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SUPPORTING REPORT

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S4

SOCIO – ECONOMY CONDITIONS

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OF  
S4 SOCIO ECONOMY CONDITIONS

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## CHAPTER 1 SOCIO-ECONOMY CONDITIONS IN BOGOTA

### 1.1 General

The Study area is a part of the Bogotá D.C. (D.C. for “Distrito Capital”, capital district) and Soacha City. The area is located in the center of the country, on the eastern "Bogotá Savanna", about 2,600 meters above sea level. The political-administrative division in Colombia is divided into four territorial entities: department, district, municipality and indigenous territories mostly inhabited by natives. Each territorial entity is given autonomy within limits defined the laws of the country's constitution.

Bogotá is the capital of the Republic of Colombia as well as the Cundinamarca Department, and houses the national administration such as the National Legislature, the Supreme Court, and the residence of the President. The city has a total of 177.598 hectares and the urban and suburban areas cover 30.736 hectares and 17.045 hectares respectively and remaining are rural area<sup>1</sup>. According to the population estimation on June 30th, 2007, the city had 7.050.133 inhabitants<sup>2</sup>.

### 1.2 Administrative System

#### 1.2.1 General

The Main Mayor and the District Council – both elected by popular vote – are responsible for the city administration. Bogotá city is divided into 20 localities which are lead by local mayors, and this presents the some difference with the rest of cities of Colombia. Each locality is governed by a JAL (Local Administrative Board) and a Local Mayor appointed by the Main Mayor from three candidates proposed by the JAL.

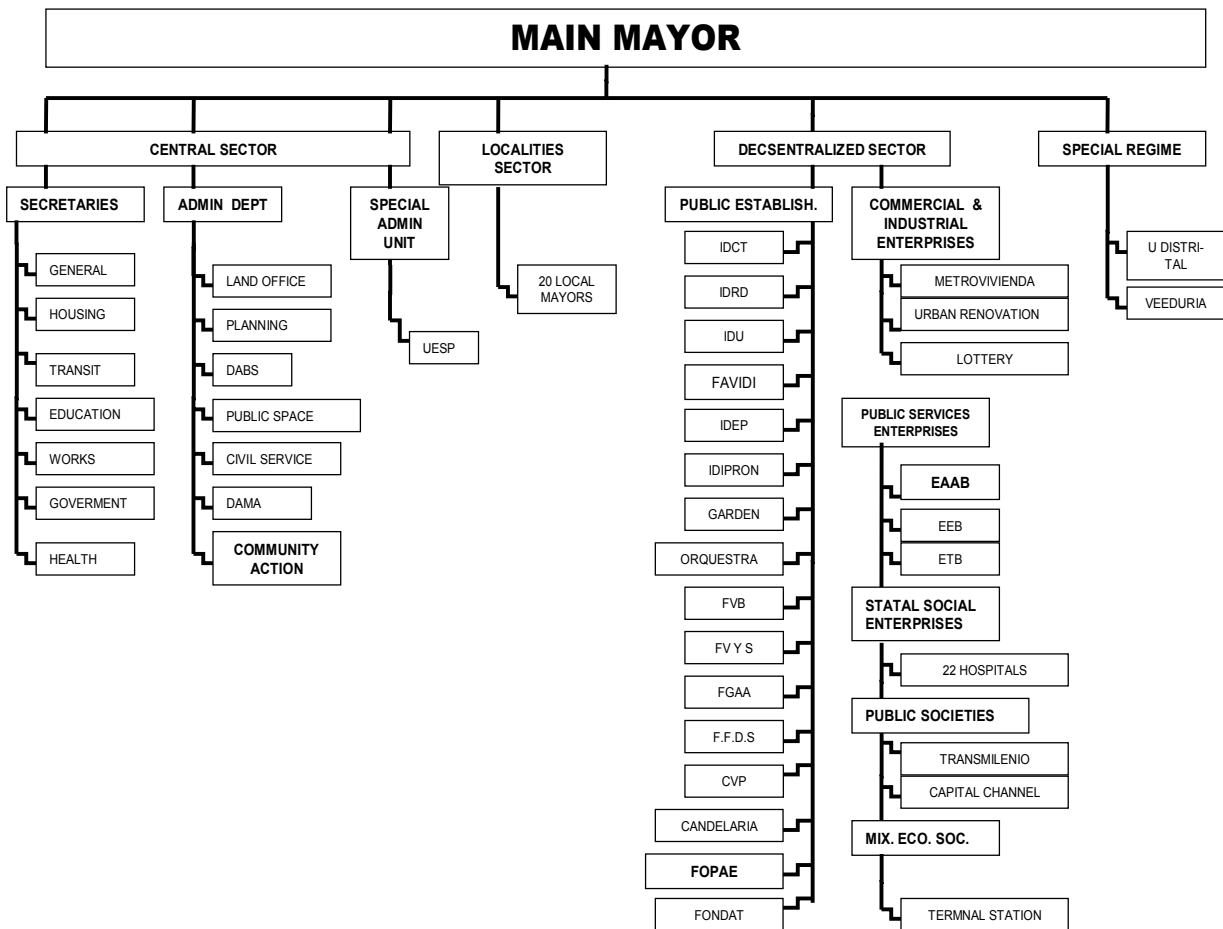
Administratively, Bogotá is divided in four main sectors<sup>3</sup>: Central Sector (Sector Central), Decentralized Sector (Sector Descentralizado), Localities (Sector Localities) and Special Regimen (Régimen Especial). Each sector has several sub-sectors such as seven (7) secretaries and seven (7) administrative departments under the Central Sector, six (6) categorized public service groups under the Decentralized Sector, 20 localities under the Localities Sector, and two (2) Offices under Special Regimes (see Figure S4-1-1)

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1: [http://www.bogota.gov.co/portel/libreria/php/frame\\_detalle.php?h\\_id=16683](http://www.bogota.gov.co/portel/libreria/php/frame_detalle.php?h_id=16683)

2: Taken from DANE [http://www.dane.gov.co/files/investigaciones/poblacion/inf\\_geo/Pob20062007.xls](http://www.dane.gov.co/files/investigaciones/poblacion/inf_geo/Pob20062007.xls)

3: Source (organigrama general del distrito. [http://www.bogota.gov.co/portel/libreria/php/frame\\_detalle.php?h\\_id=468](http://www.bogota.gov.co/portel/libreria/php/frame_detalle.php?h_id=468))



(Source: Bogotá City Website)

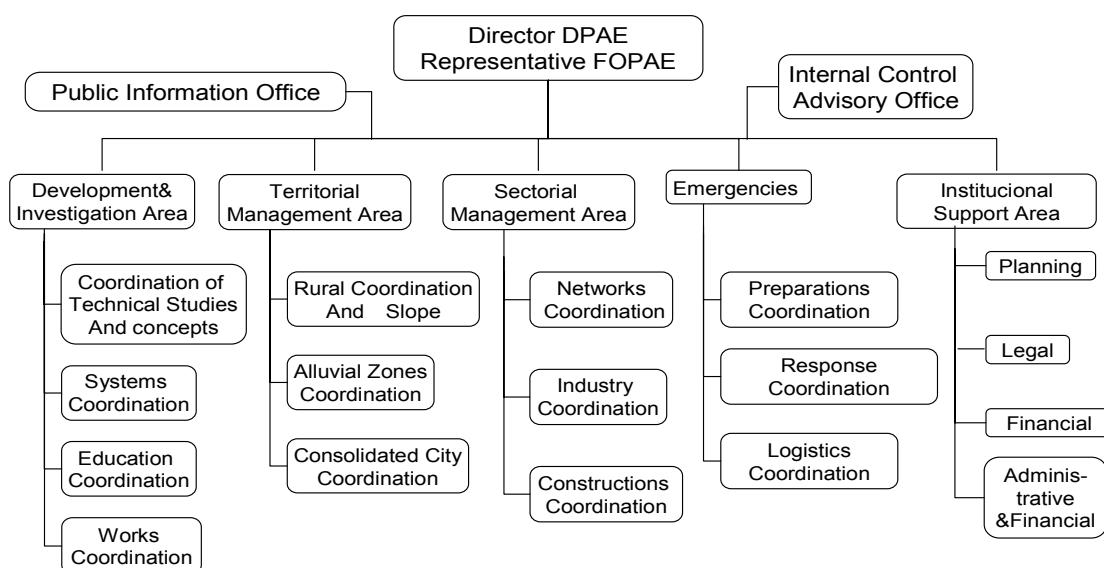
Figure S4-1-1 Administration Structure of Bogotá City

### 1.2.2 DPAAE: Disaster Management Administration

According to the city's regulation, five (5) percent of the city's annual budget is allocated to the disaster management investment and activities. FOPAE (Fondo de Prevención y Atención de Emergencias; Fund for Prevention and Emergencies response) is the authorization body for implement this budget. FOPAE was established as a public entity (Establecimiento Público) belonging to the Decentralized Sector as shown above in Figure S4-1-1.

DPAAE (Dirección de Prevención y Atención de Emergencias) is responsible for planning and implementing the disaster management activities within the city area as the legal representative of FOPAE.

DPAAE has five Sub-directions namely Sub-direction of Territorial Management (Gestión Territorial), Sectoral Management (Gestión Sectorial), Emergencias (Emergencias), Research and Development (Investigación y Desarrollo), and Institutional Support (Apoyo Institucional) and several units under the sub-directions to implement the activities with more than 100 staffs. Figure S4-1-2 shows the organization Chart of DPAAE.



(Source DPAE)

Figure S4-1-2 Organization Chart of DPAE

### 1.3 Socio-Economic Condition

#### 1.3.1 Population and Urban Expansion

##### (1) Historical population growth Bogotá

Bogotá has evolved since the first census in 1775 from about sixteen thousand up to 6.8 million in 2005 as shown in Table S4-1-1 and Table S4-1-2.

Table S4-1-1 Evolution of the number of inhabitants in Bogotá

Year	Population	Source
1775	16,233	"Padrón" (administrative registration) in charged by the viceroy Manuel de Guirior.
1800	21,964	General "Padrón" at the end of 1800.
1832	28,341	Cundinamarca Constitutional, June 10 <sup>th</sup> , 1832
1870	40,883	Statistics Year book of Colombia 1875.
1912	121,257	General census of Colombian Republic, done on March 5th, 1912
1918	143,994	Population census of Colombian Republic, done on October 14th, 1918.
1928	235,702	Population Census 1928.
1938	325,650	General population Census, July 5th, 1938.
1951	715,250	Buildings and houses census 1951.
1964	1,697,311	XIII National population Census and II National Census of buildings and houses.
1973	2,855,065	XIV National population Census and III of housing.
1985	4,236,490	XV National Census of population and IV of housing.

Table S4-1-2 Population of Bogotá<sup>4</sup>

POPULATION 1993	POPULATION 2003 PROJECTED	POPULATION ECV DANE 2003	POPULATION CENSUS 2005 DANE
4,945,448	6,823,337	6,861,499	6,778,691

4: [http://www.dane.gov.co/files/investigaciones/fichas/ficha\\_calidad\\_vida\\_2003.pdf#search=%22encuesta%20de%20calidad%20de%20vid](http://www.dane.gov.co/files/investigaciones/fichas/ficha_calidad_vida_2003.pdf#search=%22encuesta%20de%20calidad%20de%20vid)

Although, the population growth was relatively slow in its early days, the city started to grow faster in the twentieth century. The city currently hosts 16.42% of the nation’s population.

Bogotá and its metropolitan area receive permanently a large number of immigrants of all cities and countries. As calculated by CODHES about 480,000<sup>5</sup> people have migrated to Bogotá due to its metropolitan character and entrance port for non permanent residents. The city reported a population increase of 72.9% from 1993 to 2005, representing more than 1.5 million people in 12 years; this confirms the growing tendency of the District and its nature of being a receiver of immigrants.

Many of the immigrants have been settled in the south-western part of the District such as Ciudad Bolivar that is the sixth locality with high population density of Bogotá and Bosa with the highest rate of growth (DANE 2002), and these two areas are also chosen by displaced people to settle.

(2) Urban Expansion

The urban area of Bogotá is continuously expanding, while the city area comprised 900 hectares in 1900, today it is composed by 30,000 hectares<sup>6</sup>, as shown in Table S4-1-3.

Table S4-1-3 Bogotá Urban Expansion and Population Density

Year	Population (thousands)	Area (has)	Density (person/hectare)
1900	100	909	110
1928	235	1,958	120
1938	330	2,514	131
1964	1,730	14,615	118
1985	4,177	32,866	127
1991	4,960	32,300	154

(Source: Gilbert, Alan. *The Mega-City in Latin America*. United Nations University Press)

Bogotá’s spatial growth has been characterized by the absence of strong physical limits. Its favorable location, a high plain with extensive territory, and the availability of quality water sources. By the mid fifties, Bogotá city became a Special District by adding neighboring settlements (Bosa, Suba, Usaquén, Usme and Fontibón), since the late sixties its growth has been lead towards the East -Mosquera and North - Cajicá, Chia, Cota.

Similar to most Latin American large cities, the binomial urban expansion with formal and informal city has been observed. As mentioned, the city receives many immigrants and it has been resulted in the expansion of the unplanned settlements (or informal city) with low quality buildings, lack of public infrastructure, transport integration and social services. Half of Bogotá’s spatial growth is known to be a consequence of the informal urban development.

Since new comers who are mostly displaced people fleeing from violence migrated from the other departments are in precarious conditions, such as lacking of assets or cash. These families found no other place to locate themselves but in fringe areas of the city especially south of Bogotá where are known to be a high risk because its slope landform and border hill condition. Consequently, the informal urban development is mostly towards the South of the city. The people living in the surrounding areas of the flat part of the city and the slope hills have experienced over time the lack of basic conditions of regular human settlements. The most critical are proper roads and access ways, quality water supply, enough aqueduct pipes to channel sewerage from the high slopes into the city system, etc.

To mitigate uncontrolled urban expansion, local planners have made several attempts along time to integrate the unplanned settlements.

5: Fundación Corona y Cámara de Comercio de Bogotá, *Proyecto Bogotá Como Vamos*, Casa Editorial El Tiempo, Agosto 2003.  
 6: Alvarez G. Ana Maria. *Urban Practices in Bogotá*. 40th ISOCARP Congress 2004.<http://www>

### 1.3.2 General Economy

The economy in Bogotá is in constant growth with an Internal Gross Income (Producto Interno Bruto, PIB) for 2005 of USD 22,204 millions, which places the city on the 13th position of the best cities in Latin America to do business, according to America Economic magazine published in August 2005.<sup>7</sup>

The economy crisis Colombia suffered in 1999 created a harsh situation with low revenue, an economic contraction, and the rate of unemployment above 18% and weakened to a low position. While a slow recovery is taking place, the country still shows high rates of unemployment. People with unstable monthly income (\$44,660 pesos in Ciudad Bolivar) demonstrate a slow improvement.

According to the survey conducted by DANE in 2003, approximately 3 million residents in Bogotá were working while 14.67% of the unemployed rate is significantly high compared with the national figure of 12.3%.

### 1.3.3 Socio Economic Strata

The Strata (Estrato) is the index of urban residential area and is classified into six, from Strata 1 (lowest) to Strata 6 (highest), as shown in Table S4-1-4.

Table S4-1-4 Socio Economic classification

Population Strata	Description	Per capita income
Strata 1	Low low	- 1 LMMW
Strata 2	Low	1-3 LMMW
Strata 3	Low Middle	3-5 LMMW
Strata 4	Middle	5-8 LMMW
Strata 5	Middle High	8-16 LMMW
Strata 6	High	16 +

*\*Legal Monthly Minimum Wage (LMMW: Salario Mínimo Legal Mensual. At Oct 2006: 1 LMMW equals 408,000 pesos, approximately US\$ 175 monthly.*

The unit of socio economic stratification is the household, and households are applied different public service bills. Since, low Strata sectors (1 to 3) are economically more vulnerable, these families have a discount in the amount of the bill, paying below the actual cost of the service, which is balanced out by those strata that have the capacity to contribute more. For example, households in Strata 3 (Middle Low according to Table S4-1-4) can receive a subsidy in public services bills of 15%, whereas Strata 1 household inhabitants receive up to 50% of decrease their utility bills for public services.

Approximately 30% of the households in the Study Area earn below a minimum wage (aprox. \$175 USD monthly) and 70% have an average monthly income between \$175 and \$525 USD.

### 1.3.4 Study Area

#### (1) Population of Study Area

Six localities of Rafael Uribe, San Cristobal, Usme, Ciudad Bolivar, Bosa and Tunjuelito are related to the Study. The characteristics of the localities are summarized in Table S4-1-5.

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7: [http://www.americaeconomia.com/PLT\\_WRITE-PAGE-SessionId~Language~0-Modality~0-Section~Content~](http://www.americaeconomia.com/PLT_WRITE-PAGE-SessionId~Language~0-Modality~0-Section~Content~)



Table S4-1-5 Population and Its Characteristics of the Localities

Locality	Area	No Barrios	No Inhabitants	Men	Women	Professional Level
Rafael Uribe	1,310 Ha	116	385,391	48,1%	51,2%	6.5%
San Cristobal	4,816 Ha	211	460,414	48.2%	51.8%	5.0%
Usme	21,556 Ha	220	267,423	48.9%	51.1%	2.3%
Ciudad Bolivar	12,998Ha	252	658,477	48,8%	51,2%	3.2%
Bosa	2,392Ha	330	475,694	48.8%	51.2%	3.7%
Tunjuelito	1,028 Ha	30	204,367	48.2%	51.8%	8.4%

(Source: DANE. General Census 2005)

## (2) Employment in The Study Area

According to the information of Administrative Department of Planning Labor Force, economic activities in the six localities related to the Study are mainly commerce, restaurants, and hotels followed by the domestic services. Also, the manufactory industry that concentrates none qualified labor which reports revenues of around four hundred eighty thousand pesos.

Due to this low income, families are unable to cover their basic needs. The lack of permanent and stable jobs increase the poverty rates forcing people to diminish their consumption of food, clothing and recreation.

Table S4-1-6 shows the employment of the six localities in the Study Area. Rafael Uribe has the highest rate of unemployment almost 4 points above the national average, and followed by Ciudad Bolivar and San Cristobal where more than 30 thousand people have no permanent income.

Table S4-1-6 Employed and Unemployed People by localities

Locality	Employed Population	Un-employed Population	Total	Unemployment Rate (%)
Bosa	225,873	36,886	262,759	14.04
Ciudad Bolivar	244,599	44,660	289,259	15.44
Rafael Uribe	183,359	34,402	217,761	15.80
San Cristobal	179,254	30,782	210,036	14.66
Tunjuelito	91,794	14,204	105,998	13.40
Usme	103,601	15,945	119,546	13.34
Total	1,028,480	176,879	1.205.359	14.67

(Source: DANE census 2003)

## (3) Living Conditions

Majority of the population related to the Study Area is socio-economically located under strata 1 and 2. The people in lowest condition are concentrated in Ciudad Bolivar (almost all population in Strata 1 and 2) and Usme (about three quarters of population in Strata 1 and 2).

The estimations by the UBNM (Unsatisfied Basic Needs Methodology) add other evidence of socio-economically harsh conditions of people living in the area at study (see Table 4-1-7).

Table S4-1-7 Unsatisfied Basic Needs

Unsatisfied Basic Needs (UBN)	Percentage of Population under UBN by Localities
San Cristobal	33.4
Usme	87.9
Tunjuelito	32.9
Bosa	42.8
Rafael Uribe	33.9
Ciudad Bolívar	58.6

(Source: p. 41. Recorriendo USME. Does not include people in collective homes (hospitals, prisons) & homeless)

#### (4) Public Services

This section summarizes some of public services, such as water supply, sanitary sewerage and waste management, provided in the Study Area.

EAAB (Empresa de Acueducto y Alcantarillado de Bogotá), the official company to supply potable water and sanitary services, provides a high percentage of coverage of water services and sewerage systems in the Localities of the Study area.

Table S4-1-8 compares Localities in the Study Area with the average coverage for the city for water supply and sewerage disposal system.

Table S4-1-8 Percentage of Service Coverage

Locality	Aqueduct	Sanitary Sewerage system
USME	91.6	92.3
SAN CRISTOBAL	99.7	90.1
TUNJUELITO	100.0	99.7
RAFAEL URIBE	n/d	n/d
BOSA	97.6	65.3
CIUDAD BOLIVAR	n/d	n/d
Total Bogotá	98.0	90.1

For example while Tunjuelito and San Cristobal show higher coverage on aqueduct services than the city's average (100% and 99.7%), Bosa and specially Usme (91.6%) are under this average. With respect to sewerage system, the most critical area is Bosa with only 65.3% of coverage of services for the population settled, much below the service coverage of 90.1% in sanitation infrastructure.<sup>8</sup>

Regarding the waste management services in the study area, the service is delivered by three private companies (by 2002) with valid legal concessions for seven years. The administration of the contract for the services is done by the UESP (Unidad Ejecutiva de Servicios Públicos: Executive Unit for Public Services). The city has been divided to six operational sectors (ASE: Areas de Servicio Exclusivo). Table S4-1-9 shows the services currently provided by concessionaries.

Table S4-1-9 Waste Management Concessions, Coverage, Deficiencies and Causes of Deficiencies in Localities of Study Area

Localities	Concession	ASE	Coverage	Deficiency	Cause
Usme	Consortium Lime S.A. 2003: 7 years	5	100%	Access Door to Door / Irregular Service	Access limitation
San Cristobal	Consortium Lime S.A. 2003: 7 years	5	100%	Access Door to Door	Access limitation
Tunjuelito	Consortium Capital Cleaning S.A.	4	100%	Access Door to Door	Roads infrastructure deficiencies
Rafael Uribe	Consortium Lime S.A. 2003: 7 years	5	100%	Access Door to Door	Access limitation
Bosa	Clean City 7 years	6	100%	Access Door to Door	Roads infrastructure deficiencies
Ciudad Bolivar	Capital Cleaning Consortium S.A. 2003: 7 years	4	95.5%	Deficient Service	Def. Roads Use of Metallic recipients

The service providers claim not having enough access capabilities for their trucks to achieve full coverage of the waste management services, due to a number of physical limitations in site: single and multi housing units with internal walkways; narrow access and lack of pavement in the access roads; electrical posts in the middle of the way; damage of roads during the rainy season; houses with no road in front, only accessed by stairways or at dead end sections; and road made of paving stone (adoquines) which do not support the weight of the waste collector trucks.

8: Recorriendo Bosa

In some sites trash is disposed improperly. For example, along the Creeks Santa Librada and Yomasa in Usme large informal deposits of waste can be found. Also in Usme the Doña Juana sanitary landfill is located, a site where demolition gravel is received. In addition to the existence of the landfill, houses have been built in this area without proper technical supervision. In the high parts, open spaces and slopes of the Locality San Cristobal waste is thrown. In the rural areas of Ciudad Bolivar it is reported that people tend to burn or bury their trash.

In addition, some Localities related to the Study such as Rafael Uribe, San Cristobal, Bosa, and Tunjuelito are suffering from an insufficient capacity as local towns to supply community needs of education, public services and infrastructure due to rapid growth of population.

#### (5) Disaster Hazards

According to the P.O.T, areas subject to flood hazard must follow the Flood Hazard Map (Decree 190, 2004). This map identifies the areas prone to affectation by increase in water level of the streams and rivers that cross the city.

##### 1) Landslide Disaster Hazard Areas

Areas most affected by landslide (mass removal) are slopes, the stream margins, and sites where human activity has taken place, whether excavation works, soil removal in slopes or landfills without technical supervision, and with little hydraulic management. Rocks falling occur in old mining areas which did not experience proper closure and recovery. In the city of Bogotá, landslide hazard areas can be found in Ciudad Bolívar, San Cristobal, Rafael Uribe Uribe, Santa Fe, Usme, Chapinero, Usaquén y Suba.

The hazard reduction policy framed in the P.O.T. is based on the finding integration between the constructed system or built environment the socio demographic reality and the natural conditions. This implies considering the territorial, economic, social and policy dynamics that generate hazard.

Table S4-1-10 shows the calculations area in the Study Area Localities. The Localities with greater total areas in hazard by landslide are Ciudad Bolivar and San Cristobal. It also shows that 825 blocks are in high hazard in these four Localities, as opposed to 2,720 blocks in low hazard.

Table S4-1-10 Number Blocks of Landslide Hazard Area

Locality (UPZ)	High Hazard	Middle Hazard	Low Hazard
Usme (La Flora, Danubio, Gran Yomasa, Los Comuneros, Alfonso Lopez, Parque EntreNubes)	187	716	2,257
San Cristobal (La Gloria, Los Libertadores)	224	1,162	85
Rafael Uribe (Marruecos, Diana Turbay)	177	820	35
Ciudad Bolivar (El Mochuelo, Lucero, El Tesoro)	237	1,480	343
Total	825	4,178	2,720

##### 2) Flood Hazard areas

Table S4-1-11 will similarly show the high, middle and low hazard Localities and UPZ for Flood Disasters. Tunjuelito has the largest area.

Table S4-1-11 Summary of Flood Hazard Areas (unit: ha)

Locality (UPZ)	High Hazard	Middle Hazard	Low Hazard
Usme (Gran Yomasa, Los Comuneros, Parque EntreNubes)	10.34	9.28	8.64
Tunjuelito (Tunjuelito)	60.00	90.90	58.80
Rafael Uribe (Marruecos, Diana Turbay)	18.20	3.60	11.90
Ciudad Bolivar (El Mochuelo, Lucero, El Tesoro)	22.70	15.00	40.40
Total	111.24	118.78	119.74

## 1.4 Land Use and Urban Planning

### 1.4.1 Urban Planning

#### (1) Urban Development Trend

According to Alvarez and Saldarriaga, the urban development trend of Bogotá metropolitan area is broadly classified in four phases from the perspective of urban development concept as summarized in Table S4-1-12

Table S4-1-12 Bogotá Urban Development Trends

Phase	Main characteristics
1923-1944	Expansion urban development by non integrated bordering settlements
1951-1970	Modern planning, lead by Le Corbusier. The zoning concept introduced with road the road transport system.
1970-1997	City growth as a consequence of real estate and financial activities
1997 up to date	Ordering concept as a way to organize and resolve conflicts between hazards, social rights, and city functions

#### (2) Urban Planning

Currently, Bogotá has the Metropolitan Territorial Plans namely POT (Territorial Ordering Plan) which conceptually integrates the best both diverse and land uses in expanding cities. The POT set in place in 2000, constitutes a major step on the organization of the city growth, its spatial distribution of land uses, not only for Bogotá city but also for all the country's municipalities

Before introducing the POT for Bogotá, CAR (Regional Autonomous Corporation) of Cundinamarca, created in 1962 played a significant role in urban planning. The CAR is in charge of the environmental regional management plans, and also regulates the peri-urban housing as well. This entity became a key player during the POT discussions between 1997 and 2000, and currently is a regional decision maker for the larger area in and around the Capital District.

#### (3) POT (Territorial Ordering Plan) for Bogotá

The objectives of the POT, according to its fundamental law (388/97), are 1) mitigate and compensate the regional impacts of the economic trends, 2) optimal use of space, 3) prospective vision of development, 4) harmonize social and economic goals, and 5) restore and protect natural resources<sup>9</sup>.

The 2000 POT established the categories of Urban Land, Rural Land, Protection Land and Expansion Land for Bogotá DC. These follow the rationale guiding the entire POT, which seeks to adjust the "real" city with the planning instruments, in order to provide some control over the current uses, and to allow for planned adjustments towards compact growth.

Also the purpose of the POT is to integrate the urban patterns and structure, as well as complement the city functions according to the existing activities and social demands of large groups of population. Specifically, the POT devotes special attention into the population located currently in the fringe areas - mostly towards the South of the city.

The city planners have had to develop ways to incorporate spontaneous city growth into the urban grid. As a comprehensive plan, the POT is composed by a number of sectors study, master plans, and sectorial plans, projections and specific maps. The POT establishes the general components or systems for Bogotá DC: the Human Settlement System, the connectivity System (roads & transportation) and the Protected Areas System.

9: Perez Preciado, Alfonso. Bogotá y Cundinamarca Expansión Urbana y Sostenibilidad. Corporación Autonoma Regional de Cundinamarca. Santa Fe de Bogotá. 2000. Pg 18.

Administrative Department (Distrait Planning Administrative Department - Departamento Administrativo de Planeación Distrital: DAPD) has been working for developing 18 Sectors Master Plans, which are tools that derive from the POT framework. Among those to be noted are the Master Plan of Aqueduct and Sewerage; Solid Waste; Health Infrastructure and Services; Public Space; Sports and Recreation, etc.<sup>10</sup>.

1.4.2 Urban, Rural, Protected and Expansion Areas

According to the Planning Department of the Capital District of Bogotá, the city is broadly classified into urban land, rural land and expansion land. Within both Urban and Rural, the category of Protected Areas (Areas Protegidas) is found as a distinctive land use section (Table S4-1-13).

Table S4-1-13 Bogotá, Rural Urban, protected and expansion areas (in hectares, 2002)

RURAL AREA			URBAN AREA			EXPANSION			BOGOTA
Rural	Protected	Total	Urban	Protected	Total	Expansion	Protected	Total	Total
48,029	73,445	121,474	34,219	4219	38,438	2,557.70	1106	3,664	163,575

(Source: <http://www.segobdis.gov.co/>)

The Metropolitan Centers and Residential sections are located in the North and South areas and the Western border<sup>11</sup>. The Urban Land (Suelo Urbano) is subdivided into UPZs (Unidades de Planeación Zonal: Units of Zonal Planning) which will be discussed in detail in the later section.

The Rural Planning Units (Unidades de Planeamiento Rural -UPR) are foundation of the rural planning. These tools address topics such as ecological management, the uses and occupation of rural land; the farming management strategies and technical assistance, and finally the activities in the urban border. Rural land is used mainly agriculture, ranching, forest management, natural resources exploitation (such as mining), solid waste final disposal, transportation nodes and human settlements.

The Protected Areas (Areas Protegidas) area composed of Natural (ecological) Areas, Urban parks, Non Mitigating High Risk Territories, areas in which some future uses are foreseen (city infrastructure such as sanitation treatment plants) and the alluvium valley of Bogotá River. The Protected Areas within the urban areas tend to be urban parks, and ecological preservation areas would be more typical in the rural protected areas for soil protection purposes or infrastructure (city water treatment plant).

The Expansion Areas are those areas defined and selected for current or future urban use. Typically the expansion area would be in the process of applying or included in the Barrio Improvement.

Figure S4-1-3 shows the distribution of each category for the Bogotá in 2002.

10: <http://www.segobdis.gov.co/><sup>1</sup>

11: Recorriendo Bogotá.PDF

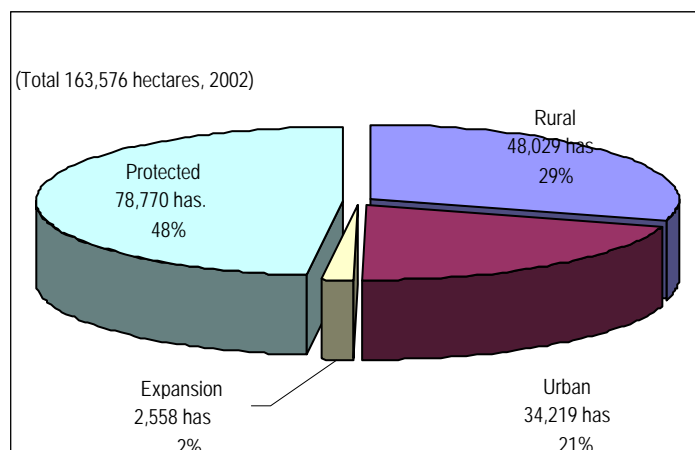


Figure S4-1-3 Bogotá DC: General Land Use

### 1.4.3 Localities, UPZs and Barrios

#### (1) Localities and UPZ containing the Study Area

The Study Area is located under six distinct Localities: San Cristobal, Usme, Tunjuelito, Bosa, Rafael Uribe and Ciudad Bolivar. Table S4-1-14 shows the area of localities by land use categories.

Table S4-1-14 Extension and Type of Soil of the 6 Localities of the Study

LOCALITIES	Total (Ha.)	RURAL AREA			URBAN AREA			EXPANSION		
		Rural	Protected	Total	Urban	Protected	Total	Expansion	Protected	Total
San Cristobal	4,816		3,187	3,187	1,425	204	1,629	-	-	-
Usme	21,556	9,239	9,068	18,307	1,496	568	2,064	882	303	1,185
Tunjuelito	1,028		-	-	752	276	1,028	-	-	-
Bosa	2,392	-	-	-	1,699	230	1,929	229	234	463
Rafael Uribe	1,310	-	-	-	1,221	89	1,310	-	-	-
Ciudad Bolivar	12,998	5,574	3,982	9,556	2,645	593	3,238	194	11	205
Total of Six	44,100	14,813	16,237	31,050	9,238	1,960	11,198	1,305	548	1,853
BOGOTA	163,575	48,029	73,445	121,474	34,219	4,219	38,438	2,558	1,106	3,664

Most of the expansion areas where are a reserve for future city growth, are located in the two southern Localities of Ciudad Bolívar and Bosa.

As stated, a Locality is further divided to smaller planning units of UPZ. These are urban tools used to establish urban micro zoning according to the homogenous characteristics of neighboring areas. A UPZ is a territorial unit and composed of a number of Barrios these can be fully incorporated into the urban structure and form, or can be recent settlements of migrants that have not been able to consolidate their location into the city structure.

Table S4-1-15 shows relation between UPZ types 1 to 3 and Strata. The Residential Type 1 is peripheral and non consolidated areas lacking basic services. As we will discuss in the following, most of the people of the Study Area are located in UPZs type 1: Incomplete Residential Urbanizations.

Table S4-1-15 Relation between UPZ Residential type and Socioeconomic Strata

TYPE OF URBANIZATION	STRATA
Type 1. Incomplete Residential Urbanization	Strata 1 y 2
Type 2. Consolidated Residential	Medium Strata 3 y 4
Type 3. Qualified residential	Medium and High Strata

Table S4-1-16 reveals the residential composition of each UPZ in the Localities of the Study Area. For example, in Bosa, five out of the six UPZ are composed by Type 1, and the remaining UPZ is the Protected Area known as “Parque Entre Nubes”, an area which has experienced resettlement and recovery policies for natural conservation purposes. Similarly, the other Localities are mainly composed by UPZ Type 1.

Table S4-1-16 Classification and estimated territory of each UPZ in the Study Area

	UPZ Type	Population	Extension in Hectares of UPZ	% UPZ	Estimated % area inside Study Area	Estimated Hectares in Study Area
<b>USME</b>						
La Flora	1	25,523	207	6.44	100%	207
Danubio	1	28,143	268	8.34	45%	121
Gran Yomasa	1	117,115	530	16.5	65%	345
Comuneros	1	64,097	483	15.03	45%	217
Alfonso López	1	19,640	234	7.27	60%	140
Parque Entre Nubes	Protected Area	1,043	535	15.56	65%	348
	-	3,627	3,249	-	-	1,378
<b>SAN CRISTOBAL</b>						
La Gloria	1	108,645	386	23.69	100%	386
Los Libertadores	1	87,622	389	23.88	95%	370
	-	196,267	1,629	-	-	2,481
<b>TUNJUELITO</b>						
Tunjuelito	1	65,217	385	37.47	50%	193
	-	65,217	1,028	37.47	-	193
<b>RAFAEL URIBE</b>						
Marruecos	1	74,542	359	27.4	100%	359
Diana Turbay	1	60,605	182	13.9	90%	164
	-	135,147	1,310	-	-	523
<b>BOSA</b>						
Bosa Central	1	214,767	717	30	65%	466
	-	214,767	2,392	-	-	466
<b>CIUDAD. BOLIVAR</b>						
El Mochuelo	2	6,600	321	9.33	10%	32
Lucero	1	229,216	582	16.89	40%	233
El Tesoro	1	43,844	223	6.48	100%	223
Jerusalem	1	78,429	462	13.42	50%	231
Ismael Perdomo	1	113,780	554	16.12	20%	111
	-	471,869	3,443	-	-	830
<b>TOTAL</b>			<b>13,051</b>	<b>-</b>	<b>-</b>	<b>5,869</b>

The fifth column in the Table S4-1-16 indicates roughly the percentage of the UPZ that overlaps with the Study Area. In the case of Ismael Perdomo of Ciudad Bolivar, only 20% of the entire UPZ is located within the Study area. In this particular case, Ismael Perdomo is the only area of the Study Area for Landslide, where Altos de La Estancia is located.

All the rest of the UPZ’s estimated Area are coincident with the four watersheds at study for the Flood Early Warning Prevention Plan, namely creeks Santa Librada, Yomasa, Chiguaza and La Estrella and Trompeta.

The complete area, by this visual overlap estimation method, adds a total of 5,869 hectares. For Bosa and Tunjuelito Localities, only one UPZ overlap with our study area: Bosa Central and Tunjuelito respectively. In the Localities of Rafael Uribe two UPZs of Diana Turbay and Marruecos are overlapping with the Study Area, and La Gloria and Los Libertadores in is the UPZs related to this Study. The largest portions of territory overlap of the Study Area are in Ciudad Bolivar and Usme.

(2) Barrio Area

Figure S4-1-4 and Figure S4-1-5 shows the number and area of Legal Barrios in six Localities (Usme, Tunjuelito, Ciudad Bolívar, Rafael Uribe, Bosa and San Cristobal). A total area of 3,745 has represents 57.6 % of legalized barrios extension of Bogotá (6499 has.).

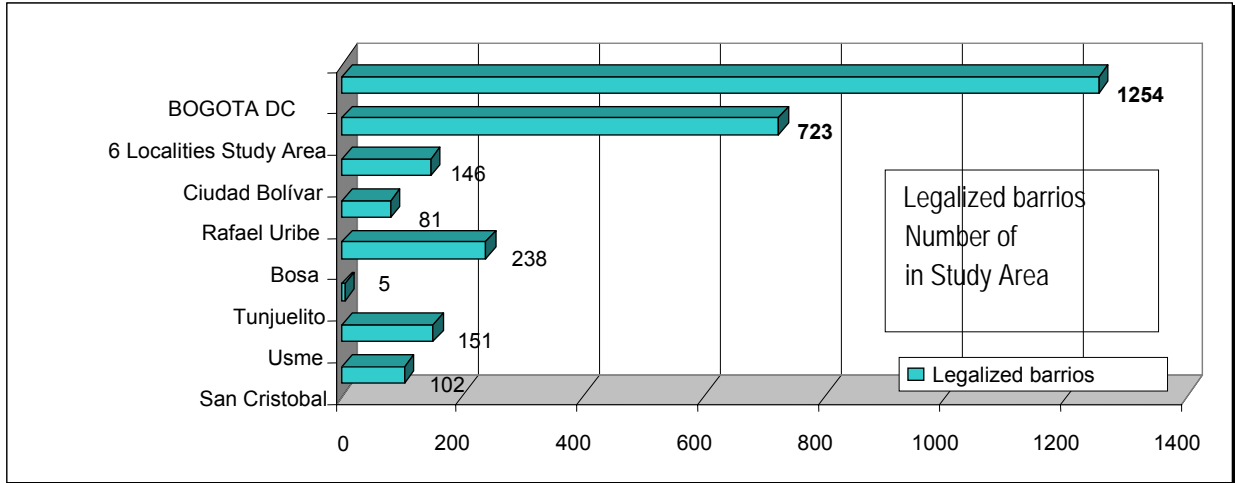


Figure S4-1-4 Number of Legalized Barrios in Six Localities<sup>12</sup>

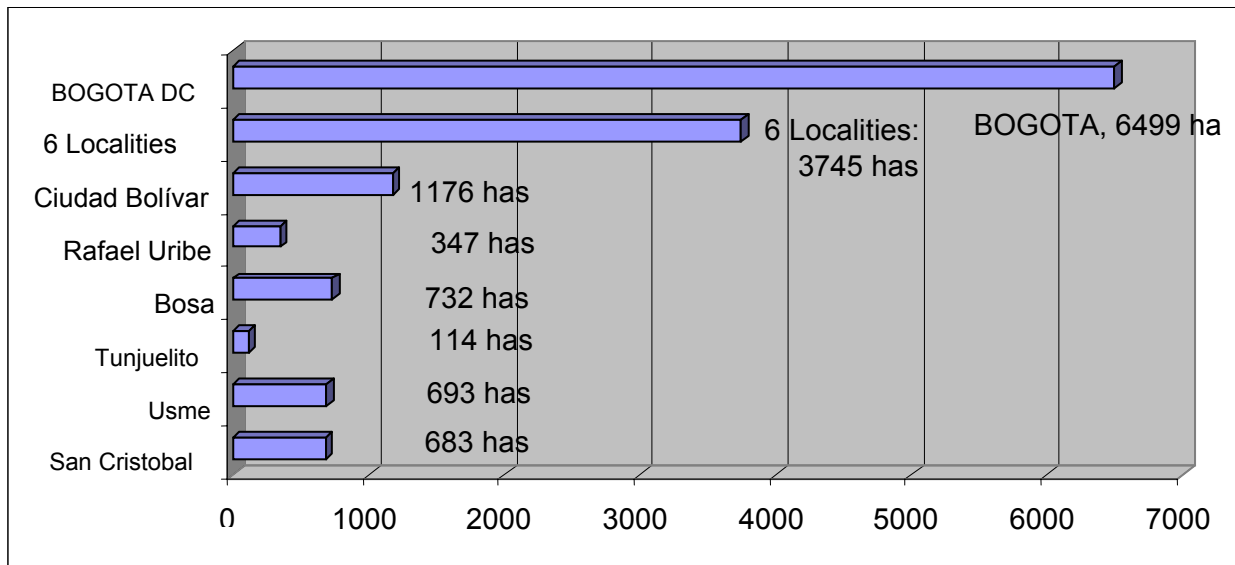


Figure S4-1-5 Extension of Barrio Areas of the Study Area Compared to Bogotá Total (Has)

### 1.5 Citizen Participation

In Bogotá different mechanisms for the citizen participation has been established such as the Local Planning Councils, the Community Health Committees, the Social and Political Councils, Citizen Inspection Groups, Development Committees and Public Services Social Control Groups. These citizen participating mechanisms are carrying out different kind of local developing activities for the community welfare and helping to protect the communities' interests in face of the district entities. In 1993 the Organic Bogotá Statute Decree, the Local Administrative Boards (JAL) were created,

12: Departamento Administrativo de Planeación. Recorriendo Usme. Diagnóstico Físico y Socioeconómico de las localidades de Bogotá D.C. Alcaldía Mayor de Bogotá. D.C. 2004. Calculations for the year 2002



enlarging the participation mechanisms<sup>13</sup>. These JALs are composed by Ediles, citizens elected by popular vote and the functions are as follows<sup>14</sup>:

- To distribute and allocate the budget assigned from the annual budget of the District taking on account the UBN (Unsatisfied Basic Necessities) of the population
- To supervise and control the district services provided to their locality and the investments done with public resources
- To accomplish the functions in matter of public services, works construction and to perform the administrative attributions assigned by law and designated by the national authorities
- To promote the participation and citizen supervision in the management and control of the public affairs
- To practice other functions assigned by constitution, the law, the district agreements and the decrees of Bogotá mayor

The Community Action Board (or JAC) is another sphere of community organization existing since the last 50 years in Bogotá. Currently 1,753<sup>15</sup> JACs are working in favor of the inhabitants within their territory. The main functions of JAC are<sup>16</sup>:

- To promote and strength in the persons, the sense of belonging to a community, district or municipality through the exercise of the participative democracy, and creating and developing training processes for its performance.
- To plan the integral and sustainable development of the community and establish the necessary communication channels for carrying out their plans.
- To create autonomous processes of identification, formulation, performance, administration and plans, programs evaluation, and communitarian development projects.
- To make contracts with public and private enterprises of international, national, departmental, municipal and local order, with the purpose of stimulate plans, programs and projects according with the communitarian and territorial plans of development.
- To create and develop economic processes of collective and solidarity character through loan contracts with national or international entities.
- To construct and preserve harmony in the collective and interpersonal relationships inside the communities, through the recognition and respect of the diversity, respect and tolerance. Also, informing the community permanently about the development of the facts, policies, programs and State services from the entities that affect their welfare and development.
- To promote and exercise the citizen actions and the accomplishment, as mechanisms foreseen by the Law and the Constitution, for the respect of the associates rights. Also, to disseminate, promote, keep and exercise the human basic rights and the environmental protection according to the Constitution and the law.
- To create and promote the organization processes and interaction mechanisms with the different expressions of the civil society, for accomplishing the objectives of the community action, promoting the participation of all the social sectors, specially the women and youngsters, in the Board of Directors of the JACS.

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13: <http://www.bogota.gov.co/portel/libreria>.

14: [http://www.alcaldiaengativa.gov.co/002\\_jal/jal.htm#2](http://www.alcaldiaengativa.gov.co/002_jal/jal.htm#2)

15: <http://www.participacionbogota.gov.co>

16: Decreto 2350 20/08/2003 by president Alvaro Uribe

- To provide a larger coverage and quality of public services, looking for the community access to the social security and to create a better life quality in their community.

Training is a key role of their activities including all the Board of directors, officers, spokesperson, representatives, affiliates and beneficiaries. The community organizations should observe the following principles: a) democracy, b) autonomy c) prevalence of the common welfare and d) good faith principle.

Table S4-1-17 shows a number of community organizations established in the Localities related to the Study. As shown in the table, only in three Localities - Usme, Rafael Uribe and Bosa- have a total of 137 Community Centers. These community centers usually constructed by the collective work of community, and it suggest a number of varied uses of space by the people, families and their relatives living in the area. A total of 435 of JAC around these 3 localities what shows high citizen participation compare to other communities.

Table S4-1-17 Number of JAC, Community Councils and Community Centers in localities related with Study Area

Locality	Number of JAC	Community Councils	Total	Community Centers
Usme	172	4	176	51
San Cristobal	111	8	119	n/d
Tunjuelito	18	1	19	n/d
Rafael Uribe	101	4	105	63
Bosa	162	12	174	23
Ciudad Bolivar	222	17	239	n/d

During the Study period, a rainfall gauge and water level gauges are installed to help community based flood monitoring activity. Table S4-1-18 shows the name of some Barrios related to the activity with some JAC members in charge of the monitoring activity.

Table S4-1-18 Some JAC organizations related with some Study Areas for floods<sup>17</sup>

Barrio Name	Locality Name	Activity related to the Study
BARRIO MOLINOS II SECTOR	RAFAEL URIBE	Water level monitoring (Molinos)
MORALBA SURORIENTAL	SAN CRISTOBAL	Rainfall monitoring (Colegio Moralba)
SAN JACINTO	SAN CRISTOBAL	Water level monitoring (La Gloria)

17: [http://www.participacionbogota.gov.co/jac\\_dignatarios\\_upz](http://www.participacionbogota.gov.co/jac_dignatarios_upz)

CHAPTER 2 SOCIO-ECONOMY CONDITIONS IN SOACHA

2.1 General

Soacha Municipality is located 18km to the southeast of Bogotá and limits to the north with the municipalities of Bojacá and Mosquera of Cundinamarca, Bosa and Ciudad Bolivar of Bogotá; to the south with Sibaté and Pasca, to the east with Bogotá; and to the west with Granada and San Antonio del Tequendama<sup>1</sup>.

Geographically the city has two defined areas of urban area with 19 km<sup>2</sup> of extension concentrates the 98% of the total population of the city and rural area with 165 km<sup>2</sup> territorial expansion.

2.2 Administrative system

2.2.1 General

The administrative structure of this municipality is constituted by a Municipal Mayor elected by popular vote, three control headquarters (Internal Control, Disciplinarian Control, Legal Advise) and eight secretaries: General, Government, Planning, Treasure, Social Development, Education, Health and Infrastructure of which detaches a series of directive offices as is shown in the Figure S4-2-1. The Mayor is the Municipality highest authority, and main administrator of the local budget and resources.

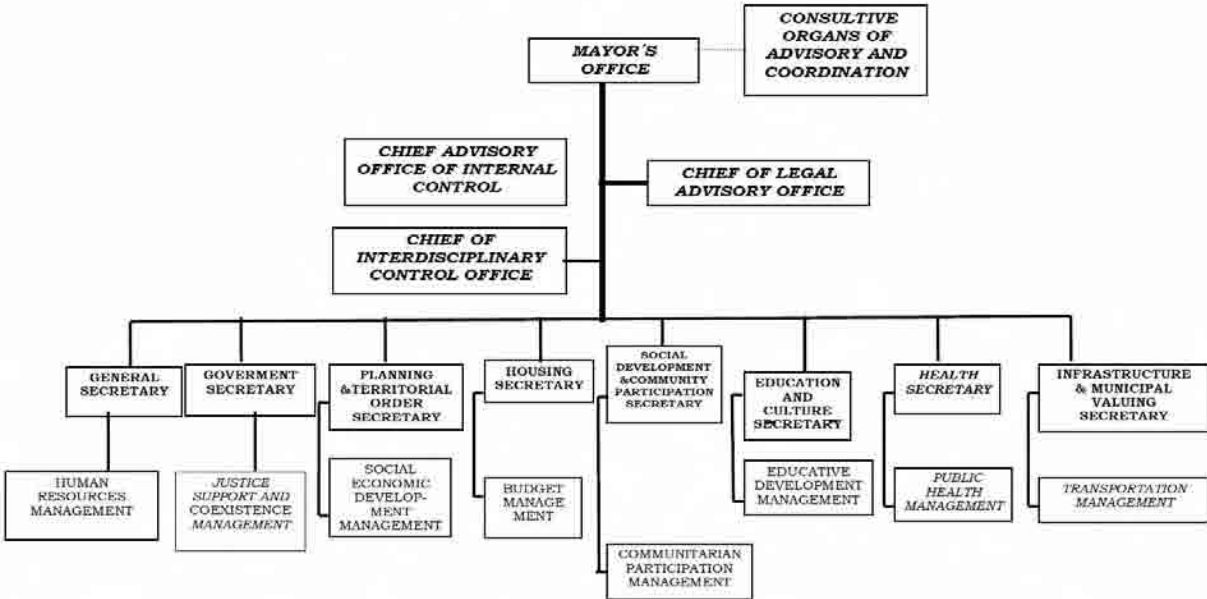
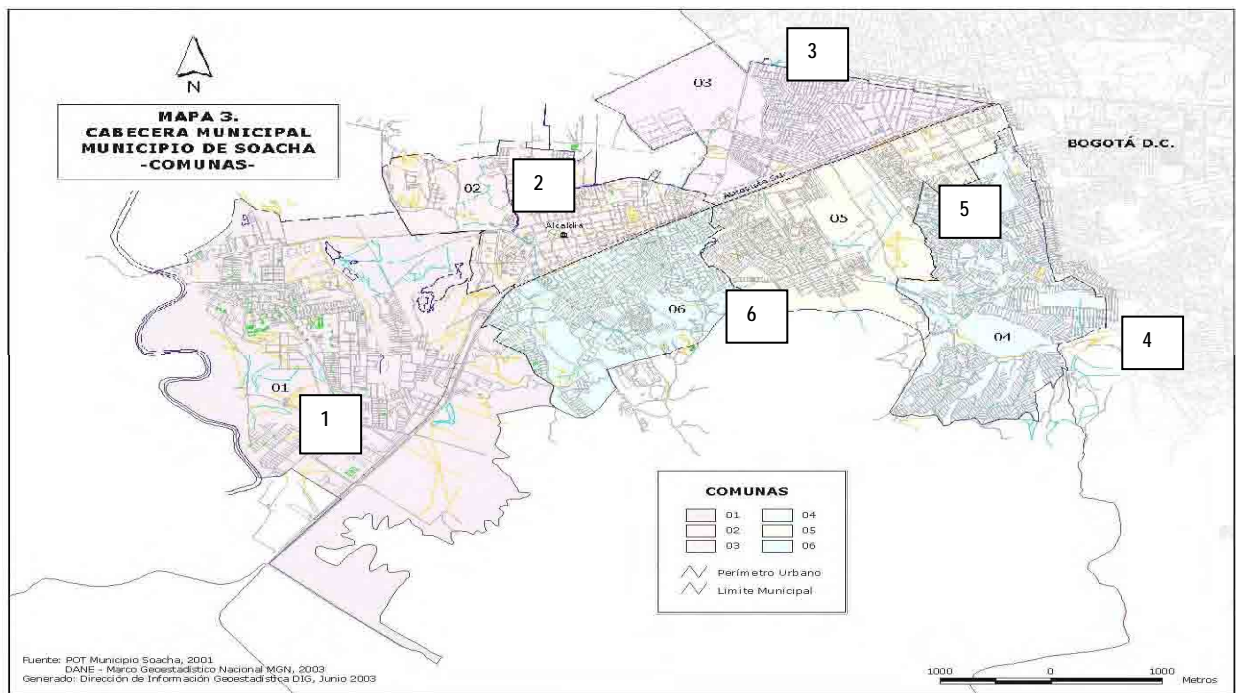


Figure S4-2-1 Organization Chart of Soacha<sup>2</sup>

As noted in the previous section, the municipality is classified into urban and rural areas, and the urban areas are politically divided in 6 communes with 348 neighborhoods<sup>3</sup> (Figure S4-2-2). On the other hand, the rural area is divided into two jurisdictions with 15 rural villages called veredas, and each one has its Corregidor, or supervisor designated by the mayor of Soacha (See table S4-2-1).

1: [http://www.disaster-info.net/desplazados/informes/soacha/informesocha\\_archivos](http://www.disaster-info.net/desplazados/informes/soacha/informesocha_archivos)  
 2: Source:Alcaldía of Soacha Website  
 3: Source: File of Alcaldía de Soacha(Power point presentation)partially printed



(Source: <http://www.alcaldiasoacha.gov.co/infoNoticia.asp?IdNot=131>)

Figure S4-2-2 Soacha Municipality Comunas

Table S4-2-1 Rural Areas of Soacha

Jurisdiction No. 1	Jurisdiction No. 2
Romeral	El Charquito
Alto del Cabra	Alto de la Cruz
Hungría	San Francisco
San Jorge	Cascajal
Fusungá	Canoas
Panamá	Bosatama
Chacua Primavera	
Tinzuque Primavera	
San Francisco	

(Source: <http://www.alcaldiasoacha.gov.co/infoNoticia.asp?IdNot=131>)

## 2.2.2 Disaster Management Administration

CLOPAD (Local Committee for Disaster Attention and Prevention) is the responsible for disaster management activities at municipal level. The member of CLOPAD consists of the eight secretaries officers of Municipality, Firefighters, Civil Defense, Red Cross, NGOs (Non government organizations), CAR Soacha (Regional Autonomous Corporation) Volunteers, supervision entity and budget control entity and international agencies.

As the CLOPAD is relatively new organization and facing a financial limitation to run disaster prevention activities and the no existence of exclusive staff, it has been relatively inactive condition, and consequently, the people and dwellers living in the municipality in general are lacking information about their hazards and how to cope with possible emergencies.

Despite these current unsatisfactory situations, CLOPAD performed quite effective operation during the emergency in May 2006. Measures taken by the municipality during the emergency are summarized in Annex S4-2-1.

## 2.3 Socio-Economic Condition

### 2.3.1 Population

#### (1) Population growth & characteristics

According to the Experimental Census 2003, Soacha is in the position fourteenth among 1,100 most populated municipalities with about 360 thousands in 2003<sup>4</sup> (See Table S4-2-2).

Table S4-2-2 Experimental Census of Soacha 2003

Area	Men	Women	Total	Total Houses
<b>URBAN</b>				
Comuna 1	38,511	40,818	79,329	19,638
Comuna 2	19,708	21,292	41,000	10,636
Comuna 3	24,816	26,095	50,911	12,987
Comuna 4	31,053	32,192	63,245	15,892
Comuna 5	27,882	30,811	58,693	17,127
Comuna 6	31,544	33,859	65,403	15,980
<b>Total</b>	<b>173,514</b>	<b>185,067</b>	<b>358,581</b>	<b>92,260</b>
<b>RURAL</b>				
Inhabit Center	669	664	1,333	364
Dispersal Rural	1,641	1,464	3,105	1,017
Special places for accommodation	287	72	359	
<b>Total</b>	<b>2,597</b>	<b>2,200</b>	<b>4,797</b>	<b>1381</b>

(Source: DANE, 2003 (Information compiled by Alcaldía de Soacha))

The table shows that;

- most of the city's population was concentrated to the urban area of 19 km<sup>2</sup> of urbanized area,
- the city has a tendency of female population's prevalence which is same as nation's tendency, and
- concentration of family members is the same level as the national average of 3.9 people by household.

According to the information, which is prepared based on the DANE Experimental Census, obtained from the Soacha municipality, the city experienced a high evolution in population in urban area and population distribution of urban area versus rural area was reversed. During from 1985 to 1993, the population growth continued with the rate of 5.9 %/annum and the growth rate has increased to 6.3%/annum from 1993 to 2003.

Table S4-2-3 summarizes the results of comparison of some variables concerning population and its variation between 1993 and 2003.

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4: Press statement, DANE, June 13 2003

Table S4-2-3 Comparison of Variables in Soacha<sup>5</sup>

Variables	Year 1993	Year 2003	ANALYSIS/REMARKS
SIZE (habitants)	230,335	363,019	The size is excessive. The availability of public services, equipments and infrastructure (e.g. education, health and housing) is not enough. There is a lack of public space and improper occupation of places. 45% of the urban perimeter is owned by few people that are not planning to urbanize, and neither for development use. So, they are just limit to solve the necessities of the municipality.
GROWING	5.91% annual average (1985-1993)	6.34% annual average (1993-2003)	The growing rate is one of the highest of the country. The demand of the physical space generates damages to the natural environment.
BIRTH RATE - FECUNDITY <sup>6</sup>	Birth Rate: was in 23.36*1000 it means the fecundity general rate is in a proportion of 117.35*1000. And the Global fecundity rate 1,063 (women in fertile age). Meaning a Reproduction rate of 2,5926 Number of daughters that a woman would have	Birth Rate: increased to a 67.74*1000. Meaning the Fecundity general rate is in a percentage of 0.91 (women in fertile age). Meaning a reproduction rate of 2,2377 Number of daughters that a woman would have	The Experimental Census omits to count to smaller than 5 years. In the year 2003, 7,072 people were born most it happens in Bogotá for the low quality of the hospital institutions. The early initiation in the sexual life contributes to the increase of births and the risk of death; there are evidenced effective controls of birth for the 24-34 year-old group. Births for mother smaller than 14 years in 1993 it was of 69, and in 2003 they register 89.
STRUCTURE	Women: 112,472 (48.83%). Men: 117,863 (51.16%)	Women: 51.53% Men: 48.46%	The young population is economically active with a deficit in the group of 20 to 24 years by the census 1993. It was displaced the group 30-34 years in the year 2003 by migratory effect. These ranges are education demanding. The female population is affected by high birth rate and family leadership.
MORTALITY	1995; 5563 deaths 244,44*100.000	1858 deaths in 2003 280.01*100.000	Death certificates in 2003: 551 (Violent death: 334). There is social decomposition, opportune medical attention, deficit in road structure, control and use of guns and safety in general.
DISTRIBUTION	Inhabitants in municipal headings: 222,550 (96.62%). Rest: 7786 (3.37%)	Inhabitants in municipal headings : 358,581. Rest: 7,660 (inhabited center and rural).	N.D.
MOBILITY	Immigration: was 160,106 (69.51%) of persons that arrived from outside the municipality. Existing Natives were 70,230. (49% ) Emigration: There is no data	Immigration: increased to 285,184 (78.55%) persons that arrived from outside the municipality. Existing Natives were 77,835 (21.44%) Emigration: from the 43,810 natives in 1993, it grew to 5.91% in 2003 from the 124,993 natives in 2003 it was reduced to 77,835 persons.	The mobility in 2003 of the population was of 56,993 persons corresponding to 15,133 houses aprox. The social programs are low impact and they don't have the expected effect. The immigrants are low of economical, educative resources and low graded labor. In the year 2003, 17,751 displaced arrived that located in Comuna 4, not proper for houses with a public services of 25.4%.

<sup>5</sup> Experimental Census of population and housing in Soacha May 25<sup>th</sup> 2003

<sup>6</sup> Source: Data given by Alcaldia of Soacha. *Demographical Minimum*. 1993-2003

## (2) Population of the Study Area

Two river basins of Soacha River and Tibanica River are the target river basins for the Study on flood monitoring, and these river basins are located in Comuna 2, 3, 4, 5 and 6 and the rural area of Bosatama, Panama, Fusunga, and San Jorge. The Study Area for landslide disasters is Altos de Cazuca in Comuna 4 and Divino Niño in Comuna 6 (Table S4-2-4, Barrio name details are presented in Annex S4-2-1).

Table S4-2-4 Comunas Related to the Study

Comuna/ Rural Area	Population	Disaster	Area	Remarks
Comuna 2	41,000	Flood	Soacha River	
Comuna 3	50,991	Flood	Tibanica River	
Comuna 4	63,245	Flood	Tibanica River	
		Landslide	Alots de Cazuca	
Comuna 5	58,693	Flood	Tibanica River	
Comuna 6	65,403	Flood	Soacha River	
		Landslide	Divino Niño	
Corregimiento No.1	4,222	Flood	Soacha River	Panama, Fusunga, San Jorge
Corregimiento No.2		Flood	Tibanica River	Bosatama

(Source: Soacha Municipality, compiled by the Study Team)

## 2.3.2 Economy in Soacha

Soacha significantly contributes the regional economy as shown in Table S4-2-5. The GDP in Soacha exceeds 1.3 trillion pesos in 2002 price and it shares 11.8% to the GDP of Department of Cundinamarca, almost five times more than cities like Zipaquirá which has a very active tourist activity and Chía with higher life standards than Bogotá.

Table S4-2-5 Participation of the Main Municipalities in the PIB of Cundinamarca (Prices of 2002)

Municipality	Gross Domestic Product (million pesos)	Percentage of Participation
Zipaquirá	300,647	2.6
Facatativa	305,029	2,7
Fusagasuga	343,348	3.0
Chía	352,250	3.1
Girardot	471,900	4.1
Soacha	1,363,533	11.8

(Source: DAPC. Cuentas Económicas de Cundinamarca 1990 – 2002)

Soacha is traditionally a mining town; estimations of 113 open sky exploitation mines<sup>7</sup>, and the materials extracted are used for bricks, decorative stones, sand and other construction materials. This activity supports the local economy however it becomes a main cause of adverse effect of environment in the area, contradicting the main objective of an industrial business of bringing development to its surroundings.

Soacha's main economic activity changed in the last decades from agriculture to services and industry activities. According to the survey carried out by the municipality in 2004, around 102 companies settled in Soacha, and hired 5,551 employees<sup>8</sup> providing jobs for non residents (61.08%) with higher education levels such as technical and professional careers. Accordingly few opportunities were left to the locals with low skills which kept the informal and low qualified tasks.

Commercial activity in Soacha is relatively active compare to other municipalities in Cundinamarca

<sup>7</sup> Idem.

<sup>8</sup> Source (<http://www.alcaldiasoacha.gov.co/infoNoticia.asp?IdNot=131>)

with its economic share of 39%, which is followed by Fusagasugá 32%, Girardot 37%, and Zipaquirá 23%<sup>9</sup>. However, this commercial activity does not offer a wide range of employments opportunities or solutions to unemployment because in most cases these small businesses are attended by immediate family members.

Despite this economic activity, Soacha is a municipality with low budget, because of lower employment opportunities and an increasing rate of non-qualified and underemployed population. The city seeks to activate their economic activities, to reduce everyday commuting to Bogotá looking for low pay jobs as domestic work, street vendors, construction work, security guards, or recycling.

Soacha's economically active population is primarily in the service sector (24%) and secondly in the industrial activities (furniture, manufactures, textiles, food processing and construction (12.6%). There is a large part of the economically active that does not fit the existing DANE Census categories named under a "not specified" or "not enough information" category (53.9%, 62,131 persons). These include a large number of people in the informal sector, and multiple-skilled workers, as well as those that have temporary subsistence jobs (See Table S4-2-6).

Table S4-2-6 Population by Economical Activity in Soacha Municipality

ACTIVITY	DETAIL	N° persons	%
INDUSTRIAL	Furniture manufacturing. Manufacturing industries. Textiles manufacture industries. Agriculture, cattle farming and hunting. Elaboration of food products and beverages. Construction.	14,511	12.60
COMMERCIAL	Wholesale and retail trading and by commission or by contract (except to the commerce of cars and motorbikes). Maintenance and repair of Machinery, and equipment, maintenance and repair of cars and motorbikes, retail trade of fuels and lubricants for cars.	10,530	9.14
SERVICE	Hotels, restaurants, bars and similar. Transport by land transportation. Transport by pipes. Social services and health. Private homes with domestic service. Other activities of services, Mail and telecommunications. Other managerial activities. Education. Spare time activities and cultural and sport activities. Public administration and defense; Social security of mandatory affiliation.	28.002	24.31
OTHERS	Non-specified activities without information	62,131	53.93
TOTAL		115,174	100%

*(Summary based on the File "Economic Development and Generation of productive Employment Economical Characterization of Soacha Municipality "2004, with data of Experimental Census of population 2003)*

### 2.3.3 Socio-Economic Conditions

Since the Soacha municipality is continuously receiving a large volume of immigrants (Figure S4-2-3) from over the country, it can be said that the socio-economic conditions of the municipality is characterized by these immigrants.

<sup>9</sup> Source: Alcaldía de Soacha website: (<http://www.alcaldiasoacha.gov.co/infoNoticia.asp?IdNot=131>)



**Distribución de la población censada, migrante, por año de llegada al municipio. 2003**

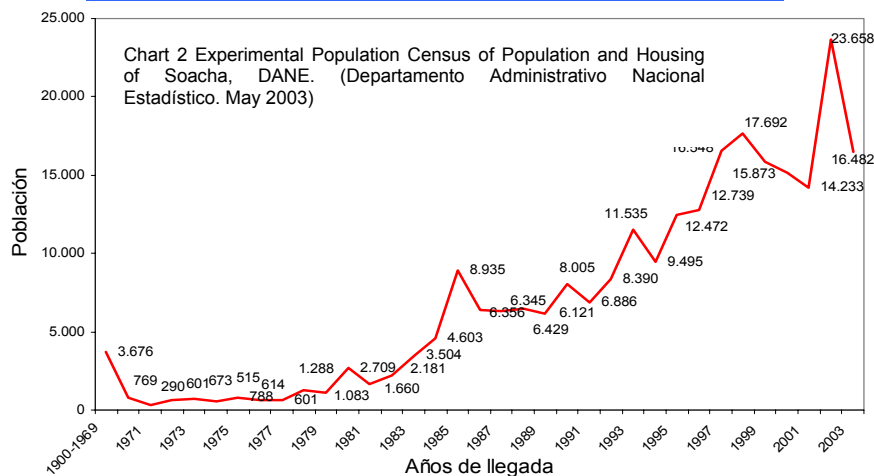


Figure S4-2-3 Immigrants to Soacha by Arrival Year

The communities formed by displaced people and families are known to have minimal infrastructure and deficient public services, including access to health. These settlements are sometimes classified as informal settlements lacking of legal status or titles for their land. These undocumented barrios are located mainly in Comunas 4 and 6<sup>10</sup>.

The Table S4-2-7 shows the comparison of living conditions between displaced people and people living in Strata 1 which is the lowest economic Strata<sup>11</sup>. The people living in Strata 1 have higher rate of housing ownership and better housing quality, however, either groups or people, they share insufficient access to proper aqueduct and drainage systems as it can be noticed that just a 1.5% of displaced and strata 1 persons have aqueduct. The new comers have to build their houses with the cheapest most available low quality of materials.

Table S4-2-7 Socio Economic indicator 2002

Variable	Displaced people	Strata 1
Percentage of houses owned by residents	47.2	76.3
Percentage of houses with permanent material walls.	47.9	64.5
Percentage of houses with disposable material walls.	52	35.5
Percentage of houses with aqueduct	1.5	1.5
Percentage of houses with sewage system	13.4	14.1
Percentage of houses with electrical energy	95	97.7

(Source: Organización Panamericana de la Salud/Instituto Nacional de Salud. 2002. Study of the epidemiological profile of displaced population and strata 1 non displaced in 4 cities of Colombia. Electronic version: <http://www.disaster-info.net/desplazados/informes/ops/epepv2002/perfil33ressoa03indicadores.htm>)

In Soacha, the most exposed to harsh conditions are children, youth, elders and people with physical disabilities.

The Social Development of the municipality has a list of local organizations classified by types which

<sup>10</sup> Garzón, Clara Stella. *Diagnóstico de Género de la Población de Soacha, con énfasis en las Mujeres Desplazadas*. Fondo de Desarrollo de las Naciones Unidas para la Mujer. UNIFEM. Colombia. 2005. [www.acnur.org/biblioteca/pdf/4088.pdf](http://www.acnur.org/biblioteca/pdf/4088.pdf).

<sup>11</sup> People under Strata 1 and Strata 2 earn below \$300 a day.

are working in for the social activities in the municipality. According to the list, 57 organizations out of 217 currently devotes the activities related with physical disabilities, and another 32 groups formed by -or working with- elders (Table S4-2-8).

Table S4-2-8 Type of Social Organizations

Type of Social Organizations and ONGS In Soacha	No.
SOCIAL AND COMMUNITARIAN ORG.	74
ELDERS ONGs	32
DISABLED ONGs	57
YOUNGS & WOMEN ONGs	54
TOTAL	217

(Source: Social Development Secretary, Alcaldía de Soacha)

A varied number of solidarity relations among people, groups and networks are detailed in Perez's study (p.70). These social interaction forms are listed as "canje" (exchange of items or services), commercializing products, convite (invitations), domestic credits, exchange of help, exchange of support, borrowing and lending labor animals, borrowing and lending land, sharing crops, seeds and produce, and many others such as "serrucho", "minga", "partija" practices.

This shows that despite many people do not know each other, they come from different locations, altitudes, cultures and identity backgrounds, they know about mutual relations for self help, a key basis for identity reconstruction and collective problem solving.

According to Perez (2004), only in Altos de Cazucá, between government ministries, universities, micro lending entities, peace and local development, there are more than forty eight institutions attempting to address the complexity of issues that barrios in Comuna 4 suffer by their condition of relatively recently being formed, and its composition by displaced population as well<sup>12</sup>.

### 2.3.4 Public Services and Education

#### (1) Public Service

Table S4-2-9 summarizes the present conditions of public services of Soacha Municipality by administrative areas. As shown in the table, the municipality has relatively high coverage of public services except Comuna 4 where is conceded to suffer from lack of basic services with low coverage of 25% of electricity, water supply, and sewage system.

Table S4-2-9 Public Services of Soacha Municipality

Areas	Total Houses	Houses with Electricity, Water and Sewage	%	Houses with Telephone	%	Houses with GAS supply	%
Total	84,318	66,664	79.06	65,063	77.16	52,199	61.91
Comuna 1	17,933	16,214	90.41	14,577	81.29	13,584	75.75
Comuna 2	9,782	9,144	93.48	8,014	81.93	685	70.03
Comuna 3	11,886	9,743	81.97	9,667	81.33	919	77.32
Comuna 4	14,063	3,569	25.38	8,077	57.43	305	21.69
Comuna 5	15,004	14,651	97.65	13,034	86.87	12,529	83.50
Comuna 6	14,159	13,159	92.94	11,612	82.01	9,738	68.78
Rural Populated Center	277	184	66.43	4	1.44	0	0.00
Rural Dispersal	714	0	0.00	78	10.92	3	0.42

(Source: Emergency Plan of Soacha Municipality. Project Support to the mobilization of the Volunteers in attention and Response to the Emergency Declared in Soacha September 8th 2006.)

<sup>12</sup> Pérez Martínez, Manuel Enrique. *Territorio y Desplazamiento. El caso de Altos de Cazucá, Municipio de Soacha*. Facultad de Estudios Ambientales y Rurales, Departamento de Desarrollo Rural y Regional. Universidad Pontificia Javeriana. Colombia. 2004. p.153

In some barrios with low coverage of public services, improper construction of sewage ditches, illegal connection of electricity are found, and it causes unfavorable living environment.

(2) Education

According to the statistics of the Secretary of Education of Soacha Municipality, there are 165 schools are located to provide education to the citizen. Most of the students are receiving traditional education in academic schools that are mainly directing scholars for university education. But, just a small percentage of total population can reach University studies. Table S4-2-10 shows the present conditions.

Table S4-2-10 Education statistics by Soacha Municipality

Gender	Number	Percentage
female	28,338	52.8%
male	25,336	47.2%
Strata	Number	Percentage
Strata 0	14	0.03%
strata 1	689	1.28%
strata 2	2,163	4.03%
strata 3	13,266	24.72%
strata 4	0	0
strata 5	0	0
Strata 6	0	0
Doesn't apply	37,542	69.94%
Zone	Number	Percentage
urban	14,699	27.39%
rural	53	0.1%
Specialty	Number	Percentage
Academic	37,606	70.6%
Agriculture	0	0 %
Commerce	3,363	6.27%
Pedagogy	2	0%
Industry	1	0 %
Social Promotion	0	0%
Others	19	0.04%
Doesn't apply	12,683	23.63%

(Source: Secretaria de Educacion y Cultura, Soacha)

**2.4 Urban Planning**

2.4.1 Urban Expansion

Due to the permanent arrival of immigrants to the municipality, housing areas are being forced to expand. However, the land suitable for live has already been occupied and consequently only available spaces for such immigrants under hardship condition are the surroundings of the mining areas (quarries).

Management of closure process of quarries are lack of strict compliance. The land recovery plans have been difficult to enforce. Many old mining areas are just left as it is, and becoming target areas for new informal settlements. As shown on the following photos, uncontrolled urban expansion with poor infrastructures can be found in many places with in the municipal territory, and such situation creates the unfavorable living conditions (poor infrastructure such as lack of road, water supply and sewerage, facing hazards, etc.).



Photo S4-2-1 Typical Pattern of Urban Expansion



Photo S4-2-2 Homes Built in the Foothills Old Mine and Facing Landslide Hazards



Photo S4-2-3 Neighborhoods growth over rural hills

Photo S4-2-3 shows the case of Altos de Cazucá, an entire hill has been covered with many barrios in which more than 60,000 people live without any plan in terms of urban development.

In the informal development areas (non zoned area), no public works are allowed and due to this, investments in infrastructures has been delayed. Therefore, sloppy roads and the rain runoff and the sewerage overflow can be seen anywhere in and around the informal development areas..

There is growing concern about the pollution coming from other types of industries located in the urban center such as chemical industries, natural gas, textiles and gasoline stations, leading the authorities to increase controls over air quality and finding strategies to improve management for the drainage systems.

Other recent processes lead Soacha’s communities and decision makers to face unforeseen challenges of development. The expansion of the public transportation system, with the construction of a new transect of the Transmilenio into Soacha’s territory. The increase of individual’s mobility will generate greater density patterns in the urban cluster, and spin-off new commercial and service activities.

**2.4.2 POT**

In order to regulate the uncontrolled urban expansion and normalize the land use by integrating the urban development and social, environmental and disaster management aspects, the POT 2000 Zoning Plan was established. However, it has been surpassed by urban expansion, continue migration and industrial growth. Areas that were once designated as open space, such as slopes and hills, old mines and rural lands have already been heavily populated and became risky areas for inhabitants.

To meet the current situation the Soacha municipality is updating the POT 2000, and the first phase (Validation) was recently finished, while the Second Phase (Assessment) is focusing on current conflicting topics, like transportation, connectivity, population and urban growth.

The current analysis of the POT is looking at the hazard prone areas and activities, stressing the need to emphasize upon the development of policies to protect environmental resources and its enforcement.

**2.4.3 Barrio Area**

Table S4-2-11 shows number of barrios in each comuna by legal status. As shown in the table, most of the illegal barrios can be found in Comuna 4 where by displaced persons are mainly settled down, and Comuna 6 with a high percentage of illegal settlements inhabited mainly by Soacha natives<sup>13</sup> and also by displaced people, that live for paying rent or paying a new house in illegal cheaper lands.

Table S4-2-11 Legality Condition of Barrios at Soacha Municipality

COMUNA	LEGAL	%	ILEGAL	%	TOTAL
Comuna 1	31	79.5	8	20.5	39
Comuna 2	29	62.5	19	37.5	48
Comuna 3	29	100	0	0	29
Comuna 4	10	25.6	27	74.4	37
Comuna 5	96	100	0	0	96
Comuna 6	28	43.1	37	56.9	65
Total	223		91		314

(Source: Alcaldía of Soacha)

In the case of Altos de Cazuca, it is known that 75% of the area is considered not having property rights, because the original 3 or 4 owners have been claiming their rights to the land. The new comers, despite living in the area for more than ten years, have not been able to claim the land for themselves, because the original owners have been claiming ownership and title of the land is theirs.

For the legalization process in barrio areas, three independent processes need to occur; the legalization of the land, of the building or house and the legalization of the barrio as urban settlement.

<sup>13</sup> Ramirez, Juan Carlos-Muñoz Jorge. *Así son los hogares en Soacha* . DANE. Bogotá, Abril 2004

For a land to be able to obtain a Title in favor of or in the name of a person, previously this land needs to be registered in the Public Registry Office. This means that it has to have a sheet (“Folio”) and a “Matrícula” (Inscription). The process of registering a possession implies that the individual person claiming a possession (or plot of land) has to visit a notary and obtain an “Escritura” or title deed. And with this document, this person has to take it to the Public Registry Office and inscribe the possession. The Public Registry Office will not know of the existence of this title deed until the individual personally takes it and registers this possession. The Public Registry has it in its records.

Once the building is inscribed in the Registry Office, the individual needs to register the construction or improvement “mejora”, as a second step. If this person has lived for more than ten years in the same place, pacifically and publicly known, then this person can claim possession over a land and whatever has been built.

To legalize a barrio, previously it is required to demonstrate the possession of land. But primarily, the zoning plan (POT) must be followed. A number of regulations will not allow the municipality to accept urban settlements in risk areas or in areas previously not determined as urban.

## **2.5 Citizen Participation**

The office of community participation of the Soacha Municipality is in charge of supervising social organizations (e.g. JAL, JAC, etc.), while the Cundinamarca Government used to be in charge of this function before the new policies of decentralization in the nineties came into effect.

In Soacha as in Bogotá, the “Ediles” are citizens elected by popular vote and they belong to JAL (Local Administrative Board) which are receiving a supervision from Soacha Municipality. All six Comunas in the urban area and two Jurisdictions in the rural area have JAL organization.

JAC is organized by community level and they are also directly supervised by the municipality, however, they can not be provided funds from the municipality. The activeness of JAC is varied, and JAC of Florida II which is located in the Study Area has shown the special achievements.

The JAC of Florida II was constituted in 1986, and currently has a total of 93 members. Nine (9) Board directors (originally 17 directors) are working actively. Since this is a voluntary activity, some of them decided to quit but others have been continuously working for their community. The Board of Directors; President, vice-president, Secretary and Treasurer and representatives composing commissions such as, Sports, Safety, and Health commissions are elected in the neighborhood meeting which is held every four years.

Some of the achievements of this particular JAC are; the barrio legalization, the procurement of an alarm system for barrio safety, the active support of community for all their internal affairs and the procurement of speaker system inside JICA Study Team project.

As mentioned, since JACs can not be provided any funds from the municipality, the JAC of Florida II has planned and implemented fundraising events and activities, such as town fairs, voluntarily created by the community itself.

Through Both JAL and JAC are officially established community participating organizations and under supervision of the municipality, Ediles, Presidents of JAC, and Municipal Councils rarely work together, but in some cases such as Florida II, they are trying to work together. In this particular case, the JAC leader is also the treasurer of “Asojuntas”, Association of Community Action Boards of all Comunas of Soacha. Besides, he belongs to “Ediles Association” and currently, he is working as Edil of Comuna 6 until December of this year.

## 2.6 Institutional Aspects on Disaster Management

### 2.6.1 Legal Framework

Table S4-2-12 shows the legal situation for disaster management. This chronological review proves that the historical change of disaster management concept from the emergency response approach during the early eighties, to total risk reduction approach including institutional strengthening and land use regulations.

Table S4-2-12 Legal Situation for Disaster Management

LAW/ DECREE	DESCRIPCIO
1982. Law-Decree 3489	Ruled the Title VIII of the Law 09, 1979 and the Law-Decree 2341 de 1971 regarding to disasters.
	Classified the emergency situations. Organizes the National Committee of Emergencies. Creates the Emergencies Operations Center. Establishes the functions for the Regional and Local Committees.
	The planning is mentioned only as task, designated to Civil Defense, Art 20.
1984. Decree 1547	Created the National Fund of Calamities. Funds for catastrophes and similar situations.
1989. Decree 919	Organized The National System for the Prevention and Attention to Disasters.
	Art. 6. Establishes Regional and Local Committees for the Disasters Prevention in each one of the Municipalities, Departments, jurisdiction and Commissaries and Local Committees for Bogotá.
1989. Law 9	Urban Reform Law explicitly frames local planning.
	Art. 4. Defines Risk Zones.
1997. Law 400	Established criteria and minimum requirements for the new buildings and community recovery after an earthquake, forces by nature or use, with the purpose of increasing their resistance, decreasing the loss of human lives, and defending the State patrimony of State and citizens.
1998. Presidential Decree No. 93	National Plan for the Prevention and Disasters Attention.
	Guided the State and civil society towards prevention and risks mitigation actions and the sustainable development of communities facing natural and anthropic events.
	Art. 3. Objectives of the National Plan for the Disasters Risk reduction and disasters prevention. Effective response and rapid recovery of affected zones.
	Art. 5. General principles guiding actions of the territorial and national entities.
	Art. 6. General Strategies of the Plan for the Prevention and Disasters Attention. Knowledge of the natural and anthropic origin of risks. Incorporation of prevention and risks reduction in the land use sphere. Strength institutional development. Dissemination of prevention and disasters mitigation topics.
2005. Decree 1065. August 31st	Soacha Municipality creates it's Local Committee for the Prevention and Disaster Attention of Soacha-CLOPAD-

(Source: Document of the Base line SCI. Local Committer for the Attention and Disasters Prevention. CLOPAD. 2006. pp. 5-7.)

### 2.6.2 Local Disaster Management Capacity

#### (1) CLOPAD and Soaca Municipality

Soacha Municipality establishes its local disaster prevention structure (CLOPAD) in 2005. It is composed of a range of existing local institutions related to disaster management such as firefighters or hospitals as well as Municipal Departments such as Infrastructure Department or Planning Department. Each institution has a specific function to avoid a duplication of tasks. Table S4-2-13 shows the inventory list of CLOPAD that is presented in the Base Line Document prepared in 2006.

Table S4-2-13 Inventory List of CLOPAD Resources

Entity	No. of Personnel	Existing Resources
<b>GOVERNMENT ORGANIZATIONS</b>		
FIREFIGHETRS	48	Pumping machine, electric plant, reflectors, rescue equipments, elements against fires, tools for manual removal and for equipment maintenance.
CIVIL DEFENSE	56	3 first aid kits vest type and 1 box type, 4 foldable couches and two rigid, 1 immobilization vest , 5 immobilization necks, rescue equipment, fires extinction equipment, communications equipment (1 radio base , 4 handy radios)
POLICE	213	n/d
ARMY	180	n/d
<b>TOTAL PERSONNEL</b>	<b>497</b>	
<b>PRIVATE ENTITIES, SUPPORT PERSONNEL(SAFETY BRIGADES, OPERATORS GROUPS)</b>		
CODENSA	10	n/d
EAAB	10	n/d
SERVIGENERALES	15	n/d
SOCILUZ	30	n/d
<b>TOTAL PERSONNEL</b>	<b>65</b>	<b>n/d</b>
<b>HEALTH PERSONNEL (DOCTORS, NURSES, OTHERS)</b>	<b>116</b>	<b>n/d</b>
HUMAN TALENT HOSPITAL MARIO GAITAN YANGUAS	49 professionals 10 nurses 62 nursery auxiliary 3 porters 5 drivers 4 radio operators 5 RX technicians	124 beds, 1 operating room, 1 resuscitation room, 1 lab, 1 images scan, ultrasound scan 4 hours, 1 respiratory therapy room, 1 land phone line, 1 radio phone, urgencies network (dentist net), 3 ambulances low complexity, 1 van, 1 car, electricity plant capacity 150A, 1 Oxygen central, 1 morgue capacity 3.
SOACHA HEALTH ENTERPRISE	5 doctors 5 nursery auxiliary 2 health promoters 1 chief nurse	18 metallic coaches, 15 gynecological coaches, 1 folding coach, 1 wood coach with immobilization.
FROM SOACHA ALCALDIA	50	2 cars, 2 radios, 1 truck, bulldozers, charger, leveling motorbike, water tank car, pneumatic drilling, pumping machine, rescue machinery.
<b>TOTAL HUMAN RESOURCE</b>	<b>708</b>	

(Source: Base Line Document SCI CLOPAD 2006. PP 36-42)

The followings are raised as lessons learned during the emergency in May 2006.

- It is necessary to consolidate the plans and protocols, and to establish a routine for upgrading them.
- It is necessary to improve at least one road in the high risk area as an infrastructure of emergency operation.
- It is necessary to have an office and warehouse for CLOPAD to guarantee the logistic support for emergency operation.
- Stable funds for disaster prevention, response and permanent resettlement are required.
- Training for all levels from government to community is necessary to enhance the capacity to cope with disasters.

The direction of the municipality has lead towards working among agencies. Collaboration among institutions and NGOs has been occurring since 2004.

Red Cross Cundinamarca, OPS/OMS and the National University, Center for Disaster Prevention (CEPREVE)<sup>14</sup>, for example, developed coordinated training workshops and topics developed were

<sup>14</sup> Need Assessment. Altos de Cazucá, Municipio de Soacha. OCHA. Junio de 2006.  
[www.colombiassh.org/imagenes\\_nuevas/documentos/Need\\_Assesment\\_Soacha\\_14.06.06.pdf](http://www.colombiassh.org/imagenes_nuevas/documentos/Need_Assesment_Soacha_14.06.06.pdf)



Risk Management, Identification of Municipal Vulnerabilities and Hazards. PAHO/WHO has been actively developing local capacity. UNDP runs a local program with participatory process for local planning with components of capacity building, leadership training and implementation of some small community projects, however, the efforts are concentrating only in Comuna 4.

## (2) Firefighters

Firefighter is one of main actors in disaster management especially emergency response. Firefighter's department of the Soaha Municipality is in operation around the clock. However, staff and equipment are very limited even for the daily operation.

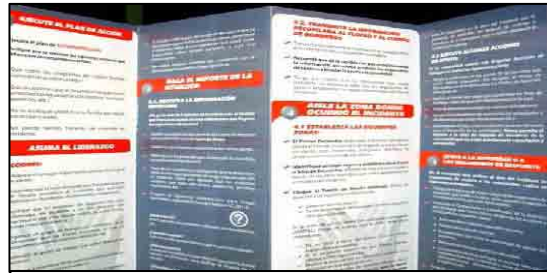
Firefighter's department of has an extensive training curriculum for any volunteer willing to serve, ranging from practical emergency skills such as use of manual ladders, electricity basics or vehicle rescue to planning principles, firefighter's legislation or management. More specialized topics add close to 90 extra training hours, in order to be a Fire-fighter 2, which learn skills like applied hydraulics or advanced rope maneuvers. The curriculum of the firefighter training is presented in the Annex S4-2-5.

### 2.6.3 Community Awareness and Response

As the communities in the Study Area are facing frequent disaster events, the awareness on the disasters are relatively high even CLOPAD dose not actively working. According to the results of the Community Survey done by the Study Team, the population has received little knowledge and training on disaster activities. Nevertheless, their willingness to learn and collaborate is honorable.

CLOPAD prepared a "Municipal Emergency Plan" with the support of UN Volunteers. This document updates the inventory resource list with phone numbers, addresses and contact names (p.112-114) for those with emergency resources, as well as a broader contact list (pp 102-104). This document includes the drafts of three types of Protocols -First Respondent, Rescue Organisms and Business. A print out brochure of each one of the Protocols has been distributed by the municipality during middle of 2007.

The protocol for the first respondent covers community's protocol as first responder of disaster event (See Photo S4-2-4). Annex S4-2-4 and S4-2-5 presents the full text of the Protocol for Community First Respondent.



The protocol for Community First Respondent contains five steps: 1. Execute the Action Plan 2. Engage leadership 3. Make situational report 4. Isolate incident zone 5. Support the response authorities.



Photo-S4-2-4 Protocol for Community as First Respondent

“Family Emergency Plan” has been produced by the municipality with the support of the UN System (OPS/OMS, OCHA, UNICEF, UNDP and UNV). This guide aims to be a tool for families to be prepared for any hazardous event, and it includes generic preparation measures for different hazards: flood, fire, strong winds, earthquakes, excessive cold and hot temperatures, droughts, radioactive and chemical pollution. To be highlighted are the recommendations before and during flood emergencies are included. These cover communication suggestions, mobility precautions, hygiene measures, and mutual support recommendations (see Annex S4-2-6)

Table S4-2-14 shows the list of minimum emergency kits recommended by CLOPAD. Some of items suggested such as “generator” is difficult to purchase individually, and it could be considered to be a collective acquisition, in agreement with their necessity in barrio or JAC.

Table S4-2-14 Minimum material for Emergencies CLOPAD Recommendations

*Radio with batteries ( operative)	*Lantern with batteries (operative)
*Emergency lighter	*New reserve batteries
*Isolating tape	*Generator
*Autonomous Store	*Reserve Fuel
*Candles and matches	

(Source: Familiar Emergencies Plan. CLOPAD. Version PEF 001/2006 Alcaldía de Soacha.)

Family Emergency Plan also contains a section on “Evacuation” which raises awareness about behavior (safety measures such as disconnecting stove, gas, water) and items to carry (personal documents, radio, personal hygiene and medications) in case of evacuation.

These materials are very useful and continuous improvement especially with careful review of the wording used in these documents to be meaningful for the target groups is required.

#### ANNEX S4-2-1 CLOPAD Activities during Emergency in May 2006

This annex summarizes the activity of CLOPAD during the emergency in May 2006, and presents the summary of lessons learned from this emergency operation. Despite its relatively recent formation, the absence of financial resources to run disaster prevention activities, and the non existence of exclusive staff, CLOPAD performed quite effectively during the emergency in May 2006.

Fortunately, the speed of movement of the landslides was slow. The moment was right when CLOPAD decided to activate their mobilization, avoiding casualties in Soacha's territory. The emergency nevertheless required an enormous interaction in attending landslides and floods in many parts of the municipality, keeping CLOPAD members (Firefighters, Civil Defense, Municipal Departments, Volunteers and International agencies) as well as community leaders, active day and night during an entire month.

On May 11, 2006, the Decree 375/06 which declared Municipal Emergency Status, including sanitary emergency, public calamity and Evident Emergency enable to allocate resources for rehabilitation<sup>15</sup> was issued.

##### **Decree No 375/2006 May 11th 2006.**

" By which is declared the municipal emergency state, the sanitary emergency, and the public and disaster calamity, and by which is declared the Evident Emergency. The Evident Emergency allows the direct contracting of what is required to attend the emergency, without matter the cost amount. Order the budgets move. It is ordered to all the Secretaries and dependencies, to organize specific committees in each area, to do the corresponding procedures for the impact mitigation and consequences of the event, to make the necessary civil and hydraulic works, so like this the procurement of equipments to give a soon solution to this problematic. All the officers, contractors and employees should be to CLOPAD disposition."

According to the interview results to the CLOPAD officials, a total of 2,500 families in risky areas in 2006 and from those, 600 people did not have a place to live during the emergency in May 2006.<sup>16</sup>

Within the city decision makers, the fact about the continuing population arriving and settling by the day presents special challenges for emergency agents, particularly in being able to keep up with reliable data about inhabitants and their location.

For families experienced loss of their homes, the Decree 2480 allows allocation of a partial subsidy of 60,000 pesos monthly, for a total of 200,000 pesos disbursed within three months, for families that decide to remove definitively from their location at risk. While this amount does not represent or intend to be any type of full coverage for living support, it does support complementary, becoming an incentive for families willing to move from homes identified risky areas.

##### **DECREEE 2480. 19/07/2005**

For which conditions of postulation are established, family allowance for urban and rural housing is assigned, and applied through Fondo Nacional de Vivienda y el Banco Agrario de Colombia S. A., to households affected **by disaster, public calamity situation or emergencies**, that happens or could occur by natural events, and dictates other dispositions in housing family allowance matters.

Art. 2° Amount of the family allowance for urban and rural housing. The amount of the allowance of family allowance for urban and rural housing given by Banco Agrario de Colombia S. A., to the households affected by, is as follows:

For improvement of housing and basic reparations, the amount of the allowance will be between 10 and 14 monthly minimum wage.

For construction in their own land or acquisition of a new house the amount will be 15 up to 18 monthly minimum wages.

In any case, the amount of the allowance of rural social housing can not be superior to 80% of the value of the

<sup>15</sup> See <http://www.alcaldiasoacha.gov.co/vercategoria.asp?Idcat=1>

<sup>16</sup> Calderón, Ivan D. Verbal Communication. July 4th, 2006.

improvement solution or basic reparation, construction on their own land or acquisition of a new house at the date of the allowance assignment.

The following table shows the summary of current capacity of the municipality and CLOPAD, as lessons learned during the emergency operation in May 2006.

Table S4-2-15 summarizes the strengths, current stage and mid/long term projections.

ASPECT	STRENGTHS	CURRENT CONDITION	MEDIUM / LONG TERM PROJECTION
Institutional presence during emergency	11.05.06 begins the emergency. It had not hurt serious, neither dead. Agencies System United Nations: UNICEF, OCHA, UNIFEM, ACNUR, UNDP, OPS, OIM, CAM, PMA. Support of CREPAD, DNPAD.	Private sector (Chamber of Trade) incorporate actively	To consolidate the Plan, the Protocols. To establish routine of to systematize leanings and to upgrade them in the Plan
Emergency Plans	19.05.06: it is obtained added data. Inventory of damages and damaged carried out by personal 22.05.06: evaluation of the situation.	Municipal Plan of Emergency in construction with support of United Nations and Red Cross	Operative Annual Plan is still to be built
Infrastructure to respond in emergencies	Decentralization of affected people in the communities. It was a contingency plan that were not used as shelters: schools, sport complex, communitarian rooms	The infrastructure limits the transportation of victims due to the conditions of the roads and the land.	Improve at least one road in areas of higher risk
Rehabilitation	Decree 2480 of the 19.07.05 authorize to grant the complementary subsidy in the event of housings on high risk or with losses. It was opted by strategy of lease subsidy by emergency, for families in need of being evacuated.	Some families while waiting for subsidies, and others are not willing to move, and who don't request subsidy	Stable Funds for political of consistent relocation and with covering of all the areas declared as critical.

Table S4-2-16 Resources and Capacity of CLOPAD

TOPIC	STRENGTH	SITUATION 2006	MEDIUM / LONG TERM
Logistic	The rainfall season emergency of May 2006 left a stock of donations (kit of toilet items, cooking stuff, bed sheets) for another emergency	Machinery and team shared with municipality. Equipment: radio communication. Private Ambulance is also shared. Just 4 firefighters by shift	To have an office and warehouse for CLOPAD  Guarantee logistic support to equip firefighters
Economic	-	Received support by negotiated projects and/or manage by ONGs	To negotiate the resources according to necessities.
Human (Training)	Training received in OFDA methodology (SCI, PRIMAT). Chamber of Commerce has imparted instructions about Managerial Protocol OPS/OMS, it trained in risk management, Vulnerabilities and hazard CLOPAD structure, Response	Training Volunteers Rescuers (Cruz Roja)  United Nations system: Training trainers	-Invigorating the municipal respond methodology OFDA -Drill: Study Team JICA -SNU: Training of communitarian organizations. Response plan for the Department of Health

ANNEX S4-2- 2 Communes, Barrios and Veredas at Study Area related with floods in Soacha Municipality

<b>River: Soacha - Comuna: No 2- Total Population : 41.000</b>
Prado las Vegas, Portoalegre, Tequendama Centro, Lincon, Villa Clara, Las Vegas, Nueva Portoalegre, Sol de Portoalegre, Portalegre Real, Altos de Portoalegre, Carmen, Amistad Oasis de Jericó, Ferias, Cadada, Bochica La Toscana, San Luis, Huertas, Veredita, Rosal Danubio, Tabacal, Eugenio Díaz Castro, Falope San Isidro, Zona Industrial Salitre, Quintas de La Laguna, Marantha, Fragua, Cobec, Villas de Santa Rosa, Ciudad Satélite, La Unión, Atenea, Santa Cecilia, Parque de las Flores, San Andrés Juan, Esmeralda, Villas, Parques del Sol, San Marcos, San Bernardino, San Juan de Ubate, Conjunto Residencial Autopista, Loira, Cipres Rincón de Sanalejo, Pradera IyII, Bosque de Cipres Boyaca, Villa de Santa Isabel, Divino Niño, Cristalina, San Martín, Alpes, Pinos, Altico, San German German, Cohabitar, Cagua, Colmena II, Chico Sur German, Cohabitar, Cagua, Colmena II, Chico Sur y Galicia III
<b>River: Tibanica- Comuna: No 3- Total Population I: 50,911</b>
Despensa, Jardín Rosales, Altos Pinar I, Altos Bosque, Potrero Grande, Altos Pinar II, Arboleda, Olivos I, Ili, Iv, Ocales, Pablo VI León XIII, Cedrol, Reina Sofía, Rincón de Santafé, Olivares, Santa María del Rincón, Hogar del Sol, Altos Pinar IV, Trébol, Prado, Rosales, Altos de Sacramento, María, y Zona Verde,
<b>River: Tibanica- Comuna: No 4- Total Population: 63,245</b>
Julio Rincón, Villa Sandra, Barreno, Arroyo, Esperanza, San Rafael, Julio Rincón III, La Nueva Unión, Luis Carlos Galán, Altos del Pino, Balkanes, Tanque Ca zucá, Casaloma, Lomalinda, Minuto de Dios, Carlos Pizarro, La Capilla, Villa Mercedes, Terranova, Santo Domingo, Paraíso de Corinto, Mirador de Corinto, oas is, Robles, Isla, Progreso, Margaritas, Buenos Aires, Pinos, Zona Verde, Villas de Casaloma, Bellavista Villa Mercedes, Rincón del Lago y Embalse Terreros Zona Industrial Cazucá, Santillana, Quintanar de los Sauces, Las Quintas II, Simón Bolívar, Quintanares VI.
<b>River: Tibanica- Comuna: No 5- Total Population: 58,693</b>
Serranías de la Peña, Quintanares Ocales, Sauces Cerezos, Almendros, Puesta del Sol, Remanso, Quintanares, Vegas, Barbados, Pimientos, Villas de San Mateo, Casalinda, Plazoletas, Arco Iris, Sumapaz Bosque, Zona Verde, Pinar, Sauces, Novipal, Lisindex Juanambu, Vipal, Mirador de San Ignacio, Parques de San Mateo, Balcones de San Mateo, Unisur, Portal de Casalinda, Portal de San Mateo, San Lucas, Mirador de San Ignacio, Central eléctrica, capitalinas, Ospinas guazu, Los Rosales, Inversiones Bogotá, Pimientos, Junin, Presencia de los Andes, Armero, Vegas de San Mateo, Mirador de San Ignacio, Bosque de Tibanica Mirador de San Ignacio III, V, VI, VII, Oasis, Hospital Regional
<b>River Soacha-Comuna: No 6- Total Population: 65,403</b>
Florida I and II, Cien Familias, Llano Grande, Cardal, Mariscal Sucre, Camilo Torres II, Santa Helena, Cagua, Balcón Real, San Carlos, Esperanza, Cristales, Bosque Cagua Chiquita, San Alberto, San Antonio, Santa María, Comfenalco, Juan Pablo II, Sol, Andalucía, Dorado, Tuso, San Juan, Esmeralda, Villas, Parques del Sol, San Marcos, San Bernardino, San Juan de Ubate, Conjunto Residencial Autopista, Loira, Cipres, Rincón de Sanalejo, Pradera IyII, Bosque de Cipres, Boyaca, Villa de Santa Isabel, Divino Niño, Cristalina, San Martín, Alpes, Pinos, Altico, San German, Cohabitar, Cagua, Colmena II, Chico Sur Galicia III, Cien Familias.
<b>River : Soacha- Sector Rural- Total Population in Rural Area 4,422</b>
Corregimiento No 1: Veredas Panamá, Fusungá, San Jorge Corregimiento No 2: Vereda Bosatama

ANNEX S4-2- 3 Barrios and Comunas related with landslides at the Study Area in Soacha Municipality

<b>Zone: Altos de Cazuca- Comuna: No 4 Total Population: 63,245</b>
Villa Esperanza-El Barreno, Julio Rincón, Villa Sandra, Arroyo, Santo Domingo, San Rafael, Julio Rincón III, La Nueva Unión, Luis Carlos Galán, Altos del Pino, Balkanes, Tanque Cazucá, Casaloma, Lomalinda, Minuto de Dios, Carlos Pizarro, La Capilla, Villa Mercedes, Terranova, Santo Domingo, Paraiso de Corinto, Mirador de Corinto, oasis, Robles, Isla, Progreso, Margaritas, Buenos Aires, Pinos, Zona Verde, Villas de Casaloma, Bellavista Villa Mercedes, Rincón del Lago.
<b>Zone: Divino Niño- Comuna: No 6 Total Population I: 65,403</b>
Florida I y II, Cien Familias, Llano Grande, Cardal, Mariscal Sucre, Camilo Torres II, Santa Helena, Cagua, Balcón Real, San Carlos, Esperanza, Cristales, Bosque Cagua Chiquita, San Alberto, San Antonio, Santa María, Comfenalco, Juan Pablo II, Sol, Andalucía, Dorado, Tuso, San Juan, Esmeralda, Villas, Parques del Sol, San Marcos, San Bernardino, San Juan de Ubate, Conjunto Residencial Autopista, Loira, Cipres, Rincón de Sanalejo, Pradera I y II, Bosque de Cipres, Boyaca, Villa de Santa Isabel, Divino Niño, Cristalina, San Martín, Alpes, Pinos, Altico, San German, Cohabitar, Cagua, Colmena II, Chico Sur Galicia III, Cien Familias.

ANNEX S4-2- 4 Gradual Training for Firefighters Academic Curriculum

<i>FIREFIGHTERS CURRICULUM I</i>	<i>FIREFIGHTERS CURRICULUM II</i> (Firefighters pre requirements I)
MODULE TOTAL HOURS 100	TOTAL MODULE 89 HOURS
Introduction to Education	Fire behavior
Fire fighters schooling	Applied hydraulics
The firefighter and his institution	Pre-hospital Attention II
Ethics and humanistic	Types of Fires
The Fire	Flammable and combustible liquids
Ropes, knots, moorings	Confined Spaces
Hoses and accessories	Collapsed Structures
Basic Hydraulic	Incident Command
Manual Stairs	Fire Extinction Machines
Vehicles against fires	Chemical Emergencies
Search and rescue	Advanced Maneuvers with ropes
Basic forced entries	Physical conditioning
Vertical and horizontal ventilation	Communications II
Chemical products	Sinister Statistics
Hydrocarbons	Series 3000
Basic Electricity	Theoretical and practical exams
Prevention Culture	
Evaluation of damages and necessities analysis.	
Firefighters Management	
Basic First Aids	
Vehicle Rescue	
Maneuvers Command	
Basic Forest Fires	
Educational Sport	
Arts and handcrafts	
Athletic Physical Development	
Projects Presentation	
Public Information	
Principles of strategically planning	
Principles of firefighters regulation	
Systems (use of computers)	
System of protection against fires	
Communications implements	
Theoretical and practical exams	

## ANNEX S4-2- 5 Protocol of Flood Response CLOPAD.2006

### a) Purpose:

This protocol was made to be used for Response Groups of the Municipality of Soacha. It is not a replacement of the group training; but a guide in establishing the steps of the Coordination and Response Process.

### b) Scope:

It must be used for the emergency response groups for Soacha and its surroundings.

### c) Priorities:

1. to guarantee the safety of the respondents and the affected community.
2. To guarantee the safety of the people in rescue activities
3. To reduce to the maximum the lost of the affected community belongings

### d) General rules of safety

- Isolate the impacted area, control the access and follow the bio-safety rules.
- Secure the scene of disaster
- Find out your limitations and the right way to use equipment. Use them according to the established ruling.
- Do not enter an area with dangerous materials; without proper equipment and/or knowledge of the operation.
- Establish clearly the systems or evacuation alarm.
- Define the monitoring systems of the phenomenon to have proper warning in case a second mass removal phenomenon happens.
- Guarantee that the staffs in the area use the Personal Protection Implements all the time.
- Never work alone (the team must be at least 2 people), avoid participating in a rescue if you are not in good physical conditions.
- Be aware of your true skills
- Wear all moment personal protection implements such as: helmet (at least 3 points), goggles, leather gloves, boots, use engineer type raincoat, work outfit.
- Restrain the number of staff at the risk area.
- Have ready equipment for the only purpose of attending an accident which might happen to the response team.
- Keep the evacuation roads clear and safe.
- Keep constant communication
- Choose a person responsible of safety.
- Establish signs for evacuation (three long beeps)

### e) Stages of protocol implementation

#### i. Preparation

- Training and update
- Equipment
- Training on protocol implementation
- Take into account the early warning systems

#### ii. Activation and mobilization

When receiving the activation call, ask for the following information:

- Time of information reception

- Area where the event happened and distance between calles and carreras.
  - Characteristics of the event: overflow, flooding (wet), reflow
  - Type of housing affected, day and time
  - Help needed
  - Atmospheric conditions
  - Actions taken by community and local response organizations
- iii. Approximation to the impact area
- Get to the area where the incident happened in a fast and safe way, taking in to account:
- Type of response vehicle
  - Characteristics of the roads
  - Day and time
  - Possible routes
  - Necessary support (heavy machinery, boats, etc)
  - Exact location of the waiting area
- iv. Arrival to the disaster scene
- Inform your arrival: time, location, and access conditions. Each institution reports to their central as well as CLOPAD's coordination.
  - Observe: water level, smoke, associate risks, type of structures, access to victims.
  - Contact scene coordinator if there is one.
  - Verify safety of the P.M.U.
  - Verify safety of your first position.
  - Locate evacuation route in the area.
- v. Installation of the P.M.U
- Organize response groups if there is more than one institution.
  - Call to the P.M.U all the institutions.
  - Action plan: established by leaders of the fire department, Secretary of Health, Defensa Civil and Cruz Roja.
  - Define a safety coordinator and a safety plan.
  - Define the evacuation needs and the evacuation coordinator.
  - Define the alarm and monitoring system of the phenomenon.
  - Inventory the resources and determine needs for the continuity of the operation.
  - Define needs of the affected people (mattress, food, clothing, etc.)
  - Establish the information systems for the affected people.
  - Guarantee the safety of the evacuee's belongings.
  - Locate Medical Emergency and choose a responsible person for the health area.
  - Determine a place for the warehouse and the waiting area.
- vi. Initial evaluation of the search
- Make a report of missing people and organize a search team.
  - This search should be done by qualify people, equipped for the conditions of this place.
  - Analyze the information of the missing people, in order to have an idea of the possible location.
- vii Evaluation and Rescue
- Organize groups of 6 people with a leader; assign them areas of recognition of the situation.
  - These groups' responsibilities are:
  - Locate affected people, trapped in terraces roofs and buildings upper floors.
  - Define rescue needs.



- Inform the affected community about the risk and the meeting places for the community.
  - Evacuate patients, people with incapacities, children and all the people who has problems to move by themselves.
  - Write down all the affected housing addresses, to make a comparison with the census.
  - Make a safety briefing before, and point out the alarm signs, evacuation routes, and actions in case affected people are found.
  - Follow safety policies for walking displacements taking into account: sewers without lids, holes, hollow, and water running on the streets that will cause water rapids or become a biologic risk.
- viii Attention of Affected people an census
- Organize the response groups if there is more than an institution.
  - Determine one or several places located in safe areas, far from the impact areas that have sanitary services and that it allows the adaptation of a temporary infrastructure for the location of affected people. (schools, communal rooms, sport complex, etc.)
  - Determine near these places a storing area for the aids that were given to the affected ones
  - As much as possible look for that the affected ones take refuge where family and friends to diminish the problems of accumulation and annoyance in the temporary housings.
  - Coordinate with the support organisms the execution of the census of the affected ones using the methodology EDAN.
- ix Access to the patient
- Come in to the houses where trapped people could be using the windows of upper floors in case other entrances are blocked.
  - Find the patient and define survival status.
  - Use a floating stretcher miller or najo (polymers)
  - Evacuate as soon as possible
- x Final control of the Scene
- Evacuation of the water of the housings and of the streets
  - Carry out a quick evaluation of the structures to determine their habitability
  - Relocation of affected people
  - Close of shelters
  - Domiciliary visit for processes of censuses
- xi Collection and Checkup of Teams
- Immobilization equipment retires in the Hospital
  - Cross and refund of teams among institutions
  - Revision of the operation of equipment used
  - Revision levels of fuel, hydraulic fluids, pressure of air among others
  - At the base decontamination of the necessary equipment has to be done, leaving it in optimal conditions for further use
- xii Consolidating the Information
- Attended people's verification
  - Other entities: full name, identification document, address, telephone, lesions and offered attention
  - Institution that transfers. Ambulance number and/or company
  - Institution that receives: Hospital, Cami, Clinic, etc.
  - Send information to the coordination of the CLOPAD
  - Verification of attention for each one of the patients vs. the possible occupants of the housings

#### f) Report of Readiness

As soon the operation concludes, a report must be delineated to the central station indicate availability, location, status of the equipment, and possible route.

### ANNEX S4-2- 6 Protocol of community as first respondent

#### a) Purpose.

This protocol was made to be used for Response Groups of the Municipality of Soacha. It does not replace the group training; it is a general guide to establish the steps of the Coordination and Attention Process. This must be developed for whom were trained on this topic.

#### b) Scope:

It must be used for the communities of the different barrios and rural areas of Soacha

#### c) Priorities:

- Guarantee the safety of the first respondents above any other consideration.
- Begin the chain of calls; activate the groups of response of the municipality.
- Carry out the initial evacuation of people in risk.
- Begin the administration - coordination of the hazard.

#### d) General rules of safety

- Do not enter to the affected area
- Locate yourself in a safe place with visibility to the scene
- Do not execute actions for which you don't have equipment or are not prepared
- Isolate the area and look for support for controlling it.
- Activate quickly to Aid groups teams and the CLOPAD

#### e) Stages of application of the Protocol

##### i. Preparation

- Training
- Equipment.
- Knowledge in the application of protocols

##### ii. Execute the Plan of Action

Execute the plan of SELF PROTECTION

Verify that they are executed the following actions that they should be contemplated in the Plan:

- The members of the family know the actions to take.
- Actions to develop have priority in safeguarding life (to evacuate, not to move patient, etc.)
- Don't take risks neither the families to save personal goods.
- Don't lose time trying to control the incident

##### iii. Adopt the Leadership

- Locate yourself in a safe place that allows you to observe the incident.
- Make sure the chosen place is outside of the reach of risks associated to the incident (for example: explosions, flood, slip, collapse, etc.)
- Verify the response entities have been informed of the incident and have indicated them with accuracy the place and the access roads, as well as the place where you are.

- Organize a working group with evacuated members of the community that have already evacuated or that they are present in the place of the incident.
  - Inform to the working group that you will lead the actions.
  - Take charge to members of the community the isolation of the area where the incident happened.
  - Support the initial evacuation of people without this implies risks for you or your working group.
  - Don't assume operative actions or of tasks like for example the attention of patient or the evacuation of goods, etc. These actions are carried out by specialized groups of the aid organisms and/or security.
  - Wait to the arrival of response teams.
  - When arriving you to the place of the incident find that there is already somebody that is leading the actions, introduce yourself and inform him/her the training that you have, ask him/her how you can support him/her and follow his/her instructions.
  - Don't carry out any activity without coordinating it with the person that has assumed the initial leadership.
- iv. Make the Report of the Situation. Do not spend more than five minutes in the evaluation, the time that lapses can be very valuable for the arrival of response aid.
- Carry out a general observation of the impact area to be able to inform, do not assume data.
  - Write down which events happened before the incident.
  - Ask people that observed what happened, if you don't know.
  - Try to know if there's a possibility for other events that can increase the risk related with the incident, as For example housings collapse new avalanche, possible explosions, etc.
  - Prepare the following information and transmit, following the List of Checkup LC-001-2:
  - What did it happen? An Explosion, a vehicular accident, a flood, etc.
  - When did it happen? The approximate date and hour in that the incident happened.
  - Where did it happen? Indicating the exact place in order to speed the arrival of the help.
  - What damages were there and which is the magnitude? Wounded people number approximately, how many vehicles were involved in the accident and what type of vehicles they were (E.g. Buses, taxis, school transport, etc.), Number and type of affected housings (E.g. Of 1 floor, of 2 floors, etc.)
  - Access roads to the area of the incident? Identify clearly which the roads are for where you can arrive quickly to the place where it the incident happened.
- v. Transmit the Gathered Information to the CLOPAD and the Fire Department
- Transmit quickly the information gathered on the incident no matter is incomplete.
  - Remember the speed with which you transmit the information, likewise the response teams will help the community.
  - Keep in mind the information you transmit, is necessary for the response agents in establishing the requirements to assist the incident
- vi. Isolate the Area where the Incident happened
- Establish the following areas:
- The First Perimeter should be minimum 100 meters from the place of the incident or of impact. If it is an incident with dangerous materials (MATPEL), the minimum distance will be of 300 meters.
  - Identify a safe place and establish the Point or Place of Encounter there, report of this to the community through the other members that are supporting in the handling of the incident.
  - Locate the Unified Control Center (PMU) according to the following instructions:
  - It should be a safe place.
  - Have visual domain of the place of the incident.

- If it is an incident with dangerous materials (MATPEL) keep in mind that the PMU should be located in:
- In a place in favor of the wind (wind blowing to the back).
- If the incident happened in a water source, locate the PMU at the upper part.
- Carry out the evacuation in an opposite direction in that the wind blows.
- Do not allow access of any person to the impact area. Exception properly trained response teams, the same as if the incident is an EXPLOSION; specialists in explosive enter first and verify if other loads can be activated.
- Guarantee the entrance and exit roads. It is fundamental to assure the roads for vehicles to support the emergency entering and leaving the area quickly.

Avoid the congestion of vehicles in the area of the incident, especially of curious and members of the community that are not supporting the control of the incident.

vii. Execute some support actions

If your community has Brigades of Emergency, carry out the following actions:

- Support the realization of the censuses of people that is being evacuated and/or taken to the Point of Encounter, or to other places like the Centers of Attention, Housings, etc.
- Carry out stocks that go mainly in favor of protecting lives, without this implying exposure.
- Try to support the evacuation without exposing more staff.
- Support inventorying necessities or elements recovered.
- Maintain in the place the strictly necessary personnel for the development of the activities.

Never allow the entrance to the area of impact of members of the community that are not properly qualified and trained.

viii. Support the Authority or the Organisms of Response

At the moment the response teams arrive to the place of the incident, carry out the following activities:

- Locate the member of bigger range of the answer organisms that arrived to the area, who will assume the control or coordination of the attention of the incident.
- Inform the Commandant or Coordinator of the attention of the incident that you were directing the actions and give him the following data:
- Work developed or that is in action.
- Possible location of victims.
- Possibilities that the community support the actions.
- Resources the community counts with.
- The existence of other dangers in the area, such as formal or informal industries, areas of risk for landslides, storage of dangerous substances, etc.
- Take data collected by initial control of the incident and the time.
- Remain available to commander's needs in case more information or support is needed.
- Maintain as much as possible organized the community, which attended the incident initially.

ANNEX S4-2-7 Emergency Familiar Plan for Inundation before the Emergency

To know the phone numbers, frequencies and channels from which the local emergencies communicate and to learn basic first aid techniques, to know the safest way to the house or to a refuge or meeting point.
<b>Measurements and Recommendations in front of an imminent inundation</b>
<b>Of communication</b>
-Keep listen a radio station. To locate family members
-To communicate the previous events and indicate the highest places of the house.
-To use the phone just when necessary. Before leaving investigate the condition of the roads.
-To do not use the sewage system until the authorities had ensure its operation
<b>How to proceed?</b>
-Avoid that toxic substance and/or inflammable take contact with water.
-Don't use the elevator.
-Forbid the access to flood parts of the house. Unplug all the electricity flow.
If water level obligates to evacuate the house, go to a higher place. Avoid the valleys, do not stay near rivers, channels, flows even they are dry or with few flow.
Have always on mind the possibility of leaving the house.
If the water level isolates us in the superior part, do not try to leave swimming. And it the water force drags us. Hold from a floating or fixed object.
Travel always with a full fuel deposit car, if the season is very cold it will be useful as heater.
The circulation during rains is dangerous. If there is not more remedy, circulate to a moderate velocity, since the breaks don't work with the same effectiveness and the visibility is not the same. Circulate by the main roads and if the water enters to the vehicle is better to abandon it.
If the water has current is better to measure the depth, tiding up a rope to the waist to a fixed object.
Never cross a bridge with water exceed, it cut be broken and you can fall down.
Once passed the emergency make an inspection to be sure there are not collapses. Do not enter with devices that can produce flame of spark. There could be flammable substances. Pay attention to the electricity fluid restoration.
Only drink bottled water. Do not eat or use what has contacted water. Do not use wet water. After inundation, the sanitary conditions are deficient and there is a contaminations risk. Specially retire animals and food un bad condition, and chemical products.
Clean up the house cooperating with the municipal services.
To collaborate as possible in tasks of rescuing and saving, following the measurements of personal protection. The training should be accomplished by all those persons, man or woman that would like to work as firefighters.

*(Source: EMERGENY FAMILIY PLAN (PEF). CLOPAD. Government Secretary. Version PEF:001/2006)*

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SUPPORTING REPORT

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S5

LANDSLIDE STUDY

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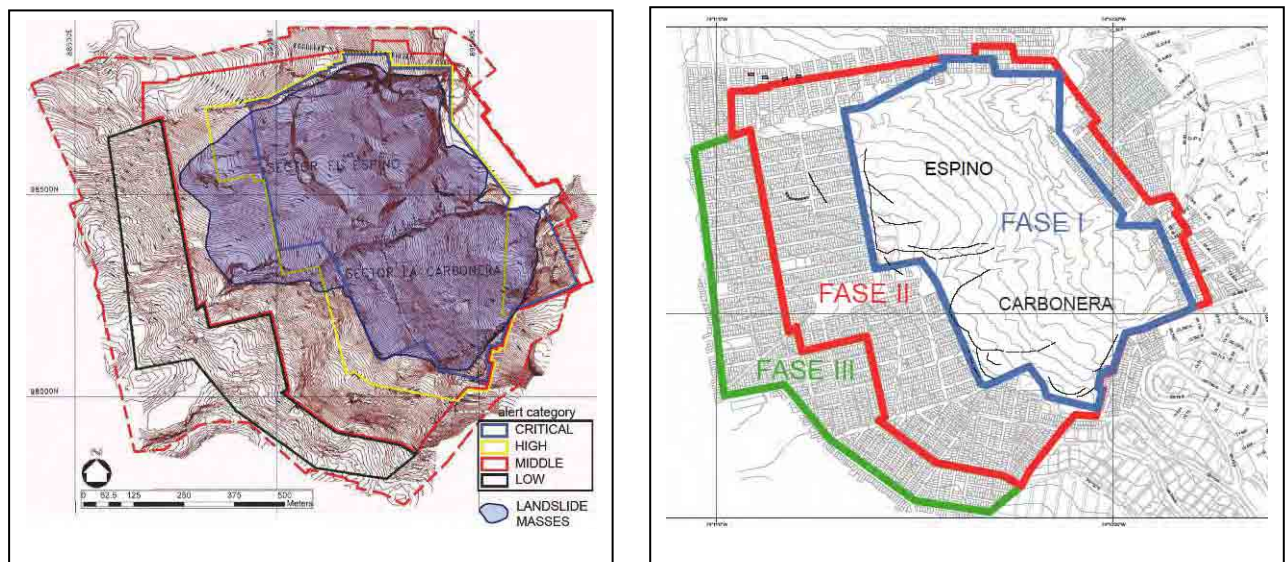
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## CHAPTER 1 LANDSLIDE IN BOGOTA

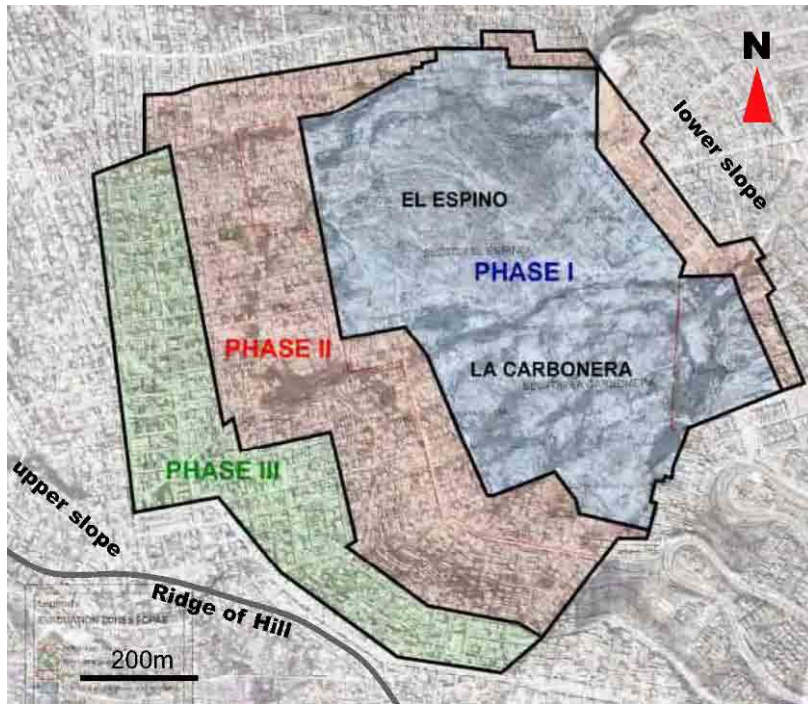
### 1.1 Outline of Landslide

Landslide study area in Bogota is only one place, called in a common way Altos de La Estancia, which is in the southwest of Bogota, in the UPZ 69 Ismael Perdomo, at the north of the Bolivar City in the neighborhoods La Carbonera, El Espino and surroundings. Hereinafter in this chapter, Chapter 1, the landslide in the Sector Altos de La Estancia is called “the Landslide”. The Landslide which is composed two major masses namely La Carbonera in south and El Espino in north are displaced hundred of thousand of cubic meters and forcing to resettlement of hundreds of families in an approximate area of 100ha. The type of the Landslide is mainly slow move massive landslide accompany with some small different types of movement. DPAE divided the Landslide area in 3 zones high alert, middle alert and low alert or Phase I, Phase II and Phase III with the purpose of relocation program. Figure S5-1-1 shows the landslide masses which may be in active at the moment, and show three phases. Figure S5-1-2 shows aero-photo of Estancia Landslides which was taken in 2002. The figure indicates there were no residential houses in Phase I areas, but still there are some houses in Phase II area in the year 2007.



(Modified from *Monitoreo y seguimiento de los deslizamientos activos que afectan el sector Altos de la Estancia, localidad de Ciudad Bolívar, Bogotá D.C.* "INGENIERIA Y GEORIESGOS, 2004 by Yokoo this study)

Figure S5-1-1 Active area of the Landslide (landslide masses) and Alert Categories, Phases I, II and III Instituted by DPAE



(Combination of aero photo and topographic map)

Figure S5-1-2 Phases in Altos de Estancia



(a)  
from East  
Darker area at the center is the Landslide

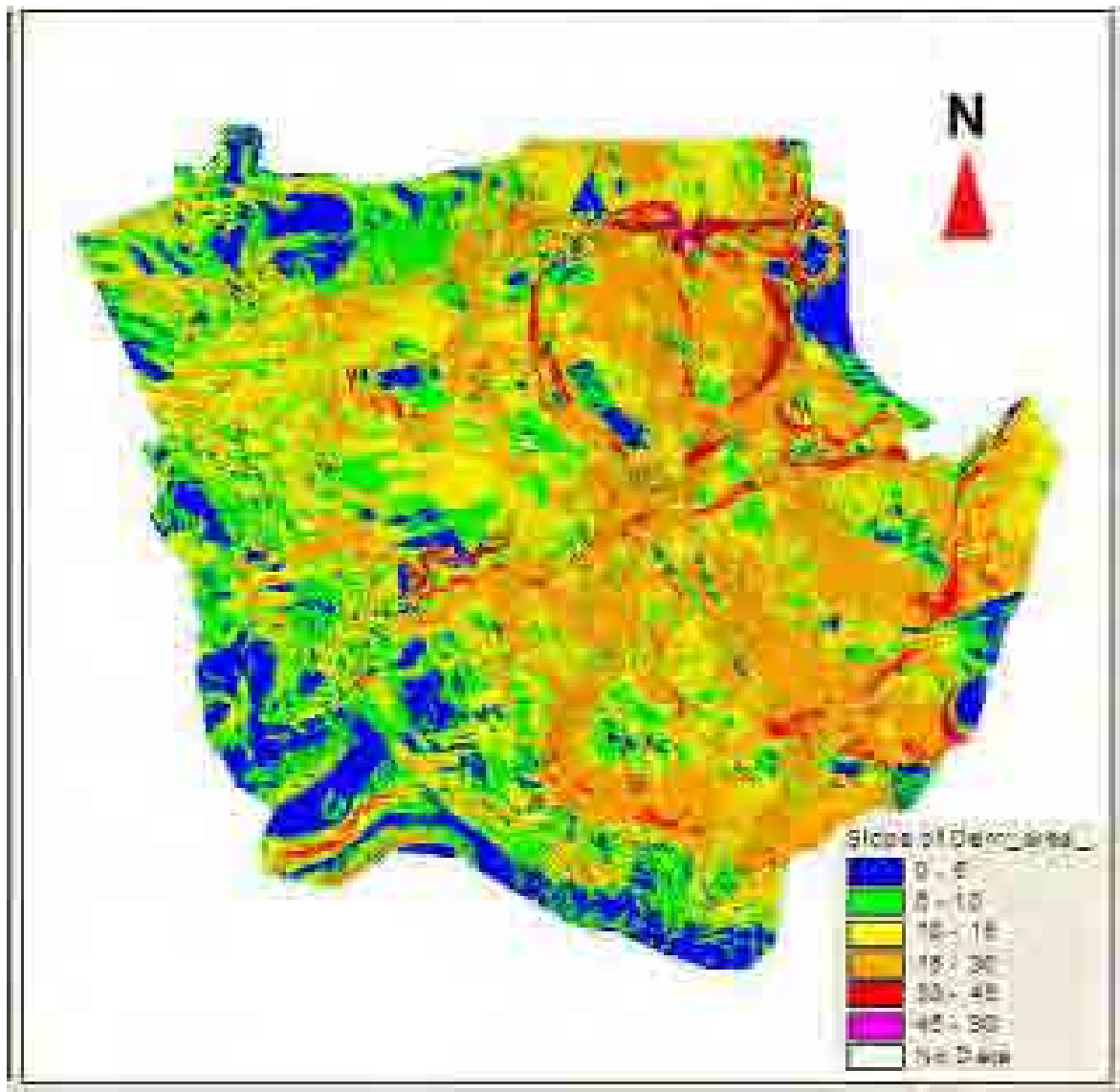


(b)  
from Northeast  
Wasteland on the slope is the Landslide

Photo S5-1-1 Panoramic Views of the Landslide

### Topography

The slope direction in the area is to north east as shown in the Figure S5-1-1 and S5-1-2, therefore moving direction of the Landslide in the aggregate is from south west to north east. Average angle of the slope is about 15-20 degrees and the slope angle is mostly less than 30 degrees as shown in Figure S5-1-3. Steep slopes (over 30 degree in Figure S5-1-3) in the area shape outlines of the active landslide masses. In Figure S5-1-3, alternations of low angles and high angles of slopes can be seen, as it is sometimes common with large scale landslide. It may show there are some sub landslide masses in the main landslide mass.



*(Source: Monitoring and following to the active landslide affecting the sector Altos de La Estancia, Bolivar City Locality, Bogota D.C., Ingenieria y Geoesgos 2004)*

Figure S5-1-3 Classification of slope angle

### Geology

The reference studies show the presence of two lithostratigraphic units in the area, Sandstone's Member of Guadalupe Formation (Ksglt) and Guaduas Formation (KTg). These members of sandstone which belong to the age of Cretaceous and Tertiary are dipping toward to almost east. Therefore the geological structure is "daylight structure" in the slope of the Landslide.

## 1.2 Existing Studies

### 1.2.1 Existing Investigations

The Landslide has been studied for long time and there are many reports regarding the Landslide. Table S5-1-1 shows recent reports on the Landslide. Among them, the most complete and comprehensive study is the report written in 2004, which compiled the result of the studies made in the past. The study in 2005 is the monitoring and follow-up study on the Landslide. Monitoring works on the Landslide have been executed and reported since 1999 as shown in Table S5-1-2.

Table S5-1-1 Recent studies on the Landslide

Source	Year	Contents
INGEOMINAS	2003	Estudio de evaluación de amenaza por deslizamiento para los Barrios El Espino y El Cerro El Diamante, e instalación y monitoreo de instrumentación geotécnica.
DPAE	2004	Estudio de Riesgo y Medidas de Mitigacion en el Sector Altos de La Estancia de La Localidad de Ciudad Bolivar
DPAE	2005	Monitoreo y seguimiento a los deslizamientos activos que afectan el sector Altos de La Estancia de la localidad de Ciudad Bogota
SIRE	2006	Emergency attention records

Table S5-1-2 Existing studies of monitoring in the study area

Year	Title	Organization
1998	Risk Zoning by Terrain Instability for different localities in the City of Santa Fe de Bogota, D. C.	INGEOCIM Ltda.
1999	Geotechnical study, mitigation measures alternative evaluation and detailed designs of the recommended works in order to stabilize the zone included between the creeks Santo Domingo and Santa Rita, El Espino neighbourhood.	Consortio Civiles Ltda – Hidroconsulta Ltda.
2000	Design of the Instrumental for the Monitoring and Following of Landslide in the basin of La Carbonera Creek.	INGEMÉTRICA Ltda.
2001	Design and Installation of the instrumental for the monitoring and following of mass removal phenomena in El Espino neighbourhood.	Geotecnia y Cimentaciones Ltda.
2001	Monitoring and following of the Mass Removal Phenomena in the neighbourhoods San Antonio del Mirador, Santa Helena and Santa Viviana of the Bogota City, D.C.	Universidad de los Andes.
2002	Monitoring and following of the landslide affecting the neighbourhoods San Antonio del Mirador, Santa Helena, Santa Viviana, Vista Hermosa, Santo Domingo and La Carbonera from the Bolivar City Locality.	Geotecnia y Cimentaciones Ltda.
2003	Monitoring and following of the landslide that affect the neighbourhoods San Antonio del Mirador, Santa Helena, Santa Viviana, Vista Hermosa, Santo Domingo and La Carbonera from the Bolivar City Locality	Moya y García Ltda.
2004	Monitoring and following to the active landslide affecting the sector Altos de La Estancia, Bolivar City Locality, Bogota D.C.	Ingeniería y Georiesgos
2005	Monitoring and following to the active landslide affecting the sector Altos de La Estancia, Bolivar City Locality, Bogota D.C., FINAL REPORT	Geotecnia y Cimentaciones Ltda.

(Source: RISK STUDY AND COUNTERMEASURE IN THE SECTOR ALTOS DE LA ESTANCIA BOLIVAR CITY LOCALITY, 2004, etc)

### 1.2.2 Past Disasters (Historical Information on Landslide)

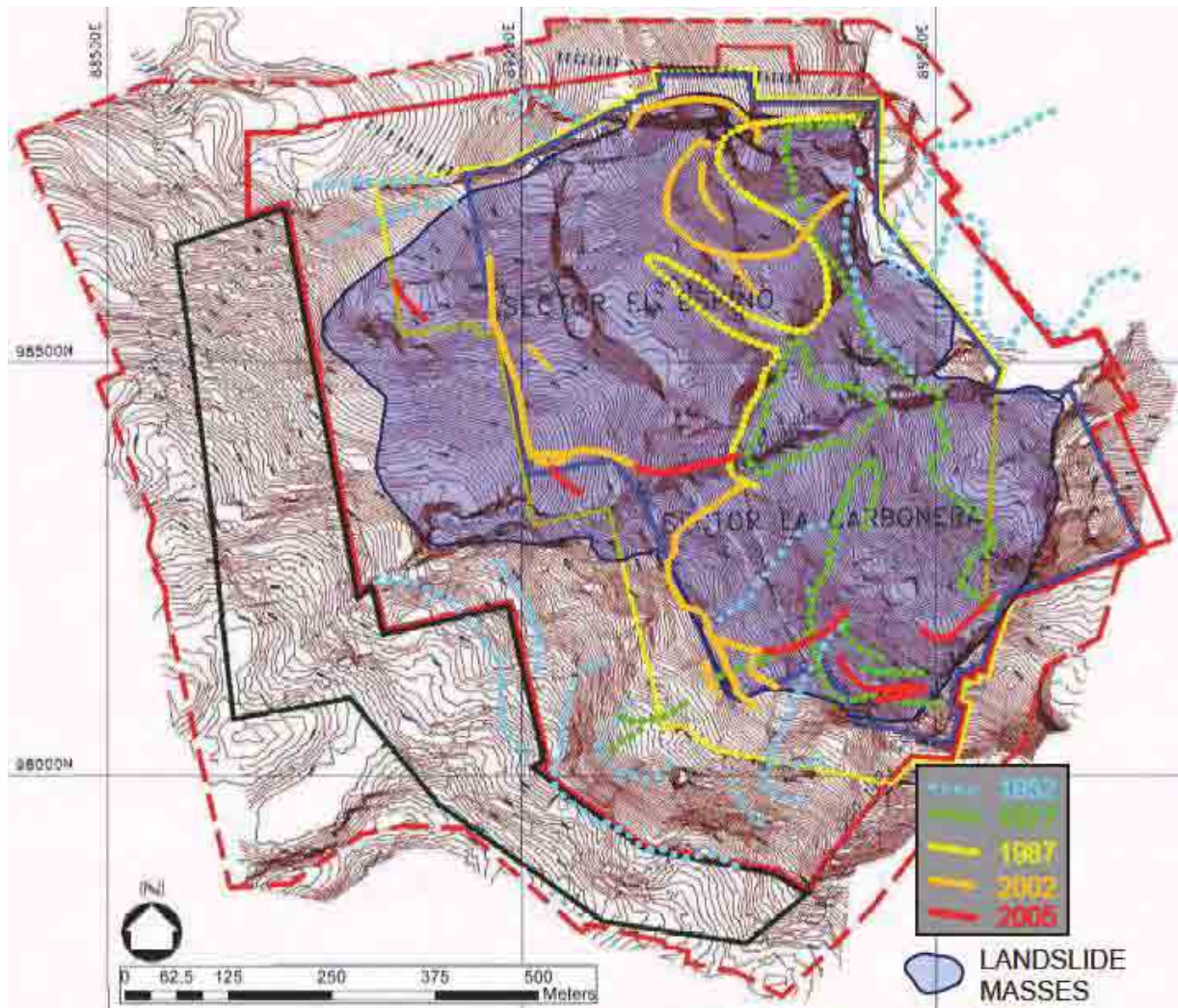
Historical information on the Landslide is described as shown in Table S5-1-3, as a compilation of existing studies. According to Table S5-1-3, the feature of the Landslide came in view clearly in 1977. In spite of the occurrence of the landslide, however, the quarries in the area had been operated until 1990's, and the things might have come to a serious pass. Figure S5-1-4 shows the development of the cracks. In 1952, cracks were seen on the slopes upper to lower. Taking account of the record of the Landslide such as Table S5-1-3, the cracks in 1952 might not be formed by the landslide activities, but had been exist before the Landslide occurred. These cracks might be seen easily in the slopes since there were few human activities on the slope in 1950's and before. After 1977, the cracks shown in

Figure S5-1-4 tended to invade upward from lower parts of slopes. The crack's upward invasions means the Landslide grew upward.

Table S5-1-3 History of land use and landslide in the study area

Year	<u>El Espino</u>	<u>La Carbonera</u>
1952	Natural forest was transformed to pasture. Exploitation of material is recorded in the upper part of the left bank of Santa Rita river. Small flow (0.9 ha) in the left bank of Santa Rita river is recorded.	Natural forest was conserved better than El Espino, but there was some human intervention. Though no landslide was recorded, there were incidents of erosive process by hydraulic erosion.
1977	Large exploitation of construction material by open cut is observed. Lower structural layer of sandstone was initially exploited, then extended to La Carbonera. Clear change in natural watershed of Santa Rita was observed. A zone of slow movement of soil is identified in wide area.	Exploitation was extended from El Espino. Landslide of semicircular form with 600m in length, 250m distant from exploitation front was originated. There was a canal in the central zone of La Carbonera. Two zone of slow movement of soil is identified in wide area.
1984-1987	Notorious advance of exploitation activities in 1980's. Two landslides associated to the Santa Rita river. Lower part of Santa Rita river lost its original course.	Retrogressive advance of the crown of landslide and major effect of slope movement in the lower part. Dispersed housing construction in the upper hill. Advance of urbanization in the lower limit of quarry. The first engineering study on landslide was executed by IGL under Caja Vivieda Popular in 1987.
1996-1998	Exploitation work in quarry was suspended. The zone was covered by its residual, changing the landscape. In 1996, the border of the zone was urbanized, and the central part was covered by garbage over old quarry. In 1998, several landslides were registered, indicating the problem had been generated in large part of the zone. In 1998, major part of drainage line in Rosales and Carbonera river were recovered, and Santa Rita river partially	
2000-2004	Major part of the zone was urbanized, and landslide affects residents, evacuation of houses began. In 2000, drainage was very much reduced from original state. Landslide had increased significantly between 1998 and 2000, notably in El Espino in the slope above the old scarp. The advance of retrogressive is serious particularly in El Espino.	

(Source: Estudio de Riesgo y Medidas de Mitigacion en el Sector Altos de La Estancia de La Localidad de Ciudad Bolivar, 2004)

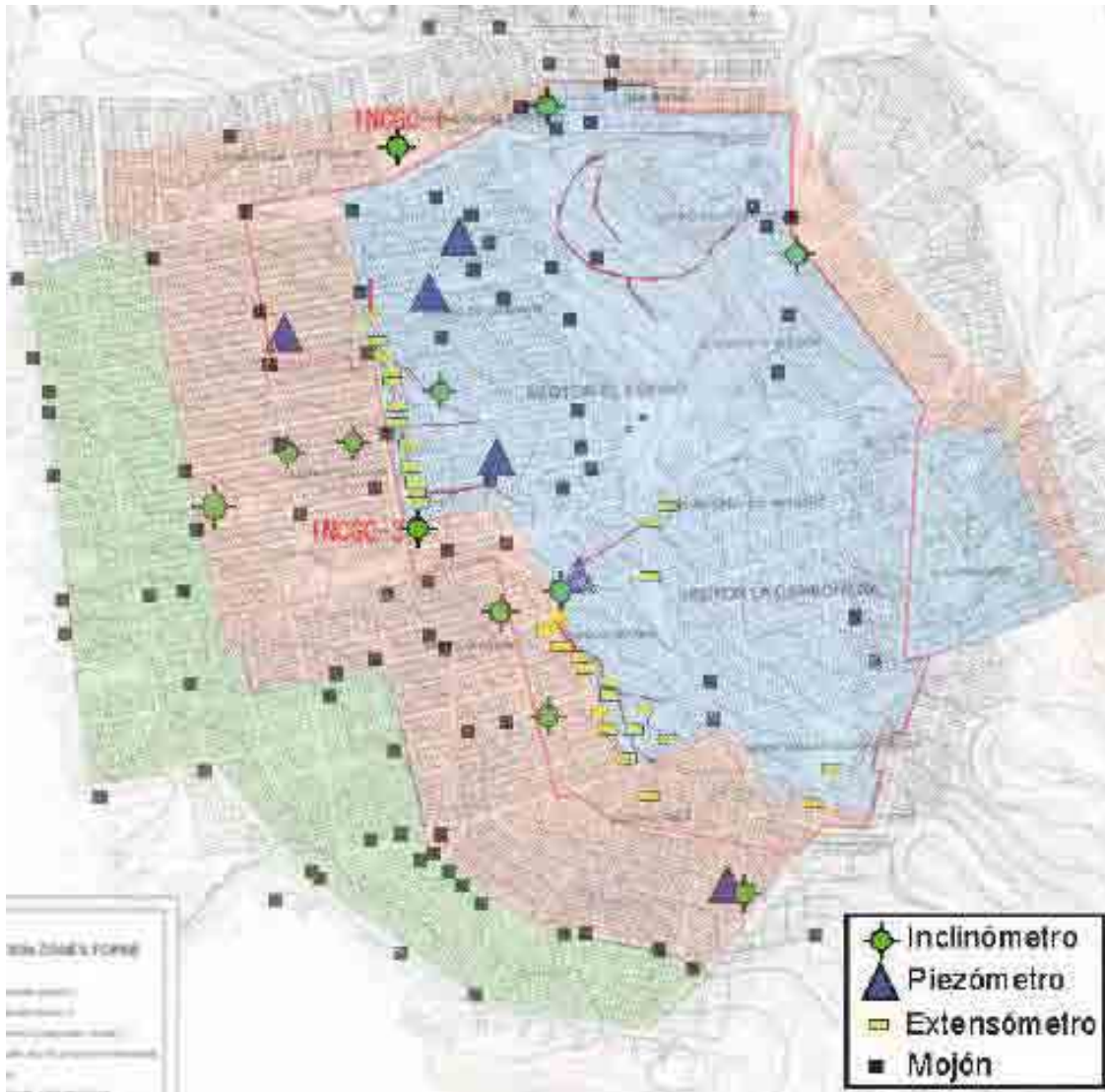


(Vectores de desplazamiento, (Modified from Monitoreo y seguimiento de los deslizamientos activos que afectan el sector Altos de la Estancia, localidad de Ciudad Bolívar, Bogotá D.C.".INGENIERIA Y GEORIESGOS, 2004 by Yokoo this study))

Figure S5-1-4 Development of cracks in the Landslide

### 1.2.3 Existing Monitoring

The latest monitoring study conclude in 2005 is composed of topographic controls of ten sections, monitoring by six inclinometers, and 250 structural monitoring. In the study, topographic controls were made in six sections in El Espino with a longitude between 335 m to 974 m, and in La Carbonera, four sections were surveyed with a longitude between 306 m to 863 m. The result shows that the maximum displacement was up to 90 mm during the period of monitoring. In La Carbonera, two inclinometers to the depth of 8 m are used, but the result showed that the area is stable. The study compiles the status monitoring instruments as shown in Figure S5-1-5 and Table S5-1-4. Besides, structural monitoring was also made for 250 houses to evaluate the degree of risk for evacuation. Figure S5-1-6 shows inclinometer monitoring results at INCGC-1 and INCGC-3 which newly installed in 2005. They show most clear movement of the Landslide in all of inclinometer monitoring results in three months from April to July 2005. The fluctuated data is not stable, but the sliding surface and moving volume can be seen in the data. At INCGC-1, the sliding surface may be at the depth of 7-8 m. At INCGC-3, two sliding surface can be seen at the depths of 9 m and 18 m. At INCGC-3, total magnitude of the movement in three month was 50 mm (17 mm/month). Figure S5-1-7 shows the directions of topographic control points differential. Most of directions cross the contour lines at right angles. The directions take a little toward to north east.



(Modified from *Monitoreo y seguimiento de los deslizamientos activos que afectan el sector Altos de la Estancia, localidad de Ciudad Bolívar, Bogotá D.C.* "INGENIERIA Y GEORIESGOS, 2004 by Yokoo this study)

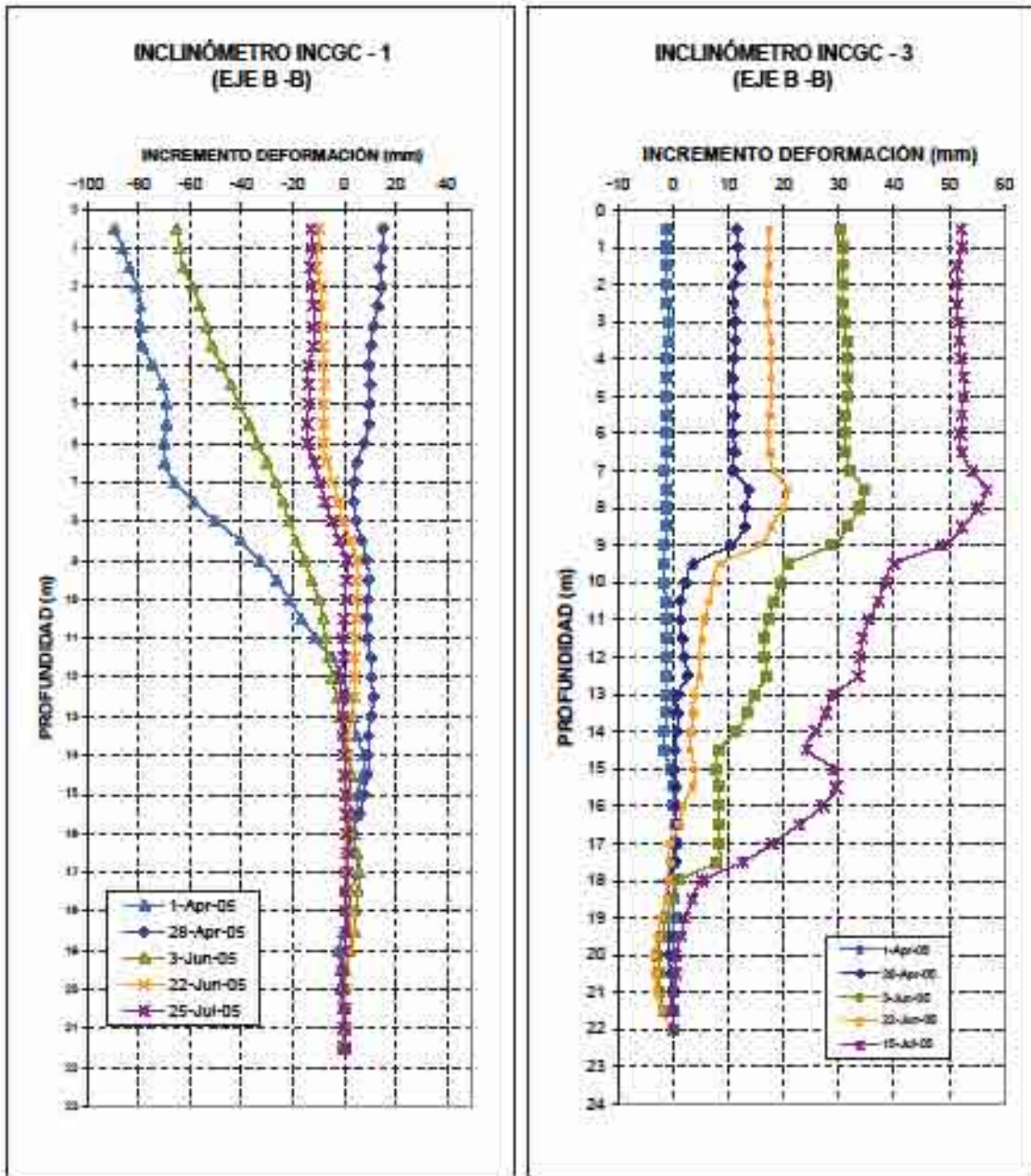
Figure S5-1-5 Landslide monitoring installation locations

Table S5-1-4 Status of monitoring instruments

Area	Instrument type	Total number	Status of instrument		
			Good	Destroyed	Filled
El Espino	Topographic points	54	28	16	9
	Extensometer	14	1	13	0
	Piezometer	2	1	1	0
	Inclinometer	6	4	2	0
La Carbonera	Topographic points	70	40	24	6
	Extensometer	24	0	20	4
	Piezometer	4	2	2	0
	Inclinometer	4	3	1	0

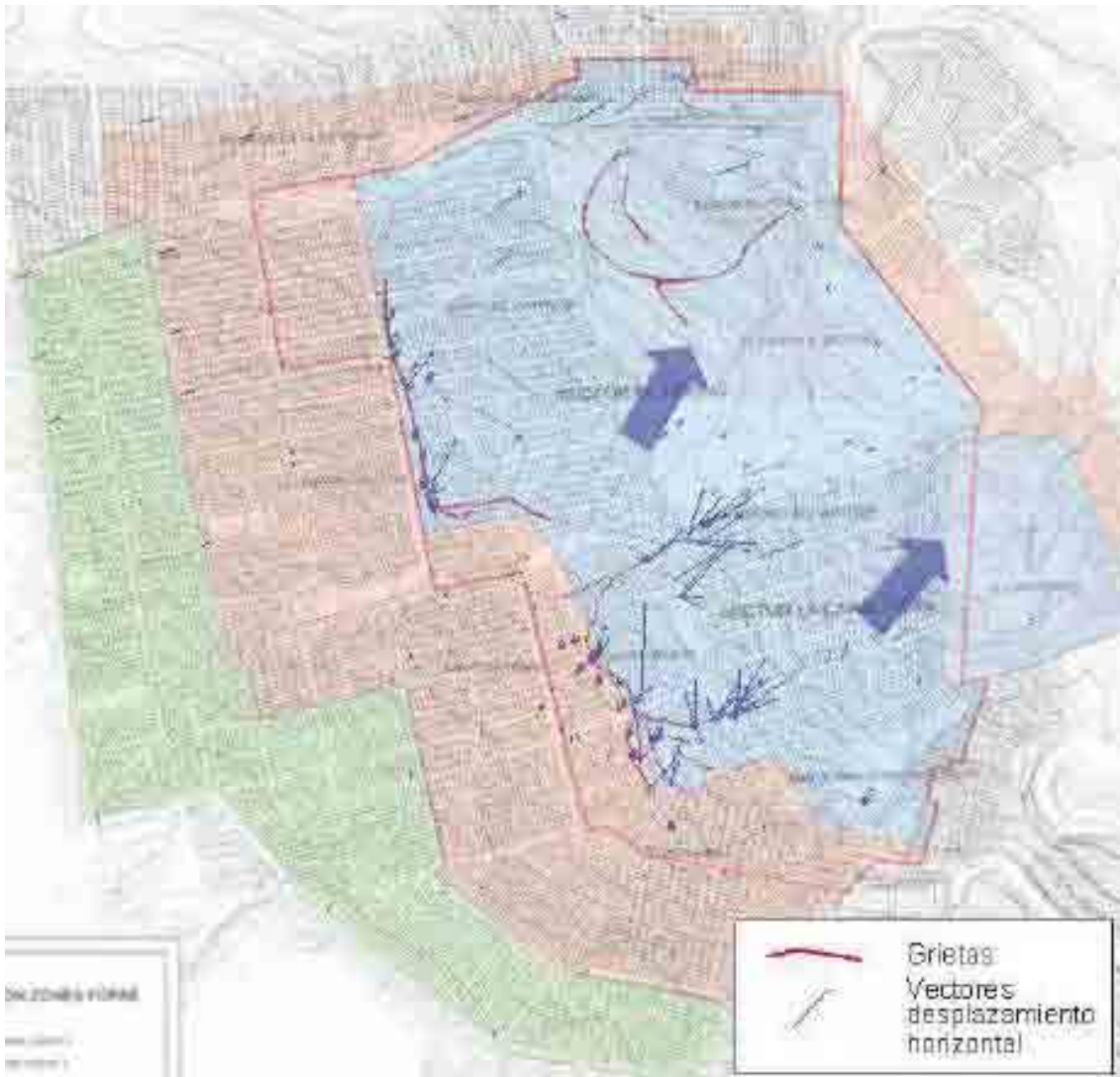
(Source: *Monitoreo y seguimiento a los deslizamientos activos que afectan el sector Altos de La Estancia de la localidad de Ciudad Bogotá, 2005*)





(Source: Monitoring and following to the active landslides in the sector Altos de La Estancia from Ciudad Bolivar Locality in Bogota, D. C. City, GEOTECNIA Y CIMENTACIONES, 2005)

Figure S5-1-6 Inclinometer monitoring results at INCGC-1 and INCGC-3



*(Vectores de desplazamiento (Modified from Monitoreo y seguimiento de los deslizamientos activos que afectan el sector Altos de la Estancia, localidad de Ciudad Bolívar, Bogotá D.C.".INGENIERIA Y GEORIESGOS, 2004 by Yokoo this study))*

Figure S5-1-7 Directions of Topographic Control Points

### 1.3 Surveys Results

#### 1.3.1 Site Survey

There are not residential people in Phase I in the Landslide, and the relocation program in Phase II is on progress, thus there is no serious danger that threatened lives in the Landslide. However, many people are still living soon about the Landslide in the vicinity, in Phase III area and outside of Phase I and Phase II. The Landslide could influences a surrounding resident by the landslide's expanding. Hereinafter, the places where are out of Phase I and II are called “the residential area” The residential area includes Phase III area and outside of Phase I and Phase II.

Site Survey was carried out at three sectors where the parts of the Landslide may approach the residential areas as shown in Figure S5-1-8. Especially, Espino 1 shown in Figure S5-1-8 is the place where the ground has been uplifted recently by the Landslide activities. The summary of the site survey is as followings. Any abnormalities such as cracks or deformations on the ground or structures are not found at three sectors in the residential areas except Espino 1. At Espino 1, some cracks were found in a house near the uplift which was made by compression at toe of landslide.

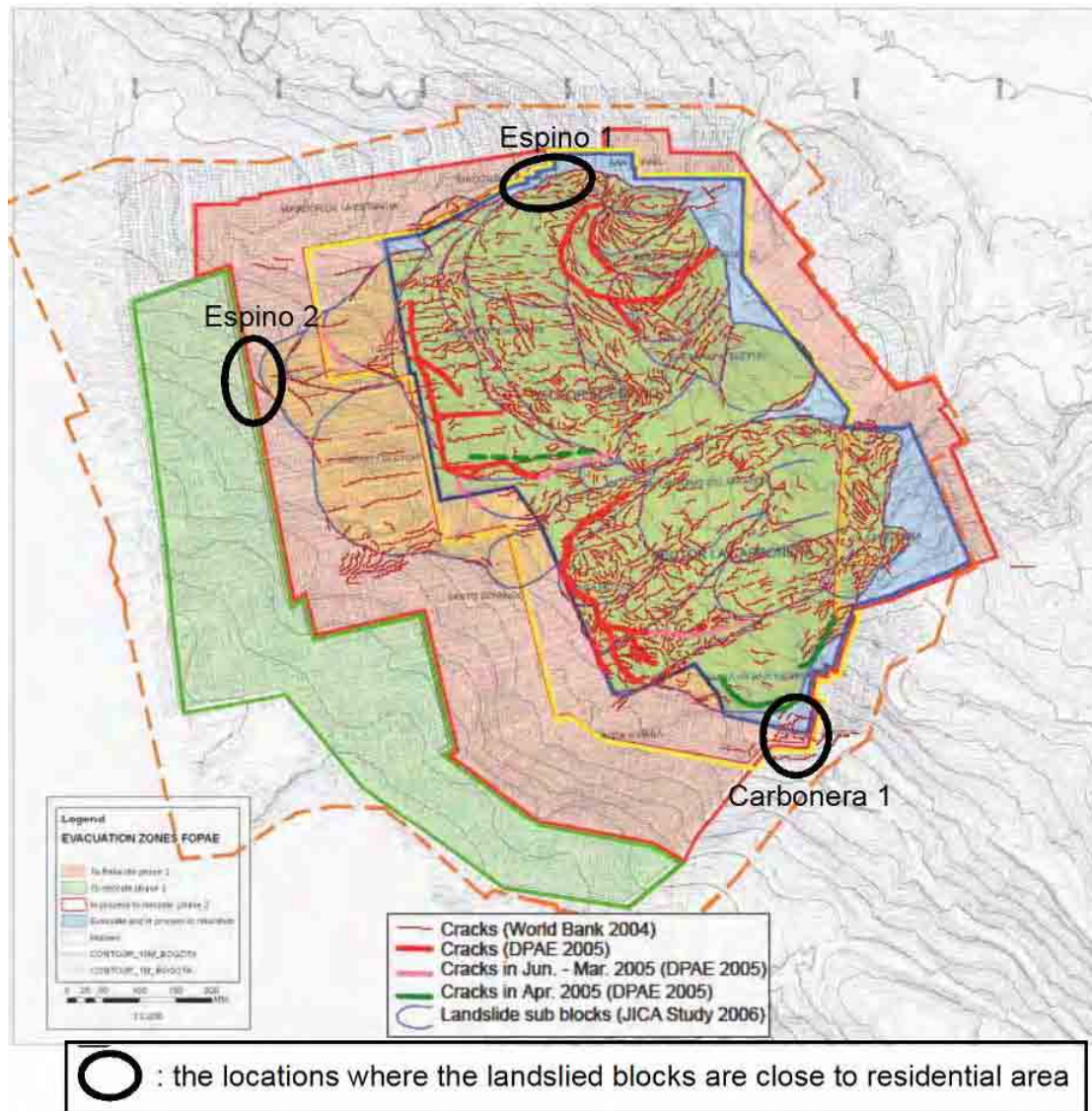


Figure S5-1-8 Locations for Site Survey

### Espino 1

According qualitative observation done in field, important deformations are not observed in the hillside or in constructions located there. However, some cracks were found in a house near the uplift which was made by compression at toe of landslide. Uplift which affected in previous years in San Rafael sector is apparently in equilibrium and according verbal communication with the president of Junta de Accion Comunal - Community Leader, collateral effects do not have been appeared such as block fall. To the middle and lower part of south side of uplifted area is observed a material saturation due to channeling of served waters from hillside's high part, this situation produce creep processes in both margins of the flow.

### Espino 2

Sector located to the high part of study zone, in which is not observed important deformations in the hillside or in construction located there. There is observed a deficient served water management, which are conducted and concentrated to the lower area forming very wet zones covered by grass. To the north-eastern side of the area is observed an instability phenomenon apparently local (toppling) observed to foundation and exterior walls of the houses, due to no technical construction applied and not to regional instability phenomena.

## Carbonera 1

In south side and high part of sector (La Carbonera) important deformations are not observed, not continuous creeks with vertical displacement which indicate retrogressive movement of instability phenomena. Over south side and to lower part of the hill will be observed some dispersal traction cracks, not continuous and in parallel to scarp direction, which indicate local landslides production due to outcropping lithology, to the diaclasa planes and to the semi-vertical slope and in some cases negative of the slope. Inside landslides mass in 2000 (approximately) and posterior re-conformed is observed deformation of lineal works (concrete's channels), continuous creeks appearing and not continuous, water outcrop, deformation or lost of verticality in present vegetation; which indicate apparently re-activation of instability phenomena.

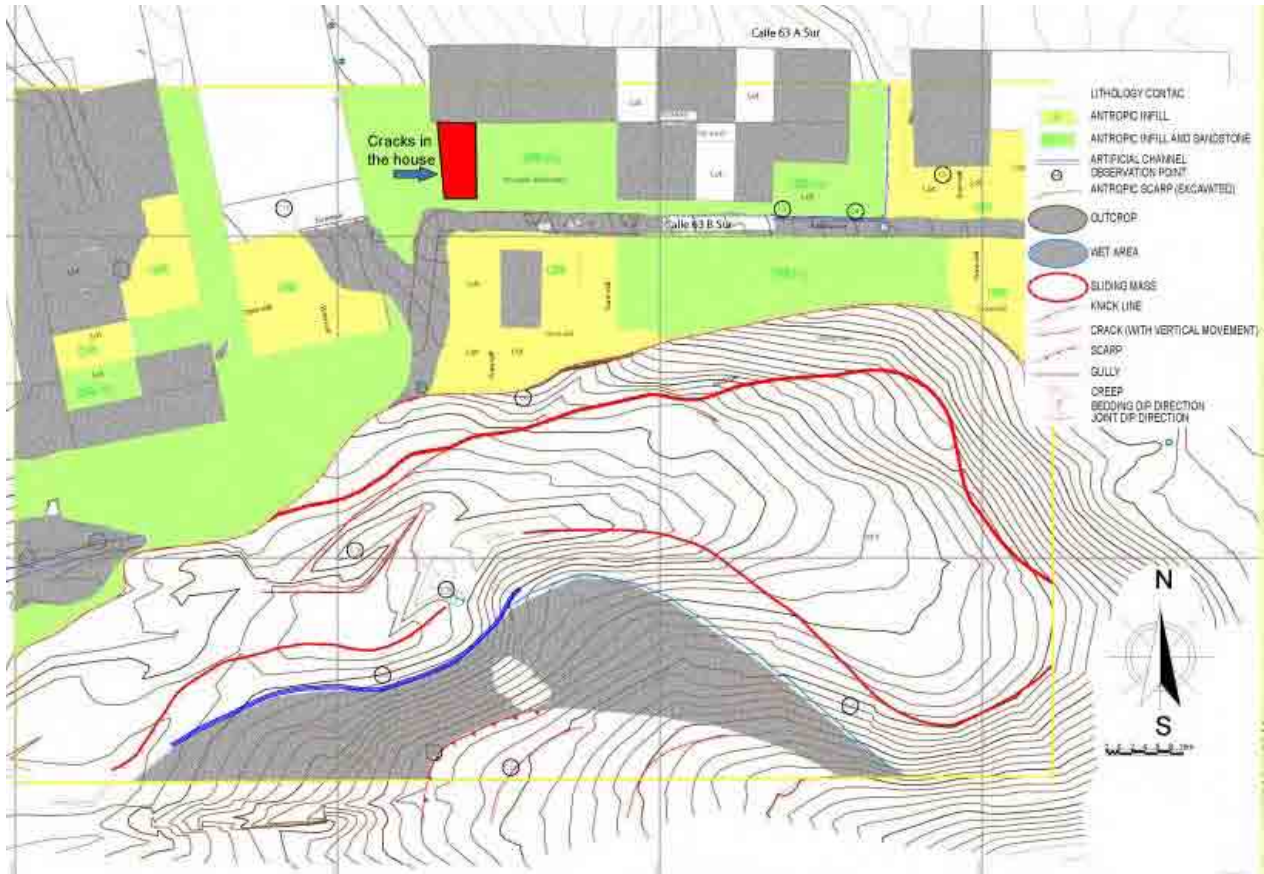


Figure S5-1-9 Geologic and Geomorphologic Features in Espino 1 Sector (the Landslide)

## Uplift at Espino 1

The uplift at Espino 1 probably rose by compression at toe of landslide as shown in Figure S5-1-10. The house which got cracks is close to the uplift, and the force of the landslide which lift the ground, could affect on the house. If the influence of the landslide on the house in the residential area is confirmed, the Landslide area (Phase I and II) should be reconsidered and be expanded.

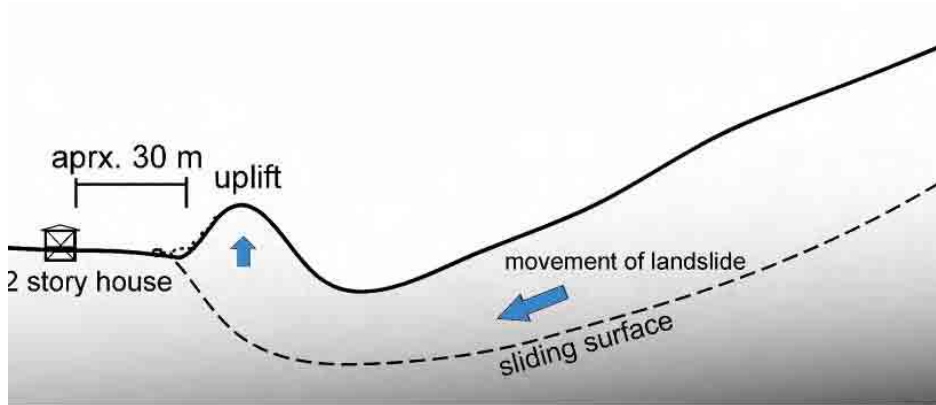


Figure S5-1-10 Supposed Mechanism of the Uplift

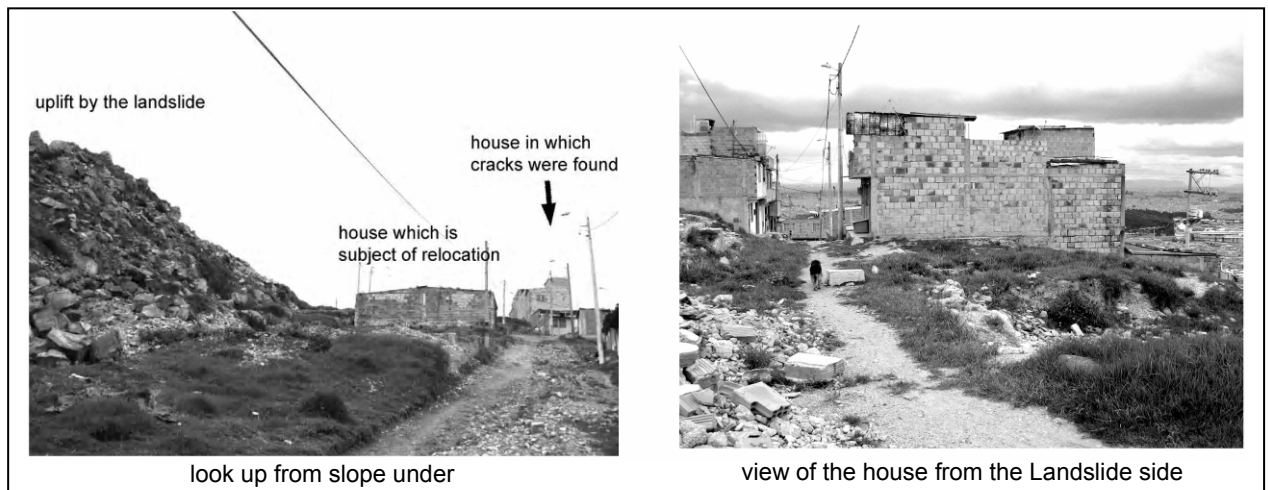


Photo S5-1-2 Photos of the House in Which Deformations were Found



Upper left; cracks on basement floor,  
 Upper right; gap between basement floor and wall,  
 Lower right; cracks on wall on ground floor

Photo S5-1-3 Deformations Found in the House

As remarkable thing in the survey, surface water which come from sewer flows into the Landslide area at all over the place. Water makes many channels and pools in the Landslide. It is easily understand that the water flow has a great influence on the Landslide. Figure S5-1-11 shows distribution of saturation in the Landslide. The figure also shows a lot of water overflows into the Landslide.



Photo S5-1-4 Water Flow into the Landslide



Photo S5-1-5 Water Pool in the Landslide



Figure S5-1-11 Saturation Zones (DPAE)

### 1.3.2 Interview Survey

Interview Survey was carried out on the residents who live near Phase II in Phase III in order to collect the information whether deformation on houses, cracks on the ground in the neighborhood, and condition in the heavy rain using the interview format as shown in Figure S5-1-12. Most of the residents interviewed reply there are any abnormality around their houses. There was a general feeling of unrest among the residents near the Landslide area. However, most of the abnormal residents mentioned could be over flow from the drains in heavy rain. The abnormal obviously by the Landslide activity was not recognized by the interview survey.

Overflow many residents in Phase III mentioned indicate the drainage system in Phase III is inadequate. In heavy rain, water overflow from the drainage and surroundings of residential houses are sodden. The drainage system is inadequate in Phase III where locate above the Landslide means water on upper slopes flows into the Landslide. This situation has a bad influence for stability of the Landslide



Photo S5-1-6 Poor Drainage in Phase III Area

**Estudio Sobre Monitoreo y Sistema de Alerta Temprana de Deslizamientos e Inundaciones**

**Encuestamiento En Altos de La Estancia**

Consecutivo

I. LOCALIZACION Y DATOS GENERALES DEL PREDIO	
Dirección: _____	
Barrio: _____	Manzana: _____ Lote: _____
Nombre del Encuestado: _____	Propietario: <input type="checkbox"/> Si <input type="checkbox"/> No
II. CANTIDAD DE HABITANTES PERMANENTES DE LA VIVIENDA	III. TIPOLOGIA ESTRUCTURAL
Entre 0 y 5 años de edad: _____	1 Construcción con predominio de materiales no convencionales en muros y techos (lámina de zinc, tela asfáltica, retales de madera etc)
Entre 6 y 10 años de edad: _____	2 Mampostería simple (Muros en ladrillo o bloque, sin columnas de concreto)
Entre 11 y 15 años de edad: _____	3 Mampostería confinada (Muros en ladrillo o bloque, con columnas de concreto pero sin vigas)
Entre 15 y 60 años de edad: _____	4 Estructura con presencia de vigas y columnas que se interconectan
Mayores de 60 años de edad: _____	5 Número de pisos _____
Total: _____	6 otra: Cuál? _____
IV. DESLIZAMIENTOS	
1. Presenta en su casa o en los alrededores lo siguiente? <i>(Localizar en el diagrama)</i> <input type="checkbox"/> Si <input type="checkbox"/> No	
Grieta _____	Deslizamiento _____
Inclinación _____	Filtración de agua _____ Caída de rocas/bloques _____
2. Presenta en su casa o en los alrededores lo siguiente? <i>(Localizar en el diagrama)</i> <input type="checkbox"/> Si <input type="checkbox"/> No	
Grieta _____	Deslizamiento _____
Inclinación _____	Filtración de agua _____ Caída de rocas/bloques _____
3. Presenta en su casa o en los alrededores problemas durante los aguaceros o lluvias fuertes? <input type="checkbox"/> Si <input type="checkbox"/> No	
<i>(Localizar en el diagrama)</i>	
Inundación _____	Lodos _____ Otros _____
4. Conoce usted algún deslizamiento reciente cercano a su casa? <i>(Localizar en el diagrama)</i> <input type="checkbox"/> Si <input type="checkbox"/> No	
¿Dónde? _____	¿Hace Cuánto? _____
5. Cual es su idea de vivir en zonas donde ocurren deslizamientos?	
Preocupado _____	No Preocupado _____ Otros _____
Un sistema que le avise "antes" a la gente de la ocurrencia de un deslizamiento es una "Alerta Temprana" y permite salvar vidas.	
6. Estaría usted de acuerdo con un sistema de alerta temprana que permita a los habitantes del sector sentirse más seguros?	
Si _____	No _____ Otros _____
Fecha: _____	Levantó: _____
Revisó y Aprobó: _____	



Figure S5-1-12 Format of Interview Survey



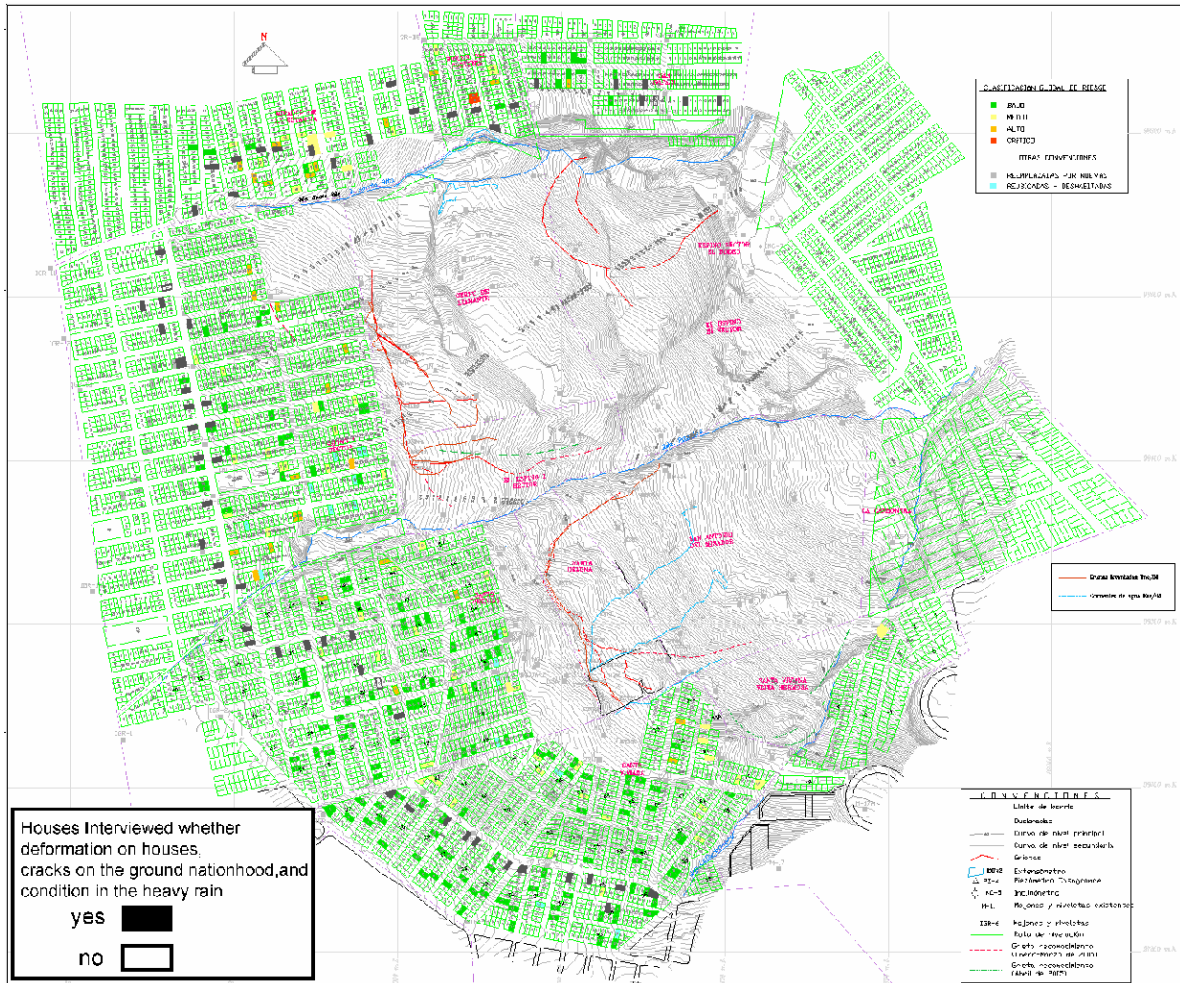


Figure S5-1-13 Results of Interview Survey

### 1.3.3 Conclusion of Study

In conclusion of the surveys, the results of the surveys are summarized as follows.

- a. Any abnormality could not be found in the residential areas (out of Phase I and II) which regarded as safety area and are out of relocation program.
- b. There is no danger of threatening residents' lives in the Landslide because relocation program is on going and nobody lives in danger area in the Landslide. Early warning system for the residents is not required.
- c. The Landslide has expanded upwards and would expand in prospect. There is no guarantee that the residential area will be safe in future, thus it is necessary to monitor whether the residential area is in safe.
- d. There is abnormally in the house near the uplift in Espino 1. If the abnormally in the house depends for the Landslide activity, the area of the Landslide should be reconsidered.
- e. The drainage system in Phase III is inadequate. For the stability of the Landslide, it is necessary to maintain the drainage system in Phase III to prevent the water flowing into the Landslide.

## 1.4 Hazard Map

DPAE did an area division in three zones named Phase I, Phase II and Phase III, based on available information and especially in the study of INGEOMINAS (2003), in order to relocate the population of all areas (Figure S5-1-1). Almost all of the inhabitants in Phase I actually have been relocated, and relocation of inhabitants in Phase II are in progress. The zone Phase III, which is counted as stable area and out of relocation plan, corresponds to the high slope part, includes part of the Santa Viviana, Santo Domingo and El Espino Sector 1 parts and the approximately area is 16.5 hectares. Due to the actual landslide movements, the water division from the slope would be reached to Phase III, for this reason the east and south zones of Phase III would be affected. In order to do vulnerability and risk evaluation for this zone, the area was increased to 27.9 hectares (Figure S5-1-14 and Figure S5-1-15).

DPAE developed a relocation program of families in immitigable high risk area. The program includes 5,591 families in Bogota, among them, 3,543 families in Ciudad Bolivar. The Landslide area corresponding to UPZ 69, the number of families included for the program is shown in Table S5-1-5 Relocation of families for phase I to II has been planned, and Phase III is planned if mitigation work will not be able to control the landslide movement.

Table S5-1-5 Number of families to be relocated in the study area

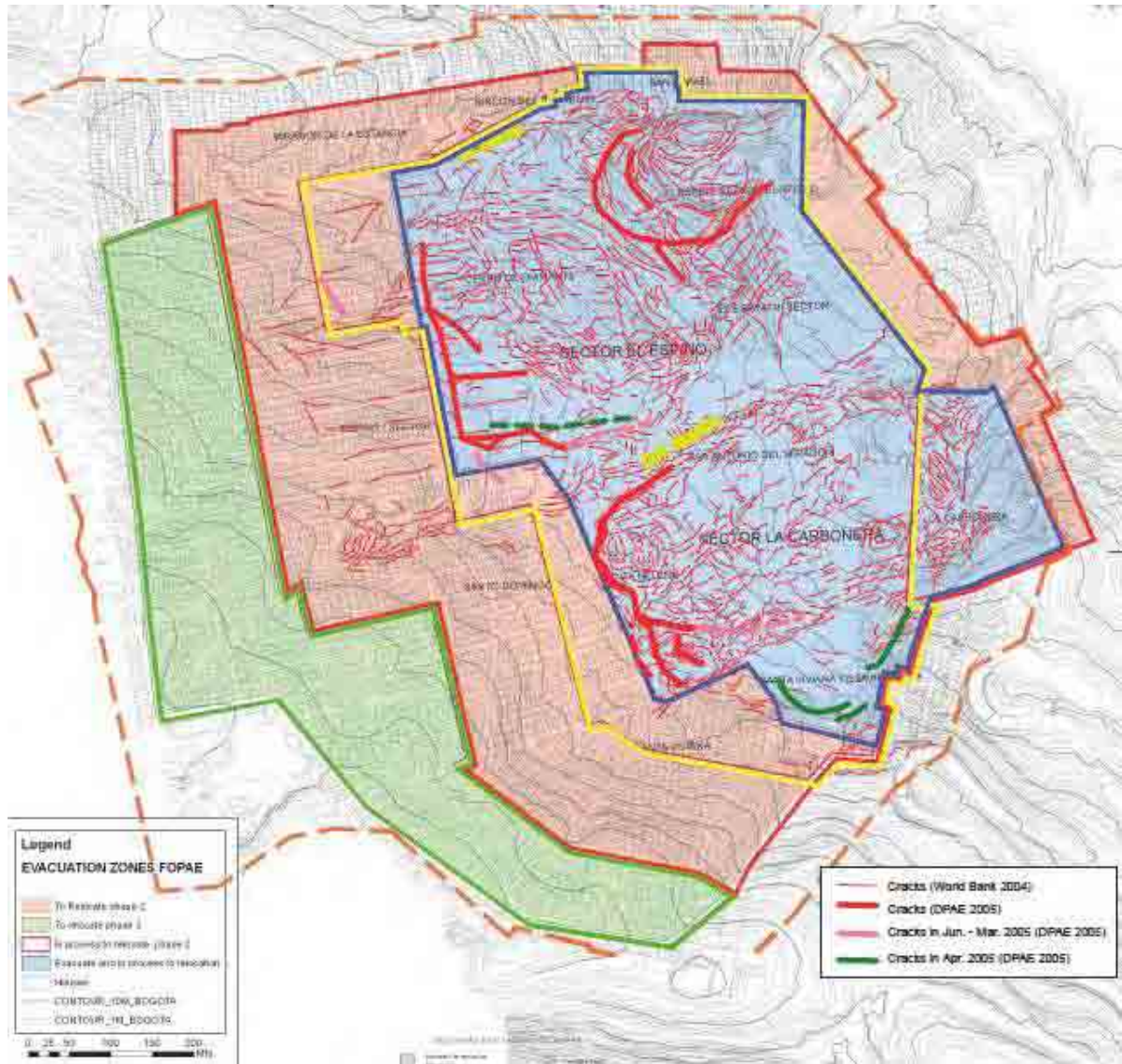
Sector	Barrio	Total included	Relocated	In process
El Espino	el cerro del diamante	368	30	338
El Espino	espino I sector	549	0	549
El Espino	espino III sector	325	4	321
El Espino	espino rodeo III sector	56	35	21
El Espino	espino sector rodeo	12	0	12
El Espino	san rafael	36	8	28
El Espino	san rafael altos de la estancia	48	0	48
El Espino	san rafael sector el rodeo	16	1	15
La Calbonera	la carbonera	12	0	12
La Calbonera	la carbonera II sector	36	14	22
La Calbonera	san antonio del mirador	169	163	6
La Calbonera	santa helena	127	122	5
La Calbonera	santa viviana	439	33	406
La Calbonera	santa viviana sec. vista hermosa	123	111	12
La Calbonera	santo domingo	444	0	444
	el rincón del porvenir	40	8	32
	Total	2800	529	2271

(Source; SIRE, [www.sire.gov.co](http://www.sire.gov.co))



(Source: Monitoring and following to the active landslide affecting the sector Altos de La Estancia, Bolivar City Locality, Bogota D.C., Ingenieria y Geoesgos 2004)

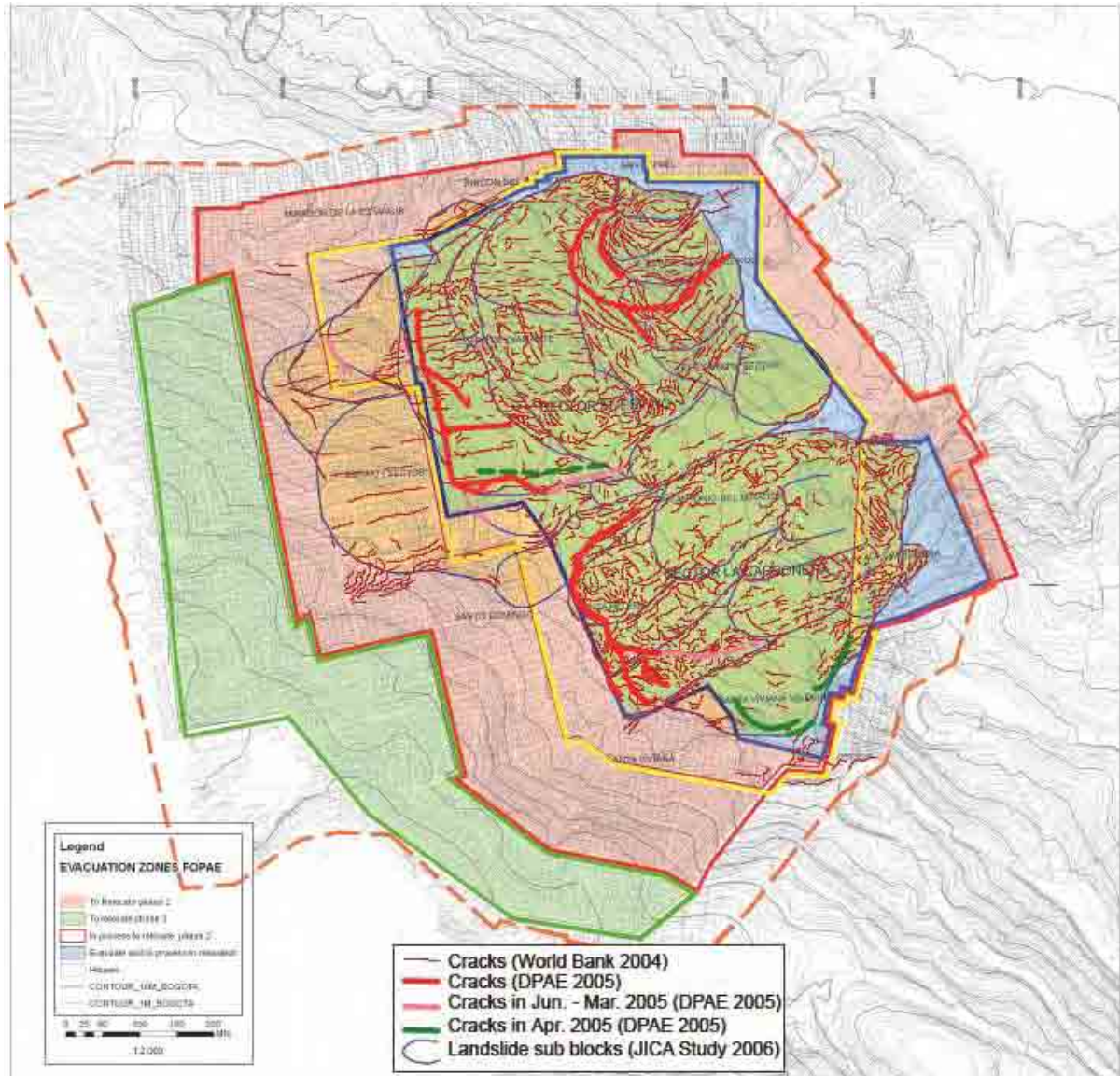
Figure S5-1-14 Zones of Alert classification



(Modified from *Monitoreo y seguimiento de los deslizamientos activos que afectan el sector Altos de la Estancia, localidad de Ciudad Bolívar, Bogotá D.C.* "INGENIERIA Y GEORIESGOS, 2004 by Yokoo this study)

Figure S5-1-15 Cracks observed in 2004 and 2005

The Landslide consists of some sub-blocks which form scarps on top normally. Based on distributions of cracks reported in the past studies and site survey, sub-blocks are identified and indicated in Figure S5-1-16. Most of the blocks are in the most critical area, Phase I, however, some blocks are close to Phase III or other residential area, at western and northern parts of El Espino, southern part of La Carbonera.



(Modified from *Monitoreo y seguimiento de los deslizamientos activos que afectan el sector Altos de la Estancia, localidad de Ciudad Bolívar, Bogotá D.C.* "INGENIERIA Y GEORIESGOS, 2004 by JICA Study Team in this study)

Figure S5-1-16 Landslide blocks based on cracks in and around the Landslide

## 1.5 Monitoring Plan

### 1.5.1 Outline of Monitoring Works

DPAE developed a relocation program of families in immitigable high risk area, and have relocated most of inhabitants of Phase I and Phase II. Also, there is not important infrastructure such as highway, railway or gas pipe in the landslide area. This means the risk area of the Landslide is empty. The average velocity of the movement at most active points in the Landslide is less than 20 mm / month in 2005. It indicates that there is fairly enough time for evacuation before occurrence of new block movement even outside of the active landslide area. The sign of landslides can easily be found in the densely populated area such as in Phase III. The early warning systems using the automatic monitoring systems are not required in the Landslide in terms of saving human loss in the area. The most recommendable thing is to observe the ground conditions by the engineers with regular patrol or by the communities in their ordinary lives. The observation of the Landslide and its adjacent areas should

be periodically conducted visually observation works to the conditions of the ground and, if necessary, to measure the site to determine whether or not any distortion of the ground has taken place. Periodic inspection of landslide prevention facilities, if there are, must be conducted to detect any abnormality of the facilities as soon as possible. If cracks and other ground abnormalities on the face of a slope or abnormalities of landslide prevention facilities are found, observation of the changing conditions of such abnormalities should be started, followed by a survey with a view to preparing emergency mitigation or stabilization works if necessary. This observation survey is performed to examine the extent, direction of movement, and the mechanism of landslides in detail when any sign of landslide motion such as slide scarps or cracks are found or when there is any possibility of the occurrence of landslides in the future.

The instrumentation and monitoring could be applicable to following conditions in this Landslide.

- a. Safety of the residential area
- b. Monitoring on specific cracks and deformation on structures and the ground when they are found
- c. Safety of construction works
- d. Verification of effectiveness of stabilization works

Figure S5-1-17 is example of time schedule of relocation program, stabilization works and monitoring works.

*Safety of the residential area*; it is for confirming the Landslide activity is not approach to the residential areas. This monitoring should be continues as far as the people are living there along the rim of the Landslide.

*Monitoring on specific cracks and deformation on structures and the ground*; it is the monitoring works on cracks or deformations on the ground or structures when they are found. This monitoring should be applied every time when cracks or deformation are found on the ground and structure.

*Safety of construction works*; it is the monitoring works to prevent accidents under construction. This accident could occur on both workers and residents surroundings. This monitoring should be applied on every construction works as long as the works continues.

*Verification of effectiveness of stabilization works*; it is necessary to confirm the effect of stabilization woks after construction works are complete.

Generally stabilization works can be classified into two categories as reduction of driving forces and increase in resisting forces. The reduction of driving forces is such as surface and subsurface drainage and reduction of weight of landslide mass. The increase in resisting forces is such as walls piles and anchors. For a large scale landslide such as Estancia landslide, the reduction of driving forces should be applied first and confirm the effectiveness of the reduction of driving forces by monitoring. Above monitoring works should be applied based on the progress of stabilization works of reduction of driving forces and increase in resisting forces as shown in Figure S5-1-17.

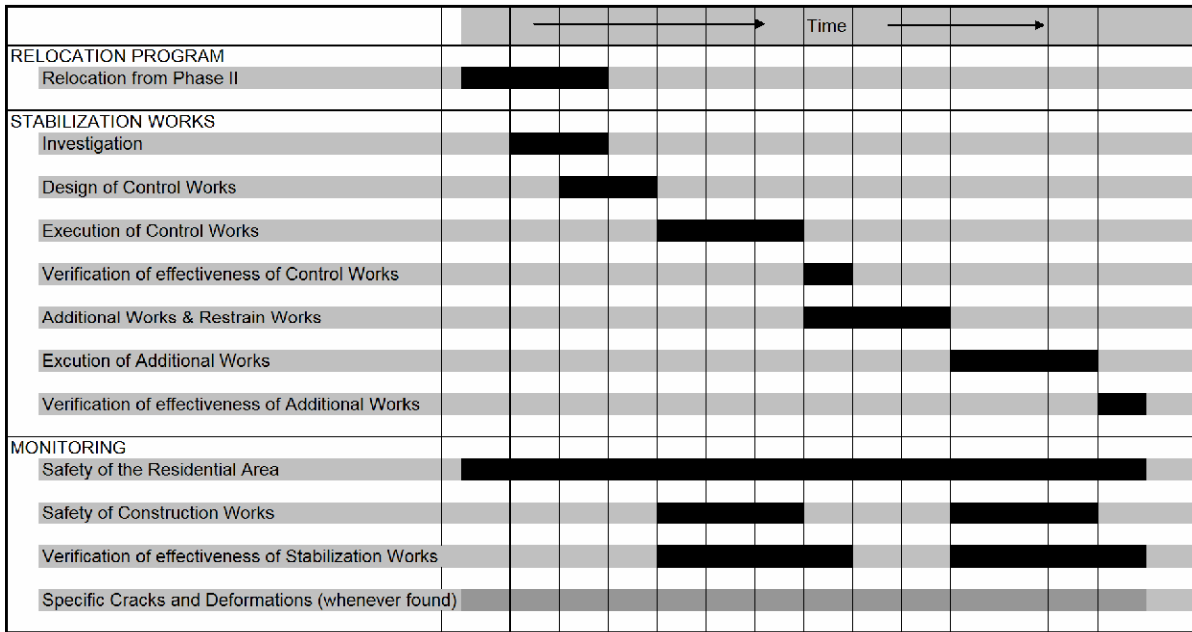


Figure S5-1-17 Example of Time Schedule of Measures against the Landslide and Monitoring (this schedule is supposition)

### 1.5.2 Monitoring for Safety of the Residential Area

The residential areas where were guaranteed as safe with the authoritative assurance based upon the past study should be monitored to aware the changing of the condition of the areas as far as the people are living there to confirm the stability of the slope and especially during the stabilization works in progress. To prognosticate the imminent landslide danger in the residential areas surroundings as early as possible, in order to take administrative measures to meet it, first of all, the most important thing is the observation survey which is carried by engineers periodically to find abnormality on the ground or houses in the residential areas where are close to the Landslide and to observe the condition of the Landslide. Second is to collect information from the residential people who are sensitive to the change of surroundings. To collect information from them, the followings are recommendable;

- to exchange information with community leaders
- to held meeting with community people periodically
- to visit and interview the residential people in the area

The point of interview is asking any abnormality around the house. To avoid the confusion of landslide activity with overflow, question should be more plainly, such as cracks on the ground or the house, tilting of the house and so on. If any abnormalities are reported, the engineers should visit the place and ascertain the situation.

When the instruments for monitoring are planed, the problem of theft and destruction should be considered in the area. For a large scale landslide, survey points monitoring is recommendable as simple and easy monitoring. Survey points should be installed along the boundary between the Landslide area and the residential area. If the movement is found on a point, it is presumed that the Landslide approaches the residential area, engineers should carry out observation survey around the point, and frequency of the monitoring should be raised. Tiltmeter and GPS can be used for the monitoring of the ground movement. Monitoring the ground movement there by these instruments along the Landslide and the residential areas as shown in Figure S5-1-18, it can be judged whether the Landslide approaches. Tiltmeter and GPS should be installed in secure places such as private sections and premises.

Extensometer is useful at the toe of landslide to monitor expansion of landslides. Generally, extensometer requires wire to monitor the distance, therefore it is not recommendable for this area.

Laser distance meter is recommendable for the area since it is not require any wire between the residential houses and the Landslide

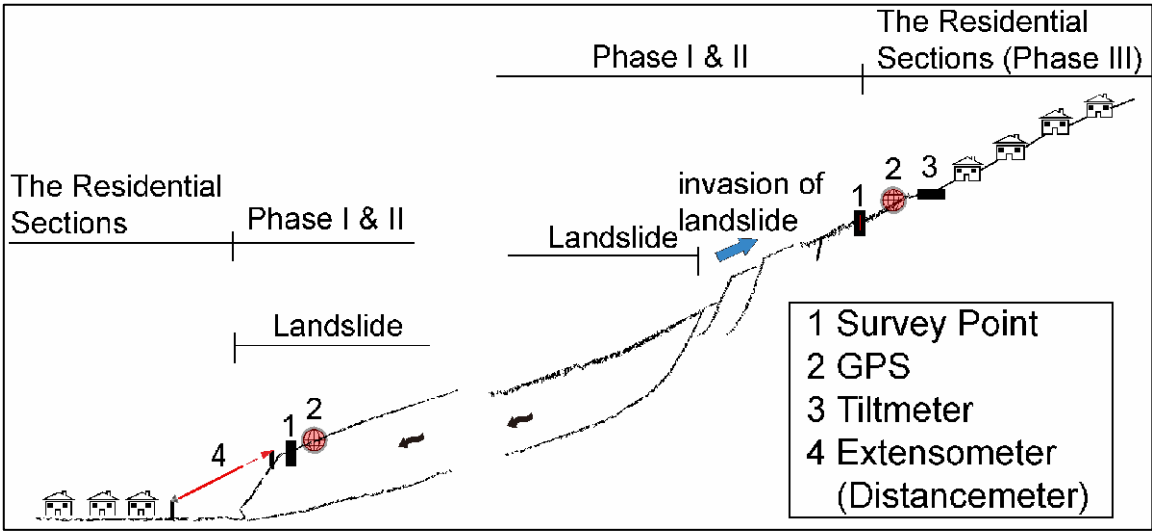


Figure S5-1-18 Example of Instrumentation along the Landslide and the Residential Area

At the area where the Landslide approaches, intensively monitoring could be carried out. Figure S5-1-19 shows four places where the landslide blocks closes to the residential area by growth of the Landslide. The place “A” may be closer to the imminent landslide danger since the landslide has grown upward. At the places “B” and “C”, the locations should be watched since cracks can be seen outside of the landslide mass. The place “D” could be in danger in future since the location is at the toe of the landslide and it is at the direction of the landslide movement. The locations A, B, C and D may have priority of monitoring over other areas, even there is no clear evidence of the critical situation at the moment.



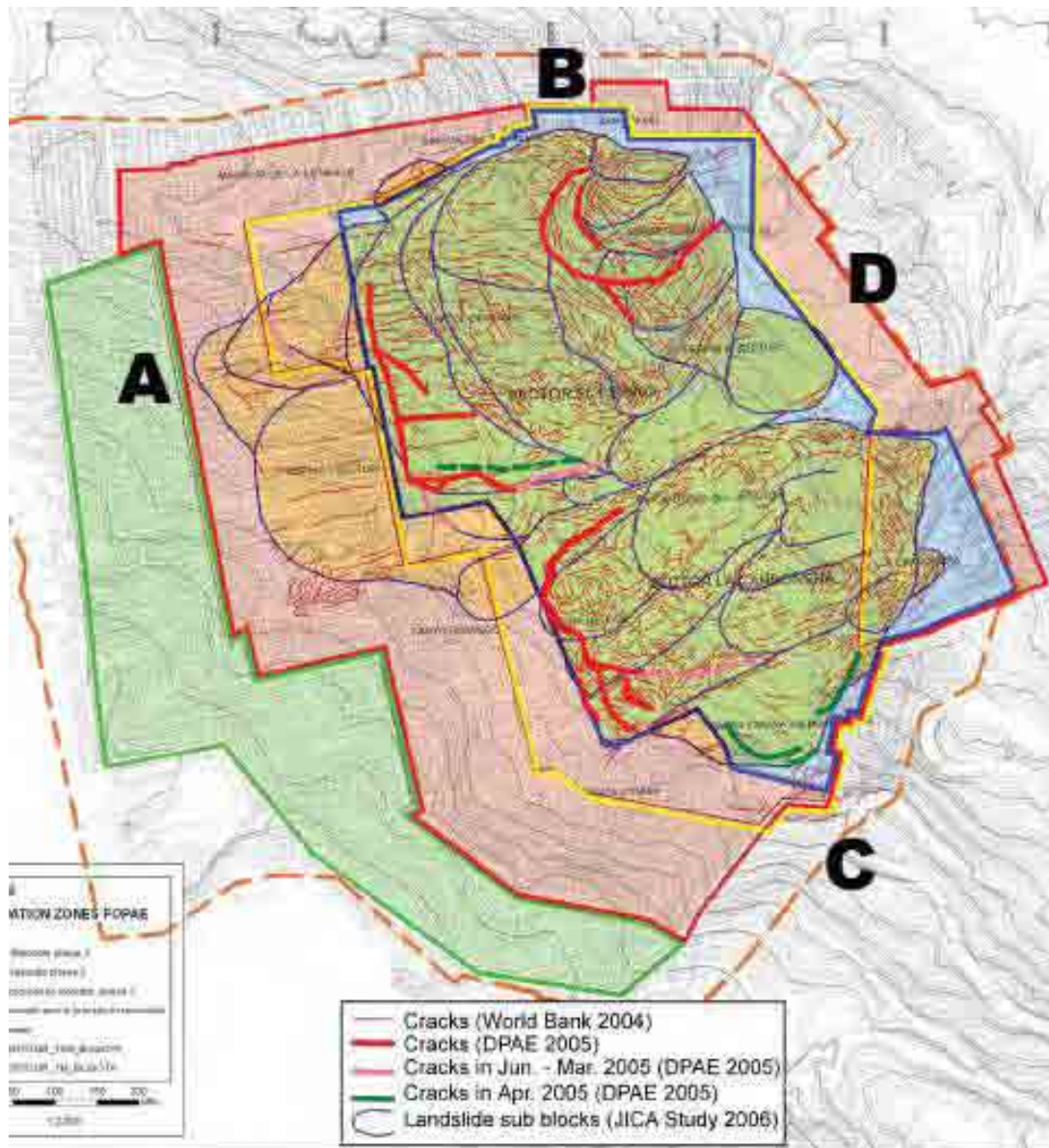


Figure S5-1-19 Four Places Where the Landslide Blocks Closes to the Residential Area

### 1.5.3 Monitoring for Specific Cracks and Deformation on Structures and the Ground

When new cracks or deformation on the ground or structures is found, it should be monitored with simple and easy way. When a crack is found on the ground, the crack should be monitored by simple crack gauge. If the crack brings big difference in level between the both sides, extensometer is useful. It can be ascertained whether the crack is still opening or ceasing by the monitoring.

The followings are explanation of Simple ground crack gauge and extensometers.

#### Simple Ground Crack Gauge

One of the simplest methods to determine landslide movement is a simple ground crack gauge. Installation of the crack gauge is to drive stakes across a tension crack along the direction of slide movement. Then attach horizontal board to the stakes, and saw through the board. Any movement across the tension crack can be determined by measuring the space between the sawed portions of the board.

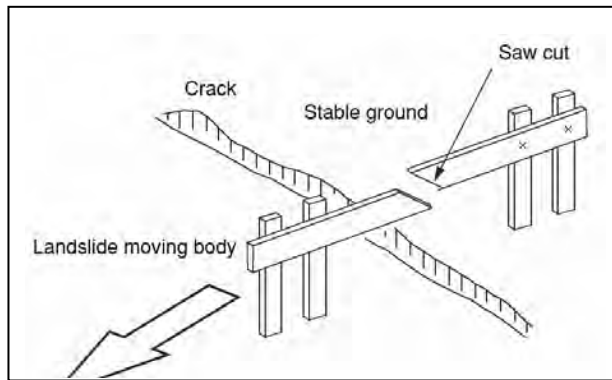


Figure S5-1-20 Simple Ground Crack Gauge

Extensometer

The extensometer is used to measure relative movement by comparing the extension of two points. the extensometers are generally installed across the main scarp, at transverse cracks and transverse ridges near the toe or front portion of the slide and parallel to the suspected slide direction. Measurements should be accurate to within 0.2 mm to 1.0 mm and the magnitude of the movement and daily rainfall data should be recorded to establish the relation ship between the measurable movement and the precipitation rate.

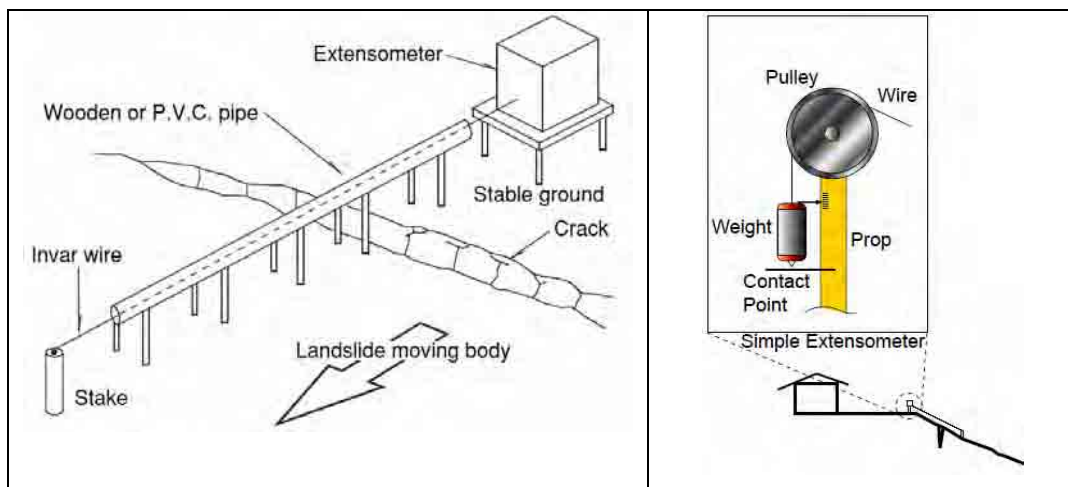


Figure S5-1-21 Extensometers

Simple Crack Gauge and Tiltmeter on Structures

When new deformation was found in a house, the house should be monitored. The crack in a house can be monitored simply by marker pen and ruler or by simple gauge as shown in Figure S5-1-22. For the monitoring on a deformed house, tiltmeter is also useful.

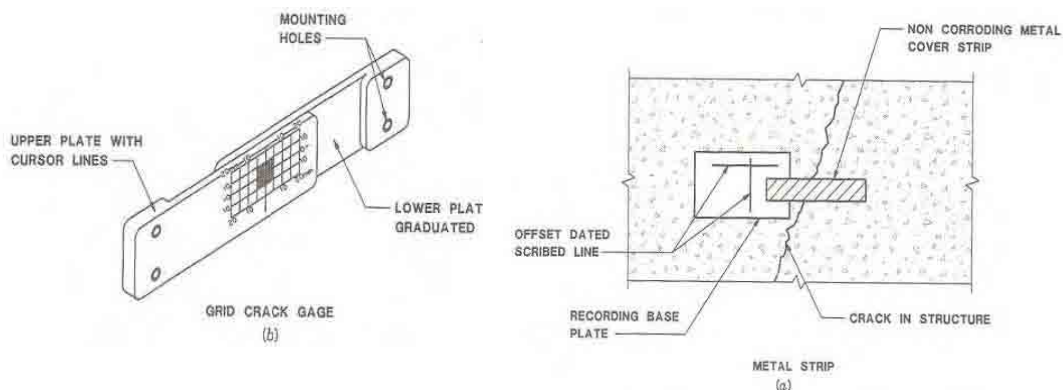


Figure S5-1-22 Simple Crack Gauge (for monitoring on structures)

### Alert

The establishment of an alert system in the study area was proposed in 2005 by DPAE as shown in Table S5-1-6. As the basic concept of the automatic monitoring on a landslide, however, the detection of differential movement - for example, the increasing of velocity of movement or inclination of the ground, or new movement occurs in the stable place -, can activate the alert.

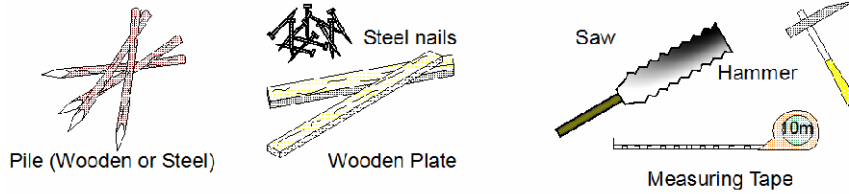
Table S5-1-6 Proposed Index of Alert

Item	Unit	Factor of Weighting	Category of Alert			
			Low	Medium	High	Critical
Altimetry	mm/day	0.25	< 1.6	1.6 – 3.3	3.3 – 5.0	> 5.0
Inclinometer	mm/month	0.15	< 2.0	2.0 – 5.0	5.0 – 10	> 10
Structural control	-	0.3	0.25 CGR (< 1.5)	0.5 CGR (1.5 – 2.0)	0.75 CGR (2.0 – 2.4)	1.0 CGR (> 2.4)
Location of house with movement	-	0.3	0.25 (> 50m)	0.5 (50 – 30m)	0.75 (30 – 10m)	1.0 (10 - 0m)
<b>Index of alert</b>		<b>1.0</b>	<b>&lt; 1</b>	<b>1 – 2.3</b>	<b>2.3 – 4.1</b>	<b>&gt; 4.1</b>

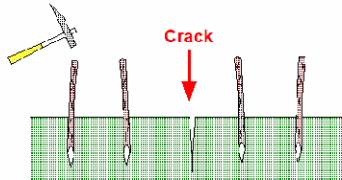
(Source: Monitoreo y seguimiento a los deslizamientos activos que afectan el sector Altos de La Estancia de la localidad de Ciudad Bogota, 2005)

## INSTALLATION OF CRACK GAUGE (NUKI-ITA)

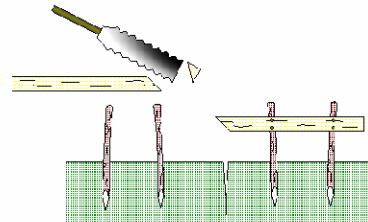
### 1 Material



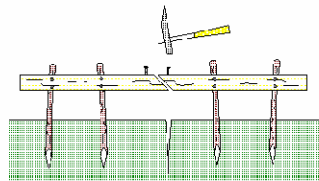
### 2 Procedure



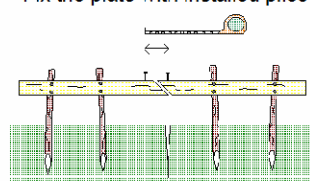
1. Install piles both side of crack



2. Cut one end of plate at a slant, and fix the plate with installed piles



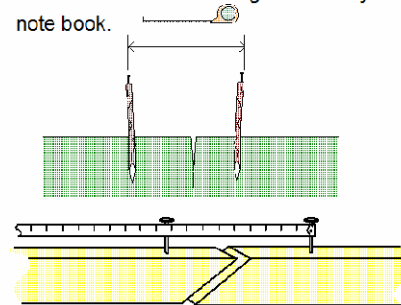
3. Drive a nail on one side of each plate



4. Measure distance of nails as soon as installation of Nuki-Ita. Basically, the distance of nails is measured everyday, and the result shall be registered on your note book.

#### In case of scanty materials

If all materials are difficult to get, pile shall be installed on both side of crack, and drive a nail on the top of both piles. The distance of nails shall be measured after installation same as a Nuki-Ita.



### 3 MEASUREMENT

Measurement of Nuki-Ita is used a measuring tape.

Measurement point is out side of nail on Nuki-Ita as figure N-1. The measurement data shall be recorded with measuring date and weather conditions.

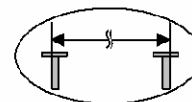


Figure N-1 Measuring Method

<Frequency of Measurement>

Basically, measurement of Nuki-Ita shall be carried out everyday.

Frequency shall be changed according to the result of measurement.

Figure S5-1-23 Installation of Crack Gauge

### 1.5.4 Monitoring for Verification of Effectiveness of Stabilization Works

The instruments correspondent with the stabilization works for the verification of effectiveness of the works should be selected. DPAE is planning of stabilization works in the Landslide, however the details are not confirmed yet at the moment.

Stabilization works are classified into two major categories, works for reduction of driving forces and works for increase in resistance force. In a large scale landslide like the Landslide, generally, method for reduction of driving forces is given to priority, since cost effectiveness for a large scale landslide is normally better than method for increase in resistance force. The only natural character of a slope that can be changed economically, and on a scale large enough to improve slope stability, is groundwater, because it can be drained by gravity. The alternatives to drainage are expensive regarding of a slope to reduce the gravity induced shear stresses with it, or equally expensive support measures to increase the resistance of the slope to these stresses. Hence the drainage of groundwater is a common component of slope design. The first thing we have to do as measure for the Landslide is to reduce the groundwater level, and prevent water penetration into the ground especially from sewer and rainwater.

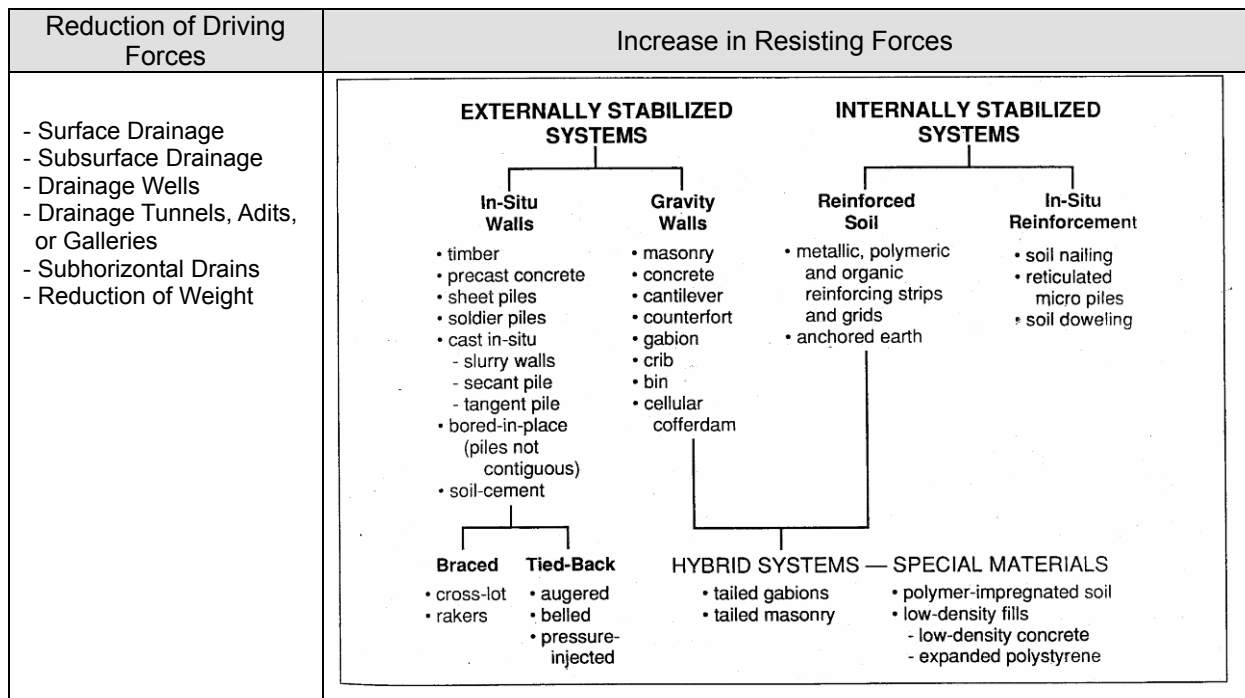


Figure S5-1-24 Stabilization Works (Turner 1996, Landslide)

#### Common Monitoring to All

Ground surface monitoring and ground movement monitoring should necessary to confirm the effectiveness of any of the stabilization works which are to stop or mitigate the landslide activities. The monitoring should be continued from before to after the stabilization works. Also it is necessary to continue to the future after construction works completer to watch reactivation of the landslide.

#### Monitoring for Water Control Works

To confirm the effectiveness of the water control works, naturally, the ground water monitoring is necessary by water standpipes and piezometers. Rain gauge monitoring in or around the Landslide is recommendable.

### Monitoring for Works for Increase in Resistance Force, Piling

Individual piles or contiguous piles are common as increase in resistance force. Monitoring of deformation of piles is recommendable if pile works are employed as stabilization works. Ground inclinometer close to the pile in behind can measure the movement of the pile. Strain gage pasted on a steel pile or on reinforcement bars of a bored pile can monitor the movement of the pile. The depth of ground inclinometer should be deeper than the pile. If the monitoring shows great movement of the pile, the pile might be at risk against the Landslide force.

### Monitoring for Works for Increase in Resistance Force, Anchoring

Anchors are also common as increase in resistance force. Anchor can be controlled by the monitoring of tension force using load cell at the anchor head.

### **1.5.5 Monitoring for Safety of Construction Works**

Most of the construction works of stabilization accompany digging and watering, therefore the construction works could trigger activation of the landslide. The frequency of monitoring should be raised under construction period.

Small landslide near the construction site has the possibility of endangering the workers on the construction site. To protect the construction workers and the site, the construction site should be always observed by engineers or workers. If a crack is found, the crack should be monitored by a simple crack gauge or an extensometer. In case the crack is opening, the construction works should be stopped and watch the area carefully.