FINAL GEOTECHNICAL INVESTIGATION & ENGINEERING ANALYSIS REPORT GOLDEN EAGLE PARK DAM NEAR GOLDEN EAGLE BOULEVARD & PALISADES BOULEVARD FOUNTAIN HILLS, ARIZONA

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Submitted To:

Stantec Consulting, Inc.
7776 Pointe Parkway West
Suite 290
Phoenix, Arizona 85044

Submitted By:

AGRA Earth & Environmental, Inc.
3232 West Virginia Avenue
Phoenix, Arizona 85009-1502

Registered Professional Engineer (Civil)
CERTIFICATE NO.
12176
NORMAN HAROLD
WETZ
Date Signed 12/10/99
ARIZONA, U.S.A.

December 10, 1999

AEE Job No. 9-117-001011

AGRA
ENGINEERING GLOBAL SOLUTIONS

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

AGRA Earth & Environmental, Inc.
3232 West Virginia Avenue
Phoenix, Arizona 85009-1502
Tel (602) 272-6848
Fax (602) 272-7239
Toll Free 1-800-248-AGRA

December 10, 1999
AEE Job No. 9-117-001011

Stantec Consulting, Inc.
7776 Pointe Parkway West
Suite 290
Phoenix, Arizona 85044

Attention: Chuck Gopperton, P.E.

Gentlemen:

RE: FINAL GEOTECHNICAL INVESTIGATION & ENGINEERING ANALYSIS REPORT GOLDEN EAGLE PARK DAM NEAR GOLDEN EAGLE BOULEVARD & PALISADES BOULEVARD FOUNTAIN HILLS, ARIZONA

Our Final Geotechnical Investigation and Engineering Analysis Report for the above referenced project is herewith submitted. The report provides the results of the subsurface investigation and laboratory analyses completed for the project, and presents criteria for design and construction of the project.

Should any questions arise concerning this report, please do not hesitate in contacting us.

Respectfully submitted,

AGRA Earth & Environmental, Inc.

Brad A. Walldorf, E.I.T.

Reviewed by:

Norman H. Wetz, P.E.
Senior Geotechnical Engineer

Registered Professional Engineer (Civil)
CERTIFICATE NO. 12176
NORMAN HAROLD WETZ
Date Signed 12/14/99
ARIZONA, U.S.A.

c: Addressee (8)

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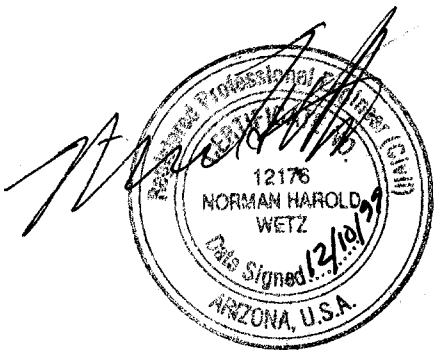

1.0 INTRODUCTION

This report presents the results of a geotechnical investigation performed by AGRA Earth & Environmental, Inc. (AEE) for the proposed modifications to Golden Eagle Park Dam in Fountain Hills, Arizona. The purpose of this investigation was to evaluate the physical properties of the soils underlying the site. Based on this evaluation, recommendations are presented for design and construction of the project.

2.0 PROJECT DESCRIPTION

Details of the project were provided to us by George Sabol, Ph.D., P.E. of Stantec Consulting, Inc. It is understood that the crest of the dam will be raised 5 feet and the emergency spillway will be expanded by adding 120 feet to the spillway crest. In addition, a low-level auxiliary outlet consisting of a 4-foot high by 10-foot wide reinforced concrete box culvert will be constructed through the earthen embankment.

The dam is a zoned earthen embankment that has a total length of about 1,000 feet, including 300 feet of emergency spillway and 700 lineal feet of embankment spillway. The crest elevation of the embankment is 1721 feet and the elevation of the spillway invert is 1716 feet. The existing slopes of the dam embankment are about 2.3H:1V (horizontal to vertical). The maximum height of the zoned earth embankment is about 28 feet. The emergency spillway consists of a concrete sill with some riprap on the downstream side of the sill. The embankment spillway consists of two 60-inch diameter reinforced concrete pipes passing through the left end of the dam.

In general, the dam appears to be in good condition. However, there are some isolated areas that have experienced some minor erosion and tree growth which potentially could adversely affect the safety of the dam. A dam safety evaluation was performed; a copy of the Dam Safety Inspection Report is provided in Appendix D (AEE, 1998)*.

3.0 INVESTIGATION

3.1 REVIEW OF EXISTING DATA

AEE has reviewed existing background information developed for the project. Available information includes original geotechnical data, as-built drawings, original contract specifications, Arizona Department of Water Resources (ADWR) "Inspection of Dam" reports,

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*References are listed at the end of this report.

the Dam Break Analysis Report for Golden Eagle Park Dam (GEPD), the GEPD Reconnaissance Study and Alternative Evaluation Interim Report and the GEPD Feasibility Study. The existing data reviewed is discussed below.

- According to the GEPD Feasibility Study, dated July 1997, three areas on the crest of the dam appear to have settled about 1 to 1.5 feet. A simplified survey of the crest of the dam was performed by AEE on February 17, 1998, indicating the crest elevation does not vary more than about 0.6 foot.

- ADWR Dam Safety Inspection Reports dated February 3, 1993 and December 27, 1989 indicated adverse vegetation and erosion on the upstream and downstream slopes. The 1989 report also indicates seepage of groundwater into the 60-inch diameter reinforced concrete pipes.

- ADWR Inspection of Dam Construction Report dated October 20, 1972 indicated that some erosion has occurred at the left downstream groin and it was requested that a down drain or other means of protection be provided.

- ADWR Inspection of Dam Construction Report dated May 8, 1972 indicated that the grouting of the pipe joints had left excess mortar on the interior of the pipes and that the "T" marks did not line up on several of the pipe joints. It was requested that the mortar in the joints be ground flush with the pipes.

- ADWR Inspection of Dam Construction Report dated April 12, 1972 noted that the outlet works may be partially founded on stream bed deposits. It was requested that the encasement be strengthened if it is founded on stream bed deposits.

- ADWR Inspection of Dam Construction Report dated April 7, 1972 indicated that contact with the clayey formation or cemented alluvium was not achieved and that the Zone I foundation was founded in gravelly clayey sand. The width of the core trench had been widened to reduce the possibility for settlement.

- U.S. Army Corps of Engineers Phase I Inspection Report dated July 11, 1978 indicated that the left abutment and upstream and downstream slopes contained no rock protection and that the upstream toe was exhibiting slight erosion. The report concluded that problems may develop in the future if rock is not added to the slopes and the left abutment.

- FCDMC Fountain Hills Flood Control Structures Report concluded that the soils in the spillway are erodible and may undermine the concrete sill and riprap.

- A review of compaction tests performed during construction indicated that the soils were compacted to at least 95 percent of maximum dry density in accordance with ASTM D1557. Dry densities varied from 127.5 to 154 lbs/ft^3 and moisture contents from 3.0 to 10.8 percent. A majority of the moisture contents were in the range of 5 to 7 percent and a majority of the dry densities were between 130 and 135 lbs/ft^3.

As-built plans prepared by Trico International, Inc. were reviewed. Deviations from the as-built plans noted during our geotechnical investigation include the following:

- Some of the riprap downstream of the concrete sill had been removed, probably to facilitate the construction of the football field for the adjacent high school.

- The plasticity and gradation of the Zone I material had not adhered to the original guide specifications for earthwork. The plasticity indices of Zone I material ranged from nonplastic to 6, whereas the original plasticity requirements were 5 to 25 and the gradation of the material was coarser than what was originally specified. Original guide specifications for earthwork are presented below:

Zone I (core)

Sieve Size (Square Openings)	Percent Passing by Weight
3-inch	100
no. 4	60-100
no. 200	15-35

The plasticity index should be between 5 and 25.

Zone II (shell)

Sieve Size (Square Openings)	Percent Passing by Weight
12-inch	100
no. 4	25-75
no. 200	0-12

The plasticity index should be less than 5.

- Zone II material did not extend all of the way up to the crest of the dam as indicated on the as-built plans. Zone I material was used to complete the dam above elevation 1716 feet because the Zone II material feathered out toward the top of the dam, and it became impractical to compact material that was thinner than equipment width.

3.2 SUBSURFACE EXPLORATION

Seven exploratory borings (Boring Nos.1 through 6 and P-1) were drilled to depths of about 2.5 to 50 feet below existing site grades. The borings were advanced using a CME-75 drill rig equipped with 6 5/8-inch O.D. hollow stem auger. Boring No. P-1 was advanced using a CME-75 drill rig equipped with 8-inch hollow stem auger. A piezometer was installed in Boring No. P-1. Standard penetration testing and open-end drive sampling were performed at selected intervals in the borings. Bulk samples of drill cuttings were also collected. During drilling, the soils encountered were continuously examined, visually classified and logged.

In addition to the borings, a total of 12 test pits were excavated to depths ranging from about 2.5 to 5.0 feet. Initially, five test pits (T-1 through T-5) were excavated to depths of about 3.5 to 5 feet below existing grade with a Case 580 backhoe. Seven additional test pits (T-6 through T-12) were excavated to depths ranging from 2.5 to 5.0 feet below existing grade in the emergency spillway to determine the presence of riprap. Test pits T-6 through T-12 were excavated using a Caterpillar 416C backhoe. Bulk samples were obtained for testing at various locations within the test pits. The soils encountered were continuously examined, visually classified and logged.

Results of the field investigation are presented in Appendix A, including a brief description of drilling and sampling equipment and procedures, a Monitor Well Completion Log of Well No. P-1 and logs of the test borings and pits. Site plans showing the test boring and pit locations are included as Figures 2 and 3. The field investigation was supervised by Brad A. Walldorf, E.I.T., of this firm.

3.3 LABORATORY ANALYSIS

Selected soil samples obtained from the borings and test pits were submitted for laboratory analysis. Grain-size analysis, Atterberg limits (plasticity index), moisture content, triaxial shear, permeability and density tests were performed on these samples. Results of the moisture content and density tests are shown on the boring and test pit logs in Appendix A. The remaining test results are presented in Appendix B.

4.0 SITE CONDITIONS & GEOTECHNICAL PROFILE

4.1 SITE CONDITIONS

The Golden Eagle Park Dam is located northwest of Fountain Hills High School near Golden Eagle Boulevard and Palisades Boulevard in Fountain Hills, Arizona. Golden Eagle Park occupies the upstream side of the dam and is fully developed with recreational facilities, with the exception of a baseball field which was under construction during our investigation. The downstream side of the dam is occupied by a football field and grandstands. The dam intersects a near-vertical cliff to the north. The dam is covered with a moderate growth of brush. A few trees are present along the toe of the dam on the upstream side, and a few scattered palo verde trees are present on the upstream and downstream slopes.

4.2 GEOTECHNICAL PROFILE

The soils encountered along the dam may be generalized as a four-strata profile as follows:

- **Stratum A.** Predominantly silty to gravelly sand with some cobbles extends from the crest of the dam to depths ranging from 7 to 18 feet. The material is generally nonplastic, slightly moist to moist, and very dense. These soils are the Zone I material (core).

- **Stratum B.** Clayey sand with some gravel and occasional cobbles is present below Stratum A and extends to depths ranging from 28 to 33 feet. This deposit is very firm to hard and low in plasticity. These soils also are the Zone I material (core).

- **Stratum C.** Sandy to clayey to silty gravel was encountered below Stratum B in borings 1 and 4 to depths of 38 and 37 feet, respectively. Boring No. 4 refused on this stratum at 37 feet. This stratum is nonplastic to low in plasticity and firm to hard. These materials are alluvial native soils.

- **Stratum D.** Silty clay and clayey silt was encountered below either Stratum B or C to the total depth of investigation. This stratum is medium to high in plasticity and the relative firmness or consistency can be described as hard. These fine grained soils are native lakebed deposits of the Pemberton Formation.

A cross section along the dam axis is shown in Figure 1.

4.3 GROUNDWATER & SOIL MOISTURE CONDITIONS

An artesian aquiclude was initially encountered in Boring No. 3 at elevation 1679.0 feet. After allowing the water level in the boring to stabilize, the water level raised to elevation 1691.5 feet. Boring Nos. 1 and 2, which were previously drilled, were checked for groundwater. Boring No. 2 had groundwater at elevation 1694.5 feet and Boring No. 1, which stayed open to a depth of 45 feet, had no indication of groundwater. Upon completion of Well No. P-1, the initial groundwater elevation was determined to be about 1671.3 feet. The water level stabilized to an elevation of about 1690.3 feet. No groundwater was encountered in any of the other borings performed for this investigation.

According to personnel at the adjacent school, a 110,000-gallon underground water tank near the dam was leaking; however, it is our understanding that the tank has been repaired and leaking has been minimized.

Soil moisture conditions were described as slightly moist to very moist and moisture contents determined for selected samples varied from 2 to 21 percent. The estimated elevation of groundwater in the general project site vicinity, based on maps presented by Hammett and Heather (1995), varies from about 1324 to 1338 feet, which is on the order of 400 feet below the crest of the dam. Thus, the groundwater encountered in the borings is most likely a perched water table due to irrigation of the park, and possibly from the golf course and its associated lakes, or the 110,000-gallon leaking tank located upstream of the dam.

5.0 SEISMIC HAZARD & EARTHQUAKE DESIGN PARAMETERS

The seismic hazard at the Golden Eagle Park Dam site was evaluated considering historic seismicity within 200 kilometers (km) of the dam site and by deterministic analysis of active faults located within 50 km of the dam site. A map of faults is not included in this report; a map of late Quaternary faulting in Arizona was published by Pearthree and others (1983) and Euge and others (1992). Pearthree (1998) recently updated the database of Quaternary faults in Arizona, and the U.S. Geological Survey, in a cooperative research project with the State of Arizona, has digitized the Quaternary fault traces.

Table 1 contains a summary of faults that are included in the lists by Euge and others (1992) or Pearthree (1998) that are located within 50 km of Golden Eagle Park Dam. The fault names, identification numbers, maximum magnitudes, and locations were taken from Euge and others (1992). Identification numbers by Pearthree (1998) are also presented. Values of mean peak and 84th percentile (one standard deviation larger than the mean) horizontal accelerations were

computed using the attenuation relationship developed by Spudich and others (1997) specifically for extensional tectonic regimes, such as the Basin and Range and Transition Zone provinces in Arizona.

TABLE 1
SUMMARY OF ACTIVE FAULTS

	Identification Number				Peak Acceleration (g)	
Fault Name	**Euge et al. (1992)**	**Pearthree (1998)**	**Maximum Magnitude**	**Distance (km)**	**Mean**	**84th Percentile**
Carefree	135	947	6.5	16.3	0.13	0.21
Rolls	142	---	6.5	21.3	0.10	0.17
Sugarloaf	141	945	6.75	25.0	0.10	0.16
Alder Creek	136	---	6.5	35.0	0.06	0.11
Horseshoe	133	946	6.75	37.0	0.07	0.11
Tonto Basin Northwest	137	---	6.5	40.0	0.06	0.09
Tonto Basin Central	138	---	6.5	45.0	0.05	0.08

Note: Peak acceleration computed using attenuation relationship of Spudich and others (1997) for rock site conditions.

The Carefree fault is the closest identified fault to the site. It is considered by Euge and others (1992) to be capable of generating earthquakes as large as magnitude 6.5. However, for rupture of its full 10.5 km length, as reported by Pearthree (1998), the expected magnitude would be 6.2, according to the procedure published by Wells and Coppersmith (1994). Pearthree (1998) summarized the Carefree fault as follows:

> "Low, fairly well defined, west- to southwest-facing fault scarps as much as 3 m high formed on Precambrian granite and possibly on Quaternary deposits. Along much of the fault zone, the fault is a contact between bedrock on the upthrown (east) side and middle Pleistocene alluvium on the downthrown (west) side. There are no unequivocal fault scarps on alluvium, but probable alluvial fault scarps observed at a couple of localities are low and gentle. Recent

> detailed geologic mapping (Skotnicki, et al., 1997) strongly suggests that middle Pleistocene deposits are faulted. Holocene and upper Pleistocene deposits cross the fault and are not displaced."

The Sugarloaf fault is considered by Euge and others (1992) to be capable of generating earthquakes as large as magnitude 6.75. However, for rupture of its full 8.0 km length, as reported by Pearthree (1998), the expected magnitude would be 6.1, according to the procedure published by Wells and Coppersmith (1994). Pearthree (1998) summarized the Sugarloaf fault as follows:

> "Fault forms low but fairly sharply-defined, east-facing scarps as much as 5 m high at the boundary between weathered Precambrian granite and Tertiary basin-fill sediment. The bedrock escarpment associated with the fault is not high, but it is quite linear and fairly steep. Fault scarps formed on alluvium are rare and poorly preserved. .... Three trenches were excavated across the fault and a natural fault exposure was cleaned off and interpreted (Pearthree et al., 1995). Detailed study of these exposures indicates that upper and probably uppermost Pleistocene alluvium is faulted against granite; middle to upper Holocene deposits are not faulted."

The omission of several of the faults in Table 1 from Pearthree's (1998) compilation of Quaternary faults in Arizona suggests that insufficient evidence exists to justify including them in the database.

Earthquake catalogs maintained by the National Geophysical Data Center (NGDC) in Boulder, Colorado, and the U.S. Geological Survey Internet site were searched for earthquakes located within a radius of 200 km of the dam site. Figure 4 shows the locations of the epicenters. Also shown are the boundaries of the seismic source zones defined by Euge and others (1992). It can be seen in Figure 4 that historical seismicity is widely scattered in the vicinity of the dam site (which lies near the edge of the Arizona Mountains Zone). A number of earthquakes are shown as having no magnitude. Typically, these are earthquakes in the catalog based on damage or felt reports. Most of these events occurred before seismographs were available to record moderate earthquakes. Improvements to the seismic monitoring networks on a worldwide basis occurred in 1963. Consequently, the threshold magnitude for detection of earthquakes improved at that time.

The historical seismicity data can be converted into a representation of earthquake activity by determining the cumulative number of earthquakes that are equal to or larger than a series of magnitudes and dividing by the number of years in the earthquake record. The annualized

earthquake activity of events of magnitude 3 or greater located within 200 km of the Golden Eagle Park Dam is shown in Figure 5. The lower curve in Figure 5 represents the same earthquake activity as described by the upper curve but normalized to an area of 1,000 km^2, or a circle with a radius of 17.8 km. The maximum earthquake magnitude shown in Figure 4 and Figure 5 is 5.2.

The data shown in Figure 4 were further developed into earthquake hazard curves shown in Figure 6. Annualized exceedance probabilities (or average recurrence intervals) are shown for a range of peak horizontal acceleration values. Plots of mean and 84th percentile peak acceleration are shown in Figure 6. As noted above, the attenuation relationship of Spudich and others (1997) for rock site conditions was used in converting the data plotted in Figure 5 to that plotted in Figure 6. Also shown in Figure 6 are probabilistic hazard curves from Euge and others (1992) and Frankel and others (1996). The curves determined by these studies are nearly identical, indicating a peak horizontal acceleration of about 0.11 g for an average recurrence interval of 2,500 years, but show higher accelerations than the site-specific deterministic analysis based on the historical earthquake catalog and faults considered active. The rate of earthquake activity within 200 km of the site has been low during historic time. The relative scarcity of geologic evidence of surface fault displacements suggests that the historically low rate probably is also representative of the prehistoric geologic rate of earthquakes in the region.

The mean and 84th percentile accelerations at the dam site for the Carefree fault, the closest active fault, are shown in Figure 6 for reference, as are values that would be generated by a magnitude 6 event at a distance of 5 km. The attenuation relationship by Spudich and others (1997) uses a distance of 0 km for all sites vertically over the projection of the subsurface fault plane. None of the faults listed in Table 1 are located under the Golden Eagle Park Dam, and a minimum distance of 5 km was used to determine maximum accelerations for non-fault specific hypothetical earthquakes (the so-called background earthquake) plotted in Figure 6. The geologic evidence of prehistoric surface faulting on the Carefree fault was discussed with Dr. Phil Pearthree, geologist with the Arizona Geological Survey (1999 personal communication). Dr. Pearthree noted that the total apparent vertical displacement across the Carefree fault in Quaternary time is probably no more than a few meters, and the slip rate is very low (< 0.01 mm/yr). Therefore, any significant earthquake activity on the Carefree fault must be very rare, even in geologic terms. Therefore, it may not be logical to have a maximum earthquake on the Carefree fault be the controlling event for design of the Golden Eagle Park Dam, particularly if the 84th percentile acceleration is used as the design parameter.

The 84th percentile acceleration at the dam site is also shown in Figure 6 for the Sugarloaf fault, the closest fault assigned a magnitude of 6.75 by Euge and others (1992). The 84th percentile acceleration for the Sugarloaf fault (0.16 g) is the 69th percentile acceleration for the Carefree fault.

Based on the data presented above, it is recommended that a peak horizontal acceleration of 0.13 g be used for the stability analysis of Golden Eagle Park Dam. Based on the 84th percentile curve shown in Figure 6, this acceleration value has an average recurrence interval of approximately 11,500 years. It also is the mean value of peak acceleration calculated for the maximum earthquake on the Carefree fault. The results of probabilistic seismic hazard analyses by Euge and others (1992) and Frankel and others (1996) suggest that the recommended design acceleration corresponds to an average recurrence interval of slightly more than 2,500 years, or a 2 percent exceedance probability in a period of 50 years.

6.0 ANALYSIS OF RESULTS & RECOMMENDATIONS

6.1 EXISTING & PROPOSED CONSTRUCTION

Golden Eagle Park Dam is a zoned earthen embankment that is approximately 28 feet high at its maximum height section. Based on a recent survey of the dam, the average slope of the upstream and downstream faces is 2.3H:1V (horizontal to vertical), as compared to the 2H:1V slope shown on the as-built construction plans.

The dam has a core that varies in width from 32 feet at the base of the dam to 16 feet near the crest at its maximum height. The construction specifications for the project indicate that the core material (Zone I) was to have 100 percent passing the 3-inch sieve, and a maximum of 35 percent passing the no. 200 sieve. In addition, the plasticity index of the material was to range between 5 and 25. Based on lab testing completed, the plasticity for the core material ranged from nonplastic to 6, and the gradation was coarser than the original specifications.

Construction specifications for the shell (Zone II) material indicated that 100 percent of the material should pass a 12-inch sieve, and a maximum of 12 percent should pass the no. 200 sieve. The plasticity of the material was to be less than 5. Laboratory testing indicates that these specifications were generally adhered to although the material is more fine that originally specified.

The proposed new construction includes widening the emergency spillway, installing a low-level auxiliary outlet consisting of a 4-foot high by 10-foot wide reinforced concrete box culvert to the right of the existing embankment spillway, and raising the dam by about 5 feet. All new material will be placed on the crest and upstream face of the existing dam. No new material will be added to the downstream face. The material will be placed at a 2H:1V slope along the upstream face.

In addition, a sand diaphragm will be constructed around the low-level auxiliary outlet to prevent piping and pressure buildup due to any leakage that may occur.

6.2 ANALYSIS OF RESULTS

AEE has completed seepage and stability analyses. The results of the analyses are presented in Sections 6.3 and 6.4, respectively. Input data and graphical output for seepage and stability analyses is included in Appendix C; additional input data is contained on enclosed CD ROM. In addition, recommendations for erosion protection and sand diaphragm design, and recommended geometry and materials for raising the dam are provided in Sections 6.5, 6.6 and 6.7, respectively.

6.3 SEEPAGE ANALYSIS

Analyses of potential seepage were completed for the maximum height section using the finite element computer program SEEP/W Version 4, developed by Geo-Slope International (1997). The analyses were limited to estimation of the seepage through the core and embankment fill section and within the upper 23.0 feet of the underlying foundation. An impervious boundary was assumed to exist at a depth of 23.0 feet, for simplicity. Table 2 lists the assumed permeability coefficients for the core, embankment fill and foundation materials. With the free water surface at the freeboard level of 3.0 feet below the dam crest, the phreatic surface is calculated to exit from the dam above the outboard dam toe, as indicated in the graphical output, Appendix C.

The phreatic line indicated in the graphical output is considered to be conservative, since the anticipated water impoundment levels will recede relatively rapidly, significantly reducing the driving pressure head, and lowering the phreatic surface. Negligible seepage is anticipated at the outboard dam face. Therefore, special protection (internal drains) of the embankment to prevent piping of soils is not considered to be necessary.

TABLE 2
Assumed Coefficients of Permeability for Flood Control Dam & Foundation Zones

Zone	Assumed Coefficient of Permeability (cm/sec)
Core (Zone I)	1×10^{-4}
Embankment Soils (Zone II)	1×10^{-2}
Foundation Soils	1×10^{-6}

Seepage beneath the embankment (within the upper 23.0 feet), computed by SEEP/W, is estimated to be 1.4×10^{-3} gallons per minute per foot of embankment, measured near the outboard dam toe. This estimated value is high for most of the dam alignment since the seepage is based on the maximum embankment section and does not account for reduced head conditions along the remainder of the dam. The analysis also assumes steady-state seepage, which likely will not develop during a short-term event. Electronic files are included with this report along with graphical output of the seepage analysis included in Appendix C.

6.4 STABILITY ANALYSIS

Analyses of embankment stability through the maximum section were performed using the computer program PC STABL5M (Achilleos, 1988). PC STABL5M is based on a two-dimensional limiting equilibrium method. The factor of safety against failure was calculated using a conventional method of slices approach with the modified Bishop method of analysis. The particular procedure employed generates circular-shaped slope surfaces between specified coordinate limits. The computed factor of safety is conservative relative to solutions obtained by more accurate methods satisfying complete equilibrium.

The geometry and strength parameters used in the analyses are listed in Table 3. The strength parameters for the various zones were chosen to represent average strengths of local materials, which will be used for embankment construction, and the underlying foundation soils. Estimates of soil strength parameters for the dam and foundation are also based on the laboratory sieve and Atterberg limits test data, as well as our experience with similar projects.

TABLE 3
Soil Strength Parameters Used for Stability Analyses

Material Type	Moist Unit Weight (pcf)	Cohesion (psf)	Internal Angle of Friction (degrees)
Core (Zone I)	130	300	32
Embankment Soils (Zone II)	135	0	38
Foundation Soils	107	1,000	28

Post-construction, steady-state seepage, rapid drawdown and pseudo-static analyses were performed for the cross section. The steady-state seepage condition assumes a fully developed phreatic surface extending through the embankment. The potential for this type of phreatic surface developing is considered to be extremely low; however, the full phreatic condition was assumed for the steady-state stability analyses. Pseudo-static analyses (assuming dry conditions) were performed assuming a horizontal acceleration of 0.13g. The likelihood of both severe flooding and a seismic event occurring simultaneously is extremely remote; thus, this combined case was not considered herein.

Results of the stability analyses are listed in Table 4, and plots of the critical shear surfaces are included within Appendix C along with input data.

TABLE 4
Results of Stability Analysis

Case	Computed Minimum Safety Factor	
	Upstream	Downsteam
Post-Construction	1.9	2.1
Steady-State	2.0	2.0
Rapid Drawdown	1.3	-
Pseudo-static	1.4	1.6

6.5 EROSION PROTECTION

According to Stantec Consulting, Inc., the exit velocity of flood waters through the emergency spillway is in the range of 10 to 25 feet per second. Due to the high velocities, a large diameter riprap material would be necessary to prevent erosion. This type of material is not available on-site, and would be expensive to import. The existing riprap extends from the sill downstream to the existing sidewalk. The maximum size of the riprap is 18 inches. The site plan in Appendix A (Figure 6) shows the extent of the existing riprap. It appears that the existing riprap is not adequate for the critical sections of the spillway where high velocity flows are anticipated. It is recommended that wire gabion baskets or mattresses be used to prevent erosion of the emergency spillway where high velocities are present.

6.6 RECOMMENDED SAND DIAPHRAGM

6.6.1 Gradation & Dimensions

The sand diaphragm was designed in accordance with the method outlined by Wilson and Marsal (1979) for filter design. The sand diaphragm material should conform to the following gradation, determined in accordance with ASTM C136:

Sieve Size (square openings)	Percent Passing by Weight
2 inch	100
1 inch	65-100
1/2 inch	50-85
No. 4	30-65
No. 10	20-50
No. 16	0-40

Dimensioning for the sand diaphragm is shown in Figure 7. The diaphragm should extend from the outer edge of the low-level auxiliary outlet 12 feet above and horizontally from the outlet, and 6 feet below. Calculations for the filter criteria of the sand diaphragm are included in Appendix C.

The sand diaphragm should be placed downstream from the centerline so that a minimum of 2 feet of cover (embankment) covers the sand diaphragm. The sand diaphragm should be drained to the downstream toe of the embankment with drain pipes paralleling the box culvert. The pipes should be located above the perched groundwater elevation of 1691.0 feet.

6.7 RECOMMENDED GEOMETRY & MATERIALS FOR DAM RAISE

6.7.1 Recommended Geometry

Based on the stability analyses reported in Section 6.4, a slope of 2H:1V is adequate for both upstream and downstream slopes. It is recommended that the core material (see Section 6.7.2) be used to raise the dam from its existing height to the proposed height. The core material should extend horizontally from the top of the existing dam to the point were it matches with the new 2H:1V slope. Below this point, Zone II material should be used for the remainder of the proposed dam addition.

6.7.2 Materials for Dam Raise

Tables 5 and 6 present recommended gradations for materials placed for Zone I (core) and Zone II (shell).

TABLE 5
Zone I (Core)

Sieve Size (Square Openings)	Percent Passing by Weight
3-inch	100
no. 4	60-100
no. 200	15-60

The plasticity index should be between nonplastic and 25.

TABLE 6
Zone II (Shell)

Sieve Size (Square Openings)	Percent Passing by Weight
12-inch	100
no. 4	25-75
no. 200	0-20

The plasticity index should be less than 10.

6.8 EARTHWORK GUIDELINES & TEMPORARY CUT SLOPES

Temporary cut slopes for the construction of the box culvert should be no steeper than 1.0H:1.0V (horizontal to vertical) when excavating in the Zone I materials (core). The cut slopes for the Zone II materials (shell) should be no steeper than 2.0H:1.0V.

Although the original embankment construction was controlled using the modified Proctor (ASTM D1557) density, it is recommended that the standard Proctor (ASTM D698) density be used to control new construction. The standard Proctor will provide for higher moisture contents to be used in construction and will provide a less brittle embankment. It will result in a better transition between the existing and new construction.

All new materials should be compacted to at least 95 percent of maximum dry density determined in accordance with ASTM D698. Moisture content during compaction should be maintained between 1 percent below to 3 percent above optimum moisture content.

Where construction of embankment materials against existing slopes occurs, the existing slope should be cut a minimum of 2.0 feet horizontally as the fill is brought up in 6- to 8-inch lifts. This will minimize the possibility of slippage between existing materials and new embankment fill. The material cut out should be compacted to the same specification as the fill material.

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AGRA Earth &
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3232 West Virginia Avenue
Phoenix, Arizona 85009
Tel (602) 272-6848
Fax (602) 272-7239
Toll Free 1-800-248-AGRA

February 23, 2000
AGRA Job No. 9-117-001011
Addendum No. 1

Stantec Consulting, Inc.
7776 Pointe Parkway West
Suite 290
Phoenix, Arizona 85044

Attention: Chuck Gopperton, P.E.

Gentlemen:

**RE: FINAL GEOTECHNICAL INVESTIGATION
& ENGINEERING ANALYSIS REPORT
GOLDEN EAGLE PARK DAM
NEAR GOLDEN EAGLE BOULEVARD
& PALISADES BOULEVARD
FOUNTAIN HILLS, ARIZONA**

In accordance with your request, we have reviewed our original Geotechnical Investigation Report with respect to seepage analysis, inlet and outlet drainage structures, box culvert settlement and floodwall design. Discussion and recommendations are given in the following paragraphs.

1.0 SEEPAGE ANALYSIS

It has been pointed out that hydraulic conductivities for the material in the dam embankment are in error. We have re-evaluated the seepage analysis and a graphical output is attached. A CD-Rom is included, providing the electronic files used in the analysis. The phreatic line was not affected, and recommendations given in the original report still apply.

2.0 BOX CULVERT SETTLEMENT

It is estimated that the maximum settlement of the box culvert will be about 0.45 inch with about 0.35 inch differential settlement from the exit points to the maximum height of embankment. It is estimated that the settlement will be gradual and should not cause adverse effects to the joints of the precast concrete box culvert.

3.0 HEADWALL & WINGWALL OF INLET & OUTLET STRUCTURES

Headwalls and wingwalls should be designed for an at-rest earth pressure with a 2H:1V (horizontal to vertical) (26.5 degrees) slope behind the walls.

A hydrostatic load diagram of 70 pounds per square foot (psf) per foot of depth is recommended for the rigid walls. This is based on the assumptions of granular backfill soils (Zone 1) being present behind the walls and no water pressure developing behind the walls. It is our opinion that there is little or no risk of water pressure developing behind the outlet walls. It is conceivable that water pressure could develop behind the inlet wall, if water were impounded and quickly drained, causing a rapid drawdown condition. In our opinion, this scenario is remote. However, an additional 62.4 psf per foot of depth should be added to the above pressures to calculate the forces on the wall if this case were to occur.

4.0 FLOODWALLS

The foundations for the floodwalls will be spread-type footings. A safe soil bearing pressure of 2,500 psf is recommended for the design of the floodwalls. This pressure should include dead plus realistic live loads and can be increased by one-third when considering wind or seismic forces. A hydrostatic diagram of 35 psf per foot is recommended for active earth pressures for level backfill behind the walls. A passive soil resistance of 350 psf per foot of depth may be applied to the walls and footings to resist lateral forces. A coefficient of friction of 0.45 is recommended for the bases of footings and the soils for resisting lateral forces.

This addendum should be attached to the original report and be made a part thereof.

Should any questions arise concerning this addendum, please do not hesitate in contacting us.

Respectfully submitted,

AGRA Earth & Environmental, Inc.

Norman H. Wetz, P.E.
Senior Geotechnical Engineer

Reviewed by:

Nicholas J. LaFronz, P.E.
Senior Engineer

c: Addressee (8)

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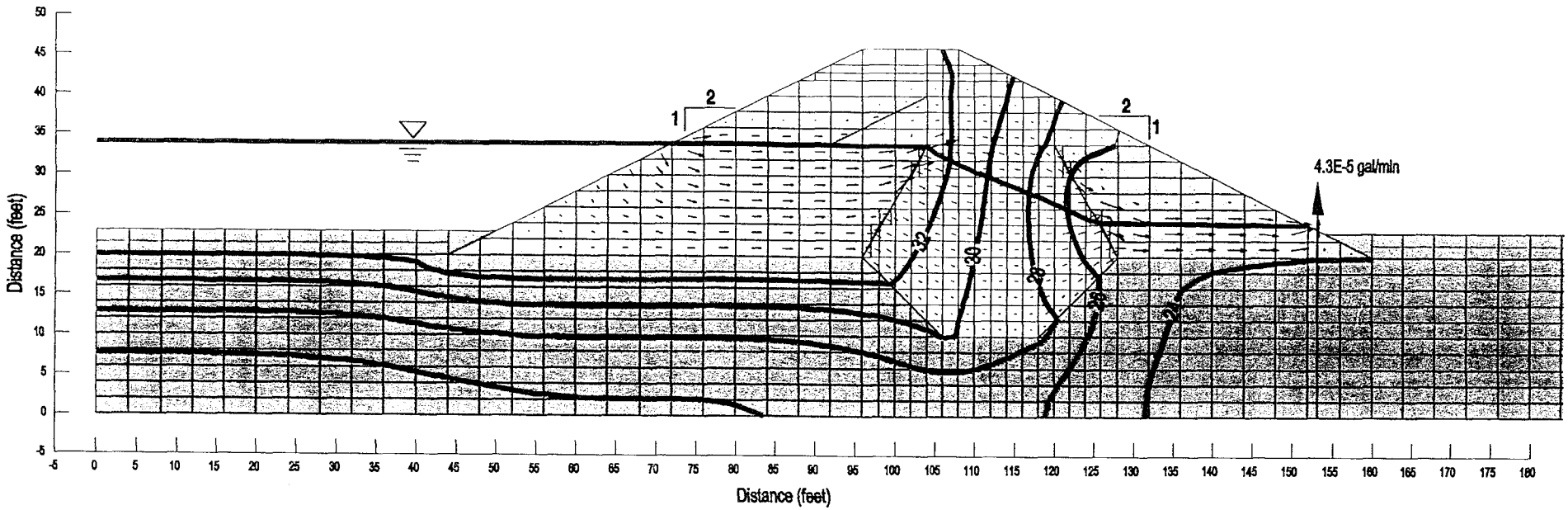

	Hydraulic Conductivity, ft/sec
Core	3.2E6
Embankment Fill	3.2E4
Foundation	3.2E8

Contours presented represent total head. Seepage rates are presented as the seepage rate for a one-foot width. Seepage analysis was modeled using the finite element computer program SEEP/W (Geo-Slope International, 1998).

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DRAWN SPG
DATE 2/2000
SCALE 1"=20'

RESULTS OF SEEPAGE ANALYSES
GOLDEN EAGLE PARK DAM
FOUNTAIN HILLS, ARIZONA

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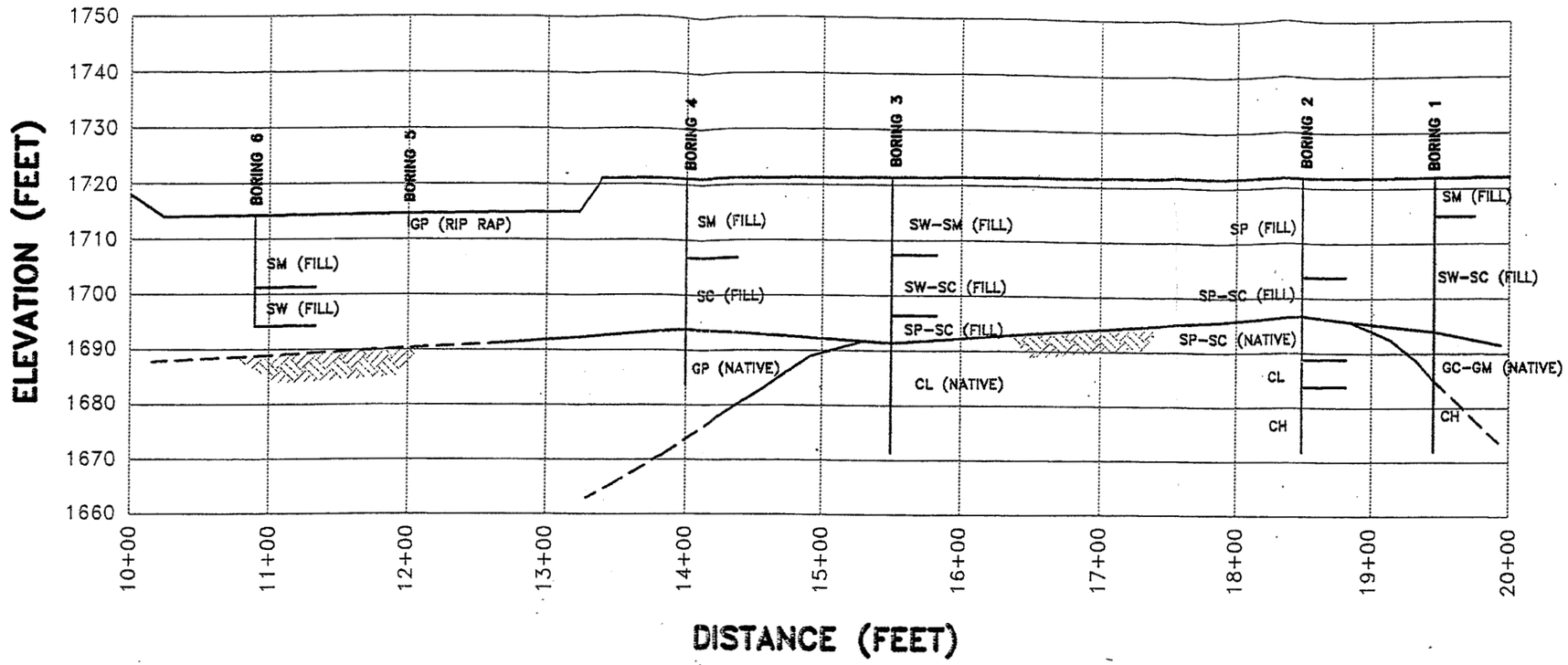
FIGURES

CROSS SECTION ALONG DAM CREST



HORIZONTAL SCALE 1"=100'

VERTICAL SCALE 1" = 25'

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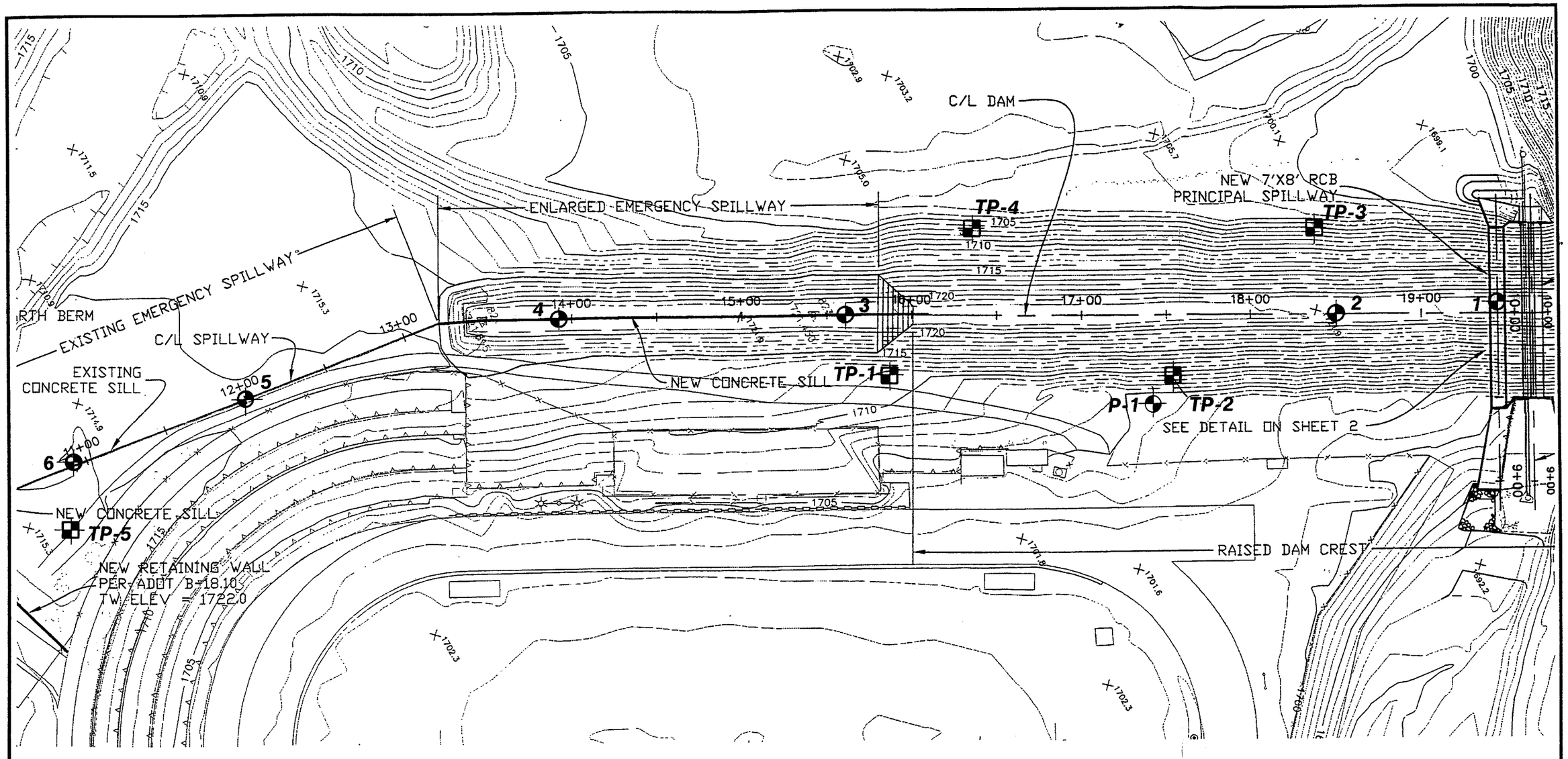
SCALE graphical

FIGURE 1
GOLDEN EAGLE PARK DAM
FOUNTAIN HILLS, ARIZONA

AEE DRAW



EXPLANATION

BORING LOCATION

TEST PIT LOCATION

P-1 PIEZOMETER LOCATION

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DRAWN	SPG
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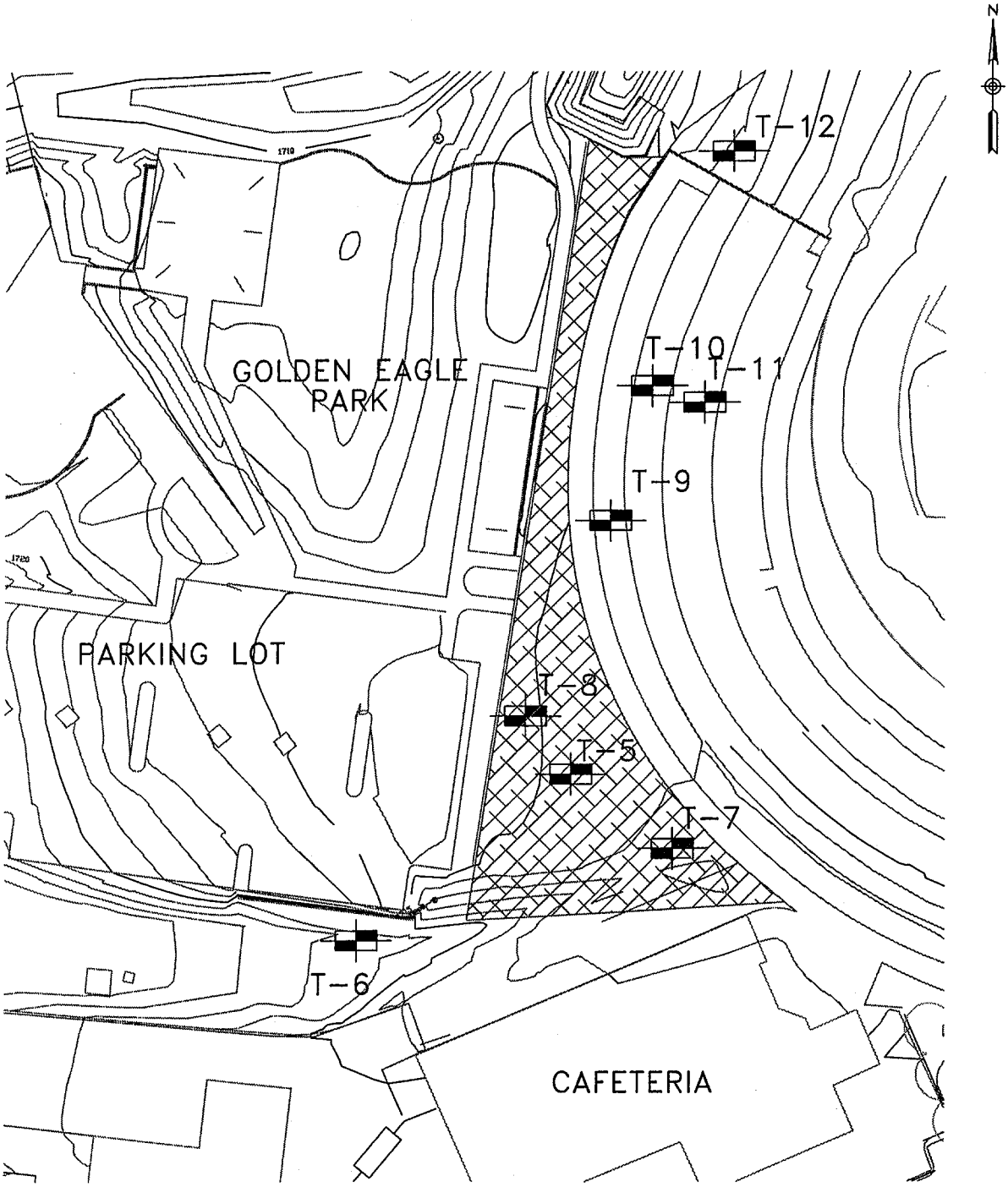
SCALE	1" = 60'

FIGURE 2
SITE PLAN
PIEZOMETER LOCATION



Hatching denotes approximate location of existing riprap.

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FIGURE 3
TEST PIT LOCATIONS

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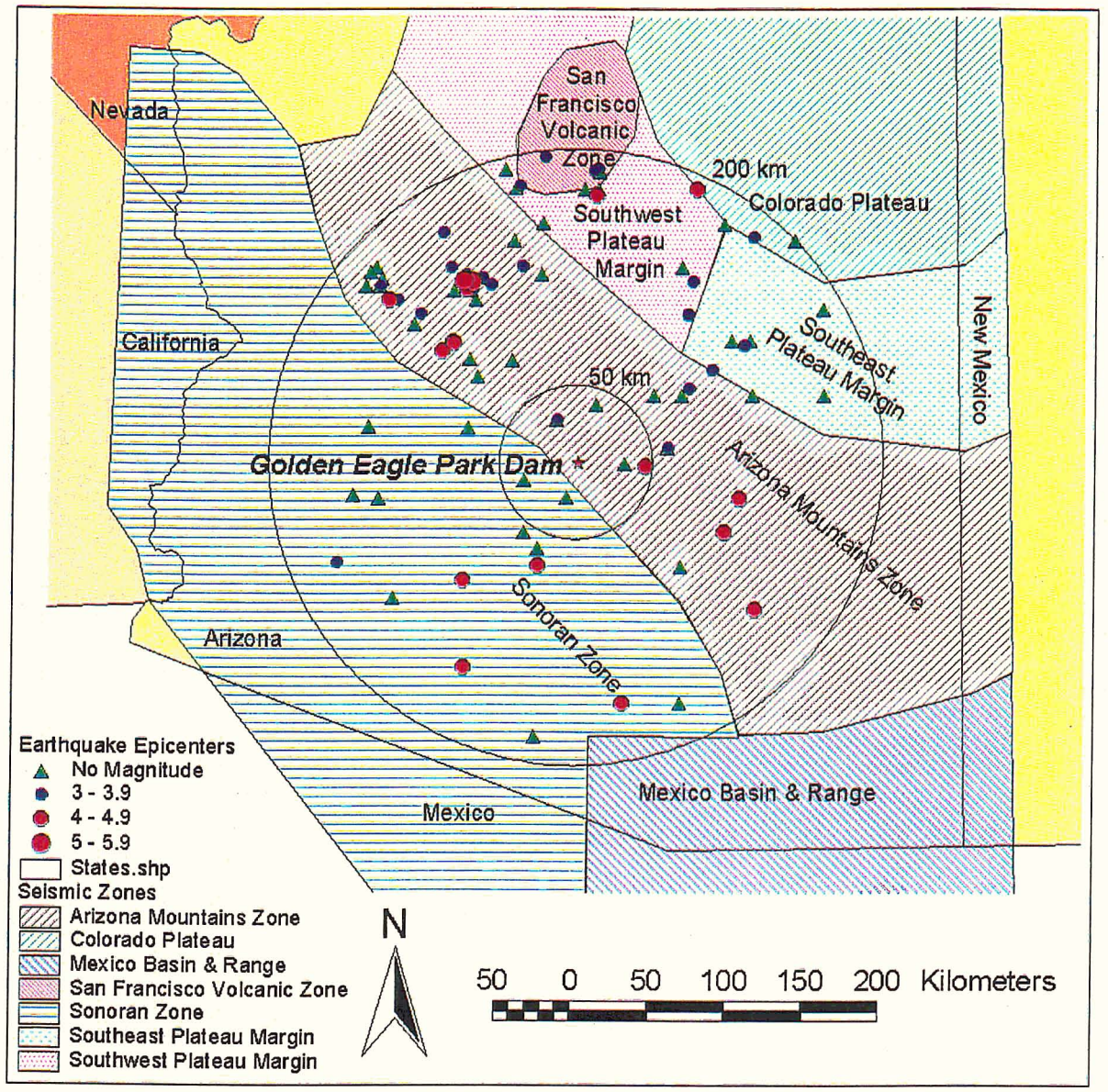

FIGURE 4

Locations of Earthquake Epicenters within 200 km
of Golden Eagle Park Dam, Fountain Hills, Arizona

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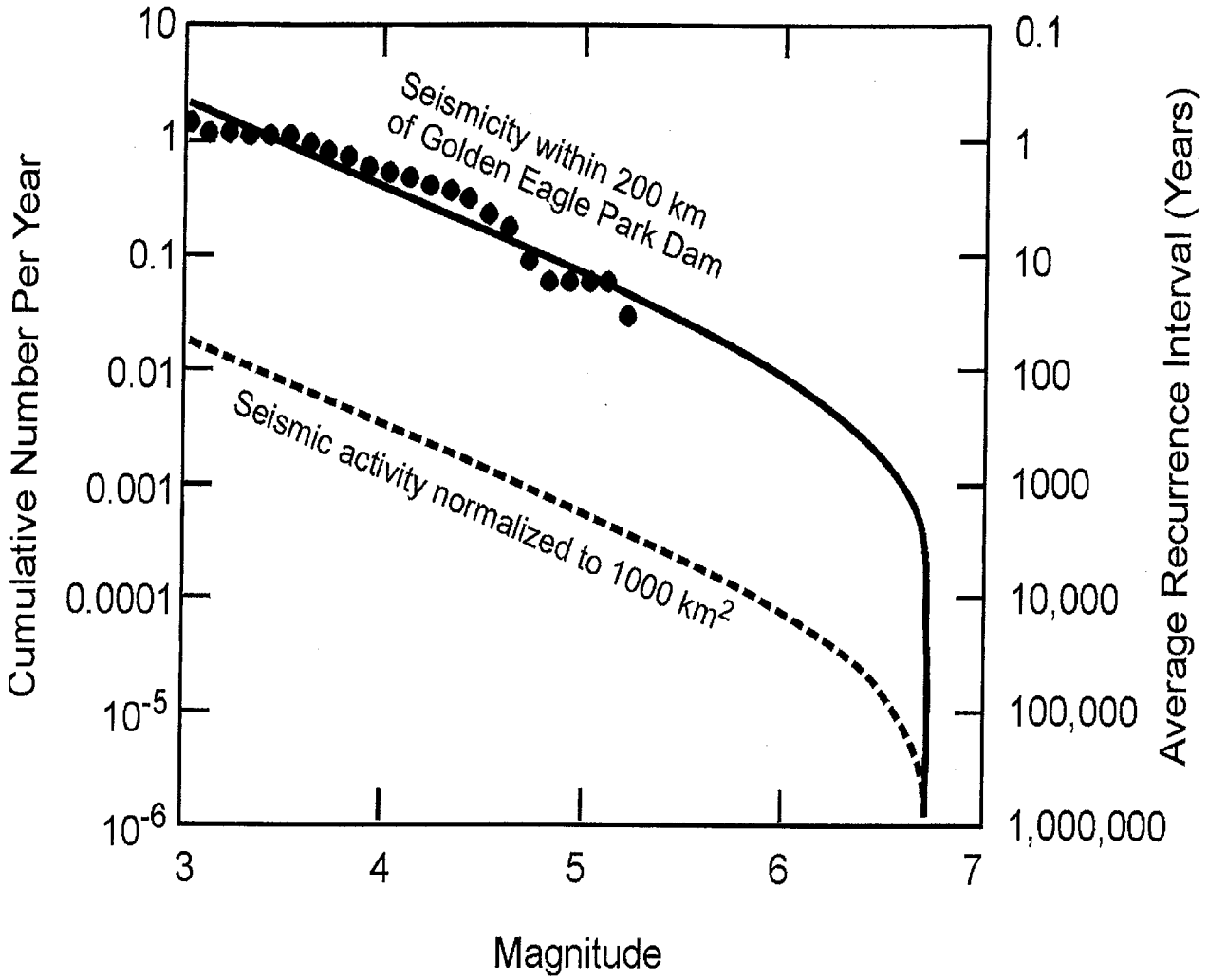

FIGURE 5

Annualized Earthquake Activity of Magnitude 3 or greater within 200 km of Golden Eagle Park Dam, Fountain Hills, Arizona

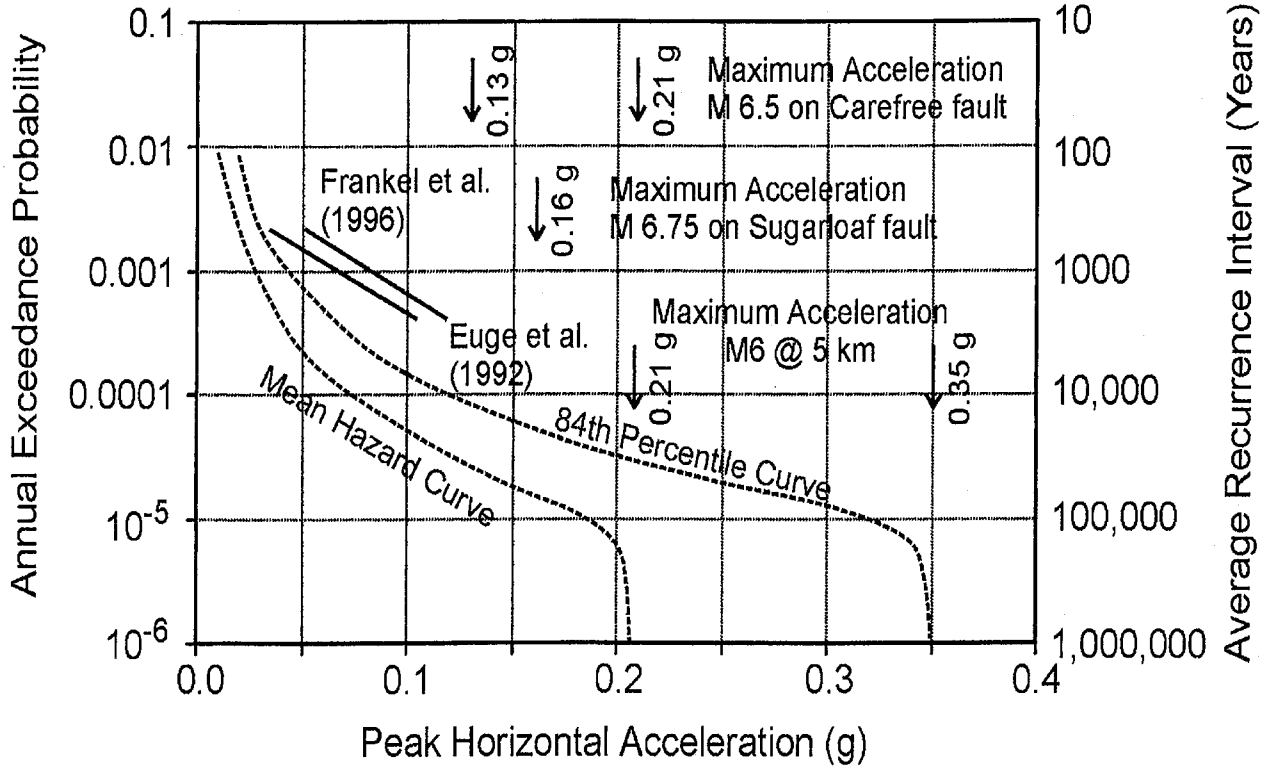

FIGURE 6

Mean and 84th Percentile Acceleration for the Carefree fault

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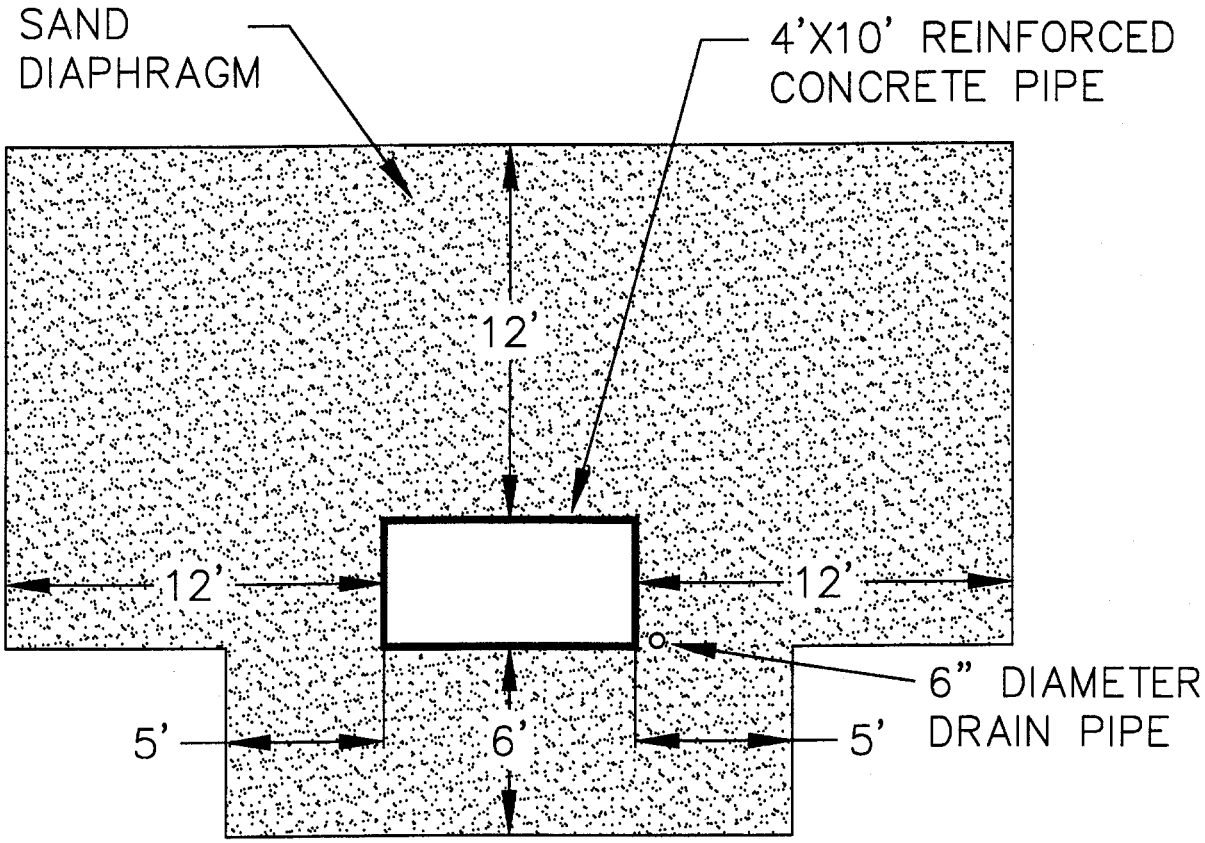

NOTE: SAND DIAPHRAGM SHOULD BE A MINIMUM OF 4' THICK

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SCALE	1"=6'

FIGURE 7
SAND DIAPHRAGM
DESIGN

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APPENDIX A

FIELD INVESTIGATION

TEST DRILLING EQUIPMENT & PROCEDURES

Description of Subsurface Exploration Methods

Auger Boring Drilling through overburden soils is performed with 6 5/8-inch O.D., 3 1/4-inch I.D. hollow stem auger or 4 1/2-inch solid stem continuous flight auger. Carbide insert teeth are normally used on bits so they can penetrate soft rock or very strongly cemented soils. A CME-75 truck-mounted drill rig is used to advance the auger. The drill rigs are powered with six-cylinder Cummins diesel engines capable of delivering about 11.4 kN-m torque to the drill spindle. The spindle is advanced with twin hydraulic rams capable of exerting 90 kN (20,000 pounds) downward force.

Generally, refusal to penetration of the auger is adopted as top of the SGC or "river-run" material or harder bedrock, which require other techniques for penetration. Grab samples or auger cuttings may be taken as necessary. Standard penetration tests or 2.42-nch diameter ring samples are taken in conjunction with the auger borings as needed, with the sampling interval and type being indicated on the boring logs.

Core Boring Rock core samples are retrieved using a CME-75 drill rig or a SAITECH GH 3 rig. The GH 3 is a portable hydraulic core drill. The GH 3 is powered by a Kohler two-cylinder 25-horsepower engine. The hydraulics motor which feeds a two-speed transmission and powers the BW spindle. This unit has a 3-foot stroke and is hand-fed with a 2,000 pound push-pull capability. The GH 3 has the capability of drilling with either B- or N-size core steel using standard or wireline systems. N-size core is the preferred size and it has a nominal O.D. of about 2 inches.

The CME-75 utilizes a wireline core drilling system that takes N-size cores. Using the NQ wireline system, core is recovered quickly by retrieving the core-laden inner tube through the drill string.

Sampling Procedures Dynamically driven tube samples are usually obtained at selected intervals in the borings by the ASTM D1586 test procedure. In many cases, 2-inch O.D., 1 3/8-inch I.D. samples are used to obtain the standard penetration resistance. "Undisturbed" samples of firmer soils are often obtained with 3-inch O.D. samples lined with 2.42-inch I.D. brass rings. The driving energy is generally recorded as the number of blows of a 140-pound, 30-inch free fall drop hammer required to advance the samples in 6-inch increments. However, in stratified soils, driving resistance is sometimes recorded in 2- or 3-inch increments so that soil changes and the presence of scattered gravel or cemented layers can be readily detected and the realistic penetration values obtained for consideration in design. These values are expressed in blows per 6 inches on the boring logs. "Undisturbed" sampling of softer soils is sometimes performed with thin walled Shelby tubes (ASTM D1587), pitcher samplers, Denison samplers or continuous CME samplers. Where samples of rock are required, they are obtained by NQ diamond core drilling (ASTM D2113). Tube samples are labeled and placed in watertight containers to maintain field moisture contents for testing. When necessary for testing, larger bulk samples are taken from auger cuttings. Also, representative samples are obtained from the cuttings from the hammer and Schramm drill rig.

Boring Records Drilling operations are directed by our field engineer or geologist who examines soil recovery and prepares the boring logs. Soils are visually classified in accordance with the Unified Soil Classification System (ASTM D2487), with appropriate group symbols being shown on the boring logs.

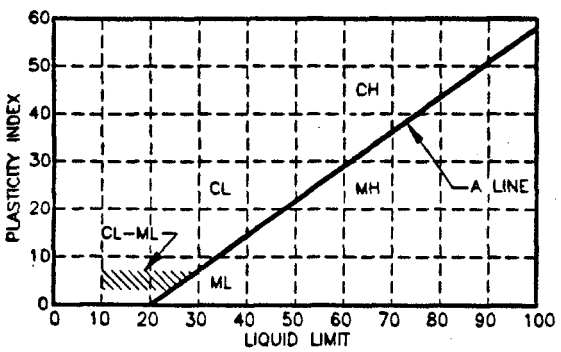
UNIFIED CLASSIFICATION SYSTEM FOR SOILS

Soils are visually classified by the Unified Soil Classification System on the boring logs presented in this report. Grain-size analysis and Atterberg Limits Tests are often performed on selected samples to aid in classification. The classification system is briefly outlined on this chart. For a more detailed description of the system, see "The Unified Soil Classification System" ASTM Designation: D2487.

MAJOR DIVISION				GRAPH SYMBOLS	GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE-GRAINED SOILS (Less than 50% passes No. 200 sieve)	GRAVELS (50% or less of coarse fraction passes No. 4 sieve)	CLEAN GRAVELS (Less than 5% passes No. 200 sieve)			GW	Well graded gravels, gravel-sand mixtures or sand-gravel-cobble mixtures.
					GP	poorly graded gravels, gravel-sand mixtures, or sand-gravel-cobble mixtures.
		GRAVELS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on plasticity chart		GM	Silty gravels, gravel-sand-silt mixtures.
			Limits plot above "A" line & hatched zone on plasticity chart		GC	Clayey gravels, gravel-sand-clay mixtures.
	SANDS (More than 50% of coarse fraction passes No. 4 sieve)	CLEAN SANDS (Less than 5% passes No. 200 sieve)			SW	Well graded sands, gravelly sands.
					SP	Poorly graded sands, gravelly sands.
		SANDS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on plasticity chart		SM	Silty sands, sand-silt mixtures.
			Limits plot above "A" line & hatched zone on plasticity chart		SC	Clayey sands, sand-clay mixtures.
FINE-GRAINED SOILS (50% or more passes No. 200 sieve)	SILTS LIMITS PLOT BELOW "A" LINE & HATCH ZONE ON PLASTICITY CHART	SILTS OF LOW PLASTICITY (Liquid Limit Less Than 50)			ML	Inorganic silts, clayey silts with slight plasticity.
		SILTS OF HIGH PLASTICITY (Liquid Limit More Than 50)			MH	Inorganic silts of high plasticity, silty soils, elastic silts.
	CLAYS LIMITS PLOT ABOVE "A" LINE & HATCH ZONE ON PLASTICITY CHART	CLAYS OF LOW PLASTICITY (Liquid Limit Less Than 50)			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		CLAYS OF HIGH PLASTICITY (Liquid Limit More Than 50)			CH	Inorganic clays of high plasticity, fat clays, silty and sandy clays of high plasticity.

NOTE: Coarse-grained soils with between 5% & 12% passing the No. 200 sieve and fine-grained soils with limits plotting in the hatched zone on the plasticity chart to have dual symbol.

PLASTICITY CHART



DEFINITIONS OF SOIL FRACTIONS

SOIL COMPONENT	PARTICLE SIZE RANGE
Boulders	Above 300mm (12in.)
Cobbles	300mm to 75mm (12in. to 3in.)
Gravel	75mm (3in.) to No. 4 sieve
Coarse gravel	75mm to 19mm (3in. to 3/4in.)
Fine gravel	19mm (3/4in.) to No. 4 sieve
Sand	No. 4 to No. 200
Coarse	No. 4 to No. 10
Medium	No. 10 to No. 40
Fine	No. 40 to No. 200
Fines (silt or clay)	Below No. 200 sieve

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TERMINOLOGY USED TO DESCRIBE THE RELATIVE DENSITY, CONSISTENCY OR FIRMNESS OF SOILS

The terminology used on the boring logs to describe the relative density, consistency or firmness of soils relative to the standard penetration resistance is presented below. The standard penetration resistance (N) in blows per foot is obtained by the ASTM D1586 procedure using 2" O.D., 1 3/8" I.D. samplers.

1. Relative Density. Terms for description of relative density of cohesionless, uncemented sands and sand-gravel mixtures.

N	Relative Density
0-4	Very loose
5-10	Loose
11-30	Medium dense
31-50	Dense
50+	Very dense

2. Relative Consistency. Terms for description of clays which are saturated or near saturation.

N	Relative Consistency	Remarks
0-2	Very soft	Easily penetrated several inches with fist.
3-4	Soft	Easily penetrated several inches with thumb.
5-8	Medium stiff	Can be penetrated several inches with thumb with moderate effort.
9-15	Stiff	Readily indented with thumb, but penetrated only with great effort.
16-30	Very stiff	Readily indented with thumbnail.
30+	Hard	Indented only with difficulty by thumbnail.

3. Relative Firmness. Terms for description of partially saturated and/or cemented soils which commonly occur in the Southwest including clays, cemented granular materials, silts and silty and clayey granular soils.

N	Relative Firmness
0-4	Very soft
5-8	Soft
9-15	Moderately firm
16-30	Firm
31-50	Very firm
50+	Hard

PROJECT Golden Eagle Park Dam

LOG OF TEST BORING NO. P-1

JOB NO. 8-117-001014 DATE 5-5-98

LOCATION See Site Plan
RIG TYPE CME-75
BORING TYPE 8" Hollow Stem Auger
SURFACE ELEV. 1705.0'
DATUM Embankment Plan, GVSCE, Inc.

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	6-50/4"			SM	slightly moist very dense	**SILTY SAND**, trace of gravel, predominantly medium to coarse grained sand, fine grained gravel, subangular to subrounded, nonplastic, light brown
5				S	14-16-32			SM	slightly moist to moist	**SILTY SAND & GRAVEL**, predominantly medium to coarse grained sand, predominantly fine grained gravel, subangular to subrounded, nonplastic to low plasticity
10				S	10-13-16				medium dense to dense	note: occasional cobbles from 3' to 5'
15				S	12-28-42				moist to very moist hard	**SILTY CLAY**, moderately lime cemented, medium plasticity, brown
20				S	20-32-50/5"			CL		
25				S	25-50/3"					
30				S	33-50/5"					
35				S	50/5"					
40										Stopped Auger at 37'
45										
50										

GROUNDWATER

DEPTH	HOUR	DATE
33.3	10:18	5-5-98
14.5	14:14	5-5-98
14.3	15:00	5-5-98
14.3	09:30	5-6-98

SAMPLE TYPE

A - Drill Cuttings
S - 2" O.D., 1.38" I.D. Tube Sample.
T - Thin Walled Shelby Tube
U - 3" O.D., 2.42" I.D. Tube Sample.
NR - No Recovery

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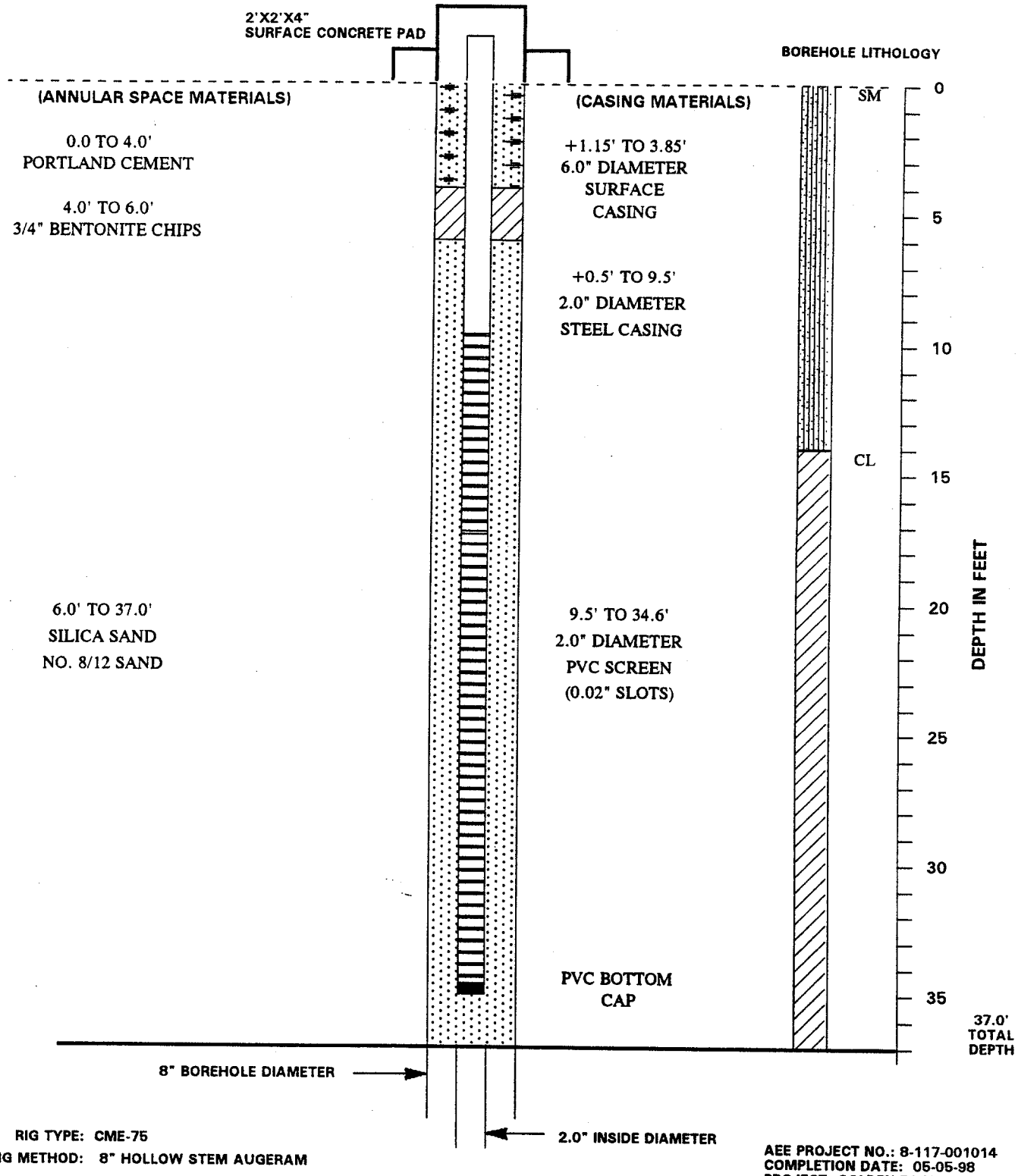
8-117-001014 GWH 07/20/98



RIG TYPE: CME-75
DRILLING METHOD: 8" HOLLOW STEM AUGERAM

AEE PROJECT NO.: 8-117-001014
COMPLETION DATE: 05-05-98
PROJECT: GOLDEN EAGLE D
LOCATION:

MONITOR WELL COMPLETION LOG
WELL NO. P-1
ADWR REGISTRATION NO.
55-567927

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PROJECT Golden Eagle Park Dam

LOG OF TEST BORING NO. 1

JOB NO. 8-117-001014 DATE 2-19-98

LOCATION Sta. 19+45, 5' L
RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV. 1722.0'
DATUM Embankment Plan, GVSCE, Inc.

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0									slightly moist to moist	Man-made FILL **SILTY SAND**, some fine grained gravel & cobbles, predominantly medium to, coarse grained, subangular to angular, nonplastic, brown
								SM		
5				S	38-45-50/5"				very dense	
										Man-made FILL **CLAYEY SAND**, trace to some fine grained gravel, well graded, low plasticity, brown
10				U	67				moist hard	
15				U	61	125	5	SW-SC		
20				U	66	119	7			
25				U	74	125	7			
30				S	12-15-16				moist firm to hard	**CLAYEY TO SILTY GRAVEL**, some sand, well graded, subangular to angular, low plasticity, dark brown
								GC-GM		
35				S	37-49-35		7			
40				S	23-50/5 1/2"				moist hard	**SILTY CLAY TO CLAYEY SILT**, moderately lime cemented, medium to high plasticity, brown
								CH/ML		
45				S	19-36-50/2 1/2"		21			
50										

8-117-001014 GWH 12/06/99

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A - Drill Cuttings
S - 2" O.D., 1.38" I.D. Tube Sample.
T - Thin Walled Shelby Tube
U - 3" O.D., 2.42" I.D. Tube Sample.
NR - No Recovery

AGRA
ENGINEERING GLOBAL SOLUTIONS

PROJECT Golden Eagle Park Dam

LOG OF TEST BORING NO. 1

JOB NO. 8-117-001014 DATE 2-19-98

LOCATION Sta. 19+45, 5' L
RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV. 1722.0'
DATUM Embankment Plan, GVSCE, Inc.

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
50				S	25-45-50/2"				moist hard	**SILTY CLAY**, continued
										Stopped Auger at 50' Sampler refused at 51'2"
55										
60										
65										
70										
75										
80										
85										
90										
95										
100										

8-117-001014 GWH 12/06/99

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A - Drill Cuttings
S - 2" O.D., 1.38" I.D. Tube Sample.
T - Thin Walled Shelby Tube
U - 3" O.D., 2.42" I.D. Tube Sample.
NR - No Recovery

AGRA
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PROJECT Golden Eagle Park Dam

LOG OF TEST BORING NO. 2

JOB NO. 8-117-001014 DATE 2-19-98

LOCATION Sta. 18 + 50, on centerline
RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV. 1722.0'
DATUM Embankment Plan, GVSCE, Inc.

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0									moist very dense	Man-made FILL **GRAVELLY SAND**, some cobbles, some silt & clay, predominantly coarse grained, subangular to angular, nonplastic, light brown
5				S	50/5"			SM		
10				S	36-43-44					
15				S	100/11"					
20				U	100/6"			SP-SC	moist very firm to hard	Man-made FILL **CLAYEY SAND**, some fine grained gravel, predominantly coarse grained, subangular to angular, low to medium plasticity, brown note: some cobbles from 20' to 25'
				A						
25				U	49					
30				S	12-12-16			SP-SC	moist firm	**CLAYEY SAND**, some fine grained gravel, predominantly coarse grained, subangular to angular, low plasticity, dark brown
35				S	22-50/5"			CL	moist hard	**SILTY CLAY**, weakly to moderately lime cemented, predominantly coarse grained, medium plasticity, dark brown
40								CH	moist hard	**SILTY CLAY**, weakly to moderately lime cemented, high plasticity, brown
45				S	21-31-50/3"					
50										

GROUNDWATER

DEPTH	HOUR	DATE
27.5	17:00	2-23-98

SAMPLE TYPE

A - Drill Cuttings
S - 2" O.D., 1.38" I.D. Tube Sample.
T - Thin Walled Shelby Tube
U - 3" O.D., 2.42" I.D. Tube Sample.
NR - No Recovery

AGRA
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8-117-001014 GWH 12/06/99

PROJECT Golden Eagle Park Dam

LOG OF TEST BORING NO. 2

JOB NO. 8-117-001014 DATE 2-19-98

LOCATION Sta. 18+50, on centerline
RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV. 1722.0'
DATUM Embankment Plan, GVSCE, Inc.

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
50				S	32-50/6"				moist hard	**SILTY CLAY**, continued
										Stopped Auger at 50' Stopped Sampler at 51'
55										
60										
65										
70										
75										
80										
85										
90										
95										
100										

8-117-001014 GWH 12/06/99

GROUNDWATER

DEPTH	HOUR	DATE
27.5	17:00	2-23-98

SAMPLE TYPE

A - Drill Cuttings
S - 2" O.D., 1.38" I.D. Tube Sample.
T - Thin Walled Shelby Tube
U - 3" O.D., 2.42" I.D. Tube Sample.
NR - No Recovery

AGRA
ENGINEERING GLOBAL SOLUTIONS

PROJECT Golden Eagle Park Dam

LOG OF TEST BORING NO. 3

JOB NO. 8-117-001014 DATE 2-23-98

LOCATION Sta. 15 + 50, on centerline
RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV. 1721.0'
DATUM Embankment Plan, GVSCE, Inc.

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0									slightly moist very dense	Man-made FILL **SILTY SAND**, some cobbles & gravel, trace of clay, well graded, subangular, nonplastic, light brown note: increasing silt with depth
5				S	29-36-49		5	SW-SM		
10				U	74		2			
15				U	65	116	6		moist hard	Man-made FILL **CLAYEY SAND**, some gravel & cobbles, well graded, subangular, low plasticity, brown
								SW-SC		
20				U	55	119	4			
25				U	86	123	8		moist hard	Man-made FILL **CLAYEY SAND**, some fine grained gravel, predominantly medium grained, subangular, low plasticity, dark brown
								SP-SC		
30				U	100/11"	102	21		moist hard	**SILTY CLAY TO CLAYEY SILT**, moderately lime cemented, medium plasticity, brown
35				U	100/7	102	19			
								ML/CL		
40				U	100/8"	104	19			
45				S	27-47-50/3"		20			
50										

GROUNDWATER

DEPTH	HOUR	DATE
30.7	11:49	2-23-98
30.0	12:07	2-23-98
28.9	12:49	2-23-98
29.5	17:00	2-23-98

SAMPLE TYPE

A - Drill Cuttings
S - 2" O.D., 1.38" I.D. Tube Sample.
T - Thin Walled Shelby Tube
U - 3" O.D., 2.42" I.D. Tube Sample.
NR - No Recovery

AGRA
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8-117-001014 GWH 12/06/99

PROJECT Golden Eagle Park Dam

LOG OF TEST BORING NO. 3

JOB NO. 8-117-001014 DATE 2-23-98

LOCATION Sta. 15+50, on centerline
RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV. 1721.0'
DATUM Embankment Plan, GVSCE, Inc.

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
50				S	50/5"		20			**SILTY CLAY**, continued
										Stopped Auger at 50'
										Sampler refused at 50'5"
55										
60										
65										
70										
75										
80										
85										
90										
95										
100										

8-117-001014 GWH 12/06/99

GROUNDWATER

DEPTH	HOUR	DATE
30.7	11:49	2-23-98
30.0	12:07	2-23-98
28.9	12:49	2-23-98
29.5	17:00	2-23-98

SAMPLE TYPE

A - Drill Cuttings
S - 2" O.D., 1.38" I.D. Tube Sample.
T - Thin Walled Shelby Tube
U - 3" O.D., 2.42" I.D. Tube Sample.
NR - No Recovery

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PROJECT Golden Eagle Park Dam

LOG OF TEST BORING NO. 5

JOB NO. 8-117-001014 DATE 2-23-98

LOCATION Sta. 12+00, on centerline
RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV. 1715.0'
DATUM Embankment Plan, GVSCE, Inc.

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0								GP	slightly moist	Man-made FILL (Riprap) **COBBLES & BOULDERS**, some silt, some sand & gravel, angular, nonplastic, light brown note: upper 6" of silty sand overlying riprap
										Auger refused at 2'6"
5										
10										
15										
20										
25										
30										
35										
40										
45										
50										

8-117-001014 GWH 12/06/99

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A - Drill Cuttings
S - 2" O.D., 1.38" I.D. Tube Sample.
T - Thin Walled Shelby Tube
U - 3" O.D., 2.42" I.D. Tube Sample.
NR - No Recovery

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PROJECT Golden Eagle Park Dam

LOG OF TEST BORING NO. 6

JOB NO. 8-117-001014 DATE 2-23-98

LOCATION Sta. 10+90, 3' L
RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV. 1715.0'
DATUM Embankment Plan, GVSCE, Inc.

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0									moist to very moist	Man-made FILL **SILTY SAND**, some gravel, trace of cobbles, well graded, subangular, nonplastic, light brown
								SM	dense to very dense	
5				S	26-21-22		11			
10				S	17-26-50/3"		11			
15				S	13-21-20		6	SW	very moist dense	Man-made FILL **GRAVELLY SAND**, well graded, subangular, nonplastic, brown
20				A						Auger refused at 20'
25										
30										
35										
40										
45										
50										

8-117-001014 GWH 12/06/99

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A - Drill Cuttings
S - 2" O.D., 1.38" I.D. Tube Sample.
T - Thin Walled Shelby Tube
U - 3" O.D., 2.42" I.D. Tube Sample.
NR - No Recovery

AGRA
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PROJECT Golden Eagle Park Dam

LOG OF TEST PIT NO. TP-1

JOB NO. 7-119-001014

DATE 2-18-98

GROUNDWATER

DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580
LOCATION Sta. 16+80, 30' R
ELEVATION 1713.0'
DATUM Embankment Plan, GVSCE, Inc.

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Soil/Rock Classification	REMARKS	VISUAL CLASSIFICATION
0			D			moist	**SILTY SAND**, some cobbles, considerable gravel, predominantly medium grained, subangular, nonplastic, light brown
1							
					SM		
2							
3							
4							
5							Stopped Backhoe at 4'6"
6							
7							
8							
9							
10							

SAMPLE TYPE

B - Undisturbed Block Sample.
D - Disturbed Bulk Sample.

7-119-001014.GWH 12/06/99

AGRA
ENGINEERING GLOBAL SOLUTIONS

PROJECT Golden Eagle Park Dam

LOG OF TEST PIT NO. TP-2

JOB NO. 7-119-001014

DATE 2-18-98

GROUNDWATER		
DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580
LOCATION Sta. 17+55, 35' R
ELEVATION 1708.0'
DATUM Embankment Plan, GVSCE, Inc.

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Soil/Rock Classification	REMARKS	VISUAL CLASSIFICATION
0			D			moist	**CLAYEY GRAVEL**, some cobbles, considerable sand, trace of boulders up to 14" in diameter, predominantly coarse grained, subangular, low plasticity, light brown
1							
					GP-GC		
2							
3							
4							
5							Stopped Backhoe at 5'
6							
7							
8							
9							
10							

SAMPLE TYPE

B - Undisturbed Block Sample.
D - Disturbed Bulk Sample.

7-119-001014.GWH 12/06/99

AGRA
ENGINEERING GLOBAL SOLUTIONS

PROJECT Golden Eagle Park Dam

LOG OF TEST PIT NO. TP-3

JOB NO. 7-119-001014

DATE 2-18-98

GROUNDWATER

DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580
LOCATION Sta. 16+35, 50' R
ELEVATION 1705.0'
DATUM Embankment Plan, GVSCE, Inc.

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Soil/Rock Classification	REMARKS	VISUAL CLASSIFICATION
0			D			moist	**SILTY SAND**, considerable gravel, some cobbles up to 10" in diameter, predominantly medium grained, nonplastic, light brown
1					SM		
2							
3							
4							
5							Stopped Backhoe at 5'
6							
7							
8							
9							
10							

SAMPLE TYPE

B - Undisturbed Block Sample.
D - Disturbed Bulk Sample.

7-119-001014 GWH 12/06/99

AGRA
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PROJECT Golden Eagle Park Dam

LOG OF TEST PIT NO. TP-4

JOB NO. 7-119-001014

DATE 2-18-98

GROUNDWATER

DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580
LOCATION Sta. 16+40, 55' L
ELEVATION 1705.0'
DATUM Embankment Plan, GVSCE, Inc.

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Soil/Rock Classification	REMARKS	VISUAL CLASSIFICATION
0			D			moist	**SILTY SAND**, considerable gravel, some cobbles & boulders up to 16" in diameter, predominantly medium grained, subangular, nonplastic, light brown
1							
					SP-SM		
2							
3							
4							
5							Stopped Backhoe at 5'
6							
7							
8							
9							
10							

SAMPLE TYPE

B - Undisturbed Block Sample.
D - Disturbed Bulk Sample.

7-119-001014.GWH 12/06/99

AGRA
ENGINEERING GLOBAL SOLUTIONS

PROJECT Golden Eagle Park Dam

LOG OF TEST PIT NO. TP-5

JOB NO. 7-119-001014 DATE 2-18-98

GROUNDWATER		
DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580
LOCATION Sta. 10+05, 10' R
ELEVATION 1719.0'
DATUM Embankment Plan, GVSCE, Inc.

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Soil/Rock Classification	REMARKS	VISUAL CLASSIFICATION
0			D			moist	Man-made FILL (Riprap) **COBBLES & BOULDERS**, some silt, sand & gravel, angular, nonplastic, light brown
					GP		note: sample is not representative of coarse fraction of material
1							
			D				**CLAYEY SAND**, considerable fine grained gravel, predominantly coarse grained, subangular, strongly lime cemented, low plasticity, light brown
2					SP-SC	slightly moist	
3							
4							Backhoe refused at 3'6"
5							
6							
7							
8							
9							
10							

SAMPLE TYPE
B - Undisturbed Block Sample.
D - Disturbed Bulk Sample.

7-119-001014 GWH 12/06/99

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PROJECT Golden Eagle Park Dam
Near Golden Eagle Boulevard & Palisades Boulevard
Fountain Hills, Arizona

LOG OF TEST PIT NO. T6

JOB NO. 9-117-001011 **DATE** 7/14/99

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

BACKHOE TYPE CAT 416C
LOCATION See Site Plan
SURFACE ELEV.
DATUM

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0					SP-SM	slightly moist	**SILTY SAND & GRAVEL**, predominantly medium to coarse grained sand, fine grained gravel, subangular, nonplastic, brown
			D				
					GP	slightly moist	**CLAYEY SAND, GRAVEL & COBBLES**, subangular to angular, lime cementation, low to medium plasticity, light brown
							Stopped Backhoe at 4'
5							
10							
15							
20							
25							

SAMPLE TYPE

B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample

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ENGINEERING GLOBAL SOLUTIONS

PROJECT Golden Eagle Park Dam
Near Golden Eagle Boulevard & Palisades Boulevard
Fountain Hills, Arizona

LOG OF TEST PIT NO. T8

JOB NO. 9-117-001011 **DATE** 7/14/99

GROUNDWATER

DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CAT 416C
LOCATION See Site Plan
SURFACE ELEV.
DATUM

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			D		GM	slightly moist to moist	FILL (Rip Rap) **SILTY SAND, BOULDERS & COBBLES**, boulders up to 18" in diameter, predominantly coarse to medium grained sand, angular, low plasticity, brown
			D		SM	slightly moist	Native **SILTY SAND**, medium to coarse grained sand, angular to subangular, nonplastic to low plasticity, brown
							Stopped Backhoe at 3'
5							
10							
15							
20							
25							

SAMPLE TYPE

B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample

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PROJECT Golden Eagle Park Dam
Near Golden Eagle Boulevard & Palisades Boulevard
Fountain Hills, Arizona

LOG OF TEST PIT NO. T10

JOB NO. 9-117-001011 **DATE** 7/14/99

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

BACKHOE TYPE CAT 416C
LOCATION See Site Plan
SURFACE ELEV.
DATUM

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0					SM	slightly moist to moist	**SILTY SAND**, some fine grained gravel, fine to coarse grained sand, subangular, nonplastic to low plasticity, brown note: occasional cobbles up to 5" in diameter from 1' to 4'
			D				
5							Stopped Backhoe at 4'
10							
15							
20							
25							

SAMPLE TYPE

B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample

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PROJECT Golden Eagle Park Dam
Near Golden Eagle Boulevard & Palisades Boulevard
Fountain Hills, Arizona

LOG OF TEST PIT NO. T11

JOB NO. 9-117-001011 **DATE** 7/14/99

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

BACKHOE TYPE CAT 416C
LOCATION See Site Plan
SURFACE ELEV.
DATUM

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0					SP-SM	slightly moist	**SILTY SAND & GRAVEL**, fine to coarse grained sand, predominantly fine grained gravel, subangular to angular, nonplastic to low plasticity, light brown
			D				
					SP	moist	**SAND**, trace of fine grained gravel, coarse grained, subangular, nonplastic, brown
							Stopped Backhoe at 3'
5							
10							
15							
20							
25							

SAMPLE TYPE

B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample

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PROJECT Golden Eagle Park Dam
Near Golden Eagle Boulevard & Palisades Boulevard
Fountain Hills, Arizona

LOG OF TEST PIT NO. T12

JOB NO. 9-117-001011 **DATE** 7/14/99

GROUNDWATER

	DEPTH	HOUR	DATE
∇		none	
▼			

BACKHOE TYPE CAT 416C
LOCATION See Site Plan
SURFACE ELEV.
DATUM

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0					SM	slightly moist	**SILTY SAND & GRAVEL**, trace of cobbles up to 12" in diameter, fine to coarse grained sand, fine to coarse grained gravel, angular, nonplastic to low plasticity, light brown
			D				
					SP	moist to slightly moist	**SAND & GRAVEL**, some silt, predominantly coarse grained sand, fine grained gravel, subangular to subrounded, nonplastic, brown
5							Stopped Backhoe at 5'
10							
15							
20							
25							

SAMPLE TYPE

B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample

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APPENDIX B

LABORATORY TEST RESULTS

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AGRA Earth & Environmental, Inc.

PROJECT: GOLDEN EAGLE PARK DAM
LOCATION: FOUNTAIN HILLS, AZ

JOB NO: 8-117-001014
WORK ORDER NO: 1
DATE SAMPLED: 2-20-98

MECHANICAL SIEVE ANALYSIS
GROUP SYMBOL, USCS (ASTM D-2487)

SIEVE SIZES

				Silt or	SAND								GRAVEL								COBBLES		
				Clay	Fine			Medium			Coarse		Fine				Coarse						
Location & Depth	USCS	LL	PI	#200	#100	#50	#40	#30	#16	#10	#8	#4	1/4"	3/8"	1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	Lab #

PERCENT PASSING BY WEIGHT

TP-1 @ 0-2.5'	SM	NV	NP	15	20	24	27	31	40	50	54	67	73	79	84	89	90	94	94	100	100	100	1
TP-2 @ 0-5'	GC	27	7	12	16	21	22	24	31	38	40	48	53	59	64	69	71	73	73	100	100	100	2
TP-3 @ 0-5'	SM	NV	NP	15	20	25	28	32	42	52	55	67	74	80	85	89	91	94	100	100	100	100	3
TP-4 @ 0-5'	SP-SM	NV	NP	12	17	21	24	28	39	51	55	67	74	82	85	91	94	98	100	100	100	100	4
TP-5 @ 0-1.5'	SM	NV	NP	17	22	27	30	33	41	49	51	61	66	71	75	79	86	92	96	100	100	100	5

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AGRA Earth & Environmental, Inc.

PROJECT: GOLDEN EAGLE PARK DAM
LOCATION: FOUNTAIN HILLS, AZ

JOB NO: 8-117-001014
WORK ORDER NO: 2
DATE SAMPLED: 2-20-98

MECHANICAL SIEVE ANALYSIS
GROUP SYMBOL, USCS (ASTM D-2487)

SIEVE SIZES

				Silt or	SAND								GRAVEL								COBBLES		
				Clay	Fine			Medium			Coarse		Fine				Coarse						
Location & Depth	USCS	LL	PI	#200	#100	#50	#40	#30	#16	#10	#8	#4	1/4"	3/8"	1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	Lab #

PERCENT PASSING BY WEIGHT

#1 @ 5-6.5'	SM	NV	NP	21	27	34	36	41	51	61	65	79	84	90	93	97	100	100	100	100	100	100	9
#1 @ 35-36.5'	SC-SM	28	6	31	40	43	47	50	60	70	73	83	85	87	89	95	100	100	100	100	100	100	13
#1 @ 45-46.2'	ML	48	16	67	74	78	80	82	86	89	90	93	96	99	99	100	100	100	100	100	100	100	15
#2 @ 15-15.9'	SM	NV	NP	22	30	37	40	44	53	63	67	81	86	91	93	97	100	100	100	100	100	100	19

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AGRA Earth & Environmental, Inc.

PROJECT: GOLDEN EAGLE PARK DAM
LOCATION: FOUNTAIN HILLS, AZ

JOB NO: 8-117-001014
WORK ORDER NO: 3
DATE SAMPLED: 2-20-98

MECHANICAL SIEVE ANALYSIS
GROUP SYMBOL, USCS (ASTM D-2487)

SIEVE SIZES

				Silt or	SAND								GRAVEL								COBBLES		
				Clay	Fine			Medium			Coarse		Fine				Coarse						
Location & Depth	USCS	LL	PI	#200	#100	#50	#40	#30	#16	#10	#8	#4	1/4"	3/8"	1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	Lab #

PERCENT PASSING BY WEIGHT

#1 @ 5-6.5'	SM	NV	NP	18	28	32	36	41	53	66	71	86	91	95	98	100	100	100	100	100	100	100	29
#3 @ 30-30.9'	ML	46	18	99	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	33
#4 @ 10.10.9'	SM	NV	NP	18	23	28	31	35	45	57	61	80	85	91	96	100	100	100	100	100	100	100	40
#4 @ 10-15'	GP-GM	NV	NP	9.6	13	13	14	15	20	25	28	39	55	71	80	91	99	100	100	100	100	100	41
#4 @ 20-21.5'	SM	NV	NP	33	42	50	53	57	67	76	79	88	92	95	98	100	100	100	100	100	100	100	43
#4 @ 30-31.5'	SM	NV	NP	16	30	31	35	39	47	54	57	67	71	75	79	89	100	100	100	100	100	100	45
#6 @ 5-6.5'	SM	NV	NP	46	57	64	67	69	75	79	81	87	91	93	95	96	100	100	100	100	100	100	47

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AGRA Earth & Environmental, Inc.

PROJECT: GOLDEN EAGLE PARK DAM MODIFICATION
LOCATION: FOUNTAIN HILLS

JOB NO: 9-117-001011
WORK ORDER NO: 1
DATE SAMPLED: ####

MECHANICAL SIEVE ANALYSIS
GROUP SYMBOL, USCS (ASTM D-2487)

SIEVE SIZES

				Silt or Clay	SAND								GRAVEL								COBBLES		
					Fine			Medium			Coarse		Fine				Coarse						
Location & Depth	USCS	LL	PI	#200	#100	#50	#40	#30	#16	#10	#8	#4	1/4"	3/8"	1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	Lab #

PERCENT PASSING BY WEIGHT

T8 @ 0-1'9"	GM	22	1	16	21	27	30	33	40	46	49	55	59	64	66	71	74	79	82	90	100	100	1
T9 @ .8'-1.4'	SM	NV	NP	22	29	35	38	42	51	61	65	78	82	86	87	95	100	100	100	100	100	100	2
T7 @ 4'-4.5'	SM	NV	NP	34	45	53	57	60	69	76	80	90	92	95	97	100	100	100	100	100	100	100	3
T6 @ 1'-2'	SP-SM	NV	NP	9.4	13	18	25	30	44	59	66	85	91	96	98	99	100	100	100	100	100	100	4
T10 @ 1'-3'	SM	NV	NP	26	34	42	46	50	60	71	75	90	95	98	99	100	100	100	100	100	100	100	5
T11 @ 6"-1'6"	SP-SM	NV	NP	12	16	22	26	30	40	50	55	69	74	78	82	83	88	88	100	100	100	100	6
T12 @ 1.5'-3.5'	SM	22	3	19	24	31	34	38	49	59	64	76	83	89	92	96	97	99	99	100	100	100	7
T8 @ 2.5'-3'	SM	NV	NP	35	42	48	51	54	63	72	75	88	92	95	97	97	100	100	100	100	100	100	8

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PROJECT:	GOLDEN EAGLE PARK DAM	**JOB NO:**	8-117-001014
LOCATION:	FOUNTAIN HILLS, AZ	**WORK ORDER NO:**	3
MATERIAL:		**LAB NO:**	39
SAMPLE SOURCE:	#4 @ 5-10'	**DATE SAMPLED:**	2-20-98
SAMPLE PREPARATION:	REMOLD TO DENSITY DETERMINED FOR 10-10.9 RING		

MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS USING A FLEXIBLE WALL PERMEAMETER (ASTM 5084-90) "CV" METHOD C

AVERAGE PERMEABILITY		1.9E-05	cm/sec	
INITIAL LENGTH OF SPECIMEN		7.11	cm	
INITIAL DIAMETER OF SPECIMEN		7.13	cm	
INITAL WATER CONTENT		4.5%		
INITIAL DRY UNIT WEIGHT		127.6	pcf	
INITIAL VOLUME		283.9	cu.cm	
PERMEANT LIQUID		BOTTLED WATER		
MAGNITUDE OF TOTAL BACK PRESSURE		64.9	psi	
EFFECTIVE CONSOLIDATION STRESS		5	psi	
RANGE OF HYDRAULIC GRADIENT USED	1.7	to		0.5
FINAL LENGTH OF SPECIMEN		7.10	cm	
FINAL DIAMETER OF SPECIMEN		7.11	cm	
FINAL WATER CONTENT		10.8%		
FINAL DRY UNIT WEIGHT		128.5	pcf	
FINAL VOLUME		281.9	cu.cm	
DEGREE OF SATURATION (BEFORE AND AFTER TEST)	40%	and		100%
SPECIFIC GRAVITY USED IN CALCULATIONS OF SATURATION		2.651		

TIME INTERVAL sec	K cm/sec	K ft/yr
24	2.0E-05	20.22
30	1.9E-05	19.86
38	2.0E-05	20.26
50	1.9E-05	19.81

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PROJECT:	GOLDEN EAGLE PARK DAM	**JOB NO:**	8-117-001014
LOCATION:	FOUNTAIN HILLS, AZ	**WORK ORDER NO:**	2
MATERIAL:	SM	**LAB NO:**	19
SAMPLE SOURCE:	#2 @ 15.0-15.9'	**DATE SAMPLED:**	2-20-98
SAMPLE PREP:	INSITU		

MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS USING A FLEXIBLE WALL PERMEAMETER (ASTM D5084) METHOD "C"

AVERAGE PERMEABILITY		1.3E-04	cm/sec	
INITIAL LENGHT OF SPECIMEN		12.97	cm	
INITIAL DIAMETER OF SPECIMEN		6.16	cm	
INITIAL WATER CONTENT		6.5%		
INITIAL DRY UNIT WEIGHT		119.1	pcf	
INITIAL VOLUME		386.5	cu.cm	
PERMEANT LIQUID		BOTTLED WATER		
MAGNITUDE OF TOTAL BACK PRESSURE		53.1	psi	
EFFECTIVE CONSOLIDATION STRESS		5.0	psi	
RANGE OF HYDRAULIC GRADIENT USED	3.0	to		2.7
FINAL LENGHT OF SPECIMEN		12.15	cm	
FINAL DIAMETER OF SPECIMEN		6.18	cm	
FINAL WATER CONTENT		12.9%		
FINAL DRY UNIT WEIGHT		126.3	pcf	
FINAL VOLUME		364.5	cu.cm	
DEGREE OF SATURATION (BEFORE AND AFTER TEST)	42%	and		103%
SPECIFIC GRAVITY USED IN CALCULATIONS OF SATURATION		2.711		

TIME INTERVAL (sec)	K (cm/sec)	K (ft/yr)
516	1.3E-04	132
698	1.4E-04	141
979	1.3E-04	136
1270	1.3E-04	133

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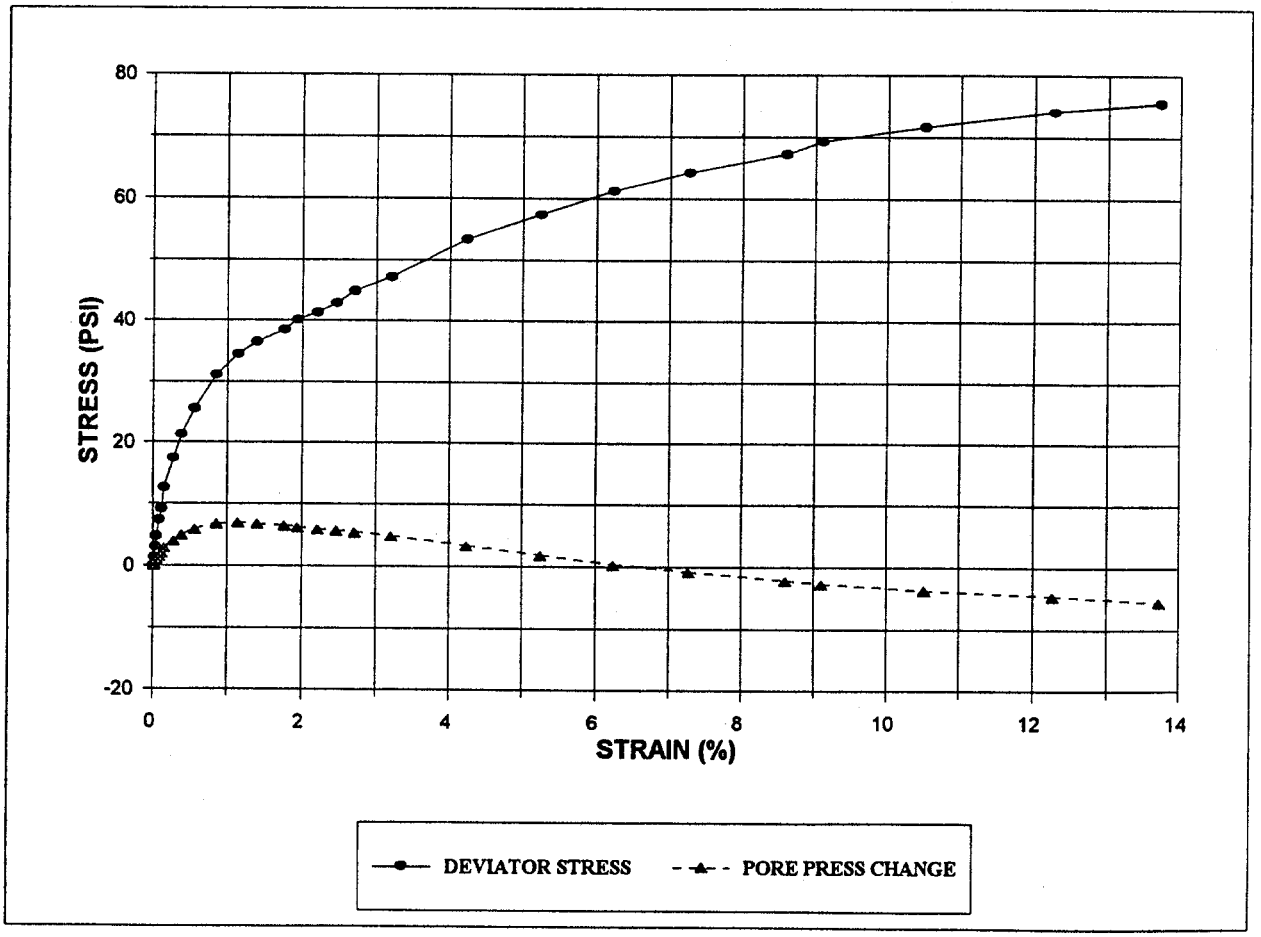
PROJECT:	GOLDEN EAGLE PARK DAM	**JOB NO:**	8-117-01014
LOCATION:	FOUNTAIN HILL, AZ	**WORK ORDER NO:**	2
MATERIAL:	SANDY, SILTY GRAVEL	**LAB NO:**	9
SAMPLE SOURCE:	1 @ 15.0-16.0	**DATE SAMPLED:**	2-20-98
SAMPLE PREPARATION:	INSITU		
EFFECTIVE STRESS (PSI):	20		

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS (ASTM D4767)

INITIAL HEIGHT (CM):	14.5	TOTAL BACK PRESSURE (PSI):	71.6
INITIAL DIAMETER (CM):	6.18	"B" VALUE AT SATURATION:	0.96
		RATE OF STRAIN (% PER MIN):	0.055
INITIAL DRY UNIT WEIGHT (PCF):	124.5		
INITIAL VOID RATIO:	0.329	FINAL DRY UNIT WEIGHT (PCF):	125.3
INITIAL WATER CONTENT (%):	5.4	FINAL VOID RATIO:	0.320
INITIAL DEGREE OF SATURATION (%):	43	FINAL WATER CONTENT (%):	10.9
		FINAL DEGR. OF SATURATION (%):	90
METHOD FOLLOWED FOR SATURATION:	DRY		
		MAX DEVIATOR STRESS (PSI):	76
		@ STRAIN (%):	13.73



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AGRA Earth & Environmental, Inc.

PROJECT:	GOLDEN EAGLE PARK DAM	**JOB NO:**	8-117-01014
LOCATION:	FOUNTAIN HILL, AZ	**WORK ORDER NO:**	2
MATERIAL:	SANDY, SILTY GRAVEL	**LAB NO:**	9
SAMPLE SOURCE:	1 @ 15.0-16.0	**DATE SAMPLED:**	2-20-98
SAMPLE PREPARATION:	INSITU		
EFFECTIVE STRESS (PSI):	20		

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS (ASTM D4767)

e (%)	s1-s3 (psi)	u (psi)	$\bar{A}$	s3 (psi)	s1 (psi)	s'3 (psi)	s'1 (psi)	s'1/s'3	q (s1-s3)/2 (psi)	p' (s'1+s'3)/2 (psi)
0.00	0.00	0.00	0.00	19.40	19.40	19.40	19.40	1.00	0.00	19.40
0.02	1.31	0.30	0.23	19.40	20.71	19.10	20.41	1.07	0.65	19.75
0.04	3.05	0.70	0.23	19.40	22.45	18.70	21.75	1.16	1.52	20.22
0.05	4.79	1.10	0.23	19.40	24.19	18.30	23.09	1.26	2.40	20.70
0.09	7.40	1.50	0.20	19.40	26.80	17.90	25.30	1.41	3.70	21.60
0.12	9.14	2.00	0.22	19.40	28.54	17.40	26.54	1.53	4.57	21.97
0.16	12.62	2.80	0.22	19.40	32.02	16.60	29.22	1.76	6.31	22.91
0.28	17.38	4.00	0.23	19.40	36.78	15.40	32.78	2.13	8.69	24.09
0.39	21.27	4.90	0.23	19.40	40.67	14.50	35.77	2.47	10.63	25.13
0.56	25.56	5.90	0.23	19.50	45.06	13.60	39.16	2.88	12.78	26.38
0.86	31.10	6.80	0.22	19.50	50.60	12.70	43.80	3.45	15.55	28.25
1.14	34.46	6.90	0.20	19.50	53.96	12.60	47.06	3.73	17.23	29.83
1.41	36.51	6.80	0.19	19.70	56.21	12.90	49.41	3.83	18.26	31.16
1.78	38.52	6.50	0.17	19.70	58.22	13.20	51.72	3.92	19.26	32.46
1.95	40.16	6.20	0.15	19.80	59.96	13.60	53.76	3.95	20.08	33.68
2.21	41.33	5.90	0.14	19.90	61.23	14.00	55.33	3.95	20.66	34.66
2.48	42.92	5.70	0.13	19.90	62.82	14.20	57.12	4.02	21.46	35.66
2.72	44.93	5.40	0.12	20.00	64.93	14.60	59.53	4.08	22.46	37.06
3.22	47.23	4.80	0.10	20.10	67.33	15.30	62.53	4.09	23.61	38.91
4.24	53.41	3.30	0.06	20.40	73.81	17.10	70.51	4.12	26.70	43.80
5.26	57.38	1.80	0.03	20.60	77.98	18.80	76.18	4.05	28.69	47.49
6.24	61.28	0.30	0.00	20.90	82.18	20.60	81.88	3.97	30.64	51.24
7.28	64.24	-0.80	-0.01	21.20	85.44	22.00	86.24	3.92	32.12	54.12
8.61	67.29	-2.20	-0.03	21.50	88.79	23.70	90.99	3.84	33.65	57.35
9.10	69.31	-2.70	-0.04	21.70	91.01	24.40	93.71	3.84	34.65	59.05
10.53	71.73	-3.70	-0.05	22.00	93.73	25.70	97.43	3.79	35.87	61.57
12.27	74.16	-4.60	-0.06	22.30	96.46	26.90	101.06	3.76	37.08	63.98
13.73	75.56	-5.60	-0.07	23.10	98.66	28.70	104.26	3.63	37.78	66.48

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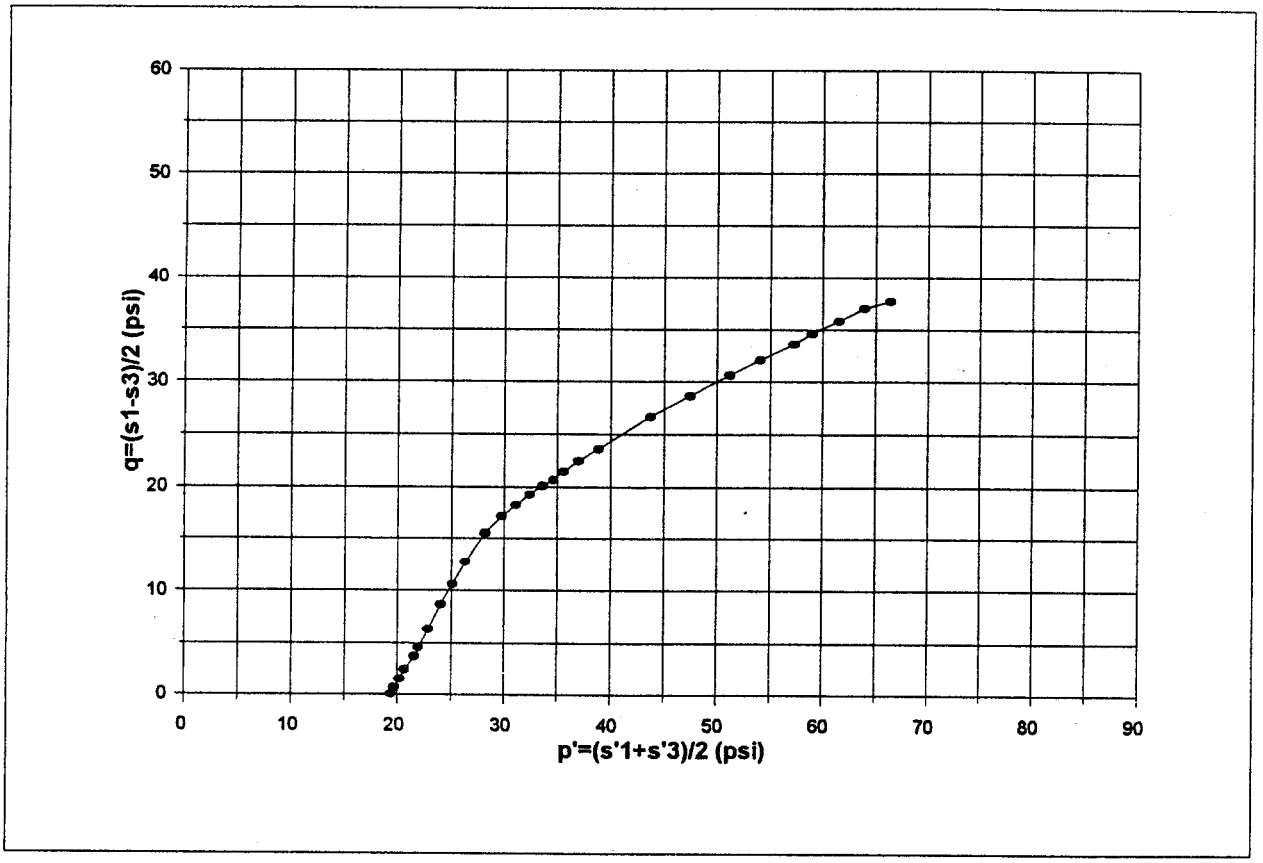
AGRA Earth & Environmental, Inc.

PROJECT:	GOLDEN EAGLE PARK DAM	**JOB NO:**	8-117-01014
LOCATION:	FOUNTAIN HILL, AZ	**WORK ORDER NO:**	2
MATERIAL:	SANDY, SILTY GRAVEL	**LAB NO:**	9
SAMPLE SOURCE:	1 @ 15.0-16.0	**DATE SAMPLED:**	2-20-98
SAMPLE PREPARATION:	INSITU		
EFFECTIVE STRESS (PSI):	20		

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS (ASTM D4767)



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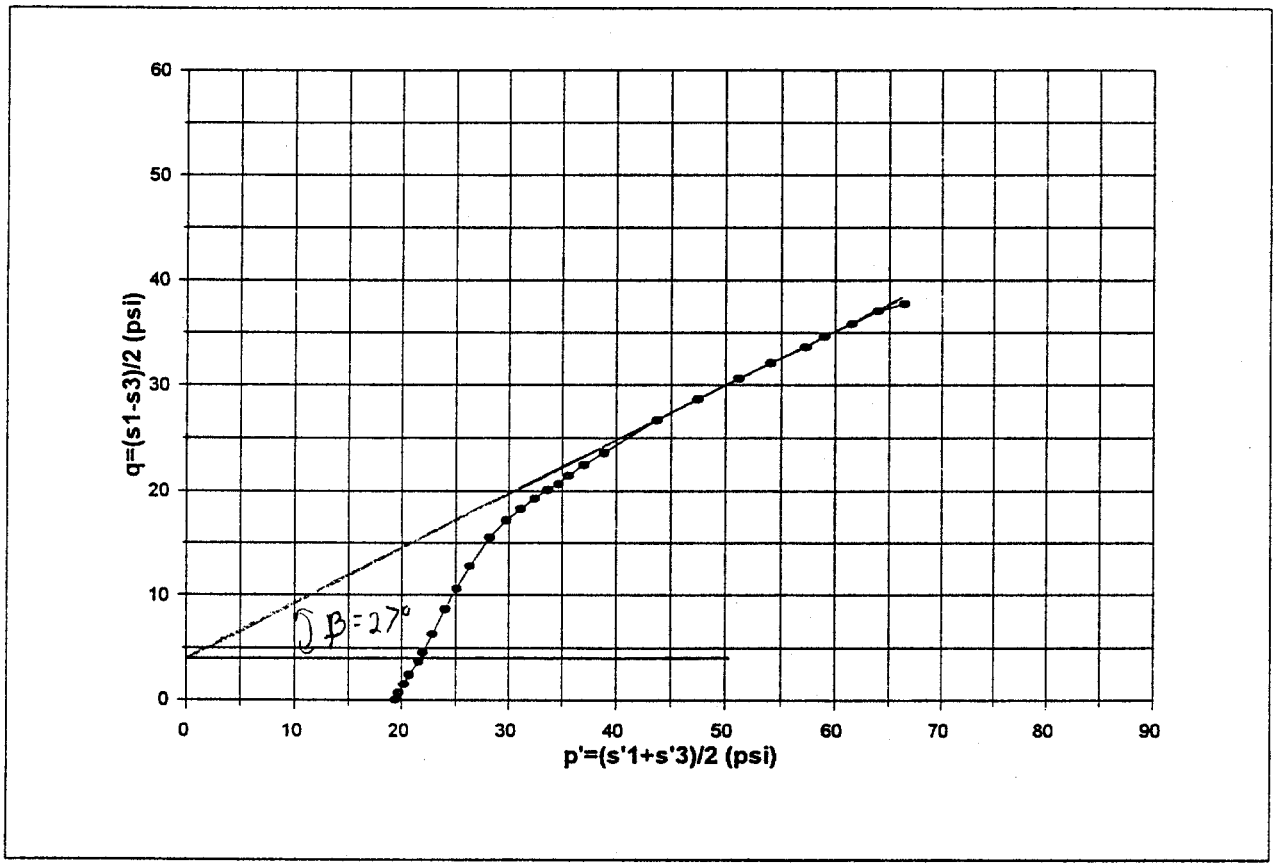
AGRA Earth & Environmental, Inc.

PROJECT:	GOLDEN EAGLE PARK DAM	**JOB NO:**	8-117-01014
LOCATION:		**WORK ORDER NO:**	2
MATERIAL:	SANDY, SILTY GRAVEL	**LAB NO:**	9
SAMPLE SOURCE:	1 @ 15.0-16.0	**DATE SAMPLED:**	2-20-98
SAMPLE PREPARATION:	INSITU		
EFFECTIVE STRESS (PSI):	20		

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS (ASTM D4767)



a = 4

$\sin \phi = \tan \beta$

$\sin \phi = \tan 27°$

$\phi = 31°$

$C = \frac{a}{\cos \phi}$

$C = \frac{4}{\cos 31°}$

$C = 5 \text{ psi}$

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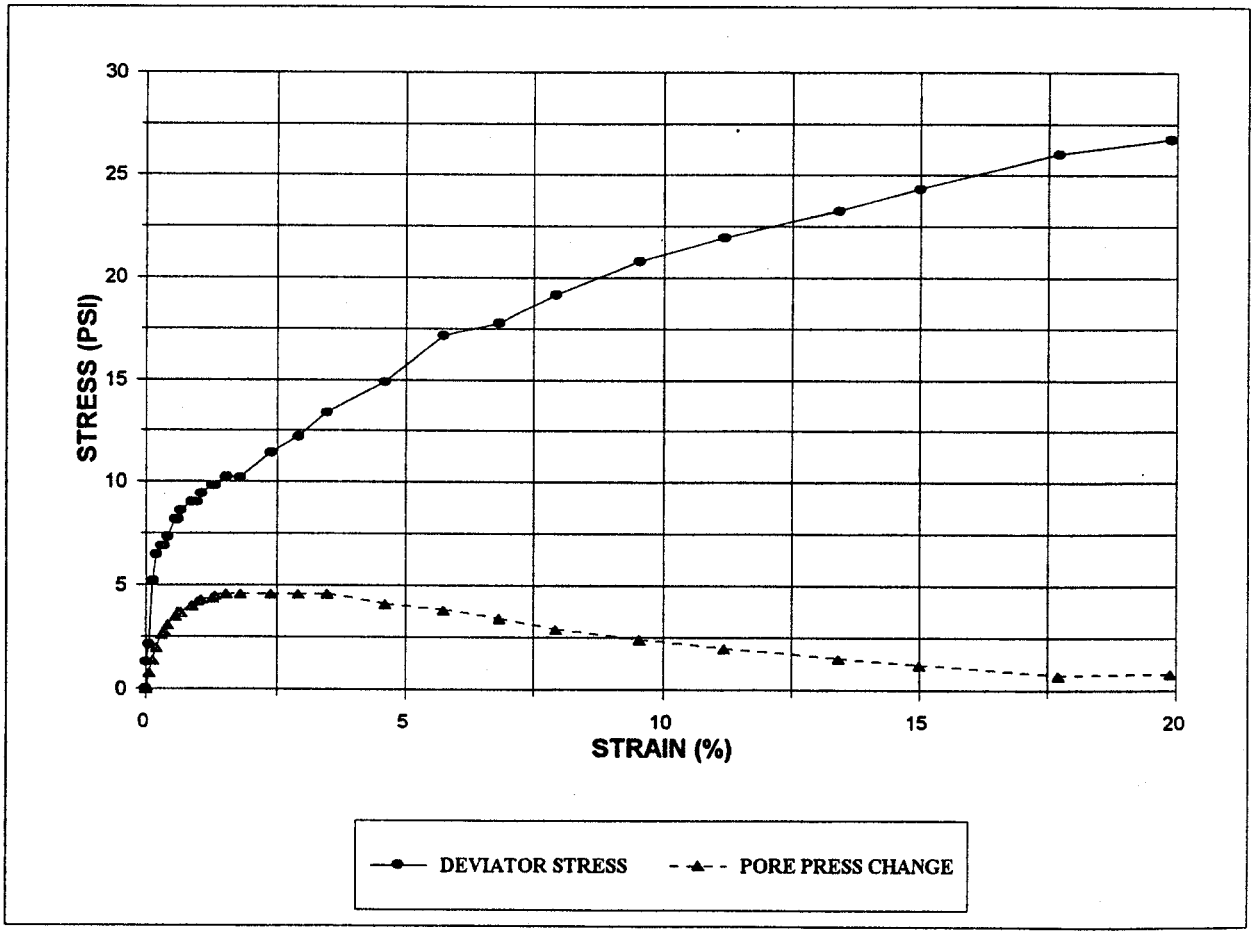
AGRA Earth & Environmental, Inc.

PROJECT:	GOLDEN EAGLE PARK DAM	**JOB NO:**	8-117-01014
LOCATION:	FOUNTAIN HILLS, AZ	**WORK ORDER NO:**	2
MATERIAL:	SANDY, SILTY GRAVEL	**LAB NO:**	10
SAMPLE SOURCE:	1 @ 20.0-21.0	**DATE SAMPLED:**	2-20-98
SAMPLE PREPARATION:	INSITU		
EFFECTIVE STRESS (PSI):	10		

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS (ASTM D4767)

INITIAL HEIGHT (CM):	14.5	TOTAL BACK PRESSURE (PSI):	62.8
INITIAL DIAMETER (CM):	6.2	"B" VALUE AT SATURATION:	0.98
		RATE OF STRAIN (% PER MIN):	0.055
INITIAL DRY UNIT WEIGHT (PCF):	119.0		
INITIAL VOID RATIO:	0.390	FINAL DRY UNIT WEIGHT (PCF):	119.7
INITIAL WATER CONTENT (%):	6.5	FINAL VOID RATIO:	0.382
INITIAL DEGREE OF SATURATION (%):	44	FINAL WATER CONTENT (%):	6.5
		FINAL DEGR. OF SATURATION (%):	45
METHOD FOLLOWED FOR SATURATION:	DRY		
		MAX DEVIATOR STRESS (PSI):	27
		@ STRAIN (%):	19.89



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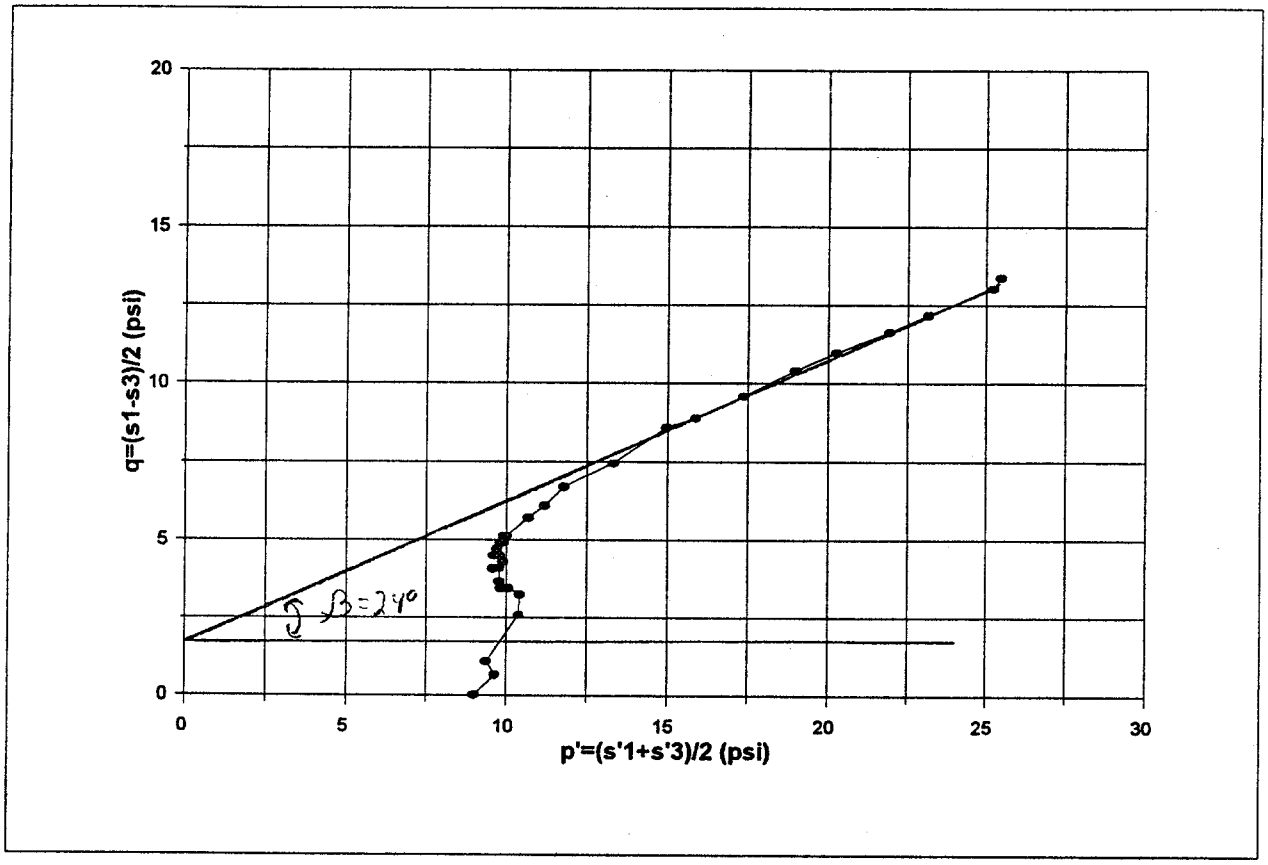
AGRA Earth & Environmental, Inc.

PROJECT:	GOLDEN EAGLE PARK DAM	**JOB NO:**	8-117-01014
LOCATION:		**WORK ORDER NO:**	2
MATERIAL:	SANDY, SILTY GRAVEL	**LAB NO:**	10
SAMPLE SOURCE:	1 @ 20.0-21.0	**DATE SAMPLED:**	2-20-98
SAMPLE PREPARATION:	INSITU		
EFFECTIVE STRESS (PSI):	10		

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS (ASTM D4767)



a 4

$\sin \phi = \tan \beta$

$\sin \phi = \tan 24°$

$\phi = 26°$

$C = \frac{a}{\cos \phi}$

$C = \frac{4}{\cos 26°}$

$C = 5 \text{ psi}$

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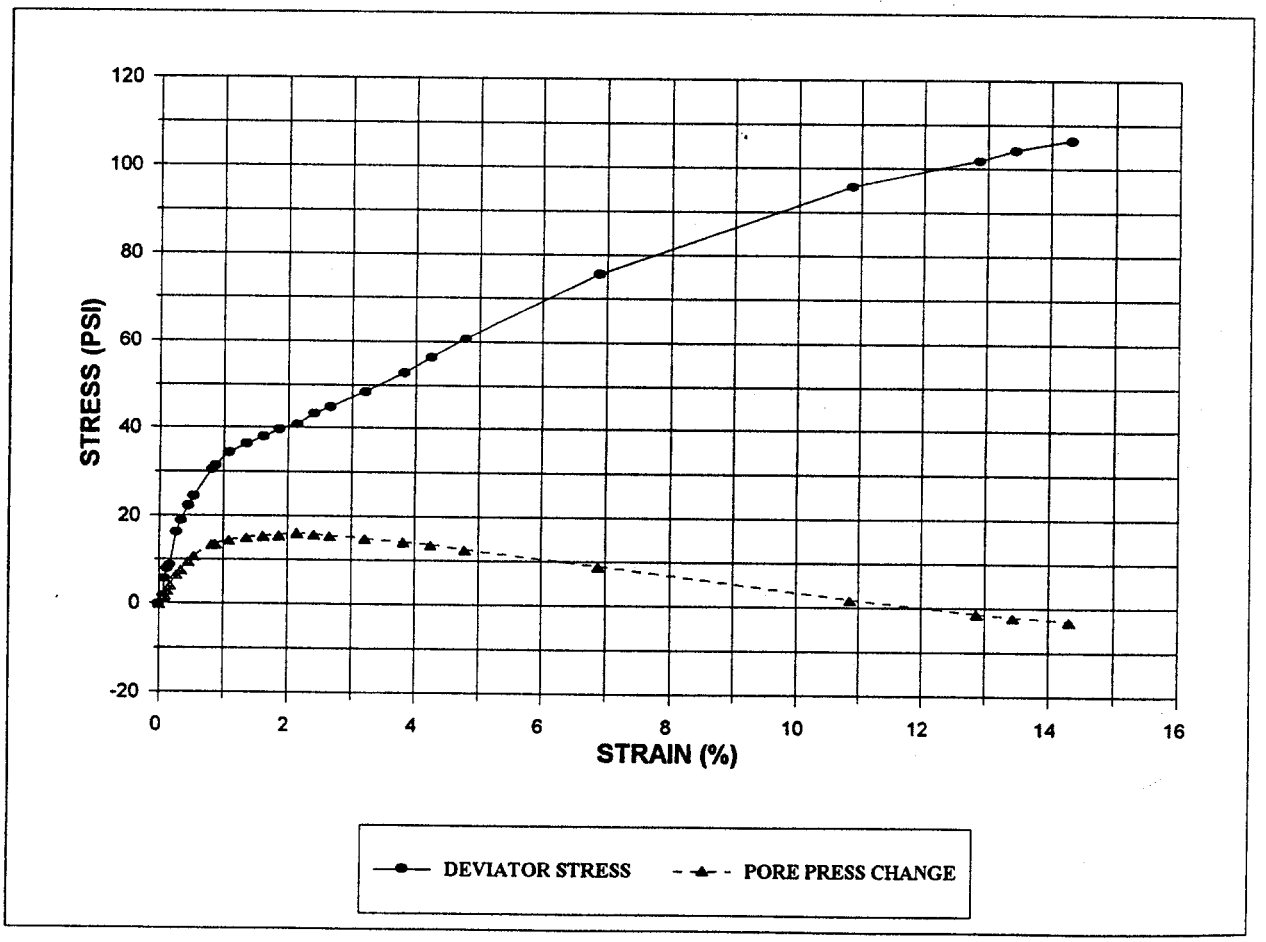
AGRA Earth & Environmental, Inc.

PROJECT:	GOLDEN EAGLE PARK DAM	**JOB NO:**	8-117-01014
LOCATION:	FOUNTAIN HILLS, AZ	**WORK ORDER NO:**	2
MATERIAL:	SANDY, SILTY GRAVEL	**LAB NO:**	11
SAMPLE SOURCE:	1 @ 25.0-26.0	**DATE SAMPLED:**	2-20-98
SAMPLE PREPARATION:	INSITU		
EFFECTIVE STRESS (PSI):	30		

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS (ASTM D4767)

INITIAL HEIGHT (CM):	14.01	TOTAL BACK PRESSURE (PSI):	62.3
INITIAL DIAMETER (CM):	6.2	"B" VALUE AT SATURATION:	0.96
		RATE OF STRAIN (% PER MIN):	0.057
INITIAL DRY UNIT WEIGHT (PCF):	125.3		
INITIAL VOID RATIO:	0.320	FINAL DRY UNIT WEIGHT (PCF):	128.0
INITIAL WATER CONTENT (%):	6.5	FINAL VOID RATIO:	0.292
INITIAL DEGREE OF SATURATION (%):	54	FINAL WATER CONTENT (%):	10.0
		FINAL DEGR. OF SATURATION (%):	91
METHOD FOLLOWED FOR SATURATION:	DRY		
		MAX DEVIATOR STRESS (PSI):	106
		@ STRAIN (%):	14.32



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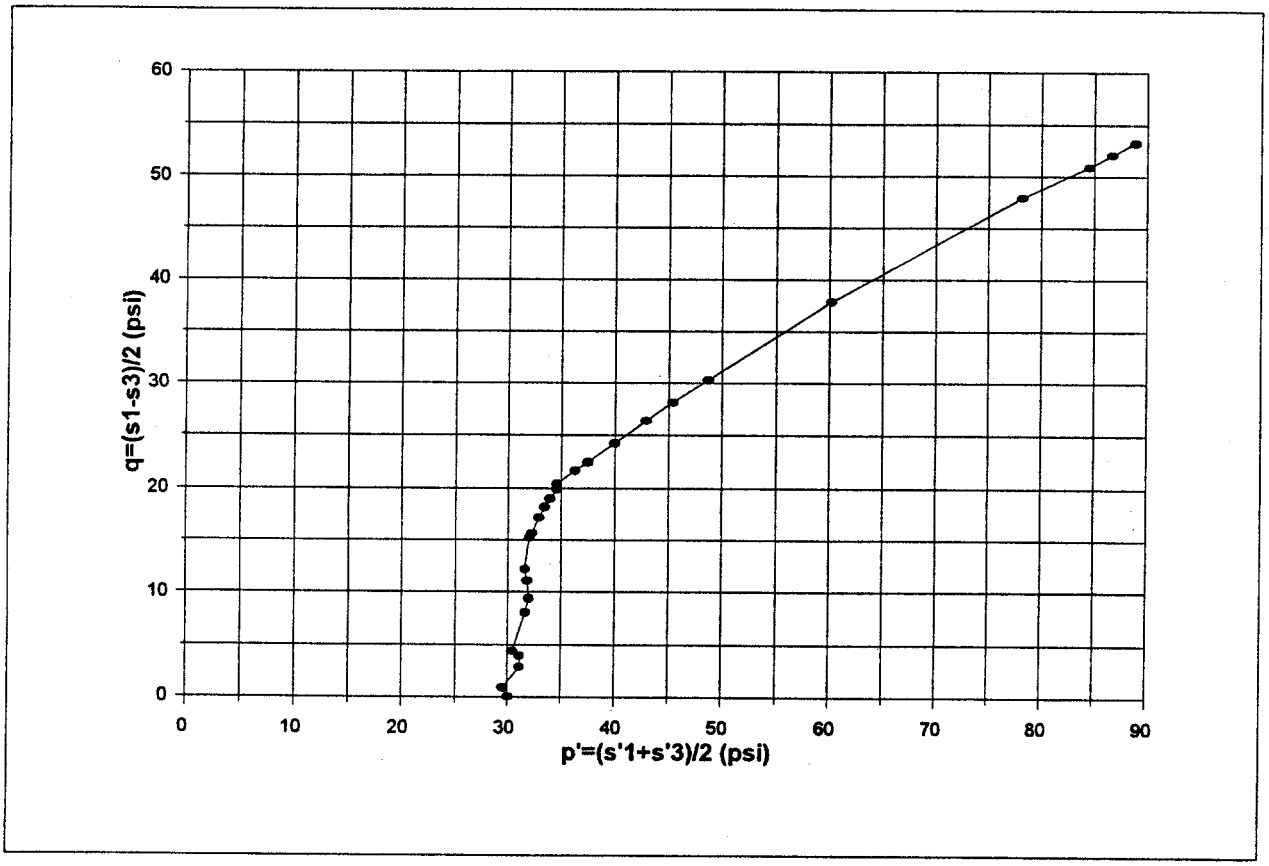
PROJECT:	GOLDEN EAGLE PARK DAM	**JOB NO:**	8-117-01014
LOCATION:	FOUNTAIN HILLS, AZ	**WORK ORDER NO:**	2
MATERIAL:	SANDY, SILTY GRAVEL	**LAB NO:**	11
SAMPLE SOURCE:	1 @ 25.0-26.0	**DATE SAMPLED:**	2-20-98
SAMPLE PREPARATION:	INSITU		
EFFECTIVE STRESS (PSI):	30		

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS (ASTM D4767)



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AGRA Earth & Environmental, Inc.

PROJECT:	GOLDEN EAGLE PARK DAM	**JOB NO:**	8-117-01014
LOCATION:	FOUNTAIN HILLS, AZ	**WORK ORDER NO:**	2
MATERIAL:	SANDY, SILTY GRAVEL	**LAB NO:**	11
SAMPLE SOURCE:	1 @ 25.0-26.0	**DATE SAMPLED:**	2-20-98
SAMPLE PREPARATION:	INSITU		
EFFECTIVE STRESS (PSI):	30		

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS (ASTM D4767)

e (%)	s1-s3 (psi)	u (psi)	$\bar{A}$	s3 (psi)	s1 (psi)	s'3 (psi)	s'1 (psi)	s'1/s'3	q (s1-s3)/2 (psi)	p' (s'1+s'3)/2 (psi)
0.00	0.00	0.00	0.00	30.10	30.10	30.10	30.10	1.00	0.00	30.10
0.07	1.76	1.40	0.80	30.10	31.86	28.70	30.46	1.06	0.88	29.58
0.09	5.70	1.80	0.32	30.10	35.80	28.30	34.00	1.20	2.85	31.15
0.13	7.90	2.90	0.37	30.10	38.00	27.20	35.10	1.29	3.95	31.15
0.18	8.77	4.00	0.46	30.10	38.87	26.10	34.87	1.34	4.38	30.48
0.27	16.21	6.50	0.40	30.10	46.31	23.60	39.81	1.69	8.10	31.70
0.35	18.82	7.60	0.40	30.20	49.02	22.60	41.42	1.83	9.41	32.01
0.45	22.30	9.50	0.43	30.20	52.50	20.70	43.00	2.08	11.15	31.85
0.55	24.46	10.80	0.44	30.20	54.66	19.40	43.86	2.26	12.23	31.63
0.82	30.49	13.40	0.44	30.20	60.69	16.80	47.29	2.81	15.25	32.05
0.87	31.35	13.60	0.43	30.20	61.55	16.60	47.95	2.89	15.67	32.27
1.09	34.32	14.50	0.42	30.30	64.62	15.80	50.12	3.17	17.16	32.96
1.36	36.39	15.10	0.41	30.40	66.79	15.30	51.69	3.38	18.19	33.49
1.62	38.02	15.40	0.41	30.40	68.42	15.00	53.02	3.53	19.01	34.01
1.87	39.65	15.60	0.39	30.40	70.05	14.80	54.45	3.68	19.82	34.62
2.15	40.83	16.10	0.39	30.30	71.13	14.20	55.03	3.88	20.41	34.61
2.42	43.29	15.80	0.37	30.50	73.79	14.70	57.99	3.94	21.64	36.34
2.67	44.88	15.50	0.35	30.60	75.48	15.10	59.98	3.97	22.44	37.54
3.22	48.46	14.90	0.31	30.70	79.16	15.80	64.26	4.07	24.23	40.03
3.82	52.80	14.20	0.27	30.80	83.60	16.60	69.40	4.18	26.40	43.00
4.26	56.35	13.60	0.24	30.90	87.25	17.30	73.65	4.26	28.17	45.47
4.78	60.64	12.60	0.21	31.00	91.64	18.40	79.04	4.30	30.32	48.72
6.89	75.65	8.90	0.12	31.30	106.95	22.40	98.05	4.38	37.82	60.22
10.86	95.92	1.70	0.02	32.00	127.92	30.30	126.22	4.17	47.96	78.26
12.88	101.78	-1.30	-0.01	32.40	134.18	33.70	135.48	4.02	50.89	84.59
13.44	104.16	-2.10	-0.02	32.60	136.76	34.70	138.86	4.00	52.08	86.78
14.32	106.50	-3.00	-0.03	32.70	139.20	35.70	142.20	3.98	53.25	88.95

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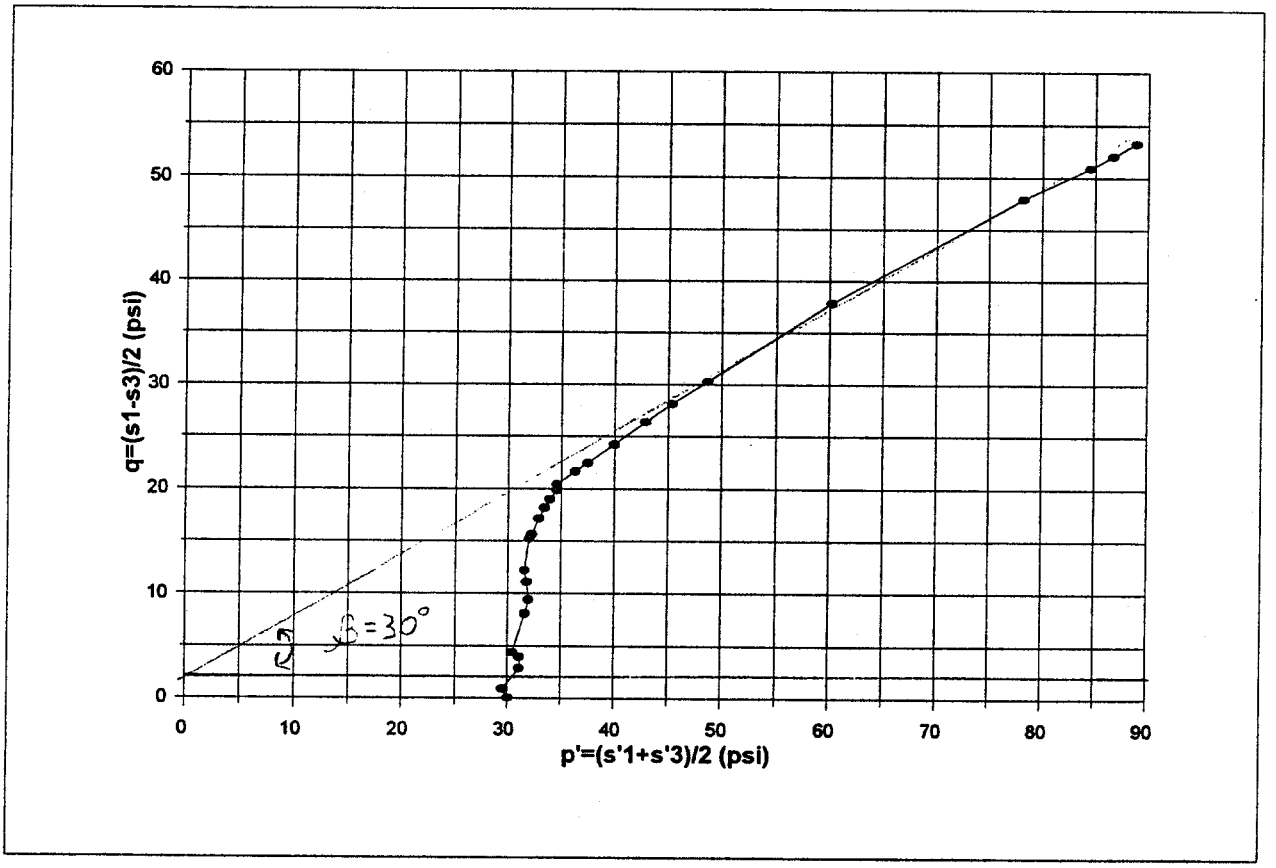
PROJECT:	GOLDEN EAGLE PARK DAM	**JOB NO:**	8-117-01014
LOCATION:		**WORK ORDER NO:**	2
MATERIAL:	SANDY, SILTY GRAVEL	**LAB NO:**	11
SAMPLE SOURCE:	1 @ 25.0-26.0	**DATE SAMPLED:**	2-20-98
SAMPLE PREPARATION:	INSITU		
EFFECTIVE STRESS (PSI):	30		

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS (ASTM D4767)



$\sin \phi = \tan \beta$

$\sin \phi = \tan 30°$

$\phi = 35°$

$C = \frac{a}{\cos \phi}$

$C = \frac{2}{\cos 35°}$

$C = 2$ psi

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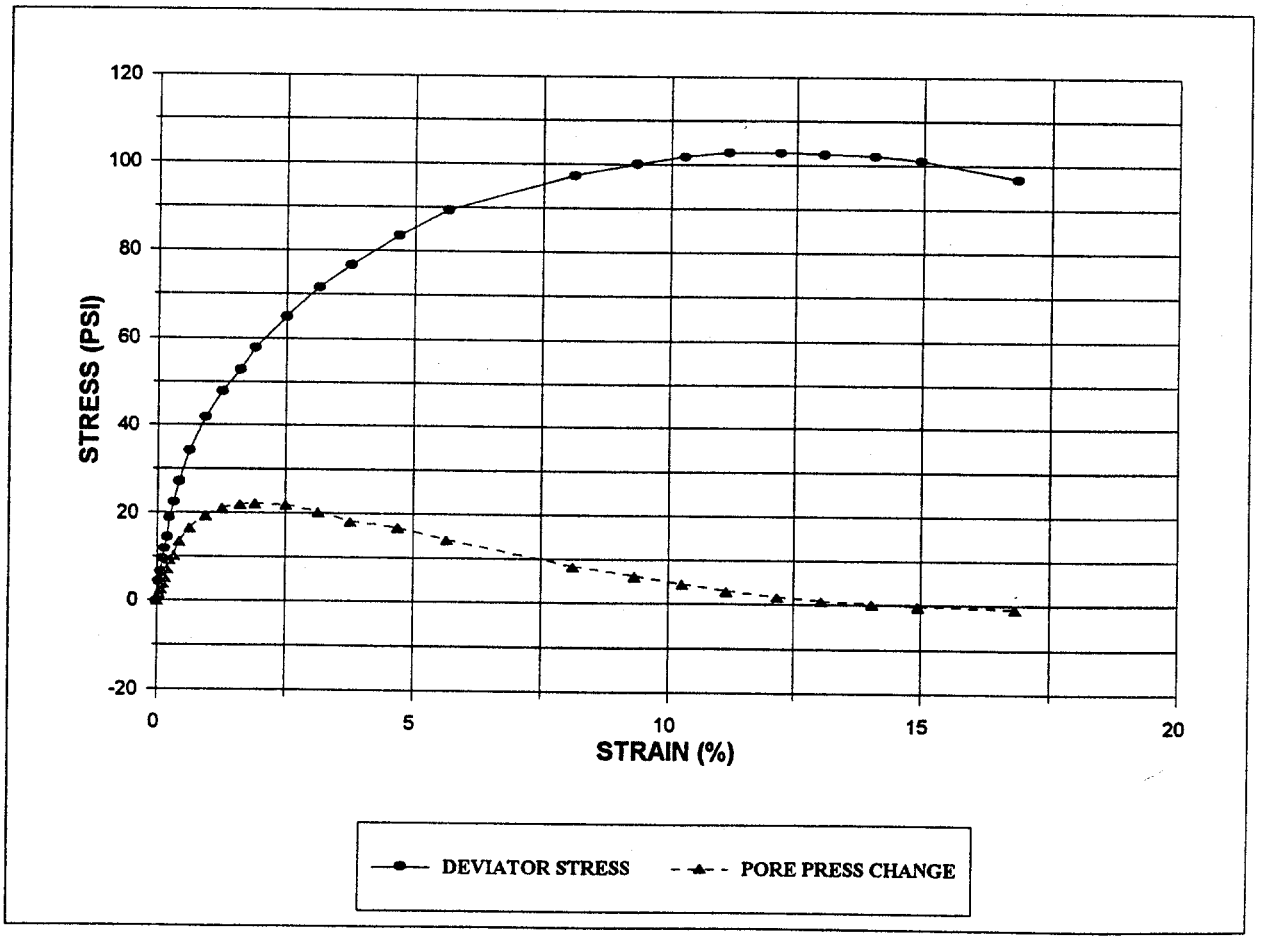
AGRA Earth & Environmental, Inc.

PROJECT:	GOLDEN EAGLE PARK DAM	**JOB NO:**	8-117-01014
LOCATION:	FOUNTAIN HILLS, AZ	**WORK ORDER NO:**	3
MATERIAL:	SANDY, SILTY GRAVEL	**LAB NO:**	33
SAMPLE SOURCE:	3 @ 30.0-30.9	**DATE SAMPLED:**	2-20-98
SAMPLE PREPARATION:	INSITU		
EFFECTIVE STRESS (PSI):	40		

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS (ASTM D4767)

INITIAL HEIGHT (CM):	13.3	TOTAL BACK PRESSURE (PSI):	62.3
INITIAL DIAMETER (CM):	6.2	"B" VALUE AT SATURATION:	1.00
		RATE OF STRAIN (% PER MIN):	0.061
INITIAL DRY UNIT WEIGHT (PCF):	101.9		
INITIAL VOID RATIO:	0.623	FINAL DRY UNIT WEIGHT (PCF):	104.8
INITIAL WATER CONTENT (%):	20.7	FINAL VOID RATIO:	0.578
INITIAL DEGREE OF SATURATION (%):	88	FINAL WATER CONTENT (%):	24.4
		FINAL DEGR. OF SATURATION (%):	112
METHOD FOLLOWED FOR SATURATION:	DRY		
		MAX DEVIATOR STRESS (PSI):	103
		@ STRAIN (%):	12.17



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AGRA Earth & Environmental, Inc.

PROJECT:	GOLDEN EAGLE PARK DAM	**JOB NO:**	8-117-01014
LOCATION:	FOUNTAIN HILLS, AZ	**WORK ORDER NO:**	3
MATERIAL:	SANDY, SILTY GRAVEL	**LAB NO:**	33
SAMPLE SOURCE:	3 @ 30.0-30.9	**DATE SAMPLED:**	2-20-98
SAMPLE PREPARATION:	INSITU		
EFFECTIVE STRESS (PSI):	40		

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS (ASTM D4767)

e (%)	s1-s3 (psi)	u (psi)	$\bar{A}$	s3 (psi)	s1 (psi)	s'3 (psi)	s'1 (psi)	s'1/s'3	q (s1-s3)/2 (psi)	p' (s'1+s'3)/2 (psi)
0.00	0.00	0.00	0.00	41.80	41.80	41.80	41.80	1.00	0.00	41.80
0.04	4.40	1.60	0.36	42.30	46.70	40.70	45.10	1.11	2.20	42.90
0.08	6.60	2.70	0.41	42.30	48.90	39.60	46.20	1.17	3.30	42.90
0.12	9.67	3.90	0.40	42.30	51.97	38.40	48.07	1.25	4.84	43.24
0.15	11.86	5.30	0.45	42.30	54.16	37.00	48.86	1.32	5.93	42.93
0.19	14.49	7.20	0.50	42.30	56.79	35.10	49.59	1.41	7.25	42.35
0.25	18.88	9.30	0.49	42.30	61.18	33.00	51.88	1.57	9.44	42.44
0.33	22.37	10.30	0.46	42.40	64.77	32.10	54.47	1.70	11.18	43.28
0.44	27.16	13.50	0.50	41.70	68.86	28.20	55.36	1.96	13.58	41.78
0.64	34.11	16.50	0.48	42.40	76.51	25.90	60.01	2.32	17.05	42.95
0.94	41.85	19.40	0.46	42.40	84.25	23.00	64.85	2.82	20.92	43.92
1.27	47.79	21.00	0.44	42.00	89.79	21.00	68.79	3.28	23.90	44.90
1.62	52.82	22.00	0.42	42.20	95.02	20.20	73.02	3.61	26.41	46.61
1.91	57.84	22.20	0.38	42.20	100.04	20.00	77.84	3.89	28.92	48.92
2.50	64.79	21.90	0.34	42.00	106.79	20.10	84.89	4.22	32.39	52.49
3.14	71.61	20.30	0.28	42.20	113.81	21.90	93.51	4.27	35.81	57.71
3.77	76.65	18.10	0.24	43.20	119.85	25.10	101.75	4.05	38.32	63.42
4.70	83.46	16.80	0.20	42.20	125.66	25.40	108.86	4.29	41.73	67.13
5.66	89.26	14.10	0.16	42.20	131.46	28.10	117.36	4.18	44.63	72.73
8.13	97.44	8.30	0.09	42.10	139.54	33.80	131.24	3.88	48.72	82.52
9.34	100.14	6.20	0.06	41.80	141.94	35.60	135.74	3.81	50.07	85.67
10.28	101.86	4.60	0.05	41.70	143.56	37.10	138.96	3.75	50.93	88.03
11.17	102.81	3.00	0.03	41.70	144.51	38.70	141.51	3.66	51.40	90.10
12.17	102.81	1.70	0.02	41.50	144.31	39.80	142.61	3.58	51.40	91.20
13.04	102.56	0.80	0.01	41.70	144.26	40.90	143.46	3.51	51.28	92.18
14.04	102.14	0.30	0.00	41.70	143.84	41.40	143.54	3.47	51.07	92.47
14.95	101.06	-0.20	-0.00	41.90	142.96	42.10	143.16	3.40	50.53	92.63
16.83	96.99	-0.80	-0.01	41.80	138.79	42.60	139.59	3.28	48.49	91.09

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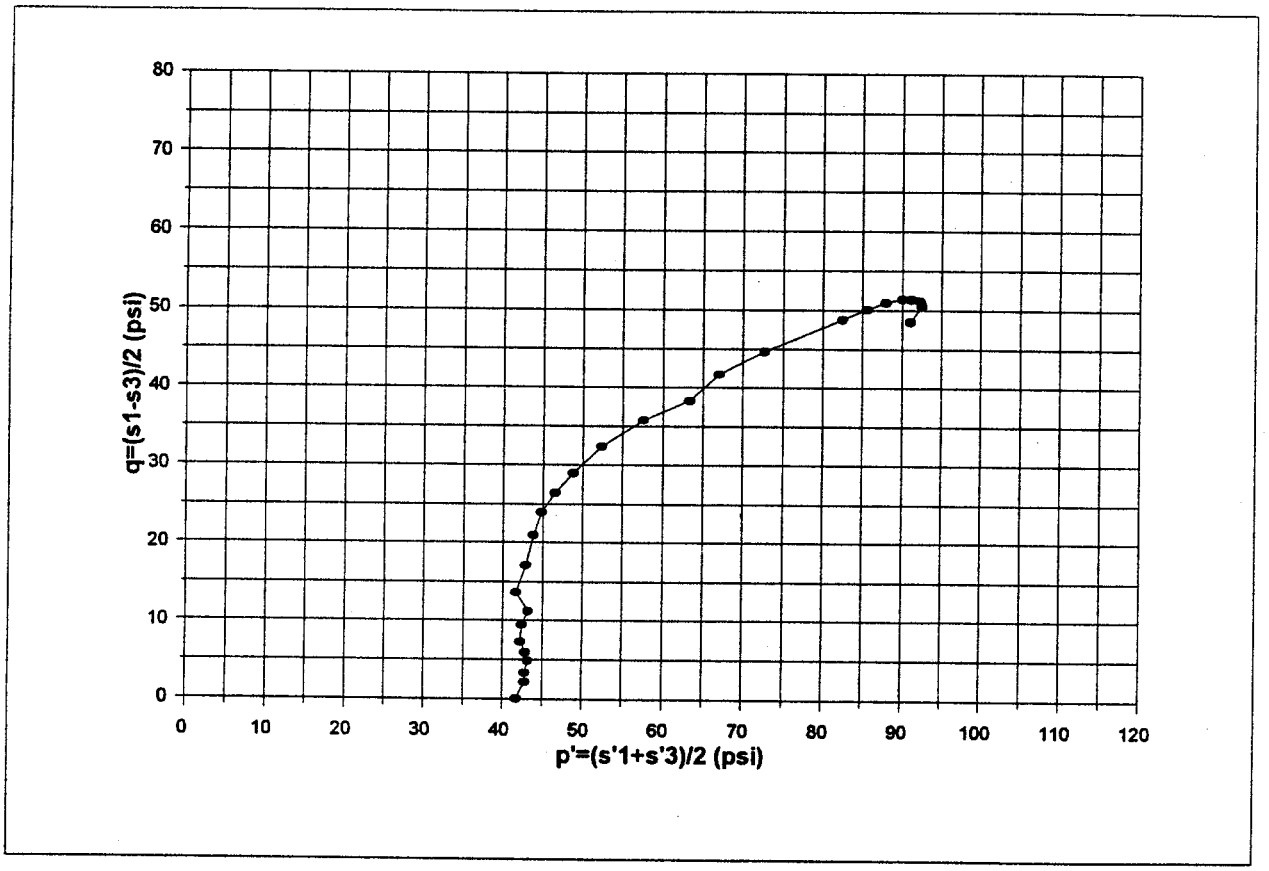
AGRA Earth & Environmental, Inc.

PROJECT:	GOLDEN EAGLE PARK DAM	**JOB NO:**	8-117-01014
LOCATION:	FOUNTAIN HILLS, AZ	**WORK ORDER NO:**	3
MATERIAL:	SANDY, SILTY GRAVEL	**LAB NO:**	33
SAMPLE SOURCE:	3 @ 30.0-30.9	**DATE SAMPLED:**	2-20-98
SAMPLE PREPARATION:	INSITU		
EFFECTIVE STRESS (PSI):	40		

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS (ASTM D4767)



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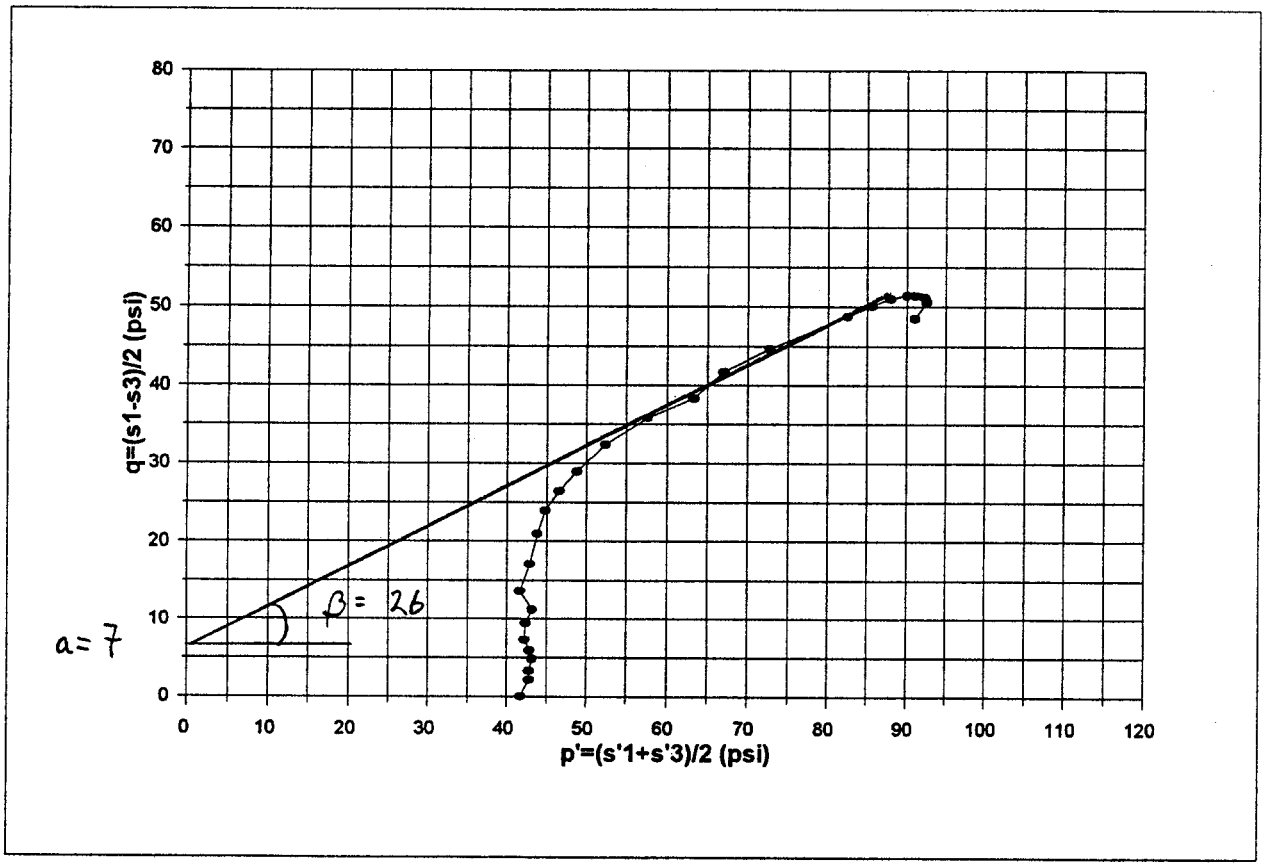
AGRA Earth & Environmental, Inc.

PROJECT:	GOLDEN EAGLE PARK DAM	**JOB NO:**	8-117-01014
LOCATION:		**WORK ORDER NO:**	3
MATERIAL:	SANDY, SILTY GRAVEL	**LAB NO:**	33
SAMPLE SOURCE:	3 @ 30.0-30.9	**DATE SAMPLED:**	2-20-98
SAMPLE PREPARATION:	INSITU		
EFFECTIVE STRESS (PSI):	40		

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS (ASTM D4767)



$\sin \phi = \tan \beta$

$\sin \phi = \tan 26^\circ$

$\underline{\phi = 29^\circ}$

$c = \dfrac{a}{\cos \phi}$

$c = \dfrac{7}{\cos 29}$

$\underline{c = 8 \text{ psi}}$

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AGRA Earth & Environmental, Inc.

PROJECT:	GOLDEN EAGLE PARK DAM	**JOB NO:**	8-117-01014
LOCATION:	FOUNTAIN HILLS, AZ	**WORK ORDER NO:**	3
MATERIAL:	SANDY, SILTY GRAVEL	**LAB NO:**	34
SAMPLE SOURCE:	3 @ 35.0-35.6	**DATE SAMPLED:**	2-20-98
SAMPLE PREPARATION:	INSITU *Damaged sample, linear shear observed		
EFFECTIVE STRESS (PSI):	30		

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS (ASTM D4767)

e (%)	s1-s3 (psi)	u (psi)	$\bar{A}$	s3 (psi)	s1 (psi)	s'3 (psi)	s'1 (psi)	s'1/s'3	q (s1-s3)/2 (psi)	p' (s'1+s'3)/2 (psi)
0.00	0.00	0.00	0.00	30.80	30.80	30.80	30.80	1.00	0.00	30.80
0.02	2.21	1.50	0.68	30.80	33.01	29.30	31.51	1.08	1.10	30.40
0.06	3.97	2.40	0.60	30.80	34.77	28.40	32.37	1.14	1.99	30.39
0.12	7.94	4.20	0.53	30.80	38.74	26.60	34.54	1.30	3.97	30.57
0.32	15.85	8.60	0.54	30.80	46.65	22.20	38.05	1.71	7.93	30.13
0.50	20.66	12.00	0.58	30.80	51.46	18.80	39.46	2.10	10.33	29.13
0.76	25.43	14.90	0.59	30.80	56.23	15.90	41.33	2.60	12.72	28.62
0.96	28.44	16.50	0.58	30.50	58.94	14.00	42.44	3.03	14.22	28.22
1.14	30.57	17.80	0.58	30.60	61.17	12.80	43.37	3.39	15.29	28.09
1.26	32.28	18.30	0.57	30.60	62.88	12.30	44.58	3.62	16.14	28.44
1.58	34.35	19.10	0.56	30.70	65.05	11.60	45.95	3.96	17.18	28.78
1.92	37.70	19.50	0.52	30.70	68.40	11.20	48.90	4.37	18.85	30.05
2.20	39.32	19.40	0.49	30.60	69.92	11.20	50.52	4.51	19.66	30.86
2.42	41.82	19.40	0.46	30.60	72.42	11.20	53.02	4.73	20.91	32.11
3.18	44.91	18.70	0.42	30.50	75.41	11.80	56.71	4.81	22.46	34.26
3.78	47.19	17.80	0.38	30.60	77.79	12.80	59.99	4.69	23.59	36.39
4.42	49.83	16.50	0.33	30.70	80.53	14.20	64.03	4.51	24.91	39.11
5.71	52.91	14.40	0.27	30.70	83.61	16.30	69.21	4.25	26.45	42.75
6.63	54.45	13.10	0.24	30.60	85.05	17.50	71.95	4.11	27.23	44.73
7.57	55.95	11.70	0.21	30.70	86.65	19.00	74.95	3.94	27.97	46.97
8.51	55.78	10.60	0.19	30.50	86.28	19.90	75.68	3.80	27.89	47.79
9.43	57.62	9.40	0.16	30.70	88.32	21.30	78.92	3.71	28.81	50.11
11.35	58.36	7.60	0.13	30.70	89.06	23.10	81.46	3.53	29.18	52.28
12.63	59.44	6.30	0.11	30.70	90.14	24.40	83.84	3.44	29.72	54.12
13.67	59.88	5.60	0.09	30.70	90.58	25.10	84.98	3.39	29.94	55.04
14.76	59.88	4.90	0.08	30.50	90.38	25.60	85.48	3.34	29.94	55.54
15.20	59.57	4.60	0.08	30.70	90.27	26.10	85.67	3.28	29.79	55.89
16.30	59.91	3.80	0.06	30.70	90.61	26.90	86.81	3.23	29.95	56.85

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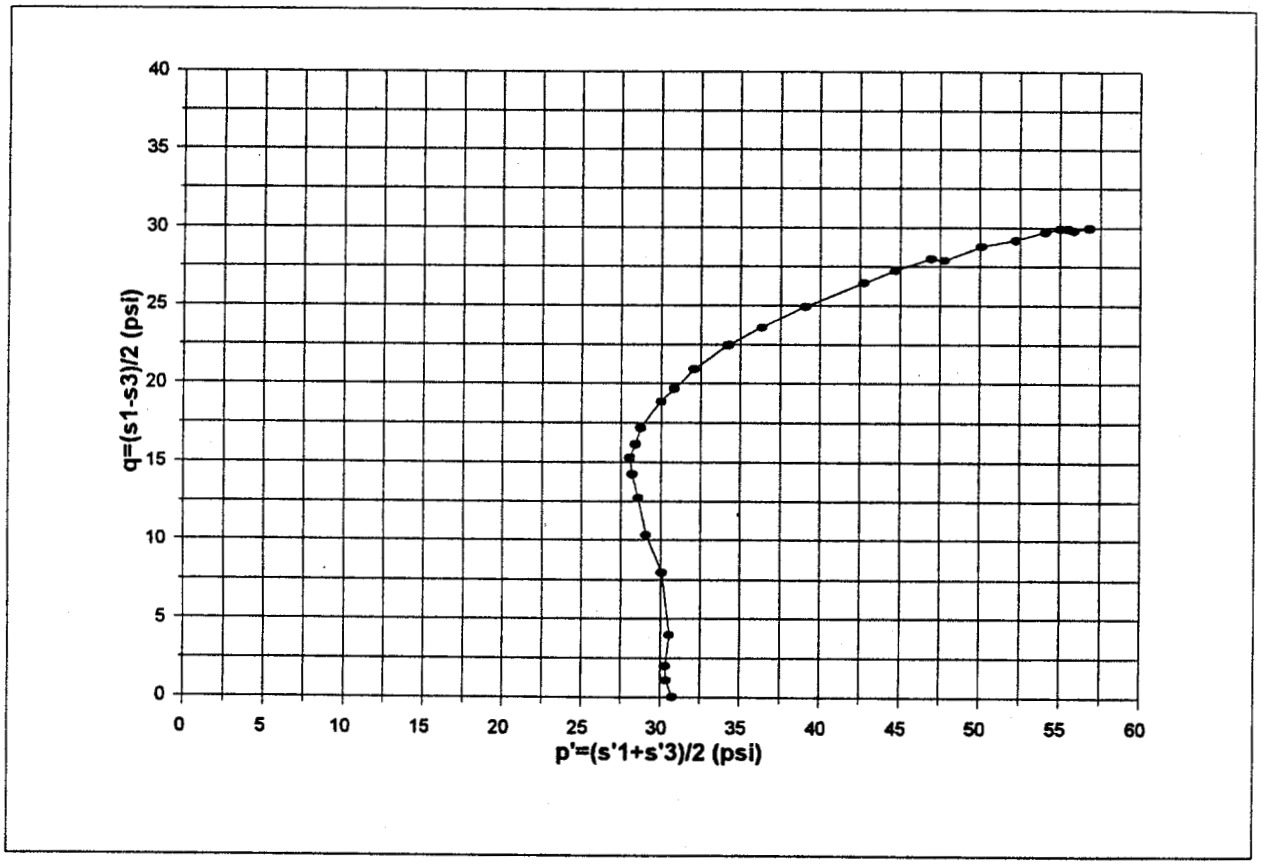
AGRA Earth & Environmental, Inc.

PROJECT:	GOLDEN EAGLE PARK DAM	**JOB NO:**	8-117-01014
LOCATION:	FOUNTAIN HILLS, AZ	**WORK ORDER NO:**	3
MATERIAL:	SANDY, SILTY GRAVEL	**LAB NO:**	34
SAMPLE SOURCE:	3 @ 35.0-35.6	**DATE SAMPLED:**	2-20-98
SAMPLE PREPARATION:	INSITU *Damaged sample, linear shear observed		
EFFECTIVE STRESS (PSI):	30		

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS (ASTM D4767)



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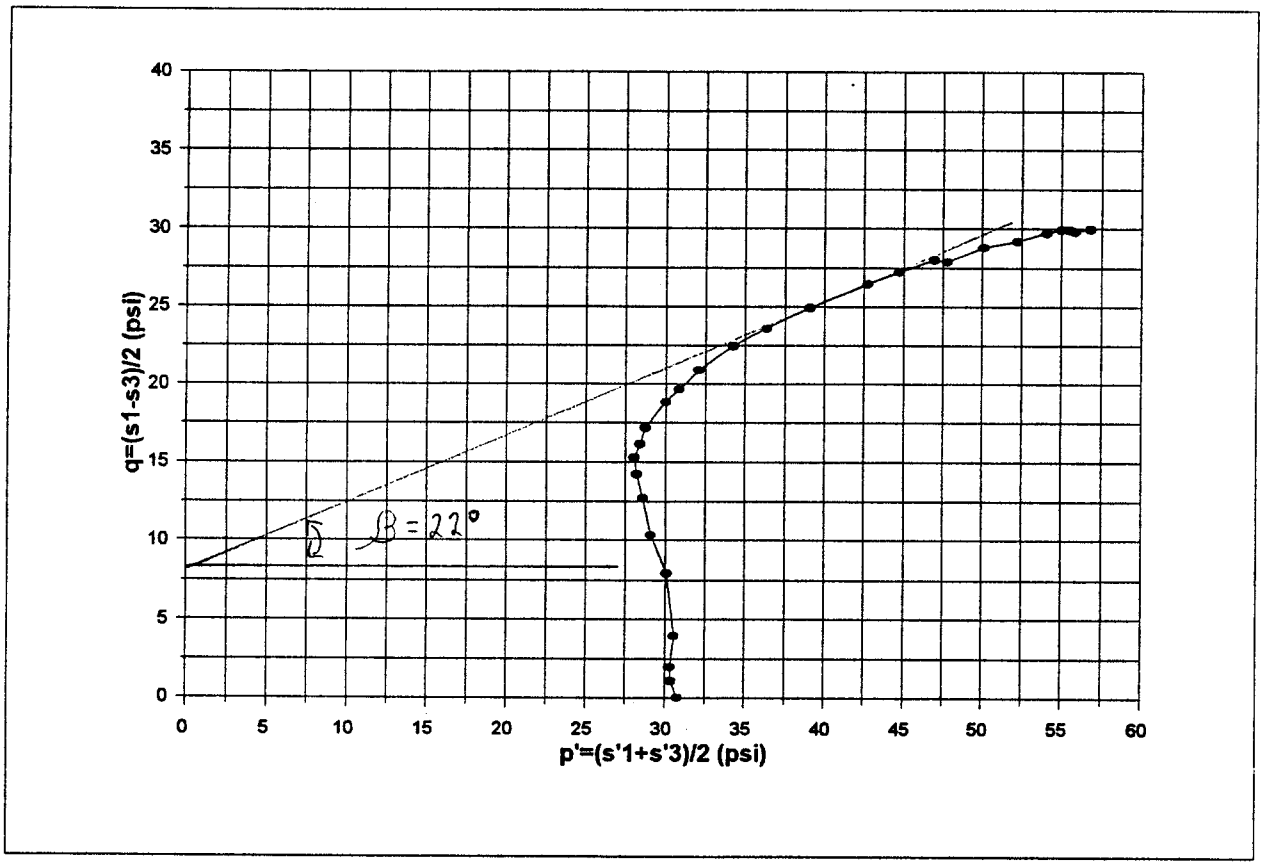
AGRA Earth & Environmental, Inc.

PROJECT:	GOLDEN EAGLE PARK DAM	**JOB NO:**	8-117-01014
LOCATION:		**WORK ORDER NO:**	3
MATERIAL:	SANDY, SILTY GRAVEL	**LAB NO:**	34
SAMPLE SOURCE:	3 @ 35.0-35.6	**DATE SAMPLED:**	2-20-98
SAMPLE PREPARATION:	INSITU *Damaged sample, linear shear observed		
EFFECTIVE STRESS (PSI):	30		

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS (ASTM D4767)



$\sin \phi = \tan \beta$

$\sin \phi = \tan 22°$

$\phi = 24°$

$C = \frac{a}{\cos \phi}$

$C = \frac{17}{\cos 24°}$

$C = 19$ psi

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AGRA Earth & Environmental, Inc.

PROJECT:	GOLDEN EAGLE PARK DAM	**JOB NO:**	8-117-01014
LOCATION:	FOUNTAIN HILLS, AZ	**WORK ORDER NO:**	3
MATERIAL:	SANDY, SILTY GRAVEL	**LAB NO:**	35
SAMPLE SOURCE:	3 @ 40.0-40.7	**DATE SAMPLED:**	2-20-98
SAMPLE PREPARATION:	INSITU		
EFFECTIVE STRESS (PSI):	20		

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS (ASTM D4767)

e (%)	s1-s3 (psi)	u (psi)	$\bar{A}$	s3 (psi)	s1 (psi)	s'3 (psi)	s'1 (psi)	s'1/s'3	q (s1-s3)/2 (psi)	p' (s'1+s'3)/2 (psi)
0.00	0.00	0.00	0.00	19.90	19.90	19.90	19.90	1.00	0.00	19.90
0.02	2.15	0.60	0.28	19.90	22.05	19.30	21.45	1.11	1.07	20.37
0.05	5.58	2.10	0.38	19.90	25.48	17.80	23.38	1.31	2.79	20.59
0.12	9.01	3.60	0.40	19.90	28.91	16.30	25.31	1.55	4.50	20.80
0.17	12.43	5.30	0.43	19.90	32.33	14.60	27.03	1.85	6.22	20.82
0.26	17.99	7.60	0.42	19.90	37.89	12.30	30.29	2.46	9.00	21.30
0.55	26.48	10.50	0.40	19.80	46.28	9.30	35.78	3.85	13.24	22.54
0.78	33.24	12.10	0.36	19.80	53.04	7.70	40.94	5.32	16.62	24.32
1.02	40.38	12.90	0.32	19.70	60.08	6.80	47.18	6.94	20.19	26.99
1.29	46.21	13.10	0.28	19.80	66.01	6.70	52.91	7.90	23.11	29.81
1.54	51.59	12.50	0.24	19.80	71.39	7.30	58.89	8.07	25.80	33.10
1.80	56.09	11.40	0.20	19.90	75.99	8.50	64.59	7.60	28.05	36.55
2.38	64.99	9.20	0.14	19.70	84.69	10.50	75.49	7.19	32.49	42.99
2.91	70.06	6.90	0.10	19.70	89.76	12.80	82.86	6.47	35.03	47.83
3.40	70.53	4.90	0.07	19.80	90.33	14.90	85.43	5.73	35.26	50.16
4.21	80.22	2.30	0.03	19.70	99.92	17.40	97.62	5.61	40.11	57.51
4.92	84.12	0.50	0.01	19.80	103.92	19.30	103.42	5.36	42.06	61.36
5.67	87.51	-1.00	-0.01	19.80	107.31	20.80	108.31	5.21	43.76	64.56
6.44	88.80	-2.80	-0.03	19.90	108.70	22.70	111.50	4.91	44.40	67.10
7.75	89.15	-5.60	-0.06	19.80	108.95	25.40	114.55	4.51	44.57	69.97
8.00	88.91	-6.40	-0.07	19.80	108.71	26.20	115.11	4.39	44.45	70.65
8.84	88.09	-7.50	-0.09	19.80	107.89	27.30	115.39	4.23	44.05	71.35
9.55	87.41	-9.10	-0.10	19.90	107.31	29.00	116.41	4.01	43.70	72.70
10.34	86.64	-10.50	-0.12	19.80	106.44	30.30	116.94	3.86	43.32	73.62
11.10	85.90	-11.90	-0.14	19.70	105.60	31.60	117.50	3.72	42.95	74.55
11.87	83.66	-13.20	-0.16	19.80	103.46	33.00	116.66	3.54	41.83	74.83
12.64	82.17	-14.60	-0.18	19.80	101.97	34.40	116.57	3.39	41.08	75.48
13.91	80.23	-16.30	-0.20	19.70	99.93	36.00	116.23	3.23	40.12	76.12
14.23	79.94	-16.60	-0.21	19.70	99.64	36.30	116.24	3.20	39.97	76.27
14.96	78.90	-17.30	-0.22	19.80	98.70	37.10	116.00	3.13	39.45	76.55
15.48	78.04	-17.20	-0.22	19.70	97.74	36.90	114.94	3.11	39.02	75.92

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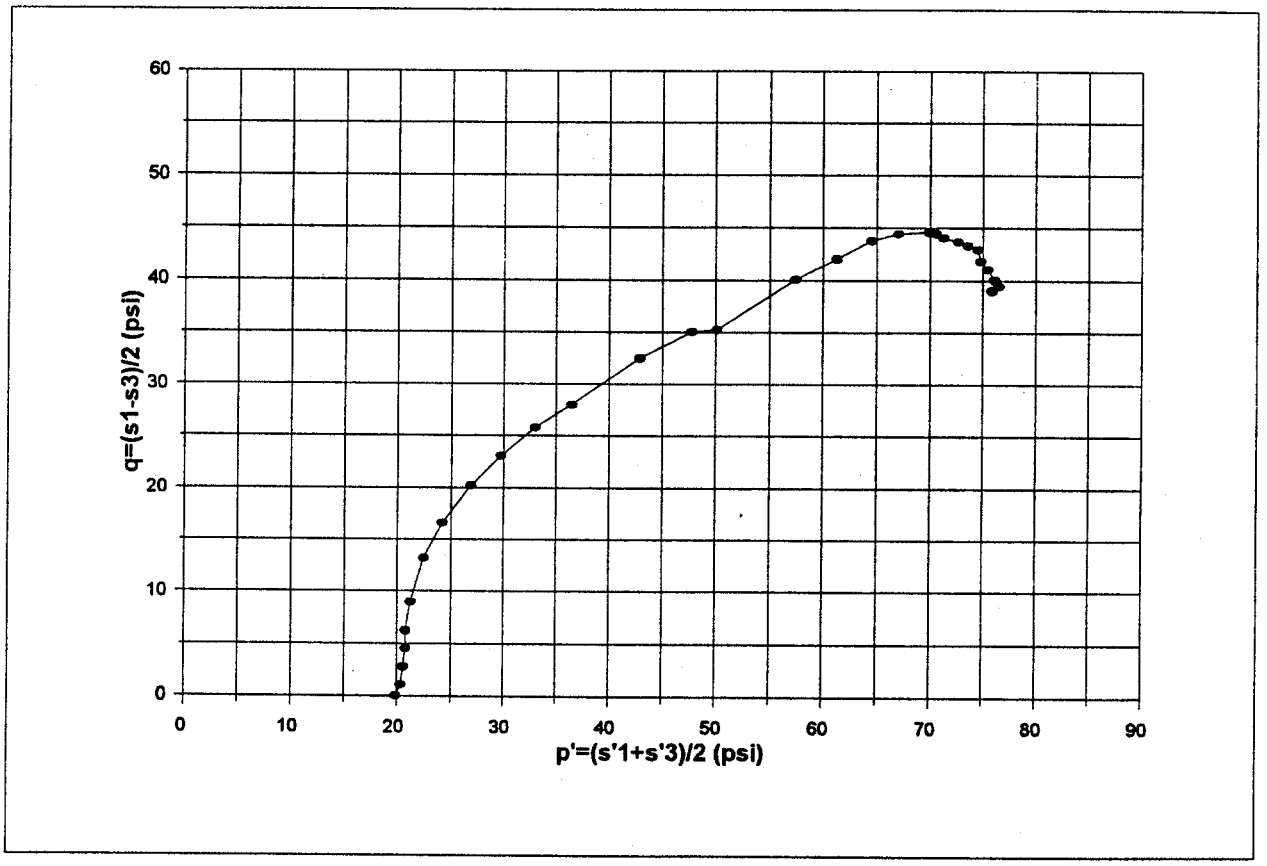
AGRA Earth & Environmental, Inc.

PROJECT:	GOLDEN EAGLE PARK DAM	**JOB NO:**	8-117-01014
LOCATION:	FOUNTAIN HILLS, AZ	**WORK ORDER NO:**	3
MATERIAL:	SANDY, SILTY GRAVEL	**LAB NO:**	35
SAMPLE SOURCE:	3 @ 40.0-40.7	**DATE SAMPLED:**	2-20-98
SAMPLE PREPARATION:	INSITU		
EFFECTIVE STRESS (PSI):	20		

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS (ASTM D4767)



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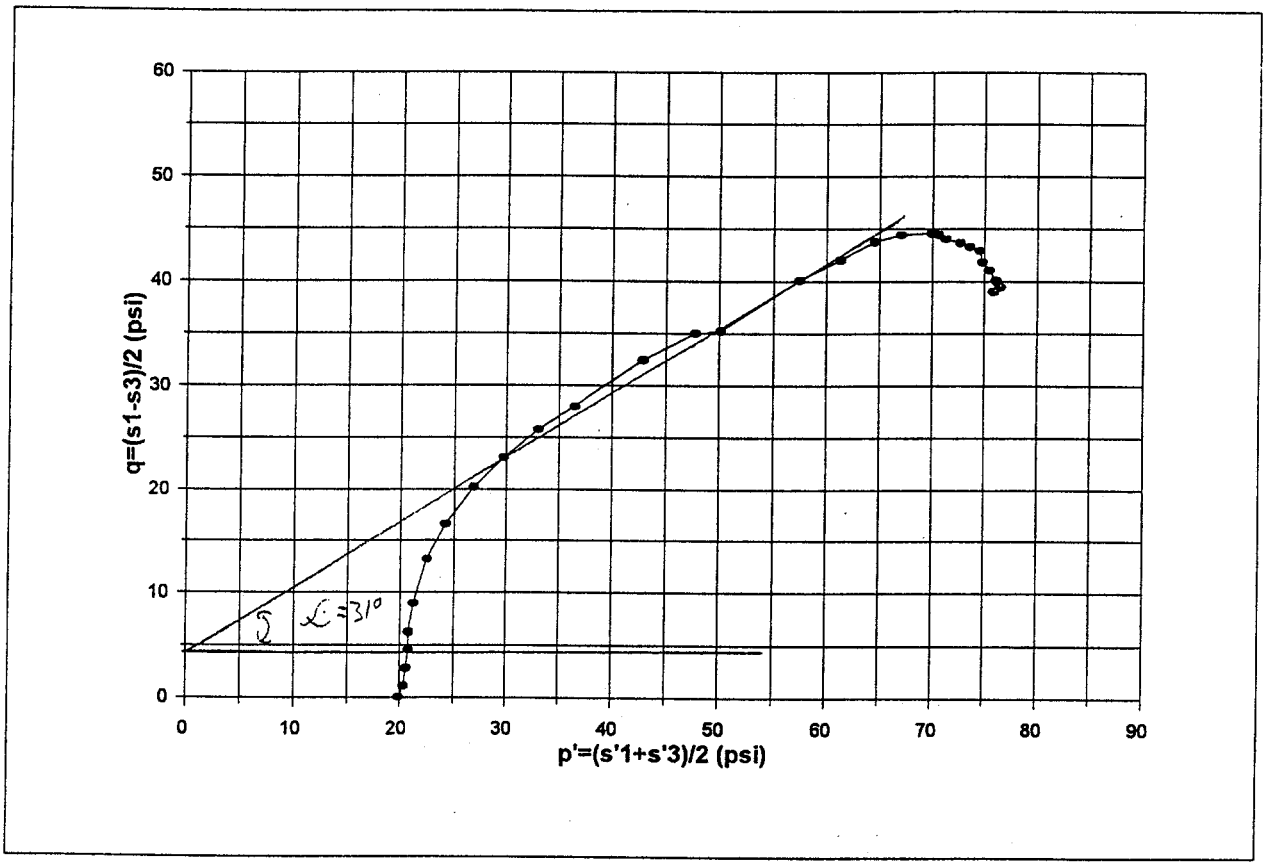
PROJECT:	GOLDEN EAGLE PARK DAM	**JOB NO:**	8-117-01014
LOCATION:		**WORK ORDER NO:**	3
MATERIAL:	SANDY, SILTY GRAVEL	**LAB NO:**	35
SAMPLE SOURCE:	3 @ 40.0-40.7	**DATE SAMPLED:**	2-20-98
SAMPLE PREPARATION:	INSITU		
EFFECTIVE STRESS (PSI):	20		

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS (ASTM D4767)



$c = 4$

$\sin\phi = \tan\alpha$

$\sin\phi = \tan 31°$

$\phi = 37°$

$C = \frac{c}{\cos\phi}$

$C = \frac{4}{\cos 37°}$

$C = 5\,psi$

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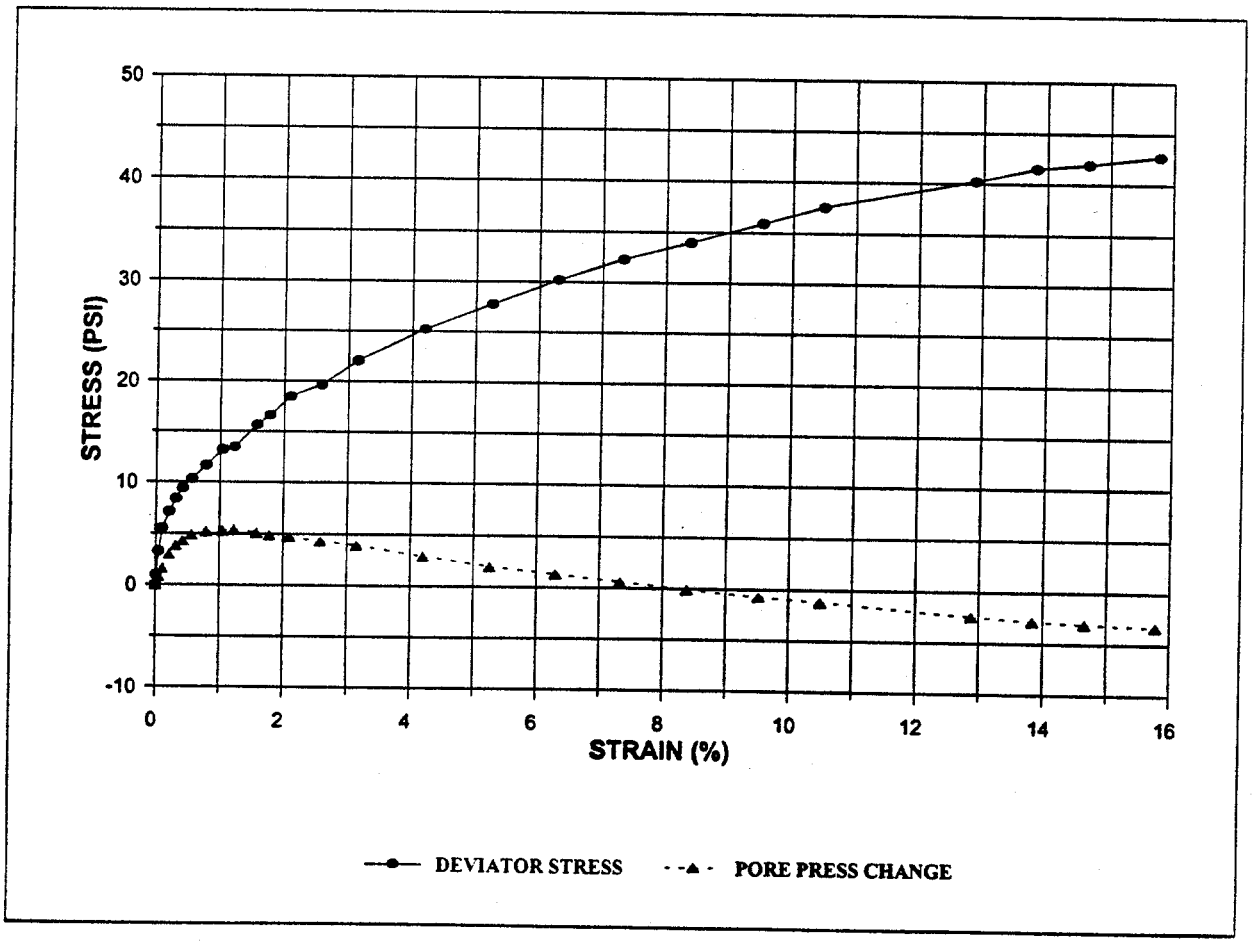
PROJECT:	GOLDEN EAGLE PARK DAM	**JOB NO:**	8-117-001014
LOCATION:		**WORK ORDER NO:**	3
MATERIAL:	SILTY SAND	**LAB NO:**	41
SAMPLE SOURCE:	4 @ 10-15'	**DATE SAMPLED:**	2-24-98
SAMPLE PREPARATION:	Remold to 100% of given density 128.6 at 10% moisture		
EFFECTIVE STRESS (PSI):	10		

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS (ASTM D4767)

LIQUID LIMIT:	NV		
PLASTICITY INDEX:	NV		
INITIAL HEIGHT (CM):	14.22	TOTAL BACK PRESSURE (PSI):	61.1
INITIAL DIAMETER (CM):	7.14	"B" VALUE AT SATURATION:	0.95
		RATE OF STRAIN (% PER MIN):	0.056
INITIAL DRY UNIT WEIGHT (PCF):	127.5		
INITIAL VOID RATIO:	0.327	FINAL DRY UNIT WEIGHT (PCF):	125.5
INITIAL WATER CONTENT (%):	10.0	FINAL VOID RATIO:	0.347
INITIAL DEGREE OF SATURATION (%):	83	FINAL WATER CONTENT (%):	11.8
		FINAL DEGR. OF SATURATION (%):	92
METHOD FOLLOWED FOR SATURATION:	DRY		
		MAX DEVIATOR STRESS (PSI):	43
		@ STRAIN (%):	15.80



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PROJECT:	GOLDEN EAGLE PARK DAM	**JOB NO:**	8-117-001014
LOCATION:		**WORK ORDER NO:**	3
MATERIAL:	SILTY SAND	**LAB NO:**	41
SAMPLE SOURCE:	4 @ 10-15'	**DATE SAMPLED:**	2-24-98
SAMPLE PREPARATION:	Remold to 100% of given density 128.6 at 10% moisture		
EFFECTIVE STRESS (PSI):	10		

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS (ASTM D4767)

e (%)	s1-s3 (psi)	u (psi)	$\bar{A}$	s3 (psi)	s1 (psi)	s'3 (psi)	s'1 (psi)	s'1/s'3	q (s1-s3)/2 (psi)	p' (s'1+s'3)/2 (psi)
0.00	0.00	0.00	0.00	9.90	9.90	9.90	9.90	1.00	0.00	9.90
0.02	0.98	0.40	0.41	9.90	10.88	9.50	10.48	1.10	0.49	9.99
0.05	3.25	0.80	0.25	9.90	13.15	9.10	12.35	1.36	1.63	10.73
0.11	5.53	1.60	0.29	9.90	15.43	8.30	13.83	1.67	2.76	11.06
0.21	7.15	3.00	0.42	9.90	17.05	6.90	14.05	2.04	3.57	10.47
0.32	8.44	3.80	0.45	9.90	18.34	6.10	14.54	2.38	4.22	10.32
0.43	9.40	4.30	0.46	9.90	19.30	5.60	15.00	2.68	4.70	10.30
0.57	10.36	4.90	0.47	9.90	20.26	5.00	15.36	3.07	5.18	10.18
0.79	11.63	5.20	0.45	9.90	21.53	4.70	16.33	3.47	5.81	10.51
1.06	13.21	5.30	0.40	10.00	23.21	4.70	17.91	3.81	6.60	11.30
1.23	13.50	5.40	0.40	10.00	23.50	4.60	18.10	3.94	6.75	11.35
1.59	15.70	5.10	0.32	10.10	25.80	5.00	20.70	4.14	7.85	12.85
1.79	16.63	4.90	0.29	10.20	26.83	5.30	21.93	4.14	8.31	13.61
2.11	18.48	4.70	0.25	10.20	28.68	5.50	23.98	4.36	9.24	14.74
2.59	19.66	4.30	0.22	10.40	30.06	6.10	25.76	4.22	9.83	15.93
3.17	22.07	3.90	0.18	10.50	32.57	6.60	28.67	4.34	11.03	17.63
4.20	25.26	2.90	0.11	10.80	36.06	7.90	33.16	4.20	12.63	20.53
5.26	27.76	2.00	0.07	11.10	38.86	9.10	36.86	4.05	13.88	22.98
6.32	30.19	1.30	0.04	11.30	41.49	10.00	40.19	4.02	15.10	25.10
7.34	32.28	0.60	0.02	11.60	43.88	11.00	43.28	3.93	16.14	27.14
8.39	34.00	-0.10	-0.00	11.80	45.80	11.90	45.90	3.86	17.00	28.90
9.54	35.93	-0.70	-0.02	12.00	47.93	12.70	48.63	3.83	17.96	30.66
10.50	37.59	-1.20	-0.03	12.20	49.79	13.40	50.99	3.80	18.79	32.19
12.88	40.27	-2.40	-0.06	12.80	53.07	15.20	55.47	3.65	20.14	35.34
13.85	41.51	-2.80	-0.07	13.00	54.51	15.80	57.31	3.63	20.75	36.55
14.67	41.95	-3.10	-0.07	13.20	55.15	16.30	58.25	3.57	20.97	37.27
15.80	42.76	-3.30	-0.08	13.40	56.16	16.70	59.46	3.56	21.38	38.08

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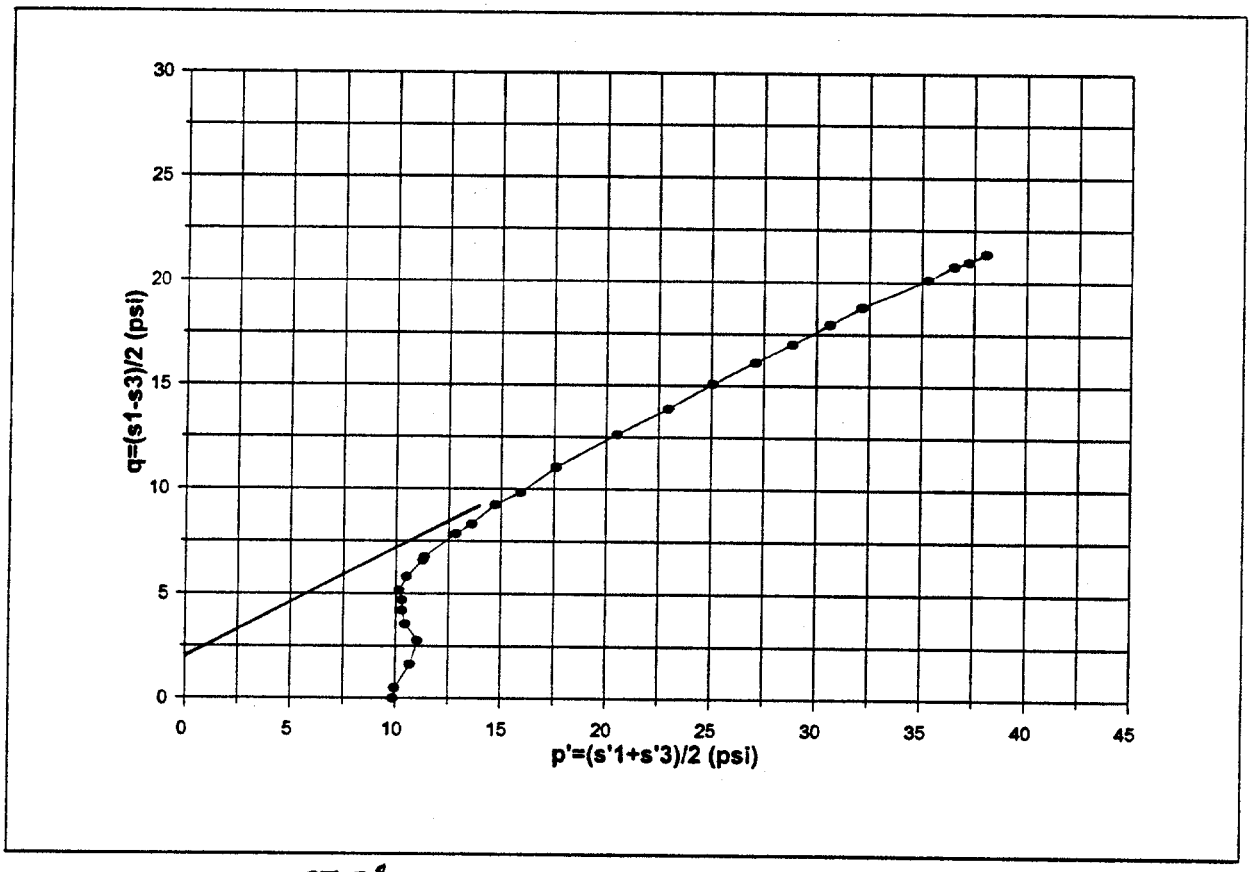
PROJECT:	GOLDEN EAGLE PARK DAM	**JOB NO:**	8-117-001014
LOCATION:		**WORK ORDER NO:**	3
MATERIAL:	SILTY SAND	**LAB NO:**	41
SAMPLE SOURCE:	4 @ 10-15'	**DATE SAMPLED:**	2-24-98
SAMPLE PREPARATION:	Remold to 100% of given density 128.6 at 10% moisture		
EFFECTIVE STRESS (PSI):	10		

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS (ASTM D4767)



$\beta = 27.2°$

$a = 2.0$ psi

$\sin\phi = \tan\beta \therefore \phi = 31°$

$c = a/\cos\phi = 2.3$ psi $= 336$ psf

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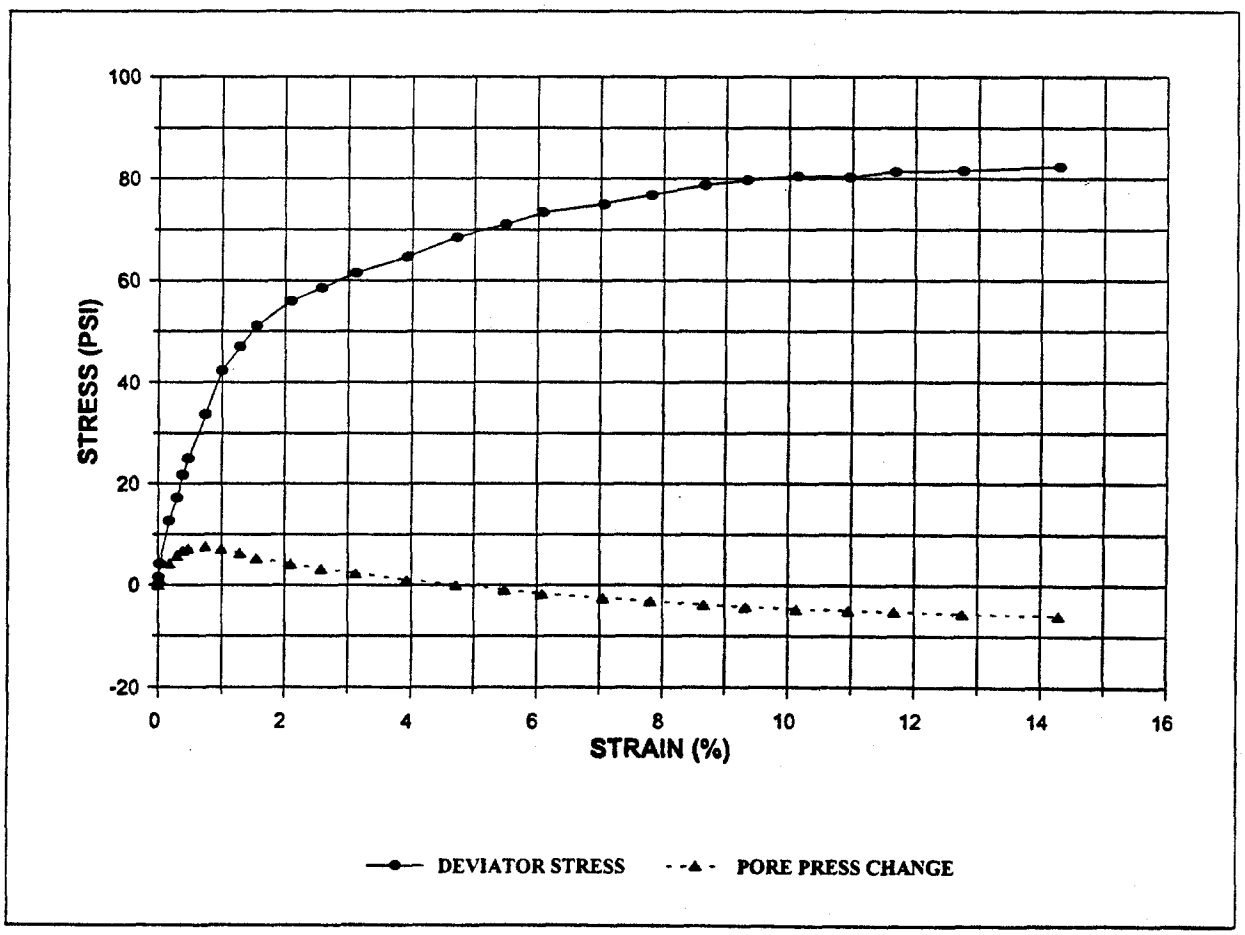
AGRA Earth & Environmental, Inc.

PROJECT:	GOLDEN EAGLE PARK DAM	**JOB NO:**	8-117-001014
LOCATION:		**WORK ORDER NO:**	3
MATERIAL:	SILTY SAND	**LAB NO:**	41
SAMPLE SOURCE:	4 @ 10-15'	**DATE SAMPLED:**	2-24-98
SAMPLE PREPARATION:	Remold to 100% of given density 128.6 at 10% moisture		
EFFECTIVE STRESS (PSI):	20		

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS (ASTM D4767)

LIQUID LIMIT:	NV		
PLASTICITY INDEX:	NV		
INITIAL HEIGHT (CM):	14.16	TOTAL BACK PRESSURE (PSI):	59.9
INITIAL DIAMETER (CM):	7.12	"B" VALUE AT SATURATION:	0.99
		RATE OF STRAIN (% PER MIN):	0.057
INITIAL DRY UNIT WEIGHT (PCF):	128.9		
INITIAL VOID RATIO:	0.312	FINAL DRY UNIT WEIGHT (PCF):	129.7
INITIAL WATER CONTENT (%):	10.0	FINAL VOID RATIO:	0.303
INITIAL DEGREE OF SATURATION (%):	87	FINAL WATER CONTENT (%):	12.2
		FINAL DEGR. OF SATURATION (%):	109
METHOD FOLLOWED FOR SATURATION:	DRY		
		MAX DEVIATOR STRESS (PSI):	82
		@ STRAIN (%):	14.30



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AGRA Earth & Environmental, Inc.

PROJECT:	GOLDEN EAGLE PARK DAM	**JOB NO:**	8-117-001014
LOCATION:		**WORK ORDER NO:**	3
MATERIAL:	SILTY SAND	**LAB NO:**	41
SAMPLE SOURCE:	4 @ 10-15'	**DATE SAMPLED:**	2-24-98
SAMPLE PREPARATION:	Remold to 100% of given density 128.6 at 10% moisture		
EFFECTIVE STRESS (PSI):	20		

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS (ASTM D4767)

e (%)	s1-s3 (psi)	u (psi)	$\bar{A}$	s3 (psi)	s1 (psi)	s'3 (psi)	s'1 (psi)	s'1/s'3	q (s1-s3)/2 (psi)	p' (s'1+s'3)/2 (psi)
0.00	0.00	0.00	0.00	20.70	20.70	20.70	20.70	1.00	0.00	20.70
0.02	1.63	0.80	0.49	20.80	22.43	20.00	21.63	1.08	0.82	20.82
0.04	4.25	1.20	0.28	20.80	25.05	19.60	23.85	1.22	2.12	21.72
0.18	12.73	4.30	0.34	20.80	33.53	16.50	29.23	1.77	6.36	22.86
0.31	17.27	5.80	0.34	20.80	38.07	15.00	32.27	2.15	8.64	23.64
0.40	21.82	6.80	0.31	20.80	42.62	14.00	35.82	2.56	10.91	24.91
0.49	25.05	7.30	0.29	20.80	45.85	13.50	38.55	2.86	12.53	26.03
0.76	33.74	7.70	0.23	20.80	54.54	13.10	46.84	3.58	16.87	29.97
1.01	42.39	7.20	0.17	20.90	63.29	13.70	56.09	4.09	21.20	34.90
1.30	47.11	6.40	0.14	20.90	68.01	14.50	61.61	4.25	23.56	38.06
1.55	51.17	5.40	0.11	21.00	72.17	15.60	66.77	4.28	25.59	41.19
2.10	56.01	4.20	0.07	21.10	77.11	16.90	72.91	4.31	28.01	44.91
2.58	58.60	3.20	0.05	21.20	79.80	18.00	76.60	4.26	29.30	47.30
3.13	61.44	2.40	0.04	21.40	82.84	19.00	80.44	4.23	30.72	49.72
3.94	64.69	1.10	0.02	21.60	86.29	20.50	85.19	4.16	32.35	52.85
4.72	68.53	0.10	0.00	21.80	90.33	21.70	90.23	4.16	34.27	55.97
5.49	71.06	-0.90	-0.01	22.00	93.06	22.90	93.96	4.10	35.53	58.43
6.09	73.38	-1.70	-0.02	22.10	95.48	23.80	97.18	4.08	36.69	60.49
7.07	75.05	-2.50	-0.03	22.30	97.35	24.80	99.85	4.03	37.52	62.32
7.83	76.84	-3.10	-0.04	22.50	99.34	25.60	102.44	4.00	38.42	64.02
8.68	78.82	-3.80	-0.05	22.70	101.52	26.50	105.32	3.97	39.41	65.91
9.34	79.73	-4.20	-0.05	22.90	102.63	27.10	106.83	3.94	39.86	66.96
10.14	80.50	-4.60	-0.06	23.10	103.60	27.70	108.20	3.91	40.25	67.95
10.97	80.33	-4.90	-0.06	23.30	103.63	28.20	108.53	3.85	40.17	68.37
11.69	81.41	-5.10	-0.06	23.50	104.91	28.60	110.01	3.85	40.71	69.31
12.76	81.57	-5.50	-0.07	23.80	105.37	29.30	110.87	3.78	40.79	70.09
14.30	82.38	-5.90	-0.07	24.30	106.68	30.20	112.58	3.73	41.19	71.39

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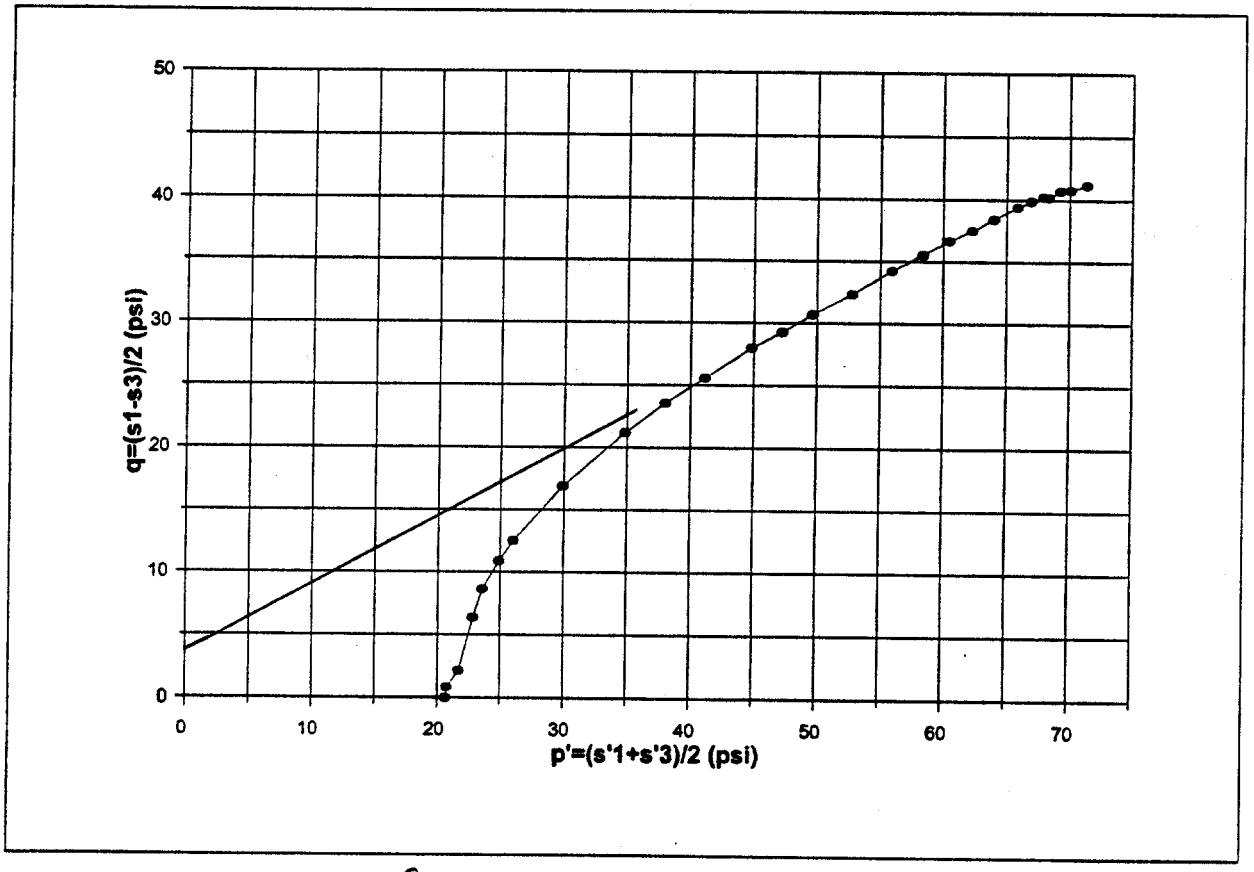
PROJECT:	GOLDEN EAGLE PARK DAM	**JOB NO:**	8-117-001014
LOCATION:		**WORK ORDER NO:**	3
MATERIAL:	SILTY SAND	**LAB NO:**	41
SAMPLE SOURCE:	4 @ 10-15'	**DATE SAMPLED:**	2-24-98
SAMPLE PREPARATION:	Remold to 100% of given density 128.6 at 10% moisture		
EFFECTIVE STRESS (PSI):	20		

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS (ASTM D4767)



$\beta = 28.1^\circ$

$a = 3.9$ psi

$\sin\phi = \tan\beta \therefore \phi = 32^\circ$

$c = a/\cos\phi = 4.6$ psi $= 665$ psf

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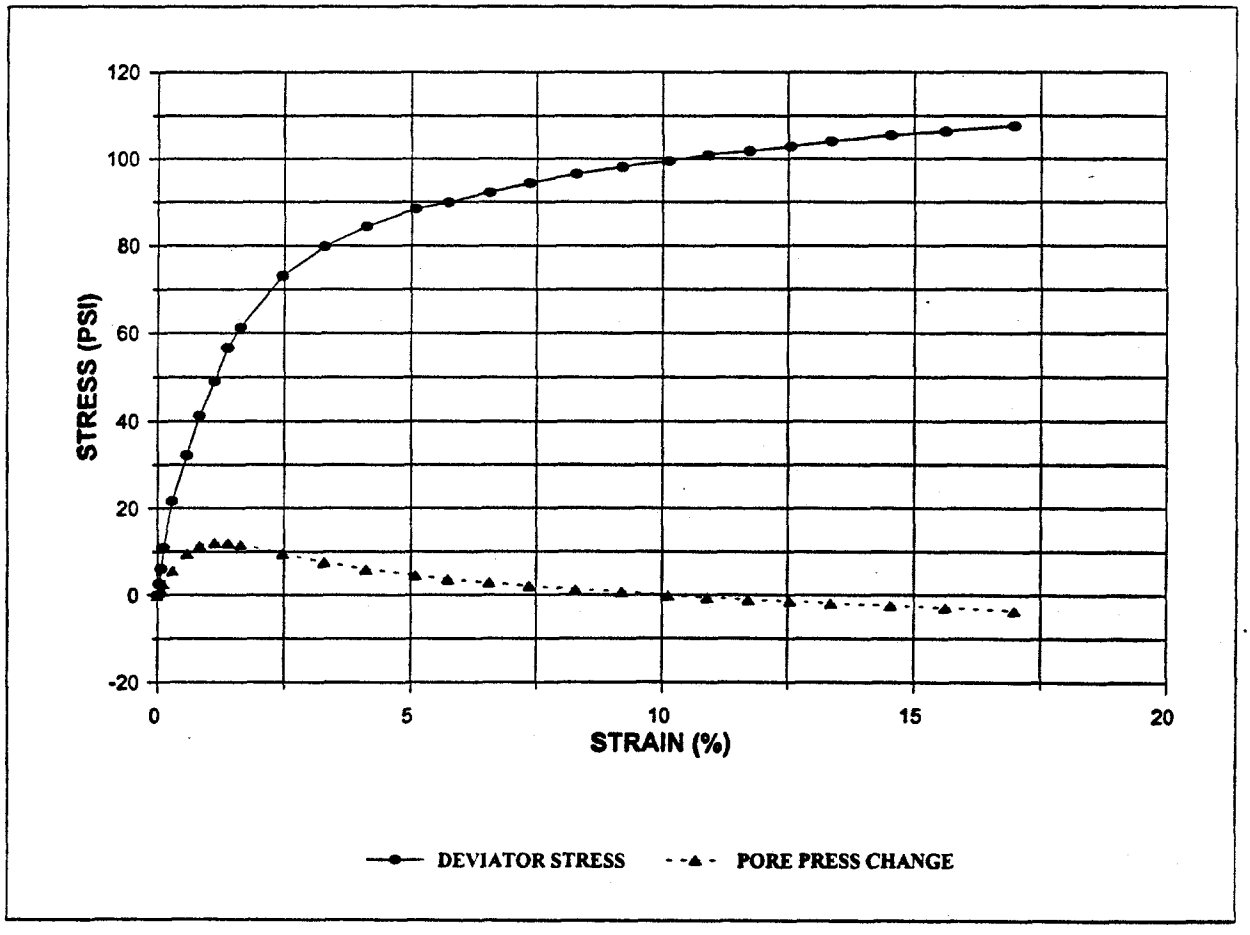
PROJECT:	GOLDEN EAGLE PARK DAM	**JOB NO:**	8-117-001014
LOCATION:		**WORK ORDER NO:**	3
MATERIAL:	SILTY SAND	**LAB NO:**	41
SAMPLE SOURCE:	4 @ 10-15'	**DATE SAMPLED:**	2-24-98
SAMPLE PREPARATION:	Remold to 100% of given density 128.6 at 10% moisture		
EFFECTIVE STRESS (PSI):	30		

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS (ASTM D4767)

LIQUID LIMIT:	NV		
PLASTICITY INDEX:	NV		
INITIAL HEIGHT (CM):	14.13	TOTAL BACK PRESSURE (PSI):	59.7
INITIAL DIAMETER (CM):	7.15	"B" VALUE AT SATURATION:	95.40
		RATE OF STRAIN (% PER MIN):	0.057
INITIAL DRY UNIT WEIGHT (PCF):	127.7		
INITIAL VOID RATIO:	0.325	FINAL DRY UNIT WEIGHT (PCF):	128.8
INITIAL WATER CONTENT (%):	10.0	FINAL VOID RATIO:	0.313
INITIAL DEGREE OF SATURATION (%):	83	FINAL WATER CONTENT (%):	11.8
		FINAL DEGR. OF SATURATION (%):	102
METHOD FOLLOWED FOR SATURATION:	DRY		
		MAX DEVIATOR STRESS (PSI):	108
		@ STRAIN (%):	16.99



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PROJECT:	GOLDEN EAGLE PARK DAM	**JOB NO:**	8-117-001014
LOCATION:		**WORK ORDER NO:**	3
MATERIAL:	SILTY SAND	**LAB NO:**	41
SAMPLE SOURCE:	4 @ 10-15'	**DATE SAMPLED:**	2-24-98
SAMPLE PREPARATION:	Remold to 100% of given density 128.6 at 10% moisture		
EFFECTIVE STRESS (PSI):	30		

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS (ASTM D4767)

e (%)	s1-s3 (psi)	u (psi)	$\bar{A}$	s3 (psi)	s1 (psi)	s'3 (psi)	s'1 (psi)	s'1/s'3	q (s1-s3)/2 (psi)	p' (s'1+s'3)/2 (psi)
0.00	0.00	0.00	0.00	30.60	30.60	30.60	30.60	1.00	0.00	30.60
0.04	2.60	0.60	0.23	30.60	33.20	30.00	32.60	1.09	1.30	31.30
0.07	6.17	1.40	0.23	30.60	36.77	29.20	35.37	1.21	3.08	32.28
0.13	11.03	2.60	0.24	30.60	41.63	28.00	39.03	1.39	5.51	33.51
0.29	21.70	5.70	0.26	30.60	52.30	24.90	46.60	1.87	10.85	35.75
0.58	32.29	9.60	0.30	30.70	62.99	21.10	53.39	2.53	16.15	37.25
0.83	41.23	11.40	0.28	30.70	71.93	19.30	60.53	3.14	20.61	39.91
1.12	49.14	12.10	0.25	30.70	79.84	18.60	67.74	3.64	24.57	43.17
1.39	56.69	12.10	0.21	30.80	87.49	18.70	75.39	4.03	28.34	47.04
1.65	61.33	11.70	0.19	30.80	92.13	19.10	80.43	4.21	30.67	49.77
2.48	73.17	9.60	0.13	31.00	104.17	21.40	94.57	4.42	36.58	57.98
3.30	79.78	7.60	0.10	31.20	110.98	23.60	103.38	4.38	39.89	63.49
4.13	84.39	6.00	0.07	31.40	115.79	25.40	109.79	4.32	42.19	67.59
5.11	88.46	4.60	0.05	31.70	120.16	27.10	115.56	4.26	44.23	71.33
5.76	89.99	3.70	0.04	31.80	121.79	28.10	118.09	4.20	45.00	73.10
6.57	92.25	2.90	0.03	32.00	124.25	29.10	121.35	4.17	46.12	75.22
7.37	94.47	2.10	0.02	32.20	126.67	30.10	124.57	4.14	47.23	77.33
8.30	96.50	1.30	0.01	32.40	128.90	31.10	127.60	4.10	48.25	79.35
9.22	98.19	0.70	0.01	32.60	130.79	31.90	130.09	4.08	49.09	80.99
10.14	99.52	-0.10	-0.00	32.90	132.42	33.00	132.52	4.02	49.76	82.76
10.92	100.97	-0.50	-0.00	33.00	133.97	33.50	134.47	4.01	50.49	83.99
11.74	101.77	-1.00	-0.01	33.20	134.97	34.20	135.97	3.98	50.89	85.09
12.55	102.82	-1.30	-0.01	33.40	136.22	34.70	137.52	3.96	51.41	86.11
13.37	104.11	-1.80	-0.02	33.60	137.71	35.40	139.51	3.94	52.06	87.46
14.54	105.47	-2.30	-0.02	33.90	139.37	36.20	141.67	3.91	52.74	88.94
15.63	106.32	-2.80	-0.03	34.20	140.52	37.00	143.32	3.87	53.16	90.16
16.99	107.58	-3.50	-0.03	34.60	142.18	38.10	145.68	3.82	53.79	91.89

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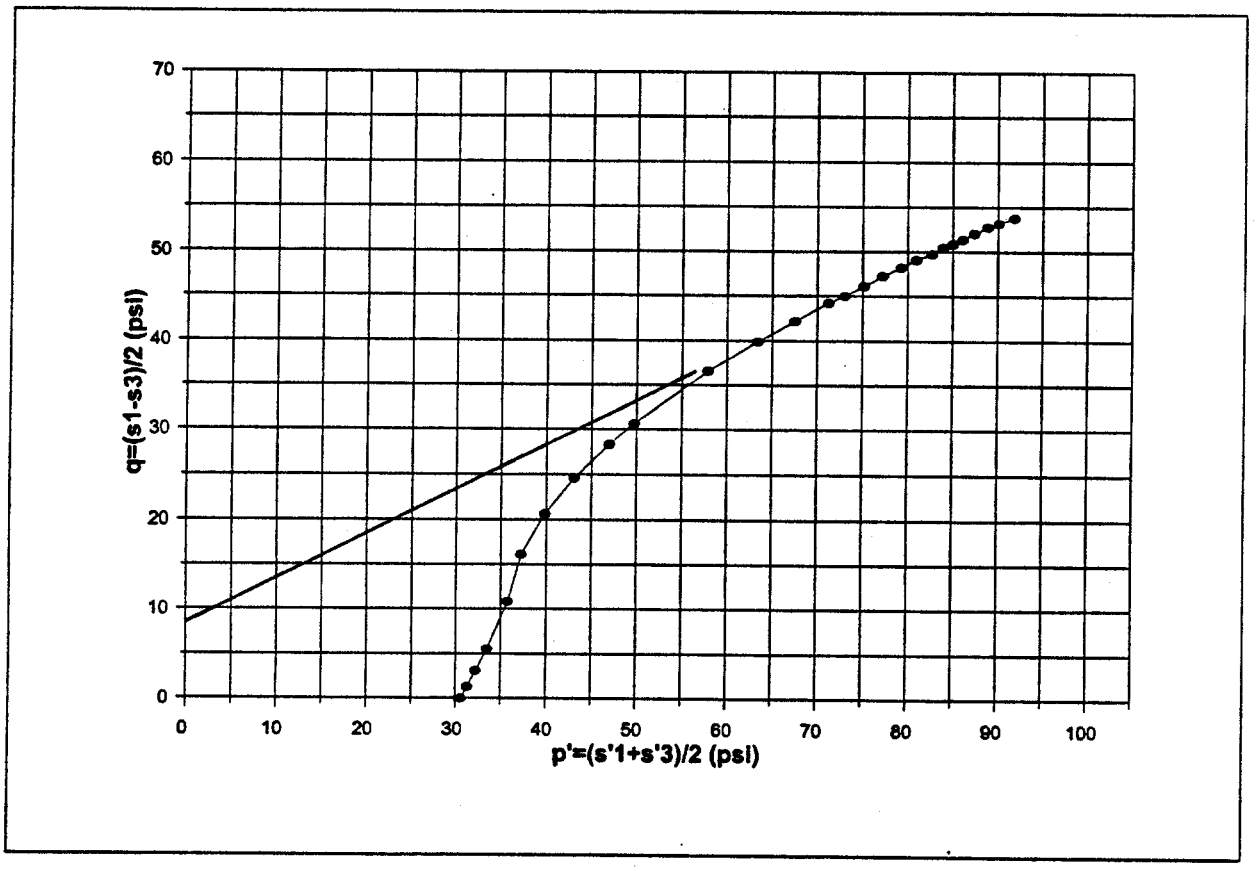
PROJECT:	GOLDEN EAGLE PARK DAM	**JOB NO:**	8-117-001014
LOCATION:		**WORK ORDER NO:**	3
MATERIAL:	SILTY SAND	**LAB NO:**	41
SAMPLE SOURCE:	4 @ 10-15'	**DATE SAMPLED:**	2-24-98
SAMPLE PREPARATION:	Remold to 100% of given density 128.6 at 10% moisture		
EFFECTIVE STRESS (PSI):	30		

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS (ASTM D4767)



$\beta = 26.1°$

$a = 8.4$ psi

$\sin\phi = \tan\beta \therefore \phi = 29°$

$c = a/\cos\phi = 9.6$ psi $= 1390$ psf

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APPENDIX C

STABILITY & SEEPAGE ANALYSES RESULTS

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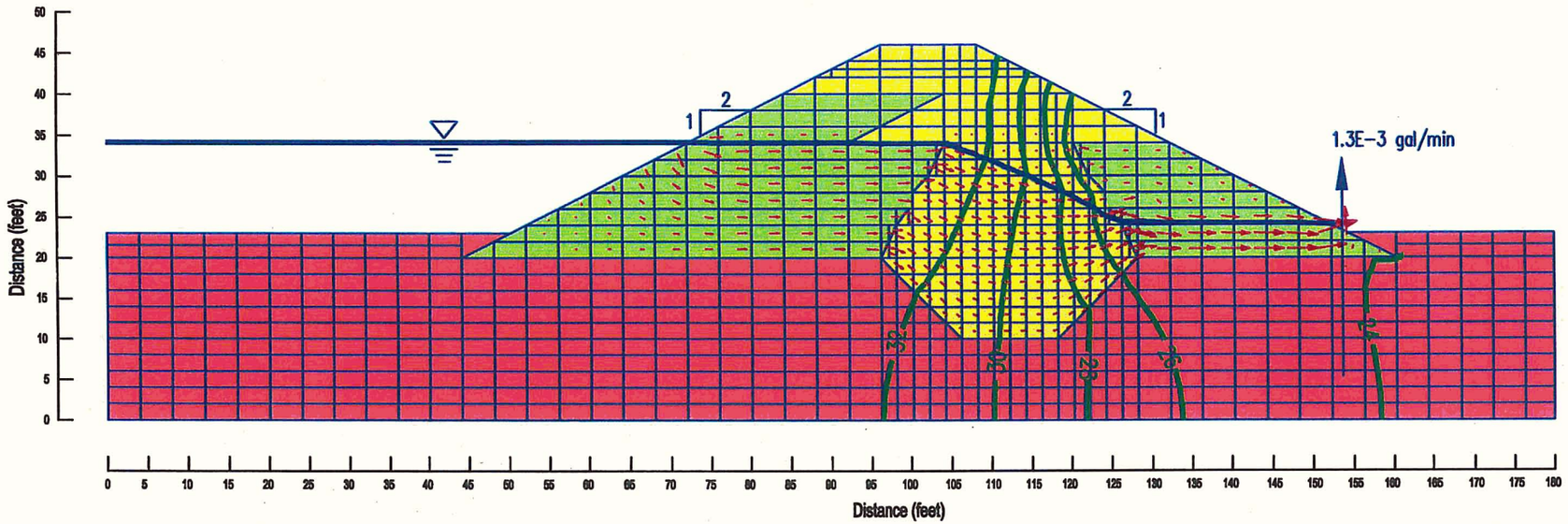


	Hydraulic Conductivity, ft/sec
Core	1E-4
Embankment Fill	1E-2
Foundation	1E-6

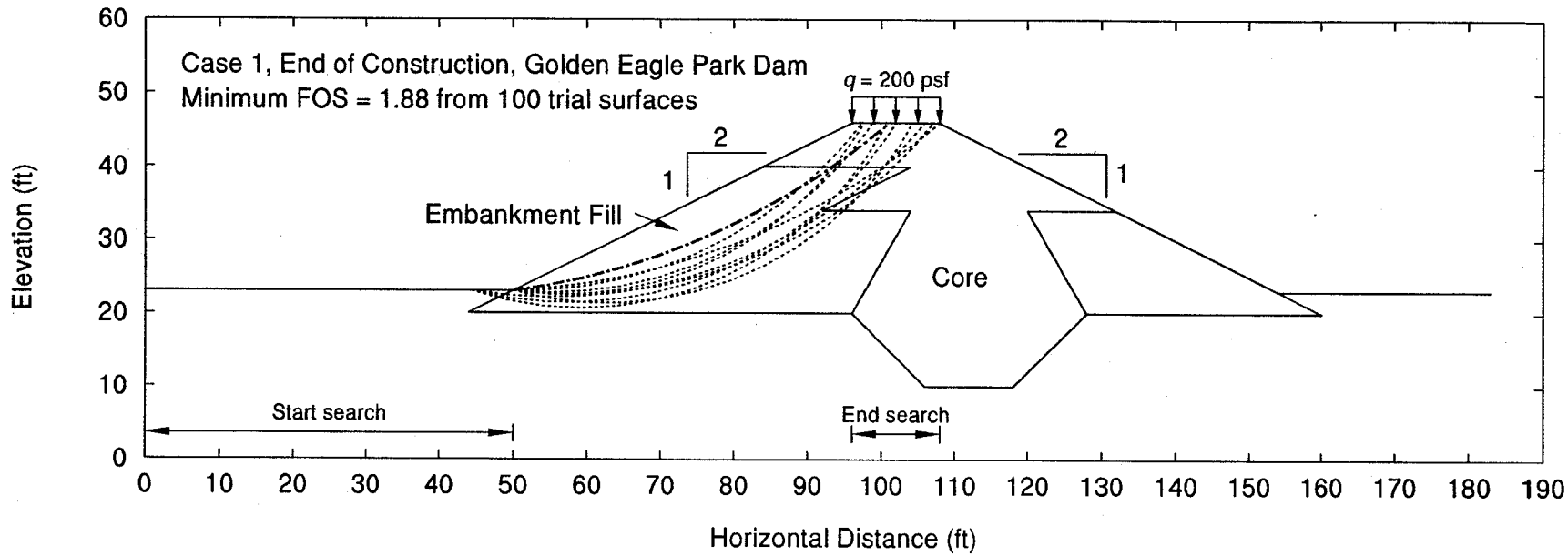
Contours presented represent total head. Seepage rates are presented as the seepage rate for a one-foot width. Seepage analysis was modeled using the finite element computer program SEEP/W (Geo-Slope International, 1998).

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS
3232 West Virginia Avenue
Phoenix, Arizona 85009
Tel: (602)272-6848
Fax: (602)272-7239

JOB NO. 9-117-001011
DESIGN NHW
DRAWN CJG
DATE 8/99
SCALE 1"=20'

RESULTS OF SEEPAGE ANALYSES
GOLDEN EAGLE PARK DAM
FOUNTAIN HILLS, ARIZONA

G:\Engineering-Development\9-117-001011 Golden Eagle Park Dam\CAD Drawings\seepage.dwg



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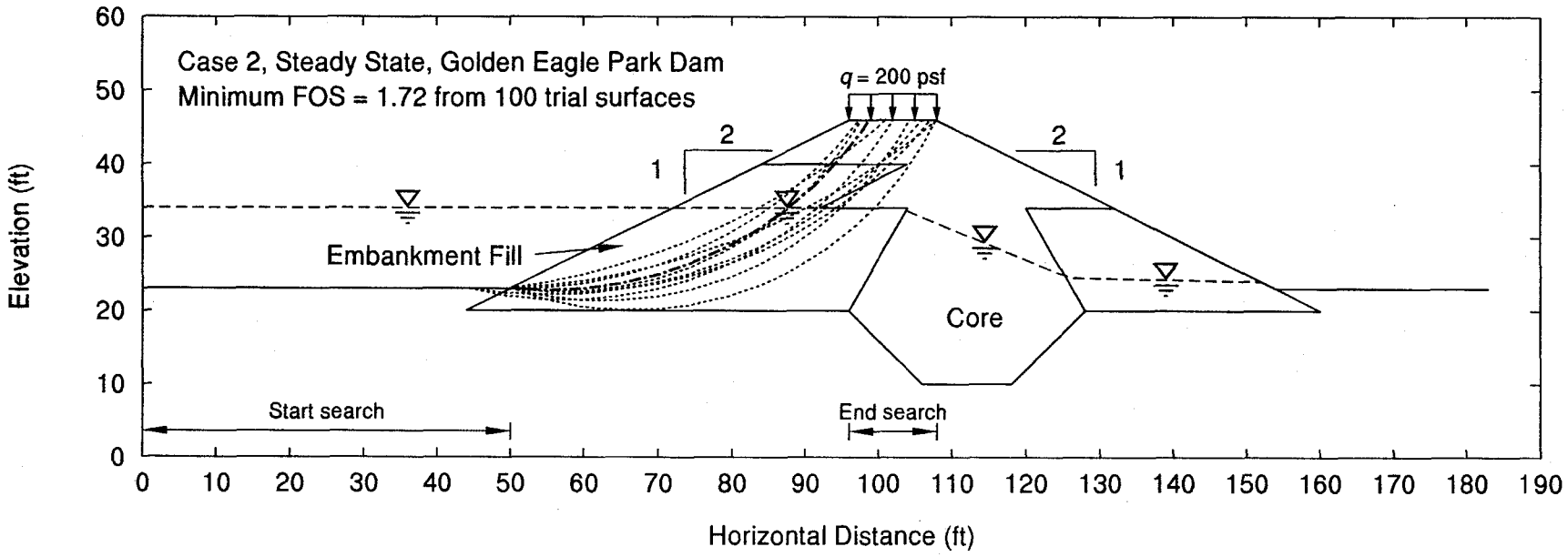

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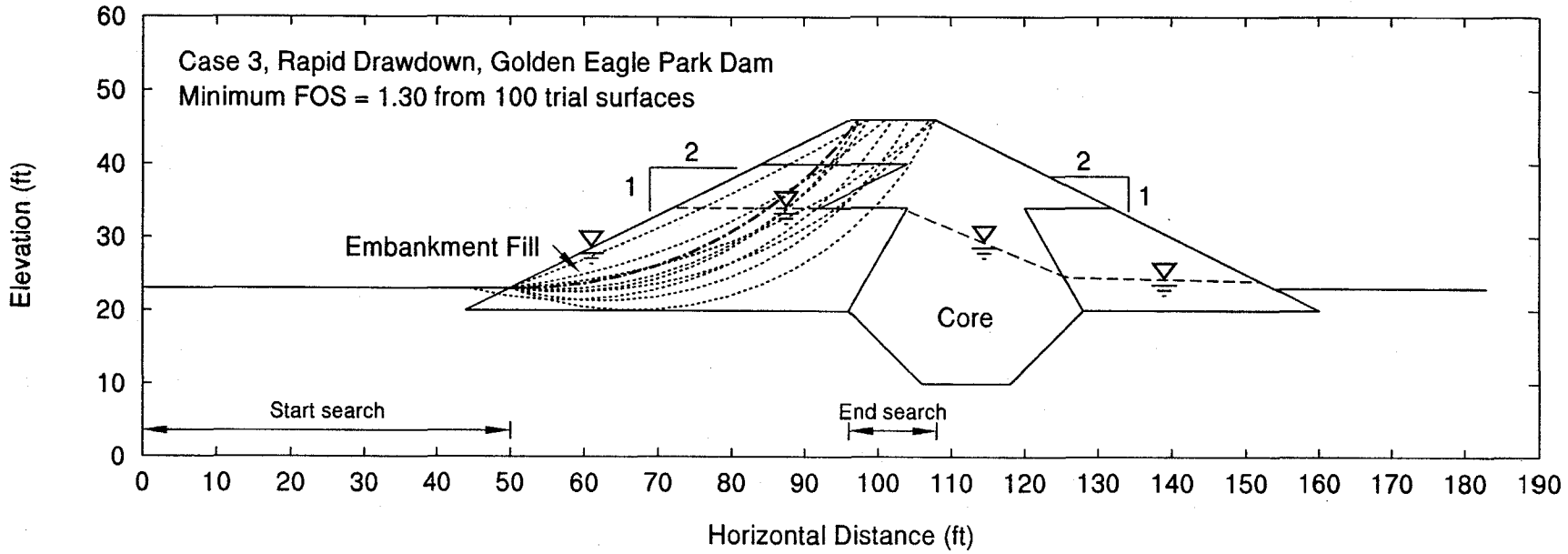

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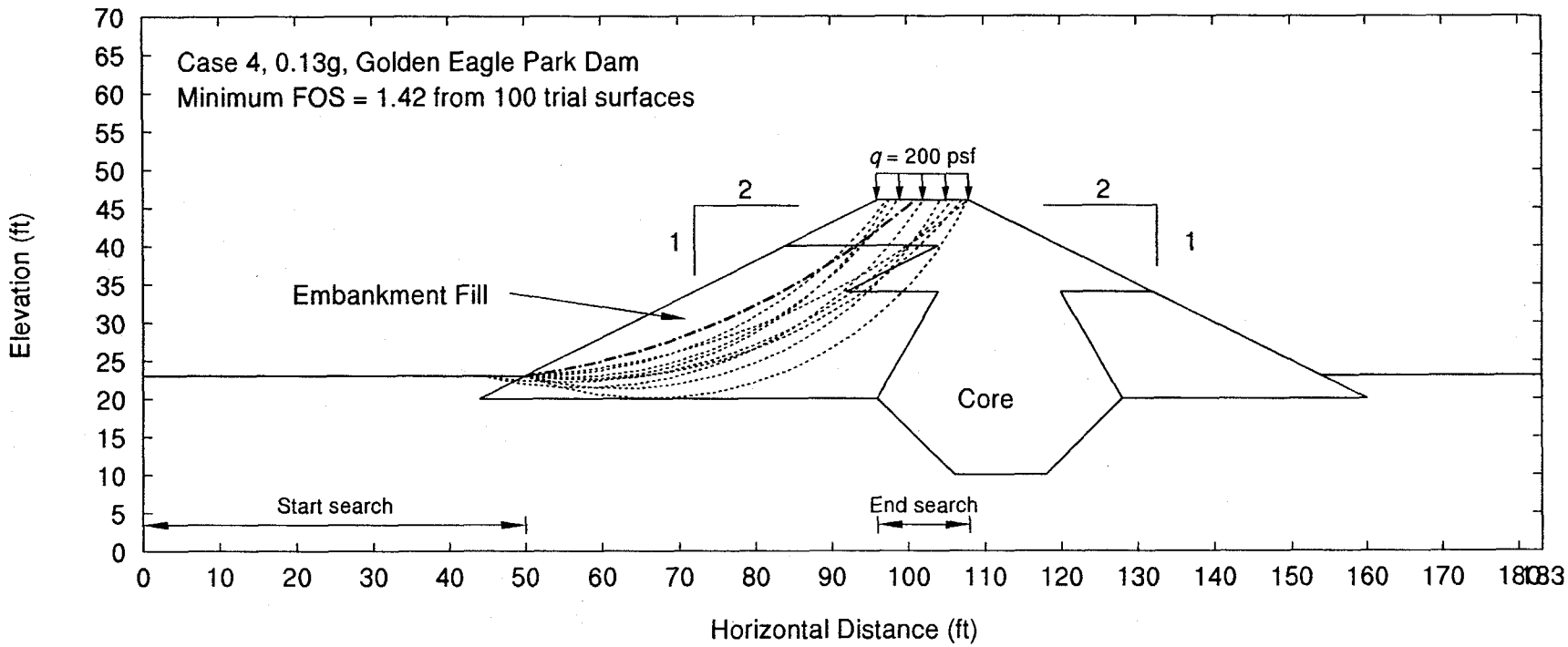

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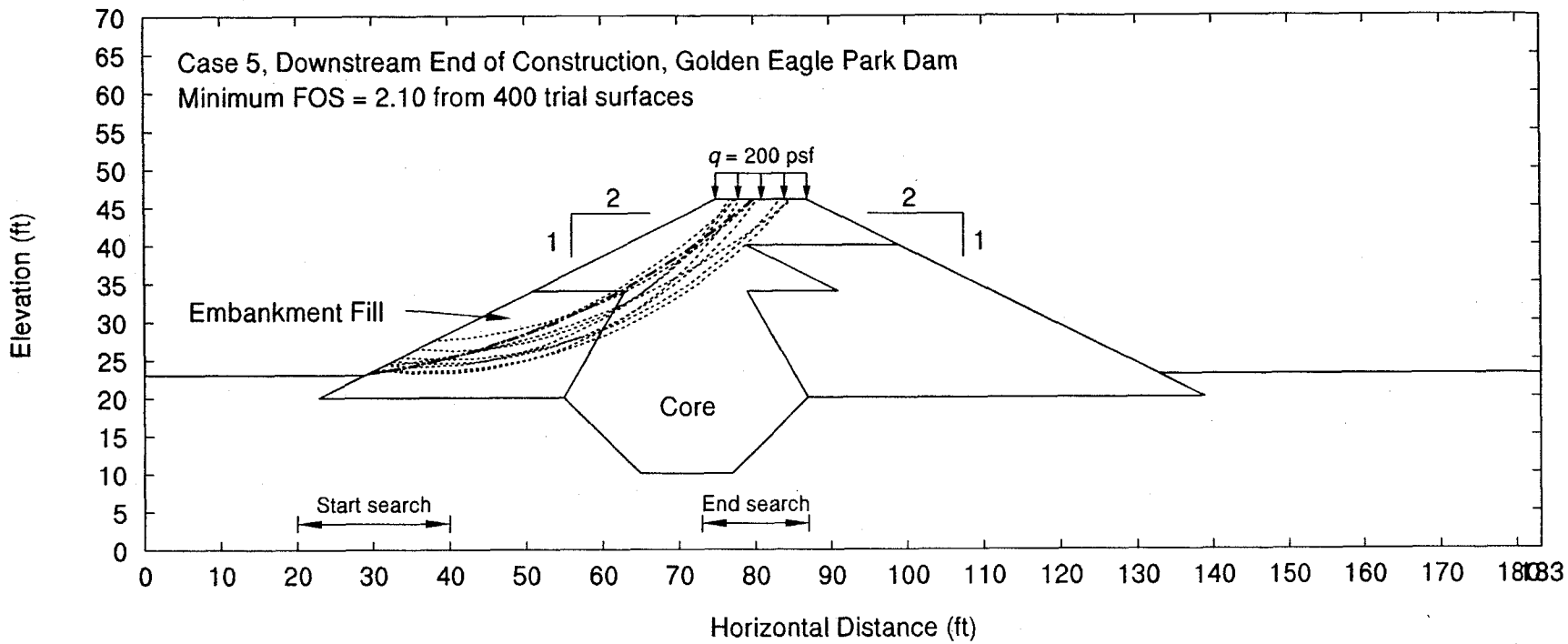

AGRA
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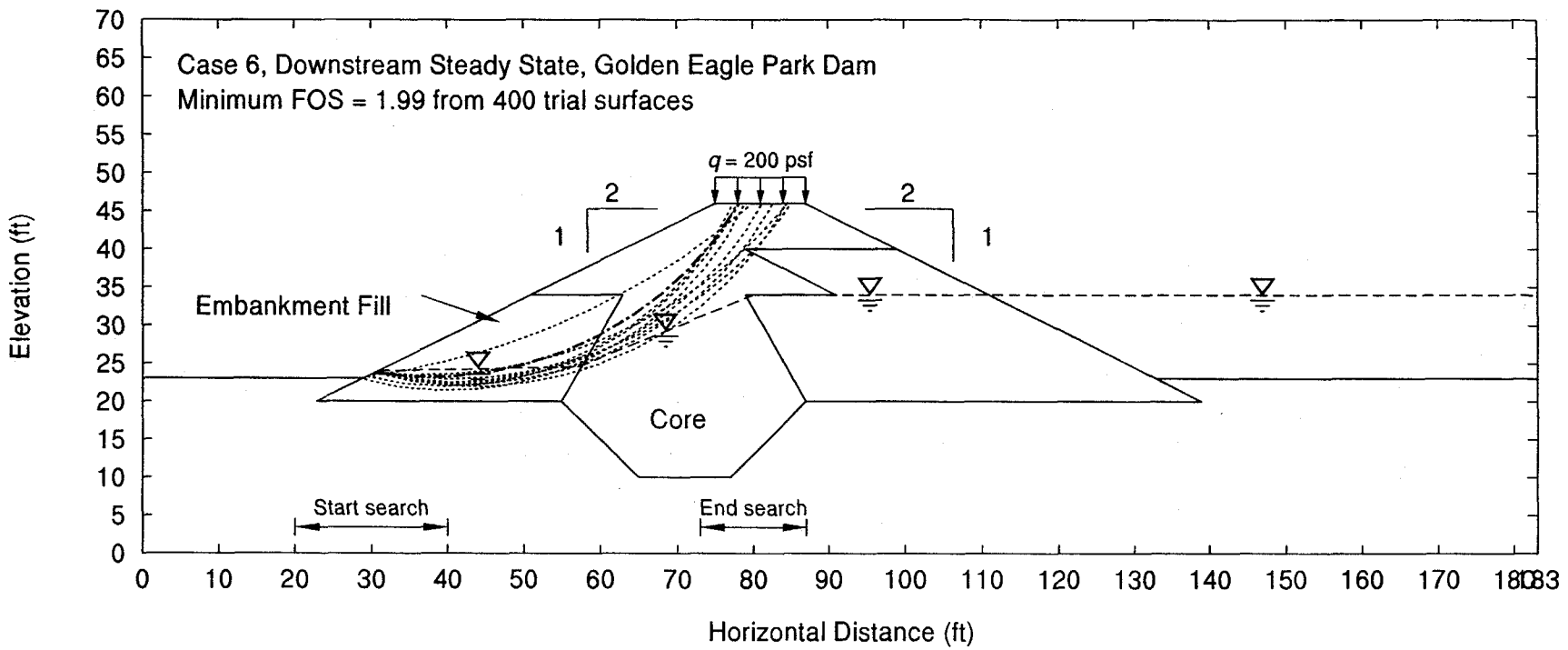

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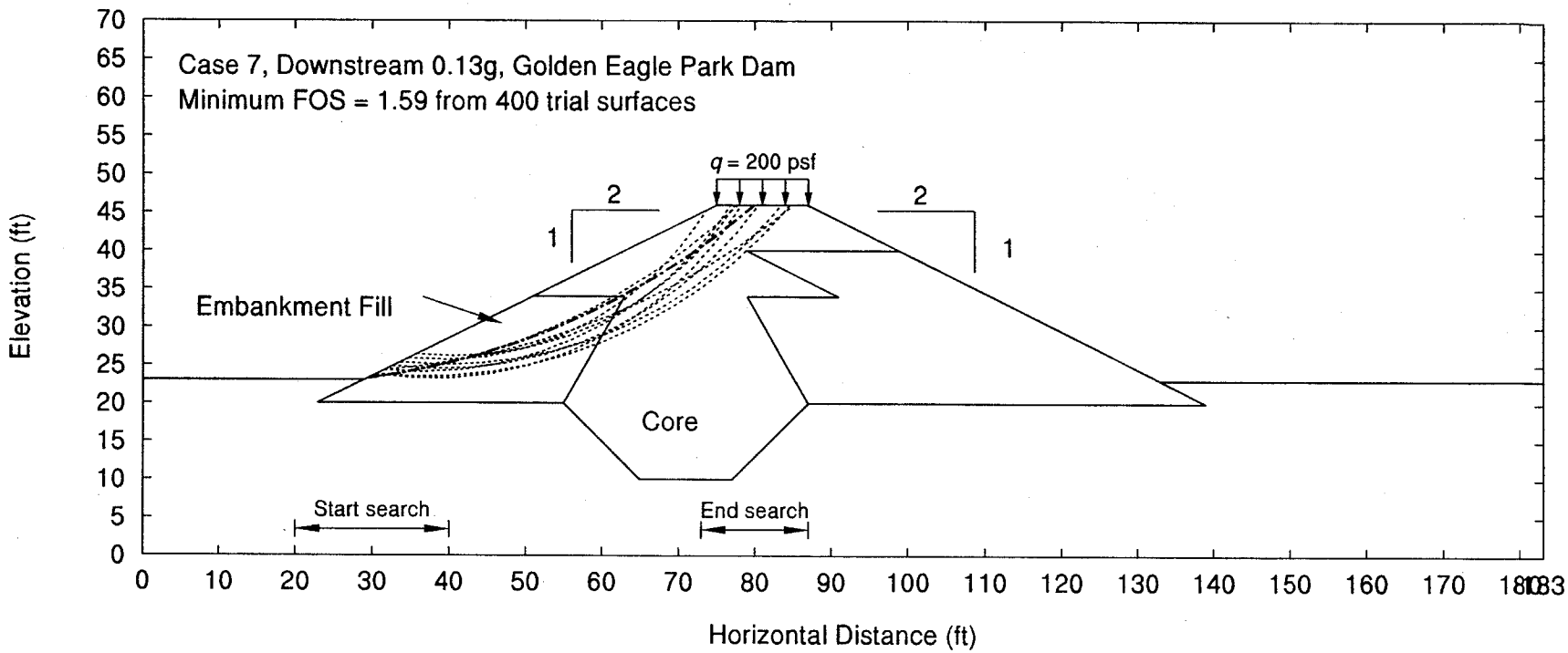

AGRA
ENGINEERING GLOBAL SOLUTIONS

```
PROFIL
Case 1, Steady State, Golden Eagle Park Dam
20 7
0. 23. 50. 23. 3
50. 23. 84. 40. 2
84. 40. 96. 46. 1
96. 46. 108. 46. 1
108. 46. 132. 34. 1
132. 34. 154. 23. 2
154. 23. 183. 23. 3
44. 20. 50. 23. 3
84. 40. 104. 40. 2
92. 34. 104. 40. 1
92. 34. 104. 34. 2
44. 20. 96. 20. 3
96. 20. 104. 34. 1
96. 20. 106. 10. 3
106. 10. 118. 10. 3
120. 34. 132. 34. 2
120. 34. 128. 20. 1
118. 10. 128. 20. 3
154.1 23. 160.1 20. 3
128. 20. 160.1 20. 3
SOIL
3
125. 130. 300. 32. 0. 0. 1
130. 135. 0. 38. 0. 0. 1
102. 107. 1000. 28. 0. 0. 1
LOADS
1
96. 108. 200. 0.
CIRCL2
10 10
0. 50. 96. 108.
0. 5. 0. 0.
```

```
PROFIL
Case 2, Steady State, Golden Eagle Park Dam
20 7
0. 23. 50. 23. 3
50. 23. 84. 40. 2
84. 40. 96. 46. 1
96. 46. 108. 46. 1
108. 46. 132. 34. 1
132. 34. 154. 23. 2
154. 23. 183. 23. 3
44. 20. 50. 23. 3
84. 40. 104. 40. 2
92. 34. 104. 40. 1
92. 34. 104. 34. 2
44. 20. 96. 20. 3
96. 20. 104. 34. 1
96. 20. 106. 10. 3
106. 10. 118. 10. 3
120. 34. 132. 34. 2
120. 34. 128. 20. 1
118. 10. 128. 20. 3
154.1 23. 160.1 20. 3
128. 20. 160.1 20. 3
SOIL
3
125. 130. 300. 32. 0. 0. 1
130. 135. 0. 38. 0. 0. 1
102. 107. 1000. 28. 0. 0. 1
WATER
1
62.4
5
0. 34.
72. 34.
103. 34.
126. 24.5
152. 24.
LOADS
1
96. 108. 200. 0.
CIRCL2
10 10
0. 50. 96. 108.
0. 5. 0. 0.
```

```
PROFIL
Case 3, Rapid Drawdown, Golden Eagle Park Dam
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96. 46. 108. 46. 1
108. 46. 132. 34. 1
132. 34. 154. 23. 2
154. 23. 183. 23. 3
44. 20. 50. 23. 3
84. 40. 104. 40. 2
92. 34. 104. 40. 1
92. 34. 104. 34. 2
44. 20. 96. 20. 3
96. 20. 104. 34. 1
96. 20. 106. 10. 3
106. 10. 118. 10. 3
120. 34. 132. 34. 2
120. 34. 128. 20. 1
118. 10. 128. 20. 3
154.1 23. 160.1 20. 3
128. 20. 160.1 20. 3
SOIL
3
125. 130. 300. 32. 0. 0. 1
130. 135. 0. 38. 0. 0. 1
102. 107. 1000. 28. 0. 0. 1
WATER
1
62.4
5
50. 23.
72. 34.
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126. 24.5
152. 24.
CIRCL2
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0. 5. 0. 0.
```

```
PROFIL
Case 4, 0.13g, Golden Eagle Park Dam
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132. 34. 154. 23. 2
154. 23. 183. 23. 3
44. 20. 50. 23. 3
84. 40. 104. 40. 2
92. 34. 104. 40. 1
92. 34. 104. 34. 2
44. 20. 96. 20. 3
96. 20. 104. 34. 1
96. 20. 106. 10. 3
106. 10. 118. 10. 3
120. 34. 132. 34. 2
120. 34. 128. 20. 1
118. 10. 128. 20. 3
154.1 23. 160.1 20. 3
128. 20. 160.1 20. 3
SOIL
3
125. 130. 300. 32. 0. 0. 1
130. 135. 0. 38. 0. 0. 1
102. 107. 1000. 28. 0. 0. 1
LOADS
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EQUAKE
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CIRCL2
10 10
0. 50. 96. 108.
0. 5. 0. 0.
```

```
PROFIL
Case 5, Downstream End of Construction, Golden Eagle Park Dam
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75. 46. 87. 46. 1
87. 46. 99. 40. 1
99. 40. 133. 23. 2
133. 23. 183. 23. 3
22.9 20. 28.9 23. 3
51. 34. 63. 34. 2
22.9 20. 55. 20. 3
55. 20. 63. 34. 1
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65. 10. 77. 10. 3
79. 40. 99. 40. 2
79. 40. 91. 34. 1
79. 34. 91. 34. 2
79. 34. 87. 20. 1
77. 10. 87. 20. 3
133. 23. 139. 20. 3
87. 20. 139. 20. 3
SOIL
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130. 135. 0. 38. 0. 0. 1
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EQUAKE
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CIRCL2
20 20
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0. 5. 0. 0.
```

```
PROFIL
Case 6, Downstream Steady State, Golden Eagle Park Dam
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51. 34. 75. 46. 1
75. 46. 87. 46. 1
87. 46. 99. 40. 1
99. 40. 133. 23. 2
133. 23. 183. 23. 3
22.9 20. 28.9 23. 3
51. 34. 63. 34. 2
22.9 20. 55. 20. 3
55. 20. 63. 34. 1
55. 20. 65. 10. 3
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79. 34. 91. 34. 2
79. 34. 87. 20. 1
77. 10. 87. 20. 3
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87. 20. 139. 20. 3
SOIL
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130. 135. 0. 38. 0. 0. 1
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WATER
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62.4
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183. 34.
LOADS
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EQUAKE
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CIRCL2
20 20
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0. 5. 0. 0.
```

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PROFIL
Case 7, Downstream 0.13g, Golden Eagle Park Dam
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75. 46. 87. 46. 1
87. 46. 99. 40. 1
99. 40. 133. 23. 2
133. 23. 183. 23. 3
22.9 20. 28.9 23. 3
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22.9 20. 55. 20. 3
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LOADS
1
75. 87. 200. 0.
EQUAKE
0.13 0. 37.4
CIRCL2
20 20
20. 40. 73. 87.
0. 5. 0. 0.
```

Golden Eagle Park Dam

Filter Design For Sand Diaphagm

Sheet 1 of 2
Date: 9/2/99
By: CJG
Ch. By: NAW.
Job/Prop. No. 9-117-001011

SHERMAN, 1977 $C_u = \frac{D_{60}}{D_{10}} = \frac{1.2}{0.042} = 29$

TO AVOID HEADLOSS IN FILTER

$D_{15F} \geq 5 D_{15B}$ $D_{15B} = 0.046$ mm

$D_{15F} \geq 0.23$mm ←

TO AVOID MOVEMENT OF PARTICLES FROM BASE

$D_{15F} \leq 5 \times D_{85B}$ $D_{85B} = 5.3$mm

$D_{15F} \leq 26.5$ mm ←

$D_{50F} \leq 25 D_{50B}$ $D_{50B} = 0.6$ mm

$D_{50F} \leq 15$mm ←

$D_{15F} \leq 40 D_{15B}$

$D_{15F} \leq 1.8$ mm ←

Reference:

WILSON, S.D. and R.J. MARSAL, 1979, Current Trends in Design and Constructing of Embankment Dams, Geotechnical Division, ASCE.

FILTER CRITERIA GRADATION

SIEVE SIZE	% PASSING
2"	100
1"	65-100
1/2"	50-85
No.4	30-65
No.10	20-50
No.16	0-40

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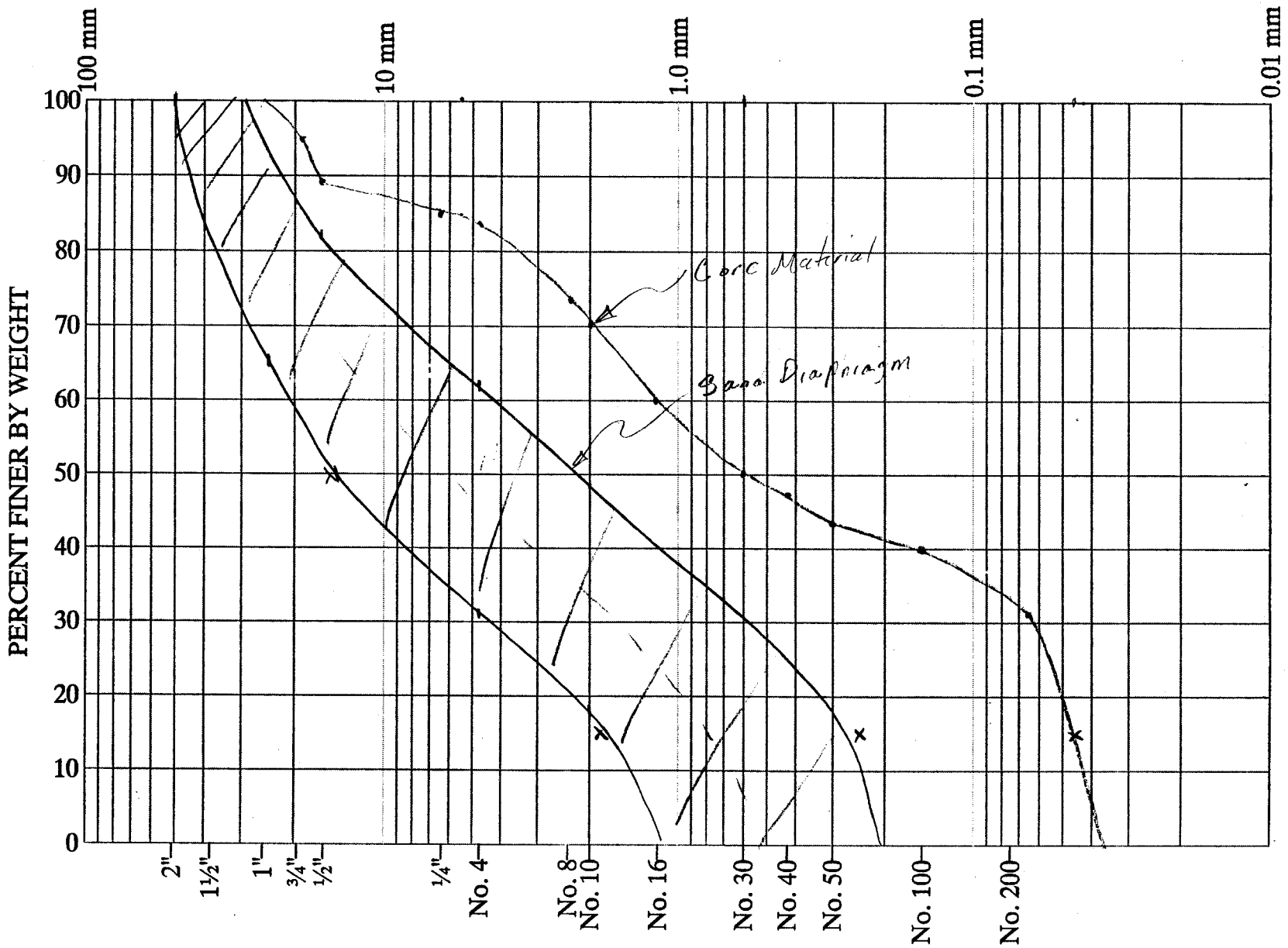

AGRA
Earth & Environmental
3232 WEST VIRGINIA AVENUE
PHOENIX, AZ, U.S.A. 85009-1502

JOB NO.	-
DESIGN	TJF
DRAWN	TJF
CHECKED	NHW
DATE	3/98

FIGURE XX
-
-
-
-

G:\MINING\MISC\PAREDONES-FILTER.DWG

APPENDIX D

DAM SAFETY INSPECTION REPORT

AGRA
ENGINEERING GLOBAL SOLUTIONS

DAM SAFETY INSPECTION
GOLDEN EAGLE PARK DAM
ASSIGNMENT NO. 5
NEAR GOLDEN EAGLE BOULEVARD
& PALISADES BOULEVARD
FOUNTAIN HILLS, ARIZONA

Registered Professional Engineer (Civil)
CERTIFICATE NO. 12276
NORMAN HAROLD WETZ
Date Signed 4/10/98
ARIZONA, U.S.A.

Submitted To:

Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, Arizona 85009

Submitted By:

AGRA Earth & Environmental, Inc.
3232 West Virginia Avenue
Phoenix, Arizona 85009-1502

April 10, 1998

AEE Job No. 8-117-001014

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

AGRA Earth & Environmental, Inc.
3232 West Virginia Avenue
Phoenix, Arizona 85009-1502
Tel (602) 272-6848
Fax (602) 272-7239
Toll Free 1-800-248-AGRA

April 9, 1998
AEE Job No. 8-117-001014

Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, Arizona 85009

Attention: Warren F. Rosebraugh, P.E.

Gentlemen:

RE: DAM SAFETY INSPECTION
GOLDEN EAGLE PARK DAM
ASSIGNMENT NO. 5
NEAR GOLDEN EAGLE BOULEVARD
& PALISADES BOULEVARD
FOUNTAIN HILLS, ARIZONA

Our revised Draft Dam Safety Inspection Report for the above referenced project is herewith submitted. The report provides the results of our dam safety inspection.

Should any questions arise concerning this report, we would be pleased to discuss them with you.

Respectfully submitted,

AGRA Earth & Environmental, Inc.

Registered Professional Engineer (Civil) CERTIFICATE NO. 22176 NORMAN HAROLD WETZ Date Signed 4/10/98 ARIZONA, U.S.A.

Norman H. Wetz, P.E.
Senior Geotechnical Engineer

Reviewed by:

Registered Professional Engineer (Civil) CERTIFICATE NO. 13872 LAWRENCE A. HANSEN Date Signed 4/10/98 ARIZONA, U.S.A.

Lawrence A. Hansen, Ph.D., P.E.
Chief Technical Officer

c: Addressee (5)
njf/J2-98/4-9-98

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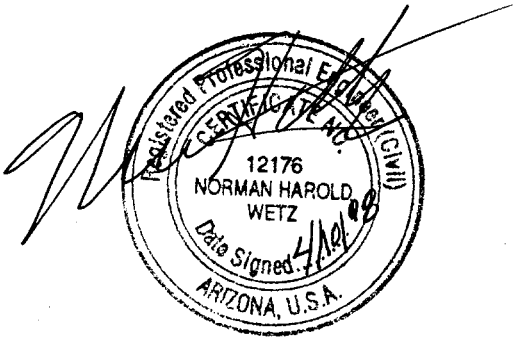
Dam Safety Inspection 1
Recommendations 4

APPENDIX A

Photographs



1.0 INTRODUCTION

This report presents the results of a dam safety inspection of the existing Golden Eagle Park Dam located near Palisades and Golden Eagle Boulevards in Fountain Hills, Arizona.

2.0 DAM SAFETY INSPECTION

2.1 GENERAL

The dam safety inspection was performed by Norman H. Wetz, P.E. on February 17, 1998. The Golden Eagle Park Dam consists of a zoned earth embankment that has outlet structures and an emergency spillway. The embankment is approximately 700 feet in length with a crest width of about 12 feet and slopes of about 2 horizontal to 1 vertical. The outlet works consist of two ungated 60-inch diameter reinforced concrete pipes, one of which is filled half full with concrete. A sewer line that is encased in the concrete extends beyond the embankment on both of the upstream and downstream slopes of the embankment. Concrete aprons are located on both the upstream and downstream sides of the outlet pipes. The emergency spillway is approximately 300 feet in width and presently appears to be unlined. A concrete sill extends from the embankment to the south end of the emergency spillway. The impoundment area upstream from the dam is occupied by the Golden Eagle Park with softball fields, playground, basketball court, maintenance, restroom buildings and paved parking lots. The area downstream from the dam is occupied by an existing high school football field with bleachers and cinder running track.

2.2 CREST

The visual inspection at the crest indicates that there are no obvious defects. No localized settlement, slides, depressions, misalignment, longitudinal or transverse cracking, animal burrows, adverse vegetation or erosion was noted. A survey with a handlevel indicated that the dam crest elevation does not vary more than about 0.6 feet over its extent. Photo No. 1 (Appendix A) shows the crest of the dam.

2.3 UPSTREAM SLOPE

The upstream slope of the dam appears to be satisfactory with the exception of trees, large brush and some minor erosion. No animal burrows, settlement, slides, depressions, bulges or cracking was noted. Several tamarisk trees and small palo verde trees are present on the upstream slope. Also, a moderate growth of low brush along with some larger brush is present. A cut has been made on the southern portion of the embankment to allow for

APPENDIX A

PHOTOGRAPHS

Photo 1. Crest of Dam

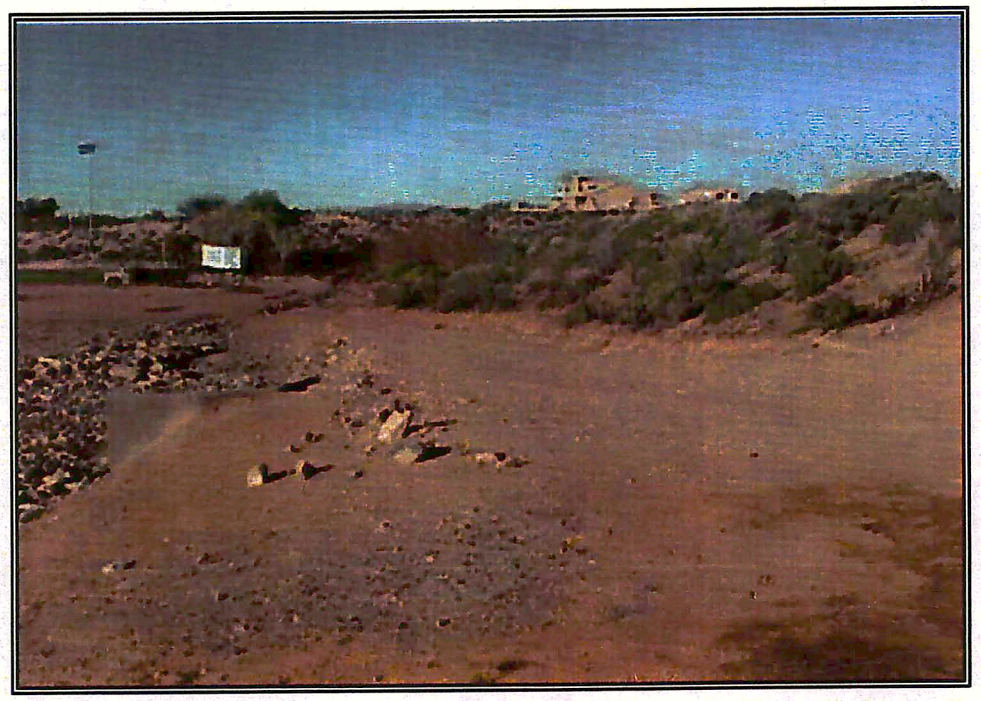


Photo 2. Cut in Upstream Slope

AEE Job No. 8-117-001014

Photo 3. Trees Along Upstream Slope

Photo 4. Downstream Slope

Photo 5. Trash Rack Area

Photo 6. Outlet Stilling Basin

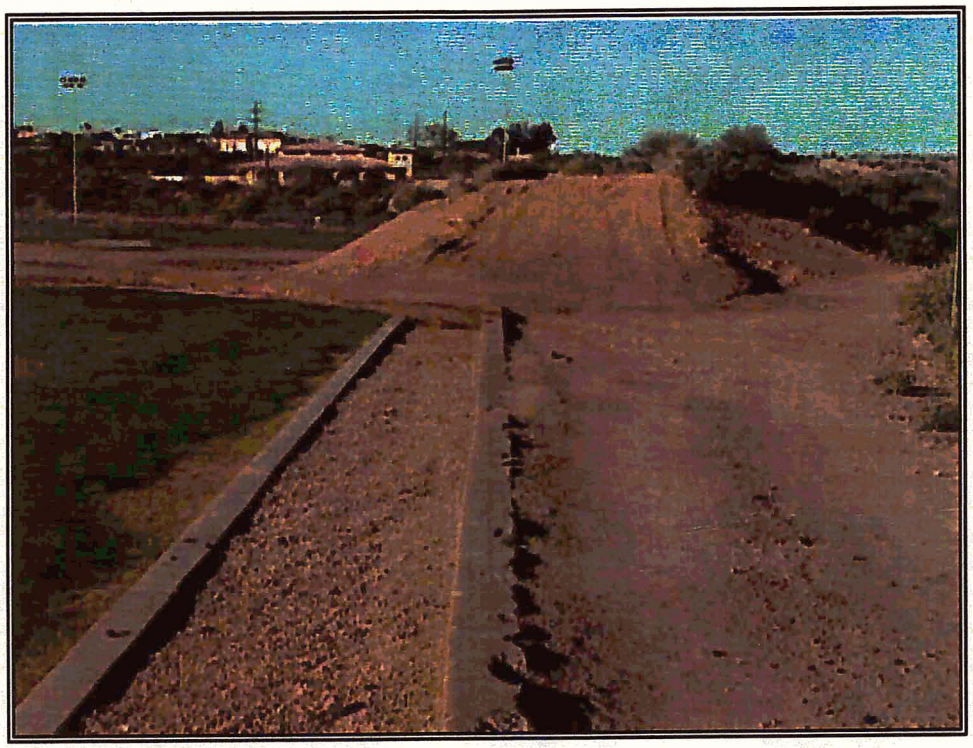


Photo 7. Emergency Spillway

Photo 8. Emergency Spillway