INTERNATIONAL URANIUM (USA) CORPORATION

Independence Plaza, Suite 950 • 1050 Seventeenth Street • Denver, CO 80265 • 303 628 7798 (main) • 303 389 4125 (fax)

December 16, 1997

Via Overnight Mail
Mr. Joseph J. Holonich, Branch Chief
High Level Waste and Uranium Recovery Projects Branch
Division of Waste Management
Office of Nuclear Regulatory Commission
2 White Flint North, Mail Stop T-7J9
11545 Rockville Pike
Rockville, MD 20852

Re: NRC Letter dated August 19, 1997, and December 5, 1997, regarding NRC Acceptance Review of the Reclamation Plan for the White Mesa Uranium Mill
Source Material License SUA-1358
Docket No. 40-8681

Dear Mr. Holonich:

Enclosed please find our responses to the August 19, 1997 and December 5, 1997 NRC comments to the White Mesa Reclamation Plan. This plan was submitted to the NRC by International Uranium (USA) Corporation on February 28, 1997.

These responses were developed following telephone conference with NRC staff and contractors and will hopefully address all of NRC's questions.

If you have any questions on the enclosed responses, or require additional clarification, please feel free to contact Michelle Rehmann or me at the letterhead phone or address.

Very truly yours,

Harold R. Roberts

Harold R. Roberts
Executive Vice President

NL05

HRR/pl
Enclosures

cc: Earl E. Hoellen
David C. Frydenlund
William N. Deal
Michelle R. Rehmann

IUC

INTERNATIONAL URANIUM (USA) CORPORATION

Responses to NRC Letter Dated August 19, 1997 and December 5, 1997, Regarding NRC Acceptance Review of the Reclamation Plan for the White Mesa Uranium Mill

Source Material License SUA-1358
Docket No. 40-8681

December 16, 1997

INTERNATIONAL
URANIUM (USA)
CORPORATION

Independence Plaza, Suite 950 • 1050 Seventeenth Street • Denver, CO 80265 • 303 628 7798 (main) • 303 389 4125 (fax)

December 16, 1997

Via Overnight Mail
Mr. Joseph J. Holonich, Branch Chief
High Level Waste and Uranium Recovery Projects Branch
Division of Waste Management
Office of Nuclear Regulatory Commission
2 White Flint North, Mail Stop T-7J9
11545 Rockville Pike
Rockville, MD 20852

Re: NRC Letter dated August 19, 1997, and December 5, 1997, regarding NRC Acceptance Review of the Reclamation Plan for the White Mesa Uranium Mill
Source Material License SUA-1358
Docket No. 40-8681

Dear Mr. Holonich:

Enclosed please find our responses to the August 19, 1997 and December 5, 1997 NRC comments to the White Mesa Reclamation Plan. This plan was submitted to the NRC by International Uranium (USA) Corporation on February 28, 1997.

These responses were developed following telephone conference with NRC staff and contractors and will hopefully address all of NRC's questions.

If you have any questions on the enclosed responses, or require additional clarification, please feel free to contact Michelle Rehmann or me at the letterhead phone or address.

Very truly yours,

Harold R. Roberts
Executive Vice President

HRR/pl
Enclosures

cc: Earl E. Hoellen
David C. Frydenlund
William N. Deal
Michelle R. Rehmann

H:\USERS\PLL\WP\HRR\LETTERS 97\HOLO1215.LTR

Response to Nuclear Regulatory Commission / White Mesa Mill Reclamation Plan
Comments Dated August 19, 1997
Source Material License SUA-1358

Comment:

(1) Information to support a review of the acceptability of the radon barrier design. Specifically:

(i) A description of the materials to be used for the radon barrier and as random fill

Response:

The materials to be used for the radon barrier and as random fill are the clay and soil and rock derived from sandstone (random fill), respectively, that are available within the site boundaries. These materials were tested as part of the original tailings reclamation plan design. Based on empirical data collected to date on the cover material placed over portions of Cells 2 and 3, the random fill material alone provides an effective barrier to radon flux. Following are brief descriptions of the clay and random fill materials.

Clay Material

Laboratory testing of the clay material was performed following a field investigation of the Section 16 clay source. The laboratory results are presented in a letter report to Energy Fuels Nuclear, Inc., from D'Appolonia Consulting Engineers, Inc. entitled "Section 16 Clay Material Test Data, White Mesa Uranium Project, Blanding, Utah" dated March 8, 1982. This letter report is presented in Attachment 1 of this response.

Based on the above-mentioned report, the Section 16 clay source contains soils classified according to the Unified Soils Classification System (USCS) as CL, CH, SC, SM, and ML. The material is a fine grained soil with varying amounts of silt and clay particles. The plasticity of the soil samples ranged from non-plastic to highly plastic.

Random Fill

Random fill material consists of soil and rock derived from sandstone and obtained from excavations within the site boundaries. The soil and rock have been stockpiled on the site for future reclamation use. Soils in these stockpiles can be described generally as a granular soil with relatively low plasticity (Tailings Cover Design, Appendix A, Table 3.4-1, indicates Plasticity Index of 7, and 48 percent passing the No. 200 sieve). However, they cannot be representatively classified according to the USCS as the piles contain highly variable amounts of clay, silt, sand and gravel. Additionally, the piles contain varying amounts of sandstone cobbles and boulders which may be screened during reclamation and utilized as riprap.

Random fill material, obtained from the on-site stockpiles, currently covers portions of the tailings piles in Cells 2 and 3. The portions of these cells are covered with three to four feet of random fill. Radon flux measurements, presented in Section 1.1.2 of the Tailings Cover Design, indicate radon flux through the random fill material of less than 20 pCi/m^2/second. These empirical data indicate that the random fill material alone is currently providing an effective barrier to radon flux.

(ii) An analysis to show that each type of material is available in sufficient quantity

Response:

Analysis of the quantity of the clay and random fill material demonstrates that sufficient material is available for constructing the cover.

Clay Layer

The reclamation construction estimate requires 259,100 cubic yards of clay material for construction of the clay layer. Based on analysis of the field investigation data, quantities in excess of 1.8 million cubic yards of clay are available. This quantity is more than six times the quantity of clay needed for the cover.

The field investigation data are presented in a letter report to Energy Fuels Nuclear, Inc., from D'Appolonia Consulting Engineers, Inc. entitled "Section 16 Clay Material Test Data, White Mesa Uranium Project, Blanding, Utah" dated March 8, 1982. This letter report is presented in Attachment 1 of this response.

The clay materials were identified in the Section 16 area encompassed by borings B-100, B-103, B-104 and B-106 as shown on Figure 1 contained within Attachment 1 of this response. The surface area between these borings is approximately 1,160,000 square feet. The average depth of CL and CH materials encountered in the seven borings is approximately 44 feet as indicated on Figure 2 contained within Attachment 1 of this response. Based on the surface area and average depth estimated from Figures 1 and 2, the quantity of clay material available is approximately 1.8 million cubic yards.

Random Fill

The reclamation construction estimate requires 1,547,500 cubic yards of random fill material to complete the cover. The material will be supplied from the random fill stockpiles generated from excavation of the cells for the tailings facility. The location of these stockpiles is shown on Figure 3.2.1 of the Reclamation Plan. According to planimetric measurements, these stockpiles contain in excess of 9 million cubic yards of random fill material, which is more than five times the quantity required for the cover.

(iii) An estimate of the potential for cover cracking due to shrinkage

Response:

The potential for cover cracking due to shrinkage is considered to be negligible for two reasons: First, the random fill material is a granular soil with low plasticity, which will inhibit cracking. Second, the clay layer will be overlain by a minimum of two feet of compacted random fill which will prevent moisture loss from the clay.

Random Fill

Cover cracking due to shrinkage of the random fill material will not be a concern, as the random fill consists of soil and rock derived from sandstone and is generally a granular soil with very low plasticity (Tailings Cover Design, Appendix A, Table 3.4-1, indicates Plasticity Index of 7, and 48 percent passing the No. 200 sieve). These material properties will inhibit cracking.

During final reclamation, the stockpiles of random fill may contain isolated pockets of material classified as CL according to the Unified Soils Classification System. Clayey materials encountered will be mixed with the granular soils to minimize the risk of surface cracking.

Clay Layer

The clay layer will be overlain by a minimum of two feet of compacted random fill which will protect the clay layer from cracking.

In order to determine the potential of clay layer cracking, the performance of the soils cover was evaluated using the Hydrologic Evaluation of Landfill Performance (HELP) Model. Weather data were input using the default parameters from Grand Junction, Colorado. Grand Junction is located northeast of Blanding, Utah in a similar climate and elevation.

Based on these values the HELP model estimates an evaporative zone depth of 18-inches on barren soil. The surface of the soil cover will be considered barren as the riprap cover layer will inhibit vegetative growth. Therefore, the moisture content of the clay layer, and six inches of random fill overlying the clay layer, will be protected from moisture changes which may induce shrinkage.

This is a conservative estimate as the depth of the riprap layer, which will provide additional protection from evaporation of the underlying soils, was not considered in the HELP model evaluation.

(iv) A delineation of measures that will be taken to prevent burrowing animals from penetrating the radon barrier

Response:

No measures short of continual annihilation of target animals can prevent burrowing. However, reasonable measures will discourage burrowing including:

- Total cover thickness of at least six-feet;
- Compaction of the upper three feet of soil cover materials to a minimum of 95-percent, and the lower three feet to 80-90 percent, based on a standard Proctor (ASTM D-698); and
- Riprap placed over the compacted random fill material.

Comment:

(2) An analysis of the total and differential settlements of the tailings surface and the effects of such settlements on soil cover integrity.

Response:

Analysis of the total and differential settlement of the tailings surface was performed using the survey data compiled for the five settlement monuments installed within Cell 2. These monuments were installed on the surface of the tailings, between August 1989 and November 1992, prior to the placement of approximately three to four feet of random fill material. Survey results of each monument were plotted as time vs. settlement graphs and are presented in Attachment 2 of this response.

Review of the survey data and graphs shows that primary consolidation of the tailings has occurred, and the settlement rate has been very slow with minor total values. The maximum total settlement recorded is 0.97 feet, and the differential settlement is on the order of 0.50 feet. Approximately 81 percent of the total measured settlement occurred within the initial three years. Additionally, recent survey data indicates that the settlement has virtually stopped. From September 1995 to September 1997 the settlement averaged less than 0.03 feet per year, which is within the expectable survey error of 0.05 feet. This indicates that the settlement since 1995 is negligible.

Placement of the final reclamation cover will induce additional settlement. However, since primary consolidation of the tailings has occurred, under current loading conditions, additional settlement is expected to be less than the total settlement values to date. This minor amount of additional settlement, due to the added surcharge of the cap, will not effect the integrity of the six foot thick final reclamation cover.

Comment:

(3) An analysis of the liquefaction potential of subsurface materials and uranium mill tailings.

Response:

Analysis of the liquifaction potential of the subsurface materials and mill tailings was performed utilizing the data from the Tailings Cover Design and the Reclamation Plan. The results of the analysis indicate that the subsurface materials have no liquifaction potential because they consist of unsaturated bedrock.

Liquifaction of the tailings would be a concern only if the cover material cracked to allow a path for additional moisture to enter the tailings and/or provide a potential escape path for liquefied tailings. However, the tailings placement methods have consolidated the sands to the maximum extent possible which will inhibit the potential for cover cracking.

Subsurface Materials

Information about the subsurface materials was obtained from boring logs compiled in Appendix G of the Tailings Cover Design, which contains Section 2 of the subsurface investigation report prepared by Chen and Associates, Inc., entitled "Soil Property Study, Earth Lined Tailings Retention Cells, White Mesa Uranium Project, Blanding, Utah", dated July 18, 1978. The bore logs indicate that the bottom of the cells are within the unsaturated Dakota Sandstone bedrock. Therefore, liquefaction of the subsurface materials is not possible.

Mill Tailings

The liquifaction potential of the mill tailings was analyzed using the data on the tailings properties and operational data concerning placement of the tailings. Information about the properties of the mill tailings was obtained from Page 2-4, Section 2.2.3 of the Reclamation Plan. Operational procedures were obtained from Page 2-5, Section 2.2.3.1 of the Reclamation Plan.

As discussed in the Reclamation Plan, the tailings produced by the mill typically contain 30 percent moisture by weight, have an in-place density of 74.2 pounds per cubic foot and have a size distribution with a predominant -325 mesh size fraction. These tailings properties indicate that the material is potentially liquefiable.

Although the tailings properties indicate that the material is potentially liquefiable the method of tailings placement substantially reduces the potential for liquifaction.

Slurry disposal has taken place in both Cells 2 and 3. Tails placement in Cell 2 was accomplished by a perimeter discharge method with discharge points around the east, north, and west boundaries of the cell. The advantage of this method is that maximum beach stability is achieved by allowing tailings sands to interfinger with slimes during placement.

During slurry disposal, solutions from Cell 2 were decanted and pumped back to Cell 1 for evaporation, to minimize net water gains. Additionally, spray systems were utilized to enhance evaporation rates. These processes allowed maximum drainage from the sands.

Tailings placement in Cell 3 is accomplished with a final grade method. The discharge points are set up in the east end of the cell and the final grade surface is advanced to the slimes pool area. When the slimes pool is reached, the discharge points are moved to the west end of the cell and worked back to the middle of the cell. The advantage of this method is that maximum beach stability is achieved by allowing water to drain from the sands to the maximum extent, and by allowing coarse sand deposition to help provide stable beaches. Additionally, solution is recycled from the active cells to the maximum extent possible.

The tailings placement methods have consolidated the sands to the maximum extent possible during active operation. This consolidation will minimize the risk of liquifaction as well as minimize the effect of cover settlement which will in turn inhibit cover cracking. Cover cracking would be the only viable pathway for the release of liquefied tailings as the tailing cells are fully contained with non-liquefiable embankments.

Comment:

(4) The locations and depths of the samples used for estimating the properties of the tailings and cover materials in the laboratory, along with details of the laboratory results. Moreover, the standards and/or procedures used to collect the samples and to measure the specific properties should be identified.

Response:

The soil cover design consists of two material types readily available within the site boundaries. The cover consists of a clay layer and a random fill layer.

Clay Layer

Locations, depths, and sampling methods of the samples used for estimating the properties of the clay layer are presented in a letter report to Energy Fuels Nuclear, Inc., from D'Appolonia Consulting Engineers, Inc. entitled "Section 16 Clay Material Test Data, White Mesa Uranium Project, Blanding, Utah" dated March 8, 1982. This letter report is presented in Attachment 1 of this response.

Random Fill

Random fill and tailings testing was performed by Chen and Associates (1987) and the results of the laboratory testing program are presented in Appendix A of the Tailings Cover Design.

Comment:

(5) A description of the soil sampling methodology and instrumentation, including the method for determining background radium concentration and a description of any other radionuclides (e.g. Th-230) for which samples will be tested.

Response:

For details refer to the Reclamation Plan, Attachment A, Sections 3.3 through 3.5 which discusses the methodology for the determination of windblown contaminants. All methods utilized will be consistent with the guidance contained in NUREG-5849: "Manual for Conducting Radiological Surveys in Support of License Termination".

Soil sampling methodology and instrumentation is further discussed below in response to Comment 6 and Comment 7.

Comment:

(6) Rationale by which guideline values were selected in the scoping survey to determine whether an area requires remediation. The method used to determine the actual Ra-226 concentration in the soil should be described as well as the confidence levels used to establish the guideline values.

Response:

Guideline Values

Reclamation Plan, Attachment A, Section 3.3.2, indicates that guideline values will be determined and will form the basis for the cleanup of the site. Specific guideline values have not been determined at this time.

Methods

The method used to determine the actual Ra-226 concentration in the soil will consist of collecting a series of soil samples and correlating the gamma reading of a Mount Sopris Model SC-132 scintillometer (or equivalent device) with the Ra-226 concentration determined by a multi-channel analyzer (or equivalent device) on each soil sample.

The actual number of samples used for correlation will depend on the correlation of the results between the gamma readings and the Ra-226 concentration. However, it is proposed that a minimum of 50 sample locations be tested in order to determine a statistically based correlation coefficient of not less than 0.7.

Comment:

*(7) **A description and rational for the criteria used to define the extent of windblown tailings contamination beyond which further sampling is not necessary.***

Response:

The description and rationale for the criteria used to define the extent of windblown contamination is presented in the Reclamation Plan. The sections of the plan containing this information for the scoping survey and the final survey are discussed below.

Scoping Survey

Reclamation Plan, Attachment A, Sections 3.3.2 and 3.3.3, indicates that the scoping survey for windblown contamination will be initially conducted using a calibrated Mount Sopris Model SC-132 scintillometer (or equivalent device) on a 50 x 50 meter grid. Furthermore, Reclamation Plan, Attachment A, Section 3.3.3 states: "Grids where no readings exceed 75 percent of the guideline value will be classified as unaffected, and therefore will not require remediation."

Final Survey

Reclamation Plan, Attachment A, Section 3.3.5 states: "After remediation, the affected areas deemed to be in compliance with standards will then undergo a final survey, utilizing a 10 x 10 meter grid system with sample point locations as shown in Figure A-3.3.2." (Standard Sampling Pattern for Systematic Survey of Soil).

The final survey will be conducted with a calibrated Mount Sopris SC-132 scintillometer (or equivalent device) at each systematic survey point. When readings at two consecutive systematic sample locations do not exceed the cleanup standards the area extending outward from the first systematic point will be classified as unaffected and no further remediation will be required.

Comment:

(8) A description of the design to be adopted in the breach area of Cell 4A and an analysis to show adequacy of the design to prevent any potential erosion.

Response:

Liquids in Cell 4A will be evaporated to dryness and the crystals, synthetic liner and any contaminated soils will be placed in Cell 2 or Cell 3. Non-contaminated soils will than be utilized to reduce the southern slopes of Cell 3 from the current 3:1 to the proposed 5:1.

Following reclamation, Cell 4A will contain no by-product materials. Therefore, the breach is designed only to prevent ponding within the area. The design does not consider potential erosion of the breach area.

It should be noted that no measures, limited to natural materials, will prevent any or all potential erosion.

Comment:

(9) A description of how the adequacy of the material properties used in the design of various components of tailing impoundments (e.g., field hydraulic conductivity of cover material, soil/tailings properties used for embankment design) is verified.

Response:

Verification of the adequacy of the material properties used in the tailings impoundment design was provided in a study provided by Dames and Moore, the results of which are presented in the report entitled "Site Selection and Design Study - Tailings Retention and Mill Facilities, White Mesa Uranium Project" dated January 17, 1978.

A summary of the material properties from the Dames and Moore report is presented in Appendix A of the Tailings Cover Design.

Comment:

(10) A description of the drainage catchment area(s) and diversion channel(s) design.

Response:

Drainage catchment area(s) and diversion channel(s) are not included in the design.

A "discharge channel" is shown on Figure A-2.2.4-1, Sedimentation Basin Detail. The purpose of this channel is to prevent ponding within Cell 1 following reclamation. A detailed discussion of this discharge channel is presented in response to Comment 18.

Comment:

(11) A replacement of seven pages of illegible data. These pages are in appendix A of Appendix D [Tailings Cover Design White Mesa Mill, October 1996 (pages marked p. 12 through p. 17)] and in appendix G of Appendix D [Tailings Cover Design White Mesa Mill, October 1996 (figure showing cross-section along Cell 4 dike)].

Response:

The seven replacement pages are included in Attachment 3 of this response.

Comment:

(12) It is not clear if the rock durability test results for the proposed sandstone source rock are based on a series of durability tests or on only one test; therefore, additional rock durability test information is needed. At a minimum, IUC should (1) provide durability test results for several representative rock samples; and (2) verify that the data represents average results for representative samples; and (3) provide separate test results if different rock types were used. Alternately, IUC should provide further justification that the information already provided is adequate to demonstrate rock durability.

Further, IUC should provide information related to the location of the proposed source(s) and, in accordance with the criteria suggested in the NRC Staff Technical Position, should provide details of the petrographic examinations (mineralogy, cementation, fractures, clay content, etc) that were conducted on the rock.

Response:

One rock durability test has been performed to date. The sandstone sample was collected approximately one mile west of the site in the Westwater Canyon Area. Representative rock durability testing and petrographic examinations will be performed as an integral part of Construction Quality Assurance procedures, prior to reclamation, on each proposed source (i.e. from sandstone cobbles within the random fill stockpiles).

Comment:

(13) Based on a site visit conducted several years ago, the NRC staff is aware that high-quality alluvial rock exists in the site area. Based on the potentially questionable quality of the sandstone source, additional information should be provided regarding this alluvial source and the reasons for its rejection.

Response:

The utilization of the alluvial source was not considered as the source is located within a riparian area. The potential impact during construction of haul roads and excavation of the alluvial material is not recommendable from an environmental standpoint. Conversely, the sandstone is readily available and the use of the material will not pose an environmental threat.

Comment:

(14) Additional information should be provided regarding the construction specifications (Appendix F) and construction testing program to be conducted on the riprap. The specifications should be revised to include specific criteria for rock placement. Specific tolerances for placement should be specified for the riprap and filter, depending on the size of the material being placed. Measures, such as depth checks on a specific grid, should be provided to verify the thickness of the riprap.

Response:

Attachment 4 of this response contains "Specification for Construction of Rock Covers and Other Erosion Protection on the Tailings Cells".

Attachment 4 is intended as an outline of the formal construction specifications that will be provided prior to reclamation. Specific values have been precluded from the document as additional soil and rock properties (riprap durability for oversizing analysis / random fill grain size analysis for determining filter criteria) will be verified at a later date. (See also response to Comment 12).

Comment:

(15) The NRC staff notes that a filter layer is not proposed for the riprap layer to be placed on the 1V on 5H side slopes of the cells. In general, a filter layer is not required for top slopes (with relatively flat slopes of about one percent or less), but a filter is likely to be needed for the side slopes. The filter is needed because velocities through the larger rock voids may erode the underlying soil particles. IUC should provide a filter layer for the side slopes or provide justification that a filter layer is not needed.

Response:

It is acknowledged that a filter layer will be required on the 5H:1V side slopes. The filter criteria will be designed in accordance with NUREG/CR-4620 "Methodologies for Evaluating Long-Term Stabilization Designs of Uranium Mill Tailings Impoundments".

According to NUREG/CR-4620, the D_{85} of the base (random fill) is required in order to establish the filter gradation. At this time, the proposed random fill materials are stockpiled on the site for future use and extensive laboratory testing has not been performed to determine a representative D_{85}. The filter layer gradation will be determined prior to reclamation, when additional laboratory analysis is available.

The filter layer will be included in the cost estimate. For costing purposes a filter thickness of six inches will be utilized.

Comment:

(16) Rock aprons/toes are likely to be needed at those locations where the steeper side slopes meet the natural ground. Based on site visits to the area, there is sufficient evidence of active gullying, and gully headcutting into the cells is possible. Several factors need to be taken into account, and the design of the apron/toe should be based on the following general concepts: (1) provide riprap of adequate size to be stable against the design storm (PMF); (2) provide uniform and/or gentle grades along the apron and the

adjacent ground surface such that runoff is distributed uniformly at a relatively low velocity, minimizing the potential for flow concentration and erosion; and (3) provide an adequate apron thickness (depth) to prevent undercutting of the disposal cells by: (I) local scour that could result from the PMF; or (II) potential gully encroachment, that could occur due to gradual headcutting over a long period of time.

The key elements which IUC needs to consider in the design of riprap protection for the apron/toe are: (1) the downstream portion of the apron/toe which is assumed to have collapsed due to scour or long-term erosion; and (2) scour at the ground surface downstream of the apron/toe. To account for the potential uncertainties in toe design, the NRC staff suggests that it may be prudent to use several different analytical methods to design the riprap for these key elements.

As part of the analysis, IUC should assume that the natural ground downstream of the toe will be eroded due to cumulative local scour and/or erosion at its base, resulting in the collapse of the rock into the eroded area. To determine the depth to which the toe must be placed, it is necessary to estimate the depth of scour which will occur to the natural ground slope just downstream of the toe. The toe should then be placed at least to the estimated depth of scour.

To further document the acceptability of the design of the rock toe/apron, it may be very useful for IUC to provide a geomorphic report. The geomorphic bases for the design of the rock toe should be provided, including a geomorphic evaluation of the potential for formation of gullies. The geomorphic analysis may also document the depth of the gullies in the immediate area and help to justify the selection of a depth of scour.

It should also be noted that rock toes are considered to be critical areas, and the rock quality criteria for these rock toes are not likely to be met by the proposed sandstone source. Use of rock of higher quality appears necessary (see Comment 2).

Response:

<u>Cell 2 South Slope</u>

A toe apron will be included where the south slope of Cell 2 discharges to the surface of Cell 3. This toe apron will consist of the same riprap size and thickness as is on the south slope (see response to comment 17) and will extend outward from the toe of the slope for a distance of ten feet.

Cell 3 South Slope

A toe apron will be included for the south side slope of Cell 3 where the Dakota sandstone is not present at the surface. No other side slope has either the dimensions (height and length) or runoff to experience significant scour. The south slope toe apron will consist of the same riprap size and thickness as is on the side slope (see response to comment 17) and will extend outward from the toe of the slope a distance of ten feet.

The final grading plan will provide for distribution of runoff from the south slope of Cell 3, with surface gradients away from established drainage courses so that runoff is not concentrated along pathways where natural erosion has caused gullying. This measure will deprive the existing gullies of most of the runoff that they had previously carried, arresting or sharply reducing the potential for future erosion.

The toe apron will not be placed where the Dakota sandstone is present at the surface. The bedrock provides natural resistance to gullying that is better than, or equal to, any scour protection using natural materials that could be constructed. It is evident, however, that the sandstone does erode and erosion cannot be absolutely prevented using sandstone as riprap or erosion barriers. For that reason, diversion and distribution of runoff away from active gullies will be more effective than constructing riprap toes below final grade.

Comment:

*(17) **Review of the calculations/spreadsheets (Appendix F) for the design of the rock on the side slopes indicates that the flow lengths used for the design of the side slope rock (275 feet) does not include the length of the top slope that will contribute runoff to the side slopes. Beginning at the upper end of Cell 2 (near Cell 1), it appears that runoff from Cells 2 and 3 will flow southward for over 1000 feet and discharge down the side slopes of the cells. Accordingly, the riprap in these areas should be redesigned, as necessary, to account for the increased flow lengths.***

Response:

The calculations have been revised to include the total flow path length of the top slope which will contribute runoff to the south and east side slope of Cell 3, and the south side slope of Cell 2. The revised calculations are presented in Attachment 5 of this response.

The size of the riprap placed along the sides of the slopes was determined using the Stephenson method (NUREG/CR-4651). The side slopes are designed at 5H:1V. Assuming that the on-site sandstone would be utilized as riprap material, with a rock rating of 55.74%, the modified D_{50} size should be at least 8.0 inches.

According to the Stephenson model, the riprap thickness should be at least 2 times the D_{50} value. This indicates a minimum thickness of 16 inches, with a suggested thickness of 18 inches, on the sides of the slopes.

Comment:

(18) Additional information should be provided for the design of the sedimentation basin and the discharge channel. HEC-1 analysis should be provided, along with HEC-2 input and output data (or other water surface profile analysis), to document the acceptability of parameters used in the design of the riprap for the channel.

In addition, sedimentation analyses should be provided to show that the capacity of the sedimentation basin is adequate and that the HEC-1 routings adequately account for decreases in storage capacity in the basin due to sediment accumulation over a long period of time. Further, each of the parameters used to design the riprap in the channel should be provided, including channel slope, width, flow rate, and water surface profiles, particularly if flow changes from subcritical to supercritical at some location in the channel.

Response:

Sedimentation Basin

Following reclamation, Cell 1 will trap sediment over long periods of time and the storage capacity of the basin will decrease. However, the cell is not designed to serve as a sedimentation basin, it will simply collect sediment due to the physical configuration of the reclaimed subsurface cell.

As Cell 1 is not designed to serve as a sedimentation basin, and the cell (following reclamation) will not be related to the reclamation of the by-product cells, sedimentation analyses to determine the long term capacity of the basin was not performed.

Discharge Channel

Surface runoff from the mill area, and immediately north of the mill area, will be routed through the sedimentation basin and ultimately discharged through the channel located in the southwest portion of Cell 1. The discharge channel and riprap were sized to accommodate the PMF flood using the HEC-1 model, as stated on Page 3-8, Section 3.2.2.2 of the Reclamation Plan.

Following reclamation Cell 1 will not contain by-product materials and will not be related to the reclamation of the by-product cells. Therefore, the purpose (and size) of the channel is only to prevent excessive ponding within the cell area.

Comment:

(1) Technical justification that the frequencies of quality control (QC) tests proposed in the reclamation plan are adequate for controlling the quality of the construction of the final disposal cell.

The NRC "Staff Technical Position (STP) on Testing and Inspection Plans During Construction of DOE's Remedial Action at Inactive Uranium Mill Tailings Sites" (NRC, 1989) provides recommended frequencies for QC tests for various parameters during the construction of tailings disposal cells. NRC has found the frequencies recommended in the STP acceptable for maintaining the quality of the construction activities for both Title I and Title II sites. In some cases, the staff recommends in the STP conducting the QC tests more frequently than IUSA has proposed in the reclamation plan.

The recommended test frequencies for specific QC tests are provided in the following table.

Test	*Recommendations for Testing Frequency*
Field Density and Moisture Tests	*Minimum of one test per 1,000 yd^3 of contaminated material.* *Minimum of one test per 500 yd^3 of other compacted material including seepage barrier and/or radon barrier earth cover.* *Minimum of two tests for each day that an appreciable amount of fill is placed (in excess of 150 yd^3).* *Minimum of one test per lift and at least one test for every full shift of compacted operations.*
Compaction Tests	*One point Proctor test at a frequency of one test for every five field density tests.* *Approximately one laboratory compaction curve based on complete Proctor tests for every 10 or 15 field tests, depending on the variability of the materials.*

Gradation and Classification Tests	*Minimum of one test per 1,000 yd³ of radon/seepage barrier material, and one test per 2,000 yd³ of other engineered soil fill material.* *For all materials other than random fill and contaminated materials, at least one gradation test should be run for each day of significant material placement (in excess of 150 yd³).*
Atterberg Limit Tests	*At least one test for each day of significant cohesive cover or liner material placement (in excess of 150 yd³).*
Rock Durability Tests	*For any type of riprap where the volume is grater than 30,000 yd³, a test series should be performed for each additional 10,000 yd³ of riprap delivered.*

IUC should adopt the frequencies recommended in the STP, or alternately, present a technical justification that the frequencies of QC tests proposed in the reclamation plan are adequate for controlling the quality of construction of the final disposal cell.

REFERENCE NRC, 1989, "Staff Technical Position on Testing and Inspection Plans During Construction of DOE's Remedial Action at Inactive Uranium Mill Tailing Sites," Revision 2, January 1989.

Response:

At this time technical justification that the proposed QC testing frequencies are adequate for construction, should not be required. The testing frequencies, presented within Attachment A of the Reclamation Plan, are intended as a rough outline for the formal construction specifications that will be prepared prior to reclamation. The QC outline, although not detailed for construction, is adequate for determining the QC cost estimate.

It is clear that the NRC "Staff Technical Position (STP) on Testing and Inspection Plans During Construction of DOE's Remedial Action at Inactive Uranium Mill Tailings Sites" rigidly provides conservative QC testing frequencies adequate for controlling construction quality. However, the STP does not allow for site specific conditions which may exist.

In order to prepare the formal QC specifications a pre-construction laboratory testing program will be performed, immediately preceding the reclamation construction, on the proposed random fill and riprap materials. This additional testing, along with the current laboratory data from the Section 16 clay source, will provide the information required to establish the site specific QC testing frequencies adequate for controlling the quality of construction.

The following chart briefly summarizes the site specific conditions that will be utilized to determine the QC testing frequencies:

Test	Testing Frequency Determinations
Field Density and Moisture Testing	Variability of the materials optimum moisture content and maximum dry density: Highly variable soils will require conservative field control. Conversely, consistent soils may require less testing than recommended in the STP as consistent compactor coverages will yield consistent results. Volume of fill materials: Large surface area fills, such as the top of the tailings cells, require less tests per cubic yard compared with small surface areas where rapid lift placement occurs. Topography of the fill area: Fill placement on slopes, and tight corners, require additional tests as compaction equipment movement is hindered.
Compaction Tests	Variability of the materials optimum moisture content and maximum dry density: Highly variable soils will require conservative laboratory control to properly identify the materials in the field. Conversely, consistent materials may require less testing than recommended in the STP as field control testing will be less conservative. If variable soils are encountered one point Proctors may be valid. However, if distinct visible variations are present within the various soils one point Proctors would not be necessary. Additionally, if consistent materials are encountered one point Proctors will not be valid.
Gradation and Classification Tests	Gradations will be necessary for soil classification purposes. However, gradation specifications for the random fill and clay layers are not included in the Reclamation Plan. Therefore gradation testing should require less testing than recommended in the STP.

Atterberg Limit Tests	Atterberg Limit tests will be required for soil classification purposes. However, liquid and plastic limits are not specified in the Reclamation Plan. Therefore Atterberg Limit tests should be less than recommended in the STP.
Rock Durability Tests	Number of borrow areas: The testing frequency will be dependent upon the number of sources utilized. Each source should have at least one test.

Following additional laboratory analysis, the construction QC site specific specifications will be established to control the quality of the construction in accordance with standard industry procedures. However, at this time the QC outline is adequate for the QC cost estimate.

Comment:

(2) ***Additional information addressing details of disposal cell construction. This information should include:***

- ***Methods, procedures, and requirements for excavating, hauling, stockpiling, and placing contaminated and non-contaminated materials and other disposal cell materials.***

Response:

The comment as stated indicates the reclamation plan includes the construction of a disposal cell. However, materials disposed during the reclamation will be placed in the existing tailings Cells 2 and 3.

Contaminated materials to be deposited within the tailings cells consists of raffinate crystals, synthetic liners, contaminated soils, and decommissioned mill equipment. The placement of these materials is discussed in Sections 2.0, 3.0 and 4.0, Attachment A, of the Reclamation Plan.

Non-contaminated materials to be placed within the tailings cells consists of the final cover materials. The placement of these materials is discussed in Sections 5.0 and 6.0, Attachment A, of the Reclamation Plan.

The excavation and hauling procedures for these materials will be the responsibility of the contractor. As per industry practice, the contractor may use any type of equipment he may desire, provided the equipment is in satisfactory condition and is of such capacity that the construction schedule can be maintained as planned. It is not expected that materials will be stockpiled during construction.

- ***Material placement and compaction procedures (e.g., lift height, compactive effort) to achieve the desired moisture content, placement density, and permeability.***

Response:

Material placement and compaction procedures will be developed by the earthwork contractor. The Quality Control testing (moisture content and dry density) will be used to verify that the specified moisture content and percent compaction is being achieved with the contractors chosen equipment and procedures.

The earthwork contractor will be required to place and compact the soil materials within the maximum lift thickness, percent compaction, and moisture content specifications presented in Table A-5.3.2.1-1, Attachment A, of the Reclamation Plan. The lift thickness and number of compactor passes required to conform to the soil placement and compaction specifications will be dependent upon the actual equipment utilized during construction. The contractor may use any type of earthmoving and watering equipment he may desire, or have at his disposal, provided the equipment is in satisfactory condition and is of such capacity that the construction schedule can be maintained as planned.

To determine that the moisture content and percent compaction requirements of the soil material is being met Quality Control field and laboratory tests will be conducted at specified intervals as presented in Section 7.4, Attachment A, of the Reclamation Plan. Furthermore, Quality Control observation will be performed to ensure that the maximum lift thickness is not exceeded during soil placement.

ATTACHMENT 1

"Letter Report
Section 16 Clay Material Test Data
White Mesa Uranium Project
Blanding, Utah"

Prepared by D'Appolonia Consulting Engineers, Inc.
Dated March 8, 1982

D'APPOLONIA

CONSULTING ENGINEERS, INC.

March 8, 1982

Project No. RM78-682B

Mr. H. R. Roberts
Energy Fuels Nuclear, Inc.
1515 Arapahoe Street
Three Park Central, Suite 900
Denver, Colorado 80202

Letter Report
Section 16 Clay Material Test Data
White Mesa Uranium Project
Blanding, Utah

Dear Harold:

This report presents the results of field investigations and laboratory tests performed on Section 16 clay material. The material tested was obtained from borings and test pits made in April 1979. The laboratory tests were performed and the data retained in our files until your recent request for the data.

Field Investigations

The area of investigation is a canyon located in Section 16, about three miles south of the mill site. Seven borings were drilled as part of the field investigations. These borings, 100 through 106, are located approximately as shown on Figure 1.

The borings were drilled with a rig provided by Energy Fuels using the rotary method with air pressure to flush out the cuttings. Samples were obtained by sampling the cuttings on five foot intervals. Only qualitative information on the subsurface materials is available because of the method of drilling and sampling utilized. However, the qualitative information and samples obtained are suitable to provide preliminary data on the character of the subsurface materials present.

Three test pits (1-3) were excavated to obtain bulk samples for laboratory testing. The location of the test pits is shown on Figure 1.

Samples from Boring 2-16 drilled by Energy Fuels in November 1978 were also provided to D'Appolonia for testing. The location of Boring 2-16 is shown on Figure 1.

Subsurface Conditions

The subsurface conditions in the canyon, based on the boring data, are shown on Cross Sections A-A' and B-B' presented on Figures 2 and 3, respectively. The plan locations of these cross sections is shown on Figure 1. As shown on the cross sections, the subsurface consists of a surficial layer of red clayey and silty sand about five feet thick. The underlying material is mostly a red or gray silty clay. The consistency of the silty clay layer varies from stiff to hard, based on observations of the drillers and rig during drilling. A lense or layer of very hard silt was noted in Boring 105. This layer appears to be a well cemented unit from the cutting samples obtained. In Boring 106, the surficial sand layer was about 20 feet thick and a clayey sand layer was also encountered at a depth of about 30 feet.

The laboratory soil classifications for the tested samples are also shown on Cross Sections A-A' and B-B'. The testing program is discussed in detail in the following section, however, the testing results indicate that the silty clay layer is mostly a CL or CH material with one sample being a SM and two a ML. These test results show the material is basically a fine grained soil with a varying amount of silt and clay size particles. The plasticity characteristics of the material vary from low to high. Further discussion of the test results and material characteristics is given below.

Water in the borings was not noted except for Boring 104 for which a depth of about 43 feet was measured. This depth is not considered completely reliable since it was measured only one day after drilling and the water level may not have had time to stabilize.

Laboratory Test Results

The laboratory testing program conducted on samples from the borings and test pits included the following types of tests:

- Classification
  - Grain size, sieve and hydrometer
  - Atterberg limits
  - Specific gravity
- X-Ray Diffraction
- Cation Exchange Capacity
- Exchangeable Cations
- Modified Proctor Compaction Density
- Permeability

The results of the classification tests are given on Table 1. The soil classifications given are shown on Cross Sections A-A' and B-B' (Figures 2 and 3) and were discussed above.

The cation exchange capacity (CEC) and exchangeable ions were conducted to evaluate the type of clays present and the chemical effects resulting from contact with the tailings liquid. Tests were run on samples from Test Pits 2 and 3 samples and Boring 103 (15-20 foot depth). Soil from each sample was treated by soaking in simulated tailings liquid for 48 hours before testing. Both treated and untreated (as received) samples were tested and the results are presented on Table 2. Results of the testing are summarized as follows:

- The untreated samples indicate pH (1:1) values between 7.40 and 8.35 with CEC values in the 45-56 meq/100g range. The predominate exchangeable ions are calcium and sodium for Test Pits 2 and 3 and calcium and magnesium for Boring 103 (15-20 ft).

- The treated samples indicate pH (1:1) values between 1.70 and 2.35 with CEC values in the 90-100 meq/100g range. The predominate exchangeable ions are hydrogen, calcium, and magnesium for all the samples.

These results indicate that exposure to the tailings water causes:

- the pH (1:1) of the material to decrease.
- the exchangeable hydrogen and magnesium to increase.
- the exchangeable calcium and sodium to decrease.
- the CEC to increase by a factor of about two due primarily to the large increase in exchangeable hydrogen.

The effects of these changes on clay material properties, particularly permeability, is discussed in the following paragraphs.

The X-ray diffraction tests were run on material from the same three samples as tested for CEC and exchangeable ions. The x-ray diffraction testing was conducted to evaluate the type of clay minerals occurring in the material. The results of the testing are given on Table 3. As shown, about 50 percent of the material is quartz, 25 percent montmorillonite, 25 percent illite, and minor percentages of other minerals. Montmorillonite is an active clay mineral which typically has a low coefficient of permeability. Illite is also a clay mineral, but it is typically relatively inactive with a somewhat higher coefficient of permeability.

Modified Proctor compaction tests were conducted on four different samples. Test Pits 1, 2 and 3 samples were tested and a composite sample from Boring 2-16 (85 to 210 feet depth). The results of the modified Proctor tests are given on Table 1. The average maximum dry density measured is 107 pounds per cubic foot and the average optimum water content is 17.5 percent.

Permeability tests were conducted on compacted samples of material from Boring 2-16 (composite 85-120 feet), Boring 101 (composite 0-25 feet), Boring 103 (composite 0-25 feet) and Test Pit 2. The tests were conducted in permeability cells with a confining pressure applied around the sample which is encased in a rubber membrane. A differential pressure was applied across the sample and flow of fluid through the sample measured. Both distilled water and simulated tailings liquid were used in the tests. The tests on Borings 101 and 103, and Test Pit 2 were conducted over a period of about five months to assess the effects of tailings liquid on the permeability of the material. The tests were conducted with distilled water for about two months to establish saturation and steady state flow. Tailings liquid was then introduced to the sample and the test continued for three more months. The results of the permeability tests are presented on Table 4 along with other pertinent sample data. The material has an average coefficient of permeability with water of 3.3×10^{-10} centimeters per second and 5.1×10^{-10} centimeters per second with simulated tailings liquid. The test results indicate that the permeability of the material was essentially the same with distilled water and tailings liquid and no degradation of the material was indicated.

Conclusions and Recommendations

Based on the field and laboratory investigations discussed above, conclusions which can be made regarding the materials in Section 16 are:

- The material is mostly a silty clay (CL to CH) with slight variation in properties. The clay minerals are mostly montmorillonite with some illite.

- The material varies laterally with some layers or lenses of sand and silt. The consistency of the material also varies from stiff to hard or very hard.

- The permeability values of the material are very low and long-term permeability tests conducted with simulated tailings liquid indicate little change in permeability with time. This result is in good agreement with the results of the CEC, exchangeable ion tests and x-ray diffraction test results.

- The clay material is suitable for use as borrow for use as a clay liner or in situ as a natural liner layer.

Recommendations for further assessment of the clay for use as a borrow area or in situ clay liner source are:

- Geotechnical borings with split spoon samples to assess the material characteristics more specifically, including consistency, natural water content, and classification.

- Field permeability tests (falling or rising head) in the borings to measure the in situ permeability.
- Installation of piezometers to determine the ground water level.

Additional discussion of the above recommendations can be provided as necessary depending on your needs.

Very truly yours,

Corwin E. Oldweiler
Project Engineer

CEO:par

TABLE 1

LABORATORY TEST RESULTS

BORING/ TEST PIT	SAMPLE DEPTH (FEET)	GRAIN SIZE ANALYSIS SAND (PERCENT)	GRAIN SIZE ANALYSIS SILT (PERCENT)	GRAIN SIZE ANALYSIS CLAY (PERCENT)	ATTERBERG LIMITS LIQUID (PERCENT)	ATTERBERG LIMITS PLASTIC (PERCENT)	ATTERBERG LIMITS PLASTICITY (PERCENT)	USCS CLASSIFICATION	SPECIFIC GRAVITY	OPTIMUM PROCTOR VALUES DRY DENSITY (PCF)	OPTIMUM PROCTOR VALUES WATER CONTENT (PERCENT)
101	0-5	61	22	17	24.0	18.5	5.5	SC-SM	-	-	-
	5-10	26	48	26	58.9	24.1	34.8	CH	-	-	-
	10-15	10	50	40	73.0	28.2	44.8	CH	-	-	-
	15-20	7	54	39	103.0	31.2	71.8	CH	2.59	-	-
102	5-10	-	-	-	-	-	NP	ML	-	-	-
	10-15	-	-	-	-	-	NP	ML	-	-	-
	15-20	-	-	-	20.3	10.2	10.1	CL	-	-	-
103	0-5	70	18	12	17.0	14.9	2.1	SM	2.71	-	-
	5-10	15	38	47	73.8	24.9	48.9	CH	-	-	-
	10-15	13	49	38	59.8	26.6	33.2	CH	-	-	-
	15-20	13	50	37	71.0	21.6	49.4	CH	-	-	-
104	0-5	55	30	15	18.4	16.2	2.2	SM	-	-	-
	5-10	30	43	27	31.2	16.5	14.7	CL	-	-	-
	10-15	66	17	17	-	-	-	-	-	-	-
	15-20	37	31	32	35.7	11.8	23.9	CL	-	-	-
105	0-5	58	22	20	-	-	NP	SM	-	-	-
	5-10	65	17	18	-	-	NP	SM	-	-	-
	10-15	62	17	21	24.0	12.0	12.0	SC	-	-	-
	15-20	17	36	47	71.0	18.9	52.1	CH	-	-	-
1(1)	-	17	40	43	108.0	25.0	83.0	CH	-	99.9	19.9
2(1)	-	17	50	33	141.2	18.4	122.8	CH	-	111.5	15.0
3(1)	-	3	42	55	115.0	23.0	92.0	CH	2.60	101.0	20.5
2-16	65	-	-	-	32.0	15.8	16.2	CL	-	-	-
	125	7	43	50	57.5	25.9	31.6	CH	-	-	-
	180	-	-	-	148.5	25.3	123.0	CH	-	-	-
	COMPOSITE 85-210(2)	95	5	0	-	-	-	SW-SC	-	-	-
	COMPOSITE 85-210(3)	18	47	35	-	-	-	cl-ml	2.72	115.8	14.7

(1) These samples are Test Pits
(2) Sample tested before soaking.
(3) Sample tested after soaking 16 hours.

D'APPOLONIA

TABLE 2

CATION EXCHANGE CAPACITY AND EXCHANGEABLE CATION TEST RESULTS

PARAMETER	UNITS	UNTREATED SAMPLES TEST PIT 2	TEST PIT 3	BORING 103	TREATED SAMPLES[(1)] TEST PIT 2[(2)]	TEST PIT 3	BORING 103
pH (1:1)	-	8.35	7.40	7.60	2.30	2.35	1.70
Buffer pH	-	NA	NA	NA	2.28	2.20	2.15
Exchangeable:							
H	meq/100g	0	0	0	56.6	57.6	58.2
Ca	meq/100g	19.5	21.1	25.8	12.3	13.5	18.7
Mg	meq/100g	4.3	4.9	15.4	17.0	20.3	17.8
Na	meq/100g	20.0	28.0	6.5	3.7	6.5	2.6
K	meq/100g	1.2	2.5	0.6	0.8	1.6	0.5
Cation Exchange Capacity (CEC)	meq/100g	45	56	48	90	100	98

(1) Samples soaked in simulated tailings liquid for 48 hours before testing.
(2) Represents triplicate results.

D'APPOLONIA

TABLE 3

X-RAY DIFFRACTION SEMI-QUANTITATIVE RESULTS

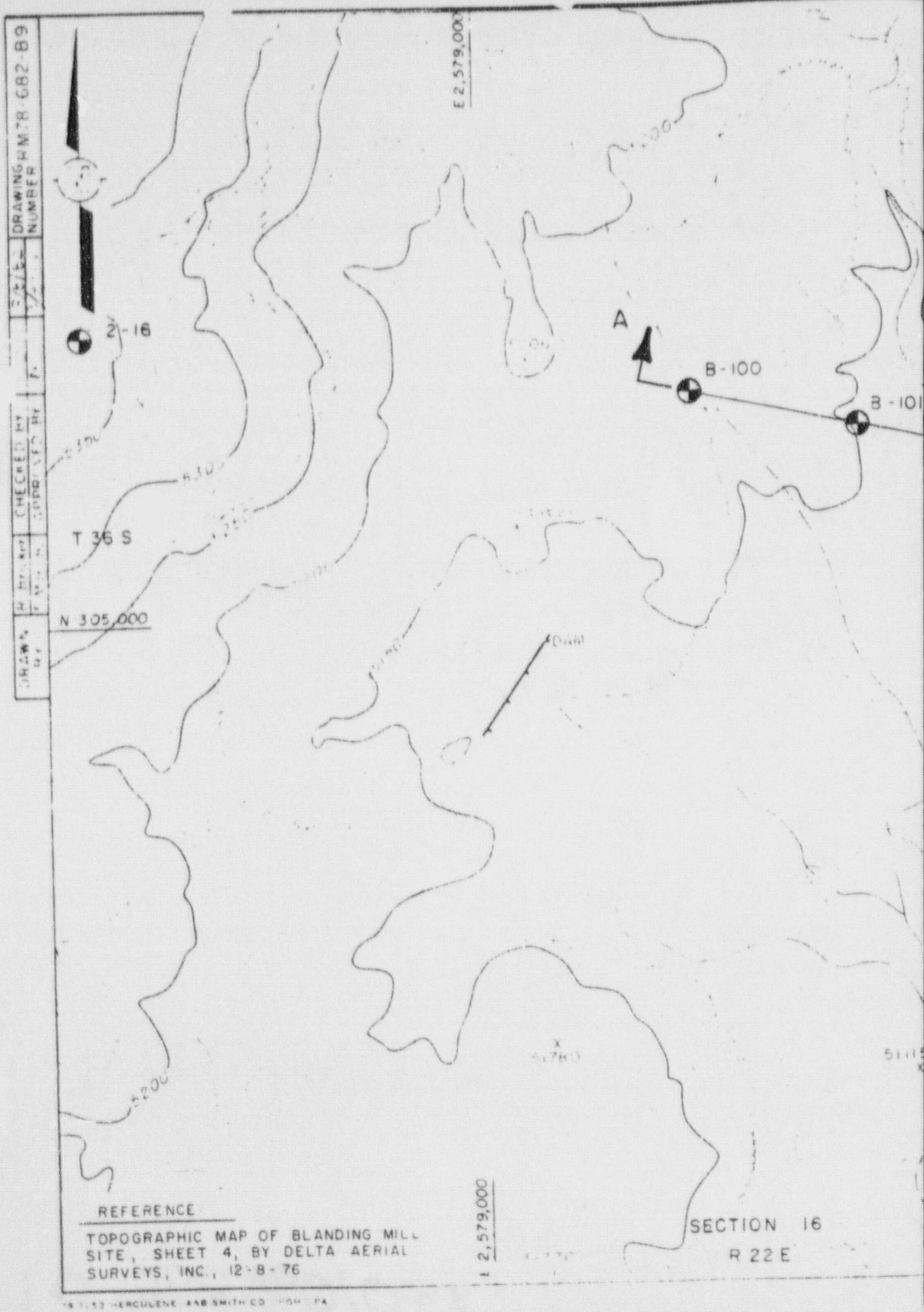
SAMPLE	QUARTZ	ANDESINE	MONTMORILLONITE	ILLITE	MIXED LAYER
Test Pit 2	50%+	-5%	10-25%	10-25%	5-10%
Test Pit 3	50%+	5-10%	10-25%	10-25%	5-10%
Boring 101 (15'-20' Depth)	50%+	5-10%	25-50%	Trace	-5%

TABLE 4

PERMEABILITY TEST RESULTS

BORING/ TEST PIT	SAMPLE DEPTH (FEET)	INITIAL CONDITIONS DRY DENSITY (PCF)	WATER CONTENT (PERCENT)	COEFFICIENTS OF PERMEABILITY WITH DISTILLED WATER (CM/SEC)	WITH TAILINGS LIQUID (CM/SEC)
103	0-25	116.7	13.3	1.2×10^{-9}	9.4×10^{-10}
101	0-25	117.5	14.6	5.2×10^{-10}	7.5×10^{-10}
2	-	110.7	14.7	4.7×10^{-10}	2.3×10^{-10}
2-16	85-210	101	15	-	1.0×10^{-10}
2-16	85-210	110	15	-	5.5×10^{-10}

D'APPOLONIA


DRAWING NUMBER RM 78-682-B9
CHECKED BY
APPROVED BY
DRAWN BY
E 2,579,000
2-16
A
B-100
B-101
T 35 S
N 305,000
DAM
SECTION 16
R 22 E
E 2,579,000
REFERENCE
TOPOGRAPHIC MAP OF BLANDING MILL SITE, SHEET 4, BY DELTA AERIAL SURVEYS, INC., 12-8-76

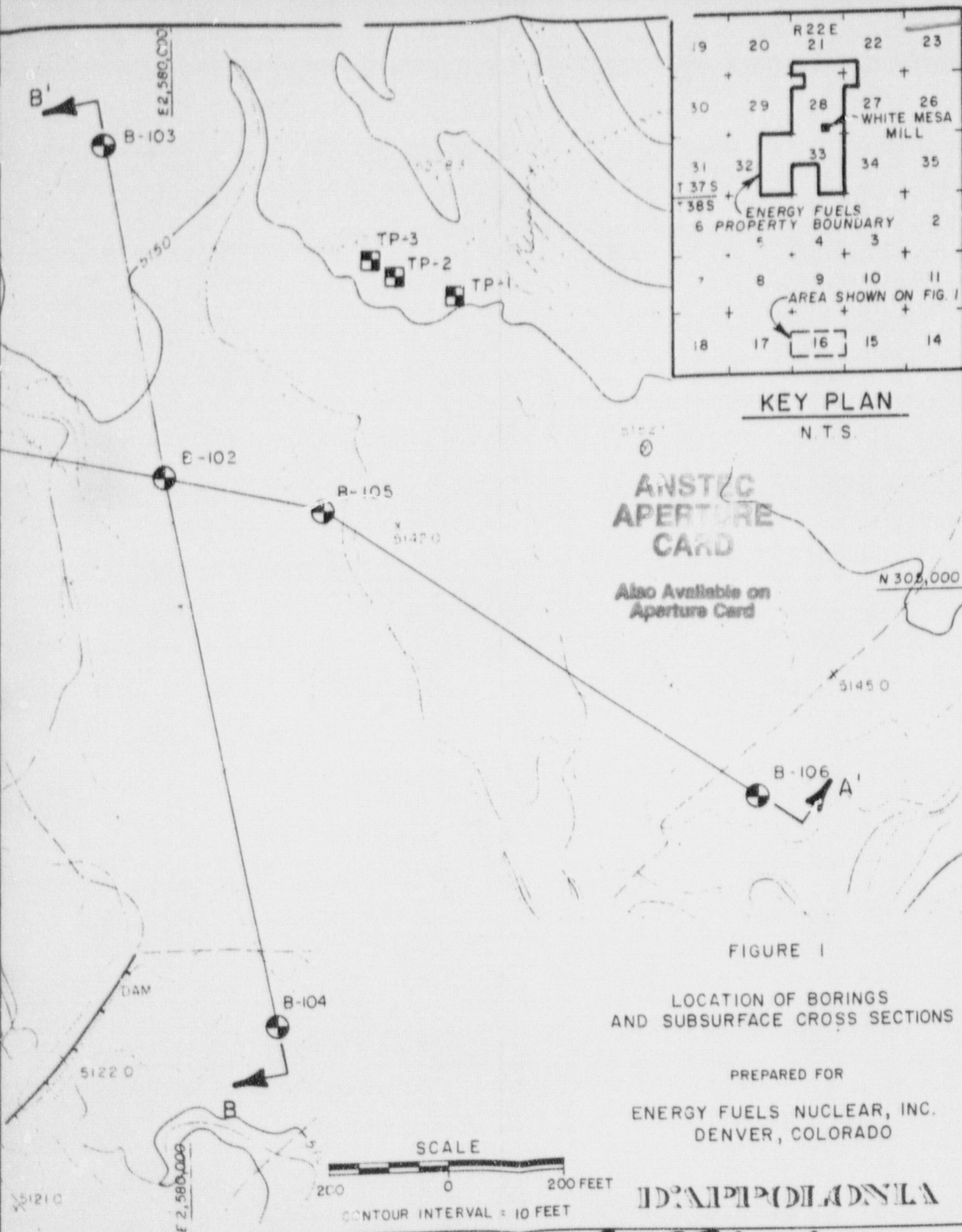


FIGURE 1

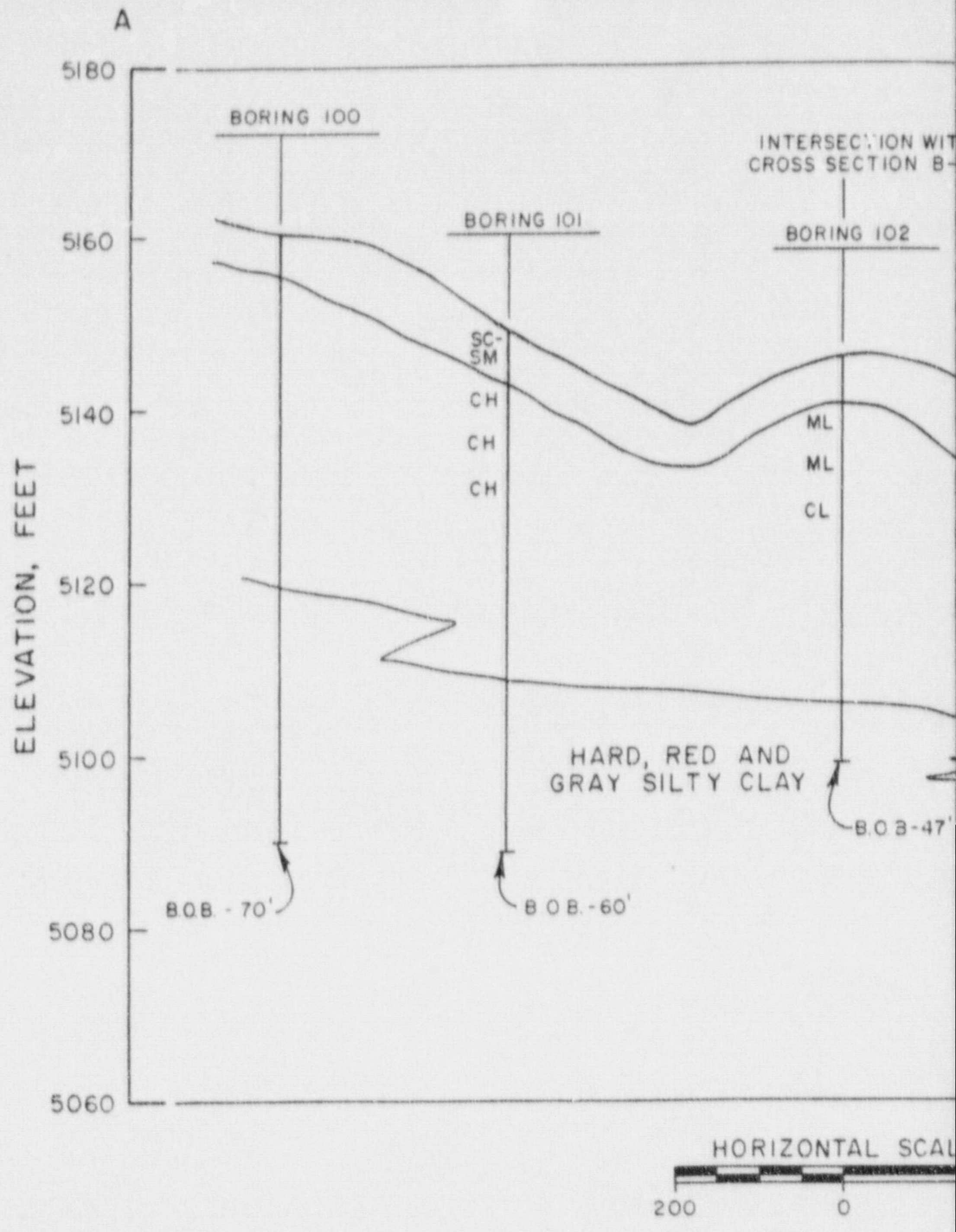
LOCATION OF BORINGS
AND SUBSURFACE CROSS SECTIONS

PREPARED FOR

ENERGY FUELS NUCLEAR, INC.
DENVER, COLORADO

D'APPOLONIA

DRAWN BY | R. Bricker | 3 Mar. 82 | CHECKED BY | [illegible] | APPROVED BY | [illegible] | DRAWING NUMBER RM78-682-B7

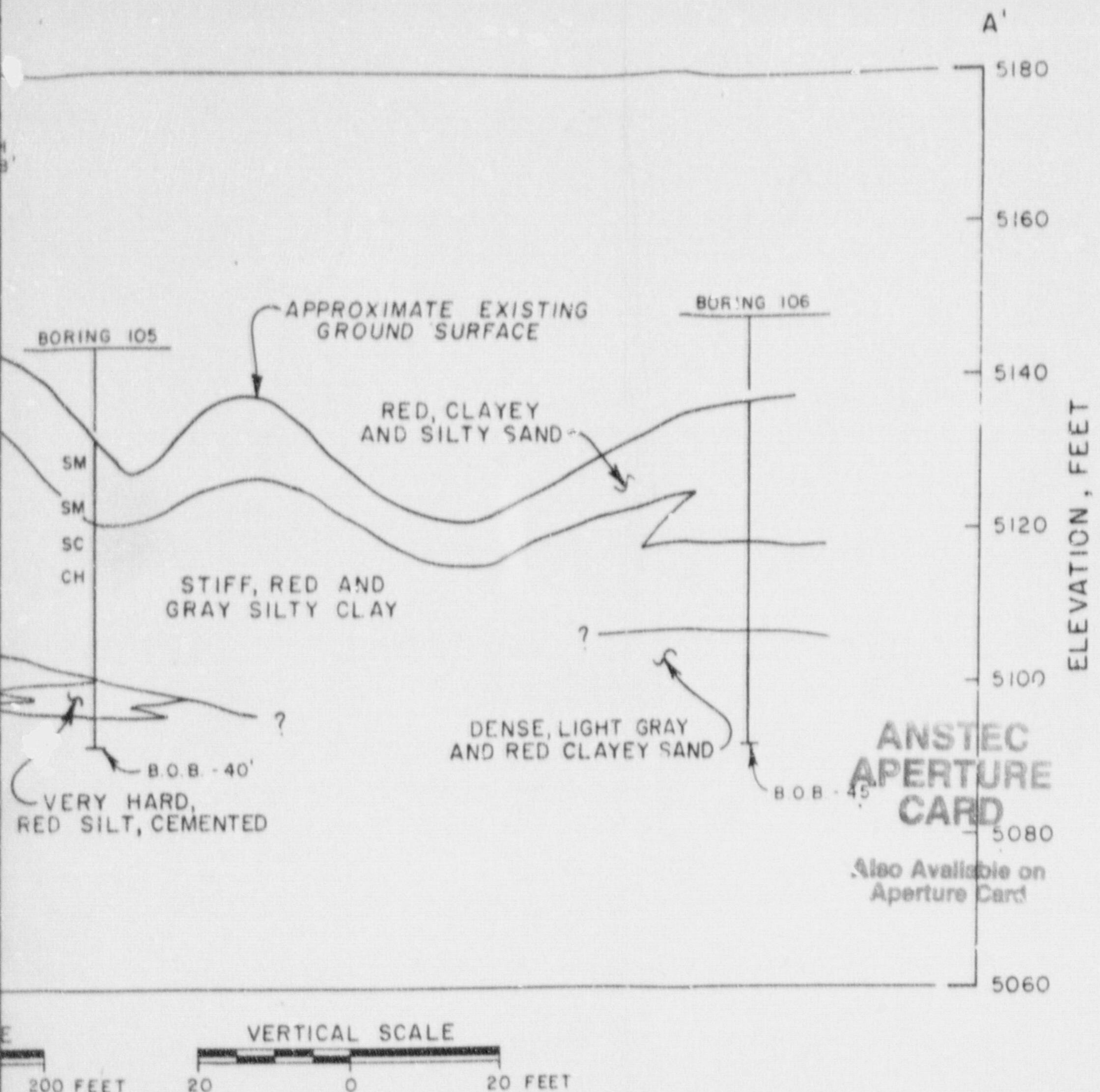


THE DEPTH AND THICKNESS OF THE SUBSURFACE STRATA INDICATED ON THE SECTIONS WERE GENERALIZED FROM AND INTERPOLATED BETWEEN THE TEST BORINGS INFORMATION ON ACTUAL SUBSURFACE CONDITIONS EXISTS ONLY AT THE LOCATION OF THE TEST BORINGS AND IT IS POSSIBLE THAT SUBSURFACE CONDITIONS BETWEEN THE TEST BORINGS MAY VARY FROM THOSE INDICATED

LEGEND

CH - LABORATORY SOIL CLASSIFICATION

(UNIFIED SOIL CLASSIFICATION SYSTEM



(LOOKING NORTH)

FIGURE 2

SUBSURFACE CROSS SECTION A-A'

PREPARED FOR

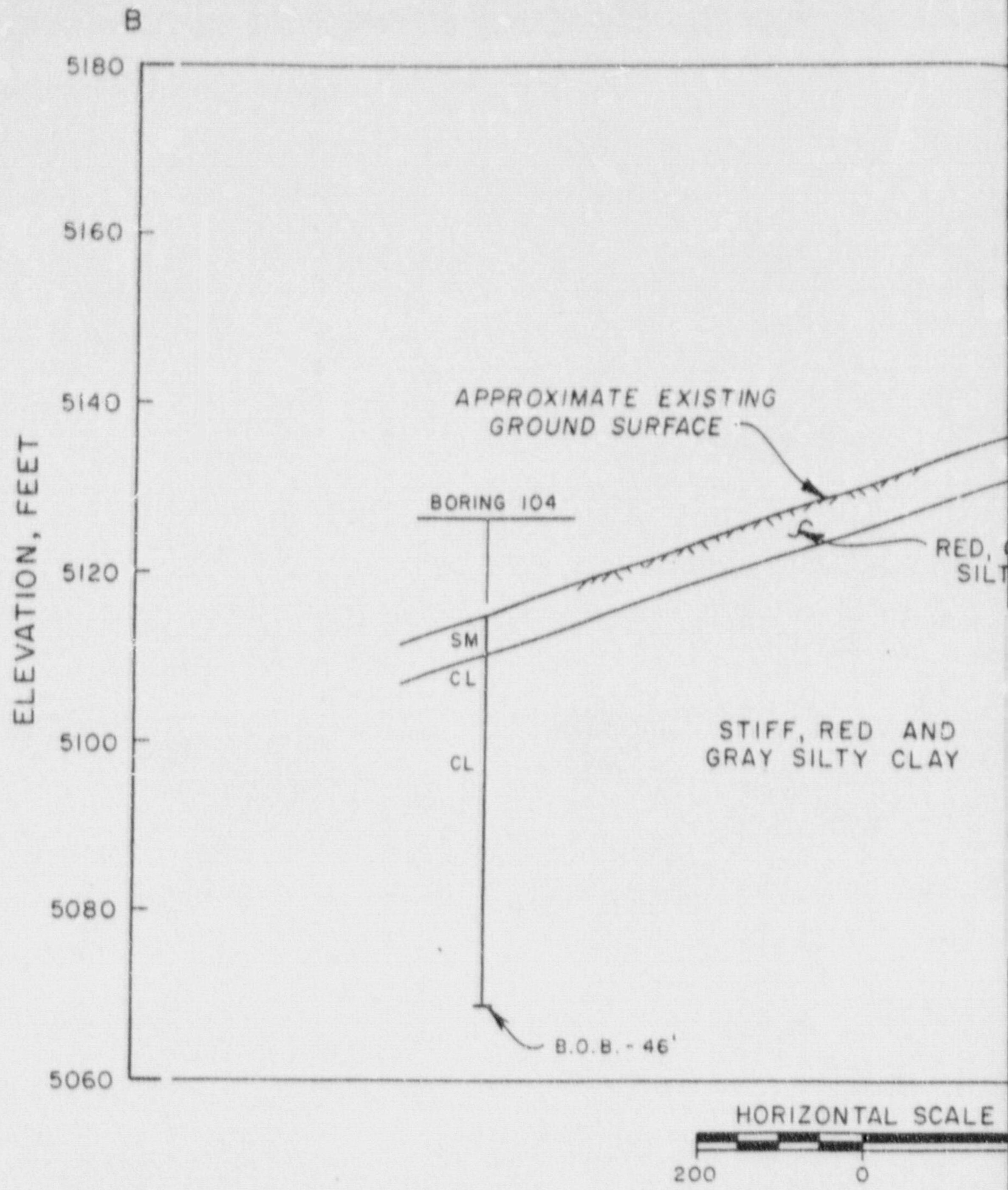
ENERGY FUELS NUCLEAR, INC.
DENVER, COLORADO

D'APPOLONIA

NOTES:

1. FOR PLAN LOCATION OF CROSS SECTION, SEE FIGURE 1.
2. VERTICAL EXAGGERATION EQUALS 10X.

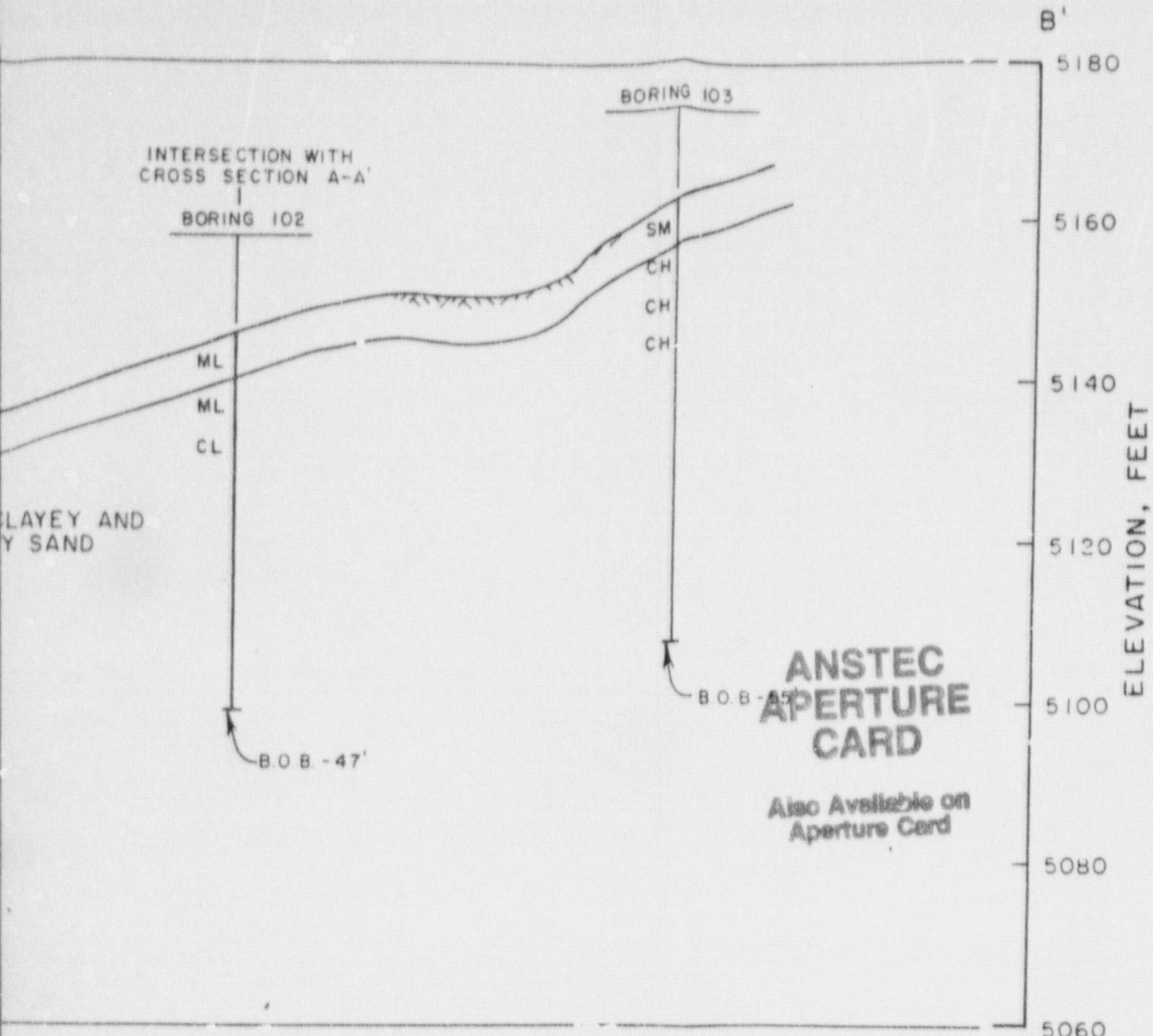
DRAWN BY	R. Bricker	CHECKED BY		DRAWING NUMBER	RM78-682-B8
	4 Mar. 82	APPROVED BY			



THE DEPTH AND THICKNESS OF THE SUBSURFACE STRATA INDICATED ON THE SECTIONS WERE GENERALIZED FROM AND INTERPOLATED BETWEEN THE TEST BORINGS INFORMATION ON ACTUAL SUBSURFACE CONDITIONS EXISTS ONLY AT THE LOCATION OF THE TEST BORINGS AND IT IS POSSIBLE THAT SUBSURFACE CONDITIONS BETWEEN THE TEST BORINGS MAY VARY FROM THOSE INDICATED

LEGEND:

CH - LABORATORY SOIL
CLASSIFICATION
(UNIFIED SOIL
CLASSIFICATION SYS



VERTICAL SCALE

200 FEET 20 0 20 FEET

LOOKING WEST)

NOTES:

1. FOR PLAN LOCATION OF CROSS SECTION, SEE FIGURE 1.
2. VERTICAL EXAGGERATION EQUALS 10 X.

TEM)

FIGURE 3

SUBSURFACE CROSS SECTION B-B'

PREPARED FOR

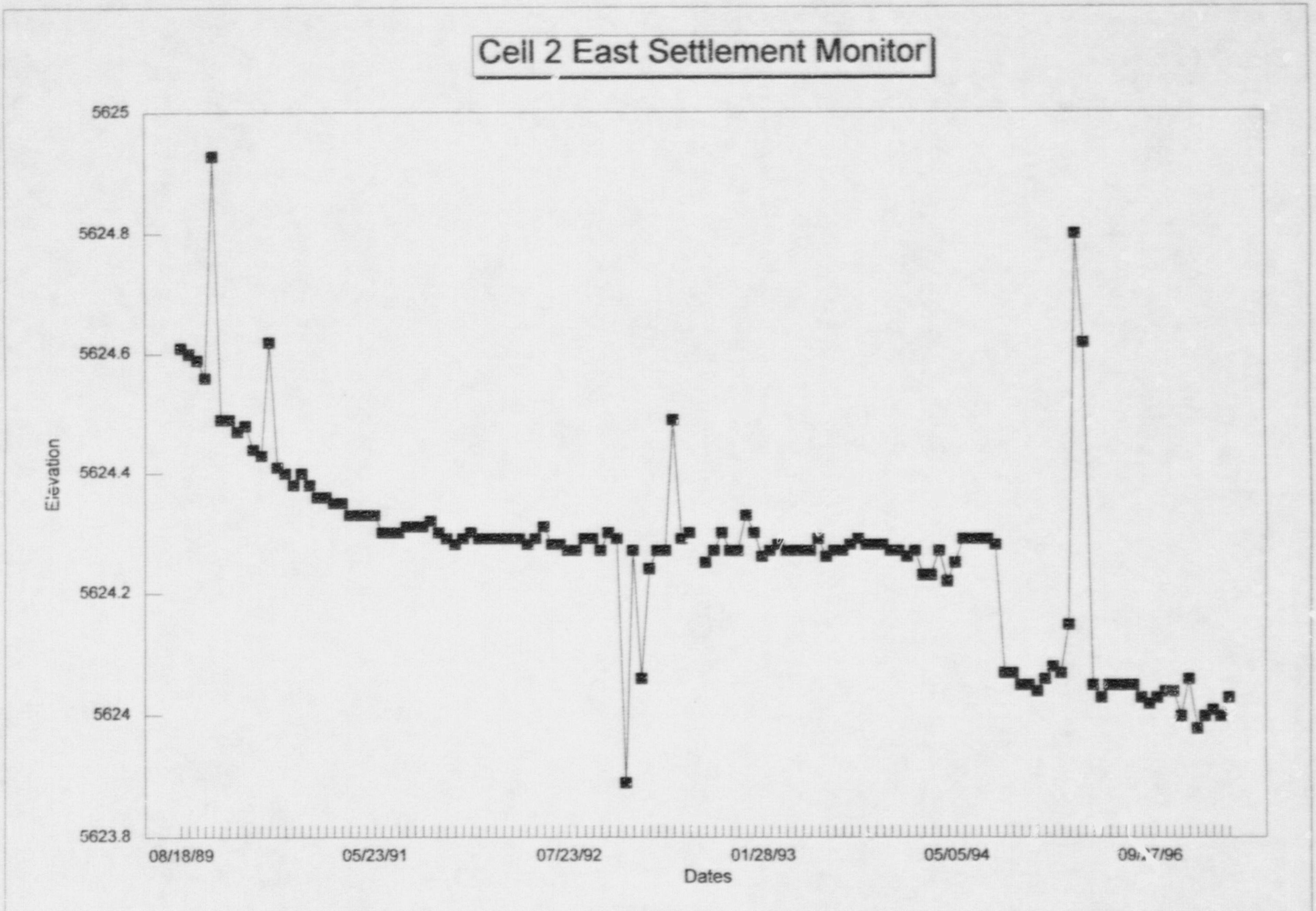
ENERGY FUELS NUCLEAR, INC.
DENVER, COLORADO

D'APPOLONIA

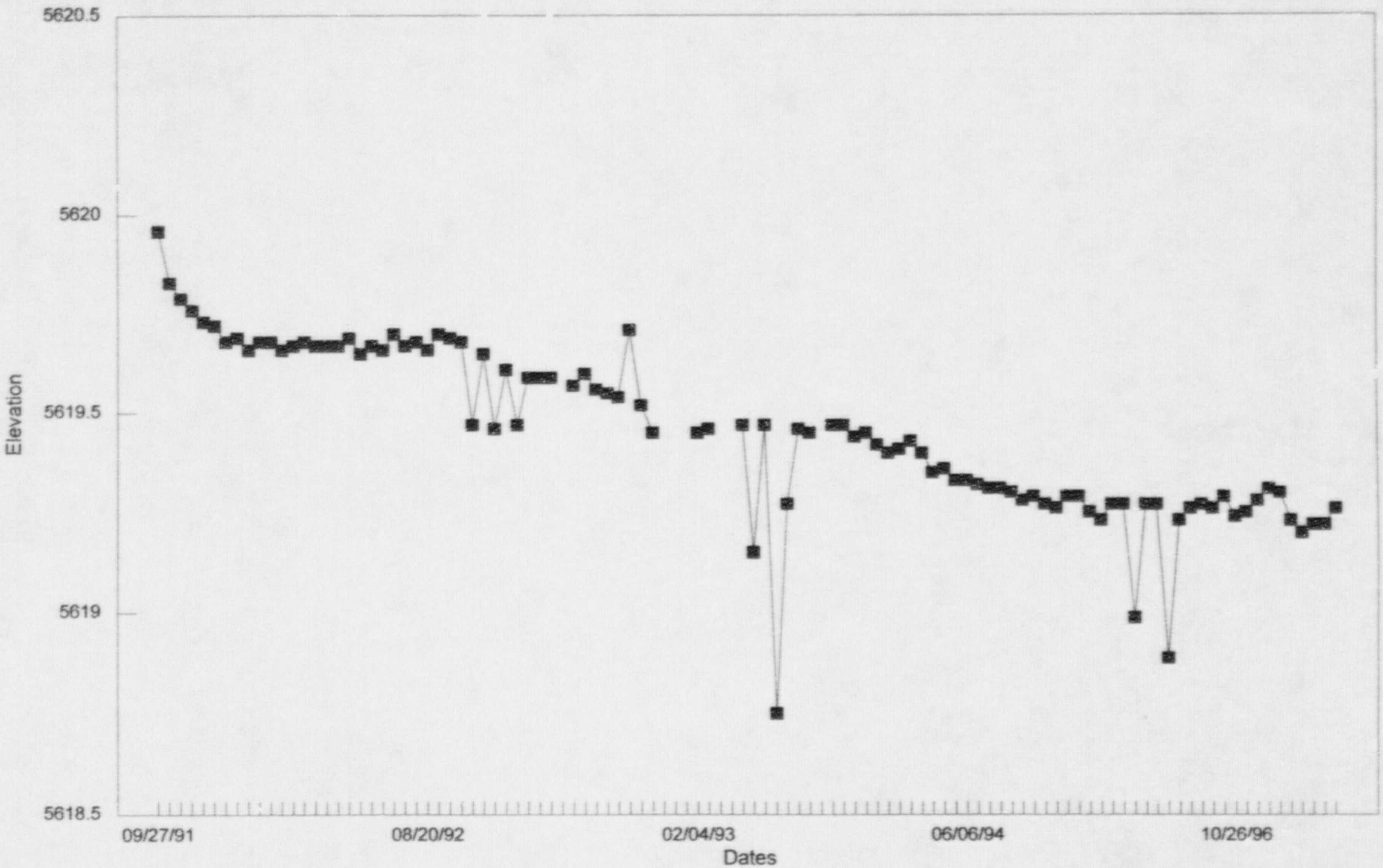
9801090276-03

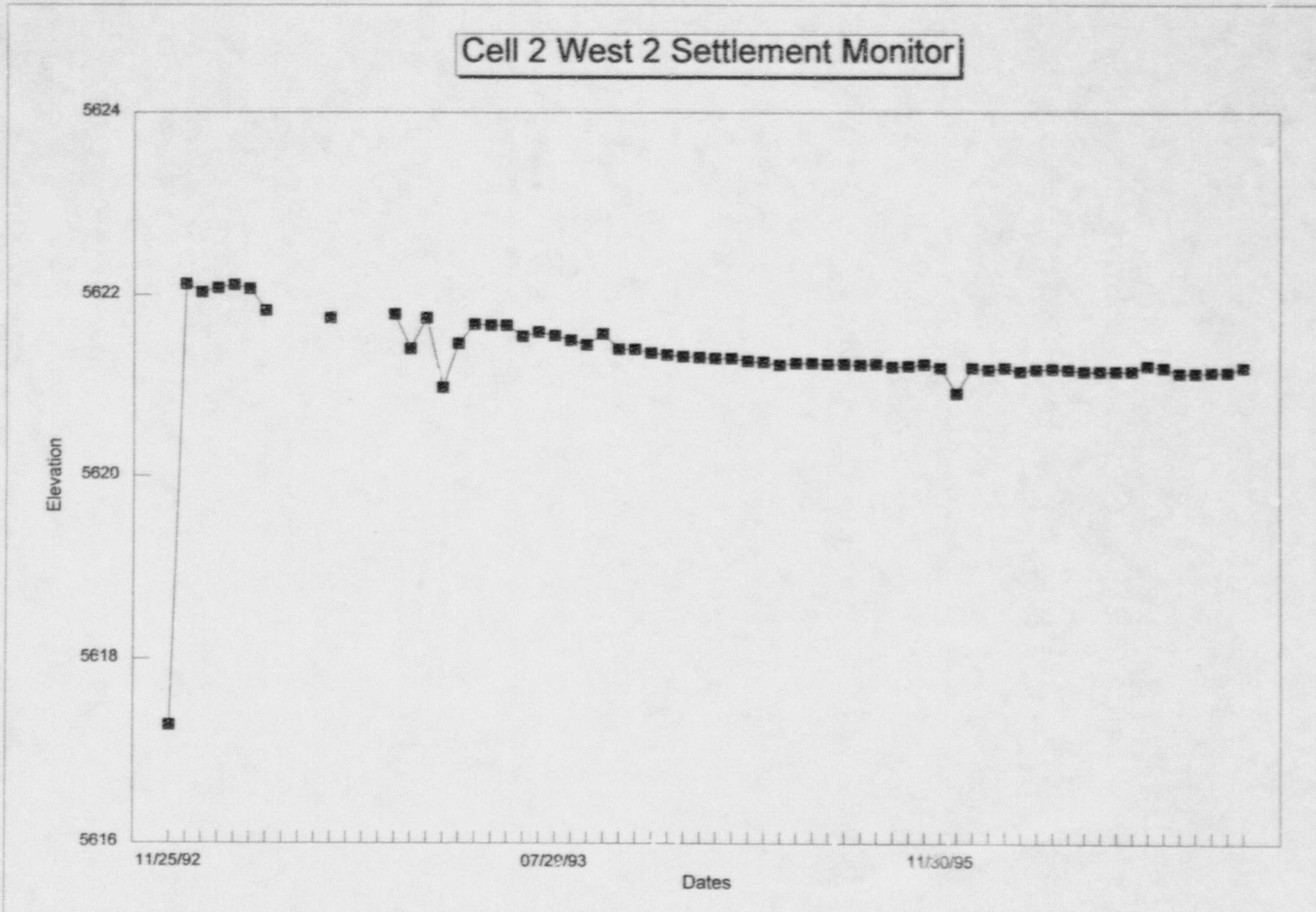
ATTACHMENT 2

Time vs. Settlement Graphs
Cell 2
White Mesa Mill
Blanding, Utah

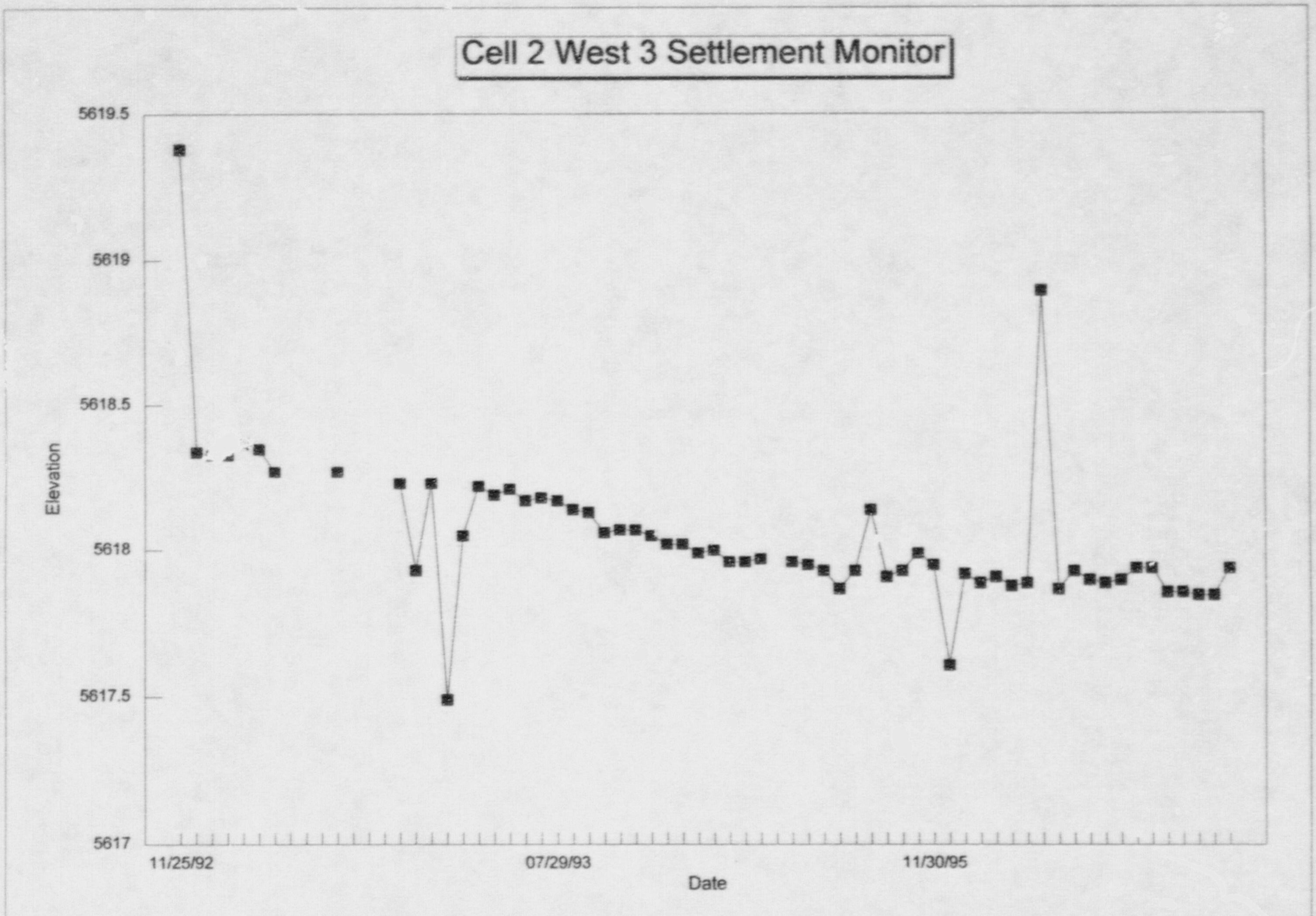

Cell 2 East Settlement Monitor
5625
5624.8
5624.6
5624.4
5624.2
5624
5623.8
Elevation
08/18/89
05/23/91
07/23/92
01/28/93
05/05/94
Dates

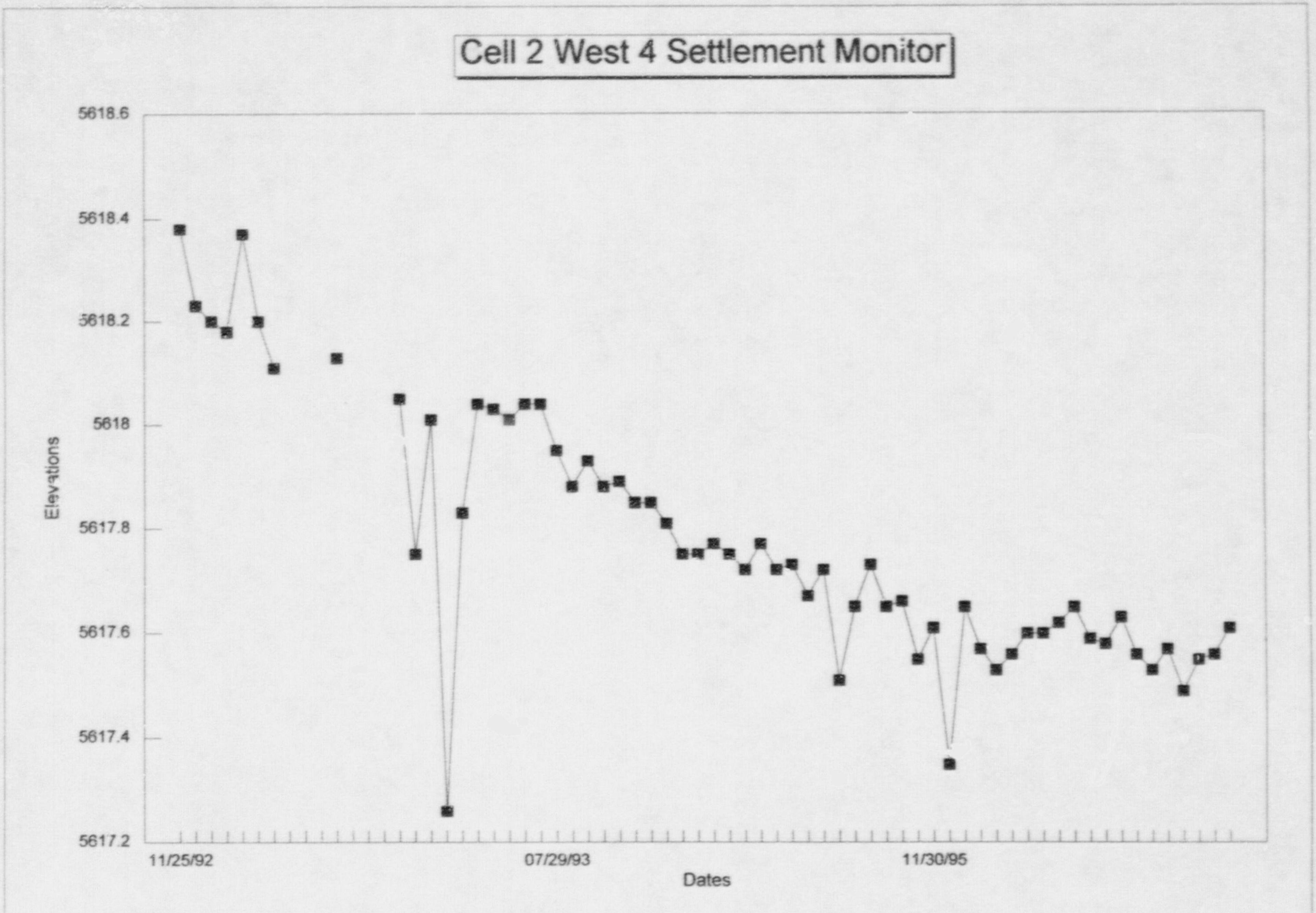
Cell 2 West 1 Settlement

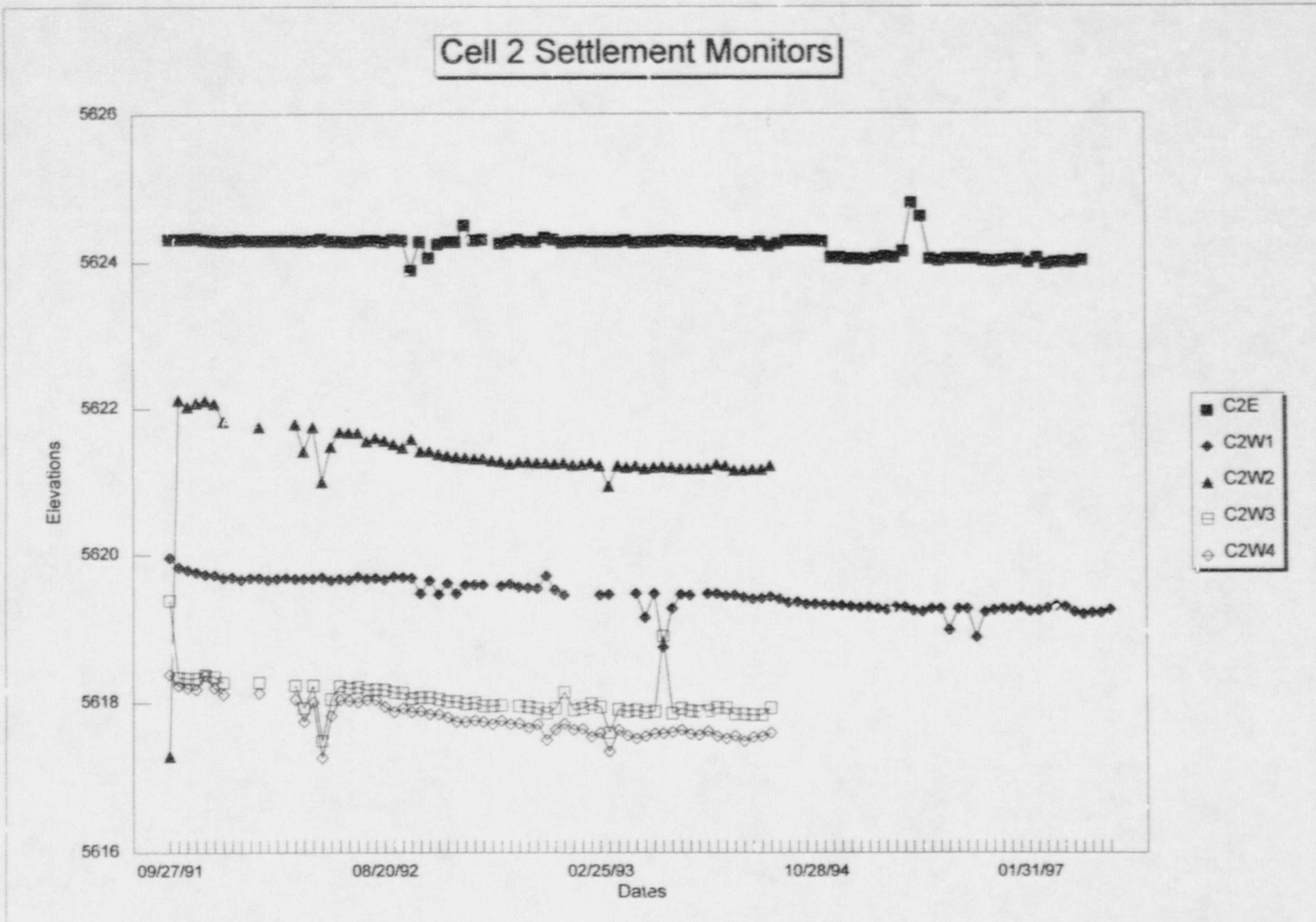




Cell 2 West 2 Settlement Monitor
5624
5622
5620
5618
5616
Elevation
11/25/92
07/29/93
11/30/95
Dates


Cell 2 West 3 Settlement Monitor
5619.5
5619
5618.5
5618
5617.5
5617
Elevation
11/25/92
07/29/93
11/30/95
Date


Cell 2 West 4 Settlement Monitor
5618.6
5618.4
5618.2
5618
5617.8
5617.6
5617.4
5617.2
Elevations
11/25/92
07/29/93
11/30/95
Dates


Cell 2 Settlement Monitors
Elevations
5626
5624
5622
5620
5618
5616
09/27/91
08/20/92
02/25/93
10/28/94
01/31/97
Dates
C2E
C2W1
C2W2
C2W3
C2W4

ATTACHMENT 3

Replacement Pages

JFC
10/4/94

MRAP - 710002307 - GEOTECHNICAL DATA BASE FOR MONTICELLO MILLSITE CHARACTERIZATION -- R.H. MORRIS; CREATED 09/30/91; LAST UPDATED 11/22/91

AREA	DATA SOURC	BORING OR TEST PIT NUMBER	SAMPLE NUMBER & TYPE	TOP OF SAMPLE (FEET)	BASE OF SAMPLE (FEET)	SAMPLE MIDPOINT (FEET)	USCS SYMBOL	MATERIAL TYPE	IN-PLACE DRY DENSITY (PCF)	NATURAL MOISTURE CONTENT (PERCENT)	SPECIFIC GRAVITY	FRACTION PASSING #4 SIEVE (PERCENT)	FRACTION PASSING #200 SIEVE (PERCENT)	LIQUID LIMIT	PLASTICITY INDEX	ASTM D 698 MAXIMUM DRY DENSITY (PCF)	ASTM D 698 OPTIMUM MOISTURE CONTENT (PERCENT)	OTHER TESTS
CARBONATE PILE	BENDIX	MRAP-85-01	MKB-652/ST	6.0	8.0	7.00	CL-ML(?)	Tails-slm(?)	89.6	4.6	2.57	100.0	97.0	NP	NP	NA	NA	Consol w/perm, CMP @15 bar
CARBONATE PILE	BENDIX	MRAP-85-02	MKB-661/ST	2.0	4.0	3.00	SM	Tails-snd	107.5	4.0	2.80	100.0	49.0	NP	NP	NA	NA	Consol w/perm, CMP @15 bar
CARBONATE PILE	BENDIX	MRAP-85-02*	MKB-787/BULK	1.0	1.0	1.00	ML	Cover	NA	NA	NA	100.0	68.0	NA	NA	114.7	14.5	
CARBONATE PILE	BENDIX	MRAP-85-02*	MKB-788/BULK	3.0	3.0	3.00	SP	Tails-snd	NA	NA	NA	NA	NA	NA	NA	102.9	13.0	
CARBONATE PILE	BENDIX	MRAP-85-02*	MKB-790/BULK	6.0	6.0	6.00	SC(?)	Tails-slm	NA	NA	2.70	NA	NA	NA	NA	94.8	28.3	
CARBONATE PILE	BENDIX	MRAP-85-03	MKB-749/ST	2.0	4.0	3.00	CL-ML	Tails-slm&snd	92.1	27.4	2.87	100.0	84.0	20.0	4.0	NA	NA	Consol w/perm, CMP @15 bar
CARBONATE PILE	D&M	31SW91-045	1/SS	2.0	4.0	3.00	CL	Tails-slm	NA	35.8	NA	NA	NA	NA	NA	NA	NA	
CARBONATE PILE	D&M	31SW91-045	2/SS	4.5	6.0	5.25	SP-SM	Tails-snd	NA	3.3	NA	NA	NA	NA	NA	NA	NA	
CARBONATE PILE	D&M	31SW91-045	3/SS	6.0	8.0	7.00	SP-SM	Tails-snd	NA	5.4	2.65	100.0	11.4	NA	NA	NA	NA	
CARBONATE PILE	D&M	31SW91-045	5/SS	10.0	12.0	11.00	SP-SM	Tails-snd	NA	4.5	NA	NA	NA	NA	NA	NA	NA	
CARBONATE PILE	D&M	31SW91-045	6/SS	13.0	14.0	13.50	SM	Tails-snd	NA	5.5	NA	100.0	18.1	NA	NA	NA	NA	
CARBONATE PILE	D&M	31SW91-045	7/SS	14.0	16.0	15.00	SM	Tails-snd	NA	14.4	NA	NA	NA	NA	NA	NA	NA	
CARBONATE PILE	D&M	31SW91-045	8/SS	17.4	18.0	17.70	CL/ML/SM	Tails-snd/slm	NA	27.5	NA	NA	NA	NA	NA	NA	NA	
CARBONATE PILE	D&M	31SW91-045	9/SS	19.5	20.0	19.75	SM	Tails-snd	NA	3.7	2.65	100.0	15.6	NP	NP	NA	NA	
CARBONATE PILE	D&M	31SW91-045	10/SS	20.2	22.0	21.10	SM	Tails-snd	NA	6.3	NA	100.0	23.8	NA	NA	NA	NA	
CARBONATE PILE	D&M	31SW91-045	13/SS	26.2	28.2	27.20	SM	Tails-snd	NA	5.8	NA	NA	NA	NA	NA	NA	NA	
CARBONATE PILE	D&M	31SW91-045	14/SS	28.3	30.0	29.15	SM	Tails-snd	NA	8.5	NA	NA	NA	NA	NA	NA	NA	
CARBONATE PILE	D&M	31SW91-045	15/SS	31.2	31.8	31.50	ML/SM	Tails-snd/slm	NA	38.0	NA	NA	NA	NP	NP	NA	NA	
CARBONATE PILE	D&M	31SW91-045	16/SS	32.7	34.0	33.35	CL/ML/SM	Tails-snd/slm	NA	21.8	NA	NA	NA	NA	NA	NA	NA	
CARBONATE PILE	D&M	31SW91-045	17/SS	35.0	36.0	35.50	CL/ML/SM	Tails-snd/slm	NA	22.9	NA	NA	NA	NA	NA	NA	NA	
CARBONATE PILE	D&M	31SW91-045	18/SS	36.0	38.0	37.00	SP-SM	Tails-snd	NA	24.2	2.70	100.0	9.7	NA	NA	NA	NA	
CARBONATE PILE	D&M	31SW91-045	19/SS	40.0	42.0	41.00	SM	Tails-snd&slm	NA	23.2	NA	NA	NA	NA	NA	NA	NA	
CARBONATE PILE	D&M	31SW91-045	20/SS	43.0	44.0	43.50	SM	Tails-snd&slm	NA	25.2	NA	100.0	14.9	NA	NA	NA	NA	
CARBONATE PILE	D&M	31SW91-045	21/SS	44.5	45.8	45.15	CL	Alluvium	NA	28.9	NA	NA	NA	NA	NA	NA	NA	
CARBONATE PILE	D&M	31SW91-045	22/SS	46.4	47.5	46.95	CL	Alluvium	NA	28.8	NA	NA	NA	NA	NA	NA	NA	
CARBONATE PILE	D&M	31SW91-045	23/SS	48.0	50.0	49.00	CL	Alluvium	NA	23.9	NA	NA	NA	33.9	18.3	NA	NA	
CARBONATE PILE	D&M	31SW91-045	24/SS	51.0	52.0	51.50	CL	Alluvium	NA	23.0	NA	NA	NA	NA	NA	NA	NA	
CARBONATE PILE	D&M	31SW91-045	25/SS	52.0	52.3	52.15	CL	Alluvium	NA	28.0	NA	NA	NA	NA	NA	NA	NA	
CARBONATE PILE	D&M	31SW91-045	26/SS	54.5	56.0	55.25	CL	Allu.slm	NA	55.6	NA	NA	NA	NA	NA	NA	NA	
CARBONATE PILE	D&M	31SW91-046	2C/SS	3.0	4.2	3.60	SC/CL	Cover(?)	NA	10.9	NA	NA	NA	NA	NA	NA	NA	
CARBONATE PILE	D&M	31SW91-046	3B/SS	4.2	5.0	4.60	SM	Tails-snd	NA	12.4	NA	NA	NA	NA	NA	NA	NA	
CARBONATE PILE	D&M	31SW91-046	4B/SS	8.0	10.0	9.00	CL	Alluvium	NA	20.1	NA	NA	NA	NA	NA	NA	NA	
CARBONATE PILE	D&M	31SW91-050a	2/SS	3.5	5.5	4.50	SM	Tails-snd(Cover?)	NA	29.7	NA	88.2	12.5	NA	NA	NA	NA	
CARBONATE PILE	D&M	31SW91-050a	3/ST	5.5	7.5	6.50	SM	Tails-snd	88.6	25.4	NA	NA	NA	NA	NA	NA	NA	
CARBONATE PILE	D&M	31SW91-050a	5/SS	10.0	10.5	10.25	SP-SM	Tails-snd	NA	21.3	NA	100.0	7.0	NA	NA	NA	NA	
CARBONATE PILE	D&M	31SW91-051	2/S[illegible]	5.5	8.0	6.75	SP-SM	Tails-snd	93.5	7.2	NA	100.0	10.2	NA	NA	NA	NA	Triax-CUPP
CARBONATE PILE	D&M	31SW91-051	4/ST	13.0	15.5	14.25	SM	Tails-snd	82.5	6.8	NA	100.0	21.8	NA	NA	NA	NA	Triax-CUPP, Perm
CARBONATE PILE	D&M	31SW91-051	5/ST	18.0	20.5	19.25	SM	Tails-snd	87.1	7.1	NA	100.0	18.3	NA	NA	NA	NA	Triax-CUPP
CARBONATE PILE	D&M	31SW91-051	8/SS	33.0	35.0	34.00	SM	Tails-snd	NA	11.9	2.79	100.0	14.6	NA	NA	NA	NA	
CARBONATE PILE	D&M	31SW91-051	9/SS	38.0	39.5	38.75	SP	Tails-snd	NA	25.6	NA	NA	NA	NA	NA	NA	NA	
CARBONATE PILE	D&M	31SW91-051	11/SS	43.5	44.4	43.95	CL	Alluvium	NA	25.5	NA	NA	NA	29.1	19.1	NA	NA	
CARBONATE PILE	D&M	31SW91-051	12/SS	48.0	49.3	48.65	CL	Alluvium	NA	24.8	NA	NA	NA	NA	NA	NA	NA	
CARBONATE PILE	D&M	31SW91-052	1/SS	4.2	6.0	5.10	SM/CL	Tails-snd/slm	NA	7.7	NA	NA	NA	NA	NA	NA	NA	
CARBONATE PILE	D&M	31SW91-052	2/SS	9.5	10.2	9.85	CL	Tails-slm	NA	31.1	NA	NA	NA	NA	NA	NA	NA	
CARBONATE PILE	D&M	31SW91-052	5/SS	15.0	16.0	15.50	SM	Tails-snd	NA	6.2	NA	100.0	14.9	NA	NA	NA	NA	
CARBONATE PILE	D&M	31SW91-052	6/SS	19.0	20.6	19.80	SM	Tails-snd	NA	8.5	NA	NA	NA	NA	NA	NA	NA	
CARBONATE PILE	D&M	31SW91-052	8/SS	29.2	31.0	30.10	CL	Alluvium	NA	27.8	2.58	NA	NA	49.0	23.9	NA	NA	
CARBONATE PILE	D&M	31SW91-052	9/SS	34.0	36.0	35.00	CL	Alluvium	NA	9.2	NA	NA	NA	NA	NA	NA	NA	
CARBONATE PILE	D&M	31SW91-052	10/SS	39.0	41.0	40.00	CL	Alluvium	NA	22.2	NA	NA	NA	NA	NA	NA	NA	
CARBONATE PILE	D&M	31SW91-052	12/SS	49.0	51.0	50.00	CL	Alluvium	NA	28.8	NA	NA	NA	NA	NA	NA	NA	
CARBONATE PILE	D&M	31SW91-056	1/SS	4.5	5.5	5.00	SM	Tails-snd	NA	12.4	2.69	100.0	35.7	NA	NA	NA	NA	
CARBONATE PILE	D&M	31SW91-056	5/SS	19.0	19.4	19.20	CL	Alluvium	NA	15.5	NA	NA	NA	NA	NA	NA	NA	
CARBONATE PILE	D&M	31SW91-056	6/SS	24.0	26.0	25.00	CL	Alluvium	NA	19.8	NA	NA	NA	NA	NA	NA	NA	
CARBONATE PILE	D&M	31SW91-056	7/SS	29.0	31.0	30.00	CL	Alluvium	NA	19.4	NA	NA	NA	NA	NA	NA	NA	
CARBONATE PILE	D&M	31SW91-056	8/SS	34.5	34.6	34.55	Km	Shale	NA	3.8	NA	NA	NA	NA	NA	NA	NA	
CARBONATE PILE	D&M	TP-6	1/ST	3.5	4.0	3.75	SM	Tails-snd	86.1	4.7	NA	NA	NA	NA	NA	NA	NA	
CARBONATE PILE	D&M	TP-6	4/BULK	4.5	4.5	4.50	SM	Tails-snd	NA	5.1	NA	NA	NA	NP	NP	101.9	17.2	Consol, Perm
CARBONATE PILE	D&M	TP-6	2/ST	6.0	6.5	6.25	ML	Tails-slm(?)	88.3	27.2	NA	NA	NA	21.5	0.2	NA	NA	
CARBONATE PILE	D&M	TP-6	3/ST	9.0	9.5	9.25	ML	Tails-slm(?)	71.0	35.4	NA	NA	NA	NA	NA	NA	NA	

7/10

JFC
10/4/94

4/10

MRAP - 71002207 - GEOTECHNICAL DATA ...SE FOR MONTICELLO MILLSITE CHARACTER... ...TION – R.N. MORRIS: CREATED 09/30/91: LAST UPDATED 11/22/91

AREA	DATA SOURC	BORING OR TEST PIT NUMBER	SAMPLE NUMBER & TYPE	TOP OF SAMPLE (FEET)	BASE OF SAMPLE (FEET)	SAMPLE MIDPOINT (FEET)	USCS SYMBOL	MATERIAL TYPE	IN-PLACE DRY DENSITY (PCF)	NATURAL MOISTURE CONTENT (PERCENT)	SPECIFIC GRAVITY	FRACTION PASSING #4 SIEVE (PERCENT)	FRACTION PASSING #200 SIEVE (PERCENT)	LIQUID LIMIT	PLASTICITY INDEX	ASTM D 698 MAXIMUM DRY DENSITY (PCF)	ASTM D 698 OPTIMUM MOISTURE CONTENT (PERCENT)	OTHER TESTS
CARBONATE PILE	D&M	TP-6	4/ST	10.5	11.0	10.75	CL	Tails-slm	70.6	48.3	NA	NA	NA	NA	NA	NA	NA	
CARBONATE PILE	D&M	TP-6	6/ST	17.0	17.5	17.25	SM	Tails-snd	73.3	19.6	NA	NA	NA	NA	NA	NA	NA	
CARBONATE PILE	D&M	TP-6	-/BULK	18.0	18.0	18.00	SM	Tails-snd(?)	NA	15.5	NA	100.0	46.4	NA	NA	95.1	18.9	
CARBONATE PILE	D&M	TP-11	-/BULK	6.0	6.0	6.00	SM	Tails-snd(?)	NA	15.7	2.78	100.0	47.8	NA	NA	103.7	16.0	Dir Shear, Perm, Mod Proct
CARBONATE PILE	D&M	TP-11	-/BULK	15.0	15.0	15.00	CL	Tails-slm	NA	53.1	NA	100.0	91.3	NA	NA	96.8	24.0	
VANADIUM PILE	BENDIX	MRAP-85-04	MKB-682/ST	4.0	6.0	5.00	SC	Tails-snd&slm	80.7	39.8	2.62	100.0	44.0	27.0	10.0	NA	NA	Consol w/perm, CMR @15 bar
VANADIUM PILE	BENDIX	MRAP-85-04*	MKB-783/BULK	1.0	1.0	1.00	ML	Cover	NA	NA	NA	NA	71.0	NA	NA	114.3	13.7	
VANADIUM PILE	BENDIX	MRAP-85-04*	MKB-784/BULK	2.0	2.0	2.00	SP	Tails-snd	NA	NA	2.67	NA	NA	NA	NA	107.6	13.2	
VANADIUM PILE	BENDIX	MRAP-85-04*	MKB-786/BULK	7.0	7.0	7.00	ML	Tails-slm	NA	NA	2.60	NA	NA	NA	NA	113.6	15.3	
VANADIUM PILE	BENDIX	MRAP-85-05	MKB-678/ST	8.0	8.0	8.00	CL-ML	Tails-slm	76.1	41.7	2.63	100.0	94.0	21.0	5.0	NA	NA	Consol w/perm, CMR @15 bar
VANADIUM PILE	D&M	31SW91-031	3/ST	5.5	7.5	6.50	SM	Tails-snd	NA	9.4	2.69	100.0	21.4	39.1	17.1	NA	NA	
VANADIUM PILE	D&M	31SW91-032	1/SS	2.0	3.5	2.75	SM/SC	Cover	NA	16.8	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	D&M	31SW91-032	2/SS	3.5	5.0	4.25	SM/CL	Tails-snd/slm	NA	16.9	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	D&M	31SW91-032	3/SS	5.0	6.5	5.75	SM	Tails-snd(?)	NA	15.0	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	D&M	31SW91-032	5/SS	8.5	10.0	9.25	ML	Tails-slm	NA	34.1	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	D&M	31SW91-032	6/SS	10.0	11.5	10.75	SM	Tails-snd&slm	NA	11.5	2.69	100.0	21.6	NA	NA	NA	NA	
VANADIUM PILE	D&M	31SW91-032	7/SS	11.5	13.0	12.25	ML	Tails-slm	NA	25.0	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	D&M	31SW91-032	9/SS	15.0	16.5	15.75	SM/CL	Tails-snd/slm	NA	28.0	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	D&M	31SW91-032	10/SS	16.5	18.0	17.25	SM/CL	Tails-snd/slm	NA	18.3	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	D&M	31SW91-032	11/SS	19.0	19.5	19.25	CL	Alluvium	NA	20.9	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	D&M	31SW91-032	12/SS	19.5	21.5	20.50	CL	Alluvium	NA	18.7	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	D&M	31SW91-032	13/SS	21.5	23.5	22.50	CL	Alluvium	NA	20.1	NA	NA	NA	44.3	24.0	NA	NA	
VANADIUM PILE	D&M	31SW91-032	14/SS	24.0	25.0	24.50	CL	Alluvium	NA	18.0	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	D&M	31SW91-032	15/SS	25.5	27.5	26.50	CL	Alluvium	NA	23.9	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	D&M	31SW91-032	16/SS	27.5	29.5	28.50	CL	Alluvium	NA	17.6	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	D&M	31SW91-032	17/SS	29.5	31.5	30.50	CL	Alluvium	NA	17.9	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	D&M	31SW91-032	18/SS	31.5	33.5	32.50	CL	Alluvium	NA	19.5	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	D&M	31SW91-032	19/SS	33.5	34.8	34.15	CL	Alluvium	NA	17.6	NA	NA	NA	37.9	19.1	NA	NA	
VANADIUM PILE	D&M	31SW91-032	20/SS	35.5	37.5	36.50	CL	Alluvium	NA	23.7	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	D&M	31SW91-032	21/SS	37.5	39.5	38.50	CL	Alluvium	NA	22.2	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	D&M	31SW91-032	22/SS	39.5	41.0	40.25	CL	Alluvium	NA	23.1	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	D&M	31SW91-032	23/SS	41.5	42.8	42.15	SC/CL	Alluvium	NA	23.2	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	D&M	31SW91-032	24/SS	43.5	44.9	44.20	GC	Alluvium	NA	16.9	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	D&M	31SW91-032	28/SS	48.5	48.9	48.70	Km	Shale	NA	16.6	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	D&M	31SW91-40b	5/ST	6.0	7.5	6.75	CL	Tails-slm	95.1	25.3	NA	NA	NA	45.7	24.9	NA	NA	Perm, CMR
VANADIUM PILE	D&M	31SW91-40b	6/SS	13.5	14.8	14.15	CL	Tails-slm	NA	20.3	2.80	NA	NA	48.7	22.5	NA	NA	
VANADIUM PILE	D&M	31SW91-40b	9/SS	18.5	20.5	19.50	CL	Tails-slm	NA	19.4	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	D&M	31SW91-40b	11/SS	23.5	25.3	24.40	CL	Tails-slm	NA	23.4	NA	NA	NP	NA	NA	NA	NA	
VANADIUM PILE	D&M	31SW91-041	1/SS	5.0	6.0	5.50	CL	Tails(?)-slm(?)	NA	23.8	NA	NA	NA	31.7	14.0	NA	NA	
VANADIUM PILE	D&M	31SW91-041	2/SS	10.0	11.0	10.50	CL	Alluvium	NA	21.3	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	D&M	31SW91-041	3/SS	14.0	16.0	15.00	CL	Alluvium	NA	18.8	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	D&M	31SW91-041	6/SS	24.0	26.0	25.00	CL	Alluvium	NA	14.9	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	D&M	31SW91-041	7/SS	29.0	31.0	30.00	CL	Alluvium	NA	19.3	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	D&M	31SW91-041	8/SS	34.5	36.0	35.25	CL	Alluvium	NA	27.7	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	D&M	31SW91-041	9/SS	39.0	40.0	39.50	SC	Alluvium	NA	13.2	NA	100.0	40.1	NA	NA	NA	NA	
VANADIUM PILE	D&M	31SW91-041	10/SS	44.0	44.5	44.25	Kd	Sandstone	NA	9.3	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	D&M	TP-5	1/ST	4.5	5.0	4.75	SM	Tails-snd	90.1	7.4	NA	NA	NA	NP	NP	NA	NA	
VANADIUM PILE	D&M	TP-5	2/ST	5.5	6.0	5.75	CL	Tails-slm	78.7	51.8	NA	NA	NA	NA	NA	NA	NA	Uncont Comp
VANADIUM PILE	D&M	TP-5	4/ST	9.0	9.5	9.25	CL	Tails-slm	71.0	45.7	NA	NA	NA	NA	NA	NA	NA	Uncont Comp
VANADIUM PILE	D&M	TP-5	5/ST	11.0	11.5	11.25	CL	Tails-slm	84.8	18.5	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	D&M	TP-5	7/ST	14.0	14.5	14.25	CL	Tails(?)-slm(-?)	69.8	51.8	NA	NA	NA	NA	NA	NA	NA	
VANADIUM PILE	D&M	TP-12	-/BULK	6.0	6.0	6.00	CL	Tails-slm	NA	24.3	2.75	NA	NA	29.2	12.3	115.0	14.0	Perm, Mod Proct
VANADIUM PILE	D&M	TP-12	-/BULK	12.0	12.0	12.00	CL	Tails-slm	NA	53.9	2.84	NA	NA	44.7	20.5	100.7	21.2	Triax-CU/PP, Perm, Mod Proct, CMR
EAST PILE	BENDIX	MRAP-85-06	MKB-689/ST	2.0	4.0	3.00	SM	Tails-snd	96.4	5.2	2.67	100.0	42.0	NP	NP	NA	NA	Consol w/perm, CMR @15 bar
EAST PILE	BENDIX	MRAP-85-06*	MKB-779/BULK	1.0	1.0	1.00	ML	Cover	NA	NA	NA	100.0	52.0	NA	NA	111.2	14.1	
EAST PILE	BENDIX	MRAP-85-06*	MKB-780/BULK	3.0	3.0	3.00	SM(?)	Tails-snd	NA	NA	NA	NA	NA	NA	NA	107.1	15.3	
EAST PILE	BENDIX	MRAP-85-06*	MKB-782/BULK	15.0	15.0	15.00	SP(?)	Tails-snd(?)	NA	NA	2.70	NA	NA	NA	NA	103.8	15.8	
EAST PILE	BENDIX	MRAP-85-07	MKB-697/ST	2.0	4.0	3.00	SM	Tails-snd	94.0	9.9	2.81	100.0	19.0	NP	NP	NA	NA	Consol w/perm, CMR @15 bar
EAST PILE	BENDIX	MRAP-85-08	MKB-714/ST	12.0	14.0	13.00	CL	Tails-slm	108.6	34.4	2.70	100.0	81.0	41.0	22.0	NA	NA	Consol w/perm, CMR @15 bar
EAST PILE	BENDIX	MRAP-85-09	MKB-706/ST	4.0	6.0	5.00	ML	Tails-slm	100.7	21.4	2.63	100.0	88.0	42.0	13.0	NA	NA	Consol w/perm, CMR @15 bar
EAST PILE	D&M	31SW91-002	1/SS	3.5	5.5	4.50	SP	Tails-snd	NA	12.8	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-002	2/SS	8.5	10.5	9.50	SM/ML	Tails-snd/slm	NA	15.8	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-002	3/SS	13.5	15.5	14.50	SM/ML	Tails-snd/slm	NA	15.3	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-002	NA	24.0	25.0	24.50	CL	Alluvium	NA	18.5	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-002	10/SS	28.0	30.0	29.00	CL	Alluvium	NA	16.5	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-003	3/SS	7.0	8.3	7.65	ML	MVP spoil	NA	7.2	NA	NA	NA	NA	NA	NA	NA	

JFC
10/4/94

1/17

MRAP - 710002307 - GEOTECHNICAL DATA BASE FOR MONTICELLO MILLSITE CHARACTERIZATION -- R.N. MORRIS: CREATED 08/30/91; LAST UPDATED 11/22/91

AREA	DATA SOURC	BORING OR TEST PIT NUMBER	SAMPLE NUMBER & TYPE	TOP OF SAMPLE (FEET)	BASE OF SAMPLE (FEET)	SAMPLE MIDPOINT (FEET)	USCS SYMBOL	MATERIAL TYPE	IN-PLACE DRY DENSITY (PCF)	NATURAL MOISTURE CONTENT (PERCENT)	SPECIFIC GRAVITY	FRACTION PASSING #4 SIEVE (PERCENT)	FRACTION PASSING #200 SIEVE (PERCENT)	LIQUID LIMIT	PLASTICITY INDEX	ASTM D 698 MAXIMUM DRY DENSITY (PCF)	ASTM D 698 OPTIMUM MOISTURE CONTENT (PERCENT)	OTHER TESTS
EAST PILE	D&M	31SW91-003	9/SS	20.5	22.0	21.25	CL	Tails-slm	NA	58.2	NA	NA	NA	48.4	22.3	NA	NA	
EAST PILE	D&M	31SW91-003	11/SS	24.5	26.0	25.25	CL/SM	Tails-snd/slm	NA	34.5	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-003	12/SS	26.5	28.0	27.25	CL/SM/ML	Tails-snd/slm	NA	50.1	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-003	13/SS	28.5	30.0	29.25	ML	Tails-snd&slm	NA	28.7	NA	100.0	73.3	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-003	19/SS	40.0	40.5	40.25	ML	Alluvium	NA	24.4	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-003	20/SS	42.0	42.7	42.35	ML	Alluvium	NA	23.8	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-003	21/SS	46.0	47.5	46.75	ML	Alluvium	NA	25.5	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-003	22/SS	48.0	48.7	48.35	ML	Alluvium	NA	24.0	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-004	1/SS	3.5	5.0	4.25	CL	MVP spoil	NA	18.4	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-004	2/SS	9.5	10.0	9.75	SM	Tails-snd	NA	28.4	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-004	3/U	14.5	15.0	14.75	CL	Tails-slm	82.1	33.1	NA	NA	NA	35.5	12.7	NA	NA	
EAST PILE	D&M	31SW91-004	4/U	19.5	20.0	19.75	CL	Alluvium	95.9	23.5	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-004	5/SS	23.5	25.0	24.25	CL	Alluvium	NA	19.8	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-004	6/SS	27.0	28.4	27.70	CL	Alluvium	NA	19.5	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-004	7/SS	28.5	30.0	29.25	CL	Alluvium	NA	18.4	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-004	8/SS	33.5	35.0	34.25	CL	Alluvium	NA	22.7	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-004	9/U	39.5	40.0	39.75	CL	Alluvium	100.2	22.5	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-008	1/U	4.5	5.0	4.75	SM	Tails-snd	99.2	7.0	NA	100.0	21.0	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-008	4/U	15.0	15.5	15.25	CL	Tails-slm	54.1	82.8	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-008	6/U	19.5	20.0	19.75	ML	Tails-slm	84.3	30.1	NA	NA	NA	23.2	2.8	NA	NA	Triax-CUPP
EAST PILE	D&M	31SW91-008	7/U	23.5	25.0	24.25	CH	Alluvium	67.3	57.4	NA	NA	NA	51.4	23.5	NA	NA	
EAST PILE	D&M	31SW91-008	9/U	28.5	30.0	29.25	CL	Alluvium	81.1	34.2	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-009	4/ST	16.0	17.5	16.75	CL	Tails-snd&slm	95.1	28.0	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-009	7/ST	20.0	22.0	21.00	CL	Tails-slm	60.0	68.3	NA	NA	NA	NA	NA	NA	NA	Unconf Comp, Consol, Perm, CMR
EAST PILE	D&M	31SW91-010a	1/SS	9.0	10.5	9.75	CL	Alluvium	NA	10.8	NA	NA	NA	38.9	18.5	NA	NA	
EAST PILE	D&M	31SW91-010a	3/SS	19.0	20.5	19.75	CL	Alluvium	NA	15.2	NA	NA	NA	NA	NA	NP	NA	
EAST PILE	D&M	31SW91-010a	4/SS	24.0	25.5	24.75	CL	Alluvium	NA	14.8	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-010a	5/SS	29.0	30.5	29.75	CL	Alluvium	NA	15.1	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-010b	3/SS	34.0	35.5	34.75	CL	Alluvium	NA	17.9	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-010b	4/SS	39.0	40.5	39.75	CL	Alluvium	NA	17.8	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-010b	5/SS	44.0	45.5	44.75	CL/SC	Alluvium	NA	21.1	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-010b	6/SS	49.0	49.5	49.25	SC	Alluvium	NA	12.7	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-013	3/ST	10.5	12.5	11.50	CL	Tails-slm	58.8	67.2	NA	NA	NA	NA	NA	NA	NA	Unconf Comp
EAST PILE	D&M	31SW91-013	8/ST	25.5	27.5	26.50	CL-ML	Tails-snd/slm	69.7	90.6	NA	NA	NA	NA	NA	NA	NA	Triax-CUPP, Consol
EAST PILE	D&M	31SW91-013	9/SS	28.5	30.5	29.50	CL/SM	Tails-snd/slm	NA	28.7	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-014	1/U	4.5	5.0	4.75	CL	MVP spoil	108.5	8.4	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-014	2/U	9.5	10.0	9.75	SM	Tails-snd	96.7	7.8	NA	100.0	22.0	NP	NA	NA	NA	Dir Shear
EAST PILE	D&M	31SW91-014	3/U	14.5	15.0	14.75	CL	Alluvium(?)	90.4	25.1	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-014	7/U	19.5	20.0	19.75	CL	Alluvium(?)	55.0	79.9	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-014	9/U	24.0	24.5	24.25	CL	Alluvium(?)	62.6	62.4	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-014	16/SS	48.0	49.3	48.65	Km	Shale	NA	13.4	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-018b	1/U	2.5	3.8	3.15	SM	Tails-snd	88.3	7.8	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-018b	2/U	7.5	8.8	8.15	SM	Alluvium	85.6	28.4	2.81	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-018b	3/U	12.5	13.7	13.10	CL/SC	Alluvium	NA	18.5	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-019	1/SS	5.5	6.5	6.00	ML	Tails-snd&slm(?)	NA	10.3	NA	100.0	55.4	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-019	3/SS	8.0	9.5	8.75	SM	Tails-snd	NA	12.4	NA	99.2	48.1	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-019	5/SS	11.0	12.5	11.75	SM	Tails-snd	NA	8.2	NA	99.5	30.8	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-019	6/SS	12.5	14.0	13.25	SM	Tails-snd	NA	9.0	NA	100.0	33.2	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-019	7/SS	14.0	15.5	14.75	SM	Tails-snd	NA	17.7	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-019	8/SS	15.5	17.0	16.25	SM	Tails-snd	NA	17.9	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-019	9/SS	17.0	18.5	17.75	CL	Tails-slm	NA	43.7	NA	NA	NA	35.0	13.9	NA	NA	
EAST PILE	D&M	31SW91-019	10/SS	18.5	20.0	19.25	CL	Tails-slm	NA	34.4	NA	NA	NA	44.7	18.7	NA	NA	
EAST PILE	D&M	31SW91-019	11/SS	20.0	21.5	20.75	CL	Alluvium(?)	NA	25.5	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-019	12/SS	21.5	23.0	22.25	CL	Alluvium(?)	NA	24.7	NA	NA	NA	39.0	19.0	NA	NA	
EAST PILE	D&M	31SW91-019	15/SS	33.0	33.5	33.25	SC	Alluvium	NA	5.7	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-020	1/SS	4.0	5.5	4.75	CL	Alluvium	NA	10.9	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-020	2/SS	9.0	10.5	9.75	CL	Alluvium	NA	13.2	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-020	3/SS	14.0	15.5	14.75	CL	Alluvium	NA	18.6	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-020	4/SS	19.0	20.5	19.75	CL	Alluvium	NA	13.8	NA	NA	NA	45.0	23.8	NA	NA	
EAST PILE	D&M	31SW91-020	5/SS	24.0	25.5	24.75	CL	Alluvium	NA	18.0	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-020	6/SS	29.0	30.5	29.75	SC	Alluvium	NA	21.4	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-020	7/SS	34.0	35.0	34.50	GC	Alluvium	NA	16.7	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-025	3/U	13.0	13.7	13.35	CL	Alluvium	101.8	22.9	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-025	4/U	18.0	19.5	18.75	CL	Alluvium	98.5	25.3	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-025	3/SS	23.5	24.8	24.15	SC(?)	Alluvium	97.9	23.2	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	31SW91-025	6/U	29.3	29.8	29.55	Km	Shale	113.4	18.1	NA	NA	NA	NA	NA	NA	NA	

JFC
10/4/91

MRAP - 71000237 - GEOTECHNICAL DATA BASE FOR MONTICELLO MILLSITE CHARACTERIZATION -- R.N. MORRIS; CREATED 09/20/91; LAST UPDATED 11/22/91

AREA	DATA SOURC	BORING OR TEST PIT NUMBER	SAMPLE NUMBER & TYPE	TOP OF SAMPLE (FEET)	BASE OF SAMPLE (FEET)	SAMPLE MIDPOINT (FEET)	USCS SYMBOL	MATERIAL TYPE	IN-PLACE DRY DENSITY (PCF)	NATURAL MOISTURE CONTENT (PERCENT)	SPECIFIC GRAVITY	FRACTION PASSING #4 SIEVE (PERCENT)	FRACTION PASSING #200 SIEVE (PERCENT)	LIQUID LIMIT	PLASTICITY INDEX	ASTM D 698 MAXIMUM DRY DENSITY (PCF)	ASTM D 698 OPTIMUM MOISTURE CONTENT (PERCENT)	OTHER TESTS
EAST PILE	D&M	TP-1	1/ST	6.5	7.0	6.75	CL	MVP spoil	103.3	11.1	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	TP-1	-/BULK	7.0	7.0	7.00	CL	MVP spoil	NA	18.2	NA	NA	NA	NA	NA	103.1	18.1	Perm, Mod Proc
EAST PILE	D&M	TP-1	2/ST	9.0	9.5	9.25	CL	MVP spoil	98.8	22.4	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	TP-1	3/ST	14.0	14.5	14.25	SM	Tails-end	101.9	7.4	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	TP-1	-/BULK	15.0	15.0	15.00	SM	Tails-end	NA	10.8	NA	99.0	31.0	NA	NA	109.4	14.3	
EAST PILE	D&M	TP-2	1/ST	9.0	9.5	9.25	SM	Tails-slm	91.8	27.9	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	TP-2	-/BULK	10.0	10.0	10.00	ML	Tails-slm	NA	33.0	NA	NA	NA	NA	NA	103.2	20.0	Consol, CMR
EAST PILE	D&M	TP-2	2/ST	10.5	11.0	10.75	SM	Tails-end	87.3	1.7	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	TP-2	3/ST	13.5	14.0	13.75	ML	Tails-end&slm(?)	65.8	53.8	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	TP-2	-/BULK	14.0	14.0	14.00	ML	Tails-end&slm(?)	NA	7.8	NA	100.0	54.4	NA	NA	103.5	17.1	CMR
EAST PILE	D&M	TP-2	4/ST	14.5	15.0	14.75	ML	Tails-end&slm(?)	74.0	25.4	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	TP-4	-/BULK	9.0	9.0	9.00	ML	Tails-end&slm	NA	32.4	NA	100.0	91.0	NA	NA	98.8	21.5	Dir Shear, Perm, CMR
EAST PILE	D&M	TP-4	3/ST	9.5	10.0	9.75	ML	Tails-end&slm	69.6	7.9	NA	NA	NA	NA	NA	NA	NA	
EAST PILE	D&M	TP-4	-/BULK	14.0	14.0	14.00	ML	Tails-end&slm	NA	14.7	2.71	100.0	56.6	NA	NA	101.8	17.3	Perm, CMR
EAST PILE	D&M	TP-4	5/ST	14.5	15.0	14.75	ML	Tails-end&slm	61.8	57.1	NA	100.0	98.1	NA	NA	NA	NA	
ACID PILE	BENDIX	MRAP-85-10	MKB-723/ST	4.0	6.0	5.00	CL	Tails-slm	66.1	43.5	2.63	100.0	78.0	29.0	11.0	NA	NA	
ACID PILE	BENDIX	MRAP-85-10"	MKB-791/BULK	1.0	1.0	1.00	SM	Cover	NA	NA	NA	100.0	49.0	NA	NA	111.8	16.9	
ACID PILE	BENDIX	MRAP-85-10"	MKB-792/BULK	3.0	3.0	3.00	SP	Tails-end	NA	NA	NA	NA	NA	NA	NA	110.4	12.4	
ACID PILE	BENDIX	MRAP-85-10"	MKB-793/BULK	6.0	6.0	6.00	CL	Tails-slm	NA	NA	2.78	NA	NA	NA	NA	94.5	28.3	
ACID PILE	BENDIX	MRAP-85-11	MKB-741/ST	4.0	6.0	5.00	CL	Tails-slm	74.8	39.8	2.69	100.0	72.0	44.0	20.0	NA	NA	Consol w/perm, CMR @15 bar
ACID PILE	BENDIX	MRAP-85-12	MKB-732/ST	4.0	6.0	5.00	ML	Tails-slm	76.4	40.5	2.68	100.0	87.0	47.0	10.0	NA	NA	Consol w/perm, CMR @15 bar
ACID PILE	D&M	31SW91-026	1/SS	4.5	5.0	4.75	CL	Tails-end&slm	NA	30.0	NA	NA	NA	33.8	13.1	NA	NA	
ACID PILE	D&M	31SW91-026	2/SS	8.5	9.0	8.75	CL	Alluvium	NA	12.8	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	31SW91-026	5/SS	13.5	14.5	14.00	CL	Alluvium	NA	17.1	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	31SW91-027	3/ST	6.0	8.0	7.00	CH	Alluvium	71.5	48.0	NA	NA	NA	58.9	28.7	NA	NA	Triax-CUPP, Unconf Comp, Perm, CMR
ACID PILE	D&M	31SW91-027	4/ST	9.0	11.5	10.25	CH	Alluvium	58.0	75.2	NA	NA	NA	68.5	31.4	NA	NA	Triax-CUPP, Unconf Comp, Consol
ACID PILE	D&M	31SW91-027	6/ST	19.0	20.5	19.75	CL/SC	Alluvium	109.3	18.3	NA	NA	NA	37.4	21.0	NA	NA	Triax-CUPP, Unconf Comp, Perm, CMR
ACID PILE	D&M	31SW91-028	2/SS	4.0	6.0	5.00	SM	Tails-end(?)	NA	17.2	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	31SW91-028	3/SS	6.0	6.9	6.45	SM	Tails-end	NA	17.2	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	31SW91-028	4/SS	9.0	10.0	9.50	CL-ML	Tails-slm	NA	37.6	2.70	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	31SW91-028	5/SS	10.5	12.0	11.25	ML	Tails-slm	NA	38.5	NA	NA	NA	34.8	9.6	NA	NA	
ACID PILE	D&M	31SW91-028	6/SS	13.5	15.0	14.25	ML	Tails-end&slm	NA	27.9	NA	100.0	51.7	NA	NA	NA	NA	
ACID PILE	D&M	31SW91-028	7/SS	15.0	17.0	16.00	SM	Tails-end&slm	NA	18.5	NA	100.0	34.7	NA	NA	NA	NA	
ACID PILE	D&M	31SW91-028	8/SS	18.0	19.0	18.50	ML	Tails-slm	NA	43.3	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	31SW91-028	9/SS	19.0	21.0	20.00	ML	Tails-slm	NA	38.0	NA	100.0	65.9	NA	NA	NA	NA	
ACID PILE	D&M	31SW91-028	10/SS	22.5	23.0	22.75	SM	Tails-end	NA	60.0	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	31SW91-028	11/SS	24.0	25.0	24.50	ML/CL	Tails-end&slm	NA	53.1	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	31SW91-028	12/SS	25.0	27.0	26.00	ML/CL	Tails-end&slm	NA	58.3	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	31SW91-028	13/SS	27.0	29.0	28.00	CL	Tails-end&slm	NA	58.9	NA	100.0	92.0	NA	NA	NA	NA	
ACID PILE	D&M	31SW91-028	14/SS	29.0	30.5	29.75	ML/CL	Tails-end&slm	NA	51.4	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	31SW91-028	15/SS	31.0	33.0	32.00	CL	Tails-end&slm	NA	64.7	NA	NA	NA	46.8	21.2	NA	NA	
ACID PILE	D&M	31SW91-028	16/SS	33.5	34.0	33.75	ML	Tails-end&slm	NA	41.3	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	31SW91-028	17/SS	36.0	37.0	36.50	ML/SC	Alluvium(?)	NA	19.1	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	31SW91-028	18/SS	37.5	39.0	38.25	SC/CL	Alluvium	NA	20.9	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	31SW91-028	19/SS	39.0	41.0	40.00	CL	Alluvium	NA	24.5	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	31SW91-034	1/SS	5.0	6.0	5.50	ML/CL	Tails-slm	NA	57.3	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	31SW91-034	3/SS	14.0	16.0	15.00	CL-ML	Tails-slm	NA	67.3	2.88	NA	NA	47.4	17.8	NA	NA	
ACID PILE	D&M	31SW91-034	7/SS	29.0	29.5	29.25	Km	Shale	NA	10.1	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	31SW91-035	3/SS	5.0	5.5	5.25	SM	Tails-end	NA	4.6	NA	100.0	20.7	NA	NA	NA	NA	
ACID PILE	D&M	31SW91-035	4/SS	10.0	10.5	10.25	SM	Tails-end	NA	5.1	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	31SW91-035	8/SS	15.0	15.5	15.25	SM	Tails-end	NA	15.3	NA	100.0	28.0	NA	NA	NA	NA	
ACID PILE	D&M	31SW91-035	9/ST	18.0	20.0	19.00	SM	Tails-end	100.8	13.4	NA	100.0	17.2	NA	NA	NA	NA	Dir Shear, Perm, CMR
ACID PILE	D&M	31SW91-035	12/SS	24.5	25.0	24.75	CL/ML	Tails-slm	NA	59.4	NA	NA	NA	46.0	18.3	NA	NA	
ACID PILE	D&M	TP-7	-/BULK	2.0	2.0	2.00	SM	Tails-end	NA	9.4	2.71	100.0	42.3	NP	NP	109.0	14.5	Triax-CUPP, Consol, Perm, Mod Proc, CMR
ACID PILE	D&M	TP-7	2/ST	5.0	5.5	5.25	CL	Tails-slm	62.5	62.8	NA	NA	NA	NA	NA	NA	NA	Unconf Shear
ACID PILE	D&M	TP-7	3/ST	6.5	7.0	6.75	CL	Tails-slm	66.1	54.4	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	TP-7	4/ST	9.5	10.0	9.75	CL	Tails-slm	51.3	65.0	NA	NA	NA	NA	NA	NA	NA	Unconf Shear
ACID PILE	D&M	TP-7	5/ST	12.5	13.0	12.75	CL	Tails-slm	53.1	74.1	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	TP-7	6/ST	16.5	17.0	16.75	CL	Tails-slm	51.4	65.1	NA	NA	NA	NA	NA	NA	NA	Unconf Shear
ACID PILE	D&M	TP-8	1/ST	2.5	3.0	2.75	SM/ML	Tails-end/slm	78.5	11.8	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	TP-8	2/ST	4.5	5.0	4.75	SM	Tails-end	90.0	9.5	2.82	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	TP-8	-/BULK	4.5	4.5	4.50	SM	Tails-end	NA	7.6	NA	100.0	28.9	NA	NA	103.8	15.9	Dir Shear, Perm, Mod Proc, CMR
ACID PILE	D&M	TP-8	3/ST	6.0	6.5	6.25	SM	Tails-end(?)	82.5	14.3	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	TP-8	4/ST	10.0	10.5	10.25	ML	Tails-slm	65.7	30.6	2.75	100.0	63.5	NA	NA	NA	NA	
ACID PILE	D&M	TP-8	5/ST	12.0	12.5	12.25	CL	Tails-slm	59.2	70.9	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	TP-8	-/BULK	13.0	13.0	13.00	CL	Tails-slm	NA	NA	NA	NA	NA	NA	NA	NA	NA	Perm

MRAP - 71000207 - GEOTECHNICAL DATA BASE FOR MONTICELLO MILLSITE CHARACTERI... ION -- R.N. MORRIS: CREATED 09/30/91: LAST UPDATED 11/22/91

AREA	DATA SOURC	BORING OR TEST PIT NUMBER	SAMPLE NUMBER & TYPE	TOP OF SAMPLE (FEET)	BASE OF SAMPLE (FEET)	SAMPLE MIDPOINT (FEET)	USCS SYMBOL	MATERIAL TYPE	IN-PLACE DRY DENSITY (PCF)	NATURAL MOISTURE CONTENT (PERCENT)	SPECIFIC GRAVITY	FRACTION PASSING #4 SIEVE (PERCENT)	FRACTION PASSING #200 SIEVE (PERCENT)	LIQUID LIMIT	PLASTICITY INDEX	ASTM D 698 MAXIMUM DRY DENSITY (PCF)	ASTM D 698 OPTIMUM MOISTURE CONTENT (PERCENT)	OTHER TESTS
ACID PILE	D&M	TP-4	1/ST	1.5	2.0	1.75	SM	Tails-end	89.6	4.5	NA	NA	NA	NA	NA	NA	NA	
ACID PILE	D&M	TP-4	2/ST	3.0	3.5	3.25	SM	Tails-end	86.0	6.8	NA	100.0	18.8	NA	NA	NA	NA	
ACID PILE	D&M	TP-4	4/BULK	10.0	10.0	10.00	ML	Alluvium	NA	23.4	NA	93.8	69.0	34.2	18.1	114.0	14.8	Perm, Mod Proc, CMR
SOMERVILLE TRACT	BENDIX	MRAP-85-17	MKB-786/SS	0.0	2.0	1.00	SC	Alluvium	NA	46.2	2.63	100.0	31.0	33.0	10.0	NA	NA	Perm, CMR @15 bar
SOMERVILLE TRACT	BENDIX	MRAP-85-17	MKB-830/BULK	0.0	5.0	2.50	ML	Alluvium(Shale?)	NA	NA	NA	87.0	81.0	NA	NA	108.3	11.0	
SOMERVILLE TRACT	BENDIX	MRAP-85-18	MKB-788/SS	0.0	2.0	1.00	CL	Alluvium	NA	14.3	2.55	100.0	65.0	32.0	14.0	NA	NA	Perm, Consol w/perm, CMR @15 bar
SOMERVILLE TRACT	BENDIX	MRAP-85-18	MKB-833/BULK	0.0	5.0	2.50	ML	Alluvium	NA	NA	NA	100.0	80.0	NA	NA	103.3	19.0	
BLM COMPOUND	BENDIX	MRAP-85-20	MKB-753/SS	0.0	2.0	1.00	OL	Alluvium	NA	10.8	2.62	100.0	80.0	41.0	7.0	NA	NA	Perm, CMR @15 bar
BLM COMPOUND	BENDIX	MRAP-85-20	MKB-836/BULK	0.0	3.0	1.50	OL	Alluvium	NA	NA	NA	100.0	71.0	NA	NA	101.9	18.9	
BLM COMPOUND	D&M	36SE91-058	2/SS	3.5	4.5	4.00	CL	Alluvium	NA	25.4	NA	NA	NA	40.7	20.0	NA	NA	
BLM COMPOUND	D&M	36SE91-058	3B/SS	4.5	5.5	5.00	CL	Alluvium	NA	31.6	NA	NA	NA	38.0	16.6	NA	NA	
BLM COMPOUND	D&M	36SE91-058	4B/SS	9.0	10.5	9.75	ML	Alluvium	NA	27.1	NA	100.0	79.2	NA	NA	NA	NA	
VALLEY BOTTOM	BENDIX	MRAP-85-21	MKB-756/SS	0.0	2.0	1.00	CL	Alluvium	NA	7.5	2.60	NA	NA	30.0	10.0	NA	NA	Perm, CMR @15 bar
VALLEY BOTTOM	BENDIX	MRAP-85-21	MKB-826/BULK	0.0	3.0	1.50	SM	Tails-end	NA	NA	NA	100.0	43.0	NA	NA	115.2	13.6	
VALLEY BOTTOM	D&M	31SW91-001	3/SS	3.5	4.8	4.15	CL	Alluvium	NA	12.8	NA	NA	NA	NA	NA	NA	NA	
VALLEY BOTTOM	D&M	31SW91-001	7/SS	8.5	10.0	9.25	CL	Alluvium	NA	15.8	NA	NA	NA	NA	NA	NA	NA	
VALLEY BOTTOM	D&M	31SW91-001	8/SS	13.5	14.3	13.90	CL	Alluvium	NA	15.3	NA	NA	NA	NA	NA	NA	NA	
VALLEY BOTTOM	D&M	31SW91-001	11/BULK	24.0	25.0	24.50	GC	Alluvium	NA	16.5	NA	NA	NA	NA	NA	NA	NA	
VALLEY BOTTOM	D&M	31SW91-022	2/SS	8.6	8.9	8.75	SC	Alluvium	NA	9.9	NA	NA	NA	NA	NA	NA	NA	
VALLEY BOTTOM	D&M	31SW91-023	3/SS	13.5	13.8	13.65	SW	Alluvium	NA	6.4	NA	NA	NA	NA	NA	NA	NA	
VALLEY BOTTOM	D&M	31SW91-030	1/SS	4.0	6.0	5.00	CL	Alluvium	NA	10.9	NA	NA	NA	NA	NA	NA	NA	
VALLEY BOTTOM	D&M	31SW91-030	2/SS	9.5	11.0	10.25	SC	Alluvium	NA	12.5	NA	NA	NA	NA	NA	NA	NA	
VALLEY BOTTOM	D&M	31SW91-030	3/SS	14.3	14.7	14.50	Km	Shale	NA	12.3	NA	NA	NA	NA	NA	NA	NA	
VALLEY BOTTOM	D&M	36SE91-071	1/SS	3.5	4.0	3.75	SM	Alluvium	NA	10.2	NA	63.1	46.7	NA	NA	NA	NA	
VALLEY BOTTOM	D&M	36SE91-071	4/SS	9.5	10.0	9.75	SP	Alluvium	NA	8.1	NA	NA	NA	NA	NA	NA	NA	
VALLEY BOTTOM	D&M	36SE91-071	6/SS	14.0	14.5	14.25	SM	Alluvium	NA	13.8	NA	50.4	18.8	NA	NA	NA	NA	
VALLEY BOTTOM	D&M	36SE91-072	1/SS	4.5	5.0	4.75	ML	Alluvium	NA	10.7	NA	97.3	71.3	NA	NA	NA	NA	
VALLEY BOTTOM	D&M	36SE91-084a	3/SS	5.0	5.5	5.25	ML	Alluvium(?)	NA	9.5	NA	100.0	51.4	NA	NA	NA	NA	
VALLEY BOTTOM	D&M	36SE91-084a	4/SS	10.0	10.5	10.25	ML	Alluvium(?)	NA	9.9	NA	NA	NA	NA	NA	NA	NA	
VALLEY BOTTOM	D&M	36SE91-084a	5/SS	13.5	14.5	14.00	CL	Alluvium(?)	NA	13.2	NA	NA	NA	NA	NA	NA	NA	
VALLEY BOTTOM	D&M	TP-13	4/BULK	5.0	5.0	5.00	GC	Alluvium	NA	20.2	NA	65.1	41.9	38.4	17.6	116.1	13.2	
MAIN MILLSITE	D&M	31SW91-055b	5/SS	6.0	6.5	6.25	CL	Alluvium	NA	27.7	NA	NA	NA	NA	NA	NA	NA	
MAIN MILLSITE	D&M	31SW91-055b	9A/SS	9.3	9.8	9.55	CL	Alluvium	NA	26.8	NA	NA	NA	NA	NA	NA	NA	
MAIN MILLSITE	D&M	31SW91-055b	10/SS	13.5	15.0	14.25	CL	Alluvium	NA	31.6	NA	NA	NA	NA	NA	NA	NA	
MAIN MILLSITE	D&M	36SE91-061	2/SS	3.8	4.5	4.15	CL	Alluvium(Shale?)	NA	23.9	NA	NA	NA	NA	NA	NA	NA	
MAIN MILLSITE	D&M	36SE91-067a	1B/SS	0.5	2.0	1.25	CL	Fill	NA	11.8	NA	NA	NA	48.3	23.9	NA	NA	
SOUTH VALLEY WALL	D&M	31SW91-011	3/SS	10.0	10.5	10.25	CL	Alluvium(Shale?)	NA	23.6	NA	NA	NA	NA	NA	NA	NA	
SOUTH VALLEY WALL	D&M	31SW91-021	4/SS	8.5	9.0	8.75	CL	Alluvium	NA	7.3	NA	NA	NA	NA	NA	NA	NA	
SOUTH VALLEY WALL	D&M	31SW91-022	4/SS	10.0	10.5	10.25	CL	Alluvium	NA	10.8	NA	NA	NA	NA	NA	NA	NA	
SOUTH VALLEY WALL	D&M	31SW91-036	1/SS	2.0	2.5	2.25	CL	Alluvium	NA	8.6	NA	NA	NA	NA	NA	NA	NA	
SOUTH VALLEY WALL	D&M	31SW91-036	3/SS	9.0	10.3	9.65	CL	Alluvium	NA	14.2	NA	NA	NA	NA	NA	NA	NA	
SOUTH VALLEY WALL	D&M	31SW91-036	4/SS	10.3	11.0	10.65	SC	Alluvium	NA	14.6	NA	NA	NA	NA	NA	NA	NA	
SOUTH VALLEY WALL	D&M	31SW91-036	5/SS	14.0	14.2	14.10	CL	Alluvium	NA	12.2	NA	NA	NA	NA	NA	NA	NA	
SOUTH VALLEY WALL	D&M	31SW91-054	4/SS	4.5	5.0	4.75	CL	Alluvium	NA	11.4	NA	100.0	80.4	43.3	23.4	NA	NA	
NORTH VALLEY WALL	D&M	31SW91-016	1B/SS	3.5	5.5	4.50	CL	Alluvium(?)	NA	12.9	NA	NA	NA	38.3	17.1	NA	NA	
NORTH VALLEY WALL	D&M	31SW91-016	2B/SS	8.5	10.5	9.50	CL	Alluvium(?)	NA	20.1	NA	100.0	87.8	NA	NA	NA	NA	
NORTH VALLEY WALL	D&M	31SW91-033	1/SS	2.0	4.0	3.00	CL	Alluvium	NA	14.2	NA	NA	NA	NA	NA	NA	NA	
NORTH VALLEY WALL	D&M	31SW91-033	3/SS	9.0	11.0	10.00	CL	Alluvium	NA	10.9	NA	NA	NA	33.6	13.8	NA	NA	
NORTH VALLEY WALL	D&M	31SW91-053	3B/SS	8.5	9.0	8.75	CL	Alluvium(?)	NA	21.2	NA	NA	NA	NA	NA	NA	NA	
NORTH VALLEY WALL	D&M	31SW91-053	6B/SS	14.5	15.0	14.75	CL	Alluvium(?)	NA	23.8	2.70	NA	NA	48.3	25.0	NA	NA	
NORTH VALLEY WALL	D&M	31SW91-053	7B/SS	18.5	19.0	18.75	CL	Alluvium(?)	NA	23.8	NA	NA	NA	NA	NA	NA	NA	
BLM PROPERTY-NORT	D&M	36SE91-073	1/SS	3.5	3.8	3.65	CL	Alluvium	NA	11.0	NA	NA	NA	38.9	15.9	NA	NA	
BLM PROPERTY-NORT	D&M	36SE91-073	3/SS	13.5	14.3	13.90	CL	Alluvium	NA	15.0	NA	NA	NA	NA	NA	NA	NA	
BLM PROPERTY-NORT	D&M	36SE91-073	4/SS	20.0	20.5	20.25	CL	Alluvium	NA	30.1	NA	NA	NA	44.9	22.8	NA	NA	
BLM PROPERTY-NORT	D&M	36SE91-076	3/SS	5.0	5.5	5.25	CL	Alluvium	NA	23.0	NA	NA	NA	41.3	20.7	NA	NA	
BLM PROPERTY-NORT	D&M	36SE91-076	4/SS	9.5	10.0	9.75	CL	Alluvium	NA	17.5	NA	NA	NA	NA	NA	NA	NA	
BLM PROPERTY-NORT	D&M	36SE91-076	6/SS	15.0	15.5	15.25	CL	Alluvium	NA	16.6	NA	NA	NA	27.0	9.4	NA	NA	
BLM PROPERTY-NORT	D&M	36SE91-076	7/SS	20.0	20.5	20.25	CL	Alluvium	NA	19.1	NA	NA	NA	NA	NA	NA	NA	
BLM PROPERTY-NORT	D&M	36SE91-077	2/SS	3.5	4.3	3.90	CL	Alluvium(Loess?)	NA	17.4	NA	NA	NA	49.9	23.7	NA	NA	
BLM PROPERTY-NORT	D&M	36SE91-077	3/SS	8.5	9.5	9.00	CL	Alluvium(Loess?)	NA	15.8	NA	NA	NA	NA	NA	NA	NA	
BLM PROPERTY-NORT	D&M	36SE91-078	2/SS	8.5	9.5	9.00	CL	Alluvium	NA	18.0	NA	NA	NA	NA	NA	NA	NA	
BLM PROPERTY-NORT	D&M	36SE91-078	3/SS	13.5	14.3	13.90	CL	Alluvium	NA	16.8	NA	NA	NA	NA	NA	NA	NA	
BLM PROPERTY-NORT	D&M	36SE91-080	2/SS	5.0	6.0	5.50	CL	Alluvium	NA	15.9	NA	NA	NA	44.7	23.4	NA	NA	
BLM PROPERTY-NORT	D&M	36SE91-080	3/SS	10.0	10.8	10.40	SW	Alluvium	NA	6.9	NA	NA	NA	NA	NA	NA	NA	
BLM PROPERTY-NORT	D&M	35SE91-087	2/SS	3.5	4.0	3.75	SM	Alluvium	NA	5.9	NA	87.?	38.4	NA	NA	NA	NA	
BLM PROPERTY-NORT	D&M	36SE91-082	3/SS	8.5	10.5	9.50	CL	Alluvium(?)	NA	23.5	NA	NA	NA	NA	NA	NA	NA	

JFC
10/4/94

UMTRAP - 710002307 - GEOTECHNICAL DATA ... SE FOR MONTICELLO MILLSITE CHARACTER... ...TION -- R.H. MORRIS; CREATED 09/30/91; LAST UPDATED 11/22/91

AREA	DATA SOURC	BORING OR TEST PIT NUMBER	SAMPLE NUMBER & TYPE	TOP OF SAMPLE (FEET)	BASE OF SAMPLE (FEET)	SAMPLE MIDPOINT (FEET)	USCS SYMBOL	MATERIAL TYPE	IN-PLACE DRY DENSITY (PCF)	NATURAL MOISTURE CONTENT (PERCENT)	SPECIFIC GRAVITY	FRACTION PASSING #4 SIEVE (PERCENT)	FRACTION PASSING #200 SIEVE (PERCENT)	LIQUID LIMIT	PLASTICITY INDEX	ASTM D 698 MAXIMUM DRY DENSITY (PCF)	ASTM D 698 OPTIMUM MOISTURE CONTENT (PERCENT)	OTHER TESTS
BLM PROPERTY-NORT	D&M	TP-10	*BULK	5.0	5.0	5.00	CL	Loess(?)	NA	10.9	NA	100.0	88.6	29.5	11.1	107.7	14.2	Mod Proc
BLM PROPERTY-NORT	D&M	TP-10	2/ST	5.0	6.5	6.25	CL	Loess(?)	91.7	6.2	NA	NA	NA	27.9	9.8	NA	NA	Unconf Comp
BLM PROPERTY-NORT	D&M	TP-10	4/ST	11.0	11.5	11.25	CL	Loess(?)	108.3	10.7	NA	NA	NA	43.8	21.6	NA	NA	Perm

KEY:

USCS Unified Soil Classification System group symbol, ASTM D 2487 or D2488 (For rocks, symbol indicates geologic unit)
ASTM Test designation of the American Society for Testing and Materials
BENDIX "Data Collection for Engineering for the Uranium Mill Tailings Site and Adjacent Peripheral Properties, Monticello, Utah," Bendix Field Engineering Corporation, September 1986
D&M "Final Report, Monticello Remedial Action Project, 1991 Millsite Characterization Study," Dames & Moore, September 17, 1991
* Sample taken from a test pit excavated next to the designated borehole.
(?) Questionable value or classification

MATERIAL TYPE:

Tails-snd	Tailings sands
Tails-slm	Tailings slimes
Tails-snd/slm	Tailings sands and slimes, interbedded
Tails-snd&slm	Tailings sands and slimes, mixed
Cover	Cover material in place on tailings piles
MVP spoils	Material removed from Monticello Vicinity Properties
Alluvium	Miscellaneous surficial deposits, mostly stream-laid
Loess	Windblown fine-grained deposits
Shale	Mancos Shale, usually weathered
Sandstone	Dakota Sandstone
Fill	Miscellaneous man-made fill

OTHER TESTS:

Mod Proc	Modified Proctor compaction
Unconf Comp	Unconfined compressive strength
Dir Shear	Direct shear, consolidated-drained
Triax-CUPP	Triaxial shear, consolidated-undrained with pore pressure measurements
Consol	One-dimensional consolidation
Perm	Permeability, falling-head or flexible-membrane
CMR	Capillary moisture rise

SAMPLE TYPES:

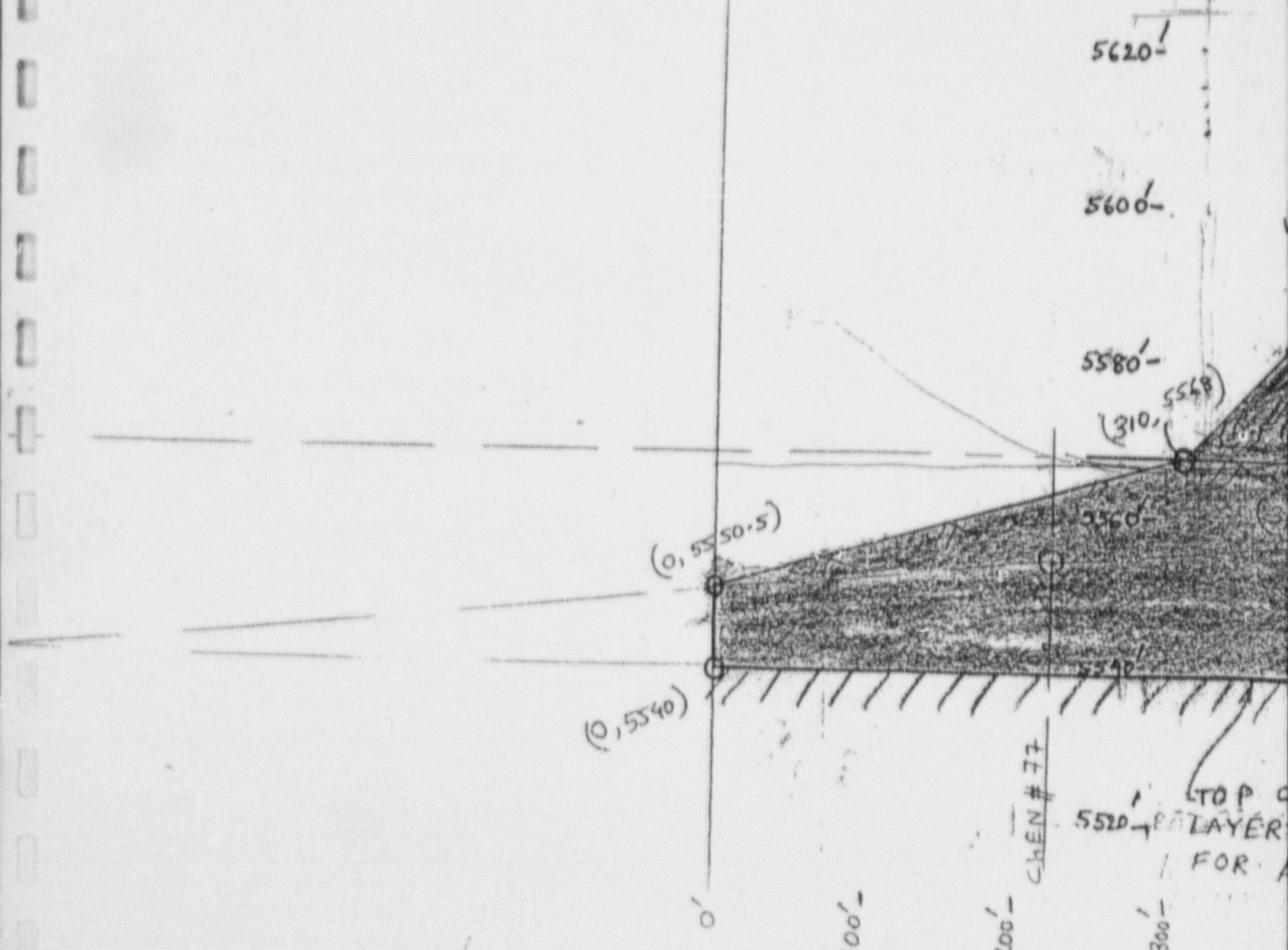
BULK	Disturbed bag sample of loose cuttings or material from test pit.
SS	Disturbed sample from 3.0" O.D. standard split-spoon drive sampler
ST	Relatively undisturbed sample from 3.0" O.D. thin-walled (Shelby) tube sampler
U	Relatively undisturbed sample from Dames & Moore Type "U" ring-lined drive sampler

All data in this table compiled or interpreted from consultant's reports by R.H. Morris, Chem-Nuclear Geotech, Inc., October 1991. Checked by L.H. Golden & corrected by R.N. Morris, November 1991.

110

SLOPE STABILITY ANA

(SECTION B-B BY UMETC



22.6, 5732.5

5732.5
− 5567.0
165.5

LYSIS ALON CELL-4 DIKE

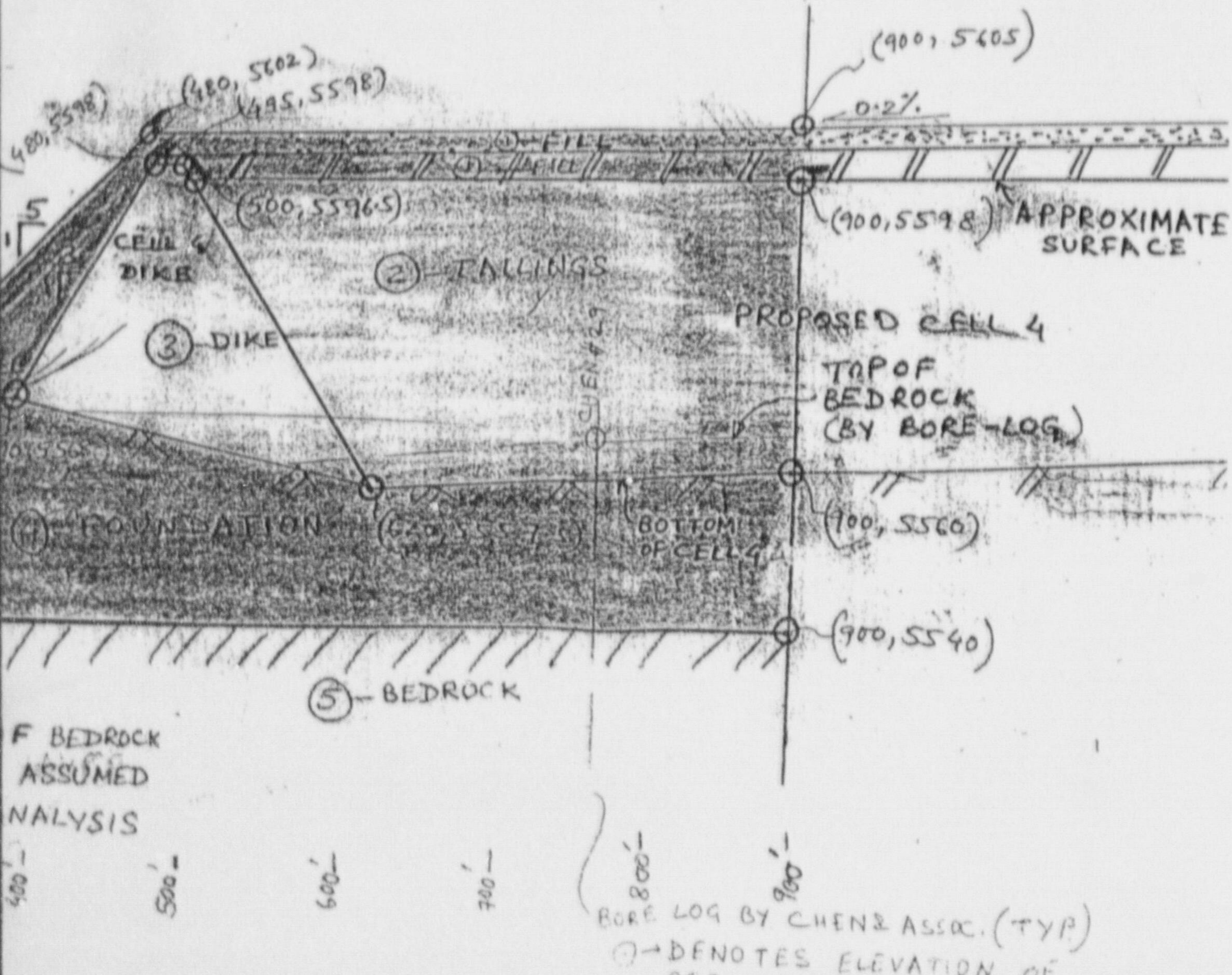


FIGURE 1

9801090276-04

Figure 1

ATTACHMENT 4

Specification for
Construction of Rock Covers and Other Erosion Protection
on the Tailings Cells

SPECIFICATION
FOR
CONSTRUCTION OF ROCK COVERS AND OTHER EROSION PROTECTION
ON THE TAILING CELLS

PART 1 - GENERAL

1.1 Project Description (to be added)

The rock covers consist of two different covers:

a. Top cover - A layer of rock covering all portions of the tailing cell tops, a surface with gradients less than 0.10. This cover will be not less than ____feet thick and will consist of rock with a d_{50} not less than _____inches.

b. Side slope cover - A two-part cover consisting of a lower ____foot thick bedding layer of d_{15} not larger than ____and d_{50} not larger than ______ and an upper ____foot thick layer of rock with a d_{50} not less than _____ inches.

Other erosion protection to be constructed includes:

c. Side slope toe apron - A 10-foot wide extension of the upper layer of the side slope rock cover along the ______ side slope toes of the tailing cells.

The rock to be used for the rock covers and other erosion protection is sandstone. This rock will be obtained from________.

The work to be performed consists of loading and hauling the rock, placing the rock on the radon barrier surfaces and toe apron surfaces, finish-grading the rock cover surfaces.

1.2 Technical Definitions

d_{50} : The size, in mean diameter, of the rock material of which 50% by weight is finer.

Earthwork control grid: Orthogonal system of uniformly spaced lines (integer multiples of 100 feet), based on the coordinate system and survey control points to be established on the site, used to record locations, thicknesses, lateral extents, and types of earthwork performed each day.

Fines: Mineral particles passing the #200 U.S. Standard sieve; i.e. smaller than 0.075 mm grain size.

Foreign material: Any solid material that is not sandstone. Includes wood, iron and steel, plastic, rubber, glass, ceramic and concrete.

Job site: The location of the tailing cells as well as all access routes, borrow areas, equipment laydown locations and storage areas on Owner property used in the Included Work.

Native soil, natural soil: Naturally-occurring alluvial or residual soils existing below and at ground surface around the job site; consisting of gravel, sand, silt and clay materials.

Tailing cell: Cell # 2 or #3

Planarity: The degree to which a surface approaches a flat (but not necessarily horizontal) surface

Sand: Mineral particles with grain sizes between #200 and #4 sieve (0.075 mm to about 5 mm).

Tailings: Solid byproduct of uranium ore milling, consisting of particles of primarily silicate minerals and containing radioactive elements (mostly uranium and radium). Particle sizes range from clay (less than 0.002 mm) to medium sand (less than #40 sieve).

1.3 List of Construction Drawings

The following drawings are incorporated into this specification by reference:

(to be added)

1.4 Included Work

The activities required for rock cover and other erosion protection construction will be performed by the Contractor using its own or subcontracted labor and equipment. The Included Work, described in detail in Part 2, consists of:

a) Preparation of haulage routes

b) Rock placement: Loading, hauling and placement of rock for rock cover layers, riprap and toe aprons

c) Scour protection trenches: Excavation and backfilling of soil; loading, hauling and placement of rock for construction of scour protection trenches, if required.

d) Dust control: Operation of water pumping, distribution and spray systems to suppress fugitive wind-blown dust in all work areas.

1.5 Related Work Performed by Others

a) Earthwork quality control: Sampling and testing to verify rock properties at the quarry site and gradations and thicknesses of placed rock

b) Quality control surveying: Surveying for verifying line and grade and for pay-quantity determination.

1.6 Responsibilities

a) International Uranium Corporation,or IUC, the "Owner", will provide controlled access to the work site, will make available construction water at locations on the mill property and will approve and make payment for work performed under this specification. The Owner will perform surveys to verify rock properties, to measure gradations and thicknesses of placed rock, and to verify finished lines and grades and placed-rock quantities.

b) "Engineer" will review or inspect and advise the Owner on the acceptance of the Included Work. The Engineer will specify and review quality control measures.

c) Contractor shall provide all equipment, materials, labor and supplies and perform all work necessary to accomplish the Included Work. Contractor shall be responsible for the knowledge of and compliance with all applicable federal, state, and local laws and regulations and for the safety of its job site and of all personnel and equipment which it employs and all others who are present on the job site. Contractor shall be responsible for limiting size segregation of rock materials during hauling and placement controlling thicknesses of rock layers, and achieving specified lines and grades of rock layers and finished rock cover surfaces.

PART 2 - EXECUTION

The Contractor shall perform the following work:

2.1 Haul Route Preparation and Maintenance

The Contractor shall select, prepare and maintain one or more haul roads from the rock stockpiles to the tailing cells. Preparation shall include:

a. Clearing of vegetation and removal to an on-site disposal location approved by the Owner. Vegetation may be burned in lieu of removal for disposal.

b. Preservation and protection of wells, water lines, and power lines needed for water supply or for the Owner's ground water restoration.

c. Preservation and protection of power lines, telephone lines and other utilities along rights-of-way crossed by the haul route(s).

d. Hauling and placement of soil or rock to construct the haul road surfaces. The Contractor may use any rock or soil it deems appropriate for this purpose. If the source of the rock or soil to be used is located on the Owner's property, the Contractor shall identify the location, types and volumes of material needed, submit a plan for regrading and revegetation of the borrow location, and obtain the Owner's approval before using that source.

e. Maintaining the haul road(s), including dust control, for the entire period of use.

f. Regrading and revegetation of both the haul-road construction material borrow site and the haul road(s) in accordance with a plan prepared by the Contractor and approved by the Owner.

Fences may be temporarily removed where they cross the haul route(s) provided that if any license-boundary (security) fence is breached, a guard shall be posted at each such location during working hours and all such openings shall be closed during non-working hours.

2.2 Loading, Hauling and Placement of Rock

The Contractor shall load and haul rock from the stockpile at______, designated by the Owner, to placement locations on the tailing cells.

All rock used for rock covers and erosion protection shall be sandstone from__________________________________.

2.2.1 Rock Covers

Rock covers shall be 90%-125% of the following thicknesses:

cell top	____feet
cell bedding (side slope)	____feet
cell side slope	____feet

A bedding layer will be placed on all side slope surfaces before placement of rock cover or riprap on those surfaces.

Rock for covers shall be loaded, hauled and placed by methods that maintain the gradation ranges in the stockpiled rock and prevent segregation of sizes during transport and placement.

The rock shall be placed and spread to create a uniform surface on the rock cover that is free of visible high or low spots. The planarity of the surface will be acceptable if irregularities of the surface do not exceed +/- 1.0 feet vertical difference from the design gradient surface over 100 feet and +/- 0.5 feet vertical difference within any 10-foot segment of a 100-foot survey line. On the rounded corners of the tailing cells this irregularity criterion shall apply along radial lines down the slope, perpendicular to the elevation contours.

2.2.2 Toe Apron

Along the south side slope toes of the tailing cells, the rock cover will be extended 10 feet beyond the toe of the side slope, as shown on Drawing ______. This toe apron will consist of the same rock sizes and gradations as the side slope rock cover and will be constructed so that the surface of the toe apron slopes away from the toe and the outer edge of the top surface is at the same elevation as the adjacent ground surface.

2.3 Dust Control

The Contractor shall employ those measures necessary to minimize dust from its operations. Unless otherwise approved by the Owner, acceptable measures are limited to spraying or other method of applying water to ground surfaces.

PART 3 - QUALITY CONTROL

The Contractor shall take all measures necessary to achieve all requirements of Part 2 of this specification. These measures shall include, as a minimum, the following:

3.1 Supervision

During all times that the Contractor's equipment or personnel are performing Included Work on the job site, the Contractor supervisor shall be present to direct the work. The supervisor shall have experience, satisfactory to Owner, in the type of work being executed. The supervisor shall have on-hand at all times a copy of the current revision of this specification and the drawings relevant to the work. The supervisor shall have the authority to make decisions for the Contractor in all matters related to parts 2 and 3 of this specification.

3.2 Line and Grade and Planarity Control

The Contractor shall perform land surveying to determine that the specified lines and grades and planarity have been achieved in accordance with the limits established in this specification. Ground control for surveys shall be based on established benchmarks and other control points on the mill property and tailing cells as shown on Drawing _______. Gradients shall be surveyed as often as necessary to control rock placement.

If any part of the rock layer surface appears by visual examination of the Owner to exceed the planarity limits, that part shall be surveyed to quantify the magnitude of irregularities. All final gradients and elevations shall be recorded on base drawings that include the site coordinate system, the earthwork control grid, and the topographic contours of the surfaces prior to fill placement. Base drawings will be provided in hard copy or Autocad (current version) plot file on 3.5-inch diskette.

When the Contractor reports to Owner that all Included Work has been completed, Owner will perform an acceptance survey to determine if line and grade requirements have been satisfied. Owner will survey the elevations and gradients at such locations as may be necessary. At its discretion, Owner may choose to have this survey done by aerial photogrammetry.

3.3 Field and Laboratory Testing of Rock and Rock Placement

Testing of rock for the necessary properties and gradations will be performed on rock in the stockpiles at the quarry by a qualified materials testing service contracted by Owner. The Contractor shall have no responsibility for the rock until it removes rock from the stockpiles. The testing service will perform measurements and tests to determine size gradations and layer thicknesses of the placed rock according to the following frequencies:

a. Visual inspection of rock delivered to the site and rock placement will be performed at least once daily.

b. Visual inspection of rock cover surfaces will be performed at least once in each control grid cell (100 feet x 100 feet) to evaluate surface uniformity and planarity. If the visual inspection results in uncertainty or dispute about adequacy of planarity at any location, the location shall be surveyed by rod and level, or other method of at least equal accuracy, to determine if allowable limits of surface irregularity are exceeded along 100-foot long horizontal and 20-foot slope-gradient lines of a 20-foot square grid covering the location in question. The allowable limits are +/- 1.0 feet vertical difference from the design gradient surface over 100 feet and +/- 0.5 feet vertical difference within any 10-foot segment of a 100-foot survey line. This requirement does not negate or substitute for rock thickness testing required below.

c. One size and gradation test using a portable screen stack shall be performed for every 5000 cy of rock or bedding placed on the Tailing cell.

d. Rock and bedding layer thicknesses shall be measured at least once per 2000 cy placed.

PART 4 - DOCUMENTATION

4.1 - Documentation by Contractor

The Contractor shall record and report, in a format acceptable to Owner, the following information:

Daily journal containing list of equipment used, hours worked, reimbursable materials consumed or used, and labor hours by wage category. The journal will also record Included Work tasks started, completed, and in progress and the units of work accomplished (e.g., volume of rock placed, area of final grading). Submit a copy to Owner by the start of the next working day.

Daily Work Summary listing all pay items and quantities. Submit by the start of the next working day.

Earthwork Control Plot, using the earthwork control grid at a scale of not less than 1 inch = 200 feet, showing the location, areal extent, and thickness of bedding or rock material placed accomplished each day.

Survey notes for line and grade and planarity control (verbally report results immediately, and submit copy to Owner within 24 hours)

Written notifications to Owner of unexpected conditions, conditions that prevent conformance with specifications, disputes over acceptance of Contractor's work. Verbally notify Owner immediately upon discovery or identification, submit in writing within 24 hours.

4.2 - Documentation by Owner

Owner will create and maintain the following documentation that relates to the Included Work:

Field inspection notes of Contractor's performance, work accomplished, and observed variances from the specification.

Records of all field and laboratory tests performed by Owner and its testing service.

Photographic and video tape records of the Incluoed Work.

Chronological record of notifications to the Contractor of variances from specifications, unacceptable work performance, discrepancies in payment quantities claimed by the Contractor, and all related resolutions thereto.

Survey notes and calculations of the acceptance survey

As-built drawings of completed work

PART 5 - ACCEPTANCE

Owner shall have sole discretion to accept in part or in full, or to reject in part or in full, the Contractor's work. Acceptance or rejection will be based on Owner's visual inspections (including those of its Engineer and testing service), quality control data required under Part 3, and documentation required under Part 4.

Upon identification of unacceptable work, Owner will notify the Contractor of the deficiency. The notification will include the location, extent, and description of the unacceptable work. Before proceeding with additional work at that location the Contractor shall correct the deficiency by bringing the work into compliance with specifications and drawings to the satisfaction of Owner. All work and materials required for such corrective actions shall be at the expense of the Contractor.

PART 6 - SCHEDULE

Complete the Included Work by (to be added) days from Notice to Proceed.

ATTACHMENT 5

Revised Calculations

RUST Rust Environment & Infrastructure

CALCULATION SHEET

PROJECT NO. ____

CLIENT IUC

SUBJECT 5:1 (H:V) RIPRAP SIZING

PROJECT WHITE MESA

NRC RESPONSE TO COMMENTS

Prepared By MWW Date 11-6-97

Reviewed By JRM Date 11-7-97

Approved By ____ Date ____

OBJECTIVE

DETERMINE SIZE OF RIPRAP ALONG 5:1 (H:V) SLOPES.

ASSUMPTIONS

- USE STEPHENSON'S METHOD FOR SIZING D_{50} OF RIPRAP
- 5 DIFFERENT FLOW PATHS ARE EVALUATED. EACH FLOW PATH IS DIVIDED INTO REACH 1 AND REACH 2. REACH 1 IS THE FLOW PATH OVER CELL 2. REACH 2 IS THE FLOW PATH ACROSS CELL 3. DESIGN FLOWS AND VELOCITIES ARE COMPUTED FOR REACH 1 AND COMBINED REACH 1/REACH 2.
- CALCULATIONS ARE SIMILAR TO CALCULATIONS PRESENTED BY TITAN. THE FLOW PATH LENGTHS ARE REVISED TO REFLECT THE ENTIRE FLOW PATH ACROSS THE COVER.
- MODIFY RIPRAP D_{50} BASED ON OVERSIZING FOR ROCK QUALITY.
- THICKNESS OF RIPRAP LAYER IS $2 \times D_{50}$ PER NUREG/CR-4620
- TIME OF CONCENTRATION CALCULATED USING EQN 4.4 NUREG/CR-4620
- PMP = 7.76"
- PEAK FLOW = $Q = CiA$

Rust Environment & Infrastructure

CALCULATION SHEET

PROJECT NO. ___

CLIENT: IUC SUBJECT: 5:1 (H:V) RIPRAP SIZING Prepared By: MW Date: 11-6-97

PROJECT: WHITE MESA Reviewed By: JRM Date: 11-7-97

NRC RESPONSE TO COMMENTS Approved By: ___ Date: ___

CALCULATIONS

(1) STEPHENSON'S METHOD

$$D_{50} = \left[\frac{q_c (\tan\theta)^{7/6} n_p^{1/6}}{C\sqrt{g}\left[(1-n_p)(G_s-1)(\cos\theta)(\tan\phi - \tan\theta)\right]^{5/3}} \right]^{2/3} \times 12 \frac{\text{INCH}}{\text{FT}}$$

WHERE θ = SLOPE ANGLE = 11.31°

n_p = POROSITY = 0.30

C = STEPHENSON CONSTANT = 0.22 FOR GRAVEL
= 0.27 FOR CRUSHED GRANITE

g = 32.2 ft/s

G_s = RELATIVE DENSITY OF ROCK = 2.48

ϕ = FRICTION ANGLE OF ROCK = 40°

K = OLIVIER'S CONSTANT FOR STABILITY = 1.2 FOR GRAVEL
= 1.8 FOR CRUSHED GRANITE

q_c = PEAK FLOW

(2) TIME OF CONCENTRATION

$$T_c = \left(0.00013 (L)^{0.77} / (i)^{0.385}\right) (60 \text{ min/hr})$$

T_c = TIME OF CONCENTRATION, MINUTES

L = SLOPE LENGTH, FT

i = SLOPE, FT/FT

3/6

REACH 1

Flow Path	0.20% slope length ft.	5:1(h:v) slope length ft.	total length ft.	unit width drainage area ac.	time of conc. min.	% pmp from table 2.1 NUREG	1 - hr precip. inches	rainfall depth inches	rainfall intensity in/hr	runoff coefficient	peak flow per unit width cfs	flow concent. factor	Design Flow cfs
1	0	0	0	0	0	0	7.76	0	0	0.8	0	2	**0**
2	720	15	735	0.0169	13.6	71	7.76	5.51	24.2	0.8	0.33	2	**0.65**
3	800	15	815	0.0187	14.8	73	7.76	5.66	23.0	0.8	0.34	2	**0.69**
4	1010	15	1025	0.0235	17.7	78	7.76	6.05	20.5	0.8	0.39	2	**0.77**
5	1130	20	1150	0.0264	19.3	81	7.76	6.29	19.5	0.8	0.41	2	**0.83**
6	1210	20	1230	0.0282	20.3	82	7.76	6.36	18.8	0.8	0.42	2	**0.85**

REACH 2

Flow Path	0.20% slope length ft.	5:1(h:v) slope length ft.	total length ft.	unit width drainage area ac.	time of conc. min.
1	960	90	1050	0.0241	17.4
2	925	150	1075	0.0247	17.1
3	900	250	1150	0.0264	17.1
4	850	220	1070	0.0246	16.3
5	850	190	1040	0.0239	16.2
6	790	40	830	0.0191	14.8

COMBINED REACH 1 AND REACH 2

Flow Path	total length ft.	unit width drainage area ac.	time of conc. min.	% pmp from table 2.1 NUREG	1 - hr precip. inches	rainfall depth inches	rainfall intensity in/hr	runoff coefficient	peak flow per unit width cfs	flow concent. factor	Design Flow cfs
1	1050	0.0241	17.4	78	7.76	6.05	20.9	0.8	0.40	2	**0.81**
2	1810	0.0416	30.7	89	7.76	6.91	13.5	0.8	0.45	2	**0.90**
3	1965	0.0451	31.9	90	7.76	6.98	13.1	0.8	0.47	2	**0.95**
4	2095	0.0481	34.0	91	7.76	7.06	12.5	0.8	0.48	2	**0.96**
5	2190	0.0503	35.5	91	7.76	7.06	11.9	0.8	0.48	2	**0.96**
6	2060	0.0473	35.1	91	7.76	7.06	12.1	0.8	0.46	2	**0.91**

VELOCITY: REACH 1

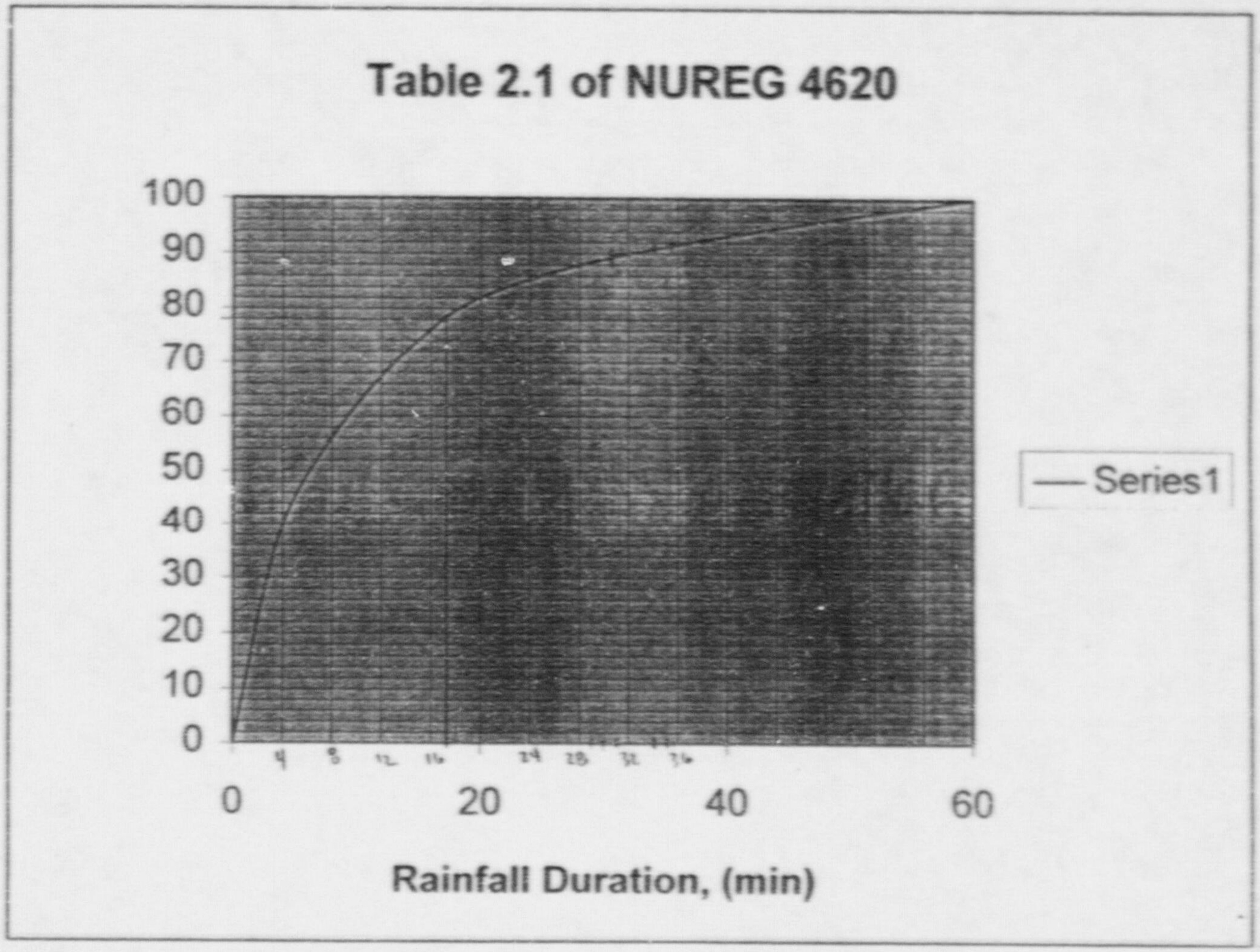
Flow Path	Design Flow cfs	manning's coefficient n	slope ft/ft	flow depth ft.	velocity ft/s
1	0.00	0.03	0.20	0.00	**0.0**
2	0.65	0.03	0.20	0.12	**5.4**
3	0.69	0.03	0.20	0.12	**5.5**
4	0.77	0.03	0.20	0.13	**5.8**
3	0.83	0.03	0.20	0.14	**5.[illegible]**
5	0.85	0.03	0.20	0.14	**6.0**

$Velocity = \frac{q}{D}$

VELOCITY: COMBINED REACH 1 AND REACH 2

Flow Path	Design Flow cfs	manning's coefficient n	slope ft/ft	flow depth ft.	velocity ft/s
1	0.81	0.03	0.20	0.05	**0.0**
2	0.90	0.03	0.20	0.15	**6.1**
3	0.95	0.03	0.20	0.15	**6.3**
4	0.96	0.03	0.20	0.15	**6.3**
5	0.96	0.03	0.20	0.15	**6.3**
6	0.91	0.03	0.20	0.15	**6.2**

0	0
2.5	27.5
5	45
10	62
15	74
20	82
30	89
45	95
60	100



RUST Rust Environment & Infrastructure

CALCULATION SHEET

PROJECT NO. ______

CLIENT: IUC

SUBJECT: 5:1 (H:V) RIPRAP SIZING

PROJECT: WHITE MESA

NRC RESPONSE TO COMMENTS

Prepared By: MWJ Date: 11-6-97

Reviewed By: JRM Date: 11-7-97

Approved By: ______ Date: ______

REACH 1 (CRUSHED GRANITE)

FLOW PATH	q_c cfs	C	D_{50} inch	OLIVEROS K	MODIFIED D_{50} inch
1	0	—	—	—	—
2	0.65	0.27	2.7	1.8	4.9
3	0.69	0.27	2.9	1.8	5.2
4	0.77	0.27	3.1	1.8	5.6
5	0.83	0.27	3.2	1.8	5.8
6	0.85	0.27	3.3	1.8	5.9

FLOW PATH	D_{50} BASED ON STEPHENSON, inch	OVERSIZING FACTOR	REVISED D_{50} inch	$2 \times D_{50}$	RECOMMENDED THICKNESS
1	—				
2	4.9	1.25	6.1	12.2	18"
3	5.2	1.25	6.5	13.0	18"
4	5.6	1.25	7.0	14.0	18"
5	5.8	1.25	7.2	14.4	18"
6	5.9	1.25	7.4	14.8	18"

RUST Rust Environment & Infrastructure

CALCULATION SHEET

PAGE 5 OF 5

PROJECT NO. ____

CLIENT IUC

SUBJECT 5.11 (H.V)

Prepared By MWW Date 11-6-97

PROJECT WHITE MESA

RIPRAP SIZING

Reviewed By JRM Date 11-7-97

NRC RESPONSE TO COMMENTS

Approved By ____ Date ____

CONCLUSIONS

- RIPRAP D_{50} = 8"

THICKNESS = 18"