

RADIUS PROJECT OF GUAYAQUIL

FIRST SEMIANNUAL REPORT (JULY 1998)

1. INTRODUCTION

1.1. Outline of the city

Guayaquil is located on the west margin of the Guayas River, on both soft alluvial soils and sedimentary volcanic rock deposits. Guayaquil has grown to the south by filling with gravel obtained from rock deposits the ocean estuaries, originally crowded of *mangle* trees.

Guayaquil is placed at the end of the Guayas River basin, bounded in the east by the Andes mountains, and in the west by the Chongón-Colonche mountains. The eastern edge of the Chongón Colonche mountains end at Guayaquil city, and are formed of sedimentary volcanic rocks reaching 800 meters in altitude.



Photographer: Mr. Felipe Huerta

The Guayaquil weather is warm and humid with two seasons well defined: the rainy season from January to May and the dry season from June to December. The average temperature is 21° C with extremes of 18° C to 36° C. The relative humidity is 50 % and, in the months between January and May, it reaches 97 %. The dominant winds have a south-west direction. The mean annual precipitation is near 1,000 mm, and the extremely high values related to El Niño are greater than 4,000 mm.

The urban area of Guayaquil city is 33,825 ha. the entire region (which includes rural areas) is 500,706 ha. The population of Guayaquil, according to the last census of 1990, was 1,508,44 inhabitants.

There are two neighboring urban areas integrated to the city which belong to the municipal governments of Samborondón and Durán. These areas are considered a part of the metropolitan area of the city. The population for the whole metropolitan area is 2,129,000 inhabitants. The recent annual growth rate of population is 3.2 % for Guayaquil, and 3.54 % for the metropolitan area.

1.2.- Economy

Guayaquil is the major industrial and commercial city of Ecuador, concentrating more than 40% of the 100 major commercial companies and industries of the country.

In 1995 The Municipal Department of Planing of The Urban and Regional Development of Guayaquil (DPLAN-G) estimated that the GNP of the city was US\$ 2,782 million, almost 20% of the gross national product of the country. The city also has the first port of Ecuador where 60% of import and export merchandise is in transit.

Right: Picture shows Guayas riverside from north to south.

Down: A panoramic view of downtown where the main commercial and financial buildings are located



Main activities performed in the city of Guayaquil are divided into the following groups:

ACTIVITY	POPULATION INVOLVED	%
Agriculture, fish industries, hunting and fishing	23,435	4.10
Open Mine	618	0.10
Industries, manufacture	72,628	12.60
Electricity, gas and water	2,523	0.40
Construction	41,813	7.30
Business	133,631	13.20
Transport, storage and communication	30,798	4.00
Finance and Insurance	31,128	5.40
Services	162,785	28.30
Activities not well defined	65,365	11.40
Non traditional activities	10,392	1.80

1.3. Urban policy and disaster management

The urban policy of Guayaquil is governed by “The Urban Growth Plan”, which was developed by the Municipal Department of Planing of The Urban and Regional Development of Guayaquil, with the technical and financial assistance of the United Nations Development Program (UNDP), in 1994. Disaster mitigation management is not considered in this plan. Therefore, the RADIUS project has identified the following areas for improvement regarding disaster management in the city:

- a) There is no office or department for disaster mitigation in the Municipality. Last year, for the management of El Niño emergency, an interdepartmental commission was established, been this effort the first step done by Municipality of Guayaquil toward the creation of a permanent unit for disaster management.
- b) The informal settlements need to be severely controlled. Many houses are being constructed without seismic resistant properties.
- c) Construction codes are not updated, mainly in respect to the seismic regulations enforcement.
- d) The local government methods for the regulation and control of design and construction of earthquake resistant buildings do not take into account the proper usage of building codes.
- e) Local government actions need to be strengthened to control the expansion of constructed buildings without a seismic resistant design and to secure the seismic security of very old buildings, in poor structural condition.



This building made of a wood structure and brick walls, is a kind of structure that can suffer severe damage during an earthquake of intensity M.M.=VIII.

1.4. Availability of data

Type of Data

Summary description

4 infrastructure data

1991; Maps of Potable Water Main Lines, for 77% of city (reference: ECAPAG);
1987; Maps of Drainage System, for 50% of city (ECAPAG);
1987; Maps of Waste Water System, for 50% of city (ECAPAG);
1997; Maps of Waste Pick up System, for 100% of city (reference: DUAR - city government of Guayaquil).

4 historic seismicity

1997; seismic catalog for Ecuador, in digital format, containing historic data from 1540 to 1902 (reference: CERESIS) and instrumental data from 1902 (reference: The World Network).

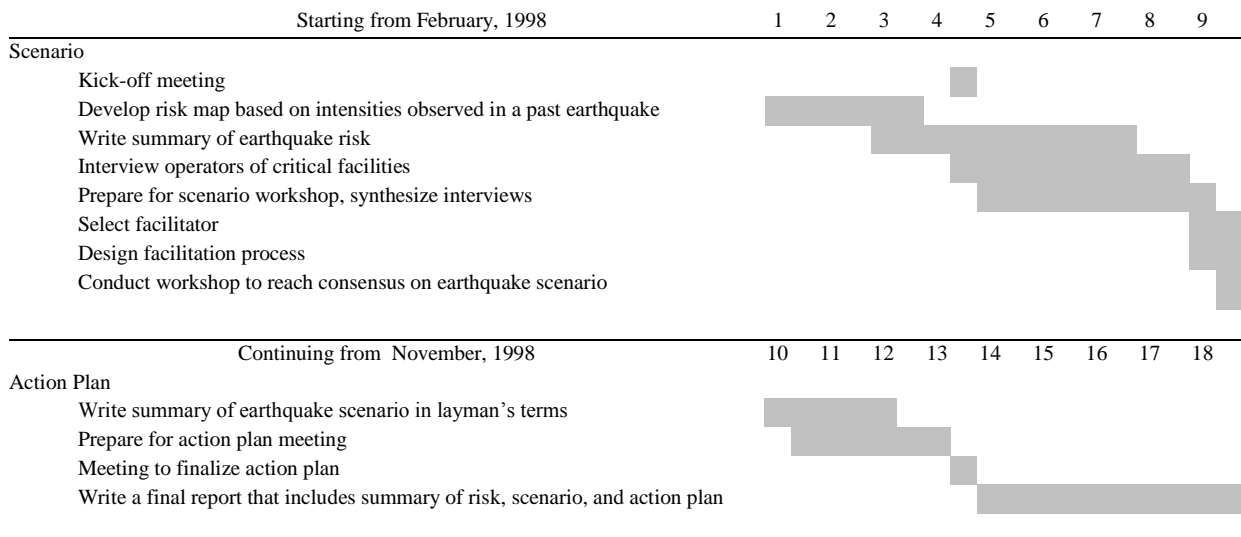
- 4 identified active faults 1990; seismic - tectonic map of Ecuador (reference: ESPE)
- 4 soils characteristics 1994; seismic zones of soils map of the city (reference: IIFIUC).
- 4 inventory of structures 1993 - 1996; for the whole city: data base of buildings census (Reference: Local Government); for the 15% of city: inventory of structures and vulnerability diagnosis (Reference: IIFIUC).

2. OBJECTIVES OF RADIUS IN GUAYAQUIL

- a) To evaluate the seismic risk and to develop an hypothetical earthquake damage scenario,
- b) To prepare an Action Plan based upon the results of the seismic risk evaluation,
- c) To increase public awareness in citizens and governmental authorities about seismic risk,
- d) To initiate an institutionalization process to support mitigation efforts and the seismic risk management.

3. SCHEDULE AND COST PLAN OF GUAYAQUIL PROJECT

3.1. Schedule



3.2. Cost plan

	<i>Management:</i>	<i>IDNDR - U.U.N.N. CONTRIBUTION</i>
1.1	PERSONNEL COSTS:	45,000.00
1.2.1.	OFFICE SUPPLIES, PUBLICATIONS, ETC.	5,000.00
	SUBTOTAL (US\$) =	50,000.00

3.3. Outline of the local financial allotment

US\$ 50.000,00 (S/. 264'500,000.00 Sucres) have been allocated as local financial resources in cash for the case study from the 1998 budget of Municipality of Guayaquil.

3.4. Expenditures from the grant (as of the end of July 1998)

None

4. SCHEME OF RADIUS

4.1. Steering Committee

NAME	RESPONSIBILITY	ADDRESS
Dr. Carlos Villacís	International Co-Chairman	GeoHazards International Stanford University, Stanford CA.
Mr. Guillermo Arguello	Local Co-Chairman	Municipality of Guayaquil 10 de Agosto y Pichincha, 1er Piso
Mr. José Navarrete	Department of Planing of The Urban and Regional Development representative	”
Mrs. Mara Vieira	Department of Planing of The Urban and Regional Development representative	”
Ms. Nastenka Calle	Environmental Affairs Department	”
Mr. John Galarza	Computing Department	”
Ms. Alexandra Loor	City Promotion & Press Department	”
Mrs. Rosalba Medina	United Nations Development Program representative	Municipality of Guayaquil 10 de Agosto y Pichincha, 1er Piso
Mr. Walter Mera	Universidad Católica de Guayaquil representative	Facultad de Ingeniería Ave. C. J. Arosemena Km. 1 ½
Mr. Jaime Argudo	Responsible Scientist	”

4.2. Working Groups

- a) Preparation of the project, cost plan, implementation guideline, formation of committees:
José Navarrete, Mara Vieira (Municipality of Guayaquil);
Walter Mera, Jaime Argudo (Universidad Católica).
- b) Preparation and data collection:
Mara Vieira, Ms. Jéssica Vincens, Edison Burgos (Municipality of Guayaquil);
Jaime Argudo, Julio Peña, Sylvia Vera (Universidad Católica).
- c) References on vulnerability functions & Elements at risk and vulnerability:
Walter Mera, Jaime Argudo, Alex Villacrés (Universidad Católica);
Felipe Huerta (Municipality of Guayaquil).
- d) Hazard assessment:
Alex Villacrés (Universidad Católica).
- e) Kick-off meeting:
Guillermo Arguello, José Navarrete, Felipe Huerta (Municipality)
Hugo Yépes (National Institute of Geophysics)
Jaime Argudo (Universidad Católica de Guayaquil).
- f) Training:
Nastenka Calle (Municipality of Guayaquil)
Walter Mera (Universidad Católica)
- g) Interviews:
José Navarrete, Felipe Huerta, Juan Torres, Mr. Eduardo Andrade (Municipality)
Ángel Fuentes, Jaime Argudo (Universidad Católica de Guayaquil)
- h) Earthquake scenario impact/ Project manager interviews for validation:
Gilberto Castro, Edison Burgos, Nastenka Calle, Mara Vieira (Municipality)
Jaime Argudo, Walter Mera, Alex Villacrés, Julio Peña (Universidad Católica).

4.3. Local Advisory Committee

Not nominated yet.

5. WHAT HAS BEEN DONE

5.1. Kick-off meeting

In the Main Conference Room of the City Hall, on the 19th of May, 1998, the Municipal Government of Guayaquil officially inaugurated RADIUS project, an English acronym for “Risk Assessment Tools for Diagnosis of Urban Areas against Seismic Disasters”.

RADIUS is a project promoted by the Secretariat of the International Decade for Natural Disaster Reduction (IDNDR) of the United Nations which is currently being carried out simultaneously in 9 cities that were selected in January 1998, after a rigorous selection process where 58 cities from all over the world participated.

Initial work began in February 1998, under the direction of the Office of Urban Planning and Development of the City of Guayaquil, and under the technical responsibility of the Research and Development Institute of the School of Engineering of Universidad Católica de Santiago de Guayaquil (IIFIUC) and the supervision of GeoHazards International Institute from the University of Stanford, California.

The Project will finish on July 31, 1999, when two main objectives will be satisfied:

- a) An Action Plan for the Reduction of the Seismic Risk in each of the nine cities, based on the “Seismic Scenarios” locally, prepared and;
- b) A set of Planning Tools for the Diagnosis of the Seismic Risk in Urban Zones, that the United Nations will share with many other cities around the world, that are located in seismic risk zones, just like Guayaquil City.



Mr. Luis Chiriboga Parra (center) during the inaugural session of RADIUS project, with Mr. Víctor Aznar (to his right), from the Office of the United Nations in Ecuador. (Taken from Diario Hoy of May 20, 1998).

The Program of the Kick-off Meeting was:

1. Welcoming Address by Mr. Luis Chiriboga Parra, Vice-Mayor of the City of Guayaquil;
2. Lecture: “The City on a Glance”, by Mr. Felipe Huerta Llona (Municipal Government of Guayaquil).
3. Lecture: An Introduction to RADIUS project by Dr. Carlos Villacís (GeoHazards International), Co-Director of Project RADIUS;
4. Conference about the Historical Seismicity of the Country and Region, by Mr. Hugo Yepes, Director of The National Institute of Geophysics;
5. Conference about Objectives, Working Plan and Organization of Project RADIUS by Mr. Jaime Argudo (Universidad Católica de Guayaquil), Responsible Scientist of the project;
6. Explanation about the Role of The Advisory Committee, by Dr. Carlos Villacís;
7. Presentation of a Report about current status of the project, by Mr. Guillermo Arguello, Director of the Office of

Urban Planning and Development of the City of Guayaquil.

A) Welcoming address:

In his welcoming address, Mr. Luis Chiriboga expressed on behalf of the City, his satisfaction for the selection of Guayaquil for Project RADIUS and stated that the Municipal Government is supporting and working together with the United Nations in this initiative aimed to produce worldwide common tools for the reduction of seismic risk.

He mentioned that the Municipal Government of Guayaquil in this year of 1998 will have a new digital cartography covering the whole city, and that important investments are being carried out aimed to the strengthening of the Municipal Planning.

He reminded that in the last six years the City of Guayaquil has made a lot of progress in this field, and based on that, it is possible nowadays for our city to contribute to world efforts such as the Project RADIUS.

B) The city on a glance:

A historical account of the City was presented, its relationship to the region and the cause of its big urban and demographic growth, specially during the sixties and seventies.

It was concluded that this unplanned growth is one of the main reasons for the Seismic Risk to be incremented in such an important way.

As a historical note, during the earthquake of may 13, 1942, the City had only 180.000 inhabitants in an area of 8 km². Today, it has more than two millions inhabitants in an urban area of 338 km².

C) An introduction to the project:

Dr. Carlos Villacís emphasized the importance of the participation of private and public institutions, NGO's from the city and country in the different stages of the Project, as well as the support that must be given by the media to allow the results of the project to be publicized to the Guayaquil community.

He explained the purpose of the two Workshops that will be organized in October 1998 and in March 1999, the former for the discussion of the Seismic Scenario and the latter for the discussion of the Action Plan.



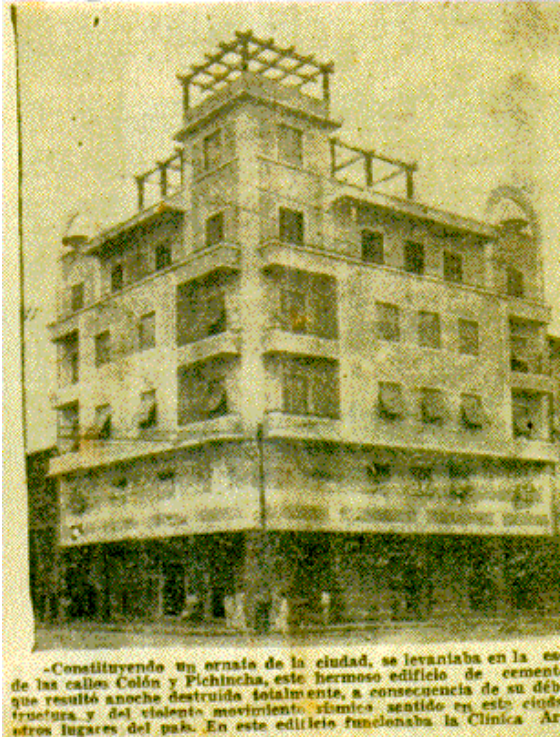
Dr. Carlos Villacís (GeoHazards International), emphasizing the participation of the Advisory Committee . (Taken from Diario El Telégrafo of may 20, 1998).

D) Historical seismicity of the country and region:

According to the historical Seismicity of Guayaquil and the region, there is a high probability that the city will experience in the future an earthquake of a maximum Intensity of VIII in Modified Mercalli Scale.

This Intensity defines structural damage in structures designed against earthquakes, considerable damage and even partial collapse in strong constructions without seismic resistant design, and major damage

in poorly constructed structures.



Building of Clínica Arreaga, one of the two which collapsed during the earthquake of may 13, 1942. (Taken from Diario El Universo).

E) Objectives, working plan and organization:

The Project has three stages:

- a) Gathering of available information (February to May 1998);
- b) Preparation of the Seismic Scenario of Damages (June to October 1998);
- c) Preparation of the Action Plan for the mitigation of damages caused by an earthquake (November 1998 to July 1999).

It was informed that the first stage has been successfully completed, thanks to the contribution given by the institutions to whom the support was requested.

Emphasis was made in that the Project is for the whole City and that the results will be totally shared and publicized to the community.

During the preparation of the Seismic

Scenario, more than thirty officials from local institutions will be interviewed to know from them the state and vulnerability of the systems they administrate, which are considered vital for the City and must be able to withstand the most probable earthquakes. Their knowledge and experience will be incorporated to this study, together with the theoretical simulations that will be conducted to estimate the damage due to an hypothetical earthquake.

It was announced that in the design of the “ Action Plan”, special treatment will be given to the safety of essential structures (hospitals, schools, etc.) and also a detailed study of the different types of buildings with great seismic risk.



A type of structure with a high seismic risk are those condominiums built by BEV in Sauces IX, in which extensions have been built without any structural design and technical supervision. This building was expanded, been converted into a vulnerable structure due to a bad construction practice.

F) Role of the advisory committee:

An Advisory Committee will be established for the RADIUS project. This Committee will be formed by various representatives of important local organizations; Ecuadorian and foreign; public and private, and its principal functions will be as follows:

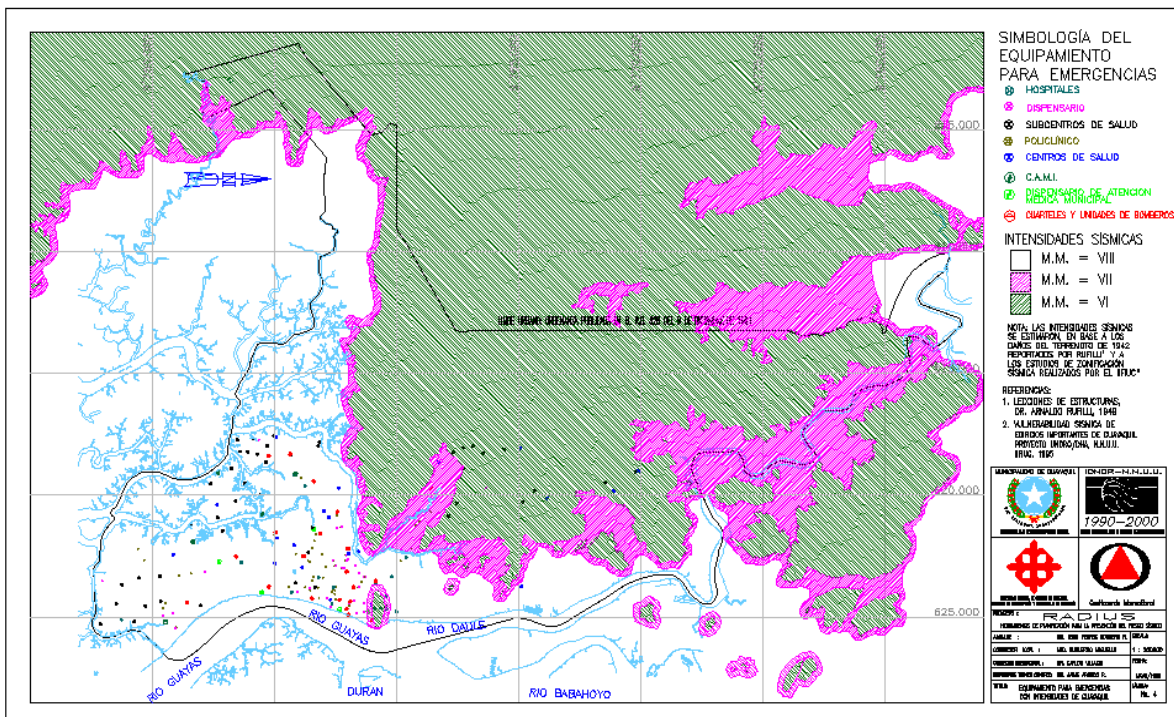
- to advise the local Executive Committee in charge of the fulfillment of the project;
- to give support to the project activities during their fulfillment; and,
- to promote the diffusion of the Action Plan within the community.

G) Report on current status of project:

The Director of the Office of Urban Planning and Development of the City of Guayaquil, Mr. Guillermo Arguello, emphasized the current development of this study: all the infrastructure information of the city has been gathered and many theme maps of the different basic services (water supply, electricity, sewage, etc.) and the urban services (hospitals, schools, etc.) combined with the expected seismic intensities for the different types of soils have been produced until now.



Diario El Universo, may 28th of 1998.



5.2. Public relation

The approach to mass media has been performed with the support of TV and newspaper interviews. The documentaries that have been done in order to raise public awareness are a TV program (30 minutes interview of the RADIUS responsible scientist) and many newspaper articles. This material is attached to this report.

5.3. Summary of collected information

- a) Gathering of available information from lifeline utilities.
- b) Historical investigation of the effects of earthquakes of intensity greater than or equal to M.M.=VI having occurred in Guayaquil during the present century (1906, 1920, 1924, 1933, 1942, 1943, 1946, 1956, 1971, 1980).
- c) Selection of the 1942 earthquake for the damage scenario and preparation of the map of expected intensities.
- d) Digitalization of the following maps: Geology, Seismic Zoning of Soils, Sewage System, Drainage System, Electrical System.
- e) Fifteen theme maps have been produced containing the infrastructure information of the city's different basic services (water supply, electricity, sewage, etc.) and urban services (hospitals, schools, etc.) combined with the expected seismic intensities for the different types of soils.
- f) Four maps showing locations of earthquake with intensities reported in Guayaquil
- g) Fourteen maps containing the distribution of damage for the main earthquakes felt in Guayaquil (1942, 1943, 1971, 1980).
- h) Preparation of a map containing the estuaries of Guayaquil downtown area as they were at the foundation of the city for studying local site effects.
- i) A methodology for the calibration of the international vulnerability functions by using results of damage observed for the main earthquakes felt in Guayaquil.
- j) The characteristics of the elements at risk and their vulnerability is been studied. For buildings the various types of structures have been defined.
- k) Eight interviews have already been conducted.
- l) Preliminary activities have been conducted, including participation of project members in a 90 hours trainee seminar for the preparation of a GIS application under MGE & Oracle software to show the results of the damage estimation prepared to conduct the earthquake scenario.

6. WHAT IS NEXT

By January 1999, the Seismic Risk Assessment will conclude with the full description of the impact of the expected earthquake by means of the Damage Scenario.

7. MISCELLANEOUS

The long time needed by the Municipality of Guayaquil, in order to complete the local administrative procedures for the complete settlement on the RADIUS project, in accordance with the IDNDR terms, may affect the project performance & results.

8. NAME AND ADDRESS OF THE WRITER OF THE REPORT

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