Addendum F

Final Remedial Action Plan
DOE-EM/GJ1547
July 2008

Fremont Junction Rock Source Data

Number	Title	
F1	Green River Remedial Action Plan, Appendix D, Addendum D4, 1988	
F2	Rock Durability Laboratory Results for Samples Collected in 2007 and 2008	
F3	Green River, Utah Final Completion Report, Volume 2, Appendix E, Material Summary Report, 1991	

Addendum F1. Green River Remedial Action Plan, Appendix D, Addendum D4, 1988

ADDENDUM D4

FREMONT JUNCTION, UTAH
ROCK BORROW SOURCE

FREMONT JUNCTION, UTAH

ROCK BORROW SOURCE

Site Description

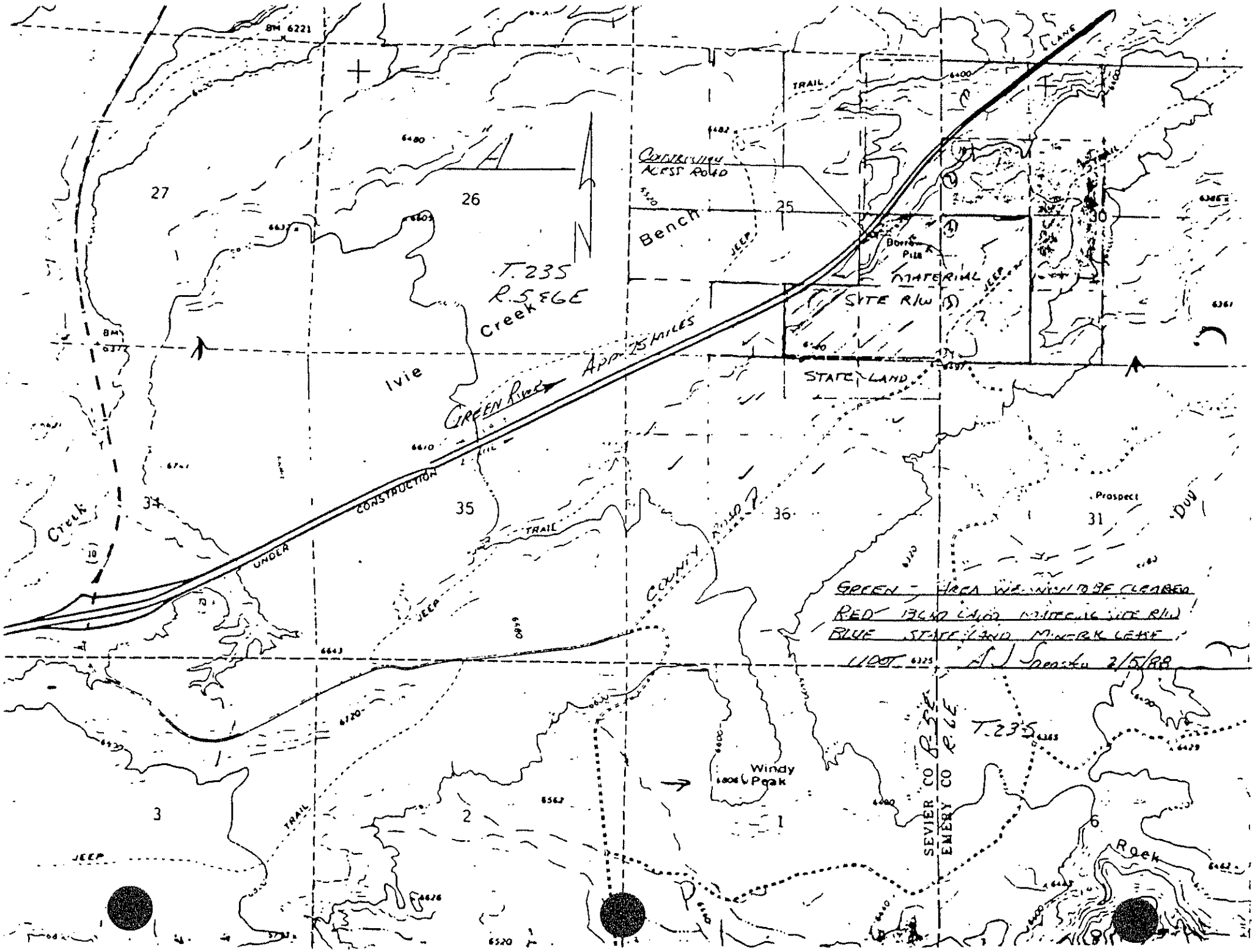
The existing quarry and test pits are located in Quaternary gravel terraces composed of outwash from nearby mountains and pediment deposits presently undergoing erosion. The upper portion of the terraces can be divided into two distinct layers. The upper layer, which is about 3-5 feet thick, consists of clayey sand and/or clayey silt. This layer should be considered as overburden. Immediately underlying the upper layer is a 5 to 15 foot thick layer of mixed sand and gravel (up to 3-inch maximum size), cobbles (3 to 12-inch size), and boulders (larger than 12-inch size). Material gradation is variable in this stratum. Approximately 1 to 3 feet of the uppermost zone of the lower layer contains up to 15 percent (approximately) of friable, weathered basalt and basalt particles with friable weathering rinds. The obviously weathered basalt particles were not observed in the underlying portion of the lower layer, which has a maximum thickness of about 12 feet in the existing test trenches.

Material Types

Based on visual examination of material, it is estimated that about 80 percent of the boulders, cobbles, and gravels in the lower bed are basalt, about 10 percent are quartz and/or quartzite and about 10 percent maximum are fine-grained sandstone. Sandstone particle sizes are approximately in the gravel-to-cobble size range, up to 8 inches maximum. Weathering rinds observed on rock samples broken at the site indicate that the basalt fraction of the deposit is relatively unweathered (except for highly weathered basalt in the confined zone noted above).

Representative hand-picked samples were obtained for laboratory tests and petrographic examination from piles of materials obtained from trenches dug with a front end loader. Particle sizes in the piles ranged from less than 1 inch to 36 inches and particle sizes in the hand-picked samples ranged from 8 inches to 15 inches.

Sandstone particles larger than 8 inches were not observed in the part of the deposit explored to date.


BM 6221
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30
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APP. 25 MILES
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TRAIL
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Borrow Pit
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SITE R/W
STATE LAND
Prospect
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34
35
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Windy Peak
SEVIER CO
EMERY CO
T.23S
R.6E
Rock
3
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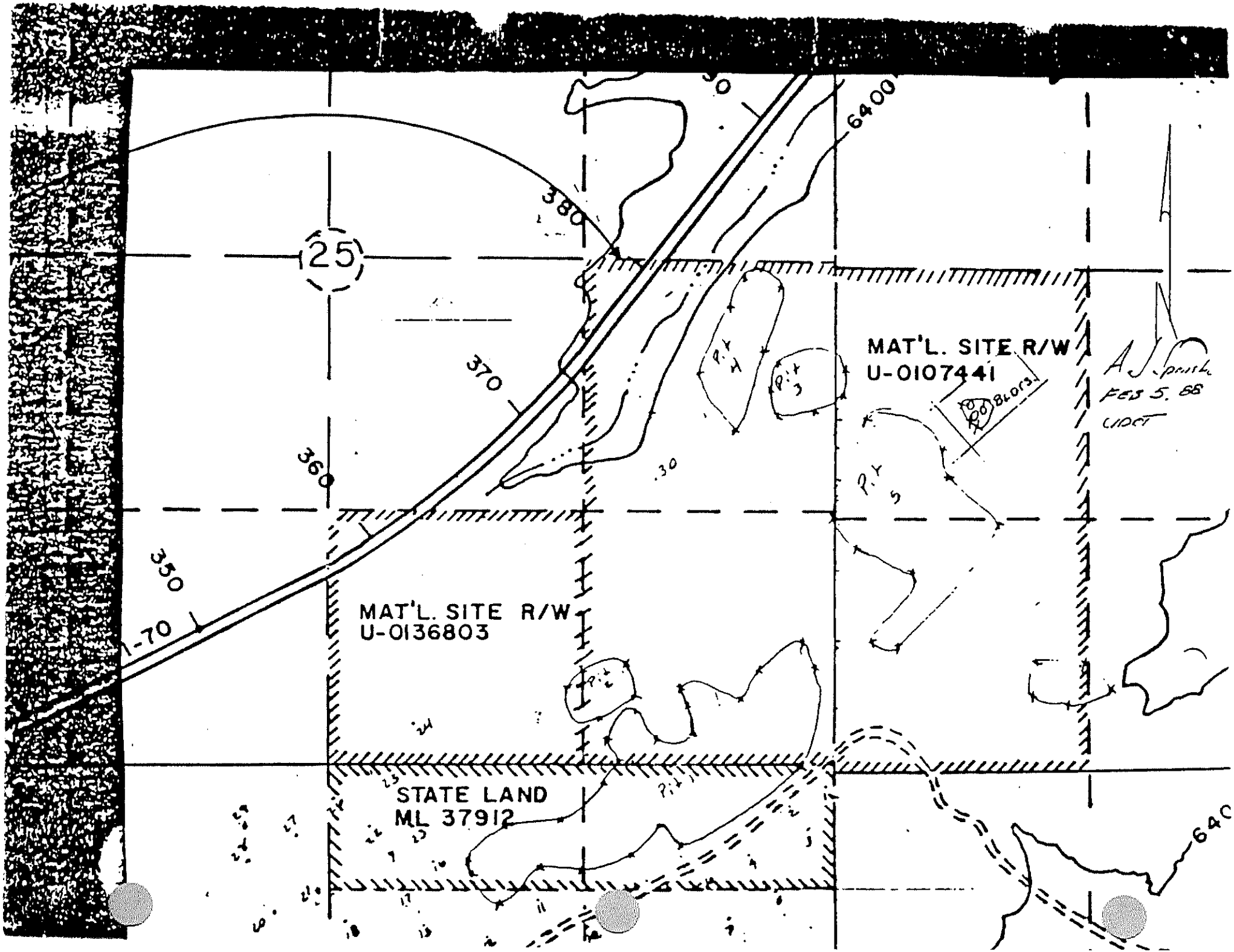
GREEN - AREA WHICH WILL NOT BE CLEARED
RED - ITEM 1340 CLEARING MATERIAL SITE R/W
BLUE - STATE LAND MARK LEASE
UDOT
A.J. Searle 2/5/88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U-0136803
STATE LAND
ML 37912
Pit 1
Pit 2
Pit 3
Pit 4
Pit 5
A. J. Smith
Feb 5, 68
USDA
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64C

UMTRAP
Green River, Utah
Job No. 1 117 88
February 5, 1988

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TABLE I

SUMMARY OF UNSOUND PARTICLES DATA

Location	Lab No.	Percentage by Weight of Sandstone and Other Unsound Particles *	Description of Unsound Particles	Size Distribution of Unsound Particles
Fremont Junction TP-2, A	115	3	Mainly sandstone, limestone, & very weathered basalt fragments	1"- No. 4
Fremont Junction TP-5, A	119	2	Clinker-like weathered basalt and soft limestone particles	1"- No. 4
Fremont Junction TP-4, A	122	1	Sandstone, very weathered basalt & limestone fragments	1 1/2"- No. 4

* Based only on the portion of the sample greater than a No. 4 sieve.

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February 5, 1988

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TABLE II

SUMMARY OF ROCK TEST RESULTS

Site Location	Lab No.	Specific Gravity Bulk	Apparent	Bulk (SSD)	Absorption, %	L.A. Abrasion Loss, %, at 100/500 Cycles	Sodium Sulfate Soundness Loss, %	Description
Fremont Junction								
TP-2A	115	2.554	2.644	2.588	1.333	---	4.5	Basalt Cobbles and Gravels
TP-2B	116	2.520	2.648	2.568	1.91	5.5/33.7	1.2	Basalt Cobbles
TP-3A	117	2.607	2.705	2.643	1.38	---	3.2	Granitic & Basaltic Cobbles
TP-3B	118	2.587	2.710	2.632	1.760	---	1.7	Basalt Cobbles
TP-5A	119	2.612	2.717	2.651	1.486	6.4/29.7	3.9	Basalt Cobbles & Gravels
TP-5B	120	2.540	2.658	2.585	1.739	6.7/30.3	3.7	Basalt Cobbles

Note: All tests reported above have been performed on specimens that do not include sandstone or other unsound
[ ]cles, as indicated in the scope of work for th project.

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Green River, Utah
Job No. 1 117 88
February 5, 1988

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TABLE III

SUMMARY OF ROCK TEST RESULTS

Site Location	Lab No.	Schmidt Rebound	Splitting Tensile Strength, psi	Description
Fremont Junction				
TP-2B	116	29	728	Basalt
TP-3B	118	--	1308	Basalt
TP-5B	120	30	1133	Basalt
TP-5B	120	—	1394	Dacite

Chen & Associates
Consulting Geotechnical Engineers

96 South Zuni
Denver, Colorado 80223
303 744-7105

Casper
Colorado Springs
Ft Collins
Glenwood Springs
Phoenix
Rock Springs
Salt Lake City
San Antonio

February 3, 1988

Subject: Additional Laboratory Rock Tests
Green River, UMTRAP Site
Green River, Utah
Subcontract No. GRN 87-02-02

Job No. 1 857 87

Mr. Vernon D. Logan
MK-Ferguson Company
P.O. Box 9136
Albuquerque, New Mexico 87119

Dear Mr. Logan:

Enclosed are completed test results for the referenced subcontract. This completes all tests as assigned in your letter dated December 29, 1987, and in our phone conversation of the week of January 9, 1988. Please note that all tests assigned could not be performed. This was due to inadequate amounts of the different rock types.

If you have any questions concerning this submittal, please contact me.

Sincerely,

CHEN AND ASSOCIATES, INC.

By _____
Kenneth R. Criley, S.E.T.
Laboratory Manager

KRC/djb
Rev. By: SKM
cc: Frank Guros
Morrison-Knudsen Engineers, Inc.

ATTACHMENT: 5057-GRN-C-09-00672-00

Job No. 1 857 87
Green River, Utah
UMTRAP Site
3 February 1988

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TABLE I

Summary of Laboratory Test Results

Sample Designation	Specific Gravity			Absorption, %	Sodium Sulfate Soundness, % Loss
	Apparent	Bulk	Bulk (SSD)		
Quartzite	2.67	2.58	2.61	1.3	—
Basalt	2.69	2.57	2.61	1.7	1.6
Sandstone	2.64	2.50	2.55	2.2	—

Composite of Quartzite, Basalt and Sandstone:

	100 Cycles	500 Cycles
Los Angeles Abrasion, % Loss	8.2	33.2

Chen & Associates

Petrography and X-Ray Diffraction Analysis of Rock Samples

Job No. 1-117-88

SUMMARY

Ten rock samples, consisting of cobble fragments, were analyzed petrographically in thin section and by X-ray diffraction. The samples fall into 4 broad groups: basalt (4 samples), andesite porphyry (4 samples), quartz monzonite (1 sample), and sandstone (one sample). The samples are all mechanically stable (fairly free of structural defects), with the exception of the quartz monzonite (coarse grain size, microfractures) and one of the basalts (internal weathering deposits).

Since all the samples lack significant amounts of deleterious minerals (calcite, chlorite, clays, olivine, feldspathoids), they should be chemically stable for thousands of years. Coarse fractions of gravels have, in effect, already proven their durability. In a geologic time frame of course, basalts are more vulnerable to chemical weathering than andesites, which in turn are more vulnerable than quartz-rich rocks such as monzonites, granites, and rhyolites.

Procedures

The samples consisted typically of cobble fragments. Following macroscopic examination, a petrographic thin section was prepared from each. The remainder of each sample was crushed to about one-quarter inch, then reduced to minus-325 Mesh for X-ray diffraction analysis.

Results

Monroe Union Pit, U-1, SLC

The rock sample consists of a cobble fragment of white quartz monzonite. There are no visible chemical weathering effects other than surface discoloration and surface alteration of biotite. The rock is equigranular; average grain size is approximately 2mm. There are no visible fractures or other defects. Examination of the crushed fragments shows that breakage is isotropic, typically intragranular, and controlled by shear. The rock is not exceptionally tough, and has a sugary or crumbly nature due to the fairly coarse grain size, and presence of microfractures (see below).

Being an acid, quartzose igeous rock, the chemical stability should be excellent. X-ray diffraction analysis indicates the following mineralogical composition:

Mineral	Weight Percent
Quartz	43
Oligoclase	22
Orthoclase	21
Biotite	11
Sphene, apatite, epidote, magnetite	3

Figures 1 and 2 show the general microscopic appearance of the rock. The microfractures visible in the orthoclase grain may assist chemical weathering to some extent. The grain textures are hypidiomorphic granular, typical of granitoid rock.

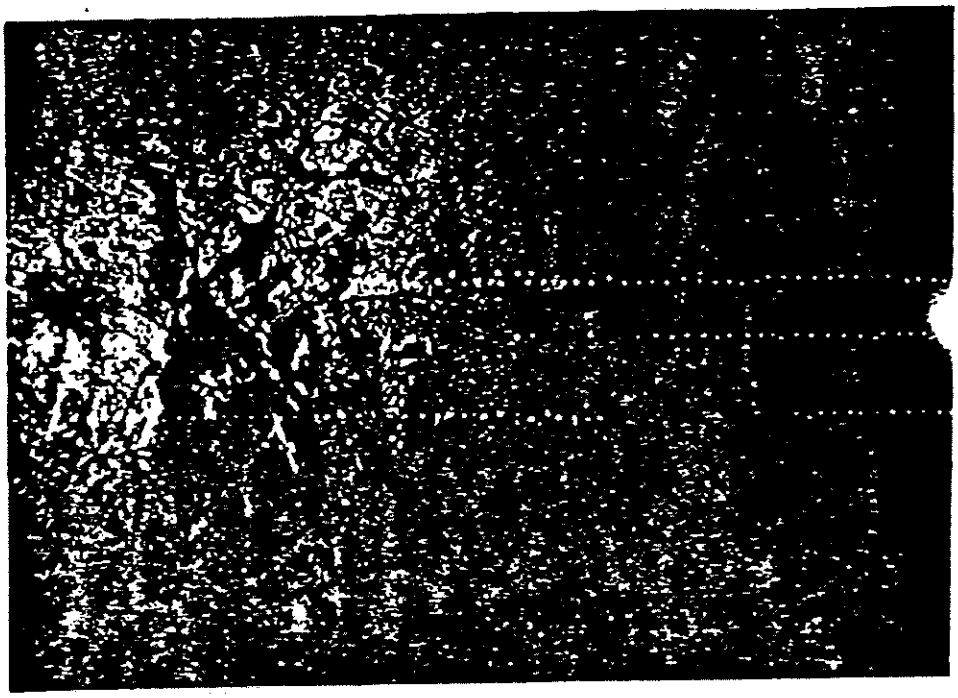

Figure 1. Monroe Union Pit, U-1, SLC. Plane-polarized light.
50X (1cm = 200 microns)
Quartz monzonite, showing hypidiomorphic granular (granitic) texture. Microfractures are apparent in orthoclase grain (upper right quadrant). Cluster of accessory minerals at left are biotite (dark green), epidote (light green), and magnetite (black). There is a very minor (dusty) sericite alteration of feldspars.

Figure 2. Monroe Union Pit, U-1, SLC. Cross-polarized light.
50X (1 cm = 200 microns)
Same field of view as Figure 1.

U-Dot, Moab, F-3

The rock sample consists of a cobble fragment of andesite porphyry. There are no visible chemical weathering effects other than surface discoloration, and surface chloritization of mafic minerals. There are no visible fractures or vesicles. The rock is porphyritic, consisting of approximately 75 percent phenocrysts (average size approximately 4mm) and 25 percent groundmass. The phenocrysts are primarily plagioclase feldspar, and minor hornblende and augite. Examination of the crushed fragments shows that breakage is isotropic, intragranular, and controlled by shear. The rock is tough.

Being an intermediate igneous rock, the chemical stability should be good. X-ray diffraction analysis indicates the following mineralogical composition:

Mineral	Weight Percent
Quartz	15
Andesine	58
Augite	10
Hornblende	9
Magnetite	4
Sphene, apatite, epidote	4

Figures 3 and 4 show the microscopic appearance of the rock. Less than one percent of the rock consists of silicate-filled vesicles, which don't, however, weather out at the rock surface. No internal fractures are visible microscopically. The grain texture is porphyritic and the grain size of the groundmass is approximately 50 microns.

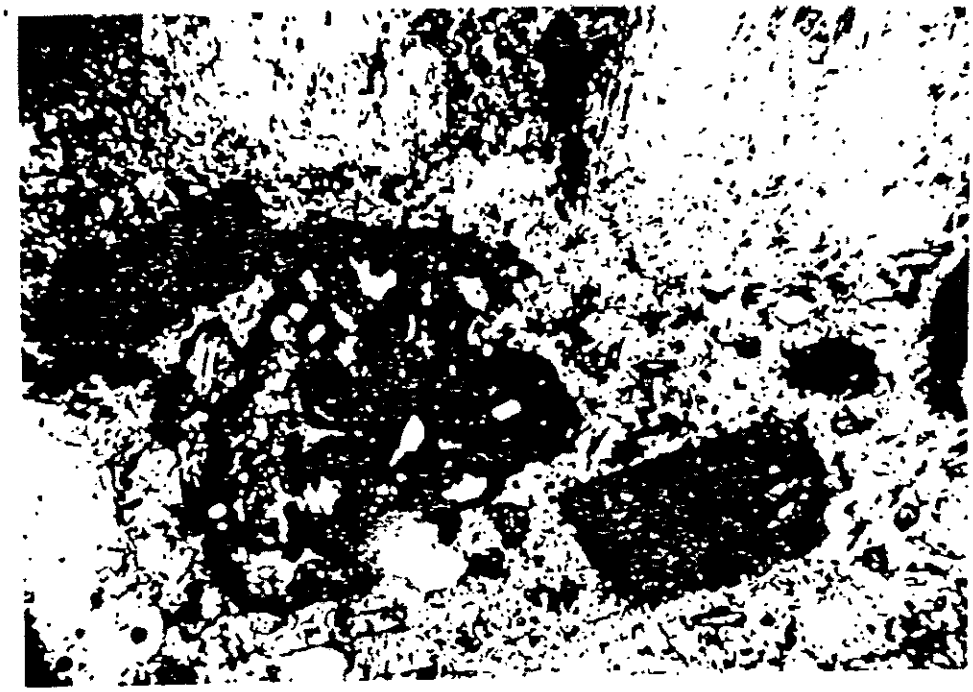

Figure 3. U-Dot Pit, Moab, F-3. Plane-polarized light.
50X (1 cm = 200 microns)
Andesite porphyry, showing porphyritic texture. Phenocrysts are plagioclase feldspar (andesine, large grains at top), hornblende (rectangular, dark green grains at left and lower right), and augite (lighter green, smaller grains). The fine grained groundmass consists primarily of plagioclase feldspar and quartz. The irregular, dark-rimmed feature at center left is an epidote/quartz/zeolite-filled vesicle.

Figure 4. U-Dot Pit, Moab, F-3. Cross-polarized light.
50X (1cm = 200 microns)
Same field of view as Figure 3. The ragged appearance of the hornblende grains is a primary growth feature, and not due to alteration.

Freemont Junction, TP-5, Sample B

The rock sample consists of a cobble fragment of basalt. Surface chemical weathering is fairly severe, characterized by a light-colored crust. Although fractures are not visible, some crushed fragments show similar internal deposits. There are no visible vesicles. The rock is porphyritic, consisting of about 50 percent phenocrysts of plagioclase feldspar, augite, and olivine, (1mm, average size) and 50 percent groundmass. Examination of the crushed fragments indicates that breakage is isotropic, intragranular, and controlled by shear. The rock is not exceptionally tough.

The chemical stability should be typical of tholeiitic (calc-alkaline) basalts. X-ray diffraction analysis indicates the following mineralogical composition:

Mineral	Weight Percent
Labradorite	72
Augite	19
Magnetite	6
Olivine	1
Rutile, apatite	2

Figures 5 and 6 show the general microscopic appearance of the rock. No internal fractures are visible microscopically. The grain texture is porphyritic, and the grain size of the groundmass is approximately 75 microns.

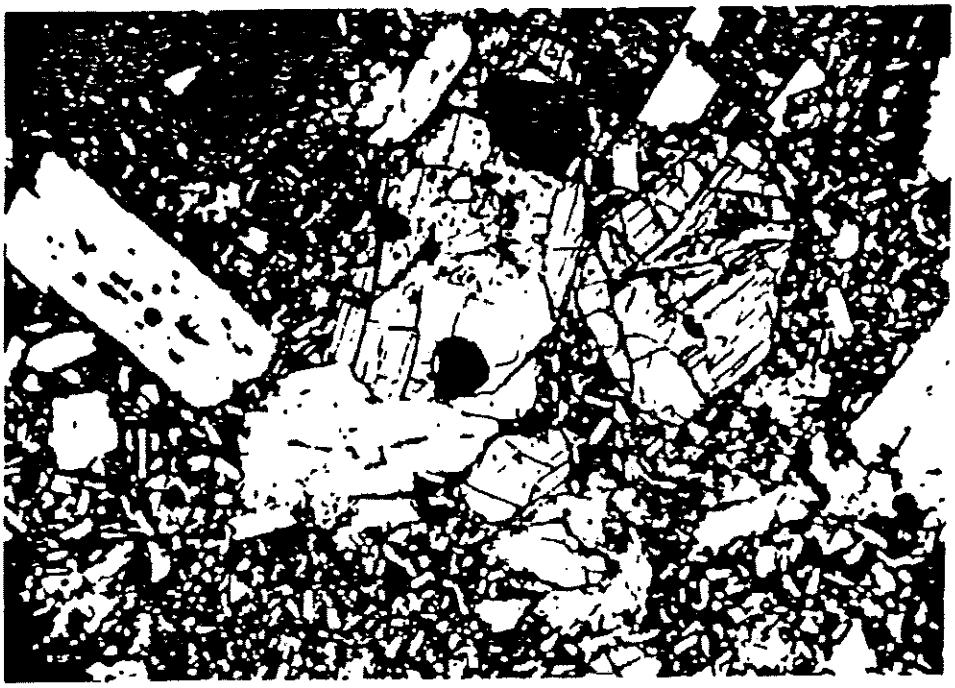

Figure 5. Freemont Junction, TP-5, Sample B. Plane-polarized light. 50X (1cm = 200 microns)
Basalt, showing porphyritic texture. Phenocrysts are augite (light green), labradorite (white) and sparse olivine (not shown). Black grains are magnetite, which occur both as phenocrysts and as a groundmass constituent. The major groundmass constituents are plagioclose feldspar (labradorite) and augite.

Figure 6. Freemont Junction, TP-5, Sample B. Cross-polarized light. 50X (1 cm = 200 microns)
Same field of view as Figure 5.

Freemont Junction, TP-2, Sample A

The rock sample consists of a cobble fragment of basalt. Surface chemical weathering is moderate, and characterized by pock marks where olivine crystals have been leached away. No fractures or vesicles are visible. The rock is porphyritic, consisting of about 50 percent phenocrysts of plagioclase feldspar, augite and olivine (1 to 2mm, average size) and 50 percent groundmass. Examination of the crushed fragments indicates that breakage is isotropic, intragranular, and controlled by shear. The rock is fairly tough.

The chemical stability should be typical of tholeiitic (calc-alkaline) basalts. X-ray diffraction analysis indicates the following mineralogical composition.

Mineral	Weight Percent
Labradorite	76
Augite	15
Magnetite	5
Olivine	1
Rutile, apatite	3

Figures 7 and 8 show the general microscopic appearance. No internal fractures are visible microscopically. The grain texture is porphyritic, and the grain size of the groundmass is approximately 75 microns.

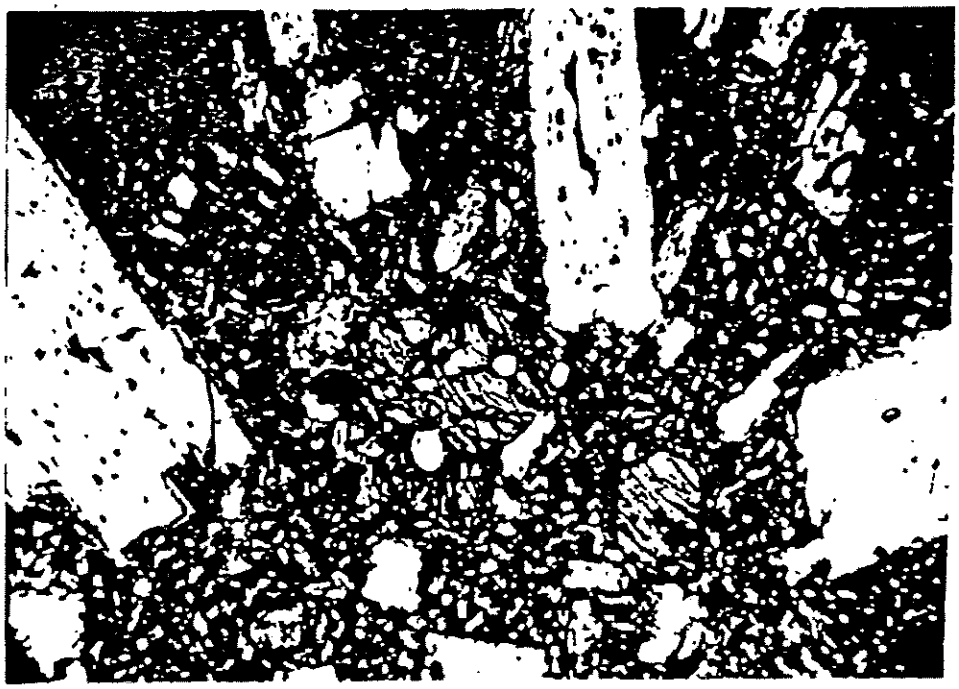

Figure 7. Freemont Junction, TP-2, Sample A. Plane-polarized light. 50X (1 cm = 200 microns)
Basalt, showing porphyritic texture. Phenocrysts are augite (light green), labradorite (white), and sparse olivine (not shown). The groundmass consists mainly of labradorite, augite, and magnetite.

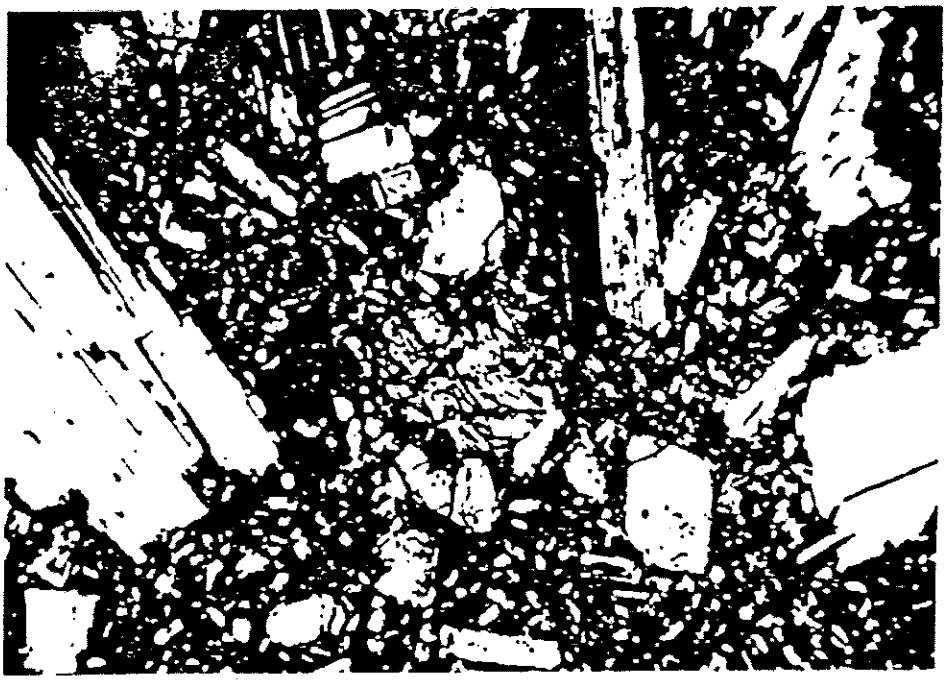

Figure 8. Freemont Junction, TP-2, Sample A. Cross-polarized light. 50X (1 cm = 200 microns)
Same field of view as Figure 7.

Freemont Junction, TP-2, Sample B

The rock sample consists of a cobble fragment of basalt. The rock contains approximately 5 percent calcite-filled vesicles, which leach out at the surface. Other surface weathering effects are moderate. No fractures are visible. The rock is porphyritic, consisting of approximately 50 percent phenocrysts of plagioclase feldspar and augite (2mm, average size), and 50 percent groundmass. Examination of the crushed fragments indicates that breakage is isotropic, intragranular, and controlled by shear. The rock is fairly tough.

The chemical stability should be typical of tholeiitic (calc-alkaline) basalts. X-ray diffraction analysis indicates the following mineralogical composition:

Mineral	Weight Percent
Labradorite	77
Augite	12
Magnetite	5
Oxyhornblende	3
Rutile, apatite	3

Figures 9 and 10 show the general microscopic appearance of the rock, including one calcite-filled vesicle. No internal fractures are visible microscopically. The grain textures are porphyritic, and the grain size of the groundmass is approximately 50 microns.

Figure 9. Freemont Junction, TP-2, Sample B. Plane-polarized light. 50X (1 cm = 200 microns)
Basalt, showing porphyritic texture. Phenocrysts are augite (light green), labradorite (white), some magnetite (black) and oxyhornblende (dark red grain at upper left). The large ovoid area at bottom is a calcite-filled vesicle. The groundmass consists mainly of labradorite, augite, and magnetite.

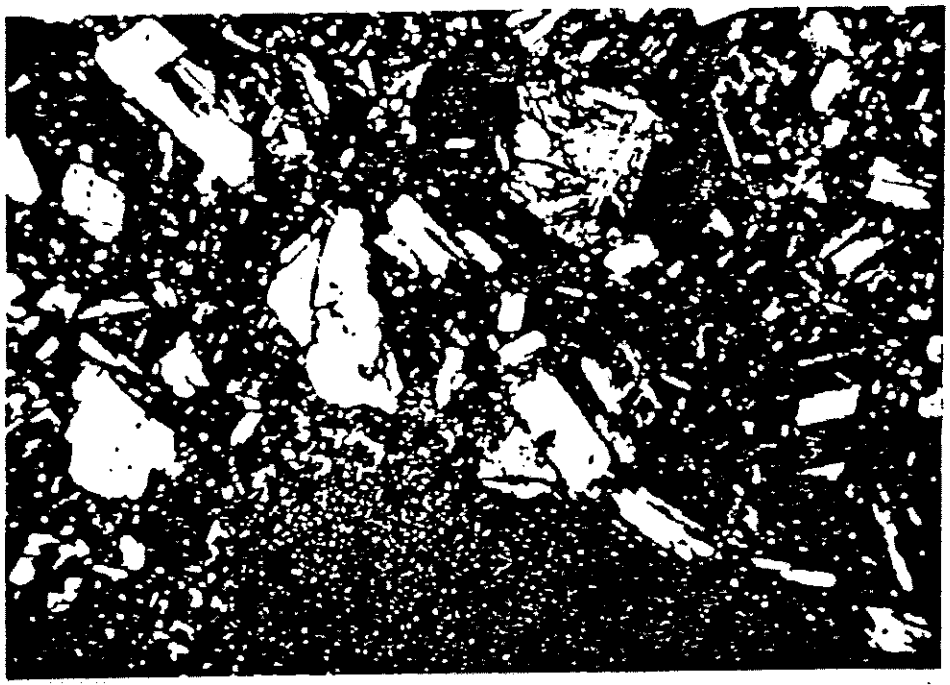

Figure 10. Freemont Junction, TP-2, Sample B. Cross-polarized light. 50X (1 cm = 200 microns)
Same field of view as Figure 9.

Freemont Junction, TP-5, Sample A

The rock sample consists of a cobble fragment of basalt. Surface chemical weathering effects are moderate. No fractures are visible. Less than one percent of the rock consists of small, open vesicles. The rock is porphyritic, consisting of approximately 50 percent phenocrysts of plagioclase feldspar and augite (1 to 2 mm, average size), and 50 percent groundmass. Examination of the crushed fragments indicates that breakage is isotropic, intragranular, and controlled by shear. The rock is fairly tough.

The chemical stability should be typical of tholeiitic (calc-alkaline) basalts. X-ray diffraction analysis indicates the following mineralogical composition:

Mineral	Weight Percent
Labradorite	67
Augite	15
Quartz	9
Magnetite	4
Oxyhornblende	1
Rutile, apatite	4

Figures 11 and 12 show the general microscopic appearance of the rock, including one open vesicle. No internal fractures are visible microscopically. The grain textures are porphyritic, and the grain size of the groundmass is approximately 50 microns.

Figure 11. Freemont Junction, TP-5, Sample A. Plane-polarized light.
50X (1 cm = 200 microns)
Basalt, showing porphyritic texture. Phenocrysts are augite (light green), labradorite (white), and oxyhornblende (dark red). The large ovoid feature at lower left is an open vesicle. The groundmass consists mainly of labradorite, augite, and magnetite.

Figure 12. Freemont Junction, TP-5, Sample A. Cross-polarized light.
50X (1 cm = 200 microns)
Same field of view as Figure 11.

Moab Southern Paving Pit, Sample 8

The rock sample consists of a cobble fragment of andesite porphyry. Surface weathering effects are moderate, and discoloration and chloritization of mafic minerals penetrates about one-quarter inch. No fractures or vesicles are visible. The rock is porphyritic, consisting of approximately 50 percent phenocrysts of plagioclose feldspar, hornblende, and augite, and 50 percent groundmass. Examination of the crushed fragments indicates breakage is isotropic, intragranular, and controlled by shear. The rock is tough.

Being an intermediate igneous rock, the chemical stability should be good. X-ray diffraction analysis indicates the following mineralogical composition:

Mineral	Weight Percent
Andesine	47
Quartz	14
Hornblende	12
Augite	11
Biotite	5
Magnetite	5
Calcite	1
Chlorite	1
Apatite, Sphene	4

Figures 13 and 14 show the general microscopic appearance of the rock. No internal fractures are visible microscopically. The grain textures are porphyritic, and the grain size of the groundmass is approximately 50 microns.

Figure 13. Moab Southern Paving Pit, Sample B. Plane-polarized light. 50X (1 cm = 200 microns)

Andesite porphyry, showing porphyritic texture. Phenocrysts are hornblende (dark rectangular grain, with brown biotite rim), andesine (white), and augite (light green, chlorite-altered grain at center). Groundmass consists mainly of andesine, quartz and magnetite, with very minor calcite and chlorite. The calcite occurs as a filling of microscopic vesicles, and the chlorite is a patchy alteration of mafic minerals.

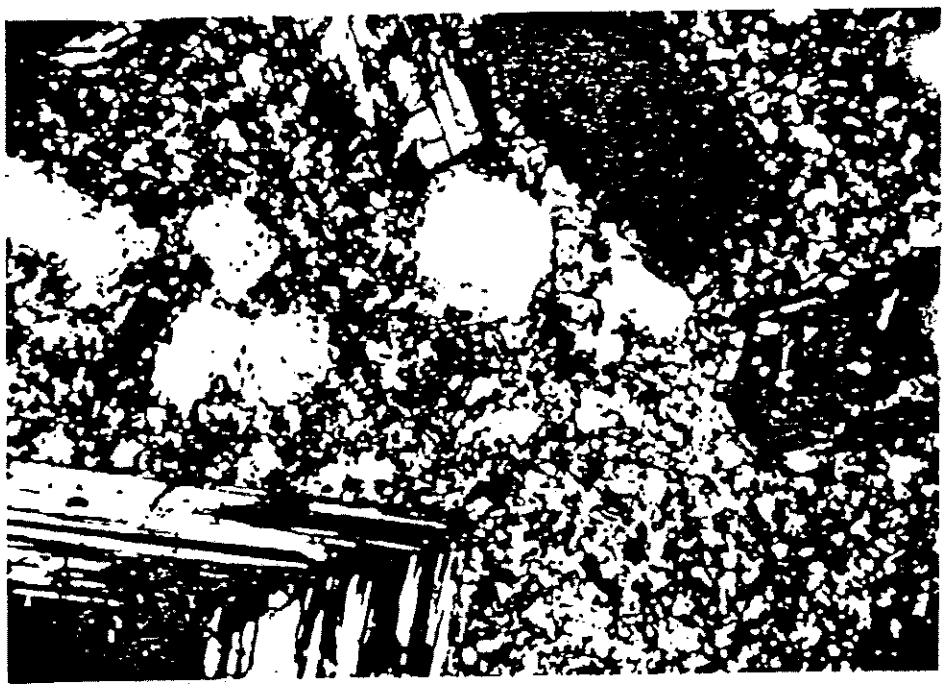

Figure 14. Moab Southern Paving Pit, Sample B. Cross-polarized light. 50X (1 cm = 200 microns)

Same field of view as Figure 13.

Moab Southern Paving Pit, Sample A
(Andesite Porphyry Fraction)

The rock sample consists of a cobble fragment of andesite porphyry. Surface chemical weathering effects are minor, and include discoloration, and chloritization of mafic minerals. No fractures or vesicles are visible. The rock is porphyritic, consisting of approximately 50 percent phenocrysts of plagioclase feldspar, hornblende, and augite, and 50 percent groundmass. Examination of the crushed fragments indicates breakage is isotropic, intragranular, and controlled by shear. The rock is tough.

Being an intermediate igneous rock, the chemical stability should be good. X-ray diffraction analysis indicates the following mineralogical composition:

Mineral	Weight Percent
Andesine	58
Quartz	17
Hornblende	10
Augite	6
Magnetite	5
Chlorite	2
Apatite, sphene	2

Figures 15 and 16 show the general microscopic appearance of the rock. No internal fractures are visible microscopically. The grain textures are porphyritic, and the grain size of the groundmass is approximately 30 microns. Mafic minerals throughout the sample (hornblende and augite) are partially chloritized.

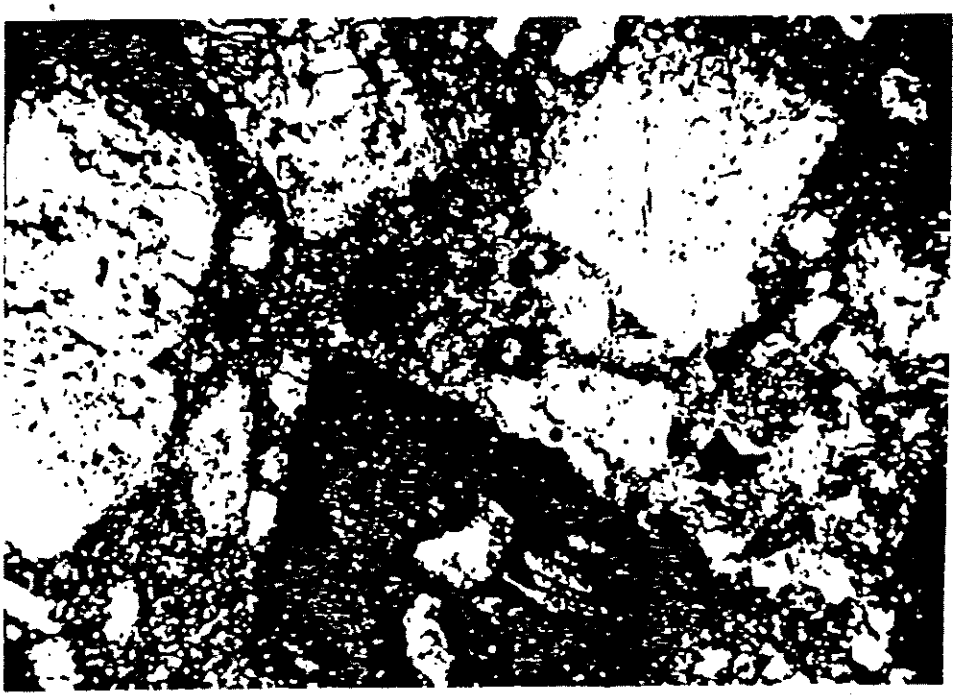

Figure 15. Moab Southern Paving Pit, Sample A (Granite Porphyry Fraction). Plane-polarized light. 50X (1 cm = 200 microns)
Andesite porphyry, showing porphyritic texture. Phenocrysits are andesine (white), hornblende (green, with chloritized rim) and augite (not shown). Groundmass consists mainly of andesine, quartz, and magnetite.

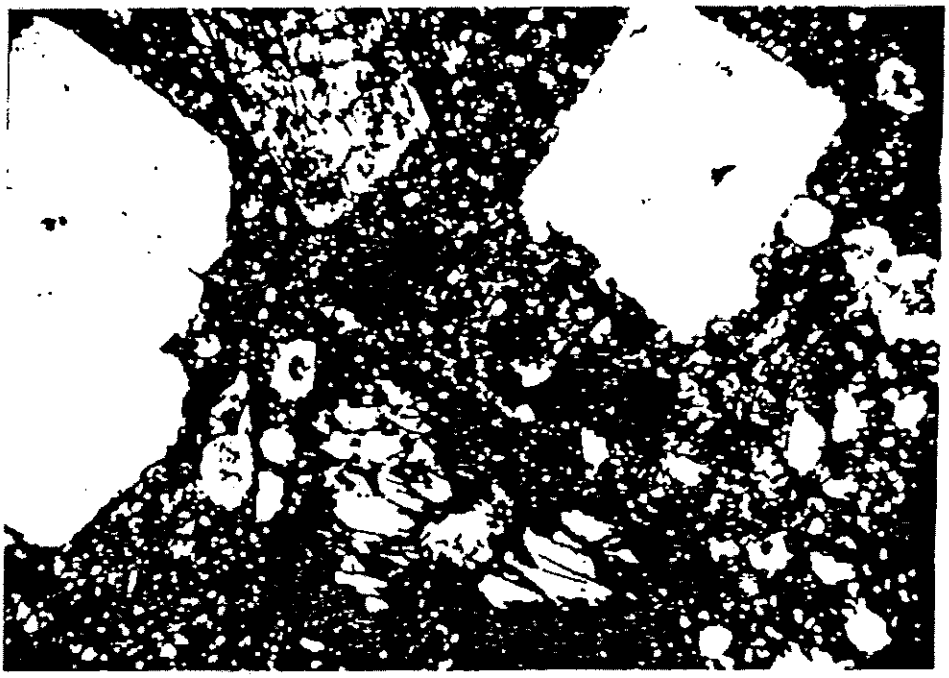

Figure 16. Moab Southern Paving Pit, Sample A. (Granite Porphyry Fraction). Cross-polarized light. 50X (1 cm = 200 microns)
Same field of view as Figure 15.

Moab Southern Paving Pit, Sample A
(Sandstone Fraction)

The rock sample consists of a cobble fragment of sandstone. Classification as sandstone, rather than quartzite, is based on the observation that breakage is primarily intergranular. Surface weathering is moderate, and consists of pitting due to leaching of carbonate grains. This effect penetrates about one-quarter inch. No fractures are visible at the surface. Cementation is an advanced stage of quartz overgrowth, with little or no pore space remaining. Calcite occurs as recrystallized limestone grains, and clays occur as labile rock fragments, often compressed into prior pore space. Examination of the crushed fragments indicates breakage is fairly isotropic, primarily intergranular, and controlled by shear. The rock is tough.

With the exception of the minor amount of calcite, the chemical stability of the rock should be excellent. X-ray diffraction analysis indicates the following mineralogical composition:

Mineral	Weight Percent
Quartz	89
Calcite	6
Kaolinite	3
Mica/Illite	2

Figures 17 and 18 show the general microscopic appearance of the rock. The average grain size is approximately 300 microns. No internal fractures are visible microscopically.

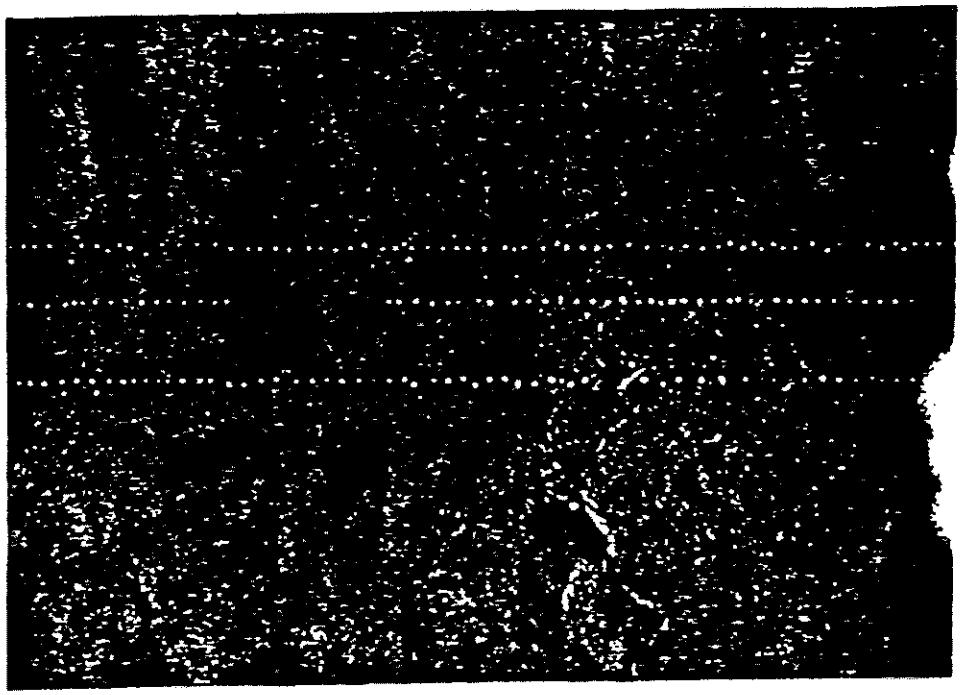

Figure 17. Moab Southern Paving Pit, Sample A. (Quartzite Fraction). Plane-polarized light. 50X (1 cm = 200 microns)

Quartz-cemented sandstone. Clay-rich rock fragments (brown, iron stained) were compacted into available pore space, followed by fairly complete quartz-overgrowth cementation (dust rims outline original quartz grain boundaries). Calcite (see below) occurs as apparently recrystallized limestone rock fragments (dispersed grains) and not as cement.

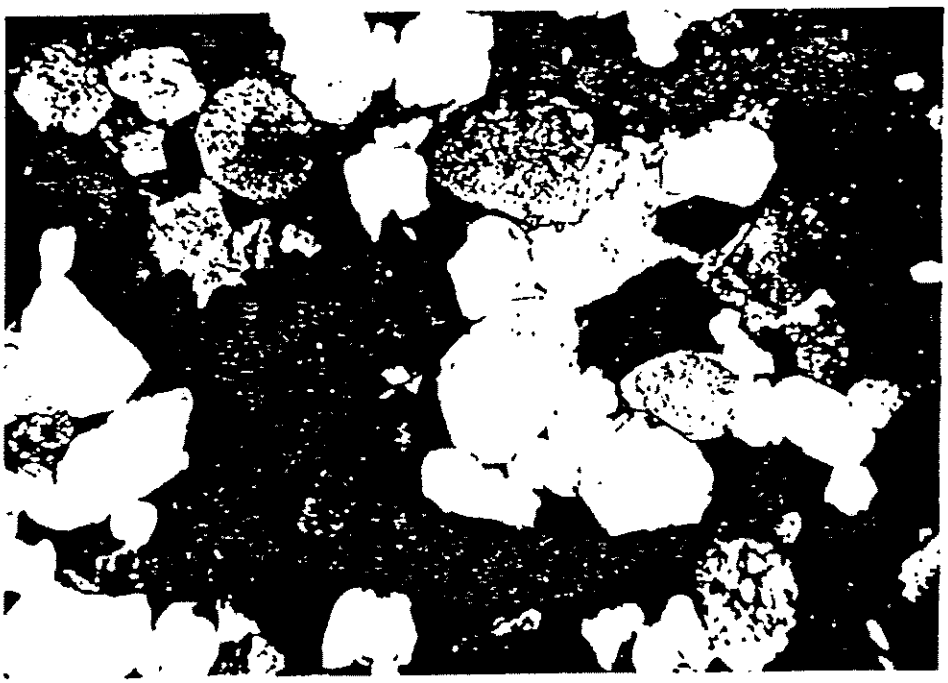

Figure 18. Moab Southern Paving Pit, Sample A (Quartzite Fraction). Cross-polarized light. 50X (1 cm = 200 microns)

Same field of view as Figure 17. Two calcite grains (bright, yellow) are visible at ten o'clock and two o'clock.

U-Dot Pit, Moab, F-2

The rock sample consists of a cobble fragment of andesite porphyry. Surface chemical weathering effects are minor, and include discoloration, and chloritization of mafic minerals. These effects penetrate about one-eighth of an inch. No fractures or vesicles are visible. The rock is porphyritic, consisting of approximately 50 percent phenocrysts of plagioclase feldspar, hornblende and augite, and 50 percent groundmass. Examination of the crushed fragments indicates that breakage is isotropic, intragranular, and controlled by shear. The rock is tough.

Being an intermediate igneous rock, the chemical stability should be good. X-ray diffraction analysis indicates the following mineralogical composition:

Mineral	Weight Percent
Andesine	56
Hornblende	16
Quartz	13
Augite	7
Magnetite	4
Calcite	1
Sphene, apatite	3

Figures 19 and 20 show the general microscopic appearance of the rock. No internal fractures are visible microscopically. The grain textures are porphyritic, and the grain size of the groundmass is approximately 30 microns. Calcite is present as a vesicle-filling mineral, in very small vesicles.

Addendum F2. Rock Durability Laboratory Results for Samples Collected in 2007 and 2008

CMT ENGINEERING LABORATORIES

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December 10, 2007

Nielson Construction
P.O. Box 620
Huntington, Utah 84528

Project: Energy Solutions
Project#: 3022
Material: Rip Rap
Source: Freemont Junction

Laboratory Test	Average Test Value	Score	Weight	Score & Weight	Max Score
Mineral Type			Igneous		
Specific Gravity	2.694	8.9	9	80.1	90
Absorption %	1.4	4.2	2	8.4	20
Sodium Sulfate %	0.0	10	11	110	110
LA Abrasion	7.6	~~7~~ 6.5	1	~~7~~ 6.5	10
Schmidt Hammer	30	3.9	3	11.7	30
Total Score				**217.7**	**260**

Rating = 83.35% ~~83.7~~% *No Oversizing Required*

TEST RESULTS

Specific Gravity and Absorption ASTM C-127
Lab # 113877

Relative Density (oven Dry)	=	2.694
Relative Density (SSD)	=	2.731
Relative Density (apparent)	=	2.798
Absorption (%)	=	1.4 %

Los Angeles Abrasion ASTM C-131
Lab # 113876

100 Revolutions
Grading A
12 Spheres

% Wear = 7.6 %

Sodium Soundness ASTM C-88
Lab # 113174

5" x 5" x .25 square % Loss = 0.0%

Schmitt Hammer

Sample	#1	#2	#3	
Rebound Number	27	31	31	Average = 30

Sincerely,

Doug Watson

Doug Watson
President

CMT ENGINEERING LABORATORIES

Construction • Materials • Technology
Geotechnical, Environmental, & Materials Engineering / Testing / Research

March 11, 2008

Nielson Construction
P.O. Box 620
Huntington, Utah 84528

Project: Energy Solutions
Project#: 3022
Material: Red Oxidized Basalt
Source: Freemont Junction

Laboratory Test	Average Test Value	Score	Weight	Score & Weight	Max Score
Mineral Type			Igneous		
Specific Gravity	2.444	3.9	9	35.1	90
Absorption %	1.5	4.0	2	8	20
Sodium Sulfate %	0.6	10	11	110	110
LA Abrasion	8.3	6.0	1	6.0	10
Schmidt Hammer	17	2.2	3	6.64	30
Total Score				165.7	260

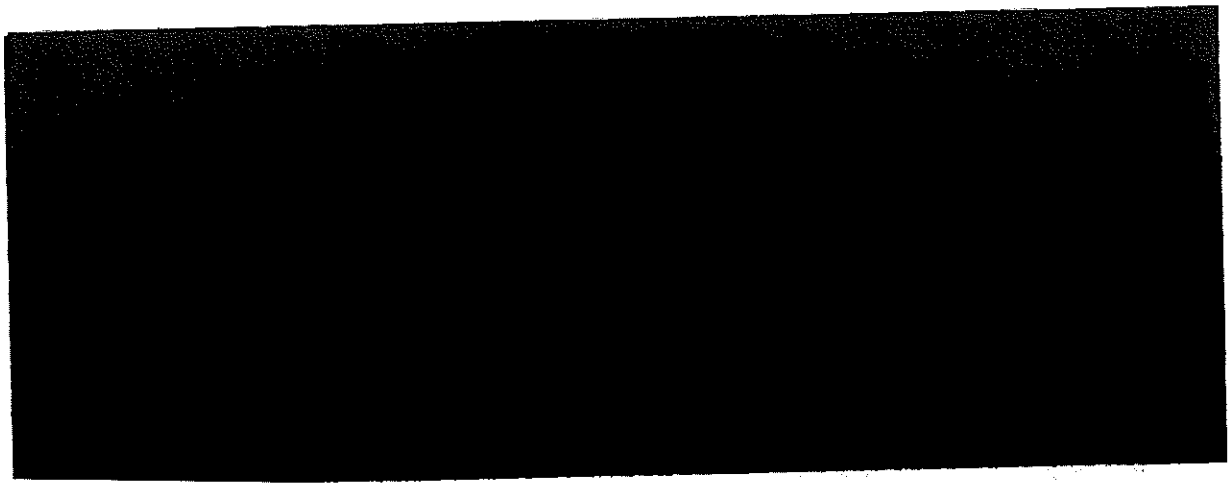
Rating = 63.7% Reject

TEST RESULTS

Specific Gravity and Absorption ASTM C-127
Lab # 118897

Relative Density (oven Dry)	=	2.444
Relative Density (SSD)	=	2.482
Relative Density (apparent)	=	2.540
Absorption (%)	=	1.5 %

LOGAN LAB 2005 NORTH 600 WEST UNIT D LOGAN, UT 84321 (phone) 435.753.2850 (fax) 435.753.2851
NORTH SALT LAKE OFFICE 801 WEST ROBINSON DRIVE, STE 1 NORTH SALT LAKE, UT 84054 (phone) 801.935.1567 (fax) 801.936.1465
WEST VALLEY CITY LAB 2688 SOUTH REDWOOD ROAD, STE E WEST VALLEY CITY, UT 84119 (phone) 801.887.0067 (fax) 801.887.0016



Freemont Junction
Red Oxidized Basalt

Los Angeles Abrasion ASTM C-131
Lab # 118899

100 Revolutions
Grading A
12 Spheres

% Wear = 8.3 %

Sodium Soundness ASTM C-88
Lab # 118898

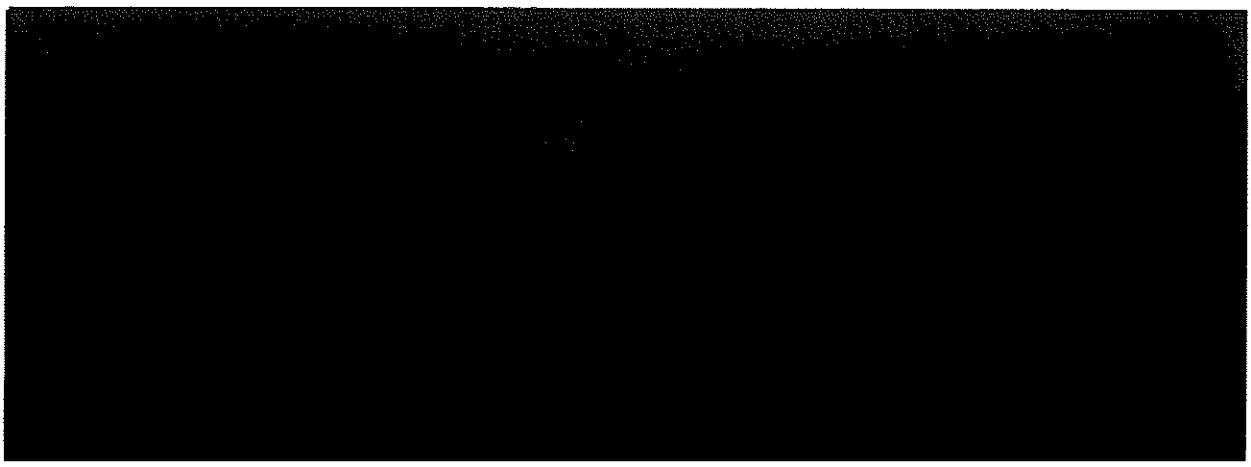
5" x 5" x .25 square % Loss = 0.9%

Schmitt Hammer

Sample	#1	#2	#3	
Rebound Number	15	20	16	Average = 17

Sincerely,

Doug Watson
President



CMT ENGINEERING LABORATORIES

Construction • Materials • Technologies
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March 11, 2008

Nielson Construction
P.O. Box 620
Huntington, Utah 84528

Project: Energy Solutions
Project#: 3022
Material: Gray Basalt
Source: Freemont Junction

Laboratory Test	Average Test Value	Score	Weight	Score & Weight	Max Score
Mineral Type			Igneous		
Specific Gravity	2.679	8.6	9	77.4	90
Absorption %	1.0	5.0	2	10	20
Sodium Sulfate %	0.9	10	11	110	110
LA Abrasion	7.0	6.8	1	6.8	10
Schmidt Hammer	30	3.8	3	11.4	30
Total Score				**215.6**	**260**

Rating = 82.9% No Oversizing Required

TEST RESULTS

Specific Gravity and Absorption ASTM C-127
Lab # 118901

Relative Density (oven Dry)	=	2.679
Relative Density (SSD)	=	2.707
Relative Density (apparent)	=	2.756
Absorption (%)	=	1.0 %

Fremont Junction
Gray Basalt

Los Angeles Abrasion ASTM C-131
Lab # 118900

100 Revolutions
Grading A
12 Spheres

% Wear = 7.0 %

Sodium Soundness ASTM C-88
Lab # 118902

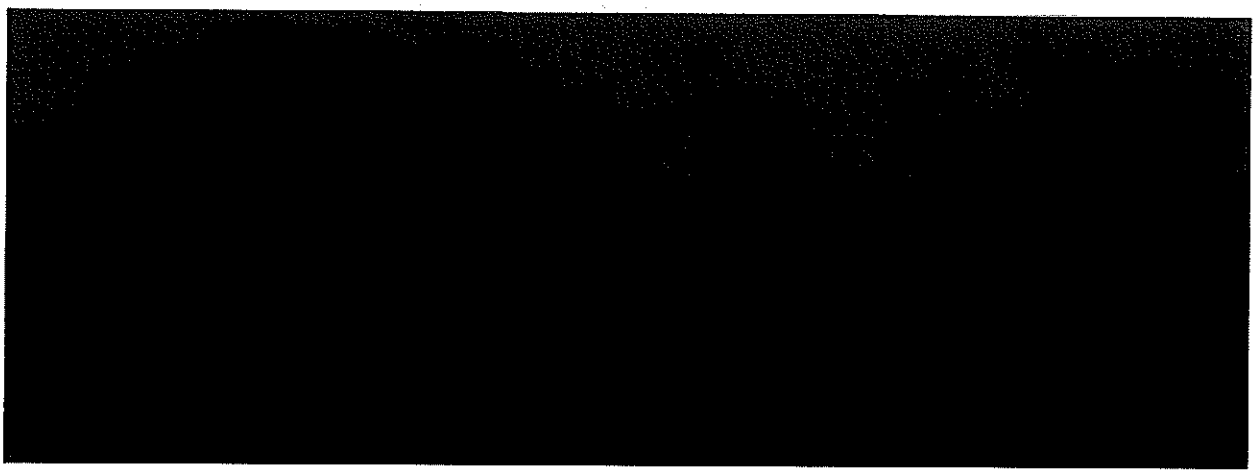
5" x 5" x .25 square % Loss = 0.9%

Schmitt Hammer

Sample	#1	#2	#3	
Rebound Number	39	20	30	Average = 30

Sincerely,

Doug Watson
President



Addendum F3. Green River, Utah, Final Completion Report, Volume 2, Appendix E, Material Summary Report, 1991

APPENDIX E

MATERIAL TESTING SUMMARY REPORT

RIPRAP TYPE A

TYPE A RIPRAP

- The riprap material was obtained from the approved Fremont Junction Borrow Source. M-K Engineers performed an in-depth investigation of the source prior to approval.

- The Type A Riprap was placed on top of the bedding material to a depth of 6 inches around the perimeter of the cell and to a depth of 12 inches on the upper 5:1 slopes. The equipment used during construction was as follows: End Dumps with Pup Trailers for hauling to the site and a Volvo 6 x 6 low ground pressure unit for hauling and dumping onto the cell embankment; and a Komatsu PC 200 LC Backhoe and a Caterpillar D-6 Dozer for spreading.

- The required durability test frequency for the Type A Riprap was one set of tests initially prior to delivery of any material to the site, one set of tests for the first-third and second-third quantities produced, and one set of tests after completion of production activities. Western Engineers, Inc. and Professional Service Industries, Inc. were the commercial testing laboratories used to perform the required durability tests.

- As required, four representative samples of Type A Riprap were acquired and sent to the laboratory for durability testing in accordance with ASTM as follows: ASTM C-127 for saturated surface dry specific gravity; ASTM C-127 for absorption; ASTM C-88 for soundness after 5 cycles; and ASTM C-131 for abrasion after 100 revolutions. The specific gravity tests produced an average result of 2.61 and a low of

2.40. The absorption test results had an average result of 1.46% and a high value of 3.12%. The soundness test results had an average of .70% loss and a high value of .93% loss. The abrasion test results had an average result of 6.9% loss and a high value of 7.3% loss.

- The Type A Riprap individual durability test results were not required to meet a specified value, however, the test results were scored for each sample and sent to M-K Engineers for acceptance. After review of the results, M-K Engineers signed for acceptance of the material.

- The average score for the four durability sample results was 85 with a low score of 78, and a high score of 90.

- The specified gradation test frequency for the Type A Riprap was one test upon delivery of the material to the disposal cell, one test for the first and second third quantities placed, and one test near completion of placement activities.

- All gradation tests were performed in accordance with ASTM C-136.

- As required, four gradation tests were taken with all four tests passing the design specifications. Considering that 9,165 cubic yards of Type A Riprap were placed, the average equalled one gradation test for every 2,291 cubic yards of material placed.

- Four additional information only gradation tests were taken during production which passed the specified gradation

limits. The gradation tests were taken at one-third production increments prior to acquiring durability samples.

- The required tolerance was 90% to 125% of the specified depth which allowed between .45 feet to .625 feet for the specified 6 inch depth and between .90 feet to 1.25 feet for the specified 12 inch depth. Thirty-nine (39) passing depth checks were taken with at least one depth check for every 100 foot by 100 foot area. The depth checks complimented a documented engineering survey.

- All areas that were found to be outside of the depth tolerances were reworked as specified and reverified by additional depth checks until passed.

- The shape of at least 75 percent of the Type A Riprap, by weight, was required to have the minimum dimension not less than one-third of the maximum dimension. Two dimension analyses were performed during production which satisfied the dimensional requirement. There were no required frequencies for performing dimensional analyses.

- Daily inspections of the Type A Riprap were conducted during excavation, production, stockpiling, transporting, and placement to assure the following: That proper techniques were employed to prevent degradation of the material due to improper handling; that distribution was uniform; that voids were kept as minimal as possible; and that proper gradation was maintained.

- Daily inspections were also conducted to assure that the Type A Riprap was sound stone, resistant to abrasion, and free from cracks, seams and weathering rinds.

- During production, sandstone was extracted from the Type A Riprap to assure that no more than 10% sandstone by volume was present in the final product.

- All scales used were calibrated against equipment having a known valid relationship to NIST (formally NBS).

- The test frequencies stated herein were derived from the total quantity of material referenced, divided by the total number of tests taken for that material. It should be noted that during remedial action, quantities are not continually surveyed during production, placement, and/or compaction but rather surveyed at various milestones, i.e., completion of first lift, for pay quantities, to verify survey coordinates. Therefore, daily quantities are estimated by load counts or conveyor belt rates until final or partial surveys are obtained. Once survey quantities are obtained, the estimated quantities are adjusted to reflect the actual test frequency. Quantities between tests were estimated during remedial action to never exceed the frequency specified by the Design Specifications and Remedial Action Inspection Plan. Tests were proportionally taken throughout production, placement, and/or compaction and were not taken all in one given time frame.

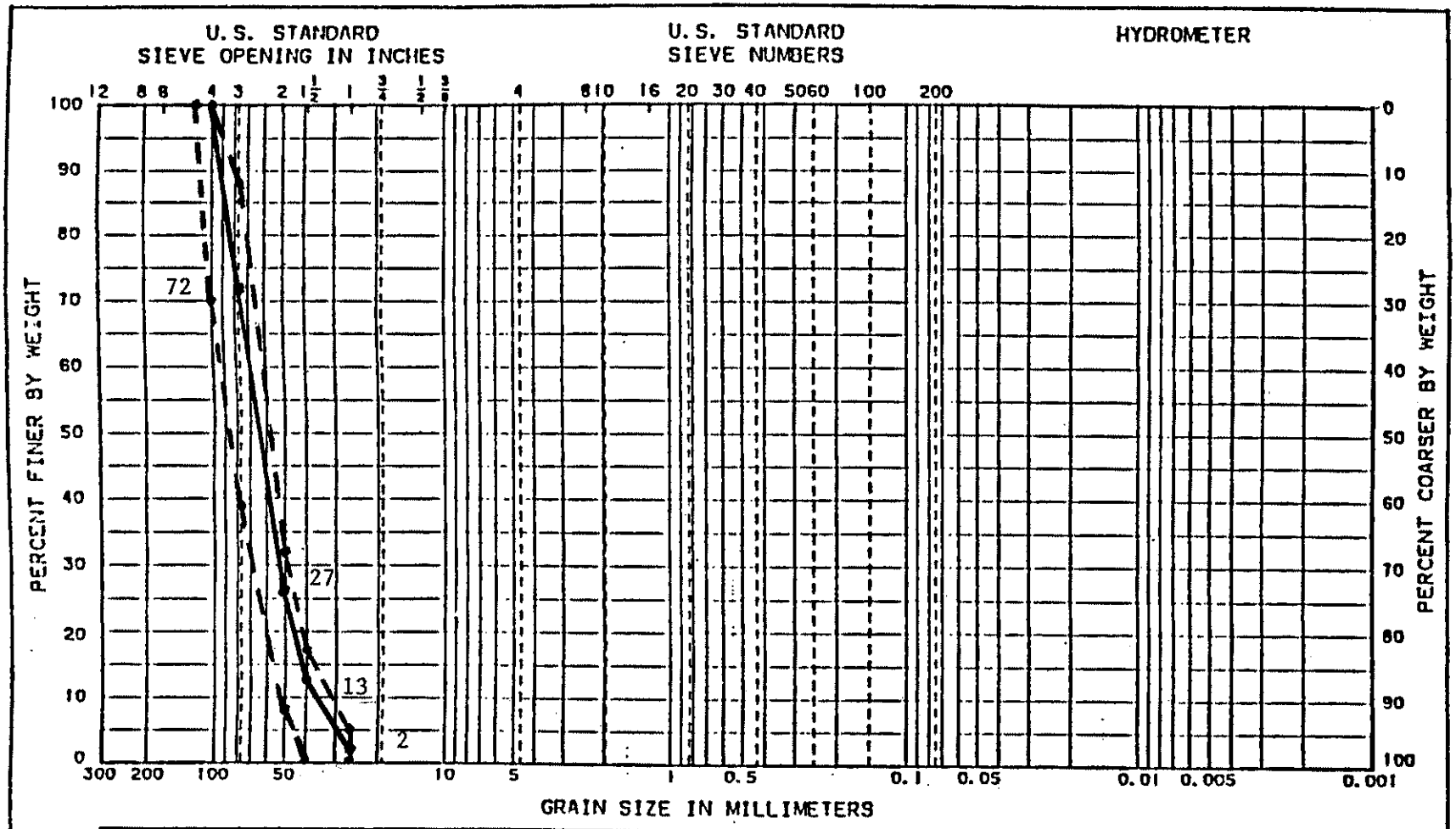
- All tests and inspections were performed in strict accordance with the specification requirements.

- The following pages contain an average gradation summary and plots of the cell embankment identifying depth check locations.

RIPRAP TYPE A

MK-FERGUSON
A MORRISON KNUDSEN COMPANY
REMEDIAL ACTIONS CONTRACTOR-UMTRA PROJECT

----- SPECIFIED LIMIT ——— ACTUAL AVERAGE VALUE



GRAIN SIZE ANALYSIS

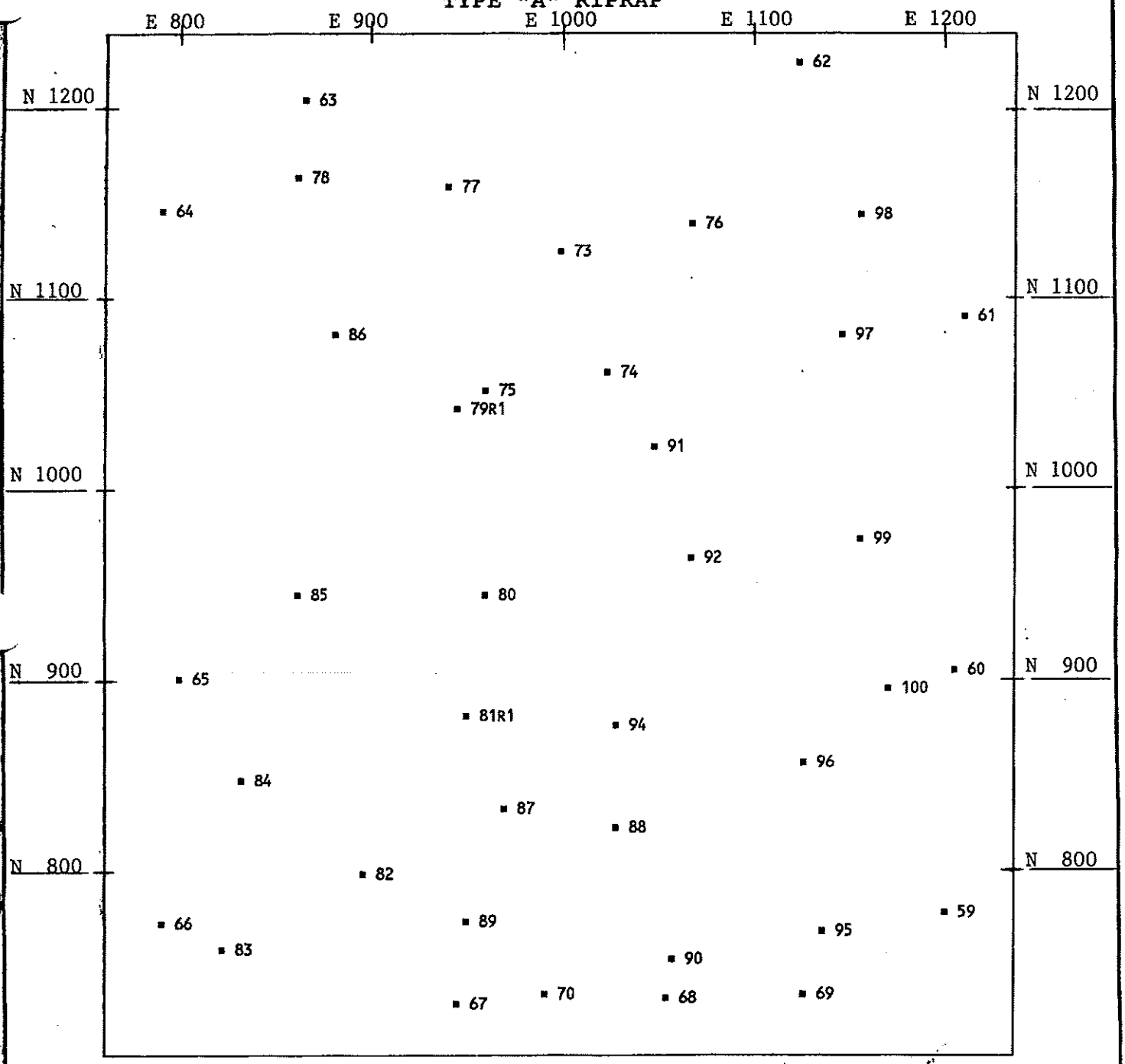
SAMPLE NO.	ELEV. OR DEPTH	CLASSIFICATION	NAT W%	LL	PL	PI

PROJECT
JOB NO.
AREA
HOLE NO.
DATE

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

GREEN RIVER DEPTH CHECKS

TYPE "A" RIPRAP



TEST NO.	AVERAGE DEPTH	TEST NO.	AVERAGE DEPTH	TEST NO.	AVERAGE DEPTH	TEST NO.	AVERAGE DEPTH
59	.59	73	.96	85	.99	98	.91
60	.51	74	1.00	86	.91	99	1.14
61	.50	75	.99	87	1.05	100	.97
62	.57	76	.91	88	1.23		
63	.59	77	.95	89	.91		
64	.53	78	.99	90	1.07		
65	.58	79R1	1.06	91	1.09		
66	.52	80	.96	92	1.01		
67	.49	81R1	1.04	94	.98		
68	.53	82	1.17	95	.92		
69	.45	83	1.01	96	1.01		
70	.45	84	.94	97	.98		

RIPRAP TYPE B

TYPE B RIPRAP

- The Riprap material was obtained from the approved Fremont Junction Borrow Source. M-K Engineers performed an in-depth investigation of the source prior to approval.

- The Type B Riprap was placed around the perimeter of the cell embankment progressing up the 2:1 slope. The primary equipment used during construction was as follows: End Dumps with Pup Trailers for hauling to the site; a Volvo 6 x 6 low ground pressure unit for hauling and dumping onto the cell embankment; and a Komatsu PC 200 LC Backhoe for placement and filling of voids.

- The required durability test frequency for the Type B Riprap was one set of tests initially prior to delivery of any material to the site, one set of tests for the first-third and second-third quantities produced, and one set of tests after completion of production activities. Western Engineers, Inc. and Professional Service Industries, Inc. were the two commercial testing laboratories used to perform the required durability tests.

- As required, four representative samples of Type B Riprap were acquired and sent to the laboratory for durability testing in accordance with ASTM as follows: ASTM C-127 for saturated surface dry specific gravity; ASTM C-127 for absorption; ASTM C-88 for soundness after 5 cycles; and ASTM C-131 for abrasion after 100 revolutions; ISRM method for Schmidt rebound hardness; and ISRM method for splitting tensile strength.

- The specific gravity tests produced an average result of 2.64 and a low result of 2.43. The absorption test results had an average result of 1.40% and a high value of 2.89%. The soundness test results had an average of 1.00% loss and a high value of 1.26% loss. The abrasion test results had an average of 7.23% loss and a high value of 8.11% loss. The Schmidt rebound hardness test results had an average value of 46.1 and a low value of 31.0. The splitting tensile strength had an average value of 1,496 and a low value of 1,025.

- The Type B Riprap individual durability test results were not required to meet a specified value, however, the test results were scored for each sample and sent to M-K Engineers for acceptance. After review of the results, M-K Engineers signed for acceptance of the material.

- The average score for the four durability sample results was 80 with a low score of 83, and a high score of 90.

- The specified gradation test frequency for the Type B Riprap was one test upon delivery of the material to the disposal cell, one test for the first and second-third quantities placed, and one test near completion of placement activities.
- All gradation tests were performed in accordance with ASTM C-136.

- As specified, four gradation tests were taken with all four tests passing the design specifications. Considering that 15,462 cubic yards of Type B Riprap were placed, the average equalled one gradation test for every 3,866 cubic yards of material placed.

- Four additional information only gradation tests were taken during production which passed the specified gradation limits. The gradation tests were taken at one-third production increments prior to acquiring durability samples.

- An engineering survey was performed for line and grade on the Type B Riprap and was found to be within tolerances.

- The shape of at least 75 percent of the Type B Riprap, by weight, was required to have the minimum dimension not less than one-third of the maximum dimension. One dimensional analyses was performed during production which satisfied the dimensional requirement. There were no required frequencies for performing dimensional analyses.

- Daily inspections of the Type B Riprap were conducted during excavation, production, stockpiling, transporting, and placement to assure the following: That proper techniques were employed to prevent degradation of the material due to improper handling; that distribution was uniform; that voids were kept as minimal as possible; and that proper gradation was maintained.

- Daily inspections were also conducted to assure that the Type B Riprap was sound stone, resistant to abrasion, and free from cracks, seams and weathering rinds.

- During production, sandstone was extracted from the Type B Riprap to assure that no more than 10% sandstone by volume was present in the final product.

- All scales were calibrated against equipment having a known valid relationship to NIST (formerly NBS).

- The test frequencies stated herein were derived from the total quantity of material referenced, divided by the total number of tests taken for that material. It should be noted that during remedial action, quantities are not continually surveyed during production, placement, and/or compaction but rather surveyed at various milestones, i.e., completion of first lift, for pay quantities, to verify survey coordinates. Therefore, daily quantities are estimated by load counts or conveyor belt rates until final or partial surveys are obtained. Once survey quantities are obtained, the estimated quantities are adjusted to reflect the actual test frequency. Quantities between tests were estimated during remedial action to never exceed the frequency specified by the Design Specifications and Remedial Action Inspection Plan. Tests were proportionally taken throughout production, placement, and/or compaction and were not taken all in one given time frame.

- All tests and inspections were performed in strict accordance with the specification requirements.

- An average gradation summary has been provided on the next page.

TYPE B RIPRAP

---- SPECIFIED LIMIT
—— ACTUAL AVERAGE VALUE

MORRISON-KNUDSEN CO., INC.

MECHANICAL ANALYSIS - ROCK

FORM ENG 474/74
PRINTED IN U.S.A.