APPENDIX-9

TOPOGRAPHIC SURVEY AND GEOTECHNICAL INVESTIGATION

Contents

A9.1 TECHNICAL SPECIFICATIONS

A9.1.1 SCOPE OF WORK

The Work comprises the following schedules:
Schedule 3.1 : Line Survey
Schedule 3.2 : Geotechnical Investigation and Assessment

(1) Line Survey

The work in this schedule comprises the following sub-schedules:
Sub-schedule 3.1(A) : Line Survey
Sub-schedule 3.1(B) : River Crossing Survey
Sub-schedule 3.1(C) : Reporting

Sub-schedule 3.1 (A): Line Survey

- Longitudinal, 9 km in total length for sewer mains
- Cross section

All the sewer mains to be surveyed are located within Rio Loyanó and Matín Pérez basins. Approximate routes of the sewer mains will be indicated by the JICA Study Team on 1: 10,000 scale maps as shown in Figure 1.

The survey for sewer mains route is composed of centerline survey and profile survey along the proposed pipeline alignment as directed by the JICA Study Team. The centerline survey is to measure distance at every station markers and angle at each turning point along the pipeline alignment. Width and depth of culvert and rivers along the route shall be measured.

Along the centerline at every 100 meter, turning point or intersection, the width of road or street shall be measured and features of land such as houses, buildings, sidewalks, electric poles, signboards, traffic lights, ditches etc., shall be investigated and marked with their limit. The range of such cross section is approximately 25 meters from the road edge at its both sides. The profile survey is to measure ground levels at every station markers and points directed by the JICA Study Team. The Contractor shall provide a temporary bench mark at the convenient location(s) under the direction of the JICA Study Team. The temporary bench mark shall be fixed into the ground with durable materials as approved to avoid any movement and loss.

Sub-schedule 3.1 (B): River Crossing Survey

- River crossing at five (5) locations

The river crossing is a profile survey of river at the locations specified in Figure 2 to 4.

Sub-schedule 3.1 (C): Reporting

The Contractor shall prepare and submit the drawings with the following scales upon the completion of field survey.

Line Survey
- Plan; 1 / 1,000
- Longitudinal Section:
  - Horizontal; 1 / 1,000
  - Vertical; 1 / 100
- Cross Section; 1 / 100

River Crossing Survey
- Cross Section:
  - Horizontal; 1 / 100
  - Vertical; 1 / 100

In addition to the above drawings, the Contractor shall submit all survey data including field notes, photographs of site survey, others obtained during field surveys.

As mentioned, the drawing of plan shall present range of road or street, features of land use along the pipelines.

The drawings shall be printed out and digital files of drawings with format of AUTOCAD latest release shall be submitted. Font size of information and notes in the drawings shall be readable when the drawings are printed out in A4 or US Letter size.

(2) Geotechnical Investigation and Assessment

The work in this schedule comprises the following sub-schedules:
Sub-schedule 3.2 (A) : Boring
Sub-schedule 3.2 (B) : Standard Penetration Test (SPT)
Sub-schedule 3.2 (C) : Sampling and Laboratory Test
Sub-schedule 3.2 (D) : Reporting

Sub-schedule 3.2 (A): Boring

Boring number shall be four (4) and an approximate location of each borehole is as shown in Figure 1: one borehole at the site for construction of a new wastewater treatment plant in the Luyanó river mouth; three locations for the sewer mains. The actual location of boreholes shall be directed by the JICA Study Team, based on information of preliminary surveys of sites by the contractor.

The depth of boring shall be 20 meters at maximum. When a bearing stratum is reached at less than 20 meters in depth, boring shall be stopped at 5 meters below the top of the stratum.

Method of boring shall be proposed by the Contractor for approval by the JICA Study Team. The diameter of a borehole shall be sufficient to ensure that the boring can be completed to the scheduled depth and that samples of the specified diameter can be obtained.

Generally, water shall not be used to assist the advance of the borehole except in the case of dry coarse soils. Where the borehole penetrates below the water table and disturbance of the soil is likely, a positive hydrostatic pressure shall be maintained in the borehole.

The Contractor shall backfill boreholes in such a manner that no subsequent depression is formed at the ground surface due to settlement of the backfill. In some circumstances special infilling may be required by the JICA Study Team. Unless otherwise instructed the special infilling shall be cement/bentonite (1:4) grout. Where artesian or other water conditions make normal backfilling impracticable, the Contractor shall consult with the JICA Study Team a procedure for sealing the borehole.

Sub-schedule 3.2 (B): Standard Penetration Test (SPT)

Standard penetration tests (SPTs) shall be carried out in accordance with ASTM D 1586-99 or equivalent standards. The sample from the split barrel sampler shall be retained as a small disturbed sample. Where a sample is not retained in the split barrel or when the cutting shoe is replaced by a solid cone, a disturbed sample shall be taken from the test zone. The water level and the depth of casing in the hole at the time of the test shall be recorded.

At each borehole, SPTs shall be conducted as follows:

- First test : 1.0 m below ground level
- At depth 1-20 m : interval 1.0 m

Sub-schedule 3.2 (C): Sampling and Laboratory Test

1) Sampling

a) Disturbed Samples

One small disturbed sample shall be taken between each two successive SPTs. It shall weigh not less than 0.25 kg and shall be placed immediately in an airtight container, which it should fill. Samples shall be protected to ensure that their temperature does not fall below 5^{o} C. They shall also be protected from direct heat and sunlight.

Samples shall be examined and described by a geotechnical specialist in accordance with the American Standards, the Clause 6.4.3 of American Society for Testing and Materials (hereinafter referred to as ASTM) D420, clause 41 of British Standard (hereinafter referred to as BS) 5930 or equivalent standards.

b) Undisturbed Samples

At each borehole, three undisturbed samples shall be taken at three different representative stratum, using open tube sampling equipment as described in the clause 2.2 of ASTM D1586, clause 19.4.4 of BS 5930 or equivalent standards.

Before an undisturbed sample is taken, the bottom of the hole shall be carefully cleared of loose materials and where a casing is being used the sample shall be taken below the

bottom of the casing. Following a break in the work exceeding one hour, the borehole shall be advanced by 250 mm before undisturbed sampling is resumed.

Where an attempt to take an undisturbed sample is unsuccessful the hole shall be cleaned out for the full depth to which the sampling tube has penetrated and the recovered soil saved as a disturbed sample. A fresh attempt shall then be made from the level of the base of the unsuccessful attempt. Should this second attempt also prove unsuccessful the Contractor shall agree with the JICA Study Team alternative means of sampling.

The samples shall be sealed as soon as possible on the same day to preserve their natural moisture content and in such a manner as to prevent the sealant from entering any voids in the sample.

The depths below ground level at which samples are taken shall be recorded. The level of the top of the sample and the length of sample obtained shall be recorded.

2) Laboratory Test

Undisturbed samples shall be taken to a soils laboratory approved by the JICA Study Team and shall be subjected to the following tests.

- specific gravity, ASTM D854-58 or BS test 6
- water (moisture) content, ASTM D2216-71 or BS test 1(A)
- density, ASTM D2937-71 or BS test 15(E) or 15(F)
- particle size distribution, ASTM D421-58 and ASTM D422-63 or BS test 7
- permeability test, ASTM D2434-68

Unconfined compressive strength, ASTM D2166-66 or BS test 20, shall be examined for one sample each taken from the bearing stratum reached at each borehole.

Contractor shall prepare a schedule of tests for approval by the JICA Study Team.

All preparation, testing and reporting shall be where applicable in accordance with the relevant American Standards, the ASTM. Where tests are not covered by the American Standards they shall be performed in accordance with the procedures given in the following references.
British Standard, Head K. H. Manual of soil laboratory testing (vols. I-III), Pentech, London
relevant publications by the Transport and Road Research Laboratory (TRRL), and the International Journal of Rock Mechanics and Mining Sciences (IJRM).

Calibration of load-displacement or other measuring and testing equipment shall be carried out in accordance with the manufacturer's instructions. Evidence of recent calibrations shall be submitted to the JICA Study Team.

Sub-schedule 3.2 (D): Reporting

The report shall be prepared in both English and Spanish. The report shall be submitted in two (2) sections, the first being the factual report, and the second the interpretative

report. Both sections of the report shall begin with a cover page showing the name of the Contract and the names of the Employer (JICA Study Team) and Contractor.

The factual report shall contain the following information, where applicable

- a description of the work carried out
- exploratory hole logs
- laboratory test results
- plan with locations of exploratory holes
- site location plan

The plans shall be presented to a scale directed by the JICA Study Team and shall include a north point.

The exploratory hole logs shall be presented to a vertical scale in the form as appropriate. The logs shall contain the following information

- Contract title and site location
- Contractor's and operator's name
- Borehole number and location
- Dates and time
- Ground level related to the agreed datum
- Diameters and depths of borehole and casings referred to the agreed datum
- Elevation of each stratum referred to the agreed datum
- The depth at which any water was added
- Records of groundwater
- A summary of groundwater observations
- Description of each stratum in accordance with ASTM D420
- Symbolic legend of strata in accordance with ASTM D420
- Depth of samples taken for laboratory tests

The interpretative report shall contain the following information

- a written appraisal of the ground and water conditions
- geotechnical analyses and recommendations, in particular, with respect to the depth and the type of the foundations for RC water retaining structures which weigh 10 to 15 ton/m^2.

The Contractor shall supply the calculations and ananlyses on which his recommendations are based.

A draft copy of the factual report and the interpretative report shall be submitted to the JICA Study Team for approval before submission of the final report.

A9.2 TOPOGRAPHIC SURVEY

INSTITUTO NACIONAL DE RECURSOS HIDRÁULICOS

Investigaciones y Proyectos
HIDRÁULICOS HABANA

RESEARCH DIRECTION

Topographic study of the working region

The Improvement of Sewerage and Drainage System for The Havana Bay in the Republic of Cuba

October 2003

INSTITUTO NACIONAL DE RECURSOS HIDRÁULICOS

INVESTIGACIONES Y PROYECTOS
HIDRÁULICOS HABANA

RESEARCH DIRECTION

WORK:

The Improvement of Sewerage and drainage System
For The Havana Bay In The Republic of Cuba

PART:

Topographic study of the working region

PROVINCE:
Havana City.

Made by:
Eng. Yalexy Guerra Castellini and
Tec. Luis Batista González
Geodesist specialist.

Checked by:
Eng. Raúl Santander
Chief of Project.

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HIDRÁULICOS HABANA

INDEX.

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1- Main data about the project.

1.1- Project denomination.
The Improvement of Sewerage and Drainage System for The Havana Bay in the Republic of Cuba

1.2- Code and number of the project.
Topographic measurement.

1.3- Province and municipality.

The region of the works is located in 10 de Octubre, Old Havana and Guanabacoa municipalities of Havana City.

1.4- Measurement method
Horizontal control of 2nd category.
Geometric leveling of 2nd category.
Direct measurement in the site with Total station.

1.5- Measurement scale and area.
1: 1000 map of topographic measurement , 22.09 Ha
Hz -1:000 y V -1:100 for the longitudinal sectors.
Hz -1:00 y V -1:100 for the river sections.

1.6- Coordinate System.
In order to make maps the Coordinate System Cuba- North.
Height System "Siboney" was used

1.9- Actual date of commencement of the project.
8/09/2003

1.10- Actual date of the project completion.

8/09/2003.

1.11- Client.

JICA

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2.Generalities

2.1- Entity, units in charge and work final stage deadline.
The topographic measurement was carried out by the following team.

Participants:
Head of the EIPHH topography department .
- Eng. Yalexy Guerra Castellini.
- Tec. Luis E Batista (Head of the Field Group).

Participants:

- Téc. Roberto Rodríguez (Topographo)
- Téc. Fidel Peñate.
- Juan Carlos Cruza
- Julio Cesar Rodríguez

2.2- Purpose of the works.

The ultimate objective for doing this work is to compile all the necessary topographic information located in the line survey shown in the map (annex 1) to project a pressure pipe, pumping stations and water treatment units for the cleansing of the sewerage and draining system affecting the Havana Bay.

The work of survey is divided by 3 sections of study (see annexe 1 General Location)_)

I. From C street and rail road line to Luyanó River and Vía Blanca street

II. From Luyanó River and Vía Blanca Street to Mañana Town

III. From Regla Town To Vía Blanca Street (avenida del Puerto)

2.3- Guideline Technical Documents (Technical instruction , Manual of Conventional Symbols, Writing directions)and others by which the works were carried out.

To make this work Technical Instructions for topographic measurement 1:2000, 1:1000 and 1:500 scale devised by MICONS and approved by a letter of mandatory character of the Head of the ONGH and the Geodesic textbook I and II written by the engineer Gustavo Córdova are going to be taken as a guideline documents.

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3. Brief physical and geographical characteristics of the working region.

3.1- Geographical localization.

The working areas are located from 23° 5′ 1" to 23° 6′ 35" north latitude and from 82° 19′ 34" to 82° 21′ 18" west longitude approximately Havana City province in 10 de Octubre and Old Havana municipalities and from 23° 5′ 1" to 23° 6′ 35" north latitude and from 82° 19′ 34" to 82° 21′ 18" west longitude approximately in 10 de Octubre, Old Havana, Guanabacoa, San Miguel del Padron and Regla municipalities, exactly as shown in annex 1

3.2- Communication networks, road network and zone accessibility.

The communication networks with the working area are acceptable , with the existence of paved streets in proper conditions to get to the working areas departing from Virtudes and Belascoaín where the Topography department, EIPHH, has its headquarter, going on Belascoaín straight to Cristina. Afterwards, going on Porvenir straight to Aguilera street turning left on 11th street straight to C street and Line of railroad and then in order to go on Vía Blanca straight to the zone of Los Elevados and there is Luyanó River. Due to the intense traffic and the pedestrians movement, sometimes the realizations of the investigative work on shedule was interfered.

3.3- Populated places.

The main populated places of the region are El Barrio Obrero, Lawton and the Mañana Town, due to the fact that the working area is located in these towns.

Taking into consideration all the aspects previously stated we believe the difficulty level of the works may be regarded as considerable.

4- Topographic study of the working region.

For this work it was possible to have the micro-localization date provided by client and the databases of the points of horizontal and vertical of the EIPHH.

5- Topographic Base.

5.1-Planimetry .
The planimetric base was created by the method of polygonometry, mapping a set of 4 polygonals making among them a net of 76 bench marks, with permanent characteristics for being plates engraved in the sidewalks as shown in the pictures related to the annex 3

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The polygonals are identified by sections:

- Polygonal of section 1, is the one that comprises the works from C street and Línea de ferrocarril in Lawton to Luyano River by Vía Blanca . (**Polygonal 1). Rounding.**
- Polygonal of the section 2, is the one that comprises the study of the section 2 from Luyanó River to the Shell Roundabout and the Old Road of Guanabacoa (**Polygonal 2). Link.**
- Polygonal of section 2, is the one that comprises the studies from the Old Road of Guanabacoa and Central street to 5ta street and 8va Mañana town. (**Polygonal 3). Surround**

5.2-Angle measurement.

The observations of the angles were carried out with total station TC 805L Swiss manufacture, guarantying 3 seconds, with an acceptable accuracy of the works 10"√n, (being n the number of vortexes of the polygonals), the results are related in the **chart 1**.

5.3- Measurement of distances.
The lineal measurement were made with the total station Leica TC 805 L of Swiss manufacture, guarantying 2mm+ 2ppm, the results of the measurements are shown in the chart 1 in the annex 3

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LIST OF COORDINATES.

No.	NOMENCLATURE	COORDINATES		
		X	Y	Z
1	**SBH –1**	362172.770	363194.593	17.425
2	**SBH -2**	362349.983	363082.651	10.331
3	**SBH -3**	362387.467	363077.121	11.915
4	**SBH -4**	362308.774	363212.807	12.504
5	**SBH -5**	362159. 830	363609.494	10.175
6	**SBH -6**	362007.294	363621.471	13.087
7	**SBH -7**	362037.006	363827.807	9.600
8	**SBH -8**	362112.461	363832.955	8.393
9	**SBH -9**	362085.143	363986.462	8.173
10	**SBH -10**	361929.037	364059.553	17.176
11	**SBH -11**	361851.224	364145.355	19.937
12	**SBH -12**	361761.269	364227.146	15.656
13	**SBH -13**	361842.461	364303.623	8.704
14	**SBH -14**	361717.041	364433.201	6.064
15	**SBH -15**	361745.769	364557.333	4.117
16	**SBH –16**	361578.614	364513.228	4.941
17	**SBH –17**	361450.045	364875.132	5.570
18	**SBH –18**	361 387,112	365 033,720	8,426
19	**SBH –19 A**	361 402,830	365 181,883	7,864
20	**SBH –20 A**	361 493,350	365 190,390	6,373
21	**SBH –21**	362 924,257	364 672,551	10,649
22	**SBH – 21A**	362 902,835	364 953,17	10,537
23	**SBH –22**	363 195,572	364 797,415	7,973
24	**SBH –23**	363 823,751	364 978,605	4,762
25	**SBH –24**	363 983,459	365 019,631	4,972
26	**SBH –25**	364 079,191	365 084,600	5,057
27	**SBH –26**	364 231,176	364 825,012	4,629
28	**SBH –27**	364 396,696	364 845,645	5,671
29	**SBH –28**	364 391,560	364 765,393	5,785
30	**SBH –29**	364 524,301	364 752,921	6,245
31	**SBH –30**	364 641,373	364 763,690	6,490
32	**SBH –31**	362653.425	364865.180	6.068
33	**SBH –32**	362 653,180	364 865,180	6,068
34	**SBH –33**	362662.711	364911.178	6.256
35	**SBH-34**	362598.516	364997.511	6.496
36	**SBH-37**	362612.817	365066.353	3.094
37	**SBH-38**	362823.904	364999.514	2.535
38	**SBH-39**	363577.757	365490.559	5.579
39	**SBH-40**	363513.275	365640.264	6.254
39	**SBH-40**	363513.275	365640.264	6.254
40	**SBH-41**	363373.267	365764.417	5.357
41	**3785-III-923 A**	361593.940	365105.910	3.022
42	**3785-III-924 A**	361804.140	364953.170	3.789
43	**3785-III-109 A**	361748.303	364993.933	3.307
44	**3785-III-110 A**	362125.909	364853.309	4.540
45	**3785-III-315 B**	364231.970	365120.680	5.803

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46	**3785-III-316 B**	364240.710	364984.48	4.993
47	**V- 2**	362245.606	364833.028	5.094
48	**V- 3**	361928.250	364929.958	3.985
49	**V- 4**	361709.185	364992.900	3.830
50	**KM-7VB**	363419.863	364855.437	6.391
51	**KM-6VB**	363012.669	364691.236	9.420

5.4- Altimetric base.

The leveling was carried out by the trigonometric method taking as valuable data to start from the values of the geodesic control stations 3785-III-923 A, 3785-III-924 A, 3785-III-315 A y 3785-III-316. All these geodesic control stations were created by the Geocuba Conglomerate in previous years.

The altimetric closure miscalculations of the 4 altimetric polygonals are included in the chart 1. in the annex 2, and the values of heights in the chart 2.

6.Topographic measurement.

6.1- Base of measurement.
It was used as a base for measurement the topographic base created, apart from establishing 51 of vortexes that served as support for the realization of the measurement in the 3 sections of studies.

6.2- Planimetric and topographic measurement.

This measurement was carried out from the base bench marks determined, measuring accurately in radial form all the objects in the area, at a 1: 1000 scale(trees, light and telephone posts, fence boundaries, buildings, electric, telephone, pluvial, and sewer registers, water valves, electric lightning, traffic light and others; taking the information of all the objects that cross the study mapping like rivers, bridges, railroads, perpendicular streets and transversals to the mapping), according to what it is established in the technical task and in the technical guideline documents for these scales.

It was also carried out the measurement of river banks as it is indicated in the service request issued by the client, taking the data of river banks and center of them as transversal section, maps 5527-200-027. Was realized the Line Survey studies as ws asked by JICA, maps 5527-200-00

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6.3- Measurement of the relief

This was carried out with a distance of altimetric points ranging from 15m to 20 m approximately in a cross-section profile, by all the lineal mapping, in other cases like the ground is semi-waved a measurement according to the forms of it was carried out. This is the case of the beginning of the section 1 and a part of the section 3, as it is possible to observe in the correspondent maps of the measurement.

6.4 - Office Data Processing.

The field data were processed at the office with the existent softwares like:
TRADITIONAL METHOD OF CÁLCULO AND AJUSTMENT OF POLYGONALS(PLANIMETRICS Y ALTIMETRICS) MANUAL AND WITH CALCULATORS.

- TOPO – 6
- AUTOCADMAP 2000
- DISPER
- MICROSOFT WORD.

7- General conclusions about the quality of the works carried out.

7.1- Control of the works and quality evaluation.

A control in the field was directly carried out by monitoring the liability of the measurement in order to do this operation so, testing measurement were carried out directly on the objects in the field. Afterwards, all the errors pinpointed were corrected by highly qualified personnel with the presence of the head of the field group. In this aspect we can conclude in this aspect that the quality of the works meets the technical requirements established for these kind of works, settled in the instructions and norms, thus with the requirements established on the part of the client.

8- Conclusions.

After an evaluation of the works carried out we can affirm that then fulfiln the established technical requirements in the guideline documents and it is in full compliance with the request (technical task) of the client. The technical report consists of 9 pages including the necessary annexes for its realization .

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10- ANNEXES.

1- General Location Annex 1
2- Planimetric and altimetric Miscalculation table Annex 2
3- Set of Pictures taken during the realization of the work. Annex 3
4- Topographic Measurement Map Section 1. Code 5527.-200-001. E- 1:1000
5- Topographic Measurement Map Section 1. Code 5527-200-002. E- 1:1000
6- Topographic Measurement Map Section 1. Code 5527.-200-003. E- 1:1000
7- Topographic Measurement Map Section 1and 2. Code 5527-200-004. E- 1:1000
8- Topographic Measurement Map Section 2 and 3. Code 5527-200-005. E- 1:1000
9- Topographic Measurement Map Section 2 and 3. Code 5527-200-006. E- 1:1000
10- Topographic Measurement Map Section 2 and 3. Code 5527-200-007. E- 1:1000
11- Topographic Measurement Map Section 3. Code 5527.-200-008. E- 1:1000
12- Topographic Measurement Map Section 2. Code 5527.-200-009. E- 1:1000
13- Planimetric Topographic Map Section 1. Code 5527.-200-010. E- 1:1000
14- Planimetric Topographic Map Section 1.. Code 5527.-200-011. E- 1:1000
15- Planimetric Topographic Map Section 1.. Code 5527.-200-012. E- 1:1000
16- Planimetric Topographic Map Section 1 and 2. Code 5527-200-013. E- 1:1000
17- Planimetric Topographic Map Section 2 and 3 Code 5527-200-014. E- 1:1000
18- Planimetric Topographic Map Section 2 and 3. Code 5527-200-015. E- 1:1000
19- Planimetric Topographic Map Section 2 and 3.Code 5527-200-016. E- 1:1000
20- Planimetric Topographic Map Section 3. Code 5527.-200-017. E- 1:1000
21- Planimetric Topographic Map Section 2. Code 5527.-200-018. E- 1:1000
22- Line Survey Measurement Map Section 1 Code 5527-200-19 E HZ-1000, V-100
23- Line Survey Measurement Map Section 1 Code 5527-200-20 E HZ-1000, V-100
24- Line Survey Measurement Map Section 1 Code 5527-200-21 E HZ-1000, V-100
25- Line Survey Measurement Map Section 2 Code 5527-200-22 E HZ-1000, V-100
26- Line Survey Measurement Map Section 2 Code 5527-200-23 E HZ-1000, V-100
27- Line Survey Measurement Map Section 2 Code 5527-200-24 E HZ-1000, V-100
28- Line Survey Measurement Map Section 2 Code 5527-200-25 E HZ-1000, V-100
29- Line Survey Measurement Map Section 3 Code 5527-200-26 E HZ-1000, V-100
30- Line Survey Measurement Map Section 3 Code 5527-200-27 E HZ-1000, V-100
31- Luyanó River Crossing Survey Code 5527.-200-028. E- 1:1000

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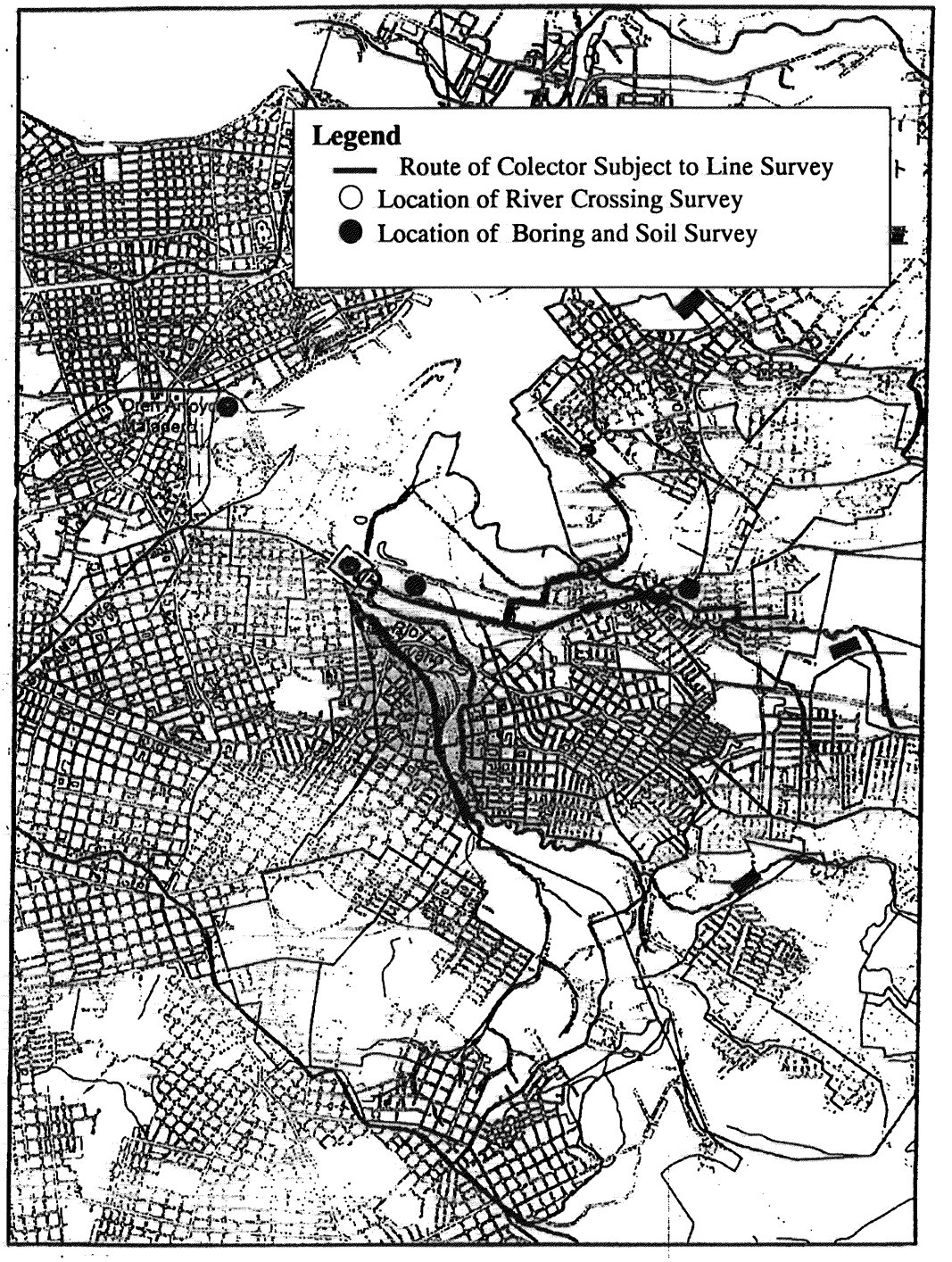
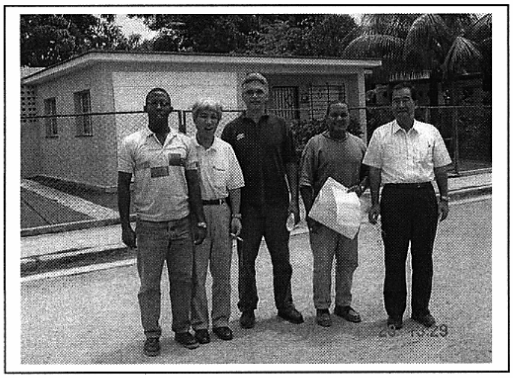
ANNEXES.I GENERAL LOCATION

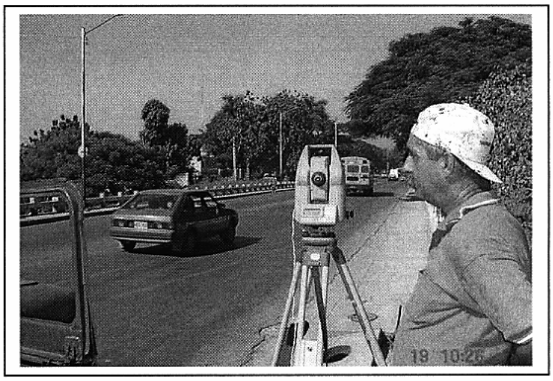


ANNEX 2 PLANIMETRIC AND ALTIMETRIC MISCALCULATION TABLE

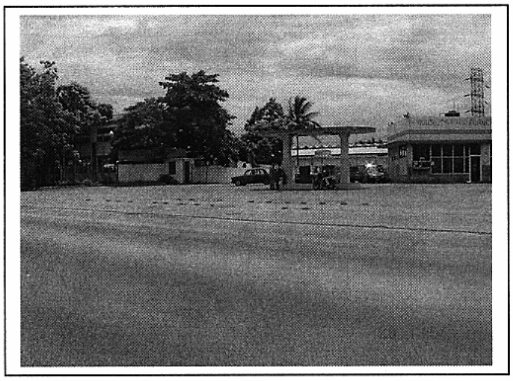
No	Denomination	No.	Acceptable Angular Miscalculation	Obtained Angular Miscalculation	Lineal Miscalculation in X (m)	Lineal Miscalculation in Y (m)	Total Lineal Miscalculation (m)	Length	Admissible Lineal miscalculation	Relative Lineal miscalculation	Permissible Altimetric Miscalculation	Altimetric Closing miscalculation
1	Polygonal 1	33	0º 0'57".45	0º 2' 45"	0.323	0.126	0.346	3226.101	1/5000	1/17995	0.0534 m	0.018 en 7664.817 m
2	Polygonal 2	12	0º 0'34".64	0º 0'36	0.036	0.245	0.247	2549.554	1/5000	1/10322	0.0294 m	0.0003 m
3	Polygonal 3	12	0º 0'34".64	0º 0'6"	0.042	0.031	0.052	1694.258	1/5000	1/32582	0.015 m	0.005 m
4	Polygonal 4	19	0º 0'43".59	0º 0'21"	0.005	0.147	0.147	3545.014	1/5000	1/24116	0.0325 m	0.030 m



EQUIPO DE TRABAJO CON EL CLIENTE

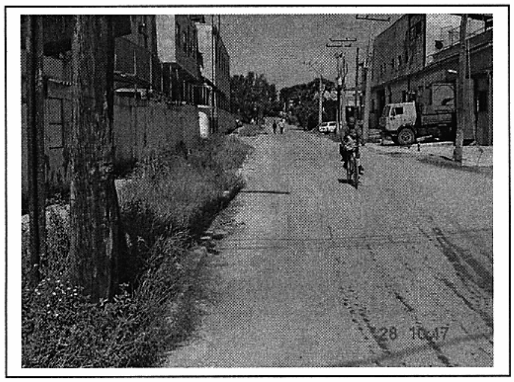


ESTACION TOTAL USADA EN EL ESTUDIO



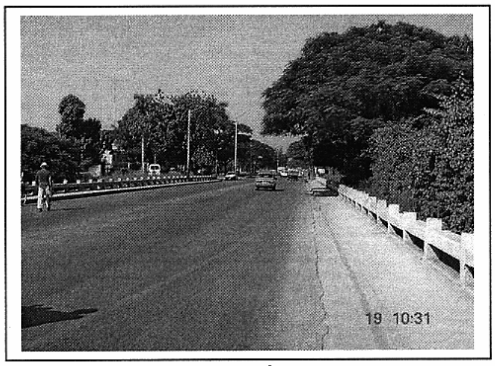
TRAZADO DE LA TUBERÍA TRAMO 1

TRAZADO DE LA TUBERÍA TRAMO 2

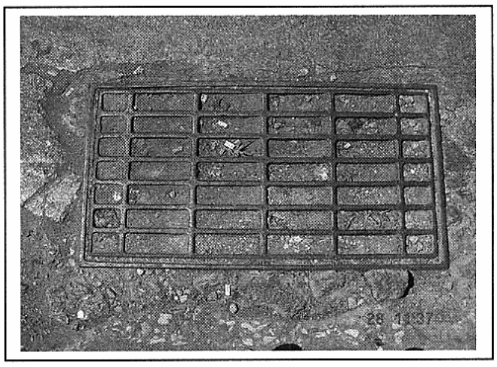


TRAZADO DE LA TUBERÍA TRAMO 1

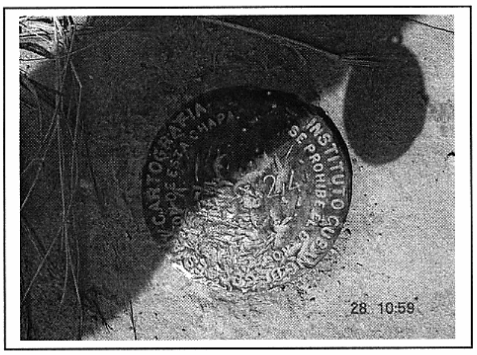
CASA PRIVADA EN EL TRAZADO DE LA TUBERÍA



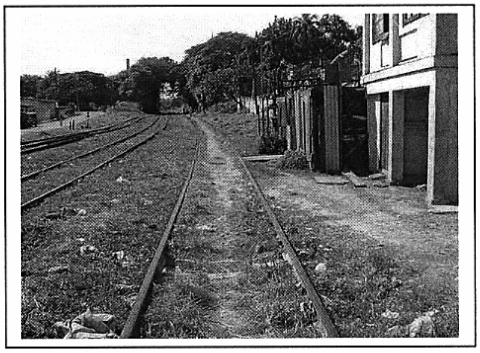
TRAZADO DE LA TUBERÍA VIA BLANCA



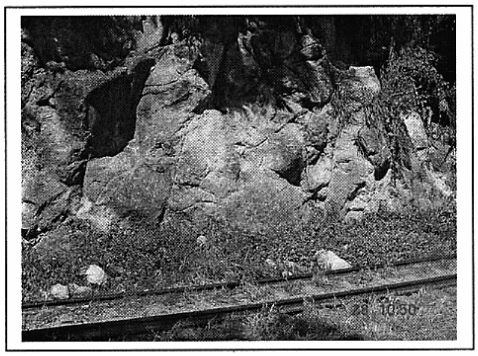
ALCANTARILLA TUPIDA TRAMO 1
CALZADA DE CONCHA Y LUYANO

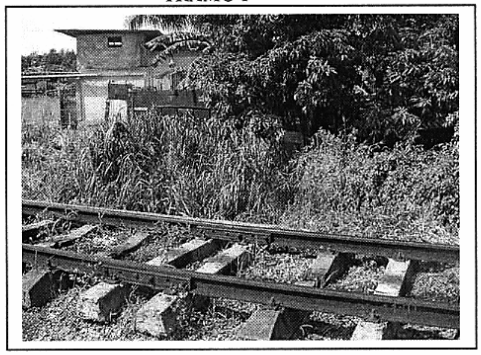


VÉRTICE SBH-4



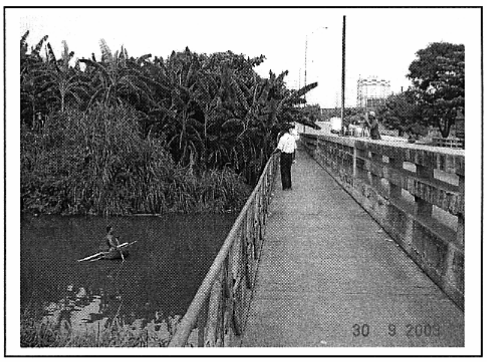
TRAZADO POR LA LINEA DE FERROCARRIL
TRAMO 1



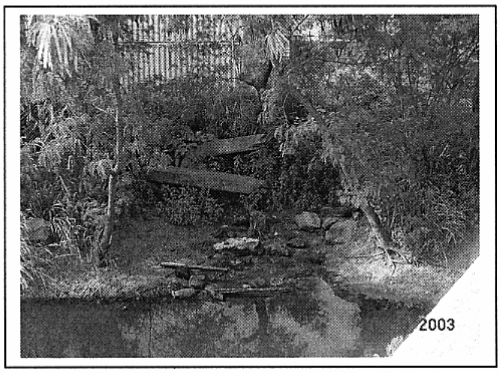


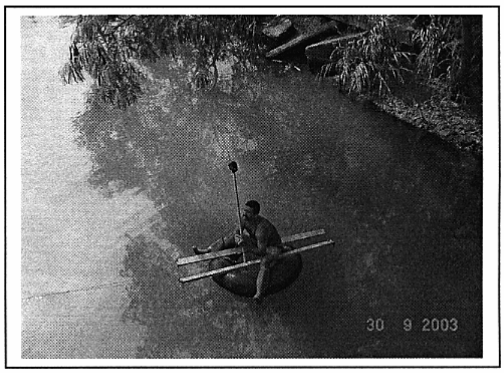
TRAZADO POR LA LINEA DE FERROCARRIL TRAMO 1

ALCANTARILLA EN EL TRAZADO DEL TRAMO 1
INICIO DEL ESTUDIO CALLE C Y LINEA DE FERROCARRIL

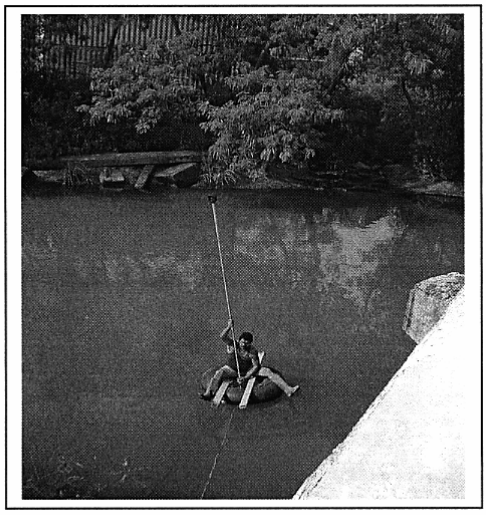


SECCIONES DEL RIO LUYANO





RELIEVE EN EL RIO MARTÍN PEREZ POR EL ANILLO DEL PUERTO Y SECCIONES TRANSVERSALES



SECCIONES
TRANSVERSALES
RIO MARTÍN PEREZ,
PUENTE DEL ANILLO
DEL PUERTO