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CONSTRUCTION QUALITY CONTROL
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DMJM
CAMELBACK RANCH LEVEE DESIGN
GLENDALE MUNICIPAL AIRPORT
FCD PROJECT NO. 95 -15
ATL JOB NO. 195039 -1

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ATL Job No. 195039-1 *April 6, 1998*

GEOTECHNICAL INVESTIGATION

REPORT FOR

DMJM

PROJECT

CAMELBACK RANCH LEVEE DESIGN
GLENDALE MUNICIPAL AIRPORT
FCD PROJECT NO. 95 -15
ATL JOB NO. 195039 -1

Reviewed by:

Registered Professional Engineer (Civil) CERTIFICATE NO. 22719 David Preston Hayes Date Signed 4/6/98 ARIZONA, U.S.A.

David P. Hayes, P.E
Executive Vice President

Prepared by:

Ammi Osorio
Project Engineer

ATL, INC.
CONSTRUCTION QUALITY CONTROL
GEOTECHNICAL CONSULTANTS

April 6, 1998

Mr. Michael Shapiro, P.E.
DMJM
300 W. Clarendon Avenue, Suite 400
Phoenix, AZ 85013-3499

Re: Geotechnical Investigation Report
Camelback Ranch Levee Design
Glendale Municipal Airport
FCD Project No. 95-15
ATL Job No. 195039-1

Dear Mr. Shapiro:

This report presents the results of a geotechnical investigation for the proposed construction of a levee/earth embankment with bank protection on the southern and eastern ends of the Glendale Municipal Airport, Glendale, Arizona. Field exploration, laboratory tests, and engineering analysis are included along with boring logs and laboratory results. A companion investigation, ATL Job No. 197080, was completed on a section of Levee surrounding the Glendale WWRF. One contract will be developed that will contain a portion of the Levee alignment represented in this report and all of the Levee alignment represented in the Glendale WWRF report.

ATL drilled and sampled five (5) boreholes to depths of approximately 20 feet below grade in the location of the proposed levee/bank protection. The final Levee alignment includes Boring Nos 3, 4, and 5 only. Eight (8) test pits were excavated and sampled in the New River channel and Agua Fria River upstream channel to determine the quality of existing material and possible source of soil cement aggregate and to provide additional data for a sediment transport analysis. The test pits were excavated to depths that ranged from 4 feet to 10 feet below grade.

The subgrade material from the borings consisted primarily of sandy material with varying percentage of silt and fines with a medium dense top layer and dense underlying layers below 10 feet. The subgrade material obtained from the test pits excavated in the location of New River and Agua Fria River consisted of either sandy or gravelly materials with varying percentage of silt and fines. Refer to Appendix A for detailed boring information.

PHOENIX	TUCSON	FLAGSTAFF	GLOBE	COTTONWOOD	PRESCOTT VALLEY	LAS VEGAS
2912 W. Clarendon	820 E. 47th Street B-1	1855 W. Kaibab Lane #6	1400½ N. Broad	2646 Union Drive	7136 2nd Street #103	3002-A Rigel Avenue
Phoenix, AZ 85017	Tucson, AZ 85713	Flagstaff, AZ 86001	Globe, AZ 85502	Cottonwood, AZ 86326	Prescott Valley, AZ 86314	Las Vegas, NV 89102
(602) 241-1097	(520) 623-4547	(520) 773-9614	(520) 425-8999	(520) 646-7311	(520) 759-2238	(702) 871-0492
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Based on the field and laboratory data obtained, an allowable bearing capacity of 4500 psf with a total settlement of 0.50 inches for the levee foundation is recommended. The recommended shrinkage factor is 5% and the ground compaction factor is 0.25 feet. The aggregate excavated from New River may be used in the mix design for the soil cement bank protection and larger cobbles placed in the bottom of the earth embankment.

ATL has appreciated the opportunity to be of service to DMJM on this project and looks forward to a continued association on future projects. Should any questions arise, please do not hesitate to contact us at your earliest convenience.

Very truly yours,

Registered Professional Engineer (Civil)
CERTIFICATE NO.
22719
David Preston
Hayes
4/6/98

David P. Hayes, P.E.
Executive Vice President

DPH/brc

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SAND EQUIVALENT

GEOTECHNICAL INVESTIGATION

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1.0 PROJECT DESCRIPTION

The City of Glendale is planning to extend its existing runway to the south in the future. In order to accomplish this, engineered fill will be placed in a transition embankment and a Levee embankment. To contain the fill and to provide a buffer against the Standard Project Flood (SPF), approximately 2,350 linear feet of Levee/Bank protection will be required.

An investigation of the subsurface materials available in the New River channel was performed to determine the aggregate quality and suitability for use as a component in the proposed soil cement bank protection. Materials sampling and testing was also performed in the Agua Fria River upstream channel for a sediment transport analysis by other team members.

2.0 LOCATION AND SITE DESCRIPTION

The project site is located south and east of the Glendale Municipal Airport, in a predominantly agricultural and vacant area in Glendale, Arizona. The proposed levee/bank protection will be constructed north of New River within the confluence of the Agua Fria River. The Agua Fria and New Rivers drain a large portion of Central Arizona and are major tributaries to the Gila River.

The Glendale area borders on the Central Highlands area but is part of the Basin-Range Province which extends north-westward over Nevada and Idaho. The Phoenix Basin is relatively flat with deep sediments and thick salt deposits. Surrounding the Basin are mountain ranges with small metamorphic core complexes , centered with light-colored granite and surfaced with a sheared, arched carapace of metamorphic rock. Other mountain ranges to the north and west are composed of granite, gneiss and/or schist. Fine sands and clay deposits are layered as alluvial fans, interspersed along with gravel and cobbles in the valley areas. Minerals such as calcium carbonate and sodium chloride are present in varying concentrations; from low to very high. The ADWR groundwater contour map indicates groundwater at an elevation of 875 feet above sea level, approximately 140 feet below the ground surface.

3.0 SCOPE OF WORK

ATL's responsibility was to design a levee/bank protection structure to contain the engineered fill and to make recommendations for the engineered fill for the future Glendale Municipal Airport runway extension ATL will also determine the quality of the native material for use in the construction of the levee/bank protection.

Field and Laboratory testing were performed to appraise the ability of the in-situ soils to support the proposed bank structure, as well as their suitability for use in soil-cement bank protection. The following issues were addressed as a result of the investigation:

1) Recommendations for the Levee Construction.

2) Foundation Recommendations for the Levee.

3) Allowable Bearing Capacity, Limiting Settlements, Rapid Draw-down effects and Lateral Pressures on the Levee.

4) Soil Cement Specifications.

5) Use of native material in the Embankment.

6) Recommendations for the Engineered Fill for the future extension of the Runway.

4.0 DRILLING AND SAMPLING PROCEDURES

A total of five (5) borings and eight (8) test pits were drilled and excavated for this project. The borings were drilled to depths of twenty (20) feet below grade, and were located every 500 feet along the new levee alignment. The test pits were excavated in New River (Pit Nos. 3 - 8) and Agua Fria (Pit Nos. 1 & 2) rivers to depths from four (4) feet to ten (10) feet below grade.

A Mobile B-50 drill rig with a 6-inch and 8-inch outside diameter, hollow stem continuous flight augers was utilized in the drilling operations. A Case 580 Backhoe with a 24-inch wide bucket was used to excavate the test pits.

With the drill rig, Standard Penetration Test (N) values were obtained at 5-foot intervals using a split-spoon sampler, penetrating 18 inches in the soil by a 140-pound hammer dropping 30 inches in accordance with ASTM D1586 standards. N values are expressed in "blows per foot" and exclude the first six (6) inches of penetration.

Bulk samples of the existing native material were selectively obtained from the auger flights and returned to the laboratory for analysis. Each borehole and test pit was immediately returned to its original state by backfilling with excess cuttings from the hole.

Boring and Test Pit locations are presented on Plate 4. Edited boring and test pit logs are presented in Appendix A.

5.0 LABORATORY TESTING

Representative bulk samples of the subgrade were collected at each boring and test pit location for soil classification purposes and selected physical property analyses.

For this project, in-situ material properties are important relative to hydrological behavior, as well as determining suitability for use in soil cement mixes and embankment fill. To determine the D_{100}, D_{60}, D_{50}, D_{30}, and D_{10} particle sizes, grain-size distribution curves were constructed for each sample tested. In addition, hydrometer analyses were performed on specified samples to determine the silt and clay fractions. Atterberg Limit tests were conducted in order to determine Liquid and Plastic Limits, from which the Plasticity Index was calculated. Where available, In-Situ Moisture Contents were determined for comparison with optimum moisture content values from Standard Proctor testing. Standard Proctor analyses were completed to determine the relationship between the maximum dry density and optimum moisture content of the in-situ material. In order to determine the materials behavior under increased loading increments, a Consolidation test was conducted. A Direct Shear test was also performed to provide parameters that were used in determining equivalent fluid pressures that potentially will be acting against the soil cement bank protection. Los Angeles Abrasion tests and Sand Equivalent tests were conducted to determine the quality and competence of natural aggregates and to determine the relative proportions and characteristics of the fines present in the native material.

All laboratory tests were conducted in accordance with ASTM published standards and are summarized in Appendix B, "Laboratory Test Results". The soils described on the edited boring logs were classified using the Unified Soils Classification System (USCS). The following table summarizes the type and quantities of laboratory tests completed for this project:

TEST	NUMBER OF TESTS
Sieve Analysis	24
Plasticity Index	18
Moisture Content	23
Soils/Agg Standard Proctor	3
Hydrometer Analysis	16
Consolidation	1
Direct Shear	1
L.A. Abrasion	2
Sand Equivalent	2

6.0 SUMMARY OF EXISTING CONDITIONS

Classification data for the soils sampled from the borings and test pits, suggests the following soil profile variation. Refer to Appendix A for detailed boring and test pit information.

6.1 Borings - New Levee Alignment

The subgrade soil sampled from Boring Nos. 1 through 5 consisted primarily of sandy material classified as either **silty SAND (SM)**, a **well-graded SAND (SW)**, with gravel or a **poorly graded SAND (SP-SM)** with silt. A 6" to 12" thick layer of a **poorly graded GRAVEL (GP)** with cobbles was observed on the surface of Boring Nos. 3 and 4. In general, the top layer was approximately 10 feet deep and was medium dense. The underlying layer was dense and became very dense as depth increased to 20 feet below grade. Traces of cementation were observed starting at 15 feet below grade.

Laboratory tests indicated minus #200 contents of less than 20% for all borings, with most results less than 7%. The samples were all non-plastic. The in-situ moisture contents were generally lower than the optimum moisture contents. Standard Proctor Analyses were performed on material from two (2) borings representing different types of materials. From Boring No. 2, a sample of the SP-SM material from the surface to 12 feet

below grade yielded a maximum dry density of 102.8 pcf at an optimum moisture content of 7.4%. From Boring No. 4, a sample of the SP material 2 feet to 6½ feet below grade, yielded a maximum dry density of 127.7 pcf at an optimum moisture content of 10.0%. A Consolidation test and a Direct Shear test were performed on the SP-SM material from Boring No. 2 and a 3% consolidation was obtained under a load of 2280 psf after saturation with water. The friction angle determined by the Direct Shear test on the same sample was 43°.

6.2 Test Pits - New River and Agua Fria

The subgrade material obtained from all test pits consisted of sands and gravels. The sandy materials were classified as either as a **silty SAND (SM)**, a **poorly graded SAND (SP)**, or a **well-graded SAND (SW)** with gravel. The gravelly materials were classified as either a **well-graded GRAVEL (GW)** with sand or a **poorly graded GRAVEL (GP-GM)** with silt and sand. A light coating of either silt or clay was observed on the rock surface of the larger rocks sizes. The samples processed for sieve analyses/grain size distribution determination showed a maximum aggregate sizes of 3" to 6". During the drilling, cobbles up to 8" diameter were encountered.

Laboratory tests indicated minus #200 contents of less than 20% on all samples tested, with most samples exhibiting less than 7.0% fines. The Plasticity Indices ranged from non-plastic to 15%. A Standard Proctor analysis was performed on a GW material, from TP-6, between 5½ feet and 10½ feet below grade. The resulting maximum dry density was 121.1 pcf at an optimum moisture content of 13.2%. The in-situ moisture contents were less than the optimum moisture content. The hydrometer results performed on the sandy materials indicated 0.5% to 7.8% clay. The gravelly materials exhibited 0.4% to 3.3% clay. The specific gravity of all test pit soil sampled ranged from 2.406 to 2.890. Los Angeles Abrasion tests and Sand Equivalent tests were performed on material from two (2) test pits (TP-5 and TP-7). The percent loss after 100 revolutions was 4.4 and 3.6 respectively. After 500 revolutions, the percent loss was 16.5 and 15.5 respectively. The average Sand Equivalent value obtained was 49 for material from TP-5 and 31 for TP-7 material. Refer to Appendix B for all laboratory test results.

7.0 DISCUSSIONS AND RECOMMENDATIONS

The sampling of the subsurface materials was performed in November, 1997. Groundwater was not encountered during drilling or test pit excavation activities. The research performed by ATL included a review of ADWR Hydrologic Maps. Three wells, labeled C, E and F are located within 7 miles of the site and provide information about changes in groundwater elevations. The project site lies in an area that exhibited an increase in ground water elevation of approximately 40 feet from 1976 to 1982. The irrigation well at location E, 6 miles SE of the site, exhibited an increase to 115' below ground level. The irrigation well at location C, 4 miles NW of the site, decreased 10 feet to 340 feet below grade. Therefore, variances in groundwater levels should not effect the construction of the toe-down element for the levee/embankment fill.

Surface water, however, could effect the project construction sequence, particularly if a flood occurs prior to completing the toe-down excavation and backfilling operation. Therefore, the contractor should consider the construction of temporary diversion dikes around the excavation. We do not anticipated the need for a de-watering system, but one may be required if temporary diversion dikes are not effective. Given the weather cycles in this area, construction should be scheduled during periods of minimum rainfall.

This "Levee" is part of an embankment fill that will be constructed to interface with the existing slope that extends from the edge of Glendale Airport taxiway. The top of the Levee elevation is determined by the Standard Project Flood (SPF) elevation plus one foot of freeboard. The front face of the Levee will consist of a 9-foot thick soil cement bank protection layer. Behind the soil cement layer is levee embankment fill that will extend vertically to the top of the levee and horizontally to the outer edge of the maintenance road at the top of the Levee to a varying width to the bottom of the Levee. The **transition embankment** will be placed adjacent to the Levee embankment and will continue to a "hinge" point at the edge of the taxiway at elevation 1039.5. See Figure 1 on page 19. The transition embankment will be able accommodate larger cobbles in the lower depths. Therefore, the "plus" stone sizes produced from the grizzly screening operation that

produces aggregate for soil cement, may be placed in the embankment fill at the specified depth below top of fill. In order to minimize erosion, the embankment slope from the edge of the maintenance road to the taxiway will be seeded.

An opening for the existing drainage channel that carries water from the airport to New River was originally contemplated for this Levee. However, this Levee's alignment now matches the alignment for the Levee that is planned for the Glendale WWRF and the channel opening will go through that portion of the Levee.

There is also an existing pipe that exits from the bottom of the taxiway embankment. This pipe will be extended through the transition embankment, the Levee embankment and soil cement bank protection and a headwall will be constructed. However, this headwall will also be part of the Levee that is aligned around the WWRF.

Both drainage structures are addressed in ATL's geotechnical report, for the Glendale WWRF. Other detailed recommendations are presented in the sections that follow.

7.1 Source of Material

The construction of the Levee toe-down section will produce material that may be used for construction of the Levee embankment. Boring Nos. 1 through 5 were drilled along the proposed Levee alignment and the samples tested representative of the material expected to be excavated during the construction of the toe-down section. The top ten feet of material is primarily a sand with silt and gravel. The maximum cobble size encountered was 8 inches. This material is suitable for use in the soil cement mix but it should be screened over a 3" grizzly to remove oversize material before incorporating into the soil cement mixture and in portions of the Levee embankment within 2 feet of the surface. The plus 3-inch cobbles may be used in the lower depths of the transition embankment.

The material in New River is a potential source of soil cement aggregate and Levee embankment fill. Excavation of the channel bottom will produce material for placement in the transition and Levee embankments, as needed. Test Pit Nos. 3 through 8 were excavated in New River's subsurface and in general, the maximum cobble size observed was 8 inches. The majority of the material was less than 6 inches and is a well-graded

gravel. ATL performed a Standard Proctor maximum dry density test which produced a maximum dry density of 121.1 pcf at and optimum moisture content of 13.2%. This material is well suited for all embankment fills.

Specifications for the embankment fills are presented in Section 8.0 of this Report

7.2 Levee and Embankment Fills

This Section addresses the design of the Levee embankment, the transition embankment for the runway extension, and the toe-down element. Generally, construction recommendations have been placed in Section 8.0 of this Report, but occasionally, compaction requirements are repeated in this Section.

The Levee construction begins at the tie-in to the existing gabion structures. ATL suggests that the transition between the gabions and proposed soil cement may be accomplished by the use of shotcrete. The shotcrete should be placed to a thickness equal to the gabion basket depth. The suggested width is 24 inches. The shotcrete would be placed in the gap between the soil cement and gabions and distributed among the rocks and wire of the gabions, approximately 24 inches from the edge of the soil cement wall. Welded 6 x 6 wire may be placed at two levels in the gap between the soil cement and gabions in order to improve the integrity of the shotcrete. See Detail 1 in Figure 2 on page 20.

The Levee will vary in height as dictated by the SPF elevation. The toe-down elevation is based on the scour components computed for the SPF and will vary as the scour depth varies. The toe-down must be constructed **below** the scour depth. We anticipate that the contractor will excavate the toe-down using scrapers and similar equipment. The material from the toe-down excavation may be used in the construction of the Levee and transition embankments. Upon reaching the proposed bottom of the toe-down excavation, the subgrade should also be proof-rolled so that at least 95% of an ASTM D698 laboratory maximum dry density is obtained within 2% of optimum moisture content.

Prior to placing embankment fills, the existing ground must be prepared to accept the fill. Clearing and grubbing may result in up to 6 inches of loose material being

removed. The resulting subgrade should be compacted to no less than 95% of a Standard Proctor maximum dry density and within 2% of optimum moisture content. It should be noted that the contractor will need to develop several proctor curves in addition to the curves provided with this report to account for variances in the subgrade material.

As the toe-down excavation progresses, the material that is placed in the Levee embankment should be compacted in 12-inch thick layers, conforming to the compaction requirements presented in Section 8.0. The slope of the excavation, from the bottom of the excavation for the Levee foundation to the toe-down elevation, should not be steeper than 2.0H:1.0V. The front slope of the Levee embankment will be protected by a 9-foot thick soil cement bank protection layer, sloped at 1H:1V. The front slope of the Levee embankment may also be placed to a 1H:1V slope but because the material is generally non-plastic, the embankment height prior to constructing the soil cement layer may vary in order to avoid sloughing. The contractor may not be able to construct the Levee embankment to its planned height before adding the soil cement bank protection. Construction stages for each element may be required in order to maintain the 1H:1V soil embankment front slope and avoid sloughing.

In addition to the Levee embankment and soil cement placement, the transition embankment that is part of the runway extension subgrade, may be placed and compacted simultaneously. If large cobbles are encountered in the aggregate intended for use in the soil cement mix, they may be placed within 8 feet of the top of fill. Compaction testing will not be required but rolling should continue until "pumping" is eliminated. The compaction requirements for the remainder of the embankment will be identical to that of the Levee embankment until the fill is within 2 feet of final grade. For the final 2 feet of fill for the transition embankment, compaction should be no less than 95% of a Modified ASTM D1557 Proctor and within 2% of optimum moisture content. This conforms to FAA requirements for runway and taxiway subgrades where loads exceed 60,000 lbs. See Detail 2 in Figure 2 on page 20 for clarification.

The following parameters were used in designing the Levee and providing information for the determination of fill quantities:

Net Allowable Bearing Capacity	**-**	**4,500psf**
Total Settlement	**-**	**0.50 inches**
Differential Settlement	**-**	**0.50 inches**
Coefficient of Sliding Friction	**-**	**N/A**
Ground Compaction Factor	**-**	**0.25 ft**
Shrinkage	**-**	**5%**

The reduction in height of the insitu foundation material at the toe-down elevation and the levee foundation elevation is identified as the "Ground Compaction Factor" and is presented in "feet". This loss will occur as the result of both proof-rolling and additional compaction due to the movement of construction equipment over the material. Shrinkage is difference in volume that is represented by in-situ densities and the final density when that material is re-compacted to the specified level.

Based on our analysis of the embankment material and its use on this project, the recommended construction slopes are:

1H : 1V	**-**	**Levee Embankment Front Slope**
3H : 1V	**-**	**Transition Embankment Front Slope**

The embankment material will create a high permeability zone consisting of SP and SM materials, adjacent to the soil cement facing. This insures vertical seepage, with an estimated permeability of no less than 1×10^{-2} cm/sec. Therefore, uplift pressures will not build up. Because the Levee is really a large embankment fill extending to the elevation of the runway extension subgrade, the build-up of pore water pressure in the material behind the soil cement bank protection will not occur and the possibility of "rapid drawdown" occurring will be eliminated.

The potential for erosion of embankment material and long term maintenance is a concern. Several treatments for the exposed slopes are available; such as spraying with clear lignosufinites, applying seed mixes and spraying with less attractive bituminous sprays.

Lateral pressures will be created by the compacted soils in the Levee and transition embankment areas. These pressures will be exerted on the soil cement protection layer.

Approximate Unit Weight	=	121 pcf
Friction Angle	=	43°

Equivalent Fluid Pressures

Passive	=	640 psf/ft
At Rest	=	38 psf/ft
Active	=	23 psf/ft

7.3 Sediment Transport Characteristics - Agua Fria

In order to determine the armoring characteristics for sediment transport analysis by other members of the design team, test pits were utilized to sample material in the top 4 feet of the Agua Fria streambed. The material in the 0 to 2.0 feet layer was bulk sampled at two locations. Additional bulk samples were taken from the 2 to 4 deep layer at each location. A sieve analysis was performed on each sample and a grain-size distribution curve developed so that the diameter at which 50% of the material was finer (D_{50}) could be determined. Appendix B contains the details of all laboratory test results. The D_{50} sizes are summarized as follows:

Location	Depth	D_{50}
TP 1	0 - 2'	1.18 mm
TP 2	0 - 2'	1.18 mm
TP 1	2 - 4'	9.50 mm
TP 2	2 - 4'	0.80 mm

The above data illustrates how the surface material increased in size on the Agua Fria as water traveled downstream (Nos. 1 and 2). This trend was not observed in the lower layers. The New River samples exhibited larger sizes in both layers, relative to the Agua Fria Material. Their grain-size distribution is presented in Appendix B.

7.4 Drainage

With the construction of the Levee around the Glendale WWRF, the drainage issues are transferred from this report to ATL's Report for the Glendale WWRF, Job No. 197080. What remains an issue for this project is the construction of the pipe trench for the extended 36 inch diameter pipe and the compaction of the material under, around and over

the pipe. ATL suggests that the pipe extension trench be excavated when the embankment level reaches the proposed top-of-pipe elevation. We suggest that pipe bedding, the specifications for which are presented in Section 8.0 of this report, be utilized under and around the circumference of the pipe, up to the spring line. This will allow for uniform settlement.

An opening for the airport drainage channel was also planned for this Levee. As with the pipe extension, the affected portion of this Levee has been eliminated from the project.

Temporary drainage during construction of the toe-down and embankment sections is important in order to insure that proper density is achieved by the Levee components. The contractor should be required to submit a construction drainage plan prior to beginning work.

7.5 Earthquakes

An issue to consider is the effect that earthquakes might have on the embankment. The Western States Seismic Council indicates that earthquakes with shaking intensities can occur in Yuma, in a north trending zone from Flagstaff to Fredonia and northwesterly through Flagstaff and Grand Canyon, merging with the Intermountain Seismic Belt in southern Utah. The Uman region holds the highest probability for damaging earthquakes. Work performed by K.M. Euge in 1992 and Bausch, Brumbaugh, and others in 1994 provide projected acceleration data for Maricopa County. This data indicates that the levee is a 90% non-probability zone. No additional precautions are anticipated for this project.

8.0 CONSTRUCTION RECOMMENDATIONS

ATL recommends that the Uniform Standards Specifications for Public Works Construction by the Maricopa Association of Governments (MAG) Standards be used as a guideline for construction specifications. The following sub-sections provide specific references to MAG, as well as containing additional recommendations specific to this project.

8.1 Clearing and Grubbing

Construction methods presented in MAG Sections 201.1 thru 201.4 should be followed and will include the removal of the existing gabions for that portion of the existing embankment that will interface with the new transition embankment.

The clearing and grubbing operation may remove as much as 6 inches of organic soil which should be discarded off site. The resulting subgrade should be proof-rolled prior to constructing the embankment sections.

8.2 Structure Excavation and Backfill

In general, Section 206 of MAG should be followed when excavating and backfilling for the levee and transition embankments. The materials excavated for the toe-down and the materials excavated from New River are acceptable for use in their native condition. However, the contractor should be aware that occasionally oversize cobbles will be contained in the excavation and may have to be removed so that the specified minimum compaction percentage may be obtained.

Structural backfill for the levee foundation and embankment should be placed in 12-inch thick compacted layers. Compaction criteria is presented in Figure 2. All layers should be placed horizontally and slopes trimmed after placement if required. Proof rolling of the subsoil material at the bottom of the excavation using the above criteria should be specified and the process should conform to MAG Section 601.4.

8.3 Borrow Excavation

The New River channel has been specified as a borrow site for the soil cement aggregate and embankment fills. The Plans will provide grading and borrow area limits. For the soil cement mix, cobbles exceeding 3 inches in diameter will have to be removed, either manually or by dumping over a 3-inch screen (grizzly).

8.4 Soil Cement Placement

There are several acceptable methods of mixing soil-cement; central plant, on-site mixing "table", or mixed-in-place. The central plant or pugmill configuration is preferred for multi-layer applications such as this.

Prior to placing and compacting the soil-cement, the subgrade should be moistened and compacted as specified previously. Haul time should be minimized. Compaction should be initiated no later than 60 minutes after water is added to the mix. It is recommended that the soil-cement be compacted to an average of 98% and no less than 95% of the maximum density as determined by ASTM D558 or AASHTO T134.

Finished surfaces should be cured using water. Permanently exposed surfaces must be kept moist for seven (7) days. Also note that construction joints will be needed whenever lay down operations are interrupted for over 3 hours.

The contractor will be responsible for developing a mix design meeting the following strength and unit weight criteria:

7-Day Compressive Strength	=	750 psi
Minimum Unit Weight	=	125 pcf
Estimated Minimum Cement Content	=	9%

8.5 Pipe Bedding

Pipe bedding material, placed under and around pipe, should conform to the following requirements developed by the Arizona Department of Transportation:

Sieve Size	Percent Passing by Weight
1 ½"	100
1"	90 - 100
No. 8	35 - 80
No. 200	0 - 8

The Plasticity Index should not exceed 8 and a resistivity no less than 2000 ohm-cm. The pH should range from 6.0 to 9.0.

8.6 Shotcrete

Shotcrete is concrete conveyed through a hose and pneumatically applied using either the dry mix process or the wet mix process. For this project, ATL suggests that the wet mix process be used. This process consists of premixing by mechanical methods a proportional combination of portland cement, aggregate and water required to produce mortar or concrete; conveying the concrete through the delivery hose to the special nozzle where additional compressed air is added at the nozzle prior to discharge. The following

gradations are required for the coarse and fine aggregates used in the shotcrete mix as suggested by the Arizona Department of Transportation:

Fine Aggregate :

Sieve Size	Percent Passing by Weight
3/8"	100
No. 4	95 - 100
No. 8	80 - 100
No. 16	50 - 85
No. 30	25 - 60
No. 50	10 - 30
No. 100	2 - 10

Coarse Aggregate:

Sieve Size	Percent Passing by Weight
½ "	100
3/8"	85 - 100
No. 4	10 - 30
No. 8	0 - 10
No. 16	0 - 5

Admixtures may be used. The air pressure should be no less than 80 psi at the nozzle when the hose length is 100 feet or less. For each additional 50 feet of hose the air pressure should be increased 5 psi. The shotcrete surface shall be kept continuously moist for at least seven (7) days, beginning immediately after finishing.

For the wet mix process, ADOT Section 912-3.0(B)(2) suggests that the mix design submitted by the contractor contain no less than 658 pounds per cubic yard of mix, developing a minimum 28-day compressive strength of 3,000 psi on core samples drilled from test panels. The slump shall be no greater than 4 inches when measured in accordance with ASTM C 143 procedures.

9.0 LIMIT OF SERVICES

ATL can provide quality control, quality assurance and construction inspection services during the construction. Our staff of experienced technicians are NICET, ACI, and Nuclear Density Gauge certified and are familiar with the requirements of the City of Glendale, ATL provides direct services to the City via an annual contract and through other consultants acting as construction manager's.

The analyses and recommendations in this report are based in part upon data obtained from the field exploration. The nature and extent of variations beyond the location of test borings may not become evident until construction. If variations then appear evident, it may be necessary to reevaluate the recommendations of this report.

Our professional services were performed using that degree of care and skill ordinarily exercised, under similar circumstances, by reputable geotechnical engineers practicing in this or similar localities. No warranty, express or implied, is made. We prepared the report as an aid in design of the proposed project.

This report is for the exclusive purpose of providing geotechnical engineering and/or testing information and recommendations. The scope of services for this project does not include, either specifically or by implication, and environmental assessment of the site or identification of contaminated or hazardous materials or conditions. If the owner is concerned about the potential for such contamination, other studies should be undertaken.

If there are questions concerning this report, do not hesitate to contact the author.

10.0 REFERENCES

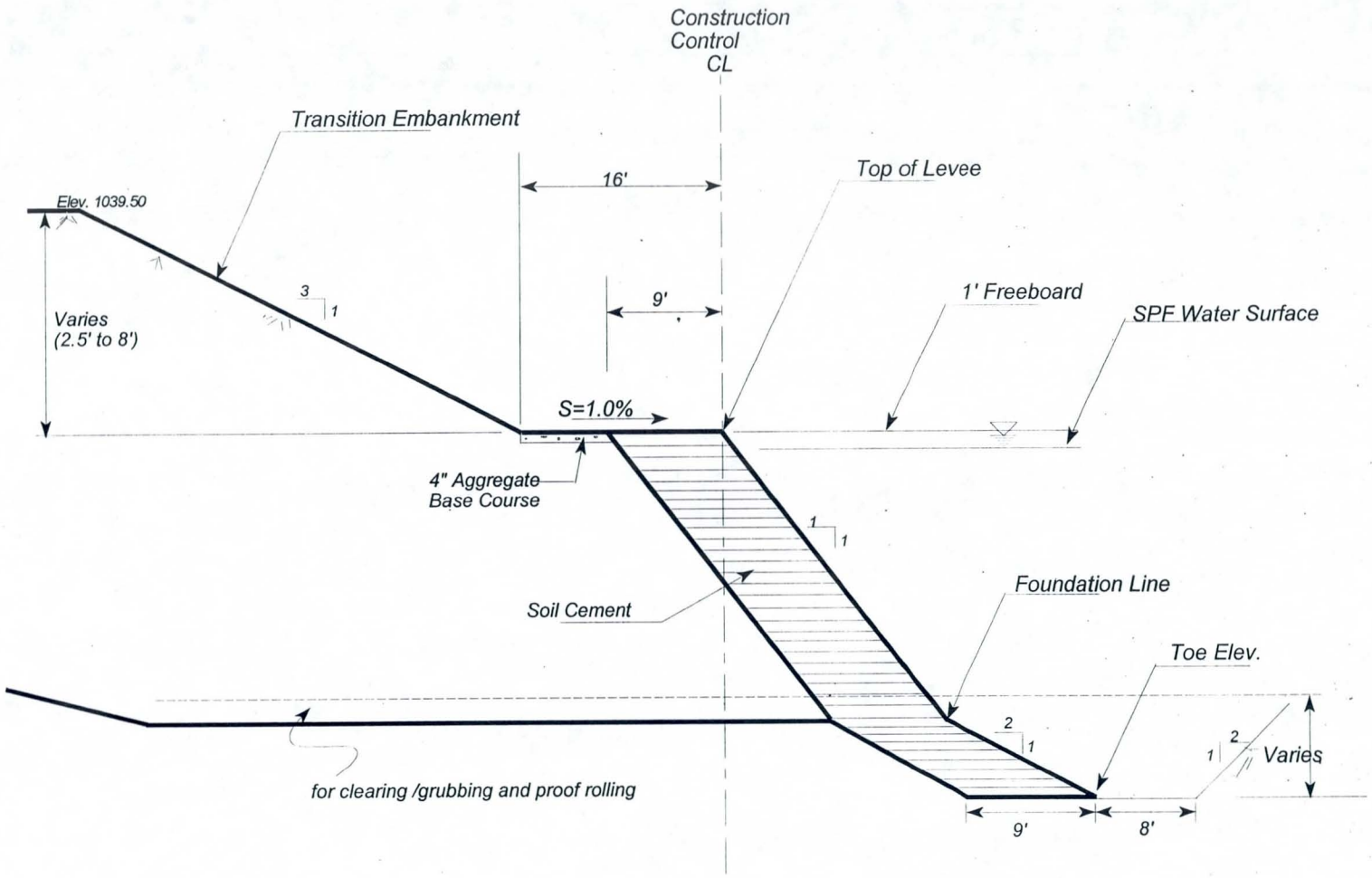
The following sources of information were consulted in part to provide information included in this report:

- ***Soil Mechanics, Design Manual 7.01***, Change 1, 9/86
  Naval Facilities Engineering Command
- ***Foundation and Earth Structures, Design Manual 7.02***
  Change 2, 9/86, Naval Facilities Engineering Command
- ***Uniform Building Code***, 1991, Part VI, Chapter 29

"Controlling Floods in the Desert with Soil-Cement"

Hansen and Lynch, 6/95

- ***"Soil-Cement for Facing Slopes and Lining Reservoirs, Channels and Lagoons"***, PCA Concrete Information, 1996
- ***"Soil-Cement Slope Protection for Embankments: Planning and Design"***, PCA Concrete Information, 1991
- ***Uniform Standard Specifications for Public Works Construction,*** Maricopa Association of Governments, 1992
- ***Roadside Geology of Arizona***, Holka Chronic, 1995
- ***Hydrological Map of Maricopa County, Series Report No. 12***, Arizona Department of Water Resources, 1983



TYPICAL SECTION

GLENDALE AIRPORT LEVEE

- Figure No. 1 -

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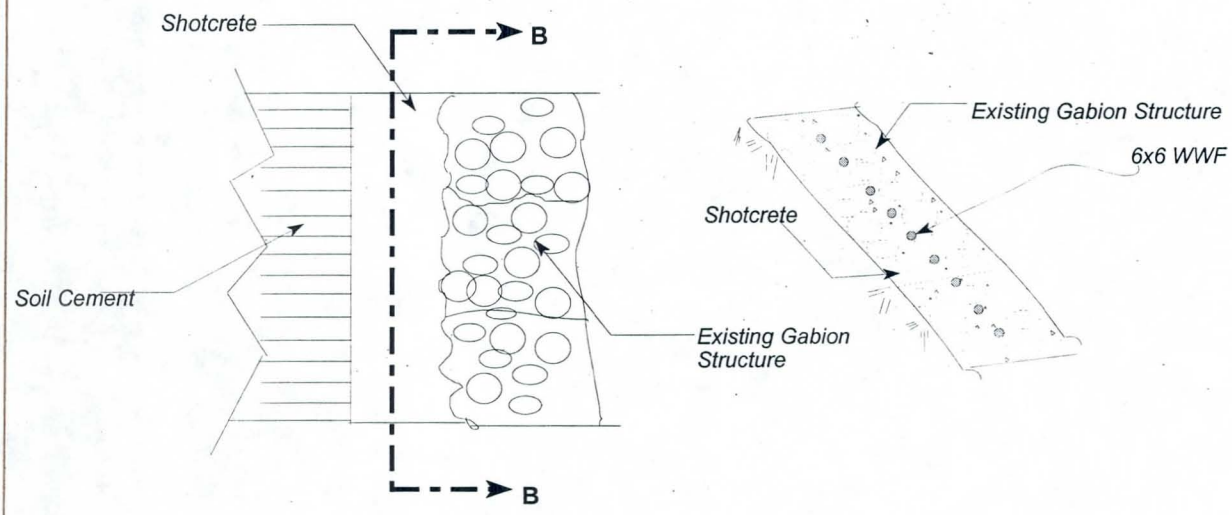
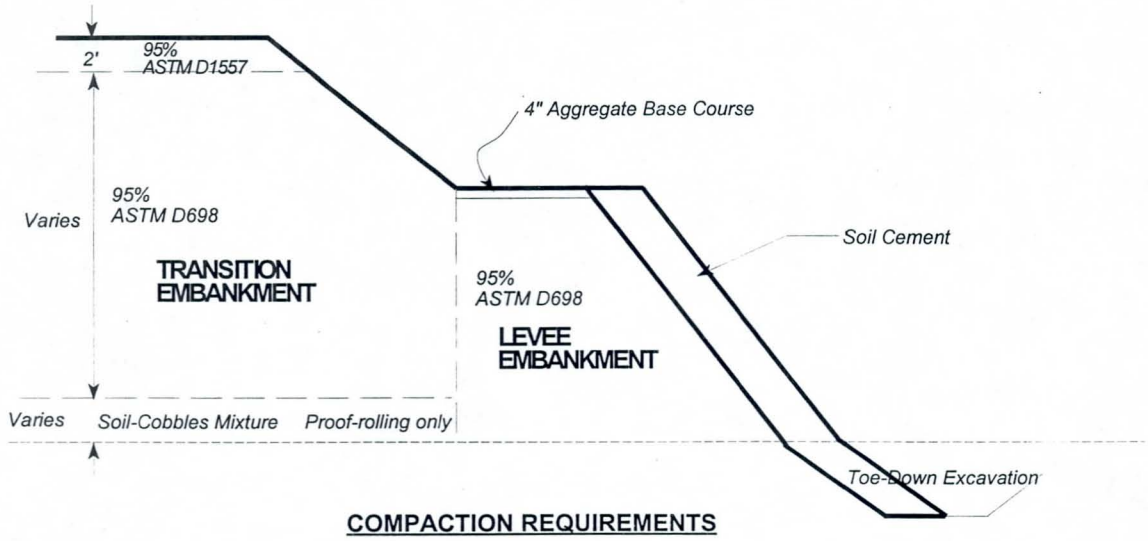


ELEVATION **SECTION B-B**

SHOTCRETE REQUIREMENTS

DETAIL 1



COMPACTION REQUIREMENTS

DETAIL 2

STANDARD DETAILS

- Figure No. 2 -

PLATES

GUIDELINES IN THE USE AND INTERPRETATION

OF THIS GEOTECHNICAL REPORT

ATL Job No. 195039-1

Our professional services were performed, our findings obtained, and our recommendations prepared in accordance with generally accepted engineering principles and practices. This warranty is in lieu of all other warranties, either expressed or implied.

The geotechnical report was prepared for the use of the Owner in the design of the subject facility and should be made available to potential contractors and/or the Contractor for information on factual data only. This report should not be used for contractual purposes as a warranty of interpreted subsurface conditions such as those indicated by the interpretive boring and test pit logs, cross sections, or discussion of subsurface conditions contained herein.

The analyses, conclusions and recommendations contained in the report are based on site conditions as they presently exist and assume that the exploratory borings, test pits, and/or probes are representative of the subsurface conditions of the site. If, during construction, subsurface conditions are found which are significantly different from those observed in the exploratory borings and test pits, or assumed to exist in the excavations, we should be advised at once so that we can review these conditions and reconsider our recommendations where necessary. If there is a substantial lapse of time between the submission of this report and the start of work at the site, or if conditions have changed due to natural causes or construction operations at or adjacent to the site, this report should be reviewed to determine the applicability of the conclusions and recommendations considering the changed conditions and time lapse.

The Summary Boring Logs are our opinion of the subsurface conditions revealed by periodic sampling of the ground as the borings progressed. The soil descriptions and interfaces between strata are interpretive and actual changes may be gradual.

The boring logs and related information depict subsurface conditions only at these specific locations and at the particular time designated on the logs. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the soil conditions at these boring locations.

Groundwater levels often vary seasonally. Groundwater levels reported on the boring logs or in the body of the report are factual data only for the dates shown.

Unanticipated soil conditions are commonly encountered on construction sites and cannot be fully anticipated by merely taking soil samples, borings or test pits. Such unexpected conditions frequently require that additional expenditures be made to attain a properly constructed project. It is recommended that the Owner consider providing a contingency fund to accommodate such potential extra costs.

This firm cannot be responsible for any deviation from the intent of this report including, but not restricted to, any changes to the scheduled time of construction, the nature of the project or the specific construction methods or means indicated in this report; nor can our firm be responsible for any construction activity on sites other than the specific site referred to in this report.

SOIL CLASSIFICATION & TERMINOLOGY

GRAPHIC SYMBOL	GROUP SYMBOL	TYPICAL NAMES
	GW	Well graded gravels, gravel - sand mixtures, or sand - gravel - cobble mixtures.
	GP	Poorly graded gravels, gravel - sand mixtures, or sand - gravel - cobble mixtures.
	GM	Silty gravels, gravel - sand - silt mixtures.
	GC	Clayey gravels, gravel - sand - clay mixtures.
	SW	Well graded sands, gravelly sands.
	SP	Poorly graded sands, gravelly sands.
	SM	Silty sands, sand - silt mixtures
	SC	Clayey sands, sand - clay mixtures
	ML	Inorganic silts, clayey silts with slight plasticity
	MH	Inorganic silts, micaceous or diatomaceous silty soils, elastic silts.
	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
	CH	Inorganic clays of high plasticity, fat clays, sandy clays of high plasticity.

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 - 4	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 thumb nail.
30 +	Hard	Indented only with difficulty by thumbnail.

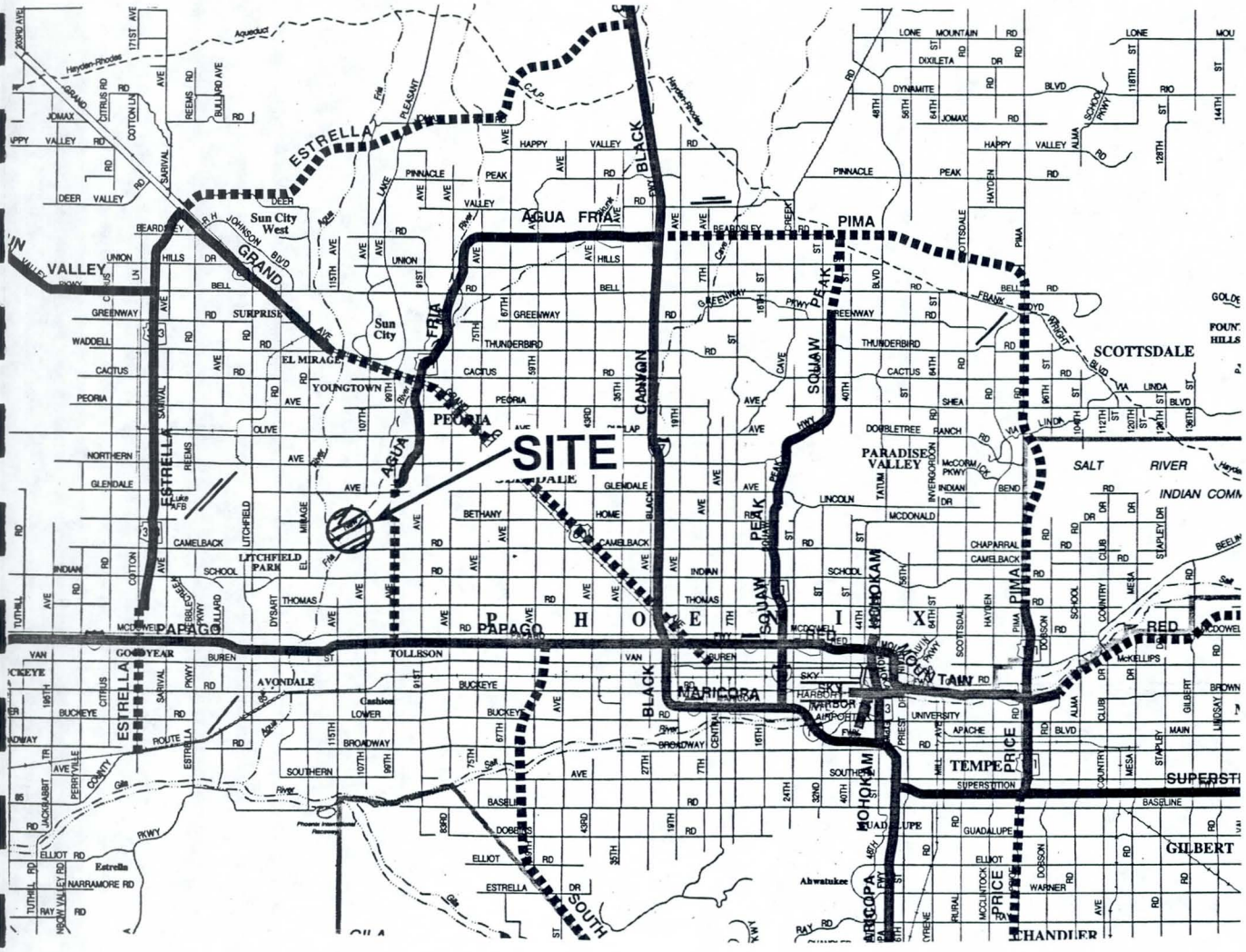
3. Relative Firmness. Terms for description of partially saturated and / or cemented soils which commonly occur in the Southwest including clays, cemented granular materials, silts and silty and clayey granular soils.

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

4. Standard Penetration Tests (SPT) =

DEFINITIONS OF SOIL FRACTIONS

SOIL COMPONENT	PARTICLE SIZE RANGE
Cobbles	Above 3 inches
Gravel	3 inches to No. 4 sieve
Coarse gravel	3 inches to 3/4 inch
Fine gravel	3/4 inch to No. 4 sieve
Sand	No. 4 sieve to No. 200
Coarse	No. 4 sieve to No. 10
Medium	No. 10 sieve to No. 40
Fine	No. 40 sieve to No. 200
Fines (silt or clay)	Below No. 200 sieve

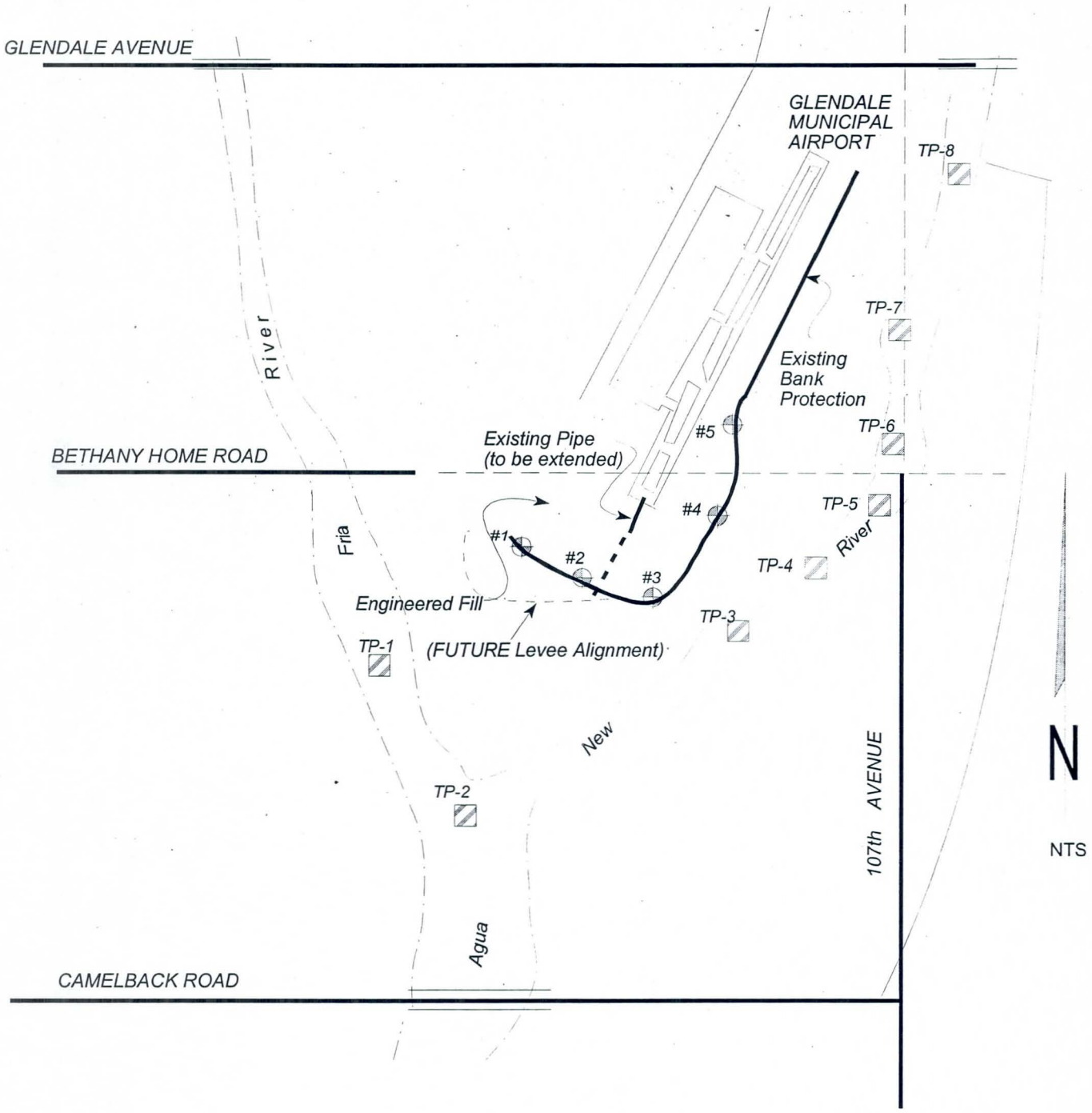


VICINITY MAP

CAMELBACK RANCH LEVEE
Glendale Municipal Airport
FCD CONTRACT #95-15

ATL JOB NO. 195039 -1

PLATE 3



TEST PIT LOCATIONS
BORING LOCATIONS

BORING AND TEST PIT LOCATIONS

CAMELBACK RANCH LEVEE
Glendale Municipal Airport
FCD CONTRACT #95-15

ATL JOB NO. 195039 -1

PLATE 4

APPENDIX A

BORING LOGS

CAMELBACK RANCH LEVEE DESIGN
Glendale Municipal Airport
FCD CONTRACT #95-15

ATL Job No. *195039-1*

Boring No. *1*

Boring Location: *Levee Station 0+06 , centerline*

Boring Equipment: *Mobile B-50 With 8 -Inch Diameter hollow Stem Auger*

Date of Boring: *11/25/97* **Elevation of Boring:** *Existing*

Driller: *J. Cowell* **Logger:** *J. Cowell* **Reviewed By:** *A. Osorio*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	Water Content %	Dry Density (pcf)
		Gray-tan, poorly - graded SAND (SP-SM) with silt, damp			*1.0*	
	5		*18*			
	10		*34*			
		Tan, well-graded SAND(SW) with gravel and cobbles, damp				
	15		*75*			
	20		*120 / 6"*			
		(Bottom of Boring at 20 feet and 6 inches)				
	25					

Boring Stopped at 20'-6" Below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	None		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

A1

CAMELBACK RANCH LEVEE DESIGN
Glendale Municipal Airport
FCD CONTRACT #95-15

ATL Job No. 195039-1

Boring No.: 2

Boring Location: *Levee Station 5+10 , centerline*

Boring Equipment: *Mobile B-50 With 8 -Inch Diameter hollow Stem Auger*

Date of Boring: *11/25/97* **Elevation of Boring:** *Existing*

Driller: *J. Cowell* **Logger:** *J. Cowell* **Reviewed By:** *A. Osorio*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	Water Content %	Dry Density (pcf)
		Gray-tan, poorly - graded SAND(SP-SM) with silt, damp			1.0	
	5		12			
	10			61		
		Tan, well - graded SAND(SW) with gravel, damp	29			
	15	*trace of cementation*	85 / 10"	73		
	20		67 / 11"			
		(Bottom of Boring at 20 feet and 11 inches)				
	25					

Boring Stopped at 20'-11" Below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	None		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

A2

CAMELBACK RANCH LEVEE DESIGN
Glendale Municipal Airport
FCD CONTRACT #95-15

ATL Job No. *195039-1*

Boring No.: *3*

Boring Location: *Levee centerline,Station 10+10*

Boring Equipment: *Mobile B-50 With 8 -Inch Diameter hollow Stem Auger*

Date of Boring: *11/25/97* **Elevation of Boring:** *Existing*

Driller: *J. Cowell* **Logger:** *J. Cowell* **Reviewed By:** *A. Osorio*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	Water Content %	Dry Density (pcf)
		Gray-tan, poorly graded GRAVEL(GP) with cobbles				
		Gray-tan, poorly graded SAND(SP-SM) with silt, damp			*1.4*	
	5	*Tan, well graded SAND(SW) with gravel and cobbles, damp*	*93*			
	10		*71 / 10"*			
		Light brown, silty SAND(SM) with gravel and cobbles (Hard drilling)			*13.3*	
	15	*trace of cementation - (water added to cool drill bit)*	*50 / 4"*			
	20	*(Bottom of Boring at 20 feet)*				
		Note: 8" auger refusal at 14 feet, changed to 4" diameter auger				
	25					

Boring Stopped at 20 Feet Below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	None		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

A3

CAMELBACK RANCH LEVEE DESIGN
Glendale Municipal Airport
FCD CONTRACT #95-15

ATL Job No. 195039-1

Boring No.: 4

Boring Location: *Levee centerline,Station 15+10*

Boring Equipment: *Mobile B-50 With 6 -Inch Diameter hollow Stem Auger*

Date of Boring: *11/25/97* **Elevation of Boring:** *Existing*

Driller: *J. Cowell* **Logger:** *J. Cowell* **Reviewed By:** *A. Osorio*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	Water Content %	Dry Density (pcf)
		Gray-tan, poorly graded GRAVEL(GP) with cobbles, damp				
		Light brown, poorly graded SAND(SP) with gravel, damp			2.2	
	5		34			
		Light brown, well graded SAND(SW) with gravel and cobbles, damp				
	10		68			
		Light brown, silty SAND(SM) with gravel and cobbles (Hard drilling)				
	15	*Trace of cementation*	98 / 11"			
	20	*(Bottom of Boring at 20 feet)*				
		Note: Auger refusal at 16 feet, changed to 4" diameter auger				
	25					

Boring Stopped at 20 Feet Below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	None		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

A4

CAMELBACK RANCH LEVEE DESIGN
Glendale Municipal Airport
FCD CONTRACT #95-15

ATL Job No. *195039-1*

Boring No.: *5*

Boring Location: *Fourteen feet right Levee ,Station 20+00*

Boring Equipment: *Mobile B-50 With 6 -Inch Diameter hollow Stem Auger*

Date of Boring: *11/25/97* **Elevation of Boring:** *Existing*

Driller: *J. Cowell* **Logger:** *J. Cowell* **Reviewed By:** *A. Osorio*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	Water Content %	Dry Density (pcf)
		Tan, silty SAND(SM) with gravel, damp				
	5		*86 / 10"*			
		with gravel and cobbles				
	10	*(Fill from previous levee placement 0 to 10 ½ feet)*				
		Tan, silty SAND(SM) with gravel, damp (Natural Ground)	*67*			
		Light brown, silty SAND(SM) with gravel and cobbles , damp				
	15	*Trace of cementation*	*50 / 3"*			
	20		*50 / 3"*			
		(Bottom of Boring at 20 feet and 3 inches)				
		Note: *6" auger refusal at 8 feet, changed to 4" diameter auger*				
	25					

Boring Stopped at 20' - 3" Below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	None		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

CAMELBACK RANCH LEVEE DESIGN
Glendale Municipal Airport
FCD CONTRACT #95-15

ATL Job No. *195039-1*

Test Pit No.: *TP-1*

Boring Location: *In Agua Fria River 3925 feet +/- upstream from Camelback Road*

Boring Equipment: *Case 580 with 24" bucket*

Date of Boring: *11/25/97* **Elevation of Boring:** *Existing*

Driller: *J. Cowell* **Logger:** *J. Cowell* **Reviewed By:** *A. Osorio*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	Water Content %	Dry Density (pcf)
		Light brown, poorly graded SAND(SP) with gravel and silt coating, With some cobbles to 5" size			1.7	
		Gray-tan, well graded GRAVEL (GW) with sand				
		Light brown, poorly graded SAND(SP) with gravel and silt coating With some cobbles to 6" size			1.6	
	5	*(Bottom of Excavation at 4 feet)*				
	10					
	15					
	20					
	25					

Excavation Stopped at 4 Feet Below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	None		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

CAMELBACK RANCH LEVEE DESIGN
Glendale Municipal Airport
FCD CONTRACT #95-15

ATL Job No. *195039-1*

Test Pit No.: *TP-2*

Boring Location: *In Agua Fria River 1480 feet +/- upstream from Camelback Road*

Boring Equipment: *Case 580 with 24" bucket*

Date of Boring: *11/25/97* **Elevation of Boring:** *Existing*

Driller: *J. Cowell* **Logger:** *J. Cowell* **Reviewed By:** *A. Osorio*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	Water Content %	Dry Density (pcf)
		Gray-tan, poorly graded SAND(SP) with gravel and some cobbles to 6" size			1.2	
		Gray-tan, poorly graded SAND(SP) with gravel			1.2	
		(Bottom of Excavation at 4 feet)				
	5					
	10					
	15					
	20					
	25					

Excavation Stopped at 4 Feet Below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	None		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

CAMELBACK RANCH LEVEE DESIGN
Glendale Municipal Airport
FCD CONTRACT #95-15

ATL Job No. *195039-1*

Test Pit No.: *TP-3*

Boring Location: *In New River channel 4160 feet +/- upstream from Camelback Road*

Boring Equipment: *Case 580 with 24" bucket*

Date of Boring: *11/25/97* **Elevation of Boring:** *Existing*

Driller: *J. Cowell* **Logger:** *J. Cowell* **Reviewed By:** *A. Osorio*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	Water Content %	Dry Density (pcf)
		Gray-tan, well graded GRAVEL(GW) with sand and some cobbles to 6" size			2.6	
		Brown, well graded SAND(SW-SM) with silt			3.5	
	5					
		Brown, well graded GRAVEL(GW) with sand and clayey coating, cobbles to 6" size				
	10	*(Bottom.of Excavation at 10 feet)*				
	15					
	20					
	25					

Excavation Stopped at 10 Feet Below Existing Grade

Groundwater: Initial Depth None; Hour; 24 Hour Depth

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

CAMELBACK RANCH LEVEE DESIGN
Glendale Municipal Airport
FCD CONTRACT #95-15

ATL Job No. *195039-1*

Test Pit No.: *TP-4*

Boring Location: *In New River channel 5800 +/- feet upstream from Camelback Road*

Boring Equipment: *Case 580 with 24" bucket*

Date of Boring: *11/26/97* **Elevation of Boring:** *Existing*

Driller: *J. Cowell* **Logger:** *J. Cowell* **Reviewed By:** *A. Osorio*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	Water Content %	Dry Density (pcf)
		Gray-tan, well graded SAND(SW-SM) with silt and gravel			2.2	
		Gray-tan, well graded SAND(SW) with gravel			3.3	
	5	*Brown, well graded SAND(SW-SM) with silt coating*				
		Tan, well graded GRAVEL(GW) with sand with cobbles to 6"				
	10	*(Bottom of Excavation at 10 feet)*				
	15					
	20					
	25					

Excavation Stopped at 10 Feet Below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	None		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

CAMELBACK RANCH LEVEE DESIGN
Glendale Municipal Airport
FCD CONTRACT #95-15

ATL Job No. *195039-1*

Test Pit No.: *TP-5*

Boring Location: *In New River channel 6580 +/- feet upstream from Camelback Road*

Boring Equipment: *Case 580 with 24" bucket*

Date of Boring: *11/26/97* **Elevation of Boring:** *Existing*

Driller: *J. Cowell* **Logger:** *J. Cowell* **Reviewed By:** *A. Osorio*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	Water Content %	Dry Density (pcf)
		Tan, well graded SAND(SW) with gravel			1.5	
		Brown, well graded GRAVEL(GW) with sand, silt coating and cobbles to 6" size			2.4	
	5					
	10	*(Bottom of Excavation at 10 feet)*				
	15					
	20					
	25					

Excavation Stopped at 10 Feet Below Existing Grade

Groundwater: Initial Depth None; Hour; 24 Hour Depth

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

CAMELBACK RANCH LEVEE DESIGN
Glendale Municipal Airport
FCD CONTRACT #95-15

ATL Job No. *195039-1*

Test Pit No.: *TP-6*

Boring Location: *In New River channel 7430 +/- feet upstream from Camelback Road*

Boring Equipment: *Case 580 with 24" bucket*

Date of Boring: *11/26/97* **Elevation of Boring:** *Existing*

Driller: *J. Cowell* **Logger:** *J. Cowell* **Reviewed By:** *A. Osorio*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	Water Content %	Dry Density (pcf)
		Gray-tan, well graded GRAVEL(GW) with sand with some cobbles to 6" size			1.7	
		Tan, poorly graded SAND(SP)				
	5					
		Brown, well graded GRAVEL(GW) with sand				
	10	*(Bottom of Excavation at 10 feet)*				
	15					
	20					
	25					

Excavation Stopped at 10 Feet Below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	None		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

CAMELBACK RANCH LEVEE DESIGN
Glendale Municipal Airport
FCD CONTRACT #95-15

ATL Job No. *195039-1*

Test Pit No.: *TP-7*

Boring Location: *In New River channel 8600 +/- feet upstream from Camelback Road*

Boring Equipment: *Case 580 with 24" bucket*

Date of Boring: *11/26/97* **Elevation of Boring:** *Existing*

Driller: *J. Cowell* **Logger:** *J. Cowell* **Reviewed By:** *A. Osorio*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	Water Content %	Dry Density (pcf)
		Gray-tan, silty SAND(SM) with gravel with cobbles to 6" size			2.3	
		Brown, well graded GRAVEL(GW) with sand			1.2	
		with clayey coating				
	5	*with cobbles to 8" size*			1.2	
	10	*(Bottom of Excavation at 10 feet)*				
	15					
	20					
	25					

Excavation Stopped at 10 Feet Below Existing Grade

Groundwater: Initial Depth None; Hour; 24 Hour Depth

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

CAMELBACK RANCH LEVEE DESIGN
Glendale Municipal Airport
FCD CONTRACT #95-15

ATL Job No. *195039-1*

Test Pit No.: *TP-8*

Boring Location: *In New River channel 10,930 +/- feet upstream from Camelback Road*

Boring Equipment: *Case 580 with 24" bucket*

Date of Boring: *11/26/97* **Elevation of Boring:** *Existing*

Driller: *J. Cowell* **Logger:** *J. Cowell* **Reviewed By:** *A. Osorio*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	Water Content %	Dry Density (pcf)
		Brown, poorly graded GRAVEL(GP-GM) with silt and sand with cobbles to 6" size			*3.9*	
		Brown, well graded GRAVEL(GW) with sand and clayey coating			*3.9*	
		(Bottom of Excavation at 4 feet)				
	5					
	10					
	15					
	20					
	25					

Excavation Stopped at 4 Feet Below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	None		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

APPENDIX B

LABORATORY TEST RESULTS

SUMMARY OF LABORATORY ANALYSIS

CLIENT: DMJM DATE: 12/18/97

PROJECT: CAMELBACK RANCH LEVEE - FCD CONTRACT NO. 95-15

LOCATION: GLENDALE MUNICIPAL AIRPORT, GLENDALE, ARIZONA

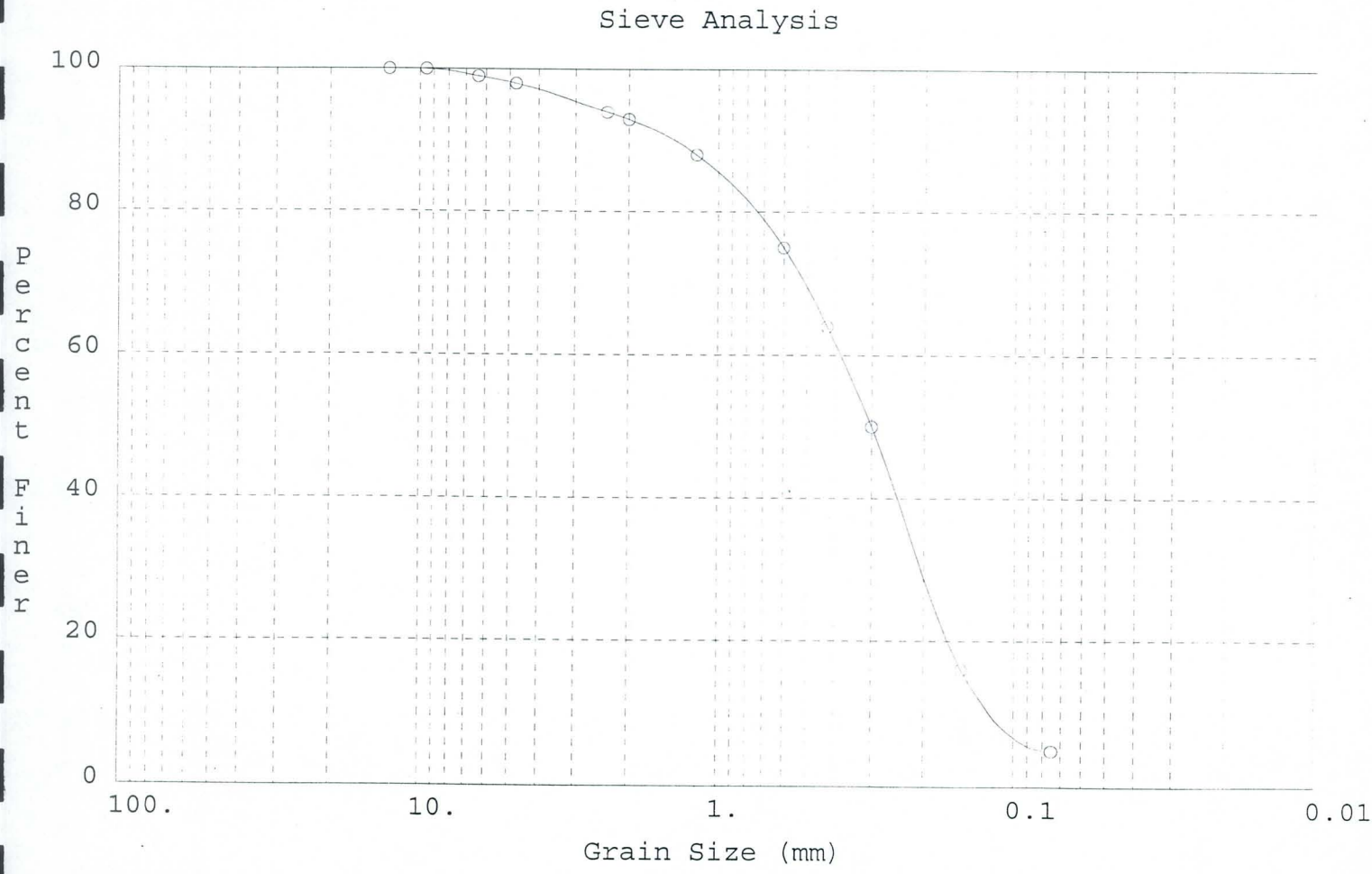
MATERIAL: See Below SAMPLING DATE: 11/25/97

REQUESTED BY: David Hayes ATL JOB NO: 195039-1

BORING / TEST PIT No.	DEPTH (Feet)	MOIST (%)	USCS	LL	PI	SIEVE ANALYSIS - PERCENT PASSING											
						200	50	30	10	#8	#4	1	2	3	3.5	5	6
1	0 - 14	1.0	SP-SM	-	NP	4.9	50	75	93	94	98	100	-	-	-	-	-
2	0 - 12	1.0	SP-SM	-	NP	6.2	39	75	95	96	98	100	-	-	-	-	-
3	4 - 10	1.4	SM	-	-	2.7	10	24	47	49	55	78	86	100	-	-	-
3	15 - 20	13.3	-	-	NP	-	-	-	-	-	-	-	-	-	-	-	-
4	2 - 6 1/2	2.7	SP	-	NP	3.6	13	29	50	51	58	80	100	-	-	-	-
5	0 - 10	1.8	-	-	NP	-	-	-	-	-	-	-	-	-	-	-	-
5	15 - 20	1.4	SM	-	-	17.4	32	45	67	68	73	88	100	-	-	-	-
TP-1	0 - 2	1.7	SP	-	-	3.0	5.0	22	67	68	73	86	91	100	-	-	-
TP-1	2 - 4	1.6	GW	-	NP	1.0	4.0	10	27	30	38	74	84	89	89	100	-
TP-2	0 - 2	1.2	SP	-	NP	1.0	6.0	32	63	65	73	94	97	100	-	-	-
TP-2	2 - 4	1.2	SP	-	-	7.0	16	48	71	72	73	80	84	84	100	-	-
TP-3	0 - 2	2.6	GW	-	NP	1.8	4	12	31	33	42	67	77	81	81	100	-
TP-3	2 - 4	3.5	SW-SM	-	NP	10.0	33	67	90	91	93	97	100	-	-	-	-
TP-4	0 - 2	2.2	SW-SM	-	NP	6.9	17	33	56	58	63	81	91	100	-	-	-
TP-4	2 - 4	3.3	SW	-	-	3.1	11	28	50	52	61	77	88	94	100	-	-
TP-5	0 - 2	1.5	SW	-	NP	3.7	19	39	62	64	65	83	90	100	-	-	-
TP-5	2 - 4	2.4	GW	26	7	4.6	7	11	18	19	23	45	64	90	100	-	-
TP-6	0 - 2	1.7	GW	-	NP	3.3	7	11	25	26	31	51	72	87	93	100	-
TP-6	2 - 4	-	SP	-	-	2.1	32	86	99	99	100	-	-	-	-	-	-
TP-7	0 - 2	2.3	SM	-	NP	16.0	26	44	54	55	58	69	84	89	89	100	
TP-7	2 - 4	1.2	GW	-	NP	1.9	4	7	19	20	25	53	84	93	100	-	-
TP-7	4-10	1.2	GW	-	NP	2.0	4	11	29	30	34	47	61	76	79	89	100
TP-8	0 - 2	3.9	GP - GM	-	NP	5.5	11	16	22	23	28	57	66	80	100	-	-
TP-8	2 - 4	3.8	GW	32	15	3.8	7	12	27	29	37	65	81	93	100	-	-

Project Number = 195039-1 Client: DMJM
Location = Camelback Ranch Levee Design-Add'l Investigation
Date = 12/5/97
Tested By = D. Johnson
Boring Number = 1
Depth = 0 - 14'
Sample Number = 97-1005
Description = Gray-tan, poorly graded SAND(SP-SM) with silt
Dry Sample Weight (g) = 1000

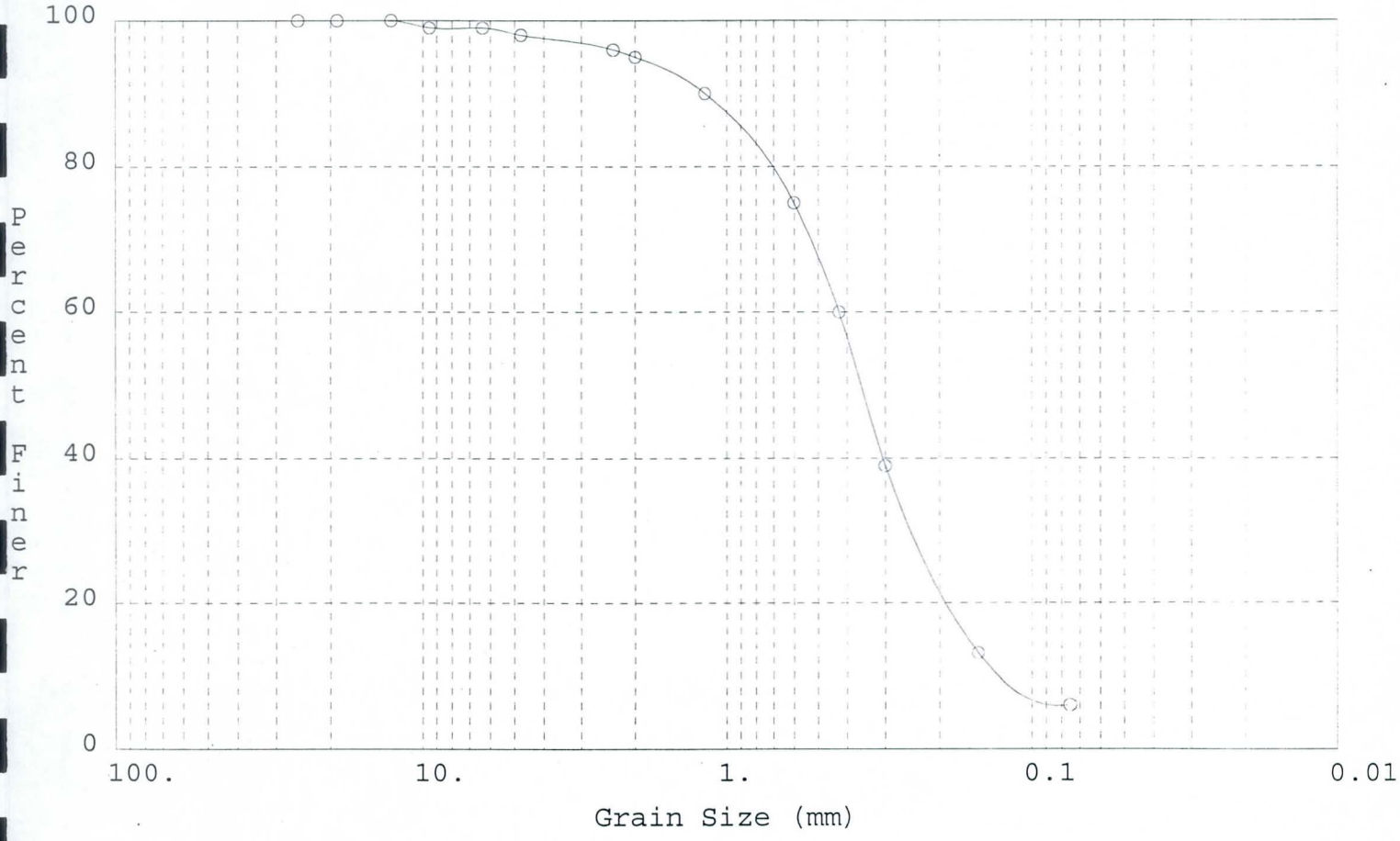
SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
1/2"	12.700	0.00	0.00	0.00	100.00
3/8"	9.500	0.00	0.00	0.00	100.00
1/4"	6.350	10.00	1.00	1.00	99.00
#4	4.750	10.00	1.00	2.00	98.00
#8	2.360	40.00	4.00	6.00	94.00
#10	2.000	10.00	1.00	7.00	93.00
#16	1.180	50.00	5.00	12.00	88.00
#30	0.600	130.00	13.00	25.00	75.00
#40	0.425	110.00	11.00	36.00	64.00
#50	0.300	140.00	14.00	50.00	50.00
#100	0.150	340.00	34.00	84.00	16.00
#200	0.075	110.00	11.00	95.00	5.00
Pan	0.000	0.00	0.00	95.00	5.00



Project Number = 195039-1 Client: DMJM
Location = Camelback Ranch Levee Design-Add'l Investigation
Date = 12/5/97
Tested By = D. Johnson
Boring Number = 2
Depth = 0 - 12'
Sample Number = 97-1006
Description = Gray-tan, poorly graded SAND(SP-SM) with silt
Dry Sample Weight (g) = 1000

SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
1"	25.400	0.00	0.00	0.00	100.00
3/4"	19.050	0.00	0.00	0.00	100.00
1/2"	12.700	0.00	0.00	0.00	100.00
3/8"	9.500	10.00	1.00	1.00	99.00
1/4"	6.350	0.00	0.00	1.00	99.00
#4	4.750	10.00	1.00	2.00	98.00
#8	2.360	20.00	2.00	4.00	96.00
#10	2.000	10.00	1.00	5.00	95.00
#16	1.180	50.00	5.00	10.00	90.00
#30	0.600	150.00	15.00	25.00	75.00
#40	0.425	150.00	15.00	40.00	60.00
#50	0.300	210.00	21.00	61.00	39.00
#100	0.150	260.00	26.00	87.00	13.00
#200	0.075	70.00	7.00.	94.00	6.00
Pan	0.000	0.00	0.00	94.00	6.00

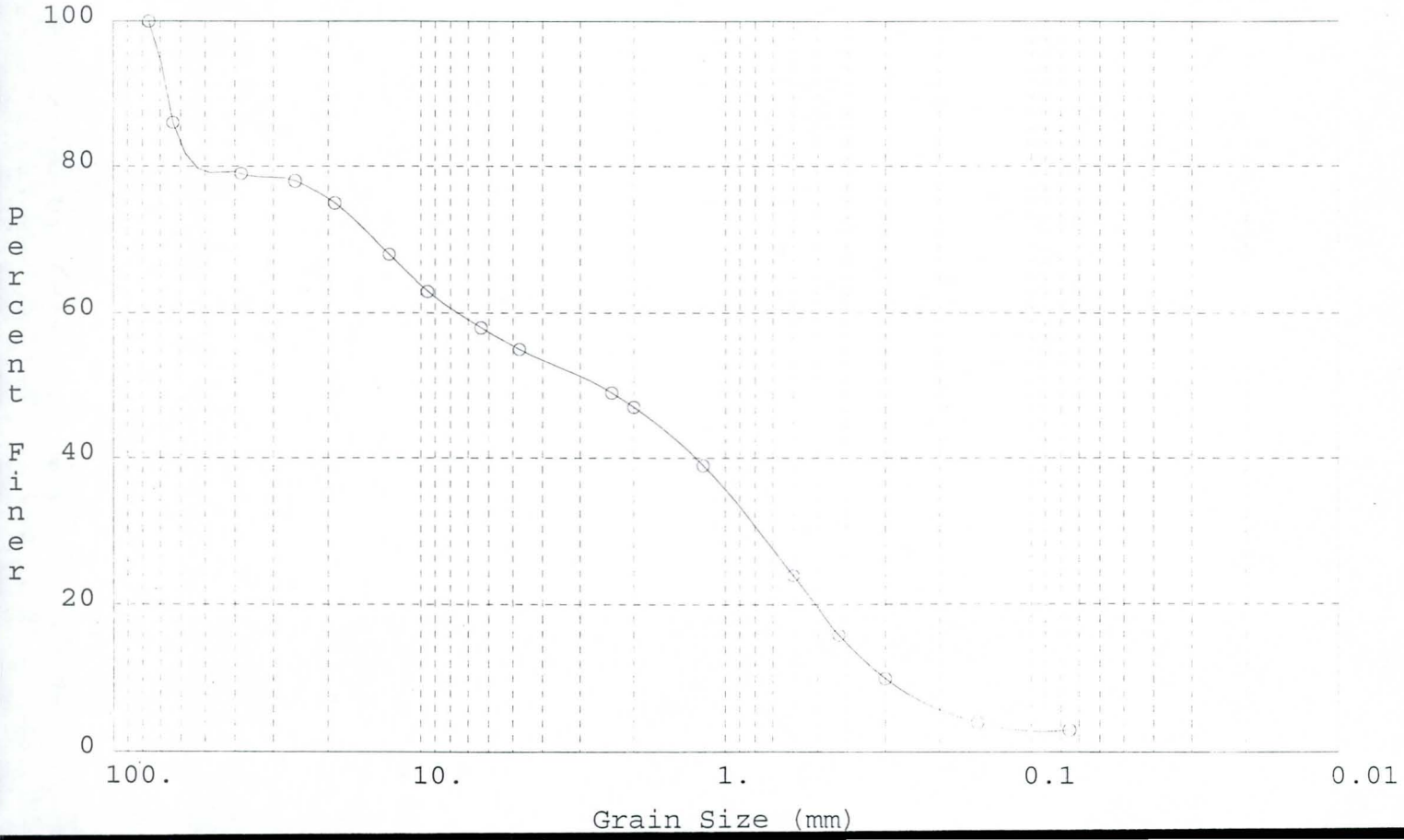
Sieve Analysis



Project Number = 195039-1 Client: DMJM
Location = Camelback Ranch Levee Design-Add'l Investigation
Date = 12/5/97
Tested By = D. Johnson
Boring Number = 3
Depth = 4' - 10'
Sample Number = 97-1008
Description = Tan, well-graded SAND(SM) with gravel
Dry Sample Weight (g) = 1000

SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
3"	76.200	0.00	0.00	0.00	100.00
2 1/2"	63.500	140.00	14.00	14.00	86.00
1 1/2"	38.100	70.00	7.00	21.00	79.00
1"	25.400	10.00	1.00	22.00	78.00
3/4"	19.050	30.00	3.00	25.00	75.00
1/2"	12.700	70.00	7.00	32.00	68.00
3/8"	9.500	50.00	5.00	37.00	63.00
1/4"	6.350	50.00	5.00	42.00	58.00
#4	4.750	30.00	3.00	45.00	55.00
#8	2.360	60.00	6.00	51.00	49.00
#10	2.000	20.00	2.00	53.00	47.00
#16	1.180	80.00	8.00	61.00	39.00
#30	0.600	150.00	15.00	76.00	24.00
#40	0.425	80.00	8.00.	84.00	16.00
#50	0.300	60.00	6.00	90.00	10.00
#100	0.150	60.00	6.00	96.00	4.00
#200	0.075	10.00	1.00	97.00	3.00
Pan	0.000	0.00	0.00	97.00	3.00

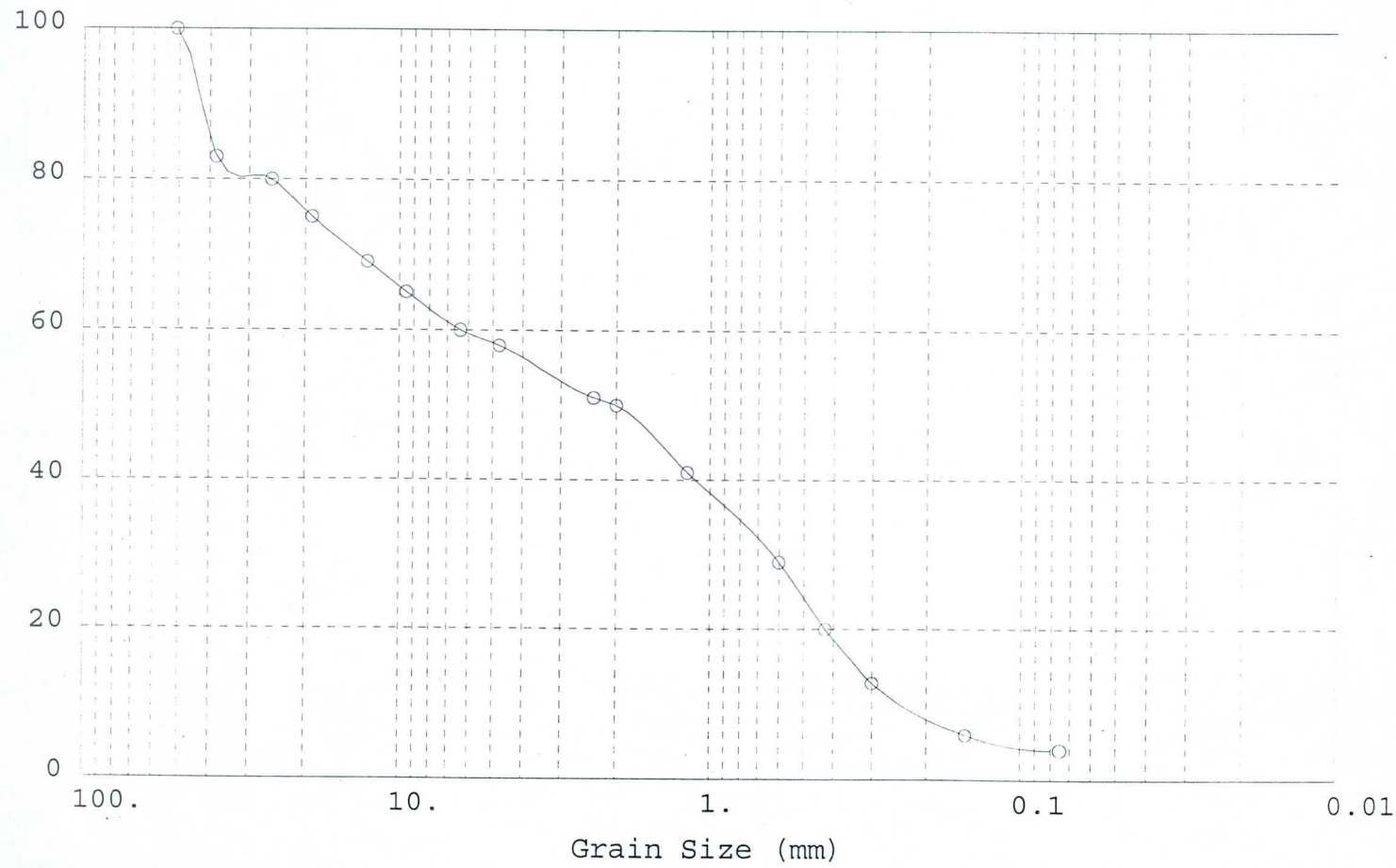
Sieve Analysis



Project Number = 195039-1 Client: DMJM
Location = Camelback Ranch Levee Design-Add'l Investigation
Date = 12/5/97
Tested By = M. Blalock
Boring Number = 4
Depth = 2' - 6 1/2'
Sample Number = 97-1010
Description = Light brown, poorly graded SAND(SP) with gravel
Dry Sample Weight (g) = 1000

SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
2"	50.800	0.00	0.00	0.00	100.00
1 1/2"	38.100	170.00	17.00	17.00	83.00
1"	25.400	30.00	3.00	20.00	80.00
3/4"	19.050	50.00	5.00	25.00	75.00
1/2"	12.700	60.00	6.00	31.00	69.00
3/8"	9.500	40.00	4.00	35.00	65.00
1/4"	6.350	50.00	5.00	40.00	60.00
#4	4.750	20.00	2.00	42.00	58.00
#8	2.360	70.00	7.00	49.00	51.00
#10	2.000	10.00	1.00	50.00	50.00
#16	1.180	90.00	9.00	59.00	41.00
#30	0.600	120.00	12.00	71.00	29.00
#40	0.425	90.00	9.00	80.00	20.00
#50	0.300	70.00	7.00	87.00	13.00
#100	0.150	70.00	7.00	94.00	6.00
#200	0.075	20.00	2.00	96.00	4.00
Pan	0.000	0.00	0.00	96.00	4.00

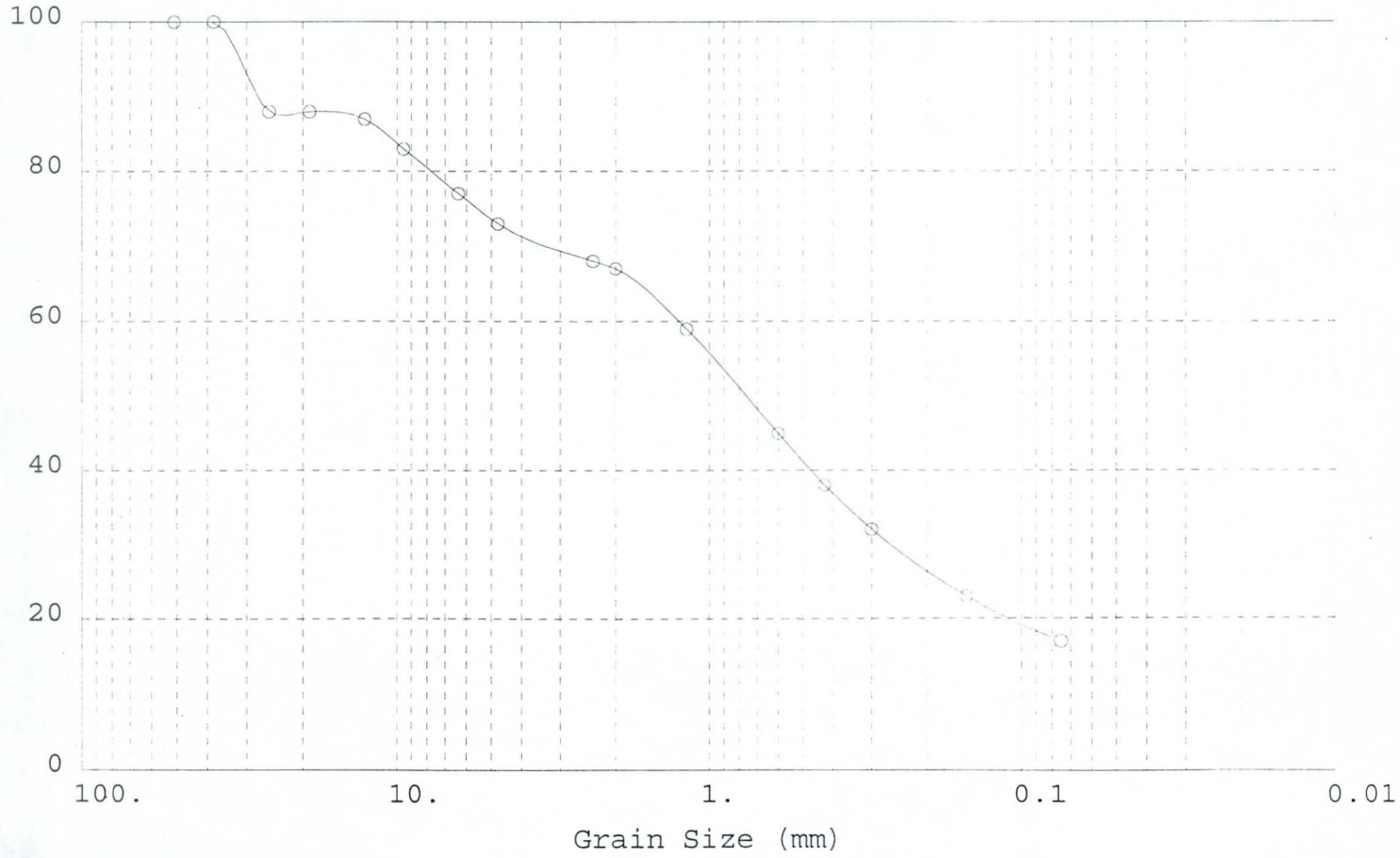
Sieve Analysis



Project Number = 195039-1 Client: DMJM
Location = Camelback Ranch Levee Design-Add'l Investigation
Date = 12/5/97
Tested By = M. Blalock
Boring Number = 5
Depth = 15' - 20'
Sample Number = 97-1013
Description = Light brown, silty SAND(SM) with gravel
Dry Sample Weight (g) = 1000

SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
2"	50.800	0.00	0.00	0.00	100.00
1 1/2"	38.100	0.00	0.00	0.00	100.00
1"	25.400	120.00	12.00	12.00	88.00
3/4"	19.050	0.00	0.00	12.00	88.00
1/2"	12.700	10.00	1.00	13.00	87.00
3/8"	9.500	40.00	4.00	17.00	83.00
1/4"	6.350	60.00	6.00	23.00	77.00
#4	4.750	40.00	4.00	27.00	73.00
#8	2.360	50.00	5.00	32.00	68.00
#10	2.000	10.00	1.00	33.00	67.00
#16	1.180	80.00	8.00	41.00	59.00
#30	0.600	140.00	14.00	55.00	45.00
#40	0.425	70.00	7.00	62.00	38.00
#50	0.300	60.00	6.00.	68.00	32.00
#100	0.150	90.00	9.00	77.00	23.00
#200	0.075	60.00	6.00	83.00	17.00
Pan	0.000	0.00	0.00	83.00	17.00

Sieve Analysis



Project Number = 195039-1 Client: DMJM
Location = Camelback Ranch Levee Design-Add'l Investigation
Date = 12/11/97
Tested By = D. Johnson
Boring Number = TP-1
Depth = 0 - 2'
Sample Number = 97-1014
Description = Light brown, poorly graded SAND(SP) with gravel
Dry Sample Weight (g) = 1000

SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
3"	76.200	0.00	0.00	0.00	100.00
2 1/2"	63.500	40.00	4.00	4.00	96.00
2"	50.800	50.00	5.00	9.00	91.00
1 1/2"	38.100	20.00	2.00	11.00	89.00
1"	25.400	30.00	3.00	14.00	86.00
3/4"	19.050	20.00	2.00	16.00	84.00
1/2"	12.700	40.00	4.00	20.00	80.00
3/8"	9.500	20.00	2.00	22.00	78.00
1/4"	6.350	30.00	3.00	25.00	75.00
#4	4.750	20.00	2.00	27.00	73.00
#8	2.360	50.00	5.00	32.00	68.00
#10	2.000	10.00	1.00	33.00	67.00
#16	1.180	160.00	16.00	49.00	51.00
#30	0.600	290.00	29.00	78.00	22.00
#40	0.425	120.00	12.00	90.00	10.00
#50	0.300	50.00	5.00	95.00	5.00
#100	0.150	10.00	1.00	96.00	4.00
#200	0.075	10.00	1.00	97.00	3.00
-	0.038	0.00	0.00	97.00	3.00
-	0.024	0.00	0.00	97.00	3.00
-	0.014	0.00	0.00	97.00	3.00
-	0.010	0.00	0.00	97.00	3.00
-	0.007	0.00	0.00	97.00	3.00
-	0.003	4.00	0.40	97.40	2.60
-	0.001	5.00	0.50	97.90	2.10
Pan	0.000	0.00	0.00	97.90	2.10

HYDROMETER ANALYSIS
(ASTM D422)

CLIENT : DMJM
300 W. Clarendon Ave.
Phoenix, AZ 85013

PROJECT : Additional Camelback Levee Design
MATERIAL :
SOURCE OF MATERIAL: Boring No.:TP-1 Depth: 0 - 2'

DATE : 12/11/97
LAB. NO.: 97-1014
JOB NO. : 195039-1
DATE RCVD: 12/01/97
SAMPLED BY: J. Cowell

WEIGHT OF SAMPLE = 100.42 (grams) SOIL PASSING #10 SIEVE = 66.70 %

SPECIFIC GRAVITY OF SOIL SAMPLE = 2.741

ELAPSED TIME (MIN)	TIME	TEMP. (oC)	CORR.(K) USING (TAB. 3)	HYDROMETER READING (WATER)	HYDROMETER READING (W/SOIL)	CORR. READING	EFFECTIVE DEPTH (cms)	PARTICLE SIZE (mm)	PERCENT FINER IN SUSPENSION
0	START 08:59 AM	18.3	0.01396	1.00375	1.00675	1.00300	14.5	0.038	3.1
2	09:01 AM	18.3	0.01396	1.00375	1.00675	1.00300	14.5	0.024	3.1
5	09:04 AM	18.3	0.01396	1.00375	1.00675	1.00300	14.5	0.014	3.1
15	09:14 AM	18.3	0.01396	1.00375	1.00675	1.00300	14.5	0.010	3.1
30	09:29 AM	18.3	0.01396	1.00375	1.00675	1.00300	14.5	0.007	3.1
60	09:59 AM	18.3	0.01396	1.00375	1.00625	1.00250	14.6	0.003	2.6
250	01:09 PM	20.5	0.01396	1.00375	1.00575	1.00200	14.8	0.001	2.1
12/11/97 1440	08:59 AM	20.0	0.01396	1.00375	1.00575	1.00200	14.8	0.001	2.1

Reviewed By:
Input By: AO

Respectfully Submitted:
Robert Rivera
Laboratory Supervisor

DMJM/Hydro/97-1014Geo

ATL, INC.
CONSTRUCTION QUALITY CONTROL
GEOTECHNICAL CONSULTANTS

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Tucson, AZ 85713
(520) 623-4547
Fax (520) 623-4603

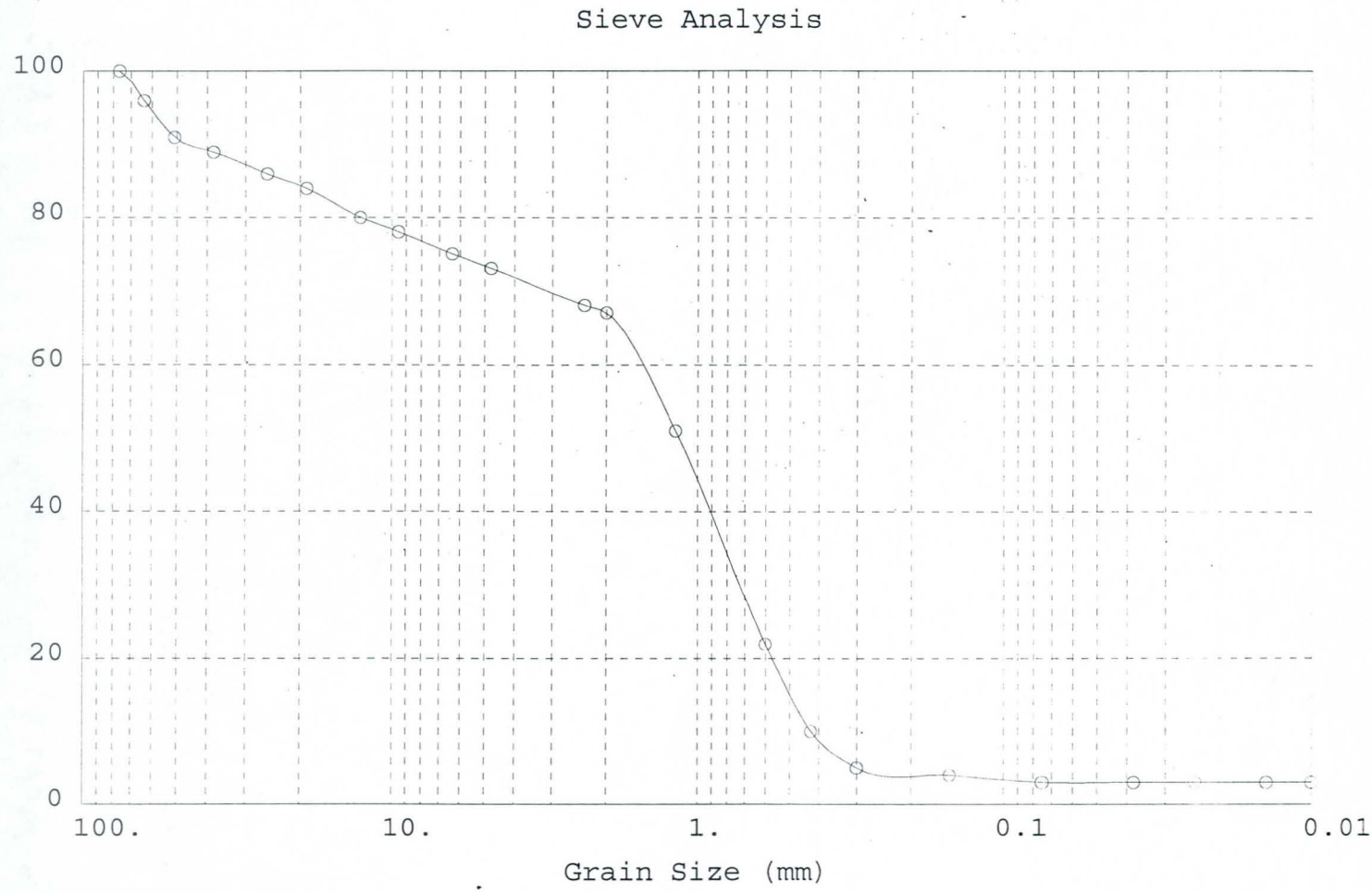
FLAGSTAFF
1855 W. Kaibab Lane #6
Flagstaff, AZ 86001
(520) 773-9614
Fax (520) 773-9522

GLOBE
1400½ N. Broad
Globe, AZ 85502
(520) 425-8999
Fax (520) 425-9597

COTTONWOOD
2646 Union Drive
Cottonwood, AZ 86326
(520) 646-7311
Fax (520) 646-7198

PRESCOTT VALLEY
7136 2nd Street #103
Prescott Valley, AZ 86314
(520) 759-2238
Fax (520) 759-2239

LAS VEGAS
3002-A Rigel Avenue
Las Vegas, NV 89102
(702) 871-0492
Fax (702) 871-3643


Sieve Analysis
100
80
60
40
20
0
Percent Finer
100.
10.
1.
0.1
0.01
Grain Size (mm)

Project Number = 195039-1 Client: DMJM
Location = Camelback Ranch Levee Design-Add'l Investigation
Date = 12/11/97
Tested By = D. Johnson
Boring Number = TP-1
Depth = 2' - 4'
Sample Number = 97-1015
Description = Gray-tan, well graded GRAVEL(GW) with sand
Dry Sample Weight (g) = 1000

SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
5"	127.000	0.00	0.00	0.00	100.00
4"	101.600	110.00	11.00	11.00	89.00
3"	76.200	0.00	0.00	11.00	89.00
2 1/2"	63.500	0.00	0.00	11.00	89.00
2"	50.800	50.00	5.00	16.00	84.00
1 1/2"	38.100	20.00	2.00	18.00	82.00
1"	25.400	80.00	8.00	26.00	74.00
3/4"	19.050	50.00	5.00	31.00	69.00
1/2"	12.700	110.00	11.00	42.00	58.00
3/8"	9.500	60.00	6.00	48.00	52.00
1/4"	6.350	70.00	7.00	55.00	45.00
#4	4.750	70.00	7.00	62.00	38.00
#8	2.360	80.00	8.00	70.00	30.00
#10	2.000	30.00	3.00	73.00	27.00
#16	1.180	60.00	6.00	79.00	21.00
#30	0.600	110.00	11.00	90.00	10.00
#40	0.425	40.00	4.00	94.00	6.00
#50	0.300	20.00	2.00	96.00	4.00
#100	0.150	20.00	2.00	98.00	2.00
#200	0.075	10.00	1.00	99.00	1.00
-	0.038	1.00	0.10	99.10	0.90
-	0.024	3.00	0.30	99.40	0.60
-	0.001	2.00	0.20	99.60	0.40
Pan	0.000	0.00	0.00	99.60	0.40

HYDROMETER ANALYSIS
(ASTM D422)

CLIENT : DMJM
300 W. Clarendon Ave.
Phoenix, AZ 85013

PROJECT : Additional Camelback Levee Design

MATERIAL :

SOURCE OF MATERIAL: Boring No.:TP-1 Depth: 2' - 4'

DATE : 12/11/97

LAB. NO.: 97-1015

JOB NO. : 195039-1

DATE RCVD: 12/01/97

SAMPLED BY: J. Cowell

WEIGHT OF SAMPLE = 100.53 (grams) SOIL PASSING #10 SIEVE = 26.80 %

SPECIFIC GRAVITY OF SOIL SAMPLE = 2.682

ELAPSED TIME (MIN)	TIME	TEMP. (oC)	CORR.(K) USING (TAB. 3)	HYDROMETER READING (WATER)	HYDROMETER READING (W/SOIL)	CORR. READING	EFFECTIVE DEPTH (cms)	PARTICLE SIZE (mm)	PERCENT FINER IN SUSPENSION
0	START 10:09 AM	18.8	0.01396	1.00375	1.00575	1.00200	14.8	0.038	0.9
2	10:11 AM	18.8	0.01396	1.00375	1.00525	1.00150	14.9	0.024	0.6
5	10:14 AM	18.8	0.01396	1.00375	1.00525	1.00150	14.9	0.014	0.6
15	10:24 AM	18.8	0.01396	1.00375	1.00525	1.00150	14.9	0.010	0.6
30	10:41 AM	18.8	0.01396	1.00375	1.00525	1.00150	14.9	0.007	0.6
60	11:09 AM	18.8	0.01396	1.00375	1.00525	1.00150	14.9	0.003	0.6
250	02:19 PM	21.6	0.01396	1.00375	1.00475	1.00100	15.0	0.001	0.4
12/11/97 1440	10:09 AM	20.0	0.01396	1.00375	1.00475	1.00100	15.0	0.001	0.4

Reviewed By:
Input By: AO

Respectfully Submitted:

Robert Rivera
Laboratory Supervisor

DMJM/Hydro/97-1015Geo

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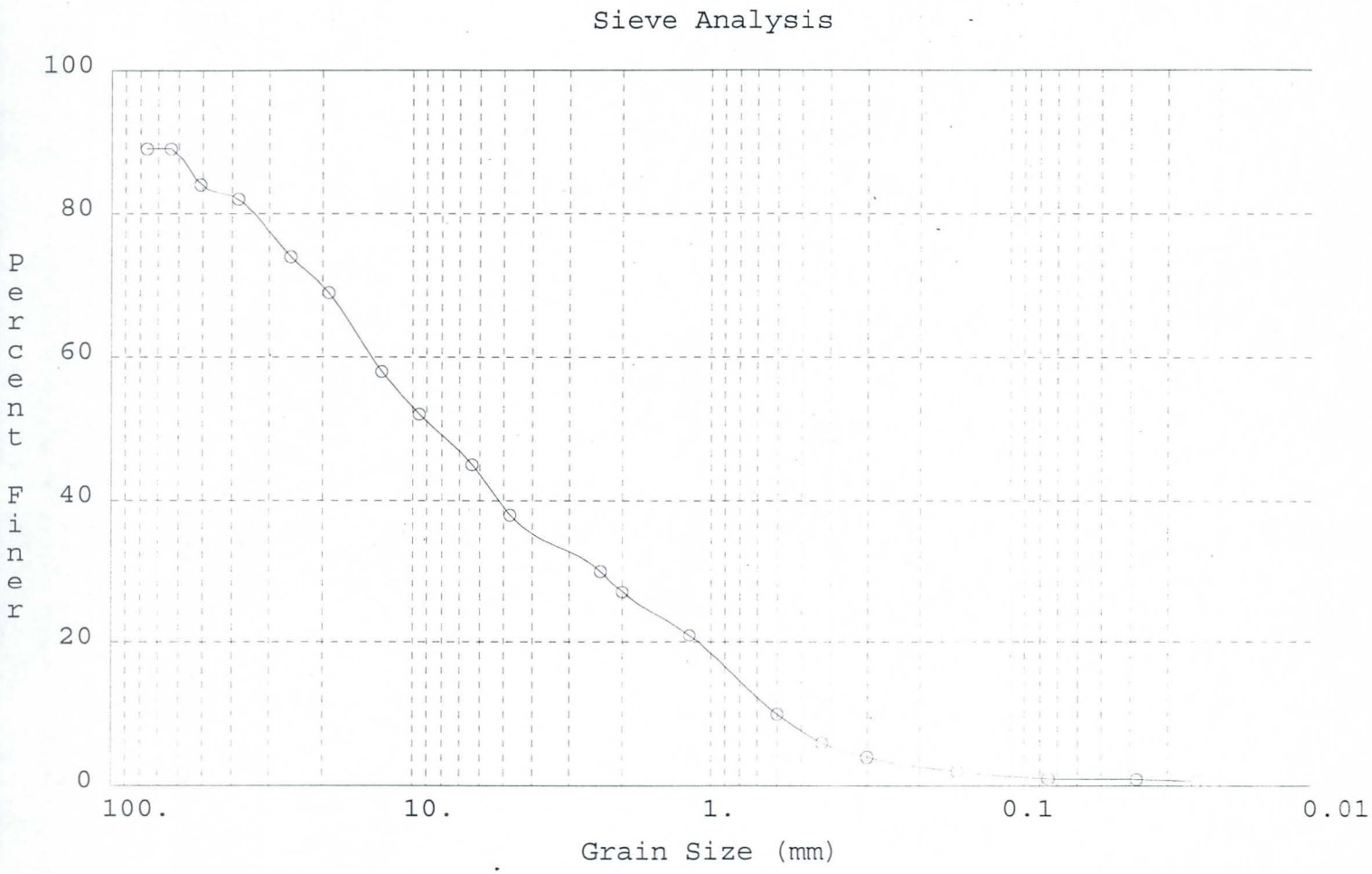
Sieve Analysis
100
80
60
40
20
0
Percent Finer
100.
10.
1.
0.1
0.01
Grain Size (mm)

Project Number = 195039-1 Client: DMJM
Location = Camelback Ranch Levee Design-Add'l Investigation
Date = 12/11/97
Tested By = D. Johnson
Boring Number = TP-2
Depth = 0 - 2'
Sample Number = 97-1016
Description = Gray-tan, poorly graded SAND(SP) with gravel
Dry Sample Weight (g) = 1000

SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
2 1/2"	63.500	0.00	0.00	0.00	100.00
2"	50.800	30.00	3.00	3.00	97.00
1 1/2"	38.100	10.00	1.00	4.00	96.00
1"	25.400	20.00	2.00	6.00	94.00
3/4"	19.050	40.00	4.00	10.00	90.00
1/2"	12.700	50.00	5.00	15.00	85.00
3/8"	9.500	40.00	4.00	19.00	81.00
1/4"	6.350	60.00	6.00	25.00	75.00
#4	4.750	20.00	2.00	27.00	73.00
#8	2.360	80.00	8.00	35.00	65.00
#10	2.000	20.00	2.00	37.00	63.00
#16	1.180	100.00	10.00	47.00	53.00
#30	0.600	210.00	21.00	68.00	32.00
#40	0.425	140.00	14.00	82.00	18.00
#50	0.300	120.00	12.00	94.00	6.00
#100	0.150	40.00	4.00	98.00	2.00
#200	0.075	10.00	1.00	99.00	1.00
-	0.038	0.00	0.00	99.00	1.00
-	0.003	0.00	0.00	99.00	1.00
-	0.001	5.00	0.50	99.50	0.50
Pan	0.000	0.00	0.00	99.50	0.50

HYDROMETER ANALYSIS
(ASTM D422)

CLIENT : DMJM
300 W. Clarendon Ave.
Phoenix, AZ 85013

PROJECT : Additional Camelback Levee Design
MATERIAL :
SOURCE OF MATERIAL: Boring No.:TP-2 Depth: 0 - 2'

DATE : 12/11/97
LAB. NO.: 97-1016
JOB NO. : 195039-1
DATE RCVD: 12/01/97
SAMPLED BY: J. Cowell

WEIGHT OF SAMPLE = 101.42 (grams) SOIL PASSING #10 SIEVE = 62.50 %

SPECIFIC GRAVITY OF SOIL SAMPLE = 2.693

ELAPSED TIME (MIN)	TIME	TEMP. (oC)	CORR.(K) USING (TAB. 3)	HYDROMETER READING (WATER)	HYDROMETER READING (W/SOIL)	CORR. READING	EFFECTIVE DEPTH (cms)	PARTICLE SIZE (mm)	PERCENT FINER IN SUSPENSION
0	START 10:32 AM	18.8	0.01396	1.00375	1.00475	1.00100	15.0	0.038	1.0
2	10:34 AM	18.8	0.01396	1.00375	1.00475	1.00100	15.0	0.024	1.0
5	10:37 AM	18.8	0.01396	1.00375	1.00475	1.00100	15.0	0.014	1.0
15	10:47 AM	18.8	0.01396	1.00375	1.00475	1.00100	15.0	0.010	1.0
30	11:02 AM	18.8	0.01396	1.00375	1.00475	1.00100	15.0	0.007	1.0
60	11:32 AM	18.8	0.01396	1.00375	1.00475	1.00100	15.0	0.003	1.0
250	02:42 PM	21.6	0.01396	1.00375	1.00425	1.00050	15.2	0.001	0.5
12/11/97 1440	10:32 AM	20.0	0.01396	1.00375	1.00425	1.00050	15.2	0.001	0.5

Reviewed By:
Input By: AO

Respectfully Submitted:

Robert Rivera
Laboratory Supervisor

DMJM/Hydro/97-1016Geo

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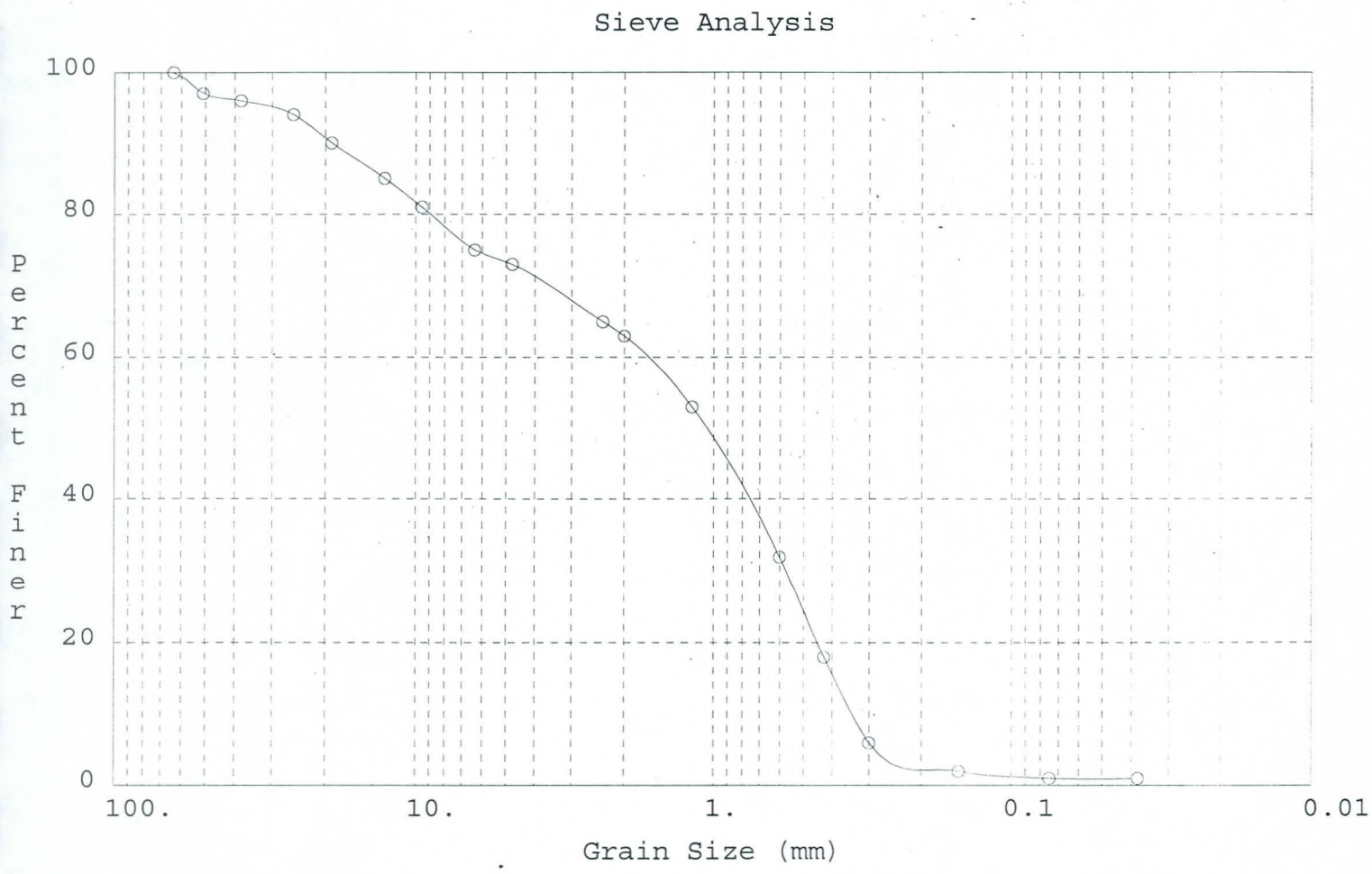
Sieve Analysis
100
80
60
40
20
0
Percent Finer
100.
10.
1.
0.1
0.01
Grain Size (mm)

Project Number = 195039-1 Client: DMJM
Location = Camelback Ranch Levee Design-Add'l Investigation
Date = 12/09/97
Tested By = D. Johnson
Boring Number = TP-2
Depth = 2' - 4'
Sample Number = 97-1017
Description = Gray-tan, poorly graded SAND(SP)with gravel
Dry Sample Weight (g) = 1000

SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
4"	101.600	0.00	0.00	0.00	100.00
3 1/2"	88.900	0.00	0.00	0.00	100.00
3"	76.200	160.00	16.00	16.00	84.00
2 1/2"	63.500	0.00	0.00	16.00	84.00
2"	50.800	0.00	0.00	16.00	84.00
1 1/2"	38.100	30.00	3.00	19.00	81.00
1"	25.400	10.00	1.00	20.00	80.00
3/4"	19.050	10.00	1.00	21.00	79.00
1/2"	12.700	10.00	1.00	22.00	78.00
3/8"	9.500	10.00	1.00	23.00	77.00
1/4"	6.350	20.00	2.00	25.00	75.00
#4	4.750	20.00	2.00	27.00	73.00
#8	2.360	10.00	1.00	28.00	72.00
#10	2.000	10.00	1.00	29.00	71.00
#16	1.180	50.00	5.00	34.00	66.00
#30	0.600	180.00	18.00	52.00	48.00
#40	0.425	140.00	14.00	66.00	34.00
#50	0.300	180.00	18.00	84.00	16.00
#100	0.150	80.00	8.00	92.00	8.00
#200	0.075	10.00	1.00	93.00	7.00
-	0.038	54.00	5.40	98.40	1.60
-	0.024	3.00	0.30	98.70	1.30
-	0.014	2.00	0.20	98.90	1.10
-	0.010	6.00	0.60	99.50	0.50
-	0.001	0.00	0.00	99.50	0.50
pan	0.000	0.00	0.00	99.50	0.50

HYDROMETER ANALYSIS
(ASTM D422)

CLIENT : DMJM
300 W. Clarendon Ave.
Phoenix, AZ 85013

PROJECT : Additional Camelback Levee Design
MATERIAL :
SOURCE OF
MATERIAL: Boring No.:TP-2 Depth: 2' - 4'

DATE : 12/11/97

LAB. NO.: 97-1017
JOB NO. : 195039-1
DATE RCVD: 12/01/97
SAMPLED BY: J. Cowell

WEIGHT OF SAMPLE = 102.49 (grams) SOIL PASSING #10 SIEVE = 71.40 %

SPECIFIC GRAVITY OF SOIL SAMPLE = 2.890

ELAPSED TIME (MIN)	TIME	TEMP. (oC)	CORR.(K) USING (TAB. 3)	HYDROMETER READING (WATER)	HYDROMETER READING (W/SOIL)	CORR. READING	EFFECTIVE DEPTH (cms)	PARTICLE SIZE (mm)	PERCENT FINER IN SUSPENSION
0	START 11:15 AM	21.7	0.01396	1.00375	1.00525	1.00150	14.9	0.038	1.6
2	11:17 AM	21.7	0.01396	1.00375	1.005	1.00125	15.0	0.024	1.3
5	11:20 AM	21.7	0.01396	1.00375	1.00475	1.00100	15.0	0.014	1.1
15	11:30 AM	21.7	0.01396	1.00375	1.00425	1.00050	15.2	0.010	0.5
30	11:45 AM	21.7	0.01396	1.00375	1.00425	1.00050	15.2	0.007	0.5
60	12:15 PM	21.7	0.01396	1.00375	1.00425	1.00050	15.2	0.003	0.5
250	02:25 PM	22.2	0.01396	1.00375	1.00425	1.00050	15.2	0.001	0.5
12/11/97 1440	11:15 AM	20.0	0.01396	1.00375	1.00425	1.00050	15.2	0.001	0.5

Reviewed By:
Input By: AO

Respectfully Submitted:
Robert Rivera
Laboratory Supervisor

DMJM/Hydro/97-1017Geo

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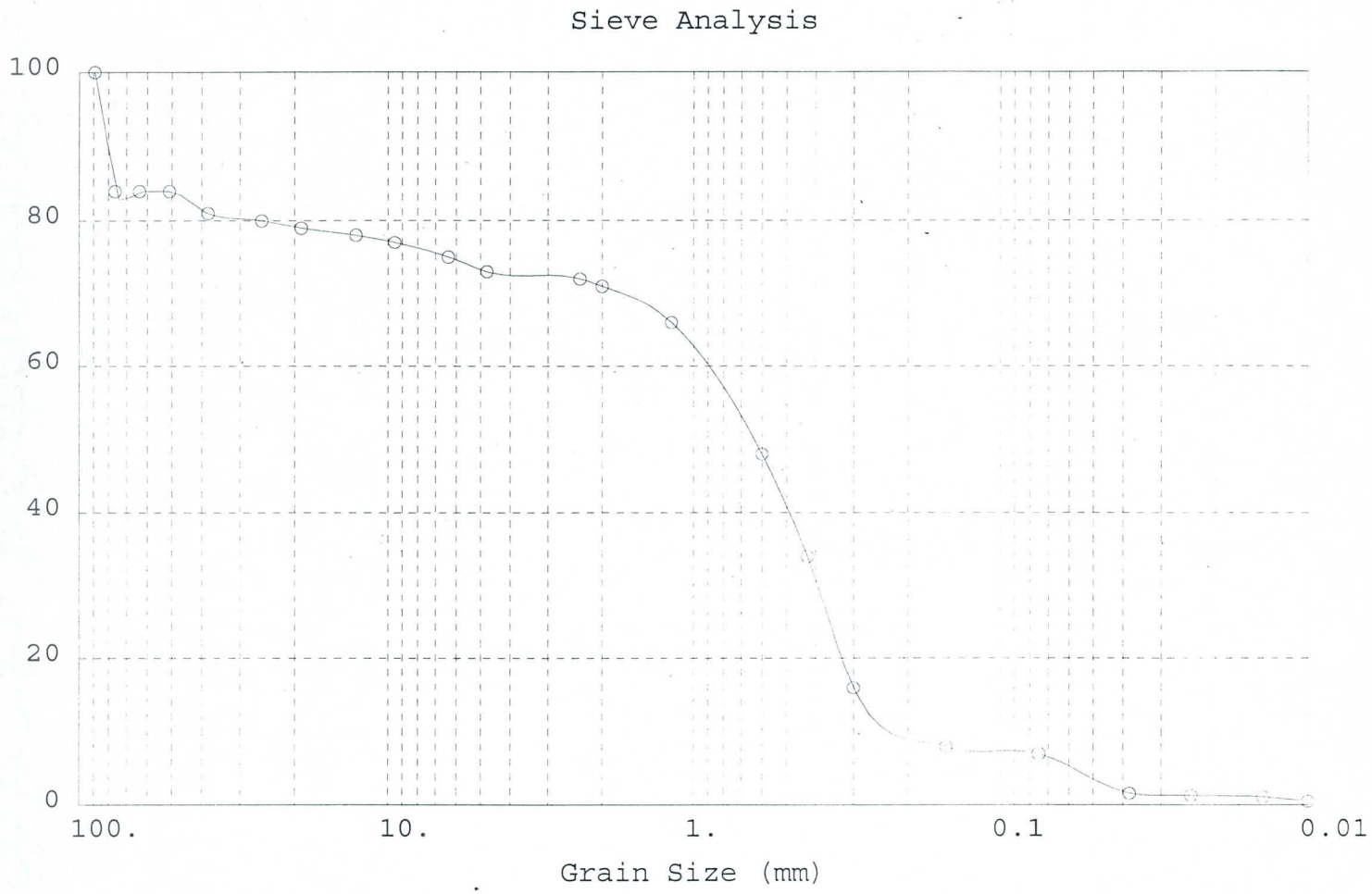
Sieve Analysis
100
80
60
40
20
0
Percent Finer
100.
10.
1.
0.1
0.01
Grain Size (mm)

Project Number = 195039-1 Client: DMJM
Location = Camelback Ranch Levee Design-Add'l Investigation
Date = 12/10/97
Tested By = M. Blalock
Boring Number = TP-3
Depth = 0 - 2'
Sample Number = 97-1018
Description = Gray-tan, well graded GRAVEL(GW) with sand
Dry Sample Weight (g) = 1000

SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
5"	127.000	0.00	0.00	0.00	100.00
4"	101.600	0.00	0.00	0.00	100.00
3 1/2"	88.900	190.00	19.00	19.00	81.00
3"	76.200	0.00	0.00	19.00	81.00
2 1/2"	63.500	0.00	0.00	19.00	81.00
2"	50.800	40.00	4.00	23.00	77.00
1 1/2"	38.100	30.00	3.00	26.00	74.00
1"	25.400	70.00	7.00	33.00	67.00
3/4"	19.050	50.00	5.00	38.00	62.00
1/2"	12.700	80.00	8.00	46.00	54.00
3/8"	9.500	40.00	4.00	50.00	50.00
1/4"	6.350	50.00	5.00	55.00	45.00
#4	4.750	30.00	3.00	58.00	42.00
#8	2.360	90.00	9.00	67.00	33.00
#10	2.000	20.00	2.00	69.00	31.00
#16	1.180	70.00	7.00	76.00	24.00
#30	0.600	120.00	12.00	88.00	12.00
#40	0.425	50.00	5.00	93.00	7.00
#50	0.300	30.00	3.00	96.00	4.00
#100	0.150	10.00	1.00	97.00	3.00
#200	0.075	10.00	1.00	98.00	2.00
-	0.037	1.00	0.10	98.10	1.90
-	0.007	0.00	0.00	98.10	1.90
-	0.003	2.00	0.20	98.30	1.70
-	0.001	3.00	0.30	98.60	1.40
Pan	0.000	0.00	0.00	98.60	1.40

HYDROMETER ANALYSIS
(ASTM D422)

CLIENT : DMJM
300 W. Clarendon Ave.
Phoenix, AZ 85013

PROJECT : Additional Camelback Levee Design

MATERIAL :

SOURCE OF MATERIAL: Boring No.:TP-3 Depth: 0 - 2'

DATE : 12/10/97

LAB. NO.: 97-1018

JOB NO. : 195039-1

DATE RCVD: 12/01/97

SAMPLED BY: J. Cowell

WEIGHT OF SAMPLE = 100.45 (grams) SOIL PASSING #10 SIEVE = 30.10 %

SPECIFIC GRAVITY OF SOIL SAMPLE = 2.740

ELAPSED TIME (MIN)	TIME	TEMP. (oC)	CORR.(K) USING (TAB. 3)	HYDROMETER READING (WATER)	HYDROMETER READING (W/SOIL)	CORR. READING	EFFECTIVE DEPTH (cms)	PARTICLE SIZE (mm)	PERCENT FINER IN SUSPENSION
0	START 08:19 AM	20.0	0.01396	1.00375	1.00775	1.00400	14.2	0.037	1.9
2	08:21 AM	20.0	0.01396	1.00375	1.00775	1.00400	14.2	0.024	1.9
5	08:24 AM	20.0	0.01396	1.00375	1.00775	1.00400	14.2	0.014	1.9
15	08:34 AM	20.0	0.01396	1.00375	1.00775	1.00400	14.2	0.010	1.9
30	08:49 AM	20.0	0.01396	1.00375	1.00775	1.00400	14.2	0.007	1.9
60	09:19 AM	20.0	0.01396	1.00375	1.00725	1.00350	14.4	0.003	1.7
250	12:29 PM	20.6	0.01396	1.00375	1.00675	1.00300	14.5	0.001	1.4
12/10/97 1440	08:19 AM	17.7	0.01396	1.00375	1.00675	1.00300	14.5	0.001	1.4

Reviewed By:
Input By: AO

Respectfully Submitted:

Robert Rivera
Laboratory Supervisor

DMJM/Hydro/97-1018Geo

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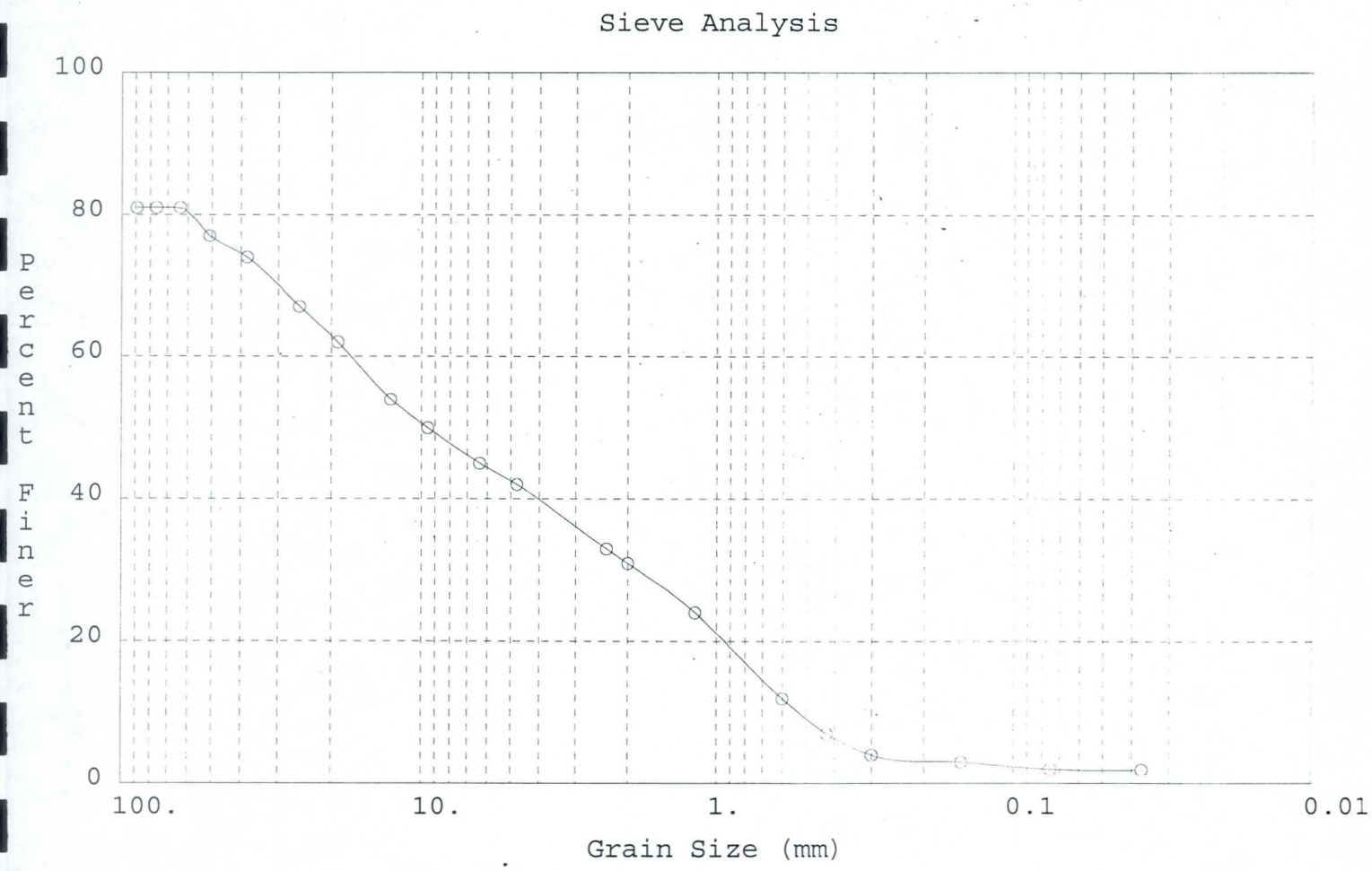
Sieve Analysis
100
80
60
40
20
0
Percent Finer
100.
10.
1.
0.1
0.01
Grain Size (mm)

Project Number = 195039-1 Client: DMJM
Location = Camelback Ranch Levee Design-Add'l Investigation
Date = 12/11/97
Tested By = D. Johnson
Boring Number = TP-3
Depth = 2' - 4'
Sample Number = 97-1019
Description = Brown, well graded SAND(SW-SM) with silt
Dry Sample Weight (g) = 1000

SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
2"	50.800	0.00	0.00	0.00	100.00
1 1/2"	38.100	20.00	2.00	2.00	98.00
1"	25.400	10.00	1.00	3.00	97.00
3/4"	19.050	10.00	1.00	4.00	96.00
1/2"	12.700	10.00	1.00	5.00	95.00
3/8"	9.500	0.00	0.00	5.00	95.00
1/4"	6.350	10.00	1.00	6.00	94.00
#4	4.750	10.00	1.00	7.00	93.00
#8	2.360	20.00	2.00	9.00	91.00
#10	2.000	10.00	1.00.	10.00	90.00
#16	1.180	50.00	5.00	15.00	85.00
#30	0.600	180.00	18.00	33.00	67.00
#40	0.425	150.00	15.00	48.00	52.00
#50	0.300	190.00	19.00	67.00	33.00
#100	0.150	190.00	19.00	86.00	14.00
#200	0.075	40.00	4.00	90.00	10.00
-	0.036	7.00	0.70	90.70	9.30
-	0.007	0.00	0.00	90.70	9.30
-	0.003	8.00	0.80	91.50	8.50
-	0.001	10.00	1.00	92.50	7.50
Pan	0.000	0.00	0.00	92.50	7.50

HYDROMETER ANALYSIS
(ASTM D422)

CLIENT : DMJM
300 W. Clarendon Ave.
Phoenix, AZ 85013

PROJECT : Additional Camelback Levee Design

MATERIAL :

SOURCE OF MATERIAL: Boring No.:TP-3 Depth: 2' - 4'

DATE : 12/10/97

LAB. NO.: 97-1019

JOB NO. : 195039-1

DATE RCVD: 12/01/97

SAMPLED BY: J. Cowell

WEIGHT OF SAMPLE = 100.85 (grams) SOIL PASSING #10 SIEVE = 89.80 %

SPECIFIC GRAVITY OF SOIL SAMPLE = 2.671

ELAPSED TIME (MIN)	TIME	TEMP. (oC)	CORR.(K) USING (TAB. 3)	HYDROMETER READING (WATER)	HYDROMETER READING (W/SOIL)	CORR. READING	EFFECTIVE DEPTH (cms)	PARTICLE SIZE (mm)	PERCENT FINER IN SUSPENSION
0	START 08:34 AM	20.0	0.01396	1.00375	1.01025	1.00650	13.6	0.036	9.3
2	08:36 AM	20.0	0.01396	1.00375	1.01025	1.00650	13.6	0.023	9.3
5	08:39 AM	20.0	0.01396	1.00375	1.01025	1.00650	13.6	0.013	9.3
15	08:49 AM	20.0	0.01396	1.00375	1.01025	1.00650	13.6	0.009	9.3
30	09:04 AM	20.0	0.01396	1.00375	1.01025	1.00650	13.6	0.007	9.3
60	09:34 AM	20.0	0.01396	1.00375	1.00975	1.00600	13.7	0.003	8.5
250	12:44 PM	20.5	0.01396	1.00375	1.00925	1.00550	13.8	0.001	7.8
12/10/97 1440	08:34 AM	20.0	0.01396	1.00375	1.00900	1.00525	13.9	0.001	7.5

Reviewed By:
Input By: AO

Respectfully Submitted:

Robert Rivera
Laboratory Supervisor

DMJM/Hydro/97-1019Geo

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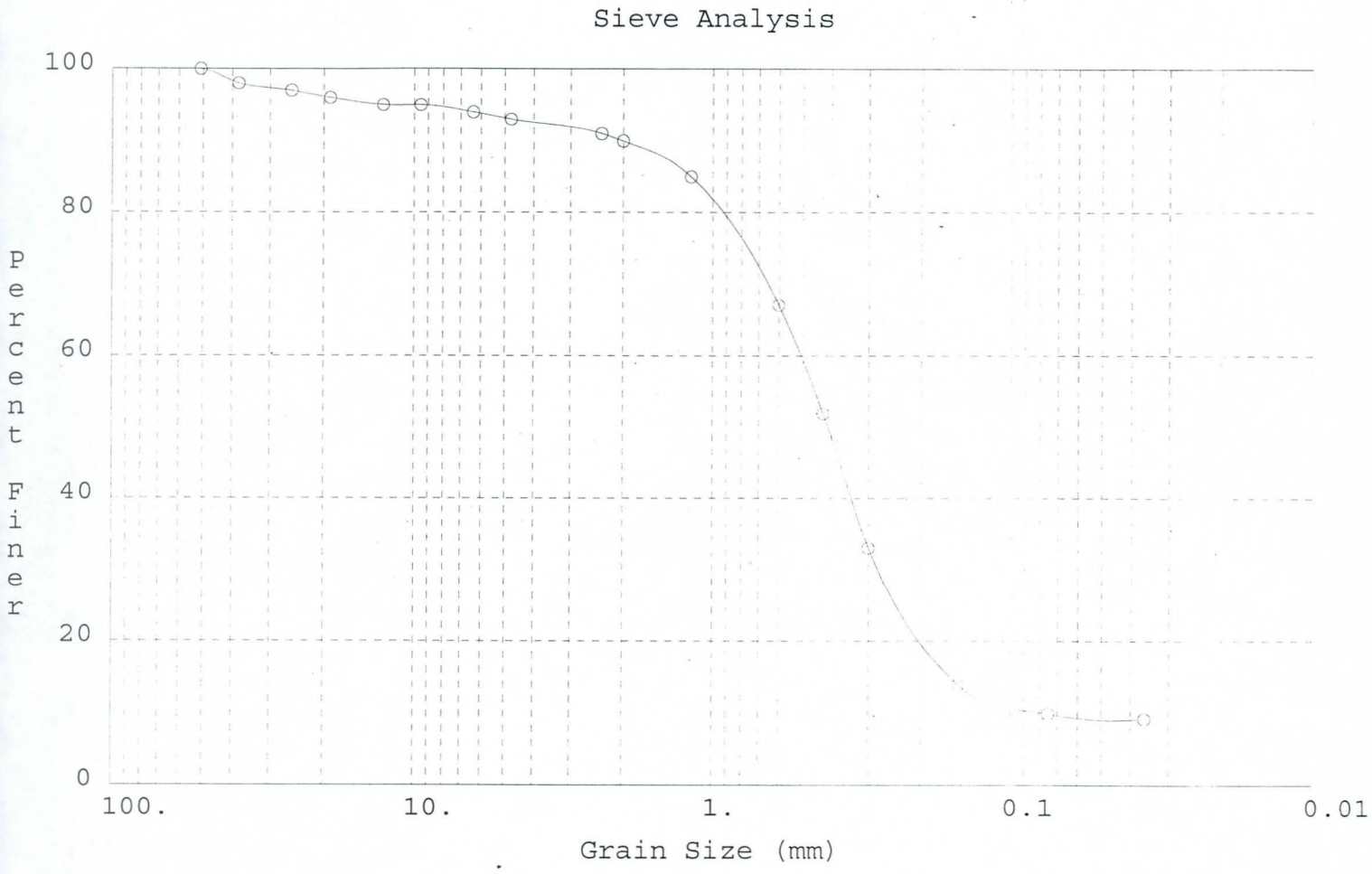
Sieve Analysis
100
80
60
40
20
0
Percent Finer
100.
10.
1.
0.1
0.01
Grain Size (mm)

Project Number = 195039-1 Client: DMJM
Location = Camelback Ranch Levee Design-Add'l Investigation
Date = 12/5/97
Tested By = D. Johnson
Boring Number = TP-4
Depth = 0 - 2'
Sample Number = 97-1020
Description = Gray-tan, well graded SAND(SW-SM) with silt and gravel
Dry Sample Weight (g) = 1000

SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
3 1/2"	88.900	0.00	0.00	0.00	100.00
3"	76.200	0.00	0.00	0.00	100.00
2 1/2"	63.500	70.00	7.00	7.00	93.00
2"	50.800	20.00	2.00	9.00	91.00
1 1/2"	38.100	40.00	4.00	13.00	87.00
1"	25.400	60.00	6.00	19.00	81.00
3/4"	19.050	60.00	6.00	25.00	75.00
1/2"	12.700	40.00	4.00	29.00	71.00
3/8"	9.500	30.00	3.00	32.00	68.00
1/4"	6.350	30.00	3.00	35.00	65.00
#4	4.750	20.00	2.00	37.00	63.00
#8	2.360	50.00	5.00	42.00	58.00
#10	2.000	20.00	2.00	44.00	56.00
#16	1.180	70.00	7.00	51.00	49.00
#30	0.600	160.00	16.00	67.00	33.00
#40	0.425	90.00	9.00	76.00	24.00
#50	0.300	70.00	7.00	83.00	17.00
#100	0.150	80.00	8.00	91.00	9.00
#200	0.075	20.00	2.00	93.00	7.00
-	0.036	9.00	0.90	93.90	6.10
-	0.023	5.00	0.50	94.40	5.60
-	0.013	8.00	0.80	95.20	4.80
-	0.010	5.00	0.50	95.70	4.30
-	0.007	4.00	0.40	96.10	3.90
-	0.003	9.00	0.90	97.00	3.00
-	0.001	4.00	0.40	97.40	2.60
Pan	0.000	0.00	0.00	97.40	2.60

HYDROMETER ANALYSIS
(ASTM D422)

CLIENT : DMJM
300 W. Clarendon Ave.
Phoenix, AZ 85013

PROJECT : Additional Camelback Levee Design

MATERIAL :

SOURCE OF MATERIAL: Boring No.:TP-4 Depth: 0 - 2'

DATE : 12/05/97

LAB. NO.: 97-1020

JOB NO. : 195039-1

DATE RCVD: 12/01/97

SAMPLED BY: J. Cowell

WEIGHT OF SAMPLE = 103.34 (grams) SOIL PASSING #10 SIEVE = 56.30 %

SPECIFIC GRAVITY OF SOIL SAMPLE = 2.680

ELAPSED TIME (MIN)	TIME	TEMP. (oC)	CORR.(K) USING (TAB. 3)	HYDROMETER READING (WATER)	HYDROMETER READING (W/SOIL)	CORR. READING	EFFECTIVE DEPTH (cms)	PARTICLE SIZE (mm)	PERCENT FINER IN SUSPENSION
0	START 09:00 AM	20.0	0.01396	1.00325	1.01025	1.00700	13.6	0.036	6.1
2	09:02 AM	20.0	0.01396	1.00325	1.00975	1.00650	13.7	0.023	5.6
5	09:05 AM	20.0	0.01396	1.00325	1.00875	1.00550	14.0	0.013	4.8
15	09:15 AM	20.0	0.01396	1.00325	1.00825	1.00500	14.1	0.010	4.3
30	09:30 AM	20.0	0.01396	1.00325	1.00775	1.00450	14.2	0.007	3.9
60	10:00 AM	20.0	0.01396	1.00325	1.00675	1.00350	14.5	0.003	3.0
250	01:10 PM	20.0	0.01396	1.00325	1.00625	1.00300	14.6	0.001	2.6
12/05/97 1440	09:00 AM	17.7	0.01396	1.00325	1.00625	1.00300	14.6	0.001	2.6

Reviewed By:
Input By: AO

Respectfully Submitted:

Robert Rivera
Laboratory Supervisor

DMJM/Hydro/97-1020Geo

ATL, INC.
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GEOTECHNICAL CONSULTANTS

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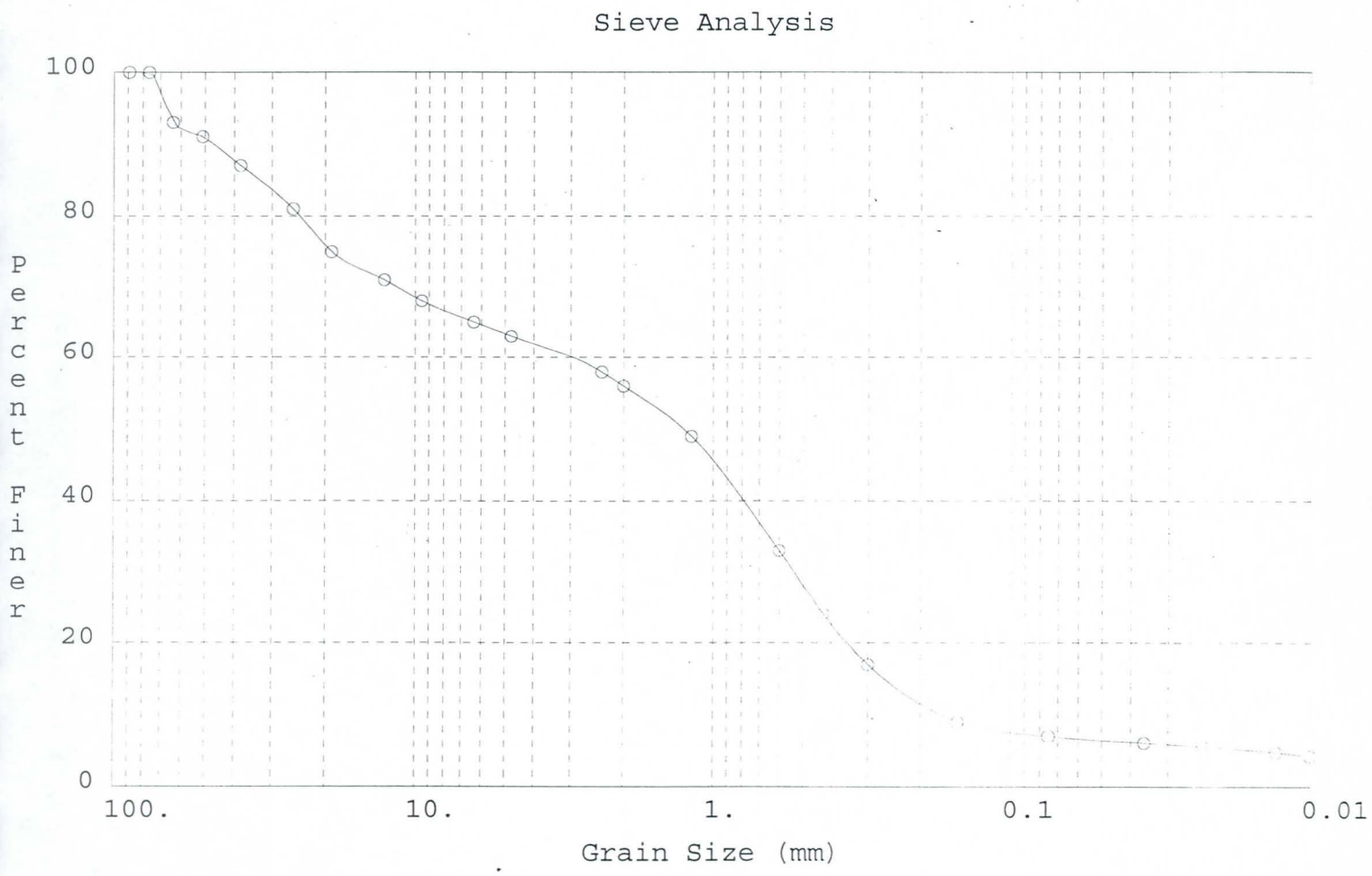
Sieve Analysis
100
80
60
40
20
0
Percent Finer
100.
10.
1.
0.1
0.01
Grain Size (mm)

Project Number = 195039-1 Client: DMJM
Location = Camelback Ranch Levee Design-Add'l Investigation
Date = 12/11/97
Tested By = M. Blalock
Boring Number = TP-4
Depth = 2' - 4'
Sample Number = 97-1021
Description = Gray-tan, well graded SAND(SW) with gravel
Dry Sample Weight (g) = 1000

SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
3 1/2"	88.900	0.00	0.00	0.00	100.00
3"	76.200	60.00	6.00	6.00	94.00
2 1/2"	63.500	0.00	0.00	6.00	94.00
2"	50.800	60.00	6.00	12.00	88.00
1 1/2"	38.100	60.00	6.00	18.00	82.00
1"	25.400	50.00	5.00	23.00	77.00
3/4"	19.050	30.00	3.00	26.00	74.00
1/2"	12.700	50.00	5.00	31.00	69.00
3/8"	9.500	20.00	2.00	33.00	67.00
1/4"	6.350	40.00	4.00	37.00	63.00
#4	4.750	20.00	2.00	39.00	61.00
#8	2.360	90.00	9.00	48.00	52.00
#10	2.000	20.00	2.00	50.00	50.00
#16	1.180	90.00	9.00	59.00	41.00
#30	0.600	130.00	13.00	72.00	28.00
#40	0.425	90.00	9.00	81.00	19.00
#50	0.300	80.00	8.00	89.00	11.00
#100	0.150	70.00	7.00	96.00	4.00
#200	0.075	10.00	1.00	97.00	3.00
-	0.037	3.00	0.30	97.30	2.70
-	0.024	4.00	0.40	97.70	2.30
-	0.003	0.00	0.00	97.70	2.30
-	0.001	8.00	0.80	98.50	1.50
Pan	0.000	0.00	0.00	98.50	1.50

HYDROMETER ANALYSIS
(ASTM D422)

CLIENT : DMJM
300 W. Clarendon Ave.
Phoenix, AZ 85013

PROJECT : Additional Camelback Levee Design

MATERIAL :

SOURCE OF MATERIAL: Boring No.:TP-4 Depth: 2' - 4'

DATE : 12/11/97

LAB. NO.: 97-1021

JOB NO. : 195039-1

DATE RCVD: 12/01/97

SAMPLED BY: J. Cowell

WEIGHT OF SAMPLE = 103.55 (grams) SOIL PASSING #10 SIEVE = 49.90 %

SPECIFIC GRAVITY OF SOIL SAMPLE = 2.696

ELAPSED TIME (MIN)	TIME	TEMP. (oC)	CORR.(K) USING (TAB. 3)	HYDROMETER READING (WATER)	HYDROMETER READING (W/SOIL)	CORR. READING	EFFECTIVE DEPTH (cms)	PARTICLE SIZE (mm)	PERCENT FINER IN SUSPENSION
0	START 10:54 AM	18.8	0.01396	1.00375	1.00725	1.00350	14.4	0.037	2.7
2	10:56 AM	18.8	0.01396	1.00375	1.00675	1.00300	14.5	0.024	2.3
5	10:59 AM	18.8	0.01396	1.00375	1.00675	1.00300	14.5	0.014	2.3
15	11:09 AM	18.8	0.01396	1.00375	1.00675	1.00300	14.5	0.010	2.3
30	11:24 AM	18.8	0.01396	1.00375	1.00675	1.00300	14.5	0.007	2.3
60	11:51 AM	18.8	0.01396	1.00375	1.00675	1.00300	14.5	0.003	2.3
250	03:04 PM	20.0	0.01396	1.00375	1.00600	1.00225	14.7	0.001	1.7
12/11/97 1440	10:54 AM	20.5	0.01396	1.00375	1.00575	1.00200	14.8	0.001	1.5

Reviewed By:
Input By: AO

Respectfully Submitted:

Robert Rivera
Laboratory Supervisor

DMJM/Hydro/97-1021Geo

ATL, INC.
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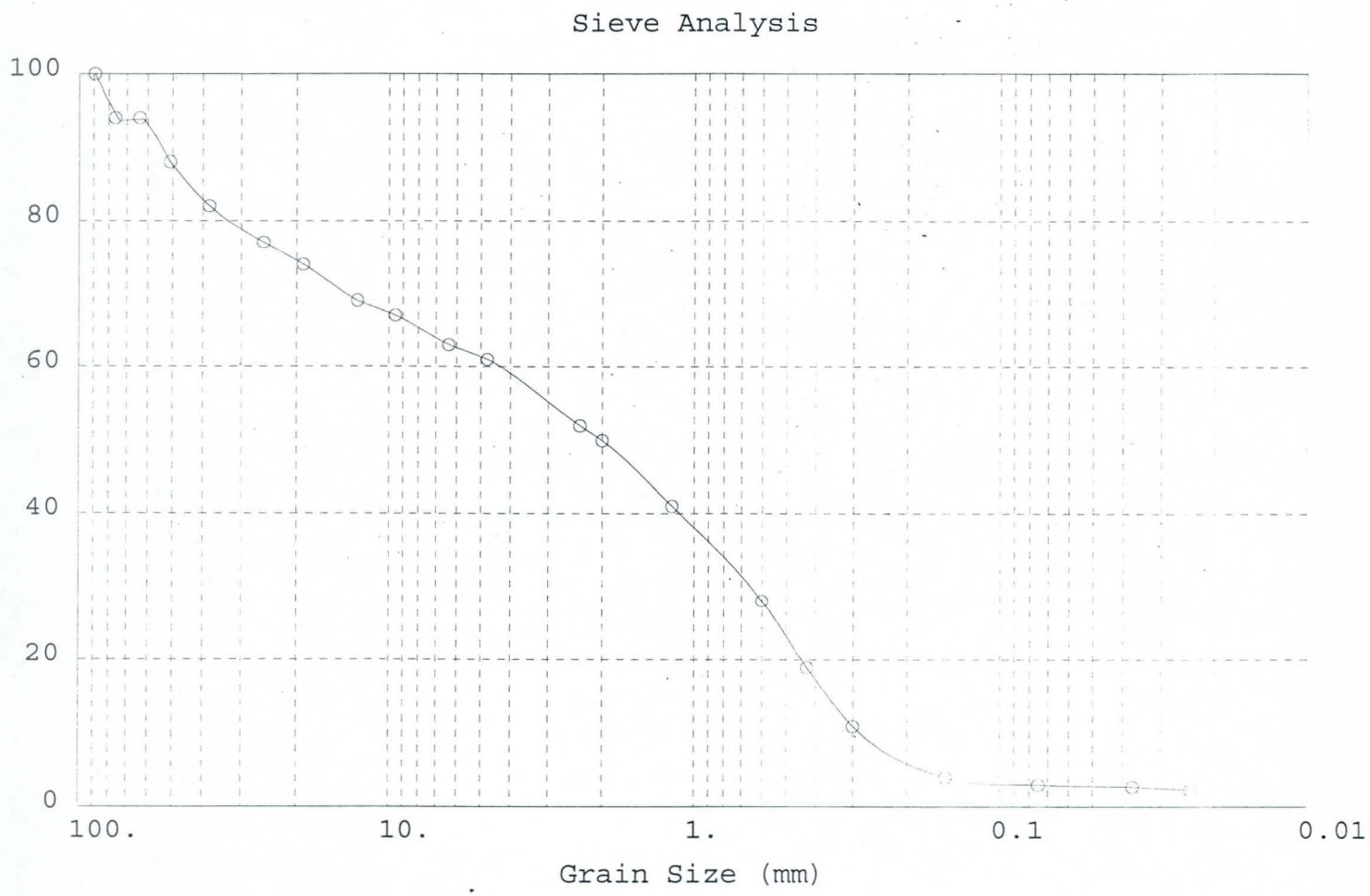
Sieve Analysis
100
80
60
40
20
0
Percent Finer
100.
10.
1.
0.1
0.01
Grain Size (mm)

Project Number = 195039-1 Client: DMJM
Location = Camelback Ranch Levee Design-Add'l Investigation
Date = 12/5/97
Tested By = D. Johnson
Boring Number = TP-5
Depth = 0 - 2'
Sample Number = 97-1022
Description = Tan, well graded SAND(SW) with gravel
Dry Sample Weight (g) = 1000

SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
3 1/2"	88.900	0.00	0.00	0.00	100.00
3"	76.200	0.00	0.00	0.00	100.00
2 1/2"	63.500	0.00	0.00	0.00	100.00
2"	50.800	100.00	10.00	10.00	90.00
1 1/2"	38.100	20.00	2.00	12.00	88.00
1"	25.400	50.00	5.00	17.00	83.00
3/4"	19.050	100.00	10.00	27.00	73.00
1/2"	12.700	30.00	3.00	30.00	70.00
3/8"	9.500	20.00	2.00	32.00	68.00
1/4"	6.350	20.00	2.00.	34.00	66.00
#4	4.750	10.00	1.00	35.00	65.00
#8	2.360	10.00	1.00	36.00	64.00
#10	2.000	20.00	2.00	38.00	62.00
#16	1.180	80.00	8.00	46.00	54.00
#30	0.600	150.00	15.00	61.00	39.00
#40	0.425	100.00	10.00	71.00	29.00
#50	0.300	100.00	10.00	81.00	19.00
#100	0.150	130.00	13.00	94.00	6.00
#200	0.075	20.00	2.00	96.00	4.00
-	0.024	8.00	0.80	96.80	3.20
-	0.014	3.00	0.30	97.10	2.90
-	0.007	2.00	0.20	97.30	2.70
-	0.003	2.00	0.20	97.50	2.50
-	0.001	5.00	0.50	98.00	2.00
Pan	0.000	0.00	0.00	98.00	2.00

HYDROMETER ANALYSIS
(ASTM D422)

CLIENT : DMJM
300 W. Clarendon Ave.
Phoenix, AZ 85013

PROJECT : Additional Camelback Levee Design
MATERIAL :
SOURCE OF
MATERIAL: Boring No.:TP-5 Depth: 0 - 2'

DATE : 12/05/97

LAB. NO.: 97-1022
JOB NO. : 195039-1
DATE RCVD: 12/01/97
SAMPLED BY: J. Cowell

WEIGHT OF SAMPLE = 102.40 (grams) SOIL PASSING #10 SIEVE = 62.50 %

SPECIFIC GRAVITY OF SOIL SAMPLE = 2.642

ELAPSED TIME (MIN)	TIME	TEMP. (oC)	CORR.(K) USING (TAB. 3)	HYDROMETER READING (WATER)	HYDROMETER READING (W/SOIL)	CORR. READING	EFFECTIVE DEPTH (cms)	PARTICLE SIZE (mm)	PERCENT FINER IN SUSPENSION
0	START 09:52 AM	20.0	0.01396	1.00325	1.00775	1.00450	14.2	0.037	4.4
2	09:54 AM	20.0	0.01396	1.00325	1.0065	1.00325	14.6	0.024	3.2
5	09:57 AM	20.0	0.01396	1.00325	1.00625	1.00300	14.6	0.014	2.9
15	10:07 AM	20.0	0.01396	1.00325	1.00625	1.00300	14.6	0.010	2.9
30	10:22 AM	20.0	0.01396	1.00325	1.00600	1.00275	14.7	0.007	2.7
60	10:52 AM	20.0	0.01396	1.00325	1.00575	1.00250	14.8	0.003	2.5
250	02:02 PM	20.5	0.01396	1.00325	1.00575	1.00250	14.8	0.001	2.5
12/05/97 1440	09:52 AM	18.3	0.01396	1.00325	1.00525	1.00200	14.9	0.001	2.0

Reviewed By:
Input By: AO

Respectfully Submitted:

Robert Rivera
Laboratory Supervisor

DMJM/Hydro/97-1022Geo

ATL, INC.
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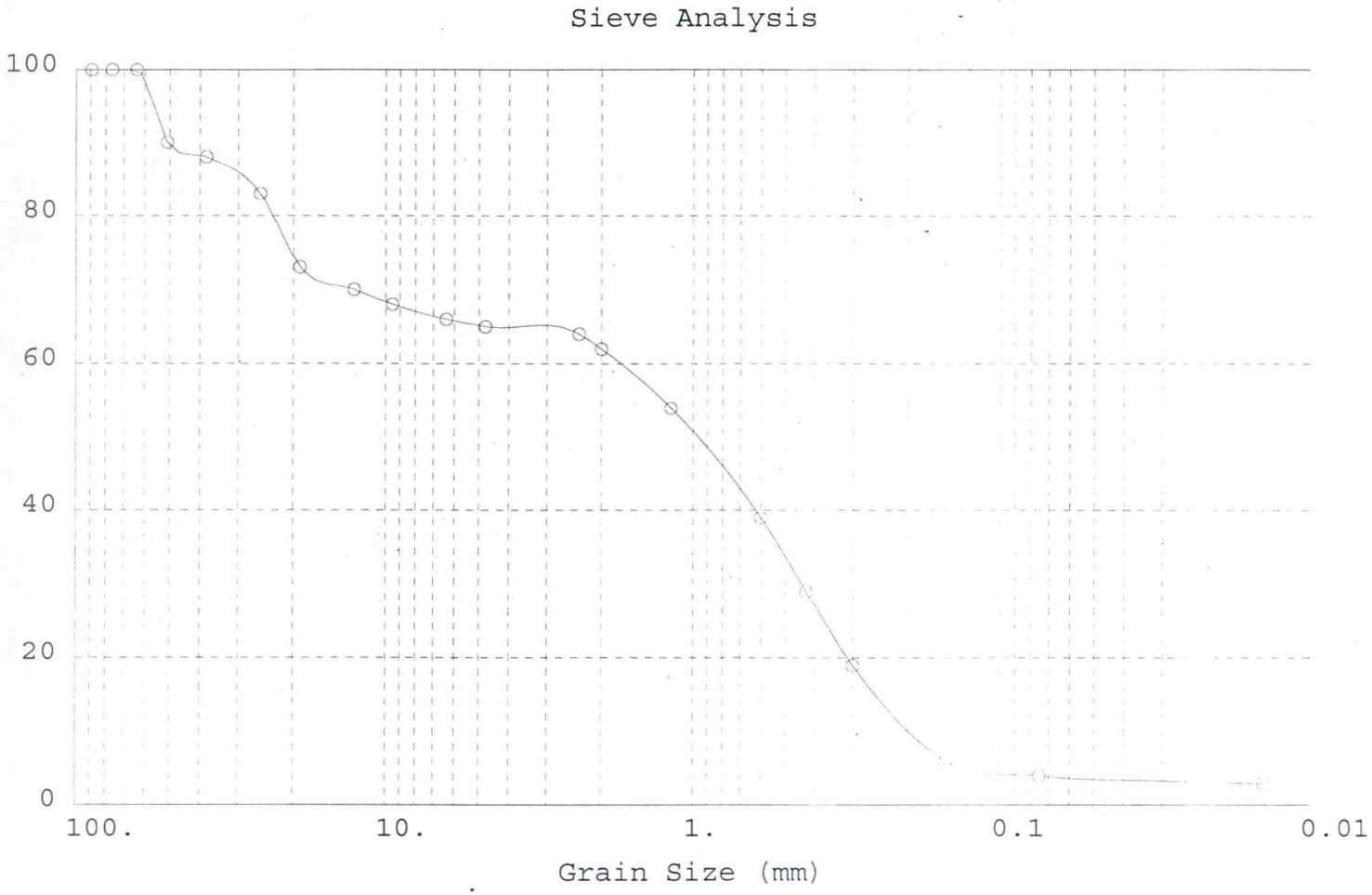
Sieve Analysis
100
80
60
40
20
0
Percent Finer
100.
10.
1.
0.1
0.01
Grain Size (mm)

Project Number = 195039-1 Client: DMJM
Location = Camelback Ranch Levee Design-Add'l Investigation
Date = 12/10/97
Tested By = M. Blalock
Boring Number = TP-5
Depth = 2' - 4'
Sample Number = 97-1023
Description = Brown, well graded GRAVEL(GW) with sand
Dry Sample Weight (g) = 1000

SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
3 1/2"	88.900	0.00	0.00	0.00	100.00
3"	76.200	100.00	10.00	10.00	90.00
2 1/2"	63.500	160.00	16.00	26.00	74.00
2"	50.800	100.00	10.00	36.00	64.00
1 1/2"	38.100	90.00	9.00	45.00	55.00
1"	25.400	100.00	10.00	55.00	45.00
3/4"	19.050	60.00	6.00	61.00	39.00
1/2"	12.700	80.00	8.00	69.00	31.00
3/8"	9.500	30.00	3.00	72.00	28.00
1/4"	6.350	30.00	3.00	75.00	25.00
#4	4.750	20.00	2.00	77.00	23.00
#8	2.360	40.00	4.00	81.00	19.00
#10	2.000	10.00	1.00	82.00	18.00
#16	1.180	20.00	2.00	84.00	16.00
#30	0.600	50.00	5.00	89.00	11.00
#40	0.425	20.00	2.00	91.00	9.00
#50	0.300	20.00	2.00	93.00	7.00
#100	0.150	10.00	1.00	94.00	6.00
#200	0.075	10.00	1.00	95.00	5.00
-	0.034	15.00	1.50	96.50	3.50
-	0.022	9.00	0.90	97.40	2.60
-	0.013	3.00	0.30	97.70	2.30
-	0.009	1.00	0.10	97.80	2.20
-	0.007	3.00	0.30	98.10	1.90
-	0.003	1.00	0.10	98.20	1.80
-	0.001	4.00	0.40	98.60	1.40
Pan	0.000	0.00	0.00	98.60	1.40

ATL, INC.
CONSTRUCTION QUALITY CONTROL
GEOTECHNICAL CONSULTANTS

HYDROMETER ANALYSIS
(ASTM D422)

CLIENT : DMJM
300 W. Clarendon Ave.
Phoenix, AZ 85013

PROJECT : Additional Camelback Levee Design
MATERIAL :
SOURCE OF
MATERIAL: Boring No.:TP-5 Depth: 2' - 4'

DATE : 12/10/97
LAB. NO.: 97-1023
JOB NO. : 195039-1
DATE RCVD: 12/01/97
SAMPLED BY: J. Cowell

WEIGHT OF SAMPLE = 101.85 (grams) SOIL PASSING #10 SIEVE = 18.10 %

SPECIFIC GRAVITY OF SOIL SAMPLE = 2.874

ELAPSED TIME (MIN)	TIME	TEMP. (oC)	CORR.(K) USING (TAB. 3)	HYDROMETER READING (WATER)	HYDROMETER READING (W/SOIL)	CORR. READING	EFFECTIVE DEPTH (cms)	PARTICLE SIZE (mm)	PERCENT FINER IN SUSPENSION
0	START 09:06 AM	20.0	0.01396	1.00375	1.01675	1.01300	11.9	0.034	3.5
2	09:08 AM	20.0	0.01396	1.00375	1.01325	1.00950	12.8	0.022	2.6
5	09:11 AM	20.0	0.01396	1.00375	1.01225	1.00850	13.1	0.013	2.3
15	09:21 AM	20.0	0.01396	1.00375	1.01175	1.00800	13.2	0.009	2.2
30	09:36 AM	20.0	0.01396	1.00375	1.01075	1.00700	13.5	0.007	1.9
60	10:06 AM	20.0	0.01396	1.00375	1.01025	1.00650	13.6	0.003	1.8
250	01:16 PM	20.5	0.01396	1.00375	1.00975	1.00600	13.7	0.001	1.6
12/10/97 1440	09:06 AM	18.3	0.01396	1.00375	1.00875	1.00500	14.0	0.001	1.4

Reviewed By:
Input By: AO

Respectfully Submitted:

Robert Rivera
Laboratory Supervisor

DMJM/Hydro/97-1023Geo

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Fax (520) 773-9522

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Globe, AZ 85502
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Fax (520) 425-9597

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Cottonwood, AZ 86326
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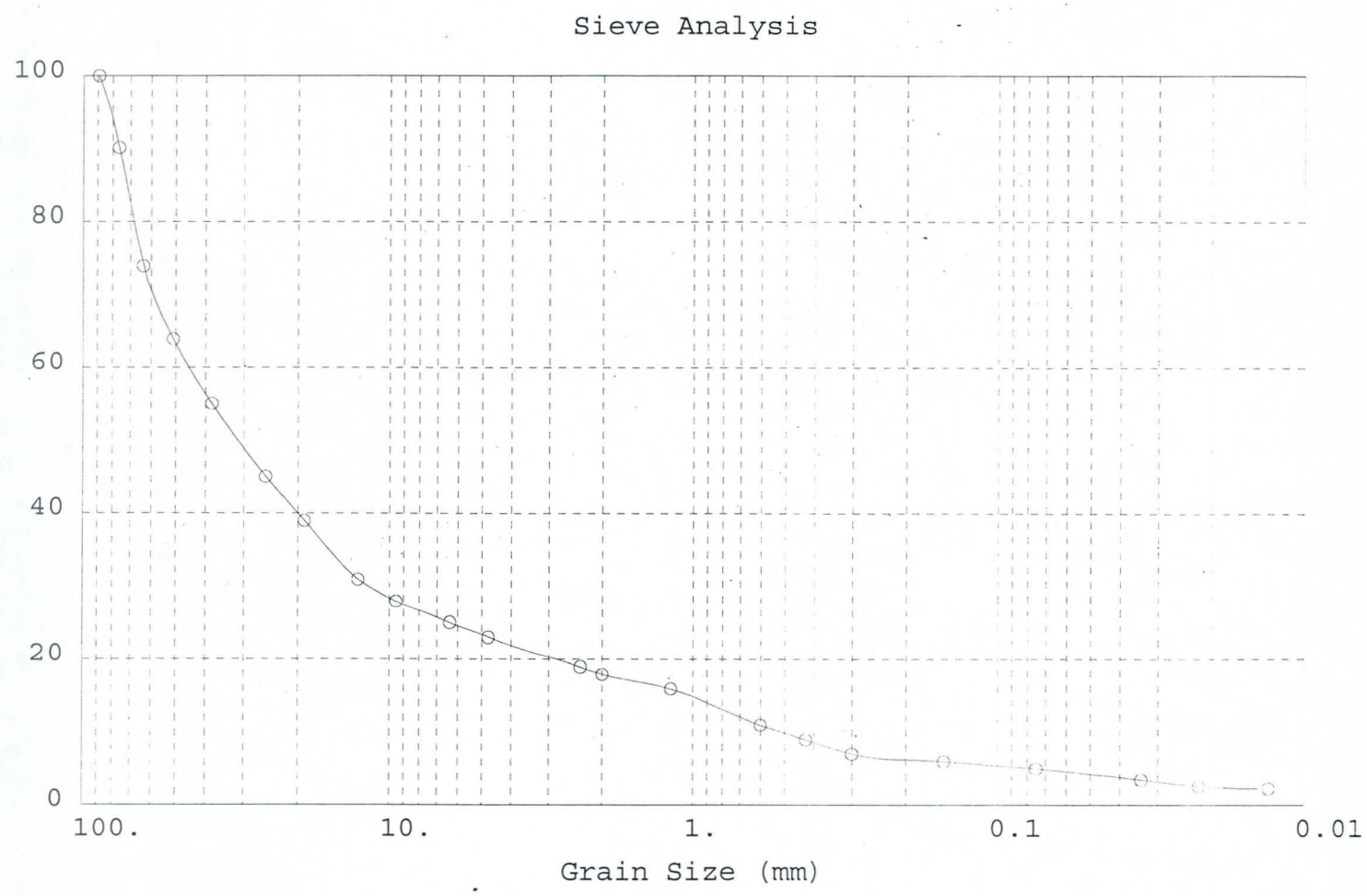
Sieve Analysis
100
80
60
40
20
0
Percent Finer
100.
10.
1.
0.1
0.01
Grain Size (mm)

Project Number = 195039-1 Client: DMJM
Location = Camelback Ranch Levee Design-Add'l Investigation
Date = 12/11/97
Tested By = D. Johnson
Boring Number = TP-6
Depth = 0 - 2'
Sample Number = 97-1024
Description = Gray-tan, well graded GRAVEL(GW) with sand
Dry Sample Weight (g) = 1000

SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
4"	101.600	0.00	0.00	0.00	100.00
3 1/2"	88.900	70.00	7.00	7.00	93.00
3"	76.200	60.00	6.00	13.00	87.00
2 1/2"	63.500	80.00	8.00	21.00	79.00
2"	50.800	70.00	7.00	28.00	72.00
1 1/2"	38.100	90.00	9.00	37.00	63.00
1"	25.400	120.00	12.00	49.00	51.00
3/4"	19.050	60.00	6.00	55.00	45.00
1/2"	12.700	70.00	7.00	62.00	38.00
3/8"	9.500	30.00	3.00	65.00	35.00
1/4"	6.350	30.00	3.00	68.00	32.00
#4	4.750	10.00	1.00	69.00	31.00
#8	2.360	50.00	5.00	74.00	26.00
#10	2.000	10.00	1.00	75.00	25.00
#16	1.180	50.00	5.00	80.00	20.00
#30	0.600	90.00	9.00	89.00	11.00
#40	0.425	30.00	3.00	92.00	8.00
#50	0.300	10.00	1.00	93.00	7.00
#100	0.150	30.00	3.00	96.00	4.00
#200	0.075	10.00	1.00	97.00	3.00
-	0.036	3.00	0.30	97.30	2.70
-	0.023	2.00	0.20	97.50	2.50
-	0.013	2.00	0.20	97.70	2.30
-	0.010	4.00	0.40	98.10	1.90
-	0.003	3.00	0.30	98.40	1.60
-	0.001	4.00	0.40	98.80	1.20
Pan	0.000	0.00	0.00	98.80	1.20

HYDROMETER ANALYSIS
(ASTM D422)

CLIENT : DMJM
300 W. Clarendon Ave.
Phoenix, AZ 85013

PROJECT : Additional Camelback Levee Design
MATERIAL :
SOURCE OF
MATERIAL: Boring No.:TP-6 Depth: 0 - 2'

DATE : 12/10/97

LAB. NO.: 97-1024
JOB NO. : 195039-1
DATE RCVD: 12/01/97
SAMPLED BY: J. Cowell

WEIGHT OF SAMPLE = 100.95 (grams) SOIL PASSING #10 SIEVE = 24.76 %

SPECIFIC GRAVITY OF SOIL SAMPLE = 2.697

ELAPSED TIME (MIN)	TIME	TEMP. (oC)	CORR.(K) USING (TAB. 3)	HYDROMETER READING (WATER)	HYDROMETER READING (W/SOIL)	CORR. READING	EFFECTIVE DEPTH (cms)	PARTICLE SIZE (mm)	PERCENT FINER IN SUSPENSION
0	START 09:58 AM	20.0	0.01396	1.00375	1.01075	1.00700	13.5	0.036	2.7
2	10:00 AM	20.0	0.01396	1.00375	1.01025	1.00650	13.6	0.023	2.5
5	10:03 AM	20.0	0.01396	1.00375	1.00975	1.00600	13.7	0.013	2.3
15	10:13 AM	20.0	0.01396	1.00375	1.00875	1.00500	14.0	0.010	1.9
30	10:28 AM	20.0	0.01396	1.00375	1.00850	1.00475	14.0	0.007	1.9
60	10:58 AM	20.0	0.01396	1.00375	1.00775	1.00400	14.2	0.003	1.6
250	02:08 PM	20.5	0.01396	1.00375	1.00675	1.00300	14.5	0.001	1.2
12/10/97 1440	09:58 AM	20.0	0.01396	1.00375	1.00675	1.00300	14.5	0.001	1.2

Reviewed By:
Input By: AO

Respectfully Submitted:

Robert Rivera
Laboratory Supervisor

DMJM/Hydro/97-1024Geo

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GEOTECHNICAL CONSULTANTS

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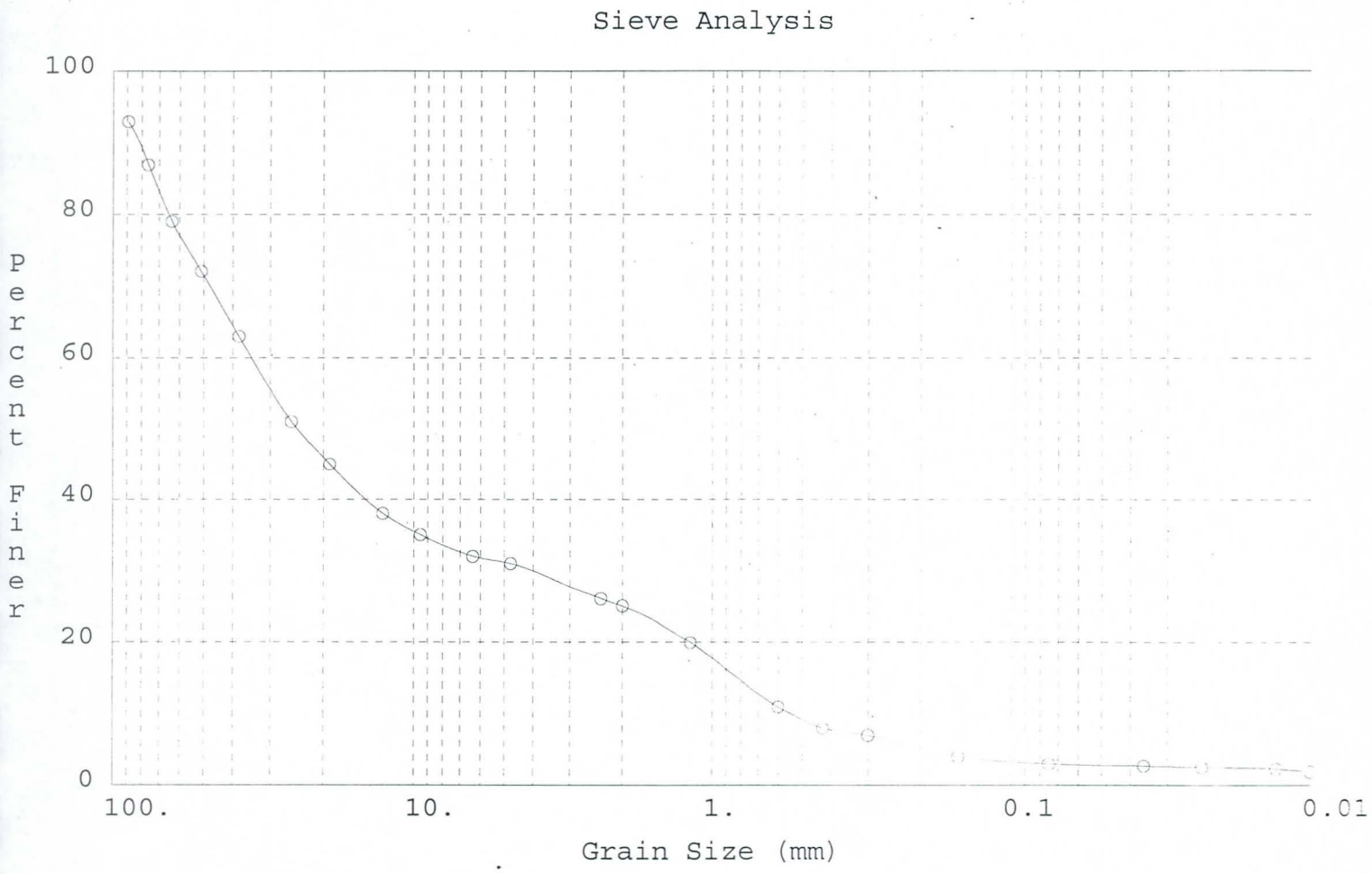
Sieve Analysis
100
80
60
40
20
0
Percent Finer
100.
10.
1.
0.1
0.01
Grain Size (mm)

Project Number = 195039-1 Client: DMJM
Location = Camelback Ranch Levee Design-Add'l Investigation
Date = 12/11/97
Tested By = D. Johnson
Boring Number = TP-6
Depth = 2' - 4'
Sample Number = 97-1025
Description = Tan, poorly graded SAND(SP)
Dry Sample Weight (g) = 1000

SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
3 1/2"	88.900	0.00	0.00	0.00	100.00
3"	76.200	0.00	0.00	0.00	100.00
2 1/2"	63.500	0.00	0.00	0.00	100.00
2"	50.800	0.00	0.00	0.00	100.00
1 1/2"	38.100	0.00	0.00	0.00	100.00
1"	25.400	0.00	0.00	0.00	100.00
3/4"	19.050	0.00	0.00	0.00	100.00
1/2"	12.700	0.00	0.00	0.00	100.00
3/8"	9.500	0.00	0.00	0.00	100.00
1/4"	6.350	0.00	0.00	0.00	100.00
#4	4.750	0.00	0.00	0.00	100.00
#8	2.360	10.00	1.00	1.00	99.00
#10	2.000	0.00	0.00	1.00	99.00
#16	1.180	10.00	1.00	2.00	98.00
#30	0.600	120.00	12.00	14.00	86.00
#40	0.425	250.00	25.00	39.00	61.00
#50	0.300	290.00	29.00	68.00	32.00
#100	0.150	250.00	25.00	93.00	7.00
#200	0.075	50.00	5.00	98.00	2.00
-	0.038	0.00	0.00	98.00	2.00
-	0.024	0.00	0.00	98.00	2.00
-	0.010	0.00	0.00	98.00	2.00
-	0.003	0.00	0.00	98.00	2.00
-	0.001	0.00	0.00	98.00	2.00
Pan	0.000	0.00	0.00	98.00	2.00

ATL, INC.
CONSTRUCTION QUALITY CONTROL
GEOTECHNICAL CONSULTANTS

HYDROMETER ANALYSIS
(ASTM D422)

CLIENT : DMJM
300 W. Clarendon Ave.
Phoenix, AZ 85013

PROJECT : Additional Camelback Levee Design

MATERIAL :

SOURCE OF MATERIAL: Boring No.:TP-6 Depth: 2' - 4'

DATE : 12/05/97

LAB. NO.: 97-1025

JOB NO. : 195039-1

DATE RCVD: 12/01/97

SAMPLED BY: J. Cowell

WEIGHT OF SAMPLE = 104.81 (grams) SOIL PASSING #10 SIEVE = 99.64 %

SPECIFIC GRAVITY OF SOIL SAMPLE = 2.671

ELAPSED TIME (MIN)	TIME	TEMP. (oC)	CORR.(K) USING (TAB. 3)	HYDROMETER READING (WATER)	HYDROMETER READING (W/SOIL)	CORR. READING	EFFECTIVE DEPTH (cms)	PARTICLE SIZE (mm)	PERCENT FINER IN SUSPENSION
0	START 10:17 AM	20.0	0.01396	1.00325	1.0055	1.00225	14.8	0.038	3.4
2	10:19 AM	20.0	0.01396	1.00325	1.00525	1.00200	14.9	0.024	3.0
5	10:22 AM	20.0	0.01396	1.00325	1.00525	1.00200	14.9	0.014	3.0
15	10:33 AM	20.0	0.01396	1.00325	1.00525	1.00200	14.9	0.010	3.0
30	10:47 AM	20.0	0.01396	1.00325	1.00525	1.00200	14.9	0.007	3.0
60	11:17 AM	20.0	0.01396	1.00325	1.00500	1.00175	15.0	0.003	2.7
250	02:27 PM	20.5	0.01396	1.00325	1.00475	1.00150	15.0	0.001	2.3
12/05/97 1440	10:17 AM	20.0	0.01396	1.00325	1.00475	1.00150	15.0	0.001	2.3

Reviewed By:
Input By: AO

Respectfully Submitted:

Robert Rivera
Laboratory Supervisor

DMJM/Hydro/97-1025Geo

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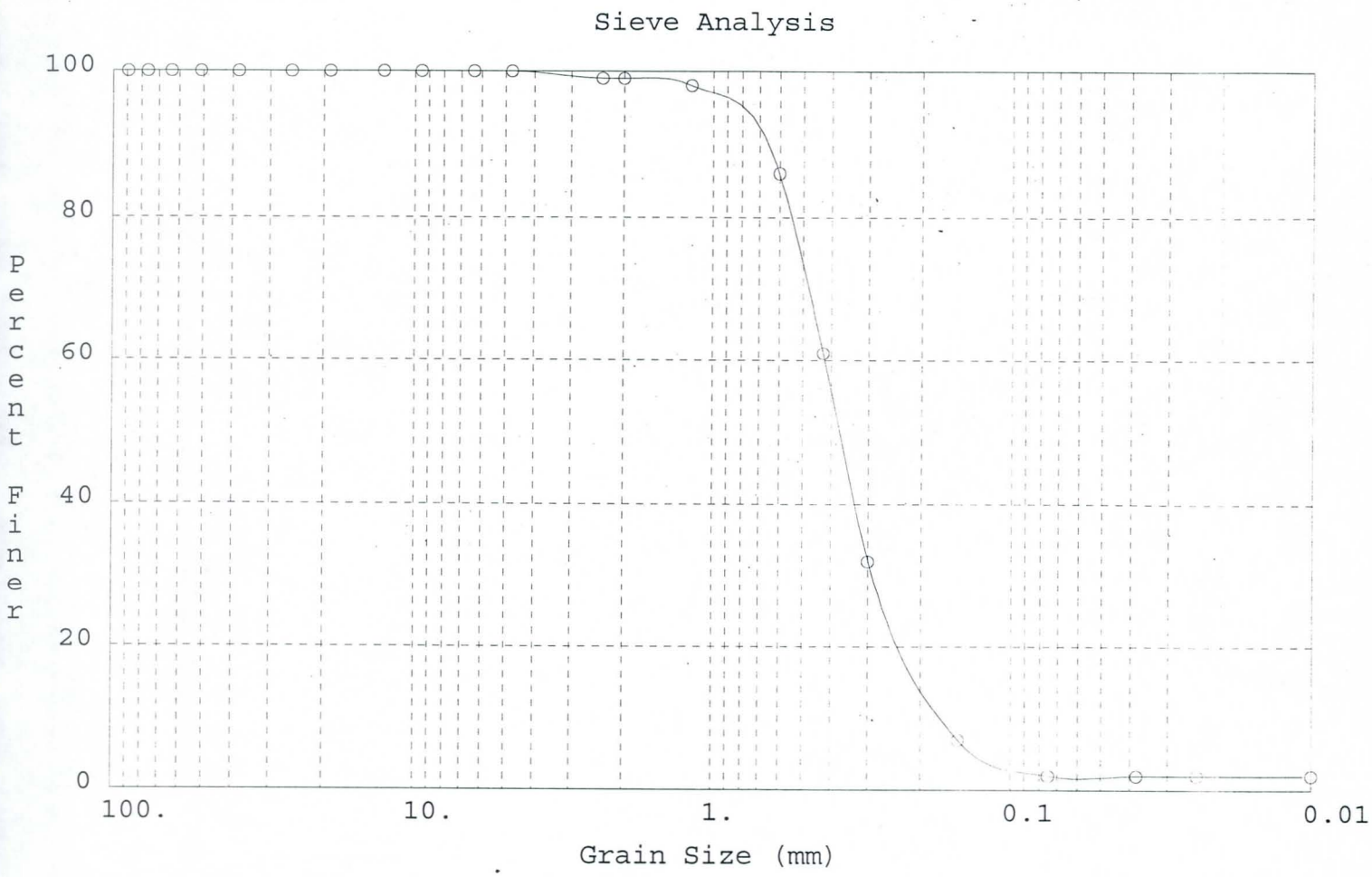
LAS VEGAS 3002-A Rigel Avenue Las Vegas, NV 89102 (702) 871-0492 Fax (702) 871-3643


Sieve Analysis
100
80
60
40
20
0
Percent Finer
100.
10.
1.
0.1
0.01
Grain Size (mm)

Project Number = 195039-1 Client: DMJM
Location = Camelback Ranch Levee Design-Add'l Investigation
Date = 12/5/97
Tested By = D. Johnson
Boring Number = TP-7
Depth = 0 - 2'
Sample Number = 97-1027
Description = Light brown, silty SAND(SM) with gravel
Dry Sample Weight (g) = 1000

SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
4"	101.600	0.00	0.00	0.00	100.00
3 1/2"	88.900	110.00	11.00	11.00	89.00
3"	76.200	0.00	0.00	11.00	89.00
2 1/2"	63.500	50.00	5.00	16.00	84.00
2"	50.800	0.00	0.00	16.00	84.00
1 1/2"	38.100	100.00	10.00	26.00	74.00
1"	25.400	50.00	5.00	31.00	69.00
3/4"	19.050	20.00	2.00	33.00	67.00
1/2"	12.700	40.00	4.00	37.00	63.00
3/8"	9.500	10.00	1.00	38.00	62.00
1/4"	6.350	30.00	3.00	41.00	59.00
#4	4.750	10.00	1.00	42.00	58.00
#8	2.360	30.00	3.00	45.00	55.00
#10	2.000	10.00	1.00	46.00	54.00
#16	1.180	30.00	3.00	49.00	51.00
#30	0.600	70.00	7.00	56.00	44.00
#40	0.425	90.00	9.00	65.00	35.00
#50	0.300	90.00	9.00	74.00	26.00
#100	0.150	60.00	6.00	80.00	20.00
#200	0.075	40.00	4.00	84.00	16.00
-	0.036	101.00	10.10	94.10	5.90
-	0.023	12.00	1.20	95.30	4.70
-	0.014	2.00	0.20	95.50	4.50
-	0.010	3.00	0.30	95.80	4.20
-	0.007	6.00	0.60	96.40	3.60
-	0.003	4.00	0.40	96.80	3.20
-	0.001	7.00	0.70	97.50	2.50
Pan	0.000	0.00	0.00	97.50	2.50

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HYDROMETER ANALYSIS
(ASTM D422)

CLIENT : DMJM
300 W. Clarendon Ave.
Phoenix, AZ 85013

PROJECT : Additional Camelback Levee Design

MATERIAL : Silty SAND(SM) with gravel

SOURCE OF MATERIAL: Boring No.:TP-7 Depth: 0 - 2'

DATE : 12/05/97

LAB. NO.: 97-1027

JOB NO. : 195039-1

DATE RCVD: 12/01/97

SAMPLED BY: J. Cowell

WEIGHT OF SAMPLE = 99.79 (grams) SOIL PASSING #10 SIEVE = 54.20 %

SPECIFIC GRAVITY OF SOIL SAMPLE = 2.781

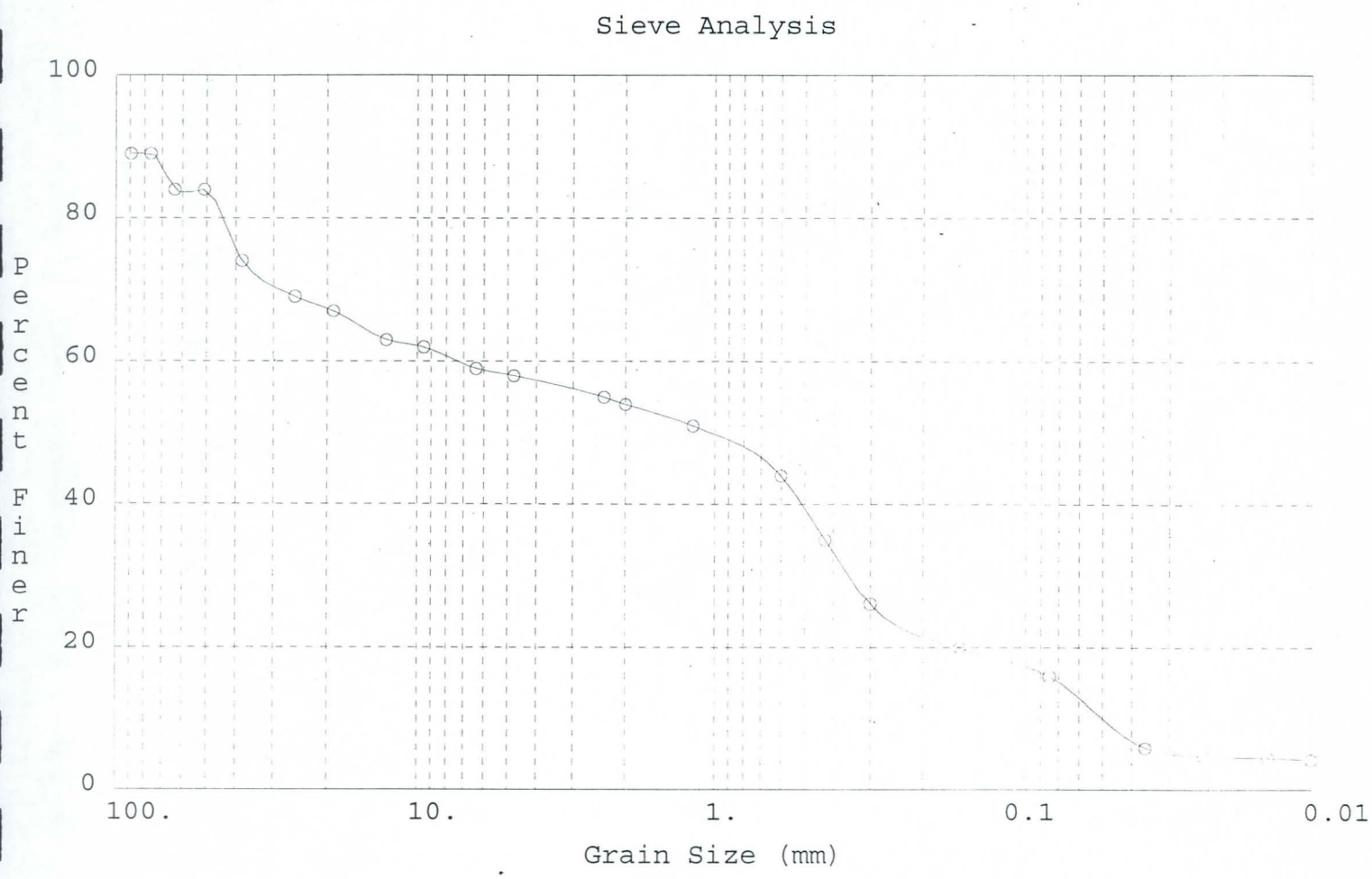
ELAPSED TIME (MIN)	TIME	TEMP. (oC)	CORR.(K) USING (TAB. 3)	HYDROMETER READING (WATER)	HYDROMETER READING (W/SOIL)	CORR. READING	EFFECTIVE DEPTH (cms)	PARTICLE SIZE (mm)	PERCENT FINER IN SUSPENSION
0	START 10:59 AM	20.0	0.01396	1.00325	1.01025	1.00700	13.6	0.036	5.9
2	11:01 AM	20.0	0.01396	1.00325	1.00875	1.00550	14.0	0.023	4.7
5	11:04 AM	20.0	0.01396	1.00325	1.00850	1.00525	14.0	0.014	4.5
15	11:14 AM	20.0	0.01396	1.00325	1.00825	1.00500	14.1	0.010	4.2
30	11:29 AM	20.0	0.01396	1.00325	1.00750	1.00425	14.3	0.007	3.6
60	11:59 AM	20.0	0.01396	1.00325	1.00700	1.00375	14.4	0.003	3.2
250	03:09 PM	20.5	0.01396	1.00325	1.00650	1.00325	14.6	0.001	2.8
12/05/97 1440	10:59 AM	18.3	0.01396	1.00325	1.00625	1.00300	14.6	0.001	2.5

Reviewed By:
Input By: AO

Respectfully Submitted:

Robert Rivera
Laboratory Supervisor

DMJM/Hydro/97-1027Geo


Sieve Analysis
100
80
60
40
20
0
Percent Finer
100.
10.
1.
0.1
0.01
Grain Size (mm)

Project Number = 195039-1 Client: DMJM
Location = Camelback Ranch Levee Design-Add'l Investigation
Date = 12/5/97
Tested By = D. Johnson
Boring Number = TP-7
Depth = 2'- 4'
Sample Number = 97-1028
Description = Brown, well graded GRAVEL(GW) with sand
Dry Sample Weight (g) = 1000

SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
3 1/2"	88.900	0.00	0.00	0.00	100.00
3"	76.200	70.00	7.00	7.00	93.00
2 1/2"	63.500	30.00	3.00	10.00	90.00
2"	50.800	60.00	6.00	16.00	84.00
1 1/2"	38.100	110.00	11.00	27.00	73.00
1"	25.400	200.00	20.00	47.00	53.00
3/4"	19.050	100.00	10.00	57.00	43.00
1/2"	12.700	90.00	9.00	66.00	34.00
3/8"	9.500	30.00	3.00	69.00	31.00
1/4"	6.350	40.00	4.00	73.00	27.00
#4	4.750	20.00	2.00	75.00	25.00
#8	2.360	50.00	5.00	80.00	20.00
#10	2.000	10.00	1.00	81.00	19.00
#16	1.180	50.00	5.00	86.00	14.00
#30	0.600	70.00	7.00	93.00	7.00
#40	0.425	10.00	1.00	94.00	6.00
#50	0.300	20.00	2.00	96.00	4.00
#100	0.150	10.00	1.00	97.00	3.00
#200	0.075	10.00	1.00	98.00	2.00
-	0.037	7.00	0.70	98.70	1.30
-	0.024	1.00	0.10	98.80	1.20
-	0.014	2.00	0.20	99.00	1.00
-	0.010	1.00	0.10	99.10	0.90
-	0.007	0.00	0.00	99.10	0.90
-	0.003	2.00	0.20	99.30	0.70
-	0.001	1.00	0.10	99.40	0.60
Pan	0.000	0.00	0.00	99.40	0.60

HYDROMETER ANALYSIS
(ASTM D422)

CLIENT : DMJM
300 W. Clarendon Ave.
Phoenix, AZ 85013

PROJECT : Additional Camelback Levee Design

MATERIAL :

SOURCE OF MATERIAL: Boring No.:TP-7 Depth: 2' - 4'

DATE : 12/05/97

LAB. NO.: 97-1026

JOB NO. : 195039-1

DATE RCVD: 12/01/97

SAMPLED BY: J. Cowell

WEIGHT OF SAMPLE = 104.00 (grams) SOIL PASSING #10 SIEVE = 19.10 %

SPECIFIC GRAVITY OF SOIL SAMPLE = 2.683

ELAPSED TIME (MIN)	TIME	TEMP. (oC)	CORR.(K) USING (TAB. 3)	HYDROMETER READING (WATER)	HYDROMETER READING (W/SOIL)	CORR. READING	EFFECTIVE DEPTH (cms)	PARTICLE SIZE (mm)	PERCENT FINER IN SUSPENSION
0	START 11:43 AM	20.5	0.01396	1.00325	1.00775	1.00450	14.2	0.037	1.3
2	11:45 AM	20.5	0.01396	1.00325	1.00725	1.00400	14.4	0.024	1.2
5	11:48 AM	20.5	0.01396	1.00325	1.00675	1.00350	14.5	0.014	1.0
15	11:58 AM	20.5	0.01396	1.00325	1.00625	1.00300	14.6	0.010	0.9
30	12:13 PM	20.5	0.01396	1.00325	1.00625	1.00300	14.6	0.007	0.9
60	12:43 PM	20.5	0.01396	1.00325	1.00575	1.00250	14.8	0.003	0.7
250	03:53 PM	20.5	0.01396	1.00325	1.00525	1.00200	14.9	0.001	0.6
12/05/97 1440	11:43 AM	18.3	0.01396	1.00325	1.00525	1.00200	14.9	0.001	0.6

Reviewed By:
Input By: AO

Respectfully Submitted:

Robert Rivera
Laboratory Supervisor

DMJM/Hydro/97-1028Geo

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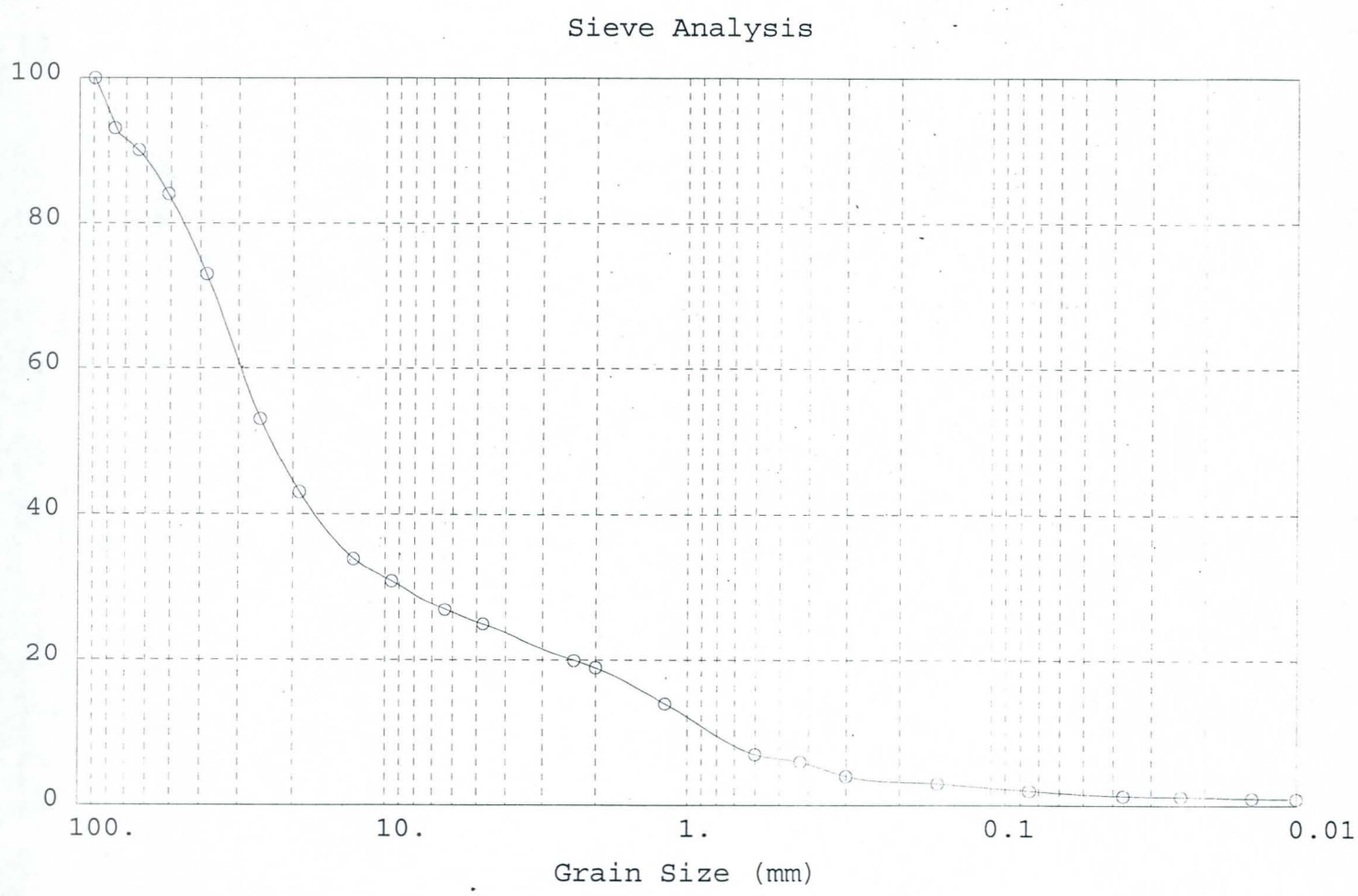
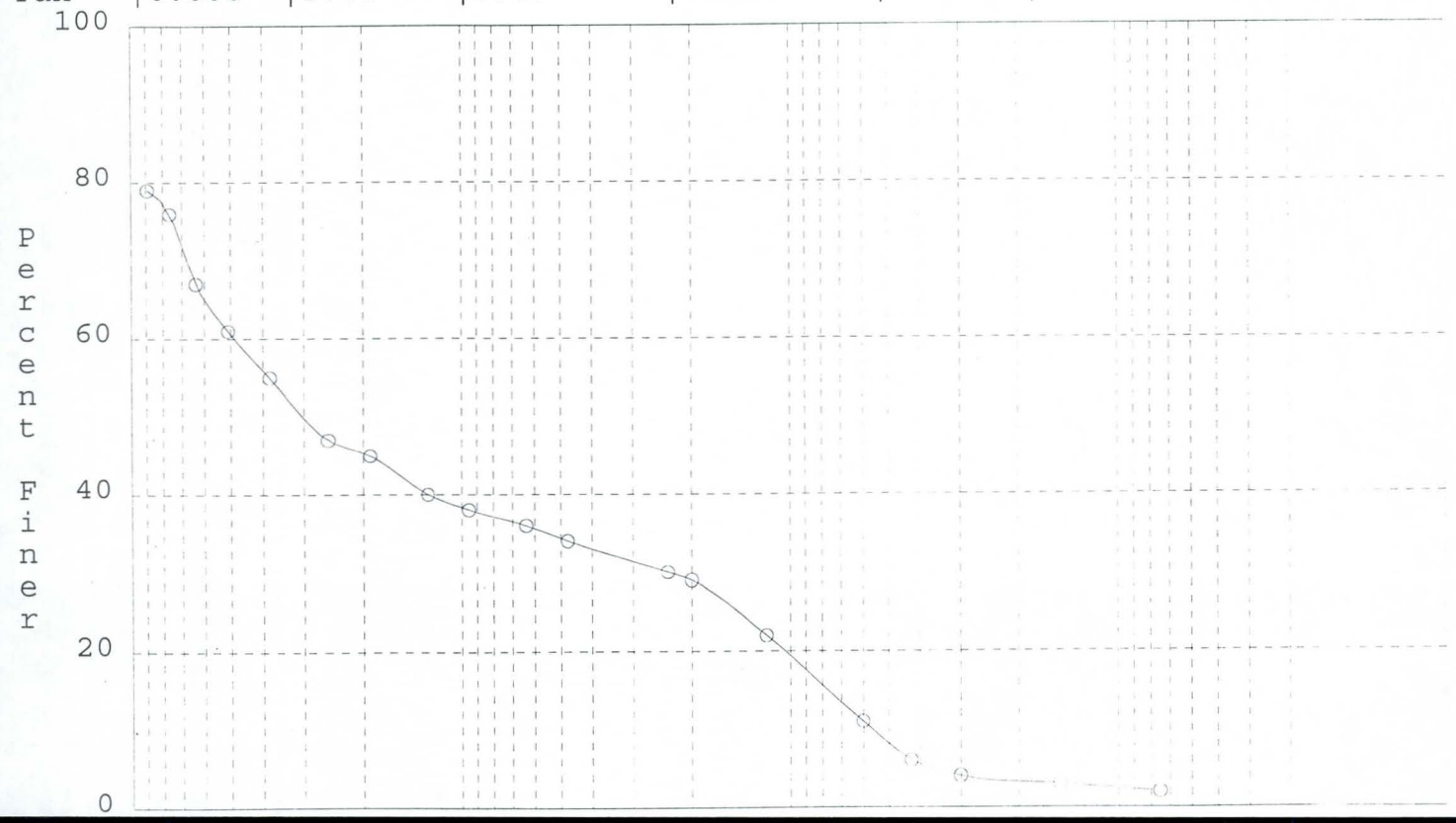

Sieve Analysis
100
80
60
40
20
0
Percent Finer
100.
10.
1.
0.1
0.01
Grain Size (mm)

Project Number = 195039-1 Client: DMJM
Location = Camelback Ranch Levee Design-Add'l Investigation
Date = 12/16/97
Tested By = M. Blalock
Boring Number = TP-7
Depth = 4' - 10'
Sample Number = 97-1085
Description = Brown, well graded GRAVEL(GW) with sand
Dry Sample Weight (g) = 1000

Sieve Analysis

SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
5 1/2"	139.700	0.00	0.00	0.00	100.00
5"	127.000	110.00	11.00	11.00	89.00
3 1/2"	88.900	100.00	10.00	21.00	79.00
3"	76.200	30.00	3.00	24.00	76.00
2 1/2"	63.500	90.00	9.00	33.00	67.00
2"	50.800	60.00	6.00	39.00	61.00
1 1/2"	38.100	60.00	6.00	45.00	55.00
1"	25.400	80.00	8.00	53.00	47.00
3/4"	19.050	20.00	2.00	55.00	45.00
1/2"	12.700	50.00	5.00	60.00	40.00
3/8"	9.500	20.00	2.00	62.00	38.00
1/4"	6.350	20.00	2.00	64.00	36.00
#4	4.750	20.00	2.00	66.00	34.00
#8	2.360	40.00	4.00	70.00	30.00
#10	2.000	10.00	1.00	71.00	29.00
#16	1.180	70.00	7.00	78.00	22.00
#30	0.600	110.00	11.00	89.00	11.00
#40	0.425	50.00	5.00	94.00	6.00
#50	0.300	20.00	2.00	96.00	4.00
#100	0.150	10.00	1.00	97.00	3.00
#200	0.075	10.00	1.00	98.00	2.00
Pan	0.000	0.00	0.00	98.00	2.00



Project Number = 195039-1 Client: DMJM
Location = Camelback Ranch Levee Design-Add'l Investigation
Date = 12/5/97
Tested By = D. Johnson
Boring Number = TP-8
Depth = 0 - 2'
Sample Number = 97-1029
Description = Brown, poorly graded GRAVEL(GP-GM) with silt and sand
Dry Sample Weight (g) = 1000

SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
3 1/2"	88.900	0.00	0.00	0.00	100.00
3"	76.200	200.00	20.00	20.00	80.00
2 1/2"	63.500	0.00	0.00	20.00	80.00
2"	50.800	140.00	14.00	34.00	66.00
1 1/2"	38.100	20.00	2.00	36.00	64.00
1"	25.400	70.00	7.00	43.00	57.00
3/4"	19.050	60.00	6.00	49.00	51.00
1/2"	12.700	60.00	6.00	55.00	45.00
3/8"	9.500	30.00	3.00	58.00	42.00
1/4"	6.350	30.00	3.00.	61.00	39.00
#4	4.750	110.00	11.00	72.00	28.00
#8	2.360	50.00	5.00	77.00	23.00
#10	2.000	10.00	1.00	78.00	22.00
#16	1.180	20.00	2.00	80.00	20.00
#30	0.600	40.00	4.00	84.00	16.00
#40	0.425	30.00	3.00	87.00	13.00
#50	0.300	20.00	2.00	89.00	11.00
#100	0.150	40.00	4.00	93.00	7.00
#200	0.075	20.00	2.00	95.00	5.00
-	0.034	11.00	1.10	96.10	3.90
-	0.022	2.00	0.20	96.30	3.70
-	0.013	2.00	0.20	96.50	3.50
-	0.009	5.00	0.50	97.00	3.00
-	0.007	3.00	0.30	97.30	2.70
-	0.003	3.00	0.30	97.60	2.40
-	0.001	5.00	0.50	98.10	1.90
Pan	0.000	0.00	0.00	98.10	1.90

HYDROMETER ANALYSIS
(ASTM D422)

CLIENT : DMJM
300 W. Clarendon Ave.
Phoenix, AZ 85013

PROJECT : Additional Camelback Levee Design

MATERIAL :

SOURCE OF MATERIAL: Boring No.:TP-8 Depth: 0 - 2'

DATE : 12/05/97

LAB. NO.: 97-1029

JOB NO. : 195039-1

DATE RCVD: 12/01/97

SAMPLED BY: J. Cowell

WEIGHT OF SAMPLE = 112.16 (grams) SOIL PASSING #10 SIEVE = 22.00 %

SPECIFIC GRAVITY OF SOIL SAMPLE = 2.657

ELAPSED TIME (MIN)	TIME	TEMP. (oC)	CORR.(K) USING (TAB. 3)	HYDROMETER READING (WATER)	HYDROMETER READING (W/SOIL)	CORR. READING	EFFECTIVE DEPTH (cms)	PARTICLE SIZE (mm)	PERCENT FINER IN SUSPENSION
0	START 11:22 AM	20.0	0.01396	1.00325	1.01575	1.01250	12.1	0.034	3.9
2	11:24 AM	20.0	0.01396	1.00325	1.015	1.01175	12.3	0.022	3.7
5	11:27 AM	20.0	0.01396	1.00325	1.01450	1.01125	12.5	0.013	3.5
15	11:37 AM	20.0	0.01396	1.00325	1.01275	1.00950	12.9	0.009	3.0
30	11:52 AM	20.0	0.01396	1.00325	1.01175	1.00850	13.2	0.007	2.7
60	12:22 PM	20.5	0.01396	1.00325	1.01075	1.00750	13.5	0.003	2.4
250	03:32 PM	20.5	0.01396	1.00325	1.01025	1.00700	13.6	0.001	2.2
12/05/97 1440	11:22 AM	18.3	0.01396	1.00325	1.00925	1.00600	13.8	0.001	1.9

Reviewed By:
Input By: AO

Respectfully Submitted:

Robert Rivera
Laboratory Supervisor

DMJM/Hydro/97-1029Geo

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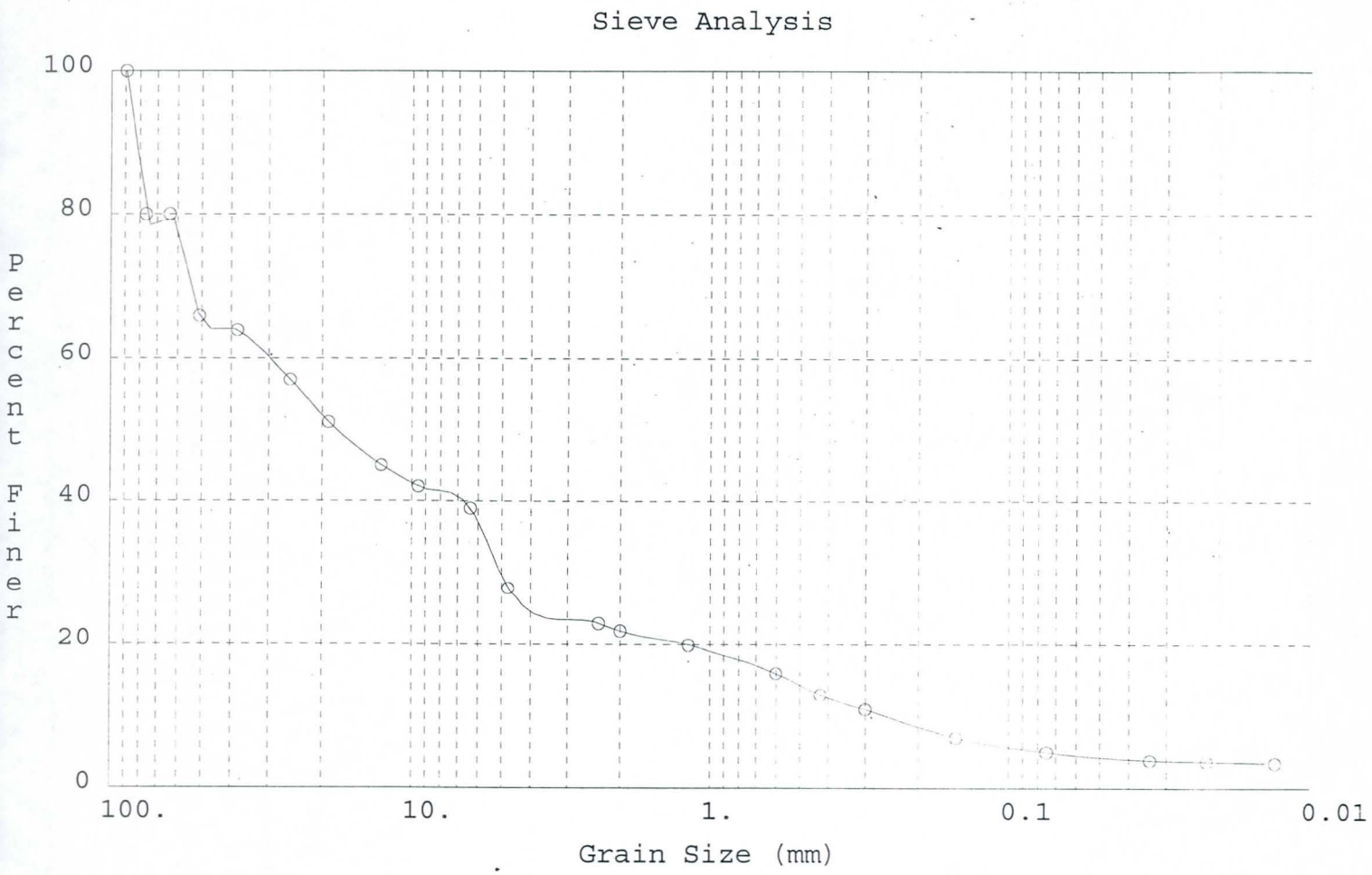
Sieve Analysis
100
80
60
40
20
0
Percent Finer
100.
10.
1.
0.1
0.01
Grain Size (mm)

Project Number = 195039-1 Client: DMJM
Location = Camelback Ranch Levee Design-Add'l Investigation
Date = 12/10/97
Tested By = D. Johnson
Boring Number = TP-8
Depth = 2' - 4'
Sample Number = 97-1030
Description = Brown, well graded GRAVEL(GW) with sand
Dry Sample Weight (g) = 1000

SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
3 1/2"	88.900	0.00	0.00	0.00	100.00
3"	76.200	70.00	7.00	7.00	93.00
2 1/2"	63.500	0.00	0.00	7.00	93.00
2"	50.800	120.00	12.00	19.00	81.00
1 1/2"	38.100	80.00	8.00	27.00	73.00
1"	25.400	80.00	8.00	35.00	65.00
3/4"	19.050	50.00	5.00	40.00	60.00
1/2"	12.700	110.00	11.00	51.00	49.00
3/8"	9.500	40.00	4.00	55.00	45.00
1/4"	6.350	50.00	5.00.	60.00	40.00
#4	4.750	30.00	3.00	63.00	37.00
#8	2.360	80.00	8.00	71.00	29.00
#10	2.000	20.00	2.00	73.00	27.00
#16	1.180	60.00	6.00	79.00	21.00
#30	0.600	90.00	9.00	88.00	12.00
#40	0.425	30.00	3.00	91.00	9.00
#50	0.300	20.00	2.00	93.00	7.00
#100	0.150	20.00	2.00	95.00	5.00
#200	0.075	10.00	1.00	96.00	4.00
-	0.036	2.00	0.20	96.20	3.80
-	0.023	2.00	0.20	96.40	3.60
-	0.007	2.00	0.20	96.60	3.40
-	0.001	4.00	0.40	97.00	3.00
Pan	0.000	0.00	0.00	97.00	3.00

HYDROMETER ANALYSIS
(ASTM D422)

CLIENT : DMJM
300 W. Clarendon Ave.
Phoenix, AZ 85013

PROJECT : Additional Camelback Levee Design

MATERIAL :

SOURCE OF MATERIAL: Boring No.:TP-8 Depth: 2' - 4'

DATE : 12/10/97

LAB. NO.: 97-1030

JOB NO. : 195039-1

DATE RCVD: 12/01/97

SAMPLED BY: J. Cowell

WEIGHT OF SAMPLE = 102.87 (grams) SOIL PASSING #10 SIEVE = 27.00 %

SPECIFIC GRAVITY OF SOIL SAMPLE = 2.406

ELAPSED TIME (MIN)	TIME	TEMP. (oC)	CORR.(K) USING (TAB. 3)	HYDROMETER READING (WATER)	HYDROMETER READING (W/SOIL)	CORR. READING	EFFECTIVE DEPTH (cms)	PARTICLE SIZE (mm)	PERCENT FINER IN SUSPENSION
0	START 10:16 AM	20.0	0.01396	1.00375	1.01225	1.00850	13.1	0.036	3.8
2	10:18 AM	20.0	0.01396	1.00375	1.01175	1.00800	13.2	0.023	3.6
5	10:21 AM	20.0	0.01396	1.00375	1.01175	1.00800	13.2	0.013	3.6
15	10:31 AM	20.0	0.01396	1.00375	1.01175	1.00800	13.2	0.009	3.6
30	10:46 AM	20.0	0.01396	1.00375	1.01125	1.00750	13.3	0.007	3.4
60	11:16 AM	20.0	0.01396	1.00375	1.01125	1.00750	13.3	0.003	3.4
250	02:26 PM	20.5	0.01396	1.00375	1.01050	1.00675	13.5	0.001	3.0
12/10/97 1440	10:16 AM	18.8	0.01396	1.00375	1.01050	1.00675	13.5	0.001	3.0

Reviewed By:
Input By: AO

Respectfully Submitted:

Robert Rivera
Laboratory Supervisor

DMJM/Hydro/97-1030Geo

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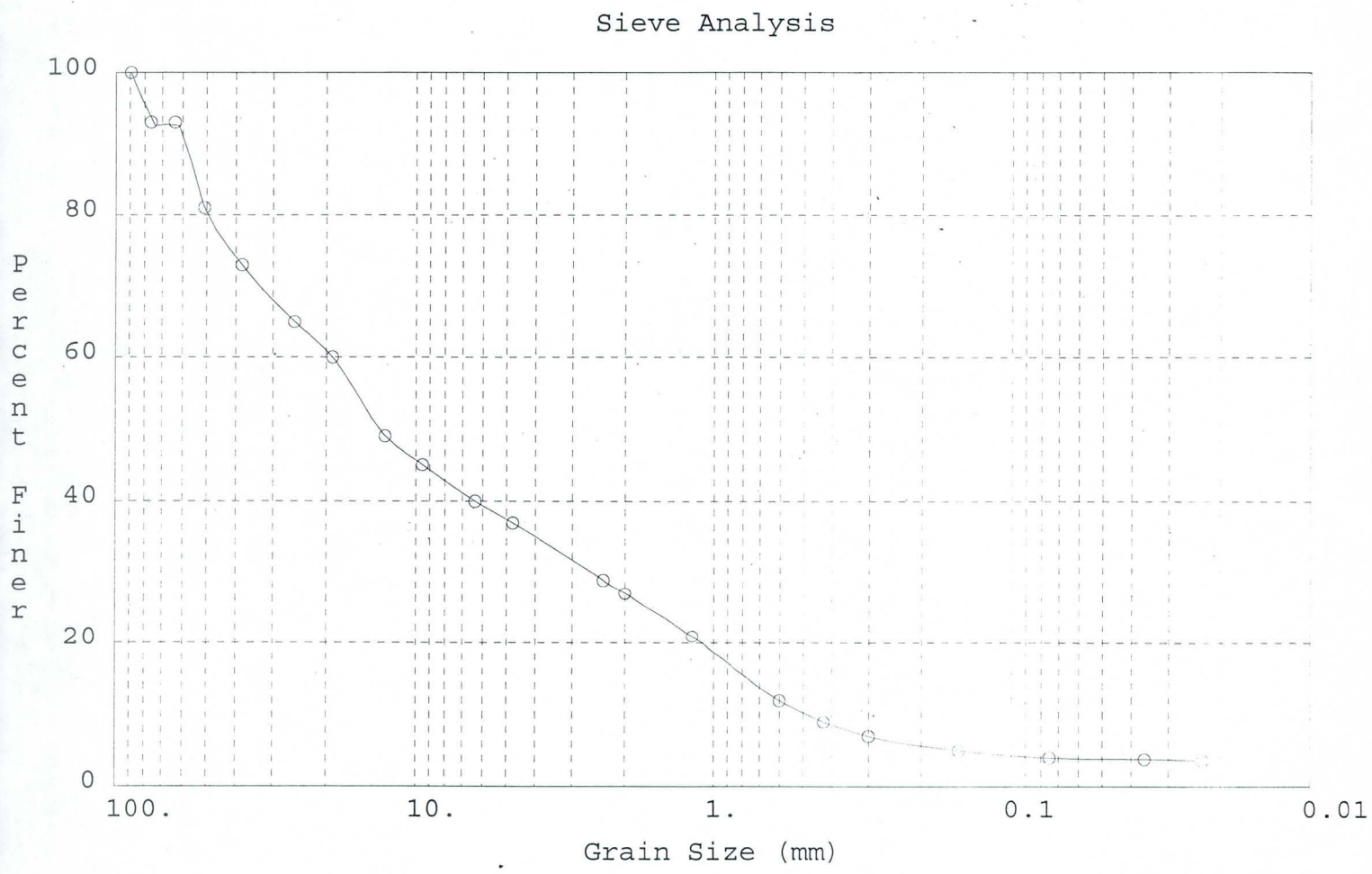
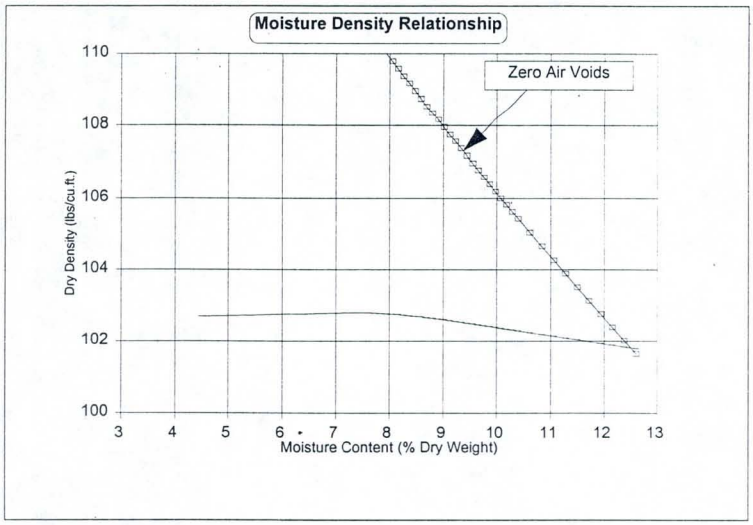

Sieve Analysis
100
80
60
40
20
0
Percent Finer
100.
10.
1.
0.1
0.01
Grain Size (mm)

ATL, INC.
CONSTRUCTION QUALITY CONTROL
GEOTECHNICAL CONSULTANTS

Summary of Moisture Density Relationship Tests

Client:	DMJM 300 W. Clarendon Ave., Phoenix, AZ 85013	**Job No.**	195039-1
		Lab No.	97-1007
		Type of Rammer:	Manual
		Test Date:	12/04/97
Project:	Additonal Camelback Ranch Levee Design	**Material Description:**	Gray-tan, poorly graded SAND (SP-SM) with silt
Test Designation:	ASTM D-698		
Test Method:	C	**Sample Source:**	Boring No.: 2 Depth: 0 - 12'



Specific Gravity Used For Zero Air Voids Curve: 2.05

Test No.	1	2	3	4
Dry Density (lbs/cu.ft.)	102.7	102.8	102.3	101.8
Moisture Content (%)	4.5	7.2	10.4	12.6

Maximum Dry Density (lbs/cu.ft.): **102.8**
Optimum Moisture Content (% of Dry Weight): **7.4**

Remarks:

Respectfully Submitted:

Robert Rivera
Laboratory Supervisor

Reviewed By:
Input By: AO

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ATL, INC.
CONSTRUCTION QUALITY CONTROL
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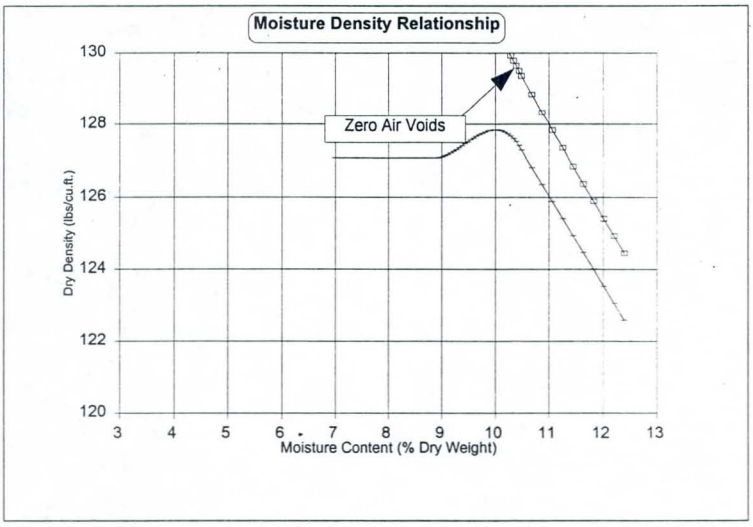
Summary of Moisture Density Relationship Tests

Client:	DMJM 300 W. Clarendon Ave., Phoenix, AZ 85013	**Job No.**	195039-1
		Lab No.	97-1011
		Type of Rammer:	Manual
		Test Date:	12/04/97
Project:	Additonal Camelback Ranch Levee Design	**Material Description:**	Light brown, poorly graded SAND (SP) with gravel
Test Designation:	ASTM D-698		
Test Method:	C	**Sample Source:**	Boring No.: 4 Depth: 2' - 6 1/2'



Specific Gravity Used For Zero Air Voids Curve: 2.65

Test No.	1	2	3	4
Dry Density (lbs/cu.ft.)	127.1	127.1	127.3	122.6
Moisture Content (%)	7.0	8.9	10.5	12.4

Maximum Dry Density (lbs/cu.ft.): **127.9**
Optimum Moisture Content (% of Dry Weight): **10.0**

Remarks:

Respectfully Submitted:

Reviewed By:
Input By: AO

Robert Rivera
Laboratory Supervisor

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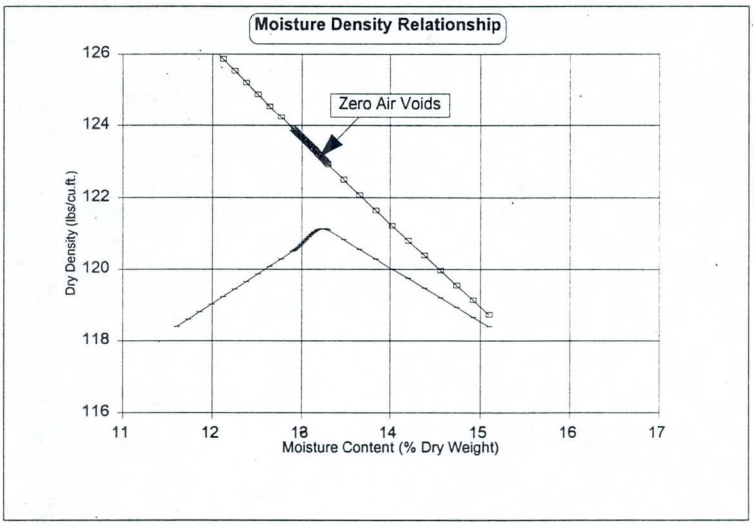
CONSTRUCTION QUALITY CONTROL
GEOTECHNICAL CONSULTANTS

Summary of Moisture Density Relationship Tests

Client:	DMJM 300 W. Clarendon Ave., Phoenix, AZ 85013	**Job No.**	195039-1
		Lab No.	97-1026
		Type of Rammer:	Manual
		Test Date:	12/04/97
Project:	Additonal Camelback Ranch Levee Design	**Material Description:**	Brown, well graded GRAVEL(GW) with sand
Test Designation:	ASTM D-698		
Test Method:	C	**Sample Source:**	Boring No.: TP-6 Depth: 5 1/2' - 10 1/2'



Specific Gravity Used For Zero Air Voids Curve: 2.67

Test No.	1	2	3	4
Dry Density (lbs/cu.ft.)	118.4	120.5	121.1	118.4
Moisture Content (%)	11.6	12.9	13.3	15.1

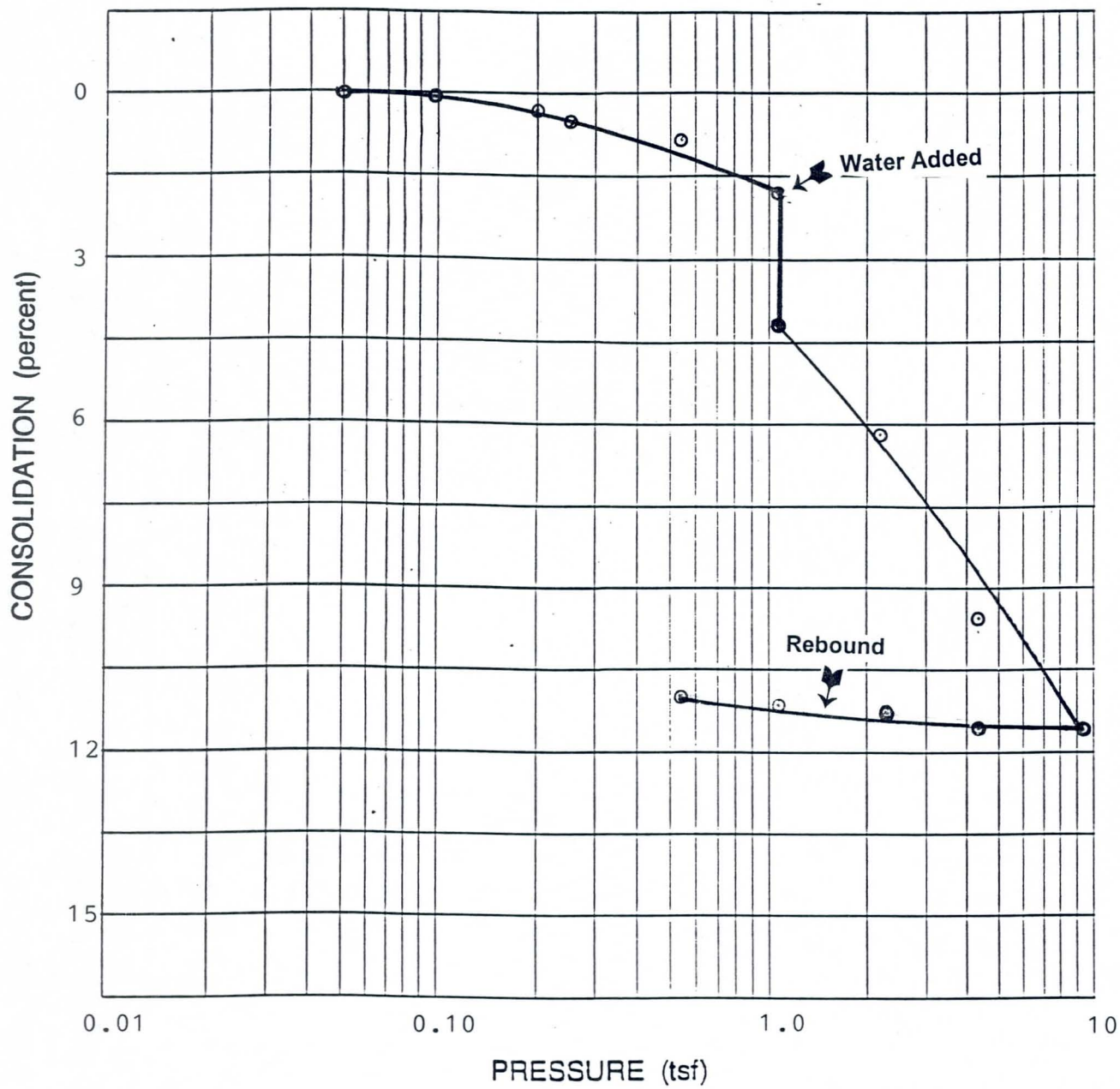
Maximum Dry Density (lbs/cu.ft.): **121.1**
Optimum Moisture Content (% of Dry Weight): **13.2**

Remarks:

Respectfully Submitted:

Reviewed By:
Input By:

pp Robert Rivera
Laboratory Supervisor



Key	Boring No.	Depth (ft.)	Soil Description	Liquid Limit (%)	Plastic Limit (%)	Moisture Content (%) Before	Moisture Content (%) After	Dry Density (pcf)
	2	10-11½	Poorly graded SAND (SP-SM) with silt	--	NP	7.6	24.2	103.5

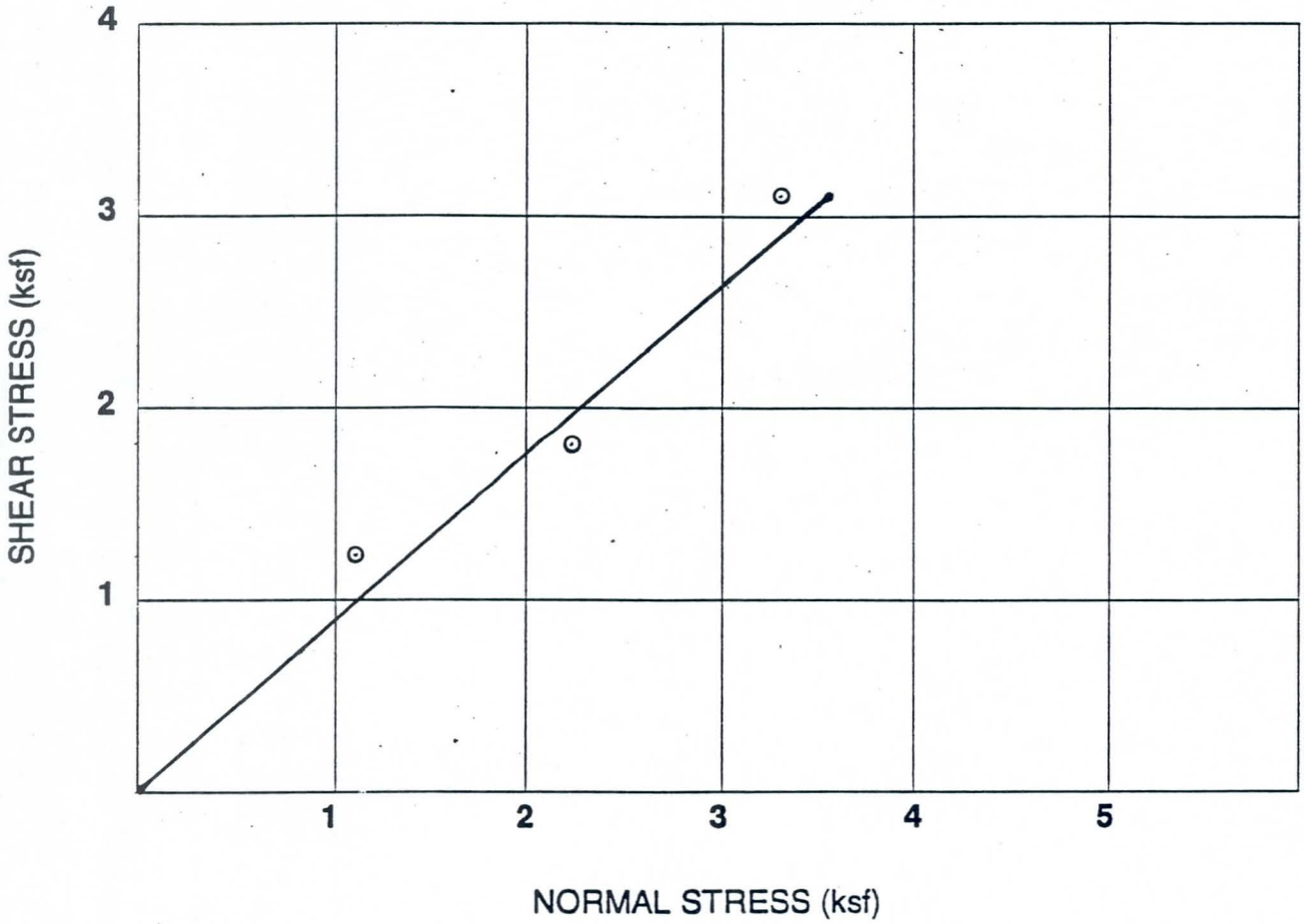
ATL Testing Laboratories

CONSOLIDATION TEST DATA

Project No. 195039-1

Date 12/08/97

ATL INC.



Boring or Test Pit no.	Depth (ft.)	USCS	Soil Description	Cohesive Strength (ksf)	Internal Friction Angle	Moisture Content (%)	Dry Density (pcf)
2	10-11½	SP-SM	Poorly graded SAND with silt		43	5.8	103.6

DIRECT SHEAR TEST DATA

JOB NO. 195039-1

ATL INC.

CAMELBACK RANCH LEVEE DESIGN
FCD CONTRACT #95-15
ATL JOB NO. 195039-1

A) **Los Angeles Abrasion (AASHTO T96)**

Test Pit No.:	TP-5	TP-7
Depth (feet):	2-4	0-2
USCS:	GW	SM
Method:	B	B
Number of Spheres:	11	11
Loss after 100 Revolutions:	4.4%	3.6%
Loss after 500 Revolutions:	16.5%	15.5%

B) **Sand Equivalent (ASTM D-2419)**

Test Pit No.:	TP-5	TP-7
Depth (feet):	2-4	0-2
USCS:	GW	SM
Reading 1:	50	33
Reading 2:	47	30
Reading 3:	49	30
Average:	49	31