

**GEOTECHNICAL ENGINEERING
SERVICES REPORT
NO. 1-40106**

**NM 4 WATERLINE REPLACEMENT
LOS ALAMOS COUNTY, NEW MEXICO**

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PREPARED FOR:

**LOS ALAMOS COUNTY
DEPARTMENT OF PUBLIC UTILITIES**



May 16, 2024
Job No. 1-40106

**Los Alamos County
Department of Public Utilities
1000 Central Ave., Suite 130
Los Alamos, NM 87544**

ATTN: Michelle Martinez

RE: Geotechnical Engineering Services Report
NM 4 Waterline Replacement
Los Alamos County, New Mexico

Dear Ms. Martinez:

Submitted herein is the Geotechnical Engineering Services Report for the above-referenced project. The report contains the results of our field investigation, laboratory testing, and criteria pertaining to below grade utility installation.

It has been a pleasure to serve you on this project. If you should have any questions, please contact this office.

Respectfully submitted:
GEO-TEST, INC.

Patrick R. Whorton, PE



Reviewed By:

Patrick J. Byres, PE

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Table of Contents

INTRODUCTION..... 4
PROPOSED CONSTRUCTION 4
FIELD EXPLORATION 4
LABORATORY TESTING 5
SURFACE CONDITIONS 5
SUBSURFACE SOIL CONDITIONS 5
CONCLUSIONS AND RECOMMENDATIONS 6
EXCAVATION & BACKFILL..... 6
FOUNDATION REVIEW AND INSPECTION..... 8
CLOSURE..... 8
BORING LOCATION MAPS..... 10
SITE PHOTOGRAPH..... 11
BORING LOGS 12
SUMMARY OF LABORATORY RESULTS..... 16
GRAIN SIZE DISTRIBUTION..... 17

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INTRODUCTION

This report presents the results of the geotechnical engineering services investigation performed by this firm for the proposed NM 4 Waterline Replacement project in Los Alamos, New Mexico.

The objectives of this investigation were to:

- 1) Evaluate the nature and engineering properties of the subsurface soils underlying the site.
- 2) Provide recommendations for subsurface utility installation including excavation and backfill criteria.

The investigation includes subsurface exploration, selected soil sampling, laboratory testing of the samples, performing an engineering analysis and preparation of this report.

PROPOSED CONSTRUCTION

It is understood that the project consists of the replacement of approximately 3 to 4 miles of water transmission line along NM 4. The new line will be installed approximately 4 feet below the existing roadway surface.

Should project details vary significantly from those outlined above, this firm should be notified for review and possible revision of the recommendations contained herein.

FIELD EXPLORATION

A total of four (4) exploratory borings were performed. Three (3) borings, Boring 6, 7 & 8 were drilled to a depth of 10 feet below existing surface grades. At the Boring 5 location at a depth of approximately 4 feet, the existing waterline was penetrated with the split spoon sampler. As shown in Photo 1 in a later section of this report, the existing waterline was not spotted in the correct location. After the line was hit at the Boring 5 location, the remaining borings, Boring 1, 2, 3, & 4 were not performed at the request of Los Alamos County.

Locations of the borings are shown on the attached Boring Location Map, Figure 1. The soils encountered in the completed borings were continuously examined, visually classified and logged during the drilling operation. The boring logs are presented in a following section of this report. Drilling was accomplished using a truck mounted drill rig equipped with 2.25-inch inner diameter hollow stem auger. Subsurface soils were sampled at five foot intervals or less utilizing an open tube split barrel sampler driven by a standard penetration test hammer.

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LABORATORY TESTING

Selected samples were tested in the laboratory to determine certain engineering properties of the soils. Moisture contents were determined to evaluate the various soil deposits with depth. The results of these tests are shown on the boring logs.

Sieve analysis and Atterberg limits tests were performed to aid in soil classification. The results of these tests are presented in the Summary of Laboratory Results and on the individual test reports presented in a following section of this report.

SURFACE CONDITIONS

A brief site reconnaissance was performed during our site exploration. The proposed waterline will be installed along NM 4 between White Rock and the East Jemez Rd. intersection. NM 4 is a two-lane asphalt paved roadway with existing subsurface utilities running beneath the shoulders. The roadway passes through Cedro Canyon, a relatively low-lying area bordered on either side by tuff bluffs.

SUBSURFACE SOIL CONDITIONS

As indicated by the exploratory borings the subsurface profile varied from each location explored.

At the Boring 5 location, above the existing waterline, medium dense low plasticity silty sand was encountered at the surface and extended to the waterline where the boring was terminated. This silty sand is processed fill primarily composed of weathered tuff.

At the Boring 6 location, very loose to loose low plasticity silt with sand was encountered and extended to the full depth explored. These soils are likely composed of some near surface man-made fill over deeper colluvial deposits of weathered tuff.

At the Boring 7 location, moderately firm low plasticity clayey sand was encountered at the surface and extended to a depth of 2 feet below surface grade where medium dense to dense non-plastic silty sand was encountered and extended to the full depth explored. These soils are likely composed of some near surface man-made fill over deeper colluvial deposits of weathered tuff.

At the Boring 8 location, moderately firm low plasticity clayey sand was encountered at the surface and extended to a depth of 2 feet below surface grade where medium dense low plasticity silty sand was encountered and

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extended to a depth of 6 feet below surface grade where firm non-plastic pumice was encountered and extended to a depth of 9 feet below surface grade where firm non-plastic weathered tuff was encountered and extended to the full depth explored.

No free groundwater was encountered in the borings and soil moisture contents were relatively low to moderate throughout the extent of the borings.

CONCLUSIONS AND RECOMMENDATIONS

As discussed in the previous section, the subsurface soils encountered along the proposed waterline alignment primarily consisted of natural colluvial deposits as well as man-made fills. Weak rock consisting of weathered tuff and pumice was encountered at the Boring 8 location.

Excavation of the subsurface soils throughout the site may be accomplished using normal earthmoving equipment and excavated soils may be reused as utility backfill given adequate processing to meet the specifications provided in the following section.

The existing near surface soils underlying the site classify as A-4 and A-2-4 according to the American Association of State Highway and Transportation Officials (AASHTO) soil classification system. According to the NMDOT, these soils possess correlated R-values ranging from 20 to 53 and are considered moderate to excellent subgrade soils for pavements.

Excavation of subsurface rock may also be accomplished with normal earthmoving equipment, although additional effort may be required. Based on the results of this investigation, difficult excavation is not anticipated, however, based on our experience in the area, hard tuff may be present along the alignment which may require the use of heavy ripping or rock breaking equipment to excavate. Although it is anticipated that a majority of the alignment may be excavated with normal earthmoving equipment, contractors should be prepared to utilize rock breaking equipment as required and at their discretion to complete the required excavations. Excavated tuff may be processed and reused and trench backfill, provided the resulting material meets the specifications included in the following section.

EXCAVATION & BACKFILL

Excavated slopes for foundation and utility construction should be designed and constructed in accordance with 29 CFR 1926, Subpart P, and any applicable state or local regulations. Excavated temporary slopes should not exceed 1.5 to 1 (horizontal to vertical). Shoring is recommended and should be designed by a qualified engineer utilizing the results of this investigation. Should additional soil data be required for shoring design; it may be provided

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by this firm upon request. Benching of temporary slopes may be conducted at the contractor's discretion provided all applicable safety standards are followed and the average slope is no steeper than 1.5:1.

Excavation of the onsite soils can be readily accomplished using normal earthmoving equipment. Areas of hard tuff may require additional effort.

All utility trench backfill should meet the fill specifications and should be placed according to the method outlined below:

- 1) The results of this investigation indicate that most of the onsite soils will be suitable for use as backfill, although some blending may be required to meet the specifications presented below. Any imported material must also meet the criteria for backfill.
- 2) All backfill should be free of vegetation and debris and contain no rocks larger than 3 inches. Gradation of the backfill material, as determined in accordance with ASTM D-422, should be as follows:

Size	Percent Passing
3 inch	100
No. 4	60 - 100
No. 200	5 - 60

- 3) The plasticity index of the structural fill should be no greater than 15 when tested in accordance with ASTM D-4318.
- 4) Bedding and pipe embedment materials to be used around the pipes should conform to the pipe manufacturer's recommendations and should be placed and compacted in accordance with project specifications, local requirements or governing jurisdiction.
- 5) All onsite soils are suitable for use as utility trench backfill provided, they are free of vegetation and debris and contain no rocks larger than 3 inches.
- 6) Structural fill and utility backfill, consisting of soils approved by the geotechnical engineer, shall be placed in 8 inch loose lifts and compacted with approved compaction equipment. Loose lifts should be reduced to 4 inches if handheld compaction equipment is used. All compaction of fill or backfill shall be accomplished to a minimum of 95 percent of the maximum dry density as determined in accordance with ASTM D-1557. The moisture content of the structural fill during compaction should be within 2 percent of the optimum moisture content.

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- 7) Tests for degree of compaction should be determined by the ASTM D-1556 method or ASTM D-6938. Observation and field tests should be carried on during fill and backfill placement by the geotechnical engineer to assist the contractor in obtaining the required degree of compaction. If less than 95 percent is indicated, additional compaction effort should be made with adjustment of the moisture content as necessary until 95 percent compaction is obtained.

REVIEW AND INSPECTION

This report has been prepared to aid in the evaluation of this site and to assist in the design of this project. It is recommended that the geotechnical engineer be provided the opportunity to review the final design drawings and specifications in order to determine whether the recommendations in this report are applicable to the final design. Review of the final design drawings and specifications should be noted in writing by the geotechnical engineer.

In order to permit correlation between the conditions encountered during construction and to confirm recommendations presented herein, it is recommended that the geotechnical engineer be retained to perform continuous observations and testing during the earthwork portion of this project.

CLOSURE

Our conclusions, recommendations and opinions presented herein are:

- 1) Based upon our evaluation and interpretation of the findings of the field and laboratory program.
- 2) Based upon an interpolation of soil conditions between and beyond the explorations.
- 3) Subject to confirmation of the conditions encountered during construction.
- 4) Based upon the assumption that sufficient observation will be provided during construction.
- 5) Prepared in accordance with generally accepted professional geotechnical engineering principles and practice.

This report has been prepared for the sole use of Los Alamos County specifically to aid in the design of the NM 4 Waterline Replacement project in Los Alamos County, New Mexico and not for use by any third parties without consent.

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We make no other warranty, either expressed or implied. Any person using this report for bidding or construction purposes should perform such independent investigation as they deem necessary to satisfy themselves as to the surface and subsurface conditions to be encountered and the procedures to be used in the performance of work on this project. If conditions encountered during construction appear to be different than indicated by this report, this office should be notified.

All soil samples will be discarded 60 days after the date of this report unless we receive a specific request to retain the samples for a longer period of time.

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BORING LOCATION MAP



NM 4 Waterline Replacement
Los Alamos County, New Mexico
Job No. 1-40106

Figure 1



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GEOTECHNICAL ENGINEERING
AND MATERIAL TESTING



NM 4 Waterline Replacement
Los Alamos, New Mexico
Job No. 1-40106

Ruptured Waterline @ Boring 5
Photo 1

GEO-TEST
GEOTECHNICAL ENGINEERING
AND MATERIAL TESTING



Project: NM 4 Waterline Replacement

Date: 04/16/2024

Project No: 1-40106

Elevation:

Type: 2.25" ID HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 5

During Drilling: none

After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE						SUBSURFACE PROFILE	
		SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION	N blows/ft
									20 40 60 80
			SS	7-8-9 17	15		SM	SILTY SAND, low plasticity, medium dense, moist, brown	17
			SS	3-3-0 3					3
5								Stopped Auger @ 2.5 feet Hit existing WATERLINE with sampler @ 4 feet - halted drilling operation	
10									
15									

LOG OF TEST BORING 1-40106.GPJ GEO TEST.GDT 5/15/24

LEGEND

SS - Split Spoon
AC - Auger Cuttings
UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level
CS - Continuous Sampler
UD - Undisturbed
ST - Shelby Tube

Stratification lines represent approximate boundaries between soil types. Transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to factors other than those present at the time measurements were made.



Project: NM 4 Waterline Replacement

Date: 04/16/2024

Project No: 1-40106

Elevation:

Type: 2.25" ID HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 6

During Drilling: none

After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE						SUBSURFACE PROFILE	
		SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION	N blows/ft
									20 40 60 80
			SS	2-1-2 3	10				3
			SS	2-3-4 7	7				7
5			SS	2-3-3 6	6		ML	SILT with SAND, low plasticity, very loose to loose, moist to slightly moist, light brown to purpleish brown	6
			SS	2-1-2 3	6				3
10			SS	2-2-2 4	6				4
							Stopped Auger @ 9 feet Stopped Sampler @ 10.5 feet		
15									

LOG OF TEST BORING 1-40106.GPJ GEO TEST.GDT 5/15/24

LEGEND

SS - Split Spoon
AC - Auger Cuttings

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Project: NM 4 Waterline Replacement

Date: 04/16/2024

Project No: 1-40106

Elevation:

Type: 2.25" ID HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 7

During Drilling: none

After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE						SUBSURFACE PROFILE	
		SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION	N blows/ft
									20 40 60 80
			SS	3-5-4 9	18		SC	CLAYEY SAND, low plasticity, moderately firm, very moist, dark brown	19
			SS	7-12-13 25	10		SM	SILTY SAND, non-plastic, medium dense to dense, moist, brown to light brown	25
5			SS	9-13-20 33	12				33
			SS	12-15-20 35	7				35
10			SS	14-10-14 24	9				24
								Stopped Auger @ 9 feet Stopped Sampler @ 10.5 feet	
15									

LOG OF TEST BORING 1-40106.GPJ GEO TEST.GDT 5/15/24

LEGEND

SS - Split Spoon
AC - Auger Cuttings
UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level
CS - Continuous Sampler
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Project: NM 4 Waterline Replacement

Date: 04/16/2024

Project No: 1-40106

Elevation:

Type: 2.25" ID HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 8

During Drilling: none

After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE INTERVAL	SAMPLE					SUBSURFACE PROFILE	
			TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION	N blows/ft
									20 40 60 80
			SS	14-11-8 19	11		SC	CLAYEY SAND, low plasticity, moderately firm, moist, dark brown	19
			SS	4-6-8 14	14		SM	SILTY SAND, low plasticity, medium dense, moist, light brown	14
5			SS	9-9-12 21	13				21
			SS	7-8-10 18	12		SW-SM	WELL GRADED SAND with SILT (pumice), non-plastic, firm, moist, blueish gray	18
10			SS	12-12-10 22	12		TUFF	WEATHERED TUFF, non-plastic, firm, moist, light brown	22
								Stopped Auger @ 9 feet Stopped Sampler @ 10.5 feet	
15									

LOG OF TEST BORING 1-40106.GPJ GEO TEST.GDT 5/15/24

LEGEND

SS - Split Spoon

AC - Auger Cuttings

UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level

CS - Continuous Sampler

UD - Undisturbed

ST - Shelby Tube

Stratification lines represent approximate boundaries between soil types. Transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to factors other than those present at the time measurements were made.

SUMMARY OF LABORATORY RESULTS

						SIEVE ANALYSIS PERCENT PASSING											
TEST HOLE	DEPTH (FEET)	UNIFIED CLASS	(%) MOIST	LL	PI	NO 200	NO 100	NO 40	NO 10	NO 4	3/8"	1/2"	3/4"	1"	1 1/2"	2"	4"
5	1.0	SM	14.9	28	1	35	47	60	94	97	98	100					
6	1.0		9.5														
6	3.0		7.2														
6	5.0	ML	6.2	28	1	74	84	92	98	100							
6	8.0		6.5														
6	10.0		6.3														
7	1.0		18.3														
7	3.0	SC	9.5	32	10	48	71	82	99	100							
7	5.0		12.1														
7	8.0	SM	7.2	NP	NP	18	37	59	95	99	100						
7	10.0		8.8														
8	1.0		11.1														
8	3.0	SM	14.2	29	3	38	59	73	94	96	99	100					
8	5.0		13.4														
8	8.0	SW-SM	11.6	NP	NP	9	14	28	83	93	97	98	100				
8	10.0		11.5														

SUMMARY OF LABORATORY RESULTS 1-40106.GPJ GEO TEST.GDT 5/15/24



LL = LIQUID LIMIT
PI = PLASTICITY INDEX
NP = NON PLASTIC or NO VALUE

Project: NM 4 Waterline Replacement
Location: Los Alamos County, NM
Number: 1-40106

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	% <#200 Sieve	Classification	Water Content (%)	Dry Density (pcf)	AASHTO CLASS	Corr. R-Value
5	1.0	28	27	1	12.5	35	SM	14.9		A-2-4	53
6	1.0							9.5			
6	3.0							7.2			
6	5.0	28	27	1	4.75	74	ML	6.2		A-4	43
6	8.0							6.5			
6	10.0							6.3			
7	1.0							18.3			
7	3.0	32	22	10	4.75	48	SC	9.5		A-4	20
7	5.0							12.1			
7	8.0	NP	NP	NP	9.5	18	SM	7.2		A-2-4	55
7	10.0							8.8			
8	1.0							11.1			
8	3.0	29	26	3	12.5	38	SM	14.2		A-4	38
8	5.0							13.4			
8	8.0	NP	NP	NP	19	9	SW-SM	11.6		A-1-b	69
8	10.0							11.5			

SUMMARY AASHTO 1-40106.GPJ GEO-TEST.GDT 5/16/24

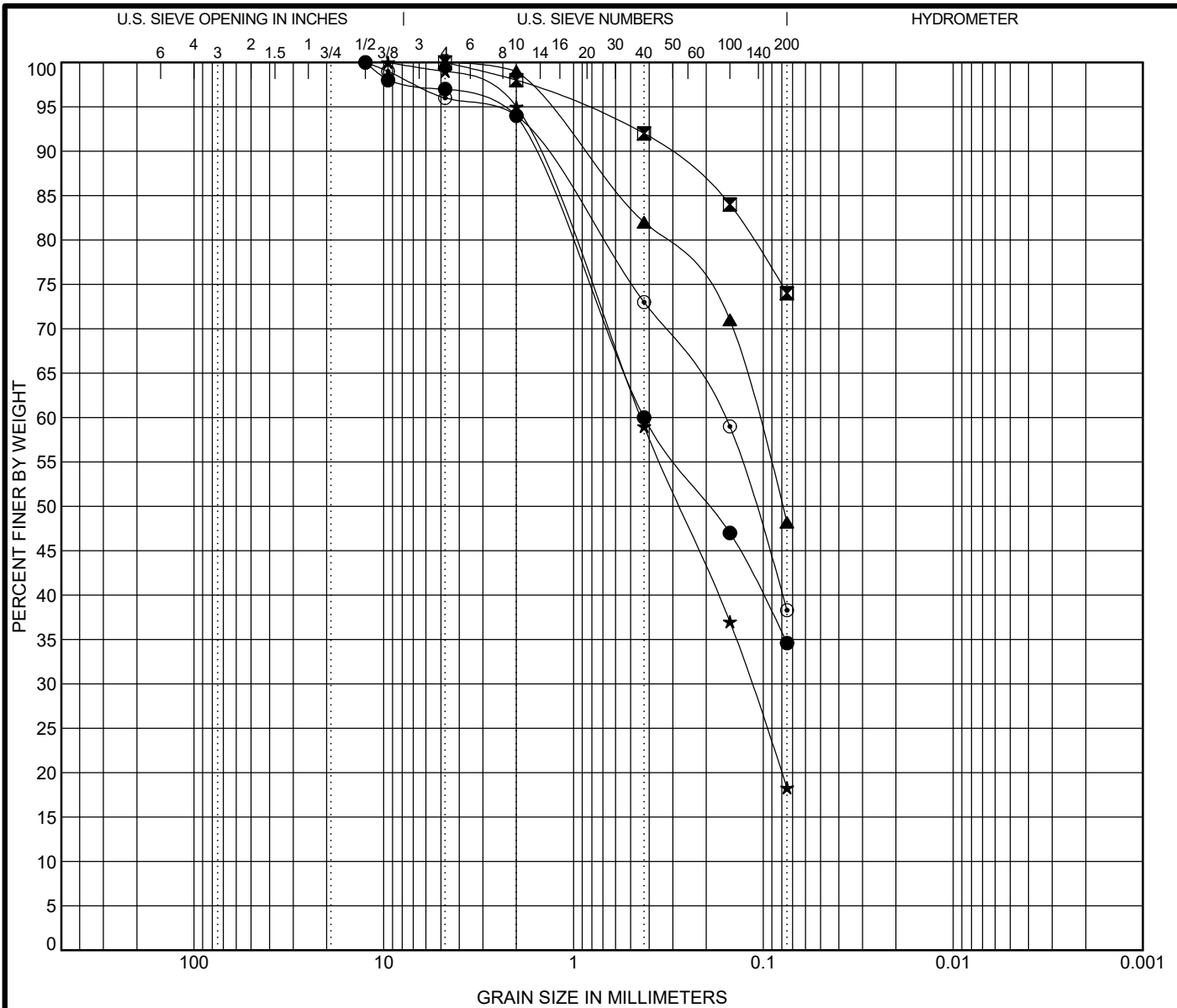


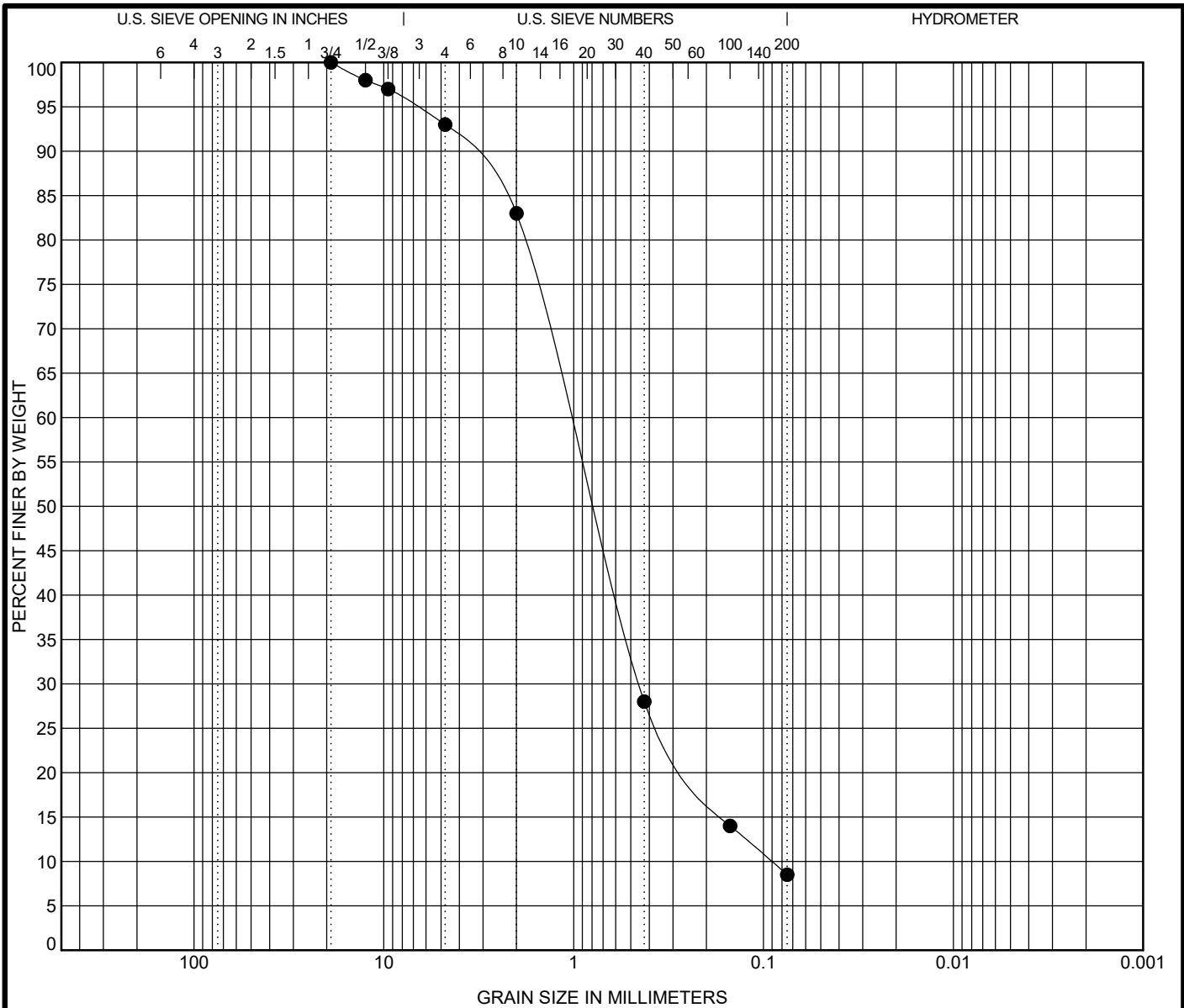
Summary of Laboratory Results

Project: NM 4 Waterline Replacement

Location: Los Alamos County, NM

Number: 1-40106





COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● 8 8.0	WELL-GRADED SAND with SILT(SW-SM)	NP	NP	NP	2.13	11.55

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 8 8.0	19	1.047	0.45	0.091	7.0	84.5	8.5	



GRAIN SIZE DISTRIBUTION

Project: NM 4 Waterline Replacement
 Location: Los Alamos County, NM
 Number: 1-40106

U.S. GRAIN SIZE 1-40106.GPJ GEO TEST.GDT 5/15/24