6-3　Geological Data(Boring)

BLOODSTONE ENGINEERING and GEOTECHNICS

[ENGINEERING CONSULTANCY SERVICES / CONSTRUCTION / SOILS & MATERIALS TESTING]
[FOUNDATION ENGINEERING/ GEOTECHNICAL INVESTIGATIONS & EVALUATION]

FINAL BOREHOLE LOG

CLIENT: CTI Engineering International Co., Ltd.	PROJECT NAME: Rehabilitation of Flood Control Operation & Warning System in M.M.	DATE STARTED: 9/18/99	BOREHOLE NO. BH-1
MACHINE: TONE TASH	LOCATION: NCR (DPWH)	DATE FINISHED: 9/21/99	PAGE: 1 OF: 2
Hammer Wt: 64 kg (140 lbs) Height of Fall: 76 cm (30 inches)	Ground Elevation: 19.129m (MLLW)	Coordinates:	LOGGED BY; R.P.A.

Depth(m)	Sample Type	Sample No.	Drill Run(cm)	Recovery(cm)	RQD (%)	S.P.T. N Values	Graphic Log	SOIL and ROCK DESCRIPTION	REMARKS
0									Top of Borehole at EL.19.129m
1	WB	SS-1	45	25		58		Very dense, grayish brown, clayey SAND with pea-sized gravel.(SC)	Fill
2	WB	SS-2	45	15		50		Medium dense, gray, medium to coarse SAND, some medium to coarse gravel, trace of silt and fragments of broken shells.(SM)	GWL @ 1.60 m.
3	WB	SS-3	45	34		17			2.25m
4	WB	SS-4	45	25		16		Medium dense, gray, fine to medium SAND and trace of shell fragments.(SM)	
5	WB	SS-5	45	40		14			4.5m
6	WB	SS-6	45	45		12		Medium dense, gray, fine SAND, trace of shell fragments.(SM)	
7	WB	SS-7	45	25		3		Medium stiff to soft, gray, clayey SILT, with fine sand, and about 45% of broken marine shells, high plasticity. (MH)	
8	WB	SS-8	45	25		1		-DO-, but very soft.	
		UDS-1	50	50		Pressed			
9		SS-9	45	15		4		-DO-, but soft.	
10	WB	SS-10	45	12		5		-DO-, but medium stiff.	
11	WB	SS-11	45	12		4			10.5m
12	WB	SS-12	45	8		3		Very loose, dark gray, silty fine Sand. with non-plastic fines. (SM)	
13	WB	SS-13	45	20		8		Loose, gray, clayey, silty SAND, and with medium plasticity fines.(SC)	

LEGEND:
- SS - SPLIT SPOON SAMPLE
- ST - SHELBY TUBE SAMPLE
- CS - CORE SAMPLE

▽-Water Level
DB - DRIVE BLOCK
WB- WASH BORING
NR - NO RECOVERY

Final Logged By: Cris C. Farum
Soils/Materials Engineer

Checked By: Reynaldo P. Abne
Geotechnical Engineer

BLOODSTONE ENGINEERING and GEOTECHNICS

[ENGINEERING CONSULTANCY SERVICES / CONSTRUCTION / SOILS & MATERIALS TESTING]
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FINAL BOREHOLE LOG

CLIENT: CTI Engineering International Co., Ltd.	PROJECT NAME: Rehabilitation of Flood Control Operation & Warning System in M.M.	DATE STARTED: 9/18/99	BOREHOLE NO. BH-1
MACHINE: TONE TASH	LOCATION: NCR (DPWH)	DATE FINISHED: 9/21/99	PAGE: 2 OF: 2
Hammer Wt: 64 kg (140 lbs) Height of Fall: 76 cm (30 inches)	Ground Elevation:	Coordinates:	LOGGED BY: R.P.A.

Depth(m)	SAMPLE TYPE	SAMPLE NO.	Drill Run(cm)	Recovery(cm	RQD (%)	S.P.T. N VALUES	Graphic Log	SOIL and ROCK DESCRIPTION	REMARKS
14	WB	SS-14	45	20		8		Loose to very loose, gray, clayey, silty SAND with medium plasticity fines. (SC)	
15	WB	SS-15	45	45		3			
16	WB	SS-16	45	15		4			
17	WB	SS-17	45	15		4		Very loose, brown, clayey SAND, with gravel, and low plasticity fines. (SC)	
18	WB	SS-18	45	30		24		Medium dense, greyish brown, sandy, clayey SILT, high plasticity.(MH)	
19	WB	SS-19	45	45		24			
20	WB	SS-20	45	20		29		-DO-	
21	WB	SS-21	20	15		>50		Very dense, gray, clayey, sandy SILT, high plasticity.(MH)	20.20m
22	WB	SS-22	10	10		>50			
23		SS-23	10	10		>50		-DO-	
24	WB	SS-24	15	10		>50		-DO-	
25	WB	SS-25	15	15		>50		-DO-	
26								Final Depth of Borehole = 25 meters	
27									

LEGEND:

- SPLIT SPOON SAMPLE
- SHELBY TUBE SAMPLE
- CORE SAMPLE

▽-Water Level

DB - DRIVE BLOCK
WB- WASH BORING
NR - NO RECOVERY

Final Logged By: Cris C. Farum
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Checked By: Reynaldo P. Abne
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BLOODSTONE ENGINEERING and GEOTECHNICS

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FINAL BOREHOLE LOG

CLIENT: CTI Engineering International Co., Ltd.	PROJECT NAME: Rehabilitation of Flood Control Operation & Warning System in M.M.	DATE STARTED: 9/22/99	BOREHOLE NO. BH-2
MACHINE: TONE TASH	LOCATION: Nangka, Concepcion	DATE FINISHED: 9/23/99	PAGE: 1 OF: 2
Hammer Wt: 64 kg (140 lbs) Height of Fall: 76 cm (30 inches)	Ground Elevation: EL. 12.568 m	Coordinates:	LOGGED BY: R.P.A.

Depth(m)	Sample Type	Sample No.	Drill Run(cm)	Recovery(cm)	RQD (%)	S.P.T. N Values	Graphic Log	SOIL and ROCK DESCRIPTION	REMARKS
0									Top of Borehole at EL. 12.568 m.
1	WB	SS-1	45	25		3		Soft, brown, clayey SILT with fine sand, low plasticity. (ML)	
2	WB	SS-2	45	15		5		Medium stiff, brown, clayey SILT with fine sand, medium plasticity. (MH)	
3	WB	SS-3	45	34		5		Medium stiff, brown, clayey SILT, with fine sand and fine gravel, medium plasticity. (MH)	2.25m
4	WB	SS-4	45	25		5			4.20m G.W.T. is about 4.55 m. below top of borehole.
5	WB	SS-5	45	40		8		Loose, greyish brown, clayey SAND, with fine to coarse gravel, and medium plasticity fines. (SC)	
6	WB	SS-6	45	45		6			
7	WB	SS-7	45	25		13		Stiff, gray, Fat CLAY, high plasticity. (CH)	
8	WB	SS-8	45	25		16			
9		SS-9	45	15		14		Stiff, gray, clayey SILT, with fine sand, medium plasticity. (MH)	
10	WB	SS-10	45	12		16			
11	WB	SS-11	45	12		22		Very stiff, brown, clayey SILT, with fine sand, medium plasticity. (MH)	
12	WB	SS-12	45	8		23			
13	WB	SS-13	45	20		16		Stiff, brown, silty CLAY, high plasticity. (CH)	

LEGEND:
- SPLIT SPOON SAMPLE
- SHELBY TUBE SAMPLE
- CORE SAMPLE

▽-Water Level
DB - DRIVE BLOCK
WB- WASH BORING
NR - NO RECOVERY

Final Logged By: Cris C. Farum
Soils/Materials Engineer

Checked By: Reynaldo P. Abne
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BLOODSTONE ENGINEERING and GEOTECHNICS

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FINAL BOREHOLE LOG

CLIENT: CTI Engineering International Co., Ltd.	PROJECT NAME: Rehabilitation of Flood Control Operation & Warning System in M.M.	DATE STARTED: 9/22/98	BOREHOLE NO. BH-2
MACHINE: TONE TASH	LOCATION: Nangka, Concepcion	DATE FINISHED: 9/23/99	PAGE:2 OF: 2
Hammer Wt: 64 kg (140 lbs) Height of Fall: 76 cm (30 inches)	Ground Elevation: EL. 12.568 m	Coordinates:	LOGGED BY; R.P.A.

DRILLING RECORDS						S.P.T. N VALUES	Graphic Log	SOIL and ROCK DESCRIPTION	REMARKS
Depth(m)	SAMPLE TYPE	SAMPLE NO.	Drill Run(cm)	Recovery(cm)	RQD (%)	20 40			
14	WB	SS-14	46	46		15		Stiff, brown, silty CLAY, high plasticity. (CH)	
15	WB	SS-15	26	10		>60			C.F. at 14.70m.
16		CS-1	76	0		Coring		Very dense, GRAVEL, (6-pcs angular stone, max. size of 50 mm.)	
17								Final Depth of Borehole = 15.56 meters	
18									
19									
20									

LEGEND:

- SPLIT SPOON SAMPLE
- SHELBY TUBE SAMPLE
- CORE SAMPLE

▽-Water Level

DB - DRIVE BLOCK
WB- WASH BORING
NR - NO RECOVERY

Final Logged By: Cris C. Farum
Soils/Materials Engineer

Checked By: Reynaldo P. Abne
Geotechnical Engineer

BLOODSTONE ENGINEERING and GEOTECHNICS

[ENGINEERING CONSULTANCY SERVICES / CONSTRUCTION / SOILS & MATERIALS TESTING]
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FINAL BOREHOLE LOG

CLIENT: CTI Engineering International Co., Ltd.	PROJECT NAME: Rehabilitation of Flood Control Operation & Warning System in M.M.	DATE STARTED: 9/25/99	BOREHOLE NO. BH-3
MACHINE: TONE TASH	LOCATION: San Juan Metro Manila	DATE FINISHED: 9/25/99	PAGE: 1 OF1
Hammer Wt: 64 kg (140 lbs) Height of Fall: 76 cm (30 inches)	Ground Elevation: EL. 13.36m.	Coordinates:	LOGGED BY; R.P.A.

Depth(m)	Sample Type	Sample No.	Drill Run(cm)	Recovery(cm)	RQD (%)	S.P.T. N Values (20 / 40)	Graphic Log	SOIL and ROCK DESCRIPTION	REMARKS
0									Top of Borehole at EL.13.36m
1	WB	SS-1	45	NR		4		Organic Materials: consisting of decomposed garbage, wastes plastic, rusted cans, etc.	
2	WB	SS-2	45	40		3		Very loose to loose, greyish brown, clayey SAND with fine gravel and plastic fines. (SC)	
3	WB	SS-3	45	45		6			2.85m (C.F.) GWT is about 2.84m below top of borehole.
4		SS-4	45	13		>50		Very dense, dark brown, silty SAND with fine porous gravel. SM)	
5		CS-1	70	35	6	Coring		Moderately strong, yellowish brown, weathered coarse grained tuffaceous SANDSTONE	4.70m
6		CS-2	70	50	17	Coring		Light brown, moderately strong, tuffaceous. SILTSTONE.	
7		CS-3	150	56	0	Coring			6.90m
8		CS-4	150	110	0	Coring		Moderately strong, light brown, medium to coarse grained tuffaceous SANDSTONE.	8.40m
9									
10								Final Depth of Borehole = 8.40 meters	
11									
12									
13									

LEGEND:
- SPLIT SPOON SAMPLE
- SHELBY TUBE SAMPLE
- CORE SAMPLE

▽-Water Level
DB - DRIVE BLOCK
WB- WASH BORING
NR - NO RECOVERY

Final Logged By: Cris C. Farum
Soils/Materials Engineer

Checked By: Reynaldo P. Abne
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6-4　Soil Analysis Data

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SUMMARY OF GEOTECHNICAL DATA

Project Name: Rehabilitation of Flood Control Operation and Warning System in Metro Manila **Location: NCR, DPWH Compound**								**Date Started: September 19, 1999** **Date Completed: September 24, 1999**			
CLIENT:CTI Engineering International Co., Ltd.								**Contractor : Bloodstone Engineering & Geotechnics**			
Surface Elevation: 19.129m (MLLW)		**GWL: . 1.60 m** below Grd. Surf.	**Coordinates:**					**Hammer Weight: 64 kg (140 lbs)** **Height of Fall: 76 cm (30 inches)**			
Borehole No.: BH-1		**Final Depth: 25.00 meters**	**Sampling: Split Spoon and Shelby Tubes**	**Equipment Used: Rotary Type / Tone Tash**				**Type of Drilling: Wash Boring Method and Core Drilling**			
Depth (M)	Sample No.	Unified Soils Classification and Description	Blows per 15 cm	Sieve Analysis (% Passing)				NMC %	Liquid Limit (%)	Plasticity Index (%)	Other Tests
				No.4	No. 10	No.40	No.200				
0.55 - 1.00	SS-1	Very dense, brown, Clayey SAND with gravel, shell fragments, low plasticity. (SC)	4-27-31	83	70	47	21	21.03	39.10	11	
1.55 - 2.00	SS-2	Medium dense, gray, Silty SAND with gravel, non-plastic fines. (SM)	7-9-10	76	58	39	21	14.82	NP	NP	
2.55 - 3.00	SS-3		11-9-8								
3.55 - 4.00	SS-4	Medium dense, gray, Silty SAND with fine gravel and non-plastic fines. (SM)	7-7-9	90	74	30	30	21.72	NP	NP	
4.55 - 5.00	SS-5		8-7-7								
5.55 - 6.00	SS-6	Medium stiff, gray, Clayey SILT, to soft, gray, Clayey SILT, with fine sand, and about 45% of broken marine shells, high plasticity. (MH)	5-6-6	98	95	92	72	50.60	53.11	21.29	
6.55 - 7.00	SS-7		2-1-2								
7.55 - 8.00	SS-8		2-0-1								
8.00 - 8.50	UDS-1		Pressed								
8.55 - 9.00	SS-9		2-2-2								
9.55 - 10.00	SS-10		2-3-2								
10.55 - 11.00	SS-11	Very loose, gray, Silty Fine SAND with non-plastic fines. (SM)	2-2-2	100	100	99	33	31.49	NP	NP	
11.55 - 12.00	SS-12		2-2-1								
12.55 - 13.00	SS-13	Loose to very loose, gray, Clayey Silty SAND and with medium plasticity fines. (SC)	2-3-5	95	75	57	48	69.90	43.08	23.72	
13.55 - 14.00	SS-14		2-3-5								
14.55 - 15.00	SS-15		2-1-2								
15.55 - 16.00	SS-16		2-2-2								

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SUMMARY OF GEOTECHNICAL DATA

Project Name: Rehabilitation of Flood Control Operation and Warning System in Metro Manila **Location: NCR, DPWH Compound**								**Date Started: September 19, 1999** **Date Completed: September 24, 1999**			
CLIENT: CTI Engineering International Co., Ltd.								**Contractor : Bloodstone Engineering & Geotechnics**			
Surface Elevation: 19.129m (MLLW)	**GWL: 1.60 m** below grd. surf.	**Coordinates:**						**Hammer Weight: 64 kg (140 lbs)** **Height of Fall: 76 cm (30 inches)**			
Borehole No.: BH-1	**Final Depth: 25.00 meters**	**Sampling: Split Spoon and Shelby Tubes**		**Equipment Used: Rotary Type / Tone Tash**				**Type of Drilling: Wash Boring Method and Core Drilling**			
Depth (M)	Sample No.	Unified Soils Classification and Description	Blows per 15 cm	Sieve Analysis (% Passing)				NMC %	Liquid Limit (%)	Plasticity Index (%)	Other Tests
				No.4	No. 10	No.40	No.200				
16.55 - 17.00	SS-17	Very loose, brown, **Clayey SAND**, with gravel, low plasticity fines. (SC)	2-2-2	71	60	44	27	23.94	38.60	12	
17.55 - 18.00	SS-18	Medium dense, greyish brown, **Sandy, Clayey, SILT**, high plasticity. (MH)	21-12-12								
18.55 - 19.00	SS-19		8-10-14	87	83	73	61	51.11	57.22	25.58	
19.55 - 20.00	SS-20		21-15-14								
20.55 - 21.00	SS-21	Very dense, gray, **Clayey, Sandy, SILT**, high plasticity. (MH)	24-50/4								
21.55 - 22.00	SS-22		50/10								
22.55 - 23.00	SS-23		50/10	100	99	94	87	62.47	59.20	26.20	
23.55 - 24.00	SS-24		50/10								
24.55 - 25.00	SS-25		50/10								

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SUMMARY OF GEOTECHNICAL DATA

Project Name: Rehabilitation of Flood Control Operation and Warning System in Metro Manila **Location: Nangka, Concepcion**											**Date Started: September 22, 1999** **Date Completed: September 26, 1999**	
CLIENT:CTI Engineering International Co., Ltd.											**Contractor : Bloodstone Engineering & Geotechnics**	
Surface Elevation: 12.568m		**GWL: 4.55 m.** below Grd. Surf.		**Coordinates:**							**Hammer Weight: 64 kg (140 lbs)** **Height of Fall: 76 cm (30 inches)**	
Borehole No.: BH-2		**Final Depth: 15.55 meters**		**Sampling: Split Spoon and Shelby Tubes**			**Equipment Used: Rotary Type / Tone Tash**				**Type of Drilling: Wash Boring Method and Core Drilling**	
Depth (M)	Sample No.	Unified Soils Classification and Description		Blows per 15 cm	Sieve Analysis (% Passing)				NMC %	Liquid Limit (%)	Plasticity Index (%)	Other Tests
					No.4	No. 10	No.40	No.200				
0.55 - 1.00	SS-1	Soft, brown, ***Clayey SILT*** with fine sand, low plasticity. **(ML)**		1-1-2	100	99	98	70	29.34	46.18	15	
1.55 - 2.00	SS-2	Medium stiff, brown, ***Clayey SILT*** with fine sand, medium plasticity. **(MH)**		2-2-3	99	98	96	77	39.32	51.60	20	
2.55 - 3.00	SS-3	Medium stiff, brown, ***Clayey SILT***, with fine sand and fine gravel, medium plasticity. **(MH)**		3-2-3	98	98	95	70	33.71	52.21	21	
3.55 - 4.00	SS-4			2-2-3								
4.55 - 5.00	SS-5	Loose, greyish brown, ***Clayey SAND***, with fine to coarse gravel, and medium plasticity fines. **(SC)**		6-4-4	70	61	51	41	25.90	48.23	11.50	
5.55 - 6.00	SS-6			3-3-3								
6.55 - 7.00	SS-7	Stiff, brown, ***Fat CLAY*** high plasticity. **(CH)**		3-6-7	100	100	98	94	32.40	62.56	32.35	
7.55 - 8.00	SS-8											
8.55 - 9.00	SS-9	Stiff, gray, ***Clayey SILT***, with fine sand, medium plasticity. **(MH)**		3-6-8	100	97	84	77	38.24	56.58	24.50	
9.55 - 10.00	SS-10			5-7-9								
10.55 - 11.00	SS-11	Very stiff, brown, ***Clayey SILT***, with fine sand, medium plasticity. **(MH)**		5-9-13	100	92	78	71	36.79	56.28	24.05	
11.55 - 12.00	SS-12			12-13-11								
12.55 - 13.00	SS-13	Stiff, brown, ***Silty CLAY***, high plasticity. **(CH)**		5-6-10	100	98	94	81	36.96	62.38	32.47	
13.55 - 14.00	SS-14			5-6-9								
14.55 - 15.00	SS-15	Very dense, ***GRAVEL***, (6 pcs angular stone , max. size of 50 mm).		34-50/10								

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SUMMARY OF GEOTECHNICAL DATA

Project Name: Rehabilitation of Flood Control Operation and Warning System in Metro Manila **Location: San Juan, Metro Manila**								**Date Started: September 25, 1999** **Date Completed: September 30, 1999**			
CLIENT:CTI Engineering International Co., Ltd.								**Contractor : Bloodstone Engineering & Geotechnics**			
Surface Elevation:	**GWL: 2.85 m. below Grd. Surf.**	**Coordinates:**						**Hammer Weight: 64 kg (140 lbs)** **Height of Fall: 76 cm (30 inches)**			
Borehole No.: BH-3	**Final Depth: 8.40 meters**	**Sampling: Split Spoon and Shelby Tubes**		**Equipment Used: Rotary Type / Tone Tash**				**Type of Drilling: Wash Boring Method and Core Drilling**			
Depth (M)	Sample No.	Unified Soils Classification and Description	Blows per 15 cm	Sieve Analysis (% Passing)				NMC %	Liquid Limit (%)	Plasticity Index (%)	Other Tests (U.C.T.)
				No.4	No. 10	No.40	No.200				
0.55 - 1.00	SS-1	Organic materials (Decomposed Garbage)	0-1-3								
1.55 - 2.00	SS-2	Very loose to loose, greyish brown, clayey	1-1-2	90	83	64	37	39.50	56.29	24.53	
2.55 - 3.00	SS-3	SAND, with fine gravel and plastic fines. (SC)	3-2-4	92	78	49	24	51.20	51.20	20.40	
3.55 - 3.68	SS-4	Very dense, dark brown, silty SAND, with fine porous gravel, (SM)	50/13	95	79	49	15	36.1	NP	NP	
4.00 - 4.70	CS-1	Light brown, weathered to moderately weathered tuffaceous SILTSTONE to light brown, fine to coarse grained tuffaceous SANDSTONE.	Coring								
4.70 - 5.40	CS-2		Coring								
5.40 - 6.90	CS-3		Coring								
6.90 - 8.40	CS-4		Coring								

Abbrev.:

Abbrev.: NMC - Natural Moisture Content
U.C.T. - Unconfined Compressive Strength

6-5 Project Effect

(1) Decrease in Flood Area

An accurate flood forecasting system can be developed under the project, by which an effective gate operation is made possible to mitigate flood damage in Metro Manila. The project effect is quantitatively described on the basis of 1~2-year flood probability which is considered as a recurrent flood causing serious damage. In this regard, flood discharge is estimated at 1,000 m^3/s at Rosario weir.

With EFCOS system, the information is quickly available to show critical water level in upper river basin, so that the gate operation can start 30 minutes in advance to make an effective diversion of flood discharge to the Mangahan Floodway. As a result, it contributes to the nearly 40 % of decrease in flood area in Metro Manila. Furthermore, if the project (rehabilitation of EFCOS) is implemented, an hour advance information will be available for flood forecasting, and an integrated gate operation will be made possible in consideration of San Juan River. Thus, it is expected to further reduce flood area particularly in flood-prone area in the downstream section. Likewise, flood time will be largely reduced. The project effect in terms of reduction of flood area is presented below:

Project Effect in Terms of Reduction of Flood Area

	Before EFCOS	EFCOS	
		Present	After Project
Flood Area (km^2)	63	39	20

(2) Mitigation of Flood Damage

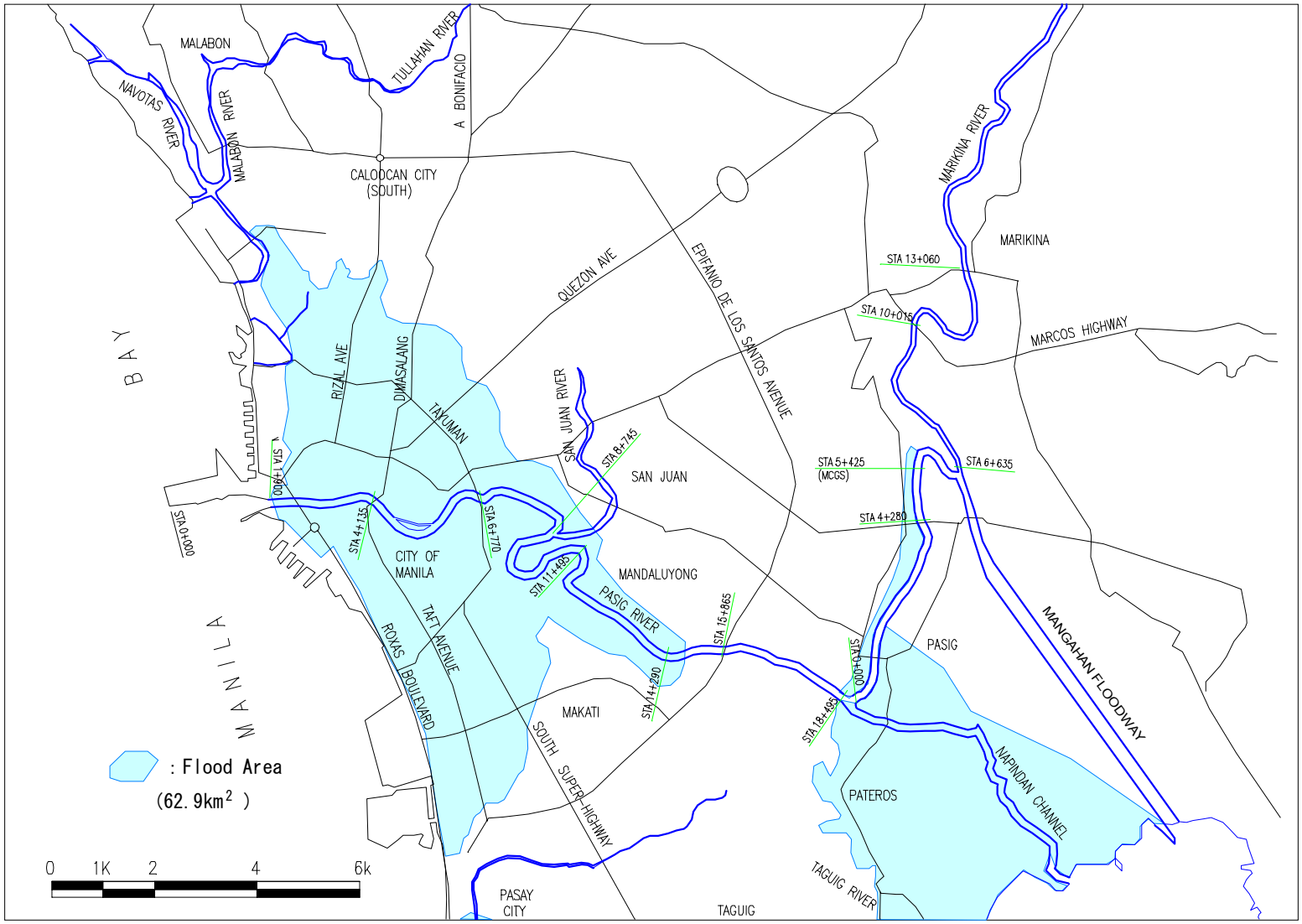
By improving flood forecasting system, warning and flood information will be promptly given to the residents, and thereby social unrest will be reduced. It will also help the residents to make advanced evacuation from the place menaced by floods, and flood damage can be practically mitigated or minimized as a result. Socioeconomic activities are paralyzed in Metro Manila due to the heavy rainfall which may occur once every two years. However, the project will solve these unfavorable situations as warning and information dissemination system are properly established in addition to the reduction of flood area.

Flood casualties in recent years in Metro Manila are presented below:

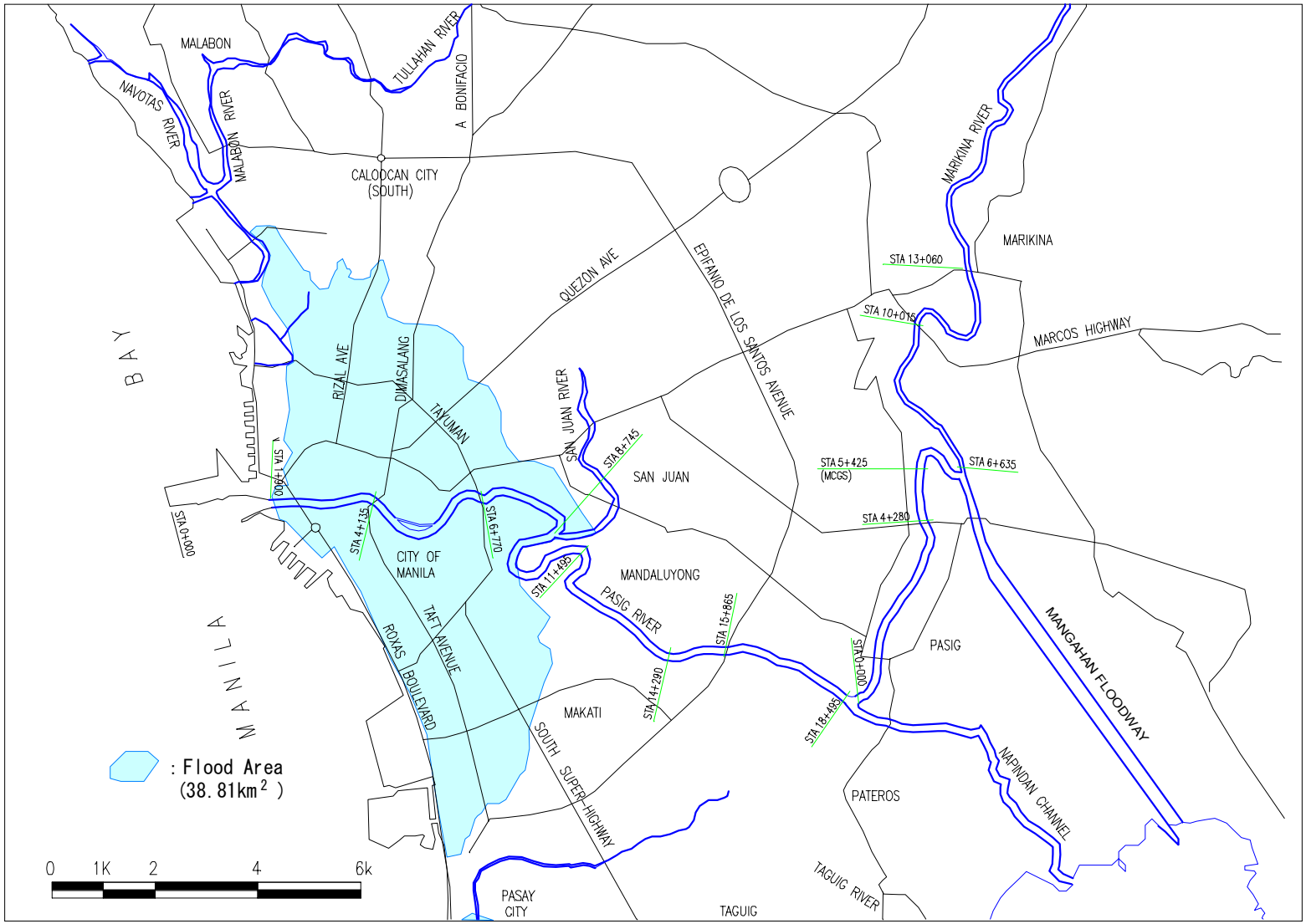
Flood Casualties in Metro Manila

Year	Dead and Missing Persons	Injured Persons	Nos. Affected Families	Nos. Evacuee Families
1993	1	1	11,106	1,190
1994	26	40	13,919	0
1995	28	253	109,254	0
1996	7	3	2,395	0
1997	42	4	119,624	28,368
1998	0	0	14,802	4,879

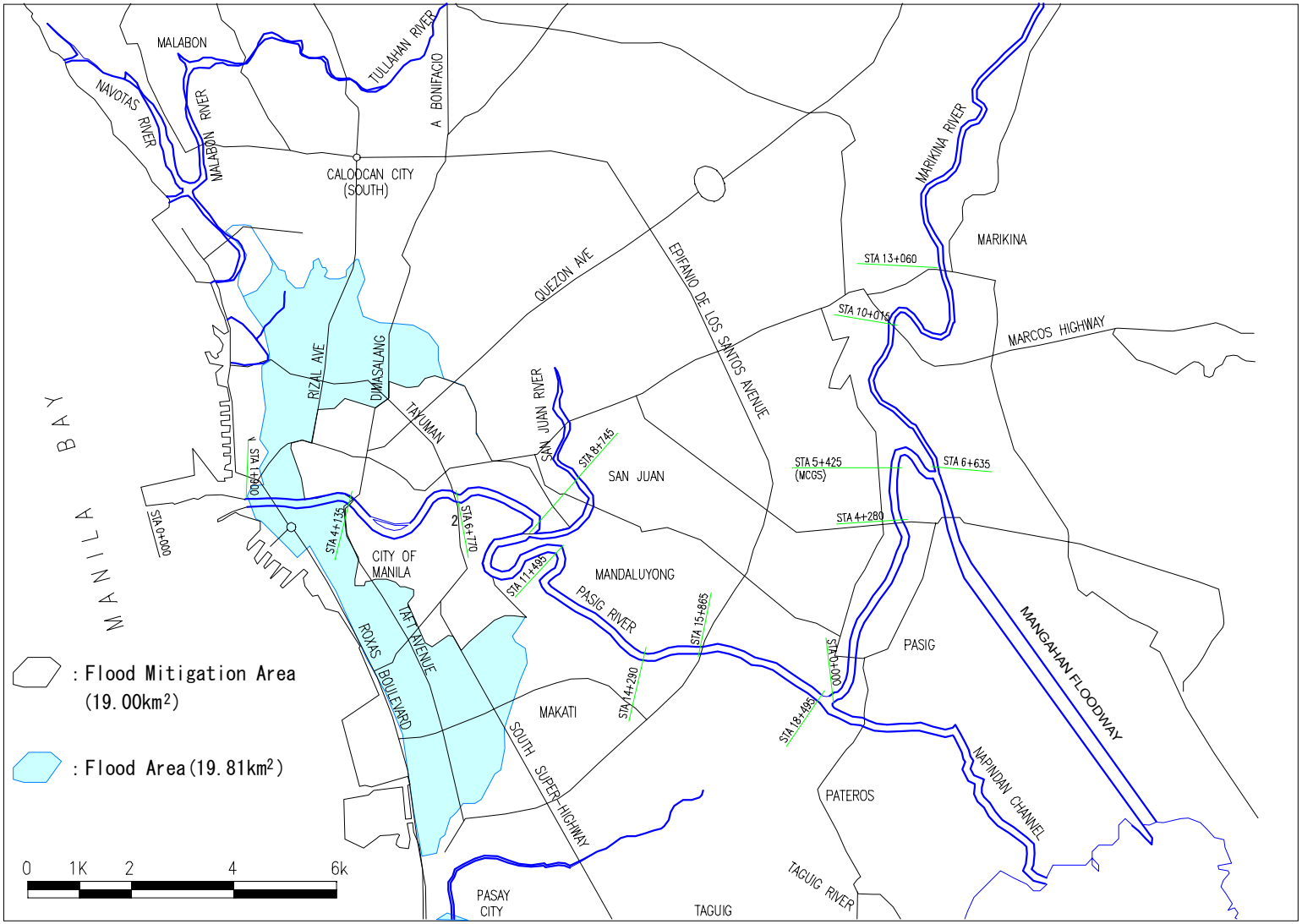
Source: Department of Social Welfare and Development
Office of Civil Defense



Flood Area Before EFCOS Project (1～2-Year Flood Probability)



Flood Area After EFCOS Project(1～2-Year Flood Probability)



Flood Area After Improvement of EFCOS Project (1～2-Year Flood Probability)