Research Report
UKTRP-82-22

REVIEW OF PERTINENT CONTRACT DOCUMENTS TENNESSEE-TOMBIGBEE WATERWAY DIVIDE CUT SECTION 3A

by

Ronald D. Hughes
Deputy Director

Robert C. Deen
Director

David L. Allen
Chief Research Engineer

Tommy C. Hopkins
Chief Research Engineer

Transportation Research Program
University of Kentucky
Lexington, Kentucky

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INTRODUCTION

During construction of a portion of the Tombigbee Canal near Corinth, Mississippi, southward from Pickwick Lake (Station 13,118+00 to 13,337+50), the Contractor reported various problems, which he termed "differing site conditions." Some of the items considered as problems by the Contractor were: the amount of cherty Paleozoic material was far less than he expected or anticipated, there were deep deposits of bluish muck, the alluvial was not sufficiently stable to place in 1-foot lifts, excessively wet materials made it necessary to shift equipment frequently, the equipment had to travel over bad roads, and the materials had no bearing strength.

The Contractor contended the Government did not forewarn of site conditions he viewed as presenting difficulties. Equipment travelling over bad roads resulted in reduced production, decreased tire life, increased fuel costs, and added to unit costs as stated by the Contractor. As a result, the Contractor claimed the job extended over 43 months rather than three 6-month construction seasons.

In an effort to determine the validity and/or justification of the Contractor's claim(s), the Ohio River Division, Corps of Engineers, contracted with the University of Kentucky Research Foundation for the purpose of having personnel of the Kentucky Transportation Research Program (KTRP) determine basic engineering parameters of project materials and assess pertinent contract documents, specifications, and data. Nashville District, Corps of Engineers personnel aided KTRP personnel in securing samples of earth materials and supplied contract documents.

Samples were secured from a test pit at the project site on June 22, 1982, and were tested and analyzed at the KTRP laboratory in Lexington, Kentucky. Findings for the materials test portion of the study were reported to the Corps in Research Report UKTRP-82-16, "Mechanical & Engineering Properties of a Cherty Paleozoic Material."

Evaluations of pertinent project documents, specifications, data, equipment use reports, project diaries, and select correspondence between Contractor and Corps personnel are reported herein. Three geotechnical engineers and one specifications engineer made independent detailed reviews of all documents supplied by the Nashville District. All documents were specifically reviewed in an endeavor to determine: 1) did the Corps of Engineers withhold information from prospective project bidders or the Contractor, and 2) were changed site conditions observed during the course of construction? Findings and conclusions contained in this report are based upon a thorough review of project documents and related correspondence listed in Appendix A.

ANNOTATION OF MAJOR DOCUMENTS

Project documents pertaining to the excavation of Divide Cut Section 3A (Station 13,118+00 to 13,337+50) of the Tennessee-Tombigbee Waterway supplied by Corps of Engineers, Nashville District, to Kentucky Transportation Research Program personnel are annotated in this section. Documents received at various times during the course of this portion of the investigation that were critically reviewed by the KTRP personnel are listed in Appendix A. Certain portions of the annotation have been supplemented with comments considered important by the reviewers from the standpoint of individual documents. Several of those comments were of value for the overall analysis and evaluation.

A. SPECIFICATIONS (INCLUDING APPENDIX A AND APPENDIX B)

KTRP personnel were verbally instructed to review and evaluate those portions of the specifications relating to excavation and grading. Section 2C specifies procedures for excavation and grading. Section 2B covers temporary diversions and care of water. Appendix A contains soils test data, and Appendix B discusses diversion of Yellow and Mackeys Creeks. These referenced portions of the specifications were considered pertinent to the assigned task and are contained in this annotation.

Subsection 2C-1 covers the scope of excavation and grading in a very general sense. A plan for dewatering as specified in Section 2B is designated under 2C-1.1. It seems evident the requirement for dewatering would indicate that the presence of water at the site could definitely be anticipated. Under 2C-2, materials to be excavated are broadly described and three test pits are referenced. The Paleozoic material was described as highly weathered Mississippian age Fort Payne Formation consisting of two general types. The primary Paleozoic (13,140+00 to 13,286+00) was a residual material of highly weathered fragmented chert, layered and containing silt and clay binder. Between Station 13,286+00 and 13,337+50, the Paleozoic was generally weathered siltstone. Those types were located within the project limits by reference to approximate stations. Quaternary alluvium overlaid the Paleozoic. Residual materials derived from parent rock were designated as being variable both laterally and vertically. Soil materials encountered were described as fine- to coarse-grained alluvial soil with silty sands and sandy gravels predominating. It was noted that silts and clays could be anticipated locally, although no persistent strata had been delineated at the site.

Soils were tested for physical characteristics. No shear strength tests were performed. Explorations were representative of subsurface conditions at their respective locations and vertical reaches, and local variations in subsurface materials were to be expected. All samples and cores were made available for inspection by bidders.

Excavation was classified as either common or rock under Subsection 2C-3. Rock excavation was to be all excavation that required specialized rock removal equipment for ripping or systematic drilling and blasting. Common excavation would be all other excavation not classified as rock excavation. Excavation could be performed by any method(s) that would produce desired results according to 2C-4, with the exception that dredging would not be allowed. Methods for drilling and blasting were designated under 2C-5 and do not appear significant for the overall analysis.

Subsection 2C-6 outlines detailed requirements for compaction equipment. Under 2C-6.2, contract drawings are referenced for disposal of all unused excavation materials. Deposition in a manner allowing the material to stabilize to the extent necessary to insure long-term stability of disposal area slopes was required. The top and sideslopes were to be covered with a minimum of 2 feet of fine sand and/or silty sand alluvial material. Temporary seeding and/or other means of protection to stabilize the slopes of disposal areas were designated. In cases of construction delays due to weather or other reasons, precautions to eliminate "disposition" (deposition) of material outside disposal area limits were described.

According to requirements of 2C-6.2.1, excavated material other than Paleozoic material was to be placed in disposal areas in 1-foot lifts and compacted with two passes of a tamping roller in designated directions. Neither density nor moisture contents were specified. However, it was required that the materials must be dried and densified to the extent necessary to support construction equipment. The requirement that the materials must be dried is indicative that wet materials were to be expected and/or anticipated. Cherty Paleozoic material was designated for use for construction of maintenance berms, access roads, temporary structures of any kind, and various grading according to 2C-6.2.2. Excess cherty Paleozoic material was to be placed in disposal areas in 2-foot thick lifts, and no compaction in those areas was required other than to effect drainage and spread the material evenly.

Subsection 2C-6.2.3 specifies methods of final grading and protection for disposal areas. Top and side surfaces were to be covered with a minimum of 2 feet of alluvial soil, graded as shown on contract drawings, and fertilized and seeded to minimize erosion. Ditching at the crest and construction of drainage structures were specified. Under 2C-6.3, construction of berms and access roads from the cherty Paleozoic excavation was outlined. Stripping of all vegetation, topsoil, and organic and objectional material was required under 2C-6.3.1, Foundation Preparation, for areas requiring fill to complete berms and access roads. Backfill was to be compacted to a density equal to or greater than that of the surrounding natural material. Construction in cut areas and fills less than 3 feet was also described.

Embankments, under 2C-6.3.2, for berms and access roads were specified to be constructed by sreading the cherty materials, from required excavations, full width of the fill area in 2-foot thick lifts. Each lift was to be tracked down by dozers and hauling equipment before placement of the next successive lift. Access road slopes of the cherty Paleozoic were to be plated with 2 feet of alluvial fine sands and silty sands. Loose lifts 8 inches thick and each compacted with six complete passes with tamping rollers were required for the plating soil. The moisture content of cohesive soils used in embankments were designated to be not less than two percent below nor more than two percent above optimum.

For future documents, consideration should be given to revision of the manner in which the permissible range in moisture content for cohesive soils is phrased. As presently stated (shall be not less than two percent below), the current specification could be interpreted by the uninitiated as requiring moisture contents three, four, five, etc. (all more than two percent) percent below optimum. It is suggested that the permissible range of moisture content be designated in the following manner: "The moisture content of the soil shall be within the range of two percentage points above or below optimum."

Subsection 2C-6.3.3 required that the contractor be responsible for maintaining road surfaces in good condition. It is suggested that the word grade be deleted from the last sentence of the subsection. In addition, "traffic disturbs" should probably be changed to "traffic unduly disturbs." These changes are suggested since grade may be interpreted to designate degrees of rise or fall and even nominal traffic will disturb the roadway to some extent.

General site grading is covered under 2C-7.1. Minor local variations in topography from that shown on contract drawings were anticipated and provisions for proper grading were made. Requirements for ditches were covered under 2C-7.2. All ditches were to be graded to drain, regardless of topography. A minimum of 2 feet of fine sand or silty sand alluvium were specified under 2C-7.3 for areas requiring filling and grading to maintain effective drainage. No formal compaction requirements were designated; compaction to support light vehicles was required.

Rechanneling of Yellow Creek and Robinson Creek as shown on the drawings were referenced under 2C-7.4. Temporary roads were covered under 2C-8, and 2C-8.1 required that temporary roads be kept to a minimum. Maximum use of berms and access roads was required to minimize construction of temporary roads. No major haul roads were to be permitted along the westerly side of the waterway other than established access roads, except temporary roads could be constructed where ditching and grading were required. All temporary roads were to be removed and the area restored to a natural state and revegetated. In this subsection,

consideration should be given to changing "removed and restored" to "removed and the site shall be restored."

Subsection 2C-8.2 specified that the contractor be responsible to design, construct, and maintain temporary roads. Stream crossings were to be constructed to allow passage of normal flows without ponding or erosion. Crossings either had to pass high water or be breached to preclude headwater flooding. For high water, reference was made to Section 2B, Temporary Diversions and Care of Water, paragraph 2B-7, Dewatering. Prior to construction, the contractor was to submit a plan showing temporary haul and access road alignments, widths, and types of stream and/or ditch crossings for approval. For future documents, consideration should be given to changing "approval" to "review."

Measurement and payment were covered under 2C-9, and 2C-9.1 specified that the contractor make a survey prior to beginning any stripping or excavation. The initial survey was to constitute the original cross-sections from which all common excavation quantities were to be calculated, without regard to ground surface changes occurring during prosecution of the work. After excavation progressed to the material classified as "Rock Excavation," another survey was to be made by the contractor and that would constitute the final survey for "Common Excavation" and the original survey for "Rock Excavation." After the waterway was excavated to full depth, a final cross-section survey was to be made and was to constitute the final cross-section for rock excavation. Survey procedures were specified.

Measurement of excavated material by cubic yard was designated under 2C-9.2.1, and payment at contract unit prices for each classification was designated in 2C-9.2.2. Subsections 2C-9.3 through 2C-9.6 covered measurement and payment for dikes, berms, access roads, site grading, disposal areas, and temporary roads. No separate payment was provided and costs therefore were to be included in the unit price per cubic yard for either "Common Excavation-Waterway" or "Rock Excavation-Waterway." The method of measurement and payment for ditching and rechanneling was designated under 2C-9.7, which referenced Subsection 2E. Temporary stone protection was to be paid for per ton and quantities could be determined from certified weigh bills.

Section 2B covered temporary diversions and care of water. The contractor was to be responsible for the care and control of all surface and ground water required to excavate the waterway and make structural excavation in the dry, except for the final plug. Construction and maintenance of a temporary diversion system capable of passing specific discharges from three reaches of Robinson Creek were specified. The section was specific in designating that runoff and all water from sumps, drains, trenches, or wells used in dewatering for construction would require care and control to prevent erosion, siltation, and damage to cut slopes during the May-November work period.

Provision was made for flooding the permanent work with a minimum head differential. The flooding plan was to be included as part of a diversion plan.

Subsection 2B-3 specified that the contractor submit drawings and schedules showing proposed diversion and dewatering plans at least 30 days prior to start of any excavation. The plans were to include schedules and related data; method or methods of dewatering; location and capacities of wells, well points, sumps, pumps, and lines; design assumptions; plan for removing system; as well as several other pertinent items. There should have been no doubt that diversion and dewatering were to be required. The order of work was to be such that the natural drainage capacity of Yellow Creek and its tributaries would be unobstructed. Hydrologic and stream-flow data were outlined in 2B-5 through 2B-6.

Dewatering for structural excavations was covered under 2B-7, and maintenace of excavations for each drainage structure in an unwatered condition was specified. Cost of dewatering for structures was to be included in the bid price for each structure.

Temporary stream crossings to allow access to the work area during construction were permitted under 2B-8, providing culverts of sufficient size to pass nominal rises of the streams were in place. It is suggested that "to pass nominal rises" be changed to read "to pass nominal discharges" in future documents.

All dewatering, excluding that for construction of structures, was designated for lump sum payment in accordance with 2B-9.

Appendix A to the specifications contained soil test data for the borings. A more detailed summary of that data is contained in Appendix B of this report. A general review of the soil test data summary sheets would indicate that wet conditions could be anticipated since many natural moisture contents were either above the liquid limit or between the plastic limit and liquid limit.

Appendix B to the specifications contained design features for diversion of Yellow and Mackeys Creeks and was not considered pertinent to earthwork.

B. PLANS FOR DIVIDE CUT SECTION 3A

Plan sheets submitted to KTRP personnel for review are indexed in Appendix C. Limits for the Divide Section as well as Divide Cut Section 3A are indicated on the location map. Plan and profile sheets show the location and elevations of the waterway and westerly and easterly access roads. Approximate original ground lines and limits of disposal areas are shown. Plans for temporary diversion of Yellow Creek to facilitate construction were included along with Highway 25 by-pass plans. Section and detail sheets for the Divide Cut designated the locations for placement of cherty Paleozoic, alluvium, plating, turf berms, stone protection, etc. Plans, sections, and details for the

disposal areas included provisions for ditching and terracing.

Provisions were included for ditching on both sides along the waterway. Miscellaneous details contained typical sections where Paleozoic material was or was not encountered, typical access road cut or fill sections, details for slope protection, and provisions for slopes of disposal areas 601A and 602A. Access road by-passes of creeks were shown. Several sheets contained detailed provisions for drainage structures, stilling basins, pipe culvets, drop inlets, and chutes for the creeks and disposal areas. Gaging station plans and sections were also included.

Informational sheets included in the plan set contained stage hydrographs from 1958 through 1976, hydrologic data for Yellow Creek and Pickwick Reservoir, a boring legend and location plan, test pit (1, 2, and 3) locations and data, groundwater investigation for Piezometer Site 8, and logs of borings.

C. AREAL GEOLOGY MAP

The predominate feature within the construction limits of the project is designated by Qal and described as Alluvium: sands, clays, silts and gravels. More specifically, the feature is varicolored brown and gray, irregularly bedded. Sands were indicated to be fine- to medium-grained, medium to very loose, and occasionally clayey. Clays were soft to very stiff and occasionally sand and gravels were fine to coarse.

D. DOSKIE QUADRANGLE

Only nominal relief is noted within the construction limits and immediately adjacent areas. Yellow Creek meandered through the area. From that, one could assume surface and ground waters might prevail.

E. CORE AND BORE LOGS

Additional rough draft copies of core and bore logs were provided. Since information contained on logs in the plans was much more detailed, the rough draft logs were not utilized in this analysis.

F. PLAN VIEW OF FIELD MAPPING

A plan view of field mapping after excavation and cross sections from template design indicating ground elevations and geology from field mapping after excavation would be sources of information for confirming volumes of rock and common excavations. According to Subsection 2C-9.1, the contractor was to make surveys from which volumes of rock and common excavations were to be based. Since the unit bid price for each class of excavation were the same, it is possible that the Contractor did not make surveys to distinguish between common and rock excavation volumes. Should the Contractor be charged the Corps' expenses for

field mapping involved in determining volumes of common and rock excavations?

G. GENERAL PLAN

The general plans indicate locations of the waterway and access roads in Divide Cut Section 3A on a topographic map to a scale of 1" = 500' having 5-foot contour intervals. It is obvious from that plan sheet that the waterway within the designated section was within a relatively wide valley having nominal relief within which Yellow Creek meandered. The presence of water and problems relating to its disposal should have been obvious from a review of TTW-3/3A.1.

H. DRAWINGS TTW-10/1 THROUGH 10/11

TTW-10/1 and 2 contained boring information that has been reviewed previously. TTW-10/3 through 5 contained details of Test Pits 1 through 3, including five photographs of each. Each sheet contained location plan, legend, geologic column, water level (on 10-14-75), plan view, and sections. Water levels were within about 3 feet of ground surface for Pits 1 and 3 and within about 40 feet for Pit 2. TTW-10/6 through 11 contained logs of borings, all of which have been previously reviewed in other documents.

I. CONSTRUCTION ANALYSIS -- DIVIDED CUT SECTION

By a contract dated May 16, 1974, the Nashville District, Corps of Engineers, engaged Jacobs Associates to make independent appraisals of construction, costs, and time requirements for completing a portion of the Divide Cut Section of the waterway. An annotation of their August 30, 1974, report is presented here. Their assignment was approached in a manner similar to that followed by a contractor in analyzing and preparing a bid for the work. The analyses considered approximately a 25-mile section of the waterway (Station 12,029+00 to 13,337+00).

The summary stated no major design changes would materially affect the construction requirement. Dredging was determined necessary for the northern portion of the waterway, and that would have required development of new design criteria. More investigation and analysis by the Corps, prior to award of work, was recommended in the event a dewatering method was to be proposed by the Corps. Minor design changes, such as compaction of disposal areas, were referenced. Numerous methods for actual excavation were considered feasible. Hauls were known to be long but scattered and thus would not warrant specialized handling methods. Overall average haul lengths were estimated to be approximately 7,000 feet. It was noted that dredging was considered as being the most appropriate for the northern portion.

The estimated bid for common excavation was $1.01 per cubic yard and $6.94 per cubic yard for rock. It was estimated the Corps' time schedule could be achieved by working two 10-hour shifts, five days per week. A decrease

or increase in construction time and associated costs were discussed. Physical conditions within the Divide Cut were considered to be major problems to be encountered. Dewatering was considered as the only major design criteria not virtually fixed. Should the owner or contractor assume that responsibility? It was noted that overall effectiveness of a dewatering method could only be determined from actual field construction. Designation of maximum flows of both Yellow and Mackeys Creeks to be handled or diverted between adjacent contracts was suggested.

Maximum lifts and minimum compaction requirements for disposal areas were recommended. The report noted that a major problem would be handling and removal of surface drainage and runoff from excavated sections. Two major basins to be considered were Yellow and Mackeys Creeks. A proposed method of handling surface runoff was contained in Figure 4 of the Jacobs' report. Analysis and design for dewatering was considered an effort beyond the scope of the reported assignment. Maintenance of open channels along one side of a disposal area until completion of final drainage structures was recognized as necessary. Equipment purchase problems also were included.

Building and maintenance of haul roads was considered as being a continuous operation. It was estimated surface material would come from the excavation or be imported from local commercial sources. Surface thickness was estimated to vary from 12 to 36 inches. It was suggested that wells be installed and pumped early to permit maximum dewatering before start of the excavation. Their inspection of the north end of the project (Station 13,206+00 to 13,337+00) indicated the ground would not support rubber-tired equipment, and it was doubtful such equipment could be used between Station 13,100+00 and 13,206+00. Dredging or large walking draglines were referenced for consideation. Dredging only was discussed for Station 13,337+00 to 13,206+00, and dry methods as an alternate for Station 13,206+00 to 13,100+00 were included.

J. DESIGN MEMORANDUM N-2

Information on the geology of the area included generalities and descriptions of materials. The groundwater system was described as complex and generally followed surface topography. Subsurface explorations included 299 borings. Attention was devoted to groundwater investigations and reported in N-2. Construction material information was to be included in a separate design memorandum.

The memorandum referenced that the waterway was to be dewatered for construction by wells adjacent to the cut. Immediate planting of cut slopes was considered essential because of acid conditions in the Tombigbee member. A description of soils encountered was included along with a discussion of the channel alignment and design criteria.

Design criteria for slope stability reportedly satisfied a factor of safety of 1.2 for steady seepage. Shear strength values for various soils were tabulated.

The estimated volume of required disposal space was based on a swell factor of 20 percent. A test fill was to be made prior to submission of plans and specifications on any section in order to provide compaction information. Areas north of Station 13,171+00 were described as wet and marshy most of the year. Use of rubber-tired equipment for conventional excavate-load-haul was considered doubtful. Dredging was considered the most practical means for excavaton. The project south of Station 13,171+00 was considered dry enough to use rubber-tired equipment in the event proper drainage and groundwater control were provided.

Protection development, erosion abatement, and wildlife habitat development were included but were not considered important to this assignment.

Pump tests were referenced as being included in Appendix A, which KTRP did not receive for review. Successful construction was considered dependent upon dewatering and a relief system capable of controlling groundwater. Nature of the subsurface was described as varying to such an extent that designing for actual conditions was complicated and generalizations over extended areas were necessary. Groundwater conditions included a high water table surface and high artesian pressures in strata within and below the bottom of the proposed cut.

The adopted design consisted of deep wells on both sides of the channel. Well spacings were designated, and other pertinent information was included. The Jacobs Associates' report was referenced and annotated. Costs considerations were included.

K. ABSTRACTS OF BIDS

Bid estimates ranged from Eby's low of $18,208,635 to a high of $28,098,551, and the Corps' estimate was $19,982,590. For the three contractors whose bids were tabulated (others simply indicated total bid), each showed the unit price for common and rock excavation being identical -- Eby bid $1.284 per cubic yard for each and the others were $1.28 and $1.38 per cubic yard. The Government's estimates were $1.26 and $1.33 for common and rock excavations, respectively. Other than the fact that common and rock excavations were bid at the same unit prices, the reviewers did not detect anything unusual about the unit bid tabulations. Eby's bid did not appear as being unbalanced.

L. EXCERPTS FROM RESIDENT ENGINEER'S DIARY

It was noted that excerpts were confined to entries concerning job progress, project milestones, alluvial excavation and disposal, Paleozoic excavation and disposal, and access road construction. Day one was 27 May 77 and the final inspection was noted for 16 Dec 80.

On 4 and 5 Aug 77, the resident engineer met with the Contractor's superintendent to discuss lack of progress. All draglines were on diversion excavation on 11 Aug 77. The resident engineer met with the Contractor's home office personnel concerning progress on 30 Aug 77. A new project manager for the Contractor arrived on 23 Sept 77. Siltstone Paleozoic was uncovered for the first time on 12 Oct 77. Boring reviews indicated actual conditions were as shown on borings. Entries for 13, 18, and 21 Oct 77 noted concern relative to lack of cherty Paleozoic materials. Ray Letourneau of Eby informed the resident engineer they were claiming "Differing Site Conditions" on 25 Oct 77. The excavation area was control flooded on 30 Nov 77.

G. A. Brunner took over the project from Resident Engineer Rainer for the Corps on 3 Feb 78. Eby began full dredging operations on 13 Feb 78 and began excavation of alluvial test pits on 27 Feb 78. Test pit excavation ended 9 Mar 78. Contractor and Government personnel met 15 Mar 78, and the Government acknowledged alluvial disposal specifications were defective but did not agree to a differing site condition. Dredging was halted on 13 Apr 78. Excavation of the Yellow Creek diversion was completed 19 May 78. Eby's Hilgenfeld informed the resident engineer on 16 Jun 78 that the Cat 637's could not work over 10 hours per day due to their age. The resident engineer noted on 26 June 78 that 637 scrapers were hauling material (alluvial) suitable for access roads into a disposal area (601A).

Notations for 7 through 20 July 78 dealt with excavation techniques. The first stone protection was placed on 24 July 78. A claim for access road construction was received from Eby on 26 July 78. They claimed the roads could not be built because site conditions differed from that presented in contract documents. The resident engineer noted on 3 Aug 78 that the water level in bleeder ditches was above dips in the rock surface. The Contractor informed the resident engineer they were sending a letter stating they could not place the cherty Paleozoic material in 2-foot lifts because of too much siltstone on 11 Aug 78. The resident engineer noted that his observations of method Eby was using to place material and indicated it could not be placed as specifications required and still be traffic compacted because it contained too much siltstone. The resident engineer felt the quality of cherty Paleozoic materials would increase as excavation proceeded southward. He also noted that some wasting of cherty Paleozoic material might be prudent.

Eby was hauling all cherty Paleozoic material to DA 602A on 14 Aug 78, and no material had been placed in access roads since 10 Aug 78. On 15 Aug 78, the resident engineer issued a change order with notice to proceed to process the cherty Paleozoic material on a segment of the easterly access road. The first day Eby really put effort into processing the change order was 18 Aug 78.

The resident engineer visited the project during the

second shift on 1 Sept 78 and discovered scrapers hauling suitable cherty Paleozoic material to a disposal area contrary to instructions given to Hilgenfeld late Friday. The project manager was instructed on 5 Sept 78 to place no more cherty Paleozoic in disposal areas. The westerly section of access road began pumping badly on 7 Sept 78. The easterly bleeder ditch in the area was higher than material being excavated. Lack of bleeder ditches caused troubles on 12 Sept 78. On 29 Sept 78, the resident engineer noted scrapers hauling cherty Paleozoic material from DA 602A and placing it on the easterly access road. That was material Eby claimed was unsuitable and which the Government claimed was suitable.

The resident engineer visited the job in the p.m. of 6 Oct 78 and observed some cherty Paleozoic material being placed in the disposal area. On 10 Oct 78, material from slopes outside of bleeder ditches was determined sufficient for fill and could have reduced Eby's haul by up to 10,000 feet. Overhaul due to failure to provide groundwater control was noted on 14 Aug 79. The project manager informed the resident engineer of all the problems they were having disposing of material on 30 Aug 79. On Saturday 1 Sept 79, Eby started work, but claimed disposal problems again and sent the men in. The resident engineer informed Hilgenfeld that the Government would pay for scraper time spent hauling material from back of DA 501 to use in raising haul roads under Case No. 111.

Beginning with the 1979 Christmas holiday shut down, Eby conducted only limited excavation until 7 April 1980, when full operations resumed. Inspection of DA 501 on 10 May 80 revealed no disposal problems. Stone protection was noted 29 July 80 as the controlling factor for completing the waterway, but Eby did not begin placing the protective stone that year until 10 June 1980. Excavation, as slow as it was, was ahead of stone protection placement. Late start would cause delay in waterway flooding. Lay offs were referenced 22 Aug 80. Flooding was underway 22 Sept 80. Final inspection was 16 Dec 80.

M. NOTES FROM WILLIAM RICKETTS' DIARY

Annotations included here are notes that appear significant and that were not contained in excerpts from the Resident Engineer's Diary.

No pumps were set in bleeder ditches 8 Sept 77 due to absence of drainage pipe. The Contractor installed a 10-inch pump in the bleeder ditch at Station 13,300+00 on 10 Sept 77. Ricketts talked with the Contractor about the bleeder system and pumping operation. The need for placing the bleeder pump in a deeper sump was noted 13 Sept 77. Corps and Contractor personnel toured the project at the Robinson Creek structure excavation site on 20 Sept 77, and it was noted the Contractor had no sound approach to the excavation and disposal of material.

On 12 Oct 77, it was noticed that sand and gravel or

Paleozoic material extended only to elevation 401, where siltstone was encountered. Available information from test pits, borings, and probings in the area confirmed that materials anticipated were actually as encountered during excavation. Ricketts stated on 18 Oct 77 that haul roads should be started from the sand and not on original ground. Turbidity was noted that date in Yellow Creek as a result of the Contractor not caring for the sediment pond. The area geologist and resident engineer toured the project on 20 Oct 77 and said the cherty Paleozoic would be good material for access roads. The haul road to disposal Area 601 was still pumping, even with 2 feet of plating.

The resident engineer asked Hilgenfeld about a letter of possible change in condition on 3 Nov 77. Hilgenfeld said the letter was written but doubted if action would be taken. He was quoted as saying, "I would rather build a job than build a case for claim." On 7 Dec 77, Hilgenfeld stated they were preparing a proposal on dredging; and if it was not approved, excavation would cease until spring. Work on the Yellow Creek diversion was to continue.

The haul road on the westerly side of Disposal Area 601A was raised beginning 6 Jan 78 to be used in a dike system for the dredging operation. On 24 Jan 78, notation indicated a 14-inch dredge arrived at the site.

N. DAILY EQUIPMENT RECORDS

A D6 dozer worked 7 through 10 Jun 77 and 13 through 15 Jun 77. A hydraulic crane was used 16 and 17 Jun 77. Between 20 Jun 77 and 11 July 77, two to five pieces of equipment worked; except on 5 July 77, six were employed. Four to seven units were worked 12 to 14 July 77. Eight to 14 units were used 20 through 31 July 77. These usages were from 24 to 30 units of heavy equipment on the site, not including pickups. About half (36 to 47 units) were used daily the first half of August, and then most units were used through 17 Sept 77, except for erratic periods. Usage varied considerably from 18 through 30 Sept 77. Of approximately 56 to 67 units reported for Oct through Dec 77, usage varied widely.

O. CORRESPONDENCE

The following annotations will be abbreviated and reference only major points of each document.

1. Eby to Corps (October 25, 1977)

It appeared the amount of cherty Paleozoic was far less than a prudent bidder would conclude from a review of all documents. They accepted the apparent assumption of the bid form that all Paleozoic material would be classified as rock excavation. Shortage of cherty Paleozoic material adversely affected construction of haul roads and increased considerably haul distances. Gave notice as required under GP 4 of claim for reimbursement of extra costs and extension of the contract completion date.

2. Corps' Disposition Form (9 Nov 77)
Eby failed to recognize differentiation between two types of Paleozoic materials in their bid preparation. Quantities of cherty Paleozoic being reviewed by S & I. Placement of weathered siltstone in 2-foot lifts could be a problem.

3. Eby to Corps (February 13, 1978)
The Contractor found results of test-pit excavations between Stations 13,265+00 and 13,284+00 alarming. Typically, they found deep deposits of bluish muck overlain with approximately 2 to 3 feet of reasonably clean sand. Most alarming thing was alluvial was always thought to be reasonably clean sand. The Contractor cited six reasons the project may not be buildable as designed and specified. Eby requested the Contracting Officer make a comprehensive and systematic study to determine actual site conditions.

4. Corps' Comments (1 March 1978)
Construction of haul roads was to be at the option of the Contractor, and the Government could make no guarantee of sufficient Paleozoic material. Relative to fact that area was wet -- it was questioned as to what was expected since the entire area was at or below the water table and was a swamp prior to construction.

5. Corps to Eby (18 July 1978)
Answering notes on 30 June and 5, 6, and 11 July 1978 Quality Control Reports, the Corps felt the situation the Contractor had encountered in the first work season was as described by specifications and problems should have been anticipated. Paleozoic material further south would become more suitable for access road construction. Reminded the Contractor he was responsible for care and diversion of water and maintenance of ditches.

6. Eby to Corps (July 21, 1978)
If material not suitable for permanent access roads, haul distance will be increased, and the Contractor would file for added compensation under GP-4.

7. Corps to Eby (7 August 1978)
Felt alternate layered cherty and siltstone Paleozoic was suitable for access road construction.

8. Eby to Corps (August 14, 1978)
Referenced seven documents and stated Case III pertained only to cherty Paleozoic material. Requested immediate written order of Contracting Officer, under GP-3 (2)(ii), to change method and manner of performance of work. Pending receipt of such order, advised the Government that affected work would be suspended as provided under GP-17(b).

9. Corps to Eby (16 August 1978)

Informed Eby they had issued proposal request for placing cherty Paleozoic material using another method. Wanted to know specific items of work Eby intended to suspend.

10. Eby to Corps (August 17, 1978)
Referenced three documents. Requested two-part change order be expanded to alter method and manner of placement of the toe of the riprap, to adjust to the deteriorated condition of Paleozoic materials, which differed materially from that indicated in contract documents.

11. Eby to Corps (August 23, 1978)
Effort by Corps to alleviate impact of subsurface condition was appreciated. Noted that specific work items affected day to day and almost hour to hour. Construction of access roads and haul roads effectively suspended.

12. Corps to Eby (5 September 1978)
Determined material in area of Stations 13,270 to 13,235 is suitable for construction of access roads; therefore, unless there was a surplus, Eby was not to place any more in disposal areas.

13. Corps to Eby (19 September 1978)
Referenced all previous correspondence, too numerous to list. By time Eby's letter arrived, quality of cherty Paleozoic became quite good.

14. Corps to Eby (19 September 1978)
Paleozoic material was wet because of Eby's failure to control groundwater. Placement of wet material on westerly access road caused portions to pump badly. Pictures depicting situation were attached.

15. Corps to Eby (25 September 1978)
Noted that Paleozoic material containing excessive fines was wasted with Corps' silent consent and that construction of access roads during first season's work had increased haul distances. Pointed out that on at least two nights Eby's scrapers placed good material for access roads into disposal area 602A. Method used to excavate ditches was contaminating Paleozoic material with alluvium and assumed Eby had concluded it was not needed for temporary or permanent work. Did not recognize situation, as presented in note, as a change to the contract.

16. Eby to Corps(November 1, 1978)
Referenced 14 documents to emphasize complexity of problem. Hoped the problem could be resolved without more correspndence "flying back and forth like a bird in a badminton game." Could not place Paleozoic material in 2-foot lifts without long periods of drying. Actual subsurface conditions encountered differed materially from

that expected. Enumerated seven circumstances that prevailed -- increased haul distances and necessity of equipment to travel over bad roads increased costs. Requested issuance of two-part change order similar to Modification P00007.

17. Corps' ORNED-G Form (8 Nov 79) by Moore (8 Jan 80)
Contractor has not encountered subsurface site conditions differing materially from those described in contract documents. Entire area was swamp prior to construction, and no reasonable interpretation of data would lead one to assume dry conditions would be encountered. During a field investigation week of 12 November, no problems the Contractor contended he was having in disposal area or access road placement were observed. Understood field personnel consistently maintained Contractor never had problems with Paleozoic materials to extent alleged. Thus, the Contractor had not encountered site conditions different from those to be expected from reasonable interpretation of data.

18. Eby's 82-Page Document to Corps (November 7, 1980)
Abbreviated requirements of contract and contract indications. Stated that no persistent strata of silts or clays were shown although logs showed that some silts and clays were present locally. Discussed implications of test pit observations. Referenced and quoted sections of the specifications. Noted it was clearly anticipated excavation materials could readily be dewatered at resumption of work each construction season. Outlined their plan of work and discussed Corps' estimate. Outlined their actual work and included photographs of operations. Suggested there was no way to build access roads or spread and compact disposal materials to meet contract specifications.

Flooding of the area around November 30, 1977, led the Contractor to the conclusion that dredging would be the only possible method to proceed with work in that winter season. By February 14, 1978, they were able to begin dredging and found it was not very successful. Only removed an estimated 40,000 cubic yards.

Eby undertook soil investigation and reported findings to Corps by letter February 13, 1978. Claimed that materials differed greatly from those described by the Corps. In March 15, 1978 meeting, were asked to submit plan for remaining work. Document discussed plan and actual construction for the second season. Peak excavation was reached in September and October 1978 at about two million cubic yards.

Discussed modification P00007 and the fact that Part I of change order was for $2,000,000. Part II had never been agreed upon. That proposal was for $10,344,163 and a time extension request for 184 days. Discussed the second winter season and third construction season. Concluded with a discussion of damages and cited prior court cases. Also

discussed defective specifications.

19. Disposition Form (13 Mar 81)
Maintained position that materials encountered were as described in plans and specifications. Noted that the Corps' estimates assumed work would begin in the southernmost two-thirds of the contract area. The Contractor chose to start first season at northernmost section. Had admitted to defective specifictions concernig placement of material in disposal areas. Referenced Modification P00007 Part I. Beyond that point, did not feel specifications were defective.

20. Eby's Report to Corps (July 13, 1981)
A 58-page document relating to claim for additional compensation. Referenced attached schedules of increased costs as result of changes, differing site conditions, and defective specifications. Increased costs were computed ~~according to basic principles of equitable adjustment~~ measured by difference between reasonable costs to perform work as required and reasonable costs to perform work absent cause giving rise to need for equitable adjustment. Information contained in this document should be subjected to review by an auditor and/or accountant.

21. Corps to Eby (10 August 1981)
Referenced Eby's 7 November 1980 letter and stated that it raised two major issues. The issues were relative to mateials encountered and defective specifications. Pointed out that Eby's conclusions based on low seepages at the test pits were contrary to indications. Low seepage there actually indicated adjacent materials were very slow draining. Concluded that Eby had not demonstrated materials actually encountered differed from those described in the contract. Referenced Case No. 111 and Eby's agreement not to base any claim for excavation and/or transportation of material on the specified method or manner of disposal.
Did not agree that cherty Paleozoic material was unsuitable for construction of permanent access roads. The reason for issuance of Modification No. P00018 was included. Eby attempted to link that modification to unsuitability of cherty Paleozoic material and reasons for modification were outlined. Modification Nos. P00024 and P00028 were referenced. In conclusion, it was noted that Eby's decision to begin at the northernmost portion of the project area compounded any problem experienced.

22. Corps' Memorandum for Record (5 November 1981)
Record of meeting between Corps' and Eby's personnel. Referenced letters of 7 Nov 80 and 13 July 81. Talked about problems and "fact" that Government had not forewarned Contractor. Mod 18 on west side had negative results. Proposal issued Oct 78 was backdated Jun 78. Later than 1979, the Corps issued Part II for a lesser amount than

agreed. Audit was performed and only 1.8 million dollars of 10.3 was questioned. Could not reconcile offer of 2 million dollars. Corps "coerced" Contractor to perform or default. Contract had been breached. Eighteen-month contract took 41 months to complete.

Eby had been in business 44 years. Seventy-five percent of all work had been with government agencies for several hundred million dollars, and this was the first major claim. Corps had assessed claim and did not believe it to be just. The Government agreed to accept all haul and disposal costs. Corps stated that this project was the most difficult location on waterway. Dredging was considered. Contractor was told to submit proposal in writing.

23. Fisher to Rosen (March 19, 1982)
Transmitted x-ray diffraction spectra on "tripolitic" material from Fort Payne rocks.

24. Rosen to Corps (March 22, 1982)
Transmitted additional information furnished by Fisher.

25. Corps' Memorandum for Record (1 April 1982)
Record of meeting between Corps' and Eby's personnel. First order of business was for the Contractor to explain information he had submitted. Covered previous meeting. Attorney for Eby noted moisture contents encountered at site were higher than indicated in contract documents. Alluvial would not support equipment. Consultant stated that high moisture content makes CBR drop to nothing. Based on 97 pits sampled by Peabody for Eby, the Contractor concluded Section 2C-2 of the specifications did not correctly classify the soil. Paleozoic material turned from a hard, dense material to a slurry when disturbed. Identified some materials as "tripolitic", finely divided silica, 95 percent quartz.

26. Corps to Eby (6 July 1982)
Referenced 22 June 1982 collection of samples from Station 13,179+75.

27. Eby to Corps (July 22, 1982)
Did not agree with Corps' contention that testing and evaluation program would depend to great degree on Eby's definition of changed conditions encountered. They believed GP-4 make it the Government's responsibility to determine technical aspects of changed conditions.

28. Corps' Draft of Finding of Fact (as of 22 July 82)
The finding of fact basically annotates 100 documents relative to the claim for additional compensation under General Provision 4. The reviewers did not find any facts in this document that had not already been presented in other documents previously reviewed.

29. Corps to Eby (4 August 1982)

Referenced Eby's (Works) agreement to immediately confirm changed condition allegations in writing and personal assurance on several occasions that the information was immediately forthcoming. Stated that the Government had proceeded in good faith with an investigation and Eby had been notified and was asked for suggestions. Until receipt of July 22, 1982 letter, Government had reason to believe Eby was in concurrence with investigative program. Letter of July 22, 1982, took position Government was long aware of changed conditions and it was Government's responsibility to determine technical aspects of changed conditions. Pointed out, in response to July 22, 1982 letter, it was not Government's responsibiliy to go out and find a changed condition for a contractor. Notified the Contractor that Government was proceeding with investigation in absence of written notice (response).

30. Eby to Corps (August 13, 1982)

Referenced Corps' June 10, 1982, request for written statement on changed conditions and stated much had previously been furnished in detail. Nevertheless, as promised in their letter of July 22, 1982, they would respond further. Noted that information Government had asked for was Government's responsibiltiy to develop and cited reasons.

Outlined their previous contentions and referenced a Government internal memorandum dated July 31, 1975, that reported test pits for Section 3A showed "The ground water table can be lowered with minimal pumping effort." Exchanges of information were presented. Drainage, shear strengths, and CBR values of the alluvium were discussed. Referenced Jacobs Associates' report and the Government's Design Memorandum N-2, mainly in regard to their notations that ground would not support rubber-tired excavating and hauling equipment and northern portion would have to be dredged (dredging referened by Jacobs' report). Said rather than requiring or at least permitting dredging, the contract specifically prohibited dredging. Maintained the Government was liable for withholding information.

Tripoli was identified as being present throughout the Paleozoic material. Maintained that presence of Tripoli vastly changed character of material within which they had to operate. Later it was stated they experienced changed conditions in Paleozoic materials regardless of whether Tripoli was present or not. Greater quantities of limestone than indicated in the contract were encountered. Noted that as a result of changed conditions and defective specifications, an approximately $18-million contract had cost in excess of $31 million to execute. Maintained they had gone well beyond period of reasonable patience in awaiting equitable adjustment.

Requested authorization for consultants of both sides to immediately begin review and exchange of data and

information. Additionally requested opportunity to meet for final review of matter. Wanted meeting during week of September 20, 1982.

P. CORPS' FIELD NOTES ON SAMPLING (JUNE 25, 82)

Referenced Change Order - Case 204 - Test Pit, dated 8 June 81. Presented brief summary of what transpired regarding test pit. June 21, met with the Contractor and showed him where to put pit. UK personnel were present as observers in the afternoon. Proposed meeting with Eby on June 22 did not transpire. Included geologic profile showing materials encountered at sampling location. Eby personnel took samples and consultant for Eby studied excavation and took samples. Corps asked UK personnel about extending their contract.

ANALYSES AND SUMMARY

From a review of pre-bid documents, it was abundantly clear that both ground and surface waters were to be expected throughout the course of the project. Hydrologic data included in the plans and specifications were indicative of surface waters that might be anticipated. Soils test data included as Appendix A to the specifications were significant from the standpoint of groundwater. Many natural (in situ) moisture contents of materials sampled and tested were either between the plastic and liquid limits or above the liquid limit. Approximately 157 natural moisture contents were reported in Appendix A of the specifications. Of these, 53 percent were between the plastic and liquid limits and 27 percent were above the liquid limit. Thirty-nine percent of the natural moisture contents ranged from 20 to 30 percent. Thirty-eight percent ranged from 30 to 40 percent, and approximately 15 percent reported were above 40 percent. Although the Contractor apparently stated in one document (0.25., Appendix A of this report) that moisture contents of 30 to 40 percent could not have been anticipated, it appears, however, there were ample reports of high moisture contents. Also, in the same document (0.25., Appendix A of this report), the Contractor's representative was reported to state that no moisture contents were reported on the gravelly material. However, there were eight reported natural moisture contents on this material with an approximate average value of 22 percent. Details of this analysis are shown in Appendix B of this report. Section 2B of the specifications included provisions for temporary diversions and care of water. Section 2B was specifically referenced in Section 2C (Excavation and Grading). Prospective bidders were most certainly forewarned of the presence of water, and it is concluded that documents were very specific in that regard.

Comparisons of pre-bid and post-bid materials test data revealed no significant discrepancies. Materials were

basically described in the specifications as consisting of highly weathered Paleozoics overlain by Quaternary alluvium. The Paleozoic material was described as consisting of two general types and each type was further described. Residual materials were noted to be variable both laterally and vertically. Soils were generally described as being fine- to coarse-grained with silty sands and sandy gravels predominating. Silts and clays were to be anticipated locally, even though no persistent strata were delineated at the site. Therein, prospective bidders were forewarned of variability of materials. Reported soil classifications in Appendix A of the specifications seem to verify the variability of the material. For example, approximately 706 feet of reported log were descibed as cherty Paleozoic material, and this material classified as 14 different types of soils under the Unified Soil Classification System (26 percent of the material classified as GM and 16 percent as ML). Detailed information is listed in Appendix B of this report.

Anticipated materials behavioral data, after excavation and placement in embankments or disposal areas, were not included in contract documents. As a result, prospective bidders were not mislead by the contract documents relative to the expected performance of materials.

From the standpoint of methodology, Section 2C was assessed as being rather broad and/or lenient, with two exceptions. The Contractor was permitted a wide latitude in conduct of the work. Excavation could be performed by any method or methods, with the exception of dredging, that would safely produce the desired results. The specifications, in that regard, were void of equipment and procedural requirements. With the exception of requirements for compaction equipment, the specifications for placement and compaction were also viewed as lenient. Again, the Contractor was permitted a large degree of freedom and latitude.

Excavated material, other than Paleozoic, was to be placed in disposal areas in 1-foot lifts and compacted with two passes of a tamping roller. Moisture content was not specified and the material simply had to be densified to an extent necessary to support construction equipment. Excess Paleozoic material was to be placed in disposal areas in 2-foot lifts. No compaction was required other than that necessary to effect drainage and spread the material evenly. The reviewers viewed designated lift thicknesses as permissive; that is, materials could be placed in lifts equal to or less than the thicknesses designated. On the other hand, it was realized that designated lift thicknesses might have been viewed by others as having been mandatory. This is an important consideration since the Contractor apparently filed a claim in relation to the matter and was eventually awarded additional compensation for placement of materials in lifts less than stated thicknesses.

An alternate manner for designating lift thickness for

future documents should be considered. One such alternate would be, "Materials are to be placed in lifts, each of uniform thickness, the maximum of which shall not exceed 2 feet." Without additional discussion or notations to that statement, a contractor might later contend he was mislead because he assumed, was lead to believe, or thought that placement of materials in thicknesses equal to the maximum permissible would always be satisfactory. The possibility of such a contention might be reduced by inclusion of a statement similar to, "Satisfactory results may not be achieved upon placement of materials in lift thicknesses at or near the maximum permissible of 2 feet and placement of materials in lifts of lesser thicknesses may be necessary." The inclusion of such statements would tend to add to the volume of contract documents and there might never be assurance that potential for other false assumptions could be totally eliminated.

Consideration could also be given to deletion of designation of specific lift thicknesses. Lift thickness may not be significantly important in the event of an end-product type specification wherein the contractor is permitted wide latitude in performing the work. The important fact is that work is to be conducted in such a manner that desired results are achieved.

The report by Jacobs Associates and Part 39 of the Corps' Design Memorandum N-2 each stated that dredging was considered a practical means of excavation within a portion of the project. Subsection 2C-4 of the specifications specifically excluded use of dredging for excavation. No reason was given for not allowing dredging. Apparently at the Contractor's request, dredging was approved by the Corps and performed by the Contractor during the period between February 13 and April 13, 1978. Approximately 40,000 cubic yards of materials were excavated by that method. No other references to dredging were found, and it was concluded that maybe the Contractor did not prefer dredging or did not find it advantageous.

The Jacobs Associates' report listed estimates for common and rock excavation as $1.01 and $6.94, respectively, per cubic yard. The Corps' estimates were $1.26 and $1.33 and the Contractor's unit bid was $1.284 for each. It appears that estimators, excluding Jacobs Associates, may have assumed either rock could be excavated with relative ease or excavation of common materials and associated work would be most, if not unusually, difficult. Temporary diversions and care of water, including dewatering, were listed as a lump-sum bid item. It was not concluded that the potential of water problems led estimators to list unit prices for common excavation the same or slightly less than that for rock excavation. The Contractor's estimate for total excavation was within approximately one percent of the Corps' estimate. His combined total estimate for excavation and temporary care and diversions of water was within approximately one half a percent of the Corps' estimate.

The specifications required that embankments for berms and access roads were to be constructed of cherty material from the excavations. Two-foot lifts tracked down by dozers and hauling equipment were specified. Comments pertaining to lift thicknesses previously discussed under materials placed in disposal areas would apply here also. Reference to permissible variation in moisture content for cohesive soils was previously discussed under Item A of ANNOTATION OF MAJOR DOCUMENTS. Consideration should be given to revision of lift-thickness and moisture-content requirements for future documents.

Excerpts from the Resident Engineer's Diary and notes from the Inspector's Diary indicate concern relative to job progress at the beginning of the project. Other notations indicated Paleozoic material suitable for access roads and berms was hauled to disposal areas and dewatering procedures were sometimes inadequate. Daily equipment records indicate progress may have been slow in the beginning. Of course, usage of equipment at the project site would in no way be indicative of job progress in lieu of an assessment of equipment necessary to accomplish the task. In that respect, the Contractor may have overestimated equipment necessary to perform the work in a timely manner and therefore did not fully utilize all equipment at the site. He could also have underestimated equipment requirements and been slow in executing the work even with 100-percent usage of equipment. Equipment usage records alone are not indicative of job progress.

Materials reviewed and discussed under Item O. Correspondence of ANNOTATION OF MAJOR DOCUMENTS were revealing in various respects. The Contractor maintained the amount of cherty Paleozoic material was far less than a prudent bidder would conclude from review of all documents. It appears that suitable materials were eventually encountered, since embankments for berms and access roads were constructed. In addition, the Contractor reportedly wasted suitable cherty Paleozoic material. The Contractor also maintained shortages of suitable cherty Paleozoic material adversely affected construction of haul roads and increased considerably haul distances. To further investigate the question, a comparison was made of the reported elevations of the top of the Paleozoic material in the plans with the measured elevations from a field mapping program conducted after excavation of the canal (comparison was made using centerline elevations). Details of the comparison are listed in Appendix B of this report. Most of the elevations compared within 1 to 2 feet of that in the plans except for one portion of the canal (approximately 1,500 feet long approximately from Station 13,250+00 to 13,265+00) where the differences ranged up to 4 feet. In the opinion of the authors, this would not constitute a major changed condition.

Subsection 2C-8 of the specifications contained absolutely no references to materials' requirements for

temporary roads. Even more specifically, Subsection 2C-8.2 stated, "All temporary roads (such as haul roads) shall be the contractor's responsibility to design, construct and maintain." It appears evident from that sentence that prospective bidders and all potential contractors were certainly forewarned that temporary roads would be totally the contractor's responsibility. Any adverse effects suffered by the Contractor associated with temporary roads are viewed as solely the Contractor's problem.

An important aspect relating to suitability of materials encountered concerns the point of beginning for the project. Contract documents did not specify a point of beginning. It may be assumed that the Contractor had reasons for his chosen point of beginning. It is also worthy of note that no clauses in the contract documents prevented the Contractor from moving from point to point during execution of the work.

The Contractor maintained Paleozoic material could not be placed in 2-foot lifts without long periods of drying. Lift thickness has been discussed previously. The fact that materials were wet and required long periods of drying is another point of contention. Prospective bidders were alerted to the fact water would be encountered and had the opportunity to bid, lump sum, for temporary diversions and care of water. The Contractor's ability in dewatering could not be fully evaluated from information presented in documents reviewed. A specific instance was referenced concerning failure to control groundwater. Any failure to control groundwater or adequately dewater would be anticipated to cause materials to be wet and increase the necessity of drying prior to placement. Again, pre-contract documents were indicative of the fact waters would be encountered.

Some of the documents reviewed indicate the Contractor was slow to begin execution of the work. Subsection SP-1 noted the Contractor was to begin work within 10 calendar days after the date of receipt by him of notice to proceed, was to prosecute said work diligently, and was to complete the entire work in not less than 1,080 calendar days after date of receipt of notice to proceed. The specification is very clear in regard to the date on which the Contractor was to complete the work. The Contractor's diligence in executing the work throughout the course of the project remains unclear. Diligence in performing the work may not be evaluated in the absence of data indicating specific work schedules and actual work completion dates.

It is not evident that Corps' personnel took specific action against the Contractor for not prosecuting the work diligently during the early stages of the project. The contract documents do not outline courses of action that may be taken to enforce the "to prosecute said work diligently" clause. Essentially, the Contractor was free to execute the work at a rate(s) of his choosing -- the primary factor was that all work be completed within a designated time period

or by a stated date. Liquidated damages in the sum of $1,450 per day were to be assessed in event of the Contractor's failure to complete the work within the time fixed by the contract.

Added costs (inflation) in performing parts of the work at some time later than originally anticipated (at time bid was prepared) should be borne solely by the Contractor in event of his failure to perform work diligently. The contract was void of any escalation clauses and unit and/or lump-sum bid prices were fixed by the Unit Price Schedule. An owner's agreement to pay extra for work performed later than originally anticipated by the Contractor could provide incentive for the Contractor to perform all work late.

In summary, it appears evident the Corps supplied prospective bidders sufficient and abundant information upon which to base their bids. Prospective bidders had access to the same pre-contract documents, were permitted to visit the project site, were requested to visit test pits, and were permitted to inspect cores and samples obtained by the Government. Two facts were obvious -- materials to be encountered varied considerably and the contractor was to be responsible for the care and control of all surface and groundwater. Prospective bidders were not coerced to make certain assumptions in preparation of their bids.

There was no evidence that site conditions encountered during the course of construction varied appreciably from those described in contract documents. Essentially, a variety of materials were encountered and water and/or wet materials were present.

APPENDIX A

DOCUMENTS SUBMITTED BY CORPS OF ENGINEERS TO KTRP

A. Specifications for Divide Section -- Excavation of Divide Cut Section 3A, Station 13,118+00 to 13,337+50 -- included Appendix A (Soil Test Data) and Appendix B (Diversion of Yellow and Mackey Creeks)

B. Plans for Divide Cut Section 3A

C. October 1972 Areal Geology Map, Tennessee-Tombigbee Waterway, Divide Cut Section

D. Photorevised 1969 Doskie Quandrangle, 7.5 Minute Series (Topographic) 14-NE

E. Core and Bore Logs (Approximate Locations), Station 13,118+00 to 13,337+50

F. Plan View of Field Mapping (Rough Draft), Section 3A after Excavation

G. Divide Cut Section 3A -- General Plan, Drawing Number TTW-3/3A.1

H. Drawing Numbers TTW-10/1 through TTW-10/11 (Boring Legends, Test Pit Details, Boring Logs)

I. "Construction Analysis -- Divide Cut Section," Jacobs Associates, August 30, 1974

J. Design Memorandum N-2 -- Divide Cut, January 1975

K. Abstract of Bids -- Construction

L. Excerpts from Resident Engineer's Diary (Jerry D. Rainer, 21 April 1977 through 24 January 1978; and George A. Brunner 3, February through End)

M. Notes from William Ricketts' Diary (24 August 1977 through 23 January 1978)

N. Contractor's Daily Equipment Use Tabulations (27 May 1977 through 2 January 1978)

O. Correspondence between Martin K. Eby Construction Co., Inc., and Corps of Engineers

   1. Eby's Ray Letourneau to Corps' Jerry Rainer, October 25, 1977

   2. Jerry O. Rainer's Disposition Form to Corps' Chief of Construction Division, 9 November 77

3. Eby's Dennis Hilgenfeld to Corps' George A. Brunner, February 13, 1978

4. Corps' M. D. Simmons Comments on Eby's 13 February 1978 Letter, 1 March 1978

5. Corps' George A. Bruner to Martin K. Eby Construction Co., Inc., 18 July 1978

6. Eby's Ray Letourneau to Corps' George Brunner, July 21, 1978

7. Corps' George A. Brunner to Martin K. Eby Construction Co., Inc., 7 August 1978

8. Eby's Ray Letourneau to Corps' George Brunner, August 14, 1978

9. Corps' George A. Brunner to Martin K. Eby Construction Co., Inc., 16 August 1978

10. Eby's Ray Letourneau to Corps' George Brunner, August 17, 1978

11. Eby's Ray Letourneau to Corps' George Brunner, August 23, 1978

12. Corps' George A. Brunner to Martin K. Eby Construction Co., Inc., 5 September 1978

13. Corps' George A. Brunner to Martin K. Eby Construction, Inc., 19 September 1978

14. Corps' George A. Brunner to Martin K. Eby Construction Co., Inc., 19 September 1978

15. Corps' George A. Brunner to Martin K. Eby Construction Co., Inc., 25 September 1978

16. Eby's Ray Letourneau to Corps' George Brunner, November 1, 1978

17. Corps' ORNED-G (8 Nov 79) Form by Moore to ORNCD, 8 Jan 80

18. Martin K. Eby to Corps' Lee Tucker, November 11, 1980

19. Moore's Disposition Form to ORNCD, 13 March 81

20. Martin K. Eby Report to Corps' Lee Tucker, July 13, 1981

21. Corps' R. H. Russell to Martin K. Eby Construction

Co., Inc., 10 August 1981

22. Corps' 5 November 1981 Memorandum for Record (Meeting with Eby, Differing Site Conditions, Contract No. DACW62-77-C-0097)

23. C. Page Fisher to Harold Rosen, March 19, 1982

24. Harold I. Rosen to Corps' R. H. Russell, March 22, 1982

25. Corps' Robert T. Heavner 1 April 1982 Memorandum for Record (1 April 1982 Meeting with Martin K. Eby to Discuss Changes, Differing Site Condition, and Defective Specifications Claims)

26. Corps' R. H. Russell to Eby's Paul Works, 6 July 1982

27. Eby's Paul W. Works to Corps' R. H. Russell, July 22, 1982

28. Draft of Corps' Findings of Fact, as of 22 July 1982

29. Corps' R. H. Russell to Eby's Paul Works, 4 August 1982

30. Eby's Paul W. Works to Corps' R. H. Russell, August 13, 1982

P. Corps' John Mindock's Field Notes on Test Pit Sampling of June 22, 1982

APPENDIX B

SUMMARY OF SELECTED SOILS DATA

Table 1. Summary of Reported Natural Moisture Contents from Appendix A of Specifications (Total Moisture Contents Tabulated = 157)

MOISTURE CONTENT RANGE (Percent)	PERCENT OF TOTAL
0 - 10	1.2
10 - 20	15.3
20 - 30	38.8
30 - 40	37.6
40 - 50	5.5
50 - 60	0.6
Over 60	1.2

Table 2. Summary of Reported Natural Moisture Contents from Appendix A of Specifications Compared to Reported Liquid and Plastic Limits (Total Moisture Contents Tabulated = 157)

	NUMBER	PERCENT OF TOTAL
Below Plastic Limit	32	20
Plastic Limit to Liquid Limit	83	53
At or Above Liquid Limit	42	27

Table 3. Summary of Unified Classifications of the Cherty Paleozoic Material as Reported in Appendix A of Specifications
(Approximately 706 feet of log was classified as Cherty Paleozoic)

CLASSIFICATION	NUMBER OF FEET	PERCENT OF TOTAL
GM	181	26
ML	113	16
GP	65	9
GP-GM	58	8
GW-GM	49	7
CL	48	7
SM	48	7
GC	36	5
SC	15	2
GW	14	2
ML & LS & SH	13	2
CL-GM	14	2
CH	5	Less than 1
SM-ML	7	Less than 1
Unclassified	40	6

Table 4. Comparison of Elevations of Top of Cherty Paleozoic as Reported on Plans with Those Measured in Field after Excavation

HOLE NUMBER	REPORTED ELEVATION (FEET ABOVE SEA LEVEL)	MEASURED ELEVATION (FEET ABOVE SEA LEVEL)
P-530	413.6	413.4
P-532	413.1	412.3
P-528	410.8	411.6
P-527	408.8	411.7
P-526	410.2	408.8
P-523	409.6	409.4
P-522	410.6	406.3
P-545	408.2	404.8
P-520	409.4	405.3
P-519	410.0	406.0
P-518	409.0	407.0
P-517	408.8	406.8
P-515	406.4	405.9
P-514	405.2	403.1

P-513	404.2	403.4
P-508	406.8	400.5
P-507	402.8	400.0

APPENDIX C

INDEX TO PLANS FOR DIVIDE CUT SECTION 3A REVIEWED BY KTRP

DWG. NO.	TITLE
TTW-3/2A	Location Map - Sta 13,118+00 to 13,337+50
TTW-65/15A.1	Plan and Profiles Sta 13,118+00 to Sta 13,171+00
15B	Plan and Profiles Sta 13,171+00 to Sta 13,228+00
15C	Plan and Profiles Sta 13,228+00 to Sta 13,286+00
15D.1	Plan and Profiles Sta 13,286+00 to Sta 13,335+97.40 (Back) and Sta 13,337+50 (Ahead)
16A	Temporary Yellow Creek Diversion Chute - Plan, Sections and Details
17A.2	Highway 25 By-Pass - Plan
19A.1	Sections
19C.1	Sections and Detail
21A.1	Disposal Areas 501 and 601A - Plans, Sections and Details
22A.1	Disposal Area 602A - Plan and Sections
23A	Ditch and Grading Profiles - Sta 13,118+00 to Sta 13,171+00
23B	Ditch and Grading Profiles - Sta 13,171+00 to Sta 13,303+00
23C	Ditch and Grading Profiles - Sta 13,303+00 to Sta 13,327+90 (Projected) and around Dispoasl Areas 601A and 602A
23D	Ditch and Grading Profiles - sta 13,197+00 to Sta 13,226+00 (Projected) and around Dispoasl Area 501
24A.2	Miscellaneous Details
25A.1	Westerly Access Road By-Pass - Little Yellow Creek - West
26A.1	Easterly Access Road By-Pass - Robinson Creek
27.1	Robinson Creek Drainage Structure - Plan and Sections
28.1	Robinson Creek Drainage Structure - Details and Reinforcement
29	Robinson Creek Drainage Structure - Details of Wing Walls
30.1	Robinson Creek and Little Yellow Creek - West Low-Water Bridge Details
31	Disposal Area Drainage Structures - Profiles
32	Disposal Area Drainage Structures - Headwall Details
33	Stilling Basins - Concrete and Reinforcement Details
34.1	Corrugated Metal Pipe Culverts - Details
35.1	Drop Inlet Plans - Sheet 1

	35A	Drop Inlet Plans - Sheet 2
	36.1	Drop Inlet S-1E - Concrete and Reinforcement Details
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	38	Drop Inlet S-10W & S-15E - Concrete and Reinforcement Details
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	41.1	Miscellaneous Structures - Details
	44.1	Little Yellow Creek - West Drainage Structure Plan and Sections
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	48.2	Drainage Chutes S-4E, S-6E, & S-7W - Sections and Details
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	50.1	Drainage Chute S-10E - Plan and Sections
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	6	Logs of Borings
	7	Logs of Borings
	8	Logs of Borings
	9	Logs of Borings
	10	Logs of Borings
	11	Logs of Borings