

# RAINBOW VALLEY

## Area Drainage Master Plan

Contract FCD 2006C029

### Sediment Yield Report



Submitted to



Submitted by

**URS**

in cooperation with

**Dibble  
Engineering**

October 2011

# Rainbow Valley Area Drainage Master Plan

## Sediment Yield Report

Prepared for:

**FLOOD CONTROL DISTRICT OF MARICOPA COUNTY**



Prepared by:

**URS CORPORATION**

October 2011



EXPIRES 9.30.2014

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## 1.0 EXECUTIVE SUMMARY

This Sediment Yield report has been prepared for the Flood Control District of Maricopa County (District) as part of the Rainbow Valley Area Drainage Master Plan (RVADMP). The sediment contributions to Waterman Wash were estimated using the Modified Universal Soil Loss Equation (MUSLE) method and the Zeller-Fullerton method. These methodologies were used to calculate the wash load, bed load, and total sediment yield using the Maricopa County Flood Control Districts DDMSW software version 4.6.0 (Reference 4). Six watersheds that contribute sediment to Waterman Wash were selected to be analyzed for this study. This report describes the methods and data used to compute the input parameters and the sediment yield results.

A USDA KINEROS2 model was developed to calculate the sediment yield for the Estrella Significant Wash Corridor 2 (Reference 5). The KINEROS2 model helps to analyze the sediment yield due to specific physical characteristics of the watershed. The KINEROS2 results are compared to the total sediment yield calculated using the empirical methods with DDMSW as well as similar sediment yield studies.

## 2.0 INTRODUCTION

The information and analysis presented in this report is part of the scope of work for the Rainbow Valley Area Drainage Master Plan (RVADMP) being prepared for the Flood Control District of Maricopa County under Contract FCD 2006C029. This report presents the existing conditions sediment yield estimates. Sediment yield is defined as the volume of stream sediment and soil transported from a watershed via the system of streams and washes located in the watershed, and can affect the storage or capacity of flood control structures and natural waterways. The data used to determine the sediment yield, as well as the methodologies used to determine the final result, are detailed in this report.

### 2.1 OBJECTIVE

The results of these analyses will be used to establish a baseline condition for the sediment yield for the significant wash corridors. This baseline condition could then be used to support the sediment transport and continuity functions of the recommended plan and help develop new regulations and/or rules of development for the significant wash corridors.

### 2.2 SCOPE

This study was performed by URS and Dibble Engineering for the District. This study is limited in its scope to planning level analyses of sediment yield in the RVADMP study area. The MUSLE method is used for predicting the event-based wash load for individual sub-basins upstream of points of interest along Waterman Wash. To determine the equivalent average annual wash load using MUSLE, event based sediment yields for 100-year, 50-year, 25-year, 10-year, 5-year, and 2-year storm events were evaluated. The Zeller-Fullerton equation was used to provide the event based bed load estimates for points of interest. To estimate the average annual bed load the sediment yield for 100-year, 50-year, 25-year, 10-year, 5-year, and 2-year storm events were evaluated. The average annual sediment yield was evaluated from the summation of the wash load and bed load estimates. The total sediment yield was adjusted using the sediment delivery ratio (SDR) developed by the District. The sediment yield analysis was completed on six of the nine Significant Wash Corridor (SWC) watersheds.

The KINEROS2 model was used to evaluate the event based sediment yield and average annual sediment yield at one of the six locations selected for sediment yield evaluation. The results from the KINEROS2 model were compared to the sediment yield obtained from MUSLE and Zeller-Fullerton methods. Further analysis of the KINEROS2 model was completed to test for parameter sensitivity for landuse and sediment input data.

### 2.3 LIMITATIONS/ASSUMPTIONS

The results described in this report are applicable only to the Rainbow Valley study area. Assumptions made for estimation of parameters were based on data provided to URS and Dibble Engineering, data collected by URS, and engineering judgment. District defaults were used for some parameters, but in some cases URS and Dibble Engineering performed additional analyses to estimate other parameters. Those estimations are documented within this report.

### 3.0 DESCRIPTION OF STUDY AREA

#### 3.1 LOCATION

The Rainbow Valley ADMP study area is bounded by the Sierra Estrella Mountains on the east, the Gila River on the north, and the North Maricopa Mountains on the west. The study area is shown on the Figure 1. The study area is approximately 515 square miles. Portions are located in the City of Avondale, City of Goodyear, and the Town of Buckeye. A large part of the study area is in unincorporated Maricopa County. There are portions of the study area that are controlled by federal, state, county, and Native American interests.

Within the Rainbow Valley study area six watersheds, also referred to as Significant Wash Corridors (SWC), were identified to be studied as part of the sediment yield analysis. Figure 1, contains the project area along with the sediment yield study locations and the soil sample locations. The total watershed areas to be studied are summarized in Table 1. The Estrella SWC-1 and 2 watersheds begin in the Sierra Estrella Mountains. Sonora SWC-1, 2, and 3 originate in the North Maricopa Mountains and Sonora SWC-4 begins in the South Maricopa Mountains. All watersheds are tributaries to Waterman Wash.

**Table 1, Watershed Area**

<b>Watershed</b>	<b>Estrella SWC - 1</b>	<b>Estrella SWC - 2</b>	<b>Sonora SWC - 1</b>	<b>Sonora SWC - 2</b>	<b>Sonora SWC - 3</b>	<b>Sonora SWC - 4</b>
Area, square miles	8.56	9.98	21.09	15.01	15.58	67.79

#### 3.2 PRECIPITATION AND CLIMATE

The study area is located in the Sonoran desert, which is characterized by two rainy seasons, one in the summer and one in the winter. The summer rainfalls are typically more intense and short-lived than the more widespread winter rainfalls, as the summer storms are typically fed by moisture from either the Gulf of California or the Gulf of Mexico, while the winter storms are typically associated with frontal storms from the Pacific Ocean. The total average annual rainfall in the Sonoran Desert is approximately 9 inches.

## 4.0 DATA SOURCES

### 4.1 MAPPING AND AERIAL PHOTOGRAPHY

The District provided the aerial imagery and topographic mapping for the study area. Aerial photographs from 2006 were provided for the entire study area and aerial photographs from 2007 were provided for a portion of the study area. The 10-foot contour interval mapping was provided for the entire study area. The 2-foot contour interval and 4-foot contour interval mapping were provided for a portion of the study area that included Waterman Wash and tributaries.

The 10-foot contour interval mapping was prepared as part of the countywide mapping project using orthophotographic methods for 1" = 500' horizontal scale by Landata Airborne Systems, Inc. More detailed topographic mapping was subsequently obtained for the Rainbow Valley area for the RVADMP. General Dynamics conducted the mapping project for the RVADMP, which covered over 300 square miles in Rainbow Valley, west of the Estrella Mountains from the Gila River to a point approximately 10 miles south of Maricopa Road. The northern 260+ square miles were mapped at and to meet National Map Accuracy Standards for 1"=200', 2-foot contour interval. The southern-most 40 square miles were mapped at and to meet National Map Accuracy Standards for 1"=200', 4-foot contour interval. The 2-foot and 4-foot mapping project was conducted under Contract FCD2003C067.

## 5.0 SEDIMENT YIELD

### 5.1 INTRODUCTION

Sediment yield is the amount of solid material moved by water past a particular point in a stream system, or alternately, the amount of material deposited in an enclosed basin. Sediment yield includes both particles small enough to be carried for a while in suspension by the supporting action of turbulence (wash load), and particles moved close to or at the bottom of the channel by rolling, sliding, or bouncing (bed load). When water is trapped behind flood retention structures, its velocity is reduced and the sediment carried by the water is deposited. Sediment yield is a major concern for public officials in charge of maintaining the effectiveness of flood control structures, because sedimentation behind dams or in floodways reduces the volume of water that can be stored or transported by the system. A reduction in effective volume increases the likelihood of a spillover in larger runoff events, increasing the chance of injuries, loss of human life, or property damage downstream, or damage to the structure itself.

### 5.2 AVERAGE ANNUAL SEDIMENT YIELD VS. EVENT-BASED SEDIMENT YIELD

Sediment yield can be examined in two different ways, the average annual sediment yield and the event-based sediment yield.

The event-based sediment yields are generated by specific frequency events, such as the 2-year flood or the 100-year flood. These predictions are useful in planning for future developments, but may not accurately estimate existing sediment yield. The event based sediment yield at a point of interest consists of two parts and is defined as the sum of the total bed material load and wash load delivered to the point of interest (Reference 1). The wash load is calculated by the MUSLE method and the total bed load is calculated with the Zeller-Fullerton equation. The sediment yield for a particular return period is defined as:

$$\text{BedL} + \text{SDR} * \text{WashL}$$

where: BedL = the total bed material load,

WashL = the wash load,

SDR = sediment delivery ratio.

The average annual sediment yield is the volume of sediment delivered to a point on average every year. Computations of average annual sediment yield take into account sediment yields from the selected runoff events, so they may overestimate the amount of sediment in drier years, but they may also underestimate the amount of sediment if a large single event occurs. The annual sediment yield is computed by:

$$\text{BedL}_P + \text{SDR} * \text{WashL}_P$$

where:  $\text{BedL}_P$  = a probability-weighted average value for Zeller-Fullerton over floods of different return periods

$\text{WashL}_P$  = is a probability-weighted average value for the MUSLE equation over floods of different return periods.

$\text{SDR}$  = sediment delivery ratio.

The probability-weighted values can be calculated by the following equations (Reference 1):

$$\text{Wash}_P = 0.015\text{Wash}_{P_{100}} + 0.015\text{Wash}_{P_{50}} + 0.04\text{Wash}_{P_{25}} + 0.08\text{Wash}_{P_{10}} + 0.2\text{Wash}_{P_5} + 0.4\text{Wash}_{P_2}$$

$$\text{BedL}_P = 0.015\text{Bed}_{P_{100}} + 0.015\text{Bed}_{P_{50}} + 0.04\text{Bed}_{P_{25}} + 0.08\text{Bed}_{P_{10}} + 0.2\text{Bed}_{P_5} + 0.4\text{Bed}_{P_2}$$

where:

$\text{Wash}_P$  = annual eroded wash load,

$\text{Wash}_{P_i}$  = eroded sediment for  $i = 2, 5, 10, 25, 50,$  and 100-year return periods using MUSLE,

$\text{BedL}_P$  = annual total bed material load,

$\text{Wash}_{P_i}$  = total bed material load for  $i = 2, 5, 10, 25, 50,$  and 100-year return periods using Zeller-Fullerton equation.

As part of this study both the event based sediment yield and the average annual sediment yield are calculated for each of the six SWCs. The results for each are discussed in section 7.0.

## 6.0 METHODOLOGIES USED

### 6.1 MUSLE

The MUSLE method was used to estimate the wash load part of the sediment yield calculations. The District's DDMSW 4.6.0 (river mechanics) software was used to perform the wash load calculations using the MUSLE method. Shapefiles of the significant wash corridor areas, soils, and landuse were entered into the DDMSW software. The basin area shapefile was intersected with the soils and landuse shapefiles within the software to obtain the parameters needed for the calculations. The  $D_{10}$ , defined as the equivalent diameter of which 10% of the sediment particle size is finer by weight, is used to calculate the Specific Weight of the soil and was calculated from soil samples taken as part of the RVADMP project.

#### 6.1.1 K – Soil Erodibility Factor

The K-values used came from the DDMSW default tables which had been prepared by the District for soils within Maricopa County and based on the Natural Resource Conservation Service (NRCS) soil data.

#### 6.1.2 C – Cover and Management Factor

The C-values and soil erosion factors were taken from the default tables within the DDMSW software. The C-values were reviewed and modified based on the aerial imagery for vegetative cover and land use to match the existing conditions.

#### 6.1.3 LS – Topographic Factor

The Topographic Factor, LS, is based on the slope length and slope. The MUSLE equation is best used for slope lengths of less than 400ft and slopes between 3 and 20 percent (DDMSW River Mechanics Manual 2010). The slope length is typically defined as the horizontal distance from the origination of overland flow to a location where there is either a defined channel or a gradient decrease enough to cause deposition of sediment. The upper reaches of the watershed consisted of mountainous terrain with slopes in excess of 20%. The lower reaches of the watershed consisted of areas that are relatively flat with slope from 1% to 5%. The slope and slope length was determined from an average of 5 locations throughout the watershed. A table summarizing the slope lengths and slope calculations can be found in with the DDMSW output in Appendix A. Table 2, summarizes the input parameters used for each watershed to calculate the topographic factor. Figures 2, 3, 4, 5, 6, and 7 show the SWC watersheds along the with the contributing HEC-1 sub-basins.

**Table 2, LS Input Parameters**

<b>Input Parameter</b>	<b>Length</b>	<b>Slope</b>
<b>Watershed</b>	<b>ft</b>	<b>%</b>
Estrella SWC - 1	4309	6.6
Estrella SWC - 2	5698	11.6
Sonora SWC - 1	6098	2.8
Sonora SWC - 2	5184	6.7
Sonora SWC - 3	10149	1.5
Sonora SWC - 4	5626	8.7

## **6.2 ZELLER-FULLERTON**

The Zeller-Fullerton method was used to calculate the bed load part of the sediment yield. The District's DDMSW 4.6.0 (river mechanics) software was used to perform the bed load calculations using the Zeller-Fullerton method. Using the 2-foot contour mapping, cross sections were created for each of the locations where the Zeller-Fullerton method was applied. Cross sections were located at the downstream end of the Watershed close to where it outlets into Waterman Wash. The soil gradation values  $D_{16}$ ,  $D_{50}$ , and  $D_{84}$  used for the bed-load calculations were determined from soil samples taken from the watersheds. Figure 1 shows the locations where sediment samples were taken to obtain the required sediment data. Figure 8 illustrates the locations of the cross sections used in the sediment yield analysis.

Hydrologic input parameters for the sediment yield analysis were obtained from the Hydrology Analysis done as part of the Rainbow Valley ADMP. The peak discharge and runoff volume associated with the SWC were obtained for the HEC-1 models for the various storm events.

## **6.3 KINEROS2**

KINEROS2 is a kinematic runoff and erosion model which is an event oriented model which describes the process of interception, infiltration, erosion and surface runoff from small watersheds. The watersheds are represented by a network of planes and channels which were roughly based on the HEC-1 model created for each wash corridor as part of the RVADMP.

The model planes were created by subdividing the HEC-1 basins into smaller areas with uniform slope and terrain. The channels were created based on the HEC-1 flowpaths or using the contours and aerial imagery. Both channels and planes were created as shapefiles and ArcGIS 9.3.1 was used to calculate the length, areas and slope of each (Reference 3).

Input parameters for the soil properties were estimated based on the soils shapefile for Maricopa County and the soils lookup table within DDMSW. Input parameters were based on the existing conditions landuse shapefile developed as part of the RVADMP and the landuse lookup table within DDMSW. Landuse parameters were adjusted at appropriate locations based on the aerial imagery. Rainfall data was obtained from DDMSW and sediment gradation data was obtained from soil samples taken in the study area. A technical memorandum was prepared to detail the process by which the input parameters were generated. The technical memorandum and supporting information for all input parameters used can be found in Appendix A.

### 6.3.1 KINEROS2 PARAMETER SENSITIVITY

As part of the Sediment Yield study a parameter sensitivity analysis was conducted on the KINEROS2 model. The parameters selected for sensitivity analysis included the sediment input data and the landuse data.

The input data for the KINEROS2 model consists of data for planes and streams. The input data for the planes consists of 16 parameters. Of these 16 parameters only one, the interception depth (IA), involves the consideration of the landuse type. Of the remaining input parameters nine are directly related to the soil data and the remaining are related to the plane geometry and vegetation.

To examine the sensitivity of the model for landuse the interception depth parameter was varied from 0.1 to 0.5. All other parameters were held constant. As the results in Table 3 show, the sediment yield varied from 107 lbs/acre to 78 lbs/acre over the range of IA values.

**Table 3, Landuse parameter sensitivity results**

Landuse Description	Interception Depth (IA), inches	Yield, lb/acre
Commercial	0.1	107.02
Desert Landscaping 2	0.2	102.54
Mountain Terrain	0.25	99.22
Very low density residential	0.3	95.98
Undeveloped Desert		
Rangeland	0.35	92.93
Agriculture	0.5	78.23

To test the sediment data sensitivity the same 100-year model was used with the sediment diameter sizes varying. The KINEROS2 model requires a list of representative soil particle diameters be entered in the global parameters for up to 5 particle classes. The particle classes correspond to the density input parameter and the fractions input parameter. The density input

parameter provides the representative density for each particle class while the fraction parameter provides the sediment distribution, in percentage, in each particle class. To test for sensitivity the fractions and density parameters were held constant and the sediment particle diameters were varied. Sediment Yield was calculated for the model at each set of particle diameters the results are presented in Table 4.

**Table 4, Sediment data sensitivity results**

Model #	Diameter Sizes (mm)	Yield lbs/acre
1	2.0, 0.25, 0.01	92.93
2	32.0, 1.0, 0.125	8.03
3	128.0, 2.0, 0.25	4.01
4	1.0, .125, 0.008	119.16
5	1.0, 0.0625, 0.002	460.82
6	2.0, 0.5, .016	57.80
7	2.0, 0.25, 0.015	63.28
Density	2.65, 2.60, 2.60	
Sediment Distribution Percentage	.03, .42, .55	

The data in Tables 3 and 4 show that by changing the diameter size (Table 4) by 50% the yield per acre can be changed by 32%. Alternatively, changing the IA (Table 3) parameter by 50% affects the yield per acre by only 9%. The results indicate higher sensitivity to diameter input for KINEROS2 model compared to the landuse parameter input.

### 6.3.2 KINEROS2 & MUSLE COMPARISON

The KINEROS model is an event oriented, physically based model which estimates erosion and sedimentation through a series of planes and channels. Within KINEROS, spatial variability of rainfall and infiltration, runoff, and erosion parameters can be accommodated. This modeling approach enables KINEROS to be used to determine the effect of various artificial features such as urban developments, small detention reservoirs, or lined channels on flood hydrographs and sediment yield (Woolhiser, 1990). The MUSLE method is similar to the KINEROS model but can estimate sediment supplied from individual design storms as well as average annual sediment production. The MUSLE method only estimates storm erosion but not the processes (e.g. infiltration, runoff, etc) within a storm (Sun 2002).

## 7.0 DISCUSSION OF RESULTS

The results of the sediment yield analysis are presented in the Tables 5, 6, 7 and 8. The peak flows used to calculate the sediment yield were obtained from the Rainbow Valley ADMP. The wash load and bed load yield were calculated for the 24 hour 2-year, 5-year, 10-year, 25-year, 50-year, 100-year, and annual events. The sediment delivery ratio (SDR) curve developed by the District was applied to the wash load to calculate the total sediment yield for each return period (Return Period = SDR\*Wash+Bed). The SDR curve developed by the District is based on the USDA curve with a shift to make the curve more suitable to an arid/semiarid region such as Arizona (Reference 1).

**Table 5, Bed Load**

Bed Load						
Watershed	Estrella-SWC-1	Estrella SWC - 2	Sonora SWC - 1	Sonora SWC - 2	Sonora SWC - 3	Sonora SWC - 4
Year	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)
2	0.073	0.31	0.014	0.008	0.001	-
5	0.156	0.518	0.055	0.032	0.004	0.004
10	0.255	0.895	0.083	0.054	0.012	0.176
25	0.12	1.794	0.038	0.105	0.037	0.249
50	0.118	2.391	0.04	0.175	0.044	0.532
100	0.156	3.69	0.063	0.254	0.087	0.974
Annual	0.09	0.462	0.026	0.025	0.006	0.047

**Table 6, Wash Load**

Wash Load						
Watershed	Estrella-SWC-1	Estrella SWC - 2	Sonora SWC - 1	Sonora SWC - 2	Sonora SWC - 3	Sonora SWC - 4
Year	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)
2	1.849	3.093	0.04	0.155	-	-
5	3.495	5.276	0.109	0.464	0.028	0.003
10	5.365	7.704	0.213	0.837	0.096	0.168
25	8.601	12.096	0.418	1.501	0.24	2.268
50	11.332	14.948	0.661	2.175	0.439	7.635
100	14.546	20.24	0.979	2.969	0.69	20.456
Annual	2.6	3.92	0.096	0.359	0.04	1.032

**Table 7, Total Yield**

Total Yield						
Watershed	Estrella-SWC-1	Estrella SWC - 2	Sonora SWC - 1	Sonora SWC - 2	Sonora SWC - 3	Sonora SWC - 4
Year	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)
2	1.922	3.403	0.054	0.163	0.001	0.003
5	3.651	5.794	0.164	0.496	0.032	0.172
10	5.62	8.599	0.296	0.891	0.108	2.444
25	8.721	13.89	0.456	1.606	0.277	7.884
50	11.45	17.339	0.701	2.35	0.483	14.078
100	14.702	23.93	1.042	3.223	0.777	21.43
<b>Annual</b>	2.69	4.382	0.122	0.384	0.046	1.079

The KINEROS2 model results are shown in Table 8, along with the results of the bed load and wash load analysis using DDMSW for the same watershed. As the table shows the results for the KINEROS2 model are much lower than the results found using DDMSW.

**Table 8, KINEROS2 Comparison of Results**

Total Yield		
Watershed	Estrella SWC - 2	KINEROS2 Estrella SWC - 2
Year	(ac-ft)	(ac-ft)
2	0.359	0.000
5	0.616	0.000
10	0.891	0.002
25	1.346	0.056
50	1.651	0.172
100	2.274	0.348
<b>*Annual</b>	0.451	0.010

\* calculated using the average annual sediment yield equation from section 5.2.

## 7.1 COMPARISON OF RESULTS WITH FCDMC DATA

The results of the MUSLE and Zeller-Fullerton calculations show an annual sediment yield for the Sonoran SWC Watersheds that is lower than expected for Maricopa County based on the results of previous studies. The Estrella SWC Watersheds fall within the expected range for Watersheds within Maricopa County. Table 9, is a comparison of results from previous studies completed in Arizona. Figure 9, shows the sediment yield results plotted on Figure 11.21 Regional Sediment Yield as a Function of Drainage Area from the Districts Hydraulics Manual

(Reference 1). The lines on the graph indicate the envelope for 51 U.S. Watersheds (Reference 2).

**Table 9, Comparison of Results**

Location	Area (sq mi)	Sediment Yield (ac-ft/sq. mi./year)
<sup>1</sup> Cave Creek Dam, AZ	121	0.24
<sup>1</sup> Spookhill FRS, AZ	16.4	0.15
<sup>1</sup> Saddleback FRS, AZ	30	0.08
<sup>1</sup> Alhambra Tank, AZ	6.61	0.03
<sup>1</sup> Black Hills Tank, AZ	1.14	0.68
<sup>1</sup> Black Hills Tank, AZ	1.56	0.58
<sup>2</sup> <i>Estrella SWC - 1</i>	<b>8.56</b>	<b>0.439</b>
<sup>2</sup> <i>Estrella SWC - 2</i>	<b>9.99</b>	<b>0.314</b>
<sup>2</sup> <i>Sonora SWC - 1</i>	<b>21.09</b>	<b>0.006</b>
<sup>2</sup> <i>Sonora SWC - 2</i>	<b>15.01</b>	<b>0.026</b>
<sup>2</sup> <i>Sonora SWC - 3</i>	<b>15.58</b>	<b>0.003</b>
<sup>2</sup> <i>Sonora SWC - 4</i>	<b>67.80</b>	<b>0.016</b>

<sup>1</sup>Data from the Districts Hydraulics Manual

<sup>2</sup>Results from the RVADMP Sediment Yield Study

The sensitivity of the wash load calculation for parameters such as slope and slope length may have contributed to the low sediment yield results for the Sonoran SWC watersheds. Due to the larger size of the watersheds and the long narrow nature of them the slope in the Sonoran watersheds tended to be lower than that found in the Estrella Watersheds. It was found that as slope values increase so does the total yield calculated for the watershed.

The results from this sediment yield analysis were used to establish a baseline condition for the sediment yield for the significant wash corridors. This baseline condition was then used to support the sediment transport and continuity functions of the recommended plan and help develop new regulations and/or rules of development for the significant wash corridors. The results from this study show that the sediment yield for the Waterman Wash watershed is relatively low compared to other watersheds within Arizona.

## 8.0 REFERENCES

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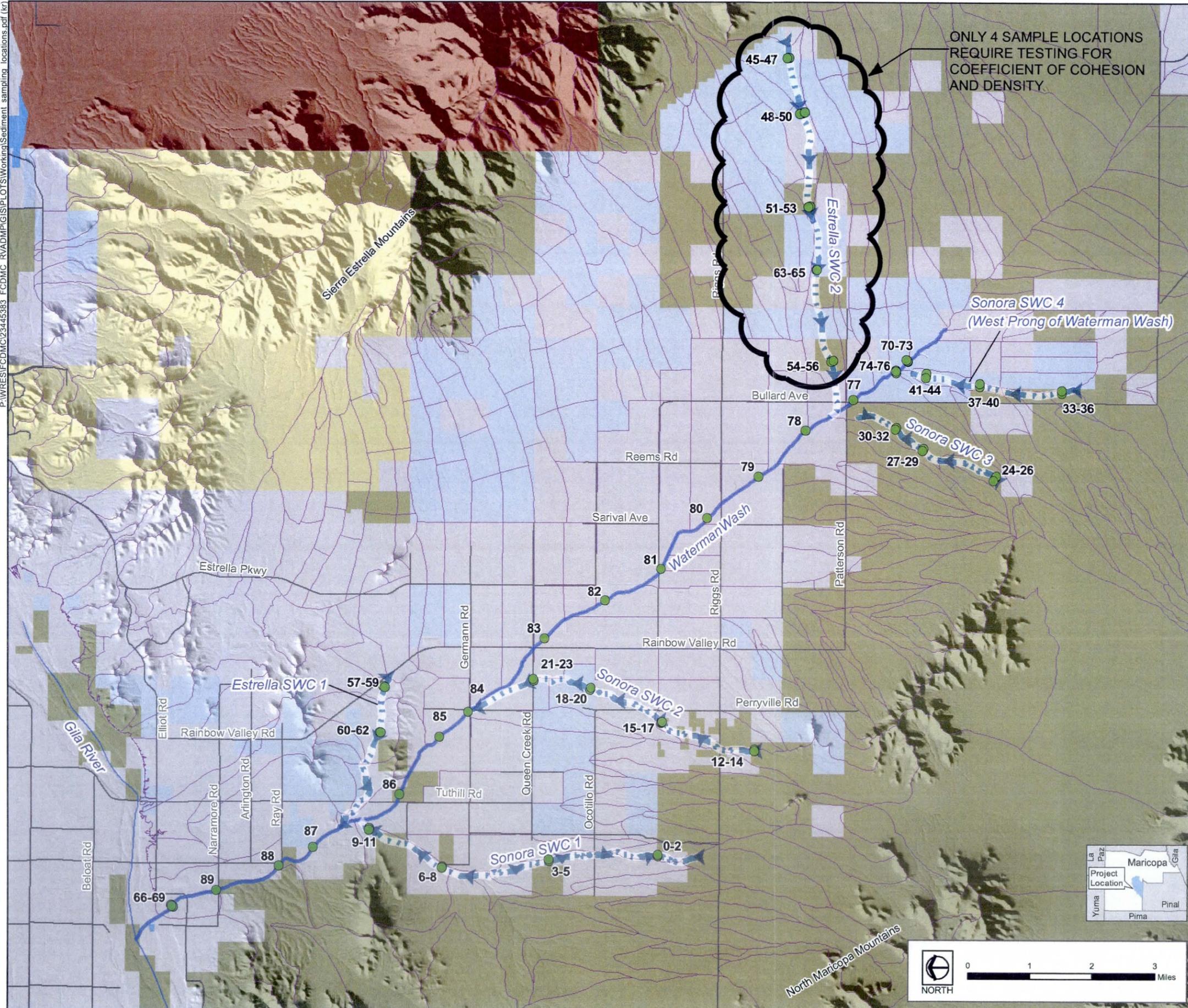
**FIGURES**

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# Rainbow Valley Area Drainage Master Plan Sediment Sample Location



Figure 1



### Project Features

- Sediment Sample Locations
  - Significant Wash Corridor
  - Waterman Wash
  - HEC-1 Drainage Sub-Basin
- ### Surface Management
- Bureau of Land Management
  - Gila River Indian Reservation
  - State Trust Land
  - Arizona Game and Fish Department (State Land)
  - County, Park and Outdoor Recreation Area
  - Private Land

### Reference Features

- Gila River
- Major Road

### Data Sources

Sediment Sampling Locations: URS 2010  
 Base: Flood Control District of Maricopa County 2008

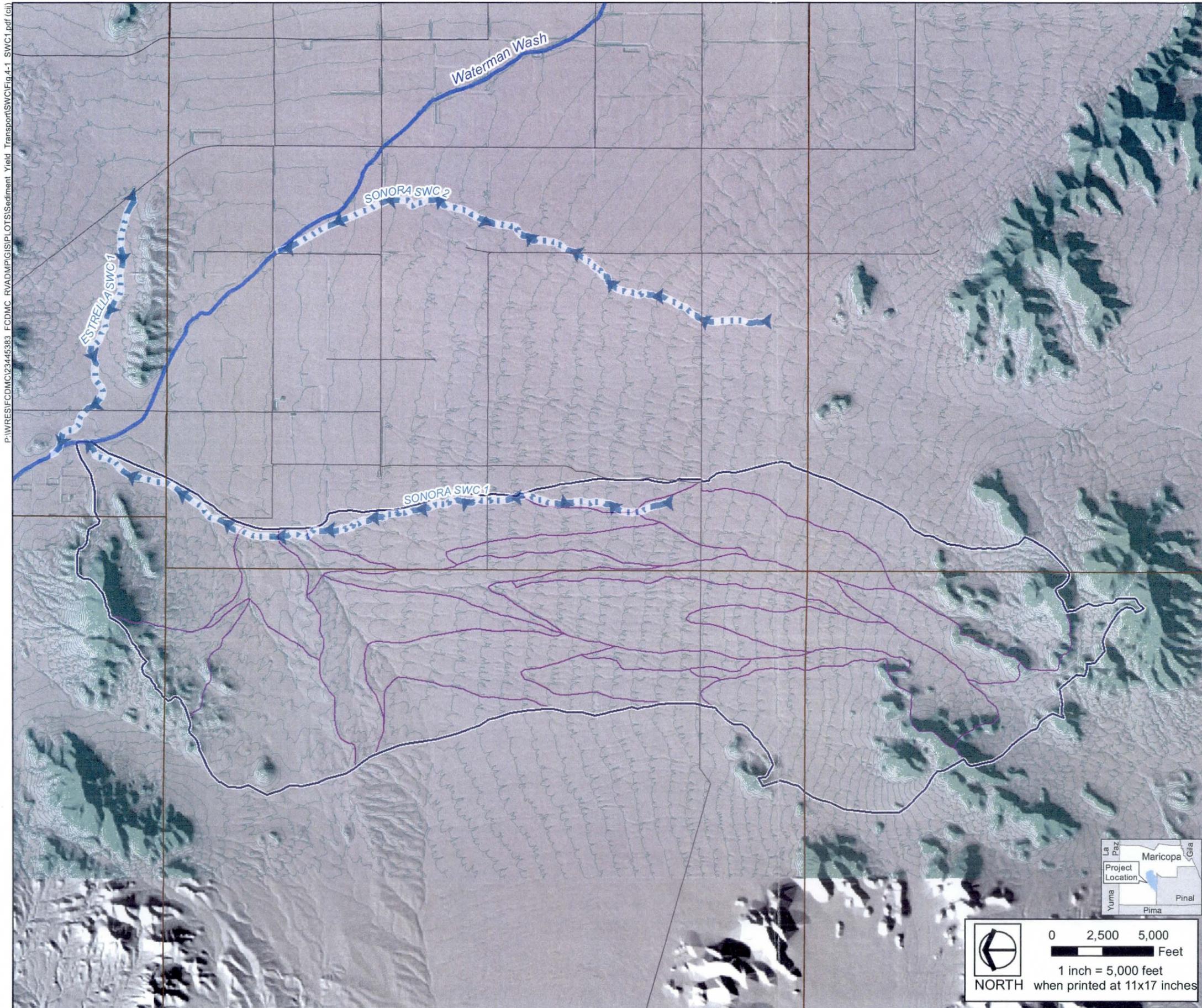


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Rainbow Valley  
Area Drainage Master Plan  
Significant Wash Corridor  
Sonora SWC 1



Figure 2



**Project Features**

- Significant Wash Corridor
- Waterman Wash
- Watershed Boundary
- HEC-1 Drainage Sub-Basin
- 10ft Contour

**Reference Features**

- County Boundary
- Rainbow Valley ADMP Boundary
- Township and Range Boundary
- Interstate Highway/Freeway
- Major Road
- River/Stream

**Data Sources**

Flood Control District of Maricopa County  
Base Vector and Hillshade Data, 2008



NORTH

0 2,500 5,000 Feet

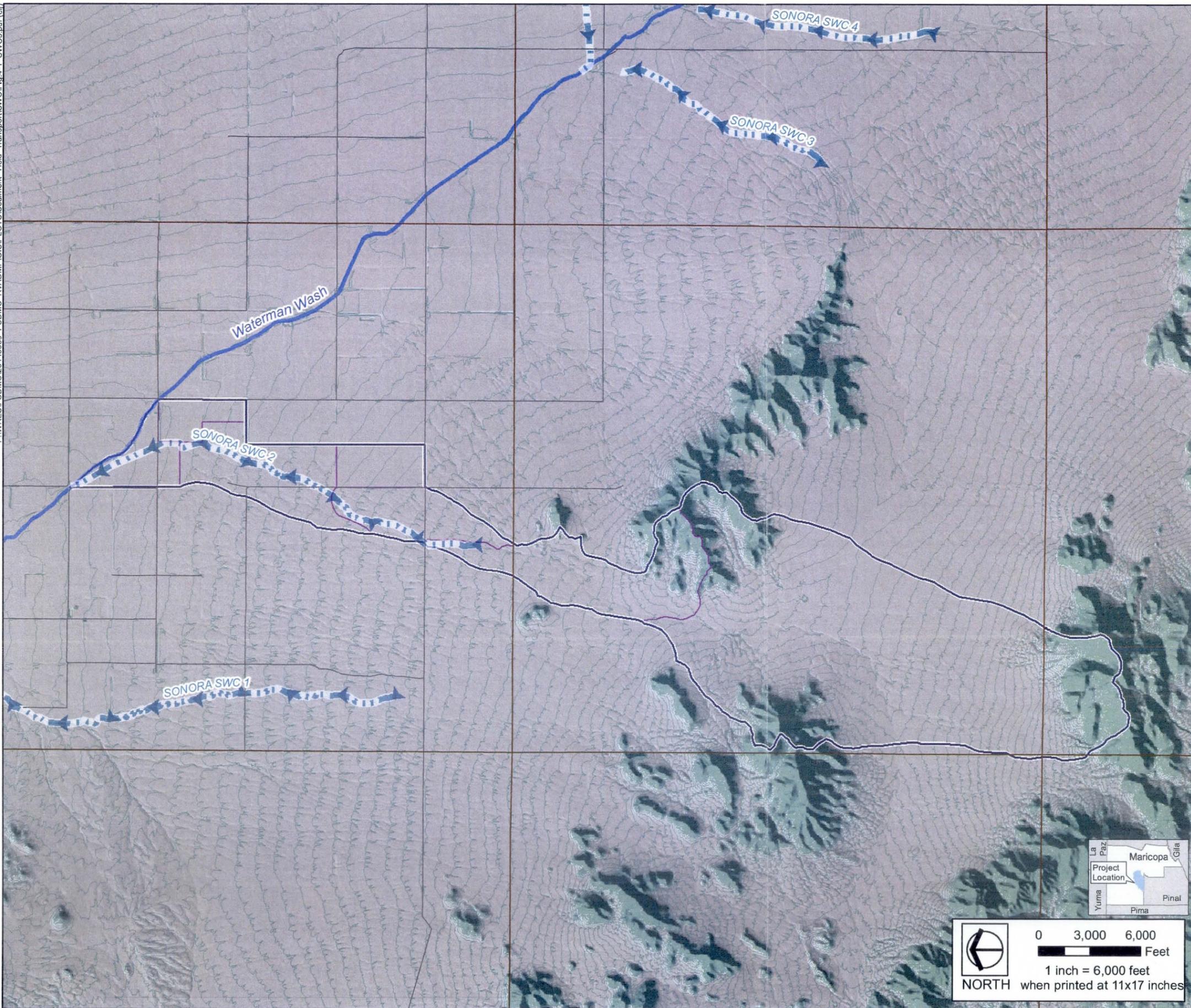
1 inch = 5,000 feet  
when printed at 11x17 inches

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Rainbow Valley  
Area Drainage Master Plan  
Significant Wash Corridor  
Sonora SWC 2



Figure 3



**Project Features**

- Significant Wash Corridor
- Waterman Wash
- Watershed Boundary
- HEC-1 Drainage Sub-Basin
- 10ft Contour

**Reference Features**

- County Boundary
- Rainbow Valley ADMP Boundary
- Township and Range Boundary
- Interstate Highway/Freeway
- Major Road
- River/Stream

**Data Sources**

Flood Control District of Maricopa County  
Base Vector and Hillshade Data, 2008



NORTH

0 3,000 6,000 Feet

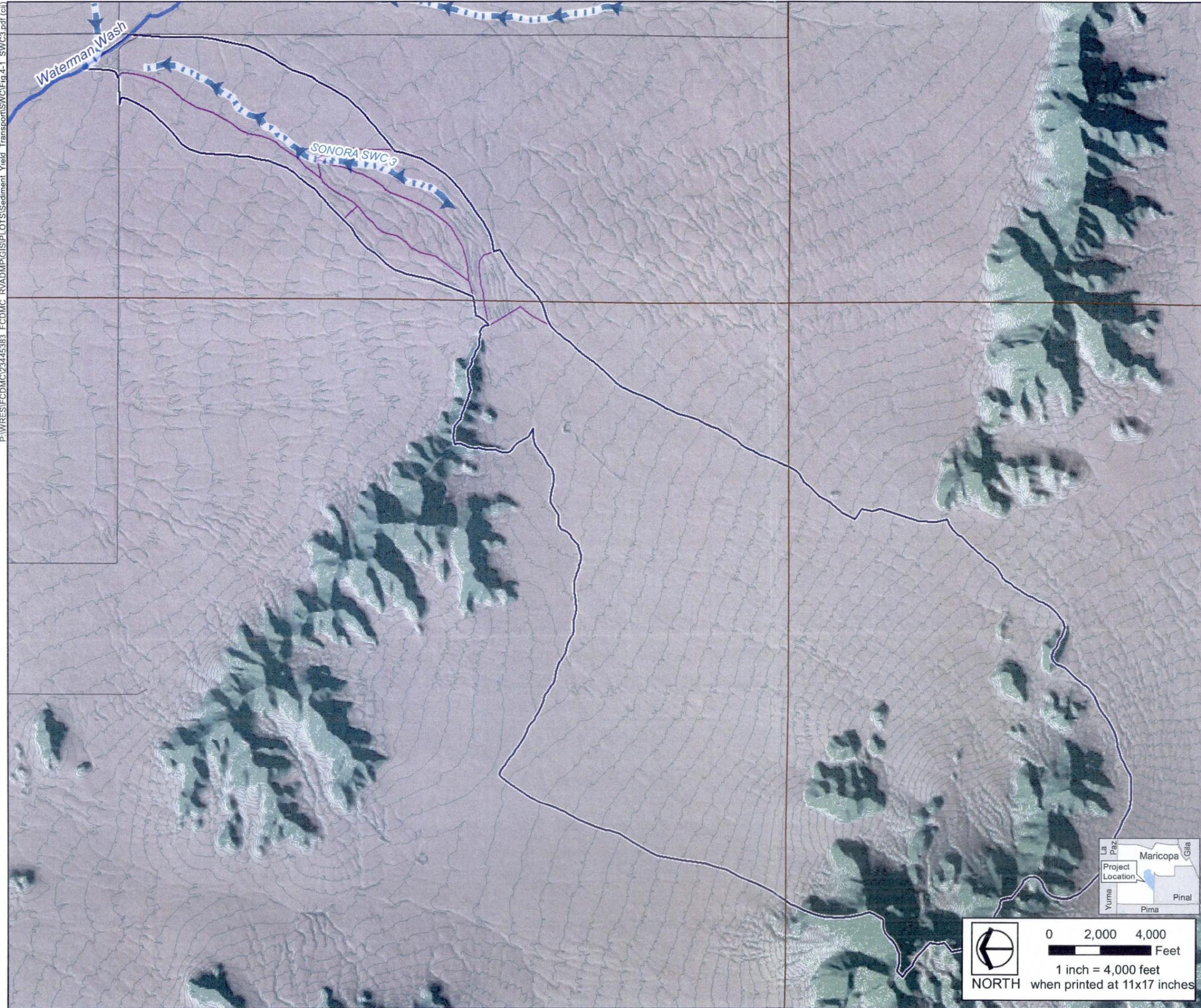
1 inch = 6,000 feet  
when printed at 11x17 inches

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Rainbow Valley  
Area Drainage Master Plan  
Significant Wash Corridor  
Sonora SWC 3



Figure 4



**Project Features**

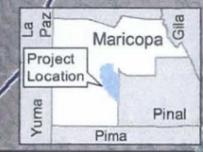
- Significant Wash Corridor
- Waterman Wash
- Watershed Boundary
- HEC-1 Drainage Sub-Basin
- 10ft Contour

**Reference Features**

- County Boundary
- Rainbow Valley ADMP Boundary
- Township and Range Boundary
- Interstate Highway/Freeway
- Major Road
- River/Stream

**Data Sources**

Flood Control District of Maricopa County  
Base Vector and Hillshade Data, 2008



NORTH

0 2,000 4,000 Feet

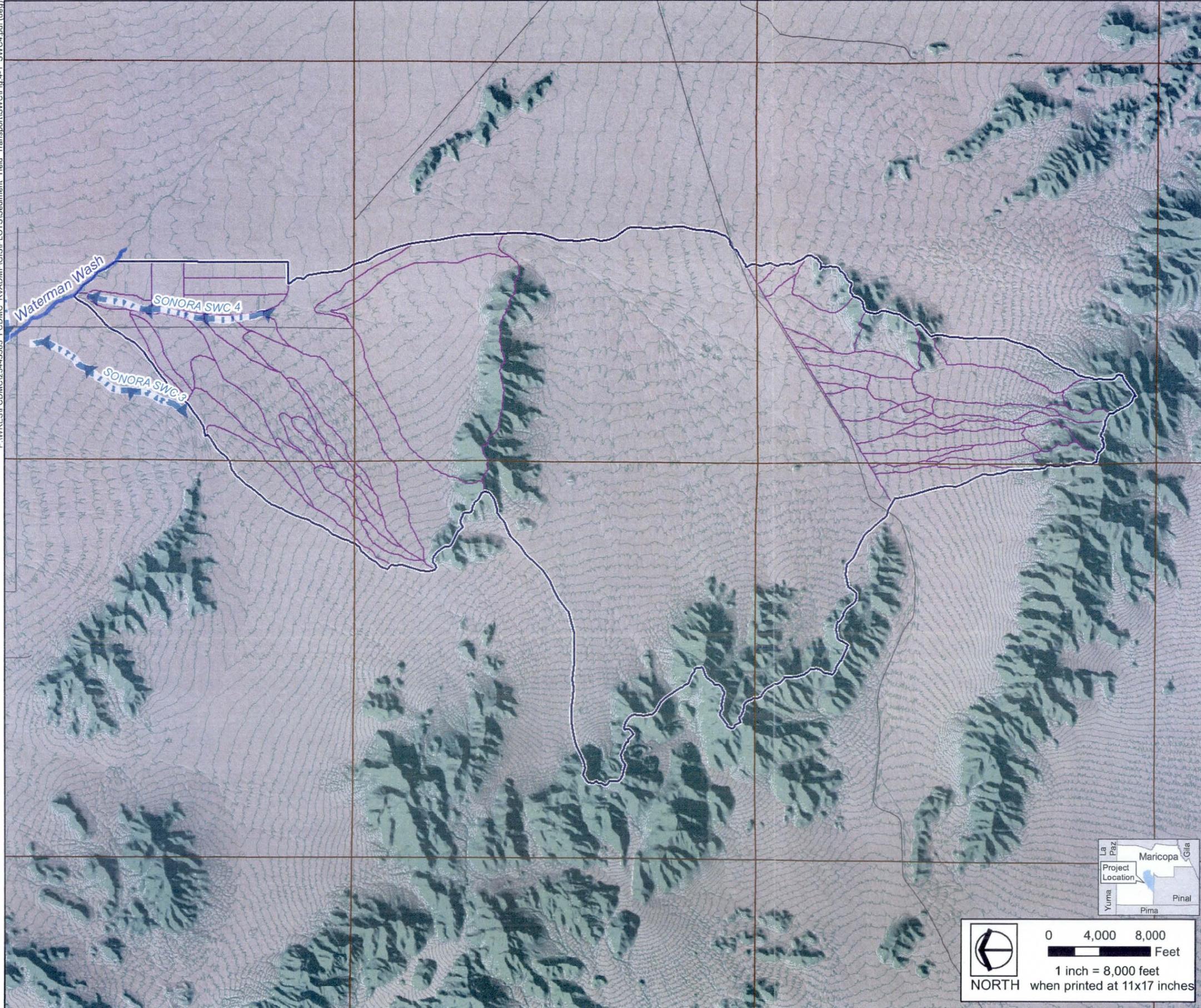
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when printed at 11x17 inches

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Rainbow Valley  
Area Drainage Master Plan  
Significant Wash Corridor  
Sonora SWC 4



Figure 5



**Project Features**

- Significant Wash Corridor
- Waterman Wash
- Watershed Boundary
- HEC-1 Drainage Sub-Basin
- 10ft Contour

**Reference Features**

- County Boundary
- Rainbow Valley ADMP Boundary
- Township and Range Boundary
- Interstate Highway/Freeway
- Major Road
- River/Stream Boundary

**Data Sources**

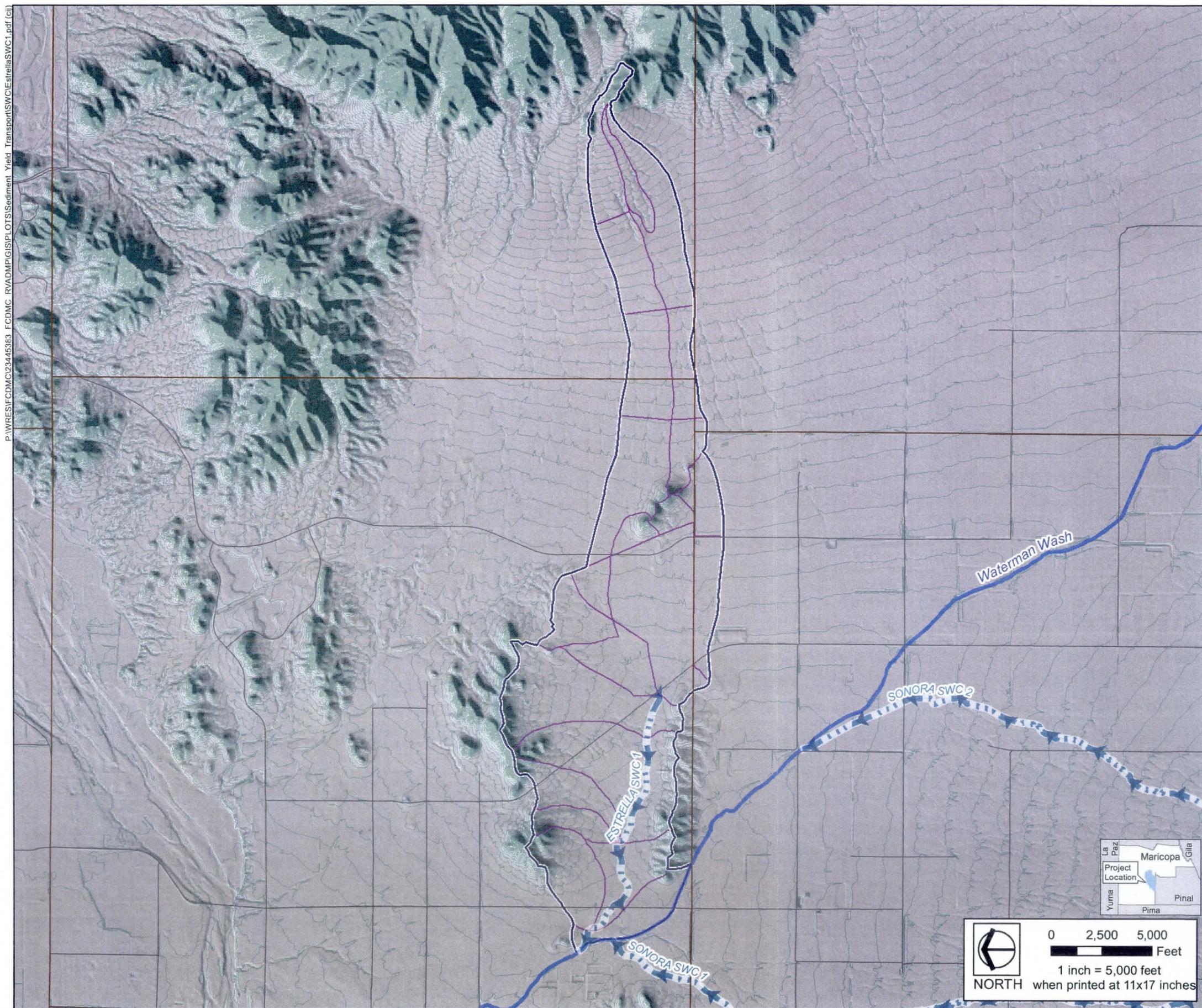
Flood Control District of Maricopa County  
Base Vector and Hillshade Data, 2008



NORTH

0 4,000 8,000 Feet

1 inch = 8,000 feet  
when printed at 11x17 inches



Rainbow Valley  
Area Drainage Master Plan  
Significant Wash Corridor  
Estrella SWC 1



Figure 6

**Project Features**

-  Significant Wash Corridor
-  Waterman Wash
-  Watershed Boundary
-  HEC-1 Drainage Sub-Basin
-  10ft Contour

**Reference Features**

-  County Boundary
-  Rainbow Valley ADMP Boundary
-  Township and Range Boundary
-  Interstate Highway/Freeway
-  Major Road
-  River/Stream Boundary

**Data Sources**

Flood Control District of Maricopa County  
Base Vector and Hillshade Data, 2008




0    2,500    5,000  
Feet  
1 inch = 5,000 feet  
when printed at 11x17 inches

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# Rainbow Valley Area Drainage Master Plan Significant Wash Corridor Estrella SWC 2



Figure 7



### Project Features

- Significant Wash Corridor
- Waterman Wash
- Watershed Boundary
- HEC-1 Drainage Sub-Basin
- 10ft Contour

### Reference Features

- County Boundary
- Rainbow Valley ADMP Boundary
- Township and Range Boundary
- Interstate Highway/Freeway
- Major Road
- River/Stream

### Data Sources

Flood Control District of Maricopa County  
Base Vector and Hillshade Data, 2008



NORTH

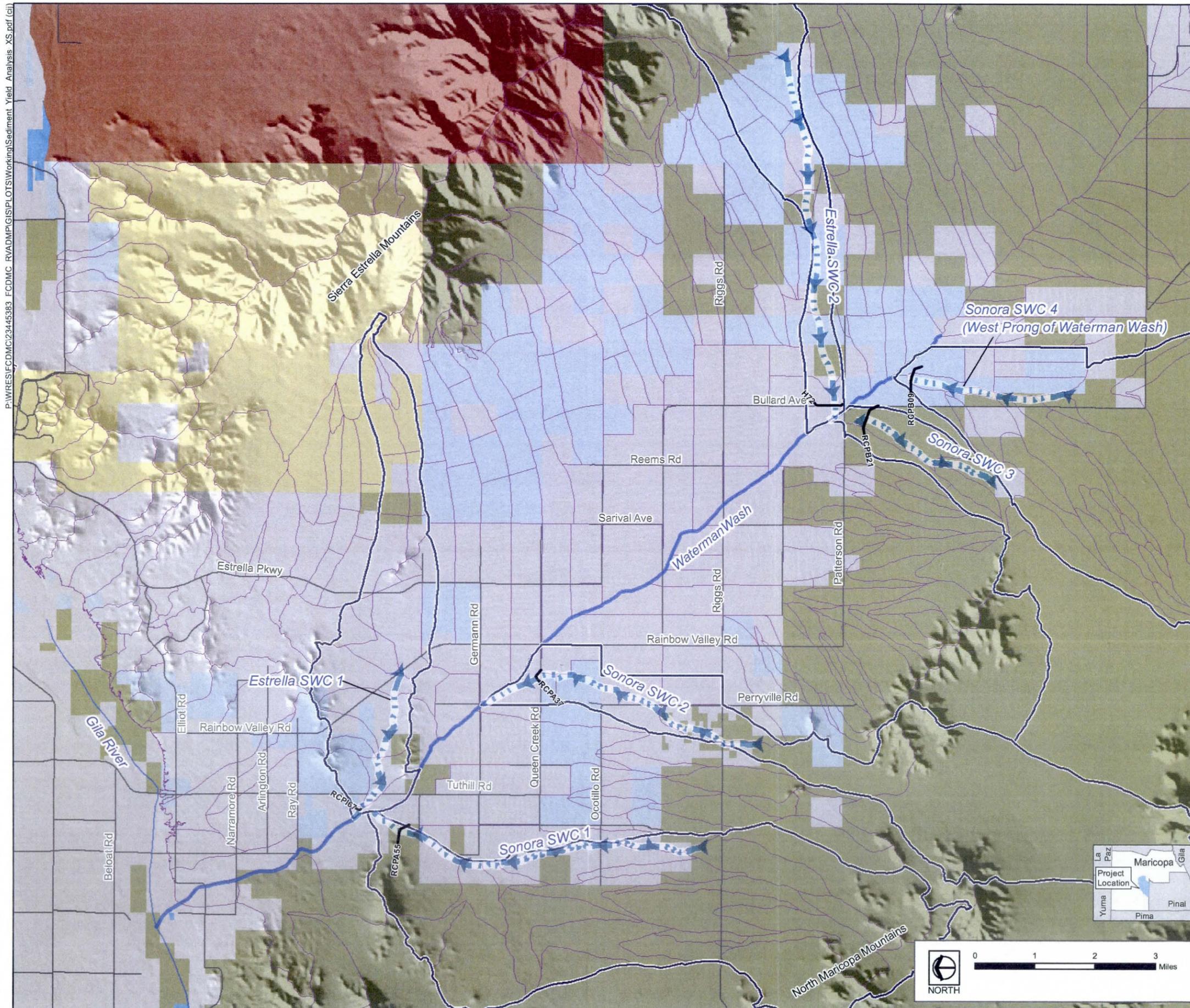
0 2,500 5,000 Feet

1 inch = 5,000 feet  
when printed at 11x17 inches

Rainbow Valley  
Area Drainage Master Plan  
Sediment Yield Analysis - Cross Section Location



Figure 8



**Project Features**

- Significant Wash Corridor
  - Waterman Wash
  - Cross Section
  - HEC-1 Drainage Sub-Basin
  - Watershed Boundary
- Surface Management**
- Bureau of Land Management
  - Gila River Indian Reservation
  - State Trust Land
  - Arizona Game and Fish Department (State Land)
  - County, Park and Outdoor Recreation Area
  - Private Land

Note:  
Typical cross sections used for Sonora SWC 2 and Estrella SWC 2 are not shown in the map.

**Reference Features**

- Gila River
- Major Road

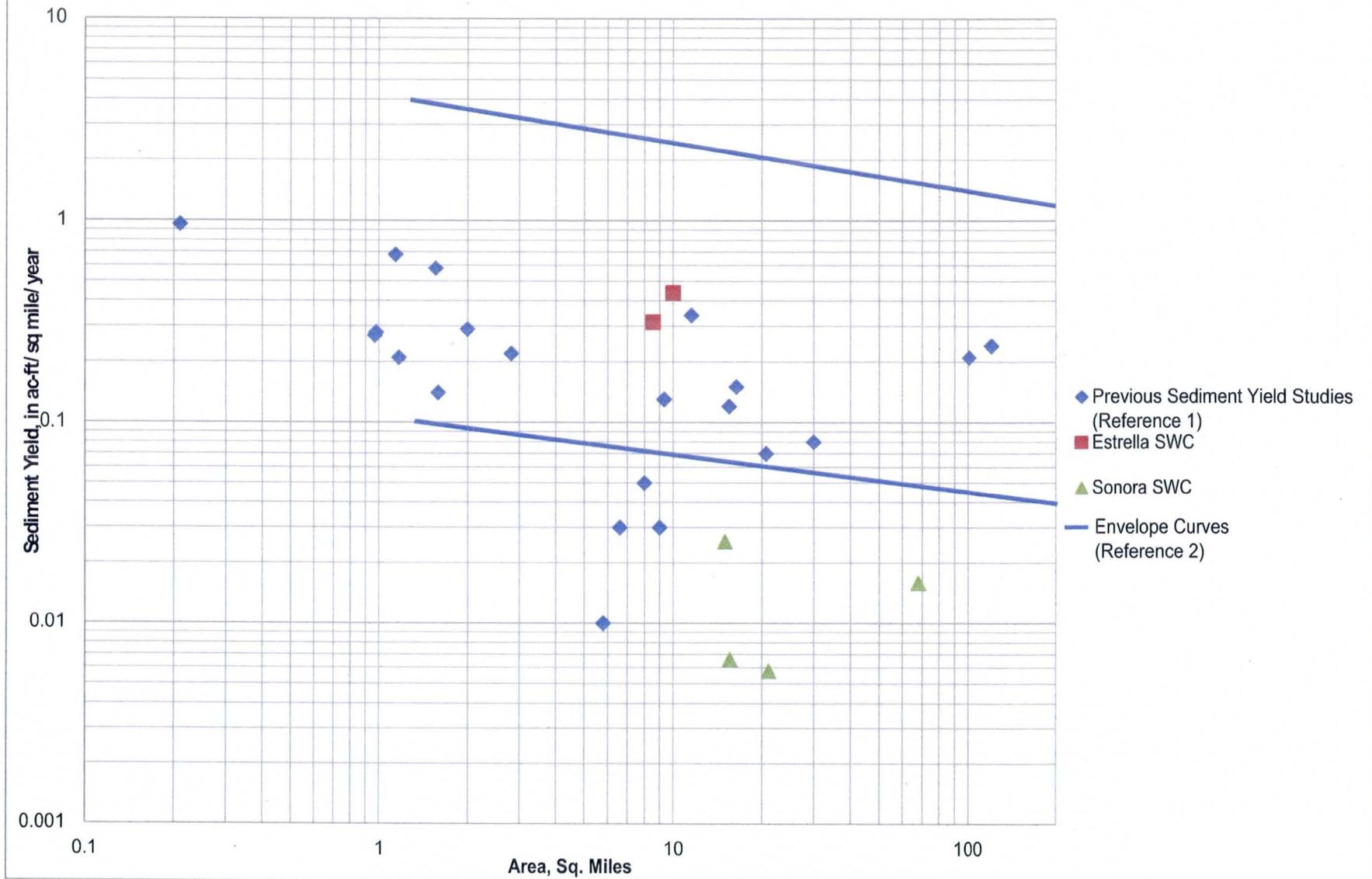
**Data Sources**

Sediment Sampling Locations: URS 2010  
Base: Flood Control District of Maricopa County 2008



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Figure 9  
Sediment Yield Validation



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Rainbow Valley  
Area Drainage Master Plan  
Significant Wash Corridor  
KINEROS2 Area



Figure 10



**Project Features**

- Significant Wash Corridor
- Waterman Wash
- Watershed Boundary
- Planes
- Drainage Basin
- 10ft Contour
- Plane Segment Number
- Stream Segment Number

**Reference Features**

- County Boundary
- Rainbow Valley ADMP Boundary
- Township and Range Boundary
- Interstate Highway/ Freeway
- Major Road
- River/Stream

**Data Sources**

Flood Control District of Maricopa County  
Base Vector and Hillshade Data, 2008

NORTH

0 2,500 5,000 Feet

1 inch = 5,000 feet when printed at 11x17 inches





## **APPENDIX A**

- DDMSW OUTPUT – ESTRELLA SWCs
- DDMSW OUTPUT – SONORA SWCs
- SLOPE AND SLOPE LENGTH CALCULATION
- SOIL TEST DATA
- ADDITIONAL SOIL DATA
- KINEROS2 SUPPORTING DOCUMENTATION

**DDMSW INPUT/OUTPUT DATA**

**ESTRELLA SWC**

Flood Control District of Maricopa County  
 Drainage Design Management System  
 Agency: FCDMC - RIVER MECHANICS - SOIL DEFAULTS

Soil ID	Map Unit	Erodibility Factor (K)	Specific Weight (lb/cf)	Description
<b>Book Number: 645</b>				
6451	1	0.20	88.10	Antho sandy loams
6452	2	0.17	55.81	Antho gravelly sandy loams
6453	3	0.20	86.59	Antho-Carrizo-Maripo complex
6454	4	0.20	86.75	Antho-Carrizo-Maripo complex, low precipitation
6455	5	0.20	84.70	Anthony sandy loam
6456	6	0.24	85.51	Anthony-Arizo complex
6457	7	0.24	85.51	Anthony-Arizo complex, low precipitation
6458	8	0.15	87.66	Arizo cobbly sandy loam
6459	9	0.05	82.58	Beeline-Cipriano complex, 3 to 45 percent slopes
64510	10	0.10	86.98	Brios-Carrizo complex, 1 to 5 percent slopes
64511	11	0.10	86.98	Brios-Carrizo complex, low precipitation, 1 to 5 percent slopes
64512	12	0.17	79.19	Carefree cobbly clay loam, 1 to 8 percent slopes
64513	13	0.32	78.74	Carefree-Beardsley complex
64514	14	0.02	83.53	Carrizo very gravelly sand
64515	15	0.15	83.22	Carrizo-Gunsight complex, 1 to 5 percent slopes
64516	16	0.10	79.19	Cellar-Rock outcrop complex, 10 to 70 percent slopes
64517	17	0.10	79.19	Cellar-Rock outcrop complex, low precipitation, 10 to 70 percent slopes
64518	18	0.10	75.04	Cheriono-Rock outcrop complex, 5 to 60 percent slopes
64519	19	0.10	77.30	Chuckawalla-Gunsight complex, 1 to 8 percent slopes
64520	20	0.10	77.30	Chuckawalla-Gunsight complex, low precipitation, 1 to 8 percent slopes
64521	21	0.10	78.28	Cipriano very gravelly loam
64522	22	0.28	77.30	Contine clay loam
64523	23	0.28	77.30	Contine clay
64524	24	0.24	80.81	continental clay loam, 0 to 3 percent slopes
64525	25	0.24	75.04	Continental clay, 0 to 3 percent slopes
64526	26	0.15	78.28	Continental cobbly clay loam, 1 to 8 percent slopes
64527	27	0.24	84.42	Continental-Mohave complex, 1 to 7 percent slopes
64528	28	0.15	78.74	Continental-Ohaco complex
64529	29	0.15	86.26	Denure-Momoli-Carrizo complex
64530	30	0.15	86.26	Denure-Momoli-Carrizo complex, low precipitation
64531	31	0.05	76.22	Dixaleta-Rock outcrop complex, 25 to 65 percent slopes
64532	32	0.05	76.22	Dixaleta-Rock outcrop complex, low precipitation, 25 to 65 percent
64533	33	0.15	78.28	Eba very gravelly loam, 1 to 8 percent slopes
64534	34	0.15	78.28	Eba very gravelly loam, 8 to 20 percent slopes
64535	35	0.15	78.28	Eba very gravelly loam, low precipitation, 8 to 20 percent slopes
64536	36	0.15	79.61	Eba-Continental complex, 1 to 8 percent slopes
64537	37	0.15	80.56	Eba-Continental-Cave association, 3 to 20 percent slopes
64538	38	0.15	80.56	Eba-Continental-Cave association, low precipitation, 3 to 20 percent
64539	39	0.15	84.13	Eba-Nickel-Cave association, 3 to 25 percent slopes
64540	40	0.15	76.22	Eba-Pinaleno complex, 3 to 20 percent slopes
64541	41	0.15	76.22	Eba-Pinaleno complex, 20 to 40 percent slopes
64542	42	0.15	76.22	Eba-Pinaleno complex, low precipitation, 3 to 20 percent slopes
64543	43	0.15	76.22	Eba-Pinaleno complex, low precipitation, 20 to 40 percent slopes
64544	44	0.10	77.30	Ebon very gravelly loam, 1 to 8 percent slopes
64545	45	0.10	77.30	Ebon very gravelly loam, 8 to 20 percent slopes
64546	46	0.10	77.30	Ebon-Contine complex, 1 to 8 percent
64547	47	0.10	78.59	Ebon-Gunsight-Cipriano association, 3 to 25 percent slopes
64548	48	0.10	76.77	Ebon-Pinamt complex, 3 to 20 percent slopes
64549	49	0.10	76.77	Ebon-Pinamt complex, 20 to 40 percent slopes
64550	50	0.32	82.91	Estrella loams
64551	51	0.10	80.03	Gachado-Lomitas complex, 8 to 25 percent slopes
64552	52	0.05	78.28	Gachado-Lomitas-Rock outcrop complex, 7 to 55 percent slopes
64553	53	0.32	73.71	Gadsden clay
64554	54	0.24	82.91	Gila fine sandy loams
64555	55	0.32	81.55	Gilman loams
64556	56	0.32	81.55	Gilman loams, low precipitation
64557	57	0.32	78.28	Gilman clay loam
64558	58	0.32	84.32	Gilman-Momoli-Denure complex
64559	59	0.32	84.32	Gilman-Momoli-Denure complex, low precipitation
64560	60	0.32	78.28	Glenbar loams
64561	61	0.10	88.31	Gran-Wickenburg complex, 1 to 10 percent slopes
64562	62	0.10	88.31	Gran-Wickenburg complex, low precipitation, 1 to 10 percent slopes
64563	63	0.10	88.31	Gran-Wickenburg-Rock outcrop complex, 1 to 7 percent slopes
64564	64	0.10	88.31	Gran-Wickenburg-Rock outcrop complex, low precipitation, 10 to 65
64565	65	0.15	81.07	Greyeagle-Continental-Nickel association, 1 to 40 percent slopes
64566	66	0.15	82.25	Greyeagle-Suncity Variant complex, 1 to 7 percent slopes
64567	67	0.32	72.20	Guest clay
64568	68	0.10	79.19	Gunsight-Cipriano complex, 1 to 7 percent slopes
64569	69	0.10	79.19	Gunsight-Cipriano complex, low precipitation, 1 to 7 percent slopes

Flood Control District of Maricopa County  
 Drainage Design Management System  
 Agency: FCDMC - RIVER MECHANICS - SOIL DEFAULTS

Soil ID	Map Unit	Erodibility Factor (K)	Specific Weight (lb/cf)	Description
<b>Book Number: 645</b>				
64570	70	0.20	79.19	Gunsight-Rillito complex, 1 to 25 percent slopes
64571	71	0.20	79.19	Gunsight-Rillito complex, low precipitation, 1 to 40 percent slopes
64572	72	0.10	76.22	Lehmans-Rock outcrop complex, 8 to 65 percent slopes
64573	73	0.10	76.22	Lehmans-Rock outcrop complex, low precipitation, 8 to 65 percent
64574	74	0.10	80.03	Luke-Cipriano association, 1 to 15 percent slopes
64575	75	0.32	78.28	Mohall loam
64576	76	0.32	80.81	Mohall loam, calcareous solum
64577	77	0.32	78.28	Mohall clay loam
64578	78	0.32	78.28	Mohall clay loam, calcareous solum
64579	79	0.24	76.22	Mohall clay
64580	80	0.32	82.58	Mohall-Tremant complex, 1 to 8 percent slopes
64581	81	0.32	82.58	Mohall-Tremant complex, low precipitation, 1 to 8 percent slopes
64582	82	0.24	85.76	Mohave sandy loam
64583	83	0.24	80.03	Mohave loam
64584	84	0.37	81.55	Mohave loam, calcareous solum
64585	85	0.32	78.28	Mohave clay loam
64586	86	0.32	79.19	Mohave clay loam, calcareous solum
64587	87	0.24	85.51	Mohave complex
64588	88	0.24	81.55	Mohave-Guest complex
64589	89	0.32	80.81	Mohave-Tres Hermanos complex, 1 to 8 percent slopes
64590	90	0.15	84.70	Momoli gravelly sandy loam, 1 to 5 percent slopes
64591	91	0.10	81.55	Momoli-Carrizo complex
64592	92	0.10	80.03	Momoli-Carrizo complex, low precipitation
64593	93	0.15	82.25	Nickel-Cave complex, 8 to 30 percent slopes
64594	94	0.15	82.25	Nickel-Cave complex, low precipitation, 8 to 30 percent slopes
64595	95	0.20	79.19	Ohaco gravelly loam
64596	96	0.10	79.19	Pinaleno-Tres Hermanos complex, 1 to 10 percent slopes
64597	97	0.10	79.19	Pinaleno-Tres Hermanos complex, low precipitation, 1 to 10 percent
64598	98	0.05	82.91	Pinamt-Tremant complex, 1 to 10 percent slopes
64599	99	0.05	82.91	Pinamt-Tremant complex, low precipitation, 1 to 10 percent slopes
645100	100	0.05	76.77	Quilotosa-Vaiva-Rock outcrop complex, 20 to 65 percent slopes
645101	101	0.32	83.53	Rillito loam, 0 to 3 percent slopes
645102	102	0.20	80.81	Rillito gravelly loam, 1 to 8 percent slopes
645103	103	0.04	77.30	Rock outcrop-Gachado complex, 5 to 55 percent slopes
645104	104	0.04	76.22	Rock outcrop-Lehmans complex, 15 to 65 percent slopes
645105	105	0.04	76.22	Rock outcrop-Lehmans complex, low precipitation, 15 to 65 percent
645106	106	0.05	76.22	Sal-Cipriano complex, 1 to 10 percent slopes
645107	107	0.05	76.22	Sal-Cipriano complex, low precipitation, 1 to 10 percent slopes
645108	108	0.05	77.30	Schenco-Rock outcrop complex, 3 to 25 percent slopes
645109	109	0.05	77.30	Schenco-Rock outcrop complex, 25 to 60 percent slopes
645110	110	0.20	79.19	Suncity-Cipriano complex, 1 to 7 percent slopes
645111	111	0.20	85.76	Torriorthents, 15 to 40 percent slopes
645112	112	0.15	88.10	Tremant gravelly sandy loams
645113	113	0.20	85.76	Tremant gravelly loams
645114	114	0.20	85.76	Tremant gravelly loams, low precipitation
645115	115	0.15	86.98	Tremant-Antho complex, 1 to 5 percent slopes
645116	116	0.20	84.42	Tremant-Gunsight-Rillito complex, 1 to 5 percent slopes
645117	117	0.20	84.42	Tremant-Gunsight-Rillito complex, low precipitation, 1 to 5 percent slopes
645118	118	0.15	83.53	Tremant-Rillito complex
645119	119	0.20	81.91	Tremant-Suncity complex, 1 to 8 percent slopes
645120	120	0.15	82.91	Tres Hermanos gravelly sandy loams
645121	121	0.20	83.83	Tres Hermanos-Anthony complex, 1 to 5 percent slopes
645122	122	0.15	85.76	Vado gravelly sandy loam, 1 to 5 percent slopes
645123	123	0.10	75.04	Vaiva very gravelly loam, 1 to 20 percent slopes
645124	124	0.20	86.75	Valencia sandy loams
645125	125	0.10	88.52	Vint loamy fine sand
645126	126	-	50.00	

**Book Number: 651**

65164	W	-	50.00	Lakes, ponds, reservoirs - perennial
6512021	Aa	0.32	82.91	Agualt loam
6512025	Ac	0.24	88.52	Antho sandy loam, saline-alkali
6512029	Ae	0.24	88.52	Antho-Brios sandy loams
6512042	AL	0.24	88.52	Antho association
6512044	AM	0.24	88.52	Antho-Valencia association
6512047	An	0.32	78.28	Avonda clay loam
6512049	Ao	0.32	78.28	Avondale clay loam
6512051	Ap	0.32	78.28	Avondale clay loam, saline-alkali
6512228	BE	0.32	78.28	Beardsley loam

Flood Control District of Maricopa County  
 Drainage Design Management System  
 Agency: FCDMC - RIVER MECHANICS - SOIL DEFAULTS

Soil ID	Map Unit	Erodibility Factor (K)	Specific Weight (lb/cf)	Description
<b>Book Number: 651</b>				
6512255	Br	0.17	88.52	Brios loamy sand
6512257	Bs	0.24	88.52	Brios sandy loam
6512259	Bt	0.32	88.52	Brios loam
6512423	Cb	0.15	87.66	Carrizo gravelly sandy loam
6512430	CF	0.15	87.66	Carrizo and Brios soils
6512433	Cg	0.24	80.03	Casa Grande Sandy loam
6512435	Ch	0.32	80.03	Casa Grande loam
6512441	Ck	0.24	80.03	Casa Grande complex
6512445	Cm	0.32	80.03	Casa Grande-Leveen complex, alkali
6512447	Cn	0.32	72.20	Cashion clay, saline-alkali
6512448	CO	0.10	80.03	Cheriono-Rock outcrop complex
6512451	Cp	0.24	88.52	Coolidge sandy loam
6512457	Cs	0.15	88.52	Coolidge-Tremant complex
6512462	CV	0.24	88.52	Coolidge-Laveen association
6512647	Dn	-	50.00	Dune land
6512857	Es	0.32	80.03	Estrella loam
6512859	Et	0.32	80.03	Estrella loam, saline-alkali
6513220	GA	0.10	80.81	Gachado-Rock outcrop complex
6513223	Gb	0.32	73.71	Gadsden clay loam
6513225	Gc	0.32	73.71	Gadsden clay
6513227	Gd	0.32	73.71	Gadsden clay, saline-alkali
6513229	Ge	0.28	80.03	Gilman fine sandy loam
6513231	Gf	0.28	80.03	Gilman fine sandy loam, saline-alkali
6513235	Gh	0.32	80.03	Gilman loam, saline-alkali
6513242	GL	0.32	80.03	Gilman complex, saline-alkali
6513244	GM	0.32	80.03	Gilman-Antho association
6513246	GN	0.32	80.03	Gilman-Laveen association
6513251	Gp	0.32	80.03	Gilman loam, clayey subsoil variant, moderately saline
6513255	Gr	0.32	76.22	Glenbar loam
6513257	Gs	0.32	76.22	Glenbar loam, saline-alkali
6513259	Gt	0.32	76.22	Glenbar clay loam
6513261	Gu	0.32	76.22	Glenbar clay loam, saline-alkali
6513263	Gv	0.32	76.22	Glenbar clay
6513444	HM	0.17	81.55	Harqua-Laveen complex
6514221	La	0.55	80.81	La Palma very fine sandy loam
6514223	Lb	0.24	82.25	Laveen sandy loam
6514227	Ld	0.32	82.25	Laveen loam, saline-alkali
6514229	Le	0.32	82.25	Laveen clay loam
6514231	Lf	0.24	82.25	Laveen-Antho complex, saline-alkali
6514421	Ma	0.24	87.66	Maripo sandy loam
6514449	Mo	0.24	77.30	Mohall sandy loam
6514451	Mp	0.32	77.30	Mohall loam
6514455	Mr	0.32	77.30	Mohall clay loam
6514457	Ms	0.32	77.30	Mohall clay
6514462	MV	0.32	77.30	Mohall-Laveen association
6515021	Pa	0.24	85.24	Perryville sandy loam
6515023	Pb	0.32	88.52	Perryville loam, saline-alkali
6515058	PT	0.17	82.25	Pinal gravelly loam
6515456	RS	0.04	80.03	Rock outcrop-Cherioni complex
6515821	Ta	0.32	80.81	Toltec loam
6515822	TB	-	50.00	Torrifluvents
6515825	Tc	-	50.00	Torriorthents
6515826	TD	-	50.00	Torrripsamments and Torrifluvents, frequently flooded
6515829	Te	0.17	79.19	Tremant loam
6515833	Tg	0.17	79.19	Tremant clay loam
6515835	Th	0.17	79.19	Tremant gravelly clay loam
6515859	Tt	0.32	77.30	Trix clay loam
6515861	Tu	0.32	80.81	Tucson loam
6515865	Tw	0.32	80.81	Tucson clay loam
6516221	Va	0.24	88.52	Valencia sandy loam
6516223	Vb	0.24	88.52	Valencia sandy loam, saline-alkali
6516225	Vc	0.15	88.52	Valencia gravelly sandy loam
6516229	Ve	0.32	75.04	Vecont loam
6516231	Vf	0.32	75.04	Vecont clay
6516233	Vg	0.20	90.44	Vint loamy fine sand
6516235	Vh	0.28	90.44	Vint fine sandy loam
6516241	Vk	0.32	90.44	Vint loam
6516247	Vn	0.32	90.44	Vint clay loam
6516255	Vr	0.28	90.44	Vint-Carrizo complex

Flood Control District of Maricopa County  
 Drainage Design Management System  
 Agency: FCDMC - RIVER MECHANICS - SOIL DEFAULTS

Soil ID	Map Unit	Erodibility Factor (K)	Specific Weight (lb/cf)	Description
<b>Book Number: 651</b>				
6516433	Wg	0.32	78.28	Wintersburg complex
65124202	CA2	-	50.00	Calciorthids and Torriorthents, eroded
65132493	Go3	0.32	80.03	Gilman, Antho and Glenbar soils, severely eroded
651202320	AbA	0.24	88.52	Anthosandy loam, 0 to 1 percent slopes
651202322	AbB	0.24	88.52	Antho sandy loam, 1 to 3 percent slopes
651202720	AdA	0.15	88.52	Antho gravelly sandy loam, 0 to 1 percent slopes
651202722	AdB	0.15	88.52	Antho gravelly sandy loam, 1 to 3 percent slopes
651203120	AfA	0.24	88.52	Antho-Carrizo complex, 0 to 1 percent slopes
651203122	AfB	0.24	88.52	Antho-Carrizo complex, 1 to 3 percent slopes
651203222	AGB	0.24	88.52	Antho-Carrizo complex, 0 to 3 percent slopes
651203424	AHC	0.15	88.52	Antho-Tremant complex, 1 to 5 percent slopes
651204122	AkB	0.15	88.52	Antho-Tremant-Mohall complex, 1 to 5 percent slopes
651225036	BPI	-	50.00	Borrow pit
651242926	CeD	0.15	87.66	Carrizo-Ebon complex, 3 to 12 percent slopes
651245522	CrB	0.15	88.52	Coolidge gravelly sandy loam, 1 to 3 percent slopes
651282326	EbD	0.17	73.71	Ebon gravelly loam, 0 to 8 percent slopes
651285026	EPD	0.17	73.71	Ebon-Pinamt complex, 0 to 10 percent slopes
651323320	GgA	0.32	80.03	Gilman loam, 0 to 1 percent slopes
651323322	GgB	0.32	80.03	Gilman loam, 1 to 3 percent slopes
651325036	GPI	-	50.00	Gravel pit
651326426	GWD	0.17	80.03	Gunsight-Pinal complex, 1 to 10 percent slopes
651326720	GxA	0.17	80.03	Gunsight-Rillito complex, 0 to 1 percent slopes
651326722	GxB	0.17	80.03	Gunsight-Rillito complex, 1 to 3 percent slopes
651326826	GYD	0.17	80.03	Gunsight-Rillito complex, 0 to 10 percent slopes
651342022	HAB	0.17	81.55	Harqua complex, 0 to 3 percent slopes
651342024	HAC	0.17	81.55	Harqua complex, 3 to 8 percent slopes
651344224	HLC	0.17	81.55	Harqua-Gunsight complex, 0 to 5 percent slopes
651345522	HrB	0.17	81.55	Harqua-Rillito complex, 1 to 3 percent slopes
651422520	LcA	0.32	82.25	Laveen loam, 0 to 1 percent slopes
651422522	LcB	0.32	82.25	Laveen loam, 1 to 3 percent slopes
651441064	M-W	-	50.00	Waste stabilization pond
651445822	MTB	0.32	77.30	Mohall-Tremant complex, 0 to 3 percent slopes
651502920	PeA	0.17	85.24	Perryville gravelly loam, 0 to 1 percent slopes
651502922	PeB	0.17	85.24	Perryville gravelly loam, 1 to 3 percent slopes
651505422	PRB	0.32	85.24	Perryville-Rillito complex, 0 to 3 percent slopes
651505720	PsA	0.32	82.25	Pinal loam, 0 to 1 percent slopes
651505722	PsB	0.32	82.25	Pinal loam, 1 to 3 percent slopes
651506322	PvB	0.32	82.25	Pinal-La Palma loams, 1 to 3 percent slopes
651506422	PWB	0.17	82.25	Pinal-Suncity complex, 0 to 3 percent slopes
651506826	PYD	0.10	82.25	Pinamt-Tremant complex, 1 to 10 percent slopes
651542120	RaA	0.24	85.24	Rillito sandy loam, 0 to 1 percent slopes
651542122	RaB	0.24	85.24	Rillito sandy loam, 1 to 3 percent slopes
651542320	RbA	0.32	85.24	Rillito loam, 0 to 1 percent slopes
651542322	RbB	0.32	85.24	Rillito loam, 1 to 3 percent slopes
651543522	RhB	0.17	85.24	Rillito-Harqua complex, 1 to 3 percent slopes
651545128	RpE	0.17	85.24	Rillito-Perryville complex, 5 to 20 percent slopes
651583120	TfA	0.17	79.19	Tremant gravelly loam, 0 to 1 percent slopes
651583122	TfB	0.17	79.19	Tremant gravelly loam 1 to 3 percent slopes
651585022	TPB	0.32	79.19	Tremant complex, 0 to 3 percent slopes
651585520	TrA	0.17	79.19	Tremant-Rillito complex, 0 to 1 percent slopes
651585522	TrB	0.17	79.19	Tremant-Rillito complex, 1 to 3 percent slopes
651585624	TSC	0.17	79.19	Tremant-Rillito complex, 0 to 5 percent slopes
6514228622828	LEVEE	-	50.00	
<b>Book Number: 653</b>				
6531	1	0.55	80.43	Agualt and Ripley soils
6532	2	0.55	80.43	Agualt and Ripley soils, saline-sodic
6533	3	0.05	78.28	Ajo-Gunsight-Pompeii complex, 3 to 25 percent slopes
6534	4	0.05	76.22	Akela-Rock outcrop complex, 15 to 65 percent slopes
6535	5	0.05	82.91	Carrizo-Dateland complex, 0 to 3 percent slopes
6536	6	0.17	80.43	Carrizo-Momoli complex, 0 to 3 percent slopes
6537	7	0.20	85.76	Cherioni very cobbly fine sandy loam, 3 to 10 percent slopes
6538	8	0.24	83.33	Cherioni-Coolidge complex, 1 to 15 percent slopes
6539	9	0.20	84.13	Cipriano-Hyder-Rock outcrop complex, 15 to 65 percent slopes
65310	10	0.05	80.43	Cipriano-Momoli complex, 1 to 7 percent slopes
65311	11	0.24	87.44	Coolidge complex, 0 to 3 percent slopes
65312	12	0.55	87.06	Cuerda-Why-Lagunita complex
65313	13	0.55	83.53	Dateland very fine sandy loam
65314	14	0.24	86.02	Dateland-Cuerda complex, 0 to 3 percent slopes

Flood Control District of Maricopa County  
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 Agency: FCDMC - RIVER MECHANICS - SOIL DEFAULTS

Soil ID	Map Unit	Erodibility Factor (K)	Specific Weight (lb/cf)	Description
<b>Book Number: 653</b>				
65315	15	0.24	87.44	Dateland-Denure fine sandy loams, saline-sodic, 0 to 3 percent slopes
65316	16	0.20	88.10	Denure sandy loam
65317	17	0.20	84.70	Denure gravelly fine sandy loam, 1 to 3 percent slopes
65318	18	0.20	84.97	Denure-Carrizo, bench, gravelly fine sandy loams
65319	19	0.28	86.51	Denure-Caveit complex, 0 to 3 percent slopes
65320	20	0.17	85.51	Denure-Coolidge complex, 1 to 3 percent slopes
65321	21	0.17	85.06	Denure-Rillito-Why complex, 1 to 5 percent slopes
65322	22	0.17	86.51	Denure-Why complex, 1 to 5 percent slopes
65323	23	-	50.00	Dumps-Pits association
65324	24	0.32	78.28	Gadsden clay loam, 0 to 3 percent slopes
65325	25	0.37	70.45	Gadsden and Kofa silty clay loams, saline-sodic
65326	26	0.05	77.80	Garzona-Rock outcrop-Winkel complex, 15 to 65 percent slopes
65327	27	0.43	82.91	Gilman very fine sandy loam
65328	28	0.43	82.91	Gilman very fine sandy loam, saline-sodic
65329	29	0.37	75.04	Glenbar silty clay loam
65330	30	0.37	73.71	Glenbar silty clay loam, saline-sodic
65331	31	0.05	78.28	Growler-Momoli complex, 1 to 3 percent slopes
65332	32	0.05	77.30	Growler-Wellton complex, 1 to 3 percent slopes
65333	33	0.05	76.22	Gunsight-Ajolito extremely gravelly sandy loams, 1 to 15 percent slopes
65334	34	0.05	76.77	Gunsight-Chuckawalla complex, 1 to 15 percent slopes
65335	35	0.02	82.58	Gunsight-Cipriano complex, 1 to 15 percent slopes
65336	36	0.05	75.65	Gunsight-Pinamt complex, 1 to 15 percent slopes
65337	37	0.05	79.19	Gunsight-Rillito-Carrizo complex, 1 to 15 percent slopes
65338	38	0.24	86.26	Harqua fine sandy loam, 0 to 3 percent slopes
65339	39	0.32	82.91	Harqua-Caveit complex, 1 to 10 percent slopes
65340	40	0.05	77.96	Hyder-Gachado-Gunsight extremely gravelly sandy loams, 1 to 25 percent s
65341	41	0.55	75.04	Indio silt loam
65342	42	0.55	75.04	Indio silt loam, saline-sodic
65343	43	0.10	90.26	Lagunita-Vint complex
65344	44	0.20	88.10	Mohall fine sandy loam
65345	45	0.32	80.81	Mohall loam
65346	46	0.43	84.13	Mohall loam, occasionally flooded
65347	47	0.32	78.28	Mohall clay loam
65348	48	0.20	65.68	Mohall complex, 0 to 3 percent slopes
65349	49	0.10	80.43	Momoli-Carrizo extremely gravelly sandy loams, 1 to 10 percent slopes
65350	50	0.10	81.19	Momoli-Carrizo, bench, very gravelly sandy loams, 1 to 3 percent slopes
65351	51	0.05	82.58	Momoli-Comobabi association, 5 to 15 percent slopes
65352	52	-	50.00	Pits
65353	53	0.02	80.56	Quilotosa-Momoli-Carrizo complex, 1 to 15 percent slopes
65354	54	0.02	85.24	Quilotosa-Rock outcrop complex, 15 to 55 percent slopes
65355	55	-	50.00	Riverwash
65356	56	0.05	76.22	Rock outcrop-Hyder complex. 25 to 65 percent slopes
65357	57	0.20	89.12	Rositas-Denure loamy fine sands, 1 to 10 percent slopes
65358	58	0.10	78.74	Schenco-Laposa-Rock outcrop complex, 10 to 55 percent slopes
65359	59	0.15	84.13	Tremant gravelly fine sandy loam
65360	60	0.37	80.81	Tucson loam
65361	61	0.02	77.80	Vaiva-Quilotosa extremely gravelly sandy loams, 3 to 25 percent slopes
65362	62	0.05	84.13	Vaiva-Quilotosa extremely stony sandy loams, 25 to 55 percent slopes
65363	63	0.49	83.53	Vint very fine sandy loam
65364	64	0.32	80.03	Wellton loam
65365	65	0.15	86.98	Wellton complex
65366	66	0.24	83.53	Why gravelly fine sandy loam
65367	67	0.24	83.83	Why-Carrizo complex, 0 to 3 percent slopes
65368	68	-	50.00	
65369	69	-	50.00	
<b>Book Number: 655</b>				
65564	W	-	62.40	Lakes, ponds, reservoirs - perennial
6552031	Af	0.28	83.53	Agualt fine sandy loam
6552033	Ag	0.32	83.53	Agualt loam
6552045	Am	-	80.81	Alluvial land
6552063	Av	0.32	78.28	Avondale clay loam
6552421	Ca	0.10	85.76	Carrizo gravelly loamy sand
6552423	Cb	0.28	85.76	Carrizo fine sandy loam
6552425	Cc	0.32	68.34	Cashion clay
6552449	Co	0.32	79.19	Contine clay loam
6552857	Es	0.32	80.81	Estrella loam
6553231	Gf	0.28	79.19	Gilman fine sandy loam
6553245	Gm	0.32	79.19	Gilman loam

Flood Control District of Maricopa County  
 Drainage Design Management System  
 Agency: FCDMC - RIVER MECHANICS - SOIL DEFAULTS

Soil ID	Map Unit	Erodibility Factor (K)	Specific Weight (lb/cf)	Description
<b>Book Number: 655</b>				
6553247	Gn	0.32	73.71	Glenbar clay loam
6553255	Gr	-	81.55	Gravelly alluvial land
6554449	Mo	0.24	82.25	Mohall sandy loam
6554463	Mv	0.32	82.25	Mohall loam
6555045	Pm	0.32	72.20	Pimer clay loam
6555049	Po	0.32	82.25	Pinal loam, moderately deep variant
6555449	Ro	-	150.00	Rock land
6555461	Ru	-	150.00	Rough broken land
6555463	Rv	-	50.00	
6555867	Tx	0.32	72.20	Trix clay loam
6556221	Va	0.24	87.66	Valencia sandy loam
6556229	Ve	0.32	72.20	Vecont clay
6556231	Vf	0.20	90.08	Vint loamy fine sand
655204720	AnA	0.24	87.66	Antho sandy loam, 0 to 1 percent slopes
655204722	AnB	0.17	87.66	Antho sandy loam, 1 to 3 percent slopes
655204922	AoB	0.17	86.75	Antho gravelly sandy loam, 1 to 3 percent slopes
655242924	CeC	0.17	82.25	Cavelt gravelly loam, 1 to 5 percent slopes
655325036	GPI	-	50.00	
655422120	LaA	0.32	79.19	Laveen loam, 0 to 1 percent slopes
655422122	LaB	0.32	79.19	Laveen loam, 1 to 3 percent slopes
655422920	LeA	0.32	79.19	Laveen clay loam, 0 to 1 percent slopes
655504720	PnA	0.17	82.25	Pinal gravelly loam, 0 to 1 percent slopes
655504724	PnC	0.17	82.25	Pinal gravelly loam, 1 to 3 percent slopes
655506320	PvA	0.10	77.30	Pinamt very gravelly loam, 0 to 1 percent slopes
655506324	PvC	0.10	77.30	Pinamt very gravelly loam, 3 to 5 percent slopes
655543720	RiA	0.20	81.55	Rillito gravelly loam, 0 to 1 percent slopes
655543722	RiB	0.20	81.55	Rillito gravelly loam, 1 to 3 percent slopes
655585522	TrB	0.17	82.91	Tremant gravelly loam, 1 to 3 percent slopes
<b>Book Number: 658</b>				
6581	1	0.10	86.26	Brios gravelly loamy sand, 3 to 5 percent slopes
6582	2	0.55	81.55	Brios very fine sandy loam, 0 to 2 percent slopes
6583	3	0.15	82.58	Carrizo-Momoli complex, 1 to 3 percent slopes
6584	4	0.15	80.03	Carrizo-Pinamt complex, 1 to 5 percent slopes
6585	5	0.02	80.81	Carrizo very gravelly coarse sand, 0 to 1 percent slopes
6586	6	0.32	78.28	Casa Grande clay loam, 0 to 1 percent slopes
6587	7	0.32	84.13	Casa Grande complex, 0 to 5 percent slopes
6588	8	0.28	88.10	Casa Grande fine sandy loam, 0 to 3 percent slopes
6589	9	0.10	79.19	Cavelt-Carrizo-Gunsight complex, 1 to 10 percent slopes
<b>Book Number: 703</b>				
7031	1	0.05	78.28	Ajo-pinamt, deep, complex, 3 to 15 percent slopes
7032	2	0.05	75.04	Anklam-cellar-rock outcrop complex, 15 to 55 percent slopes
7033	3	0.10	77.30	Anklam very gravelly sandy loam, 3 to 15 percent slopes
7034	4	0.10	88.10	Arizo-riverwash complex, 0 to 3 percent slopes
7035	5	0.10	86.02	Baboquivari-combate complex, 1 to 8 percent slopes
7036	6	0.24	88.92	Bucklebar-hayhook-tubac complex, 0 to 3 percent slopes
7037	7	0.10	76.59	Caralampi-selevin-kimrose complex, 5 to 50 percent slopes
7038	8	0.32	81.19	Casa grande-kamato complex, 0 to 1 percent slopes
7039	9	0.28	86.26	Casa grande-rositas-valencia complex, 0 to 5 percent slopes

Flood Control District of Maricopa County  
 Drainage Design Management System  
 Agency: FCDMC - RIVER MECHANICS - LAND USE DEFAULTS

Code	Group	Description	Effects of Canopy Cover (Ci)	Effects of Vegetation (Cii)	Effects of Tillage (Ciii)	Percent Impervious (%)
110	Residential	Rural Residential (<= 1/5 du per acre)	.84	.92	.38	5
120	Residential	Estate Residential (1/5 du per acre to 1 du per acre)	.84	.92	.38	5
130	Residential	Large Lot Residential - Single Family (1-2 du per acre)	.73	.87	.33	15
140	Residential	Medium Lot Residential - Single Family (2-4 du per acre)	.73	.87	.33	30
150	Residential	Small Lot Residential - Single Family (4-6 du per acre)	.73	.87	.33	30
160	Residential	Very Small Lot Residential - Single Family (>6 du per acre)	.73	.87	.33	40
161	Residential	Single Family High Density - Greater than 4 du/ac	.73	.87	.33	40
170	Residential	Medium Density Residential - Multi Family (5-10 du per acre)	.73	.87	.33	45
180	Residential	High Density Residential - Multi Family (10-15 du per acre)	.73	.87	.33	45
190	Residential	Very High Density Residential - Multi Family (>15 du per ac)	.73	.87	.33	45
200	Commercial	General Commercial (Commercial where no detail available)	.67	.84	.30	80
210	Commercial	Specialty Commercial (<=50,000 sq. ft.)	.64	.83	.29	80
220	Commercial	Neighborhood Commercial (50,000 to 100,000 sq. ft.)	.64	.83	.29	80
230	Commercial	Community Commercial (100,000 to 500,000 sq. ft.)	.59	.81	.26	80
240	Commercial	Regional Commercial (500,000 to 1,000,000 sq. ft.)	.64	.83	.29	80
250	Commercial	Super-Regional Commercial (>= 1,000,000 sq. ft.)	.62	.82	.28	80
300	Industrial	General Industrial (Industrial where no detail available)	.67	.84	.30	55
310	Industrial	Warehouse/Distribution Centers	.59	.81	.26	80
320	Industrial	Industrial	.67	.84	.30	55
400	Office	Office General (Office where no detail available)	.59	.81	.26	80
410	Office	Office Low Rise (1-4 stories)	.59	.81	.26	80
420	Office	Office Mid Rise (5-12 stories)	.59	.81	.26	80
430	Office	Office High Rise (13 stories or more)	.59	.81	.26	80
510	Tourist	Tourist and Visitor Accommodations (Hotels, motels, resorts)	.59	.81	.26	80
520	Institutional	Educational (Schools and universities)	.56	.80	.25	45
530	Institutional	Institutional (Includes hospitals and churches)	.59	.81	.26	80
540	Open Space	Cemeteries	.51	.78	.23	5
550	Institutional	Public Facilities (comm centers, libraries, sub-stations)	.59	.81	.26	80
553	Public	Public/Special Event/Military	.59	.81	.26	80
555	Other	Public	.59	.92	.38	80
560	Other	Special Events (stadiums, sports complexes and fairgrounds)	.59	.81	.26	80
572	Other Employment	Other Employment - Landfill/Proving Grounds/ Sand and Gravel	.53	.79	.26	80
580	Other Employment	Other Employment - medium	.59	.81	.26	80
590	Other Employment	Other Employment - high	.59	.81	.26	80
600	Transportation	General Transportation (where no detail available)	.59	.81	.26	80
610	Transportation	Transportation (railways, transit centers, freeways)	.59	.81	.26	80
620	Transportation	Airports (Includes public use airports)	.67	.84	.30	55
630	Transportation	General Transportation	.59	.81	.26	80
700	Open Space	General Open Space (Open space where no detail available)	.51	.78	.23	5
710	Open Space	Active Open Space (Includes parks)	.51	.78	.23	5
712	Open Space	Active Open Space	.51	.78	.23	5
720	Open Space	Golf courses	.51	.78	.23	5
730	Open Space	Passive Open Space (Includes mountain preserves and washes)	.51	.78	.23	-
740	Open Space	Water				-
750	Agriculture	Agriculture	.53	.79	.24	-
810	Office	Business Park (enclosed industrial, office or retail)	.59	.81	.26	80

Flood Control District of Maricopa County  
 Drainage Design Management System  
 Agency: FCDMC - RIVER MECHANICS - LAND USE DEFAULTS

Code	Group	Description	Effects of Canopy Cover (Ci)	Effects of Vegetation (Cii)	Effects of Tillage (Ciii)	Percent Impervious (%)
900	Open Space	Vacant (Existing land use database only)	.86	.93	.39	-
910	Residential	Developing residential	.86	.93	.39	45
920	Other Employment	Developing Employment Generating	.86	.93	.39	45
950	Other Employment	Developing Employment Generating	.86	.93	.39	45

Flood Control District Maricopa County  
 Drainage Design Management System  
 RIVER MECHANICS - SEDIMENT  
 Project Reference: ESTRELLA SWC-1

	Q (cfs)	Volume (ac-ft)	Wash Load (ac-ft)	Bed Load (ac-ft)	Total Yield (ac-ft)	
ID: 01	2 Year:	197	90.00	1.849	0.073	1.922
Return Periods for Analysis: All	5 Year:	352	157.00	3.495	0.156	3.651
	10 Year:	535	222.00	5.365	0.255	5.620
	25 Year:	857	322.00	8.601	0.120	8.721
	50 Year:	1,126	401.00	11.332	0.118	11.450
	100 Year:	1,448	487.00	14.546	0.156	14.702
	Design:	-	-	-	-	-
	Annual:			2.600	0.090	2.690

Flood Control District Maricopa County  
 Drainage Design Management System  
 RIVER MECHANICS - WASH LOAD  
 Project Reference: ESTRELLA SWC-1

Sediment Area ID	Area (sq mi)	SDR (%)	Soil and Erosion Factors			Land Use Factors					Topographic Factors		
			Soil Erodibility Factor (K)	Erosion Control Factor (P)	Specific Weight (lb/cu ft)	Effects of Canopy Cover (Ci)	Effects of Vegetation (Cii)	Effects of Tillage (Ciii)	Cover Management Factor (C)	Percent Impervious (%)	Slope Length (ft)	Slope (%)	Topographic Factor (LS)
ID: 01 I	8.5600	49.5	0.20	1.0	59.62	0.74	0.88	0.34	0.22	4	4,309	6.66	5.05

Specific Weight Method: Channel Bed Material Soil Sample      Bed Material Soil Sample D10 (mm): 0.01

Flood Control District Maricopa County  
 Drainage Design Management System  
 RIVER MECHANICS - BED LOAD  
 Project Reference: ESTRELLA SWC-1

8/29/2011

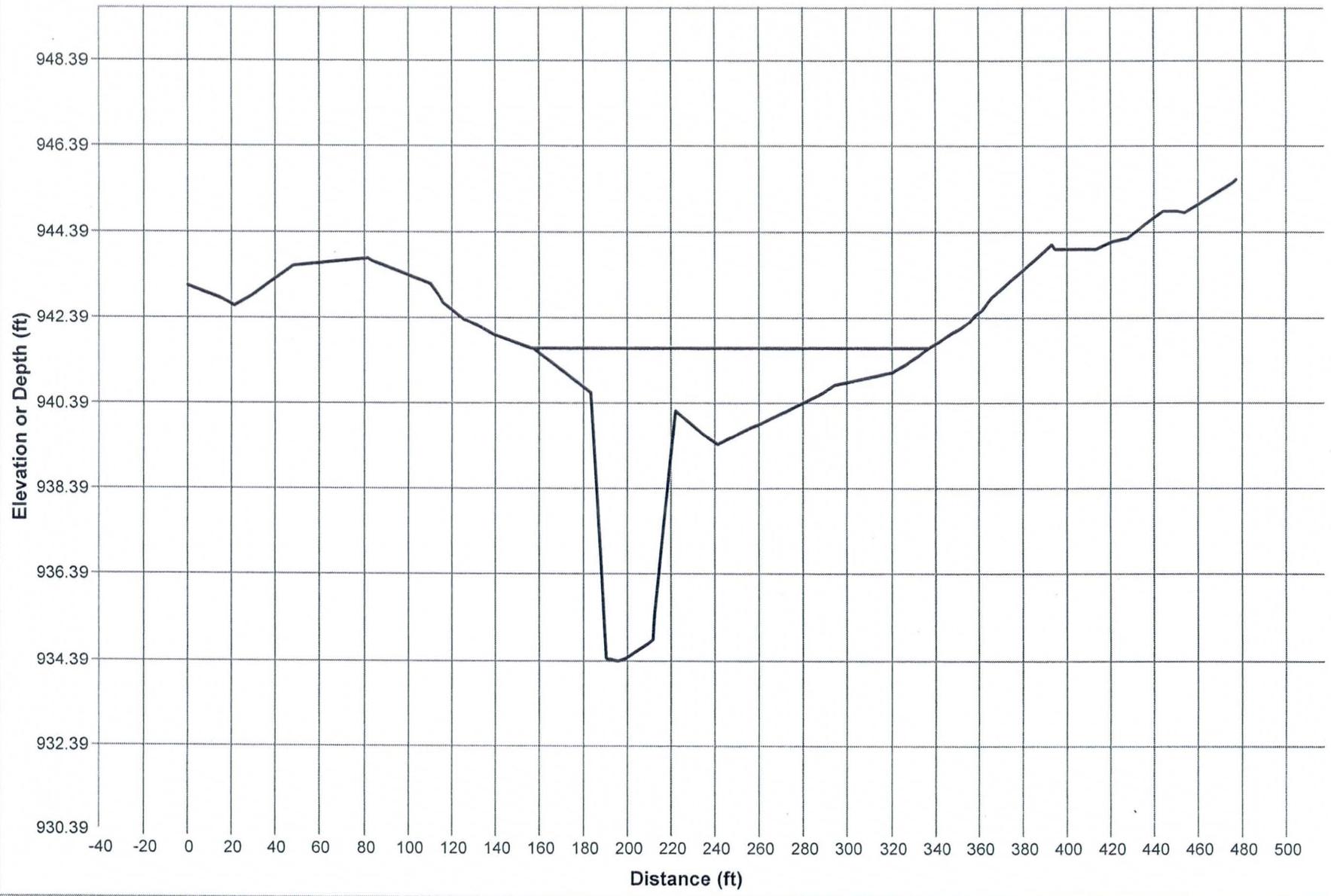
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	Slope (ft/ft)	Manning's n	D16 (mm)	D50 (mm)	D84 (mm)		Average Velocity (ft/sec)	Hydraulic Depth (ft)	Normal Depth (ft)	Average Width (ft)	Bed Load per Foot, qs (cfs/ft)	Bed Load (cfs)
ID: 01	0.005200	0.045	0.530	1.600	5.050	<b>2 Year:</b>	3.64	1.98	2.43	22.27	0.01	0.16
Cross Section ID: RCPI67						<b>5 Year:</b>	4.38	2.65	3.34	24.06	0.02	0.35
						<b>10 Year:</b>	4.99	3.25	4.19	25.59	0.02	0.62
						<b>25 Year:</b>	3.85	2.13	6.21	35.85	0.01	0.32
						<b>50 Year:</b>	3.67	1.95	6.86	44.72	0.01	0.33
						<b>100 Year:</b>	3.85	2.09	7.27	51.73	0.01	0.46
					<b>Design:</b>	-	-	-	-	-	-	-

Flood Control District of Maricopa County  
 Drainage Design Management System  
 RIVER MECHANICS - CROSS SECTION HYDRAULICS  
 Project Reference: ESTRELLA SWC-1

Section ID	Flow Type	Entire Section								Channel Section		
		Q (cfs)	Slope (f/f)	Man'g N	W.P. (ft)	Hyd Depth (ft)	Area (sq ft)	Max Depth (ft)	Vel (f/s)	Hyd Depth (ft)	Vel (ft/sec)	Froude Num
RCPI67	Design	1448	0.005200	0.045	183.88	2.09	376.24	7.27	3.85	2.09	3.85	0.47
	Dominant		0.000000	0.000	0.00	0.00			0.00	0.00	0.00	0.00

River Mechanics Channel Cross Section  
Section ID: RCPI67



— Ground Line

— Design Depth (7.27)

	Q (cfs)	Volume (ac-ft)	Wash Load (ac-ft)	Bed Load (ac-ft)	Total Yield (ac-ft)
ID: H72					
Return Periods for Analysis: All					
2 Year:	162	54.00	3.093	0.310	3.403
5 Year:	258	88.00	5.276	0.518	5.794
10 Year:	360	124.00	7.704	0.895	8.599
25 Year:	540	185.00	12.096	1.794	13.890
50 Year:	691	211.00	14.948	2.391	17.339
100 Year:	882	284.00	20.240	3.690	23.930
Design:	882	284.00	20.240	3.69	23.930
Annual:			3.920	0.462	4.382

Flood Control District Maricopa County  
 Drainage Design Management System  
 RIVER MECHANICS - WASH LOAD  
 Project Reference: ESTRELLA SWC-2

Sediment Area ID	Area (sq mi)	SDR (%)	Soil and Erosion Factors			Land Use Factors					Topographic Factors		
			Soil Erodibility Factor (K)	Erosion Control Factor (P)	Specific Weight (lb/cu ft)	Effects of Canopy Cover (Ci)	Effects of Vegetation (Cii)	Effects of Tillage (Ciii)	Cover Management Factor (C)	Percent Impervious (%)	Slope Length (ft)	Slope (%)	Topographic Factor (LS)
ID: H72 H72	9.9882	48.8	0.16	1.0	39.18	0.67	0.85	0.30	0.17	-	5,698	11.60	12.99

Specific Weight Method: Channel Bed Material Soil Sample      Bed Material Soil Sample D10 (mm): 0.00

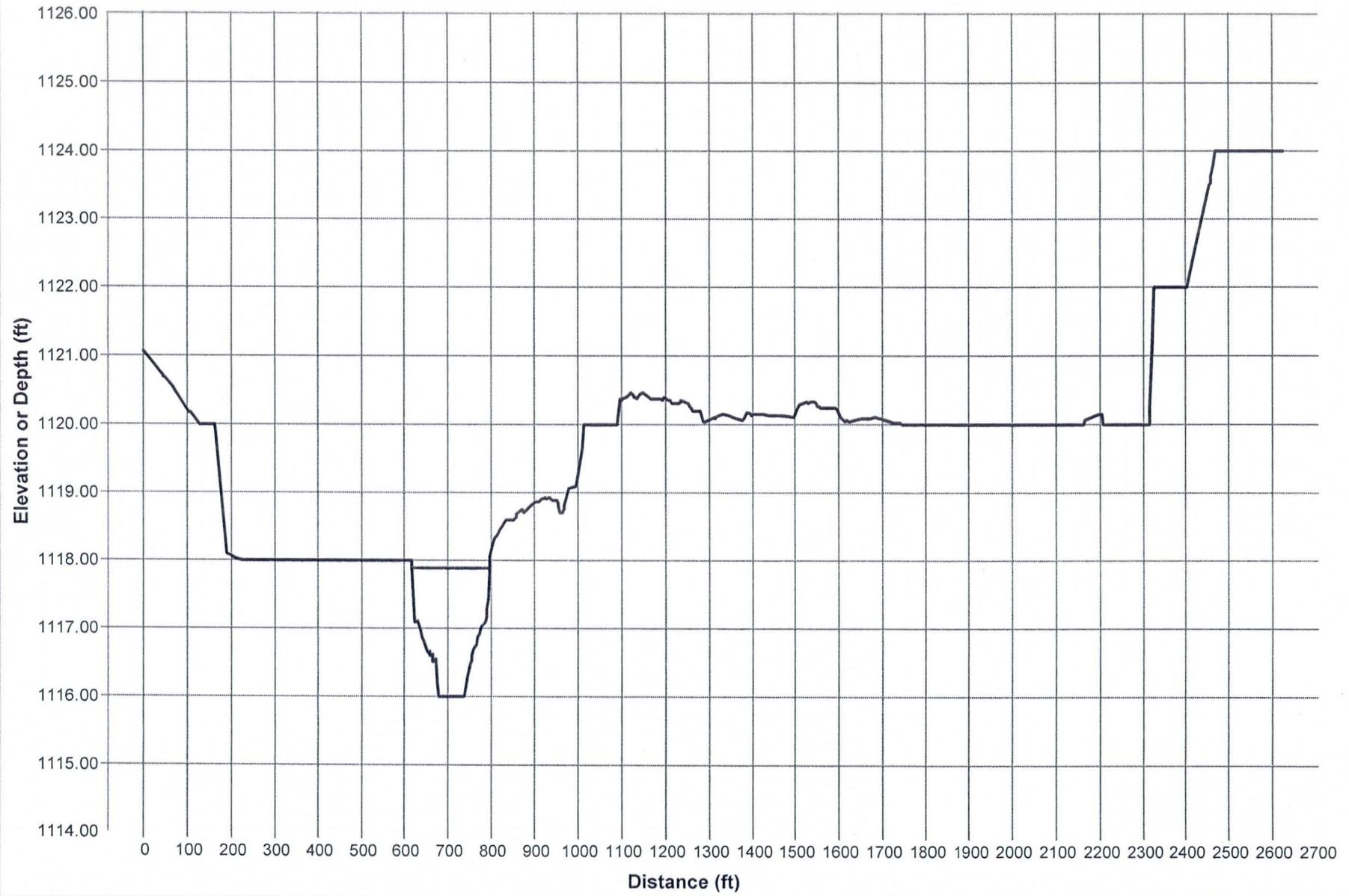
Flood Control District Maricopa County  
 Drainage Design Management System  
 RIVER MECHANICS - BED LOAD  
 Project Reference: ESTRELLA SWC-2

	Slope (ft/ft)	Manning's n	D16 (mm)	D50 (mm)	D84 (mm)		Average Velocity (ft/sec)	Hydraulic Depth (ft)	Normal Depth (ft)	Average Width (ft)	Bed Load per Foot, qs (cfs/ft)	Bed Load (cfs)
ID: H72	0.008000	0.045	0.003	0.130	0.530	<b>2 Year:</b>	2.09	0.59	0.90	86.12	0.01	0.93
Cross Section ID: H72						<b>5 Year:</b>	2.29	0.68	1.14	98.82	0.02	1.52
						<b>10 Year:</b>	2.58	0.83	1.30	107.33	0.02	2.60
						<b>25 Year:</b>	3.02	1.03	1.53	116.87	0.05	5.24
						<b>50 Year:</b>	3.31	1.19	1.70	122.80	0.06	7.83
						<b>100 Year:</b>	3.61	1.36	1.90	128.59	0.09	11.46
						<b>Design:</b>	3.61	1.36	1.90	128.59	0.09	11.46

Flood Control District of Maricopa County  
 Drainage Design Management System  
 RIVER MECHANICS - CROSS SECTION HYDRAULICS  
 Project Reference: ESTRELLA SWC-2

Section ID	Flow Type	Entire Section							Channel Section			
		Q (cfs)	Slope (f/f)	Man'g N	W.P. (ft)	Hyd Depth (ft)	Area (sq ft)	Max Depth (ft)	Vel (f/s)	Hyd Depth (ft)	Vel (ft/sec)	Froude Num
H72	Design	882	0.008000	0.045	179.07	1.36	244.14	1.90	3.61	1.36	3.61	0.55
	Dominant	882	0.000000	0.045	0.00	0.00			0.00	0.00	0.00	0.00

River Mechanics Channel Cross Section  
Section ID: H72



— Ground Line

— Design Depth (1.90)

**DDMSW INPUT/OUTPUT DATA**

**SONORA SWC**

		Q (cfs)	Volume (ac-ft)	Wash Load (ac-ft)	Bed Load (ac-ft)	Total Yield (ac-ft)
ID: SONORA SWC-1 Return Periods for Analysis: All	2 Year:	120	26.00	0.040	0.014	0.054
	5 Year:	305	62.00	0.109	0.055	0.164
	10 Year:	493	128.00	0.213	0.083	0.296
	25 Year:	791	266.00	0.418	0.038	0.456
	50 Year:	1,224	389.00	0.661	0.040	0.701
	100 Year:	1,795	535.00	0.979	0.063	1.042
	Design:	1,795	535.00	0.979	0.06	1.042
	Annual:			0.096	0.026	0.122
ID: SONORA SWC-2 Return Periods for Analysis: All	2 Year:	77	13.00	0.155	0.008	0.163
	5 Year:	192	37.00	0.464	0.032	0.496
	10 Year:	295	69.00	0.837	0.054	0.891
	25 Year:	494	117.00	1.501	0.105	1.606
	50 Year:	700	160.00	2.175	0.175	2.350
	100 Year:	939	208.00	2.969	0.254	3.223
	Design:	939	208.00	2.969	0.25	3.223
	Annual:			0.359	0.025	0.384
ID: SONORA SWC-3 Return Periods for Analysis: All	2 Year:	1	1.00	0.001	0.001	0.002
	5 Year:	127	11.00	0.068	0.004	0.072
	10 Year:	265	47.00	0.232	0.012	0.244
	25 Year:	491	130.00	0.579	0.037	0.616
	50 Year:	870	215.00	1.058	0.044	1.102
	100 Year:	1,306	321.00	1.662	0.087	1.749
	Design:	1,306	321.00	1.662	0.09	1.749
	Annual:			0.097	0.006	0.103
ID: SONORA SWC-4 Return Periods for Analysis: All	2 Year:	1	1.00	0.003	-	0.003
	5 Year:	51	24.00	0.168	0.004	0.172
	10 Year:	604	212.00	2.268	0.176	2.444
	25 Year:	1,787	626.00	7.635	0.249	7.884
	50 Year:	3,032	1,027.00	13.546	0.532	14.078
	100 Year:	4,325	1,503.00	20.456	0.974	21.430
	Design:	4,325	1,503.00	20.456	0.97	21.430
	Annual:			1.032	0.047	1.079

Flood Control District of Maricopa County  
 Drainage Design Management System  
 RIVER MECHANICS - WASH LOAD

Project Reference: RAINBOW VLY SEDIMENT

8/29/2011

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Sediment Area ID	Area (sq mi)	SDR (%)	Soil and Erosion Factors			Land Use Factors				Topographic Factors			
			Soil Erodibility Factor (K)	Erosion Control Factor (P)	Specific Weight (lb/cu ft)	Effects of Canopy Cover (Ci)	Effects of Vegetation (Cii)	Effects of Tillage (Ciii)	Cover Management Factor (C)	Percent Impervious (%)	Slope Length (ft)	Slope (%)	Topographic Factor (LS)
ID: SONORA SWC-1 A1	21.0930	45.4	0.13	1.0	65.77	0.57	0.80	0.26	0.12	-	6,098	2.83	0.93
			Specific Weight Method: Channel Bed Material Soil Sample				Bed Material Soil Sample D10 (mm): 0.02						
ID: SONORA SWC-2 A2	15.0060	46.9	0.15	1.0	63.79	0.57	0.81	0.26	0.12	-	5,184	6.71	5.60
			Specific Weight Method: Channel Bed Material Soil Sample				Bed Material Soil Sample D10 (mm): 0.02						
ID: SONORA SWC-3 B	15.5820	46.8	0.15	1.0	45.33	0.55	0.80	0.25	0.11	-	5,793	3.18	1.59
			Specific Weight Method: Channel Bed Material Soil Sample				Bed Material Soil Sample D10 (mm): 0.00						
ID: SONORA SWC-4 C	67.7950	40.5	0.16	1.0	66.21	0.52	0.78	0.23	0.09	-	5,326	8.70	8.15
			Specific Weight Method: Channel Bed Material Soil Sample				Bed Material Soil Sample D10 (mm): 0.02						

Flood Control District Maricopa County  
 Drainage Design Management System  
 RIVER MECHANICS - BED LOAD

Project Reference: RAINBOW VLY SEDIMENT

8/29/2011

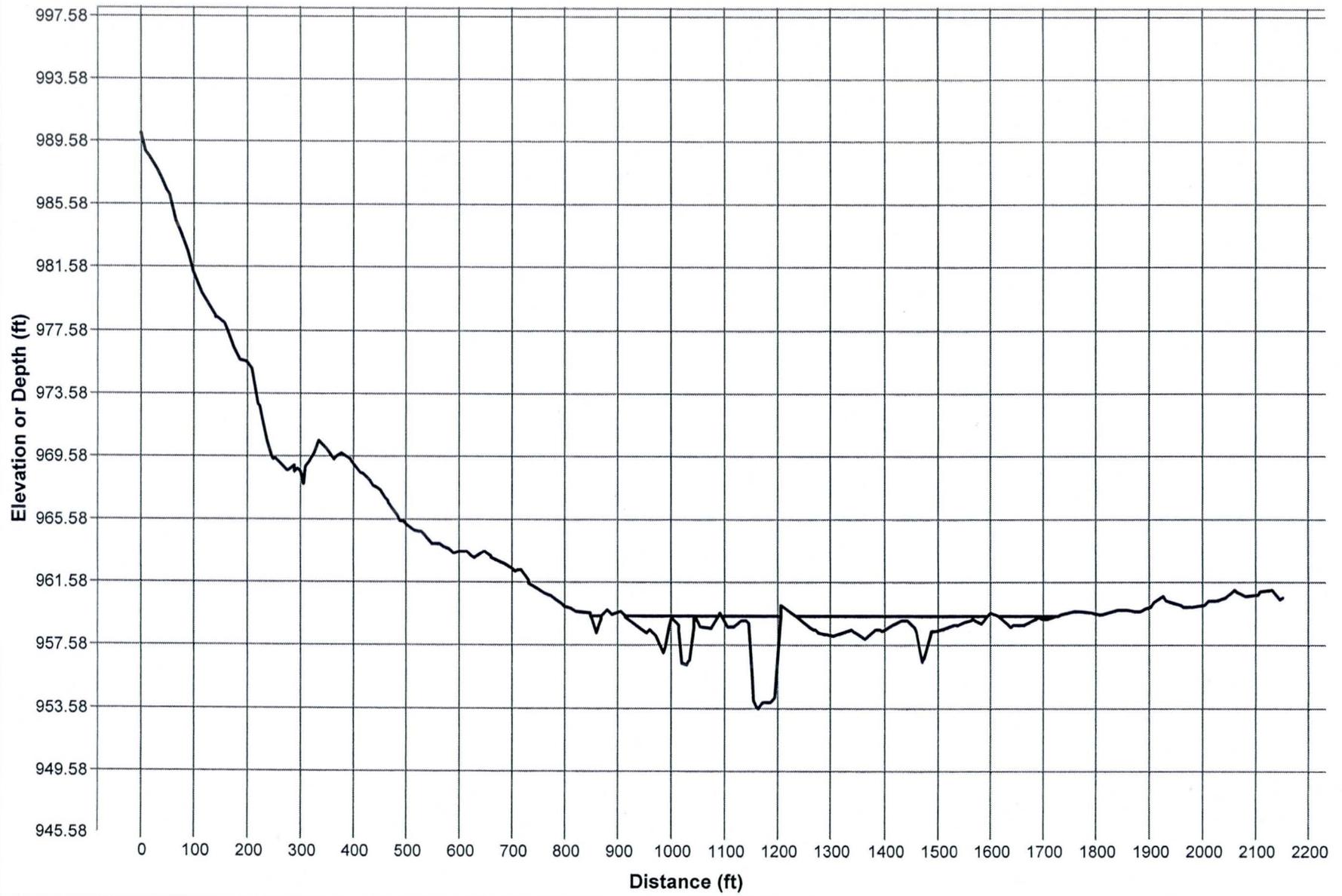
Page 1

	Slope (ft/ft)	Manning's n	D16 (mm)	D50 (mm)	D84 (mm)		Average Velocity (ft/sec)	Hydraulic Depth (ft)	Normal Depth (ft)	Average Width (ft)	Bed Load per Foot, qs (cfs/ft)	Bed Load (cfs)
ID: SONORA SWC-1 Cross Section ID: A1-RCPA55	0.004800	0.050	0.285	1.050	4.100	2 Year:	2.31	1.19	1.57	33.09	-	0.07
						5 Year:	3.22	2.01	2.51	37.74	0.01	0.27
						10 Year:	3.23	2.02	3.47	43.99	0.01	0.32
						25 Year:	2.18	1.11	5.04	71.99	-	0.11
						50 Year:	2.01	0.97	5.57	109.33	-	0.13
						100 Year:	2.14	1.07	5.89	142.41	-	0.21
						Design:	2.14	1.07	5.89	142.41	-	0.21
ID: SONORA SWC-2 Cross Section ID: A2-RCPA37	0.004800	0.050	0.021	0.084	1.000	2 Year:	0.88	0.27	0.55	159.09	-	0.05
						5 Year:	1.10	0.39	0.78	223.78	-	0.16
						10 Year:	1.14	0.41	0.94	275.29	-	0.23
						25 Year:	1.27	0.49	1.12	347.30	-	0.44
						50 Year:	1.41	0.56	1.25	397.16	-	0.77
						100 Year:	1.52	0.64	1.38	447.65	-	1.15
						Design:	1.52	0.64	1.38	447.65	-	1.15
ID: SONORA SWC-3 Cross Section ID: B-RCPB21	0.006200	0.050	0.018	0.580	3.700	2 Year:	0.90	0.15	0.30	3.70	-	-
						5 Year:	1.35	0.45	1.68	55.99	-	0.04
						10 Year:	1.31	0.42	2.07	97.72	-	0.07
						25 Year:	1.40	0.46	2.30	152.48	-	0.14
						50 Year:	1.30	0.41	2.57	260.40	-	0.18
						100 Year:	1.46	0.49	2.70	331.30	-	0.35
						Design:	1.46	0.49	2.70	331.30	-	0.35
ID: SONORA SWC-4 Cross Section ID: C-RCPB09	0.004700	0.050	0.305	0.580	2.800	2 Year:	0.51	0.10	0.20	9.80	-	-
						5 Year:	1.08	0.39	0.77	61.32	-	0.01
						10 Year:	2.64	1.48	2.06	111.06	0.01	0.50
						25 Year:	2.57	1.42	3.98	174.71	-	0.71
						50 Year:	2.96	1.76	4.58	223.65	0.01	1.57
						100 Year:	3.31	2.08	5.05	258.74	0.01	2.80
						Design:	3.31	2.08	5.05	258.74	0.01	2.80

Flood Control District of Maricopa County  
 Drainage Design Management System  
 RIVER MECHANICS - CROSS SECTION HYDRAULICS  
 Project Reference: RAINBOW VLY SEDIMENT

Section ID	Flow Type	Entire Section							Channel Section			
		Q (cfs)	Slope (f/f)	Man'g N	W.P. (ft)	Hyd Depth (ft)	Area (sq ft)	Max Depth (ft)	Vel (f/s)	Hyd Depth (ft)	Vel (ft/sec)	Froude Num
A1-RCPA55	Design	1795	0.004800	0.050	787.61	1.07	839.18	5.89	2.14	1.07	2.14	0.36
	Dominant	448	0.004800	0.045	68.21	1.92	128.25	3.13	3.49	1.92	3.49	0.44
A2-RCPA37	Design	939	0.004800	0.050	962.28	0.64	618.11	1.38	1.52	0.64	1.52	0.33
	Dominant	235	0.004800	0.045	464.35	0.40	187.51	.81	1.25	0.40	1.25	0.35
B-RCPB21	Design	1306	0.006200	0.050	1,818.48	0.49	895.14	2.70	1.46	0.49	1.46	0.37
	Dominant	327	0.006200	0.045	597.05	0.39	235.38	2.13	1.39	0.39	1.39	0.39
C-RCPB09	Design	4325	0.004700	0.050	631.70	2.08	1307.49	5.05	3.31	2.08	3.31	0.40
	Dominant	1154	0.004700	0.045	172.09	1.93	329.51	2.68	3.50	1.93	3.50	0.44

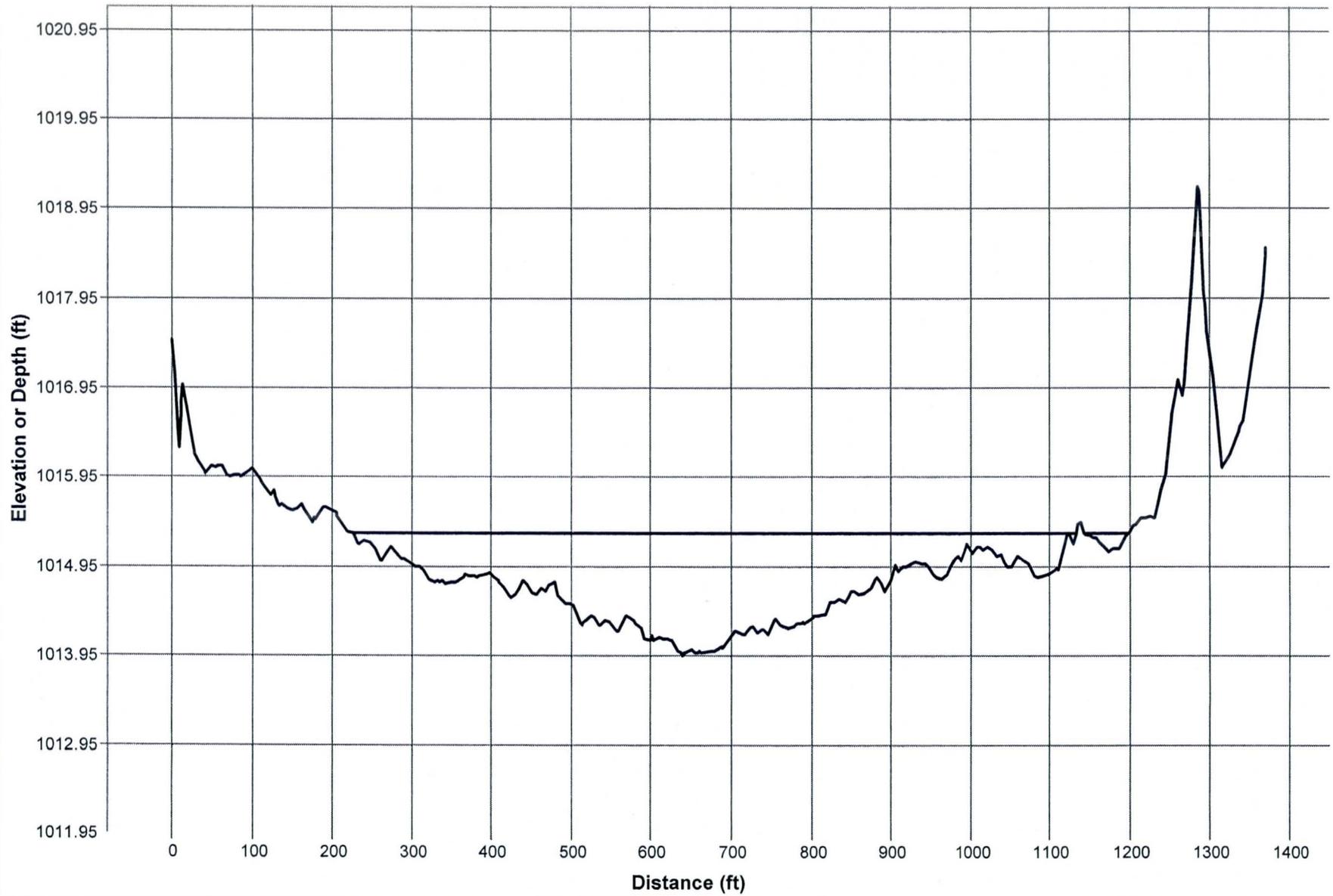
River Mechanics Channel Cross Section  
Section ID: A1-RCPA55



— Ground Line

— Design Depth (5.89)

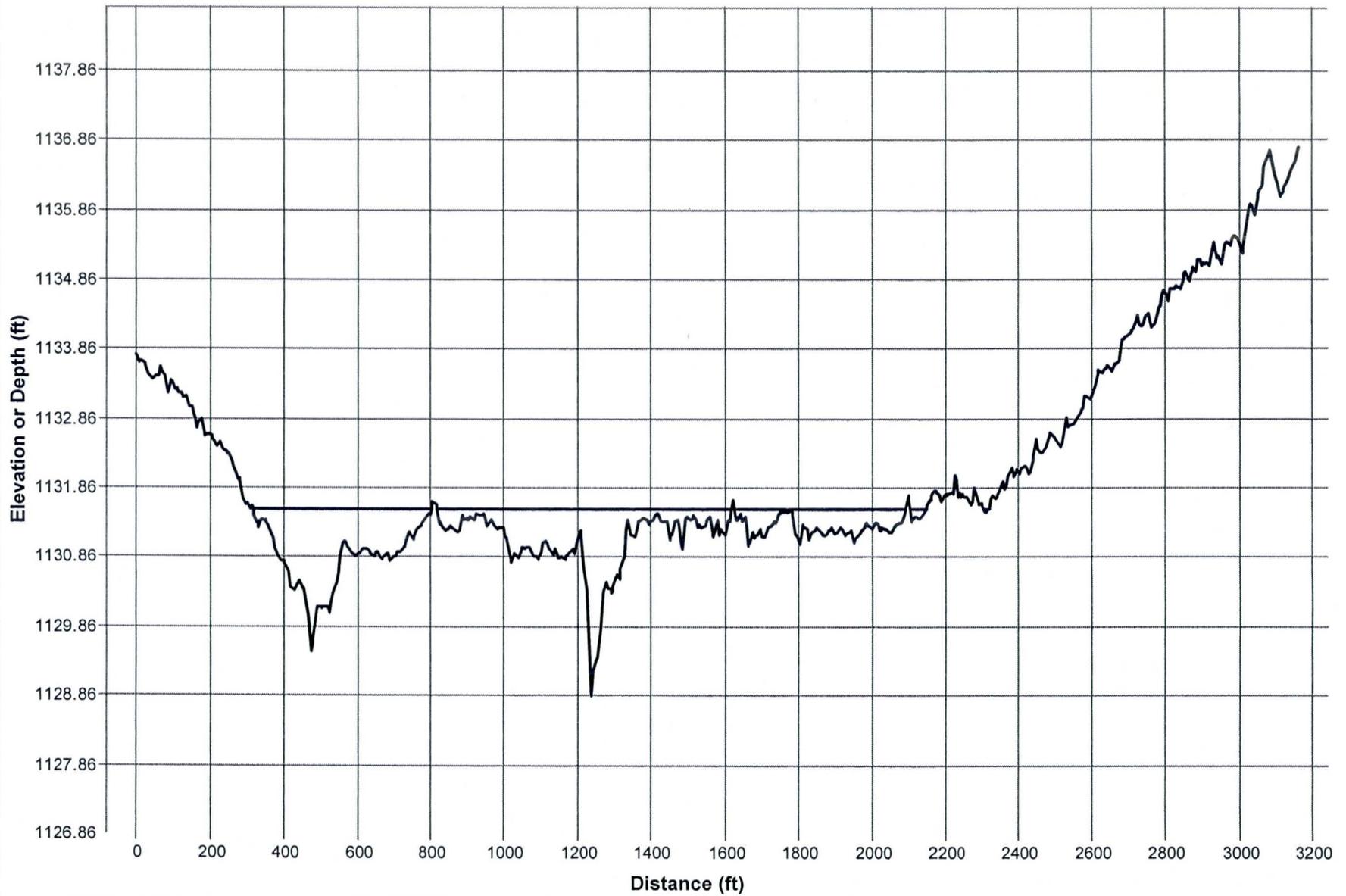
River Mechanics Channel Cross Section  
Section ID: A2-RCPA37



— Ground Line

— Design Depth (1.38)

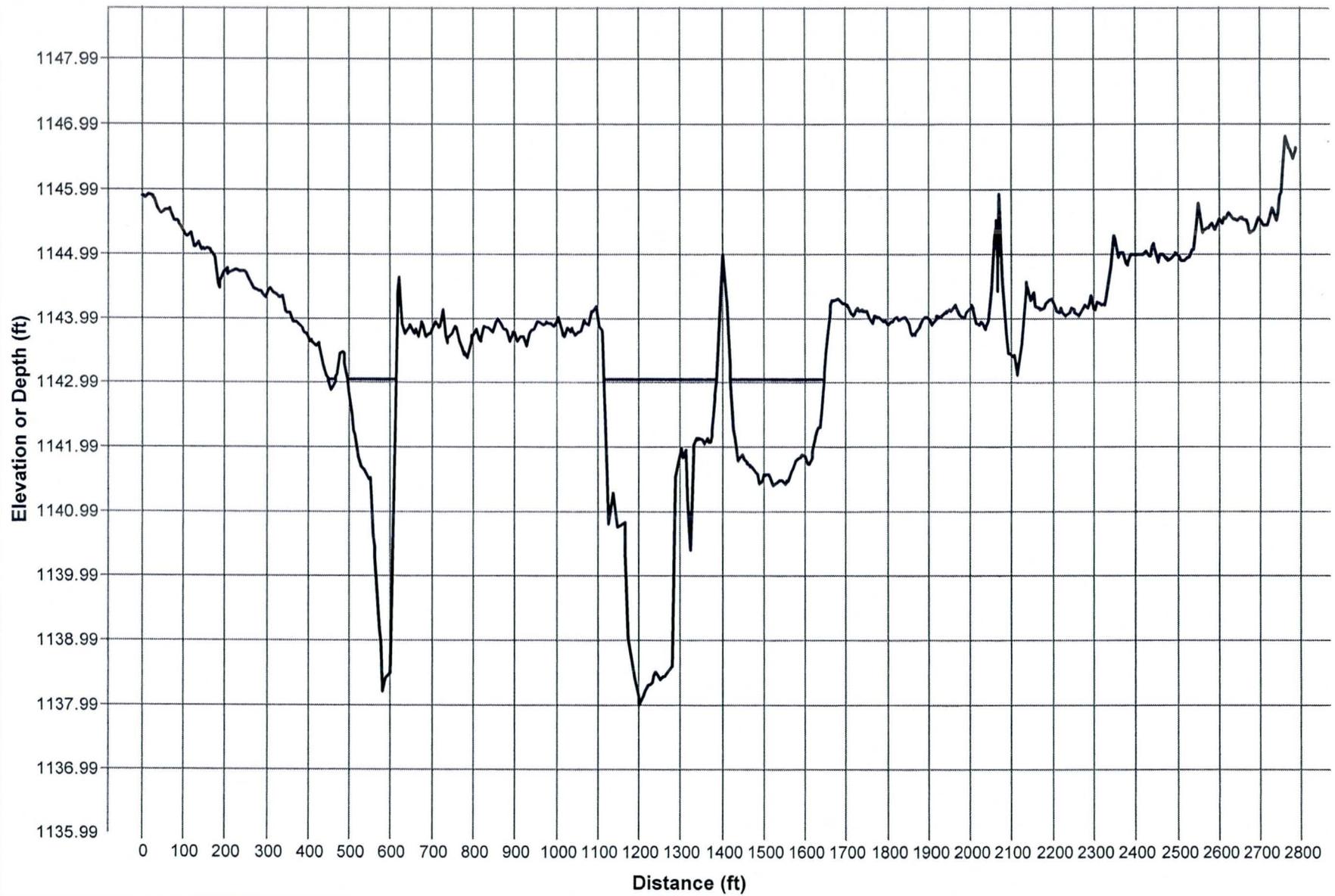
River Mechanics Channel Cross Section  
Section ID: B-RCPB21



— Ground Line

— Design Depth (2.70)

River Mechanics Channel Cross Section  
Section ID: C-RCPB09



— Ground Line

— Design Depth (5.05)

**SLOPE AND SLOPE  
LENGTH CALCULATION**

Slope Length determination for Estrella SWC - 1

Slope Length Shapefile

FID	Shape *	Id	Label	Length	Elev_UP	Elev_Down	Slope
0	Polyline	0	A	1689.594	1058	980	0.05
1	Polyline	0	B	8910.488	1200	988	0.02
2	Polyline	0	C	4917.06	1058	1020	0.01
8	Polyline	0	D	617.2553	1522	1370	0.25
3	Polyline	0	E	5410.065	1110.5	1061.5	0.01
<b>Average, ft</b>				<b>4309</b>	<b>Average, %</b>		<b>6.66</b>

Slope Length determination for Estrella SWC - 2

Slope Length Shapefile

FID	Shape *	Id	Label	Length	Elev_UP	Elev_Down	Slope
9	Polyline	0	F	3980.089	1174	1146.5	0.01
7	Polyline	0	G	4437.083	1378	1332	0.01
5	Polyline	0	H	8500.323	2406	1370	0.12
6	Polyline	0	I	3594.361	3705	2150	0.43
4	Polyline	0	J	7975.955	1280	1216	0.01
<b>Average, ft</b>				<b>5698</b>	<b>Average, %</b>		<b>11.60</b>

Slope Length determination for Sonora SWC - 1

FID	Shape *	Id	Label	Length	Elev_UP	Elev_Down	Slope
10	Polyline	0	K	2682.052	1066	1042	0.01
12	Polyline	0	L	1338.463	1470	1330	0.10
13	Polyline	0	M	7046.114	1272	1190	0.01
14	Polyline	0	N	8162.216	1147	1083	0.01
11	Polyline	0	O	11259.31	1100	1002	0.01
<b>Average, ft</b>				<b>6098</b>	<b>Average, %</b>		<b>2.83</b>

Slope Length determination for Sonora SWC - 2

FID	Shape *	Id	Label	Length	Elev_UP	Elev_Down	Slope
15	Polyline	0	P	1443.907	1132	1118	0.01
16	Polyline	0	Q	2608.485	1730	1334	0.15
17	Polyline	0	R	7291.031	2230	1340	0.12
18	Polyline	0	S	8134.627	1092	1034	0.01
19	Polyline	0	T	6441.578	1510	1220	0.05
<b>Average, ft</b>				<b>5184</b>	<b>Average, %</b>		<b>6.71</b>

Slope Length determination for Sonora SWC - 3

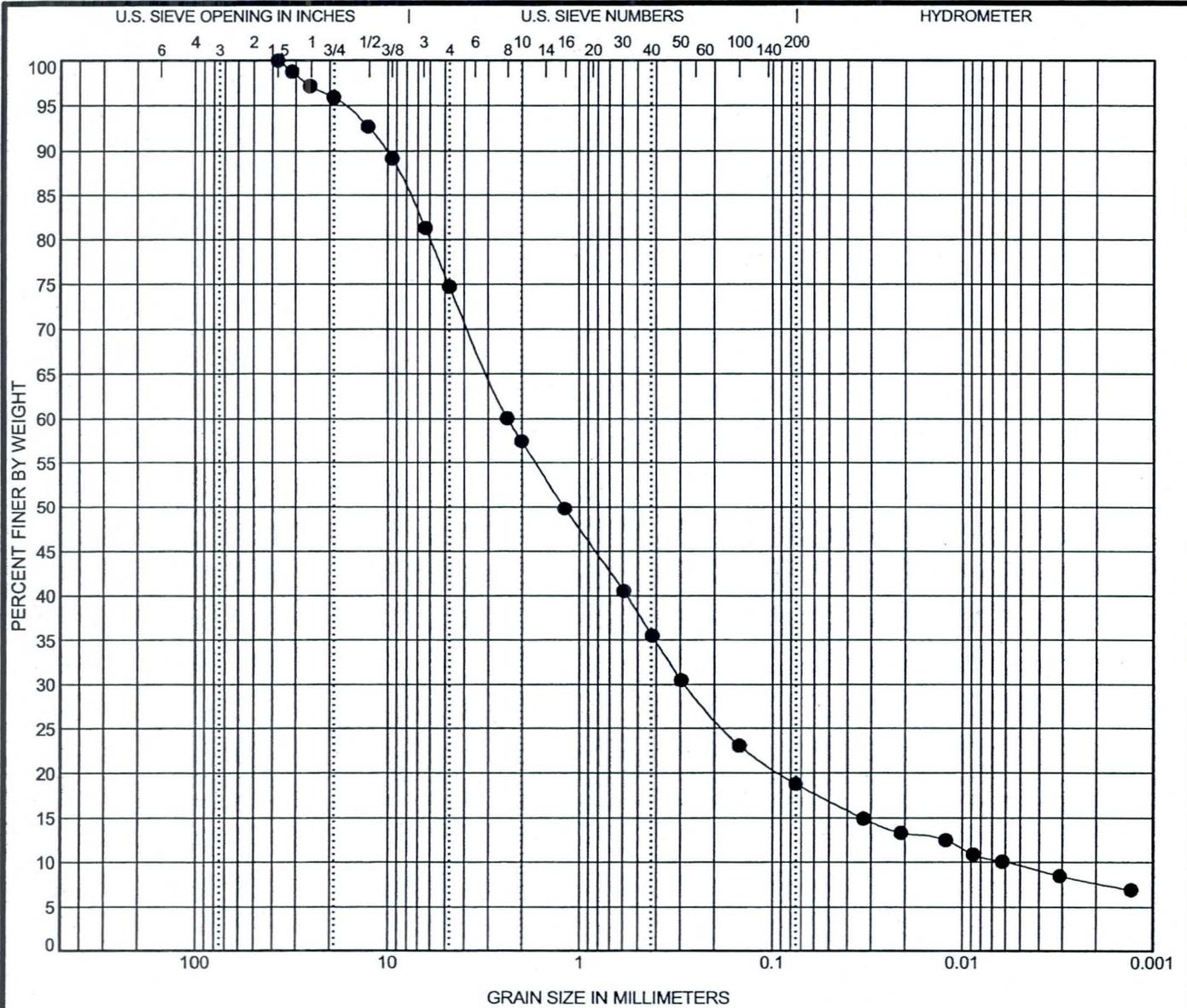
FID	Shape *	Id	Label	Length	Elev_UP	Elev_Down	Slope
23	Polyline	0	U	2117.732	1790	1518	0.13
22	Polyline	0	V	7818.44	1228	1175	0.01
24	Polyline	0	W	11624.68	1400	1280	0.01
20	Polyline	0	X	4618.403	1164	1132	0.01
21	Polyline	0	Y	2782.167	1251	1233	0.01
<b>Average, ft</b>				<b>5793</b>	<b>Average, %</b>		<b>3.18</b>

Slope Length determination for Sonora SWC - 4

FID	Shape *	Id	Label	Length	Elev_UP	Elev_Down	Slope
27	Polyline	0	AA	5539.528	1385	1350	0.01
28	Polyline	0	BB	8189.264	1204	1150	0.01
25	Polyline	0	CC	9670.209	1263	1208	0.01
29	Polyline	0	DD	1730.071	1770	1208	0.32
26	Polyline	0	Z	3000.737	1730	1455	0.09
<b>Average, ft</b>				<b>5626</b>	<b>Average, %</b>		<b>8.70</b>

**SOIL TEST DATA**

**ESTRELLA SWC 1**



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-57 0.0 ft					5.7	393.4
☒						
▲						
★						
◎						

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-57 0.0 ft	37.5	2.368	0.284	0.006	25.2	56.0	11.1	7.7
☒								
▲								
★								
◎								

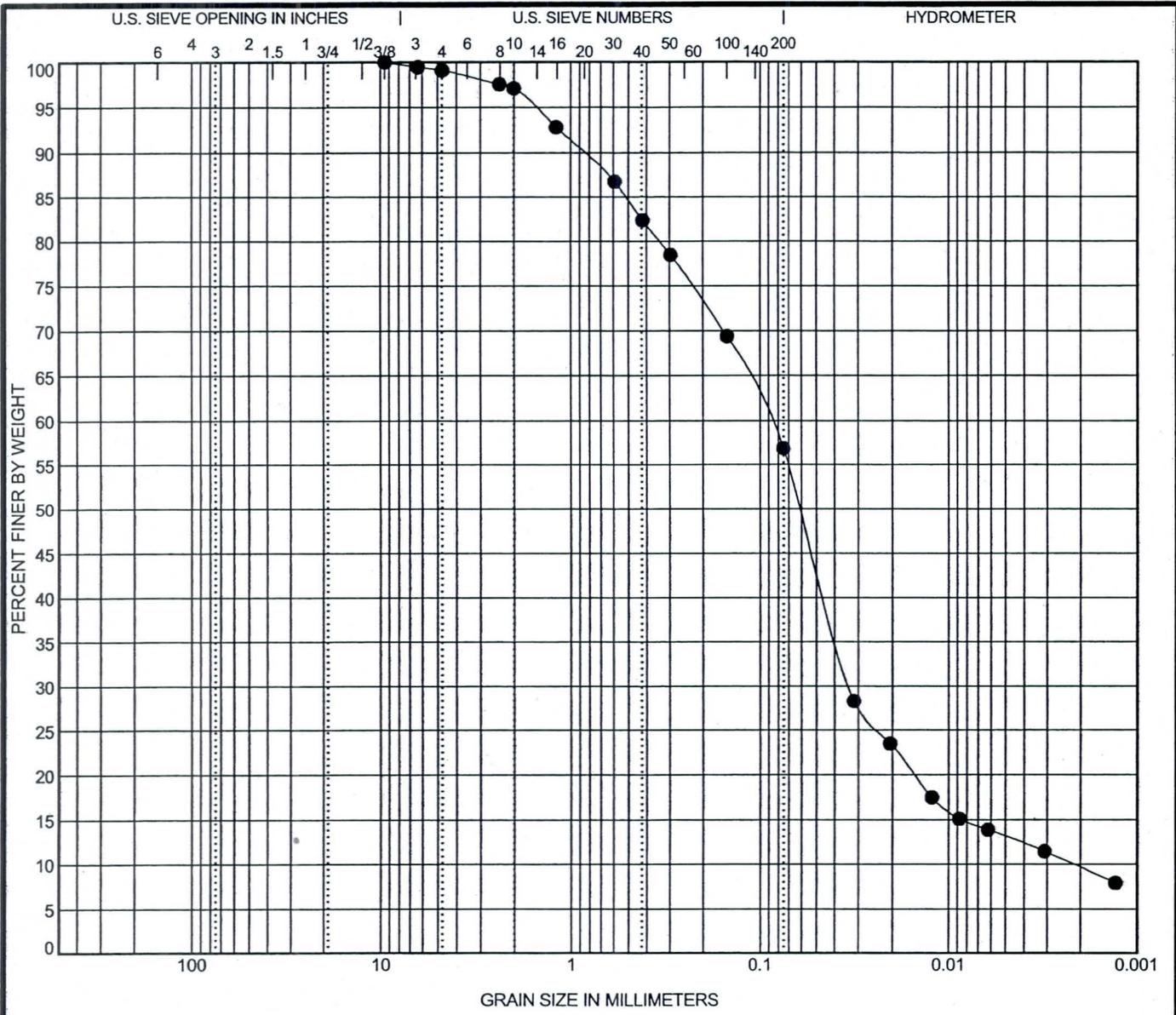
**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC: GRAIN SIZE 65101872.GPJ TERRACON.GDT 1/3/11





COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-59 1.0 ft					5.7	41.0
☒						
▲						
★						
◎						

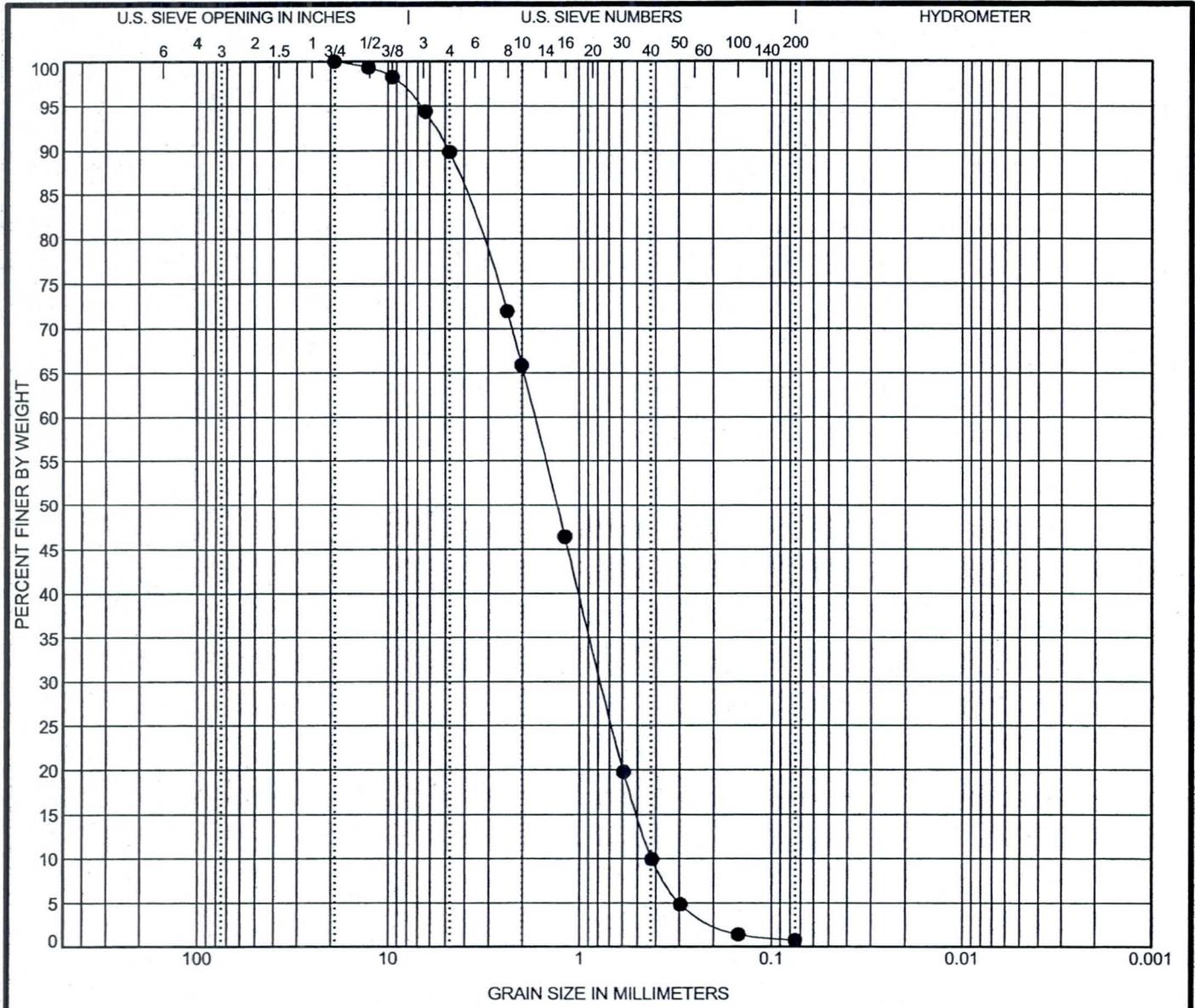
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-59 1.0 ft	9.5	0.089	0.033	0.002	0.9	42.2	47.2	9.7
☒								
▲								
★								
◎								

**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC: GRAIN SIZE 65101872.GPJ TERRACON.GDT 1/3/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		USCS Soil Classification				LL	PL	PI	Cc	Cu
●	TP-60 1.0 ft	POORLY GRADED SAND(SP)							0.8	4.1
☒	ft									
▲	ft									
★	ft									
◎	ft									

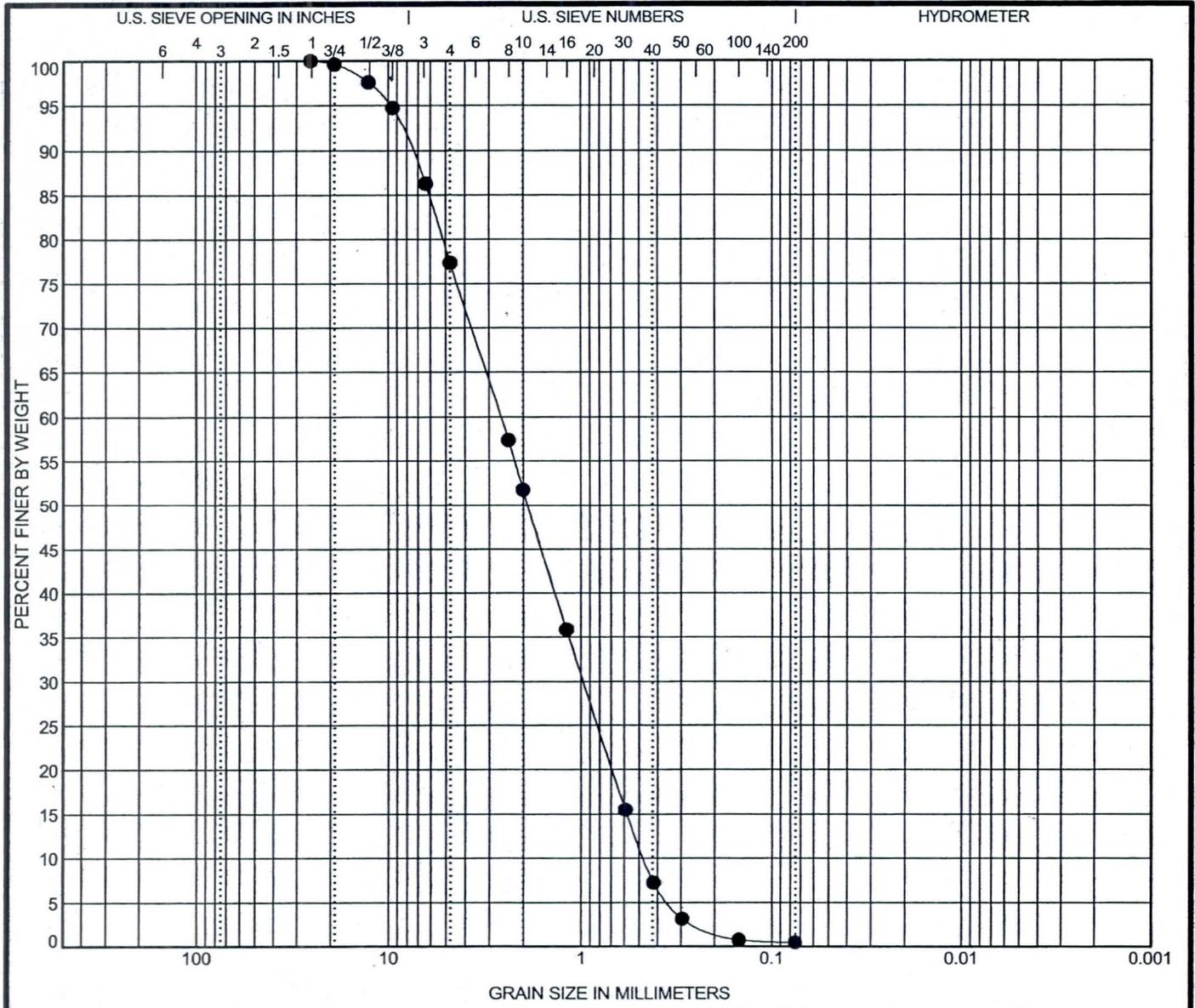
Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	TP-60 1.0 ft	19.1	1.709	0.773	0.421	10.1	89.1	0.8	
☒	ft								
▲	ft								
★	ft								
◎	ft								

TC GRAIN SIZE 65101872.GPJ\_TERRACON.GDT\_1/3/11



**GRAIN SIZE DISTRIBUTION**

Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification					LL	PL	PI	Cc	Cu
● TP-60 1.3 ft	POORLY GRADED SAND with GRAVEL(SP)								0.8	5.5
☒	ft									
▲	ft									
★	ft									
◎	ft									

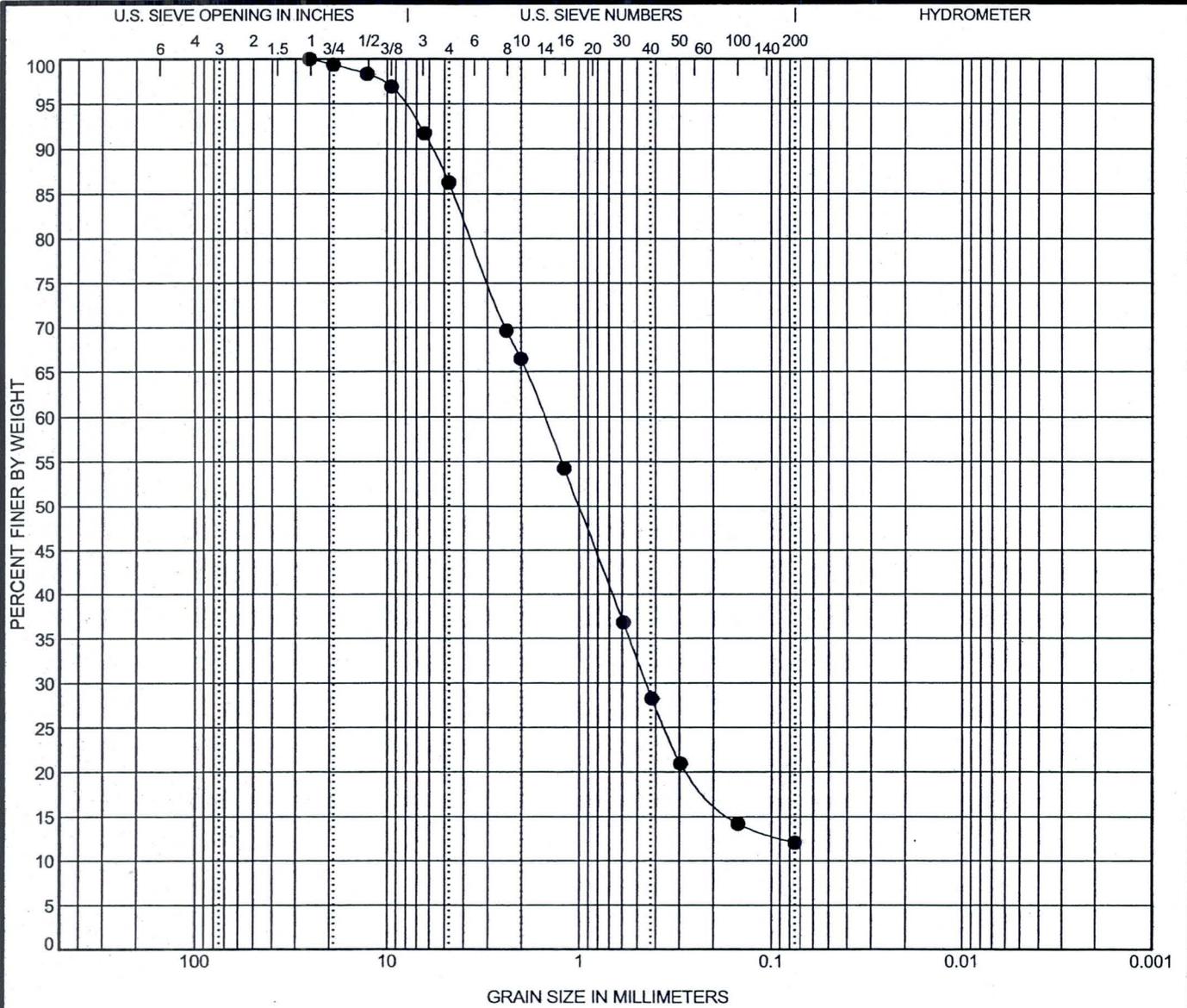
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-60 1.3 ft	25.4	2.604	0.972	0.471	22.6	76.9	0.5	
☒	ft							
▲	ft							
★	ft							
◎	ft							

**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC GRAIN SIZE 65101872.GPJ TERRACON.GDT 1/3/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification					LL	PL	PI	Cc	Cu
● TP-61 1.0 ft									3.4	38.8
☒	ft									
▲	ft									
★	ft									
◎	ft									

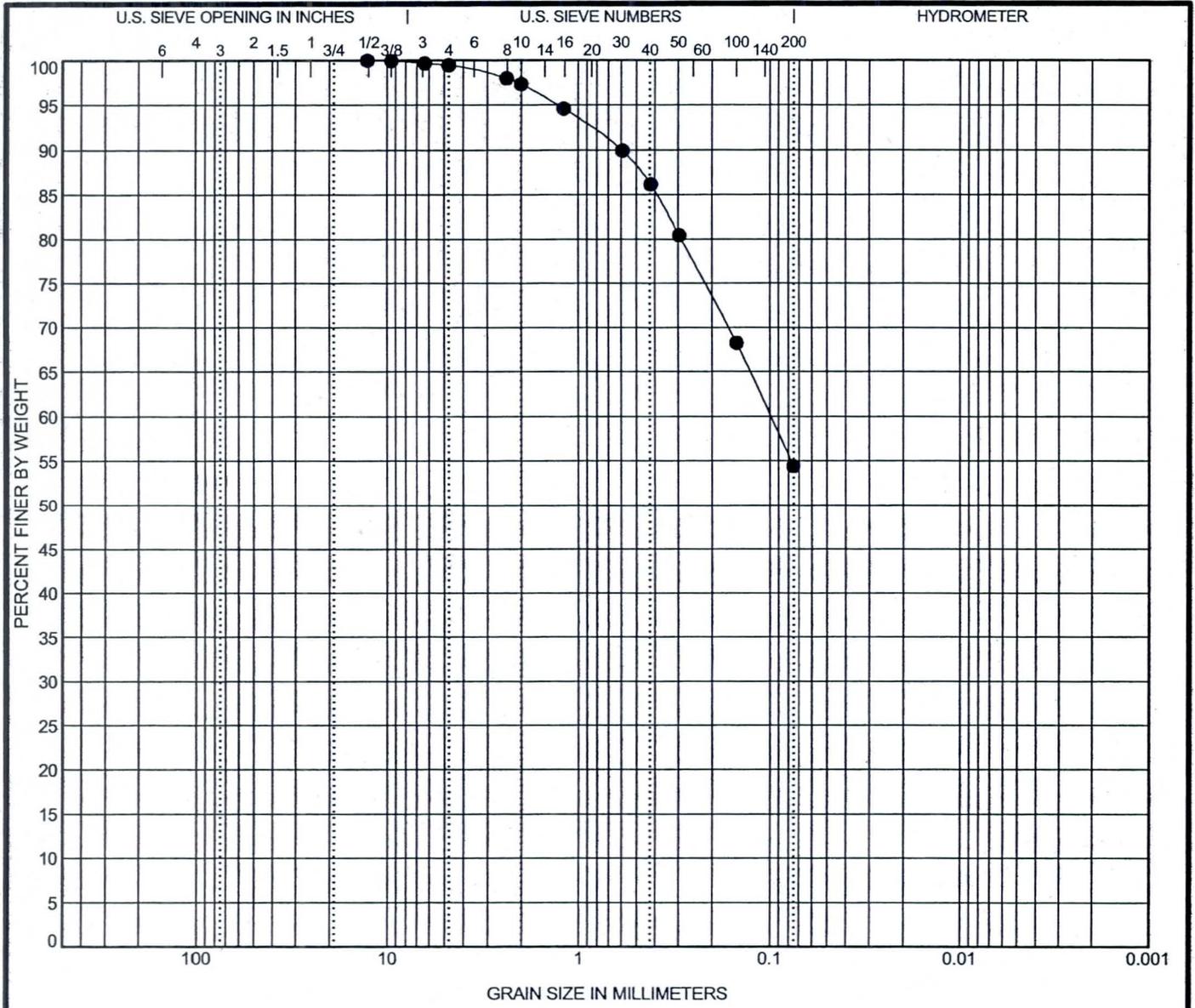
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-61 1.0 ft	25.4	1.518	0.45		13.7	74.2	12.0	
☒	ft							
▲	ft							
★	ft							
◎	ft							

### GRAIN SIZE DISTRIBUTION



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC: GRAIN SIZE 65101872.GPJ\_TERRACON.GDT 1/3/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-62 1.0 ft						
☒						
▲						
★						
◎						

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-62 1.0 ft	12.7	0.099			0.5	45.1	54.4	
☒								
▲								
★								
◎								

TC GRAIN SIZE 65101872.GPJ TERRACON.GDT 1/3/11

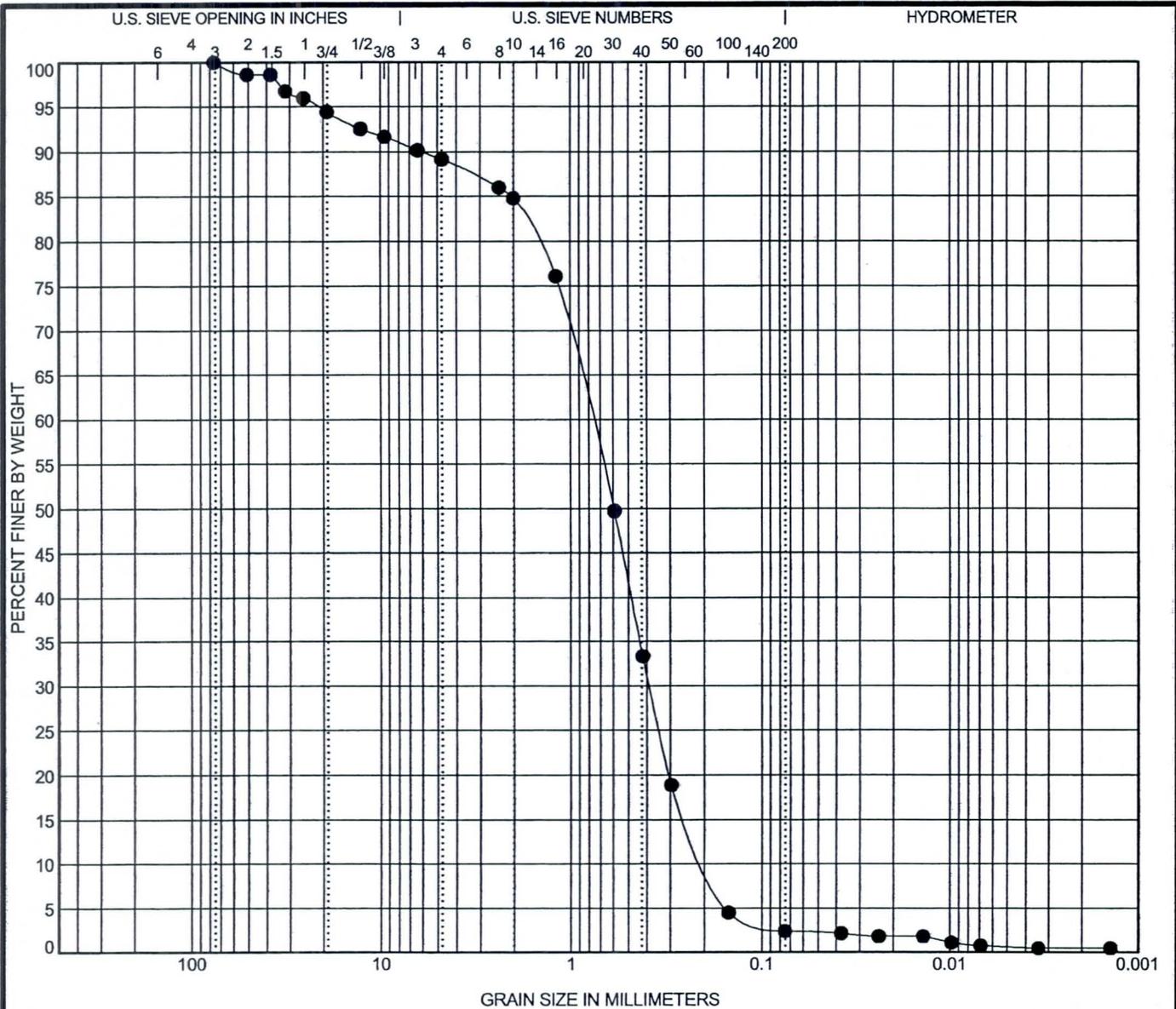
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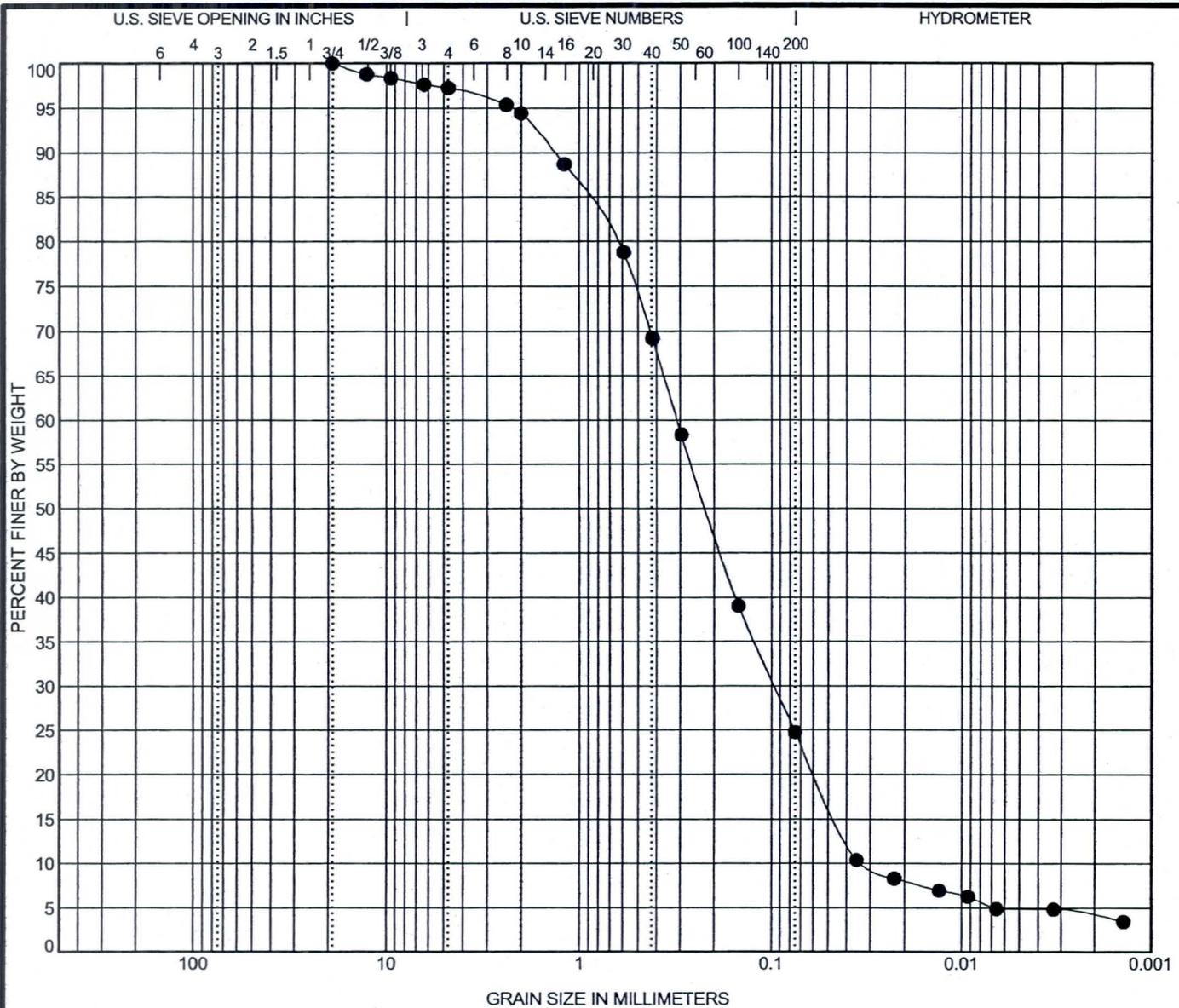


Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

**ESTRELLA SWC 2**







COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-46 1.0 ft					0.9	9.6
☒						
▲						
★						
◎						

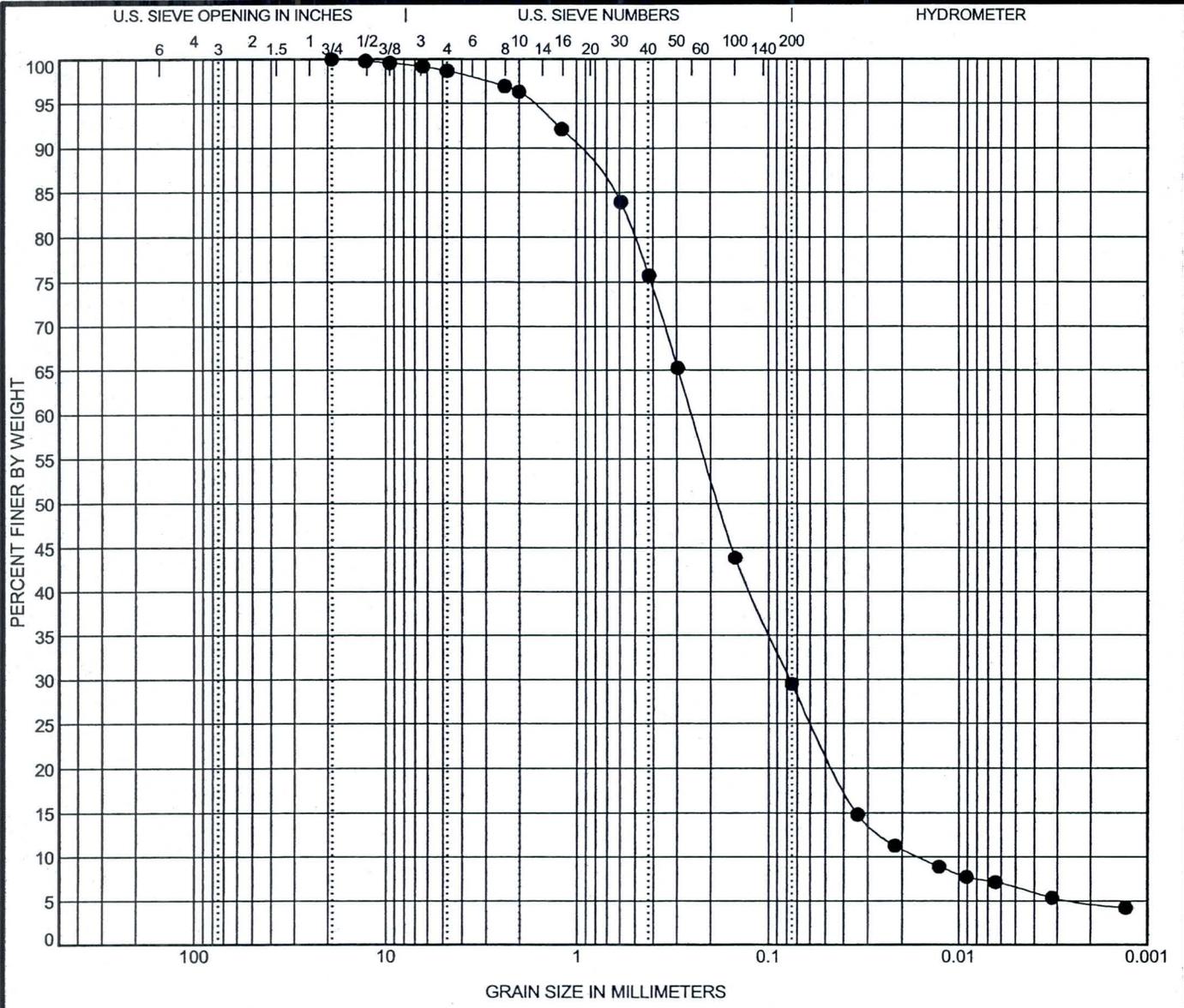
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-46 1.0 ft	19.1	0.313	0.096	0.033	2.7	72.5	20.8	4.0
☒								
▲								
★								
◎								

**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC GRAIN SIZE 65101872.GPJ TERRACON.GDT 1/3/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification					LL	PL	PI	Cc	Cu
● TP-47 0.9 ft									1.4	15.3
☒										
▲										
★										
◎										

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-47 0.9 ft	19.1	0.25	0.077	0.016	1.3	69.2	24.7	4.8
☒								
▲								
★								
◎								

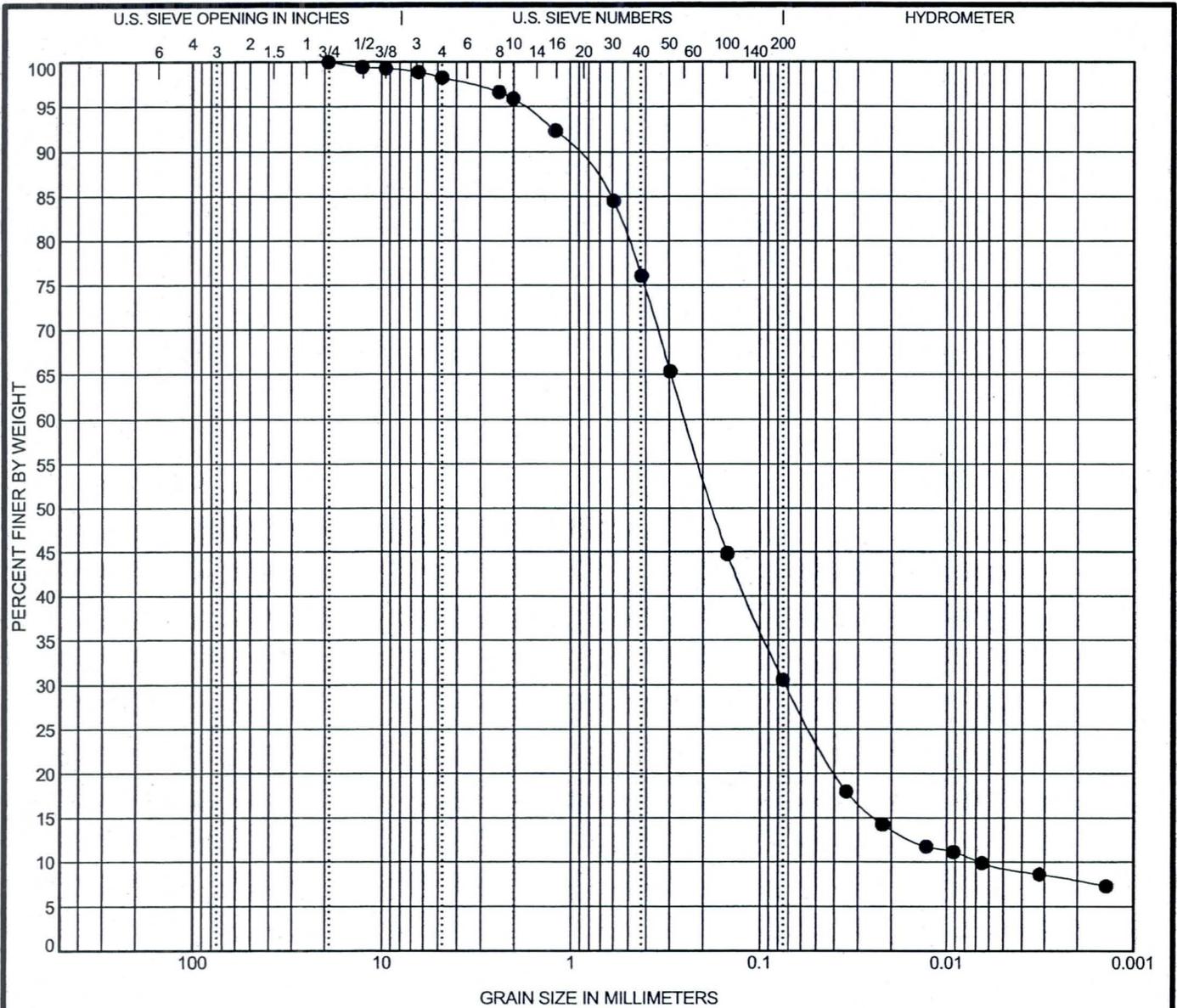
**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC: GRAIN SIZE: 65101872.GPJ\_TERRACON.GDT 1/3/11





COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-48 3.0 ft					3.2	36.9
☒ ft						
▲ ft						
★ ft						
◎ ft						

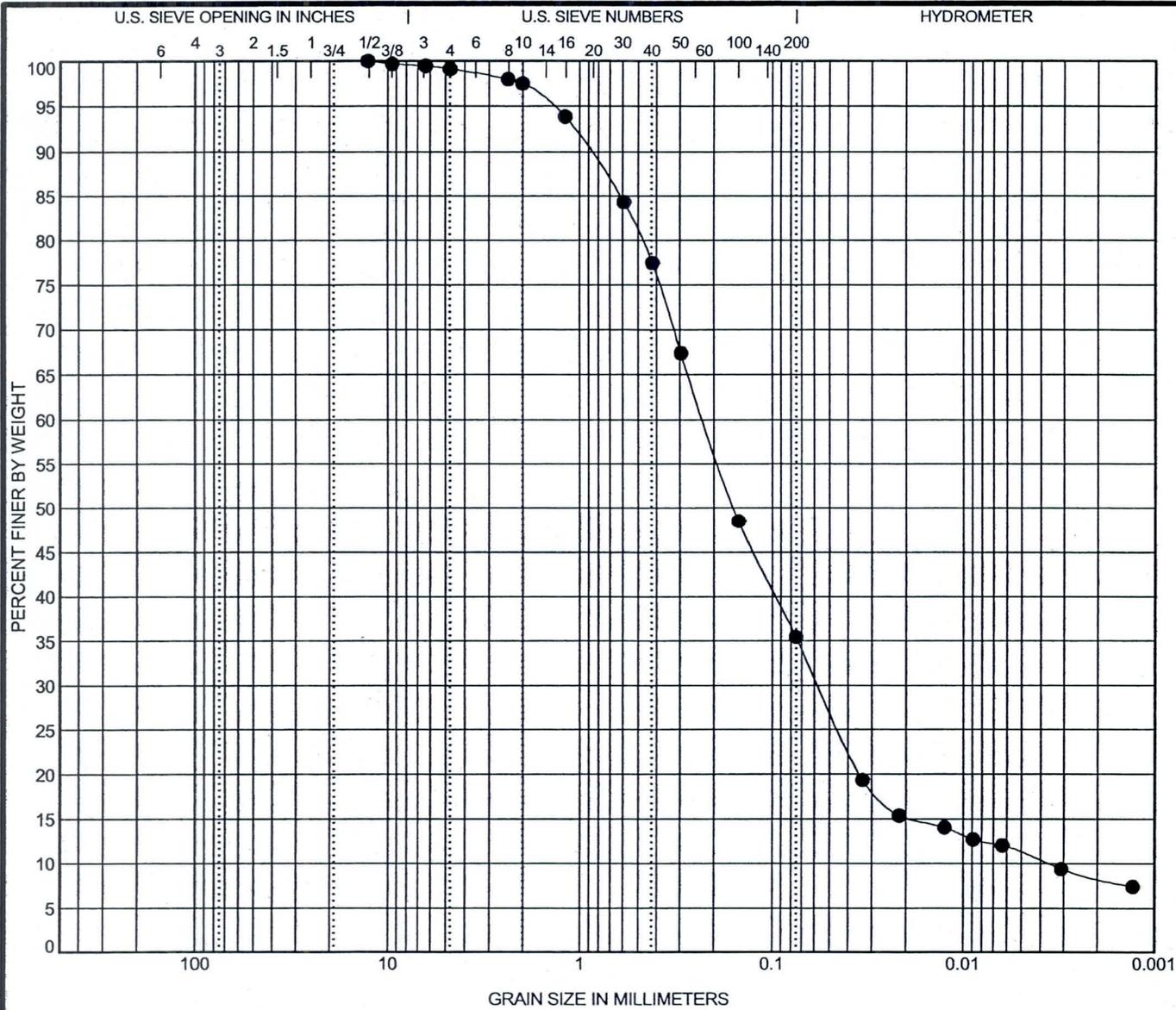
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-48 3.0 ft	19.1	0.248	0.073	0.007	1.7	67.7	22.7	7.8
☒ ft								
▲ ft								
★ ft								
◎ ft								

**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC: GRAIN SIZE 65101872.GPJ TERRACON.GDT 1/3/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-49 1.1 ft					3.9	61.9
☒						
▲						
★						
◎						

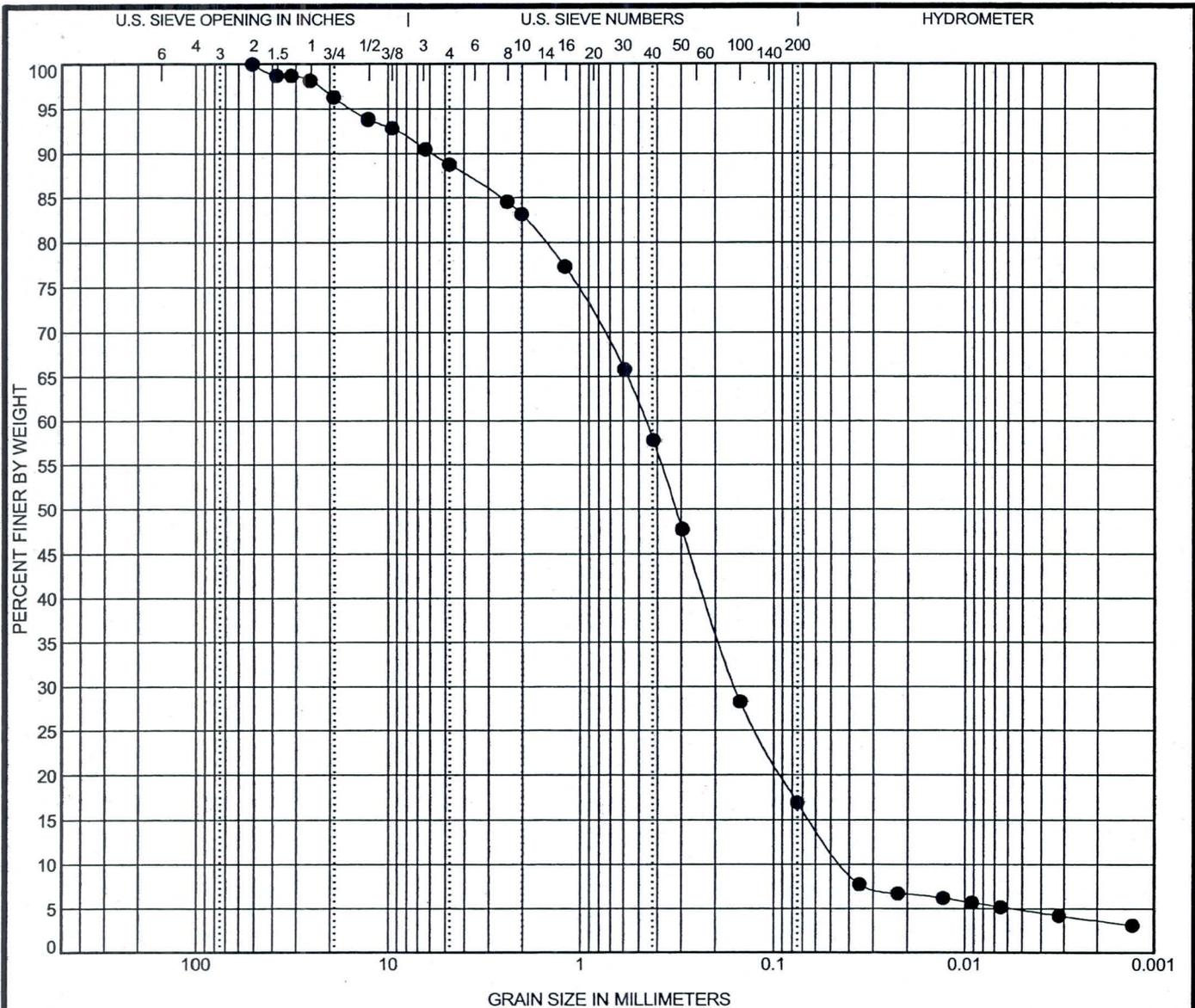
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-49 1.1 ft	12.7	0.227	0.057	0.004	0.9	63.7	27.1	8.4
☒								
▲								
★								
◎								

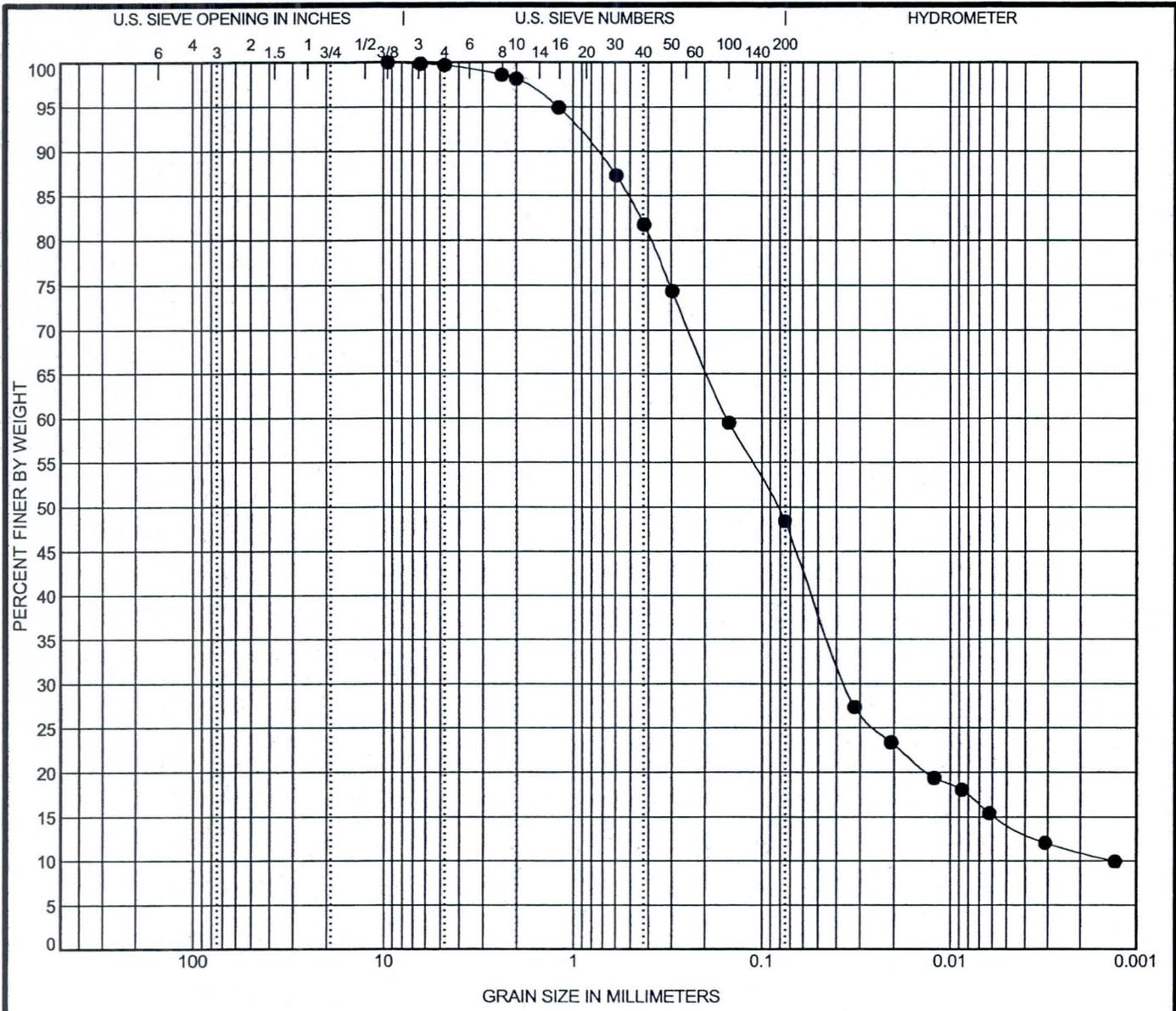
**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC GRAIN SIZE 65101872.GPJ TERRACON.GDT 1/3/11





COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification					LL	PL	PI	Cc	Cu
● TP-51 1.0 ft									6.2	113.4
☒										
▲										
★										
◎										

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-51 1.0 ft	9.5	0.153	0.036	0.001	0.3	51.3	37.4	11.0
☒								
▲								
★								
◎								

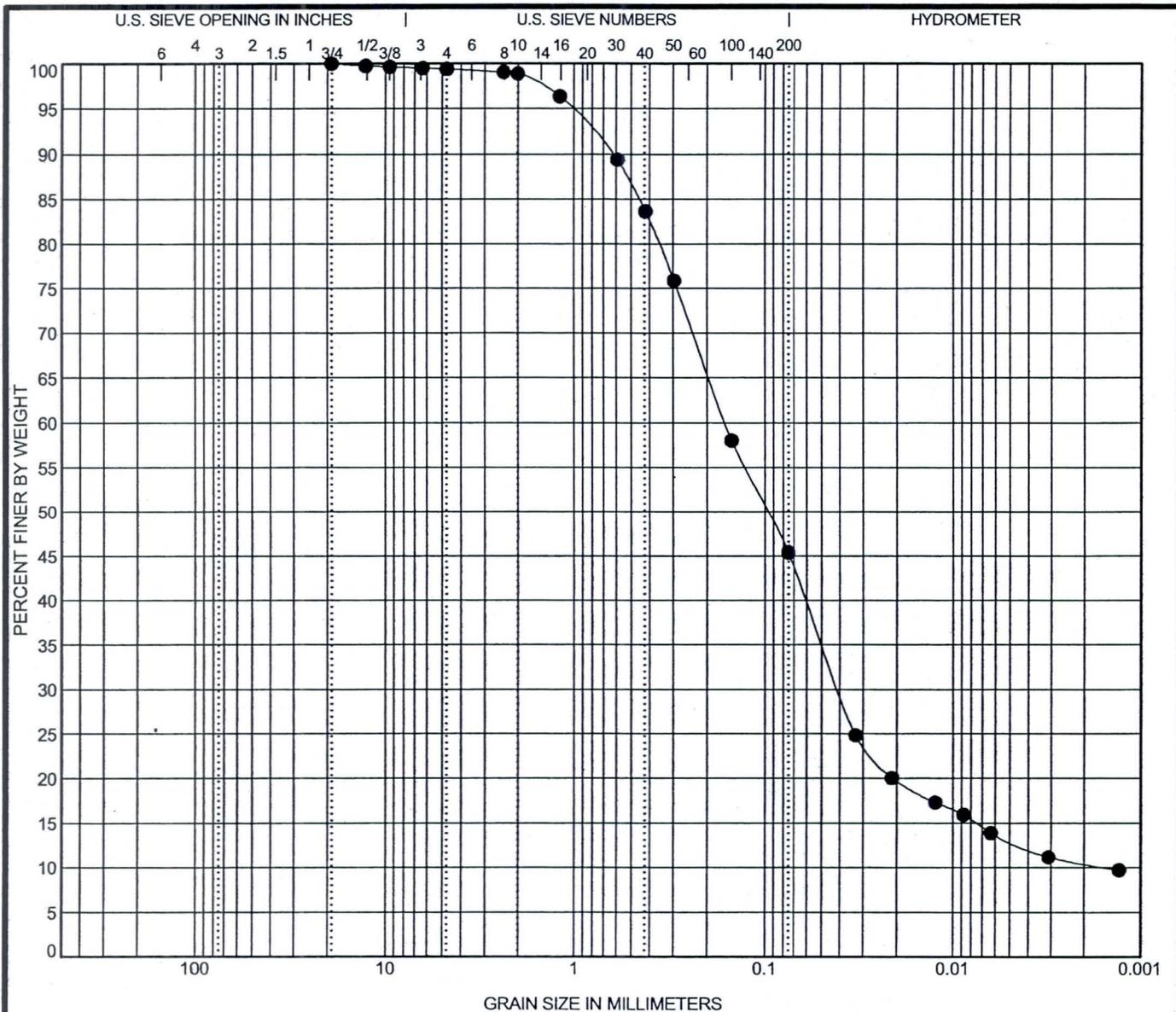
### GRAIN SIZE DISTRIBUTION



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC\_GRAIN SIZE 65101872.GPJ\_TERRACON.GDT 1/3/11





COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		USCS Soil Classification				LL	PL	PI	Cc	Cu
●	TP-52 1.0 ft								6.5	103.7
☒	ft									
▲	ft									
★	ft									
◎	ft									

Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	TP-52 1.0 ft	19.1	0.161	0.04	0.002	0.6	54.0	35.0	10.4
☒	ft								
▲	ft								
★	ft								
◎	ft								

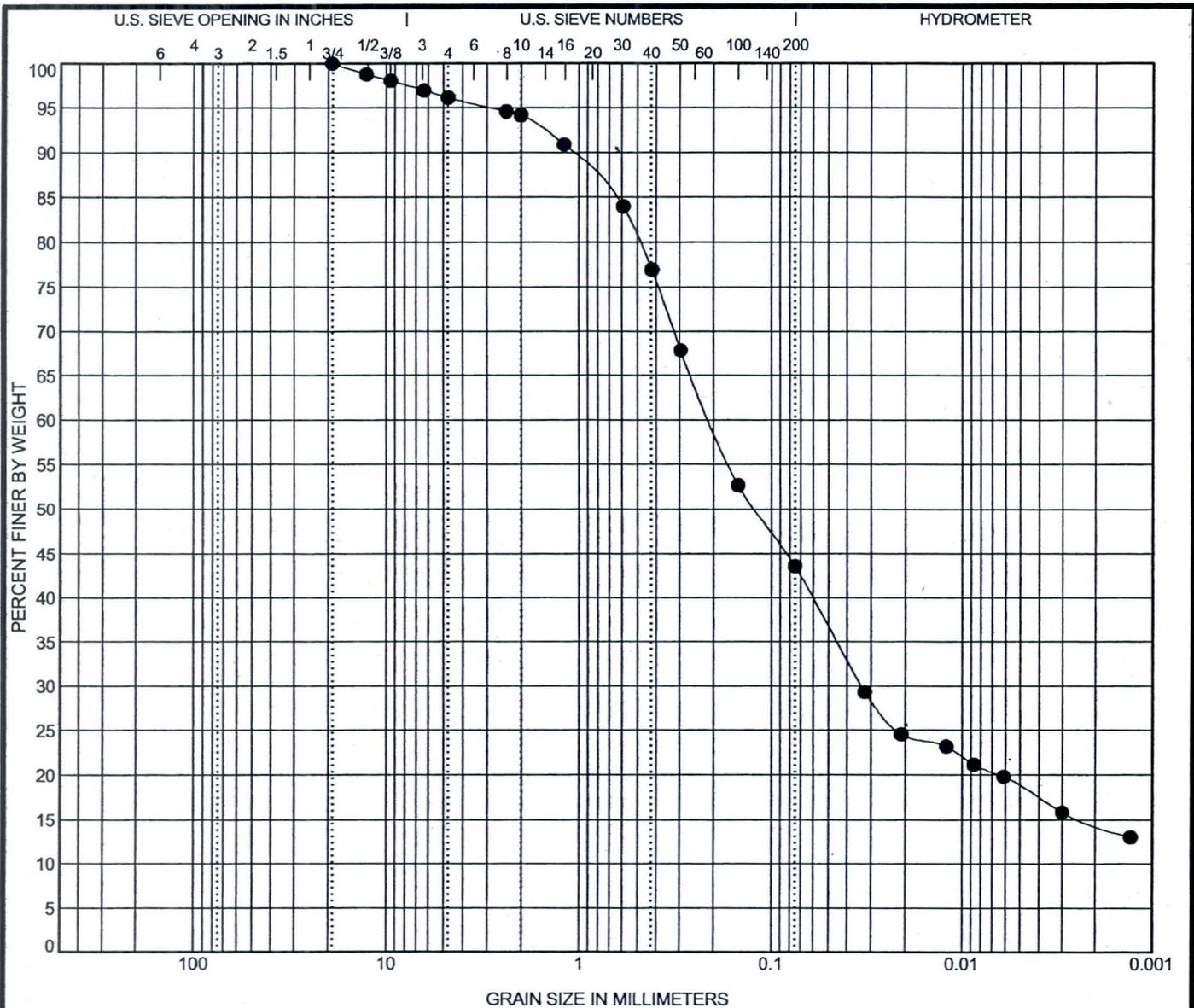
### GRAIN SIZE DISTRIBUTION



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11







COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

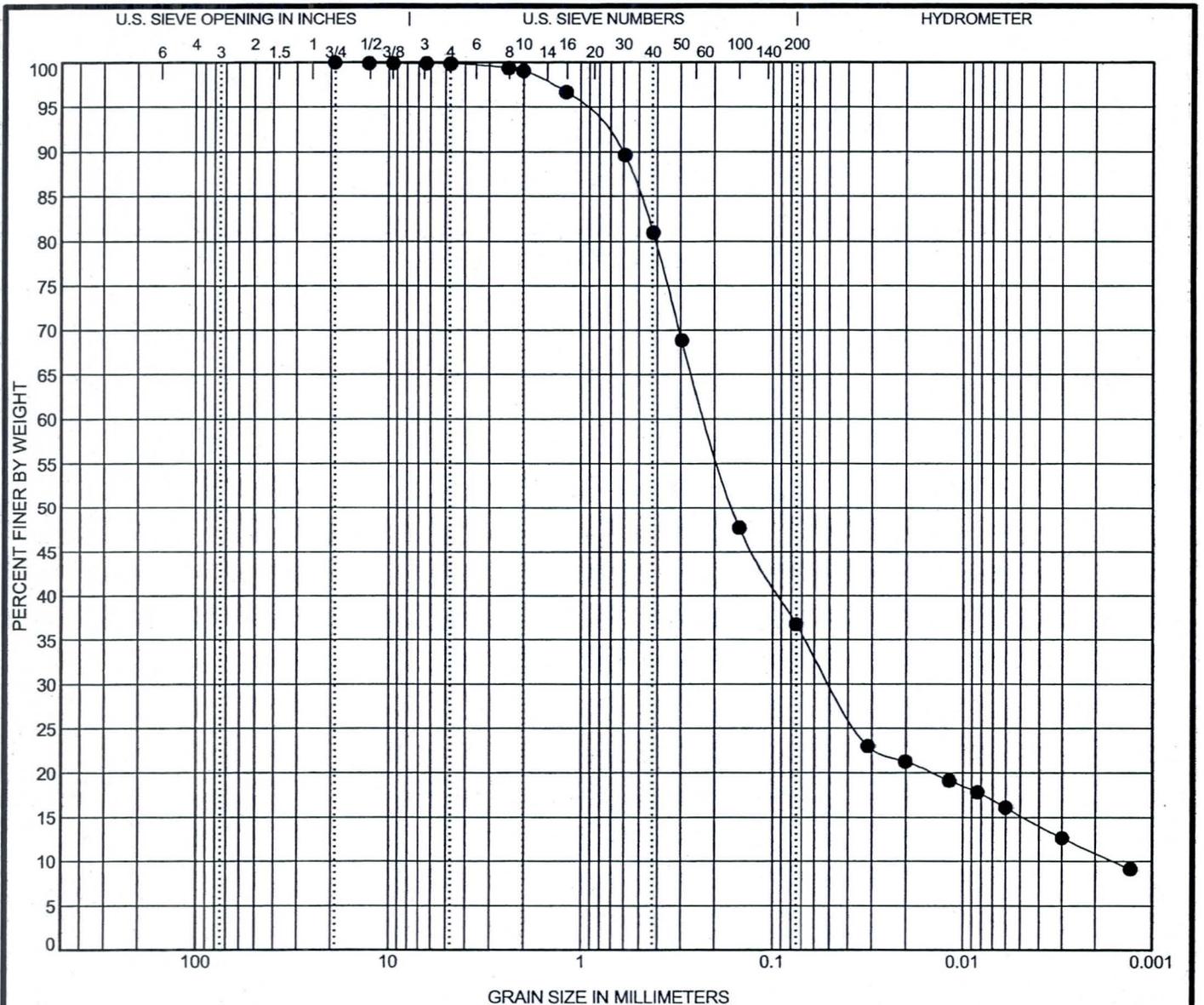
Specimen Identification	USCS Soil Classification					LL	PL	PI	Cc	Cu
● TP-54 3.0 ft										
☒ ft										
▲ ft										
★ ft										
◎ ft										

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-54 3.0 ft	19.1	0.208	0.034		3.8	52.6	29.1	14.4
☒ ft								
▲ ft								
★ ft								
◎ ft								

### GRAIN SIZE DISTRIBUTION



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-55 1.1 ft					6.7	138.7
☒ ft						
▲ ft						
★ ft						
◎ ft						

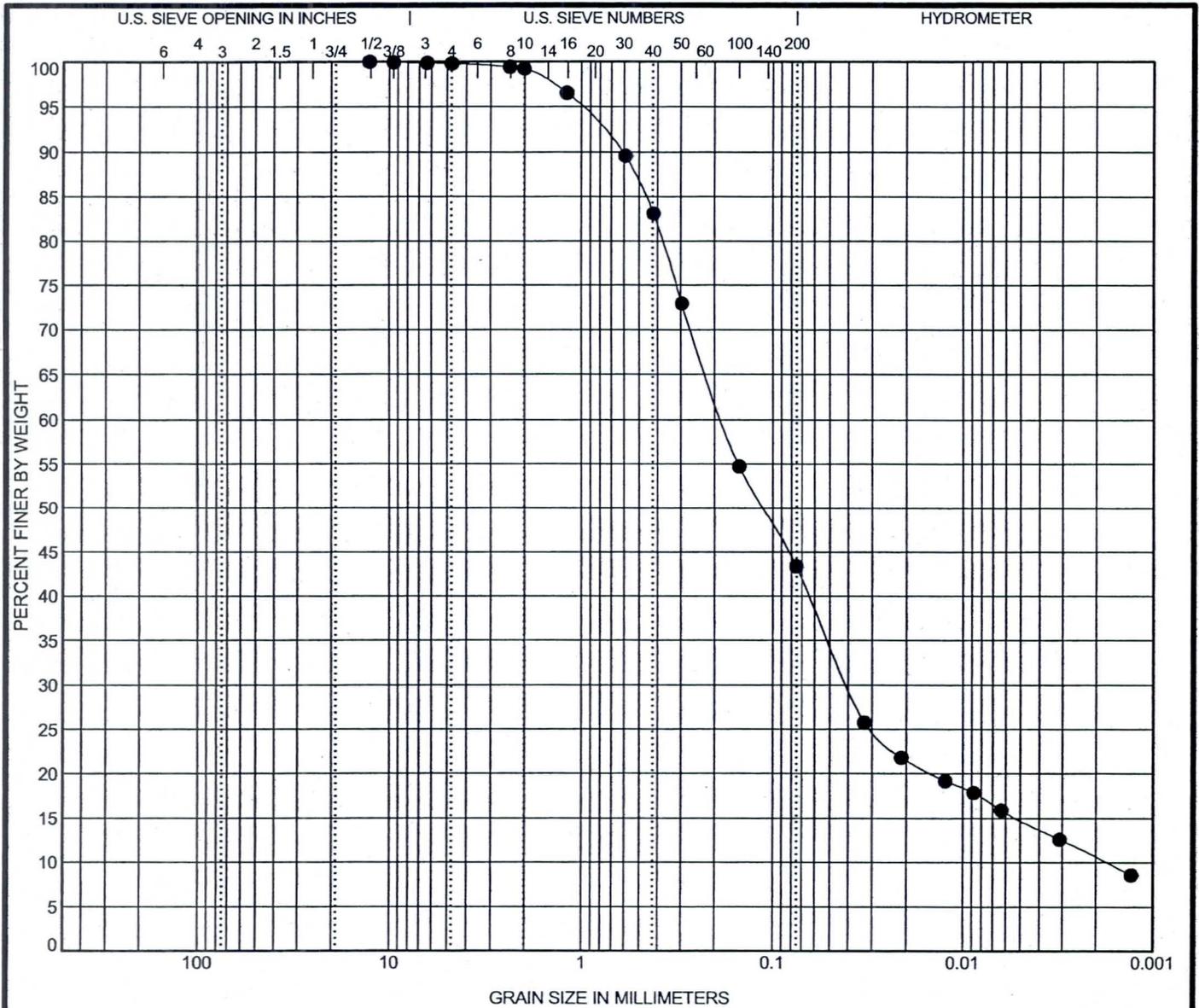
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-55 1.1 ft	19.1	0.223	0.049	0.002	0.1	63.1	25.8	10.9
☒ ft								
▲ ft								
★ ft								
◎ ft								

**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC: GRAIN SIZE: 65101872.GPJ\_TERRACON.GDT 1/3/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification					LL	PL	PI	Cc	Cu
● TP-56 1.0 ft									5.0	102.7
☒ ft										
▲ ft										
★ ft										
◎ ft										

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-56 1.0 ft	12.7	0.182	0.04	0.002	0.2	56.4	32.8	10.6
☒ ft								
▲ ft								
★ ft								
◎ ft								

**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC - GRAIN SIZE 65101872.GPJ - TERRACON.GDT 1/3/11

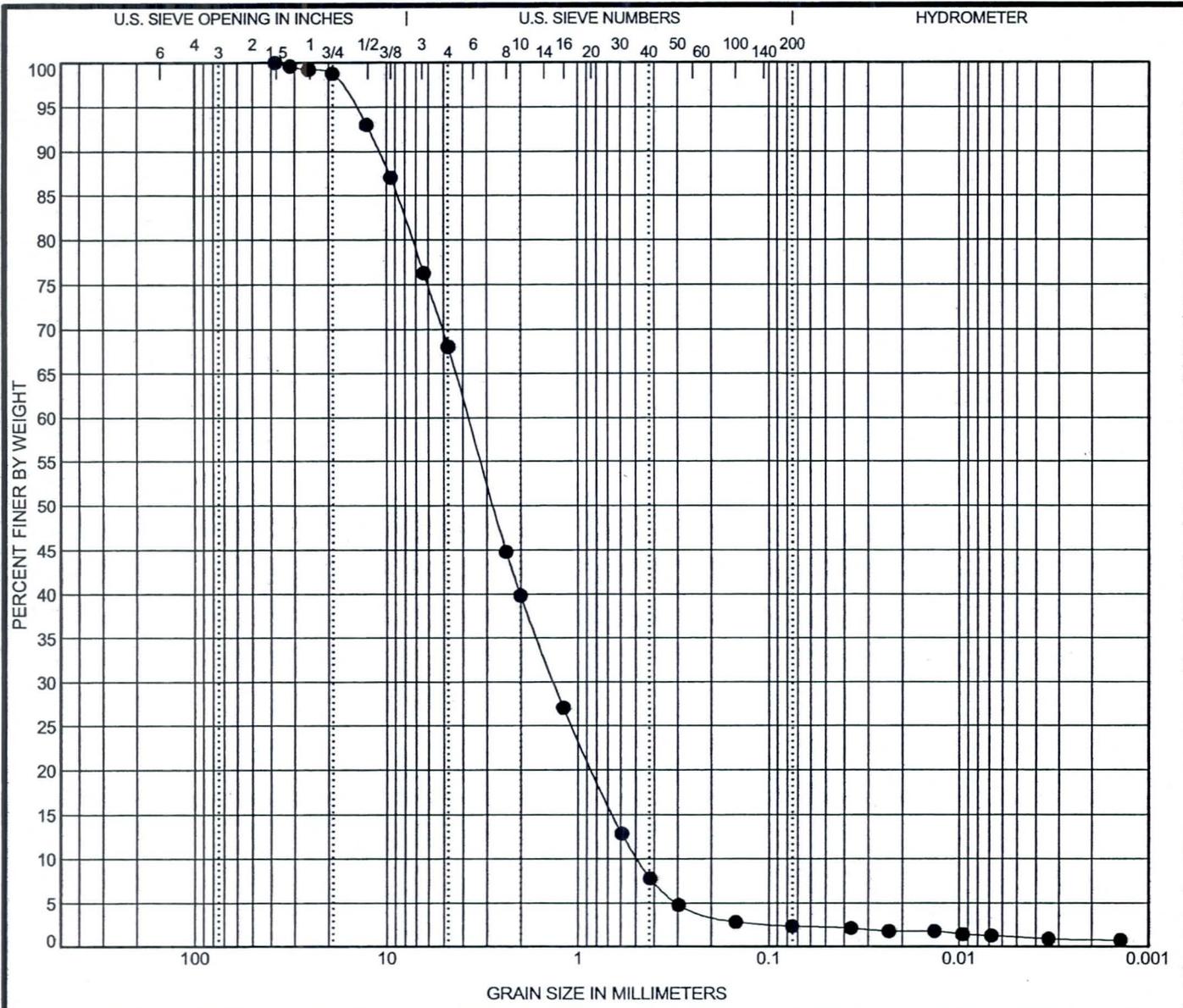




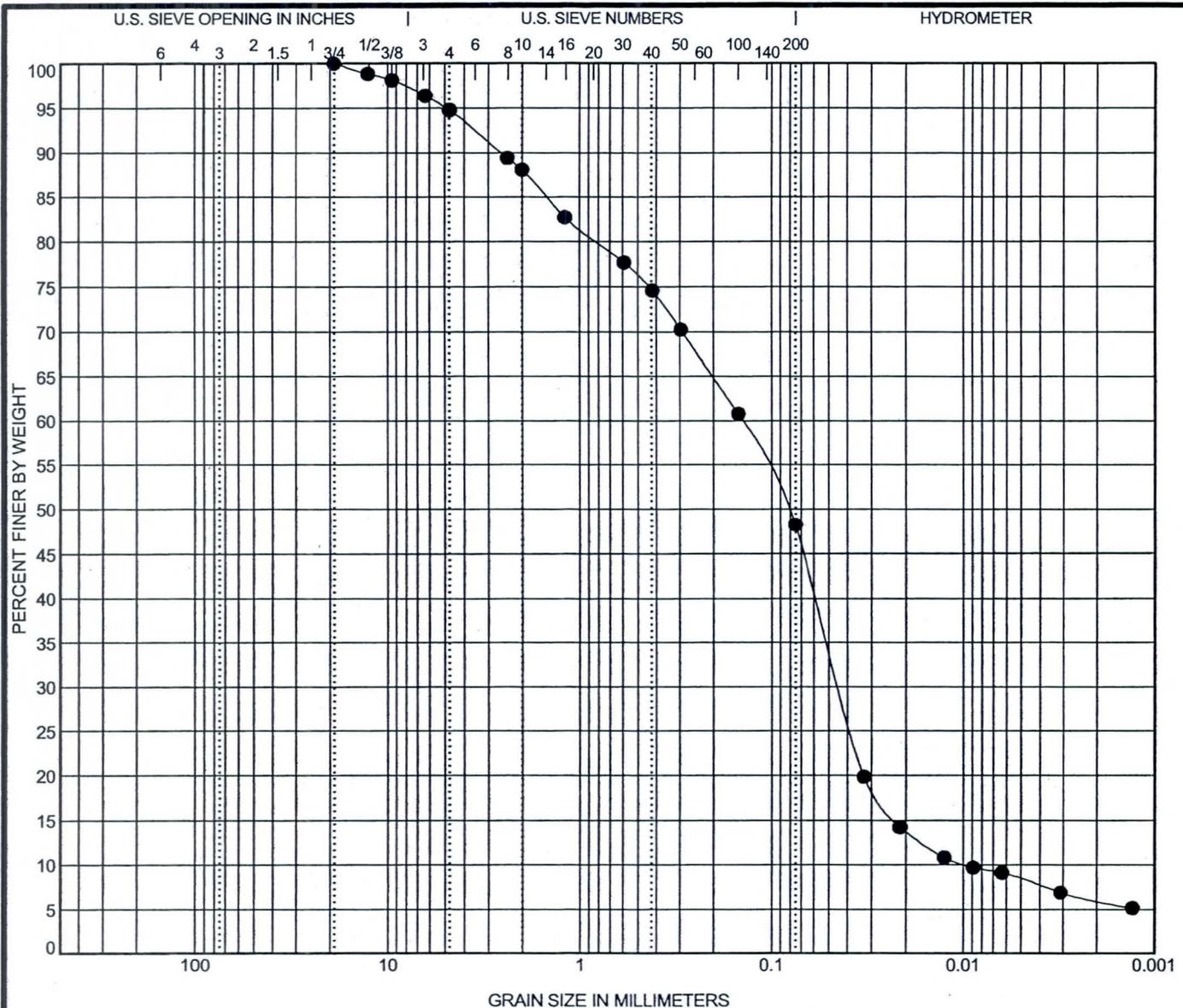




**SONORA SWC 1**







COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-01 1.0 ft					1.4	14.6
☒ ft						
▲ ft						
★ ft						
◎ ft						

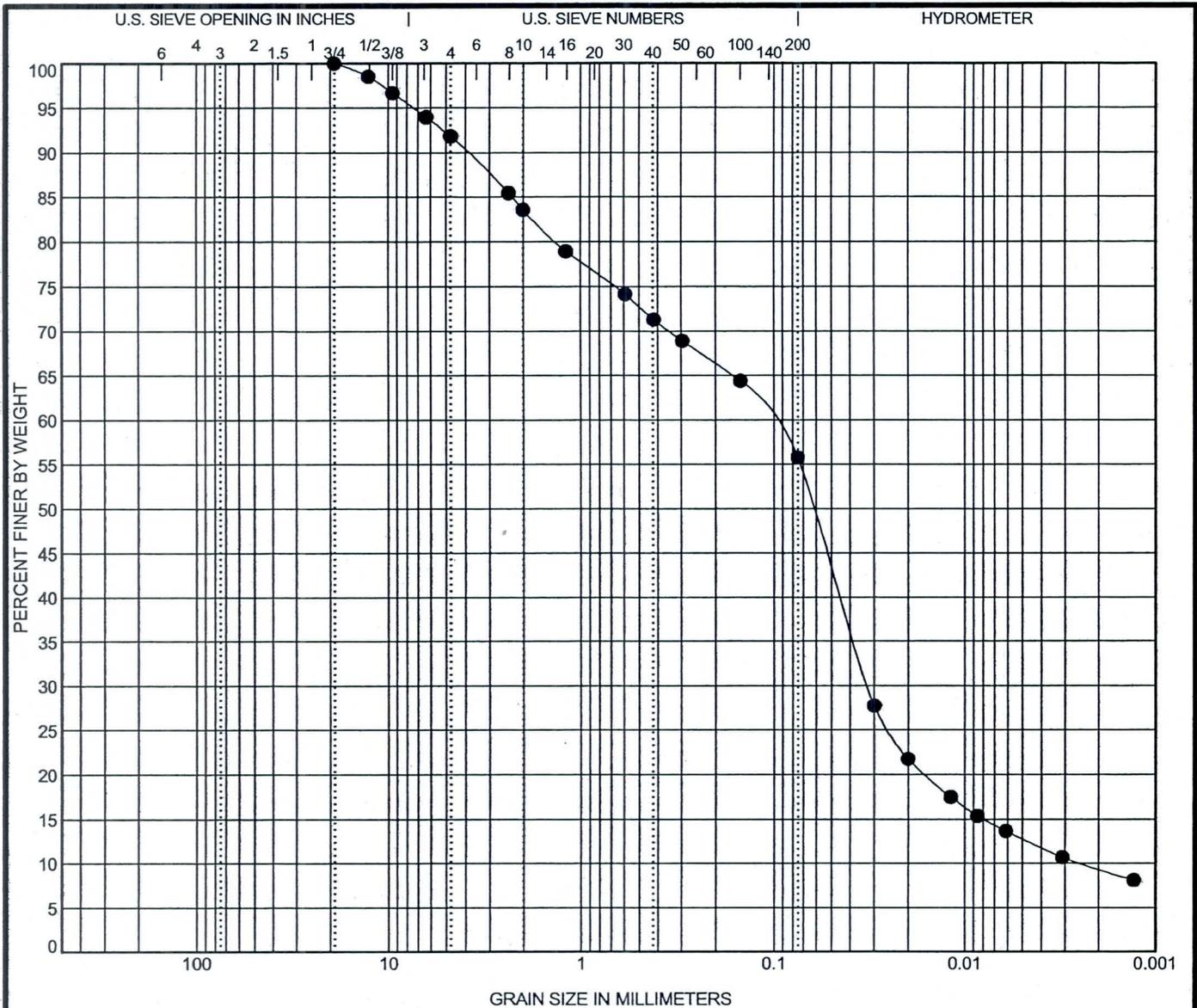
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-01 1.0 ft	19.1	0.143	0.044	0.01	5.2	46.6	42.2	6.0
☒ ft								
▲ ft								
★ ft								
◎ ft								

**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC: GRAIN SIZE: 65101872.GPJ TERRACON.GDT 1/3/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-02 0.9 ft					4.0	42.6
☒						
▲						
★						
◎						

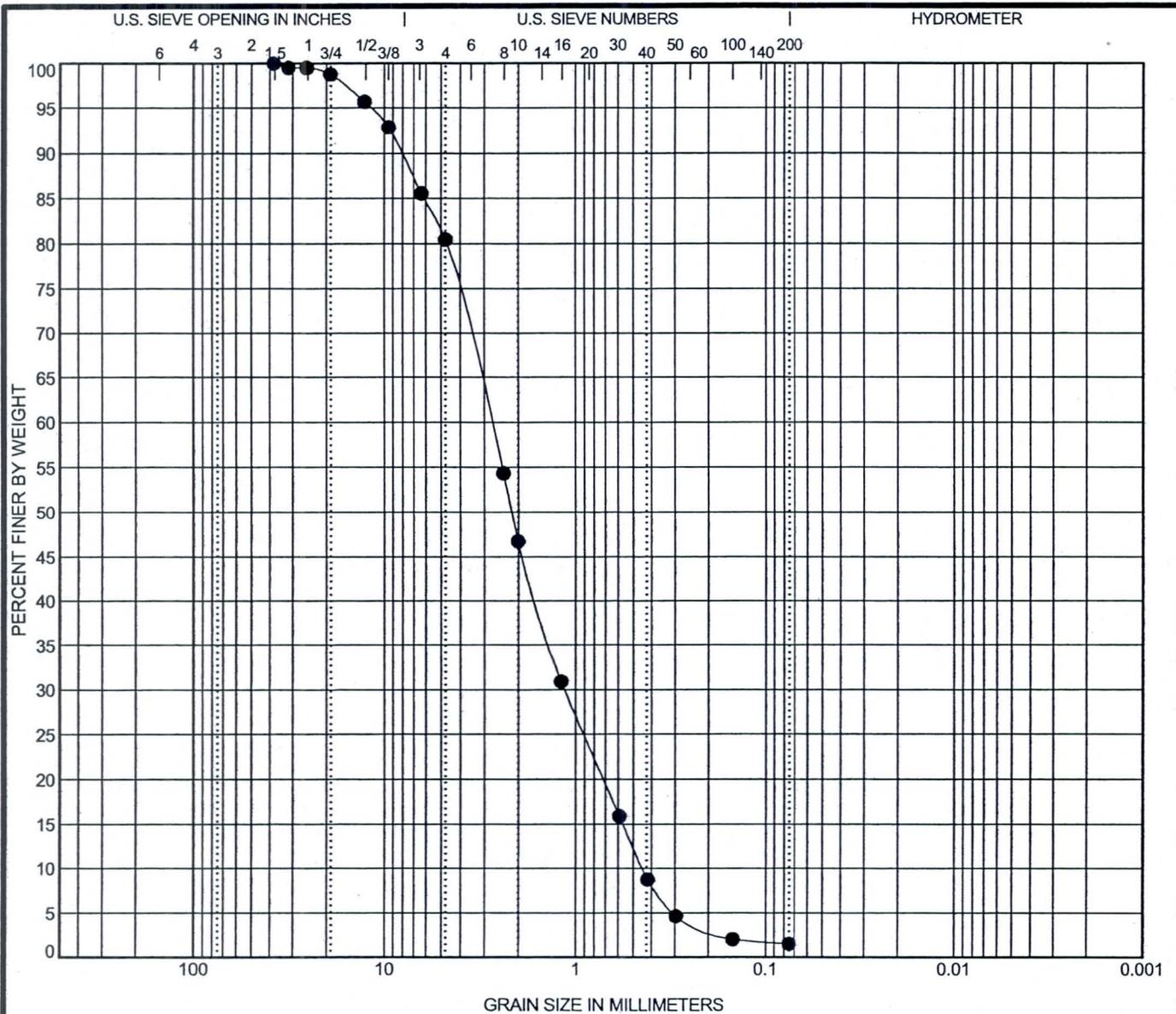
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-02 0.9 ft	19.1	0.105	0.032	0.002	8.1	36.1	46.4	9.4
☒								
▲								
★								
◎								

### GRAIN SIZE DISTRIBUTION



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC: GRAIN SIZE: 65101872.GPJ TERRACON.GDT 1/3/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		USCS Soil Classification				LL	PL	PI	Cc	Cu
●	TP-03 1.0 ft	WELL-GRADED SAND with GRAVEL(SW)							1.1	6.2
☒	ft									
▲	ft									
★	ft									
◎	ft									

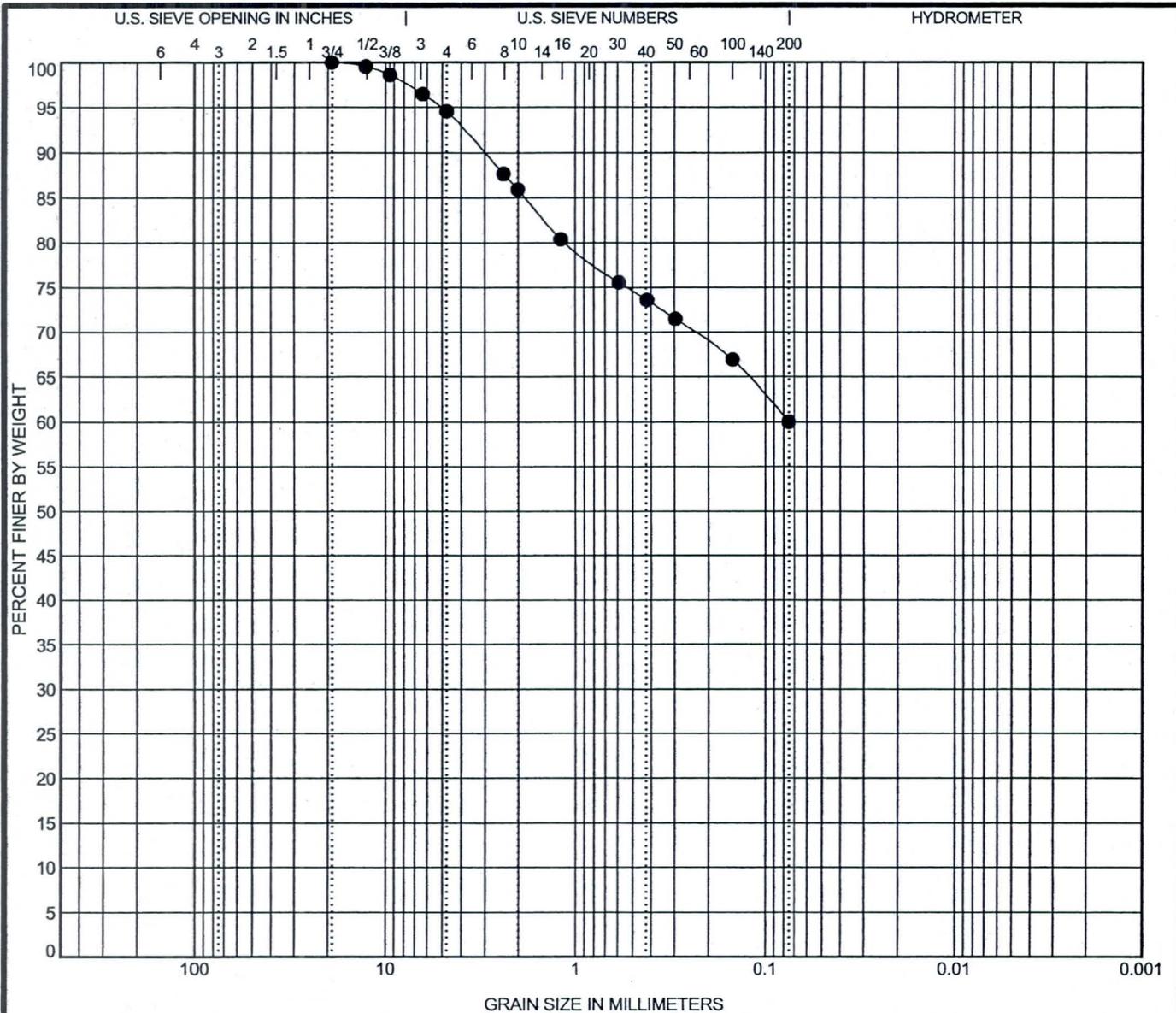
Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	TP-03 1.0 ft	38.1	2.763	1.141	0.446	19.5	78.9	1.5	
☒	ft								
▲	ft								
★	ft								
◎	ft								

### GRAIN SIZE DISTRIBUTION



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC GRAIN SIZE 65101872.GPJ TERRACON.GDT 1/3/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-04 1.0 ft						
☒						
▲						
★						
◎						

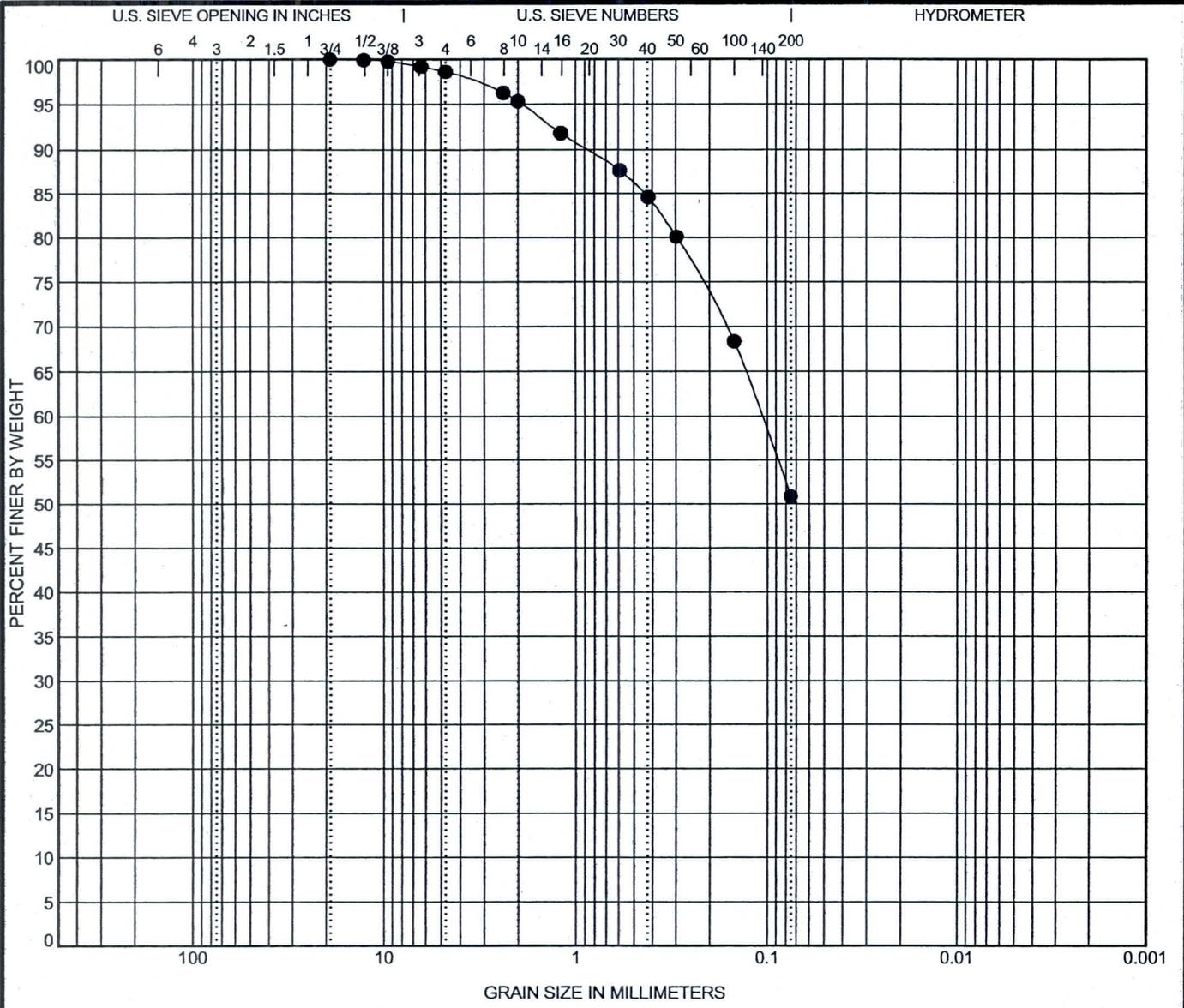
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-04 1.0 ft	19.1				5.4	34.5	60.0	
☒								
▲								
★								
◎								

### GRAIN SIZE DISTRIBUTION



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC GRAIN\_SIZE\_65101872.GPJ TERRACON.GDT 1/3/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification					LL	PL	PI	Cc	Cu
● TP-05 1.0 ft										
☒										
▲										
★										
◎										

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-05 1.0 ft	19.1	0.107			1.4	47.7	50.9	
☒								
▲								
★								
◎								

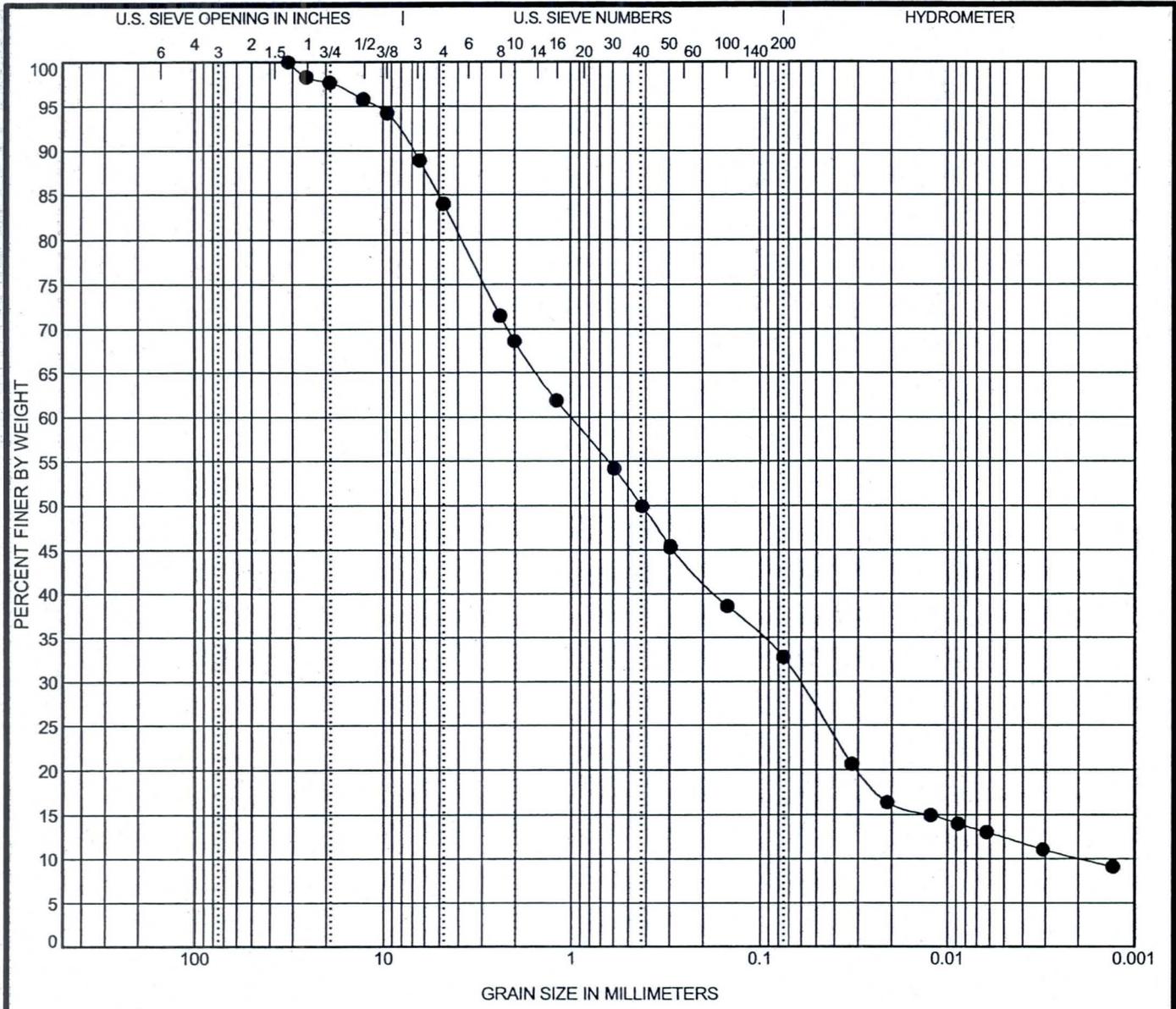
**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC: GRAIN SIZE: 65101872.GPJ\_TERRACON.GDT 1/3/11





COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification					LL	PL	PI	Cc	Cu
● TP-06 1.8 ft									2.0	517.2
☒										
▲										
★										
◎										

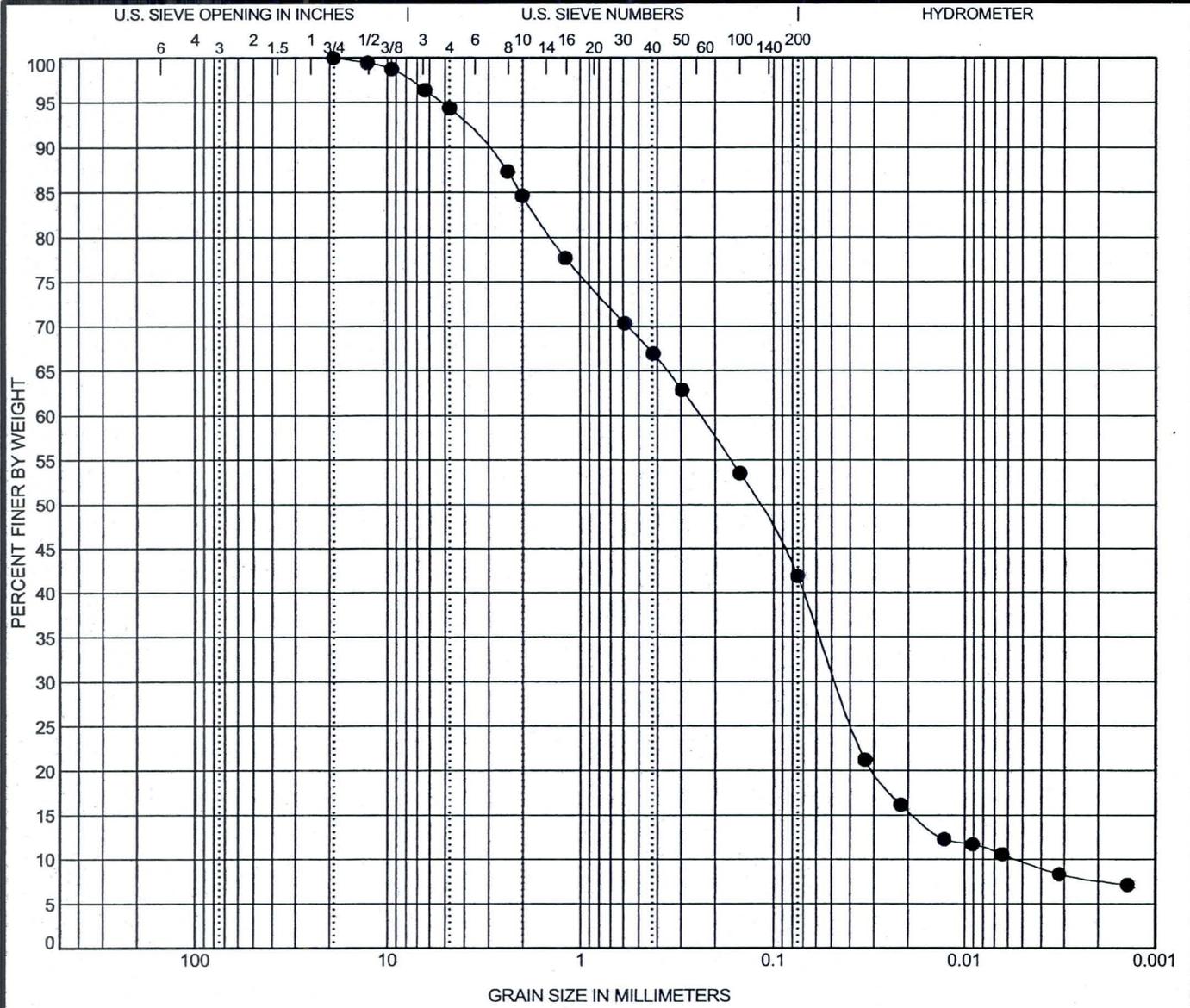
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-06 1.8 ft	31.75	1.003	0.062	0.002	16.0	51.2	22.7	10.1
☒								
▲								
★								
◎								

### GRAIN SIZE DISTRIBUTION



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
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 Date: 1-3-11

TC: GRAIN SIZE 65101872.GPJ TERRACON.GDT 1/3/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-07 1.3 ft					1.7	44.7
☒						
▲						
★						
◎						

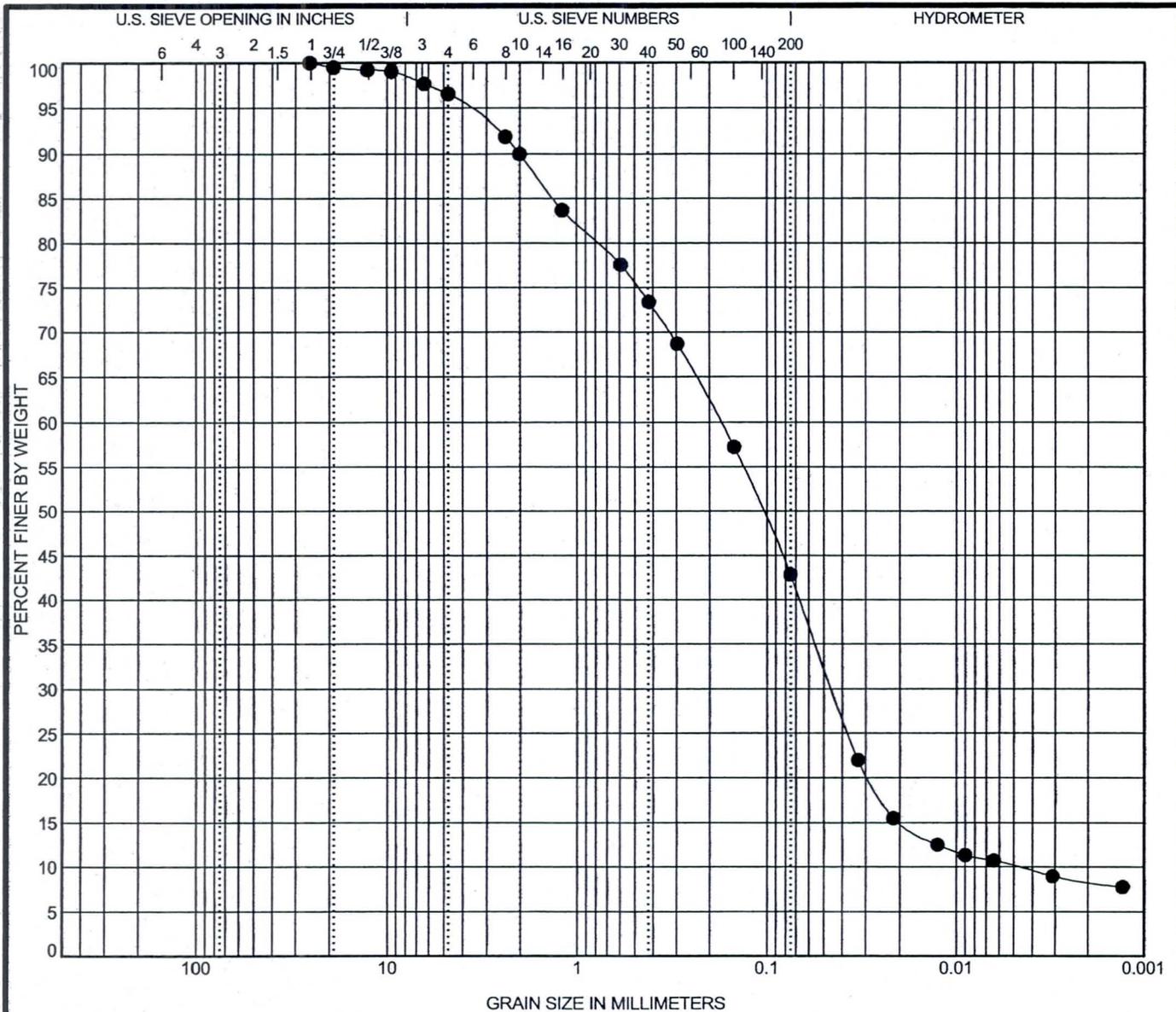
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-07 1.3 ft	19.1	0.24	0.047	0.005	5.6	52.5	34.2	7.6
☒								
▲								
★								
◎								

**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC: GRAIN SIZE: 65101872.GPJ\_TERRACON.GDT 1/3/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

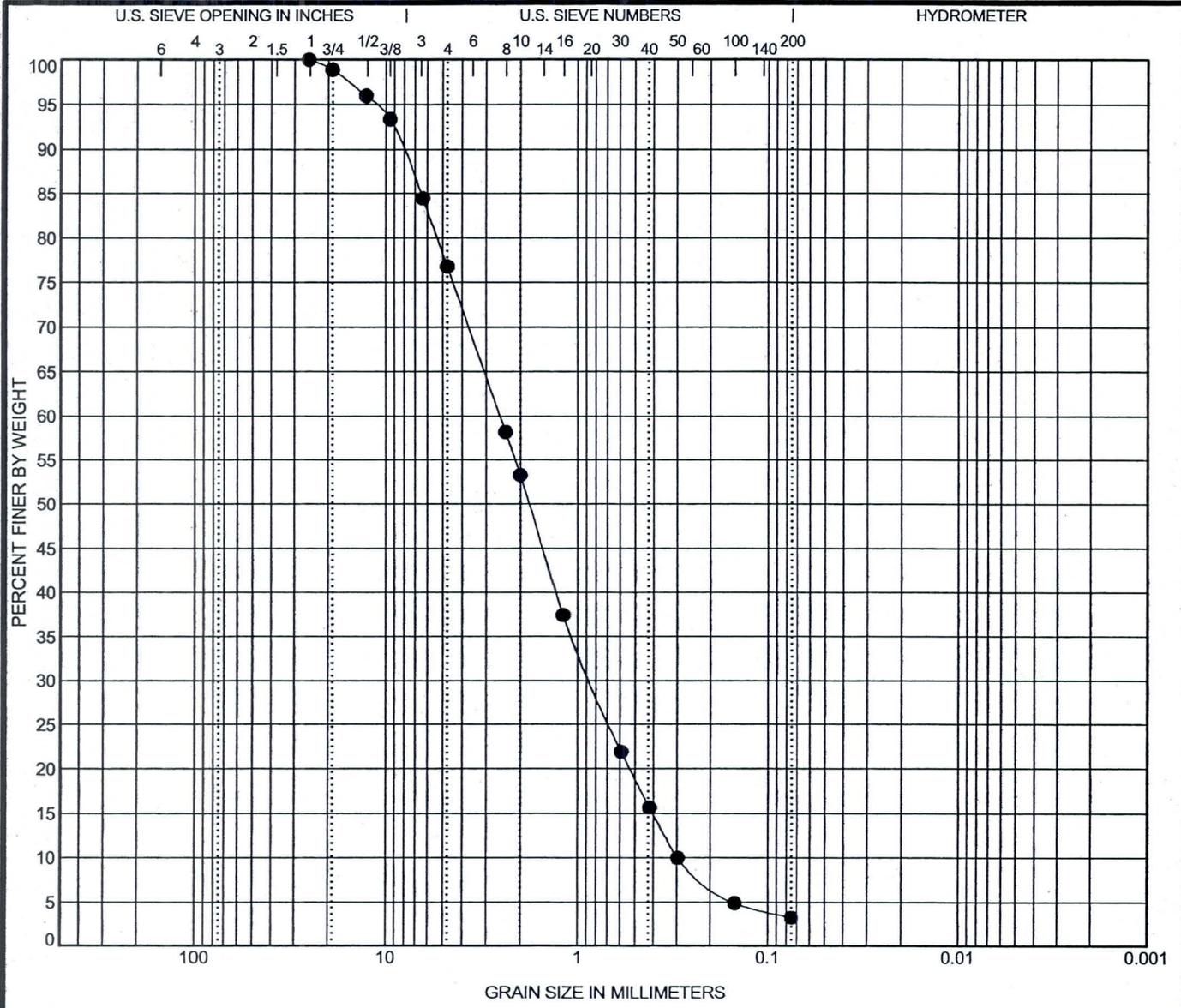
Specimen Identification		USCS Soil Classification					LL	PL	PI	Cc	Cu
●	TP-08 1.0 ft									2.4	36.9
☒	ft										
▲	ft										
★	ft										
◎	ft										

Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	TP-08 1.0 ft	25.4	0.176	0.045	0.005	3.4	53.7	34.5	8.3
☒	ft								
▲	ft								
★	ft								
◎	ft								

### GRAIN SIZE DISTRIBUTION



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		USCS Soil Classification				LL	PL	PI	Cc	Cu
●	TP-09 1.0 ft	POORLY GRADED SAND with GRAVEL(SP)							1.0	8.6
☒	ft									
▲	ft									
★	ft									
◎	ft									

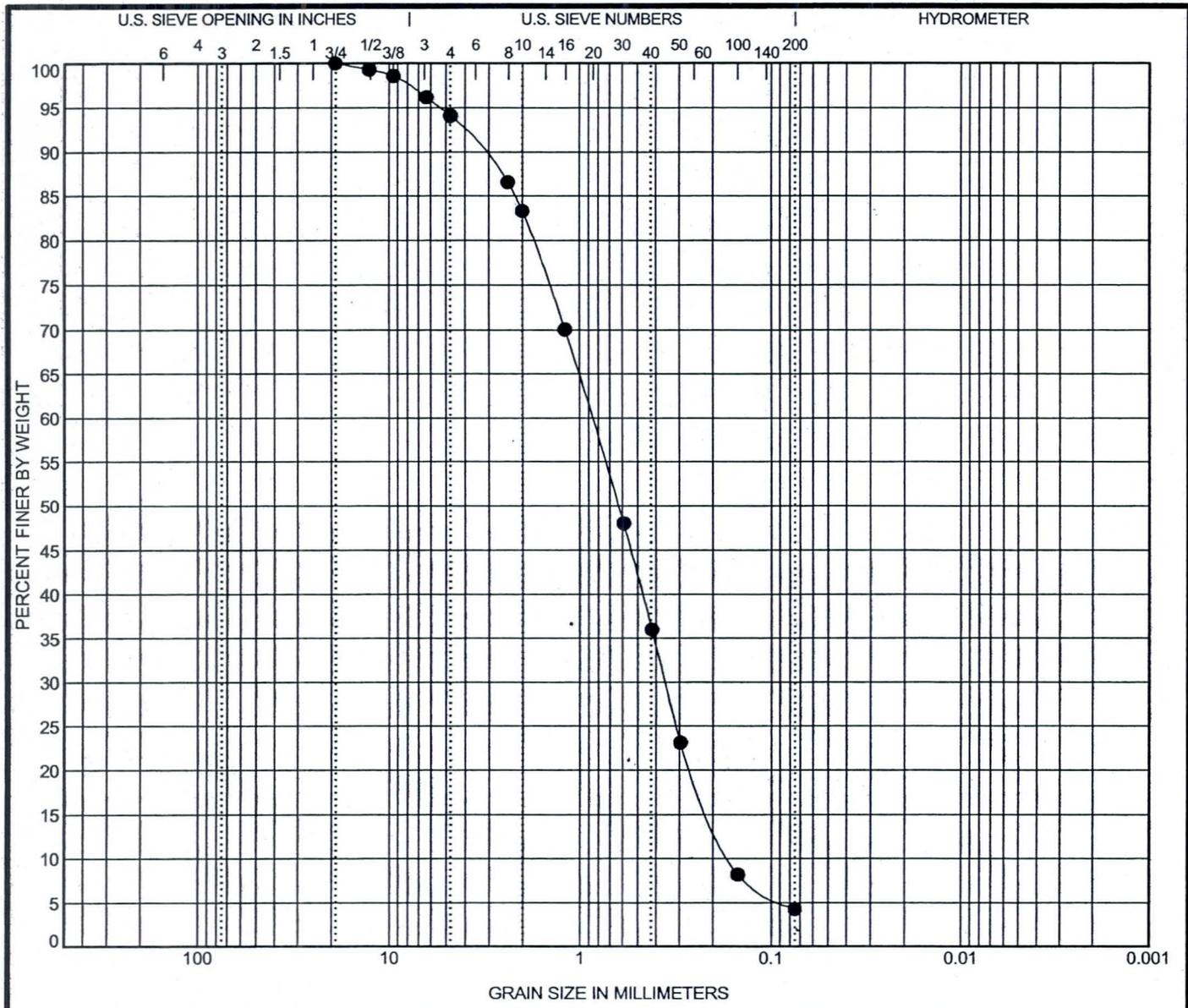
Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	TP-09 1.0 ft	25.4	2.545	0.85	0.297	23.2	73.6	3.2	
☒	ft								
▲	ft								
★	ft								
◎	ft								

### GRAIN SIZE DISTRIBUTION



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC GRAIN SIZE 65101872.GPJ TERRACON.GDT 1/3/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-09 2.8 ft	POORLY GRADED SAND(SP)				0.9	5.3
☒						
▲						
★						
◎						

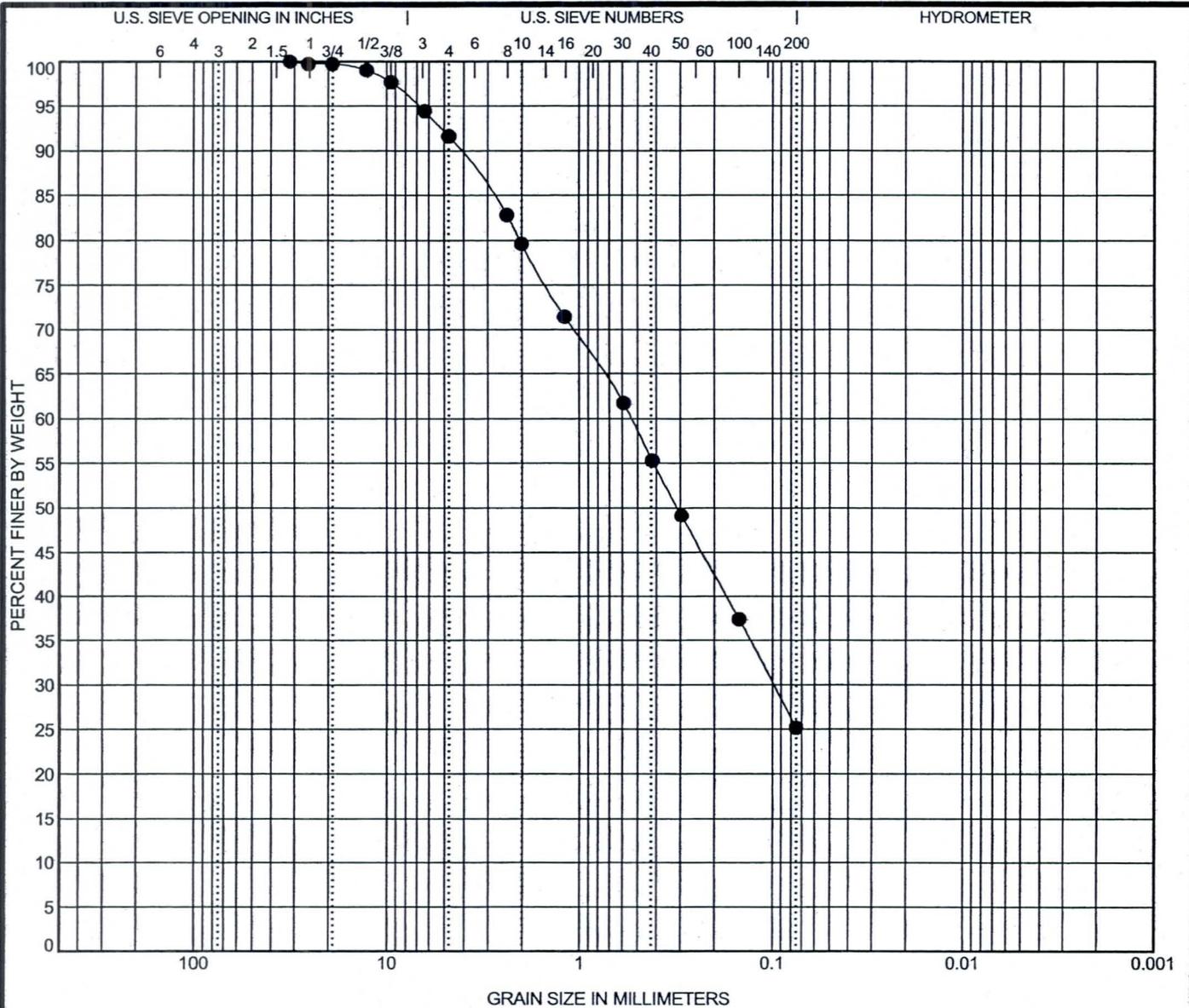
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-09 2.8 ft	19.1	0.864	0.357	0.162	5.9	89.9	4.3	
☒								
▲								
★								
◎								

**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC GRAIN SIZE 65101872.GPJ TERRACON.GDT 1/3/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

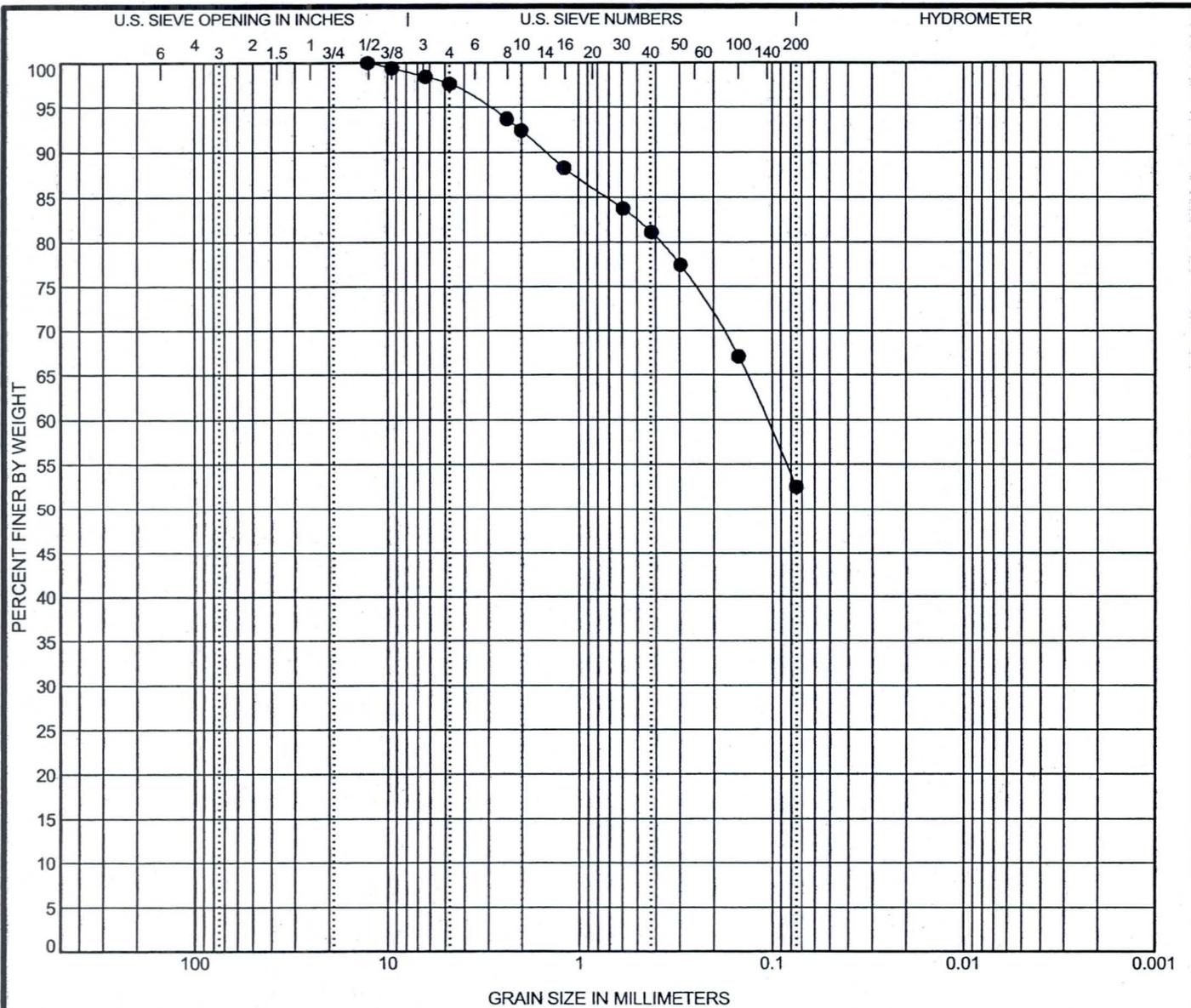
Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-10 1.0 ft						
☒						
▲						
★						
◎						

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-10 1.0 ft	31.75	0.538	0.098		8.4	66.4	25.2	
☒								
▲								
★								
◎								

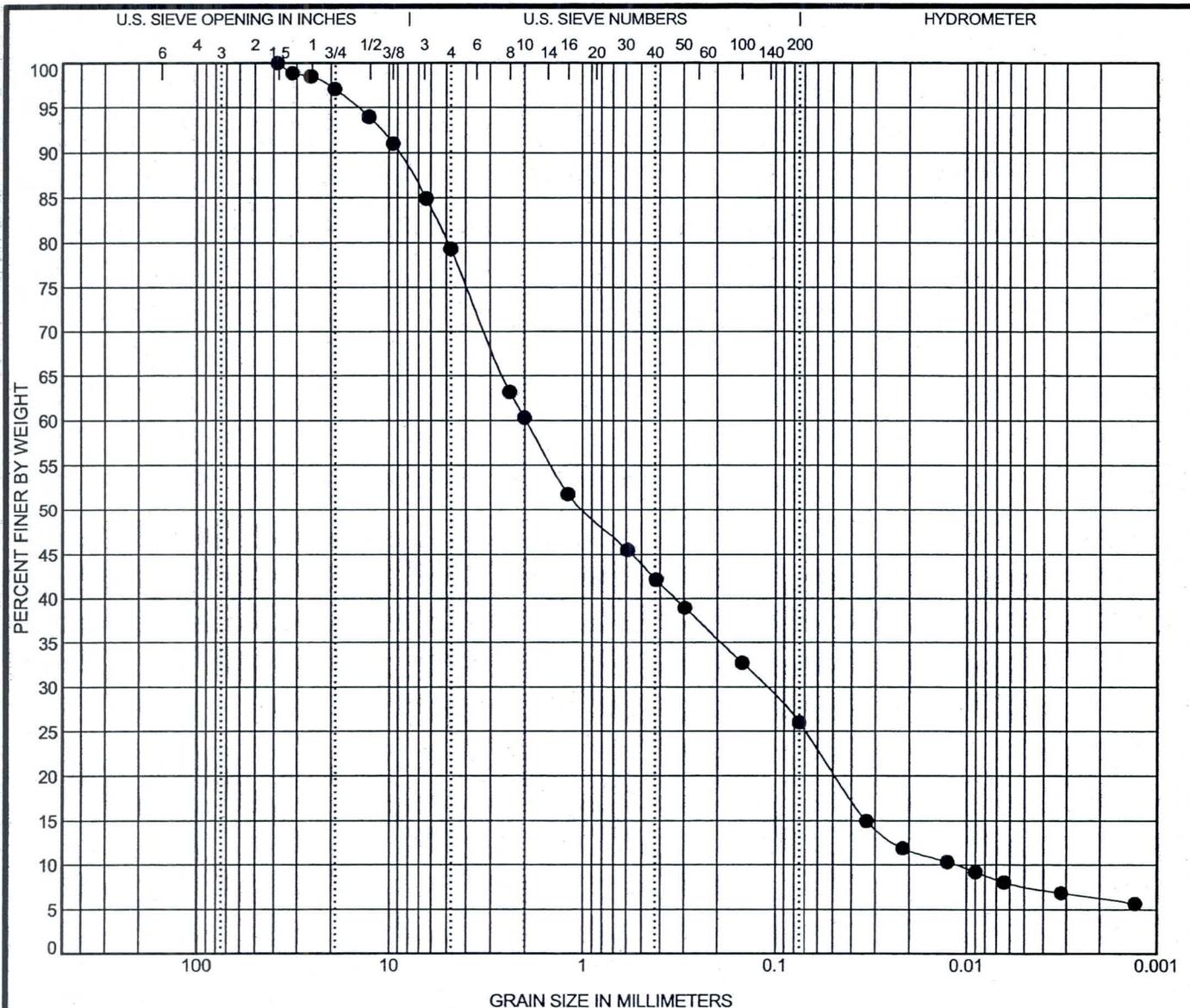
**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11



**SONORA SWC 2**



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		USCS Soil Classification				LL	PL	PI	Cc	Cu
●	TP-12 0.9 ft								0.6	171.1
☒	ft									
▲	ft									
★	ft									
◎	ft									

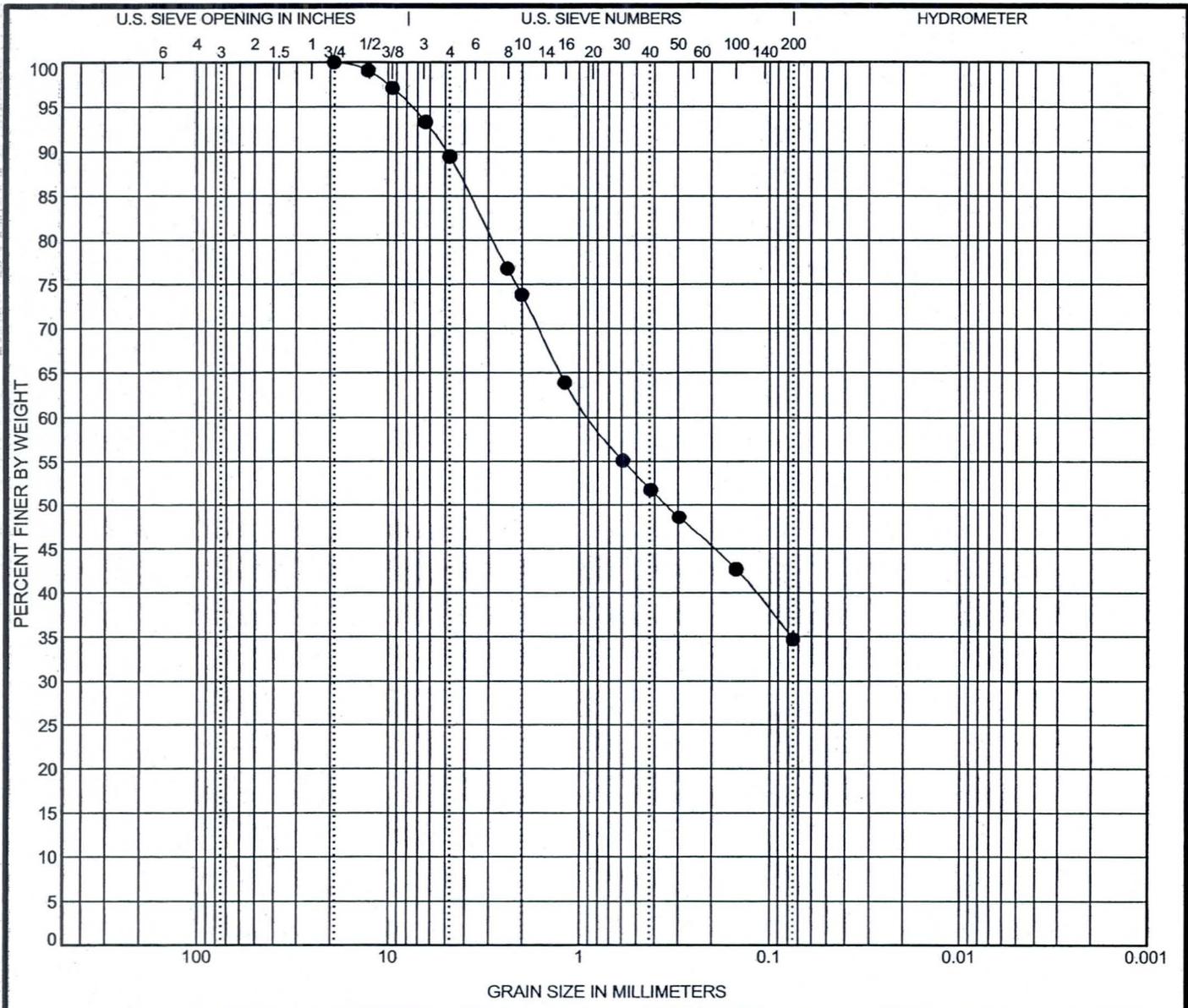
Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	TP-12 0.9 ft	38.1	1.961	0.113	0.011	20.6	53.3	19.8	6.2
☒	ft								
▲	ft								
★	ft								
◎	ft								

**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC GRAIN SIZE 65101872.GPJ TERRACON.GDT 1/3/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-12 2.5 ft						
☒						
▲						
★						
◎						

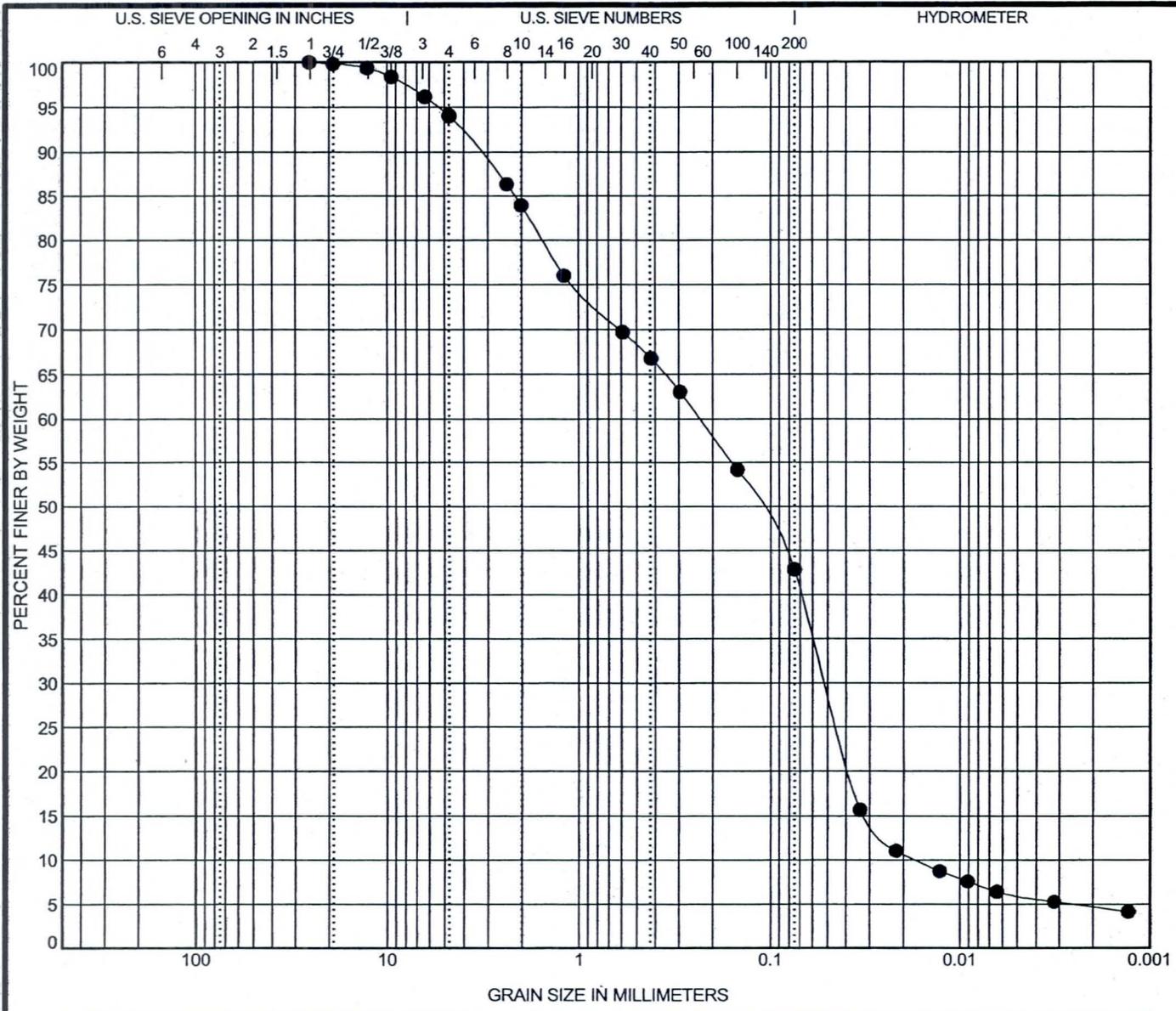
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-12 2.5 ft	19.1	0.869			10.5	54.8	34.7	
☒								
▲								
★								
◎								

**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC GRAIN SIZE 65101872.GPJ\_TERRACON.GDT 1/3/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-13 0.9 ft					0.7	13.6
☒						
▲						
★						
◎						

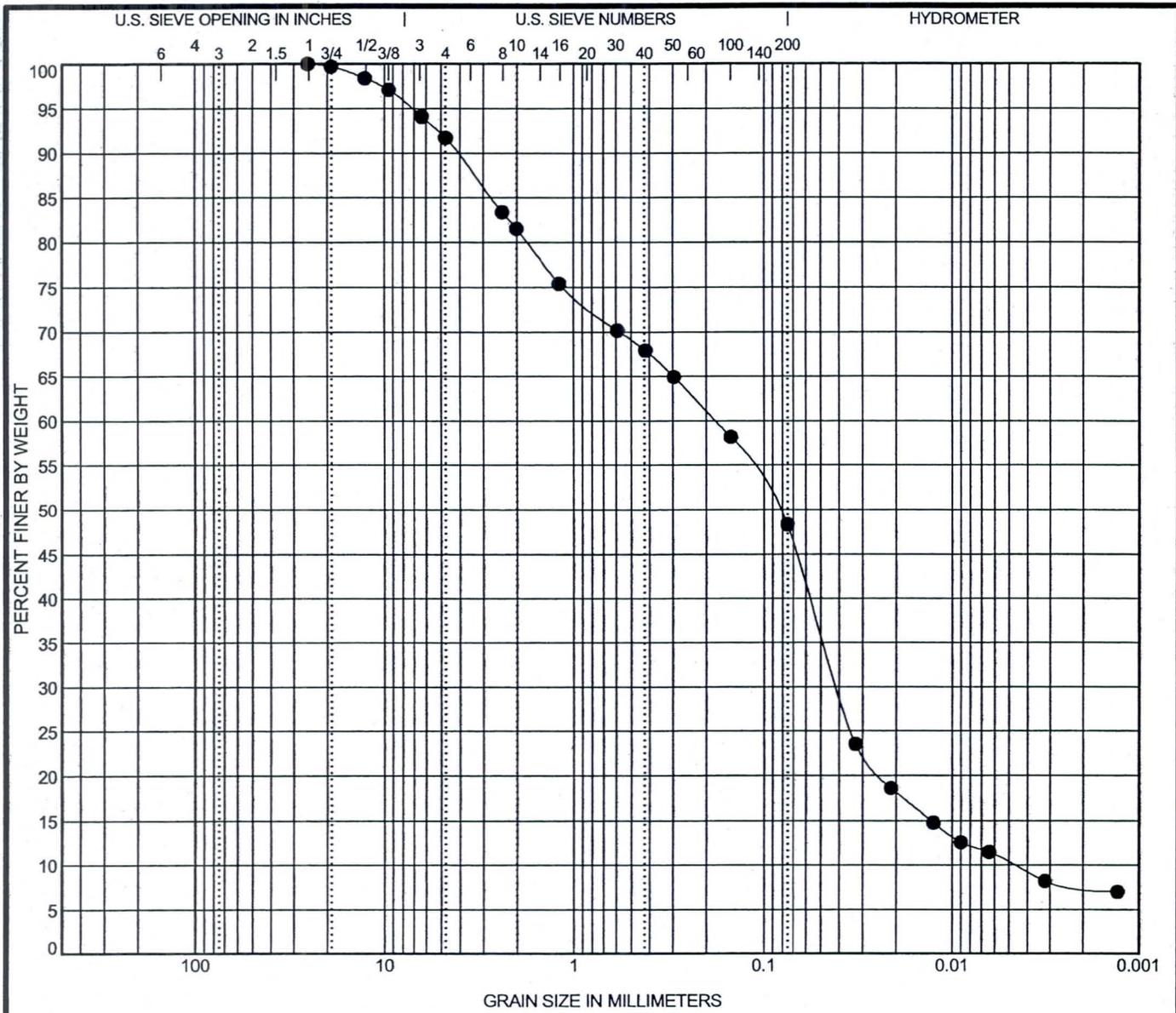
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-13 0.9 ft	25.4	0.234	0.051	0.017	5.9	51.2	38.2	4.7
☒								
▲								
★								
◎								

**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC GRAIN SIZE 65101872.GPJ\_TERRACON.GDT 1/3/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		USCS Soil Classification				LL	PL	PI	Cc	Cu
●	TP-14 0.9 ft								2.0	38.2
☒	ft									
▲	ft									
★	ft									
◎	ft									

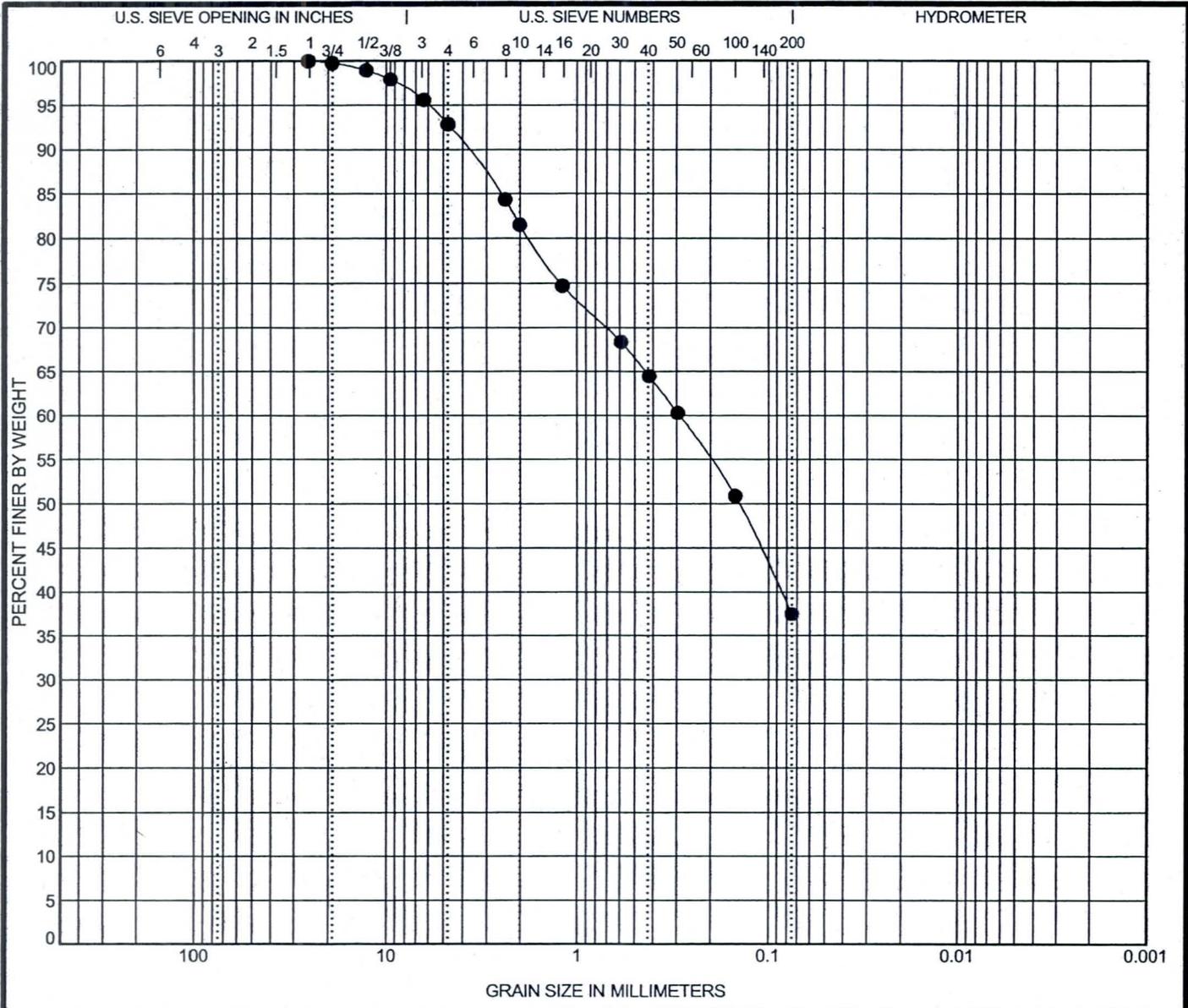
Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	TP-14 0.9 ft	25.4	0.179	0.041	0.005	8.2	43.5	40.7	7.6
☒	ft								
▲	ft								
★	ft								
◎	ft								

**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC GRAIN SIZE 65101872.GPJ TERRACON.GDT 1/3/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-15 0.9 ft						
☒						
▲						
★						
◎						

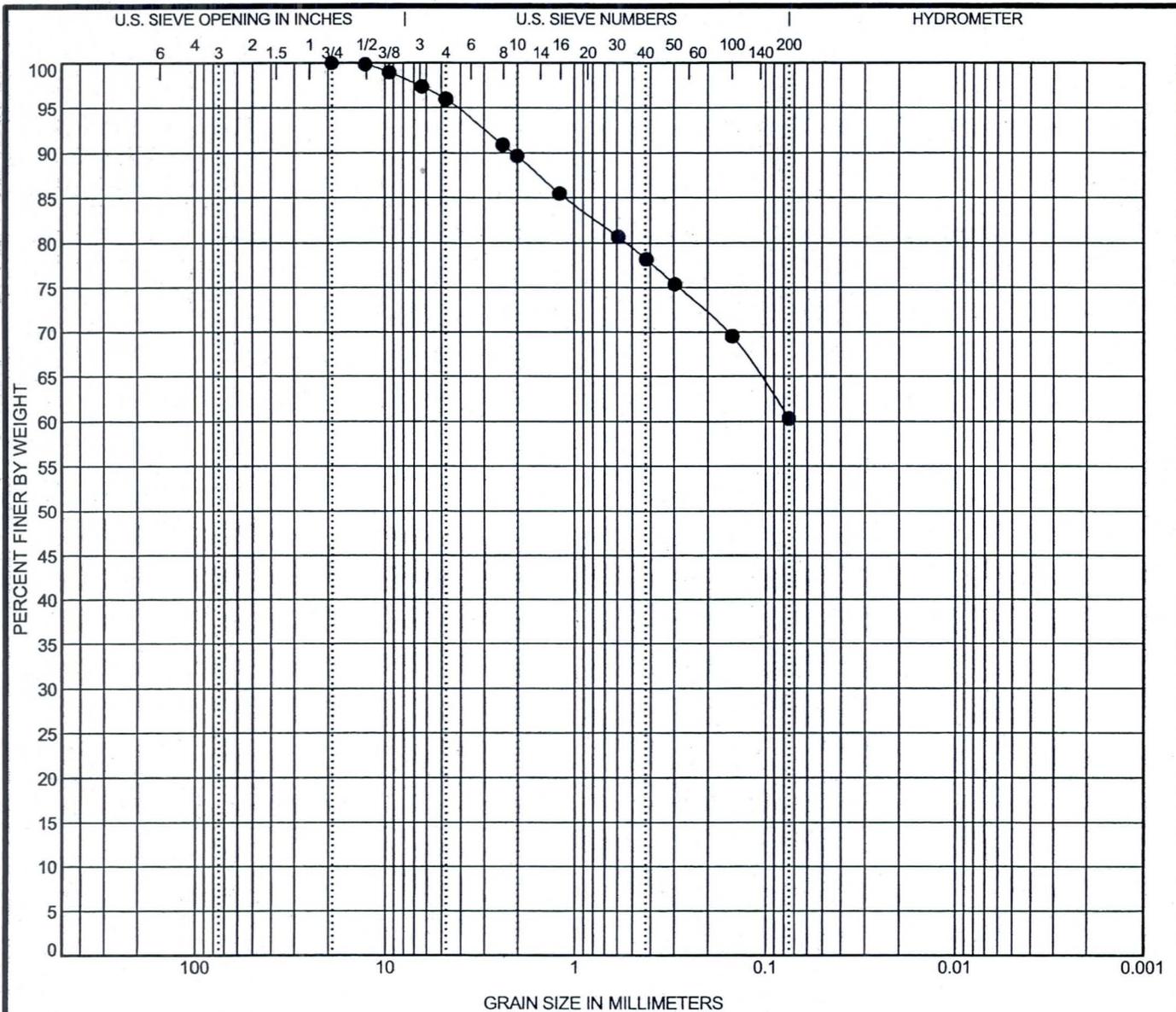
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-15 0.9 ft	25.4	0.291			7.1	55.4	37.5	
☒								
▲								
★								
◎								

**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC GRAIN SIZE 65101872.GPJ TERRACON.GDT 1/3/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		USCS Soil Classification					LL	PL	PI	Cc	Cu
●	TP-16 0.8 ft										
☒	ft										
▲	ft										
★	ft										
◎	ft										

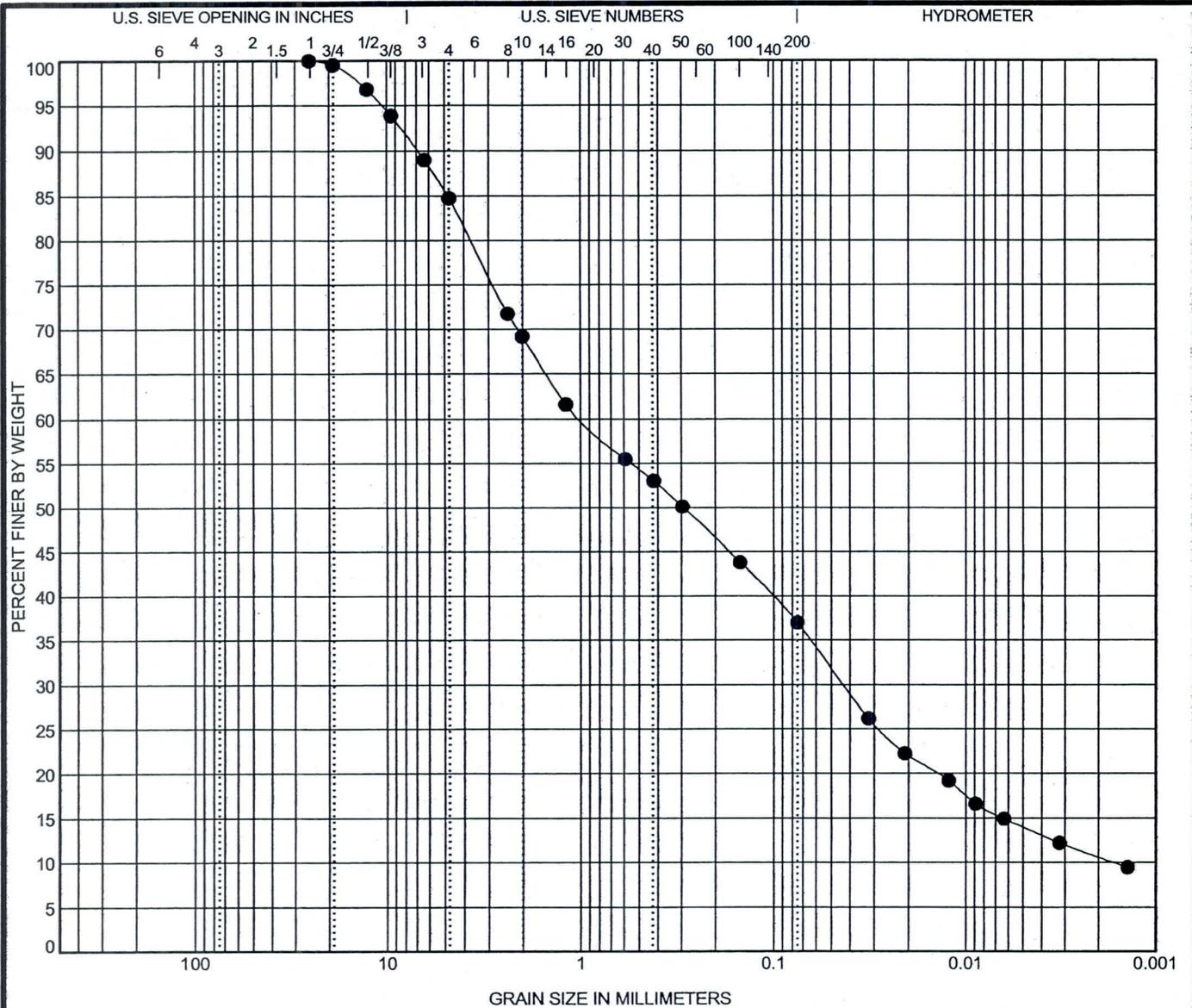
Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	TP-16 0.8 ft	19.1				4.0	35.6	60.3	
☒	ft								
▲	ft								
★	ft								
◎	ft								

**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC\_GRAIN\_SIZE\_65101872.GPJ\_TERRACON.GDT\_1/3/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification					LL	PL	PI	Cc	Cu
● TP-16 2.5 ft									1.1	597.0
☒										
▲										
★										
◎										

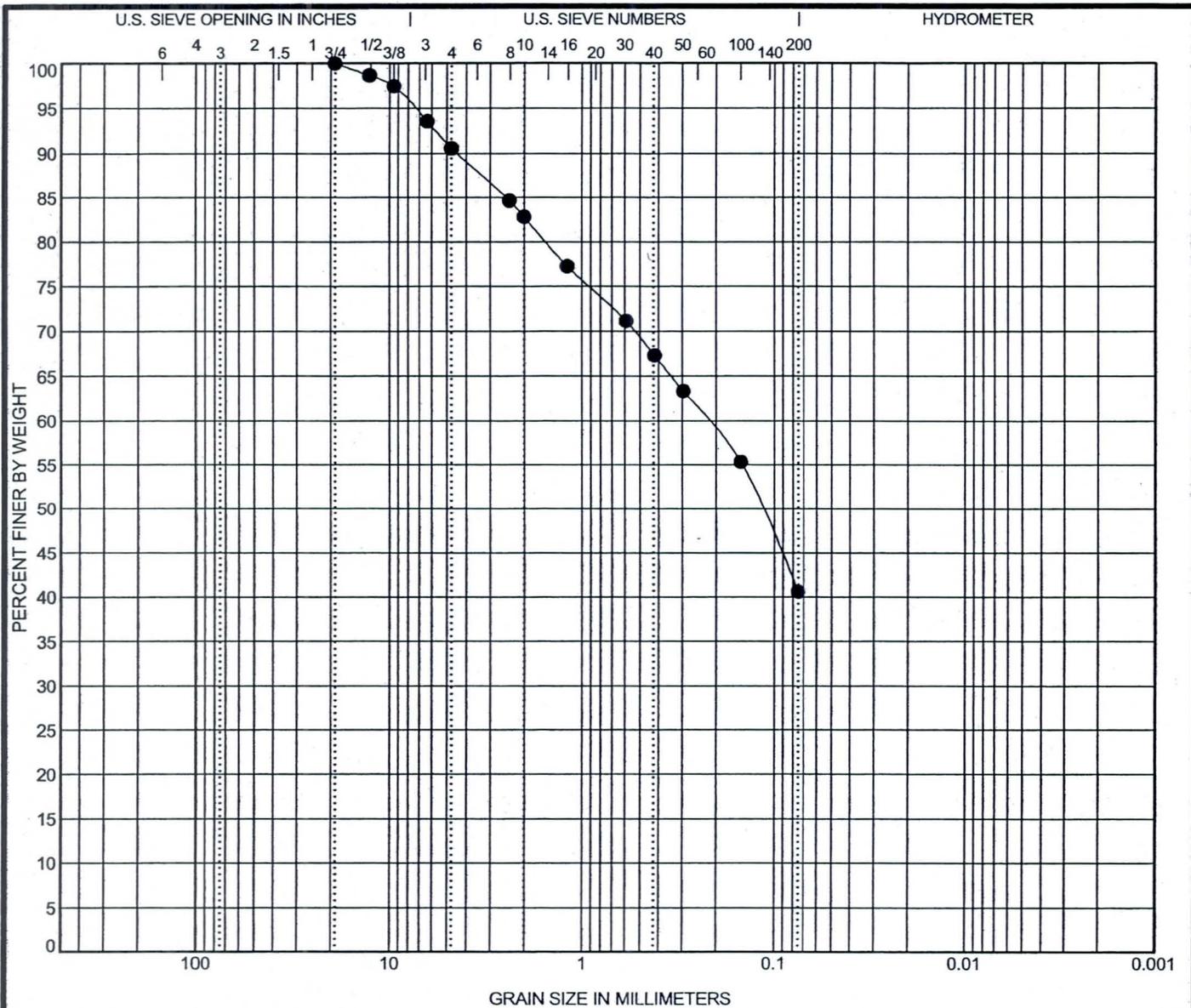
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-16 2.5 ft	25.4	0.989	0.043	0.002	15.2	47.8	26.4	10.6
☒								
▲								
★								
◎								

**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-13-11

TC. GRAIN SIZE 65101872.GPJ TERRACON.GDT 1/13/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-17 0.8 ft						
☒ ft						
▲ ft						
★ ft						
◎ ft						

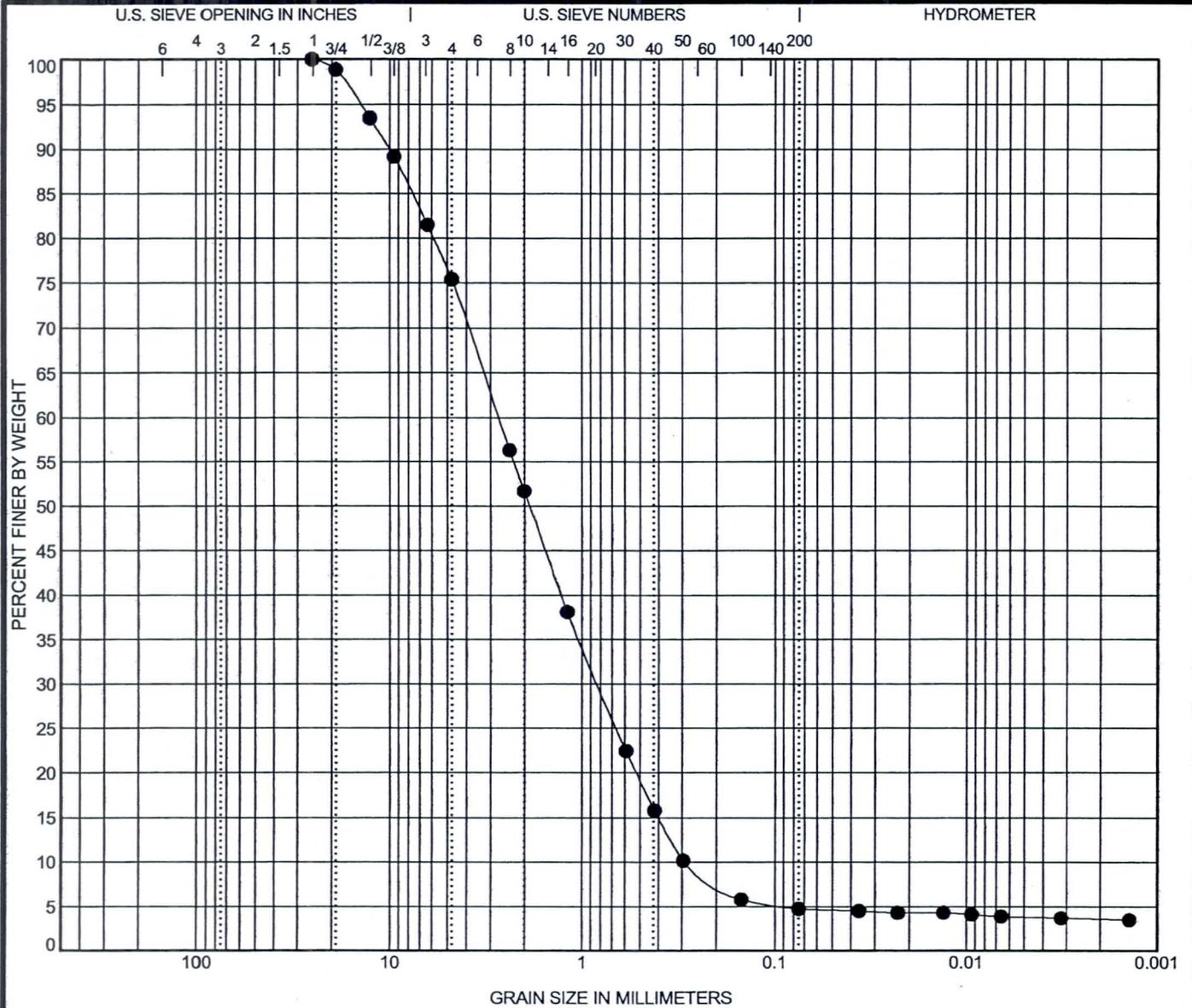
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-17 0.8 ft	19.1	0.222			9.4	50.0	40.6	
☒ ft								
▲ ft								
★ ft								
◎ ft								

**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC GRAIN SIZE 65101872.GPJ TERRACON.GDT 1/3/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-18 1.3 ft	POORLY GRADED SAND with GRAVEL(SP)				0.9	9.4
☒	ft					
▲	ft					
★	ft					
◎	ft					

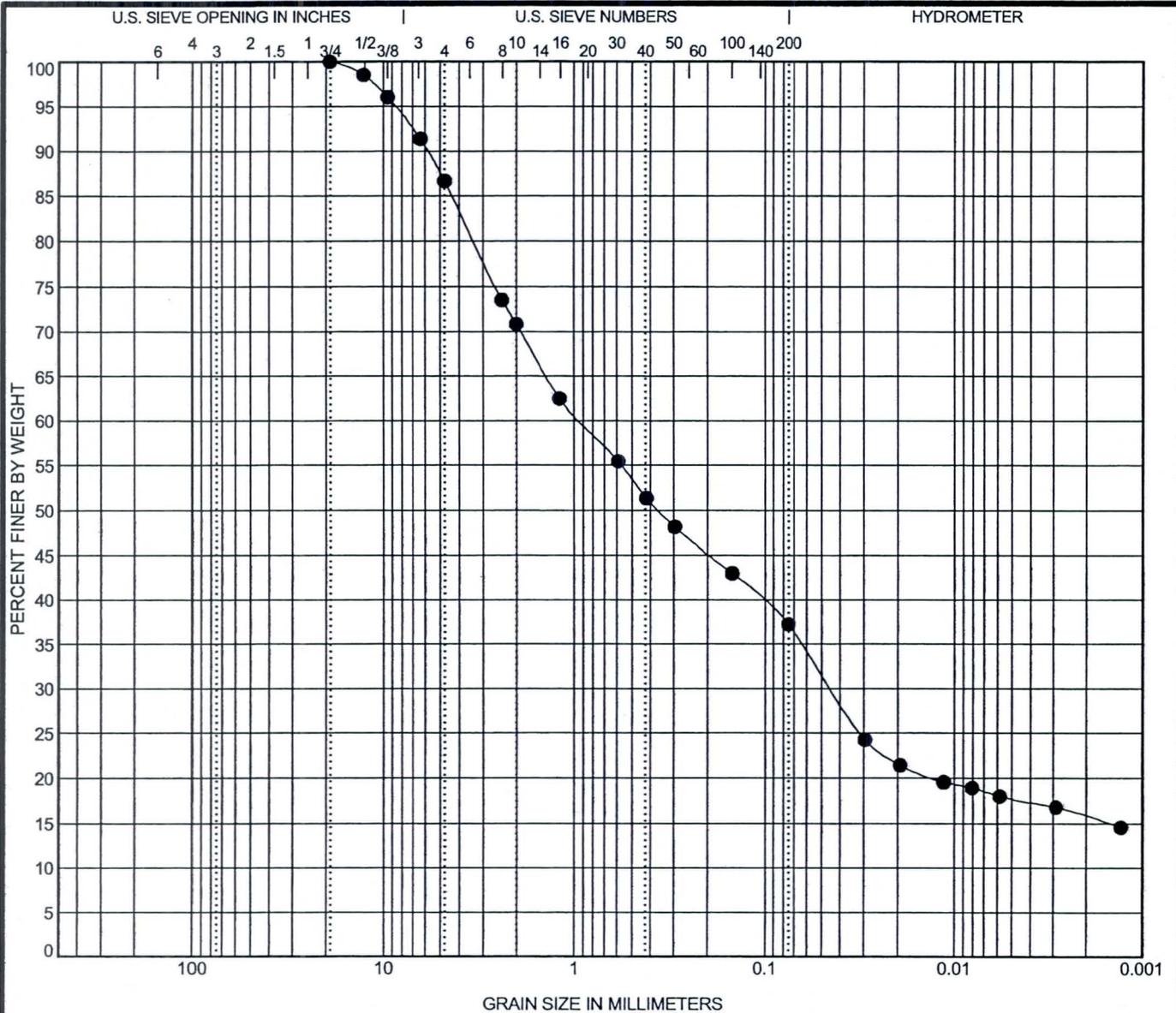
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-18 1.3 ft	25.4	2.718	0.827	0.289	24.6	70.7	1.2	3.6
☒	ft							
▲	ft							
★	ft							
◎	ft							

**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-13-11

TC GRAIN SIZE 65101872.GPJ TERRACON.GDT 1/13/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-18 2.3 ft						
☒ ft						
▲ ft						
★ ft						
◎ ft						

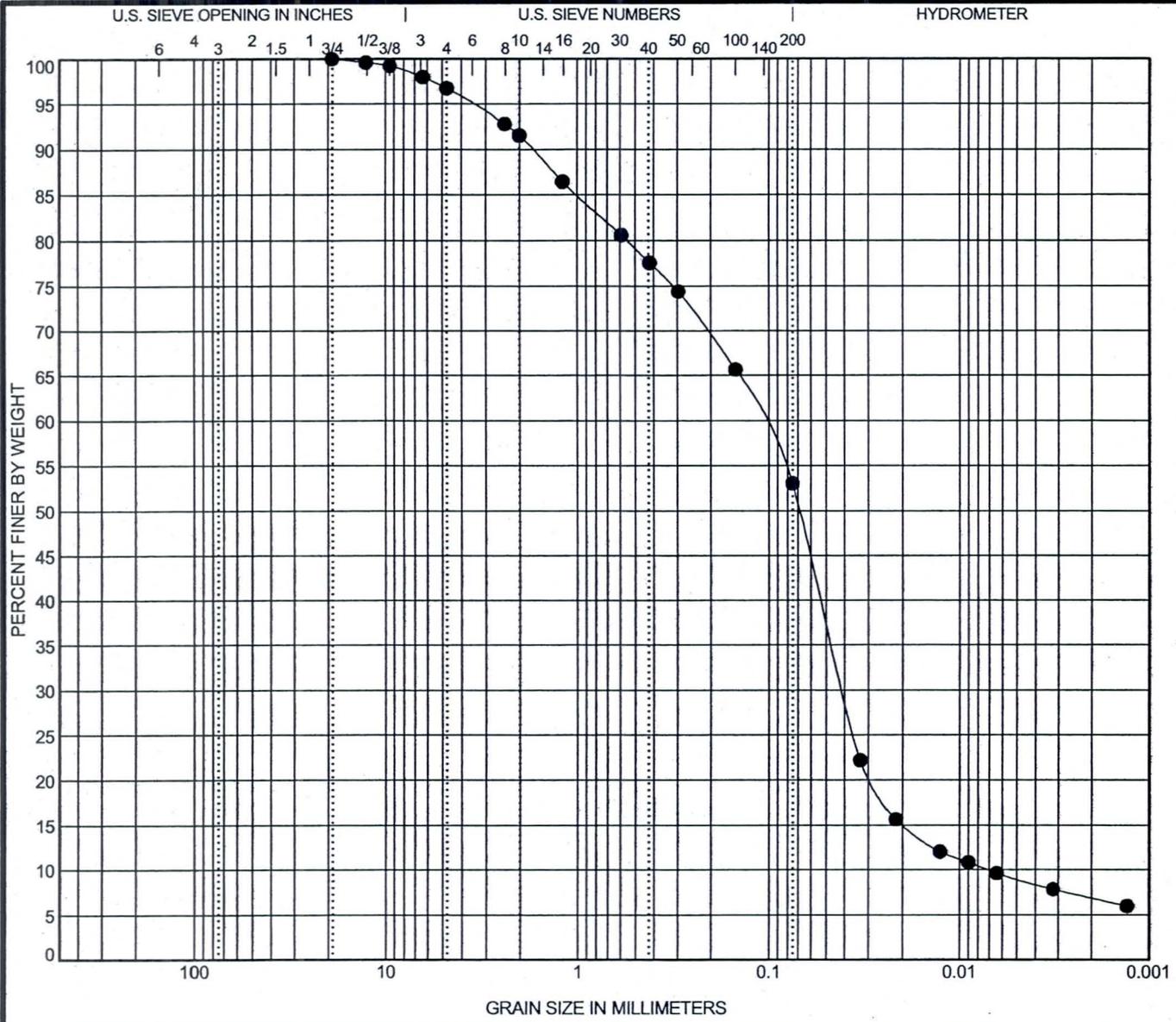
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-18 2.3 ft	19.1	0.928	0.045		13.3	49.4	21.5	15.8
☒ ft								
▲ ft								
★ ft								
◎ ft								

### GRAIN SIZE DISTRIBUTION



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-13-11

TC: GRAIN SIZE 65101872.GPJ TERRACON.GDT 1/13/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-19 1.4 ft					2.1	15.3
☒						
▲						
★						
◎						

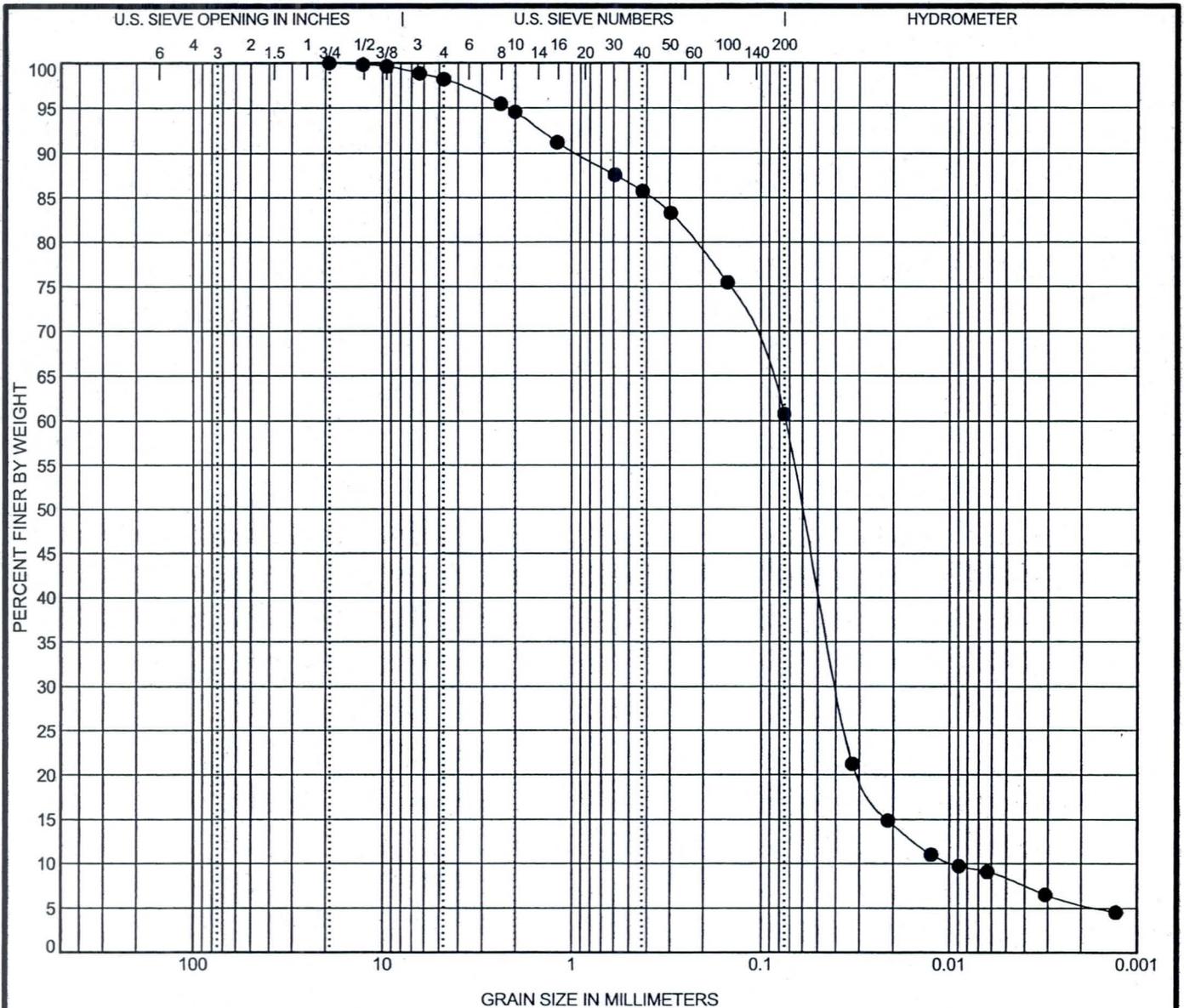
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-19 1.4 ft	19.1	0.109	0.041	0.007	3.3	43.7	46.2	6.9
☒								
▲								
★								
◎								

**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC: GRAIN SIZE 65101872.GPJ\_TERRACON.GDT 1/3/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-20 1.3 ft					2.2	7.7
☒						
▲						
★						
◎						

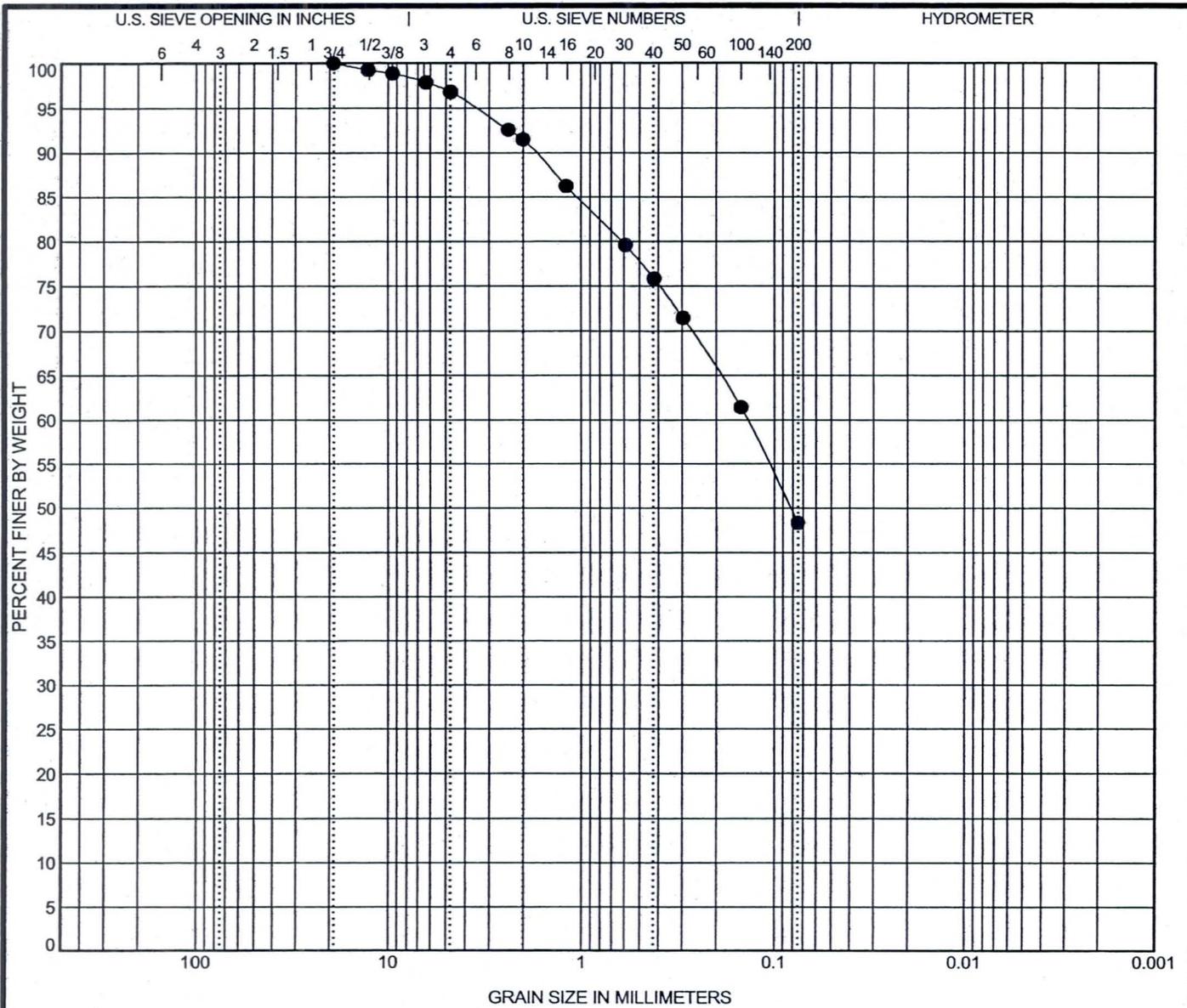
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-20 1.3 ft	19.1	0.074	0.039	0.01	1.8	37.4	55.3	5.5
☒								
▲								
★								
◎								

### GRAIN SIZE DISTRIBUTION



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC GRAIN SIZE 65101872.GPJ TERRACON.GDT 1/3/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification					LL	PL	PI	Cc	Cu
● TP-21 1.0 ft										
☒										
▲										
★										
◎										

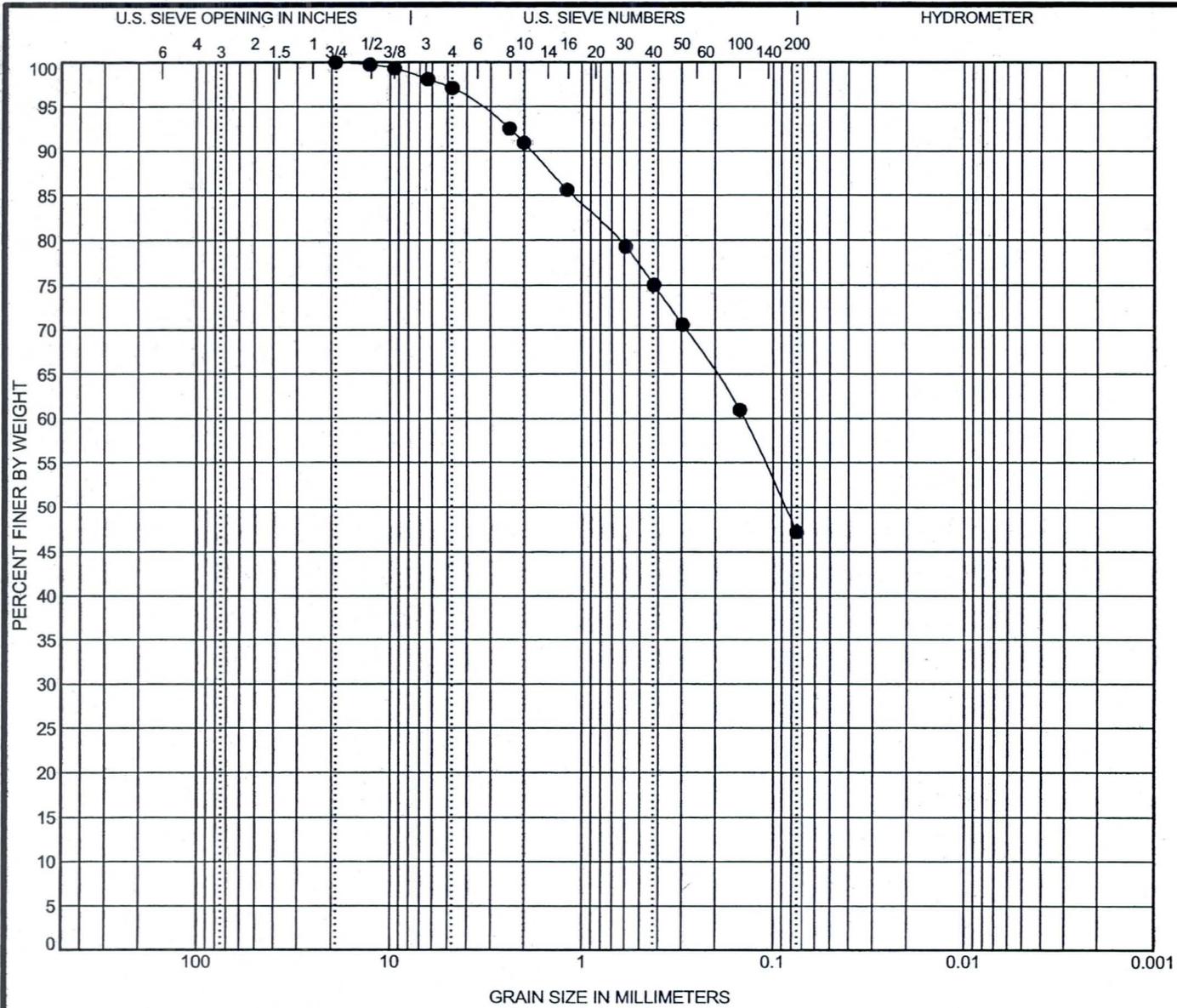
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-21 1.0 ft	19.1	0.138			3.2	48.5	48.3	
☒								
▲								
★								
◎								

**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC - GRAIN SIZE: 65101872.GPJ TERRACON.GDT 1/3/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-22 1.0 ft						
☒ ft						
▲ ft						
★ ft						
◎ ft						

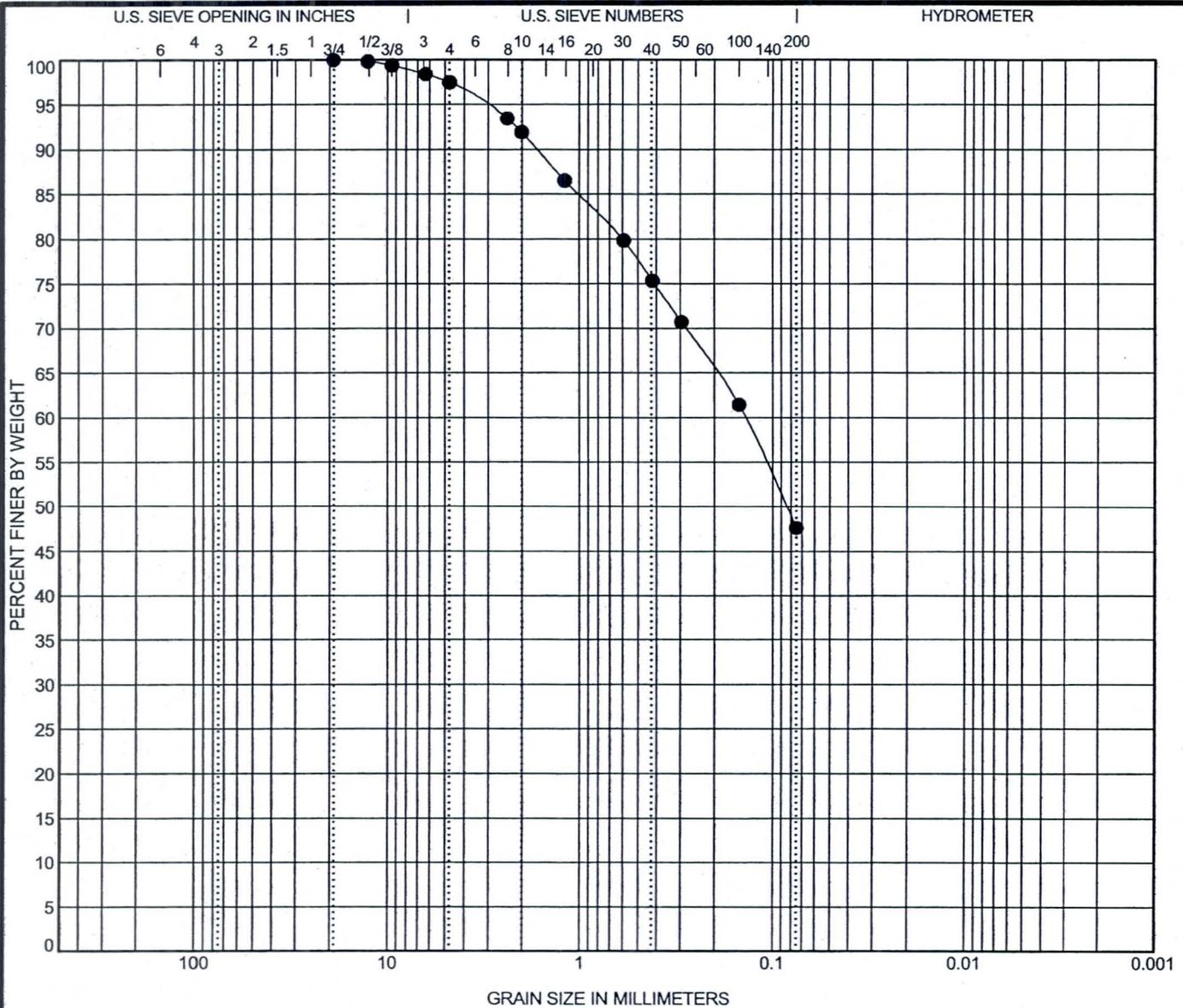
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-22 1.0 ft	19.1	0.142			2.9	50.0	47.1	
☒ ft								
▲ ft								
★ ft								
◎ ft								

**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC: GRAIN SIZE 65101872.GPJ TERRACON.GDT 1/3/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-23 0.9 ft						
▣						
▲						
★						
◎						

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-23 0.9 ft	19.1	0.139			2.5	49.9	47.6	
▣								
▲								
★								
◎								

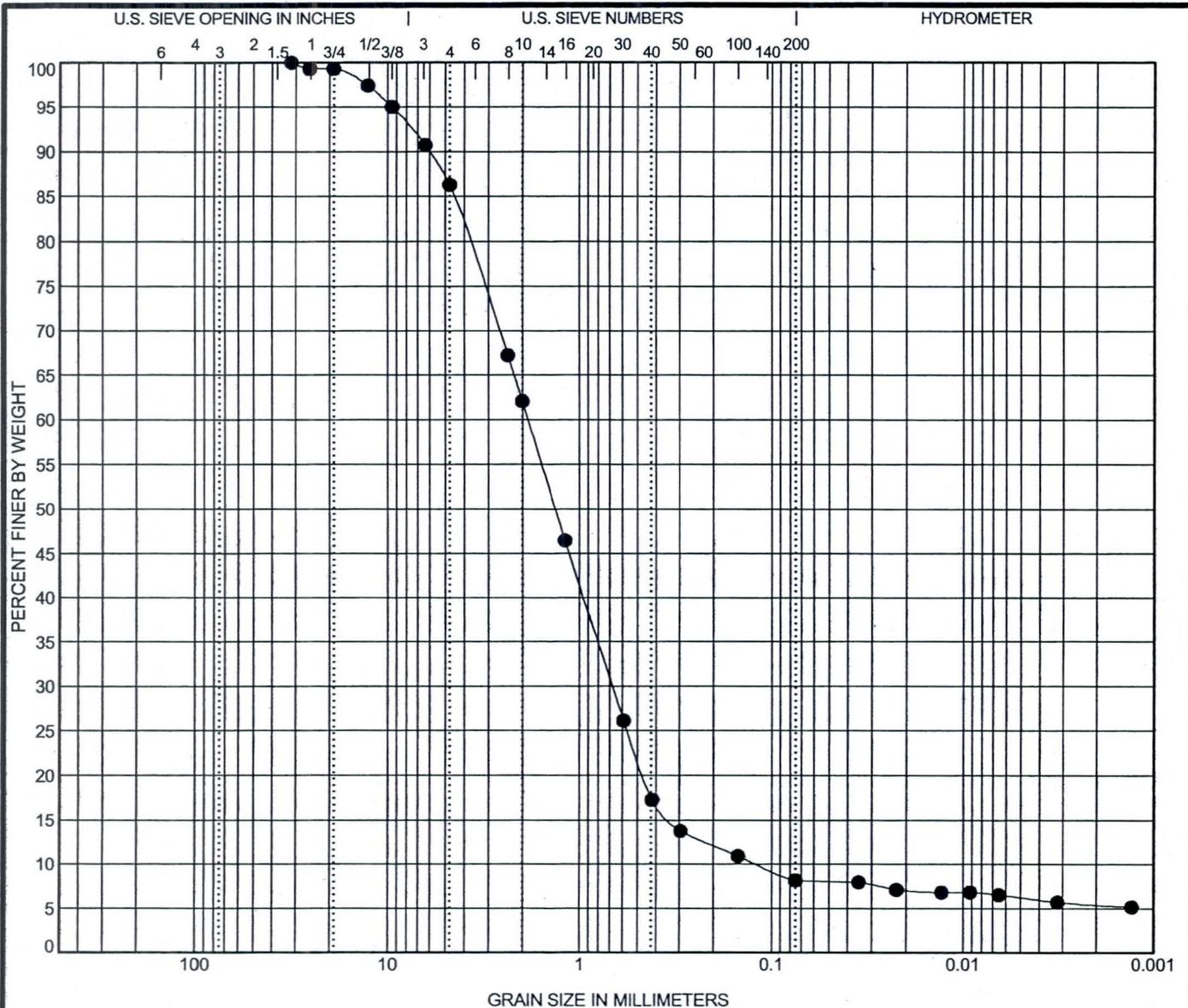
**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC GRAIN SIZE 65101872.GPJ TERRACON.GDT 1/3/11

**SONORA SWC 3**



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-24 1.0 ft					2.1	15.7
☒						
▲						
★						
◎						

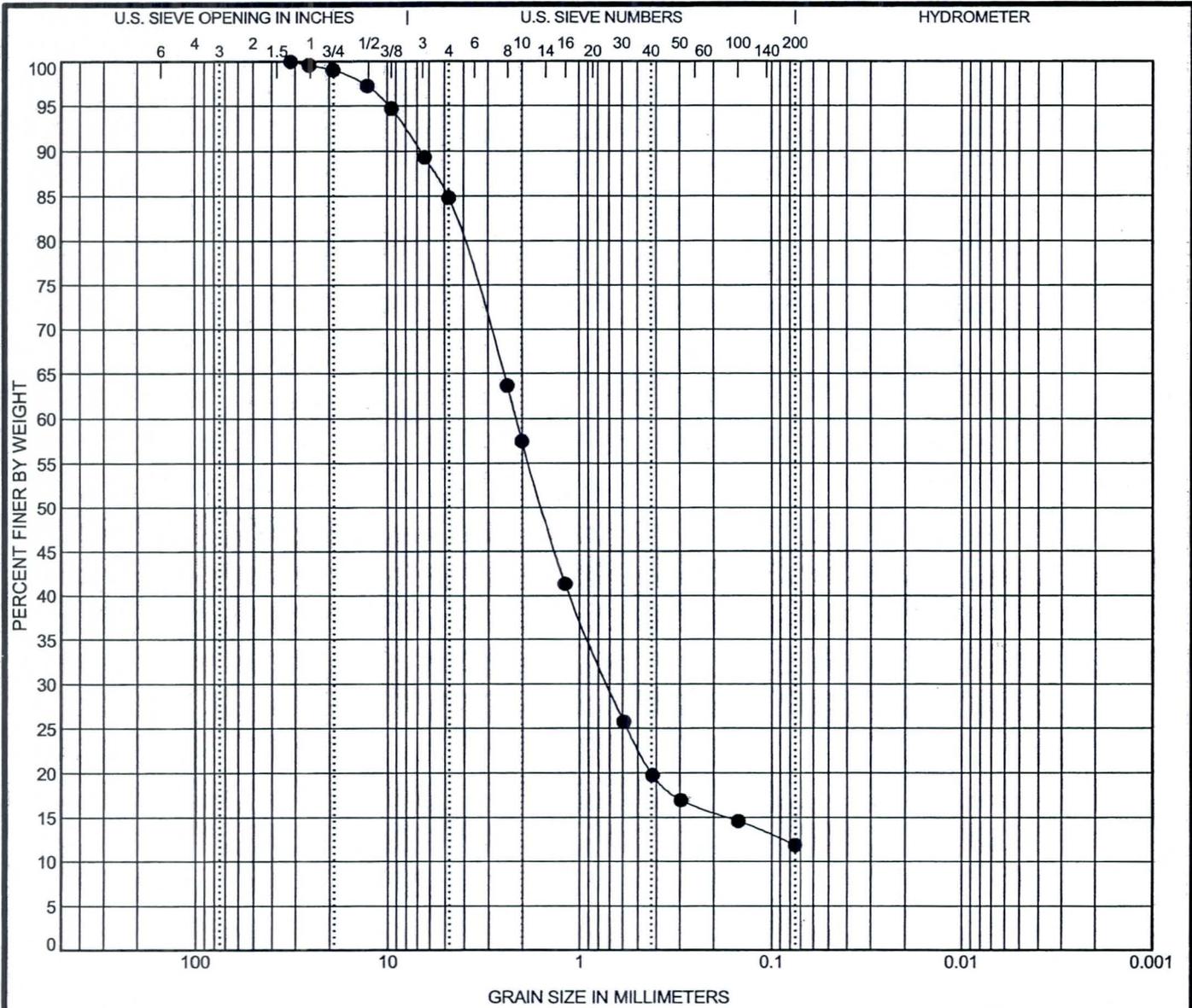
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-24 1.0 ft	31.75	1.867	0.675	0.119	13.7	78.2	2.7	5.4
☒								
▲								
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**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-13-11

TC: GRAIN SIZE 65101872.GPJ TERRACON.GDT 1/13/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-24 2.0 ft					5.0	45.5
☒						
▲						
★						
◎						

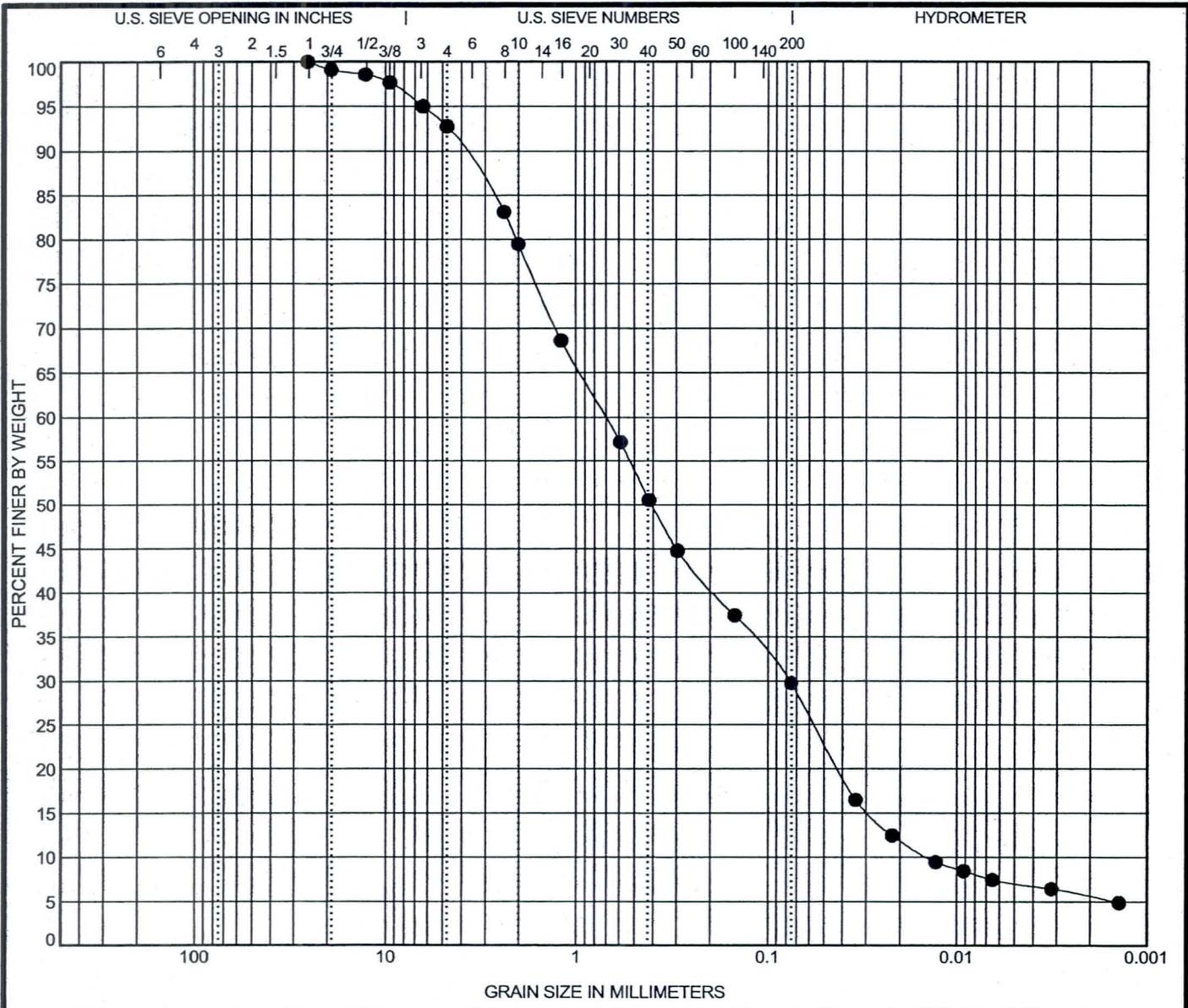
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-24 2.0 ft	31.75	2.147	0.715		15.2	73.0	11.8	
☒								
▲								
★								
◎								

**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-19-11

TC GRAIN SIZE 65101872.GPJ TERRACON.GDT 1/19/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification					LL	PL	PI	Cc	Cu
● TP-25 1.0 ft									0.6	49.2
☒										
▲										
★										
◎										

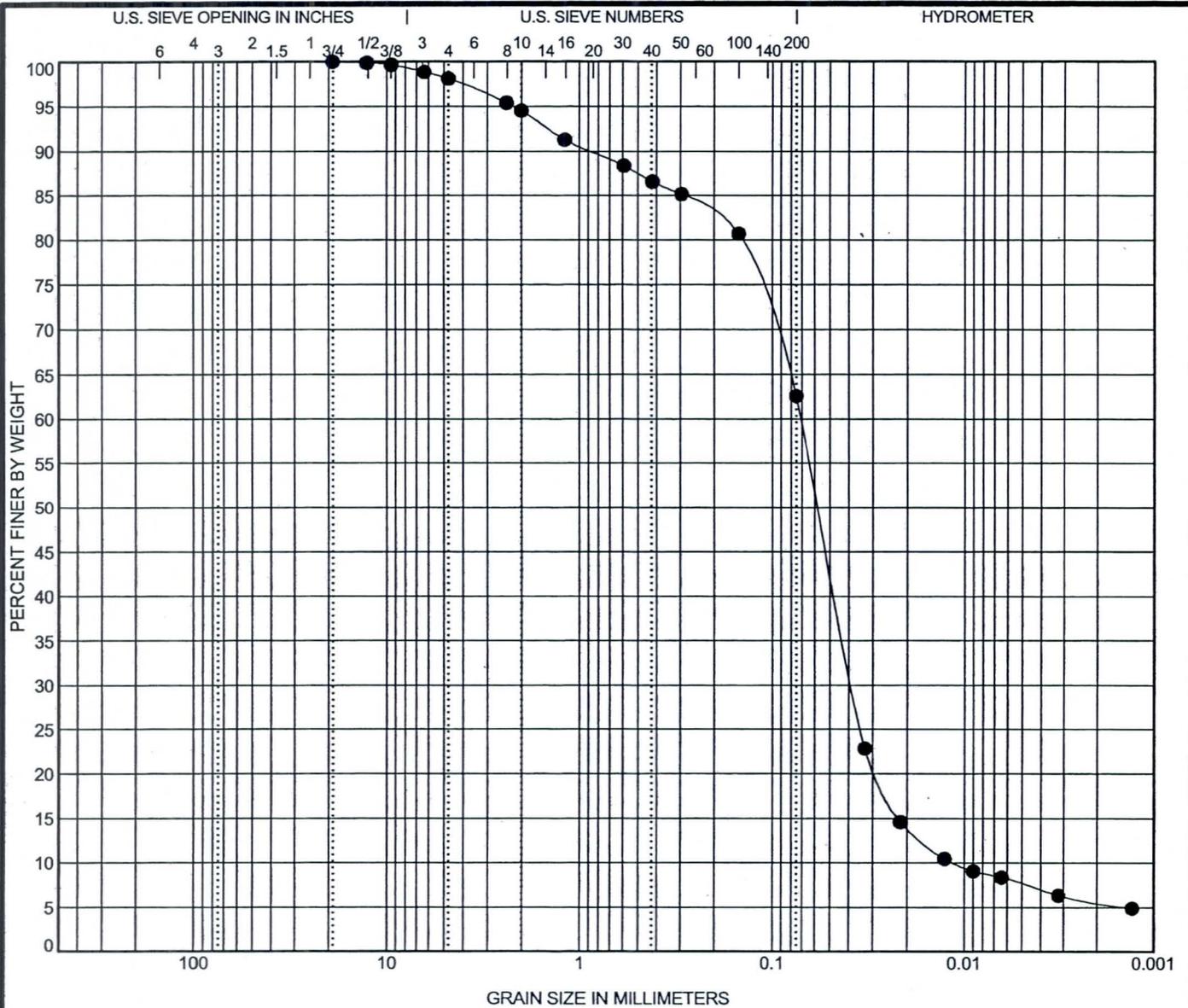
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-25 1.0 ft	25.4	0.701	0.077	0.014	7.2	63.1	24.2	5.5
☒								
▲								
★								
◎								

**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC: GRAIN SIZE 65101872.GPJ TERRACON.GDT 1/3/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-26 1.2 ft					1.8	6.2
☒						
▲						
★						
◎						

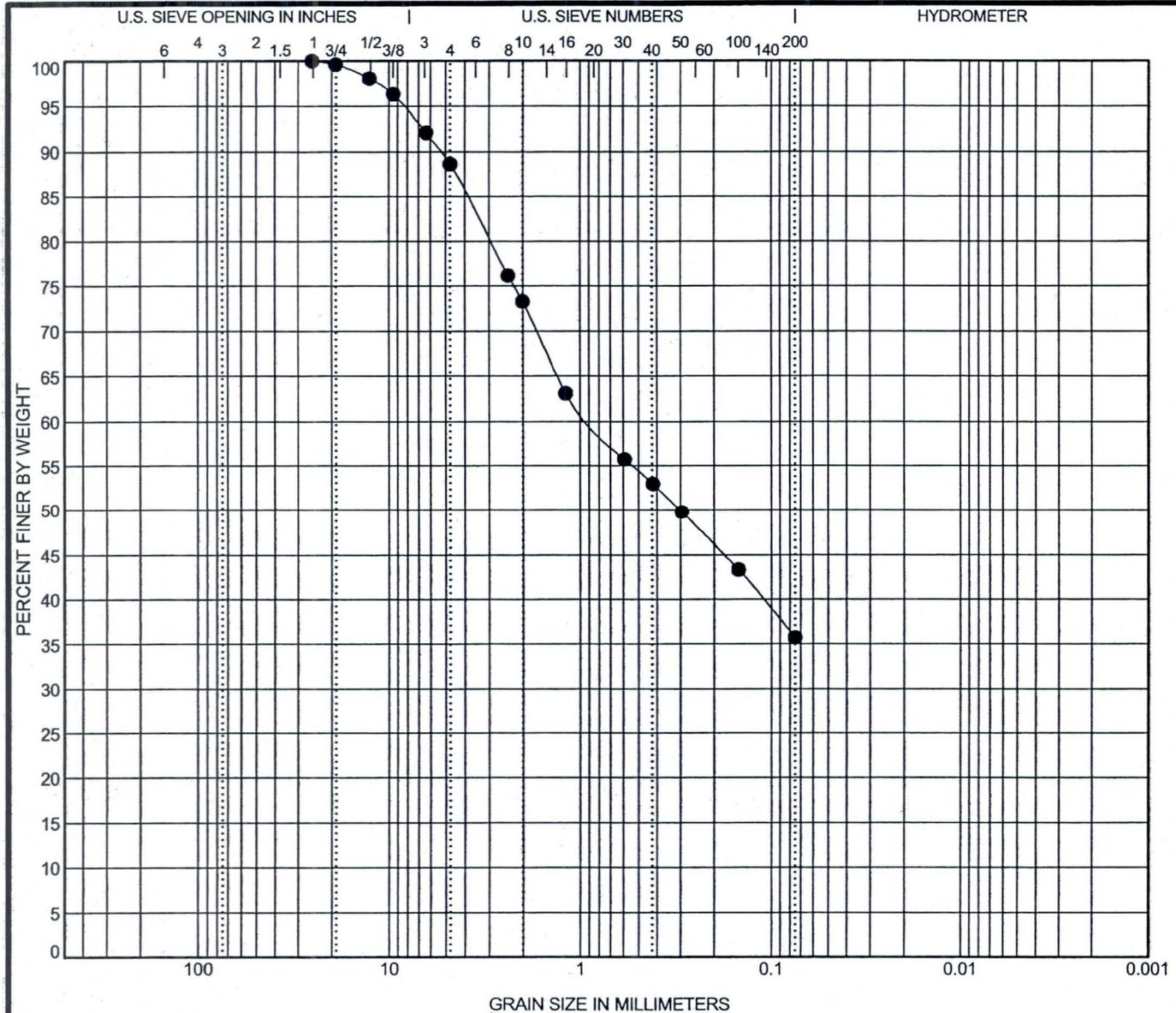
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-26 1.2 ft	19.1	0.071	0.038	0.011	1.9	35.5	57.0	5.6
☒								
▲								
★								
◎								

**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-19-11

TC: GRAIN SIZE 65101872.GPJ TERRACON.GDT 1/19/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-27 0.8 ft						
▣ ft						
▲ ft						
★ ft						
◎ ft						

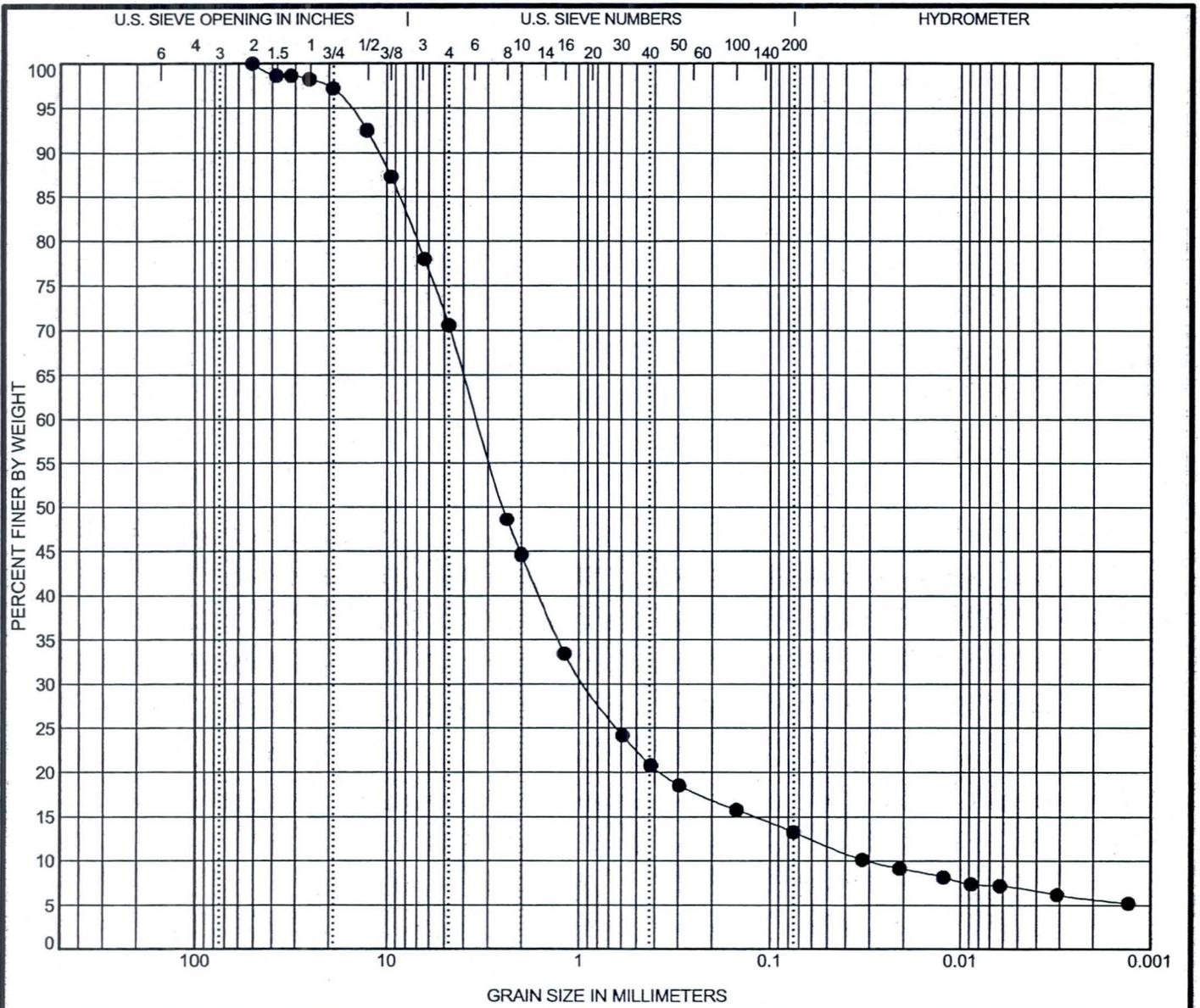
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-27 0.8 ft	25.4	0.884			11.3	52.9	35.7	
▣ ft								
▲ ft								
★ ft								
◎ ft								

### GRAIN SIZE DISTRIBUTION



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC: GRAIN SIZE: 65101872.GPJ TERRACON.GDT 1/3/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

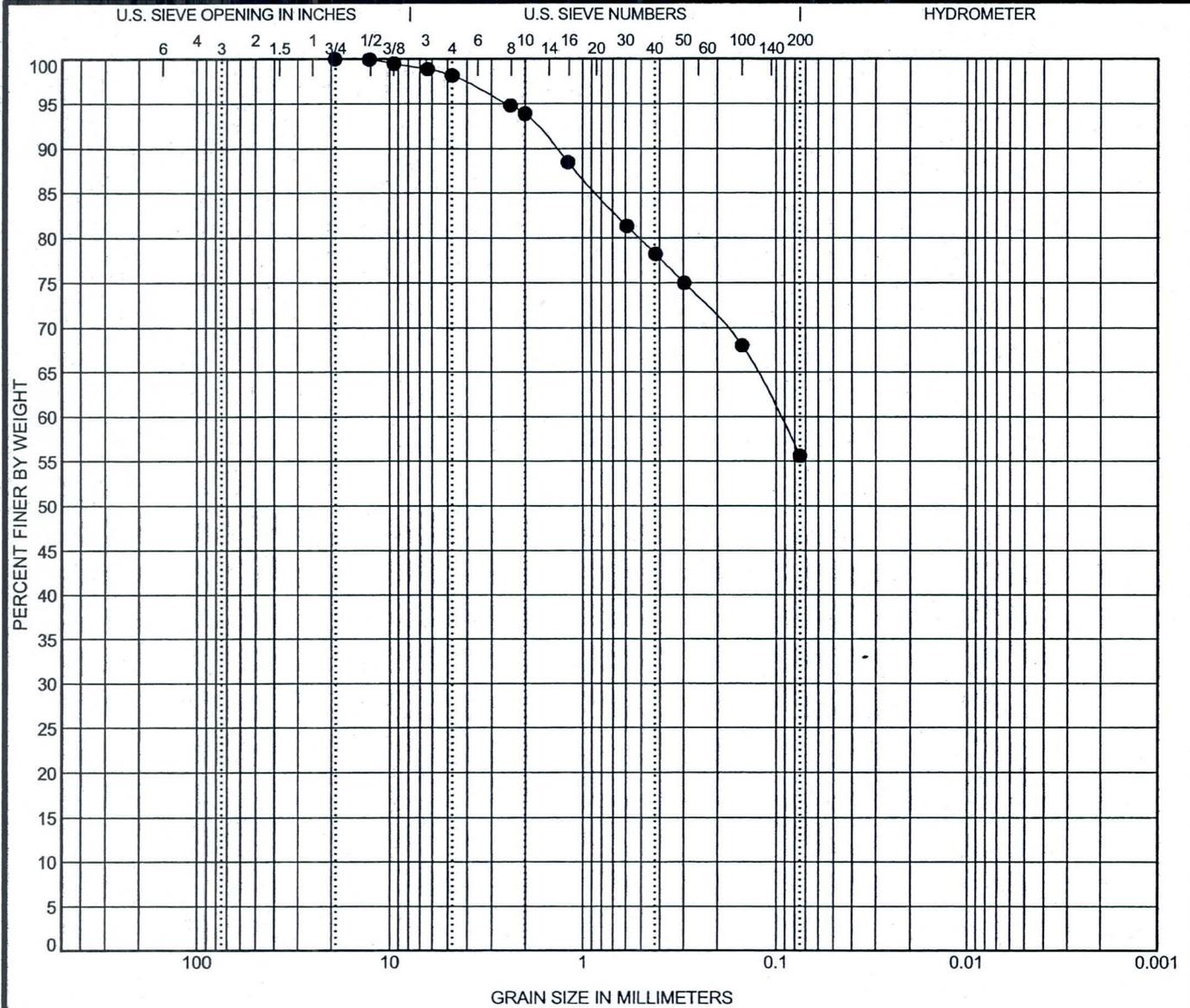
Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-27 2.1 ft					8.0	110.6
☒						
▲						
★						
◎						

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-27 2.1 ft	50.8	3.407	0.916	0.031	29.4	57.4	7.6	5.7
☒								
▲								
★								
◎								

### GRAIN SIZE DISTRIBUTION



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-13-11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-28 1.2 ft						
☒ ft						
▲ ft						
★ ft						
◎ ft						

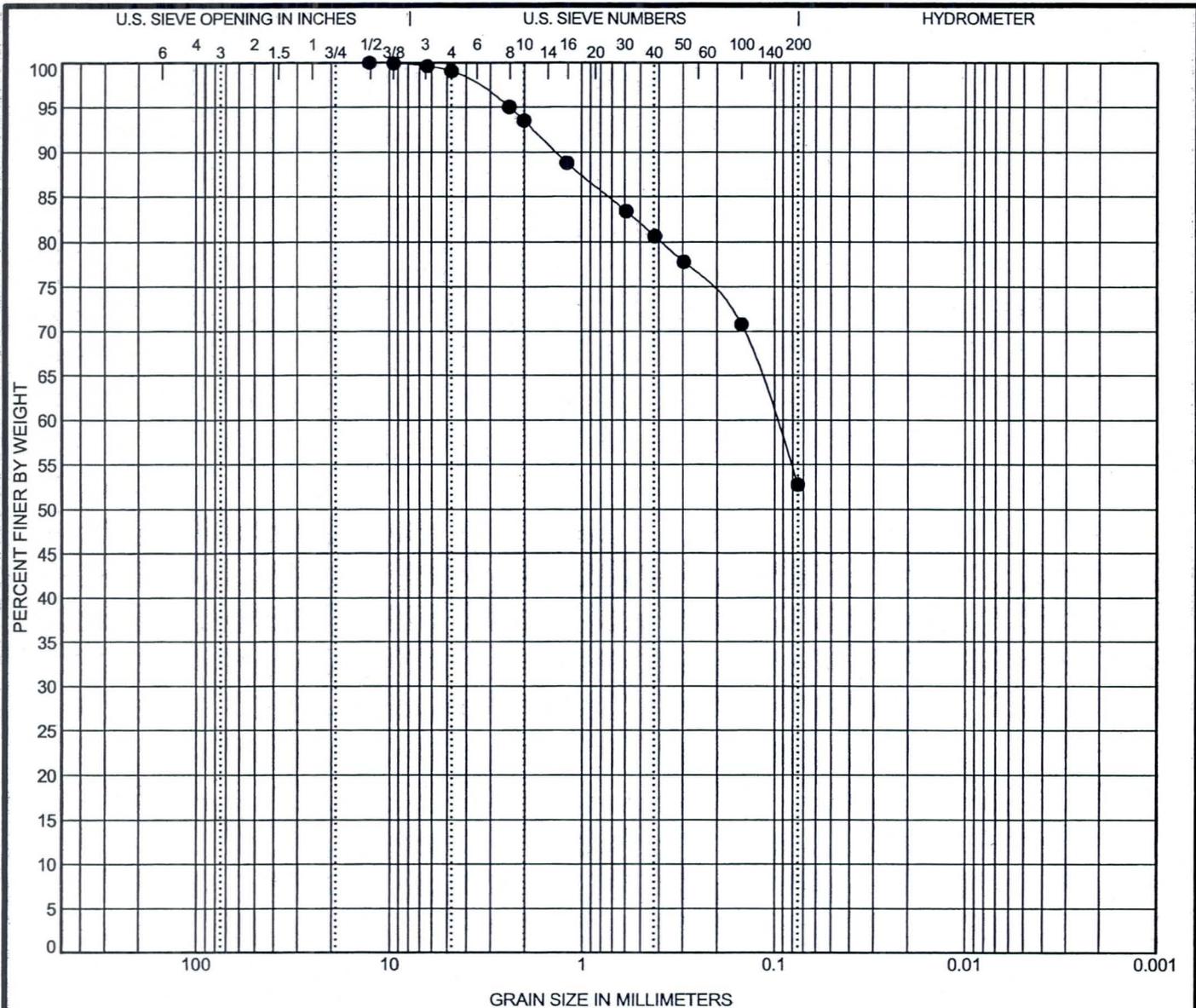
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-28 1.2 ft	19.1	0.096			1.8	42.5	55.6	
☒ ft								
▲ ft								
★ ft								
◎ ft								

**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC\_GRAIN\_SIZE\_65101872.GPJ\_TERRACON.GDT\_1/3/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-29 1.5 ft						
☒ ft						
▲ ft						
★ ft						
◎ ft						

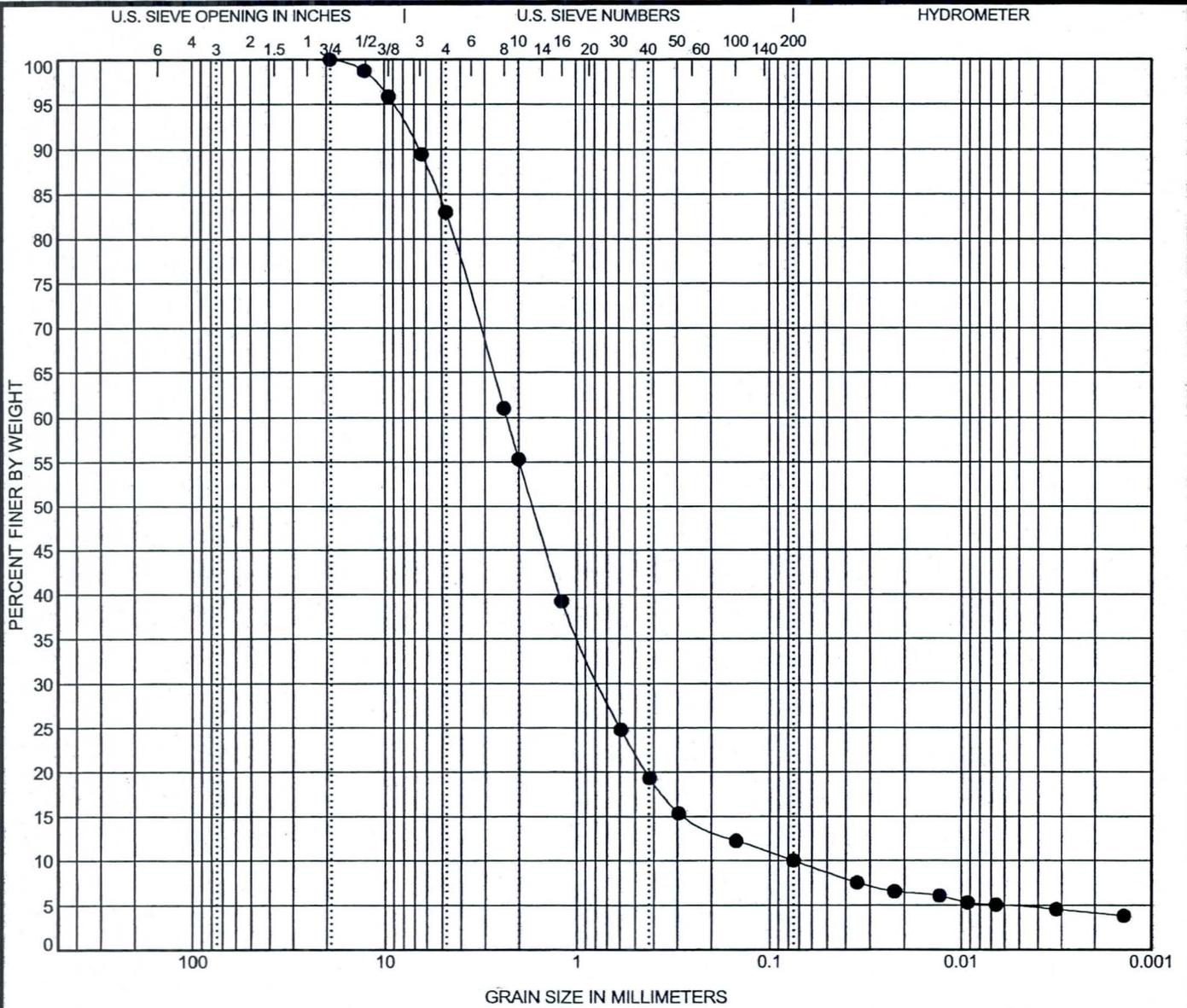
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-29 1.5 ft	12.7	0.099			0.9	46.3	52.8	
☒ ft								
▲ ft								
★ ft								
◎ ft								

**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-19-11

TC GRAIN SIZE 65101872.GPJ TERRACON.GDT 1/19/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-30 1.0 ft					3.3	30.9
▣						
▲						
★						
◎						

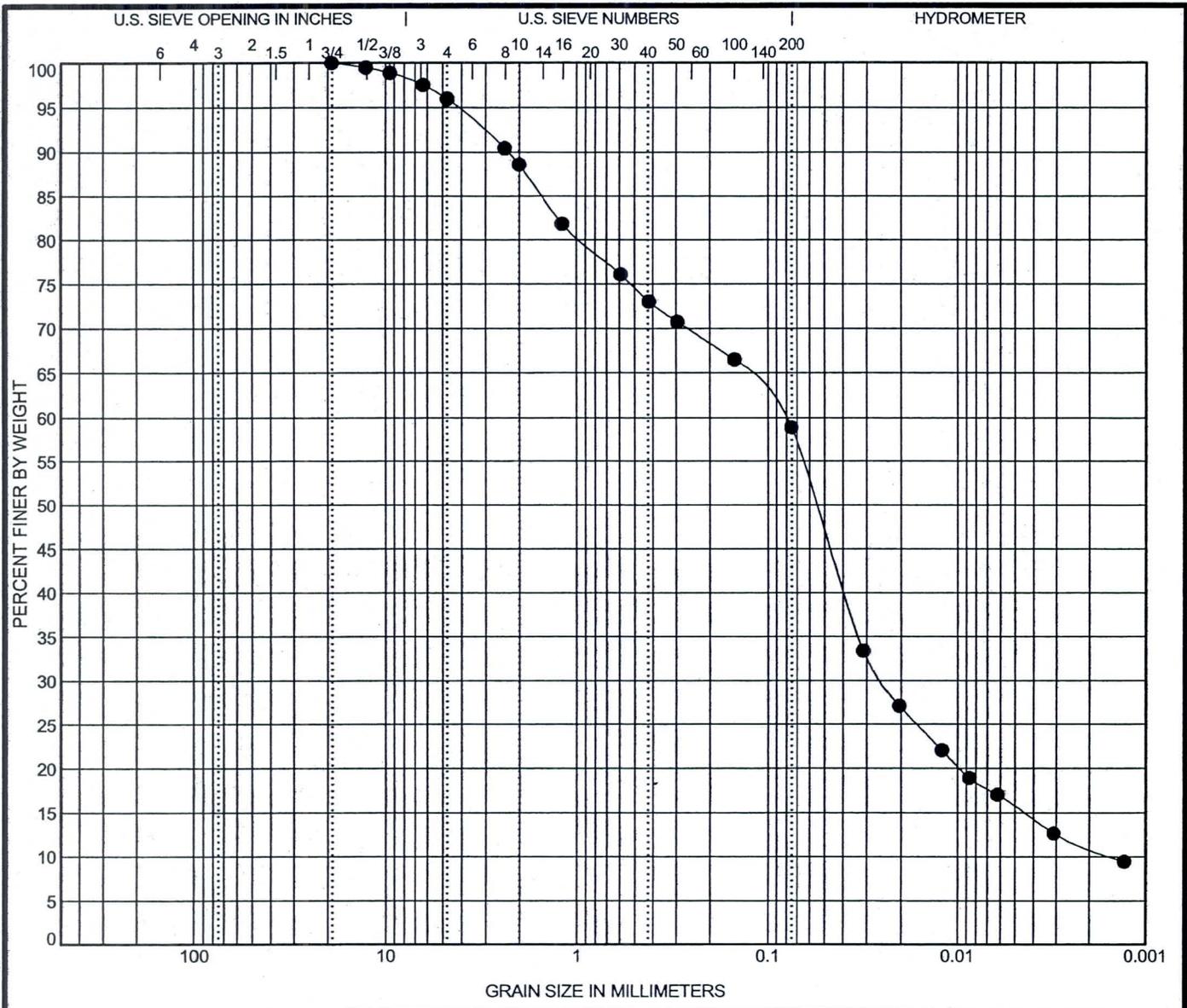
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-30 1.0 ft	19.1	2.305	0.759	0.075	17.0	73.0	5.9	4.1
▣								
▲								
★								
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**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-13-11

TC: GRAIN SIZE 65101872.GPJ TERRACON.GDT 1/13/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-30 2.7 ft					4.9	54.8
☒						
▲						
★						
◎						

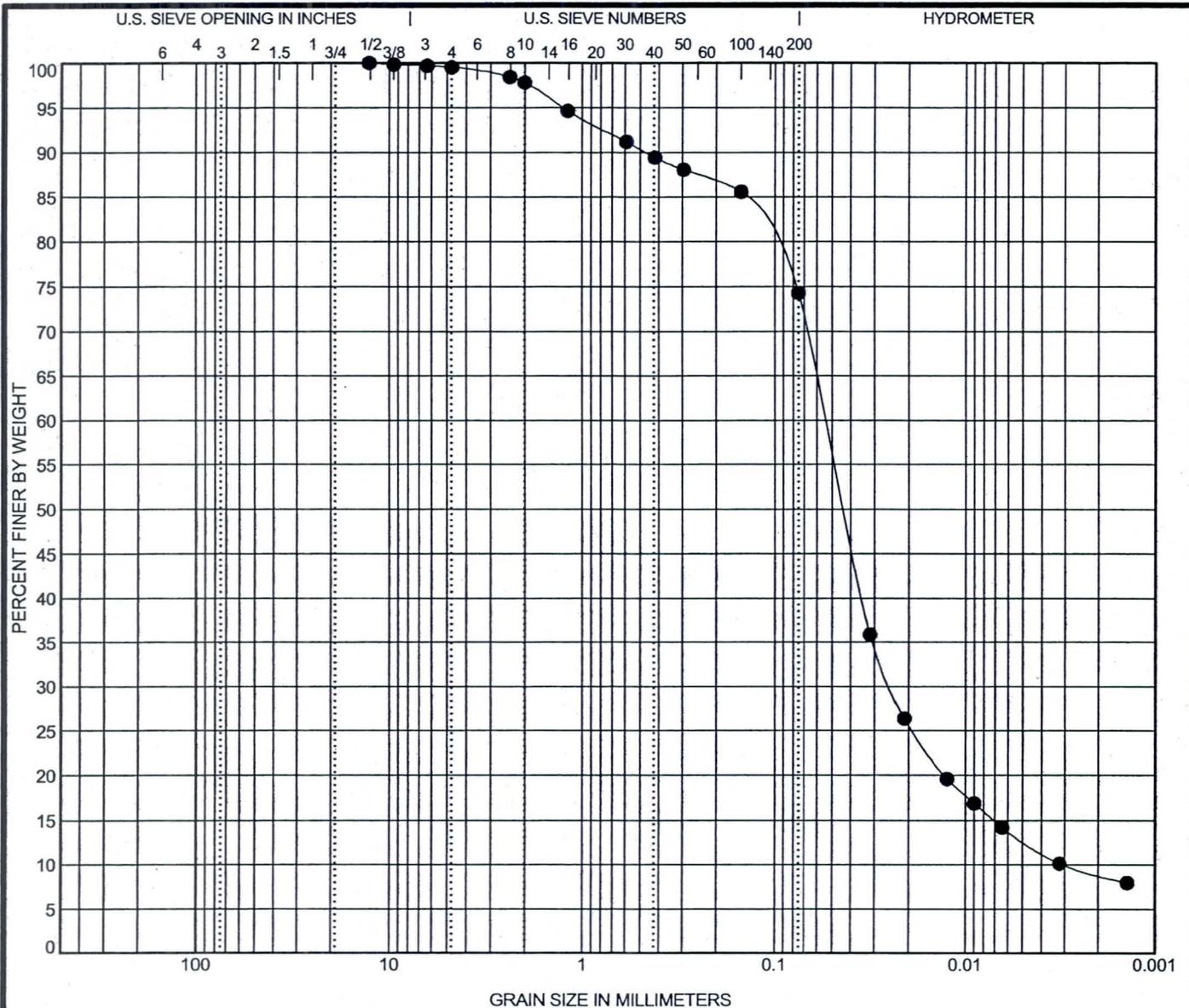
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-30 2.7 ft	19.1	0.083	0.025	0.002	4.0	37.1	47.9	11.0
☒								
▲								
★								
◎								

**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC GRAIN SIZE 65101872.GPJ TERRACON.GDT 1/3/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-31 0.9 ft					3.6	17.8
☒						
▲						
★						
◎						

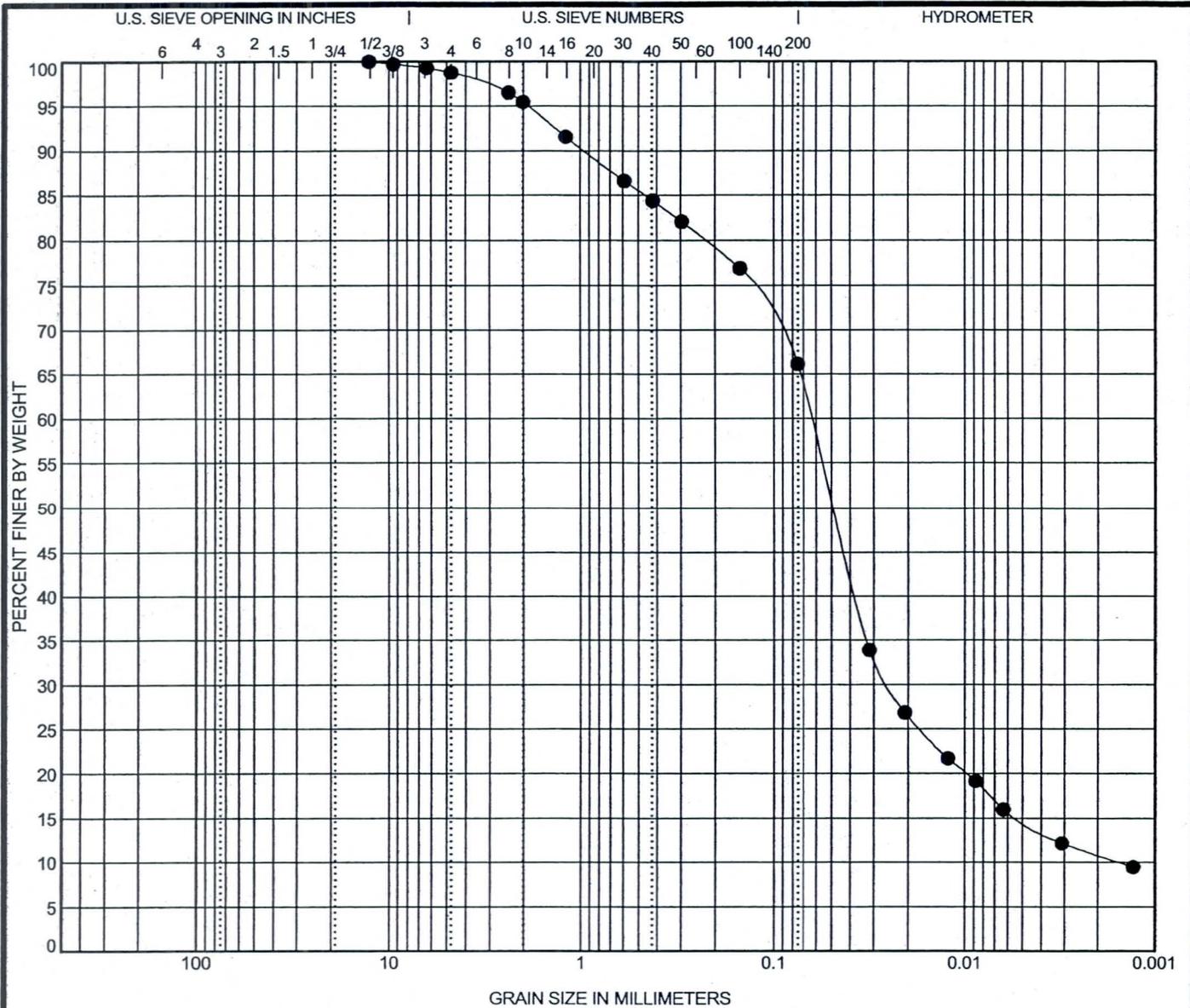
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-31 0.9 ft	12.7	0.054	0.025	0.003	0.5	25.2	65.4	8.9
☒								
▲								
★								
◎								

**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC GRAIN SIZE 65101872.GPJ TERRACON.GDT 1/3/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification					LL	PL	PI	Cc	Cu
● TP-32 1.0 ft									6.4	41.0
☒										
▲										
★										
◎										

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-32 1.0 ft	12.7	0.064	0.025	0.002	1.2	32.6	55.4	10.8
☒								
▲								
★								
◎								

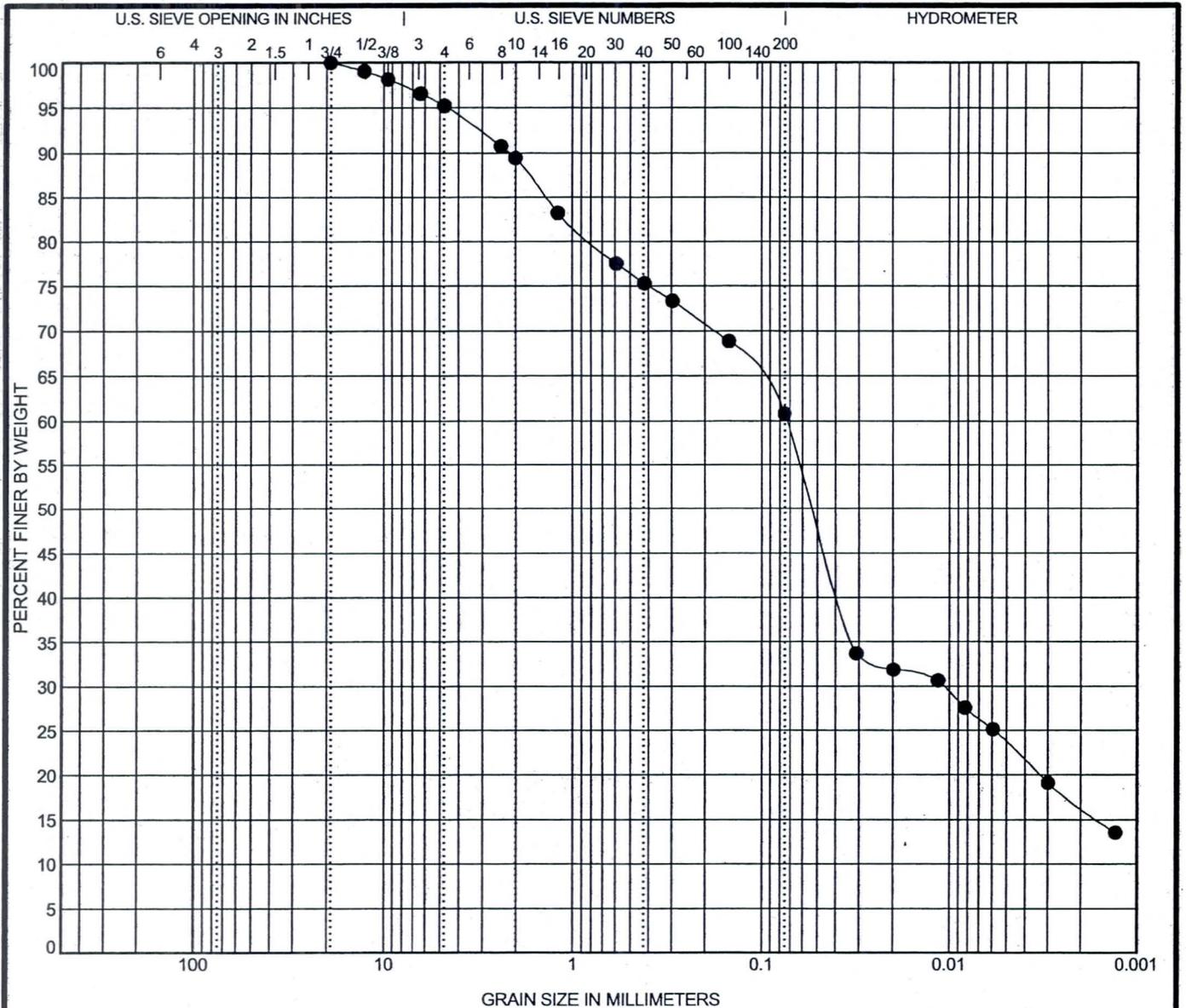
**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC: GRAIN SIZE 65101872.GPJ\_TERRACON.GDT 1/3/11

**SONORA SWC 4**



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-33 0.9 ft						
☒						
▲						
★						
◎						

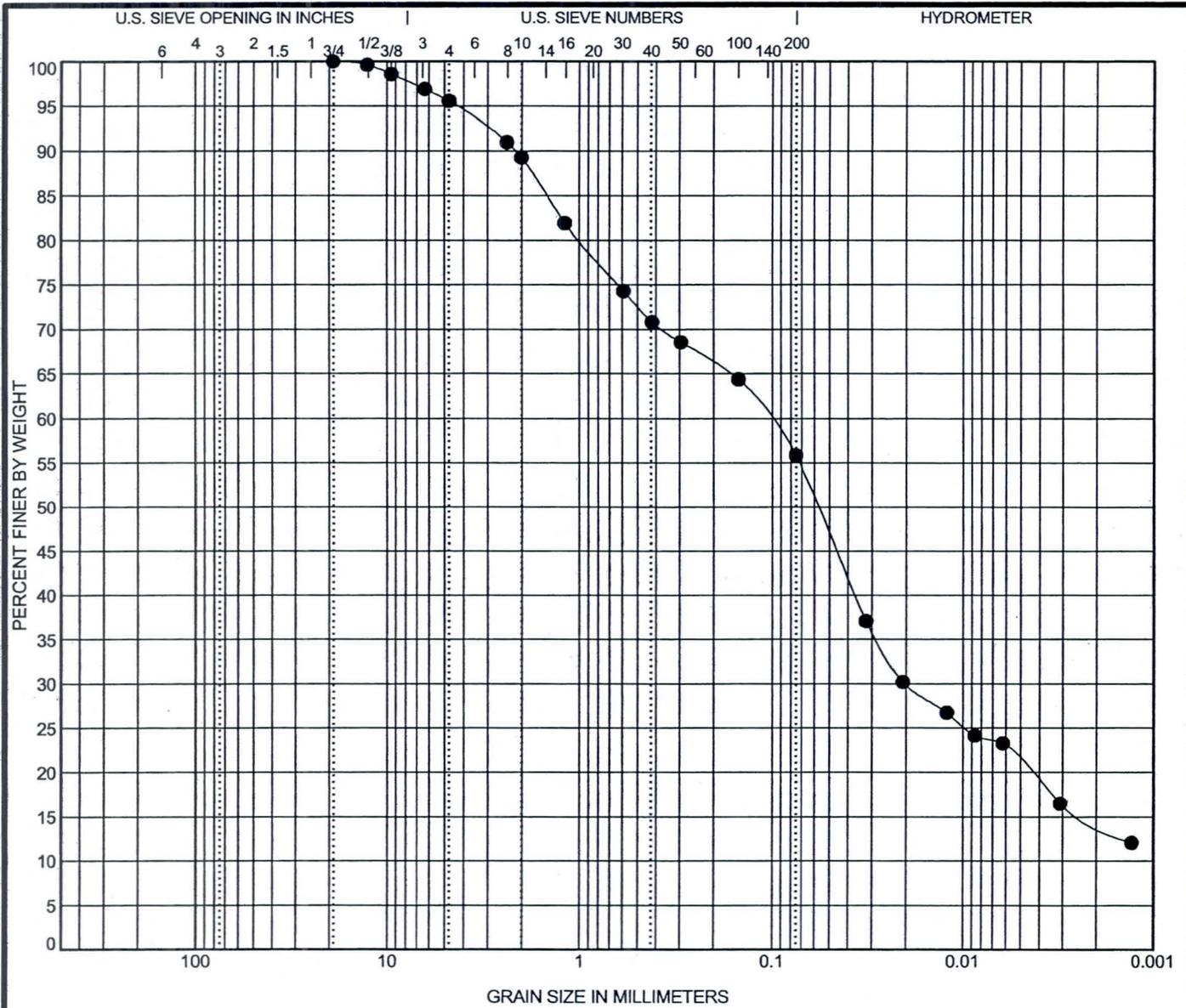
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-33 0.9 ft	19.1	0.073	0.011		4.8	34.4	44.4	16.4
☒								
▲								
★								
◎								

### GRAIN SIZE DISTRIBUTION

# Terracon

Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC GRAIN SIZE 65101872.GPJ TERRACON.GDT 1/3/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-33 1.9 ft						
☒						
▲						
★						
◎						

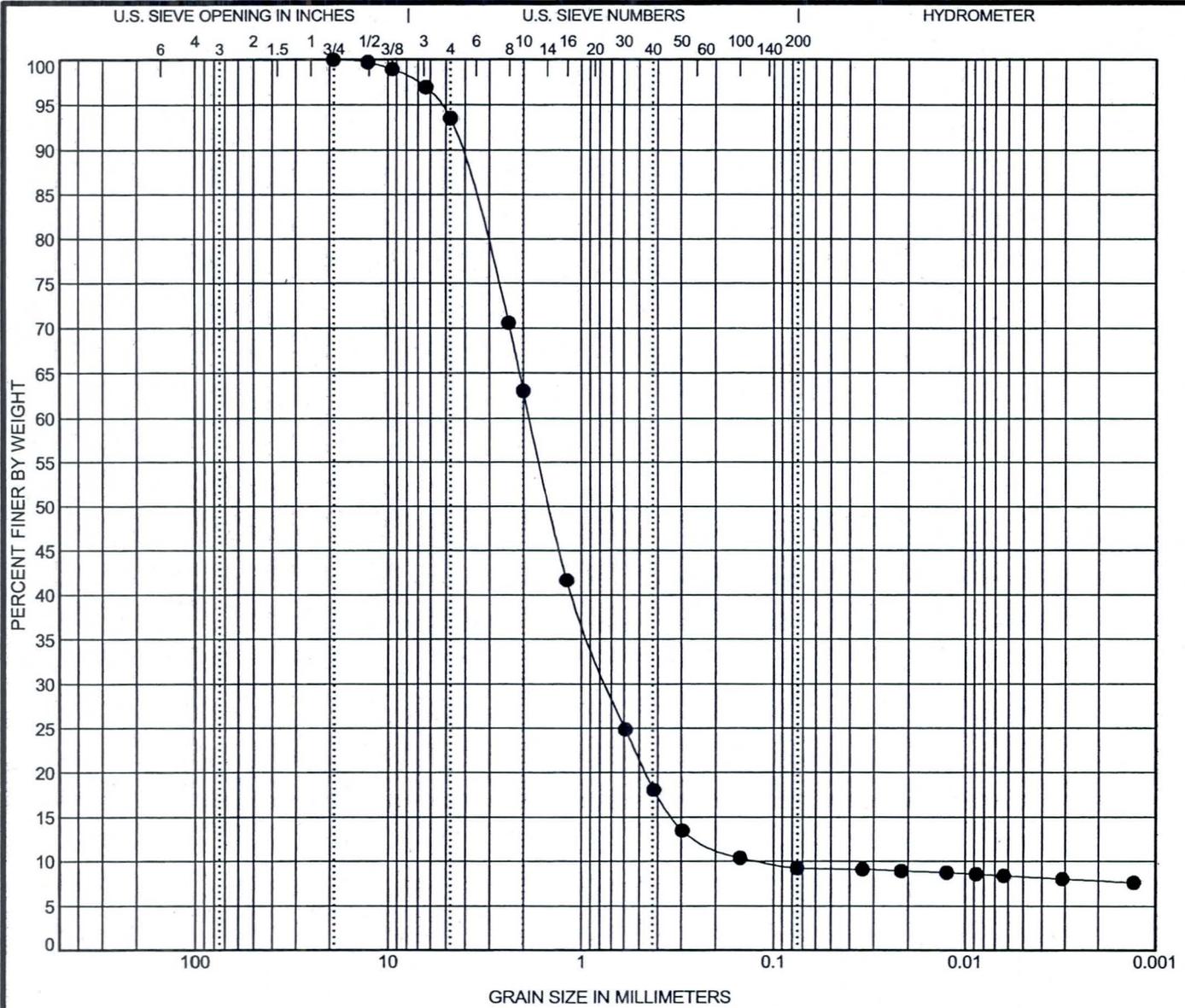
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-33 1.9 ft	19.1	0.105	0.02		4.4	39.7	41.6	14.2
☒								
▲								
★								
◎								

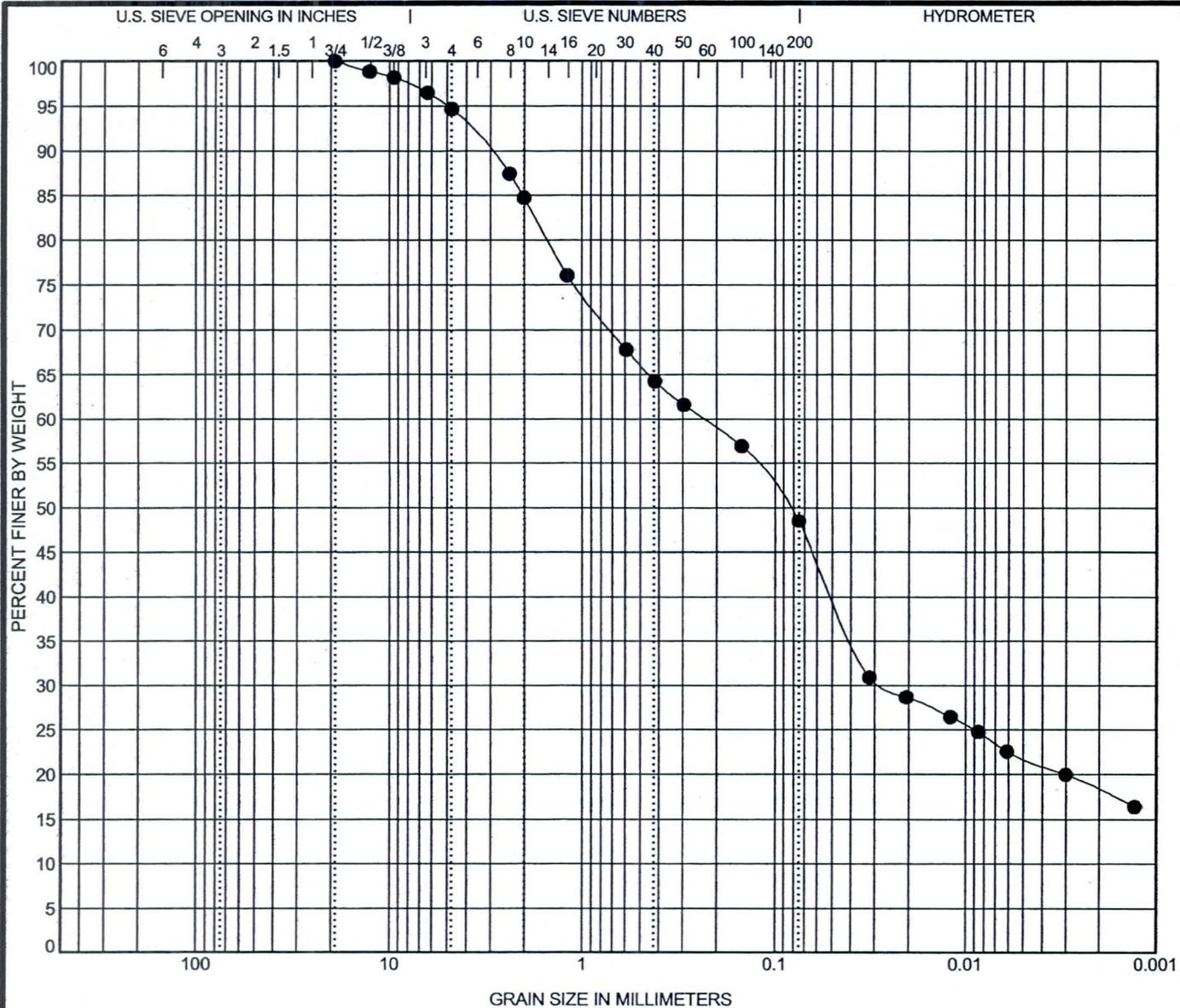
**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-19-11

TC. GRAIN SIZE 65101872.GPJ TERRACON.GDT 1/19/11





COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-34 2.8 ft						
☒ ft						
▲ ft						
★ ft						
◎ ft						

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-34 2.8 ft	19.1	0.234	0.027		5.3	46.2	30.2	18.2
☒ ft								
▲ ft								
★ ft								
◎ ft								

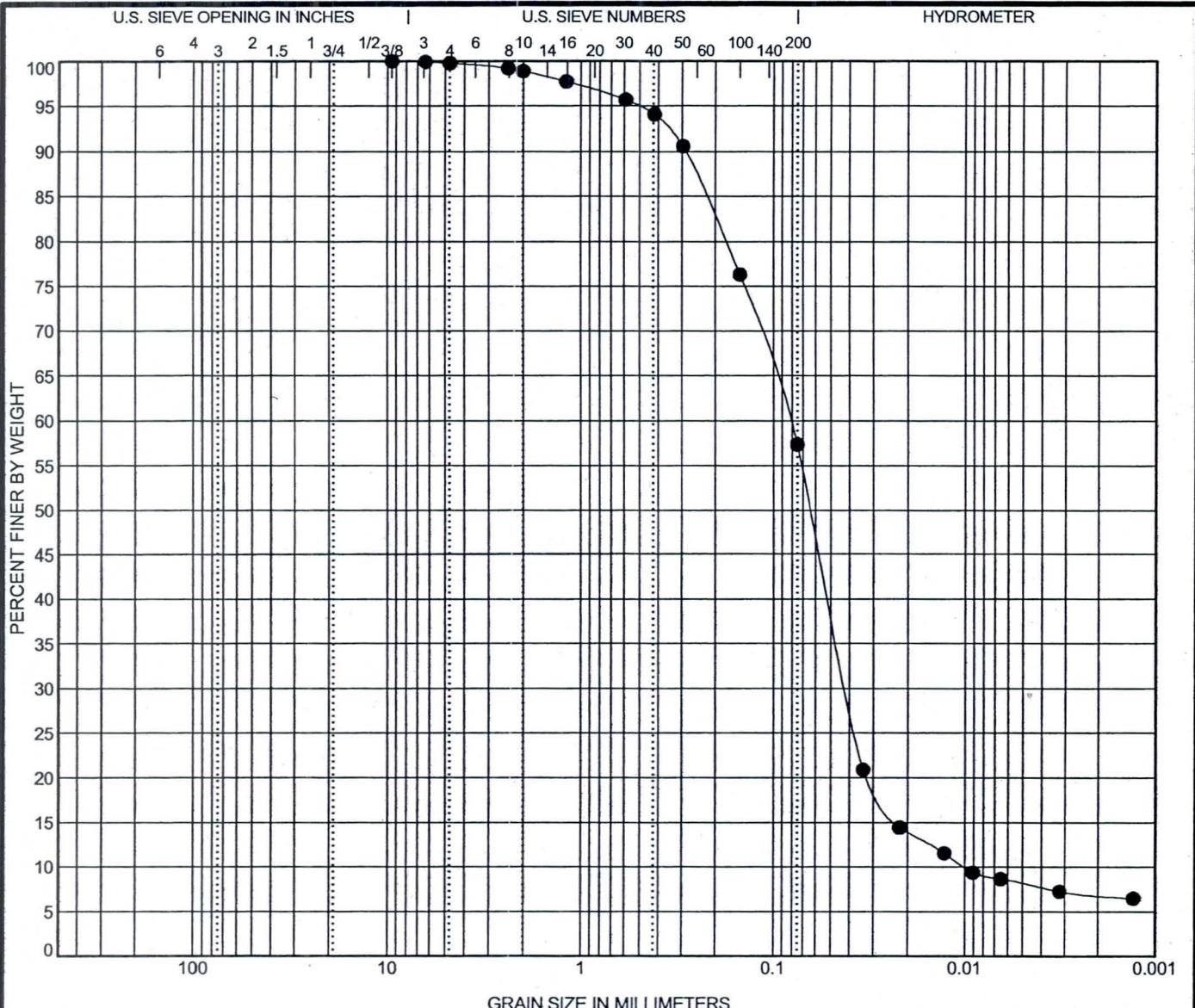
**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-13-11

T.C. GRAIN SIZE 65101872.GPJ TERRACON.GDT 1/13/11





COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-36 1.1 ft					2.0	8.2
☒						
▲						
★						
◎						

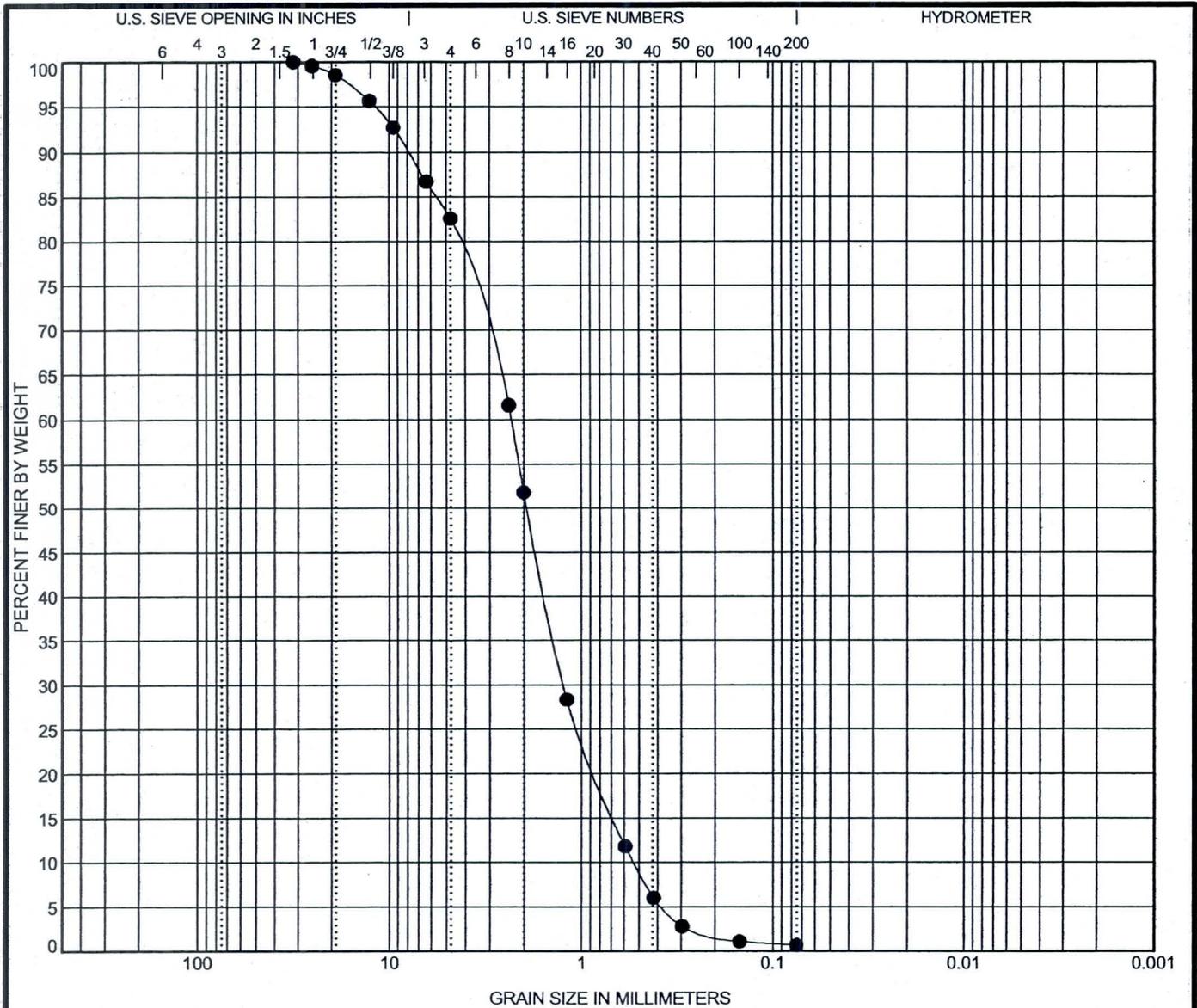
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-36 1.1 ft	9.5	0.082	0.041	0.01	0.2	42.4	50.5	6.8
☒								
▲								
★								
◎								

**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC. GRAIN SIZE 65101872.GPJ\_TERRACON.GDT 1/3/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		USCS Soil Classification				LL	PL	PI	Cc	Cu
●	TP-37 1.0 ft	POORLY GRADED SAND with GRAVEL(SP)							1.2	4.4
☒	ft									
▲	ft									
★	ft									
◎	ft									

Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	TP-37 1.0 ft	31.75	2.313	1.234	0.531	17.4	81.9	0.7	
☒	ft								
▲	ft								
★	ft								
◎	ft								

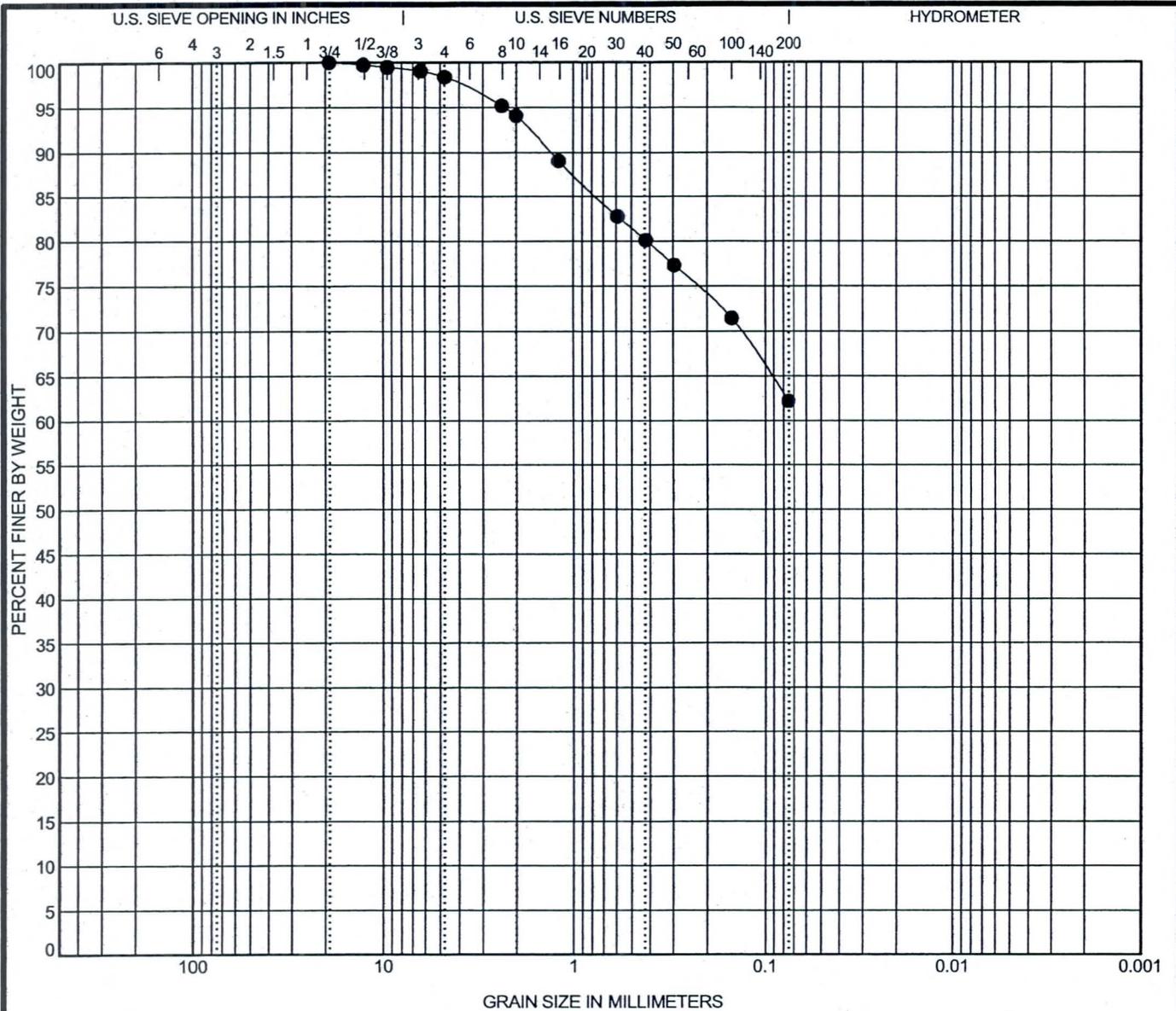
**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC: GRAIN SIZE: 65101872.GPJ\_TERRACON.GDT\_1/3/11





COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-38 0.7 ft						
☒						
▲						
★						
◎						

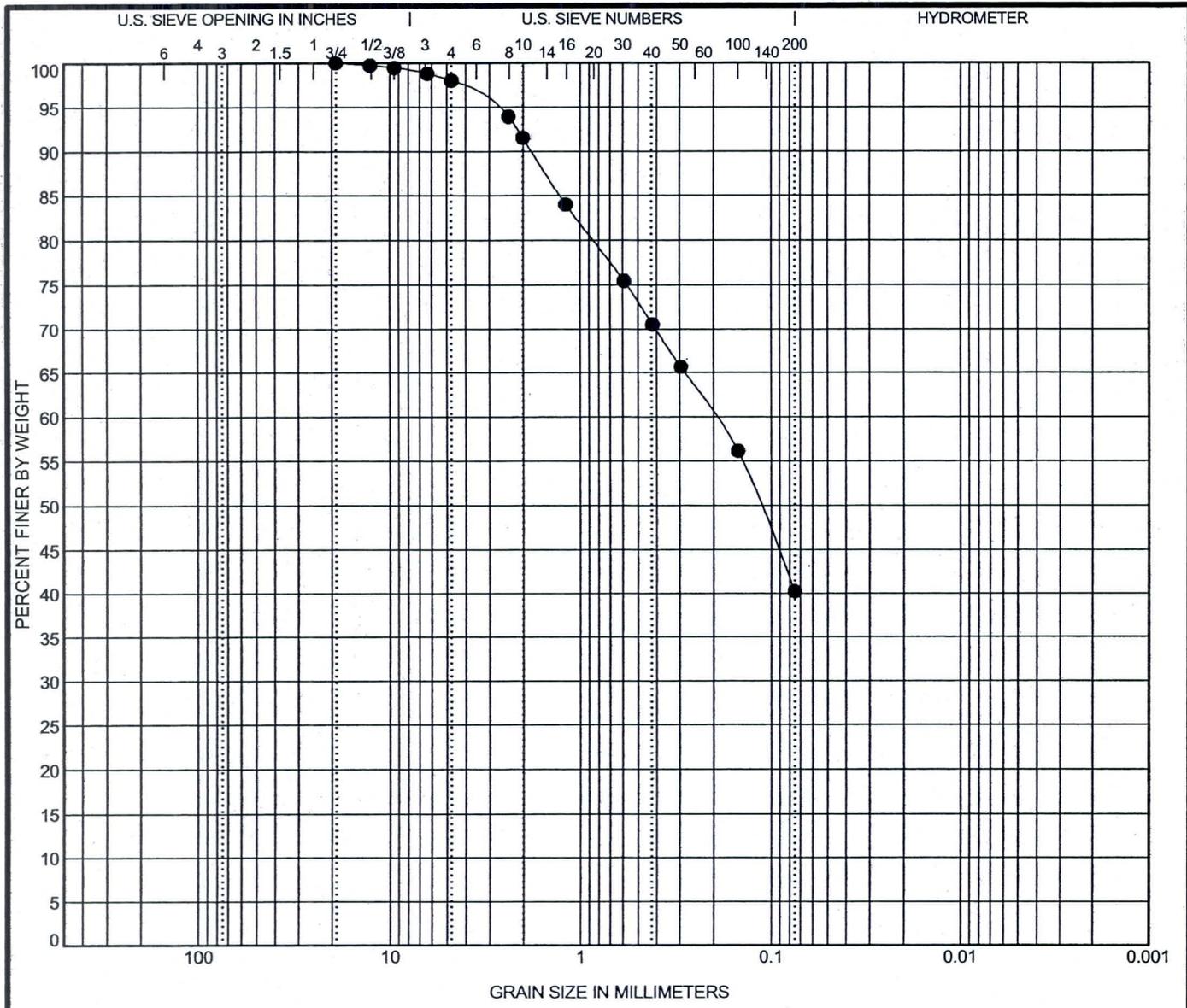
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-38 0.7 ft	19.1				1.6	36.2	62.2	
☒								
▲								
★								
◎								

**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC: GRAIN SIZE 65101872.GPJ TERRACON.GDT 1/3/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-39 1.0 ft						
☒						
▲						
★						
◎						

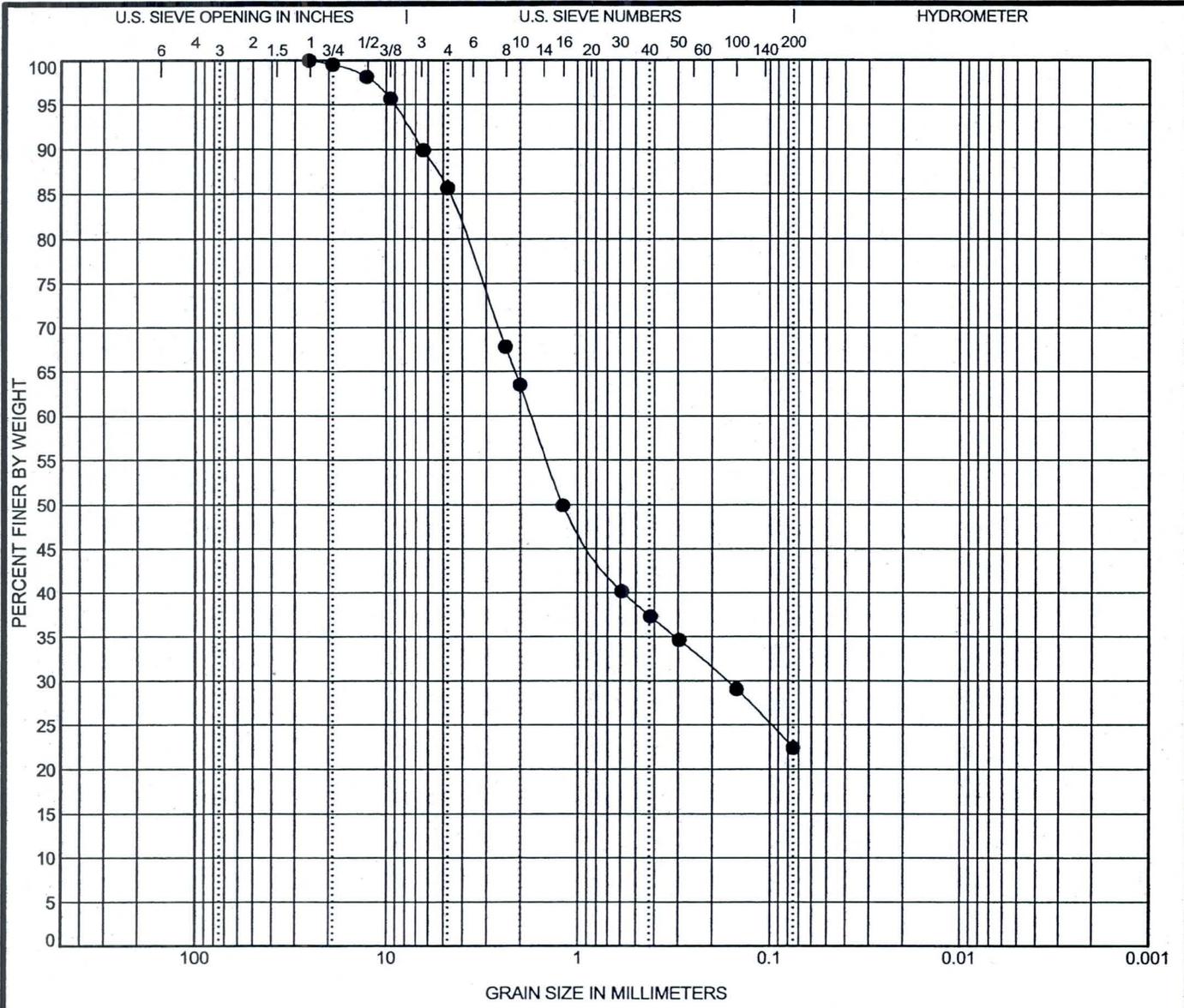
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-39 1.0 ft	19.1	0.197			2.0	57.8	40.2	
☒								
▲								
★								
◎								

**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC - GRAIN SIZE 65101872.GPJ\_TERRACON.GDT 1/3/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-40 1.0 ft						
☒						
▲						
★						
◎						

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-40 1.0 ft	25.4	1.749	0.167		14.3	63.3	22.4	
☒								
▲								
★								
◎								

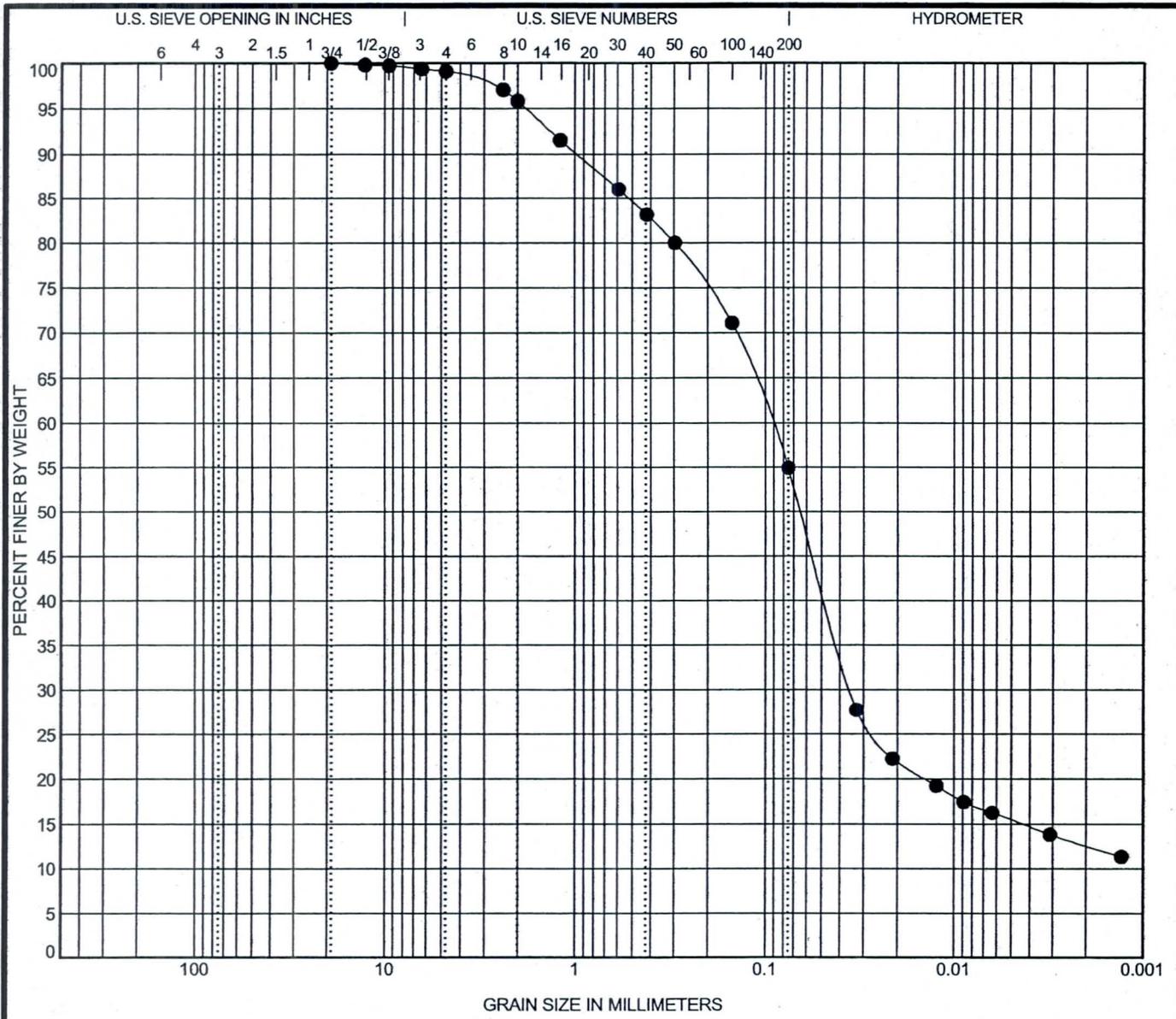
**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC\_GRAIN SIZE 65101872.GPJ\_TERRACON.GDT 1/3/11





COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-41 2.4 ft						
☒						
▲						
★						
◎						

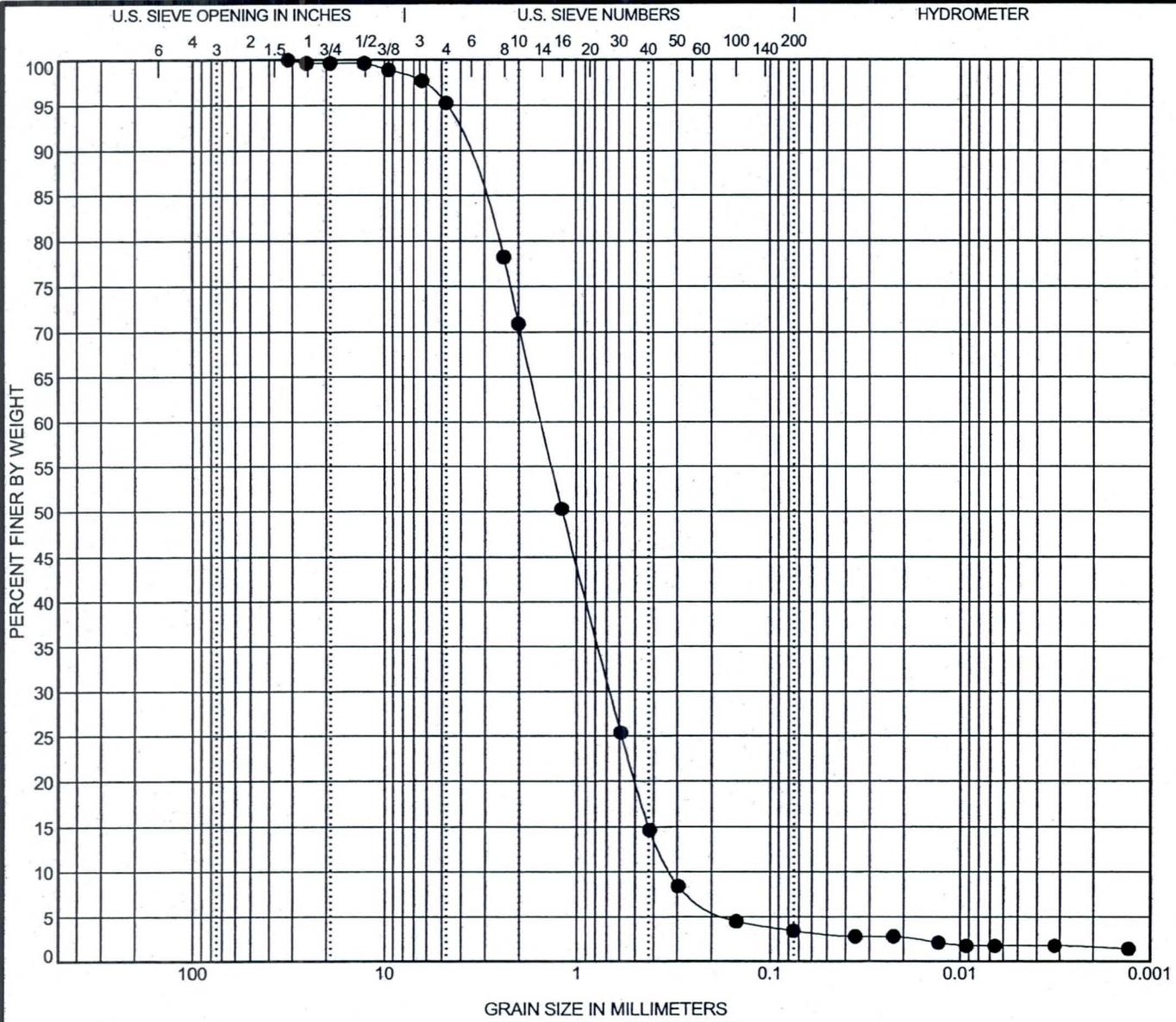
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-41 2.4 ft	19.1	0.093	0.035		0.9	44.1	42.4	12.5
☒								
▲								
★								
◎								

**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC - GRAIN SIZE: 65101872.GPJ\_TERRACON.GDT 1/3/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification					LL	PL	PI	Cc	Cu
● TP-42 0.9 ft	POORLY GRADED SAND(SP)								0.9	4.7
▣										
▲										
★										
◎										

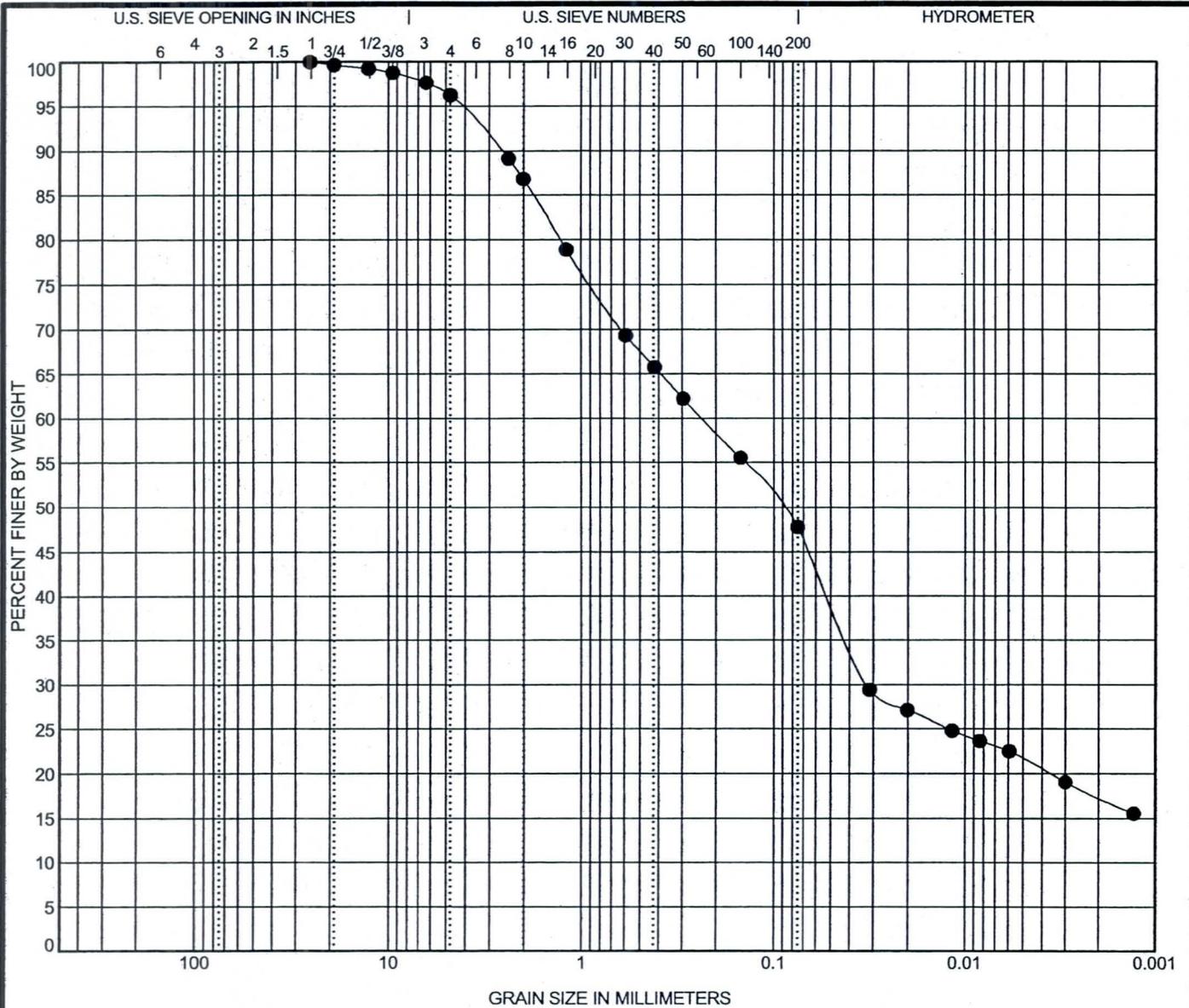
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-42 0.9 ft	31.75	1.519	0.672	0.325	4.7	91.9	1.8	1.6
▣								
▲								
★								
◎								

**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC\_GRAIN SIZE 65101872.GPJ\_TERRACON.GDT 1/3/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

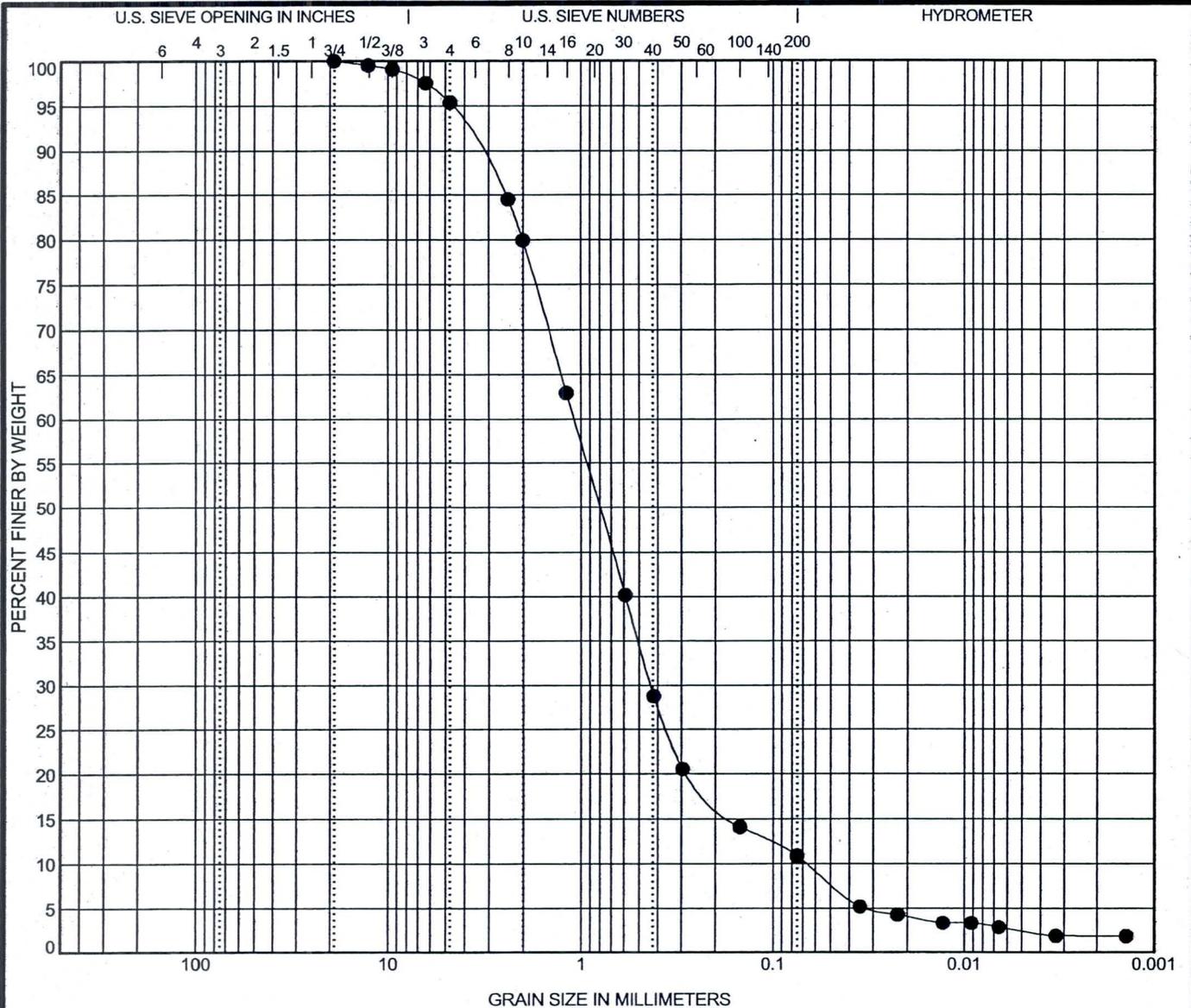
Specimen Identification	USCS Soil Classification	LL	PL	PI	Cc	Cu
● TP-42 2.4 ft						
☒						
▲						
★						
◎						

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-42 2.4 ft	25.4	0.236	0.032		3.7	48.5	30.4	17.3
☒								
▲								
★								
◎								

**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	USCS Soil Classification					LL	PL	PI	Cc	Cu
● TP-43 1.0 ft									2.6	16.3
▣ ft										
▲ ft										
★ ft										
◎ ft										

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-43 1.0 ft	19.1	1.086	0.436	0.067	4.6	84.5	9.0	1.8
▣ ft								
▲ ft								
★ ft								
◎ ft								

**GRAIN SIZE DISTRIBUTION**



Project: Rainbow Valley  
 Site: Rainbow Valley, Arizona  
 Job #: 65101872  
 Date: 1-3-11

TC GRAIN SIZE: 65101872.GPJ TERRACON.GDT 1/3/11



**ADDITIONAL SOIL DATA**

SOIL ID  
6515822

## Map Unit Description

Maricopa County, Arizona, Central Part

**TB      Torrfluvents**

### Setting

Elevation: 800 to 1400 feet  
Mean annual precipitation: 6 to 8 inches  
Mean annual air temperature: 69 to 74 degrees F  
Frost-free period: 250 to 300 days

### Composition

Torrfluvents and similar soils: 0 percent

### Description of Torrfluvents

#### Setting

Landform: Alluvial fans  
Landform position (two-dimensional): Summit  
Down-slope shape: Convex  
Across-slope shape: Convex  
Parent material: Young unconsolidated alluvium

#### Properties and Qualities

Slope: 0 to 5 percent  
Frequency of flooding: None  
Frequency of ponding: None

#### Interpretive Groups

Land capability (non irrigated): 7e  
Ecological site: Sandy Wash 7-10" p.z. (R040XB216AZ)

SOIL ID  
6515826

## Map Unit Description

Maricopa County, Arizona, Central Part

### TD      **Torrripsamments and Torrfluents, frequently flooded**

#### **Setting**

Elevation: 800 to 1400 feet  
Mean annual precipitation: 6 to 8 inches  
Mean annual air temperature: 69 to 74 degrees F  
Frost-free period: 250 to 300 days

#### **Composition**

Torrripsamments and similar soils: 0 percent  
Torrfluents and similar soils: 0 percent

#### **Description of Torrripsamments**

##### **Setting**

Landform: Flood plains  
Landform position (two-dimensional): Summit  
Down-slope shape: Linear  
Across-slope shape: Linear  
Parent material: Stratified sediment alluvium

##### **Properties and Qualities**

Slope: 0 to 3 percent  
Frequency of flooding: Frequent  
Frequency of ponding: None

##### **Interpretive Groups**

Land capability (non irrigated): 8

#### **Description of Torrfluents**

##### **Setting**

Landform: Flood plains  
Landform position (two-dimensional): Summit  
Down-slope shape: Linear  
Across-slope shape: Linear  
Parent material: Stratified sediment alluvium

##### **Properties and Qualities**

Slope: 0 to 3 percent  
Frequency of flooding: Frequent  
Frequency of ponding: None

##### **Interpretive Groups**

Land capability (non irrigated): 8

# Physical Soil Properties

Maricopa County, Arizona, Central Part

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi- bility	Organic matter	Erosion factors			Wind erodi- bility group	Wind erodi- bility index
										Kw	Kf	T		
	<i>In</i>	<i>Pct</i>	<i>Pct</i>	<i>Pct</i>	<i>g/cc</i>	<i>micro m/sec</i>	<i>In/In</i>	<i>Pct</i>	<i>Pct</i>					
AdA:														
Antho	0-13	---	---	5-15	1.20-1.30	14.00-42.00	0.08-0.12	0.0-2.9	0.0-0.5	.15	.24	5	5	56
	13-36	---	---	5-15	1.25-1.35	14.00-42.00	0.08-0.12	0.0-2.9	0.0-0.5	.24	.24			
	36-47	---	---	3-5	1.50-1.60	14.00-42.00	0.08-0.12	0.0-2.9	0.0-0.5	.17	.17			
	47-60	---	---	20-30	1.45-1.55	14.00-42.00	0.08-0.12	0.0-2.9	0.0-0.5	.32	.32			
AGB:														
Antho	0-13	---	---	5-15	1.25-1.35	14.00-42.00	0.08-0.12	0.0-2.9	0.0-0.5	.24	.24	5	3	86
	13-36	---	---	5-15	1.25-1.35	14.00-42.00	0.08-0.12	0.0-2.9	0.0-0.5	.24	.24			
	36-47	---	---	3-5	1.50-1.60	14.00-42.00	0.08-0.12	0.0-2.9	0.0-0.5	.17	.17			
	47-60	---	---	20-30	1.45-1.55	14.00-42.00	0.08-0.12	0.0-2.9	0.0-0.5	.32	.32			
Carrizo														
	0-5	---	---	5-15	1.35-1.50	14.00-42.00	0.07-0.09	0.0-2.9	0.0-0.5	.15	.24	2	5	56
	5-60	---	---	0-5	1.55-1.65	141. 00-705.00	0.03-0.05	0.0-2.9	0.0-0.5	.02	.10			
AL:														
Antho	0-13	---	---	5-15	1.25-1.35	14.00-42.00	0.08-0.12	0.0-2.9	0.0-0.5	.24	.24	5	3	86
	13-36	---	---	5-15	1.25-1.35	14.00-42.00	0.08-0.12	0.0-2.9	0.0-0.5	.24	.24			
	36-47	---	---	3-5	1.50-1.60	14.00-42.00	0.08-0.12	0.0-2.9	0.0-0.5	.17	.17			
	47-60	---	---	20-30	1.45-1.55	14.00-42.00	0.08-0.12	0.0-2.9	0.0-0.5	.32	.32			
Antho														
	0-13	---	---	5-15	1.25-1.35	14.00-42.00	0.08-0.12	0.0-2.9	0.0-0.5	.15	.24	5	5	56
	13-36	---	---	5-15	1.25-1.35	14.00-42.00	0.08-0.12	0.0-2.9	0.0-0.5	.24	.24			
	36-47	---	---	3-5	1.50-1.60	14.00-42.00	0.08-0.12	0.0-2.9	0.0-0.5	.17	.17			
	47-60	---	---	20-30	1.45-1.55	14.00-42.00	0.08-0.12	0.0-2.9	0.0-0.5	.32	.32			

# Physical Soil Properties

Maricopa County, Arizona, Central Part

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
	<i>In</i>	<i>Pct</i>	<i>Pct</i>	<i>Pct</i>	<i>g/cc</i>	<i>micro m/sec</i>	<i>In/In</i>	<i>Pct</i>	<i>Pct</i>					
CV:														
Coolidge	0-13	---	---	5-15	1.25-1.35	14.00-42.00	0.11-0.13	0.0-2.9	0.5-1.0	.24	.24	2	3	86
	13-24	---	---	5-10	1.35-1.45	14.00-42.00	0.11-0.13	0.0-2.9	0.0-0.5	.24	.24			
	24-63	---	---	10-15	1.35-1.50	14.00-42.00	0.10-0.12	0.0-2.9	0.0-0.5	.10	.24			
Laveen	0-15	---	---	5-15	1.25-1.35	4.00-14.00	0.13-0.18	0.0-2.9	0.5-0.8	.24	.24	5	3	86
	15-50	---	---	10-18	1.45-1.55	4.00-14.00	0.13-0.18	0.0-2.9	0.0-0.5	.32	.32			
	50-72	---	---	15-20	1.25-1.35	4.00-14.00	0.13-0.18	0.0-2.9	0.0-0.5	.17	.32			
GgA:														
Gilman	0-18	---	---	20-27	1.45-1.55	4.00-14.00	0.16-0.18	0.0-2.9	0.0-0.5	.32	.32	5	4L	86
	18-37	---	---	10-15	1.45-1.55	4.00-14.00	0.16-0.18	0.0-2.9	0.0-0.5	.32	.32			
	37-64	---	---	10-15	1.25-1.40	4.00-14.00	0.16-0.18	0.0-2.9	0.0-0.5	.55	.55			
GYD:														
Gunsight	0-3	---	---	20-27	1.35-1.45	4.00-14.00	0.05-0.07	0.0-2.9	0.0-0.5	.17	.32	4	6	48
	3-46	---	---	15-25	1.25-1.50	4.00-14.00	0.05-0.07	0.0-2.9	0.0-0.5	.10	.32			
	46-67	---	---	20-30	1.25-1.35	4.00-14.00	0.05-0.07	0.0-2.9	0.0-0.5	.10	.32			
Rillito	0-10	---	---	18-25	1.35-1.40	4.00-14.00	0.09-0.12	0.0-2.9	0.0-0.5	.17	.32	5	6	48
	10-75	---	---	15-25	1.35-1.40	4.00-14.00	0.09-0.12	0.0-2.9	0.0-0.5	.17	.32			
Ma:														
Maripo	0-13	---	---	5-15	1.25-1.35	14.00-42.00	0.11-0.13	0.0-2.9	0.0-0.5	.24	.24	3	3	86
	13-34	---	---	5-15	1.25-1.35	14.00-42.00	0.11-0.15	0.0-2.9	0.0-0.5	.24	.24			
	34-60	---	---	3-5	1.60-1.70	42.00-141.00	0.04-0.06	0.0-2.9	0.0-0.5	.05	.10			

# Physical Soil Properties

Maricopa County, Arizona, Central Part

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
	<i>In</i>	<i>Pct</i>	<i>Pct</i>	<i>Pct</i>	<i>g/cc</i>	<i>micro m/sec</i>	<i>In/In</i>	<i>Pct</i>	<i>Pct</i>					
PYD:														
Pinamt	0-2	---	---	20-25	1.25-1.50	1.40-4.00	0.08-0.10	0.0-2.9	0.0-0.5	.10	.32	5	8	0
	2-6	---	---	10-15	1.35-1.50	1.40-4.00	0.08-0.10	0.0-2.9	0.0-0.5	.10	.24			
	6-22	---	---	20-30	1.25-1.35	1.40-4.00	0.05-0.07	0.0-2.9	0.0-0.5	.10	.32			
	22-60	---	---	10-25	1.35-1.45	14.00-42.00	0.05-0.07	0.0-2.9	0.0-0.5	.10	.24			
Tremant														
	0-1	---	---	15-20	1.35-1.45	1.40-4.00	0.13-0.15	3.0-5.9	0.0-0.5	.17	.32	5	7	38
	1-8	---	---	30-35	1.35-1.45	1.40-4.00	0.13-0.15	3.0-5.9	0.0-0.5	.32	.32			
	8-23	---	---	20-35	1.35-1.45	1.40-4.00	0.13-0.15	3.0-5.9	0.0-0.5	.17	.32			
	23-60	---	---	7-27	1.35-1.45	0.42-1.40	0.08-0.11	0.0-2.9	0.0-0.5	.17	.32			
RS:														
Rock outcrop	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Cherioni														
	0-1	---	---	15-20	1.25-1.50	4.00-14.00	0.10-0.12	0.0-2.9	0.0-0.5	.10	.32	1	6	48
	1-6	---	---	10-20	1.20-1.30	4.00-14.00	0.10-0.12	0.0-2.9	0.0-0.5	.10	.32			
	6-12	---	---	---	---	0.00-1.40	0.00	---	---	---	---			
	12-16	---	---	---	---	0.00-0.07	---	---	---	---	---			
TB:														
Torrifluvents	---	---	---	---	---	---	---	---	---	---	---	---	---	---
TD:														
Torrifluvents	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Torrripsamments	---	---	---	---	---	---	---	---	---	---	---	---	---	---

**KINEROS2 SUPPORTING  
DOCUMENTATION**

<b>Input Parameters</b>	<b>Assumptions/Values used</b>	<b>Model Definition</b>
Area	from GIS area of plane measured	area of plane square meters or feet
Length	Length of plane, in feet, used the length of the stream bordering the plane	length of plane in meters or feet
Width	Area divided by length	width of plane in meters or feet
Slope	Slope from GIS for basin stream	plane slope
Manning	taken from HEC-1 model for basin	Manning roughness coefficient
KSAT (Ks)	XKSAT value used in DDMSW for corresponding HEC-1 basin	Saturated hydraulic conductivity, mm/hr or in/hr
G	PSIF values used in DDMSW for corresponding HEC-1 basin	Mean capillary drive, mm or inches – zero value sets the infiltration to a constant rate equal to Ks
Porosity	DTHETA values used in DDMSW for corresponding HEC-1 basin	Porosity
ROCK	RTIMP values used in DDMSW for corresponding HEC-1 basin	Volumetric rock fraction, if any. If Ks is estimated based on the textural class, it should be multiplied by (1-ROCK) to reflect this rock volume
Dist	assumed to be 0.5	Pore size distribution index. The parameter is used for redistribution of soil moisture during unponded intervals
CV	assumed to be 0.8	Coefficient of variation of Ks
SAT	Averaged initial saturation values from triaxial tests for all three locations	Initial degree of soil saturation, expressed as a fraction of the pore space filled
INTER	IA value used in DDMSW for corresponding HEC-1 basin	Interception depth in mm or inches
CANOPY	Veg Cover value used in DDMSW for corresponding HEC-1 basin	fraction of surface covered by intercepting cover – rainfall intensity is reduced by this fraction until the specified interception depth has accumulated
SPLASH	value taken from Table 4 (p29) of KINEROS documentation and users manual for Resistance parameters for overland flow corresponding to Sparse vegetation, values ranging from 1,000 to 4,000.	rainfall splash coefficient
COH	Averaged cohesion values from triaxial tests for all three locations	Soil cohesion coefficient
FRACT	used the particle size distribution values for all three tests to obtain percents and then averaged for all three samples	List of particle class fractions must sum to one
SS1	channel side slopes	Side Slope of Channel (assumed 0.002)
SS2	channel side slopes	Side Slope of Channel (assumed 0.002)
Width	channel bottom width, ft	Channel bottom width (assumed 20ft)
* KSAT adjusted for Rock		If Ks is estimated based on the textural class, it should be multiplied by (1-ROCK) to reflect this rock volume

Planes	Basin (from Hydrology)	KSAT (XKSAT)	KS (adjusted for rock) <sup>1</sup>	G (PSIF)	Canopy	SAT	COH	DIST	ROCK (RTIMP)	CV	SPLASH	INTER (IA), inches	Porosity (DTHETA)	FRACT		
														2 mm	0.25 mm	0.01 mm
9	H02	0.47	0.21	3.95	0.25	0.13	0.10	0.5	55	0.8	2500	0.35	0.35	3	42	55
10	H02	0.47	0.21	3.95	0.25	0.13	0.10	0.5	55	0.8	2500	0.35	0.35	3	42	55
11	H02	0.47	0.21	3.95	0.25	0.13	0.10	0.5	55	0.8	2500	0.35	0.35	3	42	55
12	H20, H27, H28, H62, H23	0.46	0.46	4.00	0.25	0.13	0.10	0.5	0	0.8	2500	0.35	0.35	3	42	55
13	H03	0.49	0.19	3.88	0.25	0.13	0.10	0.5	61	0.8	2500	0.35	0.35	3	42	55
14	H03	0.49	0.19	3.88	0.25	0.13	0.10	0.5	61	0.8	2500	0.35	0.35	3	42	55
15	H03, H20, H27, H23	0.49	0.19	3.88	0.25	0.13	0.10	0.5	61	0.8	2500	0.35	0.35	3	42	55
16	H22, H02	0.43	0.40	4.15	0.25	0.13	0.10	0.5	7	0.8	2500	0.35	0.35	3	42	55
17	H22	0.43	0.40	4.15	0.25	0.13	0.10	0.5	7	0.8	2500	0.35	0.35	3	42	55
18	H22	0.43	0.40	4.15	0.25	0.13	0.10	0.5	7	0.8	2500	0.35	0.35	3	42	55
19	H22, H23	0.43	0.40	4.15	0.25	0.13	0.10	0.5	7	0.8	2500	0.35	0.35	3	42	55
20	H02	0.47	0.21	3.95	0.25	0.13	0.10	0.5	55	0.8	2500	0.35	0.35	3	42	55
21	H22	0.43	0.40	4.15	0.25	0.13	0.10	0.5	7	0.8	2500	0.35	0.35	3	42	55
22	H03	0.49	0.19	3.88	0.25	0.13	0.10	0.5	61	0.8	2500	0.35	0.35	3	42	55
23	H23, H22	0.47	0.44	3.95	0.25	0.13	0.10	0.5	7	0.8	2500	0.35	0.35	3	42	55
24	H22, H23, H62	0.46	0.43	4.00	0.25	0.13	0.10	0.5	7	0.8	2500	0.35	0.35	3	42	55
25	H66, H71	0.46	0.46	4.00	0.25	0.13	0.10	0.5	0	0.8	2500	0.35	0.35	3	42	55
26	H66, H71	0.46	0.46	4.00	0.25	0.13	0.10	0.5	0	0.8	2500	0.35	0.35	3	42	55
28	H72, H71	0.46	0.46	4.00	0.25	0.13	0.10	0.5	0	0.8	2500	0.35	0.35	3	42	55
29	H71, H72	0.46	0.46	4.00	0.25	0.13	0.10	0.5	0	0.8	2500	0.35	0.35	3	42	55
30	H62, H63, H66	0.46	0.46	4.00	0.25	0.13	0.10	0.5	0	0.8	2500	0.35	0.35	3	42	55
31	H27, H62, H63	0.46	0.46	4.00	0.25	0.13	0.10	0.5	0	0.8	2500	0.35	0.35	3	42	55

Streams	Manning (From HEC-1)	KS (adjusted for rock) <sup>1</sup>	G (PSIF)	SAT	COH	DIST	ROCK (RTIMP)	CV	SPLASH	Porosity (DTHETA)	FRACT		
											2 mm	0.25 mm	0.01 mm
1	0.045	0.4	3.95	0.13	0.1	0.5	0.07	0.8	2500	0.35	3	42	55
2	0.045	0.21	3.95	0.13	0.1	0.5	0.55	0.8	2500	0.35	3	42	55
3	0.045	0.21	3.95	0.13	0.1	0.5	0.55	0.8	2500	0.35	3	42	55
4	0.045	0.19	3.88	0.13	0.1	0.5	0.61	0.8	2500	0.35	3	42	55
5	0.045	0.4	4.15	0.13	0.1	0.5	0.07	0.8	2500	0.35	3	42	55
6	0.045	0.44	4.05	0.13	0.1	0.5	0.03	0.8	2500	0.35	3	42	55
7	0.045	0.19	3.88	0.13	0.1	0.5	0.61	0.8	2500	0.35	3	42	55
8	0.045	0.46	4	0.13	0.1	0.5	0	0.8	2500	0.35	3	42	55
27	0.045	0.46	4	0.13	0.1	0.5	0	0.8	2500	0.35	3	42	55
40	0.045	0.46	4	0.13	0.1	0.5	0	0.8	2500	0.35	3	42	55
41	0.045	0.46	4	0.13	0.1	0.5	0	0.8	2500	0.35	3	42	55

KINEROS PARAMETERS

Area  
Length  
Width  
Slope

GIS Attribute Table for Plane elements

FID	Shape *	Id	Label	Area	width	Width = Area (plane, ft <sup>2</sup> )/Length(stream, ft)
2	Polygon	0	10	11204816.74	0	1173
3	Polygon	0	11	11233227.54	0	1176
5	Polygon	0	12	38682879.15	0	6275
13	Polygon	0	13	21210164.36	0	1976
8	Polygon	0	14	17389645.84	0	1620
9	Polygon	0	15	12855226.26	0	1117
-10	Polygon	0	16	8943360.549	0	1053
12	Polygon	0	17	3745801.608	0	465
11	Polygon	0	18	3126416.822	0	368
15	Polygon	0	19	12806510.39	0	4461
0	Polygon	0	20	8209970.105	0	838
6	Polygon	0	21	12068112.37	0	1497
7	Polygon	0	22	18782997.04	0	1632
14	Polygon	0	23	3020101.656	0	1052
21	Polygon	0	24	5781473.072	0	938
19	Polygon	0	25	9139242.923	0	904
4	Polygon	0	26	12448186.06	0	1231
17	Polygon	0	28	13627803.67	0	1718
18	Polygon	0	29	9506975.025	0	1198
16	Polygon	0	30	11292572.81	0	1535
20	Polygon	0	31	20461126.7	0	2780
1	Polygon	0	9	12917504.73	0	1318

GIS table for Stream elements

FID	Shape	Id	Label	Length_ft	UP_Elev	DOWN_Elev	SLOPE
0	Polyline	0	27	10114.61089	1230	1155	0.007
1	Polyline	0	5	8497.054303	1590	1350	0.028
2	Polyline	0	2	9550.183381	3840	1590	0.236
3	Polyline	0	1	8060.136773	2190	1370	0.102
4	Polyline	0	7	11506.50838	1620	1350	0.023
5	Polyline	0	3	9798.511569	3950	1590	0.241
6	Polyline	0	4	10732.90993	3800	1620	0.203
7	Polyline	0	6	2870.747798	1370	1350	0.007
8	Polyline	0	41	7359.052257	1290	1230	0.008
9	Polyline	0	8	6164.890735	1350	1290	0.010
10	Polyline	0	40	7934.174608	1155	1110	0.006

Table 2, p8 Kineros manual  
 Table 8.5, p8-35 from Hydrology Drainage Design manual  
 Table 4.1, p4-10 from Hydrology Drainage Design manual  
 Figure 4.3, p4-11 from Hydrology Drainage Design manual

from Table 2 based on soil classification of sandy loam  
 Ks calculated from XSAT adjusted for Rock  
 Porosity (Dtheta) 0.351 to 0.555  
 Saturation Residual Saturation = .09  
 Maximum Saturation = 0.91

Table 7.  
 Soil hydraulic characteristics

Texture class	Total porosity (A)	Residual saturation (S <sub>r</sub> )	Maximum saturation (S <sub>max</sub> )	Field E <sub>c</sub>
Sand	0.457 0.374 - 0.500	0.045	0.55	21.0
Loamy sand	0.437 0.316 - 0.554	0.060	0.71	14.1
Sandy loam	0.455 0.331 - 0.559	0.09	0.91	2.6
Loam	0.463 0.325 - 0.581	0.08	0.94	1.5
Silt loam	0.401 0.300 - 0.542	0.03	0.87	6.5
Sandy clay loam	0.388 0.312 - 0.464	0.17	0.81	4.3
Clay loam	0.461 0.409 - 0.515	0.16	0.84	3.8
Silty clay loam	0.471 0.419 - 0.574	0.08	0.92	1.5
Sandy clay	0.450 0.320 - 0.580	0.19	0.75	11
Silty clay	0.478 0.425 - 0.523	0.10	0.82	2.7
Clay	0.475 0.427 - 0.523	0.19	0.84	0.6

1. Obtained by analysis of data presented in Rawls et al. (1982)

2. Arithmetic mean obtained from arithmetic means of soil characteristics in Rawls et al. Geometric mean is obtained by taking the weighting of the mean of the logarithms of the same data. Range above/below each value is approximately 1 one standard deviation.

Table 9.6  
 RAINFALL LOSS CHARACTERISTICS FOR EACH SOIL MAP UNIT

Map Unit ID (1)	Description (2)	XKSAT <sup>1</sup> in/hr (3)	RTIMP <sup>1</sup> % (4)	IA <sup>2</sup> inches (5)
8	Very cobbly sandy loam	0.96	0	0.35
10	Loamy sand	0.94	0	0.35
18	Very gravelly fine sandy loam	0.44	15	0.25
21	Very gravelly loam	0.38	0	0.35
31	Extremely cobbly sandy loam	0.33	35	0.25
33	Very gravelly loam	0.23	0	0.35
41	Very gravelly loam	0.17	0	0.25
45	Very gravelly clay	0.03	0	0.25
48	Very gravelly clay	0.06	0	0.15
51	Very gravelly sandy clay loam	0.24	0	0.15
52	Very gravelly clay loam	0.16	20	0.25
86	Very gravelly loam	0.23	0	0.35
88	Very gravelly sandy loam	0.63	0	0.35
70	Very gravelly loam	0.36	0	0.25
72	Clay loam	0.09	30	0.25
93	Gravelly loam	0.33	0	0.25
95	Clay loam	0.04	0	0.35
103	Very gravelly clay loam	0.10	65	0.25
104	Gravelly clay loam	0.14	60	0.25
108	Very cobbly loam	0.31	30	0.25
109	Very cobbly loam	0.35	35	0.25
CmD <sup>3</sup>	Very gravelly sandy loam	0.44	15	0.25
Le <sup>2</sup>	Gravelly clay loam	0.09	30	0.25
Lh <sup>2</sup>	Extremely rocky clay loam	0.14	60	0.25
R <sup>2</sup>	Rock outcrop	0.01	50	0.25

Notes:

1. Values for the soil map units within the limits of the Soil Survey of Aguila, Carefree and Parts of Maricopa and Pinal Counties, Arizona are taken from Appendix C, Section 1.
2. Values for the soil map units within the limits of the Soil Survey of Yavapai County, Arizona, Western Part are based on the soil texture descriptions from that soil survey.
3. Values are based on the descriptions in the soil surveys and the use of Table 4.2.

FIGURE 4.3  
 COMPOSITE VALUES OF PSIF AND DTHETA AS A FUNCTION OF XKSAT  
 (TO BE USED FOR AREA-WEIGHTED AVERAGING OF GREEN AND AMPT PARAMETERS)

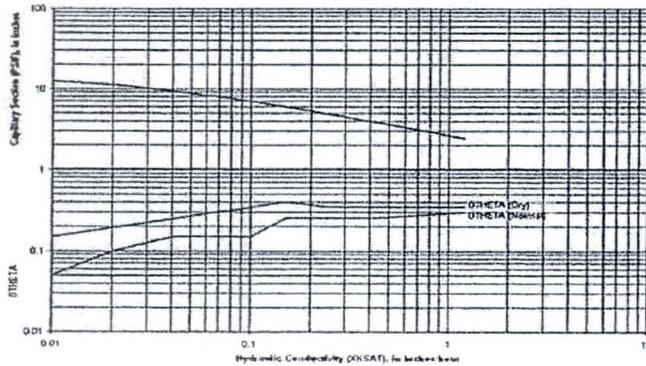


Table 4.1  
 GREEN AND AMPT LOSS RATE PARAMETER VALUES FOR BARE GROUND

Soil Texture Classification (1)	XKSAT inches/hour (2)	PSIF inches (3)	DTHETA <sup>1</sup>		
			Dry (4)	Normal (5)	Saturated (6)
loamy sand & sand	1.20	2.4	0.35	0.30	0
sandy loam	0.40	4.3	0.35	0.25	0
loam	0.25	3.5	0.35	0.25	0
silty loam	0.15	6.6	0.40	0.25	0
silt	0.10	7.5	0.35	0.15	0
sandy clay loam	0.06	8.6	0.25	0.15	0
clay loam	0.04	8.2	0.25	0.15	0
silty clay loam	0.04	10.8	0.30	0.15	0
sandy clay	0.02	9.4	0.20	0.10	0
silty clay	0.02	11.5	0.20	0.10	0
clay	0.01	12.4	0.15	0.05	0

Notes:

1. Selection of DTHETA  
 Dry = Nonirrigated lands, such as desert and rangeland.  
 Normal = Irrigated lawn, turf, and permanent pasture.  
 Saturated = Irrigated agricultural land.

SAT

Initial degree of soil saturation, expressed as a fraction of the pore space filled  
Averaged initial saturation values from triaxial tests for locations 45, 46, 47

percent                      Location 45  
                                    23, 23, 23

percent                      Location 46  
                                    5, 5, 5

percent                      Location 47  
                                    10, 9, 11

Average, percent    13

values used  
3.95

Table 4.1, p4-10 from Hydrology Drainage Design manual  
Figure 4.3, p4-11 from Hydrology Drainage Design manual

G

From Table 2, p9, kineros manual

USED PSIF FROM HEC-1 MODEL.

Value Used  
PSIF = 3.95

Framp <sup>8</sup>	$\sigma^1$			
	Arithmetic	Geometric	Arithmetic	Geometric <sup>2</sup>
	cm	cm	in	in
SAND	10.1 2.2 - 20.7	4.6 1.0 - 27.1	4.0 0.86 - 8.2	1.8 0.34 - 10.7
Loamy sand	14.7 4.1 - 32.3	6.3 2.3 - 31.7	5.8 1.6 - 12.7	2.5 .91 - 12.5
Sandy loam	24.8 9.8 - 52.6	12.7 3.0 - 54.0	9.8 3.6 - 20.7	5.0 1.2 - 21.3
Loam	37.5 18.5 - 93.7	10.8 1.9 - 74.0	14.8 7.3 - 36.9	4.3 .75 - 29.1
Silt loam	48.5 22.0 - 104.3	20.3 4.3 - 118.0	19.1 8.7 - 41.7	8.0 1.7 - 46.5
Sandy clay loam	61.7 22.0 - 107.0	26.3 6.0 - 132.0	20.1 8.7 - 42.1	10.4 2.5 - 52.0
clay loam	53.3 25.0 - 117.4	25.9 6.7 - 115.0	21.0 9.8 - 46.2	10.2 2.6 - 45.6
silty clay loam	72.0 37.0 - 147.0	34.5 8.5 - 168.0	28.3 14.6 - 57.9	13.6 3.3 - 66.1
Sandy clay	76.8 37.3 - 173.0	30.2 5.6 - 178.0	30.2 14.7 - 68.1	11.9 2.2 - 70.1
tilty clay	81.2 43.0 - 170.0	37.5 9.3 - 182.0	32.0 16.9 - 66.9	14.8 3.7 - 71.7
clay	89.0 46.0 - 183.0	40.7 8.8 - 204.0	35.0 18.1 - 72.0	16.0 3.5 - 80.3

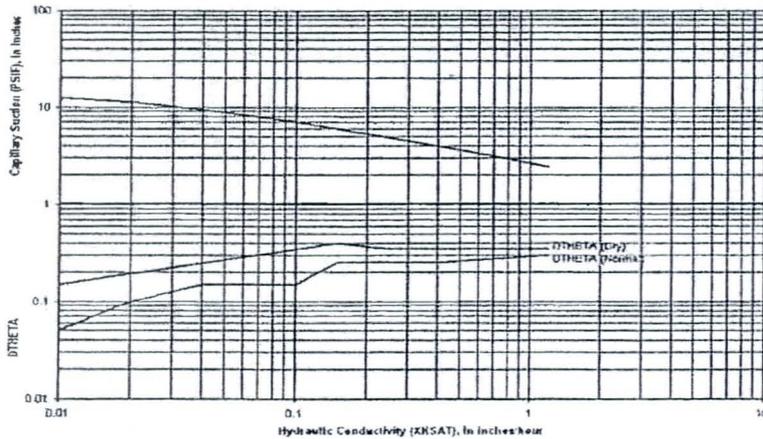
Table 4.1  
GREEN AND AMPY LOSS RATE PARAMETER VALUES FOR BARE GROUND

Soil Texture Classification (1)	XKSAT Inches/hour (2)	PSIF Inches (3)	DTHETA <sup>4</sup>		
			Dry (4)	Normal (5)	Saturated (6)
loamy sand & sand	1.20	2.4	0.35	0.30	0
sandy loam	0.40	4.3	0.35	0.25	0
loam	0.25	3.5	0.35	0.25	0
silty loam	0.15	6.6	0.40	0.25	0
silt	0.10	7.5	0.35	0.15	0
sandy clay loam	0.06	8.5	0.25	0.15	0
clay loam	0.04	8.2	0.25	0.15	0
silty clay loam	0.04	10.6	0.30	0.15	0
sandy clay	0.02	9.4	0.20	0.10	0
silty clay	0.02	11.5	0.20	0.10	0
clay	0.01	12.4	0.15	0.05	0

Notes:

- 1 Selection of DTHETA
- Dry = Nonirrigated lands, such as desert and rangeland.
- Normal = Irrigated lawn, turf, and permanent pasture.
- Saturated = Irrigated agricultural land.

FIGURE 4.3  
COMPOSITE VALUES OF PSIF AND DTHETA AS A FUNCTION OF XKSAT  
(TO BE USED FOR AREA-WEIGHTED AVERAGING OF GREEN AND AMPY PARAMETERS)



KINEROS PARAMETERS

value used  
Manning's 0.045

Table 7.5, p4-10 from Hydraulics Drainage Design manual Maricopa County  
value from Table 5, p22 Kineros manual

Table 5.  
Recommended Manning's roughness coefficients  
for overland flow

Cover or treatment	Residue rate	Value recommended	Range
	tons/acre		
Concrete or asphalt		0.011	0.010 - 0.013
Bare sand		.01	.010 - .015
Graveled surface		.02	.012 - .03
Bare clay loam (eroded)		.02	.012 - .033
Fallow - no residue		.05	.006 - .16
Chisel plow	<1/4	.07	.006 - .17
	<1/4 - 1	.18	.07 - .34
	1 - 3	.30	.19 - .47
	>3	.40	.34 - .66
Disk/harrow	<1/4	.08	.008 - .41
	1/4 - 1	.16	.10 - .25
	1 - 3	.25	.14 - .53
	>3	.30	--
No till	<1/4	.04	.03 - .07
	1/4 - 1	.07	.01 - .13
	1 - 3	.30	.16 - .47
Moldboard plow (fall)		.06	.02 - .10
Colter		.10	.05 - .13
Range (natural)		.13	.01 - .32
Range (clipped)		.10	.02 - .24
Grass (bluegrass sod)		.43	.39 - .63
Short grass prairie		.15	.10 - .20
Dense grass <sup>1</sup>		.24	.17 - .30
Bermuda grass <sup>1</sup>		.41	.30 - .68

<sup>1</sup>Veeping lovegrass, bluegrass, buffalo grass, blue grama grass, native grass mix (Okla.), alfalfa, lespedeza (from Palmer 1946).  
Sources: Woolhiser (1975) and Engman (1986).

TABLE 7.5  
VALUES OF MANNING'S n FOR AGRICULTURE OR OVERBANK AREAS  
[Modified from Chow (1959) and Thomsen and Hjelmerson (1991)]

Description	Manning's n		
	Minimum	Normal	Maximum
Pasture, no brush			
Short grass	0.025	0.030	0.035
High grass	0.030	0.035	0.050
Cultivated areas			
No crop	0.020	0.030	0.040
Mature row crops	0.025	0.035	0.045
Mature field crops	0.030	0.040	0.050
Shrubs			
Scattered shrubs, heavy weeds	0.035	0.050	0.070
Light shrubs and trees, in winter	0.035	0.050	0.060
Light shrubs and trees, in summer	0.040	0.060	0.080
Medium to dense shrubs, in winter	0.045	0.070	0.110
Medium to dense shrubs, in summer	0.070	0.100	0.160
Trees			
Dense willows, mesquite, saltcedar	0.110	0.150	0.200
Cleared land with tree stumps, no sprouts	0.030	0.040	0.050
Same as above, but heavy growth of sprouts	0.050	0.060	0.080
Heavy stand of timber, a few down trees, little undergrowth, flood stage below branches	0.080	0.100	0.120
Same as above, but with flood stage reaching branches	0.100	0.120	0.160

KINEROS PARAMETERS

Table 1, p.6 Kineros Manual  
 Table 9.6, p9-35 from Hydrology Drainage Design manual Maricopa County  
 Table 4.2, p4-17 from Hydrology Drainage Design manual Maricopa County  
 Figure 4.1, p4-2 from Hydrology Drainage Design manual Maricopa County

\* no values are applicable from the Table 1.

Table 1.  
 Interception depths (I)

Vegetative cover	Height		I		Reference
	ft	m	ft	m	
Corn	1.82	6	0.75	0.03	Horton (1919)
Tobacco	1.22	4	1.8	0.07	Horton (1919)
Small grains	.91	3	4.1	0.16	Horton (1919)
Meadow grass	.30	1	2.0	0.08	Horton (1919)
Alfalfa	.30	1	2.8	0.11	Horton (1919)
Grass (fescua)	--	--	1.0 - 1.2	0.04 - .048	Surgy and Pomeroy (1958)
Mixed hardwoods	--	--	.5 - 1.8	.02 - .07	Horton (1919)
Apple	--	--	.5	.02	Calheiros de Miranda and Butler (1986)
Big bluestem grass	.5	2	2.3	.09	Clark (1940)
Bluegrass	--	--	1.0	.04	Haynes (1940)
Tarbrush	--	--	3.0	.12	Troobis (1963)

<sup>1</sup> For 1-in (25.4-mm) storms.

<sup>2</sup> Depth of water per crown projected area.

Table 4.2  
 IA, RTIMP, AND VEGETATIVE CANOPY COVER FOR REPRESENTATIVE LAND USES  
 IN MARICOPA COUNTY

Land Use <sup>1</sup> Code	Land Use Category	Description	IA <sup>2</sup> inches	RTIMP <sup>2,3</sup> %	Vegetation Cover <sup>2,4</sup> %
VLDR	Very Low Density Residential <sup>5</sup>	40,000 sq. feet and greater lot size	0.20	5	30
LDR	Low Density Residential <sup>5</sup>	12,000 - 40,000 sq. feet lot size	0.30	15	50
MDR	Medium Density Residential <sup>5</sup>	6,000 - 12,000 sq. feet lot size	0.25	30	50
MFR	Multiple Family Residential <sup>5</sup>	1,000 - 6,000 sq. feet lot size (if outlot)	0.25	45	50
I1	Industrial 1 <sup>5</sup>	Light and General	0.15	55	60
I2	Industrial 2 <sup>5</sup>	General and Heavy	0.15	55	60
C1	Commercial 1 <sup>5</sup>	Light, Neighborhood, Residential	0.10	80	75
C2	Commercial 2 <sup>5</sup>	General, General, Office, Intermediate	0.10	80	75
P	Pavement and Rooftops	Asphalt and Concrete, Sloped Rooftops	0.05	95	0
GR	Gravel Roadways & Shoulders	Gravel and Compacted, Treated and Untreated	0.10	5	0
AD	Agricultural	Tilled Fields, Impacted Pastures, slopes < 1%	0.50	0	85
LPC	Lawns/Patios/Cemeteries	Over 80% maintained lawn	0.20	Varies <sup>5</sup>	80
DL1	Desert Landscaping 1	Landscaping with impervious under treatment	0.10	95	30
DL2	Desert Landscaping 2	Landscaping without impervious under treatment	0.20	0	30
NDR	Undeveloped Desert Rangeland	Little topographic relief, slopes < 5%	0.35	Varies <sup>5</sup>	Varies <sup>5</sup>
NHS	Highways, Sonoran Desert	Moderate topographic relief, slopes > 5%	0.15	Varies <sup>5</sup>	Varies <sup>5</sup>
NMT	Mountain Terrain	High topographic relief, slopes > 10%	0.25	Varies <sup>5</sup>	Varies <sup>5</sup>

Notes:

- Other land use or zoning classifications, such as Planned Area Development and Schools must be evaluated on a case by case basis.
- These values have been selected to fit many typical settings in Maricopa County; however, the engineer/hydrologist should always evaluate the specific circumstances in any particular watershed for hydrologic variations from these typical values.
- RTIMP = Percent Effective Impervious Area, including right-of-way. Effective means that all impervious areas are assumed to be hydraulically connected. RTIMP values may need to be adjusted based on an evaluation of hydraulic connectivity.
- Vegetation Cover = Percent vegetation cover for pervious areas only.
- RTIMP values must be estimated on a case by case basis.
- Vegetation Cover values must be estimated on a case by case basis.

Table 9.6  
 RAINFALL LOSS CHARACTERISTICS FOR EACH SOIL MAP UNIT

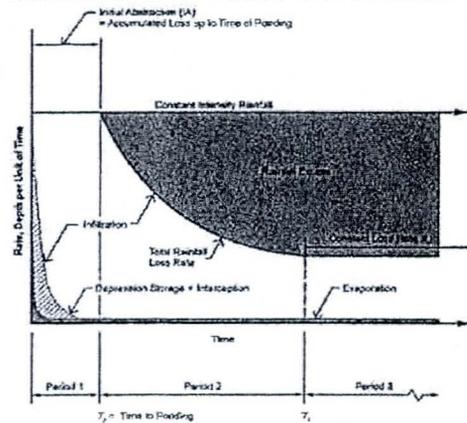
Map Unit ID (1)	Description (2)	KXSAT <sup>1</sup> In/hr (3)	RTIMP <sup>1</sup> % (4)	IA <sup>1</sup> Inches (5)
8	Very cobbly sandy loam	0.93	0	0.35
10	Loamy sand	0.84	0	0.35
16	Very gravelly fine sandy loam	0.44	15	0.25
21	Very gravelly loam	0.38	0	0.35
31	Extremely cobbly sandy loam	0.33	35	0.25
33	Very gravelly loam	0.23	0	0.35
41	Very gravelly loam	0.17	0	0.25
45	Very gravelly clay	0.03	0	0.25
48	Very gravelly clay	0.06	0	0.15
51	Very gravelly sandy clay loam	0.24	0	0.15
52	Very gravelly clay loam	0.16	20	0.25
66	Very gravelly loam	0.23	0	0.35
68	Very gravelly sandy loam	0.83	0	0.35
70	Very gravelly loam	0.36	0	0.25
72	Clay loam	0.09	30	0.25
93	Gravelly loam	0.33	0	0.25
95	Clay loam	0.04	0	0.35
103	Very gravelly clay loam	0.10	85	0.25
104	Gravelly clay loam	0.14	80	0.25
108	Very cobbly loam	0.31	30	0.25
109	Very cobbly loam	0.35	35	0.25
CmD <sup>2</sup>	Very gravelly sandy loam	0.44	15	0.25
Le <sup>2</sup>	Gravelly clay loam	0.00	30	0.25
Lh <sup>2</sup>	Extremely rocky clay loam	0.14	60	0.25
Rr <sup>2</sup>	Rock outcrop	0.01	50	0.25

Notes:

- Values for the soil map units within the limits of the Soil Survey of Aguila-Carefree and Parts of Maricopa and Pinal Counties, Arizona are taken from Appendix C, Section 1.
- Values for the soil map units within the limits of the Soil Survey of Yavapai County, Arizona, Western Part are based on the soil texture descriptions from that soil survey.
- Values are based on the descriptions in the soil surveys and the use of Table 4.2.

Vegetation Type	Interception, Inches
Hardwood tree	0.09
Cotton	0.39
Alfalfa	0.11
Meadow grass	0.08

FIGURE 4.1  
 SCHEMATIC REPRESENTATION OF RAINFALL LOSSES FOR A UNIFORM INTENSITY RAINFALL



KINEROS PARAMETERS

Splash values used  
2500

from table 4, p20 Kineros Manual  
Splash 1000-4000

Table 4.  
Resistance parameters for overland flow

Surface	Laminar flow ( $k_o$ )	
Concrete or asphalt	24 -	108
Bare sand	30 -	120
Graveled surface	90 -	400
Bare clay-loam soil (eroded)	100 -	500
Sparse vegetation	1,000 -	4,000
Short grass prairie	3,000 -	10,000
Bluegrass sod	7,000 -	40,000

Source: Woolhiser (1975).

KINEROS PARAMETERS

Boring #	Effective Stress		Total Stress		LL	PL	PI	Location
	$\phi$ ( $^{\circ}$ )	c (psi)	$\phi$ ( $^{\circ}$ )	c (psi)				
45 (W)	33.8	0.1	11.4	1.5	24	15	9	Base
51 (W)	30.9	0.5	9.8	1.1	24	16	8	Base
51 (E)	30.7	0.3	12.5	0.4	26	16	10	Base
Average	31.8	0.3	11.2	1.0	24.7	15.7	9.0	
Std Dev.	1.7	0.2	1.4	0.6	1.2	0.6	1.0	
Ave - Std Dev.	30.1	0.1	9.9	0.4	23.5	15.1	8.0	
Cohesion (psf)		14.4		63.8				

Rock  
used the RTIMP value from the DDMSW model for basins

Veg Cover  
used the veg cover value from DDMSW model for basins  
0.25

\* No reference material available

from DDMSW sediment yield model  
Composite "C" value used in the DDMSW model for basin H02 is 0.29  
C = C1\*C2\*C3

- C = cover and management factor
- C1 influence of veg canopy on effective rainfall
- C2 effect of plant residues or close-growing stems at the soil surface (muck)
- C3 effect on undisturbed land areas

Table 4.2  
IA, RTIMP, AND VEGETATIVE CANOPY COVER FOR REPRESENTATIVE LAND USES  
IN MARICOPA COUNTY

Land Use Code	Land Use Category	Description	IA <sup>2</sup> Inches	RTIMP <sup>2,3</sup> %	Vegetation Cover <sup>2,4</sup> %
VLDR	Very Low Density Residential <sup>1</sup>	40,000 sq. feet and greater lot size	0.30	5	30
LDR	Low Density Residential <sup>1</sup>	12,000 - 40,000 sq. feet lot size	0.30	15	50
MDR	Medium Density Residential <sup>1</sup>	6,000 - 12,000 sq. feet lot size	0.25	20	60
MFR	Multiple Family Residential <sup>1</sup>	1,000 - 6,000 sq. feet lot size (if duplex)	0.25	45	50
I1	Industrial 1 <sup>2</sup>	Light and General	0.15	65	00
I2	Industrial 2 <sup>2</sup>	General and Heavy	0.15	55	60
C1	Commercial 1 <sup>2</sup>	Light, Neighborhood, Residential	0.10	80	75
C2	Commercial 2 <sup>2</sup>	Central, General, Office, Intermediate	0.10	80	75
P	Pavement and Rooftops	Asphalt and Concrete, Sloped Rooftops	0.05	0	0
GR	Gravel Roadways & Shoulders	Graded and Compacted, Treated and Untreated	0.10	5	0
AG	Agricultural	Tilled Fields, Irrigated Pastures, slopes < 1%	0.50	0	55
LPC	Lawns/Parks/Cemeteries	Over 50% maintained lawn	0.20	Varies <sup>5</sup>	80
DL1	Desert Landscaping 1	Landscaping with impervious under treatment	0.10	0	30
DL2	Desert Landscaping 2	Landscaping without impervious under treatment	0.20	0	30
NDR	Undeveloped Desert Rangeland	Little topographic relief, slopes < 5%	0.35	Varies <sup>5</sup>	Varies <sup>5</sup>
NHD	Hillslopes, Sonoran Desert	Moderate topographic relief, slopes > 5%	0.15	Varies <sup>5</sup>	Varies <sup>5</sup>
NMT	Mountain Terrain	High topographic relief, slopes > 10%	0.25	Varies <sup>5</sup>	Varies <sup>5</sup>

Notes:

1. Other land-use or zoning classifications, such as Planned Area Development and Schools must be evaluated on a case by case basis.
2. These values have been selected to fit many typical settings in Maricopa County; however, the engineer/hydrologist should always evaluate the specific circumstances in any particular watershed for hydrologic variations from these typical values.
3. RTIMP = Percent Effective Impervious Area, including right-of-way. Effective means that all impervious areas are assumed to be hydraulically connected. The RTIMP values may need to be adjusted based on an evaluation of hydraulic connectivity.
4. Vegetation Cover = Percent vegetation cover for previous areas only.
5. RTIMP values must be estimated on a case by case basis.
6. Vegetation Cover values must be estimated on a case by case basis.

FIGURE 4.4  
EFFECT OF VEGETATION COVER ON HYDRAULIC CONDUCTIVITY  
FOR HYDRAULIC SOIL GROUPS B, C, AND D, AND FOR ALL SOIL TEXTURES  
OTHER THAN SAND AND LOAMY SAND

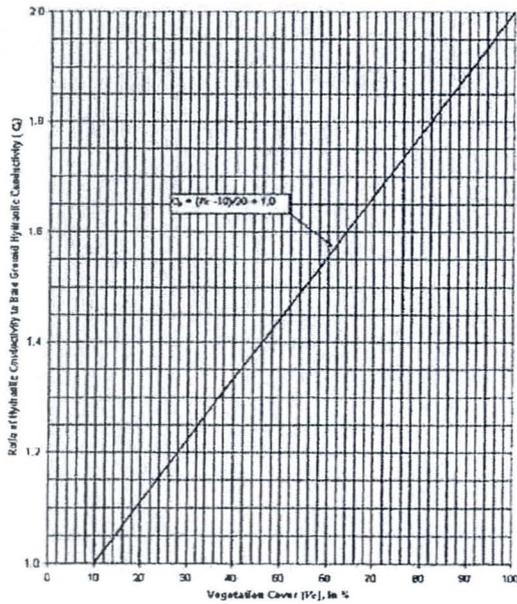
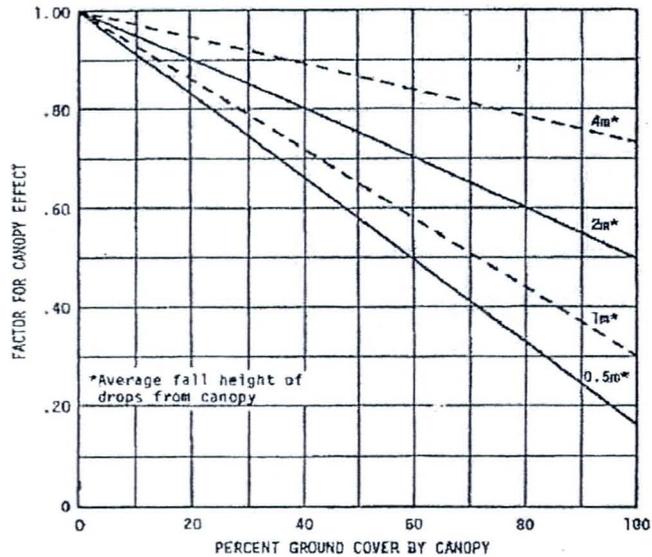


FIGURE 11.24  
INFLUENCE OF VEGETAL CANOPY ON EFFECTIVE RAINFALL, C<sub>1</sub>  
(Wischmeier and Smith, 1978)



KINEROS PARAMETERS

DIST  
Value Used      0.5

Definition:  
Pore size distribution index. The parameter is used for  
redistribution of soil moisture during unponded intervals

\* no reference material available, value assumed

KINEROS PARAMETERS

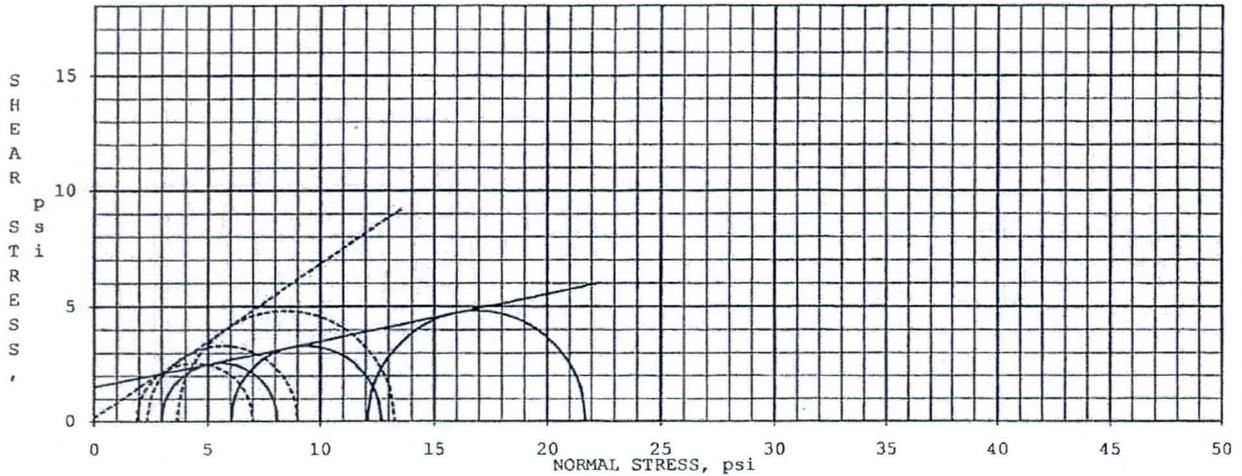
CV

Value used        0.8

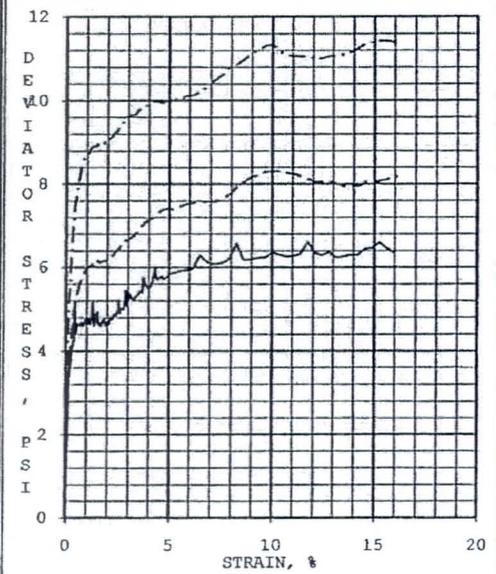
Definition:    Coefficient of variation of Ks

\* No reference material available, value assumed

**Soil Test Data**



EFFECTIVE STRESS ---	ANGLE OF INTERNAL FRICTION, deg	33.8	COHESION, psi	0.1
TOTAL STRESS —	ANGLE OF INTERNAL FRICTION, deg	11.4	COHESION, psi	1.5



SPECIMEN ID:		A	B	C
INITIAL	WATER CONTENT, %	4.3	4.3	4.4
	DRY DENSITY, pcf	112.1	112.1	112.0
	SATURATION, %	23	23	23
	VOID RATIO	0.50	0.50	0.50
BEFORE SHEAR	WATER CONTENT, %	18.6	17.8	17.2
	DRY DENSITY, pcf	112.2	113.7	115.1
	SATURATION (B PARAMETER)	0.95	0.98	0.97
	VOID RATIO	0.50	0.48	0.46
	FINAL BACK PRESSURE, psi	98.9	99.5	99.6
MINOR PRINCIPAL STRESS, psi		3.0	6.0	12.1
EFFECTIVE STRESS PEAK AT % STRAIN		3.0	3.0	3.0
EFF. DEVIATOR STRESS AT PEAK STRAIN, psi		5.1	6.7	9.6
TOTAL STRESS PEAK AT % STRAIN		3.0	3.0	3.0
TOTAL DEVIATOR STRESS AT PEAK STRAIN, psi		5.1	6.7	9.6

CONTROLLED - STRAIN TEST		ULTIMATE DEVIATOR STRESS (15% STR), psi	6.5	8.1	11.4
SAMPLE TYPE: RE-COMPACTED		TIME TO 50% PRIMARY CONSOLIDATION, min	0.44	0.45	0.32
DESCRIPTION OF SPECIMENS: CLAYEY SAND		STRAIN RATE, % / hour	5.31	5.39	5.39
		INITIAL DIAMETER, inch	2.016	2.016	2.016
		INITIAL HEIGHT, inch	4.000	4.000	4.000
LL 24   PL 15   PI 9   Gs 2.7 EST.	AREA AFTER CONSOLIDATION, inch <sup>2</sup>	3.190	3.152	3.119	
PROJECT NO. 65101872		PROJECT: RAINBOW VALLEY			
		BORING #: #45 <i>Base</i>			
LABORATORY: TERRACON - LENEXA		SAMPLE #: WEST SIDE			
DATE: 3/3/2011		DEPTH, feet:			

PROCEDURE: ASTM D4767, CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS

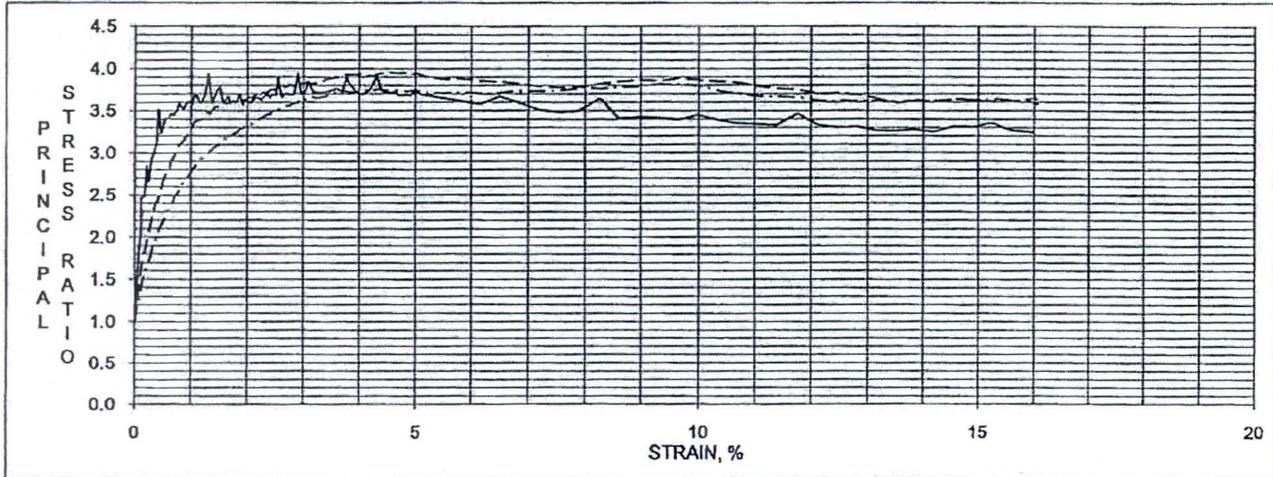


RAINBOW VALLEY

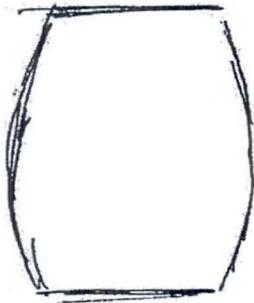
65101872

#45

WEST SIDE



FAILURE SKETCH



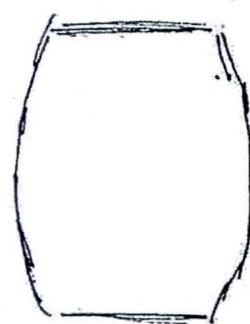
SPECIMEN A

FAILURE SKETCH



SPECIMEN B

FAILURE SKETCH



SPECIMEN C

REMARKS:

SPECIMENS SATURATED BY THE WET METHOD.  
 EFFECTIVE STRESS FAILURE DATA BASED ON 3 % STRAIN.  
 EFFECTIVE STRESS MOHR'S CIRCLES DRAWN AT 3 % STRAIN.  
 TOTAL STRESS FAILURE DATA BASED ON 3 % STRAIN.  
 TOTAL STRESS MOHR'S CIRCLES DRAWN AT 3 % STRAIN.  
 DEVIATOR STRESSES CORRECTED FOR MEMBRANE AND FILTER PAPER EFFECTS.  
 AREA AFTER CONSOLIDATION CALCULATED AS PER SECTION 10.3.2.1 METHOD A

STANDARD PROCTOR = 111.2pcf @ 5.1% MOISTURE

REMOLED TO 112 pcf @ 4.3% MOISTURE

REMOLED TO 100.8% COMPACTION

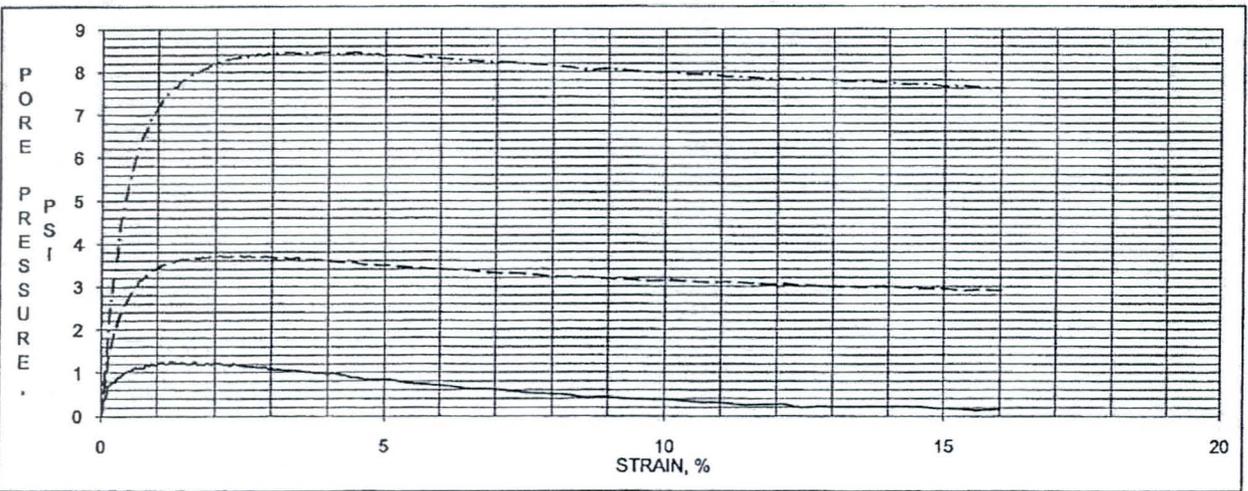
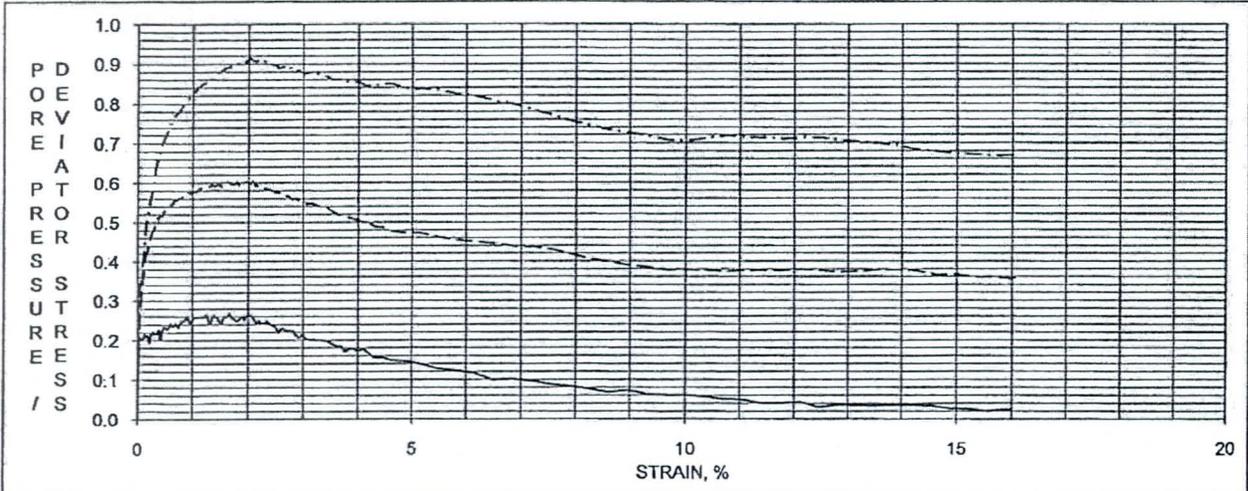
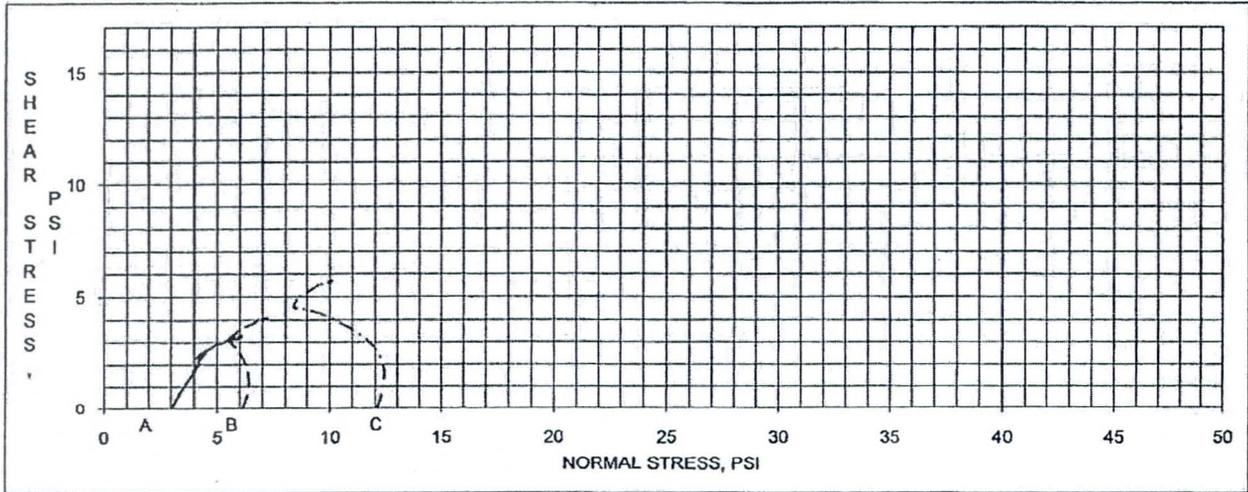
**Terracon**

RAINBOW VALLEY

65101872

#45

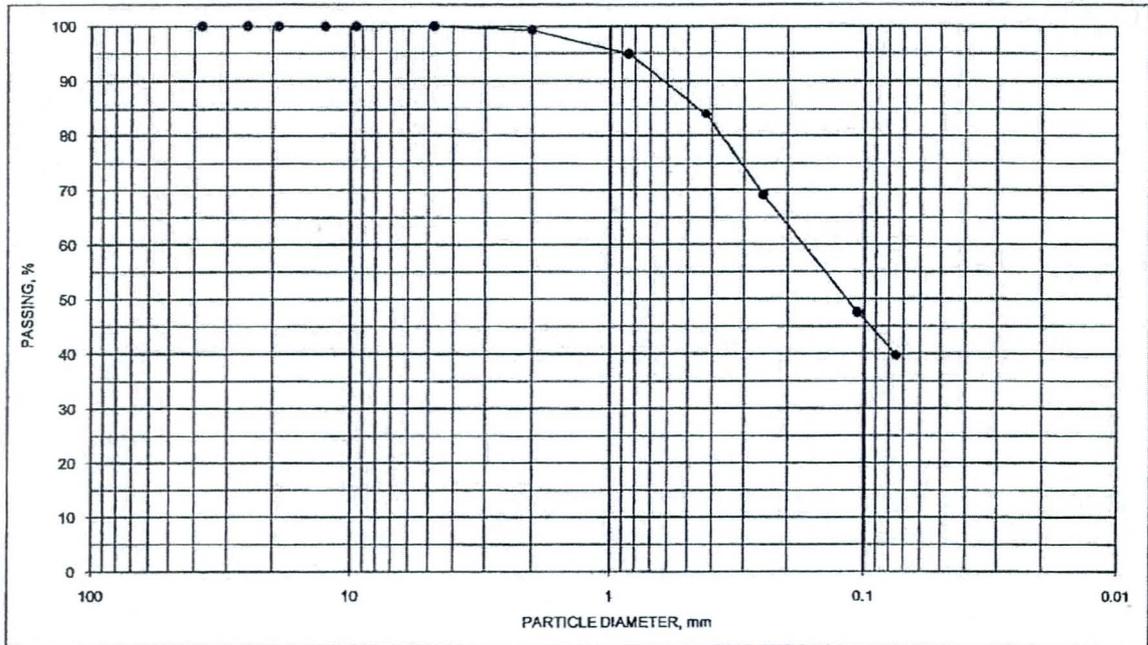
WEST SIDE



Terracon

SIEVE SIZE	DIAMETER, mm	PASS. %
1.5"	37.5	100
1"	25.0	100
3/4"	19.0	100
1/2"	12.5	100
3/8"	9.50	100
#4	4.75	100
#10	2.00	99
#20	0.850	95
#40	0.425	84
#80	0.250	69
#140	0.106	48
#200	0.075	39.7

D60 0.1735



GRAIN SIZE DISTRIBUTION CURVE

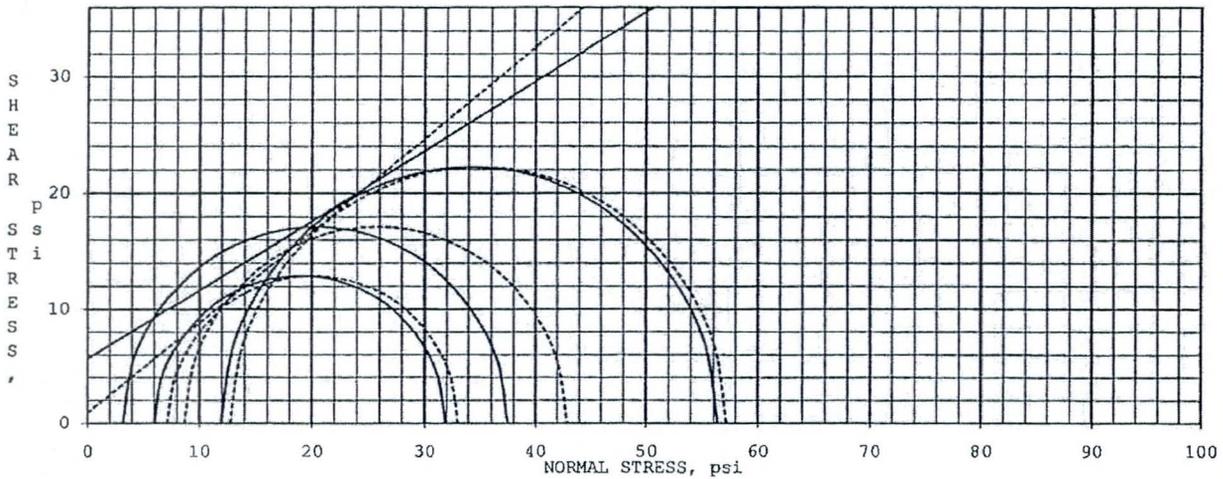
BORING ID	SAMPLE ID	DEPTH, feet	USCS DESCRIPTION	UNIFIED SYMBOL	NAT M%	ATTERBERG LIMITS		
						LL	PL	PI
#45	WEST SIDE		CLAYEY SAND	SC		24	15	9

PROJECT RAINBOW VALLEY

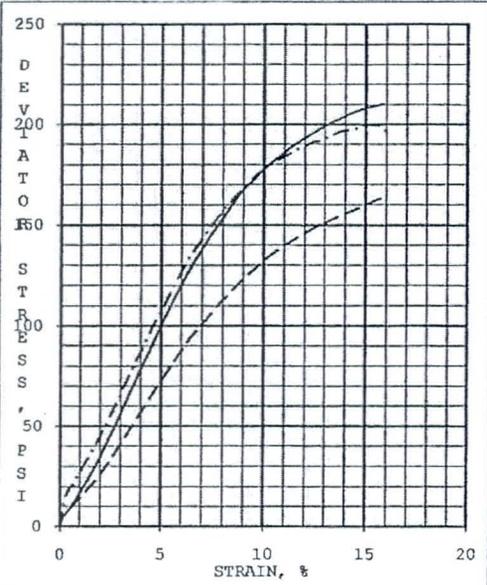
JOB NO. 65101872 DATE 2/24/2011

H:\CM\LAB\_DATA\00 Projects in Progress\2010 Projects in Progress\65101872 Lab Data\65101872 GradALPlot #45 WESTSIDE.dwg\GRADATION

Terracon



EFFECTIVE STRESS ---	ANGLE OF INTERNAL FRICTION, deg	38.4	COHESION, psi	0.9
TOTAL STRESS —	ANGLE OF INTERNAL FRICTION, deg	30.9	COHESION, psi	5.7



SPECIMEN ID:		A	B	C
INITIAL	WATER CONTENT, %	0.8	0.8	0.9
	DRY DENSITY, pcf	118.1	118.0	118.0
	SATURATION, %	5	5	5
BEFORE SHEAR	VOID RATIO	0.43	0.43	0.43
	WATER CONTENT, %	15.8	15.7	15.4
	DRY DENSITY, pcf	118.2	118.4	119.0
	SATURATION (B PARAMETER)	1.00	1.00	0.98
	VOID RATIO	0.43	0.42	0.42
	FINAL BACK PRESSURE, psi	99.4	99.4	99.4
	MINOR PRINCIPAL STRESS, psi	3.2	6.0	11.9
	EFFECTIVE STRESS PEAK AT % STRAIN	2.0	2.0	2.0
	EFF. DEVIATOR STRESS AT PEAK STRAIN, psi	34.2	25.8	44.4
	TOTAL STRESS PEAK AT % STRAIN	2.0	2.0	2.0
	TOTAL DEVIATOR STRESS AT PEAK STRAIN, psi	34.2	25.8	44.4
	ULTIMATE DEVIATOR STRESS (15% STR), psi	208.1	160.0	199.4
	TIME TO 50% PRIMARY CONSOLIDATION, min	0.16	0.16	0.17
	STRAIN RATE, % / hour	7.96	7.96	8.14
	INITIAL DIAMETER, inch	2.016	2.016	2.016
	INITIAL HEIGHT, inch	4.000	4.000	4.000
	AREA AFTER CONSOLIDATION, inch <sup>2</sup>	3.189	3.190	3.176

CONTROLLED - STRAIN TEST		ULTIMATE DEVIATOR STRESS (15% STR), psi			208.1	160.0	199.4
SAMPLE TYPE: RE-COMPACTED		TIME TO 50% PRIMARY CONSOLIDATION, min			0.16	0.16	0.17
DESCRIPTION OF SPECIMENS: SILTY SAND		STRAIN RATE, % / hour			7.96	7.96	8.14
		INITIAL DIAMETER, inch			2.016	2.016	2.016
		INITIAL HEIGHT, inch			4.000	4.000	4.000
LL	NP	PL	NP	PI	NP	Gs	2.7 EST.
PROJECT NO. 65101872		PROJECT: RAINBOW VALLEY					
		BORING #: #46 <i>South Bank</i>					
LABORATORY: TERRACON - LENEXA		SAMPLE #: WEST SIDE					
DATE: 3/3/2011		DEPTH, feet:					

PROCEDURE: ASTM D4767, CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS

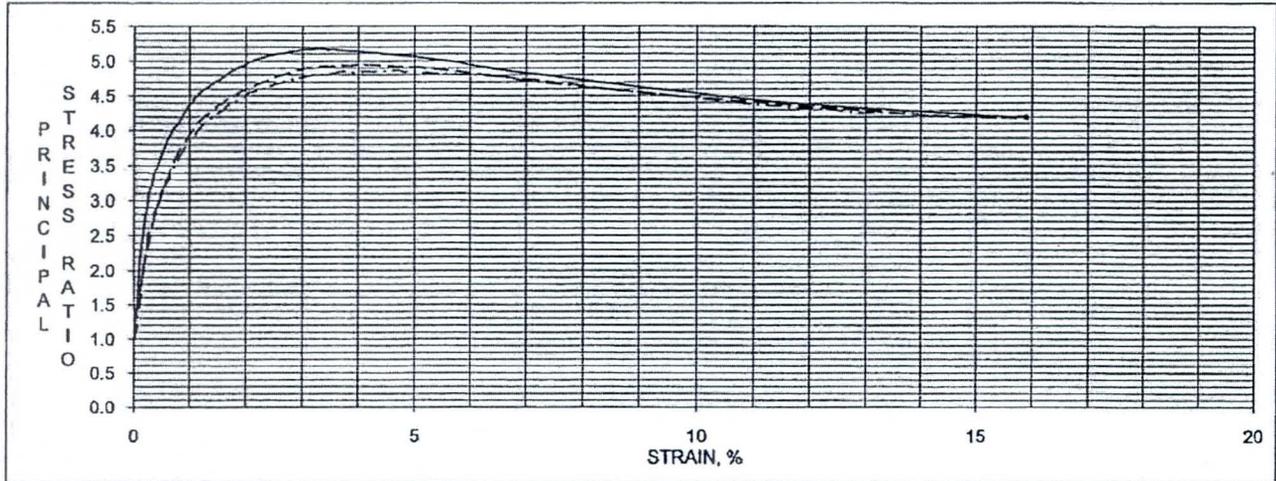


RAINBOW VALLEY

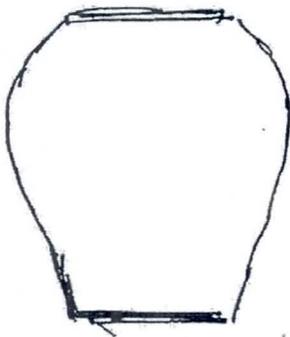
65101872

#46

WEST SIDE



FAILURE SKETCH



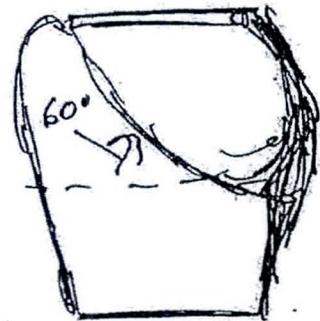
SPECIMEN A

FAILURE SKETCH



SPECIMEN B

FAILURE SKETCH



SPECIMEN C

REMARKS:

SPECIMENS SATURATED BY THE WET METHOD.  
 EFFECTIVE STRESS FAILURE DATA BASED ON 2 % STRAIN.  
 EFFECTIVE STRESS MOHR'S CIRCLES DRAWN AT 2 % STRAIN.  
 TOTAL STRESS FAILURE DATA BASED ON 2 % STRAIN.  
 TOTAL STRESS MOHR'S CIRCLES DRAWN AT 2 % STRAIN.  
 DEVIATOR STRESSES CORRECTED FOR MEMBRANE AND FILTER PAPER EFFECTS.  
 AREA AFTER CONSOLIDATION CALCULATED AS PER SECTION 10.3.2.1 METHOD A

STANDARD PROCTOR = 117.8pcf @ 120.1% MOISTURE

REMOLED TO 118 pcf @ 0.8% MOISTURE

REMOLED TO 100.2% COMPACTION

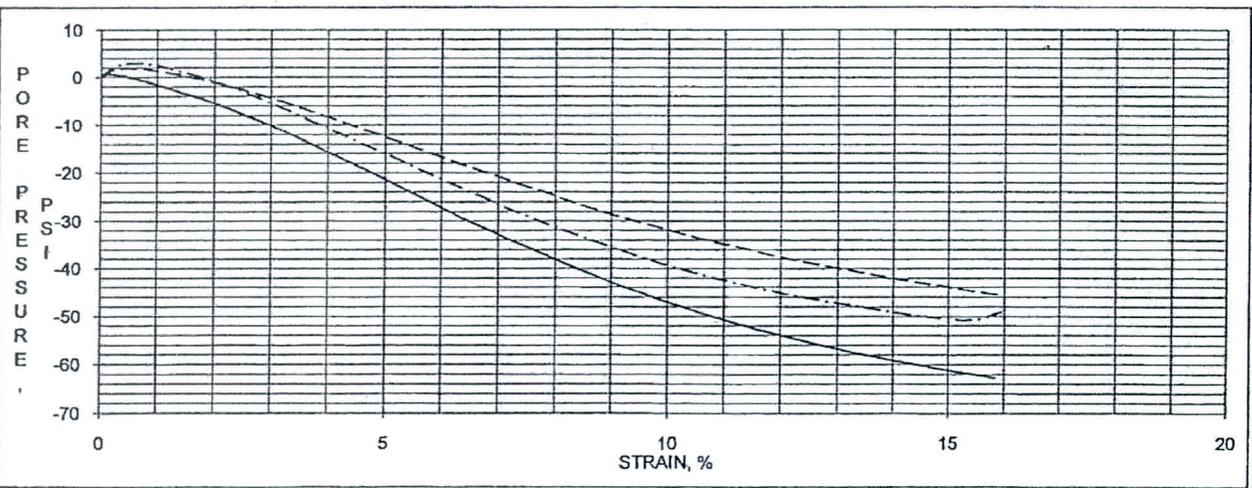
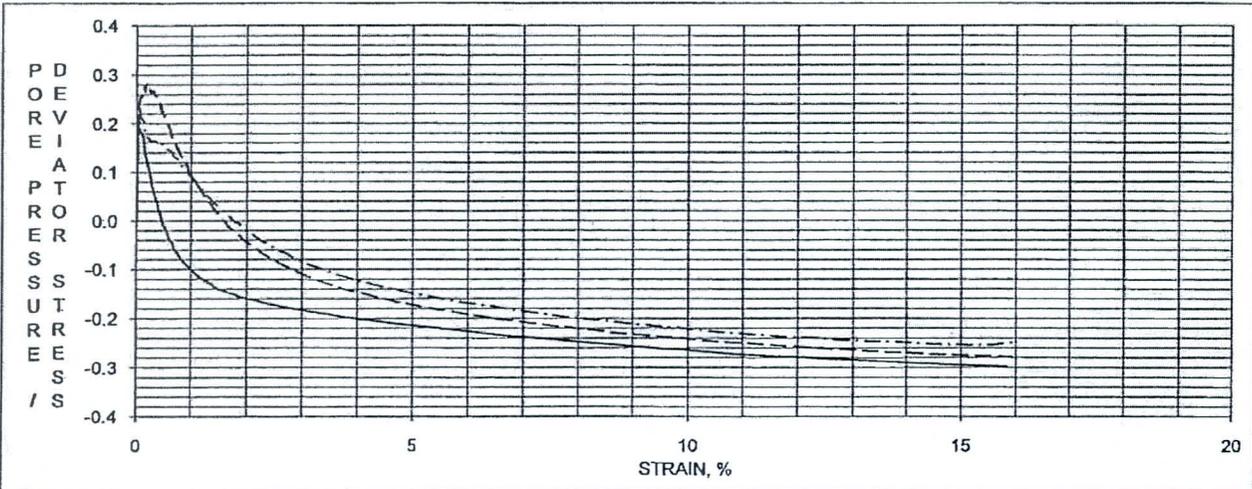
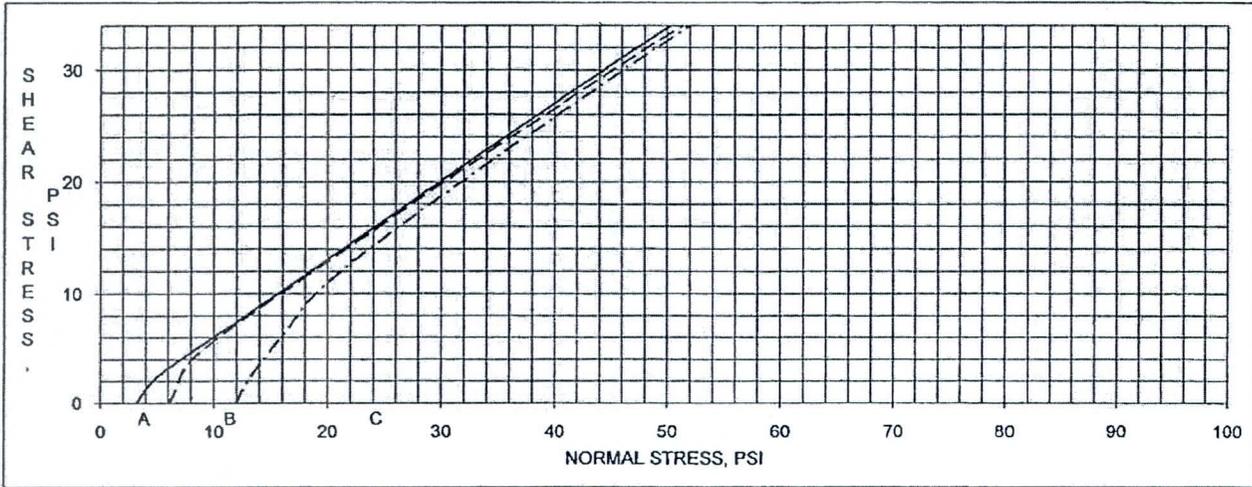
**Terracon**

RAINBOW VALLEY

65101872

#46

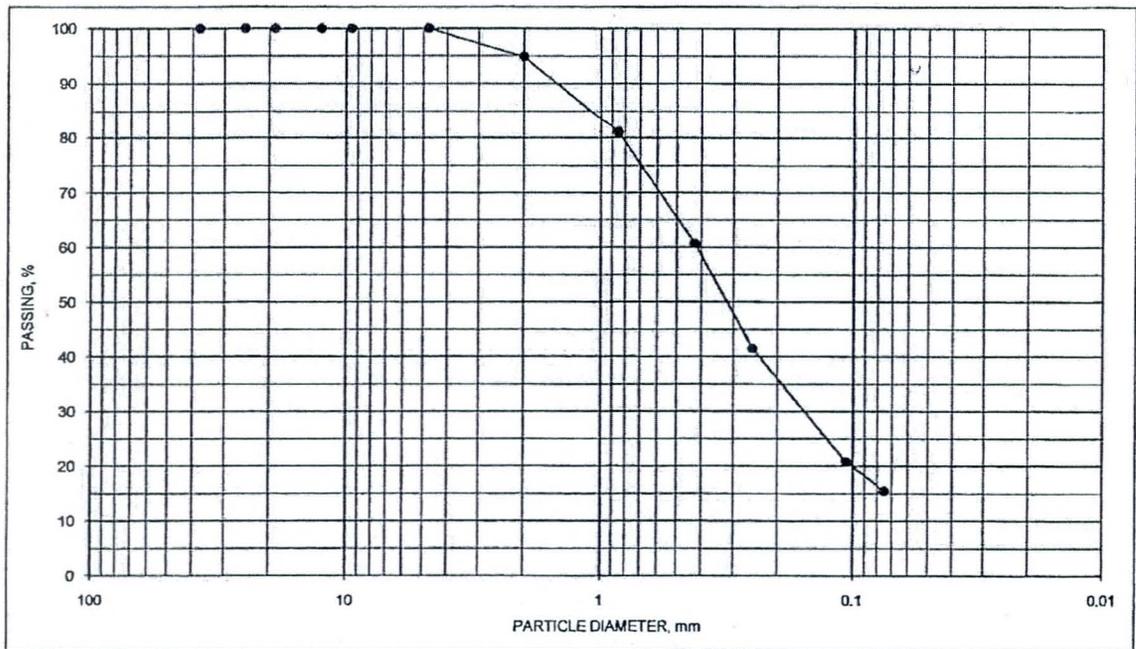
WEST SIDE



Terracon

SIEVE SIZE	DIAMETER, mm	PASS. %
1.5"	37.5	100
1"	25.0	100
3/4"	19.0	100
1/2"	12.5	100
3/8"	9.50	100
#4	4.75	100
#10	2.00	95
#20	0.850	81
#40	0.425	61
#60	0.250	41
#140	0.106	21
#200	0.075	15.4

D60 0.4171  
D30 0.1558



GRAIN SIZE DISTRIBUTION CURVE

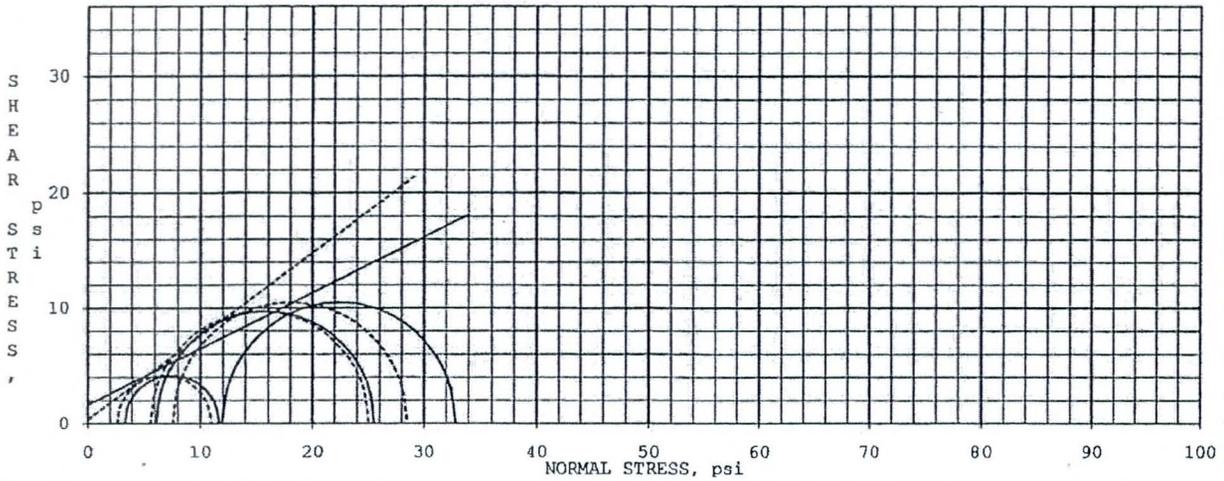
BORING ID	SAMPLE ID	DEPTH, feet	USCS DESCRIPTION	UNIFIED SYMBOL	NAT M%	ATTERBERG LIMITS		
						LL	PL	PI
#46	WEST SIDE		SILTY SAND	SM		NP	NP	NP

PROJECT RAINBOW VALLEY

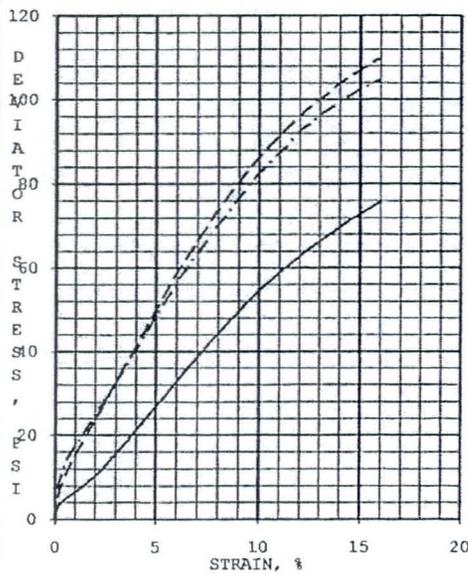
JOB NO. 85101872 DATE 2/24/2011

H:\CMLAB\_DATA\00 Projects In Progress\2010 Projects In Progress\85101872 Lab Data\85101872 Grad\ALP046 WESTSIDE.stm\GRADATION

Terracon



EFFECTIVE STRESS ---	ANGLE OF INTERNAL FRICTION, deg	35.9	COHESION, psi	0.3
TOTAL STRESS ———	ANGLE OF INTERNAL FRICTION, deg	25.9	COHESION, psi	1.6



SPECIMEN ID:		A	B	C							
INITIAL	WATER CONTENT, %	1.5	1.4	1.6							
	DRY DENSITY, pcf	120.1	120.3	120.1							
	SATURATION, %	10	9	11							
	VOID RATIO	0.40	0.40	0.40							
BEFORE SHEAR	WATER CONTENT, %	14.9	14.5	14.7							
	DRY DENSITY, pcf	120.2	121.0	120.7							
	SATURATION (B PARAMETER)	0.99	0.95	0.95							
	VOID RATIO	0.40	0.39	0.40							
	FINAL BACK PRESSURE, psi	99.0	99.5	99.3							
MINOR PRINCIPAL STRESS, psi		3.4	6.1	11.9							
EFFECTIVE STRESS PEAK AT % STRAIN		1.5	1.5	1.5							
EFF. DEVIATOR STRESS AT PEAK STRAIN, psi		8.3	19.4	21.0							
TOTAL STRESS PEAK AT % STRAIN		1.5	1.5	1.5							
TOTAL DEVIATOR STRESS AT PEAK STRAIN, psi		8.3	19.4	21.0							
ULTIMATE DEVIATOR STRESS (15% STR), psi		72.9	107.0	102.4							
TIME TO 50% PRIMARY CONSOLIDATION, min		0.19	0.14	0.14							
STRAIN RATE, % / hour		7.94	7.94	8.21							
INITIAL DIAMETER, inch		2.016	2.016	2.016							
INITIAL HEIGHT, inch		4.000	4.000	4.000							
LL	NP	PL	NP	PI	NP	Gs	2.7 EST.	AREA AFTER CONSOLIDATION, inch <sup>2</sup>	3.199	3.174	3.182
PROJECT NO. 65101872								PROJECT: RAINBOW VALLEY			
								BORING #: #47 <i>North Bank</i>			
LABORATORY: TERRACON - LENEXA								SAMPLE #: EAST SIDE			
DATE: 3/3/2011								DEPTH, feet:			

PROCEDURE: ASTM D4767, CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS

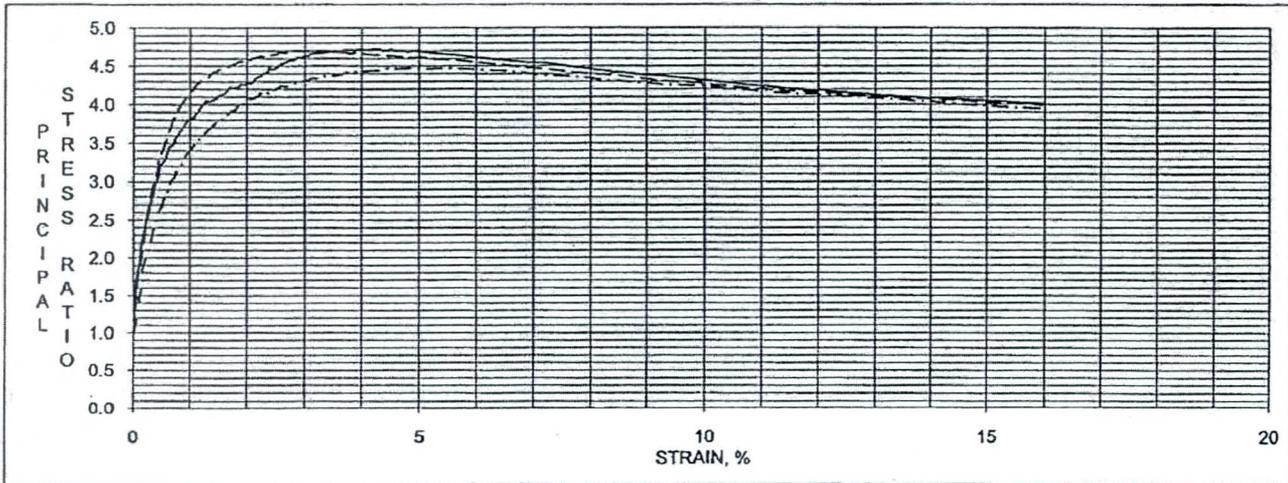
**Terracon**

RAINBOW VALLEY

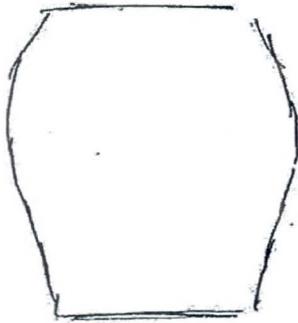
65101872

#47

EAST SIDE

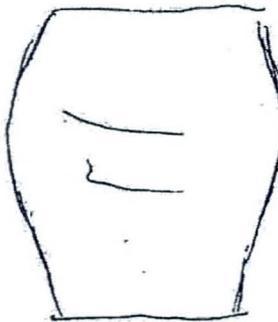


FAILURE SKETCH



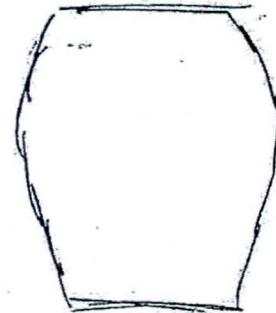
SPECIMEN A

FAILURE SKETCH



SPECIMEN B

FAILURE SKETCH



SPECIMEN C

REMARKS:

SPECIMENS SATURATED BY THE WET METHOD.  
 EFFECTIVE STRESS FAILURE DATA BASED ON 1.5 % STRAIN.  
 EFFECTIVE STRESS MOHR'S CIRCLES DRAWN AT 1.5 % STRAIN.  
 TOTAL STRESS FAILURE DATA BASED ON 1.5 % STRAIN.  
 TOTAL STRESS MOHR'S CIRCLES DRAWN AT 1.5 % STRAIN.  
 DEVIATOR STRESSES CORRECTED FOR MEMBRANE AND FILTER PAPER EFFECTS.  
 AREA AFTER CONSOLIDATION CALCULATED AS PER SECTION 10.3.2.1 METHOD A

STANDARD PROCTOR = 120pcf @ 1.7% MOISTURE

REMOLED TO 120.2 pcf @ 1.5% MOISTURE

REMOLED TO 100.1% COMPACTION

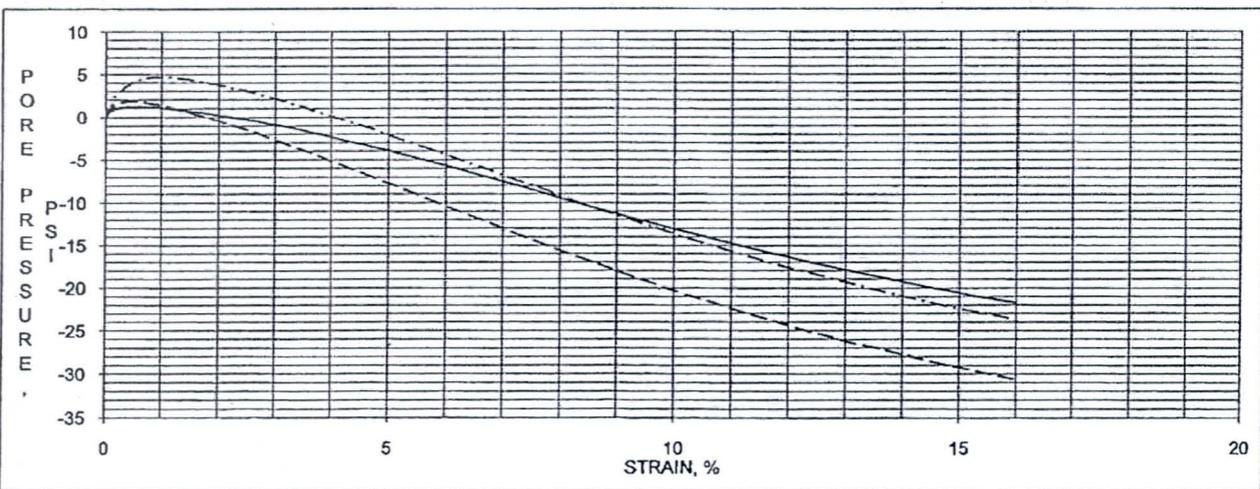
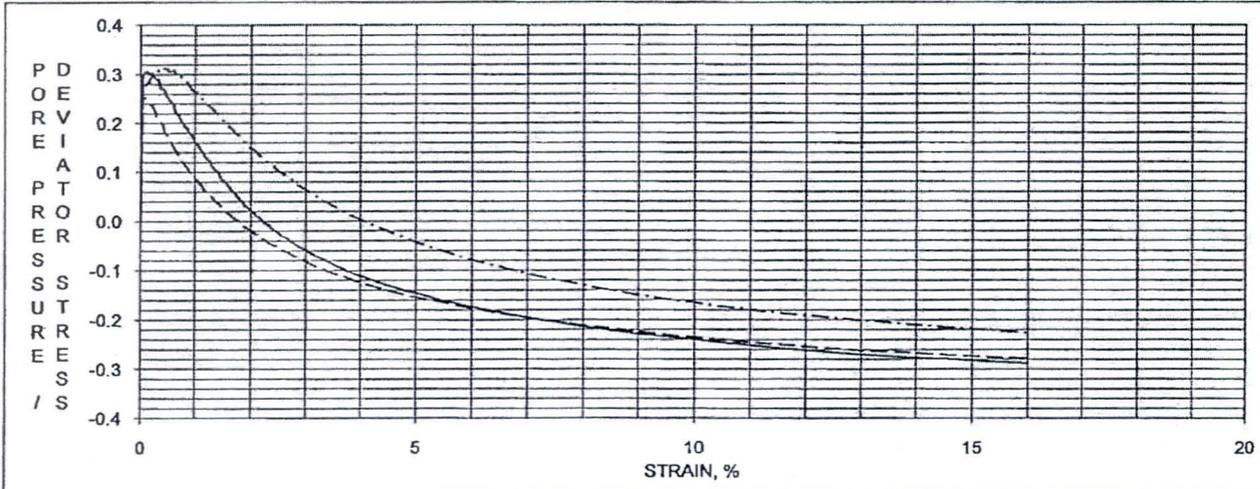
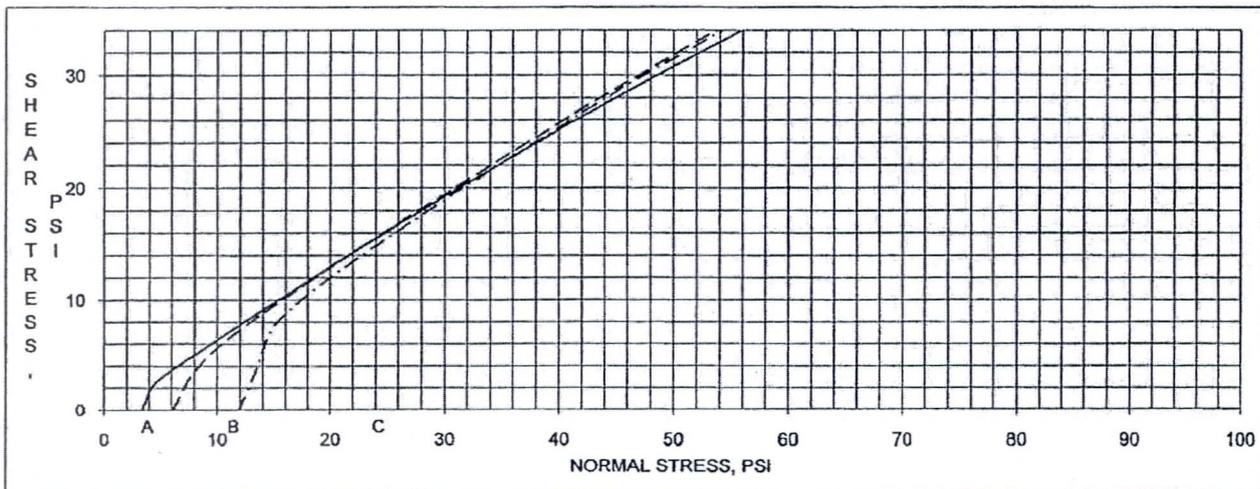
**Terracon**

RAINBOW VALLEY

65101872

#47

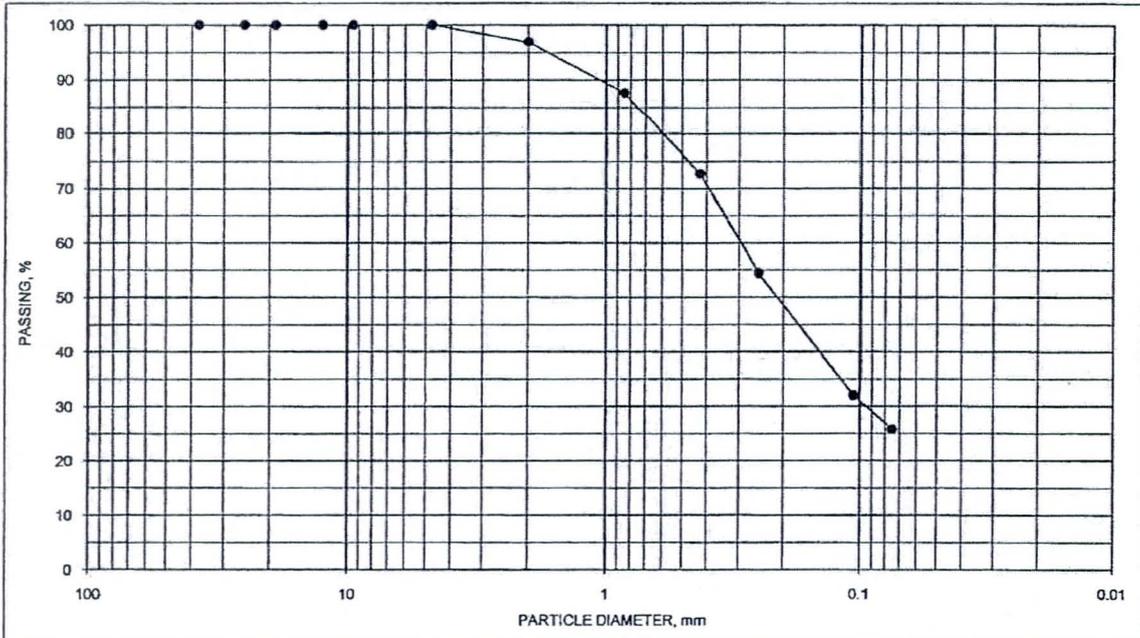
EAST SIDE



Terracon

SIEVE SIZE	DIAMETER, mm	PASS, %
1.5"	37.5	100
1"	25.0	100
3/4"	19.0	100
1/2"	12.5	100
3/8"	9.50	100
#4	4.75	100
#10	2.00	97
#20	0.850	88
#40	0.425	73
#60	0.250	54
#140	0.106	32
#200	0.075	25.8

D60 0.2937  
D30 0.0946



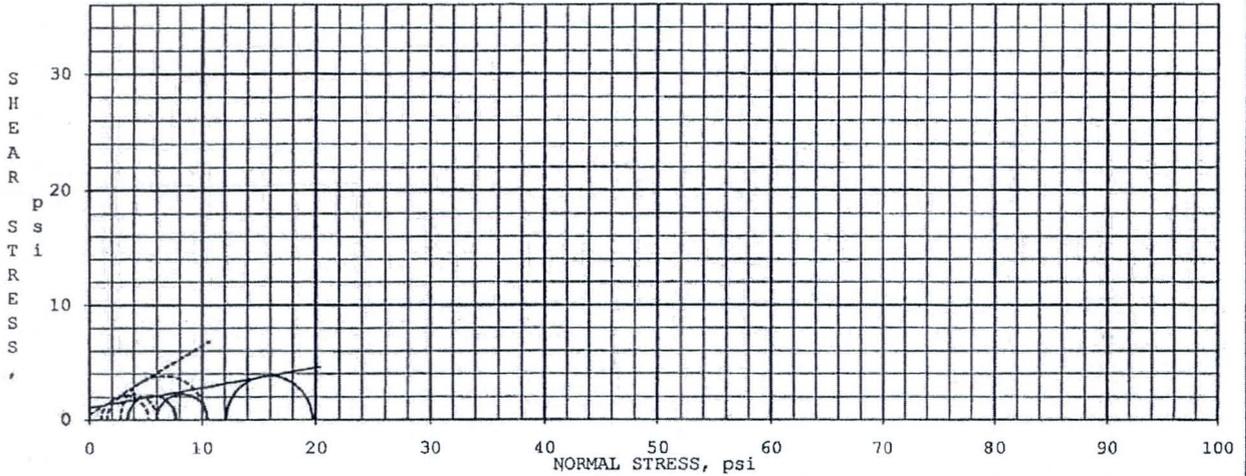
GRAIN SIZE DISTRIBUTION CURVE

BORING ID	SAMPLE ID	DEPTH, feet	USCS DESCRIPTION	UNIFIED SYMBOL	NAT M%	ATTERBERG LIMITS		
						LL	PL	PI
#47	EAST SIDE		SILTY SAND	SM		NP	NP	NP

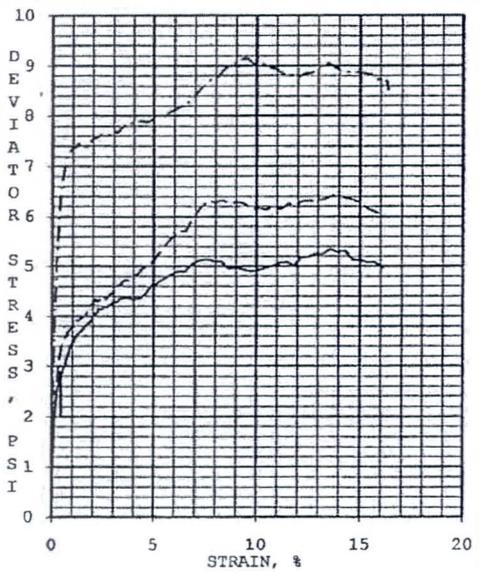
PROJECT RAINBOW VALLEY

JOB NO. 65101872 DATE 2/24/2011





EFFECTIVE STRESS ---	ANGLE OF INTERNAL FRICTION, deg	30.9	COHESION, psi	0.5
TOTAL STRESS ———	ANGLE OF INTERNAL FRICTION, deg	9.8	COHESION, psi	1.1



SPECIMEN ID:		A	B	C
INITIAL	WATER CONTENT, %	3.8	3.8	3.9
	DRY DENSITY, pcf	105.5	105.5	105.4
	SATURATION, %	17	17	18
	VOID RATIO	0.60	0.60	0.60
BEFORE SHEAR	WATER CONTENT, %	21.9	21.2	19.5
	DRY DENSITY, pcf	105.8	107.2	110.4
	SATURATION (B PARAMETER)	0.97	0.98	0.96
	VOID RATIO	0.59	0.57	0.53
	FINAL BACK PRESSURE, psi	98.9	99.4	99.4
MINOR PRINCIPAL STRESS, psi		3.4	6.0	12.1
EFFECTIVE STRESS PEAK AT % STRAIN		3.0	3.0	3.0
EFF. DEVIATOR STRESS AT PEAK STRAIN, psi		4.3	4.5	7.6
TOTAL STRESS PEAK AT % STRAIN		3.0	3.0	3.0
TOTAL DEVIATOR STRESS AT PEAK STRAIN, psi		4.3	4.5	7.6
ULTIMATE DEVIATOR STRESS (15% STR), psi		5.1	6.3	8.9
TIME TO 50% PRIMARY CONSOLIDATION, min		0.32	0.42	0.40
STRAIN RATE, % / hour		8.11	8.11	8.24
INITIAL DIAMETER, inch		2.016	2.016	2.016
INITIAL HEIGHT, inch		4.000	4.000	4.000
AREA AFTER CONSOLIDATION, inch <sup>2</sup>		3.200	3.175	3.111
CONTROLLED - STRAIN TEST				
SAMPLE TYPE: RE-COMPACTED				
DESCRIPTION OF SPECIMENS: CLAYEY SAND				
LL 24	PL 16	PI 8	Gs 2.7 EST.	
PROJECT NO. 65101872		PROJECT: RAINBOW VALLEY		
		BORING #: #51 Base		
LABORATORY: TERRACON - LENEXA		SAMPLE #: WEST SIDE		
DATE: 3/14/2011		DEPTH, feet:		

PROCEDURE: ASTM D4767, CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS

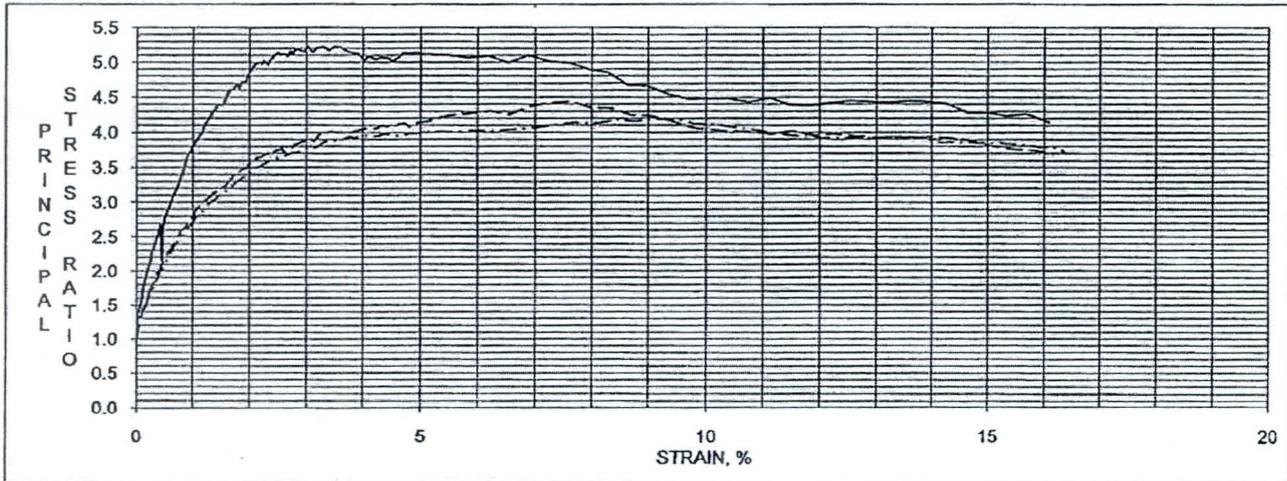
**Terracon**

RAINBOW VALLEY

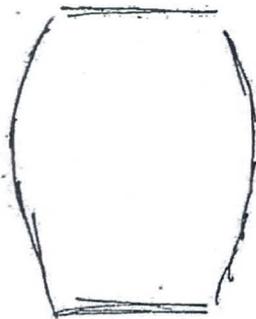
65101872

#51

WEST SIDE

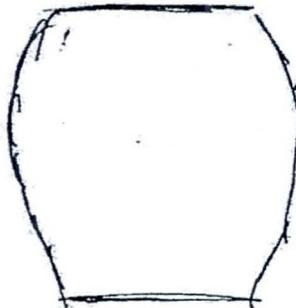


FAILURE SKETCH



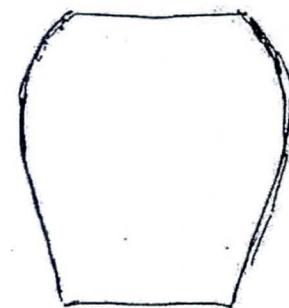
SPECIMEN A

FAILURE SKETCH



SPECIMEN B

FAILURE SKETCH



SPECIMEN C

REMARKS:

SPECIMENS SATURATED BY THE WET METHOD.  
 EFFECTIVE STRESS FAILURE DATA BASED ON 3 % STRAIN.  
 EFFECTIVE STRESS MOHR'S CIRCLES DRAWN AT 3 % STRAIN.  
 TOTAL STRESS FAILURE DATA BASED ON 3 % STRAIN.  
 TOTAL STRESS MOHR'S CIRCLES DRAWN AT 3 % STRAIN.  
 DEVIATOR STRESSES CORRECTED FOR MEMBRANE AND FILTER PAPER EFFECTS.  
 AREA AFTER CONSOLIDATION CALCULATED AS PER SECTION 10.3.2.1 METHOD A

STANDARD PROCTOR = 105.2pcf @ 4.1% MOISTURE

REMOLED TO 105.5 pcf @ 3.8% MOISTURE

REMOLED TO 100.3% COMPACTION

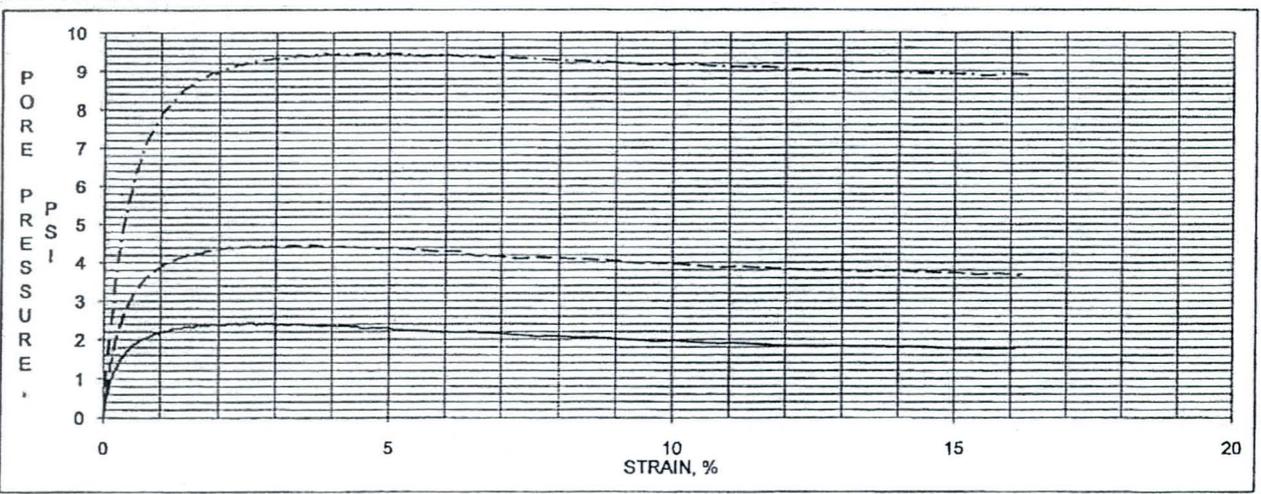
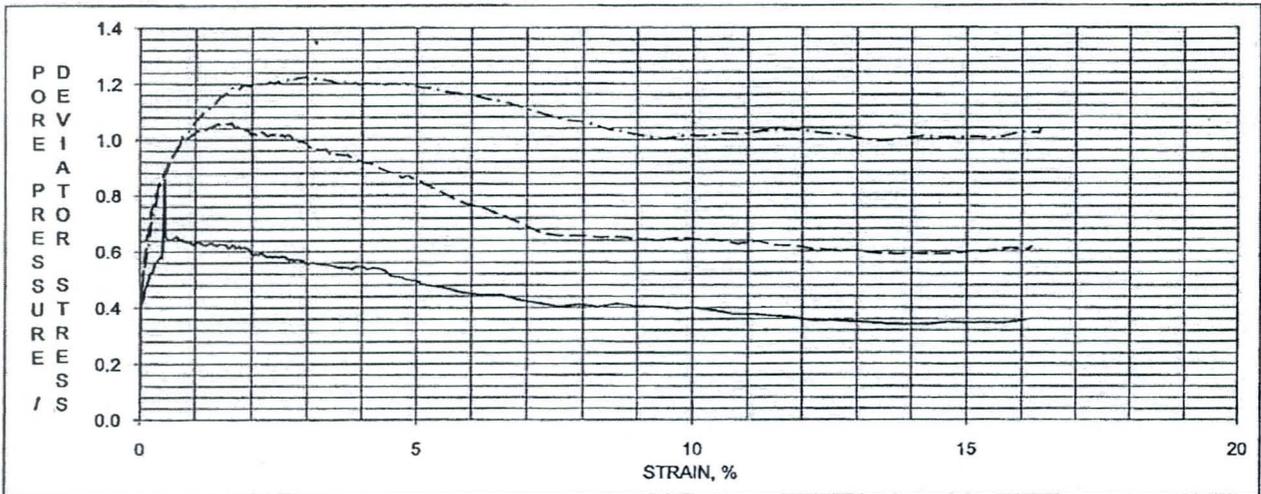
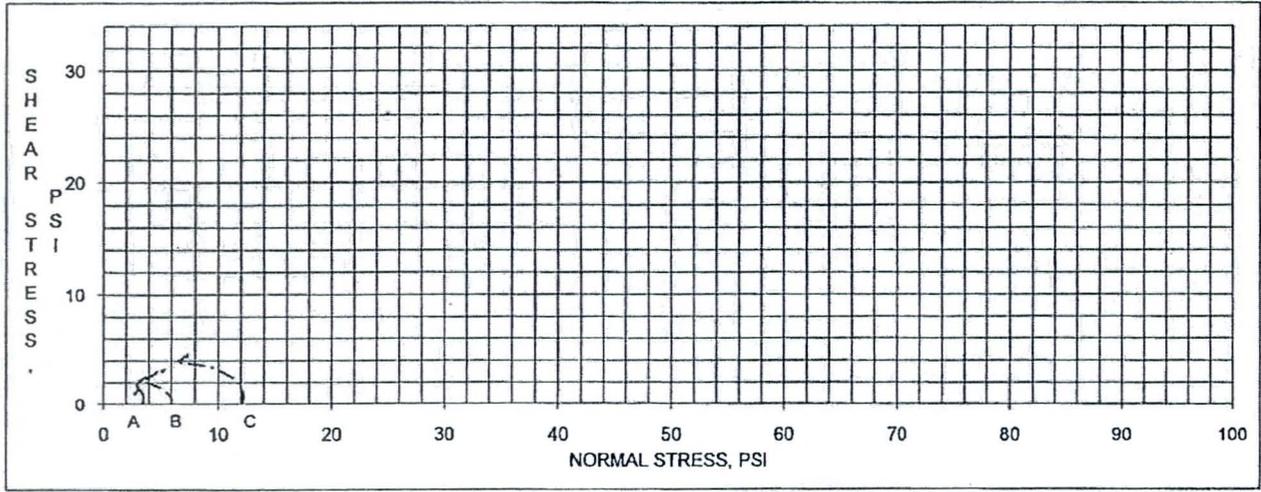
**Terracon**

RAINBOW VALLEY

65101872

#51

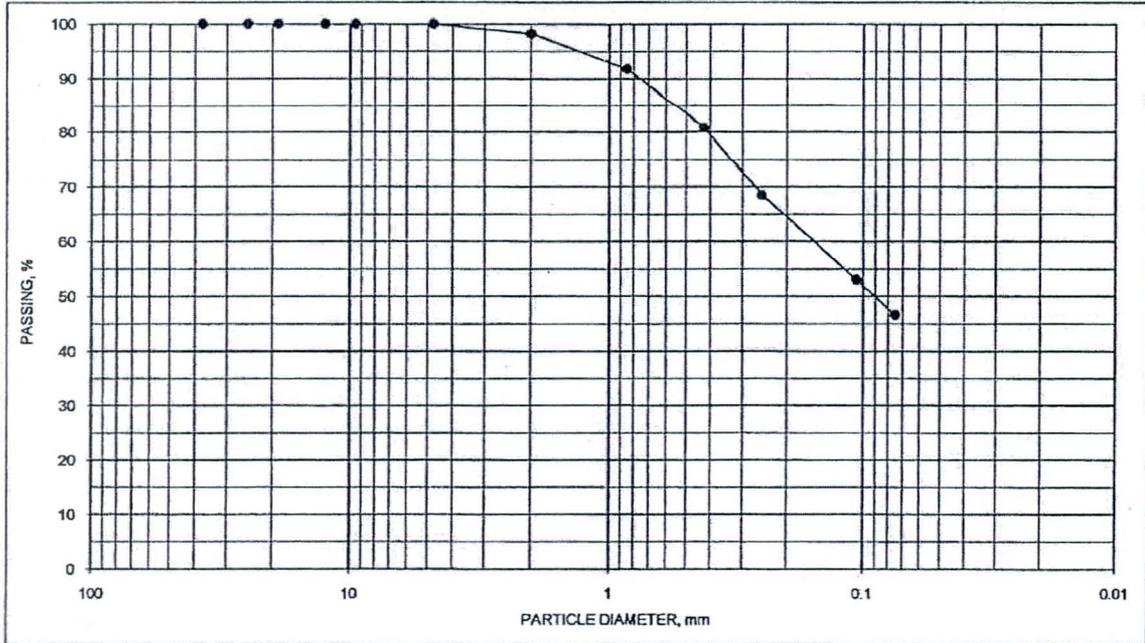
WEST SIDE



Terracon

SIEVE SIZE	DIAMETER, mm	PASS, %
1.5"	37.5	100
1"	25.0	100
3/4"	19.0	100
1/2"	12.5	100
3/8"	9.50	100
#4	4.75	100
#10	2.00	95
#20	0.850	92
#40	0.425	81
#60	0.250	69
#140	0.106	53
#200	0.075	46.5

D60 0.1559

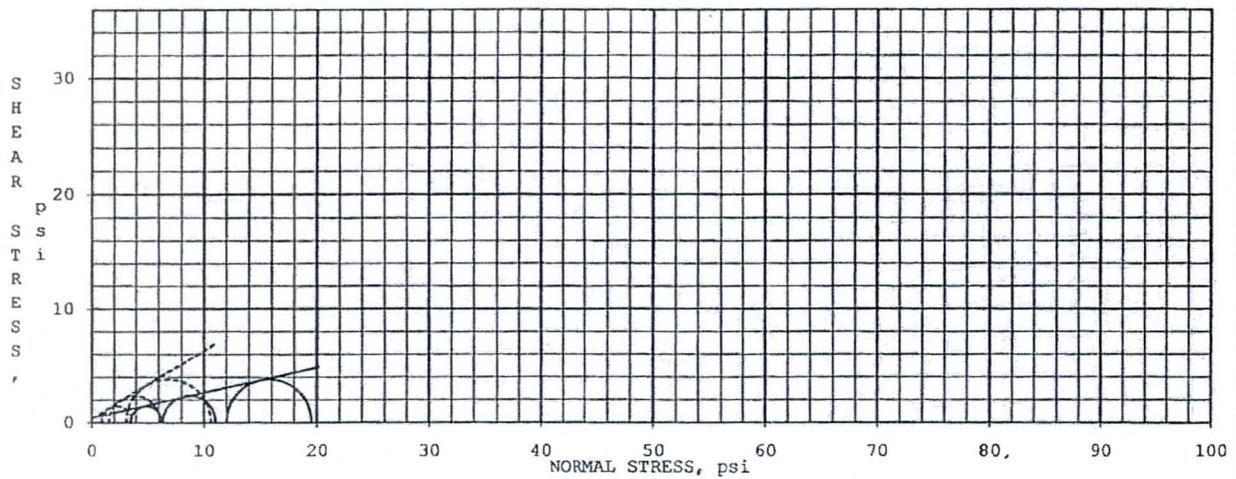


GRAIN SIZE DISTRIBUTION CURVE

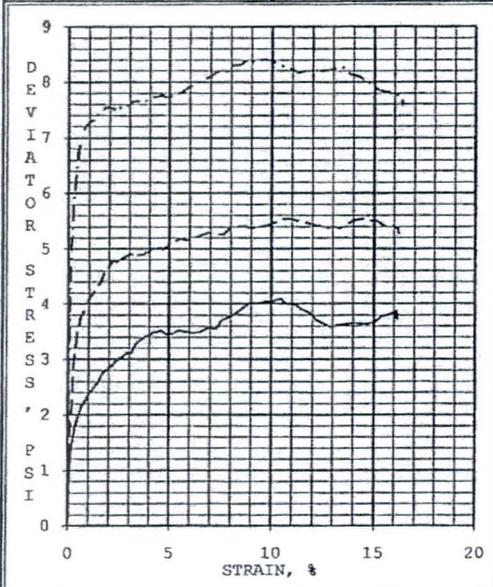
BORING ID	SAMPLE ID	DEPTH, feet	USCS DESCRIPTION	UNIFIED SYMBOL	NAT M%	ATTERBERG LIMITS		
						LL	PL	PI
#51	WEST SIDE		CLAYEY SAND	SC		24	16	8

PROJECT RAINBOW VALLEY

JOB NO. 65101872 DATE 2/24/2011



EFFECTIVE STRESS ---	ANGLE OF INTERNAL FRICTION, deg	30.7	COHESION, psi	0.3
TOTAL STRESS —	ANGLE OF INTERNAL FRICTION, deg	12.5	COHESION, psi	0.4



SPECIMEN ID:		A	B	C	
INITIAL	WATER CONTENT, %	4.0	4.1	4.1	
	DRY DENSITY, pcf	97.2	97.1	97.0	
	SATURATION, %	15	15	15	
	VOID RATIO	0.73	0.74	0.74	
BEFORE SHEAR	WATER CONTENT, %	26.2	26.2	24.1	
	DRY DENSITY, pcf	98.7	98.6	102.1	
	SATURATION (B PARAMETER)	0.99	0.97	0.97	
	VOID RATIO	0.71	0.71	0.65	
FINAL BACK PRESSURE, psi		99.7	99.2	99.3	
MINOR PRINCIPAL STRESS, psi		3.5	6.4	12.0	
EFFECTIVE STRESS PEAK AT % STRAIN		2.0	2.0	2.0	
EFF. DEVIATOR STRESS AT PEAK STRAIN, psi		2.8	4.7	7.6	
TOTAL STRESS PEAK AT % STRAIN		2.0	2.0	2.0	
TOTAL DEVIATOR STRESS AT PEAK STRAIN, psi		2.8	4.7	7.6	
CONTROLLED - STRAIN TEST		ULTIMATE DEVIATOR STRESS (15% STR), psi	3.7	5.5	7.9
SAMPLE TYPE: RE-COMPACTED		TIME TO 50% PRIMARY CONSOLIDATION, min	5.00	0.90	0.43
DESCRIPTION OF SPECIMENS: CLAYEY SAND		STRAIN RATE, % / hour	8.16	8.16	8.37
		INITIAL DIAMETER, inch	2.016	2.016	2.016
		INITIAL HEIGHT, inch	4.000	4.000	4.000
LL 26   PL 16   PI 10   Gs 2.7 EST.	AREA AFTER CONSOLIDATION, inch <sup>2</sup>	3.170	3.186	3.106	
PROJECT NO. 65101872		PROJECT: RAINBOW VALLEY			
		BORING #: #51			
LABORATORY: TERRACON - LENEXA		SAMPLE #: EAST SIDE			
DATE: 3/7/2011		DEPTH, feet:			

PROCEDURE: ASTM D4767, CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS

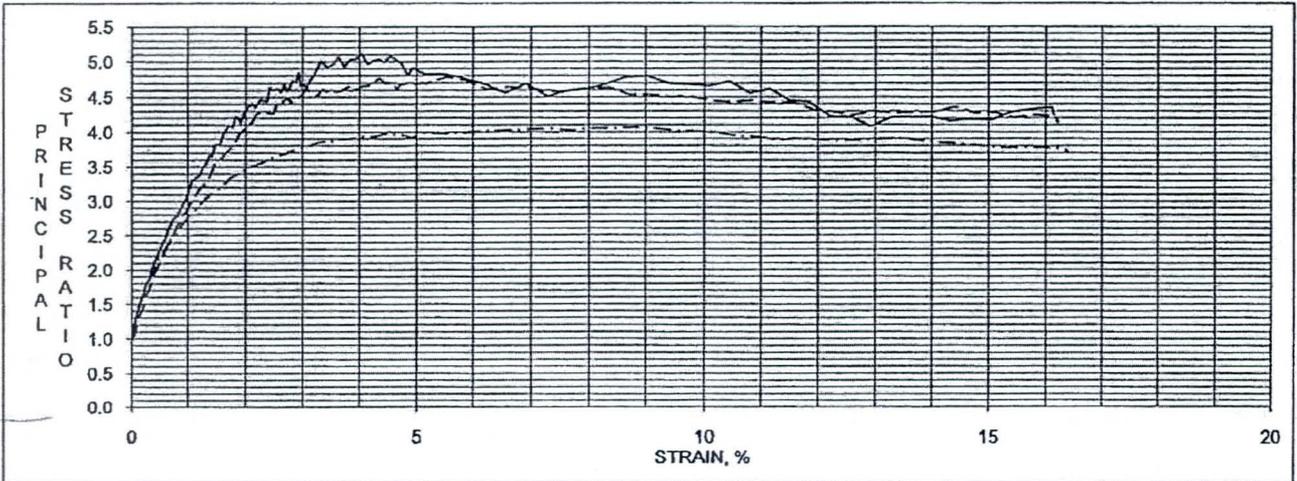
**Terracon**

RAINBOW VALLEY

65101872

#51

EAST SIDE



FAILURE SKETCH



SPECIMEN A

FAILURE SKETCH



SPECIMEN B

FAILURE SKETCH



SPECIMEN C

REMARKS:

SPECIMENS SATURATED BY THE WET METHOD.  
 EFFECTIVE STRESS FAILURE DATA BASED ON 2 % STRAIN.  
 EFFECTIVE STRESS MOHR'S CIRCLES DRAWN AT 2 % STRAIN.  
 TOTAL STRESS FAILURE DATA BASED ON 2 % STRAIN.  
 TOTAL STRESS MOHR'S CIRCLES DRAWN AT 2 % STRAIN.  
 DEVIATOR STRESSES CORRECTED FOR MEMBRANE AND FILTER PAPER EFFECTS.  
 AREA AFTER CONSOLIDATION CALCULATED AS PER SECTION 10.3.2.1 METHOD A

STANDARD PROCTOR = 96.8pcf @ 4.4% MOISTURE

REMOLED TO 97.1 pcf @ 4.1% MOISTURE

REMOLED TO 100.3% COMPACTION

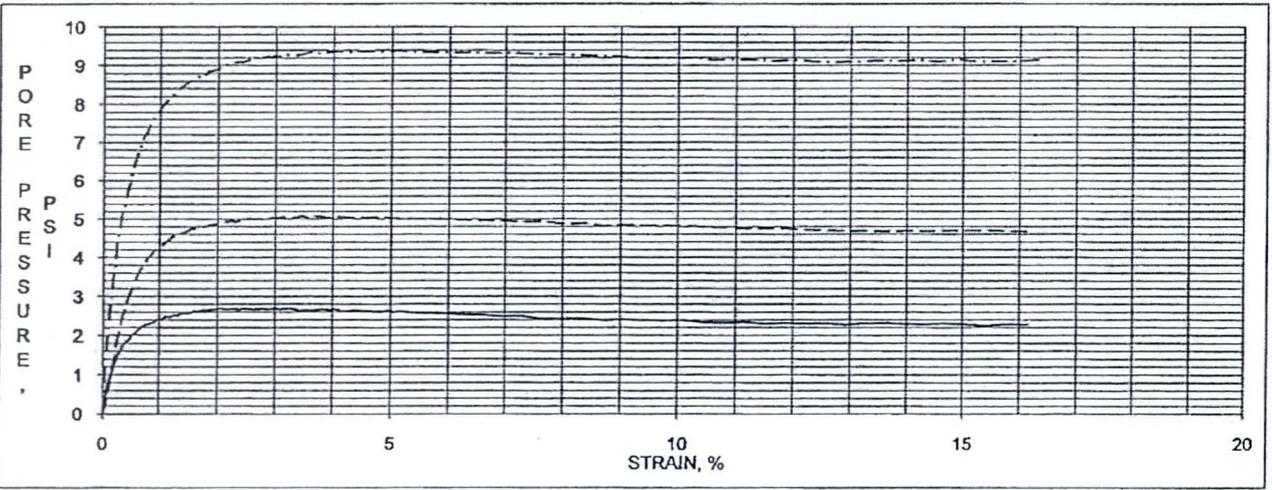
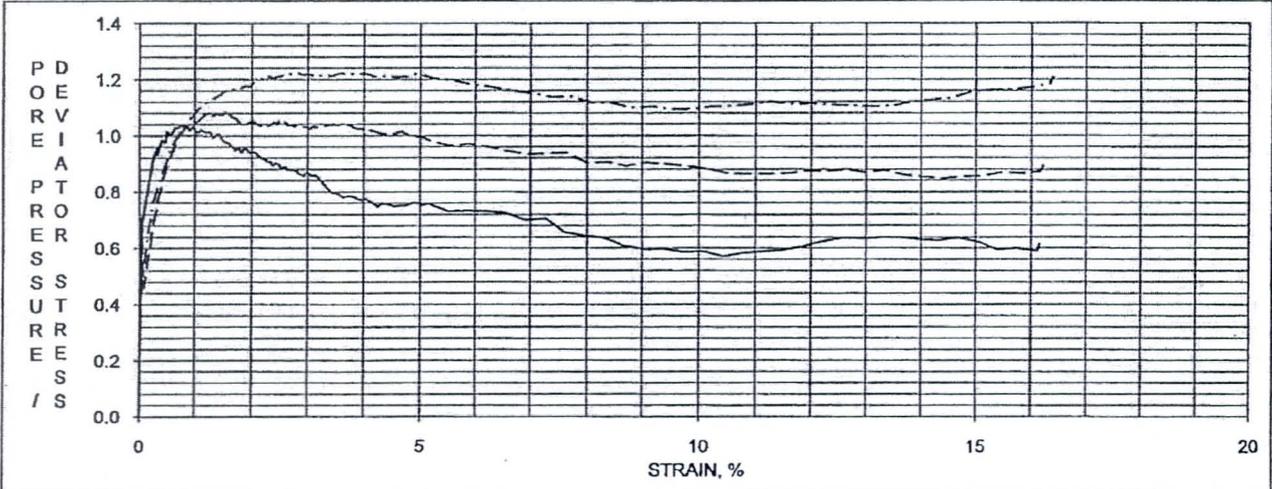
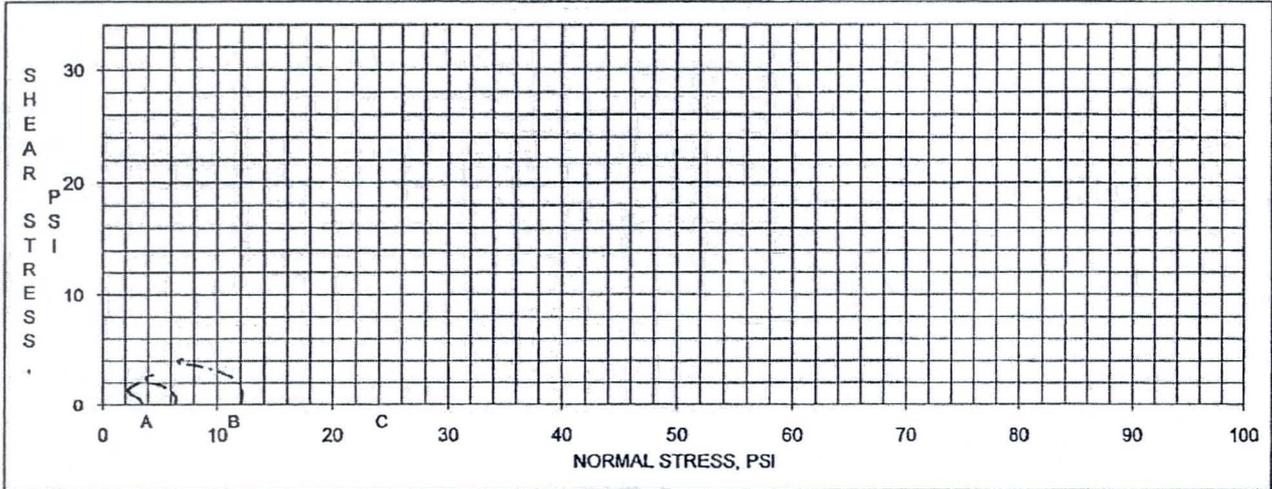
**Terracon**

RAINBOW VALLEY

65101872

#51

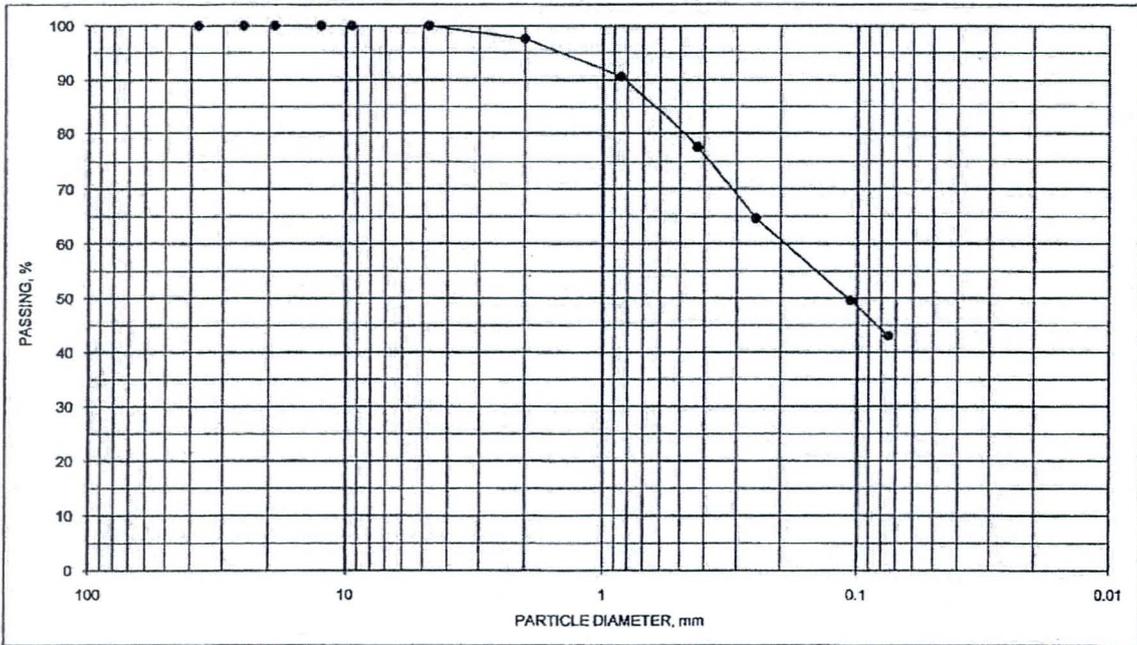
EAST SIDE



Terracon

SIEVE SIZE	DIAMETER, mm	PASS, %
1.5"	37.5	100
1"	25.0	100
3/4"	19.0	100
1/2"	12.5	100
3/8"	9.50	100
#4	4.75	100
#10	2.00	98
#20	0.850	91
#40	0.425	78
#60	0.250	65
#140	0.106	50
#200	0.075	43.0

D60 0.1919



GRAIN SIZE DISTRIBUTION CURVE

BORING ID	SAMPLE ID	DEPTH, feet	USCS DESCRIPTION	UNIFIED SYMBOL	NAT M%	ATTERBERG LIMITS		
						LL	PL	PI
#51	EAST SIDE		CLAYEY SAND	SC		28	16	10

PROJECT RAINBOW VALLEY

JOB NO. 65101872 DATE 2/24/2011

N:\CMLAB\_DATA\00 Projects in Progress\2010 Projects in Progress\65101872 Lab Data\65101872 Grad\LPot #51 EASTSIDE.vlm\GRADATION





## **APPENDIX B**

- CD – DDMSW FILES, KINEROS2 FILES, AND SUPPORTING DOCUMENTS

## **CD**

- **DDMSW FILES**