Department of Energy
Washington, DC 20585

June 26, 2019

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Deputy Director
Mail Stop T8-F5
Washington, DC 20555-0001

Subject: Interim Cover Protection Compaction Variance at the U.S. Department of Energy Office of Legacy Management Mexican Hat, Utah, Uranium Mill Tailings Remedial Action Title I, Disposal Site (NRC Docket No. WM-0063)

To Whom it May Concern:

The U.S. Department of Energy (DOE) Office of Legacy Management (LM) Mexican Hat, Utah, disposal cell was originally constructed in 1995 under the Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I program. Currently LM is undergoing engineering efforts to perform maintenance on the northeast side slope of the cell where some depression features have formed. These features have generally been the result of erosion of the radon barrier material beneath the rock cover. The goal of the current engineering effort is to restore these areas to the original thickness of the radon barrier with suitable materials and to replace the overlying bedding material due to its appearance of not meeting the original design specification. One potential issue discussed between LM and contractor staff is the original design compaction requirement of the radon barrier when considering currently available materials and suitable equipment to work in the limited area.

The original design specification for the radon barrier material utilized a locally sourced borrow area material mixed with a bentonite amendment at 10% by dry weight to generate a low permeability (1.0×10^{-7} cm/s) stratum within the cell cover system. This bentonite amendment rate was determined through bench testing of varying percent amendments and their resultant hydraulic conductivity. Compaction requirements for the radon barrier material were to compact the material to a minimum of 100% of the standard proctor (ASTM D698). During construction there were 102 failing in-place density tests on different areas of the side slopes which required rework until the material in those areas achieved a passing test value. Equipment used for compaction during the original construction were Caterpillar 815 and 825 tamping sheepsfoot compactors having operating weights of approximately 49,000 and 78,000 pounds respectively. These pieces of equipment are on the largest end of available equipment to perform soil compaction.

For the Interim Cover Protection (ICP) project, LM is planning on performing work within a confined area of 17-20,000 square feet along the toe of the northeast side slope on a 20% grade (*see* enclosed Project Site Plan). Due to the irregular shape and maneuverability within the limited work area, the equipment available to perform compaction effectively is limited to smaller, lighter equipment than that used during the original construction. This will exacerbate the difficulties experienced during the original construction to achieve the design requirement of 100% compaction.

NMSS01
NMSS

The primary goals of an UMTRCA disposal cell cap are to limit infiltration of moisture related to precipitation events and to control emissions of radon from the tailings. The original design did this by specifying a material mixture that would achieve a hydraulic conductivity of at most 1.0×10^{-7} cm/s.

Based on lab testing performed on radon barrier material available from a commercial quarry located in Bluff, Utah it is possible to reliably meet this requirement at a lower compaction value of 95% of the standard proctor (*see* enclosed Lab Data).

In addition, U.S. Nuclear Regulatory Commission and LM have teamed to perform disposal cell cover studies at various sites. Results from these studies have determined the compacted radon barrier material has expanded and become less consolidated over time since the completion of the original construction, thus reducing in density, due to natural rebounding of the engineered fill material and from freeze-thaw effects. This expansion reduces in-place density and subsequently increases permeability of the barrier material. Testing results from the cover study samples at three UMTRCA disposal sites indicated there are varying rates of saturated hydraulic conductivity from cells in place for 17 to 22 years. The mean conductivity of the sample test values ranged from 1.18×10^{-4} cm/s to 2.49×10^{-6} cm/s. Of 21 samples tested, 19 samples returned conductivity values greater than 1.0×10^{-7} cm/s. While the completion reports for the sampled sites do not include direct information from the design on a desired or specified hydraulic conductivity of the cover system, from the UMTRCA Technical Approach Document and other sites, it may be reasonable to assume the underlying goal was to achieve a standard conductivity value of 1.0×10^{-7} cm/s or less during construction. It has been determined these reductions in observed in-place density of the radon barrier materials have not impacted the performance of the cover in controlling radon gas emissions despite the changes in hydraulic conductivity.

Therefore, it is LM's opinion that installing the ICP radon barrier at a lower compaction requirement of 95% is more constructible given the limited available work area, does not compromise the initial hydraulic conductivity condition, and will still meet the radon emanation requirements of the original design for the Mexican Hat, disposal cell.

We will proceed with implementation of the reduced radon barrier compaction to start in late July 2019.

Please contact me at (970) 248-6621 or Angelita.Denny@lm.doe.gov, if you have any questions. Please address any correspondence to:

U.S. Department of Energy
Office of Legacy Management
2597 Legacy Way
Grand Junction, CO 81503

Sincerely,

Angelita Denny
Mexican Hat Site Manager

Enclosures

cc w/enclosures:
M. Roanhorse, NN UMTRA
M. Kautsky, DOE-LM (e)
P. Kerl, DOE-LM (e)
A. Kleinrath, DOE-LM (e)
K. Lott, Navarro (e)
DOE Read File
File: HAT 3500.10

Notes

Sample Receipt:
One sample in six mostly full 5-gallon buckets with lids, and one 3/4-full lidded 2-gallon bucket of bentonite, were hand delivered on March 15, 2019. The sample and bentonite were received in good order.

Sample Preparation and Testing Notes:
The six buckets of sample material were composited and thoroughly mixed. Sub-samples were obtained from the composited material for particle size analysis and Atterberg limits testing.

Particles larger than 3/4" were removed from the remaining composited material which was then air dried and separated into six approximately equal sub-samples. Bentonite was added to two of the sub-samples on a dry mass equivalent basis at 10%, and 12% bentonite. The sub-samples were thoroughly mixed, and the sub-sample ID's were amended with the percentage of bentonite added. These sub-samples, along with a sub-sample with no bentonite addition, were subjected to standard proctor compaction testing.

A portion of each sub-sample was then remolded into a testing ring to target 85% and/or 95% of the respective maximum dry bulk density at the respective optimum moisture content, based on the standard proctor compaction test results. Each of these remolded sub-samples was subjected to initial properties analysis and saturated hydraulic conductivity testing. The actual percentage of maximum dry bulk density achieved was added to each sub-sample ID.

Based on the proctor compaction method, material larger than 3/4" was removed from the sample material prior to compaction and remolding. Oversize correction calculations are not presented since the fraction removed was less than 5% of the bulk sample mass.

Porosity calculations are based on the use of an assumed specific gravity value of 2.65.

Summary of Sample Preparation/Volume Changes

	Proctor Data		Target Remold Parameters[1]			Actual Remold Data			Volume Change Post Saturation[2]		
Sample Number	Optimum Moisture Content (%, g/g)	Max. Dry Density (g/cm^3)	Moisture Content (%, g/g)	Dry Bulk Density (g/cm^3)	% of Max. Density (%)	Moisture Content (%, g/g)	Dry Bulk Density (g/cm^3)	% of Max. Density (%)	Dry Bulk Density (g/cm^3)	% Volume Change (%)	% of Max. Density (%)
Radon Barrier Material (85%)	10.5	1.87	10.5	1.59	85%	10.2	1.60	85.2%	1.60	---	85.2%
Radon Barrier Material (95%)	10.5	1.87	10.5	1.78	95%	10.8	1.77	94.8%	1.77	---	94.8%
Radon Barrier Material (10% Bentonite) (94%)	11.8	1.91	11.8	1.82	95%	12.4	1.81	94.4%	1.81	---	94.4%
Radon Barrier Material (12% Bentonite) (85%)	12.3	1.91	12.3	1.62	85%	12.2	1.62	84.9%	1.62	---	84.9%
Radon Barrier Material (12% Bentonite) (94%)	12.3	1.91	12.3	1.81	95%	13.1	1.79	93.7%	1.79	---	93.7%

[1]Target Remold Parameters: Provided by the client: 85% and/or 95% of maximum dry density at optimum moisture content.

[2]Volume Change Post Saturation: Volume change measurements were obtained after saturated hydraulic conductivity testing.

Notes:

"+" indicates sample swelling, "-" indicates sample settling, and "---" indicates no volume change occurred.

Summary of Initial Moisture Content, Dry Bulk Density Wet Bulk Density and Calculated Porosity

Sample Number	Moisture Content: As Received: Gravimetric (%, g/g)	Moisture Content: As Received: Volumetric (%, cm³/cm³)	Moisture Content: Remolded: Gravimetric (%, g/g)	Moisture Content: Remolded: Volumetric (%, cm³/cm³)	Dry Bulk Density (g/cm³)	Wet Bulk Density (g/cm³)	Calculated Porosity (%)
Radon Barrier Material (85%)	NA	NA	10.2	16.2	1.60	1.76	39.8
Radon Barrier Material (95%)	NA	NA	10.8	19.1	1.77	1.97	33.0
Radon Barrier Material (10% Bentonite) (94%)	NA	NA	12.4	22.5	1.81	2.03	31.8
Radon Barrier Material (12% Bentonite) (85%)	NA	NA	12.2	19.7	1.62	1.82	38.9
Radon Barrier Material (12% Bentonite) (94%)	NA	NA	13.1	23.4	1.79	2.02	32.6

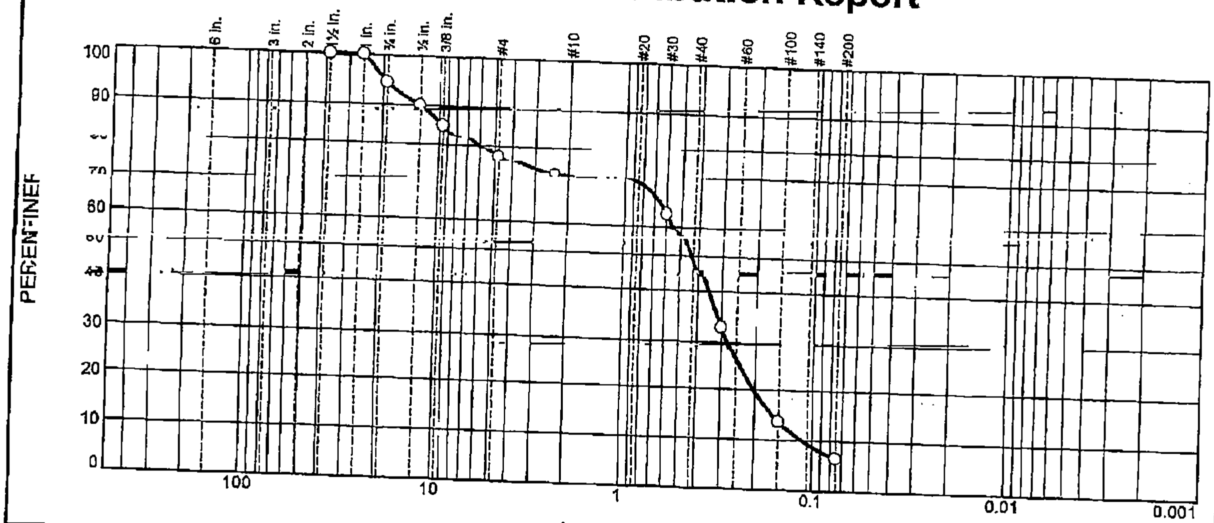
NA = Not analyzed
--- = This sample was not remolded

Summary of Saturated Hydraulic Conductivity Tests

Sample Number	K_{sat} (cm/sec)	Oversize Corrected K_{sat} (cm/sec)	Method of Analysis: Constant Head	Method of Analysis: Falling Head
Radon Barrier Material (85%)	5.4E-03	---	X	
Radon Barrier Material (95%)	4.8E-03	---	X	
Radon Barrier Material (10% Bentonite) (94%)	4.8E-07	---		X
Radon Barrier Material (12% Bentonite) (85%)	1.8E-07	---		X
Radon Barrier Material (12% Bentonite) (94%)	5.2E-09	---		X

--- = Oversize correction is unnecessary since coarse fraction < 5% of composite mass
NR = Not requested
NA = Not applicable

Particle Size Distribution Report



% +3"	% Gravel	% Sand		% Fines	
		Coarse	Fine	Silt	Clay
0.0	28.0	23.2	42.3	6.5	

Test Results (AASHTO T 27 & AASHTO T 11)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1-1/2"	100.0		
1"	100.0		
3/4"	94.5		
1/2"	90.0		
3/8"	86.1		
#4	77.3		
#8	72.6		
#16	70.4		
#30	62.5		
#50	32.9		
#100	13.7		
#200	6.5		

* (no specification provided)

Material Description

Reject Sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS (D 2487)= AASHTO (M 145)=

Coefficients

D_{90}= 12.6438 D_{85}= 8.8118 D_{60}= 0.5562
D_{50}= 0.4366 D_{30}= 0.2790 D_{15}= 0.1617
D_{10}= 0.1133 C_u= 4.91 C_c= 1.24

Remarks

Date Received: 1/10/2019 **Date Tested:** 1/10/2019
Tested By: Mark Rappleye
Checked By: Mark Rappleye
Title: Lab Manager

Location: Bluff Holliday Pit
Sample Number: M19-S-001
Date Sampled: 1/10/2019

JONES & DEMILLE ENGINEERING INC.
Richfield, Utah

Client: Holliday Construction
Project: 2019 General Materials Testing
Project No: 1901-238
Figure

Western Technologies Inc.
The Quality People
Since 1955

400 South Lorena Avenue
Farmington, NM 87404
(505) 327-4966

PHYSICAL PROPERTIES OF SOILS & AGGREGATES

Date of Report 02-26-15
Job No. 3144JK079
Event / Invoice No. 31450014 — Lab No. 1224
Authorized by ORVILLE ARVISO — Date 02-19-15
Sampled by WT/J. BATES — Date 02-19-15
Submitted by WT/J. BATES — Date 02-19-15

Client ARVISO CONSTRUCTION
PO BOX 441
FORT WINGATE, NM 87316

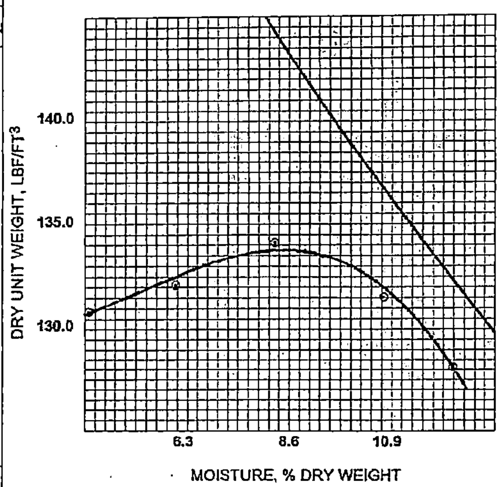
Project ARIZONA NHA INFILL & BURN HOUSING
Contractor N/A
Type / Use of Material 1" MINUS BROWN SILTY SAND/ ABC
Sample Source / Location SW CORNER OF LOT
Location KAYENTA, AZ
Arch. / Engr. N/A
Supplier / Source HOLIDAY/BLUFF PIT
Source / Location Desig. By WT/J. BATES — Date 02-19-15
Testing Authorized : SIEVE ANALYSIS, LIQUID & PLASTIC PROPERTIES, MOISTURE-DENSITY RELATIONSHIP
Special Instructions :

TEST RESULTS

SIEVE ANALYSIS : AASHTO T27
FINER THAN NO. 200 : AASHTO T11

SIEVE	ACCUMULATIVE % PASSING	SPECIFICATION
4		
3		
2		
1-1/2"		
1"	100	
3/4"	96	
1/2"	73	
3/8"	60	
1/4"	49	
No.4	45	
8	38	
10	37	
16	34	
30	29	
40	23	
50	18	
100	9	
200	5.0	

LABORATORY COMPACTION CHARACTERISTICS : ASTM D698 METHOD C



SAMPLE PREPARATION: ☒ WET ☐ DRY
RAMMER USED:
☒ 2 IN. CIRCULAR FACE ☐ OTHER
☐ MECHANICAL ☒ MANUAL

PROJECT PROCTOR ID: 18
MAXIMUM DENSITY, LBF/FT3 → 133.8
OPTIMUM MOISTURE CONTENT, % → 8.2

OVERSIZE AGGREGATE :
ASSUMED BULK SPECIFIC GRAVITY: 2.65
ASSUMED ABSORPTION, % : 1.0
% OVERSIZE IN LAB SAMPLE : 5

ASSUMED SPECIFIC GRAVITY IN ZERO AIR VOID CURVE : 2.85

CORRECTION OF MAXIMUM UNIT WEIGHT & OPTIMUM MOISTURE CONTENT FOR OVERSIZE PARTICLES : ASTM D4718

CORR. MAXIMUM DENSITY, LBF/FT3 135.1
CORR. OPTIMUM MOISTURE, % 7.8

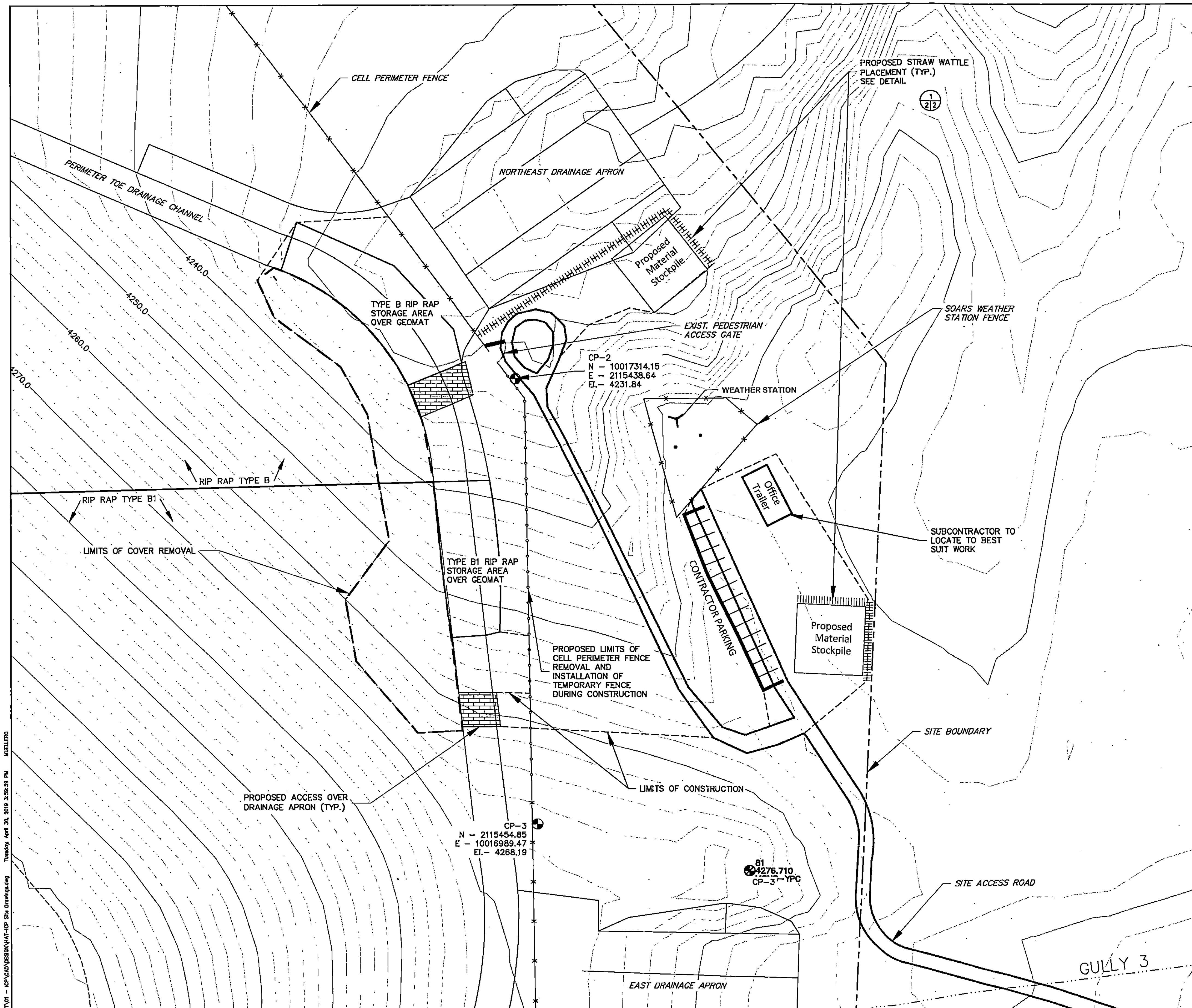
TEST PROCEDURE	RESULT	SPECS	TEST PROCEDURE	RESULT	SPECS
LIQUID & PLASTIC PROPERTIES : AASHTO T89, 90 — METHOD B — LIQUID LIMIT →			RESISTANCE TO DEGRADATION OF SMALL-SIZE COARSE AGGREGATES BY ABRASION :		
ESTIMATED % RETAINED ON NO. 40 0 — PLASTIC LIMIT →	NP		GRADING 100 REV, % LOSS →		
SAMPLE AIR DRIED ☒ YES ☐ NO — PLASTICITY INDEX →			GRADING 500 REV, % LOSS →		
MOISTURE CONTENT : AASHTO T265 — PORTION TESTED FULL — % DRY WEIGHT →	2.6		SPECIFIC GRAVITY : MAX. PARTICLE SIZE, IN. — SPECIFIC GRAVITY @ 20°C		
EXPANSION / COMPRESSION PROPERTIES OF COHESIVE SOIL : WT PROCEDURE ☐ EXPANSION ☐ COMPRESSION, % →			pH DETERMINATION : → pH →		
MAXIMUM SWELL PRESSURE, KSF →			SOLUBLE SALTS : PPM →		
SURCHARGE, KSF — INITIAL WATER CONTENT, % — DRY DENSITY, PCF			MINIMUM RESISTIVITY : OHM-CM →		

SOIL CLASSIFICATION : GROUP SYMBOL: NAME:

Comments :

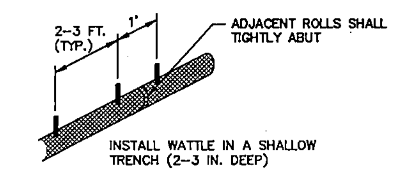
Copies to : CLIENT (1)

REVIEWED BY JENKINS
(SIGNED COPY ON FILE)

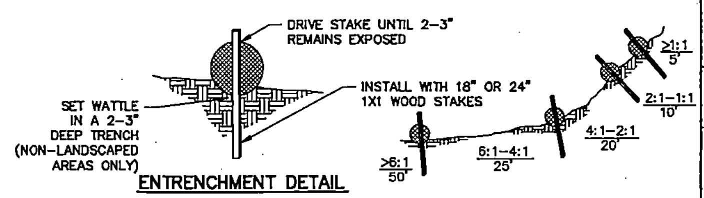


NOTES:

1. PRIOR TO START OF WORK, EROSION AND SEDIMENTATION CONTROLS SHOULD BE INSTALLED AS SHOWN IN THESE DRAWINGS AT A MINIMUM. IT MAY BE NECESSARY TO ADD EROSION CONTROL FEATURES IN AREAS NOT SHOWN ON THE PLAN SHEETS. DEPENDING ON THE SUBCONTRACTOR OPERATIONS AND ASSOCIATED DISTURBED AREAS.
2. AT THE END OF EACH WORK DAY, TEMPORARY FENCING SHALL BE INSTALLED WHERE EVER THE PERMANENT CELL PERIMETER FENCE HAS BEEN REMOVED. PERMANENT SITE FENCING SHALL BE TAKEN DOWN IN A WAY TO PRESERVE MATERIAL INTEGRITY AND ALLOW FOR REINSTALLATION BY SUBCONTRACTOR AT THE END OF THE WORK EFFORT.
3. TEMPORARY FENCING SHALL BE STANDARD ORANGE PLASTIC CONSTRUCTION FENCING. EXISTING FENCE POSTS CAN BE USED IN AREAS THAT DO NOT REQUIRE DAILY REMOVAL AND REPLACEMENT. OTHERWISE, WOODEN STAKES SHALL BE USED.
4. TEMPORARY FENCING IS NECESSARY TO PREVENT WILD BURROS AND OTHER INTRUDERS FROM ACCESSING THE CELL WHEN THE CONTRACTOR IS NOT PRESENT.
5. STOCKPILE AREAS SHALL BE DEVELOPED IN SUCH A WAY TO PREVENT SEDIMENT TRANSPORT OUT OF THE STOCKPILE AREA. ALL EROSION CONTROL FEATURES SHALL BE IN PLACE PRIOR TO PLACEMENT OF ANY STOCKPILED MATERIALS.
6. CONTRACTOR WILL DOCUMENT AREAS OF VEGETATION PRIOR TO THE START OF CONSTRUCTION. IN THOSE AREAS WHERE VEGETATION IS DISTURBED, THE AREA(S) SHALL BE REVEGETATED AT THE END OF THIS WORK EFFORT. GUIDELINES FOR REVEGETATION ARE LOCATED IN SPECIFICATION SECTION 02920.



TYPICAL WATTLE INSTALLATION GUIDE

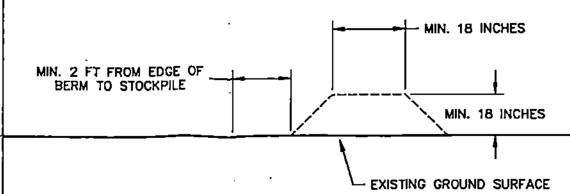


ENTRENCHMENT DETAIL

TYPICAL WATTLE SPACING BASED ON SLOPE GRADIENT

1. BEGIN AT THE LOCATION WHERE THE WATTLE IS TO BE INSTALLED BY EXCAVATING A 2-3" (5-7.5CM) DEEP X 9" (22.9 CM) WIDE TRENCH ALONG THE CONTOUR OF THE SLOPE.
2. PLACE THE WATTLE IN THE TRENCH SO THAT IT CONTOURS TO THE SOIL SURFACE. COMPACT SOIL FROM THE EXCAVATED TRENCH AGAINST THE WATTLE ON THE UPHILL SIDE. ADJACENT WATTLES SHOULD TIGHTLY ABUT.
3. SECURE THE WATTLE WITH 18"-24" (45.7-61 CM) STAKES EVERY 2-3' AND WITH A STAKE ON EACH END. STAKES SHOULD BE DRIVEN THROUGH THE MIDDLE OF THE WATTLE LEAVING AT LEAST 2-3" (5-7.5 CM) OF STAKE EXTENDING ABOVE THE WATTLE. STAKES SHOULD BE DRIVEN PERPENDICULAR TO SLOPE FACE.
4. IF BEDROCK IS TOO SHALLOW TO ALLOW WATTLE INSTALLATION, A PERIMETER BERM, AS SHOWN IN DETAIL 2 BELOW, IS AN ACCEPTABLE ALTERNATIVE.

1/2|2 STRAW WATTLE INSTALLATION GUIDE
NTS



1. IF BEDROCK IS TOO SHALLOW TO ALLOW WATTLE INSTALLATION, A PERIMETER BERM IS AN ACCEPTABLE ALTERNATIVE.

2/2|2 BERM EROSION CONTROL ALTERNATIVE
NTS

PROJECT LOCATION: MEXICAN HAT, UTAH, DISPOSAL SITE

REFERENCE: SURVEYS BY: Souder Miller & Associates, Inc.
TERRESTRIAL LIDAR – SEPT. 2018
AERIAL LIDAR – MAY 2018

APPROVALS	
DRAWN BY: C. MUELLER	04/24/19
CHECKED: C. MUELLER	04/24/19
PROJECT ENGINEER: J. Mance	04/24/19
ENGINEERING MANAGER: D. BRENNECKE	04/24/19
PROJECT LEAD: M. BUTHERUS	04/24/19
SITE MANAGER/LEAD: K. LOTT	04/24/19

U.S. DEPARTMENT OF ENERGY | Legacy Management
GRAND JUNCTION, COLORADO

Work Performed Under DOE Contract No. DE-LM0000421
NAVARRO Navarro Research and Engineering, Inc.

MEXICAN HAT NE SIDE SLOPE INTERIM COVER PROTECTION

PROJECT SITE PLAN