



REPORT

**ON THE SUBSOIL EXPLORATION
PERFORMED ALONG MAIN ROAD
FOR EL NUEVO COMANDANTE
PROJECT, CANÓVANAS, P.R.**

Submitted To

Land Development Associates, S.E.

Eng. Jorge García Massuet

Senior Vice-President

By:

Carlos A. Pérez, P.E.

Jaca & Sierra Testing Laboratories

Soil Consulting Engineers

December 4, 2006

Job No. 6453



REPORT

ON THE SUBSOIL EXPLORATION PERFORMED ALONG MAIN ROAD FOR EL NUEVO COMANDANTE PROJECT CANÓVANAS, PUERTO RICO

REPORT:

The present report covers the results of the geotechnical exploration performed along under consideration alignment for Main Road of El Nuevo Comandante project, Canóvanas Municipality.

The geotechnical exploration was performed by mean of five (5) shallow test borings at predetermined locations indicated us on submitted site plan.

The exploratory program has been directed to procure subsurface engineering soil data to be utilized principally in the formulation of the pertinent general design and construction recommendations to be followed covering the following aspects for this project.

- 1. General classification of the required project excavation earthwork along route alignment.*
- 2. Parameters for road design.*
- 3. General construction guides for fill sections.*

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To comply with the aforesaid scope, as previously discussed test borings advanced by means of powered hollow stem auger method were drilled at locations indicated on enclosed plan.

Samples secured were visual and manually described and examined for detection of weak plane or foreign matter that could undermine their shearing resistance, load bearing capacity as well as compressibility, routine laboratory tests were executed whenever possible.

The exploration program was undertaken as per conversation with Eng. Jorge García Massuet, Senior Vice-President of Land Development Associates, S.E. and as per accepted borings proposal dated September 26, 2006.

GENERAL SITE GEOLOGIC CONDITIONS:

The under consideration project is planned to be developed on El Nuevo Comandante Quarry site, which in conformity with Geologic Maps of the Carolina and Gurabo Quadrangles Puerto Rico lies in the following geologic formation.

Qa **ALLUVIUM AND RIVER-TERRACE DEPOSITS (HOLOCENE AND PLEISTOCENE)** – *Sand, clay, and sandy clay, beds of sand containing gravel at sides of Río Grande de Loíza. Thickness variable, possibly as great as 100 m.*

- Kfl** FRAILES FORMATION LEPROCOMIO MUDSTONE MEMBER
(UPPER CRETACEOUS) – *Thin to thick-bedded medium gray calcareous mudstone. Thickness 300-400 m.*
- Kf** FRAILES FORMATION (UPPER CRETACEOUS) – *Grayish-green medium to very thick bedded volcanic sandstone, in part pebbly; and fine to medium volcanic breccia. Thickness 700-800 m.*
- Kff** FRAILES FORMATION, LAVA FLOWS (UPPER CRETACEOUS) –
Basaltic to andesitic pillow lava.
- Tgl** GUARACANAL FORMATION, LIMESTONE MEMBER
(PALEOCENE) – *Medium to thick-bedded, medium-light-gray limestone containing abundant algal fragments. Thickness about 10-20 m.*

GENERALIZED SUBSOIL CONDITIONS:

The results of the exploratory work performed by means of test borings drilled along the under consideration route alignment uncovered the following general order of stratification corresponding to the local soil profile.

The explored strip of land representing the general ground of the proposed main road is found topped with man made fill deposit extending to depths varying from about 4.0 to 15.0 ft., which basically consist of yellowish brown and gray rock fragments and sandy silt matrix with rock pieces and small to large size boulders.

Underlying the aforesaid man-made fill deposit and extending to the end of the test holes, the exploration uncovered the virgin soil of the site corresponding to a rock formation. At test boring No. 1 beneath man-made fill a yellowish brown stiff silty clay was uncovered.

The ground water level of the explored strip of land was not encountered within the depths drilled below prevailing ground surface during the time of our field work.

However, temporary bodies of water might be entrapped within the existing fill and/or between the zone of transition of fill deposit and virgin soil.

The above information correspond to the general subsoil conditions of the area, however, for detailed description regarding the soil profile, field, and laboratory test results, please refer to enclosed boring logs.

RESULTS AND RECOMMENDATIONS:

The under consideration project which is to involve in the future the development of residential and commercial complex lies on a farm, which is being used since long time ago as a Quarry.

At present, as initiatory phase the planner and/or designers decided to explore the main road route with the performance of five (5) shallow test borings. Said main road alignment practically concur with existing dirt roads of the

quarry, which as per original topography of the farm fall on lower and higher grounds, which were filled or downgraded to present elevation.

The explored strip of land corresponding to main road alignment as per submitted topographic plan exhibits elevations varying from about 11.8 to 15.6 mts.

The results of the test borings performed along the proposed road uncovered a man-made fill deposit extending to depths in the order of 4.0 to 15.0 ft.

Said man-made fill deposit is mainly composed by rock fragments sandy silt matrix with rock pieces and small to large size boulders resting over natural soil corresponding to a rock formation, which was found at a profundity of 6.0 to 15.0 ft. beneath existing ground surface and varies its depth lengthwise and crosswise along the explored alignment.

Please notice that said man-made fill constructed long time ago as per observed on recovered samples was placed without following a controlled fill construction procedure containing variable amounts of rock fragments, huge rock pieces and huge boulders.

Taking in consideration the material used as backfill for dirt roads and contiguous areas prepared for mobilization of heavy equipment within the tract of land; since the existing explored strip of land maintain its service use as a main road and the loads to be transmitted in the future shall be not as great at present

use, we have considered that the principal settlements or subsidence associated with fill ramparts had practically occurred.

However, the principal aspects to size-up with said man made fill deposits shall be attributed to the huge rock pieces and huge boulders contained, which are to involve the use of fracturing equipment combined with explosives for their removal in order to provide space for project utilities and/or expected cuts if required to reach final grade elevation unknown as per today since the project as previously mentioned is on a initiatory or preliminary phase.

The rock formation natural deposit underlying man-made fill exhibits rock quality designation (RQD) ranging from of 60 to 100 (fair to excellent) and is to require the use of explosives for their removal. (The existing rocks outcrops and rock cut exposures are witness of said condition).

As per expounded on previous paragraphs in order to avoid expensive excavations costs it is recommended that the main road subgrade shall be established at a higher elevation than present by furnishing a fill foundation soil capable to provide space for project utilities and support for required pavement section.

SITE PREPARATION AND FILL CONSTRUCTION:

Prior to any filling or construction operations the under consideration route alignment shall be superficially removed from vegetation and any topsoil layer and surficial unsuitable material. The exact horizontal and vertical

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extension of unsuitable material shall be determined on the field during the progress of the earthwork operations.

The resulting exposed grade upon removal of any vegetation, topsoil and unsuitable material shall be proof rolled using heavy loaded truck.

Any weak spot encountered during the initial proof rolling operations shall be excavated and replaced with selected fill material properly placed and compacted as discussed ahead.

The removal of unsuitable material shall extend to fill rampart footprint.

The actual excavation of local beds of unsuitable material and their replacement with properly placed and compacted fill material, as previously mentioned, is a matter that has to be dealt with during the progress of earthwork operations.

The relative depth of excavation of unsuitable material is to vary between borings and within the explored area consequently, the project supervision engineer with the aid of his geotechnical staff shall delimit from visual observation said potential variations of excavation section directly in the progress of the earthwork excavation phase.

The above presented and anticipated contingencies can be effectively covered by providing in the contract documents with special provisions to cover unstable excavation areas with the corresponding replacement at a

preestablished unit price to be actually paid by field volume measurements of completed work.

Concluded the proof rolling operation and removal and replacing of weak areas the resulted subgrade shall be brought to an unyielding surface by compaction.

The fill material up to final grade elevation should be placed in successive layers not exceeding eight (8) inches uncompacted and each lift compacted to attain a minimum density of 95% of the fill material maximum dry density as obtained on typical compaction tests made according to AASHTO applicable designation and meeting the requirements of an A-2-4 classification or better material.

The controlled fill construction should be followed until final grade elevations are reached and these filling operations should be made under the direct supervision of a qualified soils laboratory.

The provision of the subgrade bed of A-2-4 or A-1-a of selected fill will permits the asphalt pavement design of the anticipated traffic loads using an estimated Resilient Modulus (MR) in the order of 24,000 to 30,000 psi respectively.

Nevertheless, the final design of the pavement structure, based on soil parameters, loads, and Average Daily Traffic (ADT) would determine the adequate pavement section for this project.

ADDITIONAL COMMENTS:

This soil report must be carefully studied and analyzed during this project design stage to coordinate those necessary office meetings to discuss and clarify any geotechnical aspects of the submitted general foundation design and earthwork construction recommendations.

The recommended office meetings are also directed to discuss and cover other additional foundation analysis and general earthwork recommendations not covered for any project structure or substructure and of any project additional earthwork not included in the present submitted soil report.

The present soil report with any necessary additional revisions as Addendum to soil report shall be made available to the bidding contractor to avoid any future contractor claims.

The above recommended office meetings during the project design stage, are necessary since our project general analysis, evaluation and formulation of the pertinent general foundation design and earthwork construction recommendations, have been formulated using advanced information.

Consequently, we strongly recommend that the recommendations covered on this soil report be revised after grading, are final elevations have been established, so that revised final recommendations can be submitted.

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Based on the results of the test borings program and on information available, the above geotechnical considerations are submitted for the preparation of the project design and cost estimates.

Each contractor bidding in this project shall obtain the opinion of a geotechnical engineer regarding the construction consideration for the preparation of his own project construction estimates.

All recommendations herein given are based on the spot checks, which constitute the test borings made within the buildable area, and are considered as representative subsoil conditions, which are and/or might be present along the project.

However, the fact does not exclude the disclosures of a different one than those found, once the construction phase starts.

Any abnormal condition hit-in between boring locations during the construction phase shall be notified to the soils engineer for further evaluation and to make the pertinent recommendations.

Please notice that the extension discussed is established by the boring locations for the purpose of estimated value, however, the actual extension occurs in a transition, consequently will varies.

We also recommend that the contractor be fully familiarized with the site working conditions, so, may program his work and perform it without endangering adjacent property not his working personnel.

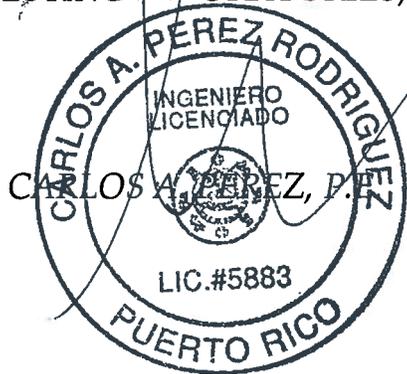
FIELD WORK:

The field work consisted of drilling five (5) test borings distributed as indicated on submitted plan along main road alignment. The test borings were performed using a hollow stem auger method as per ASTM D-1452.

The depth of the borings varied from 11.0 to 20.5 ft. with a total footage of 91.5 ln.ft. of borings drilled at the subject site.

Cordially yours,

JACA & SIERRA TESTING LABORATORIES, INC.



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Enclosure

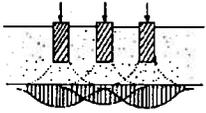
December 4, 2006

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Subsurface Exploration Field Log

Boring No.: 1
Job No.: 6453

PROJECT: HIPODROMO

Location: CANOVANAS, PR

Date Started: 11-17-06

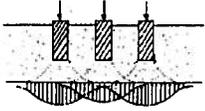
G.W. Depth ,ft. (☐): Not Found

Date: 11-17-06
Date: (☐):

Elevation:
North:
East:

Depth ft	Description of Material	Soil Graphic	"N" Value	W (%)	Qu (tsf)	Rc	RQD %
	Surface Elev.:						
0	Dark gray rock fragments and sandy silt (fill)		30	7			
		2					
	Rock fragments and asphalt pavements (fill)		41	1			
		4					
5	Reddish brown stiff silty clay		9	38	2.6		
		6					
	Yellowish brown and tan stiff silty clay		14	33	2.2		
10			10	39	3.1		
		14					
15	Yellowish brown and tan silty clay with highly weathered rock fragments		25	29			
		19					
20	Light brown and grayish brown weathered rock breaks into yellowish brown and brown sandy silt and variable weathered rock fragments		50/5"	32			
		20.5					
25							
30							

"N" - Number of blows required to drive the sampling spoon a distance of 12 in. with a 140 lbs hammer falling 30 in.
 "W" - Natural Moisture Content in percentage of dry weight. "☐" Initial G.W. Depth
 "Qu" - Unconfined Compressive strength in tons per square foot. "☐" Final G.W. Depth
 "Rc" - Core recovery in percent for each successive run. "Rqd" - Rock quality designation.
 "WH" - Sample was recovered by advancing the sampler with the weight of the hammer.
 "P" - A "P" in the Unconfined Compressive Strength test indicates the use of the pocket Penetrometer.



JACA & SIERRA TESTING LABORATORIES
Subsurface Exploration Field Log

Boring No.: 2
Job No.: 6453

PROJECT: *HIPODROMO*

Location: *CANOVANAS, PR*

Date Started: 11-9-06

G.W. Depth ,ft. (≍): Not Found

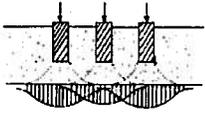
Date: 11-9-06

Date: (≍):

Elevation:
North:
East:

Depth ft	Description of Material	Soil Graphic	"N" Value	W (%)	Qu (tsf)	Rc	RQD %
	Surface Elev.:						
0	<i>Yellowish brown and gray rock fragments and sandy silt matrix and bouldres (fill)</i>		62	6			
			39	5			
5			60/3"	3			
		6					
	<i>Volcanic siltstone fragmented by high- angle fractures - volcanic sediments deposited in shallow seas - close to shore</i>						
10						100	100
		11					
15							
20							
25							
30							

"N" - Number of blows required to drive the sampling spoon a distance of 12 in. with a 140 lbs hammer falling 30 in.
"W" - Natural Moisture Content in percentage of dry weight. " ≍ " Initial G.W. Depth
"Qu" - Unconfined Compressive strength in tons per square foot. " ≍ " Final G.W. Depth
"Rc" - Core recovery in percent for each successive run. "Rqd" - Rock quality designation.
"WH" - Sample was recovered by advancing the sampler with the weight of the hammer.
"P" - A "P" in the Unconfined Compressive Strength test indicates the use of the pocket Penetrometer.



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Subsurface Exploration Field Log

Boring No.: 3
Job No.: 6453

PROJECT: HIPODROMO

Location: CANOVANAS, PR

Date Started: 11-14-06

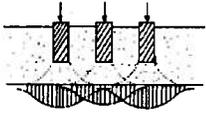
G.W. Depth ,ft. (☒): Not Found

Date: (☒):

Elevation:
North:
East:

Depth ft	Description of Material	Soil Graphic	"N" Value	W (%)	Qu (tsf)	Rc	RQD %
	Surface Elev.:						
0	<i>Gray and yellowish brown rock fragments sandy silt, rock pieces and boulders (fill)</i>		58	6			
			53/4"	4			
			53	6			
5			60/1"	3			
10	<i>Light gray volcanic andesity rock with abundant plagioclase and other mafic minerals (boulders) (fill)</i>					100	100
15	<i>Pyroclastic volcanic rock, a general term applied to volcanic material that have been explosively or aerially ejected from a volcanic vent this samples exhibits some weathering or alterations of its mineral content (rock pieces and boulders) (fill)</i>					100	45
20	<i>Pyroclastic volcanic rock, a general term applied to volcanic material that have been explosively or aerially ejected from a volcanic vent this samples exhibits some weathering or alterations of its mineral content</i>					10	85
25							
30							

"N" - Number of blows required to drive the sampling spoon a distance of 12 in. with a 140 lbs hammer falling 30 in.
"W" - Natural Moisture Content in percentage of dry weight. "☒" Initial G.W. Depth
"Qu" - Unconfined Compressive strength in tons per square foot. "☒" Final G.W. Depth
"Rc" - Core recovery in percent for each successive run. "Rqd" - Rock quality designation.
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JACA & SIERRA TESTING LABORATORIES
Subsurface Exploration Field Log

Boring No.: 4
Job No.: 6453

PROJECT: HIPODROMO

Location: CANOVANAS, PR

Date Started: 11-14-06

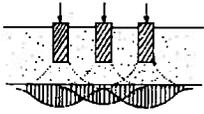
G.W. Depth ,ft. (☞): Not Found

Date: (☞):

Elevation:
North:
East:

Depth ft	Description of Material	Soil Graphic	"N" Value	W (%)	Qu (tsf)	Rc	RQD %
	Surface Elev.:						
0	<i>Yellowish brown and gray rock fragments and sandy silt matrix boulders and rock pieces (fill)</i>		25	7			
			61	6			
			60/2"	5			
5	<i>Gray rock fragments with soft silty clay matrix (fill)</i>		41	12			
			31	41			
10	<i>Volcanic sandstone with volcanic siltstone phases or facies - gray in color (fill)</i> <i>Volcanic siltstone fragmented by high- angle fractures - volcanic sediments deposited in shallow seas - close to shore (fill)</i>						
15	<i>Volcanic siltstone fragmented by high- angle fractures - volcanic sediments deposited in shallow seas - close to shore</i>					96	67
20						95	60
25							
30							

"N" - Number of blows required to drive the sampling spoon a distance of 12 in. with a 140 lbs hammer falling 30 in.
"W" - Natural Moisture Content in percentage of dry weight. "☞" Initial G.W. Depth
"Qu" - Unconfined Compressive strength in tons per square foot. "☞" Final G.W. Depth
"Rc" - Core recovery in percent for each successive run. "Rqd" - Rock quality designation.
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JACA & SIERRA TESTING LABORATORIES
Subsurface Exploration Field Log

Boring No.: 5
Job No.: 6453

PROJECT: HIPODROMO

Location: CANOVANAS, PR

Date Started: 11-13-06

G.W. Depth ,ft. (☒): Not Found

Date: (☒):

Elevation:
North:
East:

Depth ft	Description of Material	Soil Graphic	"N" Value	W (%)	Qu (tsf)	Rc	RQD %
	Surface Elev.:						
0	<i>Yellowish brown and gray rock fragments and sandy silt matrix, boulders and rock pieces (fill)</i>		60/4"	7			
			55	7			
			34	6			
5	<i>Volcanic sandstone with volcanic siltstone phases or facies - gray in color (fill) (boulders and rock pieces)</i>		60/0"	7			
10	<i>Gray highly weathered rock breaks into sandy silt and weathered rock fragments</i>		60/4"	6		88	45
15	<i>Volcanic sandstone with volcanic siltstone phases or facies - gray in color</i>		60/3"	3			
20						100	100
25							
30							

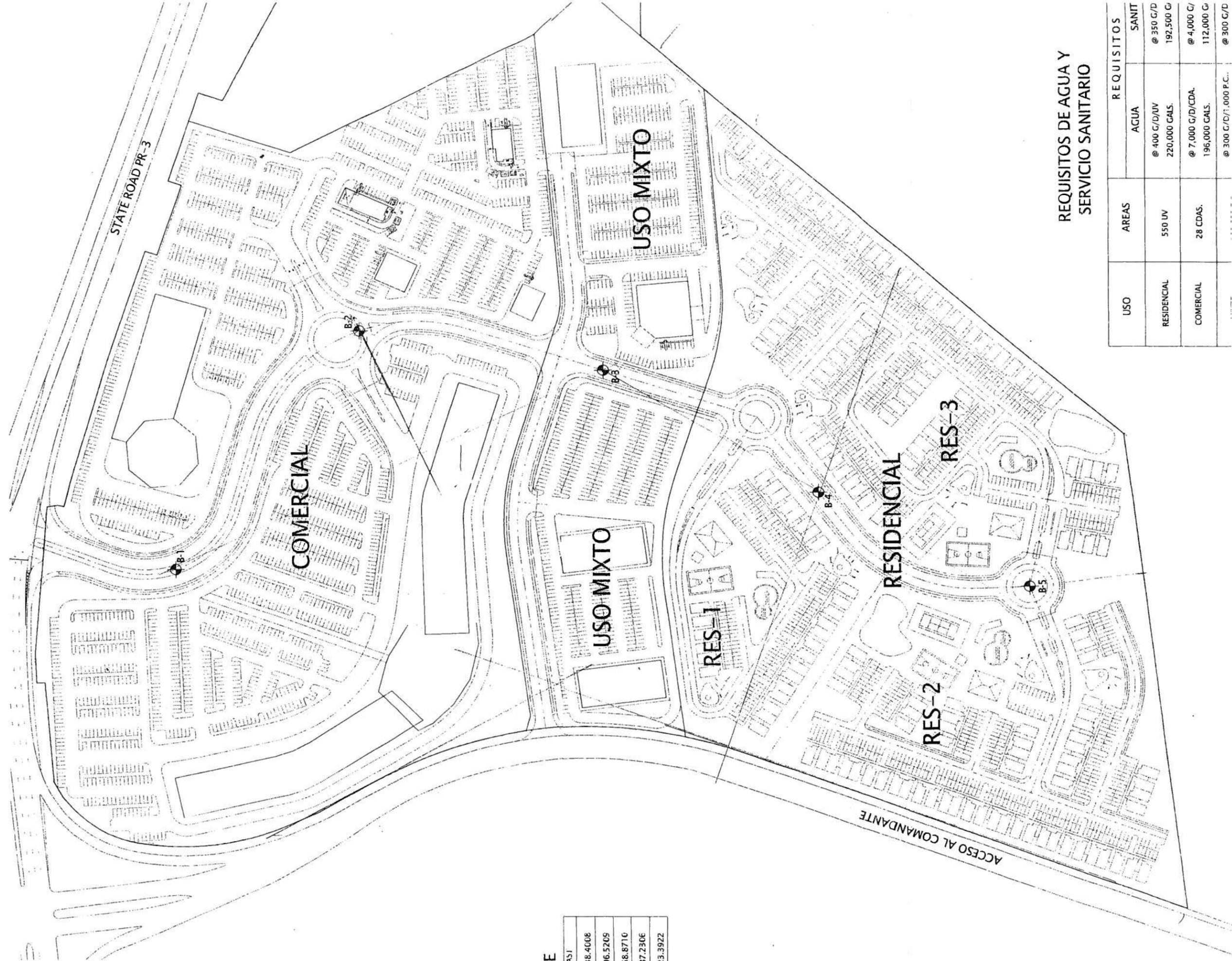
"N" - Number of blows required to drive the sampling spoon a distance of 12 in. with a 140 lbs hammer falling 30 in.
"W" - Natural Moisture Content in percentage of dry weight. "☒" Initial G.W. Depth
"Qu" - Unconfined Compressive strength in tons per square foot. "☒" Final G.W. Depth
"Rc" - Core recovery in percent for each successive run. "Rqd" - Rock quality designation.
"WH" - Sample was recovered by advancing the sampler with the weight of the hammer.
"P" - A "P" in the Unconfined Compressive Strength test indicates the use of the pocket Penetrometer.



PLAN
EL NUEVO COMANDANTE QUARRY SITE, LOCATED AT CANO

○ BORING LOCATION

Jaca & Sierra Testing Laboratories	
Date	Job no.
12-4-06	6453
 CARLOS A. PEREZ, PE Approved	



E

ASI
38.4006
36.5205
38.8710
37.2306
33.3922

**REQUISITOS DE AGUA Y
SERVICIO SANITARIO**

USO	AREAS	REQUISITOS	
		AGUA	SANIT
RESIDENCIAL	550 UV	@ 400 G/D/UV 220,000 GALS.	@ 350 G/D 192,500 G
COMERCIAL	28 CDAS.	@ 7,000 G/D/CDA. 196,000 GALS.	@ 4,000 G/ 112,000 G
		@ 300 G/D/1,000 P.C.	@ 300 G/D