OHIO DEPARTMENT OF TRANSPORTATION

1980 West Broad Street
P. O. Box 899
Columbus, Ohio 43216-0899

Reply to:
Office of Materials Management
1600 West Broad Street, Columbus, Ohio 43223-1298

September 27, 1999

Gannett Fleming Engineers and Architects
Blendonview Office Park
5015 Pine Creek Drive
Columbus, OH 43081

Attn: Mr. John R. Kenny, P.E.
Vice President

Re: ATH-33-30.980, PID 18287
Preliminary Slope Recommendations

Dear Mr. Kenny:

Reference is made to your September 10, 1999 letter outlining the recommended preliminary cut and fill slope scheme for the subject project, the Soil Profile, and preliminary cross-sections. We are in general agreement with the scheme proposed. The scheme listed below indicates some minor changes to that which you have proposed. Note that for consistency, this letter with similar text is being sent to Dodson-Stilson, Inc. for use on the adjacent ATH-33-40.981 project. Also, please note that these recommendations are general in nature and some fine-tuning may be required upon a more detailed review of the preliminary plans and subsurface information.

CUT SLOPES

Extend a 2:1 backslope to 1.5m above the back of the ditch and provide a 4.5m wide bench sloped at 10:1.

Soil. This includes are materials which were penetrated by the split-spoon sampler. Use a 2:1 slope where the thickness is less than approximately 1.5m. Use a 4:1 slope where thicker than approximately 1.5m. It may be necessary to transition over a couple of cross-sections between these two conditions, where they are present. Exceptions may be made to the 4:1 slopes if they would result in a thin sliver cut.

Shale and Mudstone. Use a 2:1 slope. Provide a 4.5m wide bench sloped at 10:1 at approximate 12.5m vertical intervals in the shale and/or mudstone. Likewise, provide the bench at the interface where shale and/or mudstone is overlain by sandstone or siltstone.

Sandstone and Siltstone. Use a 1/2:1 slope where thicker than approximately 3m. Use a 2:1 slope where the thickness is less than approximately 3 m.

FILL SLOPES

Use 3:1 fill slopes for the ATH-33-30.980 project. For the ATH-33-40.981 project, use fill slopes of 2:1, except where the foundation is cohesive soils with N less than 4 or potentially unstable shales or mudstone.

Sidehill fills should be constructed utilizing Special Benching, generally on stable rock.

Please feel free to contact us should you have any questions.

Respectfully,

Eugene C. Geiger

Eugene C. Geiger, P.E.
Geotechnical Engineering Coordinator

c. S. Eldabaja, D. Briggs, Reading File, File

Gannett Fleming

GANNETT FLEMING ENGINEERS
AND ARCHITECTS, P.C.
Blendonview Office Park
5015 Pine Creek Drive
Columbus, Ohio 43081

Office: (614) 794-9424
Fax: (614) 794-9442
www.gannettfleming.com

September 10, 1999

Mr. Eugene C. Geiger, P.E.
Geotechnical Engineering Coordinator
Geotechnical Design Section
Office of Materials Management
1600 West Broad Street
Columbus, Ohio 43223

Re: Preliminary Cut/Fill Slope Recommendations
Ohio Department of Transportation
US 33 Super Two – Lane Highway
Athens County, Ohio.

Dear Mr. Geiger:

This correspondence is an explanation of the recommended cut and fill slope ratios for Station 29+000 to 39+600 of the aforementioned project. Based upon an extensive review of the preliminary subsurface investigation by Resource International (Report No. W-7139), initial field results of supplemental test borings needed as a result of alignment and grade changes, considerations regarding the necessary land acquisition requirements and potential earthwork volumes, the Ohio Department of Transportation's apparent risk tolerances, and typical practices of the Kentucky Transportation Cabinet, the following recommendations were developed. An attempt has been made to maintain consistency over the entire length of the project where possible, which includes the alignment segment beyond Station 39+600, as requested by Mr. Doug Briggs.

Deep cuts and fills, some of which are on the order of 30 to 40 meters in magnitude, characterize the Gannett Fleming section of this project. The majority of these cuts and fills will be constructed in or with soft shale and clay shale/mudstone bedrock, referred to as "Red Beds", and their residual soil derivatives. These Red Beds typically slake and weather fairly quickly when exposed to form residual clays and silty clay soils of high plasticity and fairly low shear strength. Past experience and empirical strength correlations indicate that shear friction angles (ϕ) in this material ranging from 18 to 20 degrees are probable.

Typical cut and fill slope design incorporates a factor of safety (F.S.) equal to 1.5. Given the probable shear strengths available in these soils, a slope ratio of 4.25 to 4.6 horizontal (H) to 1 vertical (V) would be required to realize a 1.5 F.S.. Meetings with the client have indicated a higher risk tolerance than initially anticipated, reflected in the fact that a factor of safety approaching unity (1.0) has been deemed functional for the project. In light of this fact, a cut slope ratio of 3:1 in the residual soils appears to satisfy this condition. Should 3:1 cut slopes be utilized in the residual overburden soils, increased maintenance such as debris removal and ditch cleaning in the highway right-of-way should be anticipated and the placement of structures adjacent to the slopes should be discouraged without careful consideration of the foundation support conditions.

Cut slopes in the soft to very soft shale and clay shale/mudstone should be constructed utilizing a 2:1 slope ratio. This is in general agreement with the typical design and construction practices of the Kentucky Transportation Cabinet and the West Virginia Department of Transportation, which would most likely classify the material as Type II/III Nondurable Shale or Type 4 Soft Shale (silty clay

classification), respectively. Given the nature of these materials, increased maintenance similar to that outlined for the residual soil slopes should be anticipated. To help mitigate the periodic mass wasting of this material and retard the material movement toward the roadway, 4.5 to 5 meter fall benches should be constructed at 12 meter lift (elevation) intervals in the Red Bed cut slopes.

Sandstone, siltstone and occasional limestone units will also be encountered in the cut areas. Where these rock units, referred to as durable rock, are roughly 2 to 3 meters or more in thickness, a slope ratio of 0.5:1 is recommended. This slope ratio is also in agreement with the typical construction practices of the Kentucky Transportation Cabinet and the West Virginia Department of Transportation for materials classified as Massive Limestone/Sandstone and Type 2 rock, respectively. In cases where these durable rock units are underlain by the softer Red Bed deposits, a 4.5 to 5 meter sacrificial bench is recommended at the base of the durable rock unit. This will retard the undermining of the harder rock unit as the softer rock weathers and subsequently delay the onset of rock fall hazards.

The highway fill embankments for this project should be constructed with 3:1 slope ratios. Gannett Fleming is of the opinion that the available soils in the project area can be constructed with proper moisture and compaction controls to establish stable embankments. Some of the naturally occurring soils will probably require some drying to attain the optimum moisture content at which the desired final dry densities can be achieved. In areas where the embankments will be constructed along the side of existing slopes, they should be keyed into the sides of the existing slopes and into the natural foundation materials at the toes of the proposed embankments with benches and ditches on the order of 1 to 1.5 meters in width and depth. When the soft shale and mudstone/clay-shale materials are to be used to construct the embankments, they must be broken down and placed as a soil material. To this end, no pieces larger than 10 to 15 centimeters should be allowed in the embankment fills.

If there are any questions regarding the content of this letter/report, please contact Malcolm Hargraves at this office.

Sincerely,

GANNETT FLEMING ENGINEERS AND ARCHITECTS, P.C.

John R. Kenny /MDH

John R. Kenny, P.E.
Vice President
Manager, Ohio Office

JRK/MDH/mdh
cc: Doug Briggs, ODOT District 10; File – 36151.210
G:\36151\210\Prel.Cut-Fill Slope Recs.

MEETING MINUTES
AUGUST 16, 1999

Location: ODOT Test Lab
Subject: Slope limits for ATH/MEG-33-30.980/40.981

Attendees:

Gene Geiger-ODOT
Kirk Beach-ODOT
Joe Rossie-Gannett Fleming
Mitch Weber-Gannett Fleming
Todd Willis-DSI
Brent Downing-DSI
Pete Nix-DSI
Malcom Hargraves-Gannett Fleming
Doug Briggs-ODOT
Doug Morgan-ODOT
Steve Sommers-ODOT

GANNETT FLEMING - Mitch Weber

- 3:1 embankment slopes will work on GF section, maybe steeper in some locations.
- No lime stabilization will be needed.
- Rock and soil should be separated during construction.
- Rotten core method - would be expensive and should not be needed if 3:1 slopes are acceptable.
- Rock in this section is shale, red bed & mudstones (limited quality rock).
- Moisture content is the biggest concern. There must be a set moisture content during construction and it has to be enforced.
- Drainage must be taken care of properly.
- Expecting up to 3% settlement with 60% foundation and 40% overburden.
- Add special provisions
    - Specifications will need to be enforced
    - Compaction tests by inspectors
    - Commit extra inspection for the earthwork
- Embankments are not as bad as originally suspected
- Specific slopes for excavation sections haven't been determined yet.

DODSON STILSON - Pete Nix

- Fill slopes can be 3:1 except for areas that must be keep 2:1 due to environmental concerns.
- At this time our earthwork is balanced - 4.2 million cut vs 4.0 million fill.
    - 50% of the cut is unsuitable material
    - engineered 3:1 slopes for embankments
- 3:1 slopes without zoning however, zoning is possible if needed.
    - sections requiring 2:1 slopes may require some zoning

- 300-400 meters of 2:1 for this section

- Soil conditions are better for this section than the GF section.
- Dodson Stilson will cost compare 3:1 slopes vs 2:1 zoned and also look at the impacts.
- As of now, there is 1 acre of wetland being disturbed.
- If we go to 2:1 zoned, there will be a waste for this section

ODOT - Doug Briggs

- Should have similar solutions for both sections so that we are consistent throughout.
- Any material needed will be taken from the 4-lane ROW areas.
  - show future cut lines
- Excess cut or fill will be utilized within the 4 lane ROW.

GENERAL

- Embankments will be set at 3:1 slopes except for areas that require 2:1 slopes due to environmental concerns.
- Cut sections will be dealt with on a case by case basis.
- After this meeting, the Geotechnical specialists will meet to discuss problems and solutions for the cut sections within both sections.
- Gene Geiger will be sent all of the soil investigation reports by Resource International for both sections.
- Consultants to run preliminary cross sections with the 3:1 embankments and cut sections as defined from the follow up meeting.
- Note from the 401 water quality meeting held on Monday, August 23, 1999.
  - 2:1 slopes for embankments are to be evaluated at warm water stream crossings

MtS 7/20/99

30,980

from M. Weber

AGENDA
Cut Slope Design and Embankment Fill Considerations
ATH-33 Athens to Darwin Final Design Project
Station 29+500 to 39+600

1. Statement of Problem in Brief

1.1. Natural materials in GF design section are principally composed of soft, highly fractured rock and weak residual clay soils.

1.1.1. Problem strata are described as mottled red-gray or gray-purple Mudstone, Shale, Claystone, and Clay-Shale.

✓1.1.1.1. Predominant in the northern and southern one-third of GF section.

1.1.1.2. Cuts as deep as 40 meters are required.

1.1.1.3. Slickensides commonly identified.

1.1.1.4. Core loss up to100%, typically ≈ 25 to 35%.

1.1.1.5. RQD often 0%, estimated average less than 30%.

1.1.1.6. Soil Profile Report cites "mudstone and some shale … deteriorated when exposed to water." and "rock condition was typically so poor that it was difficult to identify the transition from soil to rock".

1.1.2. Residual soils from the weak 'redbeds' are also potentially problematic.

1.1.2.1. Soil strata thickness varies from 1.0 to 5.0 meters, ≈ 2.0 meters.

1.1.2.2. With respect to cut slopes, the residual soils will have shear strengths lower than the 'parent' rock material.

1.1.2.3. Soils testing determined most of the redbed residual soils are high plasticity clays.

--→ 1.1.2.3.1. About one-third of the samples tested from GF's section had Liquid Limits (LL) >50 %; however this soil represents more than one-half of the soil stratigraphy in GF's section. LL as high as 74% were determined.

1.1.2.4. High LL correlate to high Compression Indices (C_c) which indicate a high settlement potential.

→ 1.1.2.5. Soil Profile Report cites "natural moisture contents... are typically at or well above their corresponding Plastic Limits" (PL).

1.2. Consequences to the Project

1.2.1. It is GF opinion that 'standard' 2:1 cut and embankment slopes are not appropriate for our section of the project where the redbeds predominate.

1.2.1.1. GF's experience with redbeds in Ohio, West Virginia, and western Pennsylvania indicates that the shear strength of the redbed mudstone can be as low as 12° and generally falls between 16° –19°. The results of over a dozen shear strength tests are represented on the attached summaries.

1.2.1.2. GF presented our approach to developing preliminary slope ratios for 4:1 slopes in the weak rock and residual soils of the redbeds.

1.2.1.2.1. GF recommended and the District has authorized additional drilling and testing for the 'roadway' portion of the project to determine shear strength, slaking and consolidation characteristics of the suspect strata.

1.2.2. The percentage of durable rock available for embankment construction is limited.

1.2.2.1. Preliminary material balance calculations indicate that about 6 million m^3 are required for embankment construction. However, only 5.4 million m^3 are to be excavated. This indicates a slight imbalance and a net fill requirement for the section.

1.2.2.2. The preliminary estimates of available durable sandstone, limestone, and siltstone from the required excavation is only 500,000 $m^{3,}$ (<10% of the fill needed.

1.2.2.3. As a result, it is probable that a significant amount of borrow will be need to construction standard 2:1 embankment or the redbed soil and rock strata will have to be used for embankment construction. Both alternatives have potentially undesirable consequences.

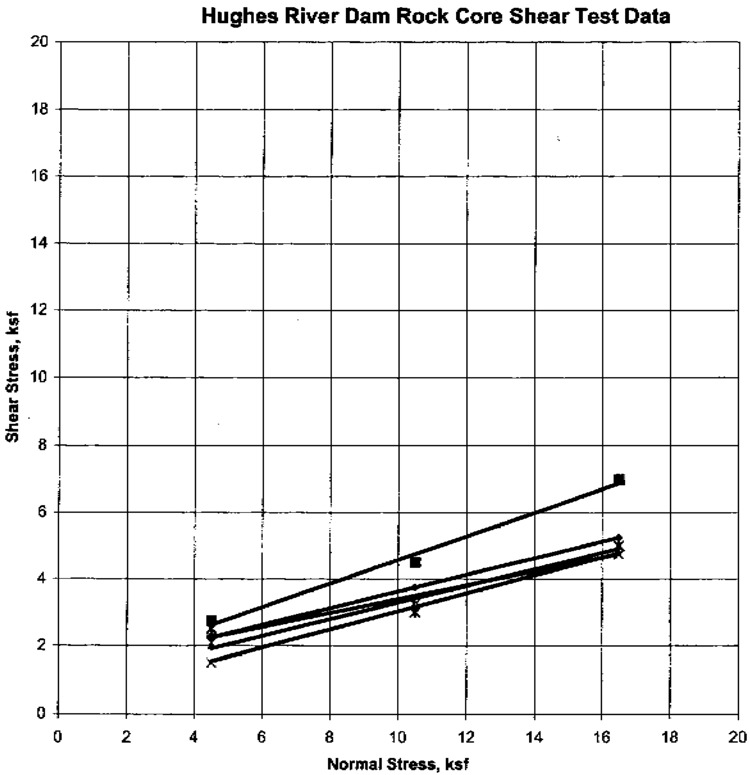
1.2.2.3.1. If durable rock is brought in to construct the embankments, the construction cost will be significantly impacted due to import of durable material and waste of material from the required excavation.

1.2.3. The residual redbed soil potentially will cause handling and placement problems for construction of embankments.

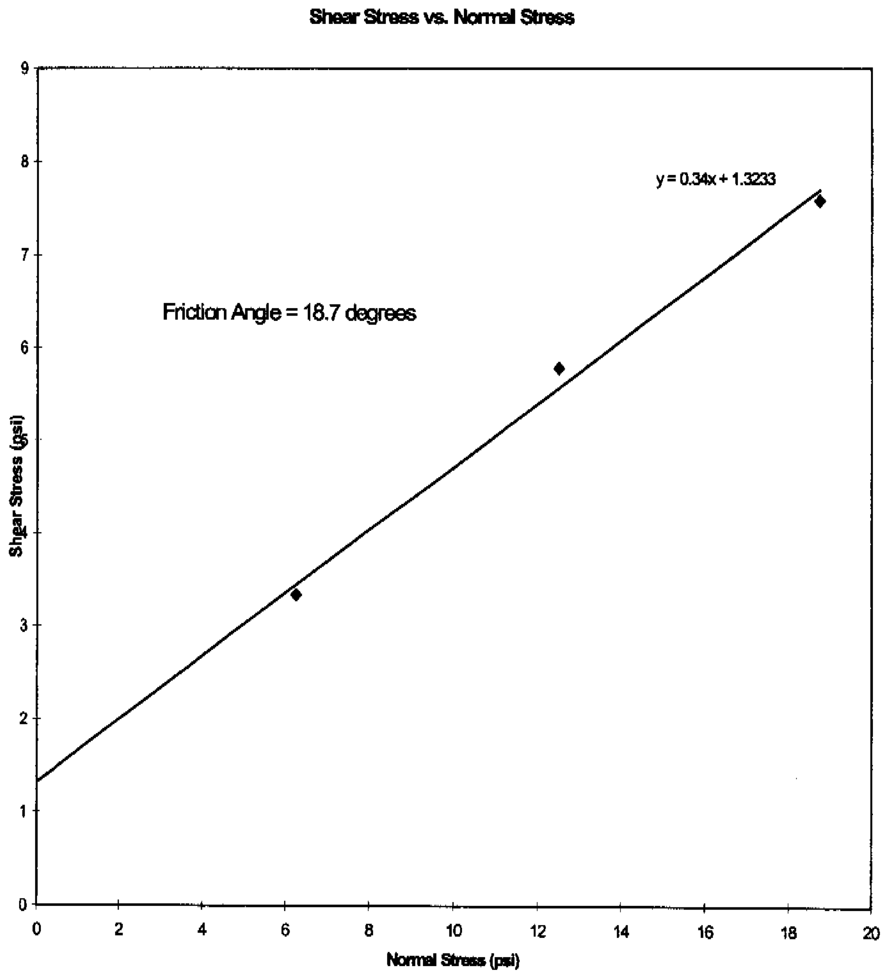
1.2.3.1. As stated in 1.1.2.5., the natural moisture content of the residual soils is at or significantly greater than the PL. The optimum moisture content to place clay soils is typically 2 to 4% greater than the soil's PL. This may require significant drying or admixture procedures in the field prior to placement of these soils in embankment construction.

1.2.3.2. The high LL indicate a high potential for settlement of embankment construction of the residual soils.

The aforementioned problems are not insurmountable; however, the issues do require that ODOT and GF come to a consensus on the best approach to mitigate the problems. Several alternatives have been presented to ODOT in GF letter to Mr. Briggs in May 1999.



Hughes River Dam Rock Core Shear Test Data
Shear Stress, ksf
Normal Stress, ksf
0
2
4
6
8
10
12
14
16
18
20



Shear Stress vs. Normal Stress
y = 0.34x + 1.3233
Friction Angle = 18.7 degrees
Shear Stress (psi)
Normal Stress (psi)
0
1
2
3
4
5
6
7
8
9
0
2
4
6
8
10
12
14
16
18
20

ATH-33-30.980 7/ /99

N third & S third >50% in red beds

3:1 Emb

2:1 Cut red shale - 20' bench @ ditchline

Sleeper cut better rock 15' bench every 40'

Aug. 16 Mon 10:00

GF: Use zoned embankment 3:1

(issues)

• Proper compaction → schedule, completion date, inspection

DS: Some 2:1 along stream, may need to zone

3:1, don't need to zone

May 12, 1999

Ohio Department of Transportation - District 10
Attention Mr. Douglas Briggs
338 Muskingum Drive
Marietta, Ohio 45750-0658

RE: Geotechnical Aspects of Embankment Fill and Cut Slope Design
U.S. 33 Athens – Darwin Project (ATH – 33-30.980)
Athens/Meigs County, Ohio

Mr. Douglas Briggs:

Presented herewith is an explanation and summary of the geotechnical review for Station 26+500 through Station 39+600 of the aforementioned project. This letter has been written per the request of The Ohio Department of Transportation (ODOT), District 10 to outline Gannet Fleming's concerns about the proposed highway alignment, as well as to suggest possible alternatives that may be available at this time for this project.

Project Profile and Geological Conditions

The section of highway assigned to Gannett Fleming begins at the intersection of Richland Avenue and Pomeroy Road (the present US 33) in Athens, Ohio and extends in a southerly direction for a distance of about 6 miles. At its present location, the proposed corridor traverses a region predominated by residual soils formed from Pennsylvanian aged sedimentary bedrock of the Marietta Plateau. Sandstone, siltstone, shale, clay shale/mudstone, along with occasional, deeper, thinly bedded coal seams dominate the bedrock profile along the proposed roadway corridor. Of particular concern are the soft shale and clay shale/mudstone units referred to as "Red beds", which appear dark maroon/purplish to red in color with occasional light gray marbling. These materials weather fairly quickly when exposed to form residual clays and silty clay soils of high plasticity and fairly low shear strength. As a result, many of the natural slopes formed in these materials exhibit signs of instability such as leaning trees (where vegetated) and toe bulges ("hummocky" appearance). More dramatic evidence of the innate instability in these materials can be found in constructed cut slopes and fill embankments along Interstate 77 and Interstate 70, as well as US 50 and US 33.

Present Cut/Fill Slope Recommendations and Rational

Based upon the proposed plans and profile elevations, substantial cuts and fills are planned for this project. Some of these cuts and fills are on the order of 30 to 40 meters in magnitude. According to the information provided in the preliminary subsurface investigation by Resource International (Report No. W-7139), these cuts and fills will be constructed predominantly in, or with, these Red bed materials or residual soils derived from these Red beds. Approximately one-third of the laboratory index tests utilized to classify the residual clay and silty clay soils on this project corridor indicated materials of high plasticity (Liquid Limits higher than 50). An empirical correlation between these index tests and shear strengths yield conservative phi angle (angle of internal friction) estimates ranging from as low as 15 degrees to about 28 degrees. Utilizing a simplified infinite slope analysis, and choosing a phi angle ranging from 18 to 20 degrees, a preliminary slope ratio of 4 horizontal (H) to 1 vertical (V) has been chosen. If it is assumed that zero cohesion is available, this slope ratio would result in a factor of safety (F.S.) ranging from about 1.3 to about 1.45 with the aforementioned phi angles. Generally a F.S. of 1.5 is recommended for slope design. By choosing a 4H to 1V slope ratio for the weak soils in this project, there is the somewhat unconservative assumption that some cohesion is available over the design life of the project.

In some segments along the project alignment, relatively durable rock units comprised of massive sandstone, siltstone, isolated limestone layers and somewhat durable sandy to silty shale will be encountered in the road cuts. The combination of relatively high phi angles (greater than 40 to 45 degrees), unconfined shear strength values in excess of 25 to 30 Mpa, and slake durability values in excess of about 75 to 80 percent, accommodates steeper slope ratios in these materials. For this project, it is proposed to use 0.5H to 1V for the limestone, sandstone, and siltstone cuts and 1 H to 1 V slope ratios in cuts made in the less durable silty to sandy shale materials. Where these materials are encountered above the Red bed deposits in sufficient thicknesses to justify a change in a slope ratio, a three meter bench is recommended to reduce the possibility of undermining and subsequent rock falls in the harder more competent bedrock units.

Presently, it is proposed that the new highway will be a four lane divided roadway for slightly more than 2 miles south of the Richland Avenue intersection in Athens, then continue as a two-lane highway for the duration of its path in Athens County. Eventually, this alignment is to be upgraded to be a four-lane highway for the entire length of the project. Based upon how the project's first stage is to be constructed, it is estimated that approximately 6 million cubic meters of material has to be placed for embankment (fill) construction, while about 5.4 million cubic meters of material has to be excavated (cut). This would create a net shortage of fill material on the Gannett Fleming section of the project. Furthermore, it is roughly estimated that no more than about 500,000 cubic meters (less than 10 percent) of the cut material volume is comprised of what is considered durable rock. As a result, it is highly probable that the embankment fills for this project will be mostly comprised of materials derived from the Red bed deposits, which for reasons previously outlined, are not considered conducive to the steeper slopes often specified for standard ODOT construction (2H to 1V slope ratios). For this reason, it is proposed that 3H to 1V or flatter slope ratios be utilized for the embankment fills. This recommendation is rendered with the assumption that the material will be placed as a soil fill and that some granular material will be partially mixed in the fill as a result of the excavation and placement activities that will effectively increase the long-term strength characteristics of the embankment soil.

Cut Slope Alternative - Additional Testing

It should be noted that the aforementioned cut and fill slope ratio proposals are based primarily upon laboratory index test results with subsequent empirical shear strength correlations, typical experimental data obtained in somewhat similar materials, and, more importantly, experience with typical cut and fill slopes in the same geological formation. As a result, an effort is made to hopefully utilize a higher degree of conservatism. In the cut slope areas, the final slope will be comprised of materials that are naturally in place. The only way to justify the use of steeper slopes, which require higher shear strengths, would be to more accurately determine the soil parameters affecting long-term slope stability. To this end, specialized laboratory tests, such as three point triaxial tests, done specifically for this project would be necessary. Once the additional data is developed, a more comprehensive, computer-aided slope stability analysis should then performed to examine different failure mechanisms. Ideally, the additional laboratory work and analysis will afford a higher degree of confidence in determining what can be done and what to expect in the cut slope areas.

Embankment Fill Slope Alternatives

The fill slope areas of the project offer more flexibility for the designer, primarily because there is somewhat more control of the embankment composition. One option is to utilize durable rock buttresses at the embankment bases. This would provide a zone of material with higher shear strength characteristics at a critical location on the roadway fills, thus increasing the overall slope stability and possibly accommodating steeper slopes. Another option is to stabilize the Red bed materials prior to placement by mixing them with lime or cement and increase the shear strength of the proposed fill soil. A third option is to utilize a mechanically stabilized earth embankment in which a geogrid type material is placed in specified lifts as the embankment is constructed. This would result in a zone of reinforced earth with a higher effective shear strength characteristics that acts like a wall to intercept potential failure planes. One more option this letter will address is very similar to the rock toe buttress concept, which is the concept of building the embankments using an inner core and an outer shell. The inner core would consist of the residual clay and silty clay soils and the outer shell would consist of granular soils derived from durable rock. Any of these four options would have to be further analyzed for overall stability to determine how they should be designed and subsequent feasibility. They also have their drawbacks.

Rock Toe Buttress

The rock toe buttresses will require a zoned type of construction and careful inspection as the embankments are built to make sure the buttresses are placed in the correct locations. Secondly, there will be a need to segregate and stockpile the durable rock material as it is excavated during construction. These inspection and segregation processes will increase the construction time needed for the embankments. Thirdly the buttress concept is also limited by the availability of durable rock fill in the cut sections which may or may not be enough to complete all of the buttresses for the project. In the event that durable rock material must be imported to the project site, it should be noted that "local" rock quarries within a 20 to 25 mile radius of the project may not have the capacity to supply material in sufficient quantities for these buttresses. This is based upon an Ohio Mineralogical Industries Report of 1994, which indicated that the combined production from quarries in counties adjacent to the project site amounted to about 700,000 cubic meters in that particular year. Another consideration is the cost associated with hauling very large quantities of material over a potential 40 to 50 mile round trip. If a substantially greater amount of durable rock fill is needed than is available in the present road cuts, this buttress concept may be out of the question.

Soil Stabilization

Chemical stabilization/improvement of the embankment soils would require preconstruction preparation to develop trial mixtures, perform subsequent lab tests, and establish the desired strength characteristics to determine the amount of additive needed for the soils. Once the project goes to construction the contractor has to develop a method to effectively and thoroughly mix the cementatious additive to large quantities of soil prior to placement, probably utilizing pug mills or other mixing equipment. The feasibility and success of the soil stabilization will depend on the amount and cost of the lime or cement additives and the efficiency with which the soil can be treated.

Soil Reinforcement

The third option of geogrid stabilization will be affected by the material costs associated with the geogrid quantities required for the project. Then there is the need for the embankment construction to be thoroughly and carefully observed to insure that the soil reinforcement is appropriately installed. It is very likely that the geogrid placement operations and subsequent construction observation, coupled with the sizable embankments proposed for this project, will increase the construction time. Depending upon contractor competence, this increase in construction time could be substantial. The feasibility of this option will ultimately depend on the relative benefits from decreasing the mass embankment quantities (i.e. steeper slopes) versus the relative costs associated with the geogrid, increased construction time, and the possible need for other specified materials.

Inner Core/Outer Shell Construction

The final option of inner core/outer shell construction (and any variations of such) is usually associated with embankment dam design, where the inner core performs as a relatively impervious barrier and the outer shell provides stability via gravity and increased shear resistance. With this type of construction, the outer shell is generally much larger than the inner core, requiring a substantial volume of durable rock material to complete construction. For this reason, this method would have the same material limitation (limestone/dolomite and sandstone availability and haul distances) as the toe buttress. Another consideration is the construction inspection and increased construction time necessary to insure that the inner core and outer shell is properly placed. Finally, there is the issue of construction sequencing. The reason is that the inner core is generally constructed with steep (1H to 1V or steeper) side slopes with this method. In this project, the inner core will be constructed with residual soils that have been unstable at these slope ratios, meaning that the core must not be exposed for extended periods of time during construction. Otherwise, construction time embankment failures, which tend to involve deep failure zones and large soil masses, will probably occur. Ideally, the outer shell and inner core should be constructed simultaneously to essentially avoid core exposure.

Summary

The earthwork quantities associated with this project are immense and, for the reasons stated in this letter, involve materials that are not compatible with typical ODOT embankment and cut slope construction methods. As a result, Gannett Fleming has proposed alternatives to these typical ODOT specifications that we feel should be used with this project to provide long term stability. These include 3H to 1V embankment fill slopes, 4H to 1V cut slopes in the residual Red bed materials, 1H to 1V cut slopes in the silty to fine sandy gray shale bedrock units, and ½H to 1V cut slopes in the sandstone, limestone, and siltstone bedrock units. Since there are substantial costs associated with implementing this set of recommendations, an attempt has been made to establish some possible alternatives that may allow more typical ODOT construction practices and decrease the amount of land acquisition required for this project. One alternative involves more comprehensive testing of the insitu materials, which may reveal the availability of higher long-term shear strengths. Other alternatives are associated with construction and include rock toe buttresses, soil improvement via lime or cement additives, soil reinforcement, and inner core/outer shell construction. Each of these construction alternatives, while potentially beneficial to the project, have their limitations and an attempt has been made to briefly discuss what they are.

If there are any questions regarding the content of this letter/report, please contact this office.

Sincerely,

Gannett Fleming Engineers and Architects, P.C.

John R. Kenny, P.E.
Vice President
Manager, Ohio Office

Ⓐ RC-1 MUDSTONE; GRAY TO REDDISH-BROWN, SOFT, HIGHLY WEATHERED, HIGHLY BROKEN.
NO CORE LOSS RQD = 13%

Ⓑ RC-2 SHALE; GRAY, SOFT, HIGHLY BROKEN, FISSILE.
SANDSTONE; GRAY, MEDIUM HARD, HIGHLY BROKEN, FINE GRAINED.
DOBNTEDSSF#SSBLE, SBOOH#LT%ARENACEOUS, WITH SPORADIC SLICKENSIDES.

Ⓒ RC-3 SHALE; REDDISH-BROWN, SOFT, HIGHLY BROKEN, SLIGHTLY
CORE LOSS = 10% RQD = 12%

Ⓓ RC-4 LIMESTONE; GRAY, MEDIUM TO MODERATELY HARD, SLIGHTLY BROKEN, FINE TO MEDIUM CRYSTALLINE.

Ⓔ RC-5 MUDSTONE; GRAY TO RED, SOFT, HIGHLY BROKEN, SLIGHTLY JOINTED, SLIGHTLY ARENACEOUS, CALCAREOUS.
CORE LOSS = 14% RQD = 38%
MUDSTONE; REDDISH-GRAY, SOFT, HIGHLY BROKEN.
CORE LOSS = 37% RQD = 0%

Ⓕ RC-6 CORE LOSS = 25% RQD = 0%
Ⓖ RC-7 CORE LOSS = 14% RQD = 0%
Ⓗ RC-8 CORE LOSS = 5% RQD = 28%

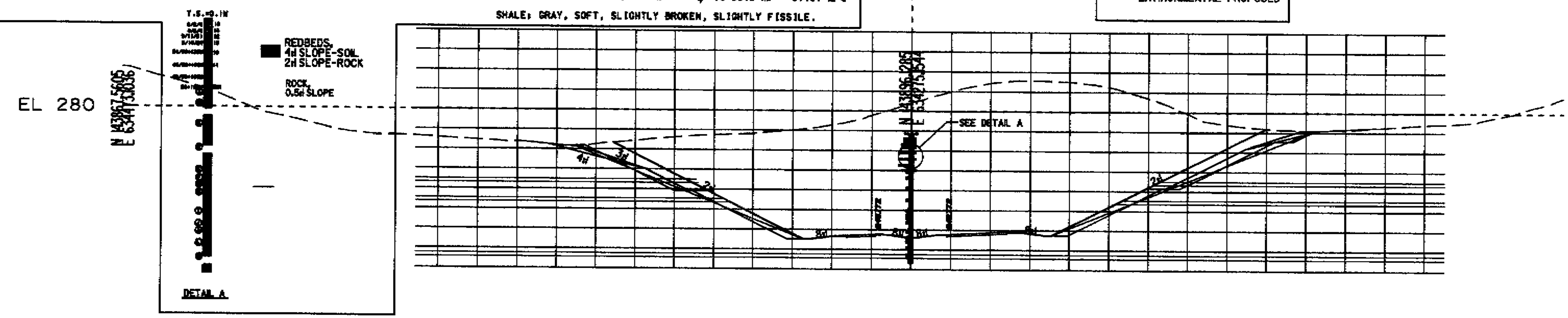
Ⓘ RC-9 SHALE; REDDISH-GRAY, SOFT TO MEDIUM HARD, HIGHLY BROKEN, FISSILE, HIGHLY ARENACEOUS.
CORE LOSS = 4% RQD = 17%

Ⓙ RC-10 MUDSTONE; RED, SOFT, HIGHLY BROKEN.
CORE LOSS = 21% RQD = 26% -qr (@ 26.2 M) = 4.97 MPa

Ⓚ RC-11 CORE LOSS = 22% RQD = 0%
Ⓛ RC-12 CORE LOSS = 17% RQD = 30%

Ⓜ RC-13 LIMESTONE; GRAY, MEDIUM TO MODERATELY HARD, SLIGHTLY MASSIVE, SLIGHTLY JOINTED, MEDIUM CRYSTALLINE.
NO CORE LOSS RQD = 77% -qr (@ 30.5 m) = 67.97 MPa

SHALE; GRAY, SOFT, SLIGHTLY BROKEN, SLIGHTLY FISSILE.



B-4

Ⓐ RC-1 SHALE; GRAY TO RED, SOFT, HIGHLY BROKEN, HIGHLY TO SLIGHTLY JOINTED, WITH SEVERAL SLICKENSIDES.
CORE LOSS = 25% RQD = 0%

Ⓑ RC-2 CORE LOSS = 27% RQD = 7%
Ⓒ RC-3 CORE LOSS = 15% RQD = 22%
Ⓓ RC-4 CORE LOSS = 28% RQD = 0%
Ⓔ RC-5 NO CORE LOSS RQD = 12%

Ⓕ RC-6 SHALE; GRAY, MEDIUM HARD, HIGHLY BROKEN TO SLIGHTLY MASSIVE.
CORE LOSS = 10% RQD = 0%

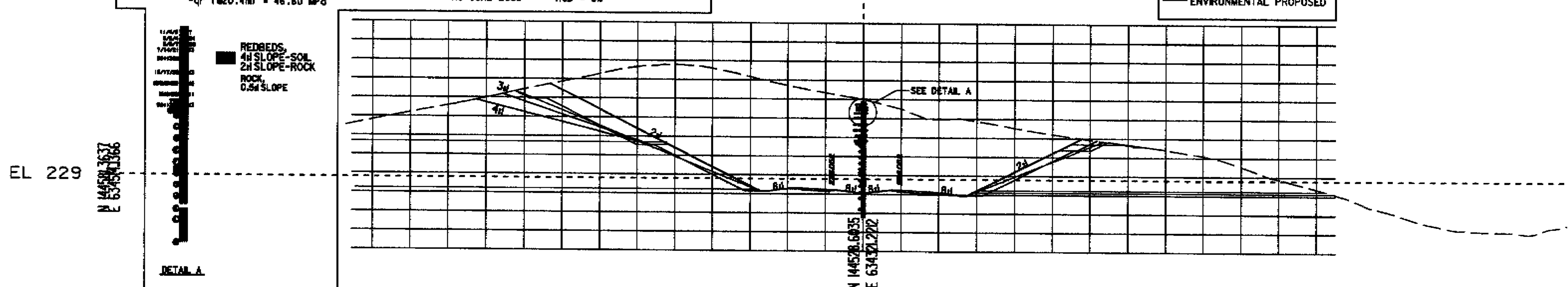
Ⓖ RC-7 CORE LOSS = 17% RQD = 0%
Ⓗ RC-8 CORE LOSS = 8% RQD = 47%
-qr (@20.4m) = 46.80 MPa

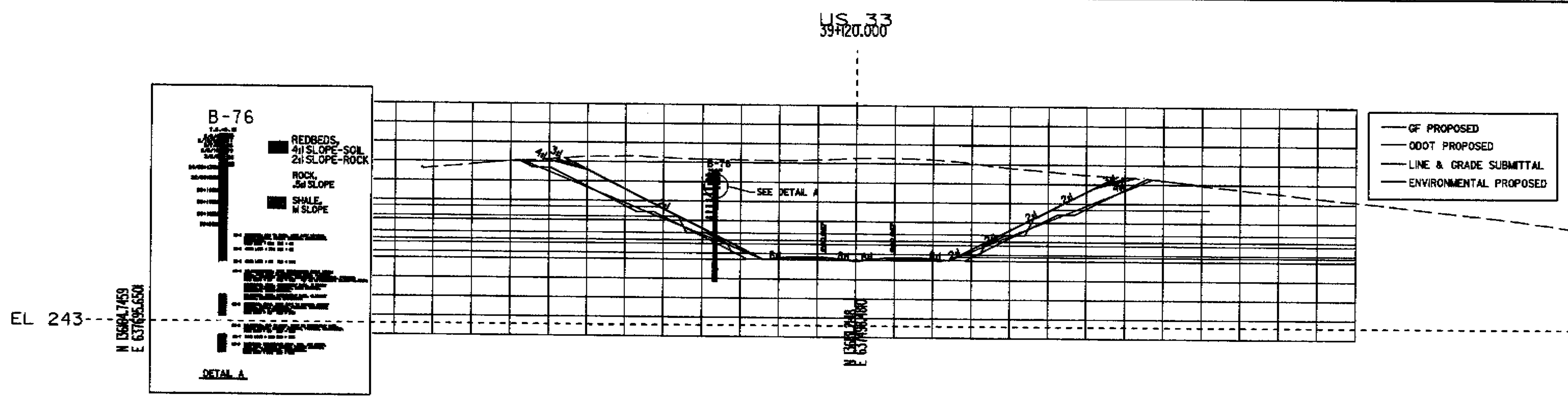
Ⓘ RC-9 CORE LOSS = 5% RQD = 43%
Ⓙ RC-10 NO CORE LOSS RQD = 27%
SILTSTONE; GRAY, MEDIUM HARD, HIGHLY BROKEN, MICACEOUS.

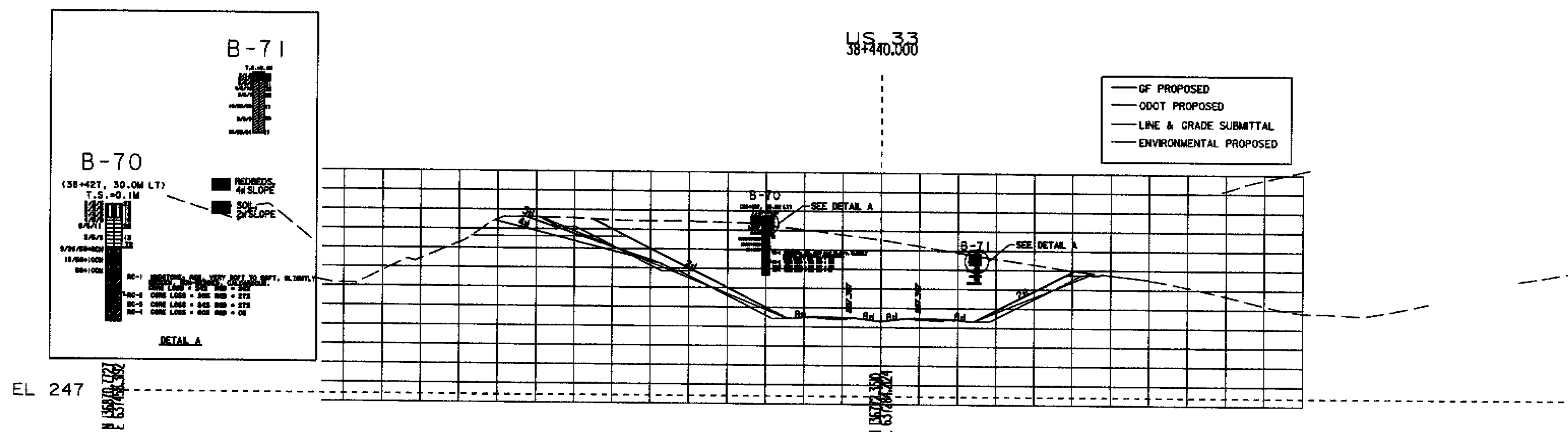
Ⓚ RC-11 SHALE; REDDISH-BROWN AND PURPLE, SOFT TO MEDIUM HARD, HIGHLY BROKEN, WITH PERIODIC SLICKENSIDES.
CORE LOSS = 30% RQD = 0%

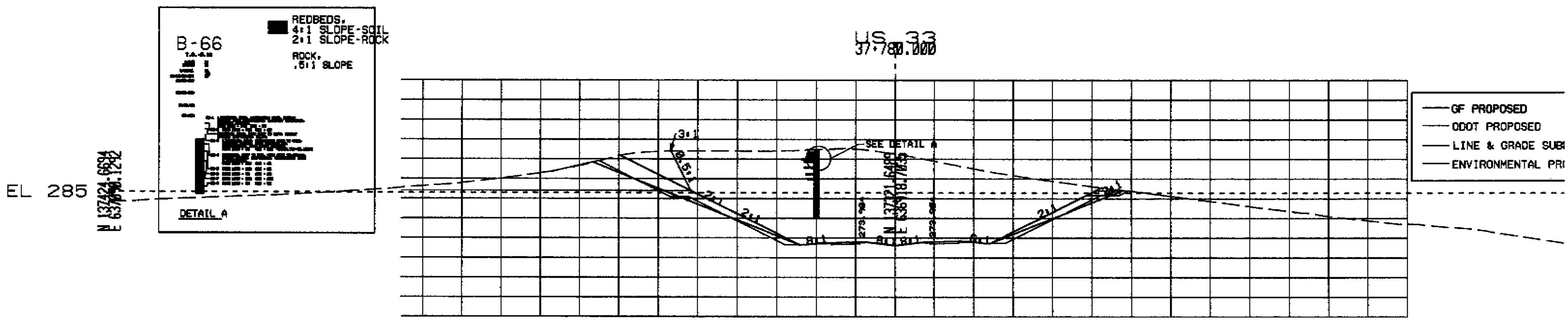
Ⓛ RC-12 CORE LOSS = 2% RQD = 0%

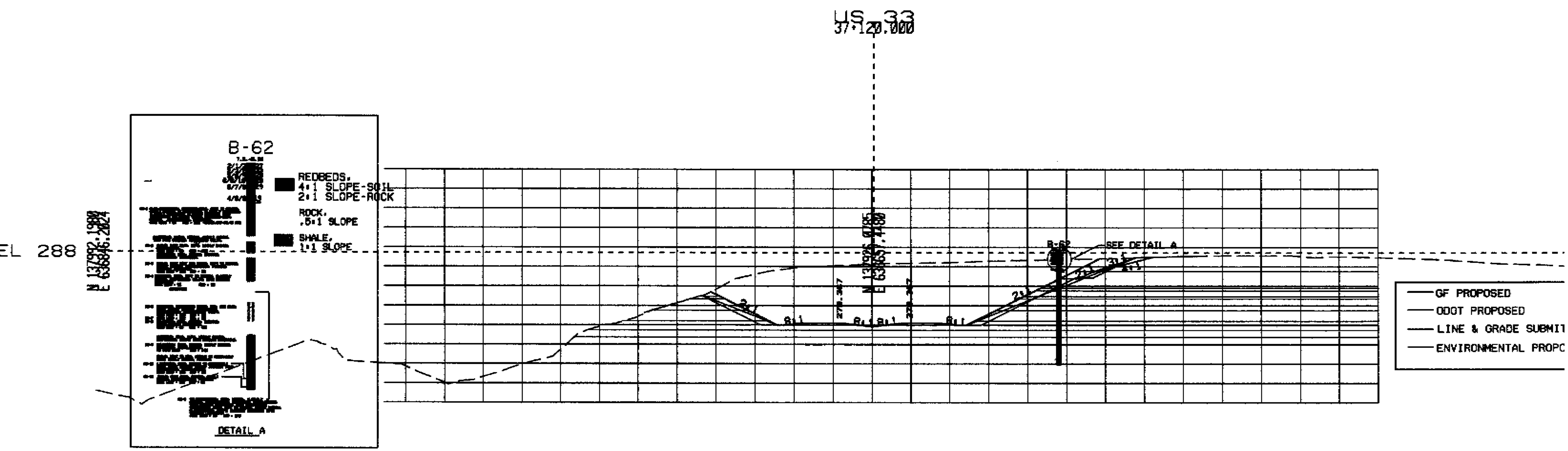
Ⓜ RC-13 LIMESTONE; BROWN AND GRAY, MODERATELY HARD, HIGHLY BROKEN, HIGHLY JOINTED, FINE CRYSTALLINE.
SANDSTONE; GRAY, MODERATELY HARD, HIGHLY BROKEN, MICACEOUS, FINE GRAINED.
NO CORE LOSS RQD = 0%

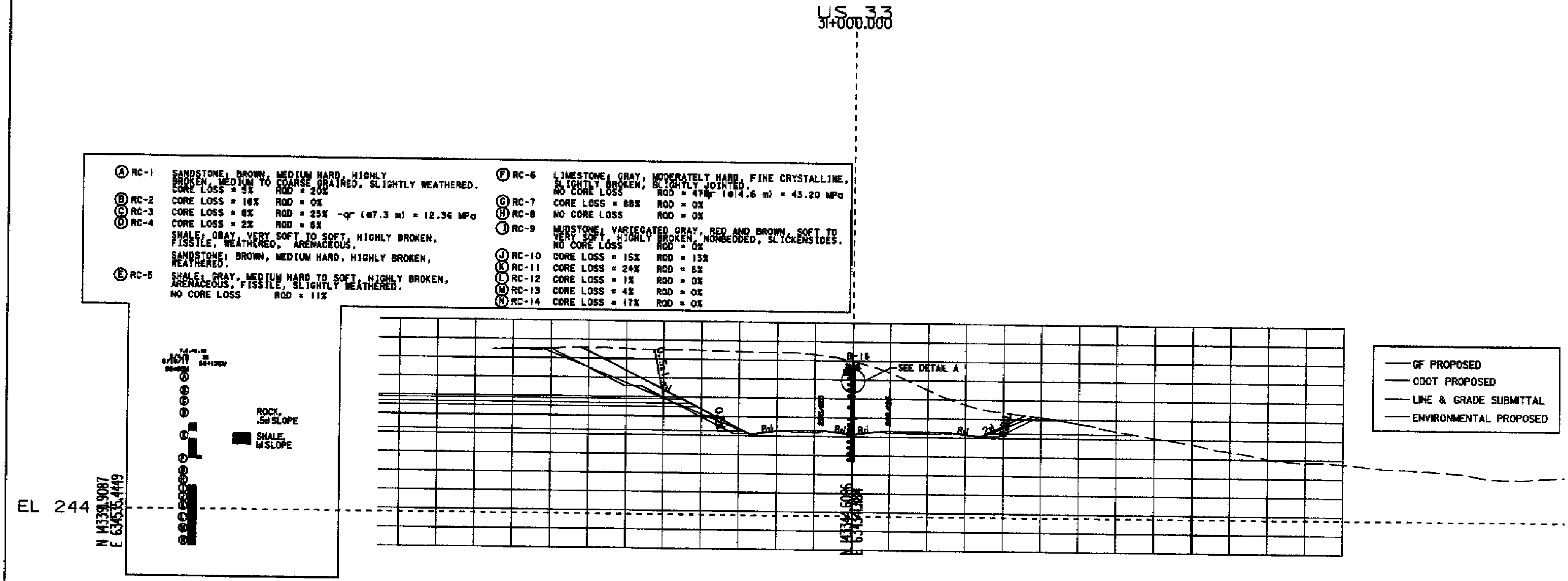


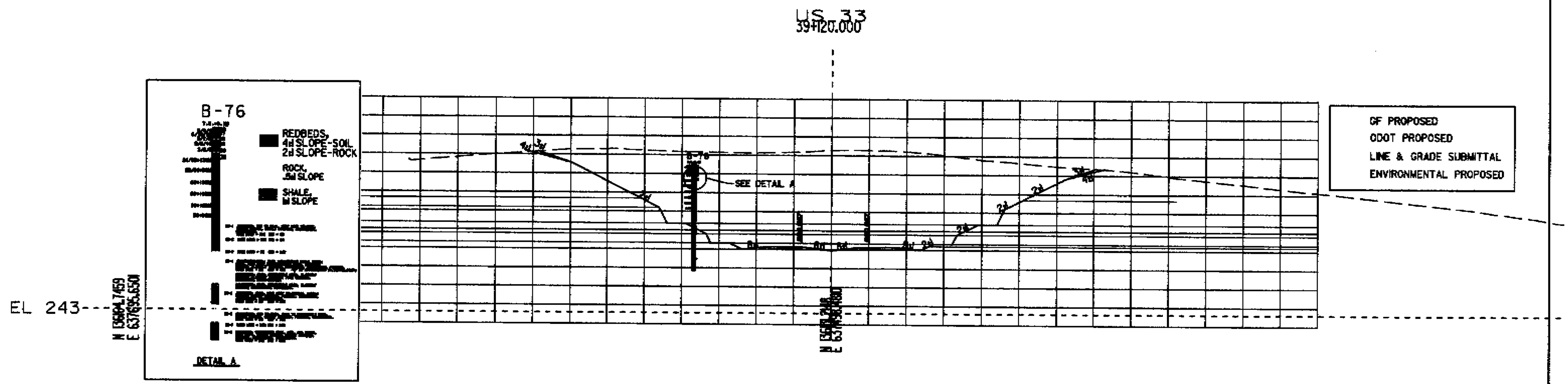

US 33
39+120.000
B-76
REDBEDS,
4:1 SLOPE-SOIL
2:1 SLOPE-ROCK
ROCK,
.5:1 SLOPE
SHALE,
1:1 SLOPE
DETAIL A
SEE DETAIL A
EL 243
N 136084.7459
E 637695.6508
GF PROPOSED
ODOT PROPOSED
LINE & GRADE SUBMITTAL
ENVIRONMENTAL PROPOSED

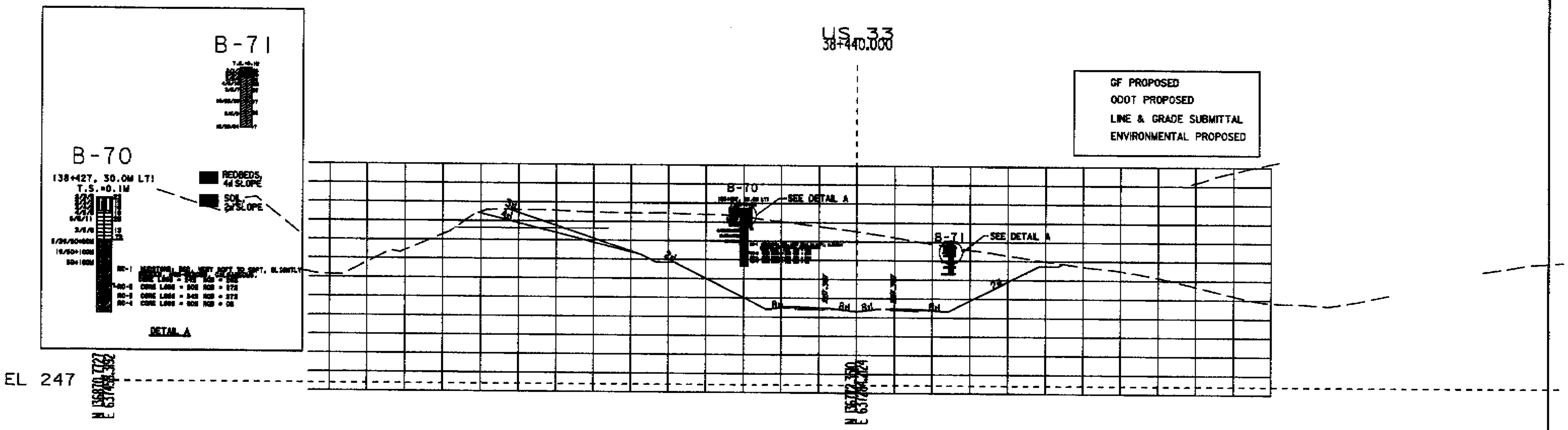

US 33
38+440.000
B-71
B-70
(38+427, 30.0M LT)
T.S.=0.1M
REDBEDS,
4:1 SLOPE
SOIL,
2:1 SLOPE
CORE LOSS
DETAIL A
SEE DETAIL A
EL 247
GF PROPOSED
ODOT PROPOSED
LINE & GRADE SUBMITTAL
ENVIRONMENTAL PROPOSED

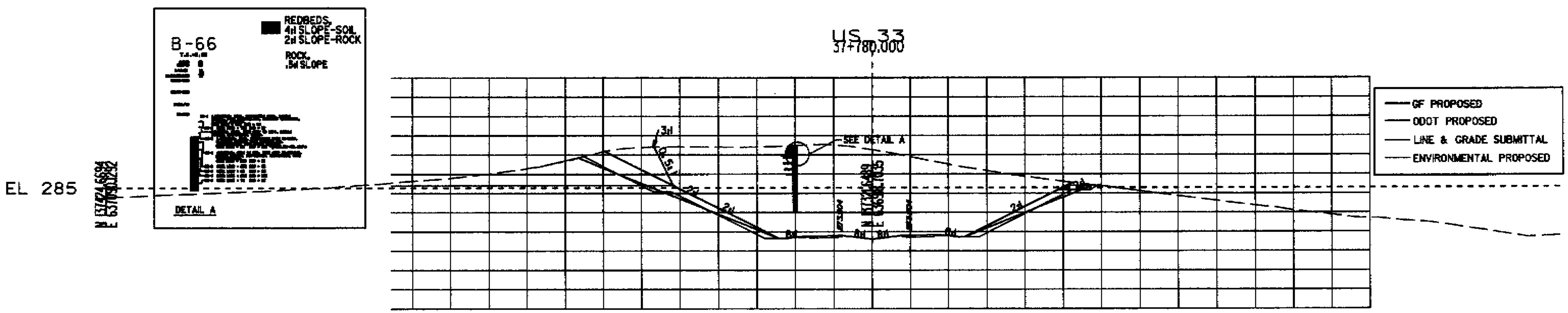

B-66
REDBEDS,
4:1 SLOPE-SOIL
2:1 SLOPE-ROCK
ROCK,
.5:1 SLOPE
DETAIL A
EL 285
N 137424.6694
US 33
SEE DETAIL A
N 137721.6489
GF PROPOSED
ODOT PROPOSED
LINE & GRADE SUB
ENVIRONMENTAL PR

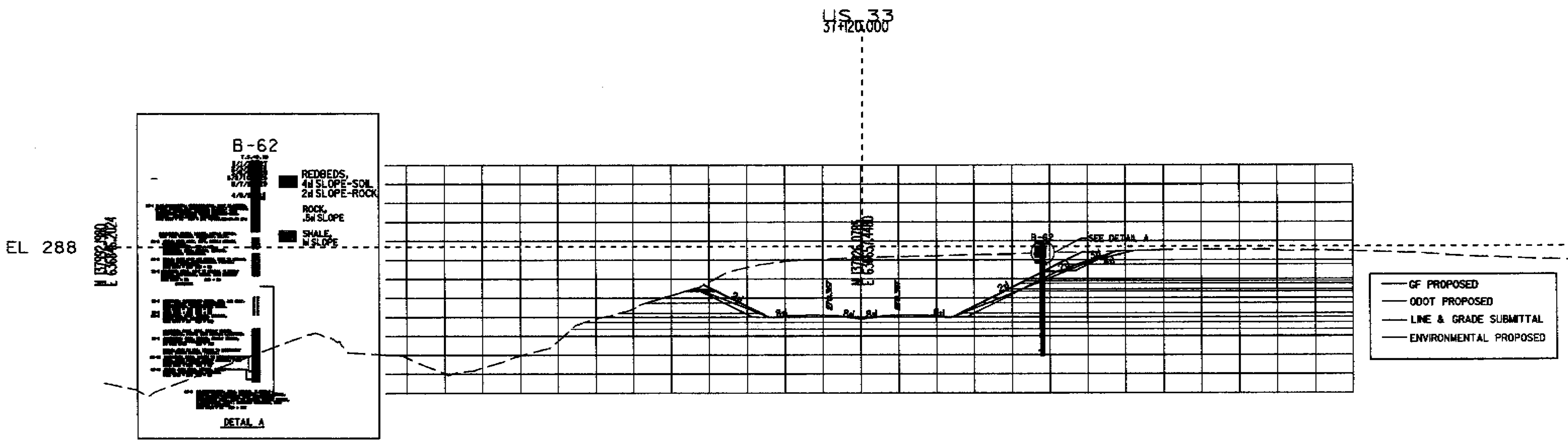

B-62
REDBEDS,
4:1 SLOPE-SOIL
2:1 SLOPE-ROCK
ROCK,
.5:1 SLOPE
SHALE,
1:1 SLOPE
DETAIL A
EL 288
N 137992.1980
E 636946.2024
US 33
37+120.000
B-62
SEE DETAIL A
GF PROPOSED
ODOT PROPOSED
LINE & GRADE SUBMIT
ENVIRONMENTAL PROPO


US 33
31+000.000
(A) RC-1 SANDSTONE, BROWN, MEDIUM HARD, HIGHLY BROKEN, MEDIUM TO COARSE GRAINED, SLIGHTLY WEATHERED.
CORE LOSS = 5% RQD = 20%
(B) RC-2 CORE LOSS = 16% RQD = 0%
(C) RC-3 CORE LOSS = 8% RQD = 25% -qr (@7.3 m) = 12.36 MPa
(D) RC-4 CORE LOSS = 2% RQD = 5%
SHALE, GRAY, VERY SOFT TO SOFT, HIGHLY BROKEN, FISSILE, WEATHERED, ARENACEOUS.
SANDSTONE, BROWN, MEDIUM HARD, HIGHLY BROKEN, WEATHERED.
(E) RC-5 SHALE, GRAY, MEDIUM HARD TO SOFT, HIGHLY BROKEN, ARENACEOUS, FISSILE, SLIGHTLY WEATHERED.
NO CORE LOSS RQD = 11%
(F) RC-6 LIMESTONE, GRAY, MODERATELY HARD, FINE CRYSTALLINE, SLIGHTLY BROKEN, SLIGHTLY JOINTED.
NO CORE LOSS RQD = 47% qr (@14.6 m) = 43.20 MPa
(G) RC-7 CORE LOSS = 88% RQD = 0%
(H) RC-8 NO CORE LOSS RQD = 0%
(I) RC-9 MUDSTONE, VARIEGATED GRAY, RED AND BROWN, SOFT TO VERY SOFT, HIGHLY BROKEN, NONBEDDED, SLICKENSIDES.
NO CORE LOSS RQD = 0%
(J) RC-10 CORE LOSS = 15% RQD = 13%
(K) RC-11 CORE LOSS = 24% RQD = 8%
(L) RC-12 CORE LOSS = 1% RQD = 0%
(M) RC-13 CORE LOSS = 4% RQD = 0%
(N) RC-14 CORE LOSS = 17% RQD = 0%
ROCK, .5:1 SLOPE
SHALE, 1:1 SLOPE
EL 244
N 143391.9087
E 634535.4449
B-16
SEE DETAIL A
N 143344.6086
GF PROPOSED
ODOT PROPOSED
LINE & GRADE SUBMITTAL
ENVIRONMENTAL PROPOSED


US 33
39+120.000
B-76
REDBEDS, 4:1 SLOPE-SOIL 2:1 SLOPE-ROCK
ROCK, .5:1 SLOPE
SHALE, 1:1 SLOPE
DETAIL A
SEE DETAIL A
EL 243
GF PROPOSED
ODOT PROPOSED
LINE & GRADE SUBMITTAL
ENVIRONMENTAL PROPOSED


US 33
38+440.000
B-71
B-70
(38+427, 30.0M LT)
T.S.=0.1M
REDBEDS, 4:1 SLOPE
SOIL, 2:1 SLOPE
DETAIL A
SEE DETAIL A
EL 247
GF PROPOSED
ODOT PROPOSED
LINE & GRADE SUBMITTAL
ENVIRONMENTAL PROPOSED


B-66
REDBEDS,
4:1 SLOPE-SOIL
2:1 SLOPE-ROCK
ROCK,
.5:1 SLOPE
DETAIL A
EL 285
US 33
37+780.000
SEE DETAIL A
GF PROPOSED
ODOT PROPOSED
LINE & GRADE SUBMITTAL
ENVIRONMENTAL PROPOSED


B-62
REDBEDS,
4:1 SLOPE-SOIL
2:1 SLOPE-ROCK
ROCK,
.5:1 SLOPE
SHALE,
1:1 SLOPE
DETAIL A
EL 288
US 33
37+120.000
SEE DETAIL A
GF PROPOSED
ODOT PROPOSED
LINE & GRADE SUBMITTAL
ENVIRONMENTAL PROPOSED

US 33
31+000.000

(A) RC-1 SANDSTONE; BROWN, MEDIUM HARD, HIGHLY BROKEN, MEDIUM TO COARSE GRAINED, SLIGHTLY WEATHERED.
CORE LOSS = 5% RQD = 20%

(B) RC-2 CORE LOSS = 16% RQD = 0%

(C) RC-3 CORE LOSS = 8% RQD = 25% -qr (@7.3 m) = 12.38 MPa

(D) RC-4 CORE LOSS = 2% RQD = 5%
SHALE; GRAY, VERY SOFT TO SOFT, HIGHLY BROKEN, FISSILE, WEATHERED, ARENACEOUS.
SANDSTONE; BROWN, MEDIUM HARD, HIGHLY BROKEN, WEATHERED.

(E) RC-5 SHALE; GRAY, MEDIUM HARD TO SOFT, HIGHLY BROKEN, ARENACEOUS, FISSILE, SLIGHTLY WEATHERED.
NO CORE LOSS RQD = 11%

(F) RC-6 LIMESTONE; GRAY, MODERATELY HARD, FINE CRYSTALLINE, SLIGHTLY BROKEN; SLIGHTLY JOINTED.
NO CORE LOSS RQD = 47%r (@14.6 m) = 43.20 MPa

(G) RC-7 CORE LOSS = 88% RQD = 0%

(H) RC-8 NO CORE LOSS RQD = 0%

(I) RC-9 MUDSTONE; VARIEGATED GRAY, RED AND BROWN, SOFT TO VERY SOFT, HIGHLY BROKEN, NONBEDDED, SLICKENSIDES.
NO CORE LOSS RQD = 0%

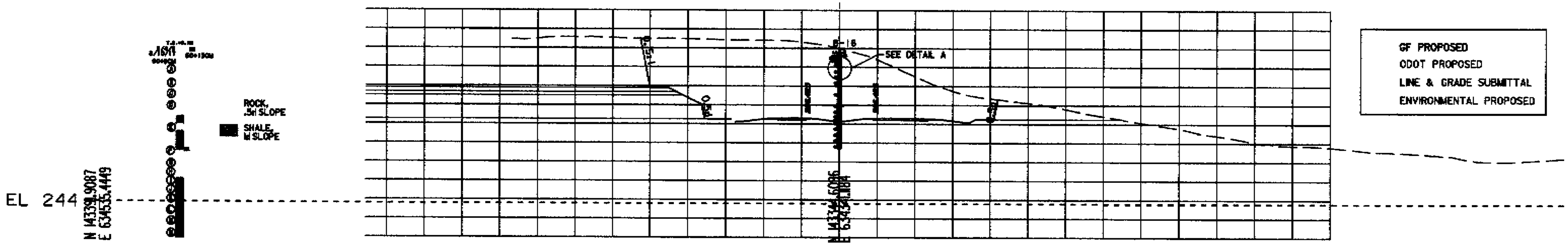
(J) RC-10 CORE LOSS = 15% RQD = 13%

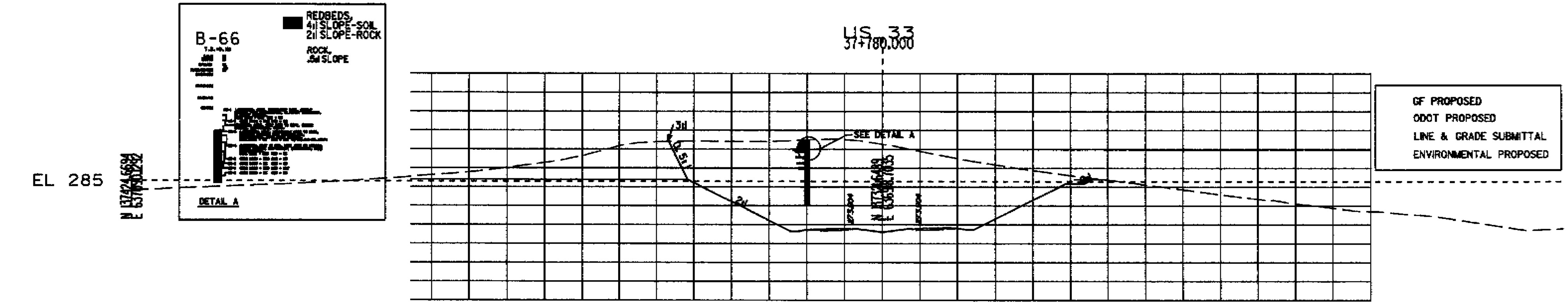
(K) RC-11 CORE LOSS = 24% RQD = 8%

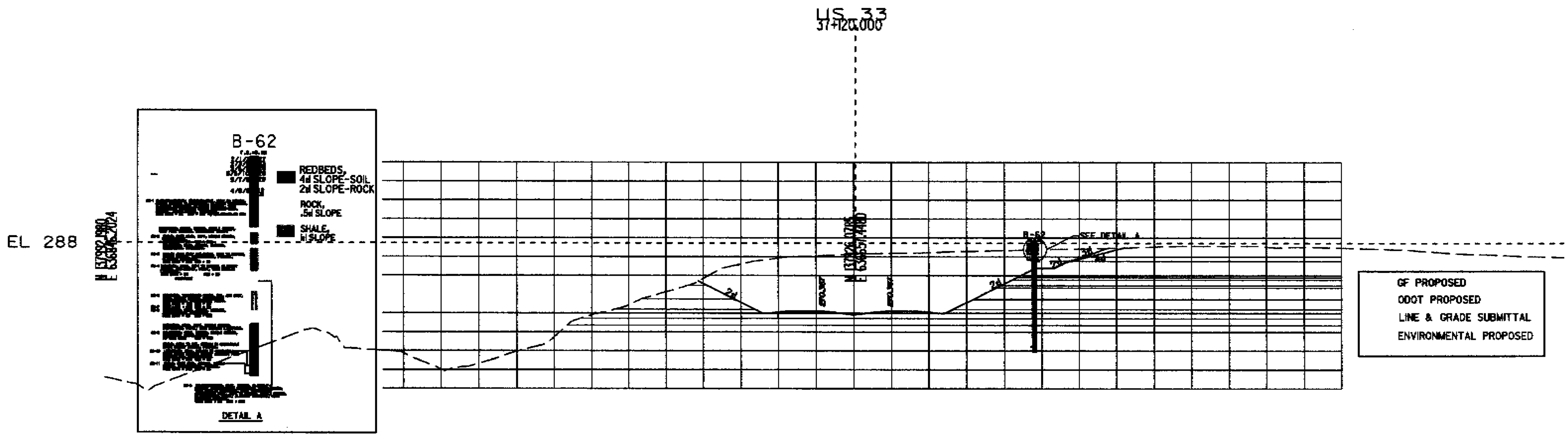
(L) RC-12 CORE LOSS = 1% RQD = 0%

(M) RC-13 CORE LOSS = 4% RQD = 0%

(N) RC-14 CORE LOSS = -17% RQD = 0%



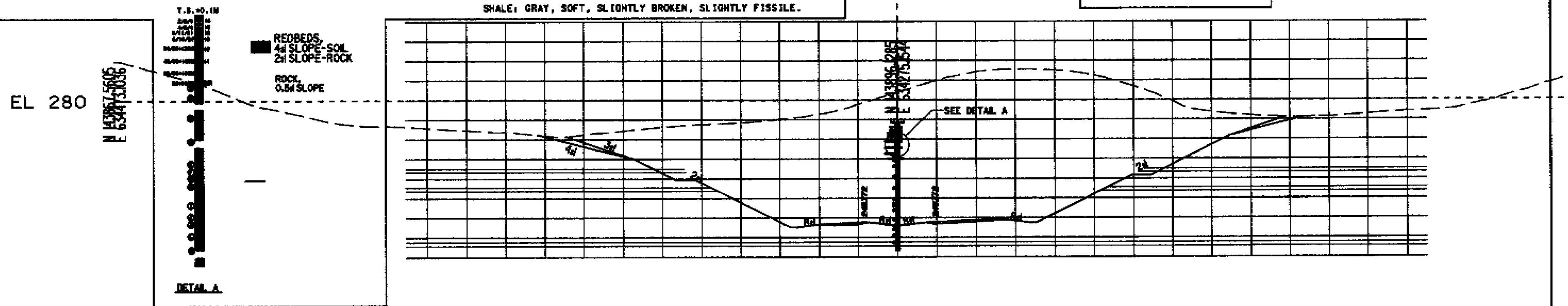

B-66
REDBEDS,
4:1 SLOPE-SOIL
2:1 SLOPE-ROCK
ROCK,
.5:1 SLOPE
DETAIL A
EL 285
US 33
37+780.000
SEE DETAIL A
3:1
2:1
GF PROPOSED
ODOT PROPOSED
LINE & GRADE SUBMITTAL
ENVIRONMENTAL PROPOSED


B-62
REDBEDS,
4:1 SLOPE-SOIL
2:1 SLOPE-ROCK
ROCK,
.5:1 SLOPE
SHALE,
1:1 SLOPE
DETAIL A
EL 288
US 33
37+120.000
SEE DETAIL A
2:1
GF PROPOSED
ODOT PROPOSED
LINE & GRADE SUBMITTAL
ENVIRONMENTAL PROPOSED

(A) RC-1	MUDSTONE; GRAY TO REDDISH-BROWN, SOFT, HIGHLY WEATHERED, HIGHLY BROKEN. NO CORE LOSS RQD = 13%	
(B) RC-2	SHALE; GRAY, SOFT, HIGHLY BROKEN, FISSILE. SANDSTONE; GRAY, MEDIUM HARD, HIGHLY BROKEN, FINE GRAINED. [illegible] ARENACEOUS, WITH SPORADIC SLICKENSIDES.	
(C) RC-3	SHALE; REDDISH-BROWN, SOFT, HIGHLY BROKEN, SLIGHTLY CORE LOSS = 10% RQD = 12%	
(D) RC-4	LIMESTONE; GRAY, MEDIUM TO MODERATELY HARD, SLIGHTLY BROKEN, FINE TO MEDIUM CRYSTALLINE.	
(E) RC-5	MUDSTONE; GRAY TO RED, SOFT, HIGHLY BROKEN, SLIGHTLY JOINTED, SLIGHTLY ARENACEOUS, CALCAREOUS. CORE LOSS = 14% RQD = 38% MUDSTONE; REDDISH-GRAY, SOFT, HIGHLY BROKEN. CORE LOSS = 37% RQD = 0%	
(F) RC-6	CORE LOSS = 25% RQD = 0%	
(G) RC-7	CORE LOSS = 14% RQD = 0%	
(H) RC-8	CORE LOSS = 5% RQD = 26%	
(I) RC-9	SHALE; REDDISH-GRAY, SOFT TO MEDIUM HARD, HIGHLY BROKEN, FISSILE, HIGHLY ARENACEOUS. CORE LOSS = 4% RQD = 17%	
(J) RC-10	MUDSTONE; RED, SOFT, HIGHLY BROKEN. CORE LOSS = 21% RQD = 26%	-qr (@ 26.2 M) = 4.97 MPa
(K) RC-11	CORE LOSS = 22% RQD = 0%	
(L) RC-12	CORE LOSS = 17% RQD = 30%	
(M) RC-13	LIMESTONE; GRAY, MEDIUM TO MODERATELY HARD, SLIGHTLY MASSIVE, SLIGHTLY JOINTED, MEDIUM CRYSTALLINE. NO CORE LOSS RQD = 77%	-qr (@ 30.5 m) = 67.97 MPa
	SHALE; GRAY, SOFT, SLIGHTLY BROKEN, SLIGHTLY FISSILE.	

US 33
30+440.000

GF PROPOSED
ODOT PROPOSED
LINE & GRADE SUBMITTAL
ENVIRONMENTAL PROPOSED

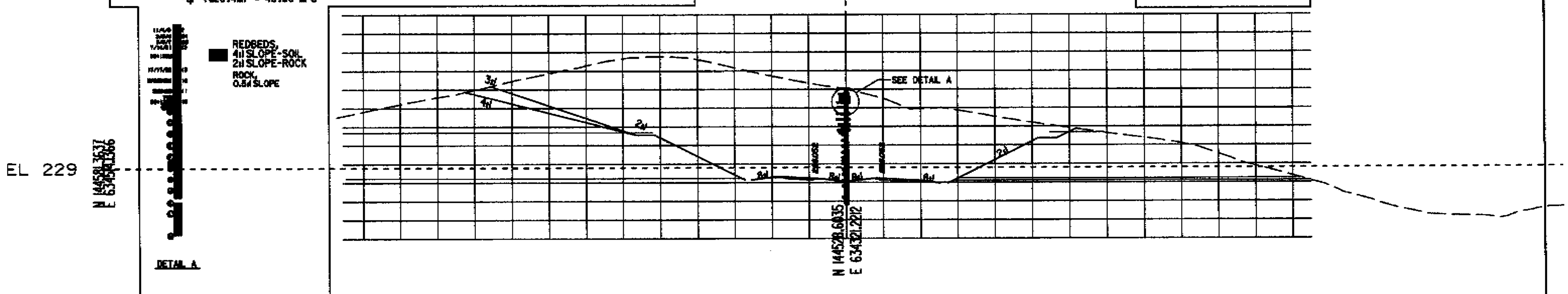


B-4

(A) RC-1	SHALE; GRAY TO RED, SOFT, HIGHLY BROKEN, HIGHLY TO SLIGHTLY JOINTED, WITH SEVERAL SLICKENSIDES. CORE LOSS = 25% RQD = 0%	
(B) RC-2	CORE LOSS = 27% RQD = 7%	
(C) RC-3	CORE LOSS = 15% RQD = 22%	
(D) RC-4	CORE LOSS = 28% RQD = 0%	
(E) RC-5	NO CORE LOSS RQD = 12%	
(F) RC-6	SHALE; GRAY, MEDIUM HARD, HIGHLY BROKEN TO SLIGHTLY MASSIVE. CORE LOSS = 10% RQD = 0%	
(G) RC-7	CORE LOSS = 17% RQD = 0%	
(H) RC-8	CORE LOSS = 8% RQD = 47%	-qr (@20.4m) = 46.80 MPa
(I) RC-9	CORE LOSS = 5% RQD = 43%	
(J) RC-10	NO CORE LOSS RQD = 27% SILTSTONE; GRAY, MEDIUM HARD, HIGHLY BROKEN, MICACEOUS.	
(K) RC-11	SHALE; REDDISH-BROWN AND PURPLE, SOFT TO MEDIUM HARD, HIGHLY BROKEN, WITH PERIODIC SLICKENSIDES. CORE LOSS = 30% RQD = 0%	
(L) RC-12	CORE LOSS = 2% RQD = 0%	
(M) RC-13	LIMESTONE; BROWN AND GRAY, MODERATELY HARD, HIGHLY BROKEN, HIGHLY JOINTED, FINE CRYSTALLINE. SANDSTONE; GRAY, MODERATELY HARD, HIGHLY BROKEN, MICACEOUS, FINE GRAINED. NO CORE LOSS RQD = 0%	

US 33
29+800.000

GF PROPOSED
ODOT PROPOSED
LINE & GRADE SUBMITTAL
ENVIRONMENTAL PROPOSED



Monthly Blasting Reports – June, July 2003
US33 – Phase II, ODOT #10425
Smith & Johnson Construction Co.

Distribution: Bob & Jeff Johnson- S & J Project Manager,
Tom Cochran – Austin Powder Blaster-in-Charge
Jamie Hendershot - ODOT Project Engineer
Randall Morris - ODOT Staff Engineer
Bill Christensen - ODOT Staff Engineer
Janice Reed – Geosonics

As per the specifications, this is the monthly blasting report of Smith & Johnson Construction's contract in Athens County for US33, ODOT #10425. Drilling and blasting has been proceeding according to plan.

June: Austin Powder continued blasting in June. According to the blast reports, there were a total of thirty-four (34) blasts on the project for the month. Twenty-seven (27) were made in production blasting in middle or lower lifts in Cut "A" with seven blasts in Cut "B" near the Gillete residence. There were no test shots this month and the blasting consultant was not present for any blasts.

Seismograph monitoring for production blasting continued at the pre-designated locations or combinations thereof, those being the Cone residence, the Exxon station and Procos Apartments at the intersection of US33 and US50 and the Ivan Cash residence along US50 for Cut A; the Gillete residence for Cut B.

In regard to the actual shot data and summary analysis by Geosonics for the month, there were eleven blasts which recorded readings above the specified limit at the Exxon/Apartment monitoring location. These were all associated with the blasting in Cut "A". Better use of timing, decking and/or hole diameter to control maximum powder charge weight should have been employed by Austin to limit these levels.

July: There were eleven (11) blasts in July. Three (3) were in Cut "A" and eight (8) were in Cut "J". It is understood that blasting is nearly complete in Cut "A" and that Cut "J" is the last remaining area requiring blasting to link up with Phase I. It does not appear that vibration limits were exceeded according to the shot report data.

Monthly Blasting Reports – May, 2003
US33 – Phase II, ODOT #10425
Smith & Johnson Construction Co.

Distribution: Bob & Jeff Johnson- S & J Project Manager,
Tom Cochran – Austin Powder Blaster-in-Charge
Jamie Hendershot - ODOT Project Engineer
Randall Morris - ODOT Staff Engineer
Bill Christensen - ODOT Staff Engineer
Janice Reed – Geosonics

As per the specifications, this is the monthly blasting report of Smith & Johnson Construction's contract in Athens County for US33, ODOT #10425. Drilling and blasting has been proceeding according to plan.

Austin Powder continued blasting in May. According to the blast reports, there were a total of fourteen (14) blasts on the project for the month. Ten were made in production blasting in middle or lower lifts in Cut "A" with one blast in Cut "E" near Sickles residence, two blasts in Cut "D" and one blast in Cut "H". There were no test shots this month and the blasting consultant was not present for any blasts.

Seismograph monitoring for production blasting continued at the pre-designated locations or combinations thereof, those being the Cone residence, the Exxon station and Procos Apartments at the intersection of US33 and US50 and the Ivan Cash residence along US50 for Cut A; the Rose residence for Cut E; the Ervin residence for Cut D and the Eldridge residence for Cut H. In regard to the actual shot data for the month, there were two blasts which recorded readings slightly above the specified limit at the Apartment monitoring location, shots #481 & #482. For these shots there are two sets of data, one by the permanent seismograph set by Geosonics and the other by the machine set by Austin just prior to the blast. As in April, there is still a significant discrepancy between these two sets of data. The Austin seismograph (also of Geosonics manufacture) is consistently reading lower than the permanent seismograph. It is the permanent machine which is still registering readings above the specified limit.

These two blasts were 155' to 202' away from the Exxon. Drill holes were 4" and in the closer blast decking appears to have been employed as well. Although these practices are the kinds of adjustment sthat should be made, if readings are still above the specified limit, further adjustments still need to made in terms of limiting the charge weight even more until acceptable results are achieved.

Monthly Blasting Reports –April, 2003
US33 – Phase II, ODOT #10425
Smith & Johnson Construction Co.

Distribution: Bob & Jeff Johnson- S & J Project Manager,
Tom Cochran – Austin Powder Blaster-in-Charge
Jamie Hendershot - ODOT Project Engineer
Randall Morris - ODOT Staff Engineer
Bill Christensen - ODOT Staff Engineer
Janice Reed – Geosonics

As per the specifications, this is the monthly blasting report of Smith & Johnson Construction's contract in Athens County for US33, ODOT #10425. Drilling and blasting has been proceeding according to plan.

Only one blasting contractor, Austin Powder continued blasting in April. Hilltop Energy will not be blasting in any areas for the duration of the job. According to the blast reports, there were a total of thirty-seven (37) blasts on the project for the month. All were made in production blasting in middle or lower lifts in Cut "A" except for one shot in Cut "E" near Sickles residence.

Seismograph monitoring for production blasting continued at the pre-designated locations or combinations thereof, those being the Cone residence, the Exxon station and Procos Apartments at the intersection of US33 and US50 and the Ivan Cash residence along US50. In regard to the actual shot data for the month, there were seven blasts which recorded readings slightly above the specified limit at the Apartment monitoring location. For these shots there are two sets of data, one by the permanent seismograph set by Geosonics and the other by the machine set by Austin just prior to the blast. After reviewing the Geosonic report, it is apparent that there is a significant discrepancy between these two sets of data.

The Austin seismograph (also of Geosonics manufacture) is consistently reading lower than the permanent seismograph. It is the permanent machine which is registering readings above the specified limit. The difference in these readings at essentially the same location deserves some explanation. Is the Austin machine in proper calibration? Is the geophone being set up in different material than the other? Is it set up properly? These are questions that come to mind. If the higher reading is to be believed, then the Austin blaster should be taking those readings into account. It appears that the blaster does not have access to the permanent machine and therefore the data is not being used as feedback for adjusting blast parameters to maintain levels within the prescribed limits. If the blaster has only been looking at his own seismograph readings for feedback, it is no wonder that adjustments have not been made in this series of blasts. The Austin machine never registered any readings above the limit at the Apartments. This is a flaw in the procedure and should be addressed. Data from the permanent seismograph is always useful but if it ends up being the most reliable of the data, it should be used immediately for the blaster to take corrective action. That is also part of its purpose.

There were no test shots this month however the blasting consultant was present for monitoring a production blast on 4/28. The shot was +800' from the Exxon where the Austin machine was set up. Readings were very low on this machine. I did not get any feedback from the blaster or the Project Engineer that there were any limits being exceeded subsequent to that shot for the month. It is now apparent from the above explanation as to why. The shot reports have been reflecting the readings from the blaster's seismographs so there was no real indication as to limit problems until the permanent machine was downloaded and reported by Geosonics.

Again, this is a procedural issue which needs to be immediately resolved. Austin Powder blasters should continue to monitor their designs very closely and watch the total weight of explosive detonated per 8 ms period whether one hole or multiple holes. Decking and/or smaller holes should be used in the areas immediately adjacent to the Apartments.

Proj: 010425
PID: 18287
CRS: ATH-33-30.981

Monthly Blasting Reports –March, 2003
US33 – Phase II, ODOT #10425
Smith & Johnson Construction Co.

Distribution: Bob & Jeff Johnson- S & J Project Manager,
Tom Cochran - Austin Powder Blaster-in-Charge
Kim Vollnogle – Hilltop Energy
Jamie Hendershot ODOT Project Engineer
Randall Morris - ODOT Staff Engineer
Steve Sommers - ODOT Staff Engineer

As per the specifications, this is the monthly blasting report of Smith & Johnson Construction's contract in Athens County for US33, ODOT #10425. Drilling and blasting has been proceeding according to plan.

Only one blasting contractor, Austin Powder continued blasting in March. According to the blast reports, there were a total of ten (10) blasts on the project for the month. All were made in production blasting in middle lifts in Cut "A".

Seismograph monitoring for production blasting continued at the pre-designated locations, the Lehlback residence along existing US33 , the Exxon station/Procos Apartments at the intersection of US33 and US50 and the Ivan Cash residence along US50. In regard to the actual shot data for the month, the readings were all well below the limit.

There were no test shots this month and the blasting consultant was not present for any shots. In discussion with job personnel, no new complaints have been made by any residents. No significant events were reported by the Project Engineer, the Contractor or the Blasting Contractor.

Austin Powder blasters should continue to monitor their designs very closely and watch the total weight of explosive detonated per 8 ms period whether one hole or multiple holes. As they move through the cut they will be moving away from some structures and closer to others, particularly the Exxon station and Apartments.