Kansas Citys, Missouri and Kansas
Flood Damage Reduction Feasibility Study
(Section 216 – Review of Completed Civil Works Projects)
Engineering Appendix to the Interim Feasibility Report

Chapter A-8

GEOTECHNICAL ANALYSIS FAIRFAX-JERSEY CREEK (JERSEY CREEK SHEET PILE WALL)

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FAIRFAX-JERSEY CREEK
(JERSEY CREEK SHEET PILE WALL)

A-8.1 INTRODUCTION

This chapter presents the results of the geotechnical evaluation in the area near Station 27+50 of the existing Fairfax-Jersey Creek Unit of protection (refer to Exhibit A-8.6 in the Supplemental Exhibits section). The levee district provided an independent evaluation of the section of retaining sheet pile wall from Station 23+30.6 to Station 29+98.9. The report identified the failure of the tieback connections and extensive rusting of the existing retaining wall structure. The retaining wall structure provides stability of the foreshore bank for the existing levee with I-wall flood protection.

A-8.2 SOURCES OF EXISTING LEVEE DESIGN INFORMATION

The primary sources of information for this chapter include the references listed in the References section of this chapter. As-built record drawings, as well as the independent wall evaluation with recent subsurface investigations, were used for the geotechnical assessments.

A-8.3 DESCRIPTION OF THE LEVEE UNIT

Refer to Section A-4.3.7 for a detailed description of the Fairfax-Jersey Creek Unit.

A-8.4 LEVEE DESIGN FEATURES

A-8.4.1 Basic Existing Levee and Floodwall Sections

The Fairfax-Jersey Creek levee unit consists of levees, floodwalls, stoplog and sandbag gaps, riprap and levee toe protection, surfaced levee crown and ramps, drainage systems, the Jersey Creek sewer structure and shutter gates, and pumping plants. It was originally constructed as a local levee, but was removed and replaced using Federal standards in 1940. The final contract for construction of the project was completed in 1955.

A plan view of the Fairfax-Jersey Creek Unit and typical sections are provided in Exhibits A-8.6 through A-8.16 of the Supplemental Exhibits section.

A-8.4.2 Future Flood Protection Concerns

A general raise of the existing level of protection has not been recommended for this unit. However, recent surveys of this unit indicate a top of levee lower than original design near Station 0+00. No geotechnical evaluation is provided for these low areas.

An existing sheet pile wall supports the riverside foreshore. The as-built drawings for the reach from Station 23+30.6 to Station 29+98.9 indicate an original cross section with the top of the levee near elevation 755 feet (see Exhibit A-8.6). The riverside slope is shown as 1.0 vertical to 3.5 horizontal. This slope extended down to elevation 724 feet. The 1.0 vertical on 3.5 horizontal slope was originally supported by a

steel sheet pile wall with tie back anchors to treated posts. This section is shown as Exhibit A-8.8 in the Supplemental Exhibits section of this chapter. The date of the as-built drawing is January 1945. The plan and elevation of the sheet pile tieback wall anchor is shown on Exhibits A-8.9 through A-8.11. A modification to the levee was completed in 1955 which added a concrete wall supported on sheet piling (I-wall) to the crest of the levee. An access road was added to the riverside 1.0 vertical on 3.5 horizontal slope. Exhibits A-8.12 through A-8.15 provide details of the modification. The latest 2003 survey of the area was obtained from a review of the sponsor provided drawings that included repair to the Jersey Creek outlet structure. The plan of the survey elevations is provided on Exhibit A-8.16 in the Supplemental Exhibits section. The cross section for Station 27+50 (see Exhibit A-8.17) was selected to model the existing condition from this survey. Station 27+50 was chosen to represent the condition of the levee from Station 23+30.6 to Station 29+89.9. Below Station 23+30.6, the cross section of the foreshore bank and height of the sheet pile retaining wall change due to an existing wharf area. Deficiencies associated with the wharf area are recognized and are being addressed through a local project. It is the reliability of the Station 27+50 cross section, as surveyed in 2003, which is being considered in this discussion.

The failure of the Station 27+50 section could occur if a consecutive sequence of failure events occurs. This sequence of failure events would consist of 1) loss of the retaining wall due to loss of soils riverside caused by degradation of the channel and velocity scour, 2) loss of the riverside foreshore bank due to velocity scour leading to global instability, and 3) subsequent loss of levee and I-wall flood protection due to continued velocity scour causing additional global instability. The overall reliability is modeled using 3 failure mechanisms combined in parallel to evaluate the damages incurred for various high water stages, sheet pile wall failure, foreshore instability, and levee with I-wall bank instability. The failure is triggered by velocity scour and channel degradation. A schematic of the model with reliability analysis results is provided on Exhibit A-8.18.

A-8.4.3 Area Site Characterization

Subsurface investigations conducted under direction of the sponsor were utilized to assess the stability of the retaining wall and the cross section of the flood protection near the reach from Station 23+30.6 to 29+98.9. The report titled, “Sheet Pile Wall and Levee Evaluation Jersey Creek Outfall to Wharf Structure”, dated 2004, provides foundation sampling and testing results. Foundation clay and sand strength values were developed and recommendations were provided. Samples of the sheet pile retaining wall were collected and damages were identified. The overall conclusion stated that the wall has lost its tieback support. It was reported that the wall, although tieback support had failed, was stable under current conditions. However, it was also recommended that the sheet pile be replaced within 10 years and quarterly observations be made before replacement is accomplished. Excessive deterioration of the sheet pile’s walls above the riverbed precluded recommendations to restore the existing tieback connections. Recommended soil design strengths that were provided in the report are shown in the tables that follow.

TABLE A-8.1
Soil Profile Immediately Behind the Wall

Layer	Elevation, Feet	Design N1(60)	Dry Unit Weight, pcf	Saturated Unit Weight, pcf	Design Φ'
Loose sand	716-706	7	95.5	121.9	32°
Medium – Dense Sand	706-698	16	105.7	128.2	37°
Dense Sand	698-685	23	110.1	131.0	39°

N1(60) refers to the standard penetration blow count where N1(60) is equal to $N_{field}C_EC_N$. C_E equals ER/60 with ER equal to the hammer system energy ratio expressed as a percentage of the theoretical energy of a 140 lb hammer falling 30 inches. C_N is a correction to the blow count based on effective overburden pressure.

TABLE A-8.2
Soil Profile Under Slope and Levee

Layer	Elevation, Feet	Design N1(60)	Dry Unit Weight, pcf	Saturated Unit Weight, pcf	Design Φ'
Dredged sand fill	750-733	10	101.9	117.1	33°
Clay Blanket	733-720	N/A	81	123	28° to 30°
Loose-medium sand	720-706	11	102.5	126.2	32°
Medium-dense sand	706-698	18	106.9	129.0	35°
Dense sand	698-685	23	110.1	131.0	36°
Medium-dense Sand	685-665	15	105.0	127.8	30°

N1(60) refers to the adjusted blow count equivalent to a drill rig delivering 60% of the available theoretical energy for a 140 lb weight falling frictionless for 30 inches. The design parameter internal friction angle correlations have been based on this energy load and effective overburden pressures near 1 psf. Field blow counts were converted to N1(60) and plotted verses depth.

The soil parameters in the above table are considered to be design parameters. For the existing condition analysis, mean soil parameters were determined using the data provided in the aforementioned report. The following soil strengths were used for analysis of the Station 27+50 cross section.

TABLE A-8.3
Soil Parameters Selected for Analysis

Layer	Elevation, Feet	Moist Unit Weight, pcf	Saturated Unit Weight, pcf	Average Strengths Assigned
Dredge Sand Fill*	750-733	110	115	30°
Clay Blanket	733-720	120	125	29°
Loose-Medium Sands	720-706	125	125	34°
Remaining Deeper Sands	706 and Below	125	125	37.5°
Riverside Sands	712 and Below	110	15	37°

* This value is not consistent with the sponsor provided report. A value lower than shown in the report is recommended based on the type of placement. The impact of the variance of the dredge sand fill ranges from 6 to 11 percent.

A-8.5 ANALYSIS MODEL FOR RISK AND UNCERTAINTY

The model used to determine the reliability of this reach considered the sequence of events that could lead to failure of the levee with the I-wall. The failure event tree consists of 1) scour of the riverbed proportionally to the flood event river level; 2) failure of the sheet pile wall; 3) global failure of the foreshore bank and then; 4) the global failure of the foreshore bank with levee and I-wall flood protection. This sequence of failures must occur in order to sustain interior flood damages.

A-8.5.1 River Bed Scour Determination

The scour potential of the Missouri River was realized during and after the Great Flood of 1993. The scour potential along the existing sheet pile wall on the right descending bank of the Missouri River in the vicinity of RM 367 was considered in the analysis model. The results of the USGS stream measurements at the gage on the Hannibal Bridge before and after the 1993 flood were reviewed. It was characterized that the gage will probably exhibit similar outside-of-the-bend scour characteristics as have been observed at the site in question. All of the USGS gage measurements were downloaded and processed. There were 17 measurements made prior to the July flood, 6 measurements made during the flood event, and 18 measurements made after the flood. From these records, the mean hydraulic depth (defined as the measured stream area divided by the observed top width) was calculated. The mean bed elevation for each observation was computed by subtracting the computed hydraulic depth from water surface elevation at the time of measurement. See Exhibit A-8.37 for further detail.

The mean bed elevations prior to the flood were fairly consistent at elevation 706 feet. The post-flood bed elevations varied from about 699 feet to 703 feet, with a mean value of about 701 feet. The post-flood measurements made in September and October were lower than the measurements made in November and December, suggesting that the bed may have been rebuilding. The 706 feet to 701 feet elevation range suggests that a general temporary scour depth of 5 feet can reasonably be expected to occur during severe flood events. A few of the early post-flood measurements suggest that the scour could be one or more feet lower.

The 6 measurements made during the flood of July, 1993 all have mean bed elevations, computed as discussed above, in the 714 feet range. An examination of the measurement data shows the observed top widths are about 1400 feet, whereas the top widths for the other measurements are all in the 900-990 feet range. Obviously the bed elevations calculated for the flood measurements were the mean elevations of the channel and its overbanks, whereas the pre-flood and post-flood measurements were for the channel only. The Kansas City District does have a copy of the filed data for USGS measurement No. 4360, which was made within a few hours of the peak of the flood. Using this field record, it is possible to compute the mean hydraulic depth for the channel portion only. The hydraulic data used for this computation, as well as a cross section comparison of before and after the 1993 flood event, is shown in Exhibits A-8.43 and A-8.44. The mean bed elevation of the channel was shown to be in the 703-704 feet range. This suggests that the mean bed was transiting from 706 to 701 feet during the flood.

The scour relationship developed for this study used no scour for the 2-year river stage. A value of 5 feet was used for river stage representing a major flood event. For this reach of the river, the relationship is shown on Exhibits A-8.1 and A-8.19.

EXHIBIT A-8.1

River Scour Relationship

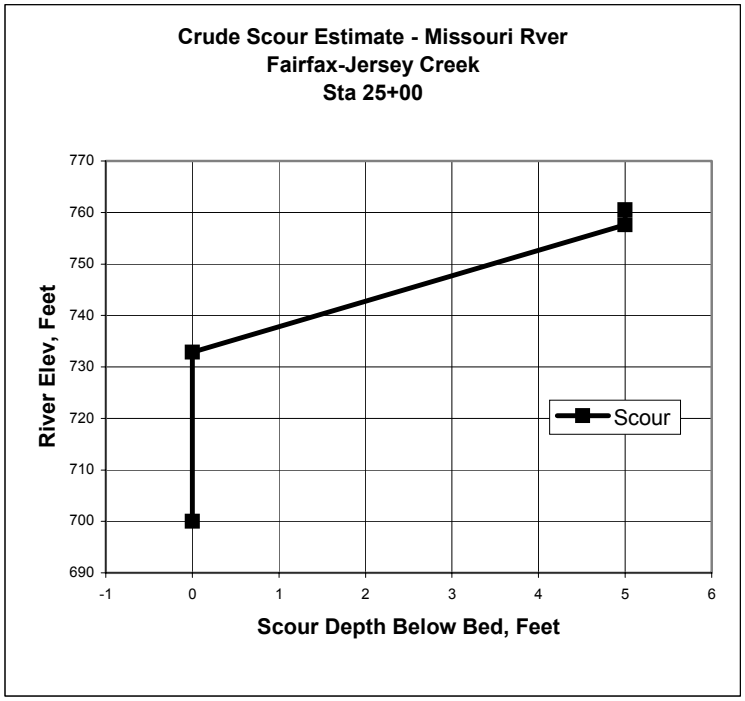


TABLE A-8.4
River Scour Relationship

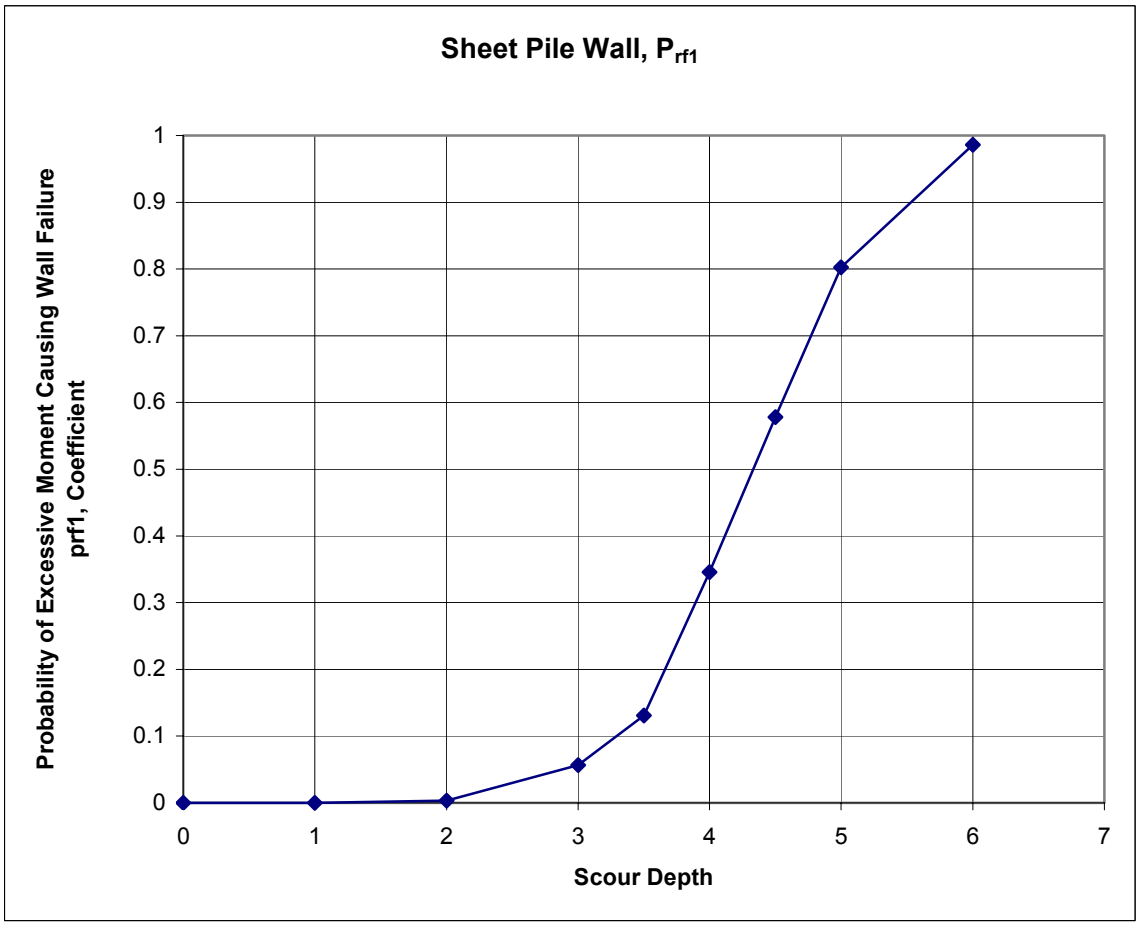
Scour Feet	River Level Feet	Flood Frequency
0	710	Below 2 year event
0	732.88	2 year event
3.6	751.9	100-year event
5	757.6	500 year event
5	760.5	Top of Flood Protection

A-8.5.2 Loss of Sheet Pile Wall

The sheet pile wall was reported to have lost tieback support. This condition creates a cantilever wall condition. A cantilever wall remains stable only as long as passive resistance exceeds the driving forces on the wall. The horizontal force and moment equilibrium was considered to determine the stability of the wall for the existing conditions. The analysis was also done for incremental increases in the scour riverside of the retaining wall. An excel spreadsheet was designed to model the wall stability analysis. The spreadsheet was developed using a simple cantilever support analysis.

The soils and geometry of the slopes and water level in the bank landward of the retaining wall were used to develop the expected active earth forces on the retaining wall. The water level, soil materials and riverbed location riverward of the sheet pile retaining wall were used to determine the passive resistance below the embedment of the sheet pile retaining wall. The horizontal forces were determined and compared to model the reliability of the riverside soil to resist the horizontal movement of the wall. The driving and resisting horizontal force locations were used to determine the moment about the bottom of the wall to model the reliability of the overturning resistance. Net pressures were calculated along the wall and used in the model. A model using Taylor's series was added to develop the reliability of the wall using mean values of the soil strength parameter and unit weight parameters. The resulting reliability of the wall system was developed for scour values ranging from 0 feet at the 2-year river level stage to a scour of 5 feet representing the rare flood occurrence. The results of these spreadsheet analyses are presented in Exhibits A-8.20 through A-8.22, A-8.29 through A-8.30, and A-8.37 through A-8.38 of the Supplemental Exhibits section. The reliability of the wall appears to be questionable above the 100-year river level. The probability of a sheet pile wall failure was determined for this condition and defined as p_{rf1}.

EXHIBIT A-8.2
Probability of Wall Failure, P_{rf1}
Versus River Bed Scour



A-8.5.3 First Loss of Foreshore Bank

In the event that the channel sheet pile wall fails, the channel velocities will rapidly remove the foundation sands behind the wall. The rapid removal and undermining of sand bank materials was observed during the high water event on the Kansas River in 1998 in the Argentine Ruby Street outlet works. If the river had continued to rise, the floodwall on the Argentine levee may have been undermined. The foreshore access of the Argentine levee allowed for rapid response emergency rock placement on the sloped riverside banks and grouting below the foundation outlet structure. The Fairfax sheet pile wall forms a vertical bank line.

The bank line is 100 feet from the centerline of the levee. By the time failure of the wall is detected, erosion of the foreshore is highly probable and access to repair the erosion is not achievable.

A cross section was developed to model the existing condition and illustrate the modeling of the loss of the sheet pile wall and scouring behind the wall. This cross section represents a failed wall with initial loss of foreshore materials due to velocity

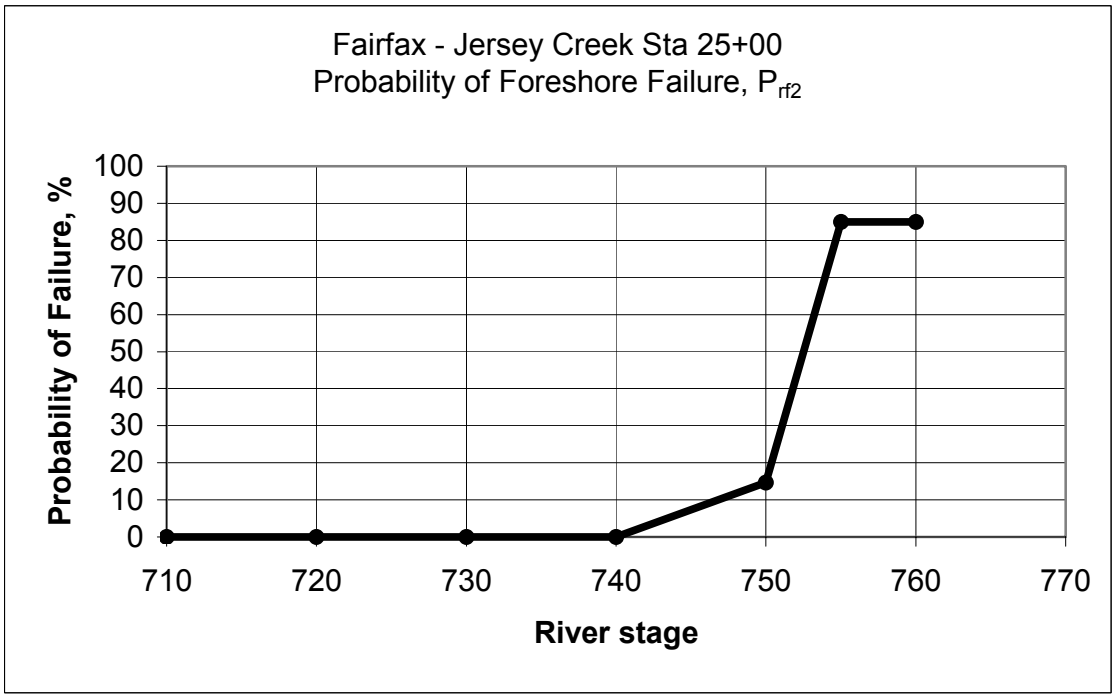
scour. The soils would develop a slope dependent on the angle of repose of the sands and clays in the bank. An additional amount of toe scour was assigned to account for scour at the toe of the slope. The section is defined on Exhibit A-8.17. It is felt that more severe erosion losses will occur than shown but those modeled are reasonable and raise enough concern for the reliability of the section. The reliability of the riverside channel bank was determined using the UTEXAS4 slope stability program. Spencer's procedure was used. The Taylor's Series expansion was used with one standard deviation about the mean and using the natural logarithm of the Factor of Safety in accordance with guidance provided in ETL 1110-2-556, "Risk-Based Analysis in Geotechnical Engineering for Support of Planning Studies". Soil parameter deviations were developed using recommended values for the drained strength of sands from Table 1: Coefficients of Variation for Geotechnical Parameters of ETL 1110-2-556. Table A-8.5 provides the random variable considered in the analysis. The standard deviation was developed using the expected mean multiplied by the coefficient of variance. Mean values for the phi angle were developed using standard penetration blow count and published values for a normalized blow count to effective overburden pressures of 1 psf.

TABLE A-8.5
Random Variables for Fairfax-Jersey Creek

Parameter	Expected Value	Standard Deviation	Coefficient of Variation, %
Dredge Fill Φ, ^{o}	30	3.60	12.00
Blanket Clays Φ, ^{o}	29	3.48	12.00
Foundation Loose-Medium Sands Φ, ^{o}	34	4.08	12.00
Remaining Deeper Sands Φ, ^{o}	37.5	4.50	12.00

Global slope stability calculations were performed and a summary of the results is provided in Exhibits A-8.23 through A-8.25, A-8.31 through A-8.33 in the Supplemental Exhibits section. The analysis provides a probability of failure of the first loss of foreshore bank after failure of the sheet pile retaining wall. The probability of the foreshore failure was determined for this condition and defined as p_{rf2}. The following graph displays the results of the probability of failure of the foreshore once the sheet pile wall fails for rising river levels.

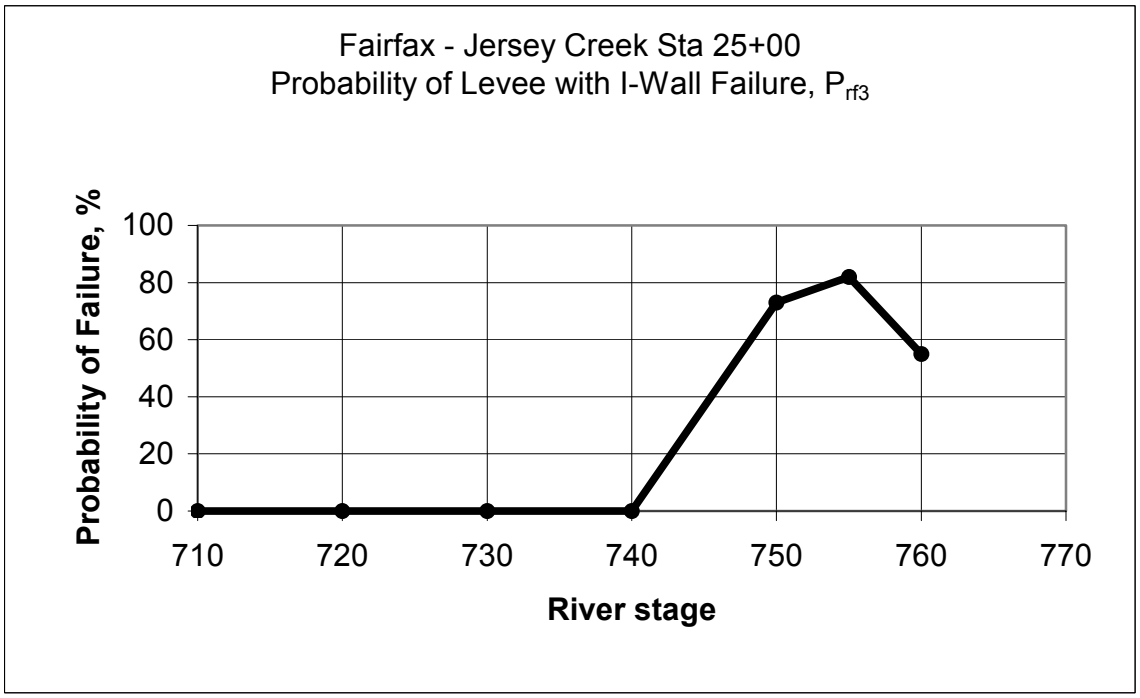
EXHIBIT A-8.3
Probability of Foreshore Failure, P_{rf2}
Versus River Elevation



A-8.5.4 Secondary Loss of Foreshore Bank Including Levee with I-Wall Flood Protection

If the foreshore bank is lost during a flood event, the remaining bank with levee and I-wall is weakened and exposed to additional velocity scour. A revision in the geometry of the foreshore was modeled to reflect only the loss of the foreshore. Additional scour of the foundation was not modeled although it is felt additional scour will occur. The previous foreshore slide was removed from the input file for UTEXAS4. The river elevation and foundation pressures were revised to model the loss of the foreshore. A new search was made for the most critical reasonable slide that would cause loss of the levee with I-wall section. The critical section was modeled for reliability using Taylor's series with mean values and standard deviations as shown in Table A-8.5. The results of the reliability of this section and summary of these results are presented in Exhibits A-8.26 through A-8.28 and A-8.34 through A-8.36 in the Supplemental Exhibits section. The probability of the levee with I-wall bank failure was determined for this condition and defined as p_{rf3}. The following graph displays the results of the probability of failure of the foreshore once the sheet pile wall fails for rising river levels.

EXHIBIT A-8.4
Probability of Levee with I-Wall Failure
P_{rf3} Versus River Elevation



The drop in the probability of failure beyond river elevation can be attributed to the increase in river level providing a lateral surcharge on the section and that no additional scour of the section has been modeled for the elevations above 755 feet.

A-8.5.5 Resulting Reliability of the Existing Cross Section Station 27+50

The reliability of the section along this reach was determined by considering the individual probability of unsatisfactory performance and applying these probabilities in a parallel system. The parallel system considers that all failures occur for the resulting failure to cause interior damages. The reliability, R, is determined by the following equation:

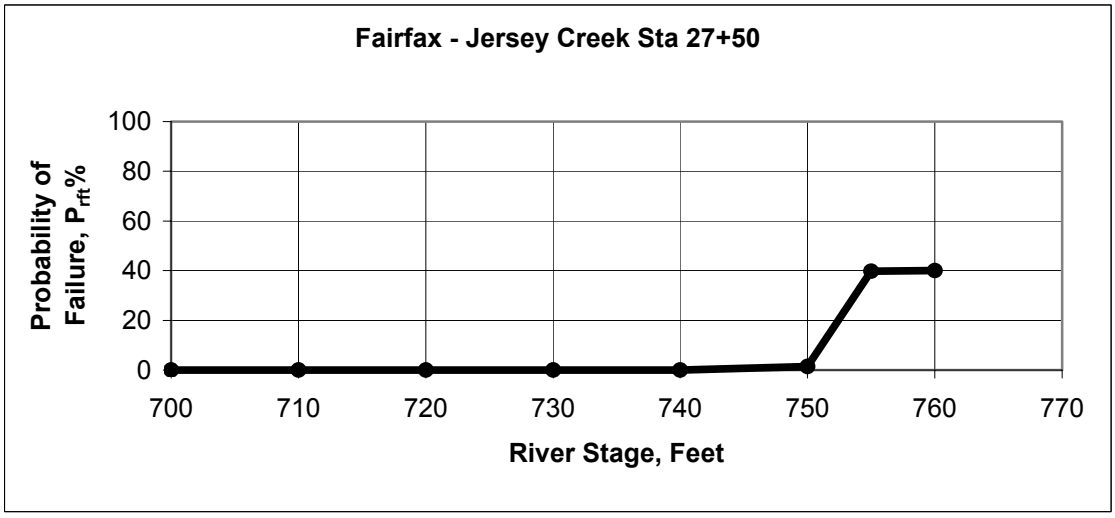
$$R = 1 - p_{rft} = 1 - (p_{rf1} * p_{rf2} * p_{rf3})$$

p_{rf1} is the assigned probability that the wall will collapse. p_{rf2} is the calculated probability that the foreshore will collapse. p_{rf3} is the calculated probability that the levee and I-Wall will collapse. p_{rft} is the total section probability of failure.

The relationship of the reliability was developed for incremental increases in the river level. This information was provided to the economist on the project team for use in the HEC-FDA model. A schematic summary is provided in Exhibit A-8.18 in the Supplemental Exhibits section. The following graph displays the results of the probability of failure of the section 27+50 for rising river levels. The analysis indicates

a geotechnical reliability of only 60% once the river stage reached the top of the flood protection.

EXHIBIT A-8.5
Probability of Failure for Levee
Section 27+50 P_{rft} Versus River Elevation



It should be noted that if the foundation soils riverside of the sheet pile foundations that support the flood wall on top of the levee are removed by scour, the individual probability of failure of the floodwall is increased. This has not been considered in the analysis.

A-8.6 RECOMMENDED COURSE OF ACTION

There exists a sufficient risk of levee and I-wall failure to consider design solutions for the existing condition that would strengthen this portion of the Fairfax-Jersey Creek levee unit. The solutions considered include flood fighting, closed cell sheet piling protection, tied back auger cast pile retaining wall and an open cell cofferdam sheet pile system.

All solution alternatives would be constructed landside of the existing sheet pile wall using a barge on the Missouri river. The construction efforts should not be allowed to overload the existing wall by surcharging the foreshore bank landside of the wall. The existing dead man support would be left in place and not utilized.

The sequence of construction should be staged such that the existing sheet pile wall and tieback is not weakened further until a new system has been installed.

The flood fight alternative is not considered a practical solution because the reaction time to failure is considered not achievable. The reliability analysis shows that the sheet pile wall failure will occur after significant scour develops for river stages well above the top of the wall. These river levels will submerge the bank. This will not allow observation of the failure of the sheet pile wall and subsequent scouring of the foreshore. Catastrophic failure of the levee will occur before any flood fight efforts

could be mobilized to provide foreshore protection of the levee with I-wall section.

Auger cast piles have been considered but the high construction cost estimated is driven by the extremely difficult construction procedures needed to assure that tiebacks rods are tensioned properly to the existing dead man supports.

The open cell and closed cell sheet pile solutions are each considered the most practical solution with the difference being cost and level of reliability. The open cell protection is the most economical, but would not be as reliable as the closed cell construction. The open cell solution poses a higher risk in that fewer sheet pile supports are constructed, lowering the overall resistance to movement. The open cell construction estimate could be considered as the most economical recommendation if it provides the minimum reliability required for flood protection.

The closed cell solution would penetrate into the foreshore bank greater than the open cell by 4 feet. The cost reflects the additional lengths of sheet piling required for closing the cells. The extra lateral extent of the cell towards the levee increases the length of sheet pile needed due to the increase in bank elevation towards the levee. The reach for placement of the final sheet piles is also increased in the construction of the closed cell solution.

The recommended solution for strengthening this reach of the Fairfax-Jersey Creek flood protection unit is the use of a driven sheet pile system without reliance on tieback anchors. The open cell appears as the most economical solution. The solution is based on an estimate that includes a proprietary design cost. The project design team considered the best solution as some type of driven sheet pile wall system with adequate penetration to prevent pull out with the use of tieback anchors. Early efforts during preparation of plans and specifications will pursue a nonproprietary economical design solution.

A-8.7 REFERENCES

1. Sheet Pile Wall and Levee Evaluation Jersey Creek Outfall to Wharf Structure, Kansas City, Kansas, prepared for Kaw Valley Drainage District by the URS Corporation, October 7, 2004.

2. Risk-Based Analysis in Geotechnical Engineering for Support of Planning Studies, ETL 1110-2-556.

3. Slope Stability Computer program, titled WINUT4, authored by Stephen Wright of the University of Texas, Austin.

A-8.8 SUPPLEMENTAL EXHIBITS

EXHIBIT A-8.6
Plan and Profile of Sheet Pile Study Reach

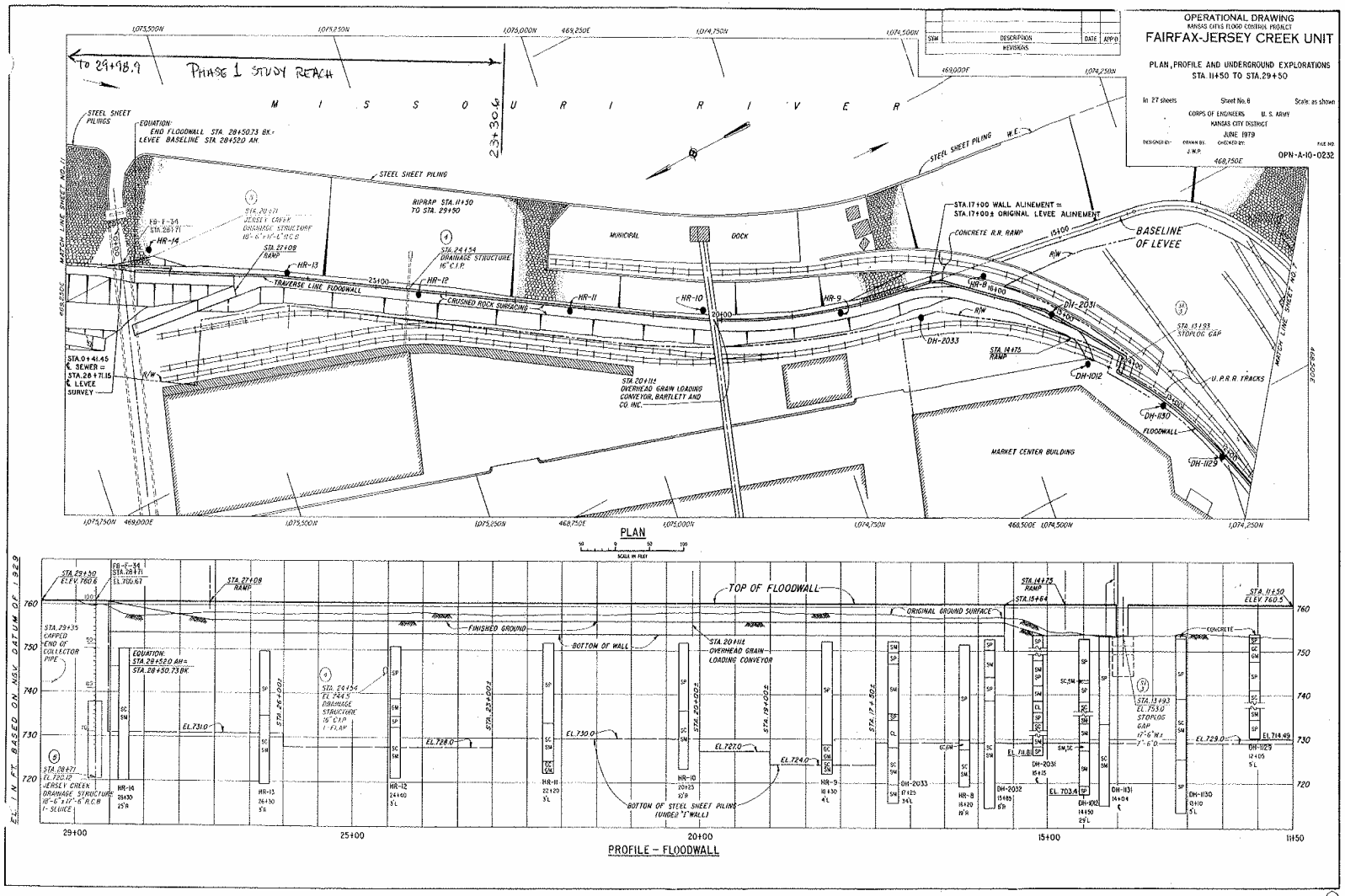


EXHIBIT A-8.7
Plan and Profile of Jersey Creek Sewer

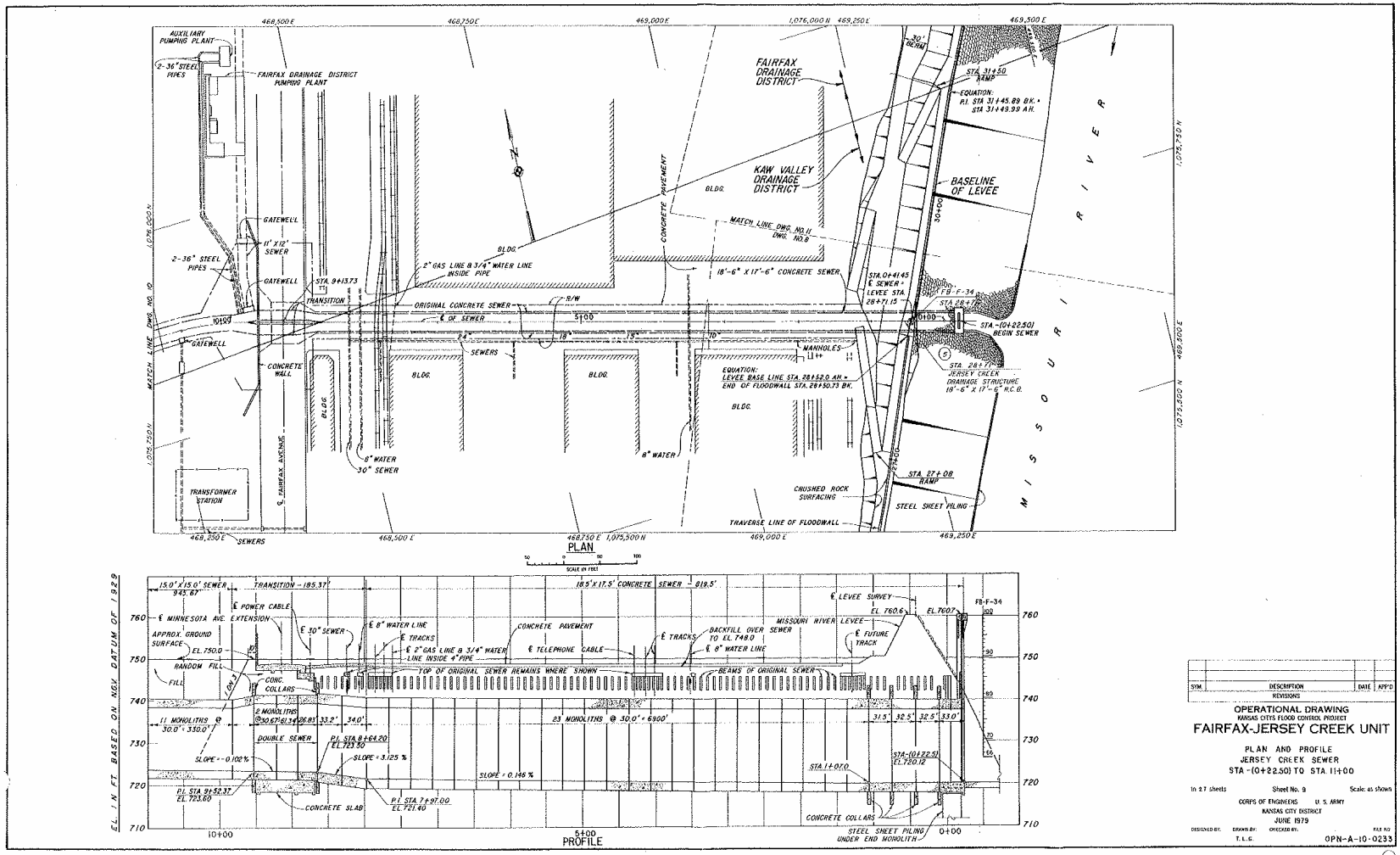
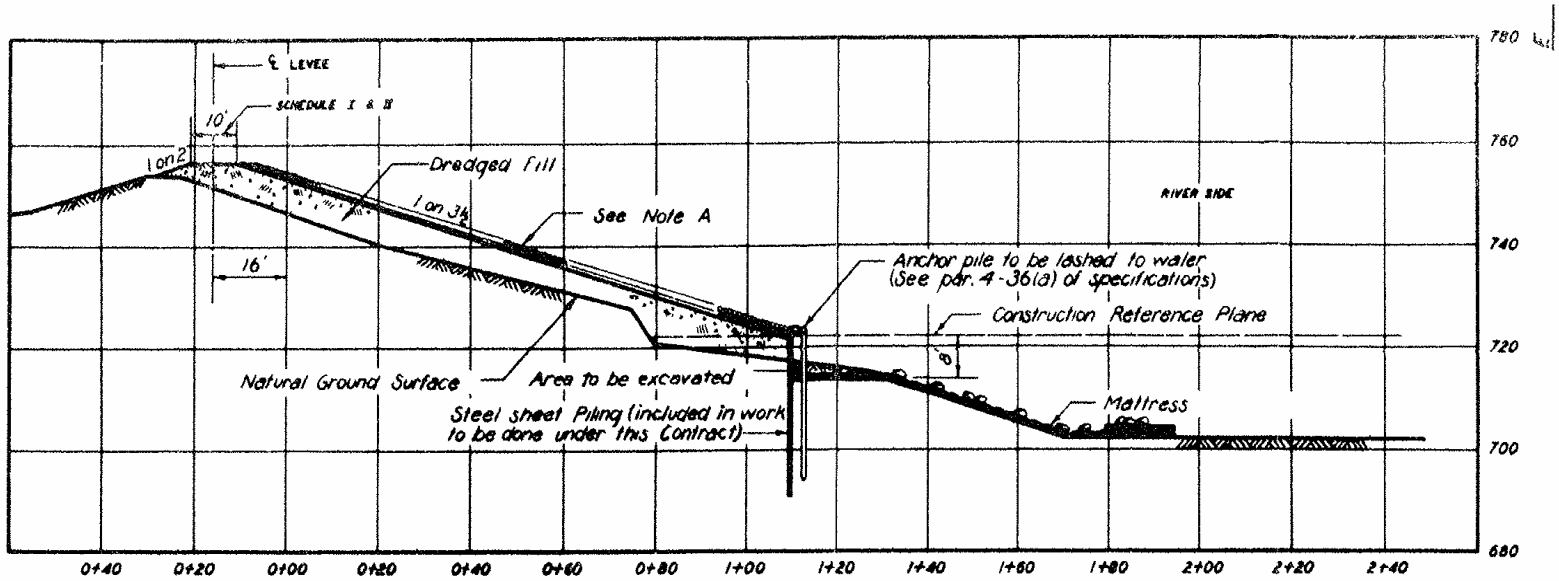


EXHIBIT A-8.8
Fairfax Levee Cross Section at Station 25+14



CROSS SECTION AT STA. 25+14

SCHEDULE II

AS BUILT

JANUARY 1945

ick at C.R.P. to 10"
4" blanket of crushed

ea level, are based
Survey, 1929 General

NO	DATE	BY	REVISIONS	APPROVED
1	1-10-45	JPC	Revised for As Built conditions	

KANSAS CITY FLOOD CONTROL PROJECT

FAIRFAX - JERSEY CREEK

FAIRFAX LEVEE

CROSS SECTIONS

In 3 Sheets — Sheet No. 1 — Scale: as shown

U.S. ENGINEER OFFICE
KANSAS CITY DISTRICT

KANSAS CITY, MO.
DECEMBER, 1939

Submitted: D. L. McCashen, Senior Engineer — Recommended: B. L. Greaves, District Corps of Engineers — Approved: A. M. Harlan, Division Corps of Engineers

Compiled by: C.B.V. — Traced by: R.J.B. — Checked by: H.L.L. — Transmitted with letter dated — File No. A-10-217

O. & M. M. PLATE NO. 2

EXHIBIT A-8.9
General Plan of Sheet Pile Walls

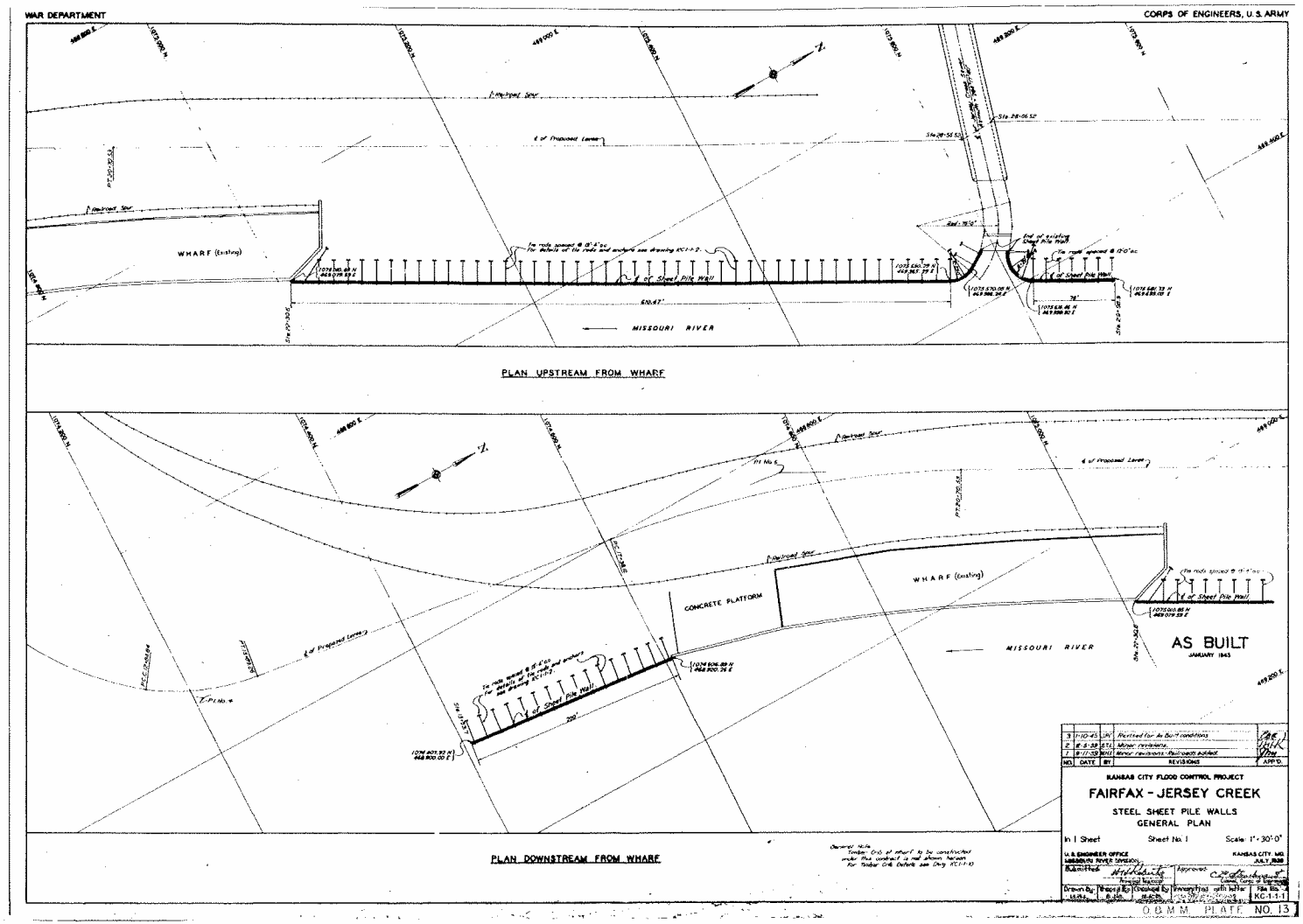


EXHIBIT A-8.10
Elevations of Sheet Pile Walls

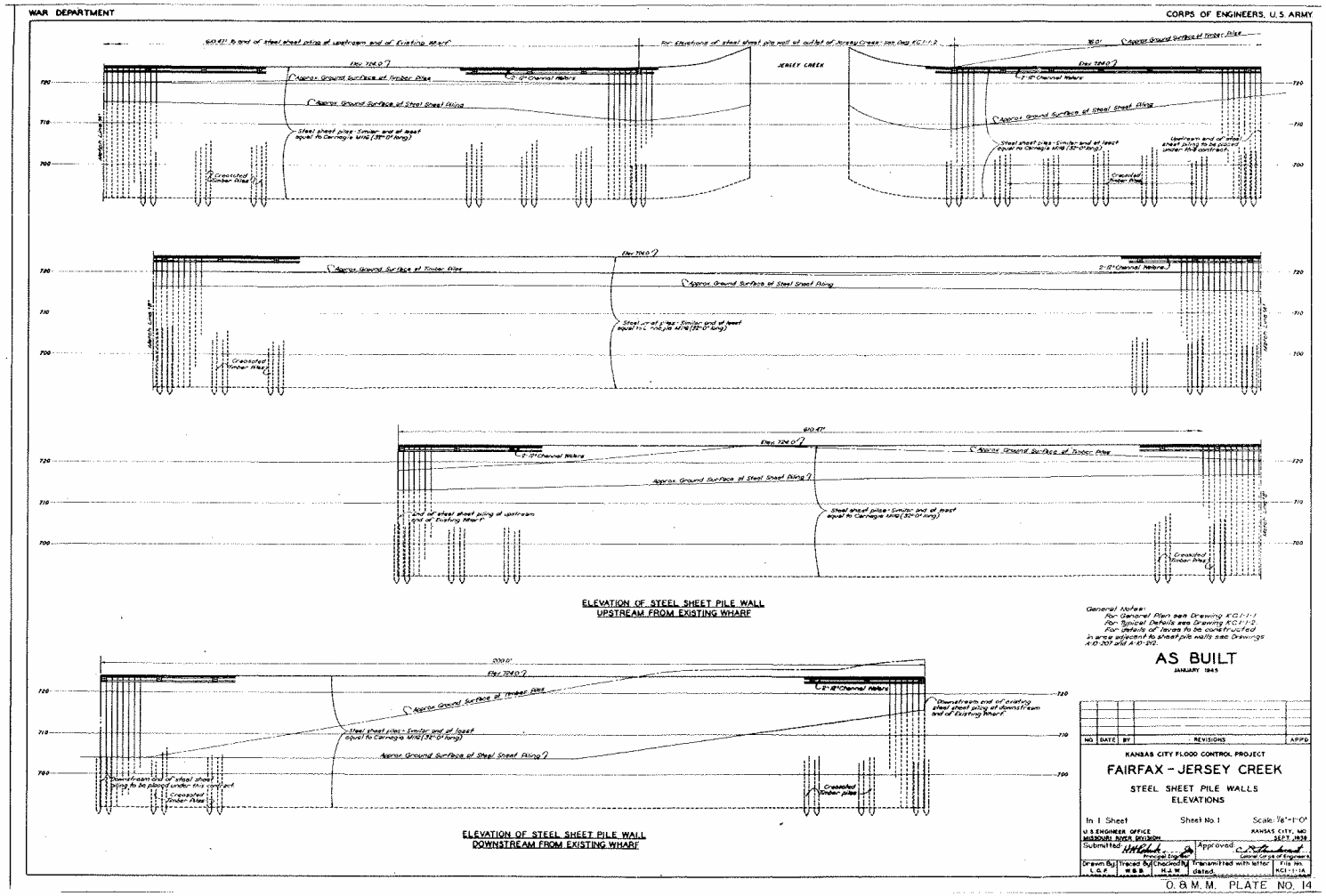


EXHIBIT A-8.11
Typical Details of Sheet Pile Walls

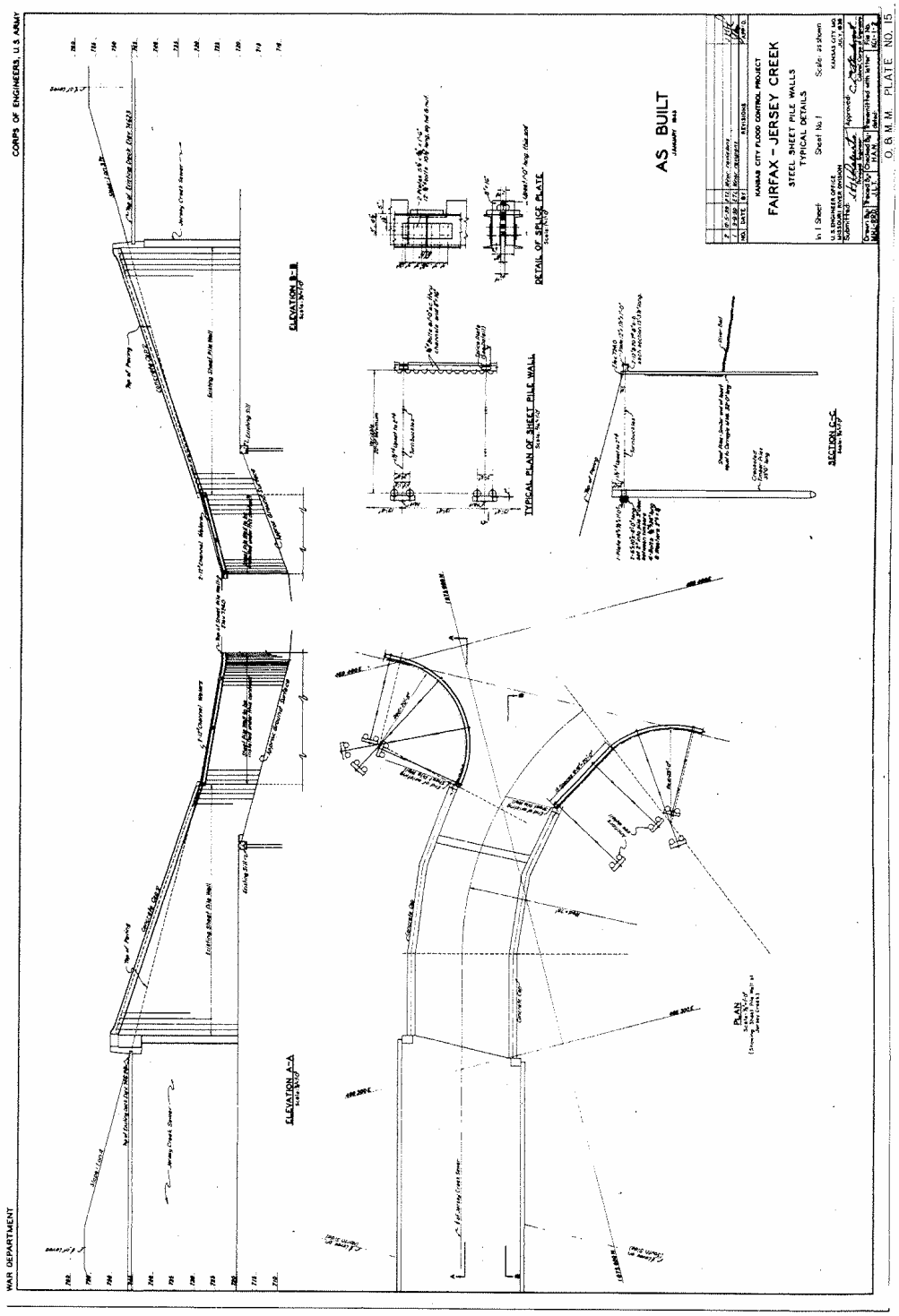


EXHIBIT A-8.12
Modification to Existing Protection Plan and Profile

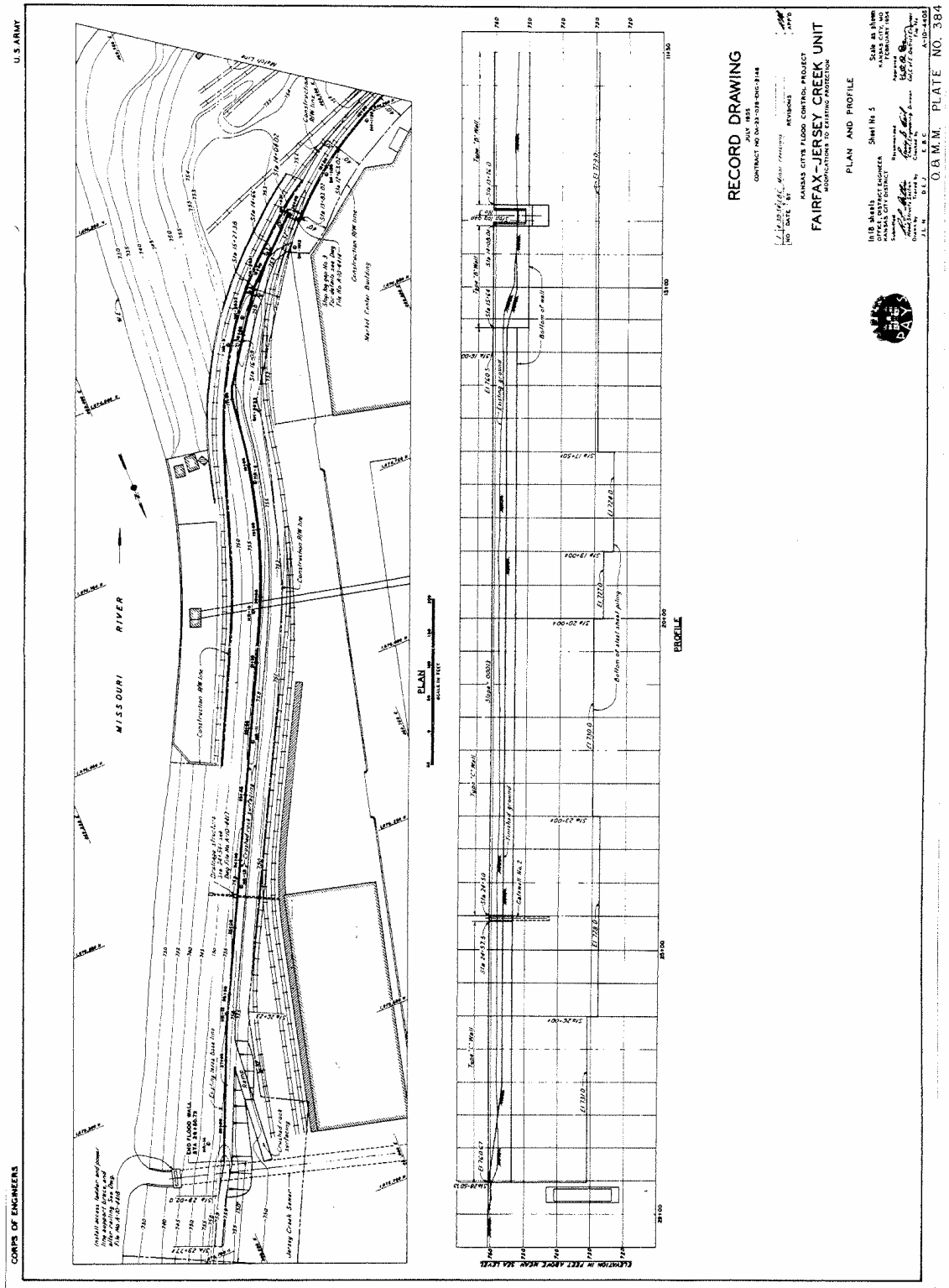
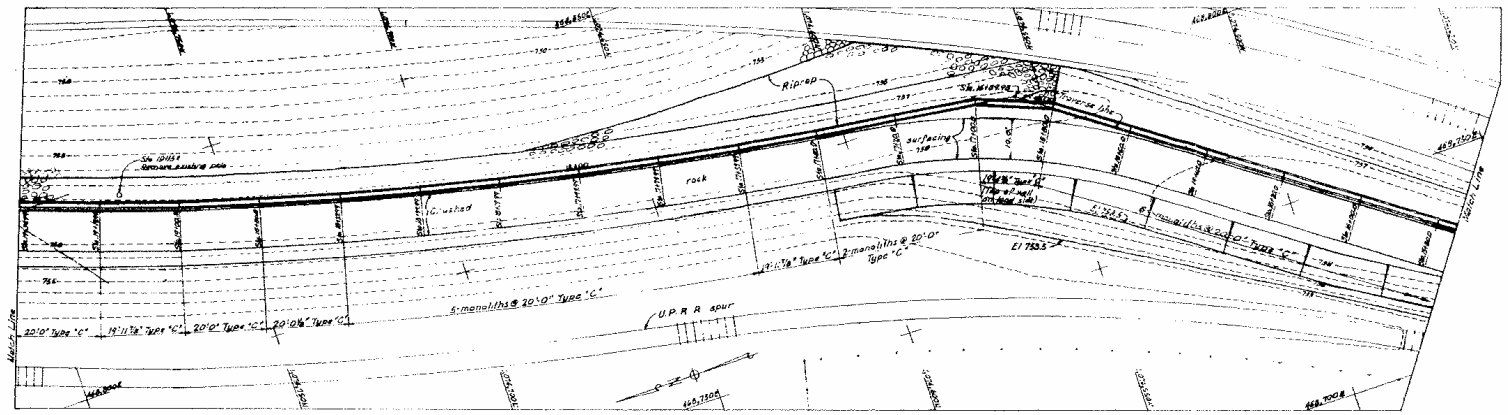


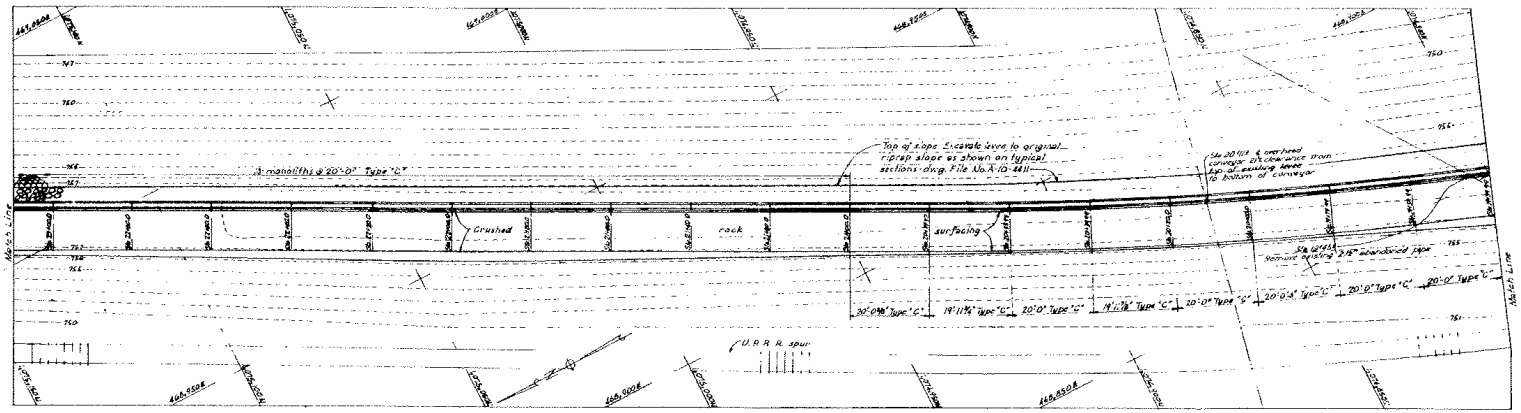
EXHIBIT A-8.13
Modification to Existing Protection
Plan Station 15+75 to Station 23+10

CORPS OF ENGINEERS

U.S. ARMY



PLAN - STA. 15+75 TO STA. 19+40



PLAN - STA. 19+40 TO STA. 23+10

TRAVERSE ALINEMENT DATA

STATION	AZIMUTH	FIELD DIST.	COORDINATES LATITUDE	COORDINATES DEPARTURE	STATION	AZIMUTH	FIELD DIST.	COORDINATES LATITUDE	COORDINATES DEPARTURE	STATION	AZIMUTH	FIELD DIST.	COORDINATES LATITUDE	COORDINATES DEPARTURE
15+27.38			N1,074,426.30	E466,708.00	16+89.99			N1,074,787.78	E466,822.14	19+78.99			N1,074,987.78	E466,844.37
16+89.98	35°27'57"	162.60	N1,074,552.74	E466,797.39	18+19.99	144°07'59"	20.00	N1,074,733.40	E466,827.04	20+00.00	201°36'18"	20.00	N1,074,854.50	E466,872.54
17+40.00	189°27'17"	50.02	N1,074,504.34	E465,809.27	18+50.00	152°26'37"	20.01	N1,074,706.37	E466,857.38	20+20.00	206°29'48"	20.00	N1,074,876.56	E466,880.08
17+59.99	188°10'00"	19.99	N1,074,496.14	E466,806.16	18+80.00	148°35'12"	20.00	N1,074,687.64	E466,888.04	20+39.99	208°00'55"	19.99	N1,074,896.81	E466,889.04
18+19.99	189°21'19"	20.00	N1,074,466.36	E466,804.10	18+99.99	147°25'52"	19.99	N1,074,781.16	E466,916.10	20+59.99	208°12'52"	20.00	N1,074,915.81	E466,891.91
18+39.99	190°34'52"	20.00	N1,074,446.14	E466,809.91	19+19.99	149°59'48"	20.00	N1,074,803.38	E466,850.87	20+79.99	207°15'26"	19.98	N1,074,934.37	E466,897.06
18+59.99	191°58'14"	20.00	N1,074,426.32	E466,819.38	19+39.99	208°12'49"	20.00	N1,074,825.18	E466,857.68	20+99.99	207°13'04"	20.00	N1,074,953.87	E466,902.84
18+79.99	193°00'04"	20.00	N1,074,406.30	E466,832.66	19+59.99	207°22'42"	20.00	N1,074,846.18	E466,857.68	21+19.99			N1,075,973.49	E466,916.23
18+99.99			N1,074,386.59	E466,848.18	19+79.99			N1,074,867.78	E466,852.87					

Notes:
For details of flood wall, excavation and backfill see dwg. File No. A-10-4411.

NO	DATE	BY	REVISIONS	APP'D.
1	6-30-58	E.R.C.	Minor revisions	

KANSAS CITY'S FLOOD CONTROL PROJECT

FAIRFAX-JERSEY CREEK UNIT

MODIFICATIONS TO EXISTING PROTECTION

PLAN

STA. 15+75 TO STA. 23+10

RECORD DRAWING

JULY 1958

CONTRACT NO. DA-23-022-ENG-2146

Sheet No. 9 of 18 sheets

Scale: 1"=10'

OFFICE, DISTRICT ENGINEER, KANSAS CITY DISTRICT

KANSAS CITY, MO. FEBRUARY 1954

Submitted: Head, Streets Section

Recommended: Chief, Engineering Division

Approved: Col. Corps of Engineers, Dist. Engr.

Drawn by: J.L.N. Traced by: Checked by: E.B.C.

E-4-140

A-10-4408

O. & M.M. PLATE NO. 388

EXHIBIT A-8.14
Modification to Existing Protection
Plan Station 23+10 to Station 29+77

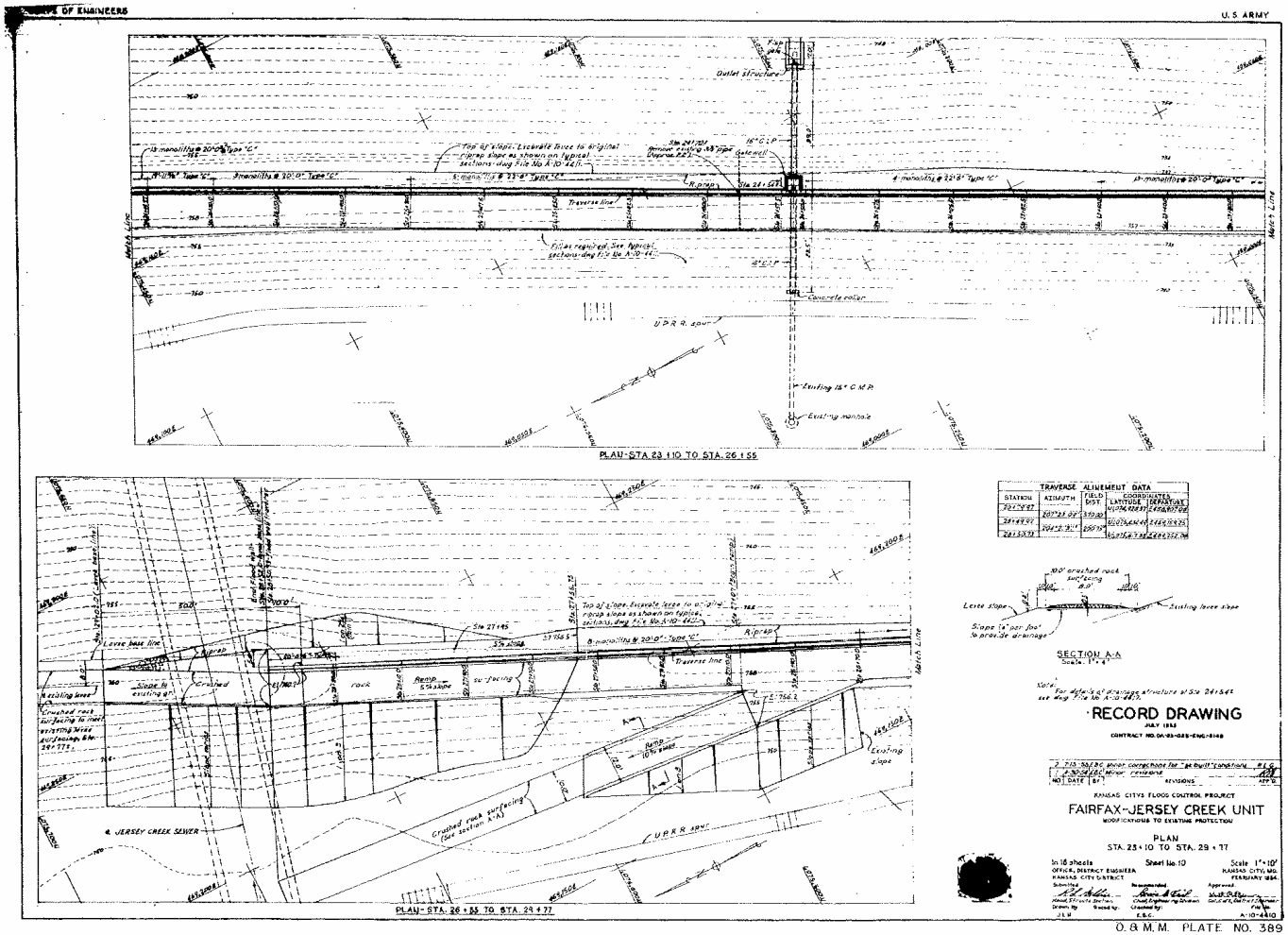


EXHIBIT A-8.15
Modification to Existing Protection
Typical Levee Sections and Wall Details

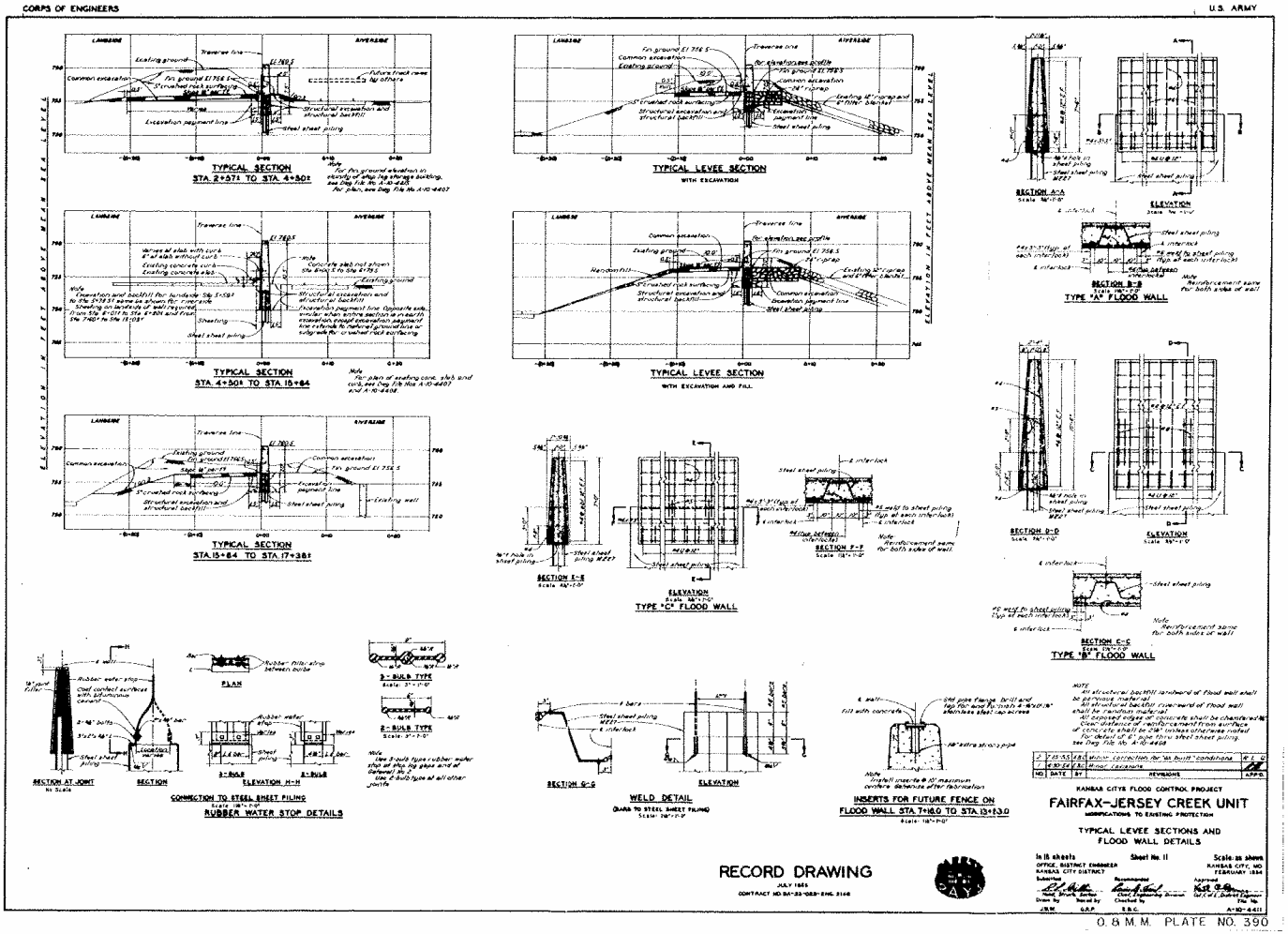


EXHIBIT A-8.16
Survey of Station 27+50 Area

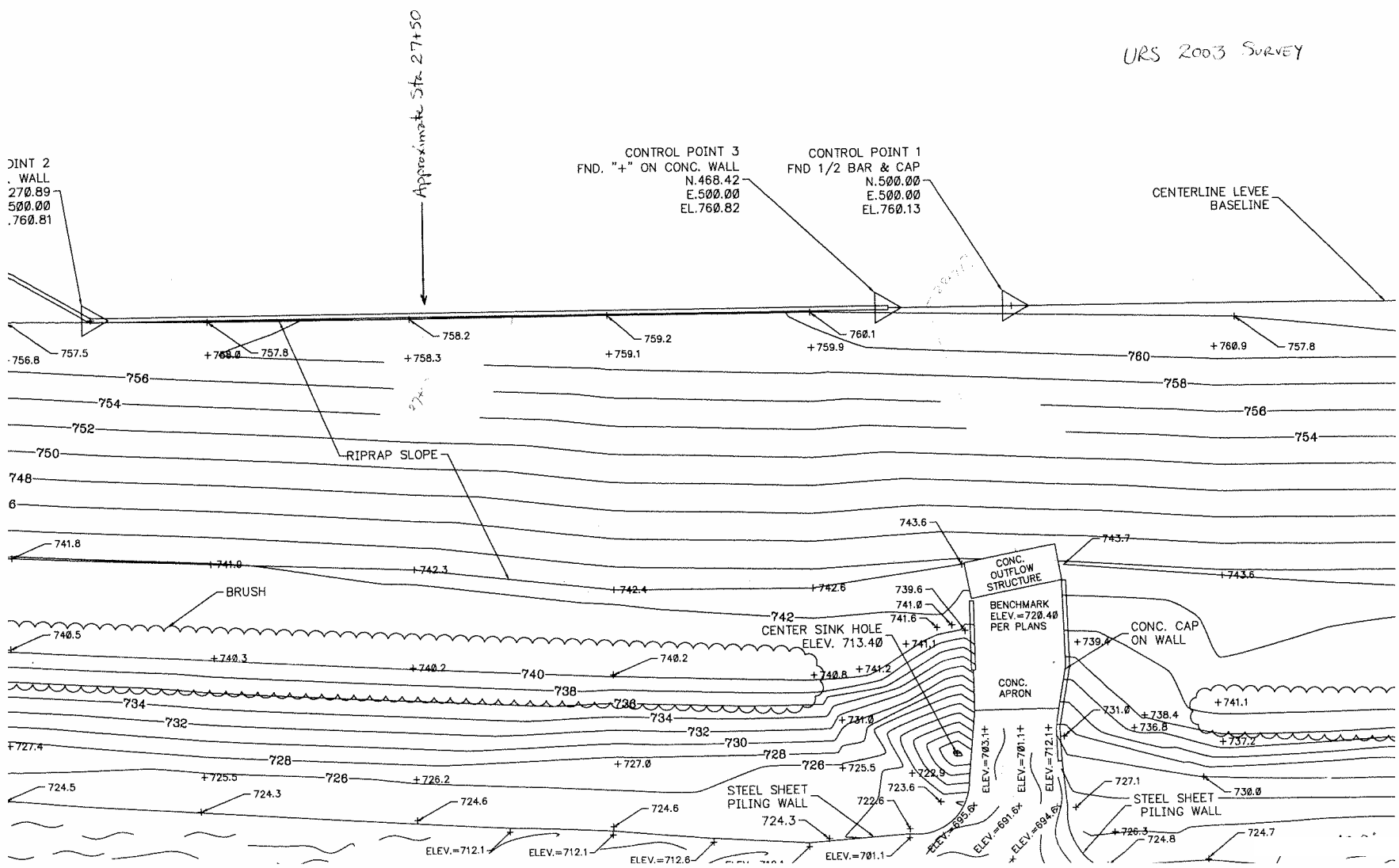


EXHIBIT A-8.17
Cross-Section of Modeled Area

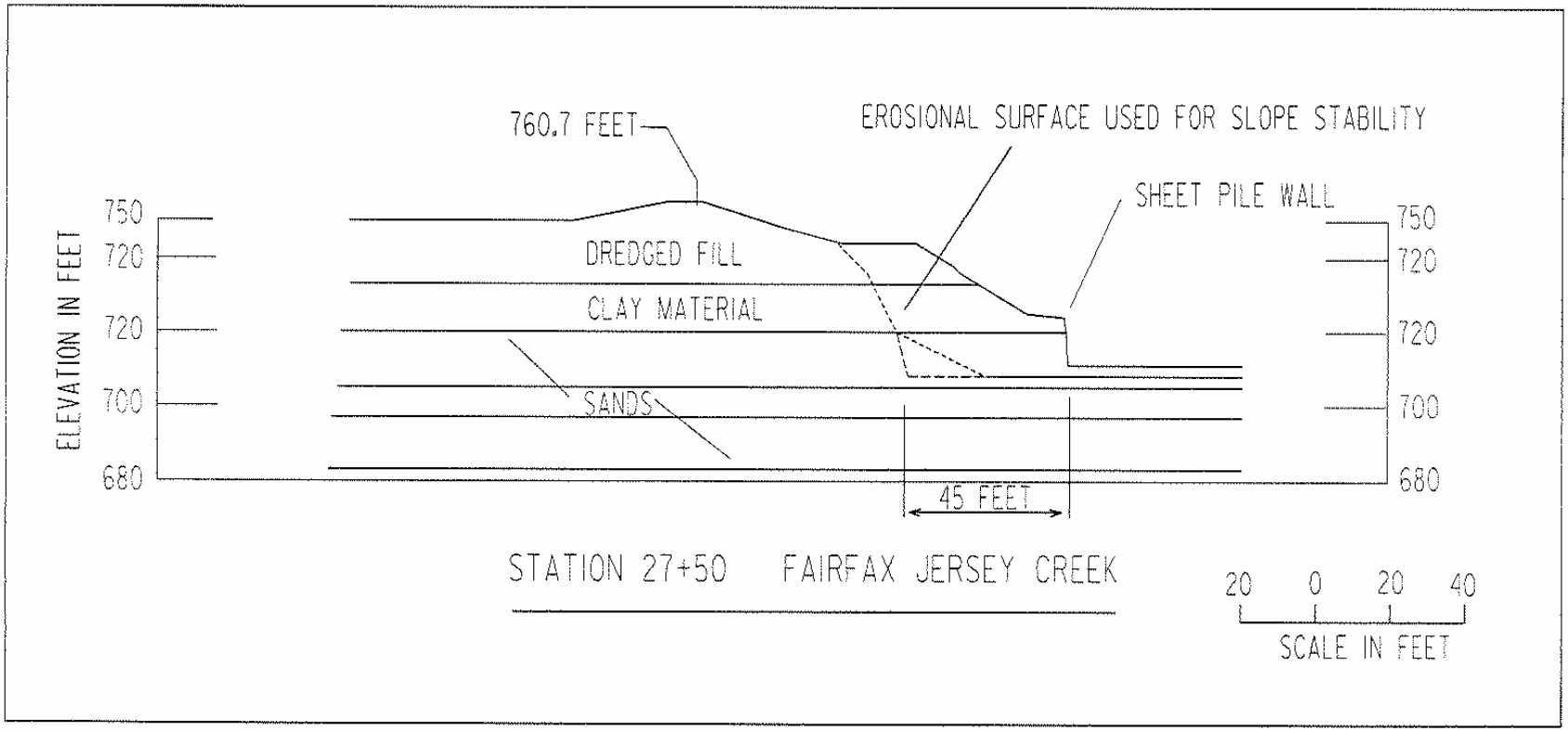


EXHIBIT A-8.18
Schematic of Failure Model

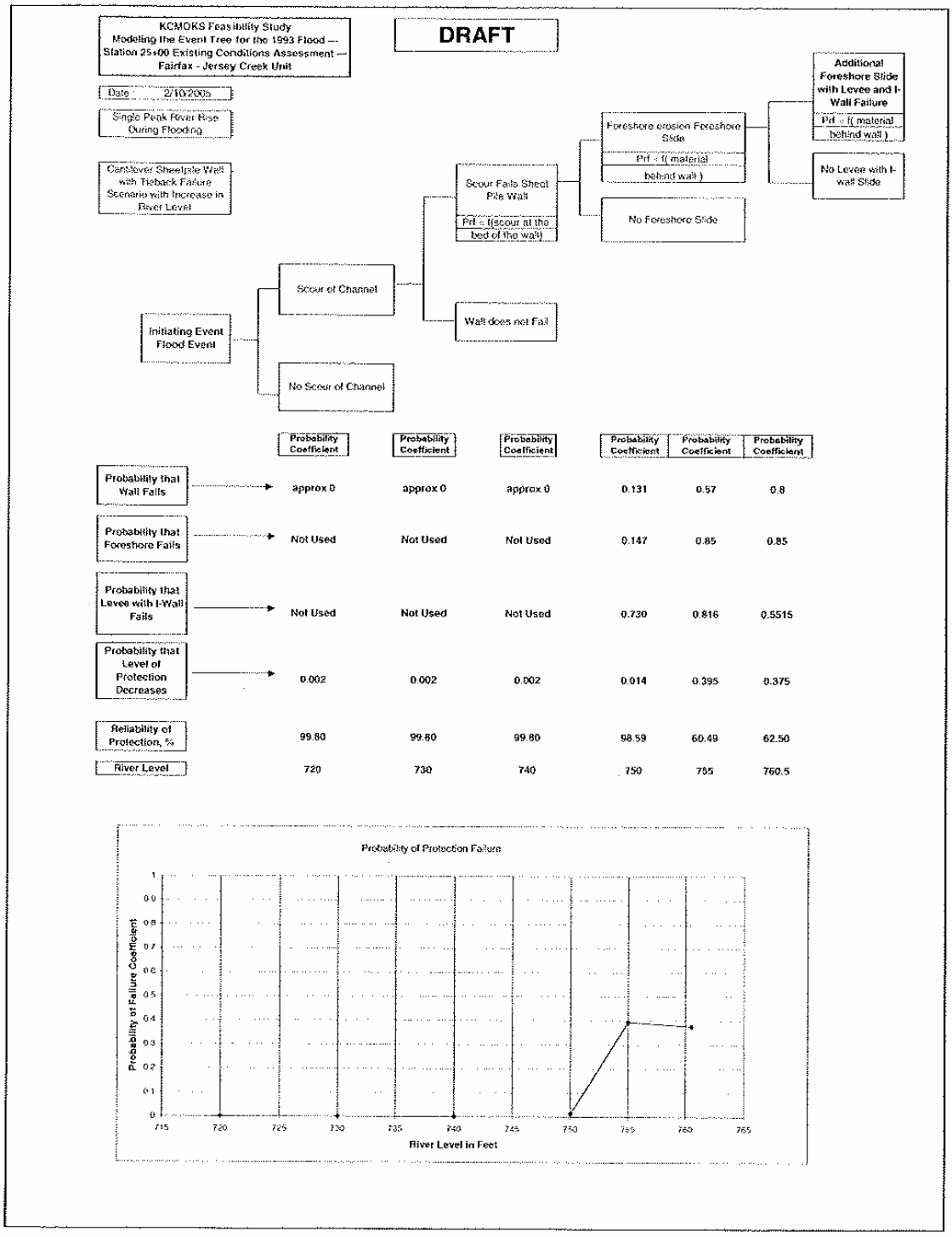
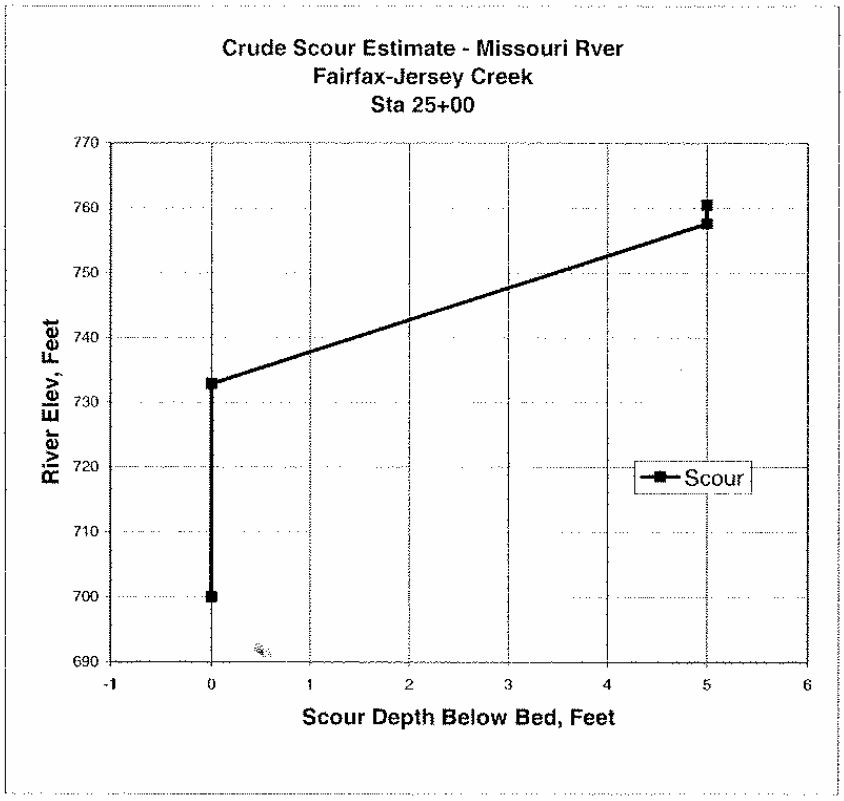


EXHIBIT A-8.19
Bed Scour Relationship Versus River Stage



Designer :	Shumate	2/10/2005
Reviewer:	Lance	2/10/2005

Scour Feet	River Level Feet	Flood Frequency
0	700	below 2 yr
0	732.88	2yr
5	757.6	500
5	760.5	Top FP

Data Based on 1993 Observation and Measurements

EXHIBIT A-8.20
Probability of Excessive Moment for Simple Cantilever Wall vs. Bed Scour

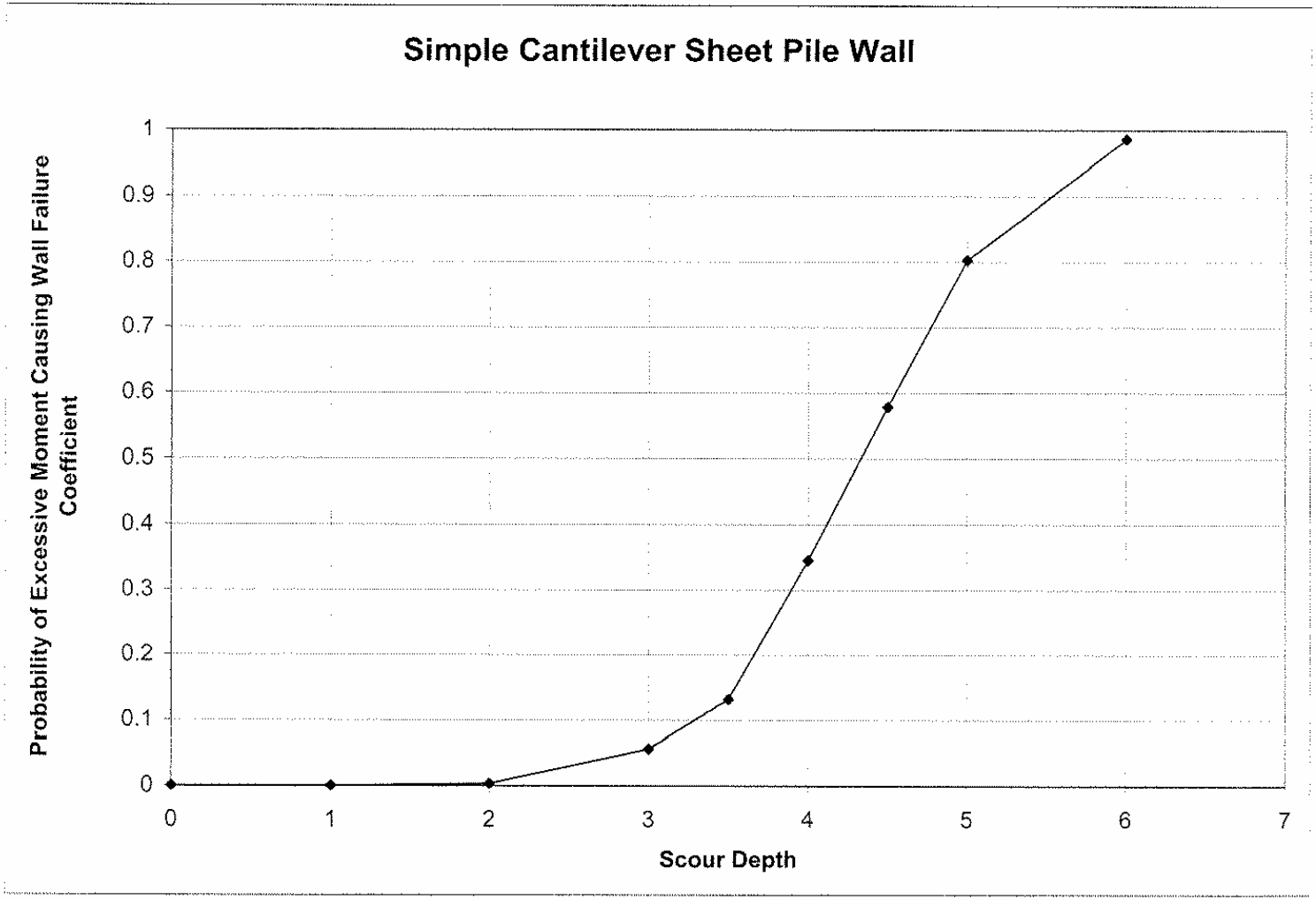


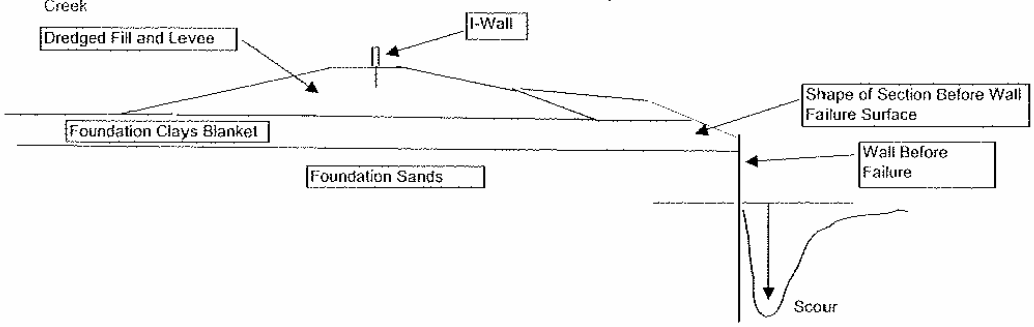
EXHIBIT A-8.21
Summary of Probability of Flood Protection Failure
Station 25+00 for River Elevation 750 Feet

STABILITY ANALYSIS — Reliability

Fairfax Jersey Creek — KCMOKS Sta 25+00

Designed By: Loehr 2/10/2005

Checked By: Perkeo 2/17/05



Probability that the Levee will fail is determine based on a parallel system for this reach. In a parallel system the system will only perform unsatisfactorily if all components perform unsatisfactorily.
Reliability = 1- p1*p2*p3

Reliability of the levee section is a function of the wall failure, and bank failure.

A parallel relationship exists for the Station 25+00 reach.

1) The Missouri river velocities create scour at the bed near the wall

2) The wall will fail if scouring at the toe removes materials below the existing bed. (p1)

3) If the wall fails, then part of the bank behind the wall will scour causing a foreshore slide. (p2)

4) After the foreshore slide and is scoured away by the flood event, alrger foreshore and levee slide can occur. (p3)

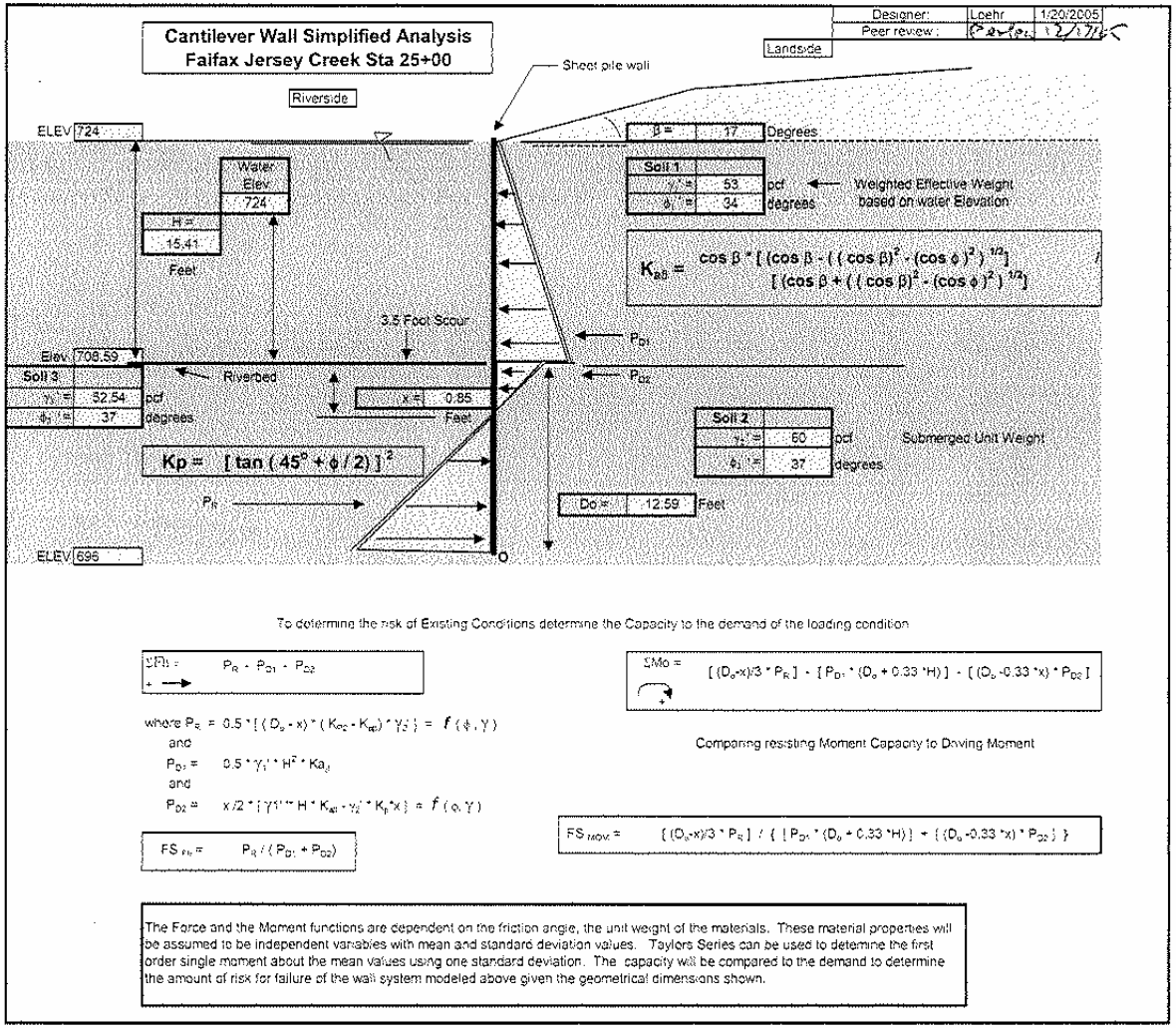
The reliability of the reach from Station 22+30 to 30+00 is determined below

	Event	Prob of Failure	
	Scour potential	1	(scour :3.5 feet)
(p1)	Wall failure (p1) =	0.131	
(p2)	Foreshore slide (p2)=	0.1470	Loss of bank - progressive erosion/slouging
(p3)	Levee Slide (p3) =	0.725	

Reliability of reach = 1-p1*p2*p3

0.1310	*	0.1470	*	0.7250	=	0.9860
Reliability	=	1.00	-	0.9860	=	**1.40%**

EXHIBIT A-8.22
Simple Cantilever Wall Model for River Elevation of 750 Feet



To determine the risk of Existing Conditions determine the Capacity to the demand of the loading condition

$\Sigma Fh = P_R - P_{D1} - P_{D2}$ (+ →)

$\Sigma Mo = [(D_o - x)/3 * P_R] - [P_{D1} * (D_o + 0.33 * H)] - [(D_o - 0.33 * x) * P_{D2}]$ (+ ↻)

where $P_R = 0.5 * [(D_o - x) * (K_{pc} - K_{aa}) * \gamma_3'] = f(\phi, \gamma)$

and

$P_{D1} = 0.5 * \gamma_1' * H^2 * Ka_\beta$

and

$P_{D2} = x/2 * [\gamma_1' * H * K_{aa} + \gamma_2' * K_p * x] = f(\phi, \gamma)$

Comparing resisting Moment Capacity to Driving Moment

$FS_{Fh} = P_R / (P_{D1} + P_{D2})$

$FS_{MOM} = [(D_o - x)/3 * P_R] / { [P_{D1} * (D_o + 0.33 * H)] + [(D_o - 0.33 * x) * P_{D2}] }$

The Force and the Moment functions are dependent on the friction angle, the unit weight of the materials. These material properties will be assumed to be independent variables with mean and standard deviation values. Taylors Series can be used to determine the first order single moment about the mean values using one standard deviation. The capacity will be compared to the demand to determine the amount of risk for failure of the wall system modeled above given the geometrical dimensions shown.

EXHIBIT A-8.22 (Continued)

Summary of the Forces - Fairfax Jersey Creek Sta 23+00 Sheet Pile Wall

$FS_{Flr} = P_R / (P_{D1} + P_{D2})$

Designer:	Lpehr	1/20/2005
Peer review:	[illegible]	1/24/05

where $P_R = 0.5 * [(D_o - x)^2 * (K_{Pa} - K_{pb}) * \gamma_2'] = f(\phi, \gamma)$

$P_{D1} = 0.5 * \gamma_1' * H^2 * Ka_\beta$

Factored Driving Forces Earth Loads =	1.0	At rest case

$P_{D2} = x/2 * [\gamma_1' * H * K_{a\beta} - \gamma_2' * K_p * x] = f(\phi, \gamma)$

Factored Resisting Forces Earth Loads =	1.0	Full Passive Case

$K_{a\beta} = \cos\beta * [(\cos\beta - ((\cos\beta)^2 - (\cos\phi)^2)^{1/2}) / (\cos\beta + ((\cos\beta)^2 - (\cos\phi)^2)^{1/2})]$

$Kp = [\tan(45° + \phi_2/2)]^2$

			(1)	(2)	(3)	(4)	(5)	(6)	$K_{a\beta}$ (7)	(8)	(9)	(10)	(11)	Kp (12)
Parameters :	phi	β	cos β	cos φ	$[(1)^2-(2)^2]^{0.5}$	(1)-(3)	(1)+(3)	(4)/(5)	(1)*(6)	γ_1'	γ_2'	ϕ_2'	tan	$(11)^2$
Calcs :	34	17	0.956	0.829	0.477	0.480	1.433	0.335	0.320	52.6	52.54	37	2.006	4.02

Independent Variables	ϕ_1'	ϕ_2'	γ_1'	γ_2'	$K_{a\beta}$	Kp	H	D_o	x	P_R	P_{D1}	P_{D2}	FS_{Flr}
Mean	34	37	52.6	60	0.32	4.02	15.41	12.59	0.85	13406	1999	23	6.63
$\phi_1' + \sigma_d$	38.1	37	52.6	60	0.26	4.02	15.41	12.59	0.85	13611	1646	4	8.25
$\phi_1' - \sigma_d$	29.9	37	52.6	60	0.39	4.02	15.41	12.59	0.85	13160	2424	47	5.33
$\phi_2' + \sigma_d$	34	41.4	52.6	60	0.32	4.91	15.41	12.59	0.85	16634	1999	4	8.31
$\phi_2' - \sigma_d$	34	32.6	52.6	60	0.32	3.33	15.41	12.59	0.85	10901	1999	38	5.35
$\gamma_1' + \sigma_d$	34	37	54.2	60	0.32	4.02	15.41	12.59	0.85	13406	2059	26	6.43
$\gamma_1' - \sigma_d$	34	37	51.0	60	0.32	4.02	15.41	12.59	0.85	13406	1939	20	6.84
$\gamma_2' + \sigma_d$	34	37	52.6	61.8	0.32	4.02	15.41	12.59	0.85	13406	1999	20	6.64
$\gamma_2' - \sigma_d$	34	37	52.6	58.2	0.32	4.02	15.41	12.59	0.85	13406	1999	26	6.62

EXHIBIT A-8.22 (Continued)

Summary of the Reliability - Fairfax Jersey Creek Sta 23+00 Sheet Pile Wall

Designer	Loehr	1/20/2005
Peer review	Perkins	12/17/05

Reliability Analysis of Existing Cantilver Sheet Pile Wall

Run	ϕ_1 Pervious	ϕ_2 Pervious	γ_1' Backfill	γ_2' Backfill	FS	Variance Component	Percent of Variance
Mean	34.0	37.0	52.6	60.0	6.63		
$\phi_1' + \sigma_d$	38.1	37.0	52.6	60.0	8.25	2.1384891	49.0013
$\phi_1' - \sigma_d$	29.9	37.0	52.6	60.0	5.33		
$\phi_2' + \sigma_d$	34.0	41.4	52.6	60.0	8.31	2.1825269	50.010
$\phi_2' - \sigma_d$	34.0	32.6	52.6	60.0	5.35		
$\gamma_1' + \sigma_d$	34.0	37.0	54.2	60.0	6.43	0.0431356	0.9884
$\gamma_1' - \sigma_d$	34.0	37.0	51.0	60.0	6.84		
$\gamma_2' + \sigma_d$	34.0	37.0	52.6	61.8	6.64	0.0000736	0.0017
$\gamma_2' - \sigma_d$	34.0	37.0	52.6	58.2	6.62		
				Total		4.3641517	100

E[FS] =	6.6303	E[ln FS] =	1.84433	1.84434
Var[FS]=	4.36415			
sigma[FS]=	2.08906	sigma [ln FS] =	0.307650	
V(FS) =	0.3151			
FS req'd =	1.000	ln(FS req'd) =	0.00000	

Beta =	5.994906
F(z) =	0.00000
Pr(f) =	0.0000

Reliability = 100.0000 percent

Table 1 : Random Variables for Fairfax Jersey Creek

Parameter	Expected Value	Standard Deviation	Coefficient of Variation, %
ϕ_1'	34.0	4.08	12.00
ϕ_2'	37.0	4.44	12.00
$\gamma 1'$	52.6	1.58	3.00
$\gamma 2'$	60.0	1.80	3.00

EXHIBIT A-8.22 (Continued)

Summary of Wall Moment FFJC Sta 25+00

$FS_{MOM} = [(D_o - x)/3 * P_R] / \{ [P_{D1} * (D_o + 0.33 * H)] + [(D_o - 0.33 * x) * P_{D2}] \}$

Factored Driving Forces earth Loads = 1.0 Active Case

Factored Resisting Forces earth Loads = 1.0 Full Passive case

Designer:	Loehr	1/20/2005
Peer review :	Perlea	12/17/0

Independent Variables →

Mean	ϕ_1'	ϕ_2'	γ_1'	γ_2'	$K_{a\beta}$	Kp	H	D_o	x	P_R	P_{D1}	P_{D2}	FS_{MOM}
	34	37	53	60	0.32	4.02	15.41	12.59	0.85	13406	1999	23	1.47
$\phi_1' + \sigma_d$	38.1	37	52.6	60	0.26	4.02	15.41	12.59	0.85	13611	1646	4	1.83
$\phi_1' - \sigma_d$	29.9	37	52.6	60	0.39	4.02	15.41	12.59	0.85	13160	2424	47	1.19
$\phi_2' + \sigma_d$	34	41.4	52.6	60	0.32	4.91	15.41	12.59	0.85	16634	1999	4	1.84
$\phi_2' - \sigma_d$	34	32.6	52.6	60	0.32	3.33	15.41	12.59	0.85	10901	1999	38	1.19
$\gamma_1' + \sigma_d$	34	37	54.2	60	0.32	4.02	15.41	12.59	0.85	13406	2059	26	1.43
$\gamma_1' - \sigma_d$	34	37	51.0	60	0.32	4.02	15.41	12.59	0.85	13406	1939	20	1.52
$\gamma_2' + \sigma_d$	34	37	52.6	61.8	0.32	4.02	15.41	12.59	0.85	13406	1999	20	1.47
$\gamma_2' - \sigma_d$	34	37	52.6	58.2	0.32	4.02	15.41	12.59	0.85	13406	1999	26	1.47

$P_R = 0.5 * [(D_o - x)^2 * (K_{P2} - K_{a\beta}) * \gamma_2'] = f(\phi, \gamma)$

$P_{D1} = 0.5 * \gamma_1' * H^2 * Ka_\beta$

$P_{D2} = x/2 * [\gamma 1' * H * K_{a\beta} - \gamma_2' * K_p * x] = f(\phi, \gamma)$

EXHIBIT A-8.22 (Continued)

Summary of Wall Reliability FFJC Sta 25+00

Designer:	Loehr	1/20/2005
Peer review :	Rerlen	12/17/05

Reliability Analysis of Existing Cantilver Sheet Pile Wall

Run	ϕ_1	ϕ_2	γ_1'	γ_2'	FSMOM	Variance Component	Percent of Variance
Mean	34.0	37.0	52.6	60.0	1.47		
$\phi_1' + \sigma_d$	38.1	37.0	52.6	60.0	1.83	0.1030300	49.0084
$\phi_1' - \sigma_d$	29.9	37.0	52.6	60.0	1.19		
$\phi_2' + \sigma_d$	34.0	41.4	52.6	60.0	1.84	0.1051228	50.004
$\phi_2' - \sigma_d$	34.0	32.6	52.6	60.0	1.19		
$\gamma_1' + \sigma_d$	34.0	37.0	54.2	60.0	1.43	0.0020764	0.9877
$\gamma_1' - \sigma_d$	34.0	37.0	51.0	60.0	1.52		
$\gamma_2' + \sigma_d$	34.0	37.0	52.6	61.8	1.47	0.0000018	0.0008
$\gamma_2' - \sigma_d$	34.0	37.0	52.6	58.2	1.47		
					Total	0.2102292	100

E[FS] =	1.4731	E[ln FS] =	0.34111	0.343125
Var[FS]=	0.21023			
sigma[FS]=	0.45851	sigma [ln FS] =	0.304093	
V(FS) =	0.3113			
FS req'd =	1.000	ln(FS req'd) =	0.00000	

Beta =	1.121729
F(z) =	0.13099
Pr(f) =	13.0989

Reliability = 86.901 percent

Table 1 : Random Variables for Fairfax Jersey Creek

Parameter	Expected Value	Standard Deviation	Coefficient of Variation, %
ϕ_1'	34.0	4.08	12.00
ϕ_2'	37.0	4.44	12.00
$\gamma 1'$	52.6	1.58	3.00
$\gamma 2'$	60.0	1.80	3.00

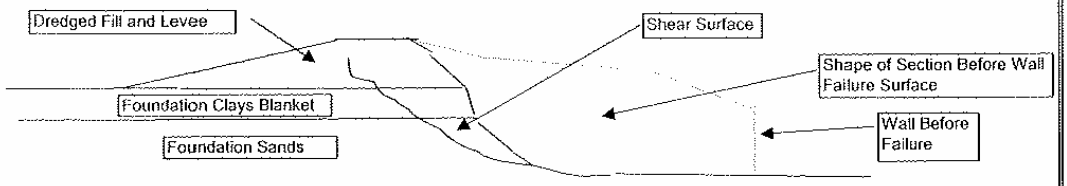
EXHIBIT A-8.23
Summary of Probability of Foreshore Global Stability Failure Using River Elevation 750 Feet

STABILITY ANALYSIS **Reliability**

Fairfax Jersey Creek — KCMOKS Sta 25+00

Designed By: Loehr 2/10/2005

Checked By: Perlea 2/17/05



Water for analysis Elev 750 feet

Foreshore Slide

Reliability Analysis of Critical Slide						
Run	ϕ' Levee Fill Pervious	ϕ', Blanket Clays, psf	ϕ' Found Sand	Factor of Safety	Variance Component	Percent of Variance
1 Mean	30.00	29.0	34	1.116		
2 $+\sigma_d$	33.60	29.00	34.00	1.125	0.0000810	0.6445
3 $-\sigma_d$	26.40	29.00	34.00	1.107		
4 $+\sigma_d$	30.00	32.48	34.00	1.187	0.0048303	38.434
5 $-\sigma_d$	30.00	25.52	34.00	1.048		
6 $+\sigma_d$	30.00	29.00	38.08	1.207	0.0076563	60.9210
7 $-\sigma_d$	30.00	29.00	29.92	1.032		
				Total	0.0125675	100

E[FS] = 1.1160 E[ln FS] = 0.10473 0.1047558

Var[FS]= 0.01257

sigma[FS]= 0.11210 sigma [ln FS] = 0.100200

V(FS) = 0.1005

FS req'd = 1.000 ln(FS req'd) = 0.00000

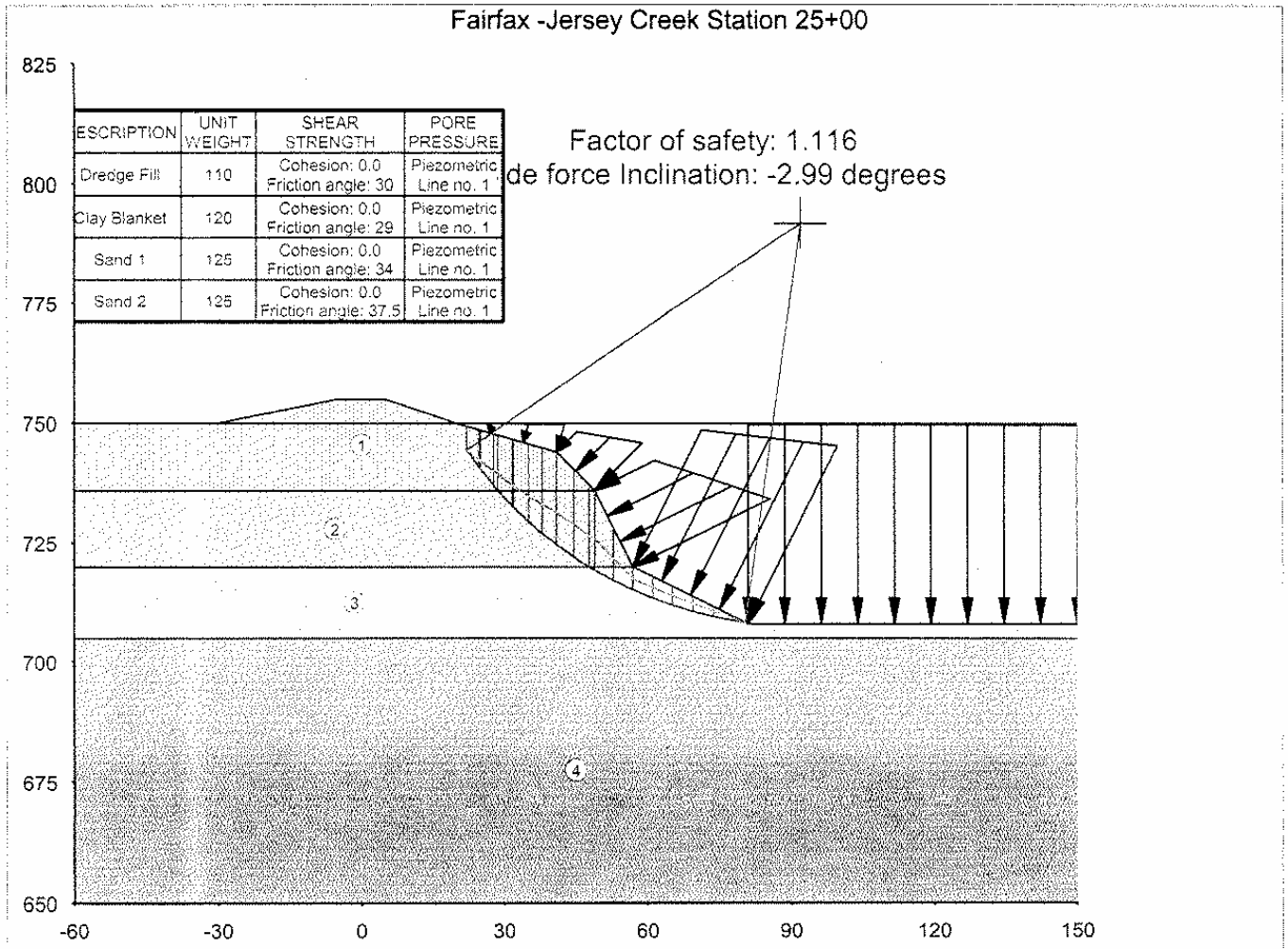
-1.13694

Beta =	1.04521
F(z) =	0.14796
Pr(f) =	14.80

0.12778

Table 1 : Random Variables for Fairfax-Jersey Creek			
Parameter	Expected Value	Standard Deviation	Coefficient of Variation, %
Levee Fill Pervious ϕ'	30	3.600	12.00
Blanket ϕ' [a]	29	3.480	12.00
Foundation ϕ'	34	4.080	12.00

EXHIBIT A-8.24
Mean Value Analysis of Global Stability of Station 25+00 Foreshore
With River Elevation 750 Feet



ESCRIPTION	UNIT WEIGHT	SHEAR STRENGTH	PORE PRESSURE
Dredge Fill	110	Cohesion: 0.0 Friction angle: 30	Piezometric Line no. 1
Clay Blanket	120	Cohesion: 0.0 Friction angle: 29	Piezometric Line no. 1
Sand 1	125	Cohesion: 0.0 Friction angle: 34	Piezometric Line no. 1
Sand 2	125	Cohesion: 0.0 Friction angle: 37.5	Piezometric Line no. 1

Filename: C:\Documents and Settings\g5epxsal\My Documents\KCMOKS\Fairfax-Jersey Creek\Sta 25+00 stability\Elev 750 PrTime: 08:49:26scour 1.UT4

EXHIBIT A-8.25
Mean Value Analysis of Global Stability Foreshore
UTEXAS4 Output File

```
TABLE NO. 1
COMPUTER PROGRAM DESIGNATION: UTEXAS4
Originally Coded By Stephen G. Wright
Version No. 4.0.0.9 - Last Revision Date: 07/27/2001
(C) Copyright 1985-2000 S. G. Wright - All rights reserved
*****************************************************************
* RESULTS OF COMPUTATIONS PERFORMED USING THIS SOFTWARE         *
* SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY HAVE       *
* BEEN VERIFIED BY INDEPENDENT ANALYSES, EXPERIMENTAL DATA      *
* OR FIELD EXPERIENCE. THE USER SHOULD UNDERSTAND THE ALGORITHMS *
* AND ANALYTICAL PROCEDURES USED IN THIS SOFTWARE AND MUST HAVE *
* READ ALL DOCUMENTATION FOR THIS SOFTWARE BEFORE ATTEMPTING    *
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*****************************************************************
```

```
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Time and date of run: Wed Jan 26 08:35:19 2005
Name of input data file: C:\Documents and Settings\g5epxsal\My Documents\KCMOKS\Fairfax-
Jersey Creek\Sta 25+00 stability\Elev 750 Prf\Foreshore\Alt scour 1.dat

    Fairfax -Jersey Creek Station 25+00
    750 Mean strengths
    1/252005 erosion scour ~~8~~ 3.5 feet wall failed

TABLE NO. 3
*************************
* NEW PROFILE LINE DATA *
*************************

-----------------------------------------------------------
----- Profile Line No. 2 - Material Type (Number): 2 -----
-----------------------------------------------------------
Description: Clay Blanket

Point        X            Y

   1       -60.00       736.00
   2        25.00       736.00
   3        49.00       736.00
   4        57.00       720.00

-----------------------------------------------------------
----- Profile Line No. 1 - Material Type (Number): 1 -----
-----------------------------------------------------------
Description: Dredge Fill

Point        X            Y

   1       -60.00       750.00
   2       -30.00       750.00
   3        -5.00       755.00
   4         5.00       755.00
   5        20.00       750.00
   6        41.00       744.00
   7        49.00       736.00

-----------------------------------------------------------
----- Profile Line No. 3 - Material Type (Number): 3 -----
-----------------------------------------------------------
Description: Sand 1

Point        X            Y

   1       -60.00       720.00
   2        32.00       720.00
   3        57.00       720.00
   4        81.00       708.00
   5       150.00       708.00

-----------------------------------------------------------
----- Profile Line No. 4 - Material Type (Number): 4 -----
-----------------------------------------------------------
Description: Sand 2

Point        X            Y

   1       -60.00       705.00
   2        38.00       705.00
   3       150.00       705.00
```

```
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    Fairfax -Jersey Creek Station 25+00
    750 Mean strengths
    1/252005 erosion scour ~~6~~ 3.5 feet wall failed

TABLE NO. 4
**********************************************************************
* NEW MATERIAL PROPERTY DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
**********************************************************************

----------------------------------------------------------------------
------------------- DATA FOR MATERIAL NUMBER 1 -------------------
----------------------------------------------------------------------
Description: Dredge Fill

Unit weight of soil (material): 110.0

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - - 0.0
Friction angle - - - - - 30.00 (degrees)

Pore water pressures are defined by a piezometric line.
Piezometric line number: 1
Negative pore water pressures are NOT allowed - set to zero.

----------------------------------------------------------------------
------------------- DATA FOR MATERIAL NUMBER 2 -------------------
----------------------------------------------------------------------
Description: Clay Blanket

Unit weight of soil (material): 120.0

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - - 0.0
Friction angle - - - - - 29.00 (degrees)

Pore water pressures are defined by a piezometric line.
Piezometric line number: 1
Negative pore water pressures are NOT allowed - set to zero.

----------------------------------------------------------------------
------------------- DATA FOR MATERIAL NUMBER 3 -------------------
----------------------------------------------------------------------
Description: Sand 1

Unit weight of soil (material): 125.0

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - - 0.0
Friction angle - - - - - 34.00 (degrees)

Pore water pressures are defined by a piezometric line.
Piezometric line number: 1
Negative pore water pressures are NOT allowed - set to zero.

----------------------------------------------------------------------
------------------- DATA FOR MATERIAL NUMBER 4 -------------------
----------------------------------------------------------------------
Description: Sand 2

Unit weight of soil (material): 125.0

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - - 0.0
Friction angle - - - - - 37.50 (degrees)
```

```
Pore water pressures are defined by a piezometric line.
Piezometric line number: 1
Negative pore water pressures are NOT allowed - set to zero.
```

```
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    Fairfax -Jersey Creek Station 25+00
    750 Mean strengths
    1/252005 erosion scour ~~6~~ 3.5 feet wall failed

TABLE NO. 6
*********************************************************************
* NEW PIEZOMETRIC LINE DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
*********************************************************************

-------------------------------------------------------------
--------------- Piezometric Line Number 1 ---------------
-------------------------------------------------------------
Description: Water at Intermediate River Stage 750
Unit weight of fluid (water): 62.4

Point        X           Y

  1       -60.00      750.00
  2        25.00      750.00
  3       150.00      750.00
```

```
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    Fairfax -Jersey Creek Station 25+00
    750 Mean strengths
    1/252005 erosion scour ~~6~~ 3.5 feet wall failed

TABLE NO. 10
***************************
* NEW SLOPE GEOMETRY DATA *
***************************

All slope data have been deleted ("cancelled") and will be re-generated.
```

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Fairfax -Jersey Creek Station 25+00
750 Mean strengths
1/252005 erosion scour ~~6~~ 3.5 feet wall failed

TABLE NO. 11

****
* NEW DISTRIBUTED LOAD DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
****

Point	X	Y	Normal Pressure	Shear Stress
1	20.00	750.00	0.0	0.0
2	41.00	744.00	375.0	0.0
3	49.00	736.00	874.0	0.0
4	57.00	720.00	1997.0	0.0
5	81.00	708.00	2604.0	0.0
6	150.00	708.00	2604.0	0.0

```
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Name of input data file: C:\Documents and Settings\g5epxsal\My Documents\KCMOKS\Fairfax-
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    Fairfax -Jersey Creek Station 25+00
    750 Mean strengths
    1/252005 erosion scour ~~8~~ 3.5 feet wall failed

TABLE NO. 16
*********************************
* NEW ANALYSIS/COMPUTATION DATA *
*********************************

Center coordinates for center of circle -
                                          X: 92.00
                                          Y: 792.00
                                     Radius: 84.50
Conventional (single-stage) computations will be performed.
Automatic search output will be in short form.
Depth of crack: 5.000
Radii for each grid point will be sorted in the order of increasing radius.
Critical circles for grid points will be output in the order of increasing factor of
safety.
Search will be continued after the initial mode to find a most critical circle.
Procedure of Analysis: Spencer

--------------------------------------------------------------------------------
The following represent default values or values that were prevously defined:
Subtended angle for slice subdivision: 3.00(degrees)
There is no water in a crack.
Seismic coefficient: 0.000
Unit weight of water (or other fluid) in crack: 62.4
No restrictions exist on the lateral extent of the search.
No shear surfaces other than the most critical will be saved for display later.
Neither slope face was explicitly designated for analysis.
Standard sign convention used for direction of shear stress on shear surface.
Iteration limit: 100
Force imbalance: 1.000000e-005 (fraction of total weight)
Moment imbalance: 1.000000e-005 (fraction of moment due to total weight)
Minimum weight required for computations to be performed: 100
Initial trial factor of safety: 3.000
Initial trial side force inclination: 17.189 (degrees)
Minimum (most negative) side force inclination allowed in Spencer's procedure: -10.00
```

```
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    Fairfax -Jersey Creek Station 25+00
    750 Mean strengths
    1/252005 erosion scour ~~5~~ 3.5 feet wall failed

TABLE NO. 26
************************************
* NEW, COMPUTED SLOPE GEOMETRY DATA *
************************************

These slope geometry were generated from the Profile Lines.

     Point        X            Y

        1      -60.00       750.00
        2      -30.00       750.00
        3       -5.00       755.00
        4        5.00       755.00
        5       20.00       750.00
        6       25.00       748.57
        7       32.00       746.57
        8       38.00       744.86
        9       41.00       744.00
       10       49.00       736.00
       11       57.00       720.00
       12       81.00       708.00
       13      150.00       708.00

UTEXAS WARNING NUMBER 4240
Possible artesian pressures detected at x = 81.00
from piezometric line number 1 (Stage 1).

UTEXAS WARNING NUMBER 4240
Possible artesian pressures detected at x = 150.00
from piezometric line number 1 (Stage 1).
```

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Fairfax -Jersey Creek Station 25+00
750 Mean strengths
1/252005 erosion scour ~~8~~ 3.5 feet wall failed

TABLE NO. 43

```
************************************************************
* Coordinate, Weight, Strength and Pore Water Pressure     *
* Information for Individual Slices for Conventional       *
* Computations or First Stage of Multi-Stage Computations. *
* (Information is for the critical shear surface in the    *
* case of an automatic search.)                            *
************************************************************
```

Slice No.	X	Y	Slice Weight	Matl. No.	Cohesion	Friction Angle	Pore Pressure
	22.20	744.37					
1	23.50	742.58	1829	1	0.0	30.00	463.2
	24.79	740.78					
2	24.90	740.65	183	1	0.0	30.00	583.7
	25.00	740.51					
3	26.39	738.79	2876	1	0.0	30.00	699.4
	27.79	737.07					
4	28.25	736.54	1141	1	0.0	30.00	840.1
	28.72	736.00					
5	30.23	734.38	4263	2	0.0	29.00	974.5
	31.74	732.76					
6	31.87	732.63	411	2	0.0	29.00	1083.7
	32.00	732.50					
7	33.60	730.97	5485	2	0.0	29.00	1187.4
	35.20	729.44					
8	36.60	728.22	5472	2	0.0	29.00	1358.8
	38.00	727.01					
9	39.50	725.82	6448	2	0.0	29.00	1509.1
	41.00	724.63					
10	42.80	723.34	7917	2	0.0	29.00	1663.7
	44.60	722.05					
11	46.18	721.02	6688	2	0.0	29.00	1808.1
	47.77	720.00					
12	48.39	719.63	2501	3	0.0	34.00	1895.1
	49.00	719.26					
13	50.93	718.18	6507	3	0.0	34.00	1985.3
	52.87	717.11					
14	54.85	716.14	3967	3	0.0	34.00	2113.1
	56.84	715.16					
15	56.92	715.13	101	3	0.0	34.00	2176.1
	57.00	715.09					
16	59.04	714.23	2421	3	0.0	34.00	2232.3
	61.07	713.36					
17	63.15	712.61	2243	3	0.0	34.00	2333.3
	65.23	711.85					
18	67.35	711.21	1915	3	0.0	34.00	2420.7
	69.46	710.56					
19	71.61	710.03	1432	3	0.0	34.00	2494.3
	73.76	709.49					
20	75.93	709.07	795	3	0.0	34.00	2553.9
	78.10	708.65					
21	79.25	708.48	115	3	0.0	34.00	2591.1
	80.40	708.30					

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Fairfax -Jersey Creek Station 25+00
750 Mean strengths
1/252005 erosion scour ~~6~~ 3.5 feet wall failed

TABLE NO. 44

```
*********************************************************
* Seismic Forces and Forces Due to Distributed Loads for *
* Individual Slices for Conventional Computations or the *
* First Stage of Multi-Stage Computations.               *
* (Information is for the critical shear surface in the  *
* case of an automatic search.)                          *
*********************************************************
```

Slices No.	X	Seismic Force	Y for Seismic Force	FORCES DUE TO DISTRIBUTED LOADS Normal Force	Shear Force	X	Y
1	23.50	0	745.79	168	0	23.66	748.96
2	24.90	0	744.62	19	0	24.90	748.60
3	26.39	0	743.48	331	0	26.49	748.14
4	28.25	0	742.09	143	0	28.26	747.64
5	30.23	0	740.67	573	0	30.30	747.06
6	31.87	0	739.51	58	0	31.87	746.61
7	33.60	0	738.39	807	0	33.66	746.10
8	36.60	0	736.56	864	0	36.64	745.25
9	39.50	0	734.92	1086	0	39.54	744.42
10	42.80	0	732.59	2477	0	42.94	742.06
11	46.18	0	729.82	3135	0	46.26	738.74
12	48.39	0	728.09	1453	0	48.39	736.61
13	50.93	0	725.13	9901	0	51.09	731.83
14	54.85	0	720.17	15064	0	54.96	724.08
15	56.92	0	717.64	715	0	56.92	720.16
16	59.04	0	716.60	9329	0	59.05	718.97
17	63.15	0	714.77	10007	0	63.17	716.92
18	67.35	0	713.02	10685	0	67.36	714.82
19	71.61	0	711.36	11359	0	71.63	712.69
20	75.93	0	709.80	12021	0	75.94	710.53
21	79.25	0	708.68	6586	0	79.25	708.87

```
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    Fairfax -Jersey Creek Station 25+00
    750 Mean strengths
    1/252005 erosion scour ~~8~~ 3.5 feet wall failed

TABLE NO. 47
*************************************************************
*  Information for the Iterative Solution for the Factor of  *
*  Safety and Side Force Inclination by Spencer's Procedure  *
*************************************************************
Allowable force imbalance for convergence:  6.4710e-001
Allowable moment imbalance for convergence: 28

        Trial      Trial
       Factor   Side Force     Force       Moment                    Delta
Iter-    of    Inclination   Imbalance   Imbalance    Delta-F       Theta
ation  Safety   (degrees)     (lbs.)     (ft.-lbs.)                (degrees)

   1   3.00000   -17.1887  -7.024e+003   4.732e+006
First-order corrections to F and Theta ............   -3.7517      5.6456
Reduced values - Deltas were too large ............   -0.5000      0.7524

   2   2.50000   -16.4363  -5.879e+003   3.953e+006
First-order corrections to F and Theta ............   -2.3037      6.0676
Reduced values - Deltas were too large ............   -0.5000      1.3169

   3   2.00000   -15.1194  -4.243e+003   2.834e+006
First-order corrections to F and Theta ............   -1.1979      6.6917
Reduced values - Deltas were too large ............   -0.5000      2.7931

   4   1.50000   -12.3263  -1.783e+003   1.144e+006
First-order corrections to F and Theta ............   -0.4244      7.2374
Reduced values - Deltas were too large ............   -0.1680      2.8648

   5   1.33200    -9.4615  -9.443e+002   5.905e+005
First-order corrections to F and Theta ............   -0.2304      5.7697
Reduced values - Deltas were too large ............   -0.1144      2.8648

   6   1.21760    -6.5967  -3.975e+002   2.384e+005
First-order corrections to F and Theta ............   -0.1057      3.4743
Reduced values - Deltas were too large ............   -0.0871      2.8648

   7   1.13048    -3.7320  -1.569e+001   1.432e+003
First-order corrections to F and Theta ............   -0.0146      0.7410
Second-order corrections to F and Theta ...........   -0.0146      0.7435

   8   1.11593    -2.9884   1.514e-002  -1.043e+001
First-order corrections to F and Theta ............    0.0000     -0.0000
```

```
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    Fairfax -Jersey Creek Station 25+00
    750 Mean strengths
    1/252005 erosion scour ~~8~~ 3.5 feet wall failed

TABLE NO. 55
*******************************************************************
* Check of Computations by Spencer's Procedure (Results are for the *
* critical shear surface in the case of an automatic search.)       *
*******************************************************************

Summation of Horizontal Forces: 1.51674e-011

Summation of Vertical Forces: 9.18021e-012

Summation of Moments: 2.20079e-005

Mohr Coulomb Shear Force/Shear Strength Check Summation: 9.54969e-012

***** CAUTION ***** Some of the Forces Between Slices Act at Points
Above the Surface of the Slope or Below the Shear Surface -
Either a Tension Crack may be Needed or the SOLUTION MAY NOT
BE A VALID SOLUTION
```

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Fairfax -Jersey Creek Station 25+00
750 Mean strengths
1/252005 erosion scour ~~8~~ 3.5 feet wall failed

TABLE NO. 58

```
*************************************************************************
* Final Results for Stresses Along the Shear Surface                    *
* (Results are for the critical shear surface in the case of a search.) *
*************************************************************************
```

SPENCER'S PROCEDURE USED TO COMPUTE THE FACTOR OF SAFETY
Factor of Safety: 1.116 Side Force Inclination: -2.99

-------- VALUES AT CENTER OF BASE OF SLICE --------

Slice No.	X-Center	Y-Center	Total Normal Stress	Effective Normal Stress	Shear Stress
1	23.50	742.58	618.3	155.1	80.2
2	24.90	740.65	781.8	198.2	102.5
3	26.39	738.79	940.2	240.8	124.6
4	28.25	736.54	1135.4	295.3	152.8
5	30.23	734.38	1338.6	364.1	180.9
6	31.87	732.63	1505.4	421.6	209.4
7	33.60	730.97	1664.9	477.4	237.2
8	36.60	728.22	1932.2	573.3	284.8
9	39.50	725.82	2169.6	660.6	328.1
10	42.80	723.34	2386.5	722.8	359.0
11	46.18	721.02	2540.3	732.2	363.7
12	48.39	719.63	2597.7	702.6	424.7
13	50.93	718.18	2663.9	678.6	410.2
14	54.85	716.14	2658.8	545.7	329.8
15	56.92	715.13	2644.2	468.1	282.9
16	59.04	714.23	2564.9	332.7	201.1
17	63.15	712.61	2640.5	307.2	185.7
18	67.35	711.21	2686.7	266.0	160.8
19	71.61	710.03	2702.0	207.7	125.6
20	75.93	709.07	2685.0	131.1	79.2
21	79.25	708.48	2651.7	60.6	36.6

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Fairfax -Jersey Creek Station 25+00
750 Mean strengths
1/252005 erosion scour 5 feet wall failed

TABLE NO. 59

```
*************************************************************************
* Final Results for Side Forces and Stresses Between Slices             *
* (Results are for the critical shear surface in the case of a search.) *
*************************************************************************
```

---------- VALUES AT RIGHT SIDE OF SLICE ----------

Slice No.	X-Right	Side Force	Y-Coord. of Side Force Location	Fraction of Height	Sigma at Top	Sigma at Bottom
1	24.79	1967	742.37	0.203	-196.4	697.0
2	25.00	2154	742.19	0.209	-199.5	733.2
3	27.79	4951	740.00	0.274	-165.5	1089.5
4	28.72	5989	739.28	0.285	-149.7	1189.1
5	31.74	9621	737.10	0.312	-86.7	1471.1
6	32.00	9950	736.92	0.314	-81.8	1494.1
7	35.20	14068	734.80	0.330	-15.1	1747.7
8	38.00	17743	733.08	0.340	41.4	1943.8
9	41.00	21629	731.38	0.348	101.3	2128.4
10	44.60	24740	728.87	0.372	310.2	2381.8
11	47.77	26576	726.70	0.389	511.4	2569.4
12	49.00	26952	725.89	0.396	603.5	2612.0
13	52.87	22234	721.89	0.428	1131.8	2847.4
14	56.84	12610	717.55	0.463	1895.4	2986.4
15	57.00	12119	717.37	0.465	1950.4	2978.6
16	61.07	11555	715.61	0.488	2320.4	2696.2
17	65.23	10295	713.88	0.503	2601.3	2498.2
18	69.46	8303	712.21	0.515	2823.6	2346.0
19	73.76	5566	710.61	0.524	2990.7	2230.3
20	78.10	2101	709.08	0.538	3226.0	2023.4
21	80.40	-0	708.30	1.000	0.0	0.0

Read end-of-file on input while looking for another command word.
End of input data assumed - normal termination.

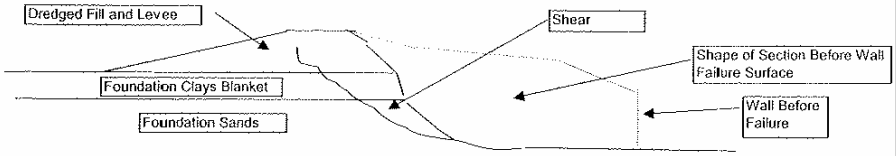
EXHIBIT A-8.26
Summary of Probability of Levee/I-Wall Global Stability Failure Using River Elevation 750 Feet

STABILITY ANALYSIS — Reliability

Fairfax Jersey Creek — KCMOKS — Sta 25+00

Designed By: Lochr 2/10/2005

Checked By: Berlen 2/17/05



Water for analysis Elev 750 feet
Levee and I-Wall Failure

Reliability Analysis of Critical Slide						
Run	ϕ' Levee Fill Pervious	ϕ' Blanket Clays, °	ϕ' Found Sand	Factor of Safety	Variance Component	Percent of Variance
1 Mean	30.00	29.0	34	0.954		
2 $+\sigma_d$	33.60	29.00	34.00	0.981	0.0007290	11.1107
3 $-\sigma_d$	26.40	29.00	34.00	0.927		
4 $+\sigma_d$	30.00	32.48	34.00	1.031	0.0057760	88.032
5 $-\sigma_d$	30.00	25.52	34.00	0.879		
6 $+\sigma_d$	30.00	29.00	38.06	0.933	0.0000563	0.8573
7 $-\sigma_d$	30.00	29.00	29.92	0.918		
				Total	0.0065612	100

E[FS] = 0.9540
Var[FS]= 0.00656
sigma[FS]: 0.08100
V(FS) = 0.0849

E[ln FS] = -0.05068 -0.05067
sigma [ln FS] = 0.084755

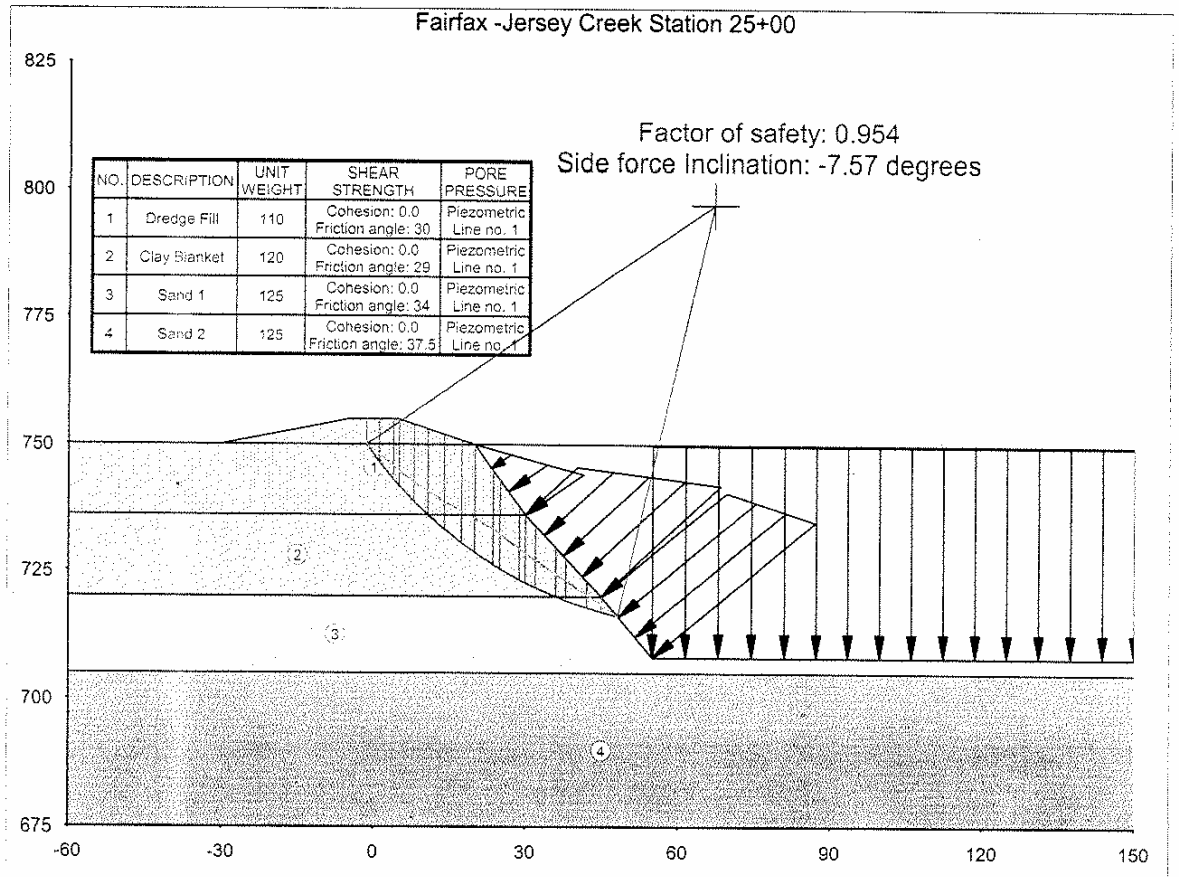
FS req'd = 1.000

ln(FS req'd) = 0.00000
-1.13694

Beta = -0.59800
F(z) = 0.72508
Pr(f) = 72.51
0.12778

Table 1 : Random Variables for Fairfax-Jersey Creek			
Parameter	Expected Value	Standard Deviation	Coefficient of Variation, %
Levee Fill Pervious ϕ'	30	3.600	12.00
Blanket ϕ' °	29	3.480	12.00
Foundation ϕ'	34	4.080	12.00

EXHIBIT A-8.27
Mean Value Analysis of Global Stability of Station 25+00 Levee/I-Wall With River Elevation 750 Feet



NO.	DESCRIPTION	UNIT WEIGHT	SHEAR STRENGTH	PORE PRESSURE
1	Dredge Fill	110	Cohesion: 0.0 Friction angle: 30	Piezometric Line no. 1
2	Clay Blanket	120	Cohesion: 0.0 Friction angle: 29	Piezometric Line no. 1
3	Sand 1	125	Cohesion: 0.0 Friction angle: 34	Piezometric Line no. 1
4	Sand 2	125	Cohesion: 0.0 Friction angle: 37.5	Piezometric Line no. 1

Filename: C:\Documents and Settings\g5epxsal\My Documents\KCMOKS\Fairfax-Jersey Creek\Sta 25+00 stability\Elev 750 Time: 11:14:26our 1.UT4

EXHIBIT A-8.28
Mean Value Analysis of Global Stability Levee/I-Wall
UTEXAS4 Output File

```
TABLE NO. 1
COMPUTER PROGRAM DESIGNATION: UTEXAS4
Originally Coded By Stephen G. Wright
Version No. 4.0.0.9 - Last Revision Date: 07/27/2001
(C) Copyright 1985-2000 S. G. Wright - All rights reserved
*****************************************************************
* RESULTS OF COMPUTATIONS PERFORMED USING THIS SOFTWARE         *
* SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY HAVE       *
* BEEN VERIFIED BY INDEPENDENT ANALYSES, EXPERIMENTAL DATA      *
* OR FIELD EXPERIENCE. THE USER SHOULD UNDERSTAND THE ALGORITHMS *
* AND ANALYTICAL PROCEDURES USED IN THIS SOFTWARE AND MUST HAVE *
* READ ALL DOCUMENTATION FOR THIS SOFTWARE BEFORE ATTEMPTING    *
* TO USE IT.  NEITHER SHINOAK SOFTWARE NOR STEPHEN G. WRIGHT    *
* MAKE OR ASSUME LIABILITY FOR ANY WARRANTIES, EXPRESSED OR     *
* IMPLIED, CONCERNING THE ACCURACY, RELIABILITY, USEFULNESS     *
* OR ADAPTABILITY OF THIS SOFTWARE.                             *
*****************************************************************
```

```
UTEXAS4 S/N:C0001  - Version: 4.0.0.9 - Latest Revision: 07/27/2001
Licensed for use by: Scott Loehr, U. S. Army Corps of Engineers
Time and date of run: Wed Jan 26 11:02:11 2005
Name of input data file: C:\Documents and Settings\g5epxsal\My Documents\KCMOKS\Fairfax-
Jersey Creek\Sta 25+00 stability\Elev 750 Prf\Levee\Alt scour 1.dat

    Fairfax -Jersey Creek Station 25+00
    750 Mean strengths
    1/26/2005 levee slide

TABLE NO. 3
*************************
* NEW PROFILE LINE DATA *
*************************

-------------------------------------------------------------
----- Profile Line No. 2 - Material Type (Number): 2 -----
-------------------------------------------------------------
Description: Clay Blanket

Point        X           Y

   1       -60.00      736.00
   2        25.00      736.00
   3        30.00      736.00
   4        45.00      720.00

-------------------------------------------------------------
----- Profile Line No. 1 - Material Type (Number): 1 -----
-------------------------------------------------------------
Description: Dredge Fill

Point        X           Y

   1       -60.00      750.00
   2       -30.00      750.00
   3        -5.00      755.00
   4         5.00      755.00
   5        20.00      750.00
   6        30.00      736.00

-------------------------------------------------------------
----- Profile Line No. 3 - Material Type (Number): 3 -----
-------------------------------------------------------------
Description: Sand 1

Point        X           Y

   1       -60.00      720.00
   2        32.00      720.00
   3        45.00      720.00
   4        55.00      708.00
   5       150.00      708.00

-------------------------------------------------------------
----- Profile Line No. 4 - Material Type (Number): 4 -----
-------------------------------------------------------------
Description: Sand 2

Point        X           Y

   1       -60.00      705.00
   2        38.00      705.00
   3       150.00      705.00
```

```
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Time and date of run: Wed Jan 26 11:02:11 2005
Name of input data file: C:\Documents and Settings\g5epxsal\My Documents\KCMOKS\Fairfax-
Jersey Creek\Sta 25+00 stability\Elev 750 Prf\Levee\Alt scour 1.dat

    Fairfax -Jersey Creek Station 25+00
    750 Mean strengths
    1/26/2005 levee slide

TABLE NO. 4
**********************************************************************
* NEW MATERIAL PROPERTY DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
**********************************************************************

----------------------------------------------------------------------
-------------------- DATA FOR MATERIAL NUMBER 1 --------------------
----------------------------------------------------------------------
Description: Dredge Fill

Unit weight of soil (material): 110.0

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - 0.0
Friction angle - - - - - 30.00 (degrees)

Pore water pressures are defined by a piezometric line.
Piezometric line number: 1
Negative pore water pressures are NOT allowed - set to zero.

----------------------------------------------------------------------
-------------------- DATA FOR MATERIAL NUMBER 2 --------------------
----------------------------------------------------------------------
Description: Clay Blanket

Unit weight of soil (material): 120.0

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - 0.0
Friction angle - - - - - 29.00 (degrees)

Pore water pressures are defined by a piezometric line.
Piezometric line number: 1
Negative pore water pressures are NOT allowed - set to zero.

----------------------------------------------------------------------
-------------------- DATA FOR MATERIAL NUMBER 3 --------------------
----------------------------------------------------------------------
Description: Sand 1

Unit weight of soil (material): 125.0

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - 0.0
Friction angle - - - - - 34.00 (degrees)

Pore water pressures are defined by a piezometric line.
Piezometric line number: 1
Negative pore water pressures are NOT allowed - set to zero.

----------------------------------------------------------------------
-------------------- DATA FOR MATERIAL NUMBER 4 --------------------
----------------------------------------------------------------------
Description: Sand 2

Unit weight of soil (material): 125.0

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - 0.0
Friction angle - - - - - 37.50 (degrees)
```

```
Pore water pressures are defined by a piezometric line.
Piezometric line number: 1
Negative pore water pressures are NOT allowed - set to zero.
```

```
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Time and date of run: Wed Jan 26 11:02:11 2005
Name of input data file: C:\Documents and Settings\g5epxsal\My Documents\KCMOKS\Fairfax-
Jersey Creek\Sta 25+00 stability\Elev 750 Prf\Levee\Alt scour 1.dat

    Fairfax -Jersey Creek Station 25+00
    750 Mean strengths
    1/26/2005 levee slide

TABLE NO. 6
*********************************************************************
* NEW PIEZOMETRIC LINE DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
*********************************************************************

-------------------------------------------------------------
--------------- Piezometric Line Number 1 ---------------
-------------------------------------------------------------
Description: Water at Intermediate River Stage 750
Unit weight of fluid (water): 62.4

Point        X            Y

  1       -60.00       750.00
  2        25.00       750.00
  3       150.00       750.00
```

```
UTEXAS4 S/N:C0001   Version: 4.0.0.9 - Latest Revision: 07/27/2001
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Time and date of run: Wed Jan 26 11:02:11 2005
Name of input data file: C:\Documents and Settings\g5epxsal\My Documents\KCMOKS\Fairfax-
Jersey Creek\Sta 25+00 stability\Elev 750 Prf\Levee\Alt scour 1.dat

    Fairfax -Jersey Creek Station 25+00
    750 Mean strengths
    1/26/2005 levee slide

TABLE NO. 10
***************************
* NEW SLOPE GEOMETRY DATA *
***************************

All slope data have been deleted ("cancelled") and will be re-generated.
```

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Name of input data file: C:\Documents and Settings\g5epxsal\My Documents\KCMOKS\Fairfax-Jersey Creek\Sta 25+00 stability\Elev 750 Prf\Levee\Alt scour 1.dat

Fairfax -Jersey Creek Station 25+00
750 Mean strengths
1/26/2005 levee slide

TABLE NO. 11
****
* NEW DISTRIBUTED LOAD DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
****

Point	X	Y	Normal Pressure	Shear Stress
1	20.00	750.00	0.0	0.0
2	30.00	736.00	874.0	0.0
3	45.00	720.00	1997.0	0.0
4	55.00	708.00	2604.0	0.0
5	81.00	708.00	2604.0	0.0
6	150.00	708.00	2604.0	0.0

```
UTEXAS4 S/N:C0001  - Version: 4.0.0.9 - Latest Revision: 07/27/2001
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Time and date of run: Wed Jan 26 11:02:11 2005
Name of input data file: C:\Documents and Settings\g5epxsal\My Documents\KCMOKS\Fairfax-
Jersey Creek\Sta 25+00 stability\Elev 750 Prf\Levee\Alt scour 1.dat

    Fairfax -Jersey Creek Station 25+00
    750 Mean strengths
    1/26/2005 levee slide

TABLE NO. 16
*********************************
* NEW ANALYSIS/COMPUTATION DATA *
*********************************

Center coordinates for center of circle -
                                        X: 67.00
                                        Y: 797.00
                                   Radius: 83.00
Conventional (single-stage) computations will be performed.
Automatic search output will be in short form.
Depth of crack: 5.000
Radii for each grid point will be sorted in the order of increasing radius.
Critical circles for grid points will be output in the order of increasing factor of
safety.
Search will be continued after the initial mode to find a most critical circle.
Procedure of Analysis: Spencer

--------------------------------------------------------------------------------
The following represent default values or values that were prevously defined:
Subtended angle for slice subdivision: 3.00(degrees)
There is no water in a crack.
Seismic coefficient: 0.000
Unit weight of water (or other fluid) in crack: 62.4
No restrictions exist on the lateral extent of the search.
No shear surfaces other than the most critical will be saved for display later.
Neither slope face was explicitly designated for analysis.
Standard sign convention used for direction of shear stress on shear surface.
Iteration limit: 100
Force imbalance: 1.000000e-005 (fraction of total weight)
Moment imbalance: 1.000000e-005 (fraction of moment due to total weight)
Minimum weight required for computations to be performed: 100
Initial trial factor of safety: 3.000
Initial trial side force inclination: 17.189 (degrees)
Minimum (most negative) side force inclination allowed in Spencer's procedure: -10.00
```

```
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Name of input data file: C:\Documents and Settings\g5epxsal\My Documents\KCMOKS\Fairfax-
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    Fairfax -Jersey Creek Station 25+00
    750 Mean strengths
    1/26/2005 levee slide

TABLE NO. 26
************************************
* NEW, COMPUTED SLOPE GEOMETRY DATA *
************************************

These slope geometry were generated from the Profile Lines.

     Point        X            Y

        1      -60.00       750.00
        2      -30.00       750.00
        3       -5.00       755.00
        4        5.00       755.00
        5       20.00       750.00
        6       25.00       743.00
        7       30.00       736.00
        8       32.00       733.87
        9       38.00       727.47
       10       45.00       720.00
       11       55.00       708.00
       12      150.00       708.00

UTEXAS WARNING NUMBER 4240
Possible artesian pressures detected at x = 55.00
from piezometric line number 1 (Stage 1).

UTEXAS WARNING NUMBER 4240
Possible artesian pressures detected at x = 81.00
from piezometric line number 1 (Stage 1).

UTEXAS WARNING NUMBER 4240
Possible artesian pressures detected at x = 150.00
from piezometric line number 1 (Stage 1).
```

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Fairfax -Jersey Creek Station 25+00
750 Mean strengths
1/26/2005 levee slide

TABLE NO. 43

```
************************************************************
* Coordinate, Weight, Strength and Pore Water Pressure     *
* Information for Individual Slices for Conventional       *
* Computations or First Stage of Multi-Stage Computations. *
* (Information is for the critical shear surface in the    *
* case of an automatic search.)                            *
************************************************************
```

Slice No.	X	Y	Slice Weight	Matl. No.	Cohesion	Friction Angle	Pore Pressure
	-1.41	750.00					
1	-0.13	748.24	1898	1	0.0	30.00	109.7
	1.14	746.48					
2	2.51	744.80	3069	1	0.0	30.00	324.8
	3.88	743.11					
3	4.44	742.46	1549	1	0.0	30.00	470.3
	5.00	741.82					
4	6.49	740.23	4667	1	0.0	30.00	609.4
	7.97	738.65					
5	9.34	737.32	4895	1	0.0	30.00	790.9
	10.72	736.00					
6	12.35	734.57	6514	2	0.0	29.00	962.9
	13.98	733.14					
7	15.69	731.79	7522	2	0.0	29.00	1136.0
	17.40	730.45					
8	18.70	729.52	6151	2	0.0	29.00	1277.9
	20.00	728.59					
9	21.82	727.41	8349	2	0.0	29.00	1409.8
	23.64	726.22					
10	24.32	725.82	2841	2	0.0	29.00	1509.0
	25.00	725.41					
11	26.90	724.36	7128	2	0.0	29.00	1599.9
	28.80	723.31					
12	29.40	723.01	1974	2	0.0	29.00	1684.4
	30.00	722.70					
13	31.00	722.22	3051	2	0.0	29.00	1733.4
	32.00	721.74					
14	33.99	720.88	5198	2	0.0	29.00	1817.3
	35.99	720.01					
15	36.00	720.01	34	2	0.0	29.00	1871.6
	36.02	720.00					
16	37.01	719.62	2125	3	0.0	34.00	1896.0
	38.00	719.23					
17	40.05	718.53	3359	3	0.0	34.00	1964.0
	42.11	717.82					
18	43.55	717.39	1476	3	0.0	34.00	2034.6
	45.00	716.97					
19	46.60	716.56	607	3	0.0	34.00	2086.5
	48.20	716.16					

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Fairfax -Jersey Creek Station 25+00
750 Mean strengths
1/26/2005 levee slide

TABLE NO. 44

```
*********************************************************
* Seismic Forces and Forces Due to Distributed Loads for *
* Individual Slices for Conventional Computations or the *
* First Stage of Multi-Stage Computations.               *
* (Information is for the critical shear surface in the  *
* case of an automatic search.)                          *
*********************************************************
```

				FORCES DUE TO DISTRIBUTED LOADS			
Slices No.	X	Seismic Force	Y for Seismic Force	Normal Force	Shear Force	X	Y
1	-0.13	0	751.62	0	0	-0.13	748.24
2	2.51	0	749.90	0	0	2.51	744.80
3	4.44	0	748.73	0	0	4.44	742.46
4	6.49	0	747.37	0	0	6.49	740.23
5	9.34	0	745.44	0	0	9.34	737.32
6	12.35	0	743.50	0	0	12.35	734.57
7	15.69	0	741.47	0	0	15.69	731.79
8	18.70	0	739.78	0	0	18.70	729.52
9	21.82	0	737.21	999	0	22.43	746.60
10	24.32	0	734.69	881	0	24.36	743.90
11	26.90	0	732.21	3948	0	27.08	740.09
12	29.40	0	729.89	1691	0	29.41	736.82
13	31.00	0	728.58	2775	0	31.03	734.91
14	33.99	0	726.31	6837	0	34.08	731.65
15	36.00	0	724.80	57	0	36.00	729.60
16	37.01	0	724.06	4057	0	37.03	728.51
17	40.05	0	721.88	9775	0	40.12	725.21
18	43.55	0	719.45	7982	0	43.58	721.51
19	46.60	0	717.32	10478	0	46.63	718.05

```
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Jersey Creek\Sta 25+00 stability\Elev 750 Prf\Levee\Alt scour 1.dat

    Fairfax -Jersey Creek Station 25+00
    750 Mean strengths
    1/26/2005 levee slide

TABLE NO. 47
*************************************************************
*  Information for the Iterative Solution for the Factor of  *
*  Safety and Side Force Inclination by Spencer's Procedure  *
*************************************************************
Allowable force imbalance for convergence:  7.2405e-001
Allowable moment imbalance for convergence: 15

        Trial      Trial
       Factor    Side Force      Force       Moment                  Delta
Iter-    of     Inclination    Imbalance   Imbalance    Delta-F      Theta
ation  Safety    (degrees)      (lbs.)     (ft.-lbs.)               (degrees)

   1   3.00000    -17.1887   -1.247e+004   8.646e+006
First-order corrections to F and Theta ............   -5.2062      2.0934
Reduced values - Deltas were too large ............   -0.5000      0.2010

   2   2.50000    -16.9877   -1.104e+004   7.650e+006
First-order corrections to F and Theta ............   -3.2758      2.2542
Reduced values - Deltas were too large ............   -0.5000      0.3441

   3   2.00000    -16.6436   -8.943e+003   6.192e+006
First-order corrections to F and Theta ............   -1.7681      2.5468
Reduced values - Deltas were too large ............   -0.5000      0.7202

   4   1.50000    -15.9234   -5.608e+003   3.865e+006
First-order corrections to F and Theta ............   -0.6869      3.2337
Reduced values - Deltas were too large ............   -0.5000      2.3537

   5   1.00000    -13.5698    3.584e+002  -3.233e+005
First-order corrections to F and Theta ............   -0.0532      6.2619
Reduced values - Deltas were too large ............   -0.0243      2.8648

   6   0.97568    -10.7050    2.109e+002  -1.865e+005
First-order corrections to F and Theta ............   -0.0236      3.1916
Reduced values - Deltas were too large ............   -0.0212      2.8648

   7   0.95446     -7.8402    3.548e+001  -2.865e+004
First-order corrections to F and Theta ............   -0.0009      0.2706
Second-order corrections to F and Theta ...........   -0.0009      0.2697

   8   0.95354     -7.5705   -7.938e-004   2.808e-001
First-order corrections to F and Theta ............   -0.0000      0.0000
```

```
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Name of input data file: C:\Documents and Settings\g5epxsal\My Documents\KCMOKS\Fairfax-
Jersey Creek\Sta 25+00 stability\Elev 750 Prf\Levee\Alt scour 1.dat

    Fairfax -Jersey Creek Station 25+00
    750 Mean strengths
    1/26/2005 levee slide

TABLE NO. 55
*********************************************************************
* Check of Computations by Spencer's Procedure (Results are for the *
* critical shear surface in the case of an automatic search.)       *
*********************************************************************

Summation of Horizontal Forces: 1.06795e-011

Summation of Vertical Forces: 9.86233e-012

Summation of Moments: 1.43703e-006

Mohr Coulomb Shear Force/Shear Strength Check Summation: 8.98837e-012

***** CAUTION ***** Some of the Forces Between Slices Act at Points
Above the Surface of the Slope or Below the Shear Surface -
Either a Tension Crack may be Needed or the SOLUTION MAY NOT
BE A VALID SOLUTION
```

UTEXAS4 S/N:C0001 - Version: 4.0.0.9 - Latest Revision: 07/27/2001
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Time and date of run: Wed Jan 26 11:02:11 2005
Name of input data file: C:\Documents and Settings\g5epxsal\My Documents\KCMOKS\Fairfax-Jersey Creek\Sta 25+00 stability\Elev 750 Prf\Levee\Alt scour 1.dat

Fairfax -Jersey Creek Station 25+00
750 Mean strengths
1/26/2005 levee slide

TABLE NO. 58
****
* Final Results for Stresses Along the Shear Surface *
* (Results are for the critical shear surface in the case of a search.) *
****

SPENCER'S PROCEDURE USED TO COMPUTE THE FACTOR OF SAFETY
Factor of Safety: 0.954 Side Force Inclination: -7.57

-------- VALUES AT CENTER OF BASE OF SLICE --------

Slice No.	X-Center	Y-Center	Total Normal Stress	Effective Normal Stress	Shear Stress
1	-0.13	748.24	426.6	316.9	191.9
2	2.51	744.80	731.2	406.4	246.1
3	4.44	742.46	944.2	473.8	286.9
4	6.49	740.23	1121.5	512.1	310.1
5	9.34	737.32	1337.5	546.6	330.9
6	12.35	734.57	1555.5	592.6	344.5
7	15.69	731.79	1774.4	638.4	371.1
8	18.70	729.52	1951.4	673.5	391.5
9	21.82	727.41	2093.6	683.8	397.5
10	24.32	725.82	2186.4	677.4	393.8
11	26.90	724.36	2262.0	662.1	384.9
12	29.40	723.01	2328.2	643.8	374.3
13	31.00	722.22	2336.9	603.6	350.9
14	33.99	720.88	2402.3	585.0	340.0
15	36.00	720.01	2441.9	570.3	331.5
16	37.01	719.62	2443.5	547.5	387.3
17	40.05	718.53	2483.9	519.9	367.8
18	43.55	717.39	2514.0	479.4	339.1
19	46.60	716.56	2498.3	411.8	291.3

UTEXAS4 S/N:C0001 - Version: 4.0.0.9 - Latest Revision: 07/27/2001
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Time and date of run: Wed Jan 26 11:02:11 2005
Name of input data file: C:\Documents and Settings\g5epxsal\My Documents\KCMOKS\Fairfax-Jersey Creek\Sta 25+00 stability\Elev 750 Prf\Levee\Alt scour 1.dat

Fairfax -Jersey Creek Station 25+00
750 Mean strengths
1/26/2005 levee slide

TABLE NO. 59

```
***************************************************************************
* Final Results for Side Forces and Stresses Between Slices               *
* (Results are for the critical shear surface in the case of a search.) *
***************************************************************************
```

---------- VALUES AT RIGHT SIDE OF SLICE ----------

Slice No.	X-Right	Side Force	Y-Coord. of Side Force Location	Fraction of Height	Sigma at Top	Sigma at Bottom
1	1.14	1019	748.07	0.187	-104.5	341.7
2	3.88	2831	745.73	0.220	-160.0	631.9
3	5.00	3733	744.81	0.227	-179.5	741.0
4	7.97	6389	742.59	0.257	-189.4	1014.0
5	10.72	9048	740.73	0.277	-177.6	1226.9
6	13.98	12403	738.69	0.294	-152.6	1455.9
7	17.40	15935	736.76	0.309	-113.1	1660.5
8	20.00	18572	735.41	0.319	-76.3	1796.0
9	23.64	21287	733.21	0.374	277.7	1982.4
10	25.00	21818	732.26	0.389	412.2	2047.1
11	28.80	21892	729.41	0.425	830.6	2191.2
12	30.00	21480	728.49	0.435	975.4	2227.3
13	32.00	21000	727.13	0.444	1143.5	2289.8
14	35.99	18789	724.44	0.461	1486.5	2392.8
15	36.02	18767	724.42	0.461	1488.8	2393.8
16	38.00	16901	723.10	0.470	1670.6	2398.1
17	42.11	11718	720.40	0.490	2071.2	2343.1
18	45.00	7014	718.47	0.496	2236.3	2351.2
19	48.20	-0	716.16	1.000	0.0	0.0

Read end-of-file on input while looking for another command word.
End of input data assumed - normal termination.

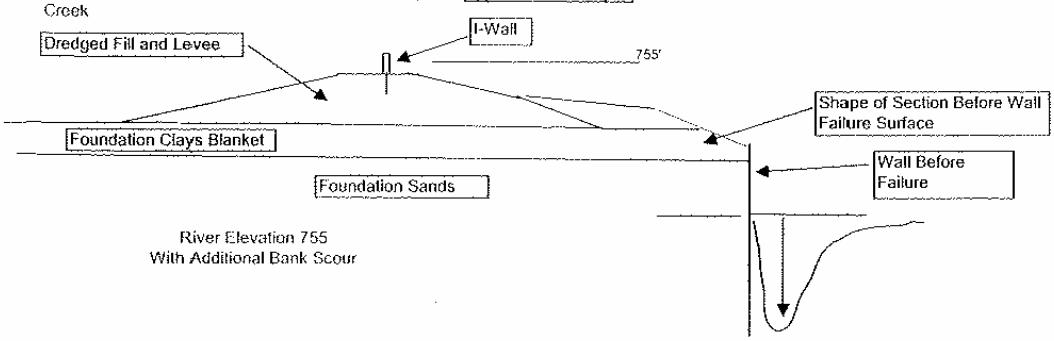
EXHIBIT A-8.29
Summary of Probability of Flood Protection Failure for Station 25+00 for River Elevation 755 Feet

STABILITY ANALYSIS — Reliability

Fairfax Jersey Creek — KCMOKS Sta 25+00

Designed By: Loehr 2/10/2005

Checked By: Perlea 2/17/05



Probability that the Levee will fail is determine based on a parallel system for this reach. In a parallel system the system will only perform unsatisfactorily if all components perform unsatisfactorily.
Reliability = 1- p1*p2*p3

Reliability of the levee section is a function of the wall failure, and bank failure.

A parallel relationship exists for the Station 25+00 reach.

1) The Missouri river velocities create scour at the bed near the wall

2) The wall will fail if scouring at the toe removes materials below the existing bed. (p1)

3) If the wall fails, then part of the bank behind the wall will scour causing a foreshore slide. (p2)

4) After the foreshore slide and is scoured away by the flood event, airger foreshore and levee slide can occur. (p3)
The reliability of the reach from Station 22+30 to 30+00 is determined below

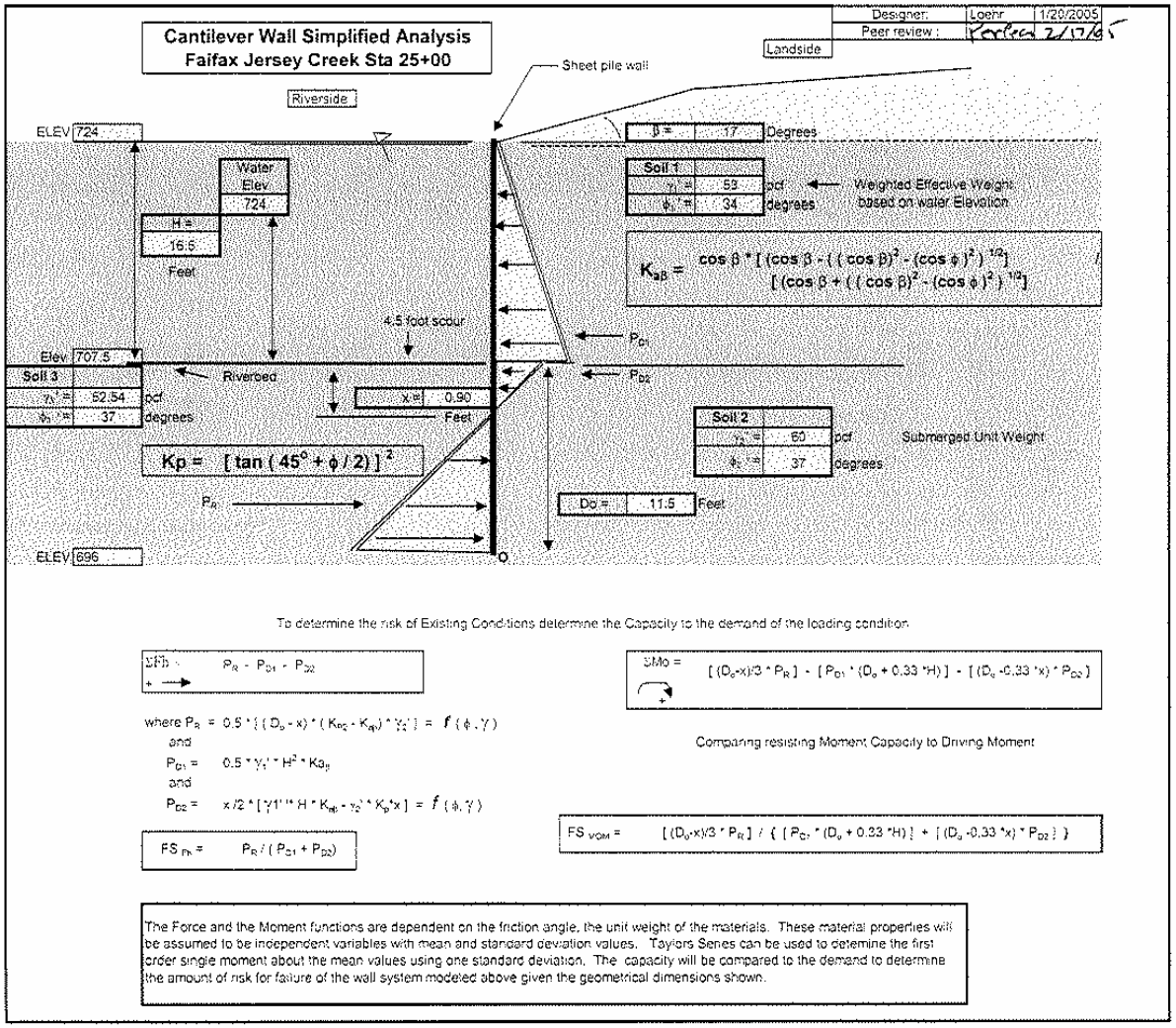
	Event	Prob of Failure	
(p1)	Scour potential	1	4.5' Scour
(p2)	Wall failure (p1) =	0.5700	
(p3)	Foreshore slide (p2)=	0.8500	Loss of bank - progressive erosion/slouging
(p4)	Levee Slide (p3) =	0.8155	When this happens Fairfax gets wet
	Reliability of reach =	1-p1*p2*p3	

0.5700 * 0.8500 * 0.8155 = 0.6049

or

Reliability = 1 - 0.6049 = 39.51%

EXHIBIT A-8.30
Simple Cantilever Wall Model for River Elevation 755 Feet



To determine the risk of Existing Conditions determine the Capacity to the demand of the loading condition

ΣFh + → $P_R - P_{D1} - P_{D2}$

ΣMo = $[(D_o - x)/3 * P_R] - [P_{D1} * (D_o + 0.33 * H)] - [(D_o - 0.33 * x) * P_{D2}]$

where $P_R = 0.5 * [(D_o - x) * (K_{pc} - K_{aβ}) * \gamma_3'] = f (\phi , \gamma)$

and

$P_{D1} = 0.5 * \gamma_1' * H^2 * Ka_\beta$

and

$P_{D2} = x / 2 * [\gamma 1' * H * K_{aβ} - \gamma_2' * K_p * x] = f (\phi , \gamma)$

Comparing resisting Moment Capacity to Driving Moment

$FS_{Fh} = P_R / (P_{D1} + P_{D2})$

$FS_{VOM} = [(D_o - x)/3 * P_R] / { [P_{D1} * (D_o + 0.33 * H)] + [(D_o - 0.33 * x) * P_{D2}] }$

The Force and the Moment functions are dependent on the friction angle, the unit weight of the materials. These material properties will be assumed to be independent variables with mean and standard deviation values. Taylors Series can be used to determine the first order single moment about the mean values using one standard deviation. The capacity will be compared to the demand to determine the amount of risk for failure of the wall system modeled above given the geometrical dimensions shown.

EXHIBIT A-8.30 (Continued)

Summary of the Forces - Fairfax Jersey Creek Sta 23+00 Sheet Pile Wall

4 - 5 foot scour

Designer:	Loehr	1/20/2005
Peer review:	Pedca	2/17/05

$FS_{Fh} = P_R / (P_{D1} + P_{D2})$

where $P_R = 0.5 * [(D_o - x)^2 * (K_{P\beta} - K_{a\beta}) * \gamma_2'] = f(\phi, \gamma)$

$P_{D1} = 0.5 * \gamma_1' * H^2 * Ka_1$

$P_{D2} = x/2 * [\gamma_1' * H * K_{a\beta} - \gamma_2' * K_p * x] = f(\phi, \gamma)$

$K_{a\beta} = \cos\beta * [(\cos\beta - ((\cos\beta)^2 - (\cos\phi)^2)^{1/2}) / (\cos\beta + ((\cos\beta)^2 - (\cos\phi)^2)^{1/2})]$

$Kp = [\tan(45° + \phi_1 / 2)]^2$

	Factored Driving Forces Earth Loads =	1.0	At rest case
	Factored Resisting Forces Earth Loads =	1.0	Full Passive Case

			(1)	(2)	(3)	(4)	(5)	(6)	$K_{a\beta}$ (7)	(8)	(9)	(10)	(11)	Kp (12)
Parameters :	phi	β	cos β	cos φ	$[(1)^2-(2)^2]^{0.5}$	(1)-(3)	(1)+(3)	(4)/(5)	(1)*(6)	γ_1'	γ_2'	ϕ_1	tan	$(11)^2$
Calcs :	34	17	0.956	0.829	0.477	0.480	1.433	0.335	0.320	52.6	52.54	37	2.006	4.02

Independent Variables	ϕ_1'	ϕ_2'	γ_1'	γ_2'	$K_{a\beta}$	Kp	H	D_o	x	P_R	P_{D1}	P_{D2}	FS_{Fh}
Mean	**34**	**37**	**52.6**	**60**	**0.32**	**4.02**	**16.5**	**11.5**	**0.90**	**10929**	**2292**	**27**	**4.71**
$\phi_1' + \sigma_d$	38.1	37	52.6	60	**0.26**	**4.02**	16.5	11.5	0.90	11096	1887	5	5.88
$\phi_1' - \sigma_d$	29.9	37	52.6	60	**0.39**	**4.02**	16.5	11.5	0.90	10728	2779	54	3.79
$\phi_2' + \sigma_d$	34	41.4	52.6	60	**0.32**	**4.91**	16.5	11.5	0.90	13560	2292	6	5.90
$\phi_2' - \sigma_d$	34	32.6	52.6	60	**0.32**	**3.33**	16.5	11.5	0.90	8886	2292	44	3.80
$\gamma_1' + \sigma_d$	34	37	54.2	60	**0.32**	**4.02**	16.5	11.5	0.90	10929	2360	31	4.57
$\gamma_1' - \sigma_d$	34	37	51.0	60	**0.32**	**4.02**	16.5	11.5	0.90	10929	2223	23	4.87
$\gamma_2' + \sigma_d$	34	37	52.6	61.8	**0.32**	**4.02**	16.5	11.5	0.90	10929	2292	24	4.72
$\gamma_2' - \sigma_d$	34	37	52.6	58.2	**0.32**	**4.02**	16.5	11.5	0.90	10929	2292	30	4.71

EXHIBIT A-8.30 (Continued)

Summary of the Reliability - Fairfax Jersey Creek Sta 23+00 Sheet Pile Wall

4.5 foot scour

Designer:	Loehr	1/20/2005
Peer review :	[illegible]	2/10/05

Reliability Analysis of Existing Cantilver Sheet Pile Wall

Run	ϕ_1 Pervious	ϕ_2 Pervious	γ_1' Backfill	γ_2' Backfill	FS	Variance Component	Percent of Variance
Mean	34.0	37.0	52.6	60.0	4.71		
$\phi_1' + \sigma_\phi$	38.1	37.0	52.6	60.0	5.56	1.0785752	49.0018
$\phi_1' - \sigma_\phi$	29.9	37.0	52.6	60.0	3.79		
$\phi_2' + \sigma_\phi$	34.0	41.4	52.6	60.0	5.90	1.1007636	50.010
$\phi_2' - \sigma_\phi$	34.0	32.6	52.6	60.0	3.60		
$\gamma_1' + \sigma_\phi$	34.0	37.0	54.2	60.0	4.57	0.0217546	0.9884
$\gamma_1' - \sigma_\phi$	34.0	37.0	51.0	60.0	4.87		
$\gamma_2' + \sigma_\phi$	34.0	37.0	52.6	61.8	4.72	0.0000355	0.0016
$\gamma_2' - \sigma_\phi$	34.0	37.0	52.6	58.2	4.71		
				Total		2.2010934	100

E[FS] =	4.7130	E[ln FS] =	1.50308	1.5051784	
Var[FS]=	2.20100				
sigma[FS]=	1.48361	sigma [ln FS] =	0.307384		
V(FS) =	0.3146				
FS req'd =	1.000	ln(FS req'd) =	0.00000		

Beta =	4.889912
F(z) =	0.00000
Pr(f) =	0.0001

Reliability = 99.9999 percent

Table 1 : Random Variables for Fairfax Jersey Creek

Parameter	Expected Value	Standard Deviation	Coefficient of Variation, %
ϕ_1'	34.0	4.08	12.00
ϕ_2'	37.0	4.44	12.00
$\gamma 1'$	52.6	1.58	3.00
$\gamma 2'$	60.0	1.80	3.00

EXHIBIT A-8.30 (Continued)

Summary of Wall Moment FFJC Sta 25+00

Factored Driving Forces earth Loads = 1.0 Active Case

Factored Resisting Forces earth Loads = 1.0 Full Passive case

$FS_{MOM} = [(D_o - x)/3 * P_R] / \{ [P_{D1} * (D_o + 0.33 * H)] + [(D_o - 0.33 * x) * P_{D2}] \}$

4.5 foot scour

Designer:	Loehr	1/20/2005
Peer review :	Berlea	2/17/05

Independent Variables →

Mean	ϕ_1'	ϕ_2'	γ_1'	γ_2'	$K_{a\beta}$	Kp	H	D_o	x	P_R	P_{D1}	P_{D2}	FS_{MOM}
	34	**37**	**53**	**60**	**0.32**	**4.02**	**16.5**	**11.5**	**0.90**	**10929**	**2292**	**27**	**0.99**
$\phi_1' + \sigma_d$	38.1	37	52.6	60	0.26	4.02	16.5	11.5	0.90	11096	1887	5	**1.22**
$\phi_1' - \sigma_d$	29.9	37	52.6	60	0.39	4.02	16.5	11.5	0.90	10728	2779	54	**0.79**
$\phi_2' + \sigma_d$	34	41.4	52.6	60	0.32	4.91	16.5	11.5	0.90	13560	2292	6	**1.23**
$\phi_2' - \sigma_d$	34	32.6	52.6	60	0.32	3.33	16.5	11.5	0.90	8886	2292	44	**0.80**
$\gamma_1' + \sigma_d$	34	37	54.2	60	0.32	4.02	16.5	11.5	0.90	10929	2360	31	**0.96**
$\gamma_1' - \sigma_d$	34	37	51.0	60	0.32	4.02	16.5	11.5	0.90	10929	2223	23	**1.02**
$\gamma_2' + \sigma_d$	34	37	52.6	61.8	0.32	4.02	16.5	11.5	0.90	10929	2292	24	**0.99**
$\gamma_2' - \sigma_d$	34	37	52.6	58.2	0.32	4.02	16.5	11.5	0.90	10929	2292	30	**0.99**

$P_R = 0.5 * [(D_o - x)^2 * (K_{P2} - K_{a\beta}) * \gamma_2'] = f(\phi, \gamma)$

$P_{D1} = 0.5 * \gamma_1' * H^2 * Ka_\beta$

$P_{D2} = x/2 * [\gamma 1' * H * K_{a\beta} - \gamma_2' * K_p * x] = f(\phi, \gamma)$

EXHIBIT A-8.30 (Continued)

Summary of Wall Reliability FFJC Sta 25+00

Designer:	Loehr	1/20/2005
Peer review :	Perlea	2/17/05

4.5 foot scour

Reliability Analysis of Existing Cantilver Sheet Pile Wall						Variance Component	Percent of Variance
Run	ϕ_1	ϕ_2	γ_1'	γ_2'	FS_{MOM}		
Mean	34.0	37.0	52.6	60.0	0.99		
$\phi_1' + \sigma_d$	38.1	37.0	52.6	60.0	1.22	0.0460374	49.0096
$\phi_1' - \sigma_d$	29.9	37.0	52.6	60.0	0.79		
$\phi_2' + \sigma_d$	34.0	41.4	52.6	60.0	1.23	0.0469704	50.003
$\phi_2' - \sigma_d$	34.0	32.6	52.6	60.0	0.80		
$\gamma_1' + \sigma_d$	34.0	37.0	54.2	60.0	0.96	0.0009277	0.9875
$\gamma_1' - \sigma_d$	34.0	37.0	51.0	60.0	1.02		
$\gamma_2' + \sigma_d$	34.0	37.0	52.6	61.8	0.99	0.0000007	0.0007
$\gamma_2' - \sigma_d$	34.0	37.0	52.6	58.2	0.99		
					Total	0.0939355	100

Table 1 : Random Variables for Fairfax Jersey Creek			
Parameter	Expected Value	Standard Deviation	Coefficient of Variation, %
ϕ_1'	34.0	4.08	12.00
ϕ_2'	37.0	4.44	12.00
$\gamma 1'$	52.6	1.58	3.00
$\gamma 2'$	60.0	1.80	3.00

E[FS] =	0.9867	E[ln FS] =	-0.05947 -0.057473
Var[FS]=	0.09394		
sigma[FS]=	0.30649	sigma [ln FS] =	0.303503
V(FS) =	0.3106		
FS req'd =	1.000	ln(FS req'd) =	0.00000

Beta = -0.195954
F(z) = 0.57768
Pr(f) = 57.7677

Reliability = 42.232 percent

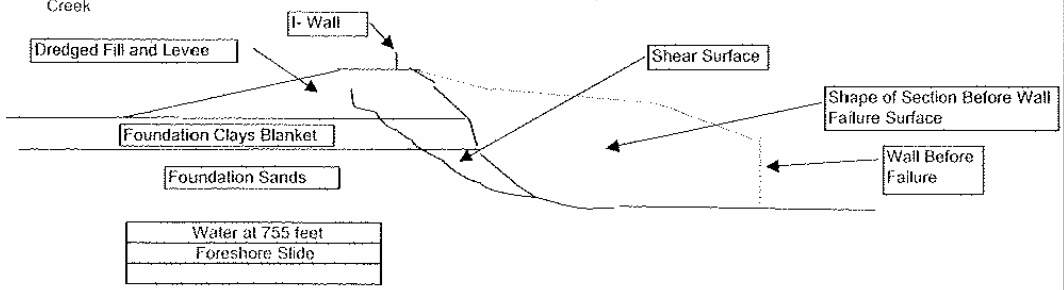
EXHIBIT A-8.31
Summary of Probability of Foreshore Global Stability Failure Using River Elevation 755 Feet

STABILITY ANALYSIS — Reliability

Fairfax Jersey Creek — KCMOKS Sta 25+00

Designed By: Loehr 1/26/2005

Checked By: Rerlen 2/17/05



Reliability Analysis of Critical Slide					Variance Component	Percent of Variance
Run	ϕ' Levee Fill Pervious	ϕ', Blanket Clays, °	ϕ' Found Sand	Factor of Safety		
1 Mean	30.00	29.0	34	**0.903**		
2 $+\sigma_\phi$	33.60	29.00	34.00	**0.915**	0.0001440	1.6783
3 $-\sigma_\phi$	26.40	29.00	34.00	**0.891**		
4 $+\sigma_\phi$	30.00	32.48	34.00	**0.989**	0.0071403	83.217
5 $-\sigma_\phi$	30.00	25.52	34.00	**0.820**		
6 $+\sigma_\phi$	30.00	29.00	38.08	**0.940**	0.0012960	15.1045
7 $-\sigma_\phi$	30.00	29.00	29.92	**0.868**		
				Total	0.0085803	100

E[FS] = 0.9030
Var[FS]= 0.00858
sigma[FS]: 0.09263
V(FS) = 0.1026

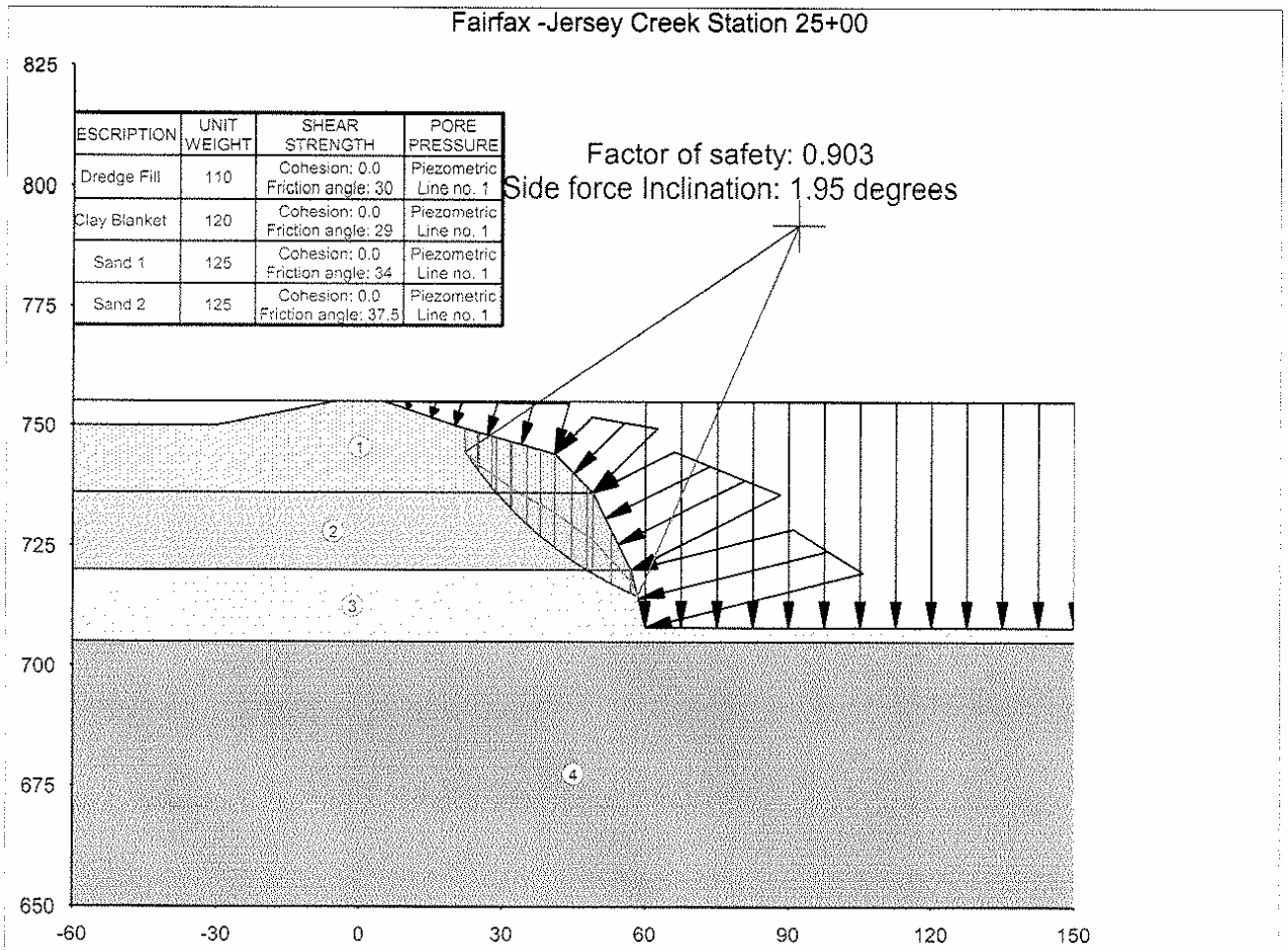
FS req'd = 1.000

E[ln FS] = -0.10727 -0.107239
sigma [ln FS] = 0.102312
ln(FS req'd) = 0.00000
-1.13694

Beta = -1.04843
F(z) = 0.85278
Pr(f) = 85.28
0.12778

Table 1 : Random Variables for Fairfax-Jersey Creek			
Parameter	Expected Value	Standard Deviation	Coefficient of Variation, %
Levee Fill Pervious ϕ'	30	3.600	12.00
Blanket ϕ'	29	3.480	12.00
Foundation ϕ'	34	4.080	12.00

EXHIBIT A-8.32
Mean Value Analysis of Global Stability of Station 25+00 Foreshore
With River Elevation 755 Feet



ESCRIPTION	UNIT WEIGHT	SHEAR STRENGTH	PORE PRESSURE
Dredge Fill	110	Cohesion: 0.0 Friction angle: 30	Piezometric Line no. 1
Clay Blanket	120	Cohesion: 0.0 Friction angle: 29	Piezometric Line no. 1
Sand 1	125	Cohesion: 0.0 Friction angle: 34	Piezometric Line no. 1
Sand 2	125	Cohesion: 0.0 Friction angle: 37.5	Piezometric Line no. 1

Filename: C:\Documents and Settings\g5epxsal\My Documents\KCMOKS\Fairfax-Jersey Creek\Sta 25+00 stability\Elev 755\Time: 13:33:51our 1.UT4

EXHIBIT A-8.33
Mean Value Analysis of Global Stability Foreshore
UTEXAS4 Output File

```
TABLE NO. 1
COMPUTER PROGRAM DESIGNATION: UTEXAS4
Originally Coded By Stephen G. Wright
Version No. 4.0.0.9 - Last Revision Date: 07/27/2001
(C) Copyright 1985-2000 S. G. Wright - All rights reserved
*****************************************************************
* RESULTS OF COMPUTATIONS PERFORMED USING THIS SOFTWARE         *
* SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY HAVE       *
* BEEN VERIFIED BY INDEPENDENT ANALYSES, EXPERIMENTAL DATA      *
* OR FIELD EXPERIENCE. THE USER SHOULD UNDERSTAND THE ALGORITHMS *
* AND ANALYTICAL PROCEDURES USED IN THIS SOFTWARE AND MUST HAVE *
* READ ALL DOCUMENTATION FOR THIS SOFTWARE BEFORE ATTEMPTING    *
* TO USE IT.  NEITHER SHINOAK SOFTWARE NOR STEPHEN G. WRIGHT    *
* MAKE OR ASSUME LIABILITY FOR ANY WARRANTIES, EXPRESSED OR     *
* IMPLIED, CONCERNING THE ACCURACY, RELIABILITY, USEFULNESS     *
* OR ADAPTABILITY OF THIS SOFTWARE.                             *
*****************************************************************
```

```
UTEXAS4 S/N:C0001  - Version: 4.0.0.9 - Latest Revision: 07/27/2001
Licensed for use by: Scott Loehr, U. S. Army Corps of Engineers
Time and date of run: Wed Jan 26 11:46:49 2005
Name of input data file: C:\Documents and Settings\g5epxsal\My Documents\KCMOKS\Fairfax-
Jersey Creek\Sta 25+00 stability\Elev 755\Foreshore\Alt scour 1.dat

    Fairfax -Jersey Creek Station 25+00
    750 Mean strengths
    1/252005 erosion scour ~~5~~ 3.5 feet wall failed

TABLE NO. 3
*************************
* NEW PROFILE LINE DATA *
*************************

-------------------------------------------------------------
----- Profile Line No. 2 - Material Type (Number): 2 -----
-------------------------------------------------------------
Description: Clay Blanket

Point        X           Y

   1       -60.00      736.00
   2        25.00      736.00
   3        49.00      736.00
   4        57.00      720.00

-------------------------------------------------------------
----- Profile Line No. 1 - Material Type (Number): 1 -----
-------------------------------------------------------------
Description: Dredge Fill

Point        X           Y

   1       -60.00      750.00
   2       -30.00      750.00
   3        -5.00      755.00
   4         5.00      755.00
   5        20.00      750.00
   6        41.00      744.00
   7        49.00      736.00

-------------------------------------------------------------
----- Profile Line No. 3 - Material Type (Number): 3 -----
-------------------------------------------------------------
Description: Sand 1

Point        X           Y

   1       -60.00      720.00
   2        32.00      720.00
   3        57.00      720.00
   4        60.00      708.00
   5       150.00      708.00

-------------------------------------------------------------
----- Profile Line No. 4 - Material Type (Number): 4 -----
-------------------------------------------------------------
Description: Sand 2

Point        X           Y

   1       -60.00      705.00
   2        38.00      705.00
   3       150.00      705.00
```

```
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Jersey Creek\Sta 25+00 stability\Elev 755\Foreshore\Alt scour 1.dat

    Fairfax -Jersey Creek Station 25+00
    750 Mean strengths
    1/252005 erosion scour ~~6~~ 3.5 feet wall failed

TABLE NO. 4
**********************************************************************
* NEW MATERIAL PROPERTY DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
**********************************************************************

----------------------------------------------------------------------
------------------- DATA FOR MATERIAL NUMBER 1 -------------------
----------------------------------------------------------------------
Description: Dredge Fill

Unit weight of soil (material): 110.0

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - 0.0
Friction angle - - - - - 30.00 (degrees)

Pore water pressures are defined by a piezometric line.
Piezometric line number: 1
Negative pore water pressures are NOT allowed - set to zero.

----------------------------------------------------------------------
------------------- DATA FOR MATERIAL NUMBER 2 -------------------
----------------------------------------------------------------------
Description: Clay Blanket

Unit weight of soil (material): 120.0

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - 0.0
Friction angle - - - - - 29.00 (degrees)

Pore water pressures are defined by a piezometric line.
Piezometric line number: 1
Negative pore water pressures are NOT allowed - set to zero.

----------------------------------------------------------------------
------------------- DATA FOR MATERIAL NUMBER 3 -------------------
----------------------------------------------------------------------
Description: Sand 1

Unit weight of soil (material): 125.0

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - 0.0
Friction angle - - - - - 34.00 (degrees)

Pore water pressures are defined by a piezometric line.
Piezometric line number: 1
Negative pore water pressures are NOT allowed - set to zero.

----------------------------------------------------------------------
------------------- DATA FOR MATERIAL NUMBER 4 -------------------
----------------------------------------------------------------------
Description: Sand 2

Unit weight of soil (material): 125.0

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - 0.0
Friction angle - - - - - 37.50 (degrees)
```

```
Pore water pressures are defined by a piezometric line.
Piezometric line number: 1
Negative pore water pressures are NOT allowed - set to zero.
```

```
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    Fairfax -Jersey Creek Station 25+00
    750 Mean strengths
    1/252005 erosion scour ~~4~~ feet wall failed
                            3.5
TABLE NO. 6
*********************************************************************
* NEW PIEZOMETRIC LINE DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
*********************************************************************

-------------------------------------------------------------
--------------- Piezometric Line Number 1 ---------------
-------------------------------------------------------------
Description: Water at Intermediate River Stage 755
Unit weight of fluid (water): 62.4

Point        X            Y

  1       -60.00       755.00
  2        25.00       755.00
  3       150.00       755.00
```

```
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Jersey Creek\Sta 25+00 stability\Elev 755\Foreshore\Alt scour 1.dat

    Fairfax -Jersey Creek Station 25+00
    750 Mean strengths
    1/252005 erosion scour ~~6~~ 3.5 feet wall failed

TABLE NO. 10
***************************
* NEW SLOPE GEOMETRY DATA *
***************************

All slope data have been deleted ("cancelled") and will be re-generated.
```

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Fairfax -Jersey Creek Station 25+00
750 Mean strengths
1/252005 erosion scour ~~8~~ 3.5 feet wall failed

TABLE NO. 11

****
* NEW DISTRIBUTED LOAD DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
****

Point	X	Y	Normal Pressure	Shear Stress
1	5.00	755.00	0.0	0.0
2	20.00	750.00	312.0	0.0
3	41.00	744.00	687.0	0.0
4	49.00	736.00	1186.0	0.0
5	57.00	720.00	2184.0	0.0
6	60.00	708.00	2932.0	0.0
7	150.00	708.00	2932.0	0.0

```
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Name of input data file: C:\Documents and Settings\g5epxsal\My Documents\KCMOKS\Fairfax-
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    Fairfax -Jersey Creek Station 25+00
    750 Mean strengths
    1/252005 erosion scour 3.5 feet wall failed

TABLE NO. 16
*********************************
* NEW ANALYSIS/COMPUTATION DATA *
*********************************

Center coordinates for center of circle -
                                          X: 92.00
                                          Y: 792.00
                                     Radius: 84.50
Conventional (single-stage) computations will be performed.
Automatic search output will be in short form.
Depth of crack: 5.000
Radii for each grid point will be sorted in the order of increasing radius.
Critical circles for grid points will be output in the order of increasing factor of
safety.
Search will be continued after the initial mode to find a most critical circle.
Procedure of Analysis: Spencer

--------------------------------------------------------------------------------
The following represent default values or values that were prevously defined:
Subtended angle for slice subdivision: 3.00(degrees)
There is no water in a crack.
Seismic coefficient: 0.000
Unit weight of water (or other fluid) in crack: 62.4
No restrictions exist on the lateral extent of the search.
No shear surfaces other than the most critical will be saved for display later.
Neither slope face was explicitly designated for analysis.
Standard sign convention used for direction of shear stress on shear surface.
Iteration limit: 100
Force imbalance: 1.000000e-005 (fraction of total weight)
Moment imbalance: 1.000000e-005 (fraction of moment due to total weight)
Minimum weight required for computations to be performed: 100
Initial trial factor of safety: 3.000
Initial trial side force inclination: 17.189 (degrees)
Minimum (most negative) side force inclination allowed in Spencer's procedure: -10.00
```

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Fairfax -Jersey Creek Station 25+00
750 Mean strengths
1/252005 erosion scour ~~8~~ 3.5 feet wall failed

TABLE NO. 26
****
* NEW, COMPUTED SLOPE GEOMETRY DATA *
****

These slope geometry were generated from the Profile Lines.

Point	X	Y
1	-60.00	750.00
2	-30.00	750.00
3	-5.00	755.00
4	5.00	755.00
5	20.00	750.00
6	25.00	748.57
7	32.00	746.57
8	38.00	744.86
9	41.00	744.00
10	49.00	736.00
11	57.00	720.00
12	60.00	708.00
13	150.00	708.00

UTEXAS WARNING NUMBER 4240
Possible artesian pressures detected at x = -60.00
from piezometric line number 1 (Stage 1).

UTEXAS WARNING NUMBER 4240
Possible artesian pressures detected at x = -30.00
from piezometric line number 1 (Stage 1).

UTEXAS WARNING NUMBER 4240
Possible artesian pressures detected at x = 60.00
from piezometric line number 1 (Stage 1).

UTEXAS WARNING NUMBER 4240
Possible artesian pressures detected at x = 150.00
from piezometric line number 1 (Stage 1).

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Fairfax -Jersey Creek Station 25+00
750 Mean strengths
1/252005 erosion scour ~~7~~ 3.5 feet wall failed

TABLE NO. 43

```
************************************************************
* Coordinate, Weight, Strength and Pore Water Pressure     *
* Information for Individual Slices for Conventional       *
* Computations or First Stage of Multi-Stage Computations. *
* (Information is for the critical shear surface in the    *
* case of an automatic search.)                            *
************************************************************
```

Slice No.	X	Y	Slice Weight	Matl. No.	Cohesion	Friction Angle	Pore Pressure
	22.20	744.37					
1	23.50	742.58	1829	1	0.0	30.00	775.2
	24.79	740.78					
2	24.90	740.65	183	1	0.0	30.00	895.7
	25.00	740.51					
3	26.39	738.79	2876	1	0.0	30.00	1011.4
	27.79	737.07					
4	28.25	736.54	1141	1	0.0	30.00	1152.1
	28.72	736.00					
5	30.23	734.38	4263	2	0.0	29.00	1286.5
	31.74	732.76					
6	31.87	732.63	411	2	0.0	29.00	1395.7
	32.00	732.50					
7	33.60	730.97	5485	2	0.0	29.00	1499.4
	35.20	729.44					
8	36.60	728.22	5472	2	0.0	29.00	1670.8
	38.00	727.01					
9	39.50	725.82	6448	2	0.0	29.00	1821.1
	41.00	724.63					
10	42.80	723.34	7917	2	0.0	29.00	1975.7
	44.60	722.05					
11	46.18	721.02	6688	2	0.0	29.00	2120.1
	47.77	720.00					
12	48.39	719.63	2501	3	0.0	34.00	2207.1
	49.00	719.26					
13	50.93	718.18	6507	3	0.0	34.00	2297.3
	52.87	717.11					
14	54.85	716.14	3967	3	0.0	34.00	2425.1
	56.84	715.16					
15	56.92	715.13	101	3	0.0	34.00	2488.1
	57.00	715.09					
16	57.69	714.78	424	3	0.0	34.00	2509.6
	58.38	714.48					

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Fairfax -Jersey Creek Station 25+00
750 Mean strengths
1/252005 erosion scour ~~6~~ 3.5 feet wall failed

TABLE NO. 44

```
*********************************************************
* Seismic Forces and Forces Due to Distributed Loads for *
* Individual Slices for Conventional Computations or the *
* First Stage of Multi-Stage Computations.               *
* (Information is for the critical shear surface in the  *
* case of an automatic search.)                          *
*********************************************************
```

Slices No.	X	Seismic Force	Y for Seismic Force	FORCES DUE TO DISTRIBUTED LOADS Normal Force	Shear Force	X	Y
1	23.50	0	745.79	1008	0	23.52	748.99
2	24.90	0	744.62	87	0	24.90	748.60
3	26.39	0	743.48	1235	0	26.42	748.17
4	28.25	0	742.09	446	0	28.26	747.64
5	30.23	0	740.67	1552	0	30.26	747.07
6	31.87	0	739.51	143	0	31.87	746.61
7	33.60	0	738.39	1844	0	33.63	746.11
8	36.60	0	736.56	1774	0	36.62	745.25
9	39.50	0	734.92	2060	0	39.52	744.42
10	42.80	0	732.59	4064	0	42.88	742.12
11	46.18	0	729.82	4536	0	46.24	738.76
12	48.39	0	728.09	1996	0	48.39	736.61
13	50.93	0	725.13	12337	0	51.04	731.92
14	54.85	0	720.17	17023	0	54.94	724.12
15	56.92	0	717.64	782	0	56.92	720.16
16	57.69	0	716.01	13417	0	57.71	717.17

```
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    Fairfax -Jersey Creek Station 25+00
    750 Mean strengths
    1/252005 erosion scour ~~4~~ feet wall failed
                              3.5
TABLE NO. 47
*************************************************************
*  Information for the Iterative Solution for the Factor of  *
*  Safety and Side Force Inclination by Spencer's Procedure  *
*************************************************************
Allowable force imbalance for convergence:  5.6212e-001
Allowable moment imbalance for convergence: 23

        Trial     Trial
       Factor   Side Force     Force       Moment                    Delta
Iter-    of    Inclination   Imbalance   Imbalance    Delta-F       Theta
ation  Safety   (degrees)     (lbs.)     (ft.-lbs.)                (degrees)

   1   3.00000   -17.1887  -6.551e+003   4.370e+006
First-order corrections to F and Theta ...........   -4.5640      6.9719
Reduced values - Deltas were too large ...........   -0.5000      0.7638

   2   2.50000   -16.4249  -5.669e+003   3.774e+006
First-order corrections to F and Theta ...........   -2.9063      7.4906
Reduced values - Deltas were too large ...........   -0.5000      1.2887

   3   2.00000   -15.1362  -4.411e+003   2.920e+006
First-order corrections to F and Theta ...........   -1.6237      8.3071
Reduced values - Deltas were too large ...........   -0.5000      2.5580

   4   1.50000   -12.5783  -2.513e+003   1.624e+006
First-order corrections to F and Theta ...........   -0.7112      9.5263
Reduced values - Deltas were too large ...........   -0.2139      2.8648

   5   1.28612    -9.7135  -1.581e+003   1.002e+006
First-order corrections to F and Theta ...........   -0.4301      9.1722
Reduced values - Deltas were too large ...........   -0.1343      2.8648

   6   1.15178    -6.8487  -9.938e+002   6.179e+005
First-order corrections to F and Theta ...........   -0.2724      7.7680
Reduced values - Deltas were too large ...........   -0.1005      2.8648

   7   1.05132    -3.9839  -5.624e+002   3.409e+005
First-order corrections to F and Theta ...........   -0.1588      5.6295
Reduced values - Deltas were too large ...........   -0.0808      2.8648

   8   0.97051    -1.1191  -2.260e+002   1.299e+005
First-order corrections to F and Theta ...........   -0.0701      3.0219
Reduced values - Deltas were too large ...........   -0.0665      2.8648

   9   0.90401     1.7457   2.802e+001  -2.251e+004
First-order corrections to F and Theta ...........   -0.0010      0.2001
Second-order corrections to F and Theta ..........   -0.0011      0.2007

  10   0.90295     1.9464  -2.270e-004   4.484e-002
First-order corrections to F and Theta ...........   -0.0000      0.0000
```

```
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    Fairfax -Jersey Creek Station 25+00
    750 Mean strengths
    1/252005 erosion scour ~~6~~ 3.5 feet wall failed

TABLE NO. 55
*********************************************************************
* Check of Computations by Spencer's Procedure (Results are for the *
* critical shear surface in the case of an automatic search.)       *
*********************************************************************

Summation of Horizontal Forces: 1.03277e-011

Summation of Vertical Forces: 3.80851e-012

Summation of Moments: 2.51457e-007

Mohr Coulomb Shear Force/Shear Strength Check Summation: 1.30314e-011

***** CAUTION ***** Effective Or Total Normal Stress on Shear
Surface is Negative at Points Along the UPPER One-Half of the
Shear Surface - A Tension Crack may Be Needed.

!!!!! WARNING !!!!! The Shear Stress at Some Points Along the
Shear Surface is NEGATIVE!
Solution is Probably INCORRECT

***** CAUTION ***** Some of the Forces Between Slices Act at Points
Above the Surface of the Slope or Below the Shear Surface -
Either a Tension Crack may be Needed or the SOLUTION MAY NOT
BE A VALID SOLUTION
```

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Fairfax -Jersey Creek Station 25+00
750 Mean strengths
1/252005 erosion scour ~~8~~ 3.5 feet wall failed

TABLE NO. 58

```
**************************************************************************
* Final Results for Stresses Along the Shear Surface                     *
* (Results are for the critical shear surface in the case of a search.) *
**************************************************************************
```

SPENCER'S PROCEDURE USED TO COMPUTE THE FACTOR OF SAFETY
Factor of Safety: 0.903 Side Force Inclination: 1.95

-------- VALUES AT CENTER OF BASE OF SLICE --------

Slice No.	X-Center	Y-Center	Total Normal Stress	Effective Normal Stress	Shear Stress
1	23.50	742.58	957.2	182.0	116.4
2	24.90	740.65	1124.4	228.8	146.3
3	26.39	738.79	1285.7	274.3	175.4
4	28.25	736.54	1483.6	331.5	212.0
5	30.23	734.38	1690.1	403.5	247.7
6	31.87	732.63	1857.3	461.5	283.3
7	33.60	730.97	2016.6	517.1	317.5
8	36.60	728.22	2282.5	611.6	375.5
9	39.50	725.82	2517.3	696.2	427.4
10	42.80	723.34	2704.0	728.3	447.1
11	46.18	721.02	2843.5	723.4	444.1
12	48.39	719.63	2881.1	674.0	503.5
13	50.93	718.18	2831.3	534.0	398.9
14	54.85	716.14	2715.8	290.7	217.1
15	56.92	715.13	2640.1	151.9	113.5
16	57.69	714.78	2413.6	-96.0	-71.7

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Fairfax -Jersey Creek Station 25+00
750 Mean strengths
1/252005 erosion scour ~~5~~ 3.5 feet wall failed

TABLE NO. 59

```
***********************************************************************
* Final Results for Side Forces and Stresses Between Slices           *
* (Results are for the critical shear surface in the case of a search.) *
***********************************************************************
```

---------- VALUES AT RIGHT SIDE OF SLICE ----------

Slice No.	X-Right	Side Force	Y-Coord. of Side Force Location	Fraction of Height	Sigma at Top	Sigma at Bottom
1	24.79	2858	742.01	0.156	-387.1	1114.9
2	25.00	3111	741.84	0.165	-388.7	1160.0
3	27.79	6702	739.81	0.255	-292.6	1544.5
4	28.72	7975	739.14	0.273	-250.0	1635.3
5	31.74	12271	737.12	0.314	-102.5	1869.5
6	32.00	12650	736.95	0.317	-90.4	1887.4
7	35.20	17300	735.00	0.343	60.2	2072.1
8	38.00	21321	733.42	0.359	186.1	2201.3
9	41.00	25466	731.86	0.374	317.3	2310.1
10	44.60	27954	729.30	0.395	562.8	2481.3
11	47.77	29164	727.11	0.413	807.9	2575.5
12	49.00	29269	726.31	0.421	921.5	2573.2
13	52.87	22778	722.15	0.451	1446.1	2633.7
14	56.84	11967	717.66	0.484	2092.7	2543.9
15	57.00	11443	717.47	0.485	2122.8	2534.8
16	58.38	-0	714.48	1.000	0.0	0.0

Read end-of-file on input while looking for another command word.
End of input data assumed - normal termination.

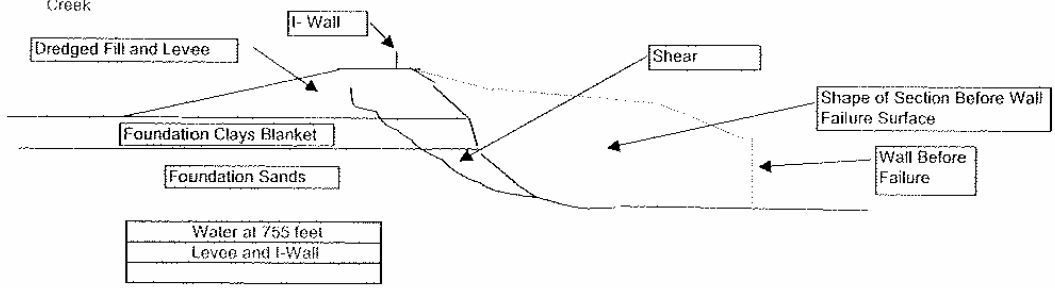
EXHIBIT A-8.34
Summary of Probability of Levee/I-Wall Global Stability Failure Using River Elevation 755 Feet

STABILITY ANALYSIS — Reliability

Fairfax Jersey Creek — KCMOKS Sta 25+00

Designed By: Loehr 2/10/2005

Checked By: Redre 2/17/05



Water at 755 feet
Levee and I-Wall

Reliability Analysis of Critical Slide						
Run	ϕ' Levee Fill Pervious	ϕ' Blanket Clays, psf	ϕ' Found Sand	Factor of Safety	Variance Component	Percent of Variance
1 Mean	30.00	29.0	34	**0.918**		
2 $+\sigma_d$	33.60	29.00	34.00	**0.939**	0.0004410	5.1127
3 $-\sigma_d$	26.40	29.00	34.00	**0.897**		
4 $+\sigma_d$	30.00	32.48	34.00	**1.006**	0.0074823	86.746
5 $-\sigma_d$	30.00	25.52	34.00	**0.833**		
6 $+\sigma_d$	30.00	29.00	38.08	**0.946**	0.0007022	8.1416
7 $-\sigma_d$	30.00	29.00	29.92	**0.893**		
				Total	0.0086255	100

E[FS] = 0.9180
Var[FS]= 0.00863
sigma[FS]= 0.09287
V(FS) = 0.1012

FS req'd = 1.000

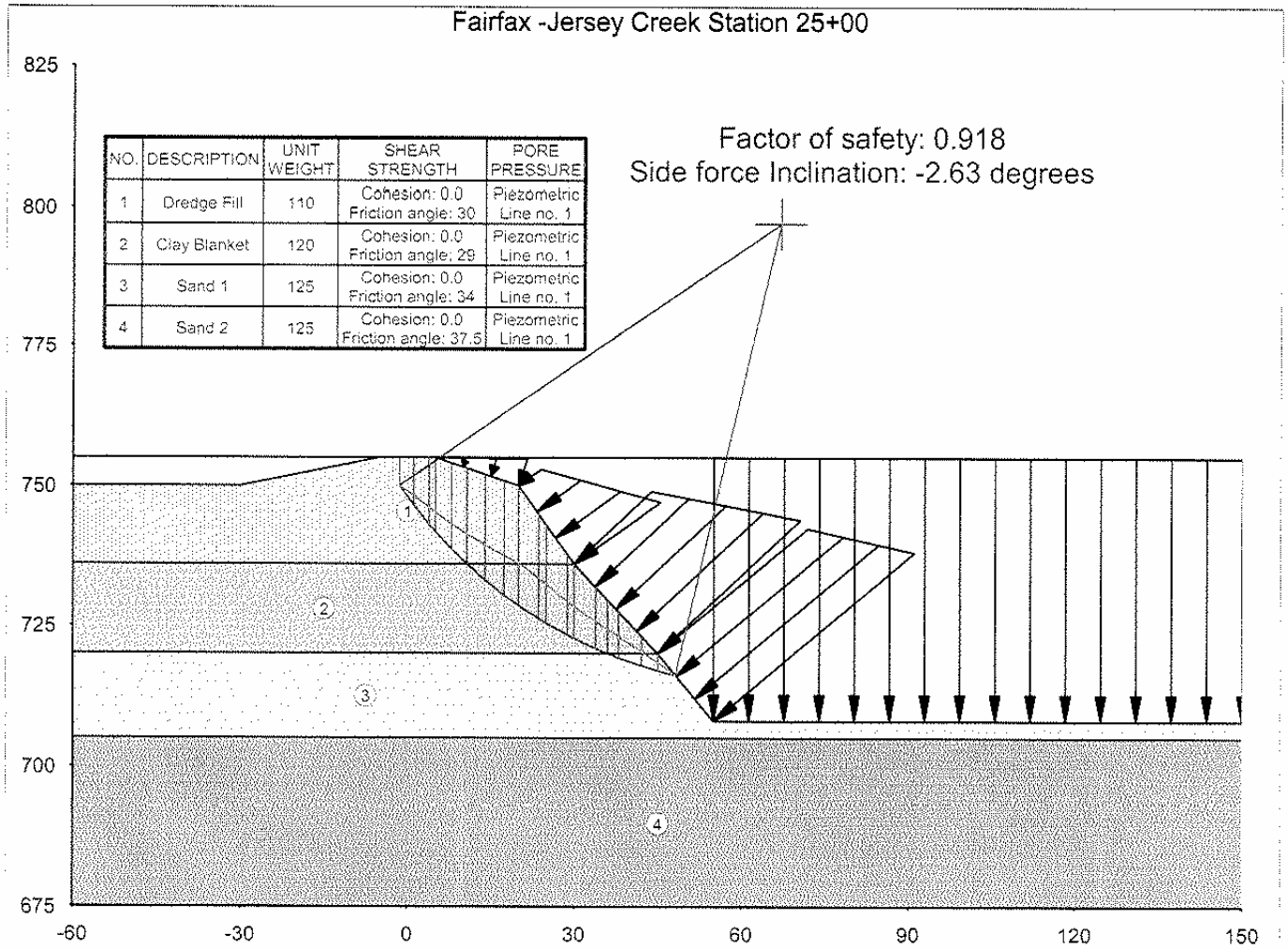
E[ln FS] = -0.09065 -0.09062
sigma [ln FS] = 0.100912
ln(FS req'd) = 0.00000
-1.13694

Beta =	-0.89830
F(z) =	0.81549
Pr(f) =	81.55

0.12778

Table 1 : Random Variables for Fairfax-Jersey Creek			
Parameter	Expected Value	Standard Deviation	Coefficient of Variation, %
Levee Fill Pervious ϕ'	30	3.600	12.00
Blanket ϕ	29	3.480	12.00
Foundation ϕ'	34	4.080	12.00

EXHIBIT A-8.35
Mean Value Analysis of Global Stability of Station 25+00 Levee/I-Wall
With River Elevation 755 Feet



NO.	DESCRIPTION	UNIT WEIGHT	SHEAR STRENGTH	PORE PRESSURE
1	Dredge Fill	110	Cohesion: 0.0 Friction angle: 30	Piezometric Line no. 1
2	Clay Blanket	120	Cohesion: 0.0 Friction angle: 29	Piezometric Line no. 1
3	Sand 1	125	Cohesion: 0.0 Friction angle: 34	Piezometric Line no. 1
4	Sand 2	125	Cohesion: 0.0 Friction angle: 37.5	Piezometric Line no. 1

Filename: C:\Documents and Settings\g5epxsal\My Documents\KCMOKS\Fairfax-Jersey Creek\Sta 25+00 stability\Elev 75Time: 13:16:41ur 1.UT4

Levee with toe scour

EXHIBIT A-8.36
Mean Value Analysis of Global Stability Levee/I-Wall
UTEXAS4 Output File

TABLE NO. 1
COMPUTER PROGRAM DESIGNATION: UTEXAS4
Originally Coded By Stephen G. Wright
Version No. 4.0.0.9 - Last Revision Date: 07/27/2001
(C) Copyright 1985-2000 S. G. Wright - All rights reserved

```
*****************************************************************
* RESULTS OF COMPUTATIONS PERFORMED USING THIS SOFTWARE         *
* SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY HAVE       *
* BEEN VERIFIED BY INDEPENDENT ANALYSES, EXPERIMENTAL DATA      *
* OR FIELD EXPERIENCE. THE USER SHOULD UNDERSTAND THE ALGORITHMS *
* AND ANALYTICAL PROCEDURES USED IN THIS SOFTWARE AND MUST HAVE *
* READ ALL DOCUMENTATION FOR THIS SOFTWARE BEFORE ATTEMPTING    *
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```

```
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Name of input data file: C:\Documents and Settings\g5epxsal\My Documents\KCMOKS\Fairfax-
Jersey Creek\Sta 25+00 stability\Elev 755\Levee\Alt scour 1.dat

    Fairfax -Jersey Creek Station 25+00
    750 Mean strengths
    1/26/2005 levee slide

TABLE NO. 3
*************************
* NEW PROFILE LINE DATA *
*************************

-------------------------------------------------------------
----- Profile Line No. 2 - Material Type (Number): 2 -----
-------------------------------------------------------------
Description: Clay Blanket

Point        X           Y

   1      -60.00      736.00
   2       30.00      736.00
   3       45.00      720.00

-------------------------------------------------------------
----- Profile Line No. 1 - Material Type (Number): 1 -----
-------------------------------------------------------------
Description: Dredge Fill

Point        X           Y

   1      -60.00      750.00
   2      -30.00      750.00
   3       -5.00      755.00
   4        5.00      755.00
   5       20.00      750.00
   6       30.00      736.00

-------------------------------------------------------------
----- Profile Line No. 3 - Material Type (Number): 3 -----
-------------------------------------------------------------
Description: Sand 1

Point        X           Y

   1      -60.00      720.00
   2       45.00      720.00
   3       55.00      708.00
   4      150.00      708.00

-------------------------------------------------------------
----- Profile Line No. 4 - Material Type (Number): 4 -----
-------------------------------------------------------------
Description: Sand 2

Point        X           Y

   1      -60.00      705.00
   2       38.00      705.00
   3      150.00      705.00
```

```
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TABLE NO. 4
*********************************************************************
* NEW MATERIAL PROPERTY DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
*********************************************************************

-------------------------------------------------------------------
-------------------- DATA FOR MATERIAL NUMBER 1 --------------------
-------------------------------------------------------------------
Description: Dredge Fill

Unit weight of soil (material): 110.0

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - 0.0
Friction angle - - - - - 30.00 (degrees)

Pore water pressures are defined by a piezometric line.
Piezometric line number: 1
Negative pore water pressures are NOT allowed - set to zero.

-------------------------------------------------------------------
-------------------- DATA FOR MATERIAL NUMBER 2 --------------------
-------------------------------------------------------------------
Description: Clay Blanket

 nit weight of soil (material): 120.0

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - 0.0
Friction angle - - - - - 29.00 (degrees)

Pore water pressures are defined by a piezometric line.
Piezometric line number: 1
Negative pore water pressures are NOT allowed - set to zero.

-------------------------------------------------------------------
-------------------- DATA FOR MATERIAL NUMBER 3 --------------------
-------------------------------------------------------------------
Description: Sand 1

Unit weight of soil (material): 125.0

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - 0.0
Friction angle - - - - - 34.00 (degrees)

Pore water pressures are defined by a piezometric line.
Piezometric line number: 1
Negative pore water pressures are NOT allowed - set to zero.

-------------------------------------------------------------------
-------------------- DATA FOR MATERIAL NUMBER 4 --------------------
-------------------------------------------------------------------
Description: Sand 2

 nit weight of soil (material): 125.0

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - 0.0
Friction angle - - - - - 37.50 (degrees)
```

```
Piezometric line number: 1
Negative pore water pressures are NOT allowed - set to zero.
```

```
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    Fairfax -Jersey Creek Station 25+00
    750 Mean strengths
    1/26/2005 levee slide

TABLE NO. 6
*********************************************************************
* NEW PIEZOMETRIC LINE DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
*********************************************************************

-------------------------------------------------------
--------------- Piezometric Line Number 1 ---------------
-------------------------------------------------------
Description: Water at Intermediate River Stage 755
Unit weight of fluid (water): 62.4

Point        X           Y

  1       -60.00      755.00
  2        25.00      755.00
  3       150.00      755.00
```

```
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TABLE NO. 10
***************************
* NEW SLOPE GEOMETRY DATA *
***************************

All slope data have been deleted ("cancelled") and will be re-generated.
```

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Fairfax -Jersey Creek Station 25+00
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TABLE NO. 11

****
* NEW DISTRIBUTED LOAD DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
****

Point	X	Y	Normal Pressure	Shear Stress
1	5.00	755.00	0.0	0.0
2	20.00	750.00	312.0	0.0
3	30.00	736.00	1186.0	0.0
4	45.00	720.00	2184.0	0.0
5	55.00	708.00	2933.0	0.0
6	150.00	708.00	2933.0	0.0

```
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TABLE NO. 16
*********************************
* NEW ANALYSIS/COMPUTATION DATA *
*********************************

Center coordinates for center of circle -
                                          X: 67.00
                                          Y: 797.00
                                     Radius: 83.00
Conventional (single-stage) computations will be performed.
Automatic search output will be in short form.
Depth of crack: 5.000
Radii for each grid point will be sorted in the order of increasing radius.
Critical circles for grid points will be output in the order of increasing factor of
safety.
Search will be continued after the initial mode to find a most critical circle.
Procedure of Analysis: Spencer

--------------------------------------------------------------------------------
The following represent default values or values that were prevously defined:
Subtended angle for slice subdivision: 3.00(degrees)
There is no water in a crack.
Seismic coefficient: 0.000
Unit weight of water (or other fluid) in crack: 62.4
No restrictions exist on the lateral extent of the search.
 > shear surfaces other than the most critical will be saved for display later.
Neither slope face was explicitly designated for analysis.
Standard sign convention used for direction of shear stress on shear surface.
Iteration limit: 100
Force imbalance: 1.000000e-005 (fraction of total weight)
Moment imbalance: 1.000000e-005 (fraction of moment due to total weight)
Minimum weight required for computations to be performed: 100
Initial trial factor of safety: 3.000
Initial trial side force inclination: 17.189 (degrees)
Minimum (most negative) side force inclination allowed in Spencer's procedure: -10.00
```

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TABLE NO. 26
****
* NEW, COMPUTED SLOPE GEOMETRY DATA *
****

These slope geometry were generated from the Profile Lines.

Point	X	Y
1	-60.00	750.00
2	-30.00	750.00
3	-5.00	755.00
4	5.00	755.00
5	20.00	750.00
6	30.00	736.00
7	38.00	727.47
8	45.00	720.00
9	55.00	708.00
10	150.00	708.00

UTEXAS WARNING NUMBER 4240
Possible artesian pressures detected at x = -60.00
from piezometric line number 1 (Stage 1).

TEXAS WARNING NUMBER 4240
ossible artesian pressures detected at x = -30.00
rrom piezometric line number 1 (Stage 1).

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TABLE NO. 43

```
************************************************************
* Coordinate, Weight, Strength and Pore Water Pressure     *
* Information for Individual Slices for Conventional       *
* Computations or First Stage of Multi-Stage Computations. *
* (Information is for the critical shear surface in the    *
* case of an automatic search.)                            *
************************************************************
```

Slice No.	X	Y	Slice Weight	Matl. No.	Cohesion	Friction Angle	Pore Pressure
	-1.41	750.00					
1	-0.13	748.24	1898	1	0.0	30.00	421.7
	1.14	746.48					
2	2.51	744.80	3069	1	0.0	30.00	636.8
	3.88	743.11					
3	4.44	742.46	1549	1	0.0	30.00	782.3
	5.00	741.82					
4	6.49	740.23	4667	1	0.0	30.00	921.4
	7.97	738.65					
5	9.34	737.32	4895	1	0.0	30.00	1102.9
	10.72	736.00					
6	12.35	734.57	6514	2	0.0	29.00	1274.9
	13.98	733.14					
7	15.69	731.79	7522	2	0.0	29.00	1448.0
	17.40	730.45					
8	18.70	729.52	6151	2	0.0	29.00	1589.9
	20.00	728.59					
9	21.82	727.41	8349	2	0.0	29.00	1721.8
	23.64	726.22					
10	24.32	725.82	2841	2	0.0	29.00	1821.0
	25.00	725.41					
11	26.90	724.36	7128	2	0.0	29.00	1911.9
	28.80	723.31					
12	29.40	723.01	1974	2	0.0	29.00	1996.4
	30.00	722.70					
13	31.97	721.79	5726	2	0.0	29.00	2072.6
	33.94	720.87					
14	34.98	720.43	2556	2	0.0	29.00	2156.9
	36.02	720.00					
15	37.01	719.62	2125	3	0.0	34.00	2208.0
	38.00	719.23					
16	40.05	718.53	3359	3	0.0	34.00	2276.0
	42.11	717.82					
17	43.55	717.39	1476	3	0.0	34.00	2346.6
	45.00	716.97					
18	46.60	716.56	607	3	0.0	34.00	2398.5
	48.20	716.16					

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Fairfax -Jersey Creek Station 25+00
750 Mean strengths
1/26/2005 levee slide

TABLE NO. 44

```
*********************************************************
* Seismic Forces and Forces Due to Distributed Loads for *
* Individual Slices for Conventional Computations or the *
* First Stage of Multi-Stage Computations.               *
* (Information is for the critical shear surface in the  *
* case of an automatic search.)                          *
*********************************************************
```

Slices No.	X	Seismic Force	Y for Seismic Force	FORCES DUE TO DISTRIBUTED LOADS Normal Force	Shear Force	X	Y
1	-0.13	0	751.62	0	0	-0.13	748.24
2	2.51	0	749.90	0	0	2.51	744.80
3	4.44	0	748.73	0	0	4.44	742.46
4	6.49	0	747.37	97	0	6.98	754.34
5	9.34	0	745.44	261	0	9.49	753.50
6	12.35	0	743.50	527	0	12.47	752.51
7	15.69	0	741.47	801	0	15.78	751.41
8	18.70	0	739.78	781	0	18.74	750.42
9	21.82	0	737.21	2955	0	22.03	747.16
10	24.32	0	734.69	1608	0	24.34	743.92
11	26.90	0	732.21	5990	0	27.02	740.18
12	29.40	0	729.89	2332	0	29.41	736.82
13	31.97	0	727.84	7585	0	32.03	733.83
14	34.98	0	725.56	4607	0	34.99	730.67
15	37.01	0	724.06	4793	0	37.02	728.51
16	40.05	0	721.88	11147	0	40.11	725.22
17	43.55	0	719.45	8823	0	43.58	721.52
18	46.60	0	717.32	11527	0	46.63	718.04

```
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TABLE NO. 47
*************************************************************
*  Information for the Iterative Solution for the Factor of  *
*  Safety and Side Force Inclination by Spencer's Procedure  *
*************************************************************
Allowable force imbalance for convergence:  7.2405e-001
Allowable moment imbalance for convergence: 15

        Trial      Trial
       Factor   Side Force      Force       Moment                    Delta
Iter-    of    Inclination    Imbalance   Imbalance    Delta-F       Theta
ation  Safety   (degrees)      (lbs.)     (ft.-lbs.)                (degrees)

   1   3.00000   -17.1887  -9.499e+003   6.460e+006
First-order corrections to F and Theta ...........   -5.0087      4.2666
Reduced values - Deltas were too large ...........   -0.5000      0.4259

   2   2.50000   -16.7628  -8.351e+003   5.673e+006
First-order corrections to F and Theta ...........   -3.1559      4.5795
Reduced values - Deltas were too large ...........   -0.5000      0.7256

   3   2.00000   -16.0373  -6.679e+003   4.525e+006
First-order corrections to F and Theta ...........   -1.7189      5.1143
Reduced values - Deltas were too large ...........   -0.5000      1.4877

   4   1.50000   -14.5496  -4.052e+003   2.713e+006
First-order corrections to F and Theta ...........   -0.7009      6.1770
Reduced values - Deltas were too large ...........   -0.3251      2.8648

   5   1.17492   -11.6848  -1.596e+003   1.024e+006
First-order corrections to F and Theta ...........   -0.2660      6.8029
Reduced values - Deltas were too large ...........   -0.1120      2.8648

   6   1.06290    -8.8200  -8.202e+002   5.119e+005
First-order corrections to F and Theta ...........   -0.1486      5.4014
Reduced values - Deltas were too large ...........   -0.0788      2.8648

   7   0.98409    -5.9552  -3.226e+002   1.918e+005
First-order corrections to F and Theta ...........   -0.0674      3.1700
Reduced values - Deltas were too large ...........   -0.0609      2.8648

   8   0.92314    -3.0904   1.310e+001  -1.533e+004
First-order corrections to F and Theta ...........   -0.0053      0.4603
Second-order corrections to F and Theta ..........   -0.0053      0.4614

   9   0.91784    -2.6290   2.475e-004  -5.641e-001
First-order corrections to F and Theta ...........   -0.0000      0.0000
```

```
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    750 Mean strengths
    1/26/2005 levee slide

TABLE NO. 55
*********************************************************************
* Check of Computations by Spencer's Procedure (Results are for the *
* critical shear surface in the case of an automatic search.)       *
*********************************************************************

Summation of Horizontal Forces: 1.28004e-011

Summation of Vertical Forces: 4.54747e-012

Summation of Moments: 1.70060e-006

Mohr Coulomb Shear Force/Shear Strength Check Summation: 6.13909e-012

***** CAUTION ***** Some of the Forces Between Slices Act at Points
Above the Surface of the Slope or Below the Shear Surface -
Either a Tension Crack may be Needed or the SOLUTION MAY NOT
BE A VALID SOLUTION
```

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Fairfax -Jersey Creek Station 25+00
750 Mean strengths
1/26/2005 levee slide

TABLE NO. 58

```
***************************************************************************
* Final Results for Stresses Along the Shear Surface                      *
* (Results are for the critical shear surface in the case of a search.) *
***************************************************************************
```

SPENCER'S PROCEDURE USED TO COMPUTE THE FACTOR OF SAFETY
Factor of Safety: 0.918 Side Force Inclination: -2.63

-------- VALUES AT CENTER OF BASE OF SLICE --------

Slice No.	X-Center	Y-Center	Total Normal Stress	Effective Normal Stress	Shear Stress
1	-0.13	748.24	576.9	155.2	97.6
2	2.51	744.80	885.9	249.1	156.7
3	4.44	742.46	1100.7	318.3	200.2
4	6.49	740.23	1296.8	375.4	236.1
5	9.34	737.32	1549.5	446.6	280.9
6	12.35	734.57	1807.8	532.9	321.8
7	15.69	731.79	2073.6	625.6	377.8
8	18.70	729.52	2294.3	704.3	425.3
9	21.82	727.41	2452.8	730.9	441.4
10	24.32	725.82	2525.4	704.4	425.4
11	26.90	724.36	2578.7	666.8	402.7
12	29.40	723.01	2622.0	625.7	377.9
13	31.97	721.79	2635.9	563.4	340.2
14	34.98	720.43	2658.4	501.5	302.9
15	37.01	719.62	2646.9	438.9	322.6
16	40.05	718.53	2641.6	365.6	268.6
17	43.55	717.39	2616.2	269.6	198.1
18	46.60	716.56	2565.1	166.6	122.4

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Fairfax -Jersey Creek Station 25+00
750 Mean strengths
1/26/2005 levee slide

TABLE NO. 59

```
*************************************************************************
* Final Results for Side Forces and Stresses Between Slices             *
* (Results are for the critical shear surface in the case of a search.) *
*************************************************************************
```

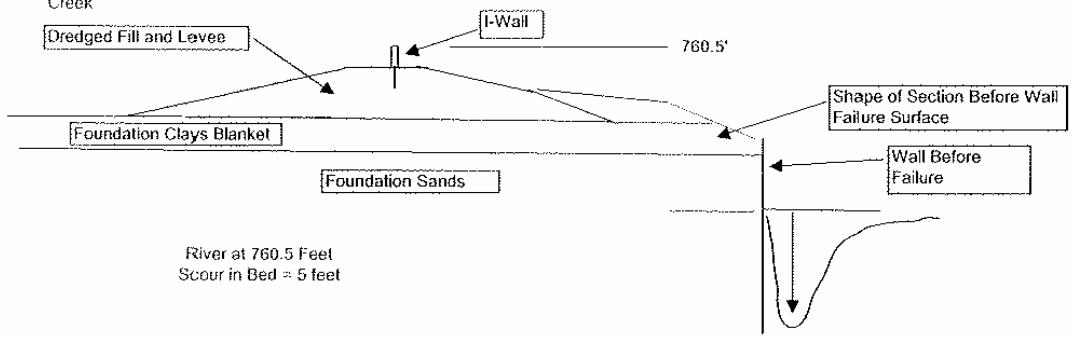
---------- VALUES AT RIGHT SIDE OF SLICE ----------

Slice No.	X-Right	Side Force	Y-Coord. of Side Force Location	Fraction of Height	Sigma at Top	Sigma at Bottom
1	1.14	1781	748.18	0.200	-167.7	585.5
2	3.88	4347	746.09	0.251	-179.8	910.1
3	5.00	5541	745.27	0.262	-180.9	1020.8
4	7.97	8922	743.21	0.297	-127.8	1288.4
5	10.72	12178	741.42	0.317	-70.2	1493.5
6	13.98	16137	739.42	0.333	-0.9	1709.8
7	17.40	20170	737.51	0.346	74.8	1899.0
8	20.00	23091	736.17	0.354	133.6	2021.1
9	23.64	24882	733.48	0.389	441.1	2221.0
10	25.00	25049	732.42	0.398	556.2	2289.0
11	28.80	24057	729.38	0.423	897.7	2448.5
12	30.00	23299	728.41	0.429	1005.4	2495.5
13	33.94	21259	725.73	0.445	1301.5	2584.6
14	36.02	19576	724.33	0.452	1451.8	2629.5
15	38.00	17473	723.02	0.460	1614.9	2623.8
16	42.11	11959	720.34	0.478	1976.2	2563.5
17	45.00	7171	718.44	0.485	2154.7	2572.0
18	48.20	-0	716.16	1.000	0.0	0.0

Read end-of-file on input while looking for another command word.
End of input data assumed - normal termination.

EXHIBIT A-8.37
Summary of Probability of Flood Protection Failure for Station 25+00 for River Elevation 760.5 Feet

	STABILITY ANALYSIS	Reliability	
Fairfax	KCMOKS	Designed By:	Loehr 1/26/2005
Jersey	Sta 25+00	Checked By:	Rodea 2/17/05
Creek			



Probability that the Levee will fail is determine based on a parallel system for this reach. In a parallel system the system will only perform unsatisfactorily if all components perform unsatisfactorily.
Reliability = 1- p1*p2*p3

Reliability of the levee section is a function of the wall failure, and bank failure.

A parallel relationship exists for the Station 25+00 reach.

1) The Missouri river velocities create scour at the bed near the wall

2) The wall will fail if scouring at the toe removes materials below the existing bed. (p1)

3) If the wall fails, then part of the bank behind the wall will scour causing a foreshore slide. (p2)

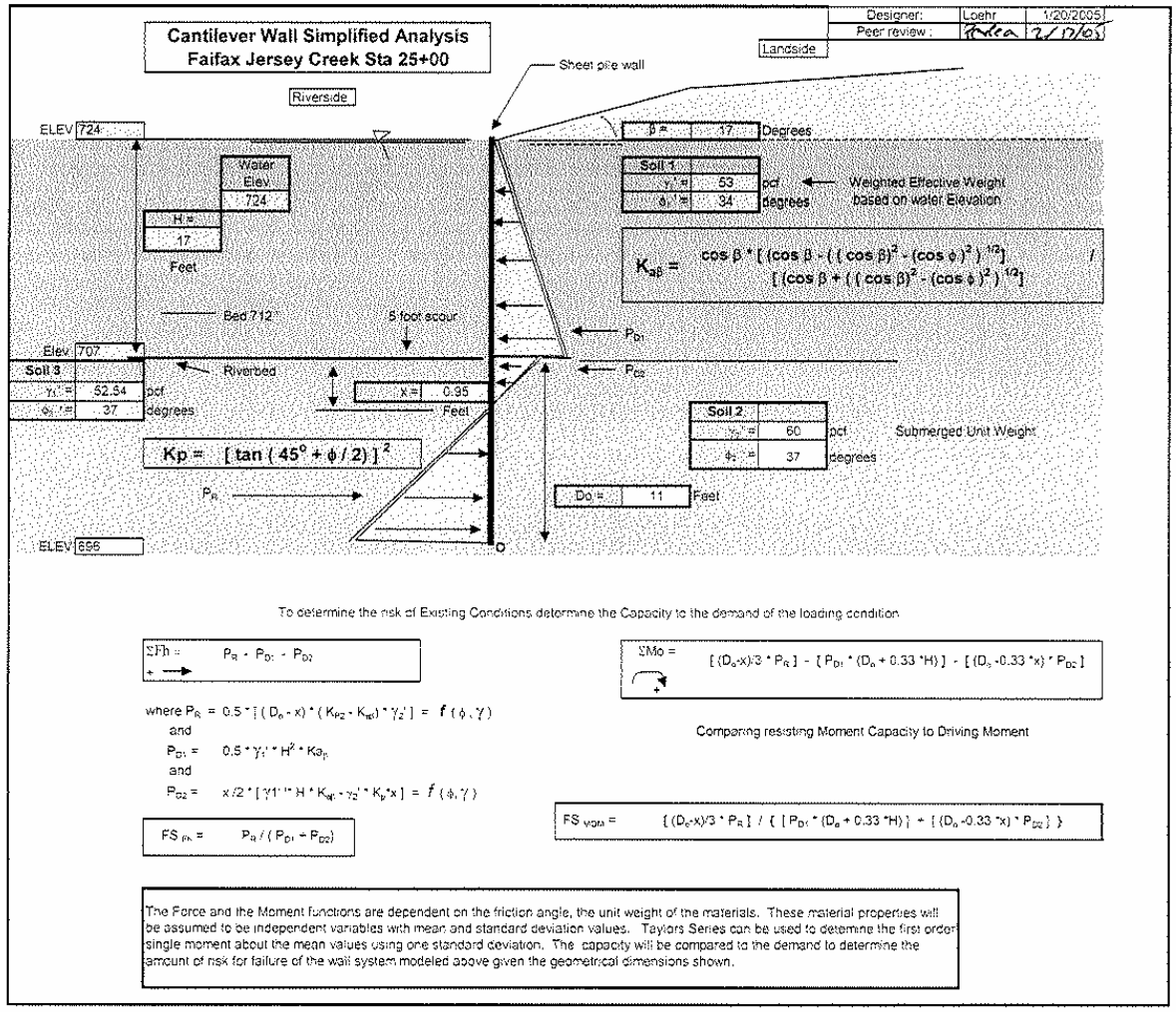
4) After the foreshore slide and is scoured away by the flood event, alrger foreshore and levee slide can occur. (p3)
The reliability of the reach from Station 22+30 to 30+00 is determined below

Event	Prob of Failure	
Scour potential	1	5' Scour
(p1) Wall failure (p1) =	0.8000	
(p2) Foreshore slide (p2)=	0.8500	Loss of bank - progressive erosion/slouging
(p3) Levee Slide (p3) =	0.5515	When this happens Fairfax gets wet

Reliability of reach = 1-p1*p2*p3*p4

0.8000	*	0.8500	*	0.5515	=	0.6250
						or
Reliability =		1	-	0.625		**37.50%**

EXHIBIT A-8.38
Simple Cantilever Wall Model for River Elevation 760.5 Feet



To determine the risk of Existing Conditions determine the Capacity to the demand of the loading condition

$\Sigma Fh = P_R - P_{D1} - P_{D2}$ (+ →)

$\Sigma Mo = [(D_o - x)/3 * P_R] - [P_{D1} * (D_o + 0.33 * H)] - [(D_o - 0.33 * x) * P_{D2}]$ (+ ↻)

where $P_R = 0.5 * [(D_o - x) * (K_{P2} - K_{a3}) * \gamma_2'] = f (\phi , \gamma)$

and

$P_{D1} = 0.5 * \gamma_1' * H^2 * Ka_\beta$

and

$P_{D2} = x /2 * [\gamma 1' * H * K_{a\beta} - \gamma_2' * K_p * x] = f (\phi , \gamma)$

Comparing resisting Moment Capacity to Driving Moment

$FS_{FH} = P_R / (P_{D1} + P_{D2})$

$FS_{MOM} = [(D_o - x)/3 * P_R] / { [P_{D1} * (D_o + 0.33 * H)] + [(D_o - 0.33 * x) * P_{D2}] }$

The Force and the Moment functions are dependent on the friction angle, the unit weight of the materials. These material properties will be assumed to be independent variables with mean and standard deviation values. Taylors Series can be used to determine the first order single moment about the mean values using one standard deviation. The capacity will be compared to the demand to determine the amount of risk for failure of the wall system modeled above given the geometrical dimensions shown.

Summary of the Forces - Fairfax Jersey Creek Sta 23+00 Sheet Pile Wall

5 foot scour

Designer:	Loehr	1/20/2005
Peer review:	Perkea	2/17/05

$FS_{Fh} = P_R / (P_{D1} + P_{D2})$

where $P_R = 0.5 * [(D_p - x)^2 * (K_{P\beta} - K_{a\beta}) * \gamma_2'] = f(\phi, \gamma)$

$P_{D1} = 0.5 * \gamma_1' * H^2 * Ka_h$

$P_{D2} = x/2 * [\gamma_1' * H * K_{a\beta} - \gamma_2' * K_p * x] = f(\phi, \gamma)$

$K_{a\beta} = \cos\beta * [(\cos\beta - ((\cos\beta)^2 - (\cos\phi)^2)^{1/2}) / (\cos\beta + ((\cos\beta)^2 - (\cos\phi)^2)^{1/2})]$

$Kp = [\tan(45^\circ + \phi_1/2)]^2$

			(1)	(2)	(3)	(4)	(5)	(6)	$K_{a\beta}$ (7)	(8)	(9)	(10)	(11)	Kp (12)
Parameters :	phi	β	cos β	cos φ	$[(1)^2-(2)^2]^{0.5}$	(1)-(3)	(1)+(3)	(4)/(5)	(1)*(6)	γ_1'	γ_2'	ϕ_2'	tan	$(11)^2$
Calcs :	34	17	0.956	0.829	0.477	0.480	1.433	0.335	-0.320	52.6	52.54	37	2.006	4.02

Factored Driving Forces Earth Loads =	1.0	At rest case
Factored Resisting Forces Earth Loads =	1.0	Full Passive Case

Independent Variables	ϕ_1'	ϕ_2'	γ_1'	γ_2'	$K_{a\beta}$	Kp	H	D_p	x	P_R	P_{D1}	P_{D2}	FS_{Fh}
Mean	34	37	52.6	60	0.32	4.02	17	11	0.95	9824	2433	27	3.99
$\phi_1' + \sigma_d$	38.1	37	52.6	60	0.26	4.02	17	11	0.95	9974	2003	3	4.97
$\phi_1' - \sigma_d$	29.9	37	52.6	60	0.39	4.02	17	11	0.95	9644	2950	56	3.21
$\phi_2' + \sigma_d$	34	41.4	52.6	60	0.32	4.91	17	11	0.95	12190	2433	3	5.00
$\phi_2' - \sigma_d$	34	32.6	52.6	60	0.32	3.33	17	11	0.95	7988	2433	46	3.22
$\gamma_1' + \sigma_d$	34	37	54.2	60	0.32	4.02	17	11	0.95	9824	2506	31	3.87
$\gamma_1' - \sigma_d$	34	37	51.0	60	0.32	4.02	17	11	0.95	9824	2360	23	4.12
$\gamma_2' + \sigma_d$	34	37	52.6	61.8	0.32	4.02	17	11	0.95	9824	2433	24	4.09
$\gamma_2' - \sigma_d$	34	37	52.6	58.2	0.32	4.02	17	11	0.95	9824	2433	30	3.99

EXHIBIT A-8.38 (Continued)

Summary of the Reliability - Fairfax Jersey Creek Sta 23+00 Sheet Pile Wall

5 foot scour

Designer	Loehr	1/20/2005
Peer review	Keller	2/17/05

Reliability Analysis of Existing Cantilver Sheet Pile Wall

Run	ϕ_1 Pervious	ϕ_2 Pervious	γ_1' Backfill	γ_2' Backfill	FS	Variance Component	Percent of Variance
Mean	34.0	37.0	52.6	60.0	3.99		
$\phi_1' + \sigma_d$	38.1	37.0	52.6	60.0	4.97	0.7777027	49.0006
$\phi_1' - \sigma_d$	29.9	37.0	52.6	60.0	3.21		
$\phi_2' + \sigma_d$	34.0	41.4	52.6	60.0	5.00	0.7937373	50.011
$\phi_2' - \sigma_d$	34.0	32.6	52.6	60.0	3.22		
$\gamma_1' + \sigma_d$	34.0	37.0	54.2	60.0	3.87	0.0156883	0.9885
$\gamma_1' - \sigma_d$	34.0	37.0	51.0	60.0	4.12		
$\gamma_2' + \sigma_d$	34.0	37.0	52.6	61.8	4.00	0.0000282	0.0018
$\gamma_2' - \sigma_d$	34.0	37.0	52.6	58.2	3.99		
				Total		1.5871283	100

E[FS] =	3.0941	E[ln FS] =	1.33741	1.339612
Var[FS]=	1.55713			
sigma[FS]=	1.25991	sigma [ln FS] =	0.307967	
V[FS] =	0.3154			
FS req'd =	1.000	ln(FS req'd) =	0.00000	

Beta =	4.342695
F(z) =	0.00001
Pr(f) =	0.0007

Reliability = 99.9993 percent

Table 1 : Random Variables for Fairfax Jersey Creek

Parameter	Expected Value	Standard Deviation	Coefficient of Variation, %
ϕ_1'	34.0	4.08	12.00
ϕ_2'	37.0	4.44	12.00
$\gamma 1'$	52.6	1.58	3.00
$\gamma 2'$	60.0	1.80	3.00

EXHIBIT A-8.38 (Continued)

Summary of Wall Moment FFJC Sta 25+00

Factored Driving Forces earth Loads = 1.0 Active Case

Factored Resisting Forces earth Loads = 1.0 Full Passive case

$FS_{MOM} = [(D_o - x)/3 * P_R] / \{ [P_{D1} * (D_o + 0.33 * H)] + [(D_o - 0.33 * x) * P_{D2}] \}$

Designer:	Loehr	1/20/2005
Peer review:	[illegible]	2/17/05

5 foot scour

Independent Variables →

	ϕ_1'	ϕ_2'	γ_1'	γ_2'	$K_{a\beta}$	Kp	H	D_o	x	P_R	P_{D1}	P_{D2}	FS_{MOM}
Mean	**34**	**37**	**53**	**60**	**0.32**	**4.02**	**17**	**11**	**0.95**	**9824**	**2433**	**27**	**0.81**
$\phi_1' + \sigma_d$	38.1	37	52.6	60	0.26	4.02	17	11	0.95	9974	2003	3	1.00
$\phi_1' - \sigma_d$	29.9	37	52.6	60	0.39	4.02	17	11	0.95	9644	2950	56	0.65
$\phi_2' + \sigma_d$	34	41.4	52.6	60	0.32	4.91	17	11	0.95	12190	2433	3	1.01
$\phi_2' - \sigma_d$	34	32.6	52.6	60	0.32	3.33	17	11	0.95	7988	2433	46	0.65
$\gamma_1' + \sigma_d$	34	37	54.2	60	0.32	4.02	17	11	0.95	9824	2506	31	0.78
$\gamma_1' - \sigma_d$	34	37	51.0	60	0.32	4.02	17	11	0.95	9824	2360	23	0.83
$\gamma_2' + \sigma_d$	34	37	52.6	61.8	0.32	4.02	17	11	0.95	9824	2433	24	0.81
$\gamma_2' - \sigma_d$	34	37	52.6	58.2	0.32	4.02	17	11	0.95	9824	2433	30	0.81

$P_R = 0.5 * [(D_o - x)^2 * (K_{P2} - K_{a\beta}) * \gamma_2'] = f(\phi, \gamma)$

$P_{D1} = 0.5 * \gamma_1' * H^2 * Ka_\beta$

$P_{D2} = x/2 * [\gamma 1' * H * K_{a\beta} - \gamma_2' * K_p * x] = f(\phi, \gamma)$

EXHIBIT A-8.38 (Continued)

Summary of Wall Reliability FFJC Sta 25+00

Designer:	Loehr	1/20/2005
Peer review :	[illegible]	2/17/05

5 foot scour

Reliability Analysis of Existing Cantilver Sheet Pile Wall						Variance Component	Percent of Variance
Run	ϕ_1	ϕ_2	γ_1'	γ_2'	FS_{MOM}		
Mean	34.0	37.0	52.6	60.0	0.81		
$\phi_1' + \sigma_d$	38.1	37.0	52.6	60.0	1.00	0.0309653	49.0093
$\phi_1' - \sigma_d$	29.9	37.0	52.6	60.0	0.65		
$\phi_2' + \sigma_d$	34.0	41.4	52.6	60.0	1.01	0.0315933	50.003
$\phi_2' - \sigma_d$	34.0	32.6	52.6	60.0	0.65		
$\gamma_1' + \sigma_d$	34.0	37.0	54.2	60.0	0.78	0.0006240	0.9876
$\gamma_1' - \sigma_d$	34.0	37.0	51.0	60.0	0.83		
$\gamma_2' + \sigma_d$	34.0	37.0	52.6	61.8	0.81	0.0000005	0.0008
$\gamma_2' - \sigma_d$	34.0	37.0	52.6	58.2	0.81		
					Total	0.0631826	100

E[FS] =	0.8087	E[ln FS] =	-0.25840	-0.258095
Var[FS]=	0.06318			
sigma[FS]=	0.25136	sigma [ln FS] =	0.303673	
V(FS) =	0.3108			
FS req'd =	1.000	ln(FS req'd) =	0.00000	

Beta = -0.850912
F(z) = 0.80259
Pr(f) = 80.2591

Reliability = 19.741 percent

Table 1 : Random Variables for Fairfax Jersey Creek

Parameter	Expected Value	Standard Deviation	Coefficient of Variation, %
ϕ_1'	34.0	4.08	12.00
ϕ_2'	37.0	4.44	12.00
$\gamma 1'$	52.6	1.58	3.00
$\gamma 2'$	60.0	1.80	3.00

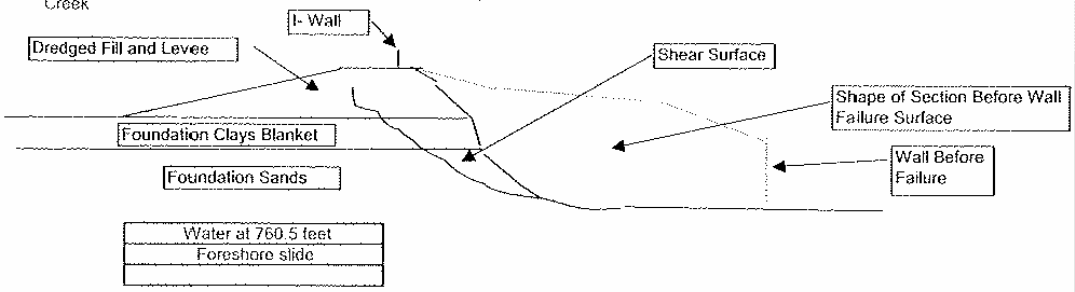
EXHIBIT A-8.39
Summary of Probability of Foreshore Global Stability Failure Using River Elevation 760.5 Feet

STABILITY ANALYSIS — Reliability

Fairfax Jersey Creek — KCMOKS Sta 25+00

Designed By: Loehr 1/26/2005

Checked By: Perlea 2/17/05



Reliability Analysis of Critical Slide					Variance Component	Percent of Variance
Run	ϕ' Levee Fill Pervious	ϕ' Blanket Clays, °	ϕ' Found Sand	Factor of Safety		
1 Mean	30.00	29.0	34	**0.903**		
2 $+\sigma_\phi$	33.60	29.00	34.00	**0.915**	0.0001440	1.6783
3 $-\sigma_\phi$	26.40	29.00	34.00	**0.891**		
4 $+\sigma_\phi$	30.00	32.48	34.00	**0.989**	0.0071403	83.217
5 $-\sigma_\phi$	30.00	25.52	34.00	**0.820**		
6 $+\sigma_\phi$	30.00	29.00	38.08	**0.940**	0.0012960	15.1045
7 $-\sigma_\phi$	30.00	29.00	29.92	**0.868**		
				Total	0.0085803	100

E[FS] = 0.9030
Var[FS]= 0.00858
sigma[FS]: 0.09263
V(FS) = 0.1026

FS req'd = 1.000

E[ln FS] = -0.10727 -0.107239
sigma [ln FS] = 0.102312
ln(FS req'd) = 0.00000
-1.13694

Beta =	-1.04843
F(z) =	0.85278
Pr(f) =	85.28

0.12778

Table 1 : Random Variables for Fairfax-Jersey Creek			
Parameter	Expected Value	Standard Deviation	Coefficient of Variation, %
Levee Fill Pervious ϕ'	30	3.600	12.00
Blanket ϕ	29	3.480	12.00
Foundation ϕ'	34	4.080	12.00

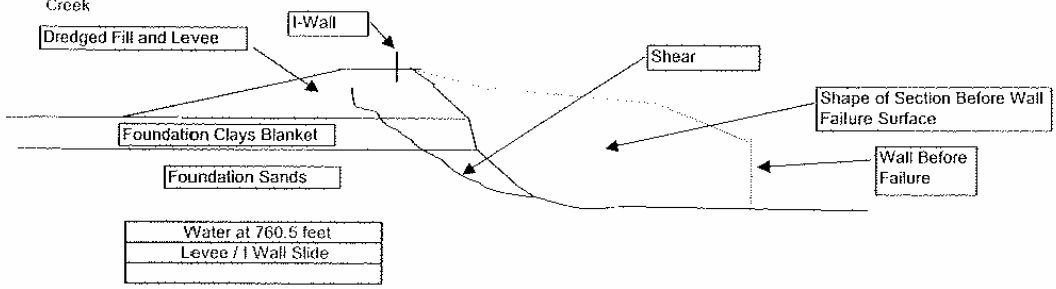
EXHIBIT A-8.40
Summary of Probability of Levee/I-Wall Global Stability Failure Using River Elevation 760.5 Feet

STABILITY ANALYSIS — Reliability

Fairfax Jersey Creek — KCMOKS — Sta 25+00

Designed By: Lochr 1/26/2005

Checked By: Berton 2/17/05



Reliability Analysis of Critical Slide						
Run	ϕ' Levee Fill Pervious	ϕ' Blanket Clays, °	ϕ' Found Sand	Factor of Safety	Variance Component	Percent of Variance
1 Mean	30.00	29.0	34	0.992		
2 $+\sigma_d$	33.60	29.00	34.00	1.018	0.0006503	6.1236
3 $-\sigma_d$	26.40	29.00	34.00	0.967		
4 $+\sigma_d$	30.00	32.48	34.00	1.092	0.0095063	89.523
5 $-\sigma_d$	30.00	25.52	34.00	0.897		
6 $+\sigma_d$	30.00	29.00	38.08	1.015	0.0004622	4.3531
7 $-\sigma_d$	30.00	29.00	29.92	0.972		
				Total	0.0106188	100

E[FS] = 0.9920
Var[FS]= 0.01062
sigma[FS]: 0.10305
V(FS) = 0.1039

FS req'd = 1.000

E[ln FS] = -0.01340 -0.01337

sigma [ln FS] = 0.103600

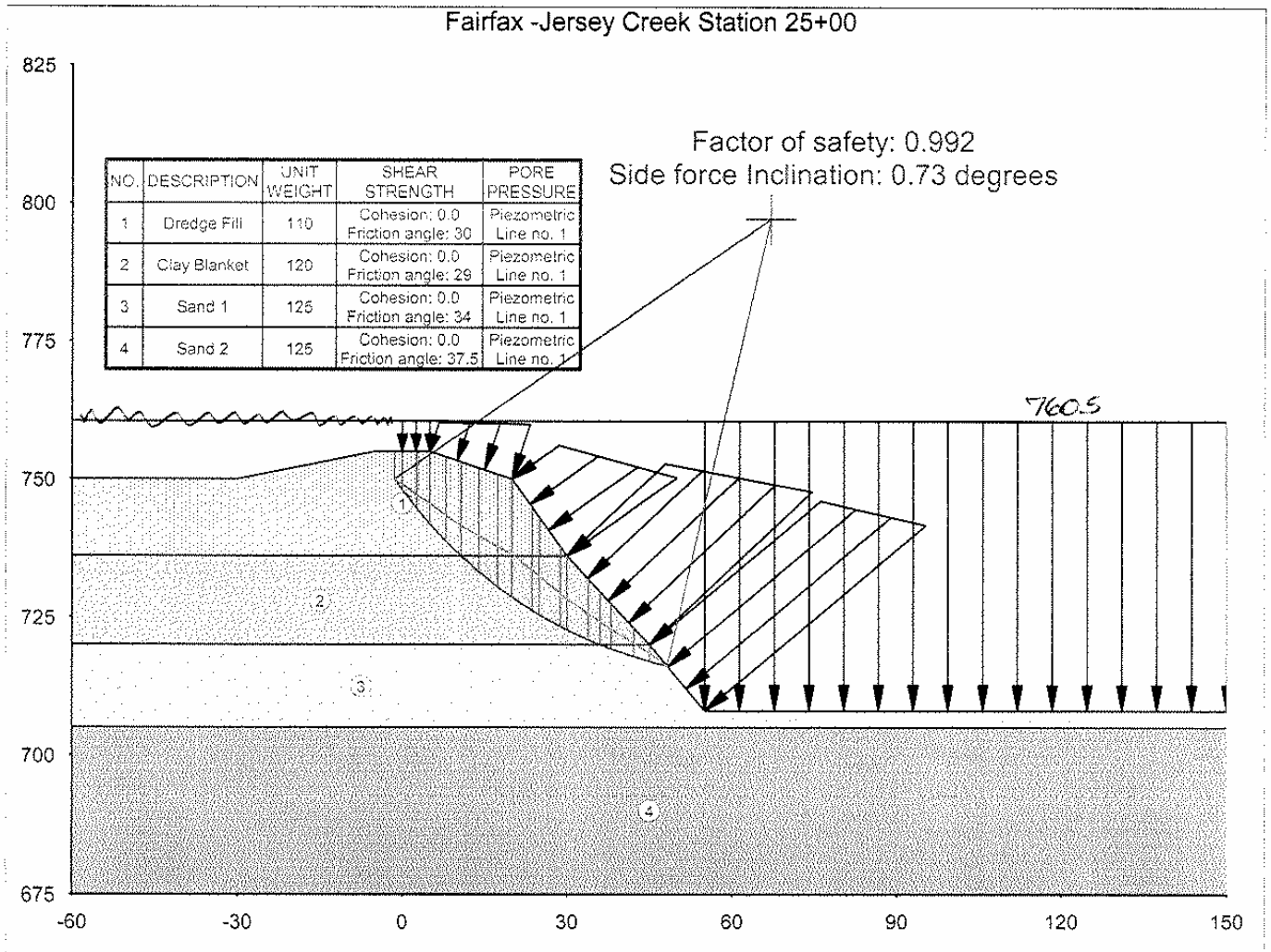
ln(FS req'd) = 0.00000

-1.13694 0.12778

Beta = -0.12933
F(z) = 0.55145
Pr(f) = 55.15

Table 1 : Random Variables for Fairfax-Jersey Creek			
Parameter	Expected Value	Standard Deviation	Coefficient of Variation, %
Levee Fill Pervious ϕ'	30	3.600	12.00
Blanket ϕ	29	3.480	12.00
Foundation ϕ'	34	4.080	12.00

EXHIBIT A-8.41
Mean Value Analysis of Global Stability of Station 25+00 Levee/I-Wall
With River Elevation 760.5 Feet



NO.	DESCRIPTION	UNIT WEIGHT	SHEAR STRENGTH	PORE PRESSURE
1	Dredge Fill	110	Cohesion: 0.0 Friction angle: 30	Piezometric Line no. 1
2	Clay Blanket	120	Cohesion: 0.0 Friction angle: 29	Piezometric Line no. 1
3	Sand 1	125	Cohesion: 0.0 Friction angle: 34	Piezometric Line no. 1
4	Sand 2	125	Cohesion: 0.0 Friction angle: 37.5	Piezometric Line no. 1

Filename: C:\Documents and Settings\g5epxsal\My Documents\KCMOKS\Fairfax-Jersey Creek\Sta 25+00 stability\Elev 760.5 PrTime: 14:11:31\lt scour 1.UT4

EXHIBIT A-8.42
Mean Value Analysis of Global Stability Levee/I-Wall
UTEXAS4 Output File

```
TABLE NO. 1
COMPUTER PROGRAM DESIGNATION: UTEXAS4
Originally Coded By Stephen G. Wright
Version No. 4.0.0.9 - Last Revision Date: 07/27/2001
(C) Copyright 1985-2000 S. G. Wright - All rights reserved
*****************************************************************
* RESULTS OF COMPUTATIONS PERFORMED USING THIS SOFTWARE         *
* SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY HAVE       *
* BEEN VERIFIED BY INDEPENDENT ANALYSES, EXPERIMENTAL DATA      *
* OR FIELD EXPERIENCE. THE USER SHOULD UNDERSTAND THE ALGORITHMS *
* AND ANALYTICAL PROCEDURES USED IN THIS SOFTWARE AND MUST HAVE *
* READ ALL DOCUMENTATION FOR THIS SOFTWARE BEFORE ATTEMPTING    *
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* IMPLIED, CONCERNING THE ACCURACY, RELIABILITY, USEFULNESS     *
* OR ADAPTABILITY OF THIS SOFTWARE.                             *
*****************************************************************
```

```
UTEXAS4 S/N:C0001  - Version: 4.0.0.9 - Latest Revision: 07/27/2001
Licensed for use by: Scott Loehr, U. S. Army Corps of Engineers
Time and date of run: Wed Jan 26 14:09:54 2005
Name of input data file: C:\Documents and Settings\g5epxsal\My Documents\KCMOKS\Fairfax-
Jersey Creek\Sta 25+00 stability\Elev 760.5 Prf\Levee\Levee\Alt scour 1.dat

    Fairfax -Jersey Creek Station 25+00
    760.5 Mean strengths
    1/26/2005 levee slide

TABLE NO. 3
*************************
* NEW PROFILE LINE DATA *
*************************

-------------------------------------------------------------
----- Profile Line No. 2 - Material Type (Number): 2 -----
-------------------------------------------------------------
Description: Clay Blanket

Point        X            Y

   1       -60.00       736.00
   2        30.00       736.00
   3        45.00       720.00

-------------------------------------------------------------
----- Profile Line No. 1 - Material Type (Number): 1 -----
-------------------------------------------------------------
Description: Dredge Fill

Point        X            Y

   1       -60.00       750.00
   2       -30.00       750.00
   3        -5.00       755.00
   4         5.00       755.00
   5        20.00       750.00
   6        30.00       736.00

-------------------------------------------------------------
----- Profile Line No. 3 - Material Type (Number): 3 -----
-------------------------------------------------------------
Description: Sand 1

Point        X            Y

   1       -60.00       720.00
   2        45.00       720.00
   3        55.00       708.00
   4       150.00       708.00

-------------------------------------------------------------
----- Profile Line No. 4 - Material Type (Number): 4 -----
-------------------------------------------------------------
Description: Sand 2

Point        X            Y

   1       -60.00       705.00
   2        38.00       705.00
   3       150.00       705.00
```

```
UTEXAS4 S/N:C0001  - Version: 4.0.0.9 - Latest Revision: 07/27/2001
Licensed for use by: Scott Loehr, U. S. Army Corps of Engineers
Time and date of run: Wed Jan 26 14:09:54 2005
Name of input data file: C:\Documents and Settings\g5epxsal\My Documents\KCMOKS\Fairfax-
Jersey Creek\Sta 25+00 stability\Elev 760.5 Prf\Levee\Levee\Alt scour 1.dat

    Fairfax -Jersey Creek Station 25+00
    760.5 Mean strengths
    1/26/2005 levee slide

TABLE NO. 4
**********************************************************************
* NEW MATERIAL PROPERTY DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
**********************************************************************

----------------------------------------------------------------------
------------------- DATA FOR MATERIAL NUMBER 1 -------------------
----------------------------------------------------------------------
Description: Dredge Fill

Unit weight of soil (material): 110.0

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - 0.0
Friction angle - - - - - 30.00 (degrees)

Pore water pressures are defined by a piezometric line.
Piezometric line number: 1
Negative pore water pressures are NOT allowed - set to zero.

----------------------------------------------------------------------
------------------- DATA FOR MATERIAL NUMBER 2 -------------------
----------------------------------------------------------------------
Description: Clay Blanket

Unit weight of soil (material): 120.0

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - 0.0
Friction angle - - - - - 29.00 (degrees)

Pore water pressures are defined by a piezometric line.
Piezometric line number: 1
Negative pore water pressures are NOT allowed - set to zero.

----------------------------------------------------------------------
------------------- DATA FOR MATERIAL NUMBER 3 -------------------
----------------------------------------------------------------------
Description: Sand 1

Unit weight of soil (material): 125.0

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - 0.0
Friction angle - - - - - 34.00 (degrees)

Pore water pressures are defined by a piezometric line.
Piezometric line number: 1
Negative pore water pressures are NOT allowed - set to zero.

----------------------------------------------------------------------
------------------- DATA FOR MATERIAL NUMBER 4 -------------------
----------------------------------------------------------------------
Description: Sand 2

Unit weight of soil (material): 125.0

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - 0.0
Friction angle - - - - - 37.50 (degrees)
```

```
Pore water pressures are defined by a piezometric line.
Piezometric line number: 1
Negative pore water pressures are NOT allowed - set to zero.
```

```
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    760.5 Mean strengths
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TABLE NO. 6
*********************************************************************
* NEW PIEZOMETRIC LINE DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
*********************************************************************

-------------------------------------------------------------
--------------- Piezometric Line Number 1 ---------------
-------------------------------------------------------------
Description: Water at Intermediate River Stage 760.5
Unit weight of fluid (water): 62.4

Point        X           Y

  1      -60.00      760.50
  2       25.00      760.50
  3      150.00      760.50
```

```
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TABLE NO. 10
***************************
* NEW SLOPE GEOMETRY DATA *
***************************

All slope data have been deleted ("cancelled") and will be re-generated.
```

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TABLE NO. 11
****
* NEW DISTRIBUTED LOAD DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
****

Point	X	Y	Normal Pressure	Shear Stress
1	0.00	755.00	343.0	0.0
2	5.00	755.00	343.0	0.0
3	20.00	750.00	655.0	0.0
4	30.00	736.00	1529.0	0.0
5	45.00	720.00	2528.0	0.0
6	55.00	708.00	3276.0	0.0
7	150.00	708.00	3276.0	0.0

```
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TABLE NO. 16
**********************************
* NEW ANALYSIS/COMPUTATION DATA *
**********************************

Center coordinates for center of circle -
                                          X: 67.00
                                          Y: 797.00
                                     Radius: 83.00
Conventional (single-stage) computations will be performed.
Automatic search output will be in short form.
Depth of crack: 5.000
Radii for each grid point will be sorted in the order of increasing radius.
Critical circles for grid points will be output in the order of increasing factor of
safety.
Search will be continued after the initial mode to find a most critical circle.
Procedure of Analysis: Spencer

--------------------------------------------------------------------------------
The following represent default values or values that were prevously defined:
Subtended angle for slice subdivision: 3.00(degrees)
There is no water in a crack.
Seismic coefficient: 0.000
Unit weight of water (or other fluid) in crack: 62.4
No restrictions exist on the lateral extent of the search.
No shear surfaces other than the most critical will be saved for display later.
Neither slope face was explicitly designated for analysis.
Standard sign convention used for direction of shear stress on shear surface.
Iteration limit: 100
Force imbalance: 1.000000e-005 (fraction of total weight)
Moment imbalance: 1.000000e-005 (fraction of moment due to total weight)
Minimum weight required for computations to be performed: 100
Initial trial factor of safety: 3.000
Initial trial side force inclination: 17.189 (degrees)
Minimum (most negative) side force inclination allowed in Spencer's procedure: -10.00
```

```
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TABLE NO. 26
************************************
* NEW, COMPUTED SLOPE GEOMETRY DATA *
************************************

These slope geometry were generated from the Profile Lines.

     Point        X            Y

        1      -60.00       750.00
        2      -30.00       750.00
        3       -5.00       755.00
        4        5.00       755.00
        5       20.00       750.00
        6       30.00       736.00
        7       38.00       727.47
        8       45.00       720.00
        9       55.00       708.00
       10      150.00       708.00

UTEXAS WARNING NUMBER 4240
Possible artesian pressures detected at x = -60.00
from piezometric line number 1 (Stage 1).

UTEXAS WARNING NUMBER 4240
Possible artesian pressures detected at x = -30.00
from piezometric line number 1 (Stage 1).

UTEXAS WARNING NUMBER 4240
Possible artesian pressures detected at x = -5.00
from piezometric line number 1 (Stage 1).

UTEXAS WARNING NUMBER 4240
Possible artesian pressures detected at x = 0.00
from piezometric line number 1 (Stage 1).

UTEXAS WARNING NUMBER 4240
Possible artesian pressures detected at x = 5.00
from piezometric line number 1 (Stage 1).

UTEXAS WARNING NUMBER 4240
Possible artesian pressures detected at x = 20.00
from piezometric line number 1 (Stage 1).
```

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TABLE NO. 43

```
************************************************************
* Coordinate, Weight, Strength and Pore Water Pressure     *
* Information for Individual Slices for Conventional       *
* Computations or First Stage of Multi-Stage Computations. *
* (Information is for the critical shear surface in the    *
* case of an automatic search.)                            *
************************************************************
```

Slice No.	X	Y	Slice Weight	Matl. No.	Cohesion	Friction Angle	Pore Pressure
	-1.41	750.00					
1	-0.71	749.01	930	1	0.0	30.00	717.3
	0.00	748.01					
2	1.33	746.29	2544	1	0.0	30.00	886.7
	2.66	744.57					
3	3.83	743.19	3044	1	0.0	30.00	1079.9
	5.00	741.82					
4	6.49	740.23	4667	1	0.0	30.00	1264.6
	7.97	738.65					
5	9.34	737.32	4895	1	0.0	30.00	1446.1
	10.72	736.00					
6	12.35	734.57	6514	2	0.0	29.00	1618.1
	13.98	733.14					
7	15.69	731.79	7522	2	0.0	29.00	1791.2
	17.40	730.45					
8	18.70	729.52	6151	2	0.0	29.00	1933.1
	20.00	728.59					
9	21.82	727.41	8349	2	0.0	29.00	2065.0
	23.64	726.22					
10	24.32	725.82	2841	2	0.0	29.00	2164.2
	25.00	725.41					
11	26.90	724.36	7128	2	0.0	29.00	2255.1
	28.80	723.31					
12	29.40	723.01	1974	2	0.0	29.00	2339.6
	30.00	722.70					
13	31.97	721.79	5726	2	0.0	29.00	2415.8
	33.94	720.87					
14	34.98	720.43	2556	2	0.0	29.00	2500.1
	36.02	720.00					
15	37.01	719.62	2125	3	0.0	34.00	2551.2
	38.00	719.23					
16	40.05	718.53	3359	3	0.0	34.00	2619.2
	42.11	717.82					
17	43.55	717.39	1476	3	0.0	34.00	2689.8
	45.00	716.97					
18	46.60	716.56	607	3	0.0	34.00	2741.7
	48.20	716.16					

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TABLE NO. 44

```
*********************************************************
* Seismic Forces and Forces Due to Distributed Loads for *
* Individual Slices for Conventional Computations or the *
* First Stage of Multi-Stage Computations.               *
* (Information is for the critical shear surface in the  *
* case of an automatic search.)                          *
*********************************************************
```

Slices No.	X	Seismic Force	Y for Seismic Force	FORCES DUE TO DISTRIBUTED LOADS Normal Force	Shear Force	X	Y
1	-0.71	0	752.00	0	0	-0.71	749.01
2	1.33	0	750.65	911	0	1.33	755.00
3	3.83	0	749.10	804	0	3.83	755.00
4	6.49	0	747.37	1172	0	6.53	754.49
5	9.34	0	745.44	1253	0	9.37	753.54
6	12.35	0	743.50	1709	0	12.39	752.54
7	15.69	0	741.47	2035	0	15.73	751.42
8	18.70	0	739.78	1721	0	18.72	750.43
9	21.82	0	737.21	5106	0	21.94	747.28
10	24.32	0	734.69	2408	0	24.34	743.93
11	26.90	0	732.21	8235	0	26.99	740.22
12	29.40	0	729.89	3038	0	29.41	736.83
13	31.97	0	727.84	9562	0	32.02	733.84
14	34.98	0	725.56	5650	0	34.99	730.68
15	37.01	0	724.06	5789	0	37.02	728.51
16	40.05	0	721.88	13212	0	40.10	725.23
17	43.55	0	719.45	10276	0	43.57	721.52
18	46.60	0	717.32	13247	0	46.63	718.05

```
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TABLE NO. 47
*************************************************************
*  Information for the Iterative Solution for the Factor of  *
*  Safety and Side Force Inclination by Spencer's Procedure  *
*************************************************************
Allowable force imbalance for convergence:  7.2407e-001
Allowable moment imbalance for convergence: 15

        Trial     Trial
       Factor   Side Force     Force       Moment                    Delta
Iter-    of    Inclination  Imbalance   Imbalance    Delta-F        Theta
ation  Safety   (degrees)     (lbs.)    (ft.-lbs.)                (degrees)

   1   3.00000   -17.1887  -6.695e+003   4.380e+006
First-order corrections to F and Theta ...........   -4.1391      7.5145
Reduced values - Deltas were too large ...........   -0.5000      0.9078

   2   2.50000   -16.2810  -5.687e+003   3.708e+006
First-order corrections to F and Theta ...........   -2.6087      7.9827
Reduced values - Deltas were too large ...........   -0.5000      1.5300

   3   2.00000   -14.7510  -4.251e+003   2.745e+006
First-order corrections to F and Theta ...........   -1.4314      8.6467
Reduced values - Deltas were too large ...........   -0.4742      2.8648

   4   1.52576   -11.8862  -2.251e+003   1.398e+006
First-order corrections to F and Theta ...........   -0.6296      9.2012
Reduced values - Deltas were too large ...........   -0.1960      2.8648

   5   1.32973    -9.0214  -1.375e+003   8.298e+005
First-order corrections to F and Theta ...........   -0.3778      8.1644
Reduced values - Deltas were too large ...........   -0.1326      2.8648

   6   1.19717    -6.1566  -7.849e+002   4.568e+005
First-order corrections to F and Theta ...........   -0.2218      6.3001
Reduced values - Deltas were too large ...........   -0.1009      2.8648

   7   1.09629    -3.2918  -3.502e+002   1.902e+005
First-order corrections to F and Theta ...........   -0.1090      3.8839
Reduced values - Deltas were too large ...........   -0.0804      2.8648

   8   1.01592    -0.4270  -3.249e+001   5.340e+003
First-order corrections to F and Theta ...........   -0.0238      1.1484
Second-order corrections to F and Theta ..........   -0.0235      1.1562

   9   0.99242     0.7292   9.669e-002  -6.718e+001
First-order corrections to F and Theta ...........    0.0000     -0.0002
Second-order corrections to F and Theta ..........    0.0000     -0.0002

  10   0.99243     0.7290  -3.638e-012   3.725e-009
First-order corrections to F and Theta ...........    0.0000     -0.0000
```

```
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TABLE NO. 55
*********************************************************************
* Check of Computations by Spencer's Procedure (Results are for the *
* critical shear surface in the case of an automatic search.)       *
*********************************************************************

Summation of Horizontal Forces: 6.93134e-012

Summation of Vertical Forces: 1.02318e-011

Summation of Moments: 4.65661e-009

Mohr Coulomb Shear Force/Shear Strength Check Summation: 1.56035e-011

***** CAUTION ***** Effective Or Total Normal Stress on Shear
Surface is Negative at Points Along the UPPER One-Half of the
Shear Surface - A Tension Crack may Be Needed.

!!!!! WARNING !!!!! The Shear Stress at Some Points Along the
Shear Surface is NEGATIVE!
Solution is Probably INCORRECT

***** CAUTION ***** Some of the Forces Between Slices Act at Points
Above the Surface of the Slope or Below the Shear Surface -
Either a Tension Crack may be Needed or the SOLUTION MAY NOT
BE A VALID SOLUTION
```

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TABLE NO. 58

```
*************************************************************************
* Final Results for Stresses Along the Shear Surface                    *
* (Results are for the critical shear surface in the case of a search.) *
*************************************************************************
```

SPENCER'S PROCEDURE USED TO COMPUTE THE FACTOR OF SAFETY
Factor of Safety: 0.992 Side Force Inclination: 0.73

-------- VALUES AT CENTER OF BASE OF SLICE --------

Slice No.	X-Center	Y-Center	Total Normal Stress	Effective Normal Stress	Shear Stress
1	-0.71	749.01	692.4	-24.8	-14.5
2	1.33	746.29	1132.6	245.9	143.1
3	3.83	743.19	1424.7	344.9	200.6
4	6.49	740.23	1695.0	430.4	250.4
5	9.34	737.32	1952.3	506.1	294.5
6	12.35	734.57	2214.7	596.6	333.2
7	15.69	731.79	2482.0	690.8	385.8
8	18.70	729.52	2702.2	769.1	429.6
9	21.82	727.41	2830.7	765.6	427.6
10	24.32	725.82	2885.9	721.7	403.1
11	26.90	724.36	2920.3	665.2	371.5
12	29.40	723.01	2944.7	605.1	338.0
13	31.97	721.79	2962.6	546.9	305.4
14	34.98	720.43	2968.9	468.8	261.9
15	37.01	719.62	2946.6	395.4	268.8
16	40.05	718.53	2924.9	305.7	207.8
17	43.55	717.39	2880.4	190.6	129.6
18	46.60	716.56	2796.0	54.3	36.9

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TABLE NO. 59

```
************************************************************************
* Final Results for Side Forces and Stresses Between Slices            *
* (Results are for the critical shear surface in the case of a search.) *
************************************************************************
```

---------- VALUES AT RIGHT SIDE OF SLICE ----------

Slice No.	X-Right	Side Force	Y-Coord. of Side Force Location	Fraction of Height	Sigma at Top	Sigma at Bottom
1	0.00	1398	749.01	0.144	-227.7	627.8
2	2.66	4914	747.09	0.241	-260.2	1202.5
3	5.00	8365	745.50	0.280	-204.3	1473.5
4	7.97	12623	743.34	0.306	-136.6	1780.1
5	10.72	16592	741.55	0.325	-50.7	1991.6
6	13.98	21301	739.59	0.342	58.6	2199.2
7	17.40	26009	737.74	0.357	179.4	2368.4
8	20.00	29378	736.44	0.367	273.7	2470.4
9	23.64	30362	733.48	0.389	540.3	2711.2
10	25.00	30201	732.37	0.395	639.5	2794.3
11	28.80	28219	729.23	0.412	925.2	3003.8
12	30.00	27131	728.23	0.416	1009.3	3071.3
13	33.94	24388	725.57	0.431	1301.8	3160.5
14	36.02	22301	724.19	0.437	1454.2	3199.8
15	38.00	19810	722.90	0.445	1618.4	3192.0
16	42.11	13444	720.26	0.463	1990.9	3117.9
17	45.00	8025	718.40	0.473	2216.7	3077.5
18	48.20	0	716.16	0.000	0.0	0.0

Read end-of-file on input while looking for another command word.
End of input data assumed - normal termination.

EXHIBIT A-8.43
Hydraulic Data Used in the Prediction of Bed Scour

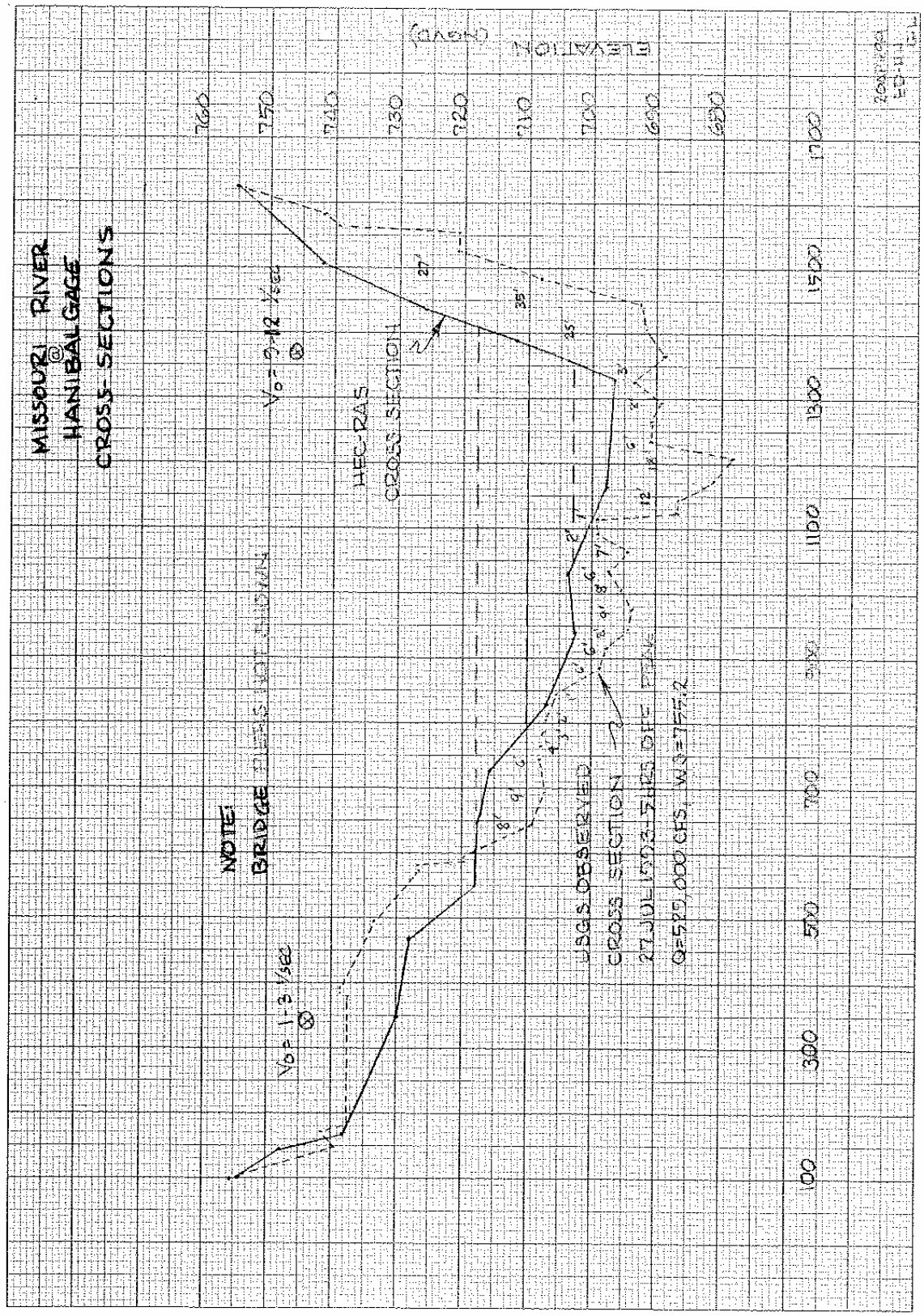

EXHIBIT A-8.43 (Continued)

#
Surface water measurements
#
Further descriptions of the columns and codes used can be found at:
http://waterdata.usgs.gov/nwis/help?output_formats_help#streamflow_measurement_data
#
Stations in this file include:
USGS 06893000 Missouri River at Kansas City, MO
#

site_no	agency_cc	measurem	measurement_dt	party_nm	channel_width	xsec_area_va	Hydraulic Depth	WS Elev	Bed Elev		inside_gag	outside_ga	discharge_	velocity_va
15s	5s	5s	19d	12s	12s	12s					12s	12s	12s	12s
6893000	USGS	4339	1/11/1993 7:10	MCM	902	10300	11.42	717.07	705.65		10.67		31900	3.1
6893000	USGS	4340	2/1/1993 7:15	MCM	902	10800	11.97	718.10	706.13		11.7		35300	3.27
6893000	USGS	4341	2/22/1993 6:45	MCM	912	13800	15.13	719.71	704.58		13.31		44200	3.2
6893000	USGS	4342	3/1/1993 7:15	MCM	902	12300	13.64	718.25	704.61		11.85		37400	3.04
6893000	USGS	4343	3/8/1993 7:00	MCM	992	23400	23.59	728.34	704.75		21.94		104000	4.44
6893000	USGS	4344	3/15/1993 6:30	MCM	990	23282	23.52	728.57	705.05		22.17		104000	4.49
6893000	USGS	4345	3/23/1993 6:45	MCM	932	17500	18.78	724.55	705.77		18.15		70000	4
6893000	USGS	4346	4/5/1993 7:15	MCM	1040	29700	28.56	734.57	706.01		28.17		174000	5.84
6893000	USGS	4347	4/12/1993 7:00	MCM/TEH	992	22000	22.18	728.71	706.53		22.31		110000	4.98
6893000	USGS	4348	4/19/1993 7:00	MCM	992	22600	22.78	728.74	705.96		22.34		103000	4.56
6893000	USGS	4349	5/3/1993 7:15	MCM	956	21200	22.18	727.14	704.96		20.74		88100	4.16
6893000	USGS	4350	5/10/1993 6:30	MCM/TEH	1378	39300	28.52	740.81	712.29		34.41		243000	6.18
6893000	USGS	4351	5/17/1993 6:45	MCM	1032	27600	26.74	732.44	705.70		26.04		126000	4.56
6893000	USGS	4352	5/24/1993 6:30	MCM	994	22900	23.04	729.85	706.81		23.45		105000	4.58
6893000	USGS	4353	6/1/1993 7:00	MCM	992	21800	21.98	728.21	706.23		21.81		95100	4.36
6893000	USGS	4354	6/7/1993 6:45	MCM	1014	26000	25.64	731.67	706.03		25.27		125000	4.81
6893000	USGS	4355	6/21/1993 7:00	MCM	1010	25700	25.45	731.22	705.77		24.82		115000	4.47
6893000	USGS	4356	6/28/1993 6:30	MCM	1006	24700	24.55	730.57	706.02		24.17		117000	4.74
6893000	USGS	4357	7/7/1993 7:45	MCM/TJP	1385	40600	29.31	742.24	712.93		35.84		236000	5.81
6893000	USGS	4358	7/12/1993 8:15	MCM/TEH	1390	41500	29.86	743.07	713.21		36.67		250000	6.02
6893000	USGS	4359	7/19/1993 6:45	MCM/TEH	1390	41500	29.86	743.69	713.83		37.29		259000	6.24
6893000	USGS	4360	7/27/1993 7:20	MCM/TEH	1485	62900	42.36	755.21	712.85	678	48.81		539000	8.57
6893000	USGS	4361	7/28/1993 9:30	RVS/JHA	1485	63400	42.69	755.25	712.56		48.85		505000	7.97
6893000	USGS	4362	7/29/1993 9:00	RVS/JHA	1485	56900	38.32	753.87	715.55		47.47		442000	7.77
6893000	USGS	4363	8/6/1993 7:15	MCM	1086	37800	34.81	738.82	704.01		32.42		190000	5.03
6893000	USGS	4364	8/12/1993 6:30	MCM	1024	30800	30.08	731.89	701.81		25.49		129000	4.19
6893000	USGS	4365	8/23/1993 6:45	MCM	994	25900	26.06	730.73	704.67		24.33		122000	4.14
6893000	USGS	4366	8/30/1993 11:00	TJP	999	27200	27.23	727.39	700.16		20.99		100000	3.68
6893000	USGS	4367	9/3/1993 10:45	MCM	1034	31100	30.08	731.73	701.65		25.33		130000	4.24
6893000	USGS	4368	9/13/1993 7:00	MCM	956	25800	26.99	726.09	699.10		19.69		94900	3.68
6893000	USGS	4369	9/20/1993 6:45	MCM	1024	29300	28.61	730.38	701.77		23.98		121000	4.13
6893000	USGS	4370	9/27/1993 9:50	TEH	1056	33000	31.25	733.28	702.03		26.88		151000	4.58
6893000	USGS	4371	10/1/1993 9:15	TEH	954	24600	25.79	725.53	699.74		19.13		90200	3.67
6893000	USGS	4372	10/7/1993 11:00	TEH	938	22800	24.31	723.67	699.36		17.27		78400	3.44
6893000	USGS	4373	10/12/1993 7:00	MCM	922	21000	22.78	722.32	699.54		15.92		71100	3.39
6893000	USGS	4374	10/18/1993 7:00	MCM	922	20600	22.34	722.63	700.29		16.23		71700	3.48
6893000	USGS	4375	11/1/1993 7:00	MCM	922	17900	19.41	720.68	701.27		14.28		63000	3.52
6893000	USGS	4376	11/8/1993 6:45	MCM	914	16000	17.51	719.44	701.93		13.04		55200	3.45
6893000	USGS	4377	11/22/1993 6:45	MCM	914	15200	16.63	719.38	702.75		12.98		55500	3.65
6893000	USGS	4378	11/29/1993 7:00	MCM	902	13600	15.08	717.48	702.40		11.08		48000	3.53
6893000	USGS	4379	12/2/1993 7:30	MCM	902	13600	15.08	717.19	702.11		10.79		47900	3.52
6893000	USGS	4380	12/13/1993 7:00	MCM	902	13500	14.97	717.82	702.85		11.42		49400	3.66

EXHIBIT A-8.43 (Continued)

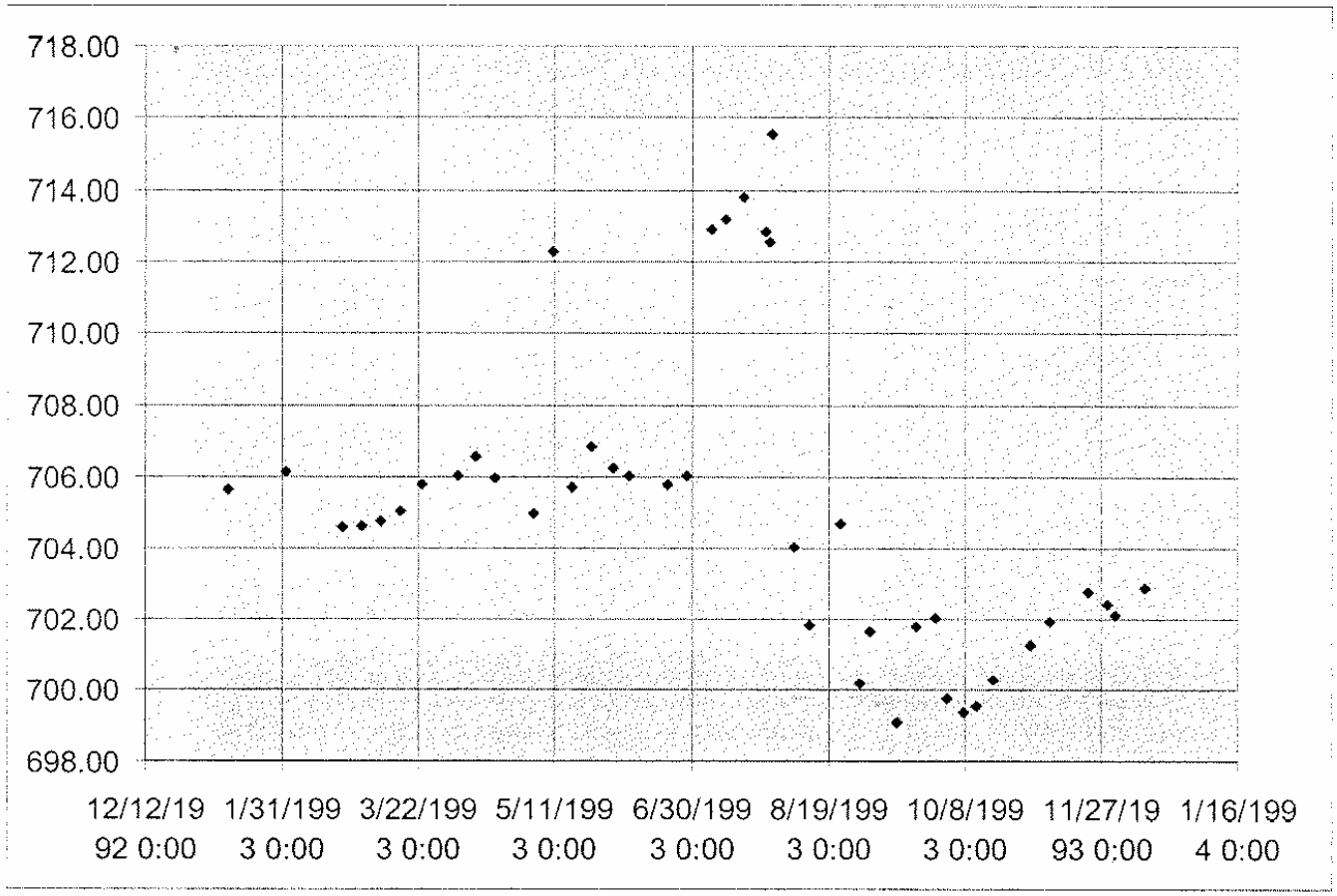

EXHIBIT A-8.44
Missouri River Future Conditions Without Project
Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	rofile Frequency Percent	Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Lower		366.183	Broadway Bridge									
Lower	Lower Missouri	366.2	10%	10	245,000	740.3	741.3	0.00028	8.1	31,592	1,362	0.26
Lower	Lower Missouri	366.2	1%	100	401,000	749.4	750.9	0.00030	9.9	44,528	1,445	0.28
Lower	Lower Missouri	366.2	0.5%	200	454,000	751.9	753.5	0.00031	10.5	48,083	1,469	0.28
Lower	Lower Missouri	366.2	0.2%	500	530,000	755.1	757.0	0.00033	11.3	52,848	1,469	0.29
Lower	Lower Missouri	366.2	0.133%	750	565,000	756.5	758.5	0.00033	11.7	54,832	1,469	0.30
Lower	Lower Missouri	366.2	0.100%	1000	590,000	757.4	759.5	0.00034	11.9	56,268	1,469	0.30
Lower	Lower Missouri	366.2	0.080%	1250	610,000	758.3	760.4	0.00034	12.1	57,473	1,469	0.30
Lower	Lower Missouri	366.2	0.067%	1500	625,000	758.9	761.1	0.00034	12.2	58,359	1,469	0.31
Lower	Lower Missouri	366.23	10%	10	245,000	740.5	741.4	0.00025	7.7	33,139	1,392	0.24
Lower	Lower Missouri	366.23	1%	100	401,000	749.6	751.0	0.00027	9.4	46,195	1,448	0.26
Lower	Lower Missouri	366.23	0.5%	200	454,000	752.1	753.6	0.00028	10.0	49,774	1,469	0.27
Lower	Lower Missouri	366.23	0.2%	500	530,000	755.3	757.1	0.00030	10.8	54,568	1,469	0.28
Lower	Lower Missouri	366.23	0.133%	750	565,000	756.7	758.5	0.00030	11.1	56,568	1,469	0.28
Lower	Lower Missouri	366.23	0.100%	1000	590,000	757.7	759.6	0.00031	11.3	58,014	1,469	0.29
Lower	Lower Missouri	366.23	0.080%	1250	610,000	758.5	760.5	0.00031	11.5	59,225	1,469	0.29
Lower	Lower Missouri	366.23	0.067%	1500	625,000	759.1	761.1	0.00031	11.6	60,116	16,798	0.29
Lower	Lower Missouri	366.48	10%	10	245,000	740.9	741.7	0.00020	7.1	37,812	1,580	0.22
Lower	Lower Missouri	366.48	1%	100	401,000	750.2	751.3	0.00022	8.7	52,814	1,666	0.24
Lower	Lower Missouri	366.48	0.5%	200	454,000	752.7	753.9	0.00023	9.2	56,979	1,675	0.24
Lower	Lower Missouri	366.48	0.2%	500	530,000	756.0	757.5	0.00024	9.8	62,575	1,686	0.25
Lower	Lower Missouri	366.48	0.133%	750	565,000	757.4	758.9	0.00024	10.1	64,928	1,690	0.26
Lower	Lower Missouri	366.48	0.100%	1000	590,000	758.4	760.0	0.00024	10.4	66,630	1,694	0.26
Lower	Lower Missouri	366.48	0.080%	1250	610,000	759.3	760.9	0.00025	10.5	68,052	1,696	0.26
Lower	Lower Missouri	366.48	0.067%	1500	625,000	759.9	761.5	0.00025	10.6	69,101	2,279	0.26
Lower	Lower Missouri	366.75	10%	10	245,000	741.3	742.0	0.00016	6.5	41,665	1,890	0.20
Lower	Lower Missouri	366.75	1%	100	401,000	750.7	751.6	0.00017	7.9	59,769	1,972	0.21
Lower	Lower Missouri	366.75	0.5%	200	454,000	753.2	754.2	0.00018	8.4	64,780	1,981	0.22
Lower	Lower Missouri	366.75	0.2%	500	530,000	756.6	757.8	0.00018	9.0	71,515	1,992	0.22
Lower	Lower Missouri	366.75	0.133%	750	565,000	758.1	759.3	0.00019	9.2	74,353	1,996	0.23
Lower	Lower Missouri	366.75	0.100%	1000	590,000	759.1	760.3	0.00019	9.4	76,403	2,000	0.23
Lower	Lower Missouri	366.75	0.080%	1250	610,000	759.9	761.2	0.00019	9.5	78,109	2,441	0.23
Lower	Lower Missouri	366.75	0.067%	1500	625,000	760.6	761.9	0.00019	9.6	79,367	2,443	0.23
Lower	Lower Missouri	367.04	10%	10	245,000	741.5	742.3	0.00020	7.2	37,461	1,974	0.22
Lower	Lower Missouri	367.04	1%	100	401,000	750.9	751.9	0.00021	8.5	57,769	2,204	0.23
Lower	Lower Missouri	367.04	0.5%	200	454,000	753.4	754.6	0.00021	8.9	63,564	2,364	0.23
Lower	Lower Missouri	367.04	0.2%	500	530,000	756.9	758.1	0.00021	9.4	71,862	2,459	0.24
Lower	Lower Missouri	367.04	0.133%	750	565,000	758.3	759.6	0.00021	9.6	75,393	2,463	0.24
Lower	Lower Missouri	367.04	0.100%	1000	590,000	759.3	760.6	0.00021	9.8	77,942	2,467	0.24
Lower	Lower Missouri	367.04	0.080%	1250	610,000	760.2	761.5	0.00021	9.9	80,061	3,023	0.24
Lower	Lower Missouri	367.04	0.067%	1500	625,000	760.8	762.2	0.00021	10.0	81,623	3,025	0.24
Upper	Lower Missouri	367.57	10%	10	168,000	741.8	742.3	0.00013	5.2	34,898	2,071	0.18
Upper	Lower Missouri	367.57	1%	100	261,000	751.5	751.9	0.00010	5.6	58,570	2,531	0.18
Upper	Lower Missouri	367.57	0.5%	200	295,000	754.1	754.6	0.00010	5.8	65,201	2,573	0.18
Upper	Lower Missouri	367.57	0.2%	500	348,000	757.6	758.1	0.00010	6.2	74,283	2,660	0.18
Upper	Lower Missouri	367.57	0.133%	750	374,000	759.0	759.6	0.00010	6.4	78,206	2,723	0.19
Upper	Lower Missouri	367.57	0.100%	1000	394,000	760.1	760.6	0.00010	6.5	81,089	2,796	0.19
Upper	Lower Missouri	367.57	0.080%	1250	411,000	760.9	761.5	0.00010	6.6	83,509	3,953	0.19
Upper	Lower Missouri	367.57	0.067%	1500	424,000	761.6	762.2	0.00011	6.7	85,299	19,376	0.19
Upper	Lower Missouri	367.89	10%	10	168,000	741.9	742.6	0.00017	6.3	27,613	1,579	0.20
Upper	Lower Missouri	367.89	1%	100	261,000	751.5	752.2	0.00015	7.0	45,227	1,928	0.20
Upper	Lower Missouri	367.89	0.5%	200	295,000	754.1	754.8	0.00015	7.3	50,238	1,950	0.20
Upper	Lower Missouri	367.89	0.2%	500	348,000	757.5	758.4	0.00015	7.8	57,004	1,979	0.20
Upper	Lower Missouri	367.89	0.133%	750	374,000	759.0	759.9	0.00016	8.0	59,873	1,991	0.21
Upper	Lower Missouri	367.89	0.100%	1000	394,000	760.0	760.9	0.00016	8.2	61,937	1,999	0.21

Fairfax-
Jersey Creek
STA 27+50