January 9, 2007

Note To: Jack Guttmann

From: Randall Fedors /RA/

Subject: SOIL DEPTHS MEASURED AT YUCCA MOUNTAIN DURING SITE VISITS IN 1998

This intra-office note briefly describes the methodology used and summarizes measurements made of soil depth on the hillslopes of Yucca Mountain above the potential repository footprint. These hillslopes were the focus of measurements because soils are generally less than 0.5 m (1.6 ft) thick.

Soil depths were measured by Center for Nuclear Waste Regulatory Analyses (CNWRA) staff and contractors during two site visits to Yucca Mountain, January 26-29, 1998 and May 13-18, 1998. The field participants were Randy Fedors (CNWRA, now U.S. Nuclear Regulatory Commission), Stuart Stothoff (contractor, now CNWRA), Dani Or (contractor), and David Groeneveld (contractor). Field observations are recorded in Scientific Notebooks 175 (ML043630294) and 255 (ML040650582).

Nine transects were completed (Figure 1 and Table 1). Spacing of locations of soil measurements along each transect varied from 10 to 50 m [33 to 160 ft] such that 5 to 10 locations were sampled along most transects. The soil at each measurement location (Table 2) was cleared off using shovel, trowel, and brushes over an area <1 m^2 [11 ft^2]. Average (or representative) soil depth was visually estimated by qualitatively taking into account an area weighting of soil depths in the pit supported by measuring several locations with ruler or measuring tape. Maximum and minimum soil depths were recorded for many locations. Slope of the bedrock surface was also approximated with a Branton compass.

Layering in the soil profile was absent except at two locations. These latter two locations (RTW-2 and HDN-1 in Table 2) are inferred to be remnants of Pleistocene soils because of the presence of layering, development of several B-horizons, increased clay content, and presence of prominent iron-staining. All other locations are inferred to be Holocene eolian-derived soils that can be described as a relatively uniform soil classified as a silt or fine-sand loam. Volume fraction of rock fragments in the soil varies widely.

A comment on accuracy of the locations of the soil measurement sites is warranted. This exploratory study for measuring the variation in soil depths on hillslopes did not utilize an accurate method of locating measurement locations. Downslope positions are fairly well constrained because a tape measure was used. Accuracy for lateral position on the hillslope was constrained by topographic features. Whereas coordinates from hand-held Geographic Position System (GPS) units were recorded in the scientific notebooks, it should be cautioned that satellite signals in 1999 were scrambled; a differential GPS setup was not utilized to compensate for the military-scrambled signal. Note that UTM NAD83 (m) or geographic coordinates were recorded in scientific notebooks, however, the UTM NAD27 coordinate projection is used in Figure 1 and

Table 1. Estimates of transect locations (Table 1) that utilized topographic features are considered more reliable than the recorded GPS coordinates for each location.

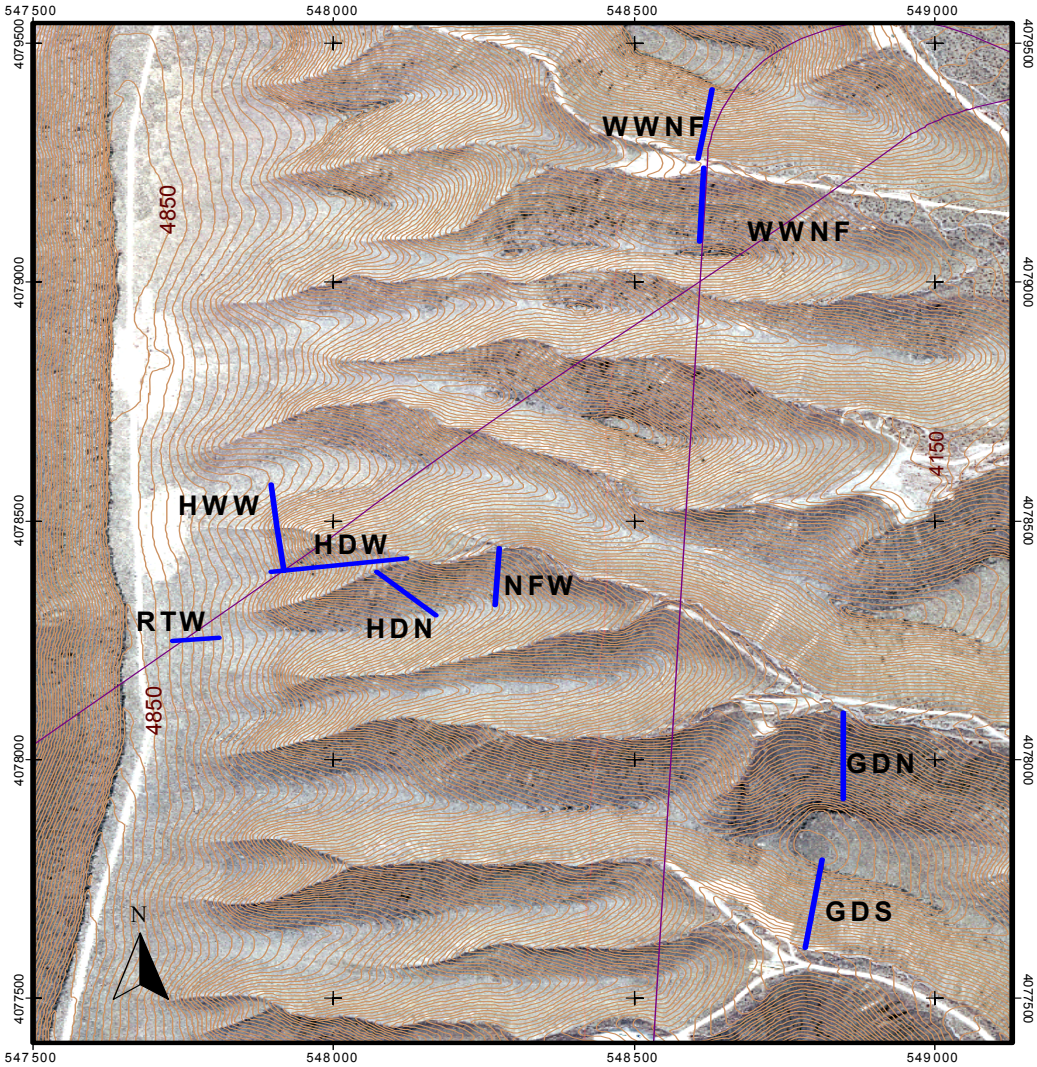

Figure 1. Locations of Soil Depth Transects (Blue Lines) on Yucca Mountain with Portions of ECRB and ESF Shown in Purple. Contours Are at 10-ft Intervals. Projection Coordinates Are UTM NAD27 (m). 1 m = 3.28 ft

Table 1. Descriptions and Locations of Soil Depth Transects. Actual Measurement Locations Along Each Transect Are Listed in Table 2. UTM NAD27 Coordinate Projection Is Used.

Transect Name	Description	Measured Distance of Transect, m	Map Distance of Transect , m	Slope angle, degrees	Start Easting and Northing, m	End Easting and Northing, m
GDS	Ghost Dance South, south-facing slope between Whaleback and Antler Ridges	205	187	24.2	548,783 4,077,606	548,812 4,077,791
GDN	Ghost Dance North, north-facing slope on Antler Ridge in Split Wash	200	182.3	24.3	548,846 4,078,098	548,846 4,077,917
WWSF	Wren Wash south facing slope	150	131	29.2	548,606 4,079,257	548,628 4,079,405
WWNF	Wren Wash north-facing slope	170	158	21.7	548,615 4,079,239	548,609 4,079,083
HWW1-4	Headwall transect in small watershed at top of Split Wash, south-facing slope	95	91	16.7	547,576 4,078,576	547,905 4,078,486
HWW5-10	Headwall transect in small watershed at top of Split Wash, north-facing slope	90	89	8.5	547,905 4,078,486	547,912 4,078,397
HDW	East-west headwall of small watershed in upper Split Wash	246	228	22.1	547,895 4,078,394	548,120 4,078,421
HDN	North-facing slope of small watershed in upper Split Wash, western transect	135	133.3	9.1	548,169 4,078,302	548,071 4,078,395
NFW	North-facing slope of small watershed in upper Split Wash; eastern transect	125	119	17.8	548,268 4,078,324	548,277 4,078,443
RTW	Broad slope of crest above south branch of upper Split Wash	2 locations near crest	78	9	547,810 4,078,256	547,731 4,078,250

Table 2. Soil Depths and Positions Along Each Soil Depth Transect. Locations are keyed to Transects Listed in Table 1 Using Letters at Beginning of Site Name. Length Listed in Last Column Is an Approximate Average Length in Each Direction.

Site Name	Position on Slope (top=1, bottom=9)	Maximum Soil Depth, cm	Measured Distance Along Transect, m	Map Distance Along Transect, m	Local Surface Slope, deg	Local Bedrock Slope, deg	Representative Soil Depth, cm	Minimum Soil Depth, cm	Size of Cleared Area, cm
GDS-1	7	27	50	45.6	19	6	19	10	40
GDS-2	6	35	60	54.7	22	14	21	1	60
GDS-3	5	42	70	63.9	28	11	32	22	50
GDS-4	4	60	100	91.2	23	-	42	42	50
GDS-5	3	29	130	118.6	27	22	28	26	65
GDS-6	2	33	165	150.5	19	11	24	16	120
GDS-7	1	36	205	187.0	1	0	36	36	55
GDN-1	8	16	23	21.0	20	18	16	15	70
GDN-2	7	38	50	45.6	22	22	22	12	65
GDN-3	6	50	75	68.4	25	-	50	50	60
GDN-4	5	25	100	91.2	25	15	18	12	75
GDN-5	4	25	125	113.9	28	25	23	20	60
GDN-6	3	21	150	136.7	22	21	21	20	100
GDN-7	2	25	175	159.5	22	-	24	23	60
GDN-8	1	17	200	182.3	20	-	15	13	70
WWSF-1	6	32	25	21.8	26	15	29	25	80
WWSF-2	5	31	50	43.7	22	0	11	0	70
WWSF-3	4	15	75	65.5	31	-	3	0	60
WWSF-4	3	29	100	87.3	23	0	20	10	60
WWSF-5	2	24	125	109.2	29	27	17	10	60
WWSF-6	1	42	150	131.0	27	11	28	12	100

Table 2. Continued. Soil Depths and Positions Along Each Soil Depth Transect. Locations are keyed to Transects Listed in Table 1 Using Letters at Beginning of Site Name. Length Listed in Last Column Is an Approximate Length in Each Direction.

Site Name	Position on Slope (top=1, bottom=9)	Maximum Soil Depth, cm	Measured Distance Along Transect, m	Map Distance Along Transect, m	Local Surface Slope, deg	Local Bedrock Slope, deg	Representative Soil Depth, cm	Minimum Soil Depth, cm	Size of Cleared Area, cm
WWNF-1	7	95	25	23.2	20	-	95	-	-
WWNF-2	6	61	50	46.5	24	27	61	-	-
WWNF-3	5	3	75	69.7	31	31	2	0	-
WWNF-4	4	37	100	92.9	26	22	17	-	-
WWNF-5	3	18	125	116.2	23	22	15	8	-
WWNF-6	2	40	150	139.4	27	25	35	30	-
WWNF-7	1	35	170	158.0	23	25	35	-	-
HWW-1	1	43	95	91.0	9e	-	31	20	-
HWW-2	2	40	45	43.1	26e	-	29	14	-
HWW-3	3	22	20	19.2	33e	-	5	0	-
HWW-4	4	22	5	4.8	33	-	8	-	-
HWW-5	6	15	15	14.8	29	-	15	-	-
HWW-6	5	45	30	29.7	27	-	15	-	-
HWW-7	4	35	45	44.5	30	-	30	-	-
HWW-8	3	20	60	59.3	33	-	10	0	-
HWW-9	2	20	75	74.2	30e	-	8	0	-
HWW-10	1	55	90	89.0	27	-	40	-	-

e = slope estimated from topographic map

Table 2. Continued. Soil depths and Positions Along Each Soil Depth Transect. Locations are keyed to Transects Listed in Table 1 Using Letters at Beginning of Site Name. Length Listed in Last Column Is an Approximate Length in Each Direction.

Site Name	Position on Slope (top=1, bottom=9)	Maximum Soil Depth, cm	Measured Distance Along Transect, m	Map Distance Along Transect, m	Local Surface Slope, deg	Local Bedrock Slope, deg	Representative Soil Depth, cm	Minimum Soil Depth, cm	Size of Cleared Area, cm
HDW-1	1	12	246	228.0	29	-	12	0	-
HDW-2	2	55	221	204.8	27	-	-	-	-
HDW-3	3	10	196	181.7	26	-	10	-	-
HDW-4	4	12	171	158.5	26	-	12	-	-
HDW-5	5	25	146	135.3	22	-	25	-	-
HDW-6	6	28	121	112.1	21	-	28	-	-
HDW-7	7	20	96	89.0	21	-	20	-	-
HDW-8	8	21	71	65.8	21	-	21	-	-
HDW-9	9	6	46	42.6	17	-	6	0	-
HDN-1	1	24	135	133.3	6	-	24	-	-
HDN-2	2	70	85	83.9	24	-	40	-	-
HDN-3	3	32	35	34.6	25	-	32	-	-
NFW-1	1	26	125	119.0	14	-	26	-	-
NFW-2	2	31	100	95.2	24	-	25	-	-
NFW-3	3	40	75	71.4	23e	-	35	-	-
NFW-4	4	38	50	47.6	21	-	38	-	-
NFW-5	5	43	25	23.8	22e	-	43	-	-
RTW-1	-	60	-	-	9	-	60	-	-
RTW-2	-	50	-	-	9	-	50	-	-

e = slope estimated from topographic map

January 9, 2007

Note To: Jack Guttmann

From: Randall Fedors /RA/

Subject: SOIL DEPTHS MEASURED AT YUCCA MOUNTAIN DURING SITE VISITS IN 1998

This intra-office note briefly describes the methodology used and summarizes measurements made of soil depth on the hillslopes of Yucca Mountain above the potential repository footprint. These hillslopes were the focus of measurements because soils are generally less than 0.5 m (1.6 ft) thick.

Soil depths were measured by Center for Nuclear Waste Regulatory Analyses (CNWRA) staff and contractors during two site visits to Yucca Mountain, January 26-29, 1998 and May 13-18, 1998. The field participants were Randy Fedors (CNWRA, now U.S. Nuclear Regulatory Commission), Stuart Stothoff (contractor, now CNWRA), Dani Or (contractor), and David Groeneveld (contractor). Field observations are recorded in Scientific Notebooks 175 (ML043630294) and 255 (ML040650582).

Nine transects were completed (Figure 1 and Table 1). Spacing of locations of soil measurements along each transect varied from 10 to 50 m [33 to 160 ft] such that 5 to 10 locations were sampled along most transects. The soil at each measurement location (Table 2) was cleared off using shovel, trowel, and brushes over an area <1 m^2 [11 ft^2]. Average (or representative) soil depth was visually estimated by qualitatively taking into account an area weighting of soil depths in the pit supported by measuring several locations with ruler or measuring tape. Maximum and minimum soil depths were recorded for many locations. Slope of the bedrock surface was also approximated with a Branton compass.

Layering in the soil profile was absent except at two locations. These latter two locations (RTW-2 and HDN-1 in Table 2) are inferred to be remnants of Pleistocene soils because of the presence of layering, development of several B-horizons, increased clay content, and presence of prominent iron-staining. All other locations are inferred to be Holocene eolian-derived soils that can be described as a relatively uniform soil classified as a silt or fine-sand loam. Volume fraction of rock fragments in the soil varies widely.

A comment on accuracy of the locations of the soil measurement sites is warranted. This exploratory study for measuring the variation in soil depths on hillslopes did not utilize an accurate method of locating measurement locations. Downslope positions are fairly well constrained because a tape measure was used. Accuracy for lateral position on the hillslope was constrained by topographic features. Whereas coordinates from hand-held Geographic Position System (GPS) units were recorded in the scientific notebooks, it should be cautioned that satellite signals in 1999 were scrambled; a differential GPS setup was not utilized to compensate for the military-scrambled signal. Note that UTM NAD83 (m) or geographic coordinates were recorded in scientific notebooks, however, the UTM NAD27 coordinate projection is used in Figure 1 and

DISTRIBUTION:
RFedors

ML063600082

OFC	HLWRS
NAME	RFedors
DATE	1/9/07

OFFICIAL RECORD COPY