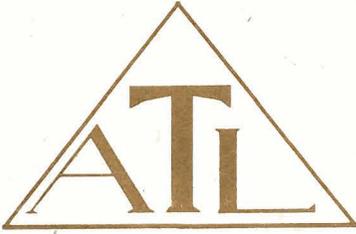


PPM  
12/1/97



**ATL, INC.**

**CONSTRUCTION QUALITY CONTROL  
GEOTECHNICAL CONSULTANTS**

**BULLARD WASH - CHANNEL  
CONTRACT FCD 95-39  
GOODYEAR, ARIZONA  
ATL JOB NO. 196020-3**

FLOOD CONTROL DISTRICT  
RECEIVED

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CHENG	P & PM
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ADMIN	LMGT
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ENGR	
REMARKS	

**BULLARD WASH - CHANNEL  
CONTRACT FCD 95-39  
GOODYEAR, ARIZONA  
ATL JOB NO. 196020-3**

**GEOTECHNICAL INVESTIGATION**

**REPORT FOR**

---

**SVERDRUP CIVIL, INC.**

---

**PROJECT**

**BULLARD WASH - CHANNEL  
CONTRACT FCD 95-39  
GOODYEAR, ARIZONA  
ATL JOB NO. 196020-3**

Reviewed by:



**David P. Hayes  
Executive Vice President**



Prepared by:



**Ammi Osorio  
Project Engineer**

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# GEOTECHNICAL INVESTIGATION

REPORT FOR

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SVERDRUP CIVIL, INC.

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## PROJECT

**BULLARD WASH - CHANNEL**

**CONTRACT FCD 95-39**

**GOODYEAR, ARIZONA**

### **1.0 PROJECT DESCRIPTION**

As part of the Bullard Wash Project for the Flood Control District of Maricopa County (FCD), a new 10,500-foot long channel, approximately six (6) feet in depth, will be constructed. The purpose of this project is to increase the capacity of the Bullard Wash Channel to contain 100-year flood flows within a stable channel. The channel will begin south of Lower Buckeye Road and east of Estrella Parkway. It will continue under the Santa Fe Railroad, under MC-85 through Broadway Road, over the Buckeye Irrigation District (BID) Canal, under the BID service road through a box culvert, ending at Southern Avenue, east of Estrella Parkway. Also included is the construction of a 2,000-foot long

Tributary Channel parallel to the Southern Pacific Railroad (SPRR) and MC-85. This tributary will drain into the new Bullard Wash Channel and extend eastward to the existing Bullard Wash Bridge north of MC-85.

## **2.0 LOCATION AND SITE DESCRIPTION**

The project is located in the western Salt River Valley, a broad basin filled with alluvium of varying grain sizes. The fill deposits are composed of a Lower Conglomerate Unit consisting of cemented sand, gravel, silt, and clay. The fills Upper Alluvial Unit consisting primarily of sands and gravels with clay with silt lenses. Groundwater flows northwesterly north of Yuma Road and southwesterly, south of Yuma Road. Depths of flow range between 40 and 120 feet below land surface.

## **3.0 SCOPE OF WORK**

ATL's responsibility was to drill and sample sub-surface material in order to develop design data for the outfall channel and the east tributary channel. Soil borings were spaced at 500-foot intervals and were drilled to depths of 15 feet below existing grade. Soil testing included the determinations of the basic physical properties in order to classify the individual soil types along with structural support tests appropriate for developing channel design parameters. Resistivity and pH data was also obtained in order to evaluate corrosivity potential of the subsoils.

Field and laboratory data were used in the development of recommendations that address the following issues:

- 1) Allowable Bearing Capacity and Limiting Settlements
- 2) Foundation Recommendations for the Channel.
- 3) Grain-Size distribution of Native Materials with the Channel Bed.
- 4) Re-use of Native Material.
- 5) Lateral Pressures

#### **4.0 DRILLING AND SAMPLING PROCEDURES**

A total of twenty-six (26) borings were drilled for this portion of the project. Five (5) of these borings were drilled on the east tributary channel proposed alignment. Seven (7) were drilled in the landfill area at the end of the Goodyear Airport runway. All borings were drilled to depths of fifteen (15) feet below existing grade.

A Mobile B-50 drill rig, using 6-inch outside hollow stem continuous flight augers, performed the drilling and sampling of the subsurface soils. A 140-pound hammer dropping 30-inches was used to drive the split-spoon sampler that collected drive samples. Bulk samples were obtained continuously off the auger flights during the drilling operation.

Upon completion of each day's drilling, boreholes were backfilled with excess cuttings from the holes. All samples were transported to ATL's Phoenix Laboratory for analysis. Upon delivery to the laboratory, soil samples were checked by the Project Engineer and the following laboratory tests assigned:

- Sieve Analysis
- Swell Test
- pH and Resistivity
- Plasticity Index
- Moisture Content
- Standard Proctor

#### **5.0 LABORATORY TESTING**

Sieve Analysis and Atterberg Limit tests, were conducted on representative samples in order to classify the soils in accordance with the Unified Soils Classification System. Moisture Content tests were performed to determine the amount of water present in the soil at the time of sampling. Standard Proctor tests were performed to determine the maximum dry density and optimum moisture content relationship of each material. The pH and Resistivity Tests were performed to determine the potential corrosivity of soil. In addition, Percent Swell tests were performed to determine the expansion tendencies of the material under various surcharge loads when water is added. Consolidation testing was not performed since other reports addressed that issue.

The following table lists the types and quantities of tests performed to provide the project design information:

<u>TEST</u>	<u>QUANTITY</u>
Sieve Analysis	19
Atterberg Limit	19
Moisture Content	19
Standard Proctor	3
Percent Swell	2
pH and Resistivity	3

All laboratory tests were conducted in accordance with ASTM or AASHTO published procedures. The soils presented on the edited boring logs in Appendix A were classified using the Unified Soils Classifications System (USCS).

#### **6.0 SUMMARY OF EXISTING SUBSURFACE CONDITIONS**

The soils encountered at the proposed site consisted of a wide range of sandy and clayey materials. The clayey materials were classified as CL, CL-ML, and ML and the sandy materials were classified as SM, SP-SM, and SC. Modules of strong cementation was observed in several SM and ML layers. See the detailed boring logs presented in Appendix A.

Minus #200 contents for CL, CL-ML, and ML materials ranged from 52.2% to 94.2%. For the SM, SP-SM, and SC materials, the minus #200 contents ranged from 6.6% to 43.7%. The Plasticity Indices for all soils tested ranged from NP to 15. Standard Proctor analyses were performed on the SM, ML, and CL materials. For the SM material 10 feet below grade in Boring No. 26, the maximum dry density was 118.3 pcf at an optimum moisture content of 14.1%. For the ML material 11 feet below grade in Boring No. 19, the maximum dry density was 115.0 pcf at an optimum moisture content of 15.3%. For the CL material 10 feet below grade in Boring No. 11, the maximum dry density was 111.3 pcf at an optimum moisture content of 15.7%.

Soil resistivity and pH tests were also performed on material used for the above testing. The soil resistivity results ranged from 520 to 991 ohm/cm<sup>3</sup> with pH levels ranging from 7.8 to 8.2. Percent Swell tests were performed on CL material from Boring No. 11

and from Boring No. 19. A 2% swell was measured for both borings under a surcharge of 100 psf.

## **7.0 DISCUSSIONS AND RECOMMENDATIONS**

As indicated in Section 1.0, the main channel will be 10,500 feet in length with the open section approximately six (6) feet deep. In open areas, the channel slopes will be protected by either loose riprap, grouted riprap, gabions or shotcrete. Shotcrete and grouted riprap should not be required for this project unless the projected velocities are high enough to warrant their consideration. The bottom of the channel will be natural ground in the open areas. As the channel alignment approaches roadways, the bottom will transition to concrete, particularly under a new bridge to allow MC 85 to pass over the channel and through an "overchute" structure that will allow the channel water to pass over the Buckeye Irrigation District (BID) Canal. After the channel passes over the BID Canal, it will pass through box culvert sections under the BID Canal southern service road. The concrete bottom will terminate as the channel section is ended at the outfall end of the alignment.

An "eastern" tributary approximately 2500 feet long, will be constructed north of MC 85 and south of the Goodyear airport and will outlet into the main channel north of proposed MC 85 bridge. The pH and Resistivity tests indicate that the soil is corrosive, suggesting that encapsulated metal or concrete pipe should be used to achieve the desired life of the system.

The following sections provide soil analysis in the main channel alignment, the east tributary alignment, and the box culvert under the BID Canal service road. The bridge structures have been addressed in another report prepared by ATL.

### **7.1 Main Channel**

ATL's borings revealed that the subsoil from the northern end of the main channel to the MC 85 bridge is generally a silty clay with sand. Strong cementation was observed at depths greater than 6 feet below greater, with weak to moderate cementation encountered nearer the surface. For acceptability as fill material for roadway widening or behind structures, the material between Boring Nos. 12 and 15 appears to be a higher

quality and is the preferred source for use as a roadway subgrade or structural backfill. It is possible that all the material between Boring Nos. 12 and 17 could be mixed and used throughout the project. Ground water was not encountered in any of these borings.

As the main channel passes under MC 85 and continues to the BID Canal, a wide variance in material types was encountered. Sandy-silty material encountered in Boring Nos. 22, 25 and 26. The material in Boring Nos. 24 and 27 also contains sufficient sand to use in a mix with SP, SM or SC material that could be acceptable subgrade fill.

Side slopes should be cut no steeper than 2 H: 1V even though some areas should be able to sustain slopes as steep as 1H:1V. Prior to placing slope protection, the subgrade should be proof-rolled to a density of no less than 90% of the maximum dry density as determined by ASTM D 698. In areas where concrete is placed, the subgrade must be proof-rolled to a density of no less than 95% of the maximum dry density as determined by ASTM D 698 prior to placing no less than 6 inches of aggregate base course, compacted to the same specification (See Section 8.0 of this Report). The concrete should conform to MAG requirements as re-stated in Section 8.0 of this Report. The transition between a natural bottom and the concrete slab is susceptible to increased scour. A turn-downed concrete edge, extending to a depth of at least two (2) feet below the channel invert is suggested. The depth of this edge should depend on local scour calculations.

## **7.2 Tributary Channel**

The tributary channel alignment was investigated by drilling Boring Nos. 23 through 27. Within the top 10 feet, the material exhibited a weak to strong cementation matrix within the silts, sandy silts and clays encountered. No groundwater was encountered by moisture generally increased as depth below grade increased. Side slopes should not be placed steeper than 2 H:1V and the excavated materials may be re-used elsewhere as roadway subgrade or structural backfill.

The outlet end of this channel will empty into the main channel, north of the proposed MC 85 bridge. Compaction of the side slopes and channel bottom should be performed in an identical manner as recommended in Section 7.2 for the main channel. ATL suggests that the outlet end be constructed of stable material such as shotcrete, or

portland cement concrete in order to reduce erosion. Energy dissipaters may also be required to reduce scour potential.

During drilling, it was observed that a fill of unknown depth existed near the end of a Goodyear runway. ATL drilled seven (7) borings, Nos. 28 through 34, to determine the partial nature of the fill and its depth. Fill varied from 6 to 18 feet, averaging 15 feet in depth. "Chunks" of asphaltic concrete and portland cement concrete were encountered, along with plastic sheets, electrical wire, tree limbs and processed gravel. The fill soil was predominately a silty clay.

### **7.3 BID Box Culvert**

This box culvert is being constructed in order for the water transported by the overchute structure will pass under the southern service road. It is anticipated that the box culvert will be constructed prior to the construction of the overchute structure so that the service road may be re-routed over the box culvert during construction of the overchute. The soil present in the area of the box culvert is represented by Boring Nos. 21 and 22. The overlying layer is silt, varying in depth from 12 feet to 6 feet over a distance of 560 feet. It is anticipated that the foundation for the box will set on the poorly grade sand and gravel layer underlying the silt strata. The following foundation parameters are provided for this structure:

Allowable Bearing Capacity	-	3500 psf
Total and Differential Settlement	-	1 inch maximum
Founding Material	-	Poorly Graded Sand
Coefficient of Friction	-	0.40

We anticipate that the material excavated for the construction of the box culvert will be used to backfill behind the side walls, over which the service road will be constructed. ATL does not recommend use of the silt material. The sand and gravel may be used, however, and the following equivalent fluid pressures are presented for this material using an insitu unit weight of 120 pcf:

Active	-	26 psf
At Rest	-	43 psf
Passive	-	552 psf

The roadway surface should be six inches of ABC compacted in place as per recommendations of Section 8.0 of this report.

## **8.0 GENERAL CONSTRUCTION RECOMMENDATIONS**

### **8.1 Structural Excavation and Backfill**

Along the channel alignment, a significant amount of material will be excavated. Some of this material is suitable for re-use as compacted subgrade for the reconstruction of Estrella Parkway and the portion of MC 85 that lies within the project limits. The silts and clays with minus #200 values exceeding 55% are not acceptable for re-use.

The acceptable material should be compacted in layers as specified in Section 8.2 and meet the minimum maximum density and optimum moisture content requirements.

### **8.2 Compaction**

MAG Section's 211 and 215 should be followed, using either AASHTO T-99 or ASTM D698 procedures for obtaining the laboratory proctor maximum dry density and optimum moisture content. This report provides several proctor values but the contractor should confirm these during actual construction. For both soils and aggregate base course materials, compaction should be no less than 95% of the applicable maximum dry density at moisture contents within 2% of optimum for the material being tested. One-point proctors may be used to confirm the laboratory values.

### **8.3 Borrow**

It is not anticipated that imported borrow will be required. If requested, it should meet the following requirements for material placed within 2-feet of the base course.

<b><u>Sieve Size</u></b>	<b><u>Percent Passing</u></b>
3"	100
3/4"	55 - 80
No. 4	35 - 60
No. 40	5 - 20
No. 200	0 - 12

Plasticity Index  $\leq$  10

In addition, the borrow shall contain no "chunks" of clay, organic matter, tree limbs, excess moisture and stones larger than 3 inches.

#### **8.4 Aggregate Base Course**

The aggregate base course (ABC) material used under pavement sections should conform to Section 702 of MAG as follows:

<b><u>Sieve Size</u></b>	<b><u>Percent Passing</u></b>
1 1/8	100
No. 4	38 - 65
No. 8	25 - 60
No. 30	10 - 40
No. 200	3 - 12.

Plasticity Index  $\leq$  5

#### **8.5 Portland Cement Concrete**

The portland cement concrete for the box culvert and channel should conform to MAG Class A as detailed in MAG Section 725. Placement should conform to MAG Section 505.

#### **8.6 Gabions**

One method of slope protection is the use of gabions and mattresses. These are typically galvanized metal "baskets" that contain single-sized stone from 4" to 8" in diameter. Connecting wires and ties, also constructed of galvanized metal, are used to establish unity from basket to basket. Gabions may be constructed vertically, as well as on a slope. Several manufacturers supply this material, including Macaffari and Terra Aqua.

#### **8.7 Riprap**

If riprap is used to protect the slopes, it should conform to the applicable provisions of MAG Section 703.

## **9.0 ADDITIONAL SERVICES**

It is recommended that the Geotechnical Engineer be retained to provide a general review of final design plans and specifications in order to confirm that the recommendations from this report have been interpreted correctly and implemented in the proper context. In the event that any changes of the proposed project are planned, the conclusions and recommendations contained in this report should be reviewed and the report modified or supplemented as necessary.

The Geotechnical Engineer should also be retained to provide testing services during excavation, grading, and channel construction phases of the work. Construction testing should be performed to determine whether applicable project specifications have been met. ATL's staff consists of certified technicians with several years in this business and have completed many similar FCD, City of Phoenix, and City of Flagstaff projects over the past ten years.

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 re-evaluate 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. The reader of this report must draw his own conclusions regarding site conditions and specific construction techniques to be used on this 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, any 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.

***PLATES***

# ***GUIDELINES IN THE USE AND INTERPRETATION OF THIS GEOTECHNICAL REPORT***

---

ATL Job No.196020-3

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.

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.

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

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

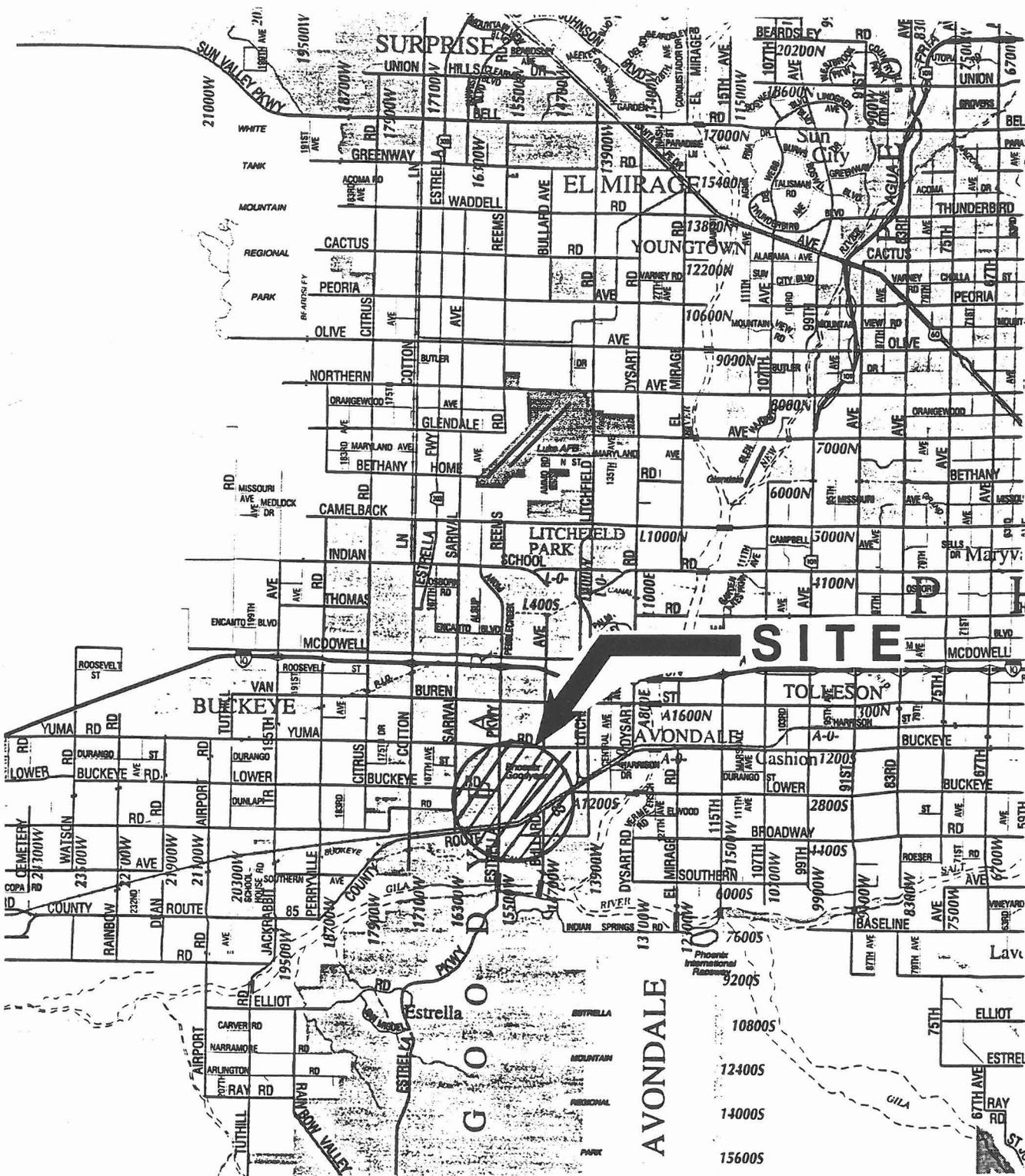
2. Relative Consistency. Terms for description of clays which are saturated or near saturation.

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.

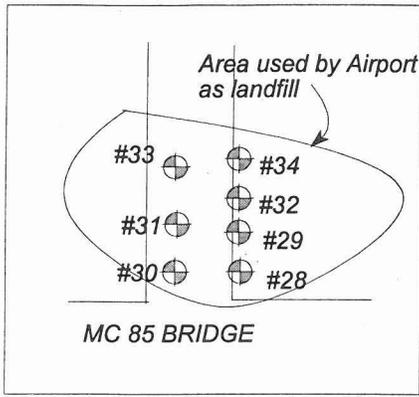
N	Relative Firmness
0 - 4	Very soft
5 - 8	Soft
9 - 15	Moderately firm
16 - 30	Firm
31 - 50	Very firm
50 +	Hard

4. Standard Penetration Tests (SPT) =

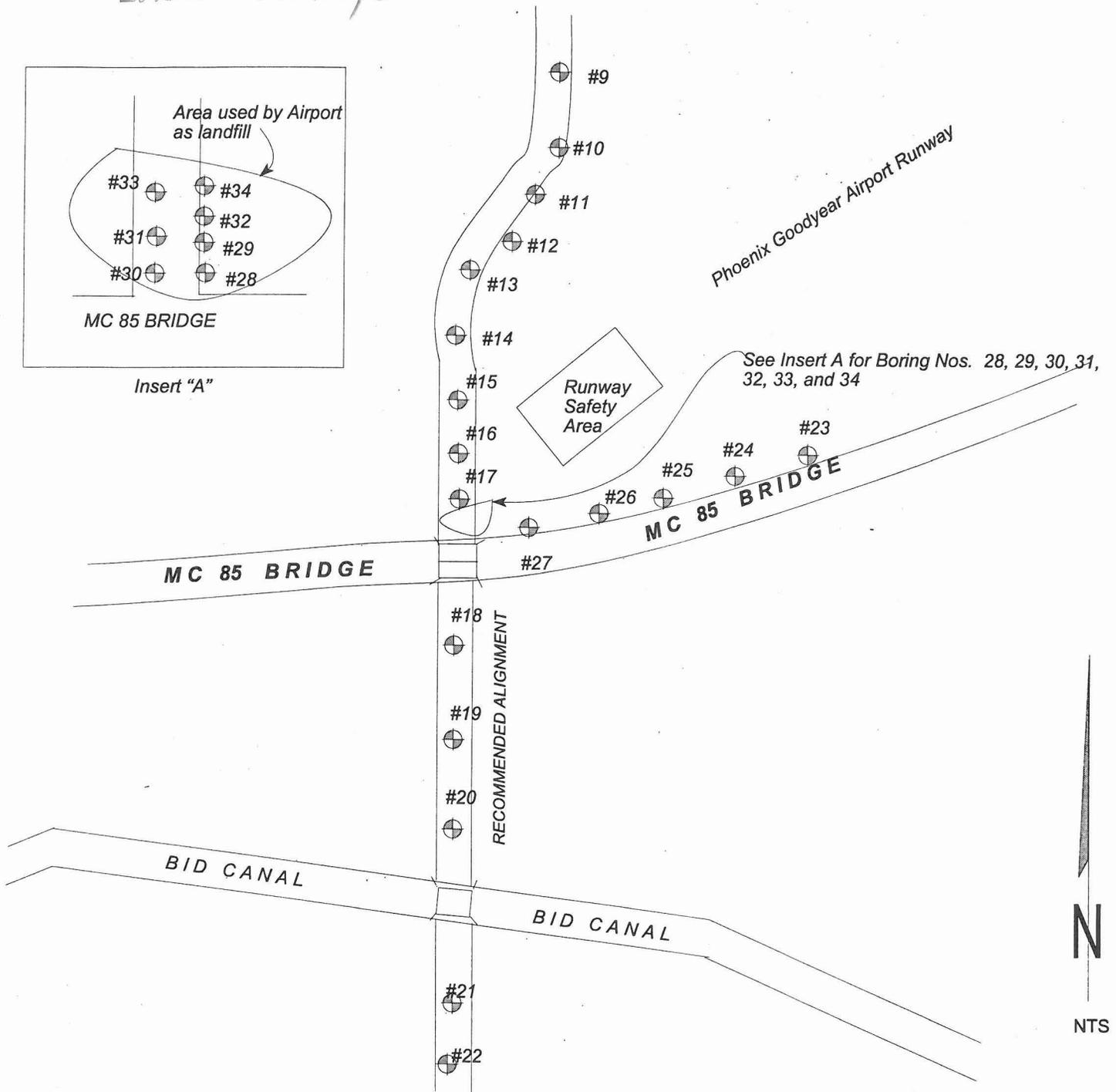


**VICINITY MAP**  
**BULLARD WASH - CHANNEL**  
 Goodyear, Arizona

Lower Buckeye



Insert "A"



⊕ BORING LOCATIONS

# BORING LOCATIONS BULLARD WASH - CHANNEL Goodyear, Arizona

***APPENDIX A***  
***BORING LOGS***



# BULLARD WASH - MAIN CHANNEL

## Goodyear, Arizona

ATL Job No.  
196020-3  
Boring No.: 9

**Boring Location:** Centerline, Sta 119+57

**Boring Equipment:** Mobile B-50 with 6 - Inch diameter hollow stem auger

**Date of Boring:** 9-29-97      **Elevation of Boring:** 948.0

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

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	% Passing No. 200	Plasticity Index
		Brown, lean CLAY(CL), Moist				
	5	Brown, silty CLAY(CL-ML) with sand  Weak cementation			78.3	7
	10	Brown, lean CLAY(CL), damp				
	15	(Bottom of boring at 15 feet)				
	20					
	25					

Boring Stopped at 15 Feet below Existing Grade

Groundwater

Initial Depth

Hour

24 Hour Depth

None



# BULLARD WASH - MAIN CHANNEL

## Goodyear, Arizona

ATL Job No.  
196020-3

Boring No.: 10

**Boring Location:** 100' Right Station 116+00, 5' West of airport fence

**Boring Equipment:** Mobile B-50 with 6 - Inch diameter hollow stem auger

**Date of Boring:** 9-30-97

**Elevation of Boring:** 943.0

**Driller:** J. Cowell

**Logger:** J. Cowell

**Reviewed By:** A. Osorio

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	% Passing No. 200	Plasticity Index
	5	<i>Brown, silty CLAY(CL-ML), Moist</i>			74.6	5
	10	<i>Moisture increases to wet</i>				
. . . . .		<i>Gray-tan, Poorly graded SAND(SP-SM) with silt and gravel</i>				
	15	<i>(Bottom of boring at 15 feet)</i>				
	20					
	25					

Boring Stopped at 15 Feet below Existing Grade

Groundwater

Initial Depth

Hour

24 Hour Depth

None



# BULLARD WASH - MAIN CHANNEL

Goodyear, Arizona

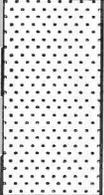
ATL Job No.  
196020-3  
Boring No.:11

Boring Location: 100' Right Station 111+00

Boring Equipment: Mobile B-50 with 6 - Inch diameter hollow stem auger

Date of Boring: 9-30-97 Elevation of Boring: 941.0

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

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	% Passing No. 200	Plasticity Index
	0 - 5	Brown, lean CLAY(CL), Moist  Moisture increases to wet			94.2	11
	5 - 10	Gray-tan, Poorly graded SAND(SP-SM) with silt and gravel				
	10 - 15	Brown, lean CLAY(CL), very moist				
	15 - 25	(Bottom of boring at 15 feet)				

Boring Stopped at 15 Feet below Existing Grade

Groundwater

Initial Depth

Hour

24 Hour Depth

None



# BULLARD WASH - MAIN CHANNEL

Goodyear, Arizona

ATL Job No.  
196020-3

Boring No.:12

Boring Location: 100' Right Station 106+00

Boring Equipment: Mobile B-50 with 6 - Inch diameter hollow stem auger

Date of Boring: 9-30-97

Elevation of Boring: 941.0

Driller: J. Cowell

Logger: J. Cowell

Reviewed By: A. Osorio

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	% Passing No. 200	Plasticity Index
	0	<i>Brown, lean CLAY(CL), Moist</i>				
	5	<i>Tan, clayey SAND(SC), Moist Weak to moderate cementation</i>			41.9	15
	10	<i>Cementation increase to strong to moderate</i>				
	15	<i>Brown, silty CLAY(CL-ML) with sand, very moist</i>				
	20					
	25	<i>(Bottom of boring at 15 feet)</i>				

Boring Stopped at 15 Feet below Existing Grade

Groundwater

Initial Depth

Hour

24 Hour Depth

None



# BULLARD WASH - MAIN CHANNEL

Goodyear, Arizona

ATL Job No.  
196020-3  
Boring No.:13

**Boring Location:** Centerline right Sta 101+00

**Boring Equipment:** Mobile B-50 with 6 - Inch diameter hollow stem auger

**Date of Boring:** 9-30-97

**Elevation of Boring:** 942.8

**Driller:** J. Cowell

**Logger:** J. Cowell

**Reviewed By:** A. Osorio

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	% Passing No. 200	Plasticity Index
[Diagonal Hatching]	0	<i>Brown, lean CLAY (CL) with sand, Moist</i>				
[Diagonal Hatching]	5	<i>Light brown, sandy lean CLAY (CL) Strong cemented strata Moderate to strong cementation</i>			52.2	15
[Vertical Lines]	10	<i>Cementation increase to strong to moderate Brown, silty CLAY (CL-ML) with sand, Moist</i>				
[Vertical Lines]	15	<i>(Bottom of boring at 15 feet)</i>				
[Vertical Lines]	20					
[Vertical Lines]	25					

Boring Stopped at 15 Feet below Existing Grade

Groundwater

Initial Depth

Hour

24 Hour Depth

None



# BULLARD WASH - MAIN CHANNEL

Goodyear, Arizona

ATL Job No.  
196020-3  
Boring No.:14

**Boring Location:** Channel centerline, Station 91+90

**Boring Equipment:** Mobile B-50 with 6 - Inch diameter hollow stem auger

**Date of Boring:** 9-25-97

**Elevation of Boring:** 944.1

**Driller:** J. Cowell

**Logger:** J. Cowell

**Reviewed By:** A. Osorio

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	% Passing No. 200	Plasticity Index
	5	<p><i>Brown, lean CLAY(CL) with sand, damp</i></p>			77.0	12
	10	<p><i>Brown, sandy SILT(ML), damp with nodules of strong cementation</i></p> <p><i>- Moisture increases to moist</i></p>				
	15	<p><i>(Bottom of boring at 15 feet)</i></p>				
	20					
	25					
<p>Boring Stopped at <u>15</u> Feet below Existing Grade</p>		<p>Groundwater</p>	<p>Initial Depth</p> <p>None</p>		<p>Hour</p>	<p>24 Hour Depth</p>



# BULLARD WASH - MAIN CHANNEL

Goodyear, Arizona

ATL Job No.  
196020-3

Boring No.: 15

**Boring Location:** Channel centerline, Station 86+40

**Boring Equipment:** Mobile B-50 with 6 - Inch diameter hollow stem auger

**Date of Boring:** 9-25-97

**Elevation of Boring:** 941.5

**Driller:** J. Cowell

**Logger:** J. Cowell

**Reviewed By:** A. Osorio

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	% Passing No. 200	Plasticity Index
	0	<i>Brown, sandy SILT(ML) with nodules and strong cementation, damp (Fill)</i>				
	5	<i>Brown, silty SAND(SM) with fine gravel, nodules of strong cementation, damp</i>			33.1	NP
	10	<i>Increases in nodules percent and size to 1"</i>				
	15	<i>(Bottom of boring at 15 feet)</i>				
	20					
	25					
Boring Stopped at <u>15</u> Feet below Existing Grade		Groundwater	Initial Depth	Hour	24 Hour Depth	
			None			



# BULLARD WASH - MAIN CHANNEL

Goodyear, Arizona

ATL Job No.  
196020-3  
Boring No.:16

Boring Location: Channel centerline, Station 78+50

Boring Equipment: Mobile B-50 with 6 - Inch diameter hollow stem auger

Date of Boring: 9-25-97 Elevation of Boring: 942.50

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

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	% Passing No. 200	Plasticity Index
		Brown, lean CLAY(CL) with sand, damp				
	5	Brown, sandy SILT(ML), with nodules of strong cementation, damp			63.6	7
	10	Brown, lean CLAY(CL) with sand, damp				
	15	(Bottom of boring at 15 feet)				
	20					
	25					
Boring Stopped at <u>15</u> Feet below Existing Grade			Groundwater	Initial Depth	Hour	24 Hour Depth
				None		





# BULLARD WASH - MAIN CHANNEL

Goodyear, Arizona

ATL Job No.  
196020-3  
Boring No.:18

**Boring Location:** Channel centerline, Station 63+35

**Boring Equipment:** Mobile B-50 with 6 - Inch diameter hollow stem auger

**Date of Boring:** 9-22-97

**Elevation of Boring:** 918.5

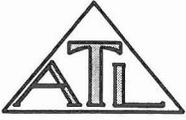
**Driller:** J. Cowell

**Logger:** J. Cowell

**Reviewed By:** A. Osorio

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	% Passing No. 200	Plasticity Index
[Vertical line pattern]	5	<i>Brown, SILT(ML) with sand, Moist</i>			74.1	3
[Vertical line pattern]	10	<i>Brown, silty CLAY(CL-ML) with sand, Moist</i>				
[Vertical line pattern]	15	<i>Brown, sandy SILT(ML) with nodule of strong cementation, Moist</i>				
[Vertical line pattern]	20	<i>Brown, silty CLAY(CL-ML) with sand, Moist</i>				
[Vertical line pattern]	25	(Bottom of boring at 15 feet)				
Boring Stopped at <u>15</u> Feet below Existing Grade		Groundwater	Initial Depth	Hour	24 Hour Depth	
			None			





# BULLARD WASH - MAIN CHANNEL

Goodyear, Arizona

ATL Job No.  
196020-3  
Boring No.:20

Boring Location: Channel centerline, Station 36+71

Boring Equipment: Mobile B-50 with 6 - Inch diameter hollow stem auger

Date of Boring: 9-22-97 Elevation of Boring: 912.5

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

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	% Passing No. 200	Plasticity Index
	0 - 5	Brown, silty CLAY(CL-ML), Moist				
	5 - 10	Brown, SILT(ML) with sand, very moist			83.0	6
	10 - 15	(Bottom of boring at 15 feet)				
	15 - 20					
	20 - 25					
	25 - 30					

Boring Stopped at 15 Feet below Existing Grade

Groundwater

Initial Depth

Hour

24 Hour Depth

None



# BULLARD WASH - MAIN CHANNEL

Goodyear, Arizona

ATL Job No.  
196020-3  
Boring No.:21

**Boring Location:** 10 feet left centerline, Sta 25+60

**Boring Equipment:** Mobile B-50 with 6 - Inch diameter hollow stem auger

**Date of Boring:** 9-30-97      **Elevation of Boring:** 909.8

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

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	% Passing No. 200	Plasticity Index
	5	<i>Brown, SILT(ML), Moist</i>			86.9	5
	10	<i>Gray-Tan, Poorly graded SAND(SP-SM) with silt and gravel</i>				
	15	<i>(Bottom of boring at 15 feet)</i>				
	20					
	25					
Boring Stopped at <u>15</u> Feet below Existing Grade		Groundwater	Initial Depth	Hour	24 Hour Depth	
			None			



# BULLARD WASH - MAIN CHANNEL

Goodyear, Arizona

ATL Job No.  
196020-3  
Boring No.:22

**Boring Location:** Centerline at Station 20+10

**Boring Equipment:** Hand dug

**Date of Boring:** 9-30-97

**Elevation of Boring:** 902.0

**Driller:** J. Cowell

**Logger:** J. Cowell

**Reviewed By:** A. Osorio

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	% Passing No. 200	Plasticity Index
[Vertical line pattern]		Brown, SILT(ML), damp				
[Dotted pattern]	5	Gray, Poorly graded SAND(SP-SM) with silt and gravel			6.6	NP
		(Bottom of boring at 6 feet)				
	10					
	15					
	20					
	25					
Boring Stopped at <u>6</u> Feet below Existing Grade		Groundwater	Initial Depth	Hour	24 Hour Depth	
			None			



# BULLARD WASH - EAST TRIBUTARY CHANNEL

Goodyear, Arizona

ATL Job No.  
196020-3  
Boring No.:23

Boring Location: 5 feet Right Channel centerline at Station 35+00

Boring Equipment: Mobile B-50 with 6" diameter hollow stem auger

Date of Boring: 9-25-97

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	% Passing No. 200	Plasticity Index
[Hatched pattern]	0	Brown, SILT(ML), damp				
[Vertical lines pattern]	5	Brown, sandy, silty CLAY(CL-ML), Moist			68.7	4
[Dotted pattern]	10	Gray-tan, gravelly SAND(SP), Moist				
[Hatched pattern]	15	Brown, SILT(ML), Moist				
	20	(Bottom of boring at 15 feet)				
	25					

Boring Stopped at <u>15</u> Feet below Existing Grade	Groundwater	Initial Depth	Hour	24 Hour Depth
		None		



# BULLARD WASH - EAST TRIBUTARY CHANNEL

Goodyear, Arizona

ATL Job No.  
196020-3  
Boring No.:24

**Boring Location:** Channel centerline - Station 30+00  
(35 feet North of South airport fence)

**Boring Equipment:** Mobile B-50 with 6" diameter  
hollow stem auger

**Date of Boring:** 9-29-97      **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	% Passing No. 200	Plasticity Index
	0 - 9	Light brown, sandy lean CLAY(CL), damp weak cementation			54.4	9
	9 - 15	Gray-tan, SILT(ML) with gravel, damp with cementation, hard, 9' - 10'				
	15	(Bottom of boring at 15 feet)				
	20					
	25					

Boring Stopped at 15 Feet below Existing Grade

Groundwater

Initial Depth

Hour

24 Hour Depth

None



# BULLARD WASH - EAST TRIBUTARY CHANNEL

Goodyear, Arizona

ATL Job No.  
196020-3  
Boring No.:25

**Boring Location:** Channel centerline - Station 25+00  
(35 feet North of South airport fence)

**Boring Equipment:** Mobile B-50 with 6" diameter  
hollow stem auger

**Date of Boring:** 9-25-97      **Elevation of Boring:** 934.0

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

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	% Passing No. 200	Plasticity Index
	0 - 5	Light brown, sandy SILT(ML), damp weak cementation with nodules of strong cementation				
	5 - 15	Gray-tan, SILT(ML) with gravel, damp			10.0	NP
	15 - 25	(Bottom of boring at 15 feet)				

Boring Stopped at <u>15</u> Feet below Existing Grade	Groundwater	Initial Depth	Hour	24 Hour Depth
		None		



# BULLARD WASH - EAST TRIBUTARY CHANNEL

Goodyear, Arizona

ATL Job No.  
196020-3

Boring No.:26

**Boring Location:** Channel centerline - Station 20+00  
(35 feet North of South airport fence)

**Boring Equipment:** Mobile B-50 with 6" diameter  
hollow stem auger

**Date of Boring:** 9-25-97      **Elevation of Boring:** 931.0

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

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	% Passing No. 200	Plasticity Index
	5	Brown, silty SAND(SM), with gravel with nodules of strong cementation			43.7	3
	10	Gray-tan, gravelly SAND(SP), Moist				
	15	(Bottom of boring at 15 feet)				
	20					
	25					

Boring Stopped at <u>15</u> Feet below Existing Grade	Groundwater	Initial Depth	Hour	24 Hour Depth
		None		



# BULLARD WASH - EAST TRIBUTARY CHANNEL

Goodyear, Arizona

ATL Job No.  
196020-3  
Boring No.:27

**Boring Location:** Channel centerline - Station 15+00  
(35 feet North of airport fence)

**Boring Equipment:** Mobile B-50 with 6" diameter  
hollow stem auger

**Date of Boring:** 9-25-97

**Elevation of Boring:** 924.5

**Driller:** J. Cowell

**Logger:** J. Cowell

**Reviewed By:** A. Osorio

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	% Passing No. 200	Plasticity Index
	0 - 12	Brown, sandy SILT(ML), damp  <i>Moisture increases to moist</i>			54.0	1
	12 - 14	Brown, silty SAND(SM) with trace of gravel				
	14 - 15	(Bottom of boring at 15 feet)				

Boring Stopped at 15 Feet below Existing Grade

Groundwater

Initial Depth

Hour

24 Hour Depth

None







# BULLARD WASH - MAIN CHANNEL

Goodyear, Arizona

ATL Job No.  
196020-3  
Boring No.:30

Boring Location: 10 feet Left(west) of Channel Station 77+95

Boring Equipment: Mobile B-50 with 6" diameter hollow stem auger

Date of Boring: 10/14/97 Elevation of Boring: 937.2

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

## SOIL DESCRIPTION

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	% Passing No. 200	Plasticity Index
	0	Light brown, silty CLAY(CL-ML) with sand, damp with broken asphaltic concrete				
	5					
	10	Fill  Increase in moisture to moist				
	15	(Bottom of boring at 15 feet)				
	20					
	25					

Boring Stopped at 15 Feet below Existing Grade

Groundwater

Initial Depth  
None

Hour

24 Hour Depth



# BULLARD WASH - MAIN CHANNEL

Goodyear, Arizona

ATL Job No.  
196020-3

Boring No.: 31

**Boring Location:** Channel centerline Station 79+20

**Boring Equipment:** Mobile B-50 with 6" diameter hollow stem auger

**Date of Boring:** 10/14/97      **Elevation of Boring:** 937.0

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

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	% Passing No. 200	Plasticity Index
	5	Light brown, silty CLAY(CL-ML), damp with gravel and black plastic sheeting  Fill				
	10	Light brown, silty SAND(SM), Moist				
	15	(Bottom of boring at 15 feet)				
	20					
	25					
Boring Stopped at <u>15</u> Feet below Existing Grade			Groundwater	Initial Depth None	Hour	24 Hour Depth





# BULLARD WASH - MAIN CHANNEL

Goodyear, Arizona

ATL Job No.  
196020-3

Boring No.: 33

Boring Location: Channel centerline at Station 80+00

Boring Equipment: Mobile B-50 with 6" diameter hollow stem auger

Date of Boring: 10/14/97

Elevation of Boring: 938.00

Driller: J. Cowell

Logger: J. Cowell

Reviewed By: A. Osorio

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	% Passing No. 200	Plasticity Index
		Light brown, silty CLAY(CL-ML), damp				
		with broken concrete and piece of electrical wire				
	5					
	10					
	15	(Bottom of boring at 15 feet)				
	20					
	25					

Boring Stopped at 15 Feet below Existing Grade

Groundwater

Initial Depth

Hour

24 Hour Depth

None



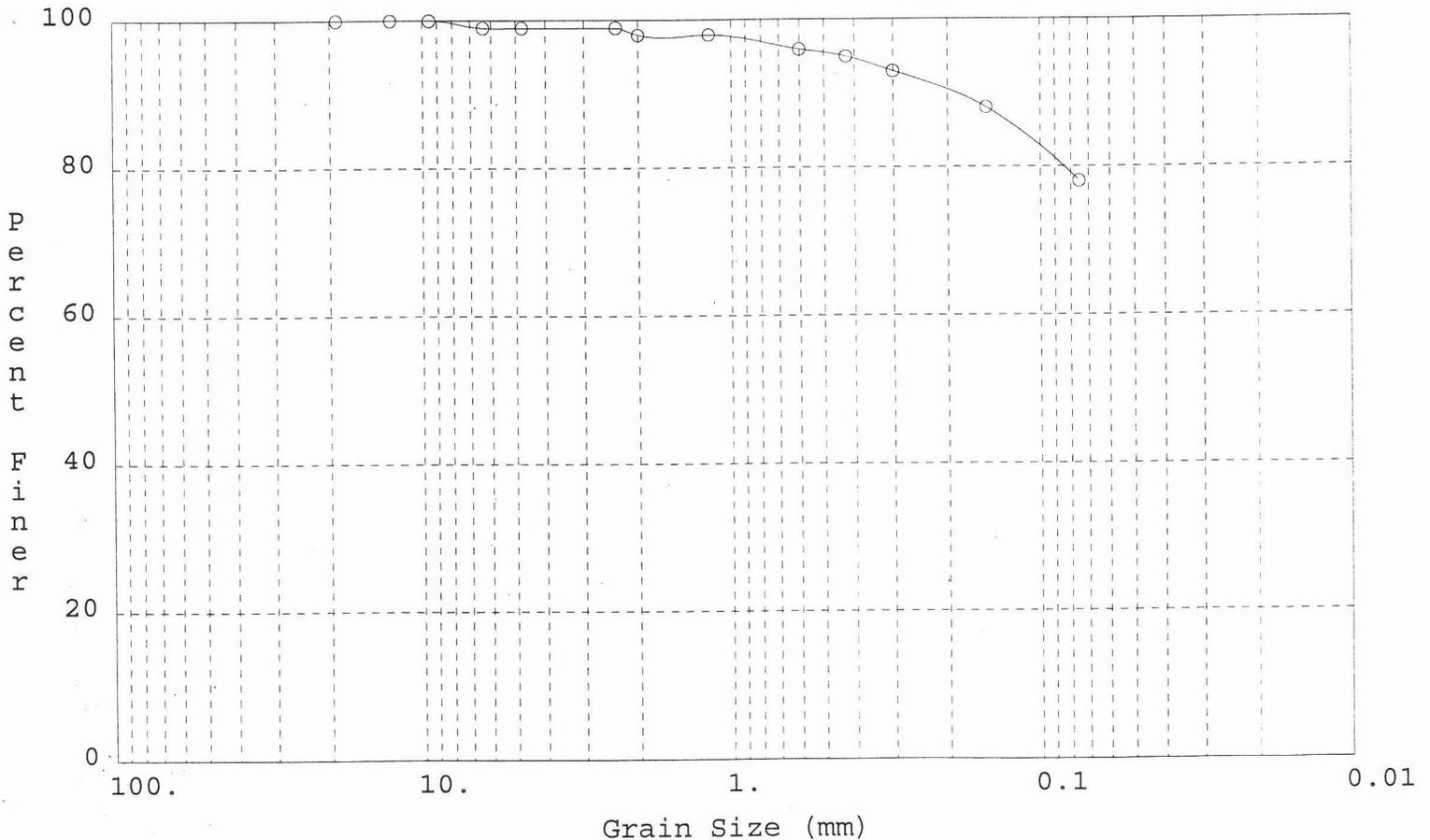
***A P P E N D I X B***  
***LABORATORY TEST RESULTS***



Project Number = 196020-3 Client: Sverdrup Civil , Inc.  
 Location = Bullard Wash, Channel  
 Date = 10/4/97  
 Tested By = D. Johnson  
 Boring Number = 9  
 Depth = 3' - 9'  
 Sample Number = 97-0794  
 Description = Brown, silty CLAY(CL-ML) with sand  
 Dry Sample Weight (g) = 1000

SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
3/4"	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	10.00	1.00	1.00	99.00
#4	4.750	0.00	0.00	1.00	99.00
#8	2.360	0.00	0.00	1.00	99.00
#10	2.000	10.00	1.00	2.00	98.00
#16	1.180	0.00	0.00	2.00	98.00
#30	0.600	20.00	2.00	4.00	96.00
#40	0.425	10.00	1.00	5.00	95.00
#50	0.300	20.00	2.00	7.00	93.00
#100	0.150	50.00	5.00	12.00	88.00
#200	0.075	100.00	10.00	22.00	78.00
Pan	0.000	0.00	0.00	22.00	78.00

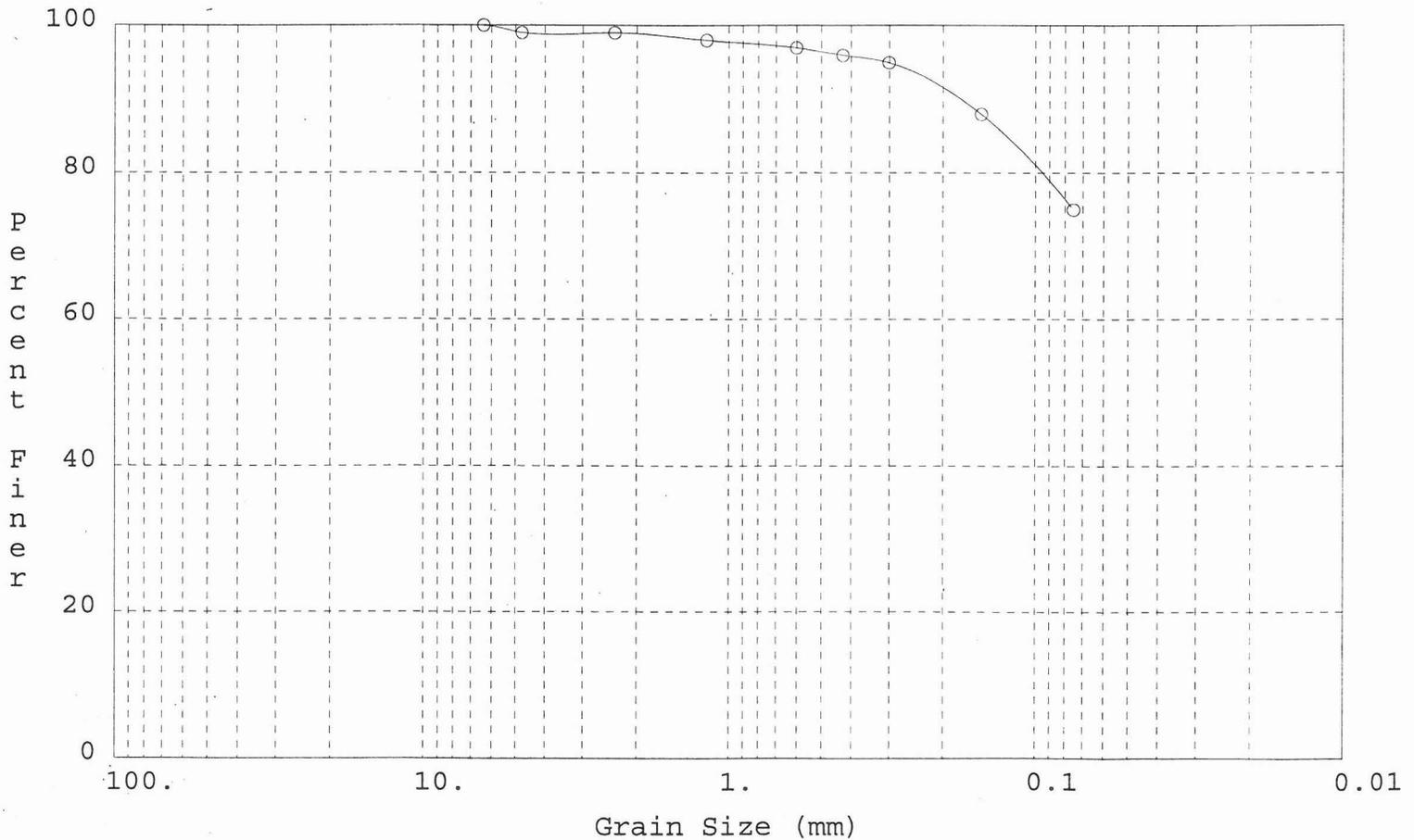
Sieve Analysis



Project Number = 196020-3 Client: Sverdrup Civil , Inc.  
 Location = Bullard Wash, Channel  
 Date = 10/6/97  
 Tested By = D. Johnson  
 Boring Number = 10  
 Depth = 0 - 11'  
 Sample Number = 97-811  
 Description = Brown, Silty CLAY (CL-ML)  
 Dry Sample Weight (g) = 1000

SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
1/4"	6.350	0.00	0.00	0.00	100.00
#4	4.750	10.00	1.00	1.00	99.00
#8	2.360	0.00	0.00	1.00	99.00
#16	1.180	10.00	1.00	2.00	98.00
#30	0.600	10.00	1.00	3.00	97.00
#40	0.425	10.00	1.00	4.00	96.00
#50	0.300	10.00	1.00	5.00	95.00
#100	0.150	70.00	7.00	12.00	88.00
#200	0.075	130.00	13.00	25.00	75.00
Pan	0.000	0.00	0.00	25.00	75.00

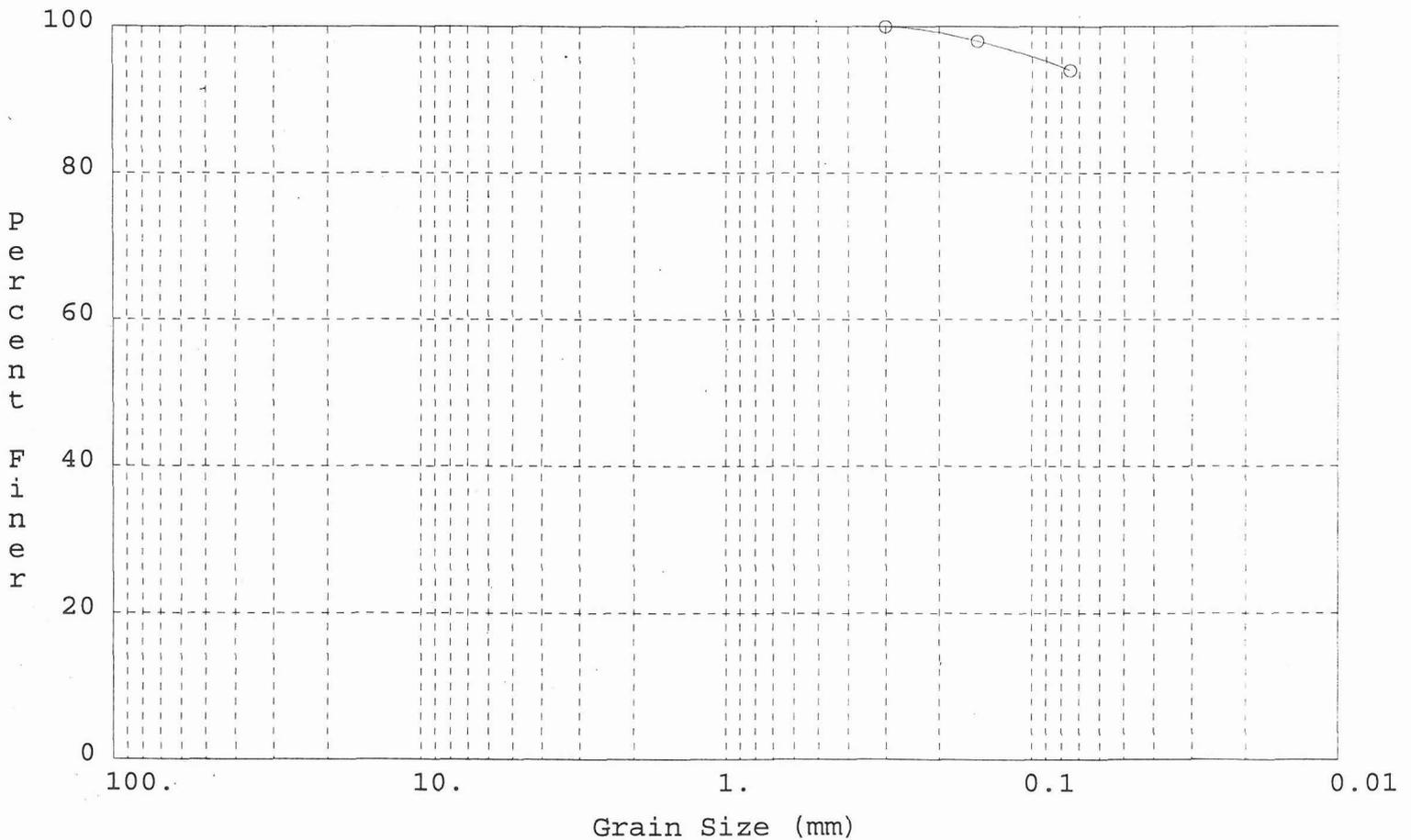
Sieve Analysis



Project Number = 196020-3 Client: Sverdrup Civil , Inc.  
 Location = Bullard Wash, Channel  
 Date = 10/9/97  
 Tested By = M. Blalock  
 Boring Number = 11  
 Depth = 5' - 10'  
 Sample Number = 97-0812  
 Description = Brown, lean CLAY (CL)  
 Dry Sample Weight (g) = 1000

SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
#50	0.300	0.00	0.00	0.00	100.00
#100	0.150	20.00	2.00	2.00	98.00
#200	0.075	40.00	4.00	6.00	94.00
Pan	0.000	0.00	0.00	6.00	94.00

Sieve Analysis

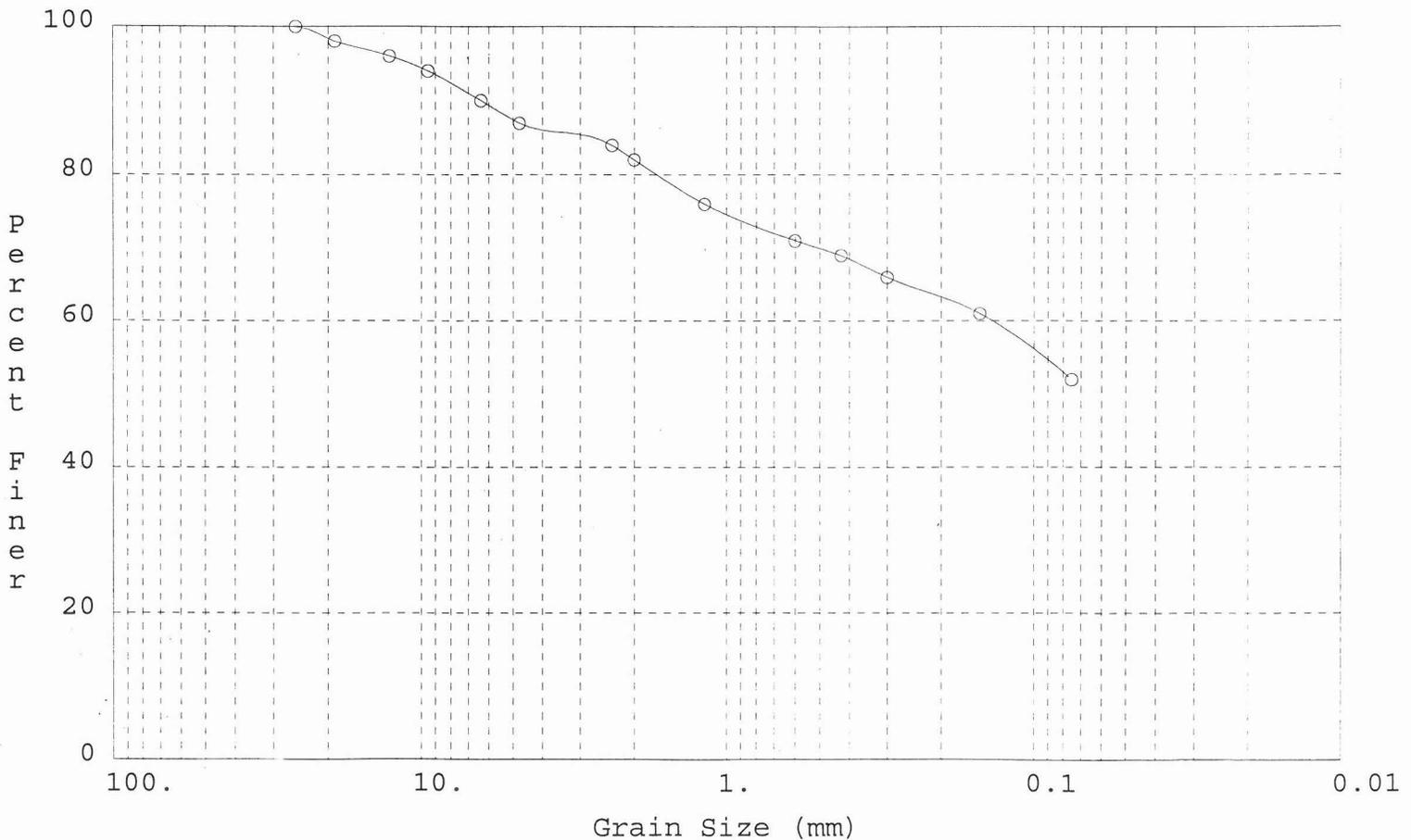




Project Number = 196020-3 Client: Sverdrup Civil , Inc.  
 Location = Bullard Wash, Channel  
 Date = 10/4/97  
 Tested By = D. Johnson  
 Boring Number = 13  
 Depth = 2 1/2' - 11'  
 Sample Number = 97-0815  
 Description = Light brown, Sandy lean CLAY(CL)  
 Dry Sample Weight (g) = 1000

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	20.00	2.00	2.00	98.00
1/2"	12.700	20.00	2.00	4.00	96.00
3/8"	9.500	20.00	2.00	6.00	94.00
1/4"	6.350	40.00	4.00	10.00	90.00
#4	4.750	30.00	3.00	13.00	87.00
#8	2.360	30.00	3.00	16.00	84.00
#10	2.000	20.00	2.00	18.00	82.00
#16	1.180	60.00	6.00	24.00	76.00
#30	0.600	50.00	5.00	29.00	71.00
#40	0.425	20.00	2.00	31.00	69.00
#50	0.300	30.00	3.00	34.00	66.00
#100	0.150	50.00	5.00	39.00	61.00
#200	0.075	90.00	9.00	48.00	52.00
Pan	0.000	0.00	0.00	48.00	52.00

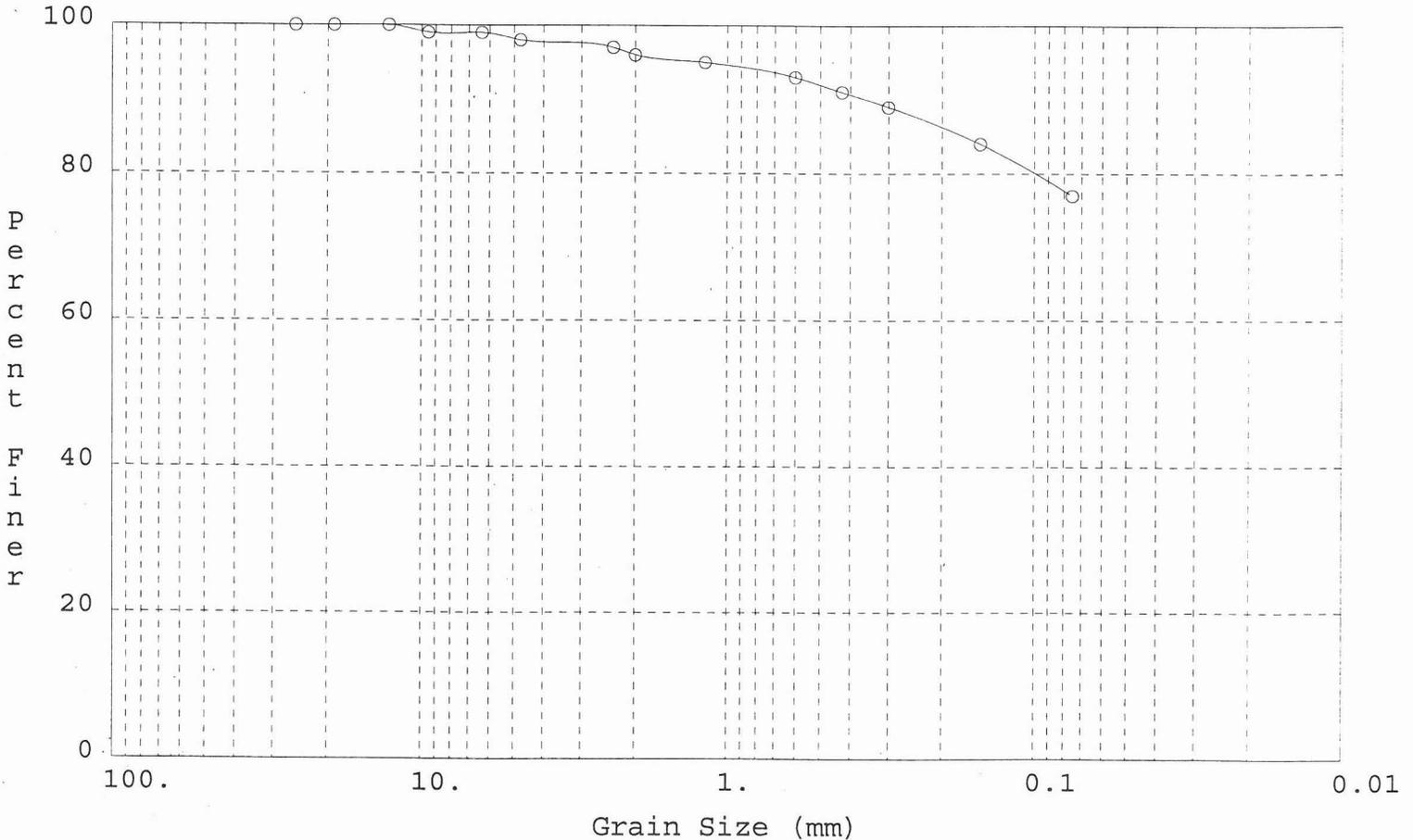
Sieve Analysis



Project Number = 196020-3 Client: Sverdrup Civil , Inc.  
 Location = Bullard Wash, Channel  
 Date = 10/4/97  
 Tested By = D. Johnson  
 Boring Number = 14  
 Depth = 0' - 8'  
 Sample Number = 97-0795  
 Description = Brown, lean CLAY(CL) with sand  
 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	10.00	1.00	3.00	97.00
#10	2.000	10.00	1.00	4.00	96.00
#16	1.180	10.00	1.00	5.00	95.00
#30	0.600	20.00	2.00	7.00	93.00
#40	0.425	20.00	2.00	9.00	91.00
#50	0.300	20.00	2.00	11.00	89.00
#100	0.150	50.00	5.00	16.00	84.00
#200	0.075	70.00	7.00	23.00	77.00
Pan	0.000	0.00	0.00	23.00	77.00

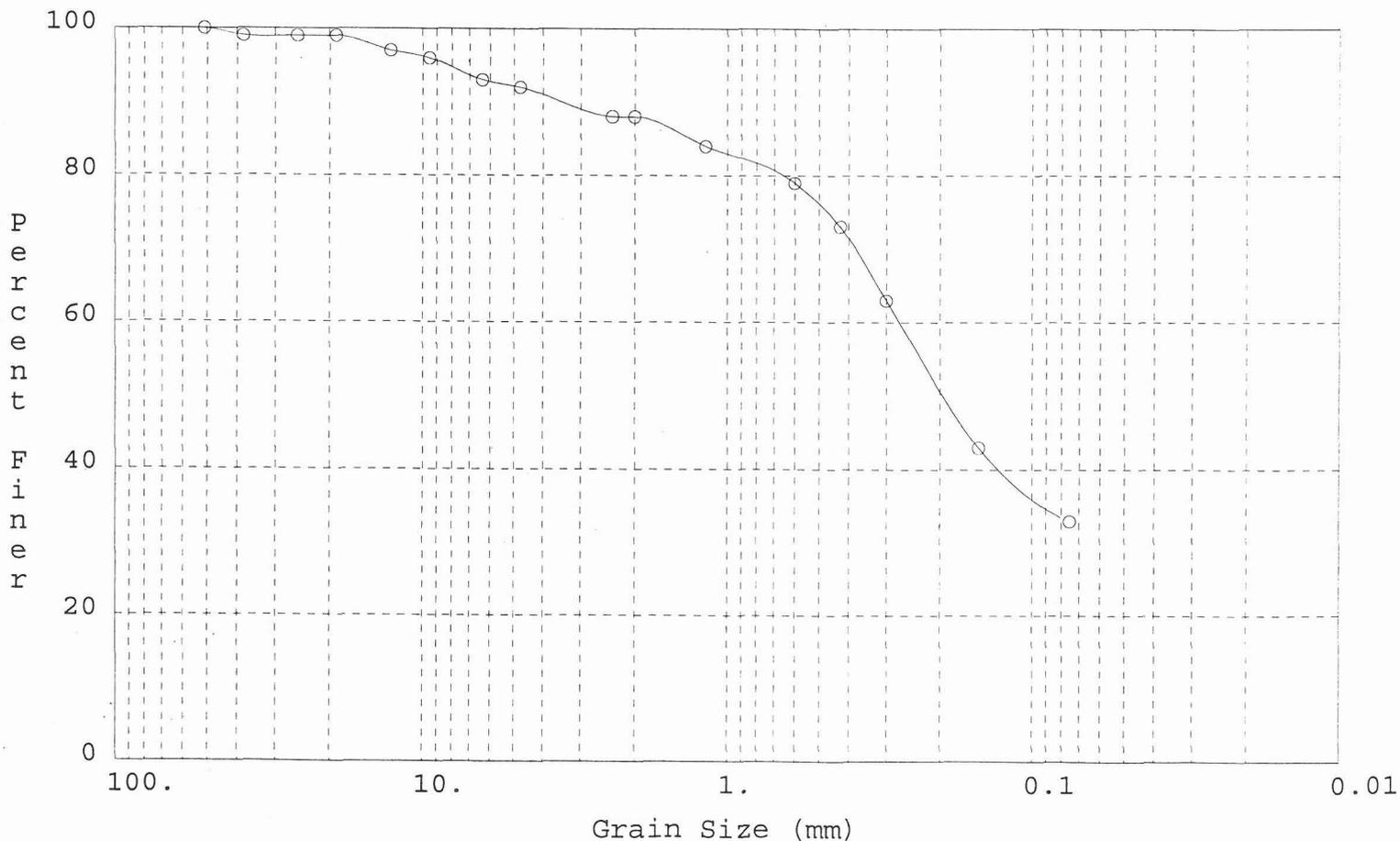
Sieve Analysis



Project Number = 196020-3 Client: Sverdrup Civil , Inc.  
 Location = Bullard Wash, Channel  
 Date = 10/1/97  
 Tested By = D. Johnson  
 Boring Number = 15  
 Depth = 2' - 15'  
 Sample Number = 97-0798  
 Description = Brown, silty SAND(SM)  
 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	10.00	1.00	1.00	99.00
1"	25.400	0.00	0.00	1.00	99.00
3/4"	19.050	0.00	0.00	1.00	99.00
1/2"	12.700	20.00	2.00	3.00	97.00
3/8"	9.500	10.00	1.00	4.00	96.00
1/4"	6.350	30.00	3.00	7.00	93.00
#4	4.750	10.00	1.00	8.00	92.00
#8	2.360	40.00	4.00	12.00	88.00
#10	2.000	0.00	0.00	12.00	88.00
#16	1.180	40.00	4.00	16.00	84.00
#30	0.600	50.00	5.00	21.00	79.00
#40	0.425	60.00	6.00	27.00	73.00
#50	0.300	100.00	10.00	37.00	63.00
#100	0.150	200.00	20.00	57.00	43.00
#200	0.075	100.00	10.00	67.00	33.00
Pan	0.000	0.00	0.00	67.00	33.00

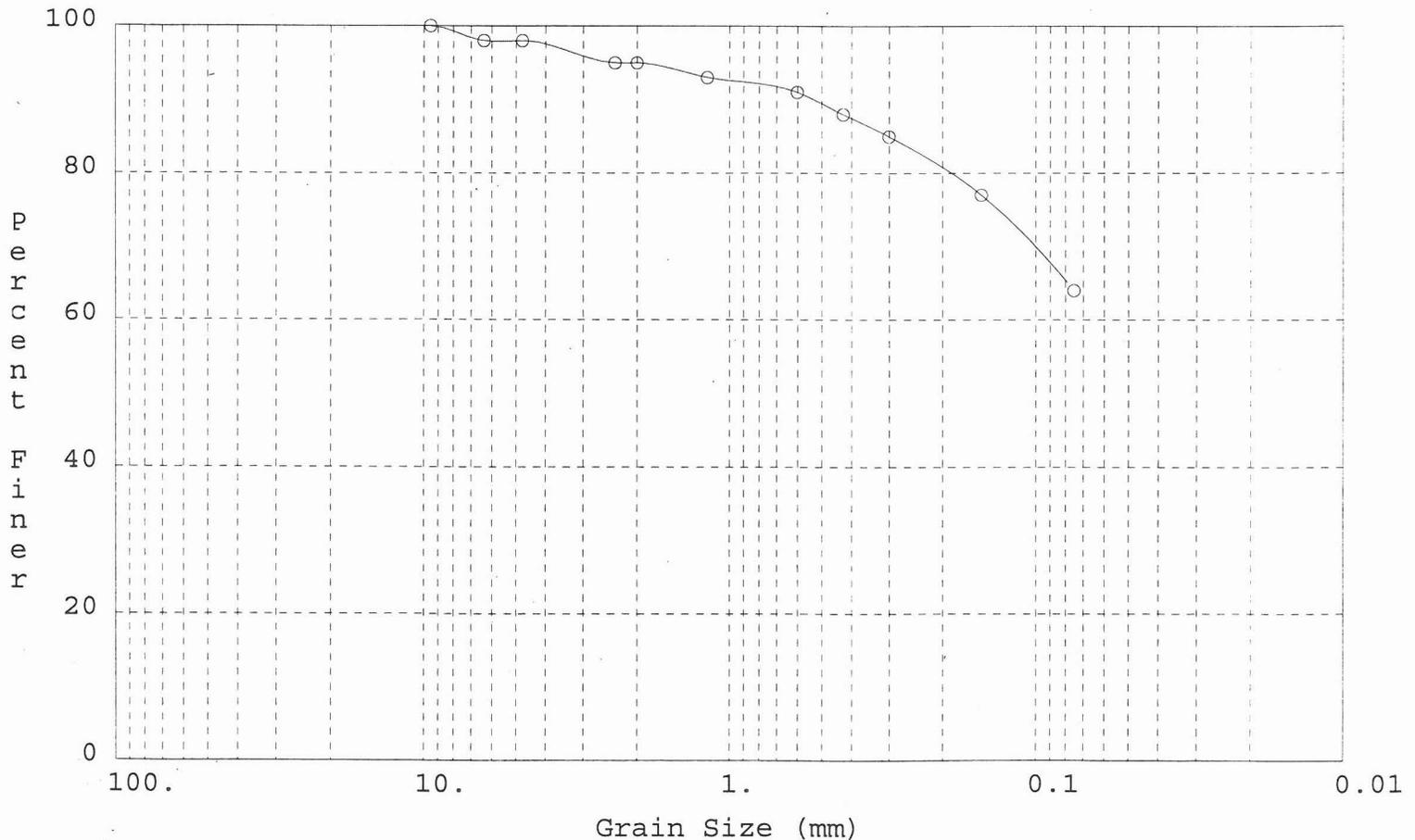
Sieve Analysis



Project Number = 196020-3 Client: Sverdrup Civil , Inc.  
 Location = Bullard Wash, Channel  
 Date = 10/1/97  
 Tested By = D. Johnson  
 Boring Number = 16  
 Depth = 4' - 10'  
 Sample Number = 97-0799  
 Description = Brown, sandy SILT (ML)  
 Dry Sample Weight (g) = 1000

SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
3/8"	9.500	0.00	0.00	0.00	100.00
1/4"	6.350	20.00	2.00	2.00	98.00
#4	4.750	0.00	0.00	2.00	98.00
#8	2.360	30.00	3.00	5.00	95.00
#10	2.000	0.00	0.00	5.00	95.00
#16	1.180	20.00	2.00	7.00	93.00
#30	0.600	20.00	2.00	9.00	91.00
#40	0.425	30.00	3.00	12.00	88.00
#50	0.300	30.00	3.00	15.00	85.00
#100	0.150	80.00	8.00	23.00	77.00
#200	0.075	130.00	13.00	36.00	64.00
Pan	0.000	0.00	0.00	36.00	64.00

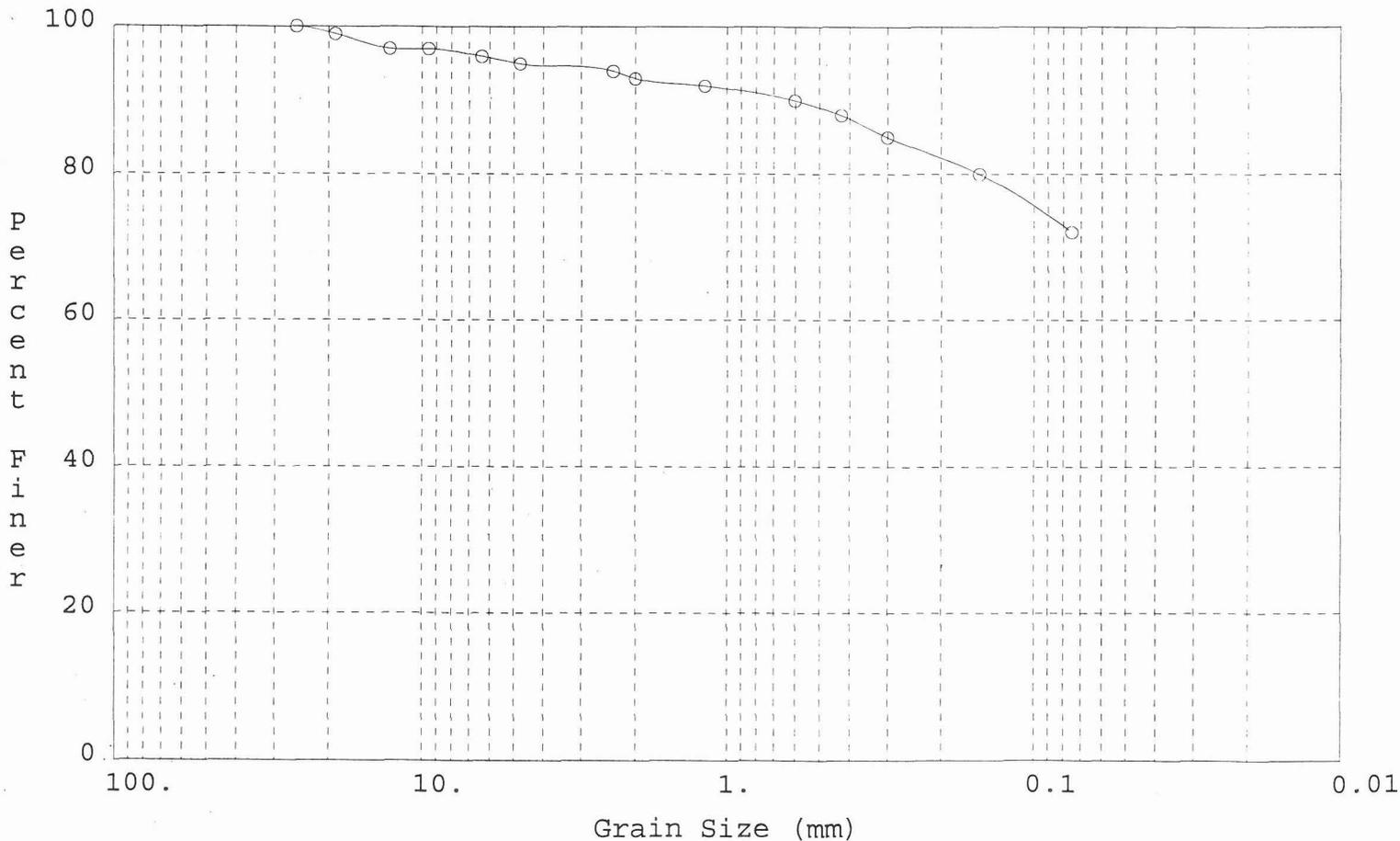
Sieve Analysis



Project Number = 196020-3 Client: Sverdrup Civil , Inc.  
 Location = Bullard Wash, Channel  
 Date = 10/1/97  
 Tested By = D. Johnson  
 Boring Number = 17  
 Depth = 0 - 8'  
 Sample Number = 97-0800  
 Description = Brown, silty CLAY(CL-ML) with sand  
 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	10.00	1.00	1.00	99.00
1/2"	12.700	20.00	2.00	3.00	97.00
3/8"	9.500	0.00	0.00	3.00	97.00
1/4"	6.350	10.00	1.00	4.00	96.00
#4	4.750	10.00	1.00	5.00	95.00
#8	2.360	10.00	1.00	6.00	94.00
#10	2.000	10.00	1.00	7.00	93.00
#16	1.180	10.00	1.00	8.00	92.00
#30	0.600	20.00	2.00	10.00	90.00
#40	0.425	20.00	2.00	12.00	88.00
#50	0.300	30.00	3.00	15.00	85.00
#100	0.150	50.00	5.00	20.00	80.00
#200	0.075	80.00	8.00	28.00	72.00
Pan	0.000	0.00	0.00	28.00	72.00

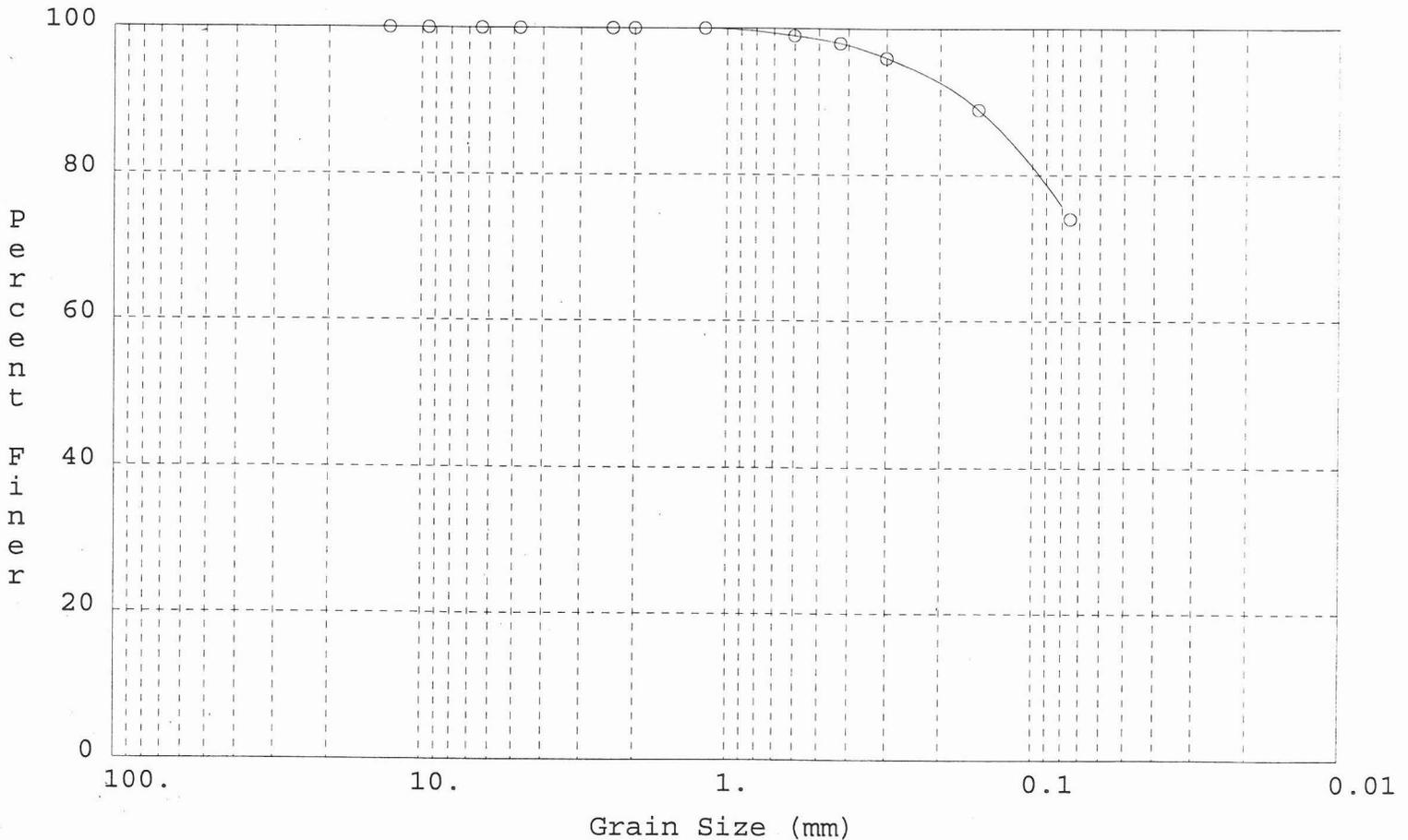
Sieve Analysis



Project Number = 196020-3    Client: Sverdrup Civil , Inc.  
 Location = Bullard Wash, Channel  
 Date = 9/29/97  
 Tested By = M. Blalock  
 Boring Number = 18  
 Depth = 0 - 6'  
 Sample Number = 97-0778  
 Description = Brown, SILT(ML) with sand  
 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	0.00	0.00	0.00	100.00
#4	4.750	0.00	0.00	0.00	100.00
#8	2.360	0.00	0.00	0.00	100.00
#10	2.000	0.00	0.00	0.00	100.00
#16	1.180	0.00	0.00	0.00	100.00
#30	0.600	10.00	1.00	1.00	99.00
#40	0.425	10.00	1.00	2.00	98.00
#50	0.300	20.00	2.00	4.00	96.00
#100	0.150	70.00	7.00	11.00	89.00
#200	0.075	150.00	15.00	26.00	74.00
Pan	0.000	0.00	0.00	26.00	74.00

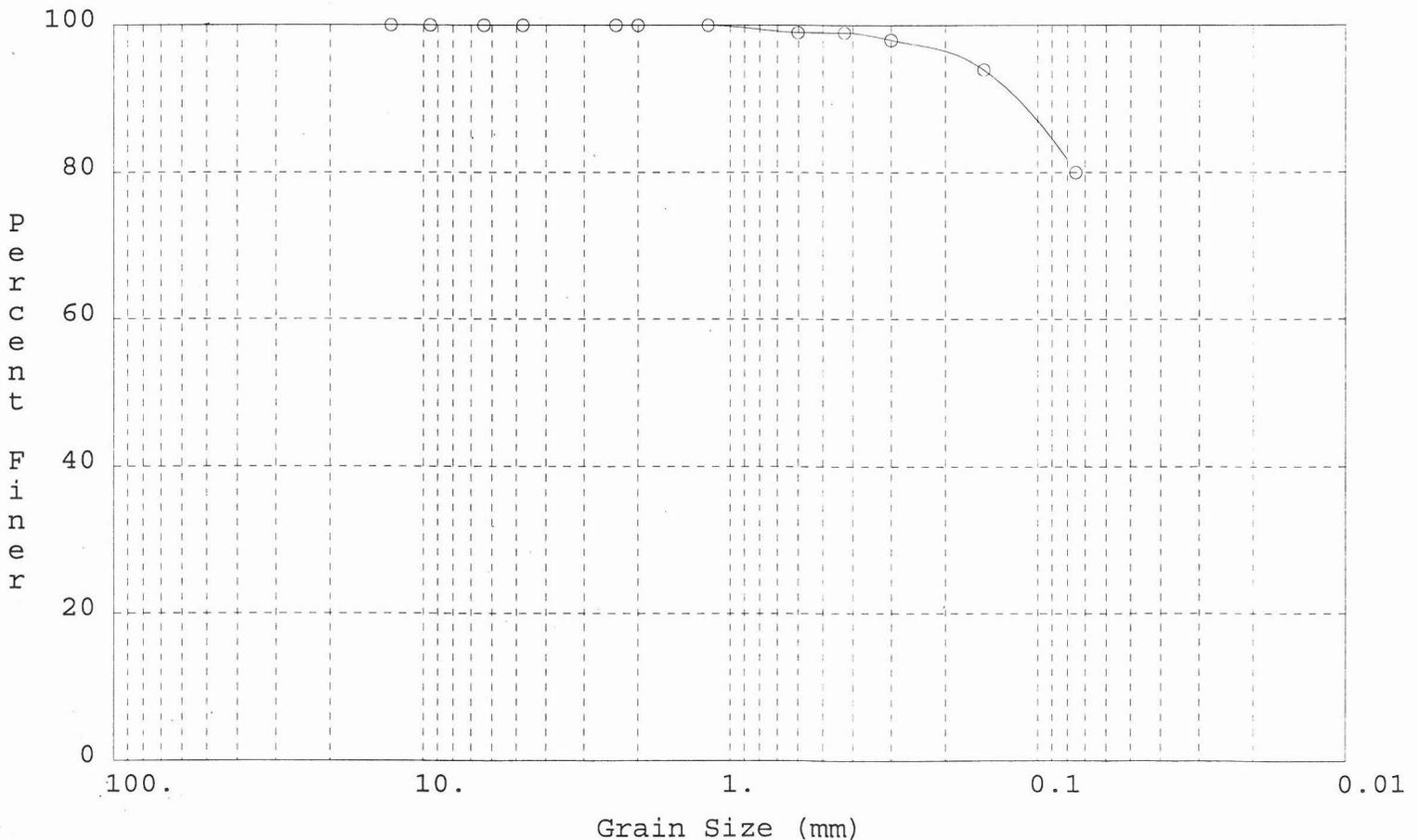
Sieve Analysis



Project Number = 196020-3    Client: Sverdrup Civil , Inc.  
 Location = Bullard Wash, Channel  
 Date = 9/29/97  
 Tested By = M. Blalock  
 Boring Number = 19  
 Depth = 0 - 11'  
 Sample Number = 97-0779  
 Description = Brown, SILT(ML) with sand  
 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	0.00	0.00	0.00	100.00
#4	4.750	0.00	0.00	0.00	100.00
#8	2.360	0.00	0.00	0.00	100.00
#10	2.000	0.00	0.00	0.00	100.00
#16	1.180	0.00	0.00	0.00	100.00
#30	0.600	10.00	1.00	1.00	99.00
#40	0.425	0.00	0.00	1.00	99.00
#50	0.300	10.00	1.00	2.00	98.00
#100	0.150	40.00	4.00	6.00	94.00
#200	0.075	140.00	14.00	20.00	80.00
Pan	0.000	0.00	0.00	20.00	80.00

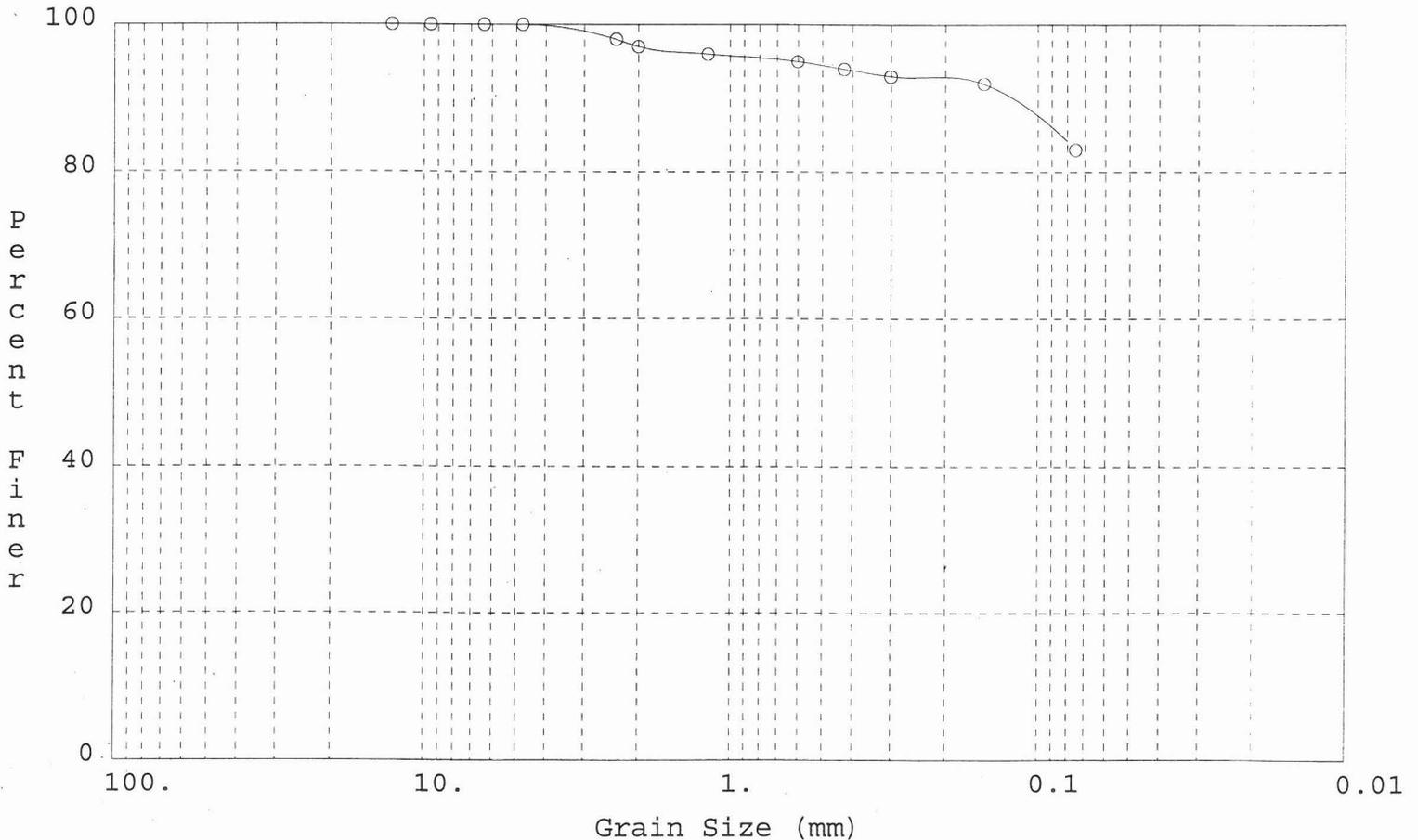
Sieve Analysis



Project Number = 196020-3    Client: Sverdrup Civil , Inc.  
 Location = Bullard Wash, Channel  
 Date = 9/29/97  
 Tested By = M. Blalock  
 Boring Number = 20  
 Depth = 8' - 15'  
 Sample Number = 97-0780  
 Description = Brown, SILT(ML) with sand  
 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	0.00	0.00	0.00	100.00
#4	4.750	0.00	0.00	0.00	100.00
#8	2.360	20.00	2.00	2.00	98.00
#10	2.000	10.00	1.00	3.00	97.00
#16	1.180	10.00	1.00	4.00	96.00
#30	0.600	10.00	1.00	5.00	95.00
#40	0.425	10.00	1.00	6.00	94.00
#50	0.300	10.00	1.00	7.00	93.00
#100	0.150	10.00	1.00	8.00	92.00
#200	0.075	90.00	9.00	17.00	83.00
Pan	0.000	0.00	0.00	17.00	83.00

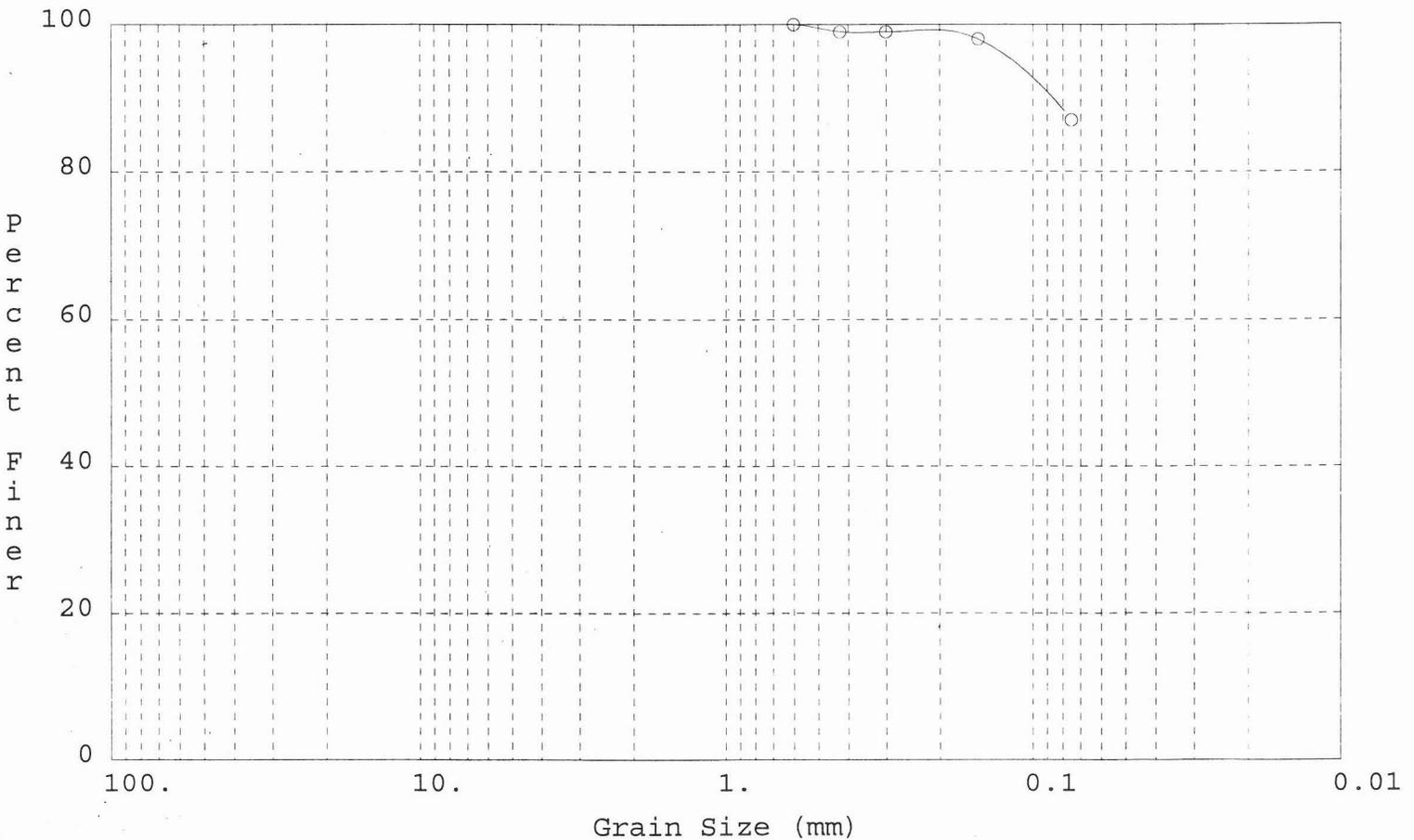
Sieve Analysis



Project Number = 196020-1 Client: Sverdrup Civil , Inc.  
 Location = Bullard Wash, Channel  
 Date = 10/4/97  
 Tested By = D. Johnson  
 Boring Number = 21  
 Depth = 0 - 11 1/2'  
 Sample Number = 97-0816  
 Description = Brown, SILT (ML)  
 Dry Sample Weight (g) = 1000

SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
#30	0.600	0.00	0.00	0.00	100.00
#40	0.425	10.00	1.00	1.00	99.00
#50	0.300	0.00	0.00	1.00	99.00
#100	0.150	10.00	1.00	2.00	98.00
#200	0.075	110.00	11.00	13.00	87.00
Pan	0.000	0.00	0.00	13.00	87.00

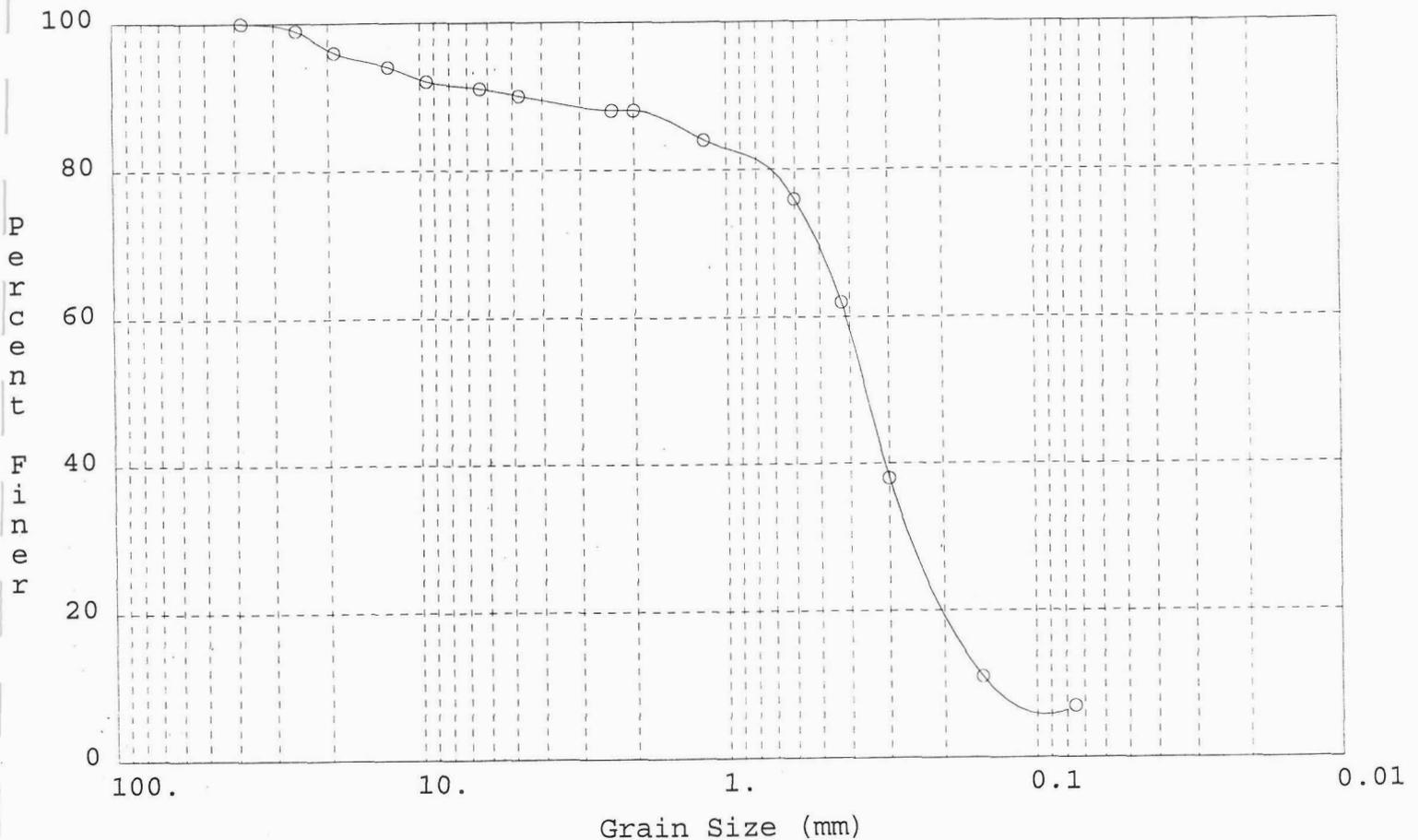
Sieve Analysis



Project Number = 196020-3 Client: Sverdrup Civil , Inc.  
 Location = Bullard Wash, Channel  
 Date = 10/4/97  
 Tested By = D. Johnson  
 Boring Number = 22  
 Depth = 4' - 6'  
 Sample Number = 97-0817  
 Description = Gray, Poorly graded SAND(SP-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 (%)
1 1/2"	38.100	0.00	0.00	0.00	100.00
1"	25.400	10.00	1.00	1.00	99.00
3/4"	19.050	30.00	3.00	4.00	96.00
1/2"	12.700	20.00	2.00	6.00	94.00
3/8"	9.500	20.00	2.00	8.00	92.00
1/4"	6.350	10.00	1.00	9.00	91.00
#4	4.750	10.00	1.00	10.00	90.00
#8	2.360	20.00	2.00	12.00	88.00
#10	2.000	0.00	0.00	12.00	88.00
#16	1.180	40.00	4.00	16.00	84.00
#30	0.600	80.00	8.00	24.00	76.00
#40	0.425	140.00	14.00	38.00	62.00
#50	0.300	240.00	24.00	62.00	38.00
#100	0.150	270.00	27.00	89.00	11.00
#200	0.075	40.00	4.00	93.00	7.00
Pan	0.000	0.00	0.00	93.00	7.00

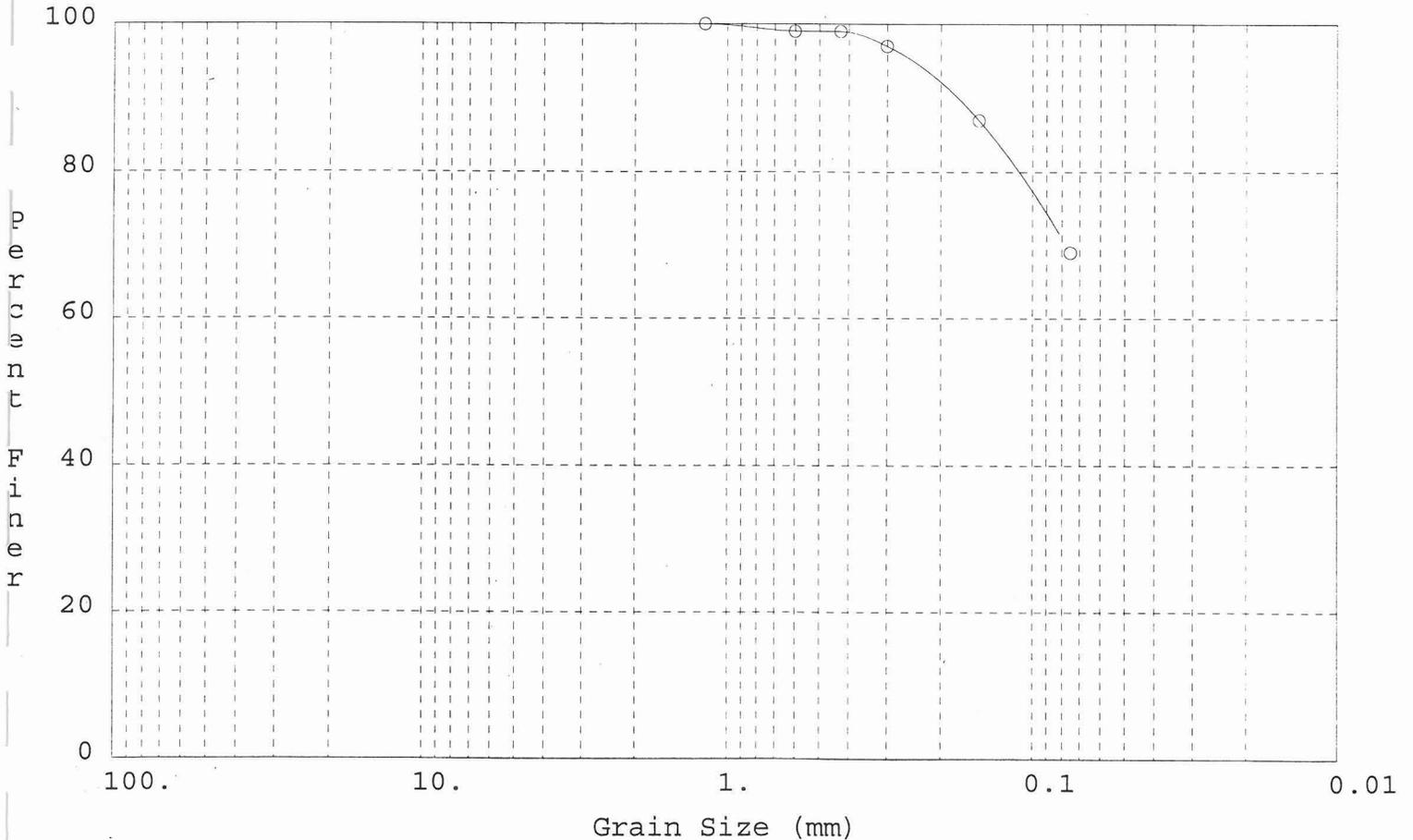
Sieve Analysis



Project Number = 196020-3 Client: Sverdrup Civil , Inc.  
 Location = Bullard Wash, East Tributary Channel  
 Date = 10/1/97  
 Tested By = D. Johnson  
 Boring Number = 23  
 Depth = 3' - 11 1/2'  
 Sample Number = 97-0801  
 Description = Brown, sandy, silty CLAY (CL-ML)  
 Dry Sample Weight (g) = 1000

SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
#16	1.180	0.00	0.00	0.00	100.00
#30	0.600	10.00	1.00	1.00	99.00
#40	0.425	0.00	0.00	1.00	99.00
#50	0.300	20.00	2.00	3.00	97.00
#100	0.150	100.00	10.00	13.00	87.00
#200	0.075	180.00	18.00	31.00	69.00
Pan	0.000	0.00	0.00	31.00	69.00

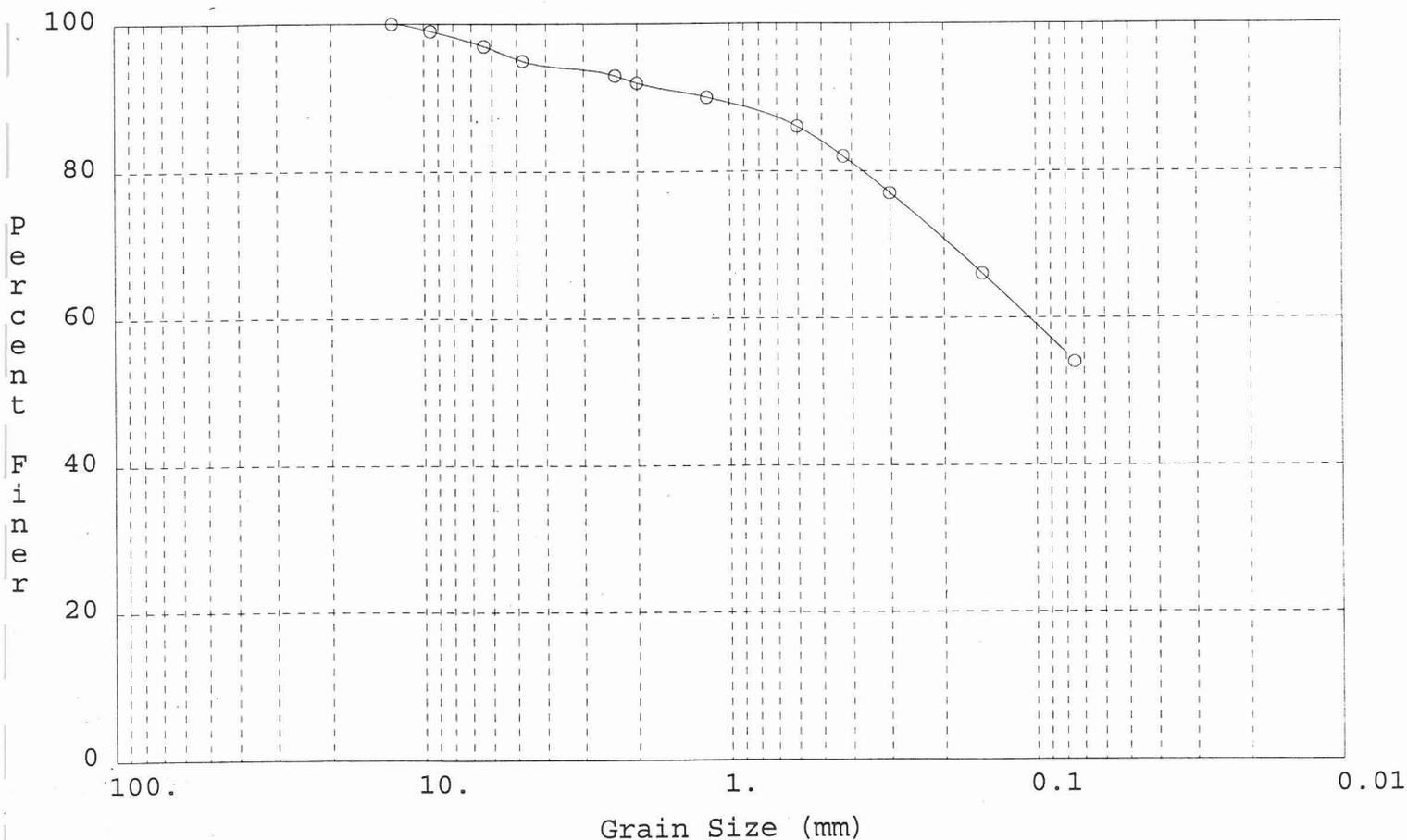
Sieve Analysis



Project Number = 196020-3 Client: Sverdrup Civil , Inc.  
 Location = Bullard Wash, East Tributary Channel  
 Date = 10/1/97  
 Tested By = L. Gitner  
 Boring Number = 24  
 Depth = 0 - 8'  
 Sample Number = 97-0802  
 Description = Brown, sandy lean CLAY (CL)  
 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	10.00	1.00	1.00	99.00
1/4"	6.350	20.00	2.00	3.00	97.00
#4	4.750	20.00	2.00	5.00	95.00
#8	2.360	20.00	2.00	7.00	93.00
#10	2.000	10.00	1.00	8.00	92.00
#16	1.180	20.00	2.00	10.00	90.00
#30	0.600	40.00	4.00	14.00	86.00
#40	0.425	40.00	4.00	18.00	82.00
#50	0.300	50.00	5.00	23.00	77.00
#100	0.150	110.00	11.00	34.00	66.00
#200	0.075	120.00	12.00	46.00	54.00
Pan	0.000	0.00	0.00	46.00	54.00

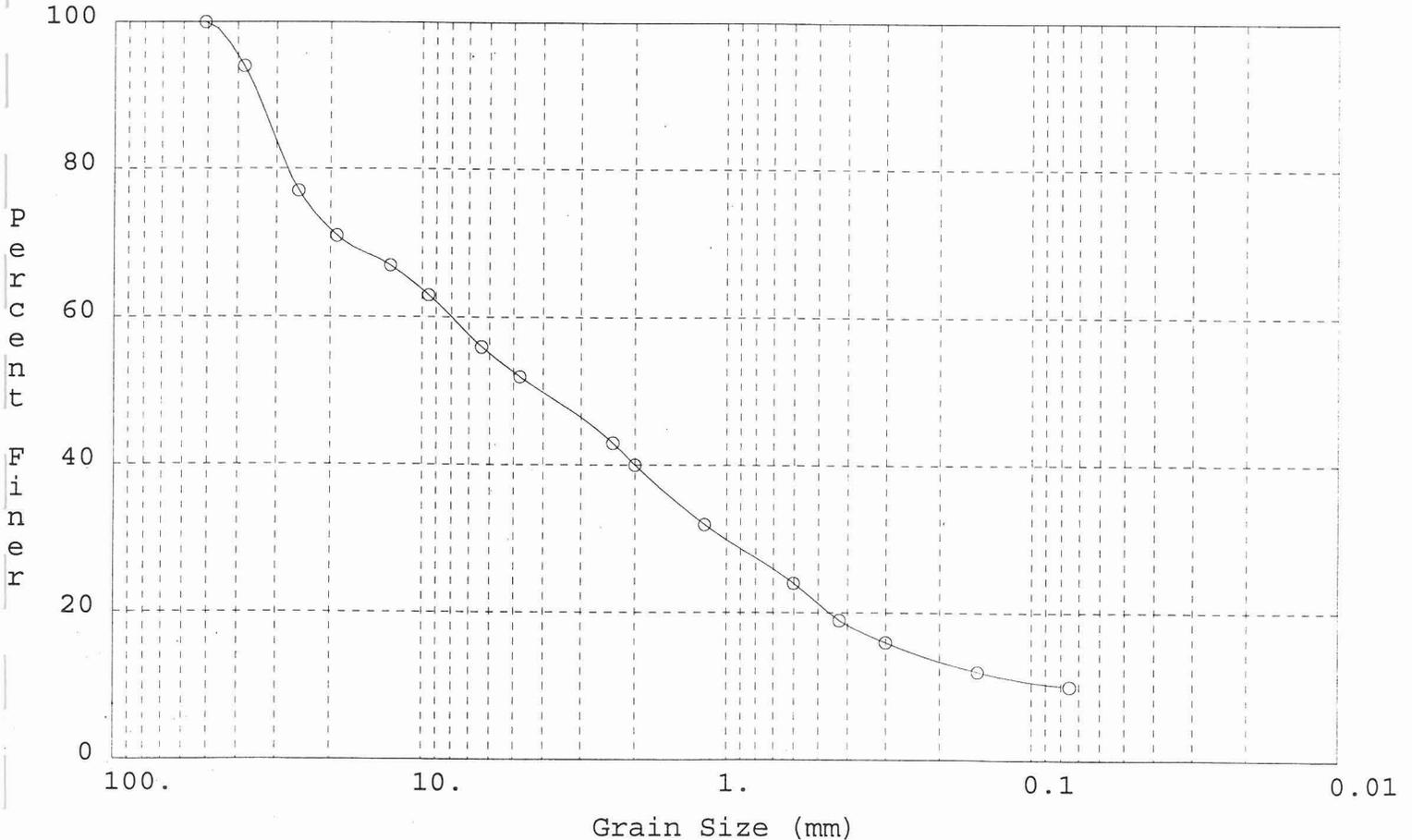
Sieve Analysis



Project Number = 196020-3 Client: Sverdrup Civil , Inc.  
 Location = Bullard Wash, East Tributary Channel  
 Date = 10/1/97  
 Tested By = D. Johnson  
 Boring Number = 25  
 Depth = 6'- 15'  
 Sample Number = 97-0803  
 Description = Gray-tan, SILT(ML)  
 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	60.00	6.00	6.00	94.00
1"	25.400	170.00	17.00	23.00	77.00
3/4"	19.050	60.00	6.00	29.00	71.00
1/2"	12.700	40.00	4.00	33.00	67.00
3/8"	9.500	40.00	4.00	37.00	63.00
1/4"	6.350	70.00	7.00	44.00	56.00
#4	4.750	40.00	4.00	48.00	52.00
#8	2.360	90.00	9.00	57.00	43.00
#10	2.000	30.00	3.00	60.00	40.00
#16	1.180	80.00	8.00	68.00	32.00
#30	0.600	80.00	8.00	76.00	24.00
#40	0.425	50.00	5.00	81.00	19.00
#50	0.300	30.00	3.00	84.00	16.00
#100	0.150	40.00	4.00	88.00	12.00
#200	0.075	20.00	2.00	90.00	10.00
Pan	0.000	0.00	0.00	90.00	10.00

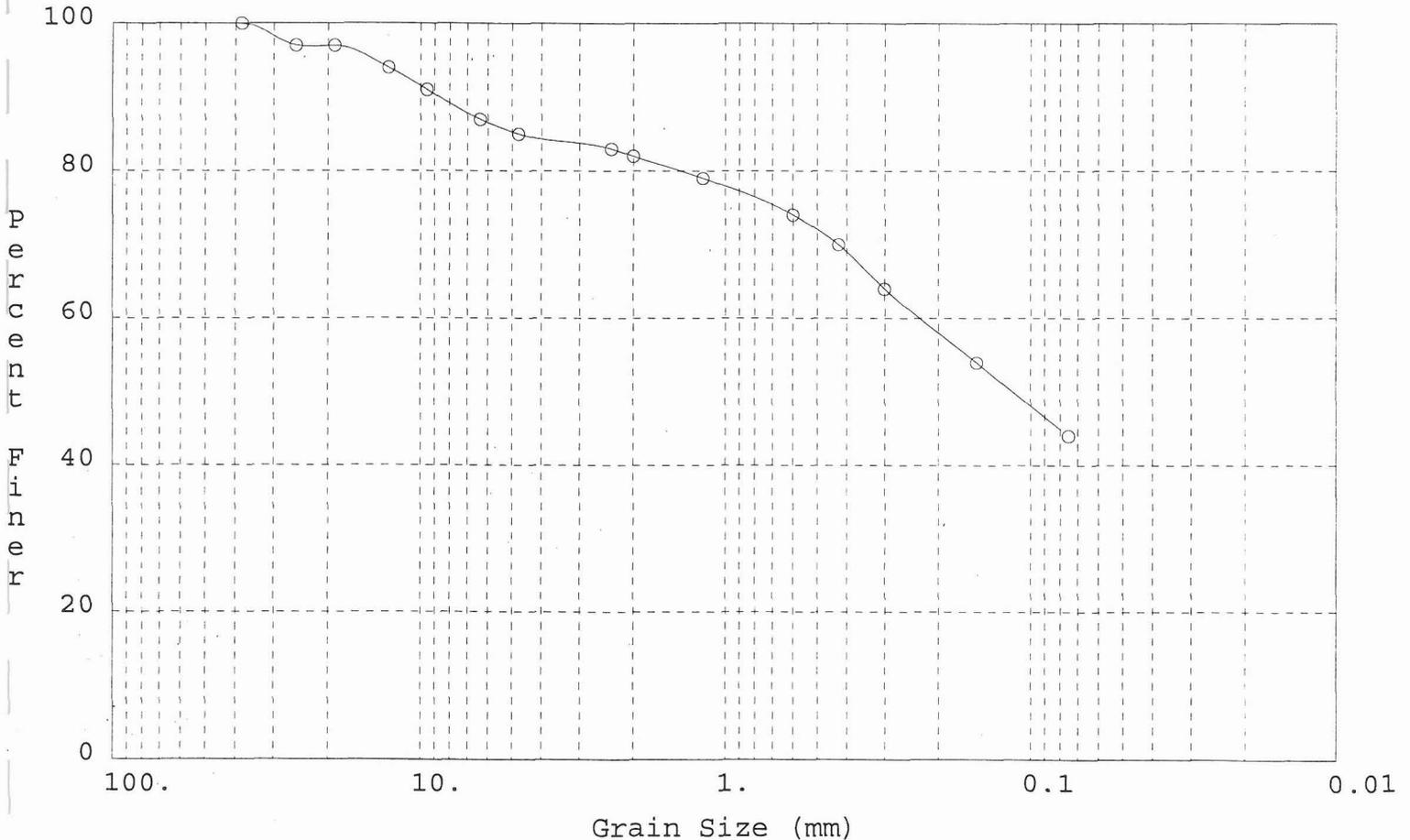
Sieve Analysis



Project Number = 196020-3 Client: Sverdrup Civil , Inc.  
 Location = Bullard Wash, East Tributary Channel  
 Date = 10/11/97  
 Tested By = D. Johnson  
 Boring Number = 26  
 Depth = 0 - 10'  
 Sample Number = 97-0804  
 Description = 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 (%)
1 1/2"	38.100	0.00	0.00	0.00	100.00
1"	25.400	30.00	3.00	3.00	97.00
3/4"	19.050	0.00	0.00	3.00	97.00
1/2"	12.700	30.00	3.00	6.00	94.00
3/8"	9.500	30.00	3.00	9.00	91.00
1/4"	6.350	40.00	4.00	13.00	87.00
#4	4.750	20.00	2.00	15.00	85.00
#8	2.360	20.00	2.00	17.00	83.00
#10	2.000	10.00	1.00	18.00	82.00
#16	1.180	30.00	3.00	21.00	79.00
#30	0.600	50.00	5.00	26.00	74.00
#40	0.425	40.00	4.00	30.00	70.00
#50	0.300	60.00	6.00	36.00	64.00
#100	0.150	100.00	10.00	46.00	54.00
#200	0.075	100.00	10.00	56.00	44.00
Pan	0.000	0.00	0.00	56.00	44.00

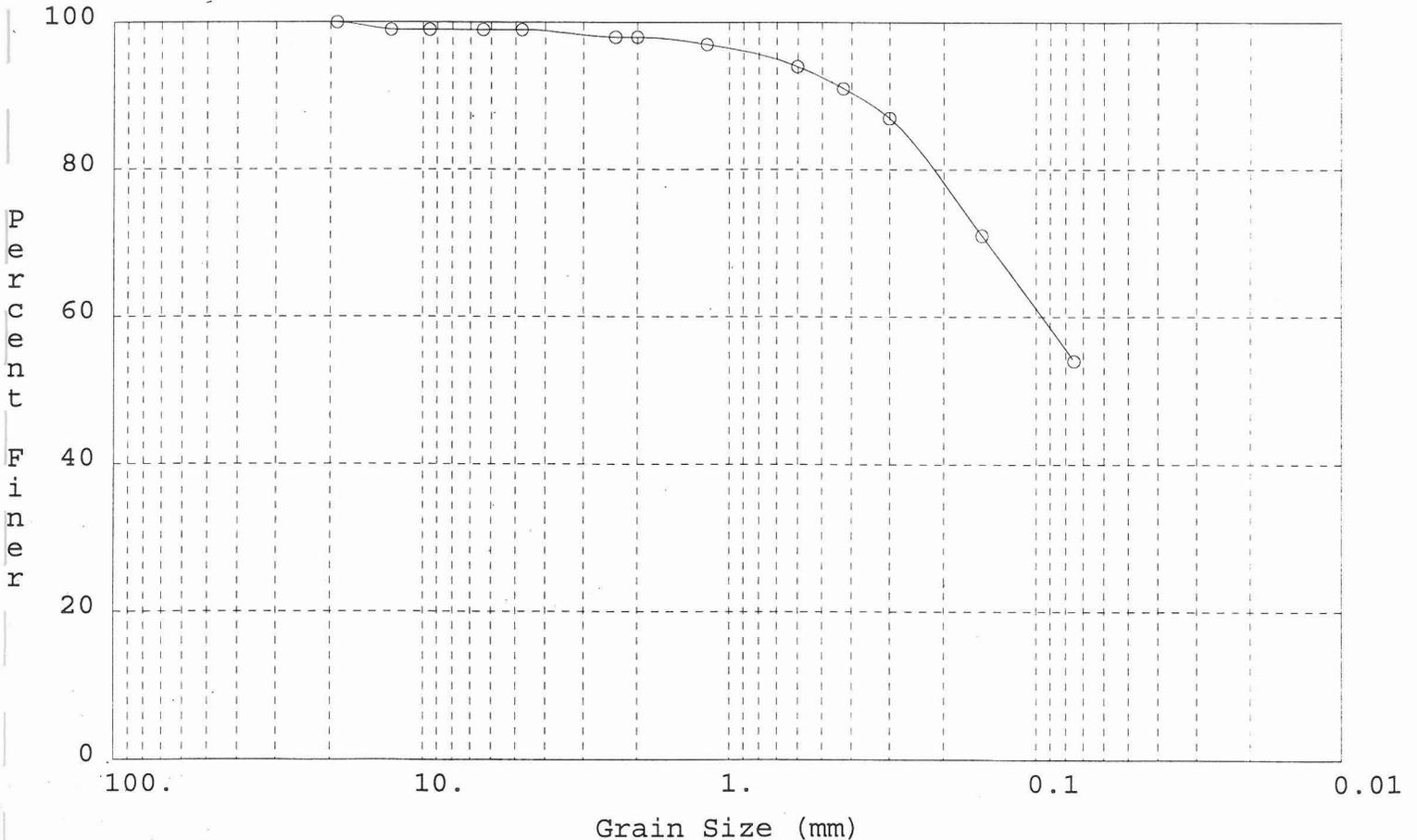
Sieve Analysis



Project Number = 196020-3 Client: Sverdrup Civil , Inc.  
 Location = Bullard Wash, East Tributary Channel  
 Date = 10/1/97  
 Tested By = D. Johnson  
 Boring Number = 27  
 Depth = 0 - 12 1/2'  
 Sample Number = 97-0806  
 Description = Brown, sandy SILT (ML)  
 Dry Sample Weight (g) = 1000

SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
3/4"	19.050	0.00	0.00	0.00	100.00
1/2"	12.700	10.00	1.00	1.00	99.00
3/8"	9.500	0.00	0.00	1.00	99.00
1/4"	6.350	0.00	0.00	1.00	99.00
#4	4.750	0.00	0.00	1.00	99.00
#8	2.360	10.00	1.00	2.00	98.00
#10	2.000	0.00	0.00	2.00	98.00
#16	1.180	10.00	1.00	3.00	97.00
#30	0.600	30.00	3.00	6.00	94.00
#40	0.425	30.00	3.00	9.00	91.00
#50	0.300	40.00	4.00	13.00	87.00
#100	0.150	160.00	16.00	29.00	71.00
#200	0.075	170.00	17.00	46.00	54.00
Pan	0.000	0.00	0.00	46.00	54.00

Sieve Analysis





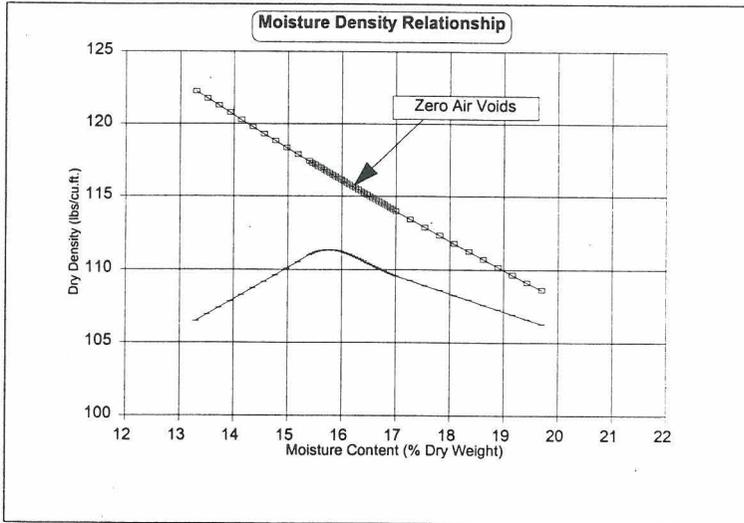
**Summary of Moisture Density Relationship Tests**

**Client:** Sverdrup Civil  
 432 N. 44th Street, Ste 250  
 Phoenix, Az 85008

**Job No.** 196020-3  
**Lab No.** 97-0813  
**Type of Rammer:** Manual  
**Test Date:** 10/07/97

**Project:** Bullard Wash - Channel  
**Test Designation:** ASTM D-698  
**Test Method:** A

**Material Description:** Brown, lean CLAY(CL)  
**Sample Source:** Boring No. 11 Depth: 5' - 10'



Specific Gravity Used For Zero Air Voids Curve: 2.65

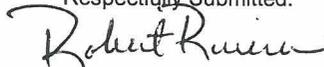
Test No.	1	2	3	4
Dry Density (lbs/cu.ft.)	106.5	111.0	109.6	106.3
Moisture Content (%)	13.3	15.4	17.0	19.7

Maximum Dry Density (lbs/cu.ft.): 111.3  
 Optimum Moisture Content (% of Dry Weight): 15.7

Remarks:

Reviewed By:   
 Input By: MC

Respectfully Submitted:

  
 Robert Rivera  
 Laboratory Supervisor



**Summary of Moisture Density Relationship Tests**

**Client:** Sverdrup Civil  
 432 N. 44th Street, Ste 250  
 Phoenix, Az 85008

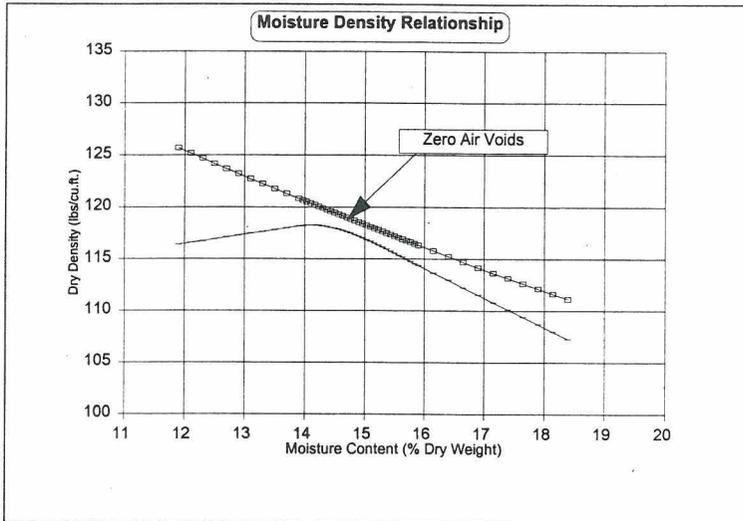
**Job No.** 196020-3  
**Lab No.** 97-0805  
**Type of Rammer:** Manual  
**Test Date:** 10/07/97

**Project:** Bullard Wash - Channel

**Test Designation:** ASTM D-698

**Test Method:** A

**Material Description:** Brown, silty SAND (SM) with gravel  
**Sample Source:** Boring No. 26 Depth: 0-10'



Specific Gravity Used For Zero Air Voids Curve: 2.65

Test No.	1	2	3	4
Dry Density (lbs/cu.ft.)	116.4	118.2	114.4	107.3
Moisture Content (%)	11.9	13.9	15.9	18.4

Maximum Dry Density (lbs/cu.ft.): 118.3  
 Optimum Moisture Content (% of Dry Weight): 14.1

Remarks:

Reviewed By:  
 Input By:

Respectfully Submitted:

Robert Rivera  
 Laboratory Supervisor



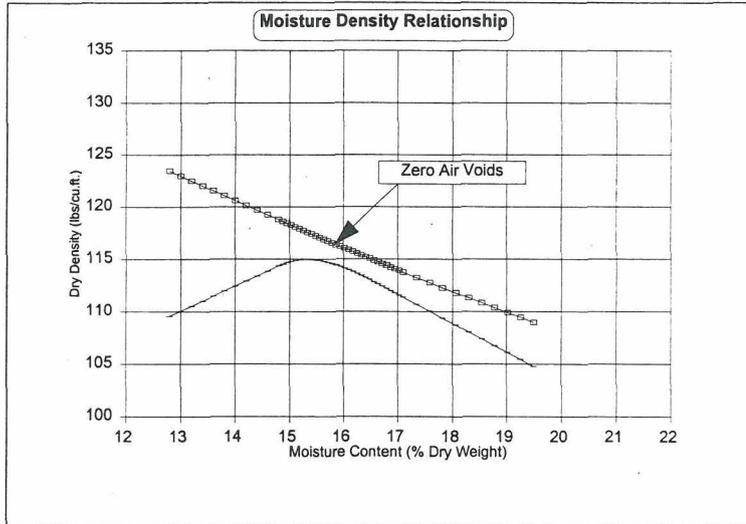
**Summary of Moisture Density Relationship Tests**

**Client:** Sverdrup Civil  
432 N. 44th Street, Ste 250  
Phoenix, Az 85008

**Job No.** 196020-3  
**Lab No.** 97-0779  
**Type of Rammer:** Manual  
**Test Date:** 10/07/97

**Project:** Bullard Wash - Channel  
**Test Designation:** ASTM D-698  
**Test Method:** A

**Material Description:** Brown, SILT(ML) with sand  
**Sample Source:** Boring No.:19 Depth: 0-11'



Specific Gravity Used For Zero Air Voids Curve: 2.65

Test No.	1	2	3	4
Dry Density (lbs/cu.ft.)	109.6	114.4	111.4	104.8
Moisture Content (%)	12.8	14.8	17.1	19.5

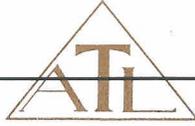
Maximum Dry Density (lbs/cu.ft.): **115.0**  
Optimum Moisture Content (% of Dry Weight): **15.3**

Remarks:

Reviewed By:   
Input By: 

Respectfully Submitted:

  
Robert Rivera  
Laboratory Supervisor



**BULLARD WASH - CHANNEL  
GOODYEAR, ARIZONA  
ATL JOB NO. 196020-3**

**PERCENT SWELL TEST  
(Surcharge = 100psf)**

<b><u>Boring No.</u></b>	<b><u>Sample Depth (ft)</u></b>	<b><u>USCS</u></b>	<b><u>Percent Swell</u></b>	<b><u>Dry Density (pcf)</u></b>	<b><u>Saturation Moisture (%)</u></b>
<b>11</b>	<b>5 - 10</b>	<b>CL</b>	<b>1.9</b>	<b>102.4</b>	<b>25.3</b>
<b>19</b>	<b>0 - 11</b>	<b>ML</b>	<b>1.9</b>	<b>105.5</b>	<b>24.4</b>



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**pH AND RESISTIVITY TESTS**

<b>Boring No.</b>	<b>Depth (Ft)</b>	<b>USCS</b>	<b>pH</b>	<b>Average Soil Resistivity (Ohms /cm<sup>3</sup>)</b>
11	5 - 10	CL	7.8	520
19	0 - 11	ML	8.2	991
26	0 - 10	SM	7.8	734