February 27, 1998

Mr. George Rael, Director
U.S. Department of Energy
Albuquerque Operations Office
ERD/UMTRA
P.O. Box 5400
Albuquerque, NM 87185-5400

SUBJECT: CONSTRUCTION PHASE PROBLEM RESOLUTION REVISION NUMBERS 20, 22, 23, AND 24 FOR THE NATURITA DISPOSAL SITE

Dear Mr. Rael:

By letter dated November 14, 1997, the U.S. Department of Energy (DOE) transmitted Construction Phase Problem Resolution Revision (CRR) Numbers 20, 22, 23, and 24 for the Naturita, Colorado, Upper Burbank disposal site to the U.S. Nuclear Regulatory Commission for review and approval. Based on its review of the information provided by DOE, the NRC staff has concluded that the subject CRRs, as proposed, are acceptable.

The proposed revisions relate to Specification 02278 and Drawing Numbers NAT-DS-10-1791, NAT-DS-10-1789, and NAT-DS-10-1797. The staff's review is documented in the enclosed Technical Evaluation Report. If you have any questions concerning this letter or the enclosure, please contact the NRC Project Manager, Robert Carlson, at (301) 415-8165.

Sincerely,

[Original signed by]

Joseph J. Holonich, Chief
Uranium Recovery Branch
Division of Waste Management
Office of Nuclear Material Safety
and Safeguards

Enclosure: As stated

WM-66
NL14

cc: B. Cornish, DOE Alb
F. Bosiljevac, DOE Alb
E. Artiglia, TAC Alb

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OFC	URB*		URB*	E	URB	N				
NAME	MHaque		DGillen		JHolonich					
DATE	02/20/98		02/25/98	H	02/ /98					

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Albuquerque Operations Office
ERD/UMTRA
P.O. Box 5400
Albuquerque, NM 87185-5400

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OFC	URB		URB	E	URB					
NAME	MHaque		DGillen		JHolonich					
DATE	02/20/98		02/25/98		02/ /98					

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Department of Energy
Albuquerque Operations Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

NOV 1 4 1997

Mr. Robert Carlson
Uranium Recovery Branch
Division of Waste Management
Office of Nuclear Material Safety
and Safeguards MS-T7J9
U. S. Nuclear Regulatory Commission
11545 Rockville Pike
Rockville, MD 20852-2738

Dear Mr. Carlson:

Enclosed are copies of CRRs numbered 20 through 24 pertaining to the Uranium Mill Tailings Remedial Action Project site at Naturita, Colorado. CRR No. 20 allows Type A rock to be used as bedding in the interceptor channel. CRR No. 21 involves well head protection and/or the extension of existing monitor wells near the disposal cell. CRRs No. 22 and 23 amend the erosion protection specification, Section 02278, to clarify the testing of small gradation materials and provide a method for the field selection of oversized sandstone. CRR No. 24 changes specification Section 02278 to allow up to 50 percent of the rock to have a minimum dimension less than one-third of the maximum.

Please call me at 505-845-5654 if you have any questions.

Sincerely,

Robert E. Cornish

Robert E. Cornish
Naturita Site Manager
Environmental Restoration Division

Enclosures

cc w/o enclosures:
C. Abrams, NRC

 35pp

UPPER BURBANK DISPOSAL SITE
CONSTRUCTION PHASE PROBLEM RESOLUTION FORM
RESOLUTION/REVISION No. 20

Date: August 18, 1997
Commentor: R. Waddington Organization: MK-Ferguson
Drawing: NAT-DS-10-1791
Specification: N/A Section: N/A

APPROVED

Problem (Continue on next page if more space is needed):

Amount of Type A rock produced exceeds requirement due to increase in cell volume and decrease in top surface area. Some of excess rock could be used as bedding in the Interceptor Channel. See filter criteria compatibility check next page.

Solution (Provide a brief discussion of rationale including references):

Add Note 6 to Dwg. NAT-DS-10-1791 (handwritten correction: 7, initialed 8/20/97) stating that Type A rock may be used in place of bedding in areas of the Interceptor Channel where bedding is required. Issue revised Drawing NAT-DS-10-1791, Rev. 2.

Umetco Project Manager [signature] Date: 8-18-97

Umetco Design Engineer [signature] Date: 8-18-97

Umetco QA Manager [signature] Date: 8·18·97

MK-F Site Manager Ralph Waddington for Date: 8/21/97

MK-F Construction Engineer [signature] Spencer Date: 8/21/97

MK-F Q/A Manager Paul M. Bee for GJD Date: 8/21/97

____ Approved ____ Disapproved ✓ Approved as Noted

Criteria Change? ____ Yes XX No (If yes, DOE approval needed)

DOE Site Manager Approval N.A. Date: ____

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

February 27, 1998

Mr. George Rael, Director
U.S. Department of Energy
Albuquerque Operations Office
ERD/UMTRA
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SUBJECT: CONSTRUCTION PHASE PROBLEM RESOLUTION REVISION NUMBERS 20, 22, 23, AND 24 FOR THE NATURITA DISPOSAL SITE

Dear Mr. Rael:

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The proposed revisions relate to Specification 02278 and Drawing Numbers NAT-DS-10-1791, NAT-DS-10-1789, and NAT-DS-10-1797. The staff's review is documented in the enclosed Technical Evaluation Report. If you have any questions concerning this letter or the enclosure, please contact the NRC Project Manager, Robert Carlson, at (301) 415-8165.

Sincerely,

Joseph J. Holonich, Chief
Uranium Recovery Branch
Division of Waste Management
Office of Nuclear Material Safety
and Safeguards

Enclosure: As stated

cc: B. Cornish, DOE Alb
F. Bosiljevac, DOE Alb
E. Artiglia, TAC Alb

ENCLOSURE

NATURITA DISPOSAL SITE
CRR NUMBERS 20, 22, 23, & 24

TECHNICAL EVALUATION
NATURITA CRR NO. 20

DATE: February 17, 1998

FACILITY: Naturita, Colorado Uranium Mill Tailings Remedial Action Project site

PROJECT MANAGER: Robert Carlson

TECHNICAL REVIEWER: Mohammad Haque

SUMMARY AND CONCLUSIONS

Based on its review of the U.S. Department of Energy's (DOE's) submittal by letter dated November 14, 1997, the staff concludes that use of some of the excess Type A rock as bedding in the interceptor channel, as proposed by DOE, is acceptable.

DESCRIPTION OF DOE'S REQUEST AND TECHNICAL EVALUATION

By letter dated November 14, 1997, the DOE submitted Construction Resolution Revision (CRR) 20, requesting to use some of excess Type A rock as bedding in the interceptor channel. DOE indicated that due to an increase in cell volume and a decrease in the top surface area, the amount of Type A rock that was produced was in excess of its required volume.

In support of its request, DOE provided an appropriate filter criteria compatibility check to show that there will be a prevention of migration of fines into the riprap and prevention of erosion of base material.

Based on its review, the staff concludes that because of the proposed revision, the bedding in the interceptor channel will actually be improved, while maintaining layer uniformity. Therefore, the staff finds the proposal acceptable.

TECHNICAL EVALUATION
NATURITA CRR NO. 22

DATE: February 17, 1998

FACILITY: Naturita, Colorado Uranium Mill Tailings Remedial Action Project site

PROJECT MANAGER: Robert Carlson

TECHNICAL REVIEWER: Mohammad Haque

SUMMARY AND CONCLUSIONS

By letter dated November 14, 1997, the U.S. Department of Energy (DOE) submitted Construction Resolution Revision (CRR) 22, requesting changes in Specification 02278, to eliminate testing for Schmidt Hammer and Splitting Tensile Strength tests after processing of riprap Type A material because its size is too small for these tests. Based on its review, the staff concludes that the proposed changes in the specification will have no significant impact on the construction, and therefore, are acceptable.

DESCRIPTION OF DOE'S REQUEST AND TECHNICAL EVALUATION

By letter dated November 14, 1997, DOE submitted CRR 22, requesting the following changes in Specification 02278, in order to eliminate testing for Schmidt Hammer and Splitting Tensile Strength tests after processing of riprap Type A material because its size is too small for these tests.

Amend the first sentence of Article 2.2.A.4, as follows:

> The Schmidt Hammer Test, Splitting Tensile Strength Test, and Petrographic Examination will not be required at the frequency specified in Paragraph 1.6.C on the bedding and Riprap Type A materials, and in lieu thereof for scoring, the initial test results obtained during investigating the source shall be used.

Amend the last sentence of Article 2.1.F as follows:

> For bedding and Riprap Type A materials, Schmidt Rebound and Splitting Tensile Strength tests shall be performed for source material before any processing.

Based on its review, the staff concludes that the proposed changes in the specification will have no significant impact on the construction. Therefore, the staff finds the proposal acceptable.

TECHNICAL EVALUATION
NATURITA CRR NO. 23

DATE: February 17, 1998

FACILITY: Naturita, Colorado Uranium Mill Tailings Remedial Action Project site

PROJECT MANAGER: Robert Carlson

TECHNICAL REVIEWER: Mohammad Haque

SUMMARY AND CONCLUSIONS

By letter dated November 14, 1997, the U.S. Department of Energy (DOE) submitted Construction Resolution Revision (CRR) 23, requesting to include a procedure for selection of oversize sandstones, in Specification 02278, as discussed below. DOE indicated that since oversize sandstones available at the site did not meet durability standards in all instances, there was a need for a method for selecting suitable sandstones. DOE's proposed procedure includes a rock monitoring plan, and a rock placement plan. DOE's proposal revises Specification 02278, and drawings numbers NAT-DS-10-1797 and 1789. Based on its review of the information provided by the DOE, the staff concludes that the changes proposed in DOE's request dated November 14, 1997, are acceptable.

DESCRIPTION OF DOE'S REQUEST AND TECHNICAL EVALUATION

In a submittal dated November 14, 1997, DOE requested a revision to Specification 02278, and drawings numbers NAT-DS-10-1789 and 1797, to be able to implement its proposed procedure for selection of on-site oversize sandstones for three supplemental erosion protection design features at the Upper Burbank disposal cell. The current design for the Upper Burbank disposal site calls for placing sandstone riprap to establish three erosion control features: 1) an apron trench to regulate off-site runoff and to serve as an energy dissipator; 2) an erosion blanket on the slope above the apron trench to protect the trench from potential gully flow; and 3) a sediment trap dam to control sediment originating from the upland areas.

The current specifications require that the riprap for these three features shall be a D_{50} size of approximately 36 inches, a minimum size of 24 inches, and a rockscore of about 50. A total of approximately 9400 cubic yards of sandstone will be required.

The total volume of DOE's current stockpiles of sandstone boulders ranging in size from one foot to a maximum of 12 feet is about 4,000 cubic yards. DOE expects that about 30,000 cubic yards of sandstone will be produced by the excavation of the extension to diversion Channel No. 2. Based on its field and laboratory tests and a geological assessment, DOE has categorized those sandstone as "satisfactory" and "unsatisfactory." The rockscores for the satisfactory rocks ranged from 41% to 51.1%. In order to minimize the impact on construction costs, health and safety, and schedule delay required to import higher scoring rocks from a greater distance, DOE proposes to utilize the on-site "satisfactory" sandstone for riprap for the apron trench, the erosion blanket, and the sediment trap dam.

The other general physical features considered by DOE for "satisfactory" rock included:

- The sandstone is fine grained, with calcite and quartz mineralization, and has a very low porosity. The rock is relatively hard; surface scratching (test for hardness) hardly penetrates the rock surface.
- The rock block size ranges from 18 inches to over 10 feet. Vertical and horizontal partings of the rock blocks are relatively insignificant. The rock blocks are generally angular and show little evidence of chemical or physical weathering processes that induce rounding of angular fragments.
- Rock weathering, as indicated by discoloration or staining, ranges from a few mm to five mm into the rock. A few individual rock fragments are more weathered, but during riprap production, these weathered rock pieces will be rejected.
- Rock exfoliation attributed to the removal of cementing material from the interstices is almost non-existent.
- Rocks lamellae due to interbedded weak or clay material is non-existent in "satisfactory" rocks. However, rock lamellae were noted along some block surfaces due to the presence of bedding contacts between durable, hard sandstone and interbedded, poorly cemented sandstone.

DOE further explains that both the apron trench and the erosion blanket features are not part of the disposal cell but will serve as a part of the off-site structures. Their design function is to regulate off-site runoff and provide energy dissipation. The sediment trap dam is intended to control sediment from the upland areas.

DOE provided proposed revisions to the specifications to demonstrate that the larger rock could be acceptably placed in the apron trench, the erosion blanket, and the sediment trap dam under the direction of a field engineer or a geologist. The riprap shall be placed so that the larger pieces are uniformly distributed and the smaller pieces serve to fill the spaces between them to provide well-keyed, densely placed layers of the approximately specified thicknesses.

Based on the considerations of health and safety, impact on construction costs, schedule delay in importing higher scoring rocks from a greater distance, and DOE's field procedures, the staff concludes that the proposed revisions are acceptable.

TECHNICAL EVALUATION
NATURITA CRR NO. 24

DATE: February 17, 1998

FACILITY: Naturita, Colorado Uranium Mill Tailings Remedial Action Project site

PROJECT MANAGER: Robert Carlson

TECHNICAL REVIEWER: Mohammad Haque

SUMMARY AND CONCLUSIONS

By letter dated November 14, 1997, the U.S. Department of Energy (DOE) submitted Construction Resolution Revision (CRR) 24, requesting a revision to the criteria for shape requirement in Specification Section 02278, Article 2.1.E. The proposal suggests that the shape of at least 50 percent of the material, by weight, shall be such that the minimum dimension is not less than one third of the maximum dimension. The current specification requires at least 75 percent of the material to have that shape (dimension ratio of 3 to 1). Based on review of the field assessment performed by DOE, including evaluation of the interlocking behavior of the riprap on a test ramp, the staff concludes that the proposed revision to the specification would not impact the stability and performance of the riprap. The staff, therefore finds the proposal acceptable.

BACKGROUND

The stone shape (dimension ratio) requirement implemented in the Erosion Protection Specification for the Naturita site was roughly based on the 1970 U.S. Army Corps of Engineers riprap protection guideline for riprap channel protection (EM 1110-2-1601, Engineering and Design, Hydraulic Design of Flood Control Channels, July 1970). In general, the shape requirement primarily provides a better interlocking of rock particles.

DESCRIPTION OF DOE'S REQUEST AND TECHNICAL EVALUATION

By letter dated November 14, 1997, DOE submitted CRR 24, requesting to revise the criteria for shape requirement in Specification Section 02278, Article 2.1.E. The proposal suggests that the shape of at least 50 percent of the material, by weight, shall be such that the minimum dimension is not less than one third of the maximum dimension. The current specification requires at least 75 percent of the material to have that shape (dimension ratio of 3 to 1). Based on review of the field assessment performed by DOE, including evaluation of the interlocking behavior of the riprap on a test ramp, the staff concludes that the proposed revision to the specification would not impact the stability and performance of the riprap. The staff, therefore finds the proposal acceptable.

UPPER BURBANK DISPOSAL SITE
CONSTRUCTION PHASE PROBLEM RESOLUTION FORM
RESOLUTION/REVISION No. 20
(Problem Continued)

APPROVED

Filter Criteria Compatibility Checks:

Filter Criteria (NUREG/CR-4620):

$\frac{D_{15}\text{ Filter}}{D_{85}\text{ Base}}$ < 5 to prevent migration of fines into Riprap.
<10 to prevent erosion of base material.

Type A/Type B1 Compatibility:

D_{15} max. Type B1 = 185 mm
D_{85} min. Type A = 42 mm

185/42 = 4.4 *Check*

Base Soil/Type A Compatibility:

D15 max. Type A = 38 mm
D85 avg. Base Soil = 31 mm (from Site material gradations for sediment transport analysis).

38/31 = 1.22 *Check*

UPPER BURBANK DISPOSAL SITE
CONSTRUCTION PHASE PROBLEM RESOLUTION FORM
RESOLUTION/ REVISION NO. 22

APPROVED

Date: June 19, 1997

Commentor: Wei Lin Organization: MKES

Drawing:

Specification: 02278 Section: 2.2.A.4

Respond by (Date):

Problem (Continue on next page if more space is needed):

The size of Riprap Type A material is too small to test for Schmidt Hammer and Splitting Tensile Strength.

Solution (Provide a brief discussion of rationale including references):

Amend the first sentence of Article 2.2.A.4 as follows:

"The Schmidt Hammer Test, Splitting Tensile Strength Test, and Petrographic Examination will not be required at the frequency specified in Paragraph 1.6.C on the bedding and Riprap Type A materials, and in lieu thereof for scoring, the initial test results obtained during investigating the source shall be used."

Umetco Project Manager [signature] Date: 10-10-97

Umetco Design Engineer [signature] Date: 10/10/97

Umetco QA Manager [signature] Date: 10.10.97

MK-F Site Manager [signature] for Date: 9/30/97

MK-F Construction Engineer [signature] Date: 9/30/97

MK-F QA Manager [signature] Class I Date: 9/30/97

X Approved ____ Disapproved ____ Approved as Noted

Criteria Change? ____ Yes X No (If yes, DOE approval needed)

DOE Site Manager Approval ________ Date: ______

UPPER BURBANK DISPOSAL SITE
CONSTRUCTION PHASE PROBLEM RESOLUTION FORM
RESOLUTION/REVISION NO. 22

APPROVED

Amend last sentence of Article 2.1.F as follows: For bedding and Riprap Type A materials, Schmidt Rebound and Splitting Tensile Strength tests shall be performed for the source material before any processing.

UPPER BURBANK DISPOSAL SITE
CONSTRUCTION PHASE PROBLEM RESOLUTION FORM
RESOLUTION/ REVISION NO. 23

Date: October 1, 1997

APPROVED

Commentor: P.K. Chen Organization: MKES

Drawing: NAT-DS-10-1789 & NAT-DS-10-1797

Specification: 02278 Article ~~Section~~: 2.4.A.2

Problem (Continue on next page if more space is needed):
Oversize sandstone available at the site does not meet durability standards in all instances. A method for selecting suitable sandstone is required.

Solution (Provide a brief discussion of rationale including references):
Procedure for selection of oversize sandstone was developed (attached) and revisions to specifications and two drawings were provided. Specifications and drawings will be revised accordingly.

Umetco Project Manager [signature] Date: 10/10/97

Umetco Design Engineer LE Grieb Date: 10/10/97

Umetco QA Manager [signature] Date: 10.10.97

MK-F Site Manager R.E. Waddington for Date: Oct. 1, 1997

MK-F Construction Engineer [signature] Date: 10/1/97

MK-F QA Manager [signature] Class 10/1/97 Date: 10/1/97

X Approved ____ Disapproved ____ Approved as Noted

Criteria Change? ____ Yes X No (If yes, DOE approval needed)

DOE Site Manager Approval ________________ Date: ______

UMTRA PROJECT - UPPER BURBANK DISPOSAL SITE
PROCEDURES
FOR SELECTION AND UTILIZATION OF SANDSTONE
FOR THE APRON TRENCH, EROSION BLANKET
AND SEDIMENT TRAP DAM

APPROVED

1.0 PURPOSE

On-site sandstone is proposed for the construction of three supplemental erosion protection design features at the Upper Burbank disposal cell. The purpose of this paper is to present the procedures for the selection and utilization of the on-site sandstone.

2.0 BACKGROUND

2.1 Design Requirement

The current design for the Upper Burbank disposal site calls for placing sandstone riprap to establish the following three erosion control features: 1) an apron trench to regulate offsite runoff and serve as an energy dissipator; 2) an erosion blanket on the slope above the apron trench to protect the trench from potential gully flow; and 3) a sediment trap dam to control sediment originating from the upland areas. The apron trench, which is part of the diversion channel, is located along the north perimeter of the disposal cell. The erosion blanket and the sediment trap dam are located at Station 5+50 to 7+75 and at Station 10+50 to 13+20, respectively, of the diversion channel No.2. Figure 1 (pg 20) shows the location of these features, while Figure 2 (pg 21) depicts the corresponding cross sections and details.

According to the current specifications, the riprap used to construct these three features shall be well graded with a D_{50} size of approximately 36 inches, a minimum size of 24 inches and a rock score of about 50. A total of approximately 9,400 cubic yards of sandstone will be required. The features and design requirements are illustrated in Table 1.

APPROVED

TABLE 1

Design Features and Riprap Requirements

Feature	Required Ranges of D_{50} (inches)		Estimated Volume (cubic yards)
Apron Trench	10 to 36		3,900
Erosion Blanket	23 to 31		2,800
Sediment Trap Dam	16 to 33		2,700
		Total	9,400

2.2 Available Sources

The riprap for these features will be obtained from sandstone of the Saltwash member of the Morrison Formation. Specific sources include:

- existing sandstone stockpiles at the borrow material stockpile area (primary) and on the disposal cell north floor (secondary),
- additional sandstone excavated from the Club Mesa Borrow Area during production of the radon and frost protection barrier materials.

If necessary, additional sandstone rocks produced by the excavation of the diversion Channel No. 2 extension may be used.

Current stockpiles of sandstone boulders ranging in size from about one foot in diameter to a maximum of 12 feet have been produced from the following activities; 1) excavation of the 1 : slope on the north end of the disposal cell; 2) the development of the Club Mesa Borrow Area, and 3) the excavation of the Interceptor Channel. These rocks are in two separate stockpiles. The total volume of these stockpiles is about 4,000 cubic yards.

APPROVED

According to Umetco personnel, approximately 30,000 cubic yards of sandstone will be produced by the excavation of the extension to diversion Channel No. 2. During this excavation, Umetco will maximize the production of rocks having a minimum size of 24 inches.

3.0 DURABILITY SAMPLING AND TESTING CHRONOLOGY

Rock durability of sandstone to be used for energy dissipation structures was investigated and evaluated on sandstone rocks from the Salt Wash Member of the Morrison Formation at the Club Mesa Area of Uravan in 1996 and 1997 by both MKES and TAC geologists. General descriptions of the sandstones are discussed in each trip report (see Attachment A). Geological assessments of the sandstones are in agreement among all the geologists, and as a result the sandstone can be categorized into two basic groups -- "satisfactory" and "unsatisfactory". Four types of sandstones were identified by Jose Cercone, Mr. geologist: Type S-2, S-3, S-4 and Others. Types S-2 and S-3 were categorized as "satisfactory"; while types S-4 and "others" were categorized as "unsatisfactory".

Specific geologic evaluations at the site are summarized below.

a. Trip Report: Oversize and Type C Erosion Protection Material Evaluation, 10 -13 June 1996, by Ralph Dow (MKES).

The stockpiled sandstone rocks from one foot in diameter and larger were from the excavation of the 1 : 1 slope on the north end of the cell. The sandstone is fine-grained and tan; some is tinged a light green color; few cracks are present in the large pieces; jointing is widely spaced and bedding planes in the more massive pieces are tight. Four samples of sandstone rocks were obtained for testing from the existing stockpile on the disposal cell floor, however, the samples were inadvertently combined into one very large sample and the rock tests were not performed. Thus, in July 1997, four additional samples of the oversized sandstone rock were obtained from the stockpiles at the borrow material stockpile area. They were designated as sample Nos. S-2, S-3 and S-4 for rock testing.

APPROVED

b. Trip Report: Inspect Oversize Erosion Protection Material, Inspect Erosion Protection Quarries, and Conduct Visit to Material Testing Laboratory, Sept. 10-Oct. 2, 1996, by Mike Godwin (MKES).

Oversized sandstone rocks in the stockpiles at the borrow material stockpile area north of the disposal site were inspected. The rocks were composed of red sandstone, pale green to white sandstone, green siltstone, conglomerate, and red sandstone with rip-up clast layers. The green siltstone and the red sandstone with rip-up clast layers are differentially soft and fractured easily parallel to bedding. The rest of the sandstone seems hard, dense and well indurated.

c. Correspondence, Discussion of Schmidt Hammer Testing Procedure and Results of Tests Conducted on Sandstone Boulders at Upper Burbank Disposal Site Near Uravan, CO, 4/22/97-Reference: Trip Summary Report, Naturita Site Visit, 4/22-24/97 (G. Lindsey, J. Lommler, A. E. Artiglia), 28 May 1997, by Gerry Lindsey (TAC).

Fourteen sandstone boulders were picked at random, 10 on the upper level and 4 on the lower level of the disposal site, and tested with an AGRA Hammer (Model CT-320A). This hammer is commonly used for concrete testing. Results including the hammer readings ("R" values) and the compressive strengths of the sandstone boulders are presented. A follow-up memo titled "Assessment of Rock Quality of Sandstone Boulders

Proposed for Use as An Energy Dissipation Field for the Upper Burbank Disposal Site of the Naturita Waste Cell" is enclosed from Gerry Lindsey to John Lommler on 27 June 1997.

APPROVED

d. Trip Report: Geological Assessment of Sandstones at The Club Mesa Borrow Area for Use as Large Riprap at The Upper Burbank Title I Disposal Site, 1-2 July 1997, by Jose Cercone (MKES)

Inspected and conducted petrographic examination and Schmidt hammer testing on representative sandstone samples to determine durability qualities at the existing stockpiles in Club Mesa borrow material stockpile area. Performed geological assessment and trained MKF-QC personnel to visually inspect and test the sandstone with Schmidt hammer and geological hammer. Developed procedures of field monitoring plan for selection of sandstone.

It is to be noted that efforts to locate suitable rocks with a minimum size of about 12 inches and meeting the UMTRA rock score of at least 65 were made during several of the above-mentioned geologic investigations. Similar efforts were made during the design phases of the Dry Flat disposal site and the Slick Rock disposal embankment.

4.0 SUMMARY OF TEST RESULTS

4.1 Field Tests

Rebound Hardness tests on sandstone boulders, Sample Nos. TAC-1 through TAC-14, with an AGRA Hammer were conducted by TAC on 22 April 1997. The same boulders were retested with a Type L Schmidt Hammer by MKES on 2 July 1997. The AGRA Hammer does not read "R" values directly, because it is not a "L-Type" Schmidt Hammer (used for rock), but rather the AGRA Hammer was designed for concrete testing. Using correlations to compressive strength, the AGRA hammer test results were converted to equivalent "R" values. MKES also performed Schmidt Hammer tests on rock boulders which were retrieved earlier and stored at the laboratory (refer to Sample Nos. MKES #2 -#X). The test results are tabulated as follows:

APPROVED

TABLE 2

Field Test Results

APPROVED

SAMPLE NO.	AGRA HAMMER "R" READING (AVE)	SCHMIDT HAMMER "R" VALUE	REMARKS
TAC-1	45	41	Top of rock
TAC-2	43	42	Massive bedded
TAC-3	40	43	Clay inclusions
TAC-4	44	40	Massive bedded
TAC-5	45	--	Med-fine bedded
TAC-6	47	41	Med-thin bedded
TAC-7	44	44	Fresh fracture
TAC-8	48	44	Next fresh fracture
TAC-9	44	--	Cross bedded
TAC-10	48	43	On fracture face
TAC-11	55	--	Conglomerate
TAC-12	55	--	Conglomerate
TAC-13	55	--	Fine-grained med bed
TAC-14	44	--	
MKES-#2		49	Type S-2
MKES #3		44	Type S-3
MKES #4		20-29	Type S-4
MKES #X		30-39	Others

4.2. Laboratory Tests

The rock scoring method adopted by the UMTRA project is based on the following test data: Specific Gravity, Absorption, Sodium Sulfate Soundness, Los Angeles Abrasion, Schmidt Hammer, and Tensile Strength. The rock test results of the sandstone from the existing stockpiles (refer to the trip report in June 1996) are shown in TABLE 3.

TABLE 3

Laboratory Rock Test Results

SAMPLE TYPE No.	SPECIFIC GRAVITY	ABSORPTION (%)	SODIUM SULFATE (%)	L.A. ABRASION (%for100rev.)	SCHMIDT HAMMER (reading)	TENSILE STRENGTH (psi)	ROCK SCORE (%)
S-2	2.46	2.7	11.6	18.2	53	1400	51.1
S-3	2.42	3.4	15.8	23.6	48	1498	41.0
S-4	2.34	5.2	78.1	56.9	33	915	24.0

5.0 GEOLOGICAL ASSESSMENT SUMMARY

The following geological assessment of the sandstone stockpiled at the Club Mesa borrow area is primarily based on surface geological examinations, magascopic examination with a 10X hand lens magnifier and the evaluation of all test results.

The predominant sandstone rocks at Club Mesa are classified as "satisfactory" (approximately 85%). These sandstones are relatively hard and durable. A ringing sound is produced when they are struck with a geologist hammer. Mohs' hardness is above six based on a scratching test with a hardened steel tip. The boulders are usually large, massive pieces with sizes ranging from about one foot to larger than 10 feet in diameter. Jointing is widely spaced, generally ranging from two to several feet apart . These observations are also evident for sandstones located at existing distinct near-vertical cliffs along the disposal cell, County Road EE-22 and adjacent Hieroglyphic

Canyon. The rock pieces are mostly blocky to elongated. The rock is generally angular and shows little evidence of undercut by chemical or physical weathering processes which induce rounding of angular fragments. Superficial weathering is slight, less then 3 mm. No weathering rinds were noted.

Based on the magascopic analysis with a 10X hand lens magnifier, the sandstone is mostly fine-grained, well-cemented with calcite and quartz mineralization. The predominant rock color is light gray to bluff; some is tinged a reddish brown due to hematite content. The reddish brown sandstone appears to be as indurated and resistant as the light gray one. The sandstone appears to be relatively impermeable, displaying no open pores as noted with the hand lens.

Other general physical features, for "satisfactory rock", based on visual examinations consist of:

- The sandstone is fine-grained with calcite and quartz mineralization, and has a very low porosity. The rock is relatively hard; surface scratching (test for hardness) hardly penetrated the rock surface.

- The rock block size ranges from 18-inches to over ten feet. Vertical and horizontal partings of the rock blocks are relatively insignificant. The rock blocks are generally angular and show little evidence of chemical or physical weathering processes that induce rounding of angular fragments.

- Rock weathering, as indicated by discoloration or staining, ranges from a few millimeters to 5 mm into the rock. A few individual rock fragments are more weathered, but during riprap production, these weathered rock pieces will be rejected.

- Rock exfoliation attributed to the removal of cementing material from the interstices is almost non-existent.

* Rock lamellae due to interbedded weak or clay material is non-existent in "satisfactory" rocks. However, rock lamellae were noted along some block surfaces due to the presence of bedding contacts between durable, hard sandstone and interbedded, poorly cemented sandstone.

Poor quality "unsatisfactory" rocks (approximately 15%) are either individual pieces or a portion of one of the good quality sandstones. "Unsatisfactory" sandstone is interbedded, coarse-grained and small pebble-size conglomerate and thin bedded, fine-grained sandstone, containing clay pockets, clay partings, and small cavities (vugs). These rocks types are considered unsuitable rock material and will be separated and rejected during field operations.

6.0 ENGINEERING DESIGN ASSESSMENT

Both the apron trench and erosion blanket features are not part of the disposal cell but will serve as a part of the offsite structures. Their design function is to regulate offsite runoff and provide energy dissipation. The sediment trap dam is intended to control sediment from the upland areas.

Firstly, design criteria for these features are conservatively based on the occurrence of a PMP / PMF event. For a rainfall event less than a PMP, the design, in terms of rock sizes, has more than ample factors of safety (See Table 5). Secondly, since these are offsite structures serving specific functions, any malfunctions would not immediately and directly impact the disposal cell embankment.

With respect to resisting long-term potential erosion and weathering of the sandstone, one of the primary contributing factors is to keep the bottom of the apron trench, erosion blanket, and sediment trap dam unsaturated. As shown in Figures 1 and 2, the erosion blanket is placed directly on the steep upslopes above the apron trench and the sediment trap dam directly connects to the diversion channel No. 2. To facilitate drainage of the apron trench, two design features are incorporated: reasonable longitudinal gradient for the apron trench itself and transverse french drains connecting from the bottom of the apron trench to the invert of the diversion channels.

With the aid of the permeable bedrock foundation of the site (as evidenced at the bottom of the disposal cell excavation), it is expected that at most only a few inches of the bottom of the sandstones will be inundated with water during a rainfall event less than a PMP. The remaining bulk of the sandstone will be exposed to ambient air conditions. Thus, the design criteria of an "occasionally saturated area" for the onsite sandstone is considered conservative.

TABLE 4

Rock Sizes vs. Rainfall Events of Design Features

Feature	Required Range of D_{50} (Inches)	Rainfall Event
Apron Trench	7 to 24	Half of a PMP
	6 to 19	One-Third of a PMP
	4 to 12	500 years
Erosion Blanket	16 to 28	As above
	12 to 24	
	7 to 15	
Sediment Trap Dam	11 to 28	As above
	8 to 23	
	5 to 17	

7.0 DISCUSSIONS

Discussions of rock quality of "satisfactory" sandstone boulders which will be selected for erosion protection material are presented below.

7.1 General

Compared to metamorphic and igneous rocks commonly used on the UMTRA Project for erosion protection, sandstone always has lower rock scores due to its relatively lower structural strength. Sandstone that scores greater than 50 is relatively rare, as can be seen from the limited test data available from the UMTRA Project shown on Figures 3 and 4. Reviewing data from the Club Mesa sandstones, a rock with a specific gravity of 2.54 would have to have an "R" value of about 57 to have a rock score of approximately 50. Field Schmidt Hammer "R" values for "satisfactory" rock were consistently between 40 and 45 with a few values up to 55 on highly "desert varnished" conglomerates. It is well documented in geologic literature that sandstone boulders with even minor development of desert varnish have existed in essentially their current configuration for many thousands of years.

In addition to the consistency of Schmidt Hammer "R" values and the consistency of the "satisfactory" rocks' grain size and porosity, other factors contributing to the conservatism of their utilization in energy dissipation features include:

- The required ranges of D_{50} rock sizes for these three features are about 10 inches to 36 inches. The available sandstone rock is greatly oversized for the intended purpose. The boulders have an estimated size range of 3x3x2 feet to 5x6x8 feet sizes with a corresponding weight range from 2,600 to 34,800 pounds
- The blocky shape of the boulders is resistant to movement from runoff.

7.2 Resistance to Water Exposure and Weathering

The general trend of the regional temperature and precipitation data indicates alternating (seasonal) cycles of cooling and warming periods that for the next hundred to a thousand years will probably continue (Baker, 1983). Trends in precipitation are roughly inverse to those for temperature but are less constant. Therefore, it is reasonable to assume that the sandstone will continue to be exposed to wetting and drying and freeze and thaw. Under these conditions, the rock is expected to be subjected to physical stresses from ice expansion, absorption, and to chemical alteration due to pH changes and salt crystallization in the ponding water.

Based on the macroscopic (hand lens) petrographic analysis, the sandstone has the following physical and chemical properties that will resist long-term physical and chemical weathering under both dry or saturated conditions:

- Many of the sandstones are fine-grained sand cemented with quartz. Quartz is an inert silica mineral highly resistant to weathering. Weathering or alteration of quartz mineralization is a very slow process.

- Carbonate mineralized sandstones are also present, but they should not present any problems due to the predominant dry weather and consequently high evaporation rates in the area. These climatic conditions result in high pH which should not affect the rock calcite mineralization.

- Close visual inspection indicates that the rock porosity is relatively low (fine grained, well-cemented with few fractures and no open pores or rusts), therefore, the effects of interstitial freeze-thaw are low or insignificant.

- Vertical or horizontal joints, fractures, seams or parting of the roçk blocks, which tend to induce ice wedging, are relatively insignificant.

- The boulders are self-sizing as a consequence of separation during excavation / handling along an existing widely spaced joint system and rarely along clayey laminae bedding planes. It is rare to observe a fresh mechanical fractured face that is not a joint face since the sandstone rock strength is adequate to form boulders to 8x8x8 feet. Close examination of the existing stockpiles shows a few larger boulders with calcite cemented joints, which have sizes averaging 5x5x5 feet. These could split in half from additional handling but would still have effective sizes of 2.5x5x5 feet.

- The sandstone rock has been derived from massive bedded formations where boulders with any significant type of bedding are in the minority within the stockpiles of boulders. Those bedding planes which do not have silt or clay lamination, (mostly observed as cross bedding with short lateral extent), are uniformly cemented and show minimal signs of deterioration on weathered or desert varnished surfaces. Schmidt hammer tests that were normal and parallel to the bedding planes show there is no decrease in strength associated with these features from the massive unbedded portions.

- It is expected that most weathering due to inundation and other factors would be surficial rather than split the blocks.

In summary, based on the assessment and evaluation of the field inspection, laboratory test data and professional geological judgement, sandstone classified as "satisfactory" at the Club Mesa borrow area are anticipated to have a service life expectancy of more than 200 years.

8.0 IMPLEMENTATION

8.1 Design Revision

Specification Section 2278 will be revised as shown in the attached specification section 2278, with the following specifics.

- The apron trench and the sediment trap dam shall be constructed with the sandstone riprap having a minimum D_{50} size of approximately 36 inches and a minimum size of 24 inches. Oversized rocks shall be placed as directed by the field engineer or geologist.

- The sediment trap dam shall be constructed with the sandstone riprap having a minimum D_{50} size of approximately 36 inches and a minimum size of 24 inches. Oversized rocks shall be placed at the exterior portion of the dam. Rocks smaller than 24 inches are allowed to be placed at the interior portion of the dam, if needed.

- The erosion blanket shall be constructed with the sandstone riprap having a minimum D_{50} size of approximately 36 inches and a minimum of 6 inches. Oversized rocks shall be used as directed by the field engineer or geologist.

Construction drawings will be revised as shown on DWG. Nos. NAT-DS-10-17~~8~~97 and 1789.

- Apron trench drains shall be constructed to connect the bottom of the apron trench to the inverts of the diversion channels on approximately 100 feet centers as shown on drawings. The drains consist of a 2-foot-thick Type A riprap layer underlain by 6 inches of bedding material. Adequate gradient should be made to promote drainage.

8.2 Field Procedures

8.2.1 Rock monitoring plan

- Assign a licensed professional geologist to select and label all "satisfactory" sandstones.

- The rocks selected for placement shall be visually inspected for consistency in grain size, porosity, cementing and durability. The rocks shall not contain joints or planes of weakness with a spacing of less than 24 inches and shall be predominantly angular and blocky in shape. As necessary, devices such as a Schmidt hammer, geologist hammer and magnifying lens will be utilized in the selection process. The general selection process will be documented with a video tape.

- All "unsatisfactory" rocks will be identified and separated from the "satisfactory" rocks. This operation is reasonably achievable due to the large sizes of these rock pieces. "Satisfactory" rock and "unsatisfactory" rock can be separated using equipment such as a clamp, grapple, or front-end loader.

- The geologist will train QC/QA personnel to assist in the sandstone boulders inspection / selection procedures. A training video will be produced on how to inspect and select suitable sandstone in the field to standardize QC/QA procedures, if necessary. The training of the QC/QA inspector will include selection of unfractured boulders, identifying uncracked seams and checking for particle shapes to assure they meet the maximum and minimum dimensions criteria.

- Videotape and photograph rock selection, testing (if required), hauling and placement to document for quality control and quality assurance.

8.2.2 Placement Plan

The selected oversized sandstone shall be reasonably well graded throughout the apron trench, the erosion blanket and sediment trap dam with a minimum D_{50} size of approximately 36 inches and a minimum size of 24 inches to 6 inches respectively. Large oversized rocks shall be placed as directed by the field engineer or geologist. The riprap shall be placed so that the larger pieces are uniformly distributed and the smaller pieces serve to fill the spaces between them to provide well-keyed, densely placed layers of the approximately specified thicknesses.

8.2.3 Equipment Requirement

Equipment and facilities needed to implement the above plan are as follows.

- An excavator with a clamp or grapple, and front-end loaders to manipulate the large boulders for inspection, stockpiling and hauling.
- A working area for inspecting, selecting and stockpiling both suitable and unsuitable rocks.
- A geologist hammer or a lightweight sledge hammer, HCL acid (10% concentration), and spray paint.
- A video camcorder and a camera.

8.2.4 Rock Monitoring Enhancement Plan

Other alternative options which are relatively simple, efficient and economical that may be implemented to enhance the rock monitoring plan:

- Schmidt Hammer Test. The test consists of striking the rock surface with the Schmidt Hammer to determine the rebound hardness ("R" value).
- Schmidt Hammer data of "satisfactory" Sandstone rocks indicate that the "R" value of these rocks ranges from 40 to 48. Sandstone rocks passing field visual inspection and having "R" values higher than 40 will be considered as suitable riprap.

9.0 CONCLUSIONS

In addition to the above-mentioned discussions on the use and selection of on-site sandstone for the oversized energy dissipation rock, the impact on construction costs, health and safety, and schedule delay required to import higher scoring rocks from a great distance should be evaluated and considered.

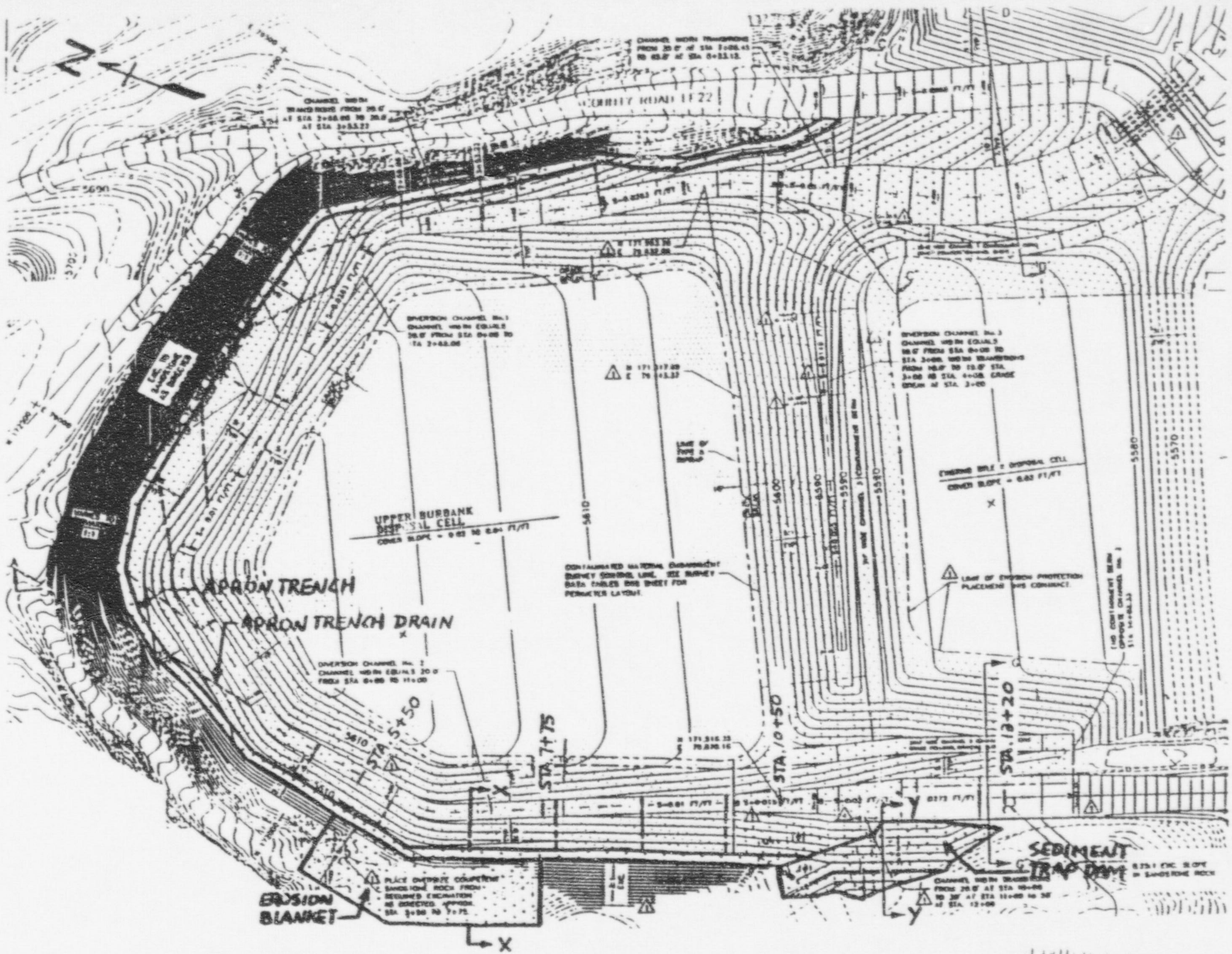


FIGURE 1 LOCATIONS OF DESIGN FEATURES

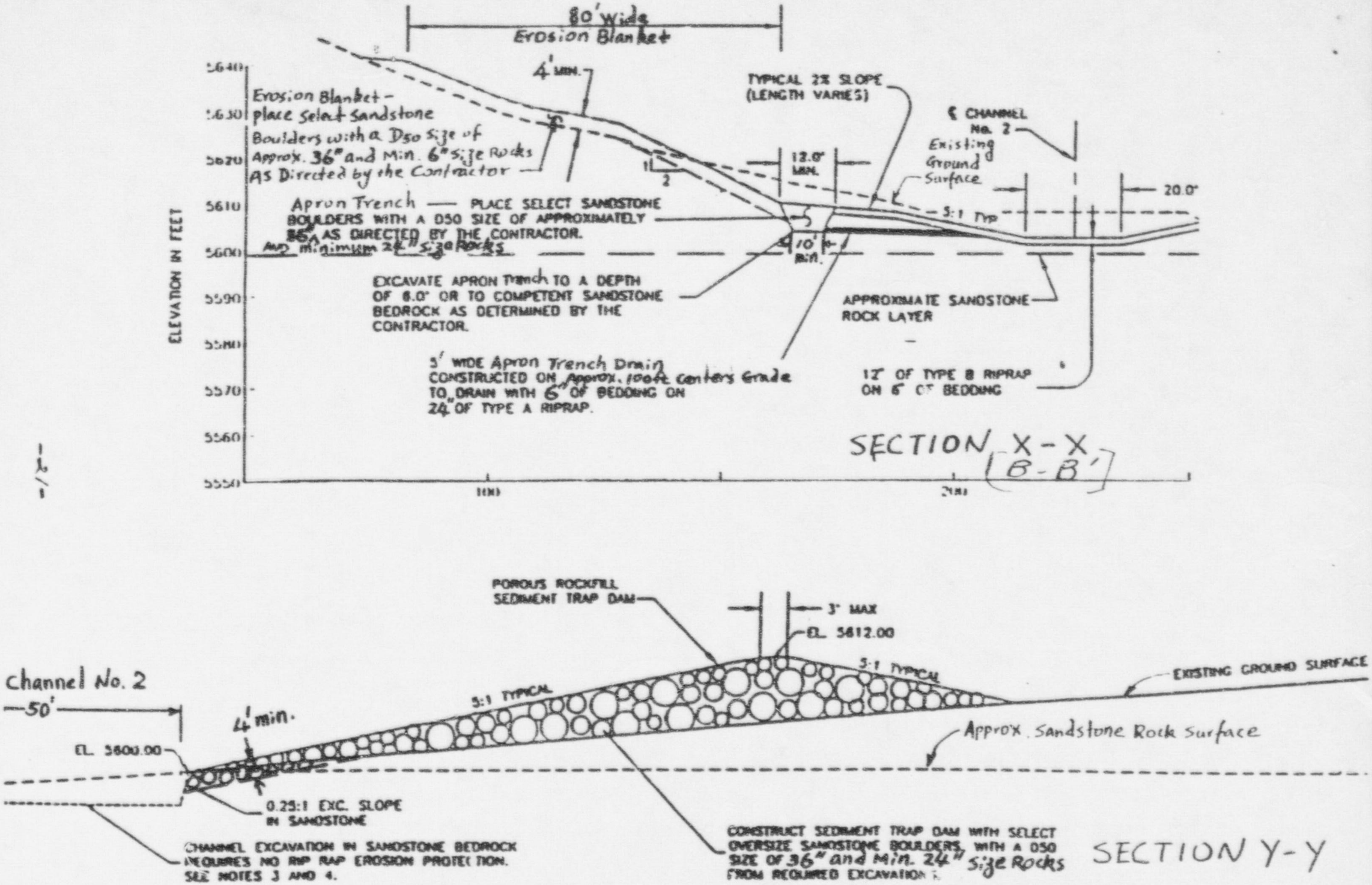


FIGURE 2 CROSS SECTIONS
(NOT TO SCALE)

APPROVED

FIGURE 3 - ROCK SCORE VS. SPECIFIC GRAVITY OF SANDSTONE

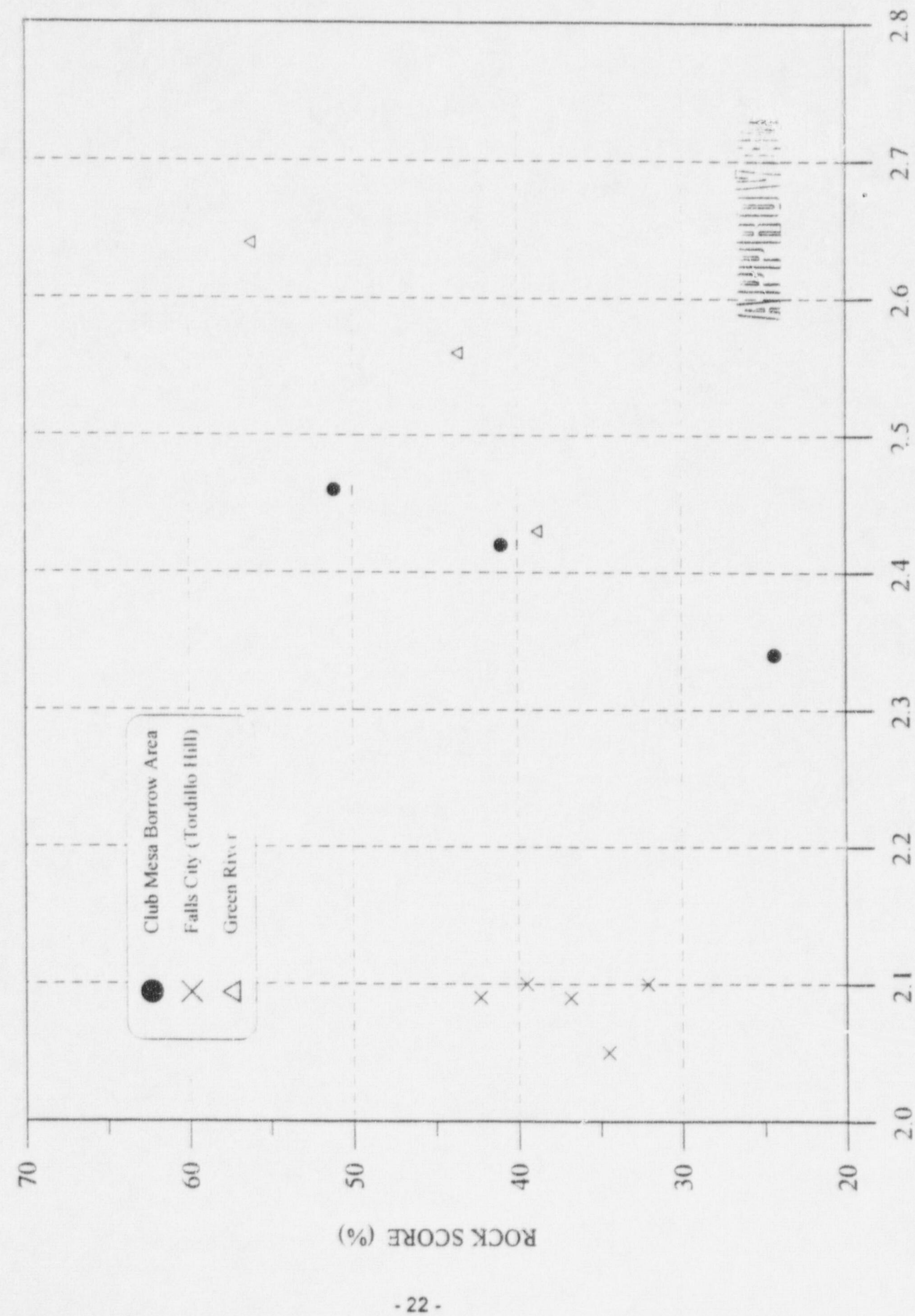
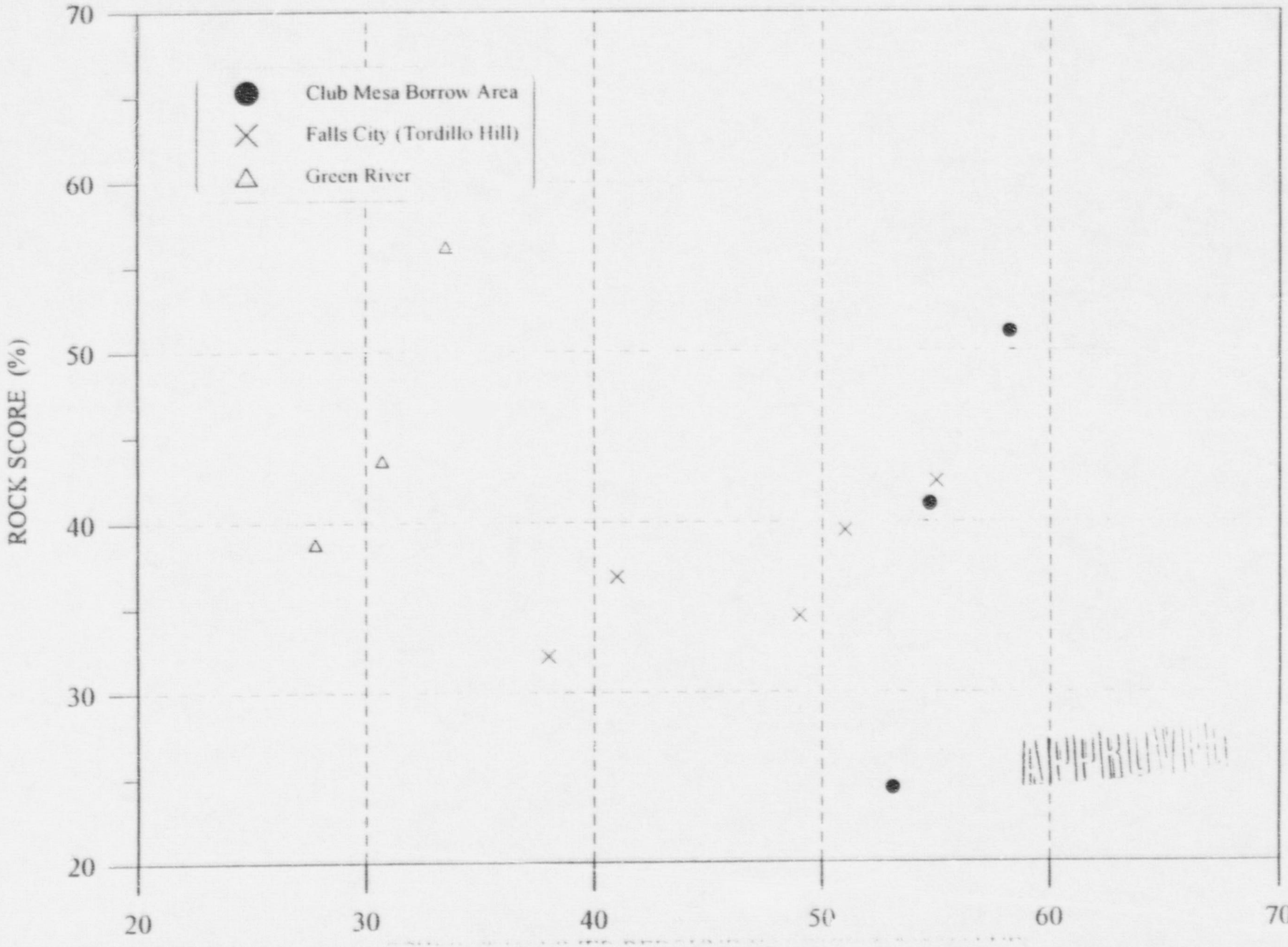


FIGURE 4 - ROCK SCORE VS. SCHMIDT HAMMER REBOUND HARDNESS OF SANDSTONE



Revise Specification Section 02278, Erosion Protection, as follows:

Article 2.4.A.2, Revise the paragraphs to read as follows:

2. Sandstone Rock for the Apron Trench, Erosion Blanket and Sediment Trap Dam:

   a. Sandstone rocks shall consist of various sizes of hard, durable and sound sandstone rock selectively obtained from the existing stockpiles at the Borrow Material Stockpile Area and the Club Mesa Borrow Area. Additional sandstone rocks shall be selectively obtained from the proposed diversion Channel No. 2 extension work.

   b. Sandstone rocks selected for use in this application shall be selected by the Contractor's qualified geologists familiar with the specific characteristics of this rock, i.e., mineral compositions, jointing, etc.

   c. The rock shall be prequalified or selected from the above designated borrow areas. Satisfactory sandstone shall be separated and labelled from the unsatisfactory rock using equipment such as a clamp, grapple or front end loader prior to placement.

   d. Sandstone selected for placement shall be visually inspected for consistency in cementing and durability. If necessary, devices such as a Schmidt hammer, geologist hammer and magnifying lens will be utilized in the selection process.

   e. The sandstone rock shall be angular and blocky in shape. The shape of at least 50 percent of the material, by weight, shall be such that the minimum dimension is not less than one third of the maximum dimension or as directed by the Contractor.

   f. The selected sandstone riprap layer shall be placed to the lines and grades established on the drawings in accordance with Article 3.1 of this Section. The riprap layer shall be reasonably well graded throughout the layer thickness with a minimum D_{50} size of approximately 36 inches and a minimum size of 24 inches and 6 inches for 1) the apron trench and sediment trap dam and 2) the erosion blanket, respectively. Large oversized rocks shall be placed as directed by the Contractor. The riprap material shall be placed so that the larger pieces are uniformly distributed and the smaller pieces serve to fill the spaces between them to provide well-keyed, densely placed layers of the specified thickness.

   g. Activities of selecting and testing sandstone shall be documented by videotape and photograph.

UPPER BURBANK DISPOSAL SITE
CONSTRUCTION PHASE PROBLEM RESOLUTION FORM
RESOLUTION/ REVISION NO. 24

APPROVED

Date: September 26, 1997

Commentor: Pam Li / Wei Lin Organization: MKES

Drawing:

Specification: 02278 Section: 2.1.E

Respond by (Date):

Problem (Continue on next page if more space is needed):

The current specification requires that "the shape of at least 75 percent of the (rock) material, by weight, shall be such that the minimum dimension is not less than one third of the maximum dimension." However, the dimension analysis of the Type B rock samples from the West End Pit indicated that 58.9 to 76 percent by weight of the material met the maximum/minimum dimension ratio requirement.

Solution (Provide a brief discussion of rationale including references):

Revise Specification Section 02278, Article 2.1.E to read as follows:

"E. The shape of at least 50 percent of the material, by weight, shall be such that the minimum dimension is not less than one third of the maximum dimension."

See brief discussion of rationale on the following pages.

Umetco Project Manager [signature] Date: 10-10-97

Umetco Design Engineer LE Gusich Date: 10/10/97

Umetco QA Manager [signature] Date: 10.10.97

MK-F Site Manager R.E. Waddington for Date: 10/6/97

MK-F Construction Engineer Robert D'Arezzo Date: 10/6/97

MK-F QA Manager [signature] Class I Date: 10/6/97

X Approved ______ Disapproved ______ Approved as Noted

Criteria Change? X Yes ______ No (If yes, DOE approval needed)

DOE Site Manager Approval Robert E. Cornish Date: 10-27-97

Solution (Cont'd)

Discus ion of Rationale:

APPROVED

Design Criteria

The stone shape (dimension ratio) requirement implemented in the Erosion Protection Specification for the Naturita site, as for many other UMTRA Project sites, was roughly based on the 1970 Army Corps of Engineers riprap protection guideline for riprap channel protection (EM 1110-2-1601, Engineering and Design, Hydraulic Design of Flood Control Channels, 1 July 1970). According to our engineering judgement and experience, the stone shape requirement was primarily to provide better interlocking of rock particles. A similar stone shape requirement is documented in a Caltrans final report titled "California Bank and Shore Rock Slope Protection Design" (No. FHWA-CA-TC-95-10). Based on our discussion with the author, this dimension requirement of 3(maximum dimension) : 1(minimum dimension) is intended to exclude placing large flat pieces of demolished concrete blocks/slabs which are commonly provided for river shore protection, and placing flat riprap material for protecting natural steep slopes [(up to 1(H) : 1(V)].

Field Assessment

A total of eight samples of Type B material from the West End Pit was tested for dimension ratio. The percentage by weight of the material meeting the maximum required dimension ratio (3 to 1) ranges from 58.9 to 76 percent, with one sample (Sample No. 2) exceeding the minimum required 75 percent.

Sample No. 6 of the Type B material was selected to be analyzed for particle dimensions in detail. The sample weighed 3556 pounds and consisted of 196 rock pieces; 59 of which were elongated particles. 31.4% by weight of the sample had a dimension ratio exceeding the maximum required ratio of 3:1. Figure 1 shows the percent by weight vs. dimension ratio for rock pieces having a dimension ratio greater than 3:1. As can be seen, although the dimension ratio ranges from 3.1 to 9.3:1, the majority falls in the range of only 3.1 to 4.1:1.

To evaluate the interlocking behavior of the riprap, a test ramp using Type B material was constructed during September 18-19, 1997 at the West End Pit borrow site. The test ramp was 20 ft. long by 10 ft wide and the thickness varied from 1ft at the bottom to 5 ft at the top to simulate the 5(H):1(V) embankment sideslope. The test ramp was built of Type B material obtained randomly from the on-site stockpile by use of a front-end loader. The test ramp material consisted of both rounded and elongated (i.e. with dimension ratio > 3) rock particles. There were approximately 23% (by piece count) of elongated pieces by observation from the surface. The ramp was then inspected by an MKES geologist to evaluate the interlocking behavior of the rock particles during and after construction. The rounded and elongated particles were observed to be interlocking well. Also, no segregation of particles was noted.

Engineering Assessment

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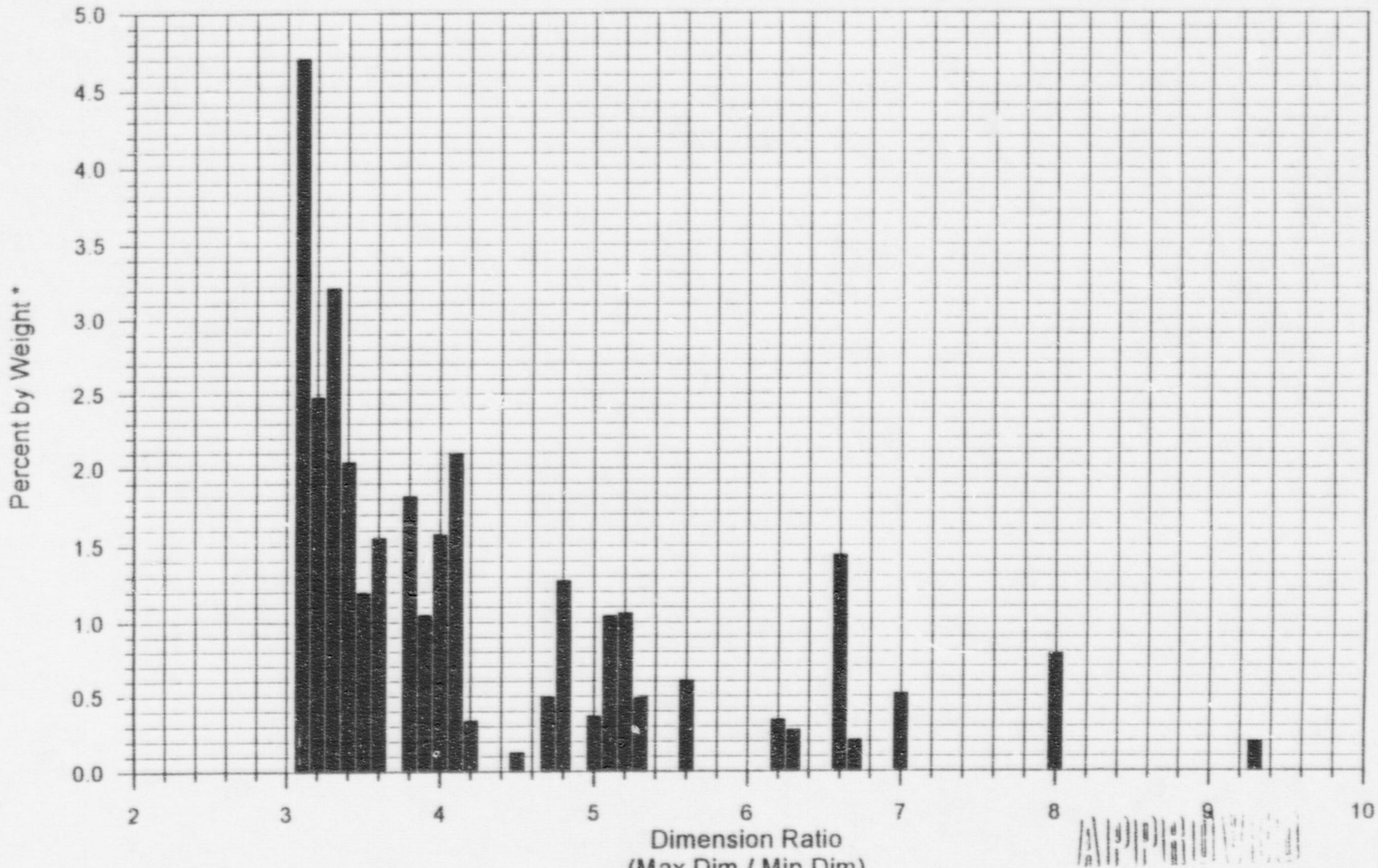
The correlation of elongated rock particles with the angle of repose is not exactly known. However, it is judged that the effects of the presence of the percentage (24% to 41%) of elongated particles in our Type B material would be insignificant. An angle of repose of 38° is conservatively assumed for rounded Type B rock particles with a minimum D_{50} of 5.6 inches in the design. The design slope of the embankment sideslope is relatively flat [5(H):1(V), i.e. 11°]. The rock only requires an angle of repose of 16.7° and 22.6° to be stable for the static and seismic cases respectively.

Based on the results of field gradation tests on ten Type B samples, the actual D_{50} of the material ranges from 6.5 to 7 inches, exceeding the required minimum D_{50} of 5.6 inches as determined by the Stephenson's method for the embankment sideslope and the Safety Factor method for the diversion channels. Moreover, on the channel reaches where Type B rock is provided for erosion protection, the computed factor of safety for the required minimum D_{50} is in the range of 1.2 to 2.0, which exceeds the required factor of safety of 1.0. The factor of safety would be even higher for the actual D_{50} of 6.5 to 7.0 inches. Thus, even if the presence of elongated particles might in some ways affect the hydraulic parameters used in the design, the margin of safety would be adequate to prevent impact on the minimum D_{50} design rock size.

Conclusion

Based on the above assessment, it can be concluded that the presence of flat rock particles would not impact the stability and performance of the riprap. The original purpose of the dimension ratio requirement was for better interlocking of the rock particles. The test ramp described above provides supporting evidence that the slightly out-of-specification Type B riprap material satisfies the purpose. Since Article 3.1 in the current specification has already included placement control requirements to provide a well-interlocked riprap, the dimension ratio requirement in Article 2.1.E can be revised as indicated on page 1, Solution.

UMTRA - NATURITA
RIPRAP TYPE B SAMPLE # 6 FROM WEST END PIT
DIMENSION ANALYSIS
(for Rock Particles w/ Dimension Ratio >3 1)



* Based on total weight of sample

FIGURE 1

GRAPHER: F:/BYW/NAT/EROSPROT.GRF
DATA: F:/BYW/NAT/DIM CHAR.WK1