.03			0.02				0.01	0.02	0.02			
31	0.02			T		0.02		0.01			0.01	0.02					
TOTAL	0.82	0.30	0.20	0.19	0.15	0.61	0.16	0.39	0.07	0.20	0.40	0.72	0.27	0.16	0.41	0.22	0.17

Area 12 Dip Stick Rain Gage Reading: 0.60 inches of precipitation from 12/04/01 to 01/02/02.

Data Tabulated By: *Raymond V. Dennis* 01/04/02

Data Quality Control: *Raymond V. Dennis* 01/04/02

Certified By: *Stephen L. Smith* 01/04/02

NTS PRECIPITATION																	
January 2002																	
	A12	BJY	CS	A06	DRA	E Tu	4JA	40 Mi	LF2	MER	MV	PM1	PHS	RV	TS2	W5B	UCO
1																	
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	
11																	
12																	
13																	
14																	
15																	
16																	
17																	
18																	
19																	
20																	
21																	
22																	
23																	
24																	
25																	
26																	
27	0.20	0.04	0.11	0.07	0.10	0.17		0.20	0.20	0.20	0.24	0.03	0.06	0.09	0.23	0.24	0.13
28					T	0.06		0.01	0.01					0.02			
29	0.05				0.20	0.04	0.06	0.05	0.03	0.20				0.09			
30																	
31																	
TOTAL	0.25	0.04	0.11	0.07	0.30	0.27	0.06	0.26	0.24	0.40	0.24	0.03	0.06	0.20	0.23	0.24	0.13
Area 12 Dip Stick Rain Gage Reading: 0.20 inches of precipitation from 01/02/2002 to 02/04/2002																	
Data Tabulated By: <i>[Signature]</i> 02/05/02																	
Data Quality Control: <i>[Signature]</i> 02/05/02																	
Certified By: <i>[Signature]</i> 02-05-02																	

NTS PRECIPITATION

February 2002

	A12	BJY	CS	A06	DRA	E Tu	4JA	40 Mi	LF2	MER	MV	PM1	PHS	RV	TS2	W5B	UCC
1																	
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	
11																	
12																	
13																	
14																	
15																	
16																	
17	0.29	0.02	0.05	0.04	0.04	0.34	0.04	0.05	0.19	0.02	0.04	0.25	0.08	0.05	0.14	0.02	0.02
18	0.01				0.02	0.02		0.02	0.05		0.01						
19																	
20																	
21																	
22																	
23																	
24																	
25																	
26																	
27																	
28																	
TOTAL	0.30	0.02	0.05	0.04	0.06	0.36	0.04	0.07	0.24	0.02	0.05	0.25	0.08	0.05	0.14	0.02	0.02

Area 12 Dip Stick Rain Gage Reading: 0.20 inches of precipitation from 02/04/2002 to 03/04/2002

Data Tabulated By: *Bill Allen* 3-6-02

Data Quality Control: *Raymond W. Davis* 3-6-02

Certified By: *Raymond W. Davis* 3-6-02

	NTS PRECIPITATION																
	March 2002																
	A12	BJY	CS	A06	DRA	E Tu	4JA	40 Mi	LF2	MER	MV	PM1	PHS	RV	TS2	W5B	UCC
1																	
2																	
3																	
4																	
5																	
6					T												
7	0.06	0.03	0.04	0.10		0.05	0.02	0.04		0.01	0.08	0.08	0.04	0.01	0.03	0.15	0.06
8																	0.02
9																	
10																	
11																	
12																	
13																	
14																	
15	0.13					0.10			0.02		0.02	0.11	0.03				
16	0.04	0.01			T	0.06		0.09	0.06		0.01	0.01	0.01		0.04		
17	0.48	0.02	0.18	0.05	0.17	0.31	0.03	0.36	0.21	0.30	0.30	0.25	0.28	0.08	0.17	0.21	0.08
18	0.02	0.05			0.04	0.02		0.01	0.04	0.08				0.02			
19																	
20																	
21																	
22																	
23			0.03		T	0.03	0.02			0.03				0.01		0.02	
24	0.02	0.02	0.02		0.14	0.01	0.02	0.04	0.02	0.03	0.02	0.03		0.02	0.02	0.02	0.02
25								0.01							0.01		
26																	
27																	
28																	
29																	
30																	
31																	
TOTAL	0.75	0.13	0.27	0.15	0.35	0.58	0.09	0.55	0.35	0.45	0.43	0.48	0.36	0.14	0.27	0.40	0.18

Area 12 Dip Stick Rain Gage Reading: 0.90 inches of precipitation from 02/04/2002 to 04/01/2002

Data Tabulated By: *Raymond V. Demaria* 04/03/02

Data Quality Control: *Raymond V. Demaria* 04/03/02

Certified By: *James H. Smith* 04-03-02

NTS PRECIPITATION

April 2002

	A12	BJY	CS	DRA	A06	E Tu	4JA	LF2	MER	MV	40 Mi	PM1	PHS	RV	TS2	W5B	UCC
1																	
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	
11																	
12																	
13																	
14																	
15																	
16																	
17																	
18																	
19																	
20																	
21																	
22																	
23																	
24																	
25																	
26	0.11	0.05				0.63	0.18				0.08	0.74	0.28		0.05		
27	0.44																
28																	
29																	
30																	
TOTAL	0.55	0.05	0.00	0.00	0.00	0.63	0.00	0.18	0.00	0.00	0.08	0.74	0.28	0.00	0.05	0.00	0.00

Area 12 Dip Stick Rain Gage Reading: 0.30 inches of precipitation from 04/01/2002 to 05/01/2002

Data Tabulated By: Raymond D. Dennis 05/03/02

ata Quality Control: Raymond D. Dennis 05/03/02

ertified By: Stephen P. Smith 05/03/02

NTS PRECIPITATION

May 2002

	A12	BJY	CS	DRA	A06	E Tu	4JA	LF2	MER	MV	40 Mi	PM1	PHS	RV	TS2	W5B	UCC
1																	
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	
11																	
12																	
13																	
14																	
15																	
16																	
17																	
18																	
19																	
20	0.01		0.01			0.02		0.01		0.02	0.02	0.02					0.04
21	0.05					0.09						0.02					0.01
22																	
23																	
24																	
25																	
26																	
27																	
28																	
29																	
30																	
31																	
TOTAL	0.06	0.00	0.01	0.00	0.00	0.11	0.00	0.01	0.00	0.02	0.02	0.04	0.00	0.00	0.00	0.00	0.05

Area 12 Dip Stick Rain Gage Reading: 0.40 inches of precipitation from 05/01/2002 to 06/03/2002

Data Tabulated By: *Raymond D. Dennis* 06/03/02

Data Quality Control: *Raymond D. Dennis* 06/03/02

Certified By: *Stephen L. Smith* 06-04-02

	NTS PRECIPITATION																
	June 2002																
	A12	BJY	CS	DRA	A06	E Tu	4JA	LF2	MER	MV	40 Mi	PM1	PHS	RV	TS2	W5B	UCC
1	0.01		0.01		0.02	0.02				0.01			0.02			0.04	0.03
2	0.06	0.27				0.12				0.21							
3				T													
4																	
5																	
6																	
7																	
8																	
9																	
10																	
11																	
12																	
13																	
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21																	
22																	
23																	
24																	
25																	
26																	
27																	
28																	
29																	
30																	
31																	
TOTAL	0.07	0.27	0.01	0.00	0.02	0.14	0.00	0.00	0.00	0.22	0.00	0.00	0.02	0.00	0.00	0.04	0.03

Area 12 Dip Stick Rain Gage Reading: 0.00 inches of precipitation from 06/03/2002 to 07/01/2002

Data Tabulated By: *Raymond D. Dennis* 07/02/2002

Data Quality Control: *Raymond D. Dennis* 07/02/2002

Certified By: *Stephen A. Smith* 07-02-2002

NTS PRECIPITATION

July 2002

	A12	BJY	CS	DRA	A06	E Tu	4JA	LF2	MER	MV	40 Mi	PM1	PHS	RV	TS2	W5B	UC
1																	
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	
11						0.05											
12																	
13																	
14																	
15																	
16																	
17	0.04	0.07	0.03	0.01	0.03	0.05	0.05	0.02	0.05	0.02	0.03	0.33	0.06	0.16	0.09	0.70	
18	0.12	0.03	0.10			0.02				0.09	0.05				0.23		
19						0.05											
20																	
21																	
22																	
23																	
24	0.07			0.24		0.24			0.55		0.03			0.07			
25																	
26																	
27																	
28																	
29																	
30																	
31																	
TOTAL	0.23	0.10	0.13	0.25	0.03	0.41	0.05	0.02	0.60	0.11	0.11	0.33	0.06	0.23	0.32	0.70	0.00

Area 12 Dip Stick Rain Gage Reading: 0.10 inches of precipitation from 07/01/2002 to 08/01/2002

Data Tabulated By: *Raymond O. Dennis* 08/02/02

Data Quality Control: *Raymond O. Dennis* 08/02/02

Certified By: *Stephen A. Hinkle* 08-02-02

NTS PRECIPITATION

August 2002

	A12	BJY	CS	DRA	A06	E Tu	4JA	LF2	MER	MV	40 Mi	PM1	PHS	RV	TS2	W5B	UCC
1																	
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	
11																	
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22																	
23																	
24																	
25																	
26																	
27																	
28																	
29																	
30																	
31																	
TOTAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Area 12 Dip Stick Rain Gage Reading: 0.00 inches of precipitation from 08/01/2002 to 09/03/2002

Data Tabulated By: *Raymond D. Dennis* 09/05/02

Data Quality Control: *Raymond D. Dennis* 09/05/02

Certified By: *Gregory A. Smith* 09-05-02

NTS PRECIPITATION

September 2002

	A12	BJY	CS	DRA	A06	E Tu	4JA	LF2	MER	MV	40 Mi	PM1	PHS	RV	TS2	W5B	UCX
1	0.07					0.07											
2																	
3																	
4	0.06			T		0.08					0.06		0.05		0.07		
5	0.02			T		0.03				0.01			0.02			0.02	0.02
6	0.03									0.01	0.04	0.04					
7																	
8																	
9																	
10																	
11		0.07	0.05	0.08	0.13				0.06	0.16					0.04	0.09	0.07
12		0.04															
13																	
14																	
15																	
16																	
17																	
18																	
19																	
20																	
21																	
22																	
23																	
24																	
25																	
26																	
27																	
28			0.01				0.03	0.01	0.01	0.01		0.03					
29																	
30																	
31																	
TOTAL	0.18	0.11	0.06	0.08	0.13	0.18	0.03	0.01	0.07	0.19	0.10	0.07	0.07	0.00	0.11	0.11	0.04

Area 12 Dip Stick Rain Gage Reading: 0.20 inches of precipitation from 09/03/2002 to 10/01/2002

Data Tabulated By: *Raymond J. Dennis* 10/02/2002

Data Quality Control: *Raymond J. Dennis* 10/02/2002

Certified By: *Christopher L. Smith* 10-02-02

NTS PRECIPITATION

October 2002

	A12	BJY	CS	DRA	A06	E Tu	4JA	LF2	MER	MV	40 Mi	PM1	PHS	RV	TS2	W5B	UCC
1	0.04	0.22	0.06	0.35	0.10	0.09	0.08	0.04	0.42	0.02	0.02	0.02	0.19	0.15	0.03	0.02	0.17
2				T													
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	
11																	
12																	
13																	
14																	
15																	
16									0.01								
17	0.01	0.02			0.01		0.02	0.02	0.02					0.03			
18		0.01							0.01					0.01			
19																	
20																	
21																	
22																	
23																	
24																	
25				T										0.08			
26		0.02		0.05	0.03				0.12				0.01			0.02	0.03
27	0.01	0.01		0.09	0.01		0.01	0.01	0.02	0.01		0.01	0.01	0.01		0.02	
28																	
29																	
30																	
31																	
TOTAL	0.06	0.28	0.06	0.49	0.15	0.09	0.11	0.07	0.60	0.03	0.02	0.03	0.21	0.28	0.03	0.06	0.20

Area 12 Dip Stick Rain Gage Reading: 0.00 inches of precipitation from 10/01/2002 to 11/01/2002

Data Tabulated By: *Raymond D. Danner* 11/05/2002

Data Quality Control: *Raymond D. Danner* 11/05/2002

Certified By: *D. G. Rode* 11/05/2002

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