Chapter 5

EXISTING MAIN COMBINED SEWER IMPROVEMENT

CHAPTER 5 EXISTING MAIN COMBINED SEWER IMPROVEMENT

5.1 Present Conditions of Main Combined Sewer

(1) Existing Main Combined Sewer Network

The existing combined sewer network in the study area is a large and complicated one. The study area is divided into 13 catchments based on the existing main combined sewer networks, rivers and canals.

The left bank area of the Tau Hu – Ben Nghe Canal is divided into 6 catchment areas and the right bank of the Doi – Te Canal is divided into 3 catchment areas. The remaining 4 catchment areas of G (Khanh Hoi), H (Hung Phu), I (Tung Thien Vuong) and J (Binh Dong) locate between the Tau Hu – Ben Nghe Canal and the Doi – Te Canal. The 13 catchment areas are shown in Fig. 5.1 and the following table.

Coverage Area by Existing Combined Sewer

Sub	Catchment Name	Catchment Area (ha)	Coverage (ha)	(%)
Tau Hu – Ben Nghe Canal Left Bank Area				
1.	A	390.9	390.9	100
2.	B	114	114	100
3.	C	440.6	440.6	100
4.	D	471	471	100
5.	E	168.1	168.1	100
6.	F	108.8	108.8	100
	Sub Total	1,693.4	1,693.4	100
Islands between Tau Hu – Ben Nghe and Doi – Te Canal Left Bank				
7.	G (Khanh Hoi)	354.1	354.1	100
8.	H (Hung Phu)	76.7	76.7	100
9.	I (Tung Thien Vuong)	82.0	82.0	100
10.	J (Binh Dong)	48.6	48.6	100
	Sub Total	561.4	561.4	100
Doi – Te Canal Right Bank				
11.	K (Rach Ong)	133.0	133.0	100
12.	L (Pham The Hien)	195.8	33.2	17
13.	M (Binh Dang)	208.0	29.5	14
	Sub Total	536.8	195.7	36
	Total	2,791.6	2,450.5	88

The main combined sewer with a length of about 102 km covers 2,450 ha, which is 88 % of the study area.

Main combined sewer has been completely installed in the left bank area of the Tau Hu – Ben Nghe Canal and the catchment areas between Tau Hu – Ben Nghe Canal and the Do – Te Canal. Only two (2) catchment areas of L (Pham The Hien) and M (Binh Dang), which locate on the right bank of the Doi – Te Canal, have not developed yet by combined sewer system. The coverage ratio of the 2 catchment areas of L (Pham The Hien) and M (Binh Dang) are estimated at 17 % and 14 %, respectively.

(2) Existing Drainage Condition of Catchment Areas

"Ho Chi Minh City Environmental Improvement Project" financed by the Asian Development Bank will carry out an improvement of the drainage condition for E and F catchments. Therefore, these 2 catchment areas are excluded from this study.

According to information from the Urban Drainage Company and the inundation survey of the JICA feasibility study, sewer inundation has mainly occurred in 2 catchment areas of C and D. The present condition of the 2 catchment areas is described as follows;

[C Cacthment Area]

Inundation Prone Area

Inundation prone areas are identified along the following streets and shown in Fig. 5.2.

- 3 Thang 2 street
- Le Hong Phong (between 3 Thang Hai and Nga 7 rotary) street
- Su Van Hanh street
- Dien Bien Phu (between Cao Thang and Nga 7 rotary) street

Inundation Period and Depth

The duration ranges from 30 minutes to 2 – 3 hours and the depth ranges from 0.2 m to 0.5 m.

Existing Main Combined Sewer

Existing main combined sewers are listed up as follows;

Existing Main Combined Sewer in C-Catchment

No.	Street Name	From	to	Dimensions
1	Dien Bien Phu	Cao Thang	Nga 7 Rotary	⌓800 mm x 2 lines
2	Le Hong Phong	3 Thang 2	Nga 7 Rotary	⌓1000 mm, ⌓600 mm x 2 lines
3	ditto	Nga 7 Rotary	Tran Phu	⌓600 mm x 2 lines
4	ditto	Tran Phu	An Duong Vuong	⌓600 mm x 2 lines
5	ditto	An Duong Vung	Nguyen Trai	⌓600 mm x 2 lines
6	Ly Thai To	Nga 7 Rotary	Nguyen Dinh Chieu House No. 226	⌓1200 mm
7	Tran Binh Trong	Nguyen Dinh Chieu House No. 226	Tau Hu Canal	Arch 2500 mm x 2200m
8	Su Van Hanh	3 Thang 2	Ly Thai To	⌓600 mm
9	ditto	Ly Thai To	Ba Hat	⌓600 mm
10	ditto	Ba Hat	Ngo Gia Tu	⌓400 mm
11	ditto	Ngo Gia Tu	An Duong Vuong	⌓400 mm, ⌓600 mm

[D Cacthment Area]

Inundation Prone Area

Inundation prone areas are identified along the following streets and shown in Fig. 5.2.

- Ly Thuong Kiet street
- Thuan Kieu street
- Chau Van Liem street

Inundation Period

The duration ranges from 30 minutes to 3 hours and the depth ranges from 0.3 m to 0.5 m.

Existing Main Combined Sewer

Existing main combined sewers are listed up as follows;

Existing Main Combined Sewer in D-Catchment

No.	Street Name	from	to	Dimensions
1	Ly Thuong Kiet	To Hien Thanh	3 Thang 2	⌓600 mm, ⌓1000 mm
2	Le Dai Hanh	Binh Thoi	Nguyen Chi Thanh	⌓600 mm, ⌓1500 mm
3	Thuan Kieu	Le Dai Hanh	Hung Vuong	⌓600 mm, ⌓400 mm
4	Chau Van Liem	Hung Voung	Hai Thuong Lan Ong	Arch 600 mm x 1200m
5	Mac Cuu	Hai Thuong Lan Ong	Tau Hu Canal	Arch 800 mm x 1400m

(3) Evaluation of Existing Main Combined Sewer Discharge Capacity

Modeling & Boundary Conditions

The existing main combined sewer network is complex. Furthermore the outlets of the sewers are affected by the tidal time varying water levels.

Thus, for consideration of the network and the hydraulic condition at the outlet, unsteady sewer pipe flow modeling software called “MOUSE” was applied to hydrodynamic simulation one in the JICA feasibility study.

The evaluation for the discharge capacity of the main combined sewer was carried out for the design rainfall of 3 year return period and the design flood water level of 2 year return period under the condition of existing land use.

The delineation of sub-cathcment area for C and D catchments is shown in Fig. 5.3.

Simulation Results

[C Cacthment Area]

Fig. 5.4 (1) shows the most critical condition that a existing main combined sewer can not discharge the storm water from its catchment area under the boundary condition above-mentioned. The simulation results the critical condition is considered to happen to

the sewer installed along the following street and to continue for about 40 minutes in this catchment area.

- Le Hong Phong (between 3 Thang Hai and Nga 7 rotary) street
- Su Van Hanh street
- Dien Bien Phu (between Cao Thang and Nga 7 rotary) street
- Nguyen Bieu street

This result nearly presents to actual conditions of the existing main combined sewer discharge capacity.

[D Cacthment Area]
Fig. 5.4 (3) shows the most critical condition that a existing main combined sewer can not discharge the storm water from its catchment area under the boundary condition above-mentioned. The simulation results the critical condition is considered to happen to the sewer installed along the following street and to continue for about 40 minutes in this catchment area.

- Ly Thuong Kiet street
- Thuan Kieu street
- Hung Vuong street
- Chau Van Liem street

This result nearly presents to actual conditions of the existing main combined sewer discharge capacity.

5.2 Planning Concept and Design Criteria

(1) Planning Concept

The existing main combined sewer networks shall be utilized to minimize the project cost and to achieve an immediate improvement of the main combined sewer system.

Consequently, two (2) options for the sewer improvement are considered as follows;

1) In case that the road width is sufficient to install, an additional sewer is proposed to supplement the shortage.
2) In case that the road width is insufficient to install, the existing sewer is proposed to be replaced to a sewer dealing with the full discharge.

(2) Design Criteria

Design criteria are stipulated are applied to design the new sewer according to the Vietnamese design standard.

Earth covering
Minimum covering is determined to be 1.2 m because these streets have a heavy traffic.

5.3 Conclusion

(1) Proposed Improvement Plan

Hydrodynamic simulation model established based on the existing conditions is used to determine a proposed plan for each catchemnt.

The route is selected to discharge the storm water from the north to the Tau Hu Canal.

[C Cacthment Area]
Fig. 5.5 shows the proposed route of the improvement. There are 5 main routes of improvement.

- LINE 1: ϕ 1000mm 722m
- LINE 2: ϕ 800-1500mm 677m
- LINE 3: Box2000x2000-2500x2000mm 1,361m
- LINE 4: ϕ 1500-Box2000x2000mm 1,723m
- LINE 5: ϕ 1000-Box2000x2000mm 2,326m

The plan and the longitudinal profile of the proposed plan are shown Fig. 5.5 and 5.6.

[D Cacthment Area]
Fig. 5.4 shows the proposed route of the improvement. There is 1 main route of improvement.

- LINE 6: ϕ 2000-Box2500x2000mm 2,713m

The plan and the longitudinal profile of the proposed plan are shown Fig. 5.5 and 5.7.

FIG. 5.1 DELINEATION OF 13 CATCHMENT AREAS AND EXISTING MAIN COMBINED SEWER COVERAGE IN STUDY AREA

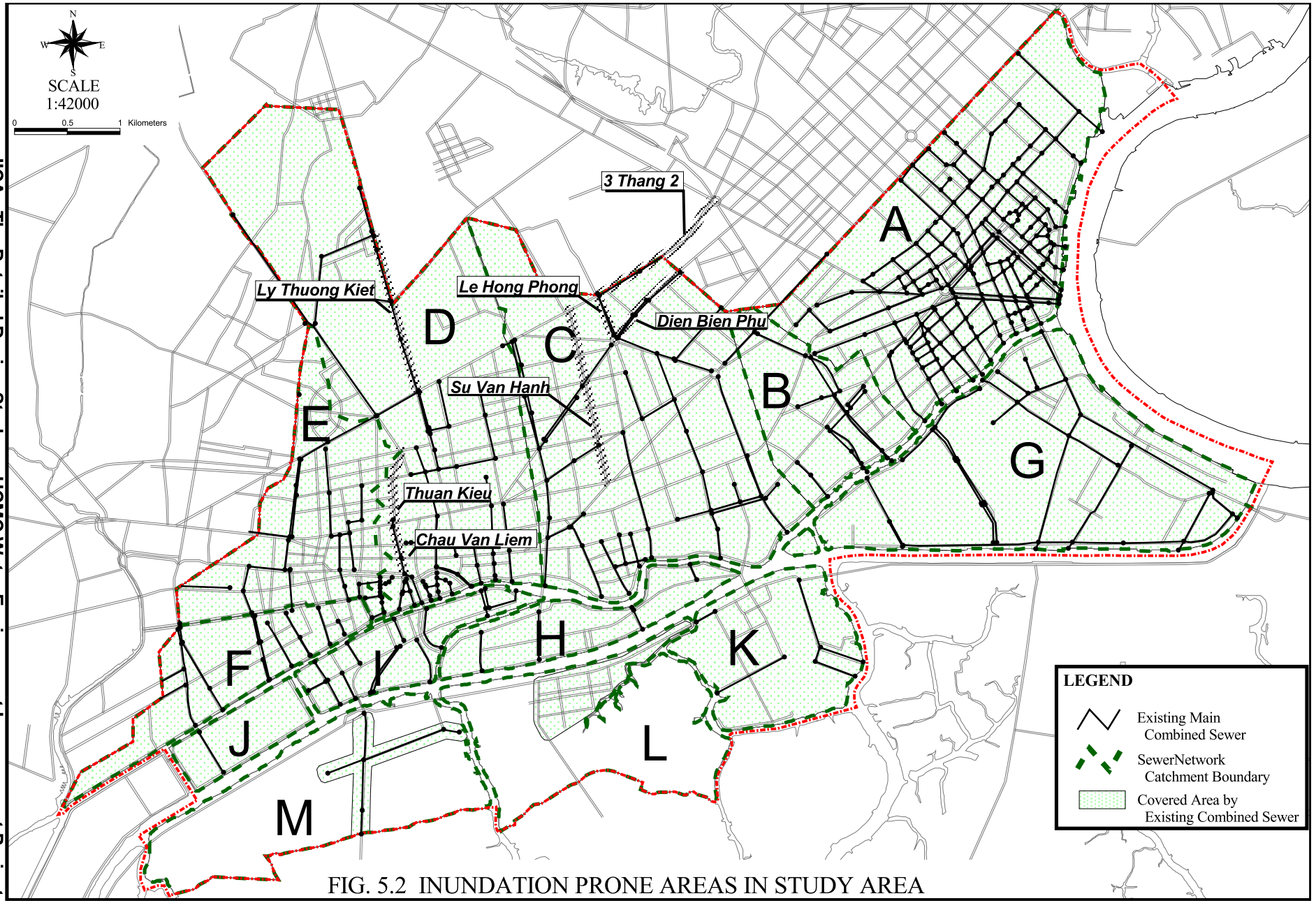


FIG. 5.2 INUNDATION PRONE AREAS IN STUDY AREA

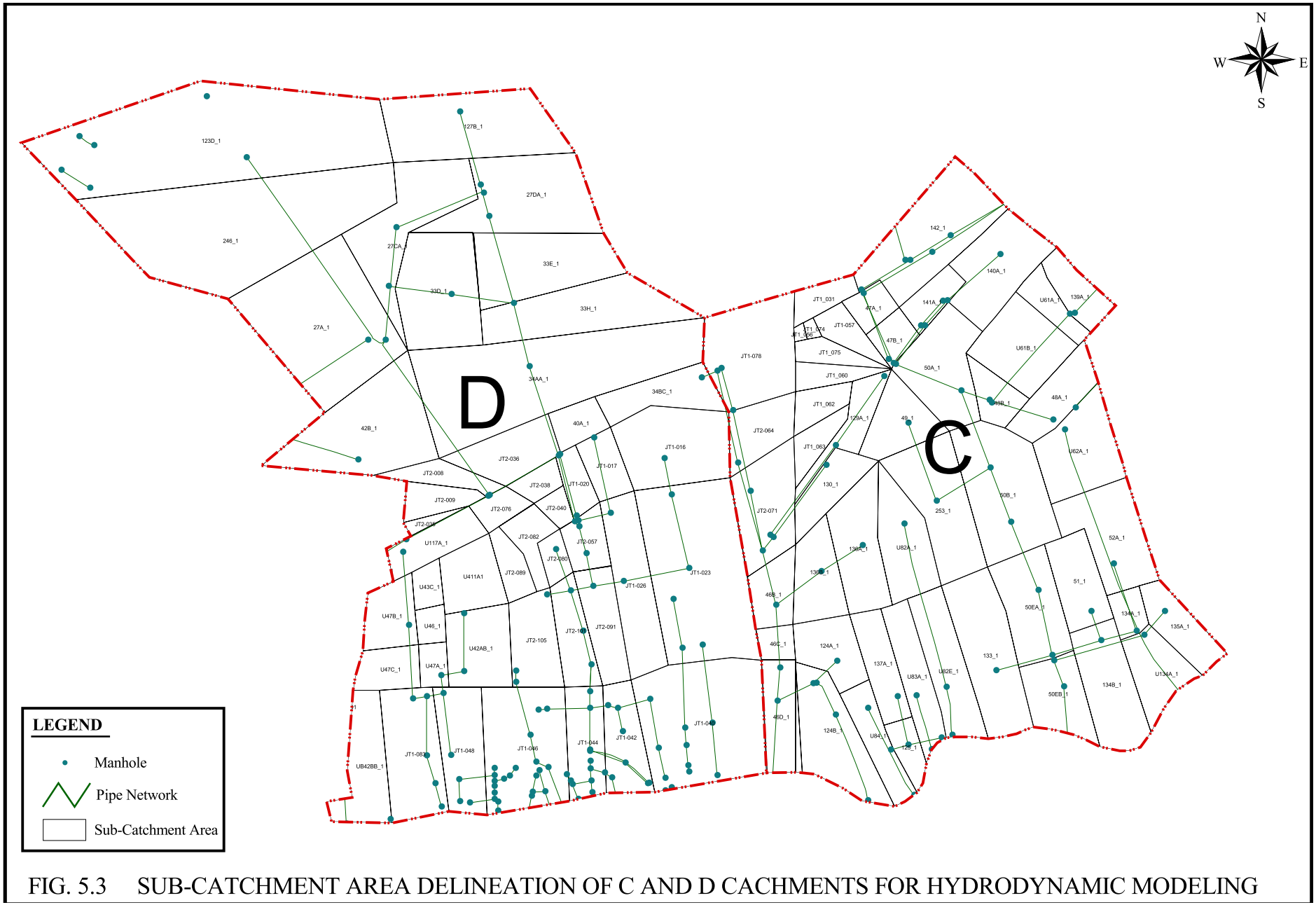
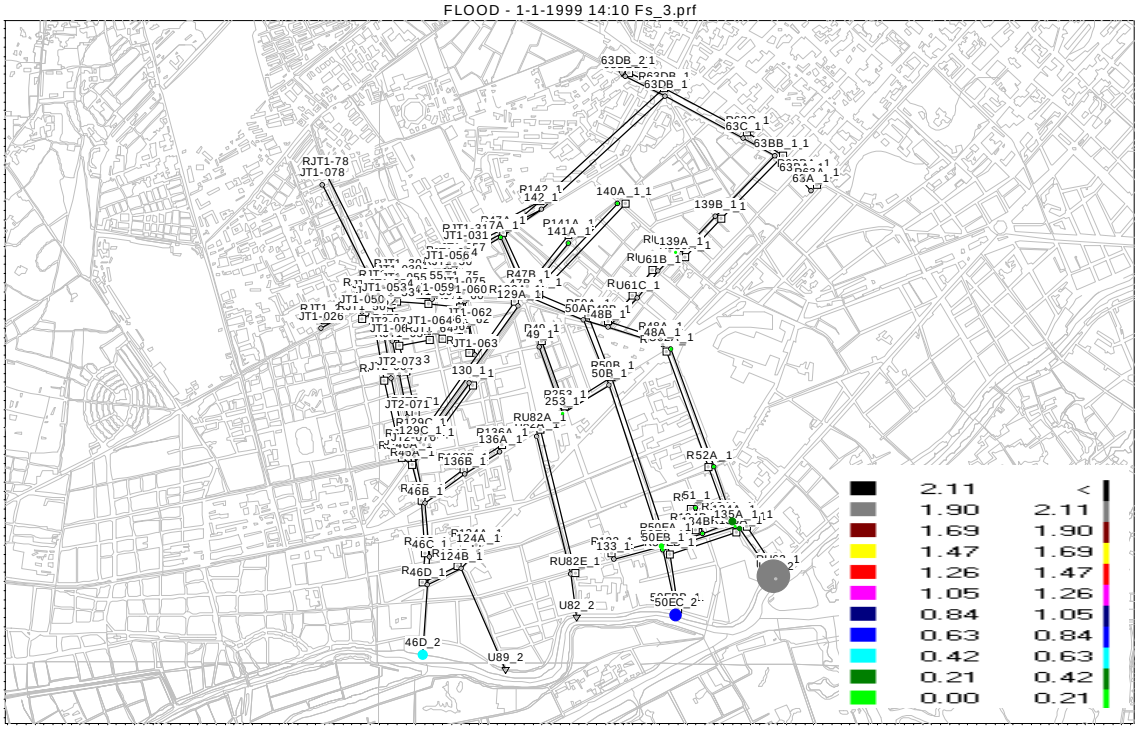


FIG. 5.3 SUB-CATCHMENT AREA DELINEATION OF C AND D CACHMENTS FOR HYDRODYNAMIC MODELING

Start Time of Critical Condition (t=0 min.)



Time of Most Critical Condition (t=30 min.)

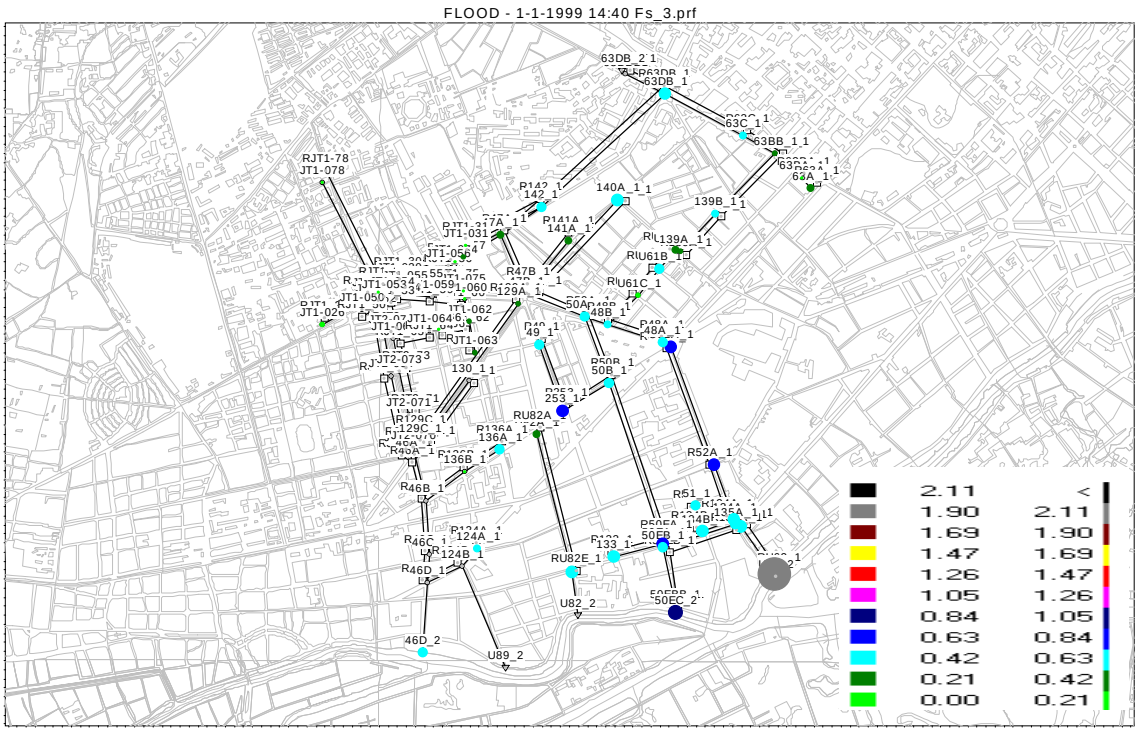
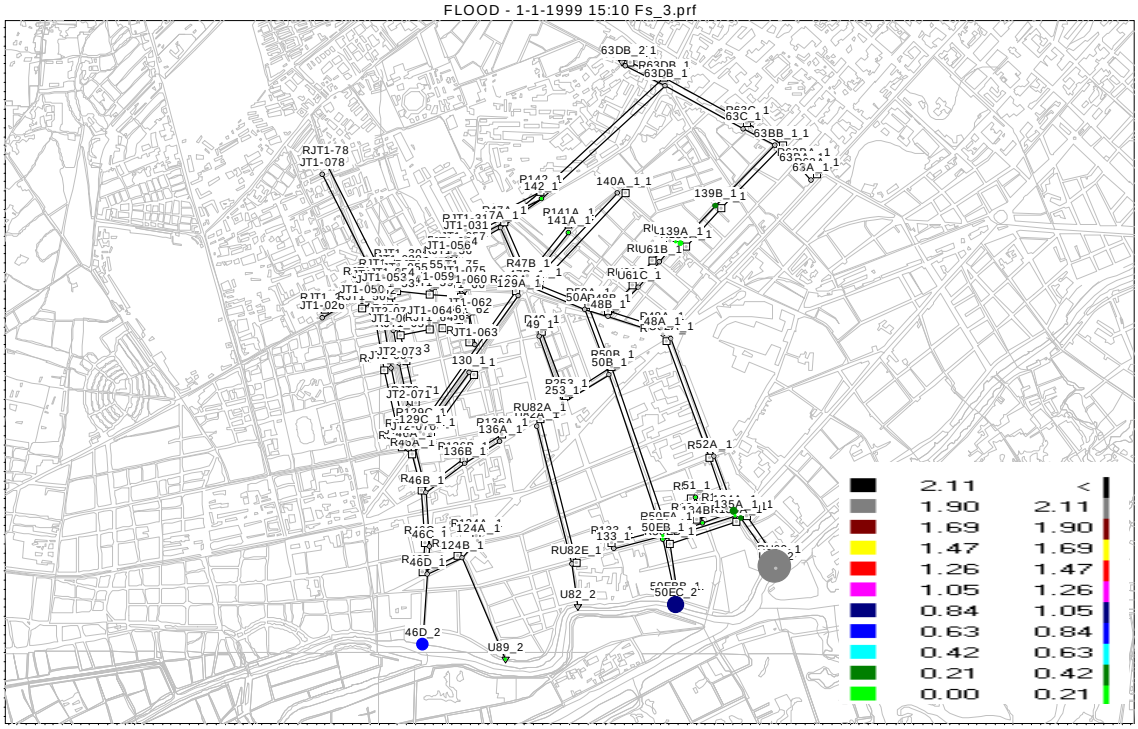


FIG. 5.4 (1/4) SIMULATION RESULTS OF HYDRODYNAMIC MODEL C-CATCHMENT

End Time of Critical Condition (t=60 min.)



After Improvement

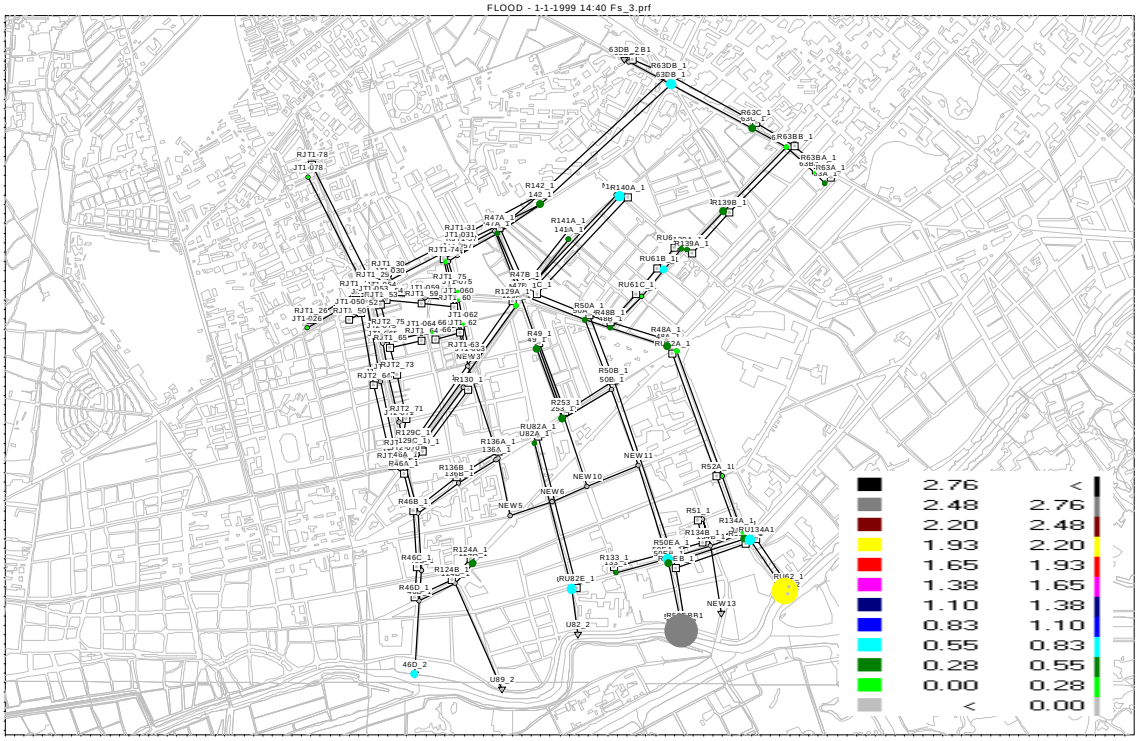
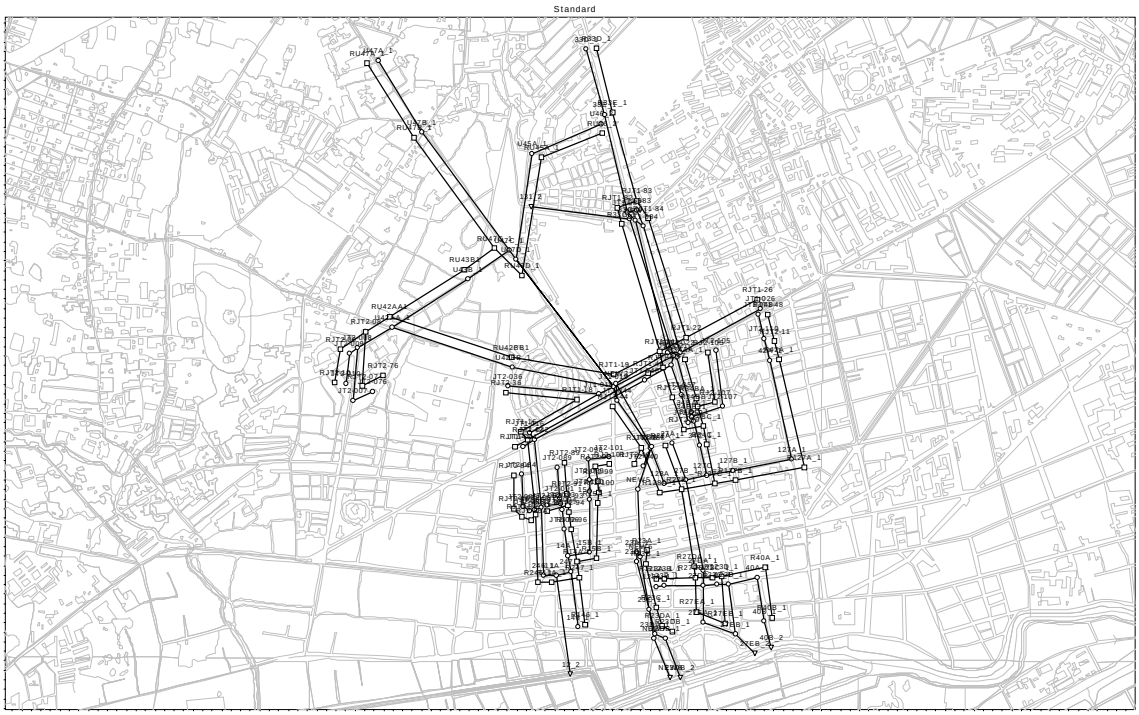


FIG. 5.4 (2/4) SIMULATION RESULTS OF HYDRODYNAMIC MODEL C-CATCHMENT

Existing Main Combined Sewer Network



Time of Most Critical Condition (t=30 min.)

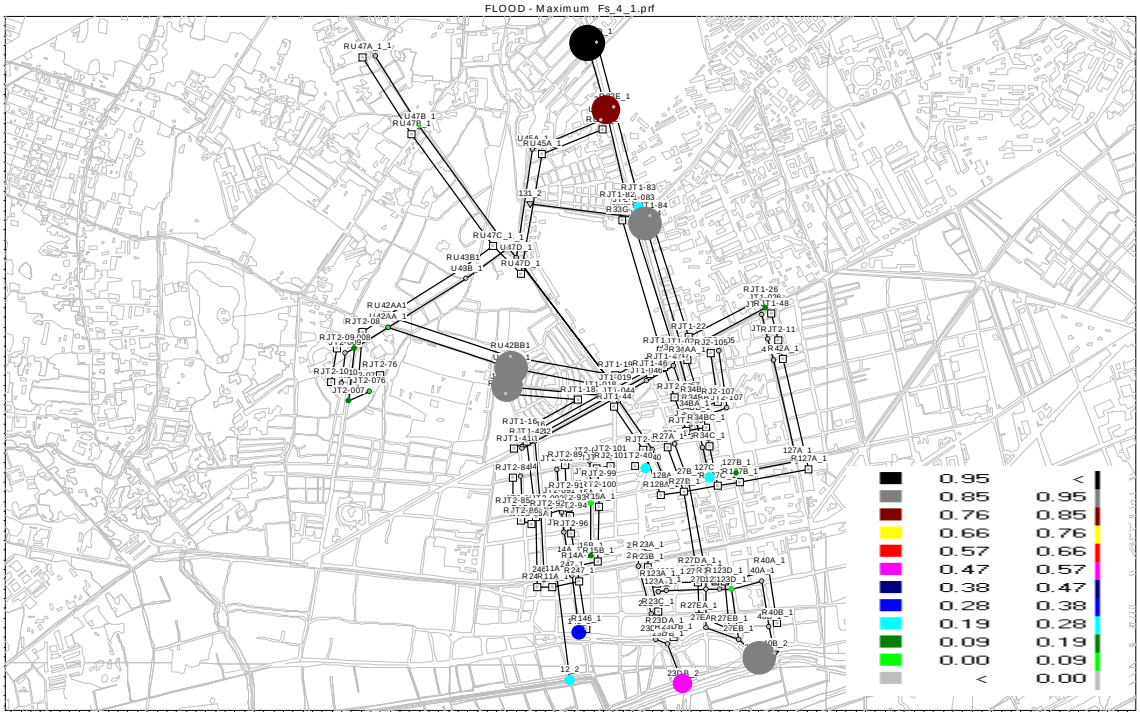


FIG. 5.4 (3/4) SIMULATION RESULTS OF HYDRODYNAMIC MODEL D-CATCHMENT

After Improvement

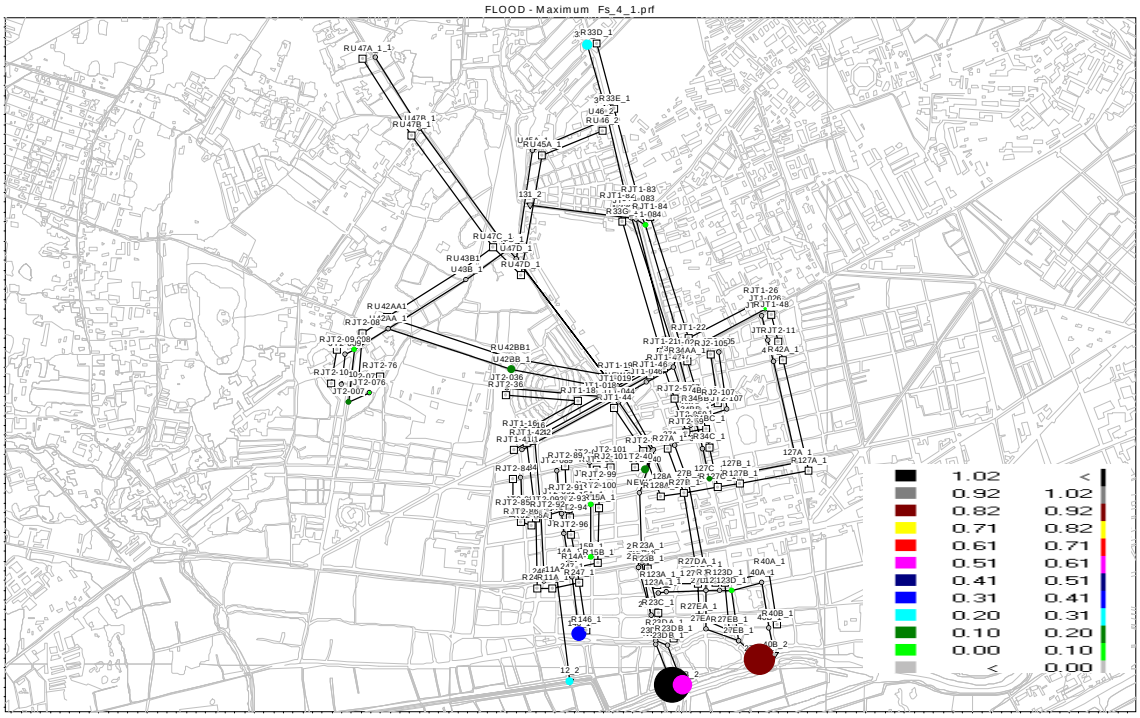


FIG. 5.4 (4/4) SIMULATION RESULTS OF HYDRODYNAMIC MODEL D-CATCHMENT

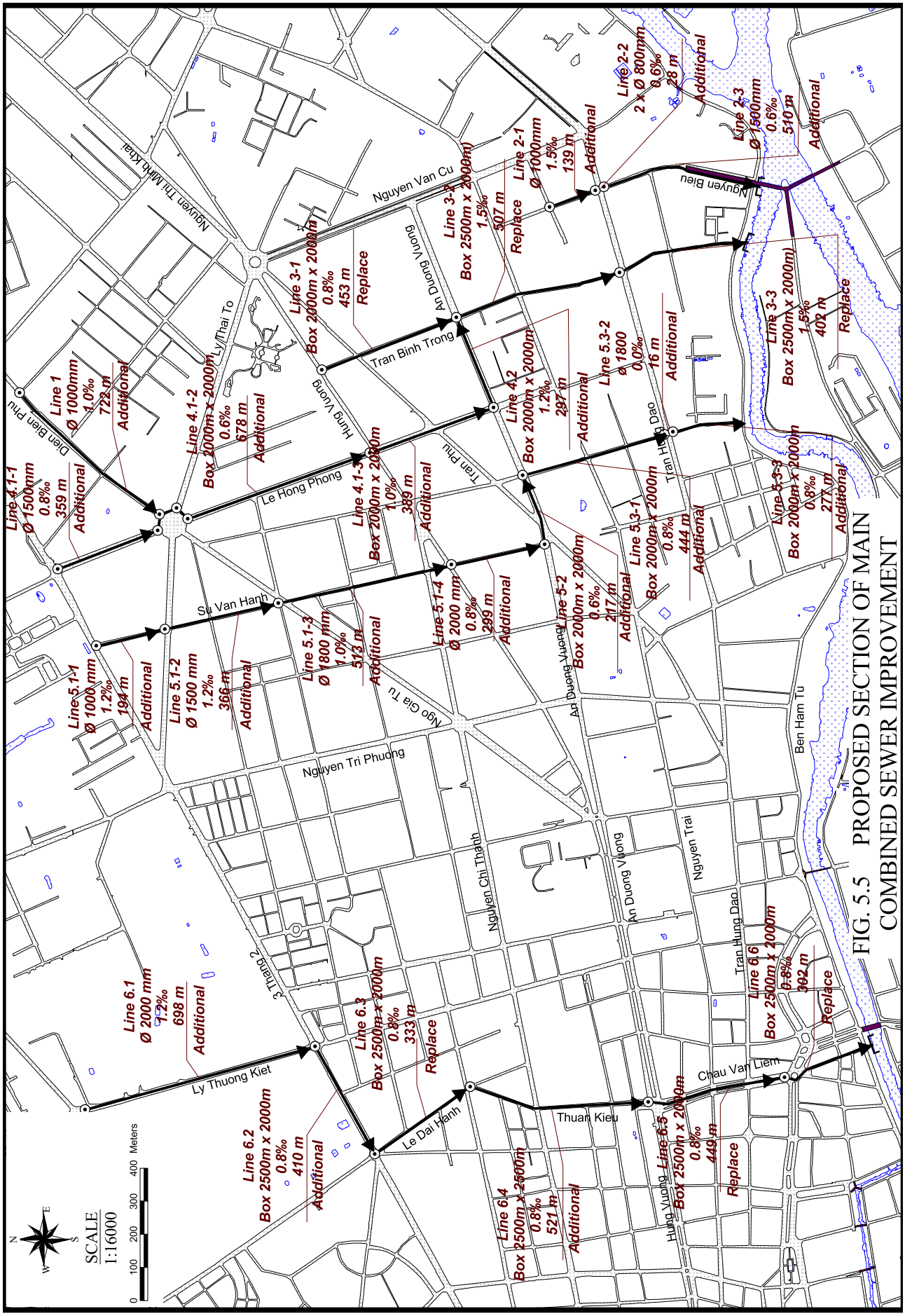
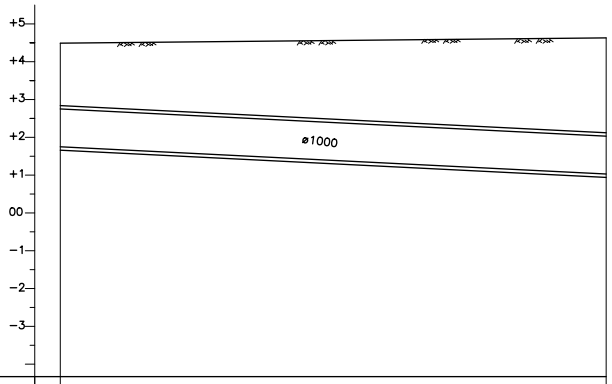


FIG. 5.5 PROPOSED SECTION OF MAIN COMBINED SEWER IMPROVEMENT

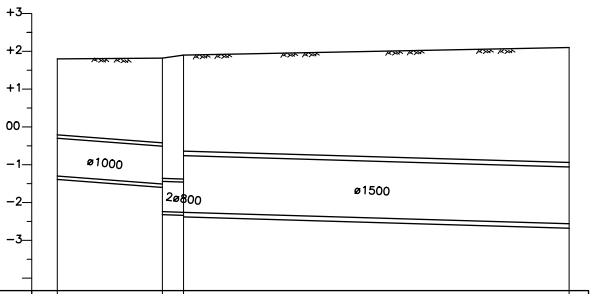
LINE 1:

Scale 1/10000 Length
1/200 Hight



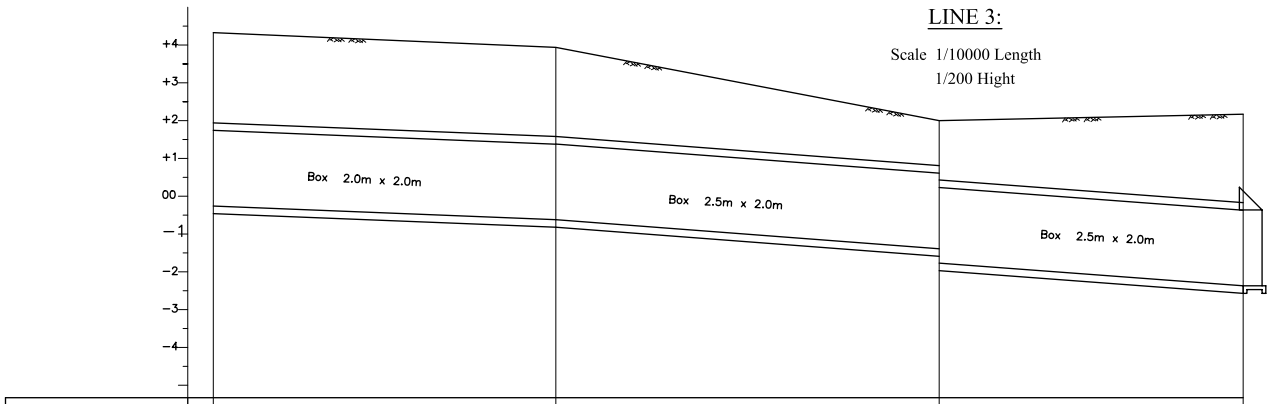
Line No.		1	
Ground elevation (m)	+4.49		+4.63
Invert elevation (m)	+1.75		+1.03
Length of section (m)		722	
Acumulated length (m)	0.00		722
Slope (‰)		1.0	

LINE 2:

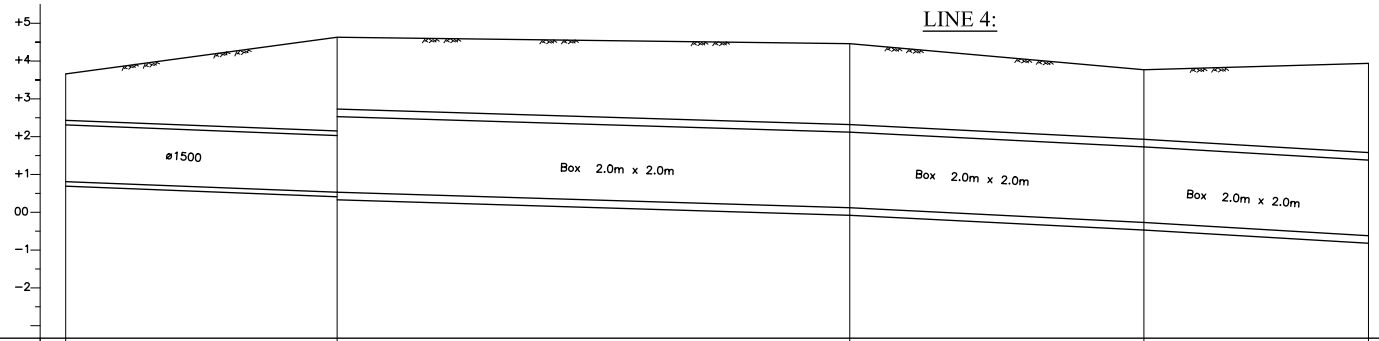


Line No.		2.1	2.2	2.3	
Ground elevation (m)	+1.80	+1.82	+1.90		+2.10
Invert elevation (m)	−1.30	−1.51	−2.24 −2.26		−2.56
Length of section (m)		139	28	510	
Acumulated length (m)	0.00	139	167		677
Slope (‰)		1.5	0.6	0.6	

FIG. 5.6 (1) PROPOSED PROFILE OF MAIN COMBINED SEWER IMPROVEMENT



Line No.		3−1	3−2	3−3	(Outlet)
Ground elevation (m)	4.34		3.95	+2.00	2.17
Invert elevation (m)	−0.26		−0.62	−1.39 −1.77	−2.37
Length of section (m)		453	507	402	
Acumulated length (m)			453	959	1361
Slope (‰)		0.8	1.5	1.5	

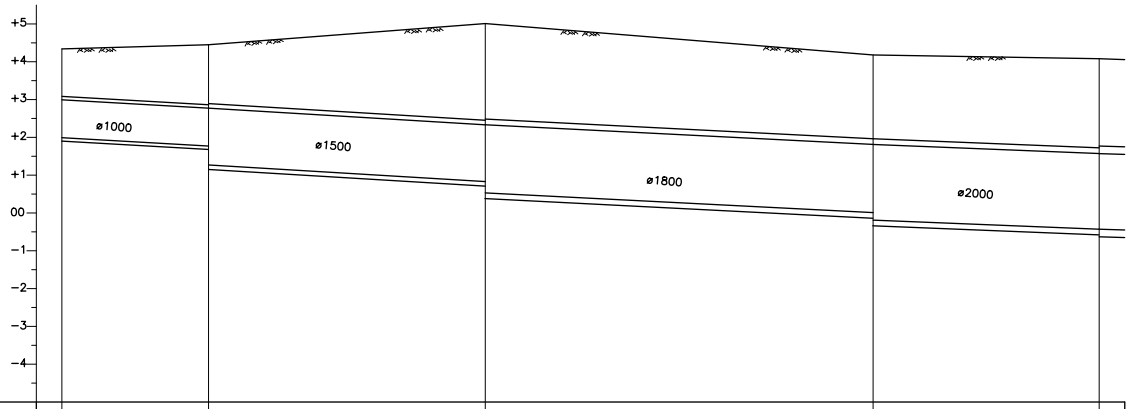


Line No.		4.1−1	4.1−2	4.1−3	4.2	
Ground elevation (m)	3.66		4.63	4.46	3.77	3.94
Invert elevation (m)	0.81		0.53 0.53	0.12	−0.27	−0.62
Length of section (m)		359	678	389	297	
Acumulated length (m)			359	1037	1426	1723
Slope (‰)		0.8	0.6	1.0	1.2	

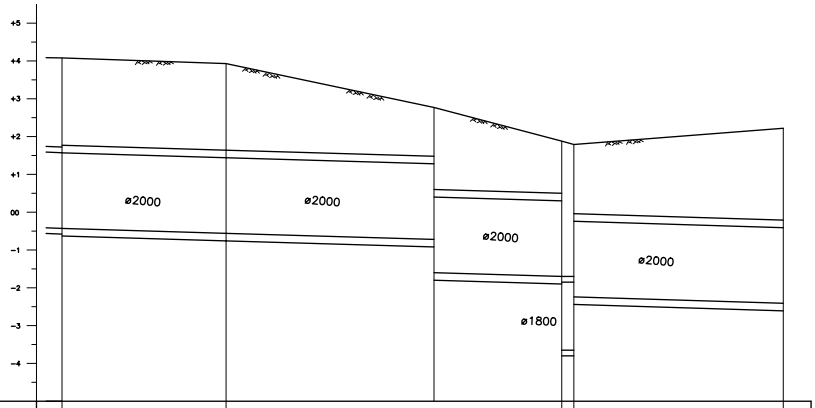
FIG. 5.6 (2) PROPOSED PROFILE OF MAIN COMBINED SEWER IMPROVEMENT

LINE 5:

Scale 1/10000 Length
1/200 Hight



Line No.		5.1−1	5.1−2	5.1−3	5.1−4	
Ground elv_ (m)	4.34		4.45	5.01	4.18	4.06
Invert elv_ (m)	2.00		1.77 1.27	0.83 0.53	0.01 −0.19	−0.43
Length of section (m)		194	366	513	299	
Acumulated length (m)			194	560	1073	1372
Slope (‰)		1.2	1.2	1.0	0.8	

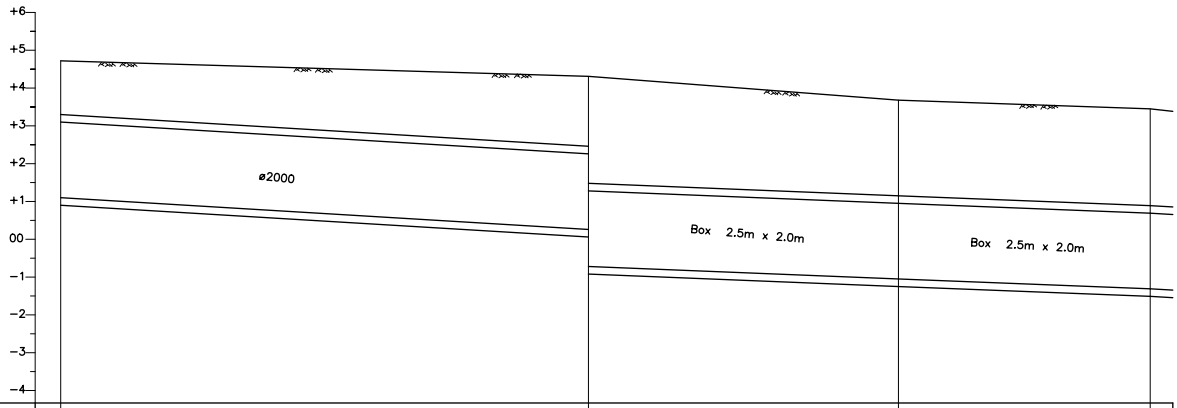


Line No.		5.2	5.3−1		5.1−4	
Ground elevation (m)	4.06	3.93	2.77	1.88	1.79	2.22
Invert elevation (m)	−0.43	−0.56	−0.72 −1.60	−1.70 −1.85	−2.24	−2.41
Length of section (m)		217	275	169	277	
Acumulated length (m)	1372	1589	1864	2033	2049	2326
Slope (‰)		0.6	0.8	0.8	0.8	

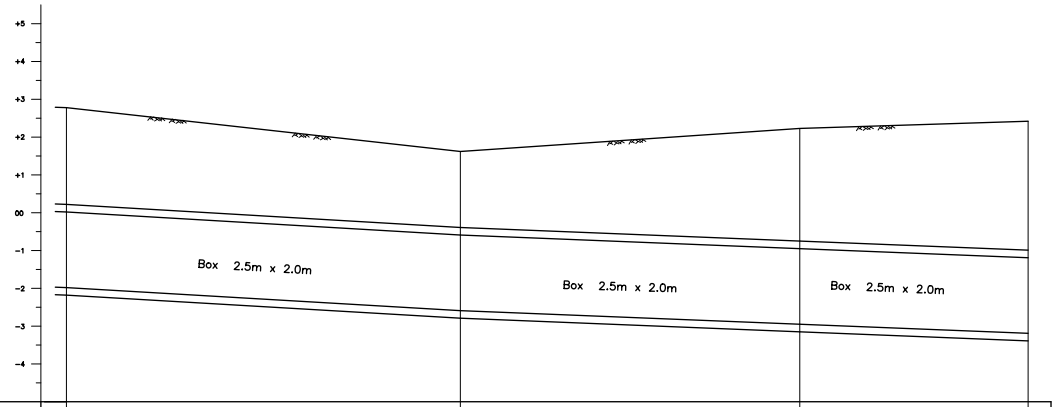
FIG. 5.6 (3) PROPOSED PROFILE OF MAIN COMBINED SEWER IMPROVEMENT

LINE 6:

Scale 1/10000 Length
1/200 Hight



Line No.		6−1	6−2	6−3
Ground elevation (m)	+4.72		+4.31	+3.68 +3.45
Invert elevation (m)	+1.10		+0.26 −0.72	−1.05 −1.31
Length of section (m)		698	410	333
Acumulated length (m)	0.00		698	1108 1441
Slope (‰)		1.2	0.8	0.8



Line No.		6.4	6.5	6.5
Ground elevation (m)	+3.45		+2.29	+2.90 +3.09
Invert elevation (m)	−1.31		−1.92	−2.28 −2.52
Length of section (m)		521	449	302
Acumulated length (m)	1441		1962	2411 2713
Slope (‰)		0.8	0.8	0.8

FIG. 5.7 PROPOSED PROFILE OF MAIN COMBINED SEWER IMPROVEMENT

Chapter 6
SEWER SYSTEM IN SOUTHERN NEW URBAN AREA

CHAPTER 6 SEWER SYSTEM IN SOUTHERN NEW URBAN AREA

6.1 Present Condition

Southern new urban area includes Rach Ong, Phan The Hien and Binh Dang in the right bank area of Doi – Te canal. This area has not been fully developed yet including road networks. Existing condition of sewer has not been developed sufficiently, either (Fig. 6.1).

This area is expected to develop in near future, therefore, the sewerage system also need to be developed hormonally with the land development. Vietnamese standards stipulate that the sewerage development for newly developed area must be covered by separate sewer system. Hence the separate sewer system is proposed in Rach Ong, Phan The Hien and Binh Dang.

6.2 Sanitary Sewer System

6.2.1 Planning Concept and Design Criteria

Planning concept and design criteria are almost same as interceptor described in Chapter 7.
The concept and criteria are summarized in followings.

Target year:	year 2020
Service area:	537 ha
Unit flow:	0.335 m3/c/d in 2020
Pipe material:	centrifugal concrete pipe
Minimum diameter:	300 mm
Design flow:	Hourly maximum flowrate (1.4 times of unit flowrate in year 2020 plus groundwater infiltration)
Flow system:	gravitation
Sewer system:	separation
Flow equation:	Manning equation n=0.013 concrete pipe
Minimum velocity:	0.7 m/s
Standard slope:	see Table 6.1
Minimum earth covering:	1.2 m
Secondary/tertiary pipe:	48m/ha

6.2.2 Proposed Definitive Plan

Sanitary sewer development in southern new urban area is designed to have main, secondary and tertiary sewer. Main sewer is designed based on unit flowrate in 2020.

Length of secondary and tertiary sewer is estimated based on an average length of secondary and tertiary sewer for each ha in District 1.

Route of main sewer for Rach Ong, Phan The Hien and Binh Dang is shown in Fig. 6.2 to Fig. 6.4. This route is under the future planed road based on the urban plan by UPI.

All main sanitary sewers are connected to interceptors installed along Doi - Te Canal.

The total length of the secondary/tertiary and the main sanitary sewers are 26 km and 35 km, respectively. The construction cost is as follows:

Rach Ong	24 billion VND
Phan The Hien	36 billion VND
Binh Dang	37 billion VND
Total	97 billion VND.

The pipe diameter ranges from ϕ 300 mm to ϕ 600 mm, and the main features of the new sanitary sewer pipe by each sub-zone are presented in Table 6.2.

6.3 Storm Sewer System

6.3.1 Planning Concept and Design Criteria

Planning concept and design criteria for storm sewer are similar to Pump Drainage Improvement in Chapter 4. The following is summarized concept and design criteria:

Target Year:	2020
Design scale:	2-year return period
Area:	537 ha
Pipe material:	centrifugal concrete pipe
Flow system:	gravitation
Sewer system:	separation
Flowrate equation:	Manning equation
	n=0.013 concrete pipe
Minimum velocity:	0.7 m/s
Standard slope:	see Table 6.1
Minimum earth covering:	1.2 m

Design rainfall for storm sewer pipe is designed by Rational formula.

Qp = (1/3.6)*C*(f*I)*A
where Qp: peak runoff (m3/s)
C: runoff coefficient
f: areal reduction factor, 1.0 (because of not large catchment)
I: rainfall intensity, mm/hr

A: catchment area, km2

Rainfall intensity, I, is applied to the following equation:

$I = 13{,}567 / (t^{1.18}+89) : t < 3$ hr
where t: duration, min

6.3.2 Proposed Definitive Plan

Storm sewer is proposed to install under the same road as sanitary sewer. Route of storm sewer for Rach Ong, Phan The Hien, and Binh Dang is shown in Fig. 6.5 to 6.7.

The total length of storm sewer is 7, 10, and 9 km in for Rach Ong, Phan The Hien, Binh Dang, respectively. The construction cost is as follows:

Rach Ong	35 billion VND
Phan The Hien	55 billion VND
Binh Dang	54 billion VND
Total	144 billion VND.

The main feature of the new storm sewer are summarized in Table 6.3.

TABLE 6.1 STANDARD SLOPES FOR DESIGN CRITERIA

Diameter (mm)	Slope, I (‰)	V_{full} (m/s)	Q_{full} (m3/d)	Design Criteria in Vietnam	
				V_{min}(m/s)	I_{min}(‰)
300	2.3	0.7	0.05	0.8	2.5
400	2.1	0.8	0.10	0.8	-
500	2.0	0.9	0.17	0.9	-
600	1.9	0.9	0.27	1.0	-

TABLE 6.2 SUMMARY OF SANITARY SEWER DEVELOPMENT IN SOUTHERN NEW URBAN AREA

(unit: m)

Sewer	Diameter (mm)	Rach Ong (133 ha)	Pham The Hien (196 ha)	Binh Dang (208 ha)	Total (537 ha)
Secondary /Tertiary	300	6,384	9,398	9,984	25,766
Main	300	5,289	9,404	7,161	21,854
	400	920	287	782	1,989
	500	647	-	995	1,642
	600	250	-	-	250
	Sub total	7,106	9,691	8,938	25,735
Total		13,490	19,089	18,922	51,501
No. of House Connection		67,480	42,796	41,562	151,838
No. of Manhole		279	388	391	1,058
Earth Covering Depth		1.2 - 1.8	1.2 - 4.6	1.2 - 5.9	

TABLE 6.3 SUMMARY OF STORM SEWER DEVELOPMENT IN SOUTHERN NEW URBAN AREA

(unit: m)

Diameter (mm)	Rach Ong (133 ha)	Pham The Hien (196 ha)	Binh Dang (208 ha)	Total (537 ha)
600	-	90	-	90
700	-	99	-	99
800	-	-	181	181
1000	484	476	107	1,067
1200	2,074	2,196	740	5,010
1500	1,849	4,103	3,627	9,579
1800	1,956	1,221	2,302	5,479
2000	211	367	-	578
2500	602	1,459	2,316	4,377
Total	7,176	10,011	9,273	26,460
Earth Covering Depth	1.2 - 1.8	1.2 - 1.8	1.2 - 2.0	

FIG. 6.1 EXISTING DRAINAGE PIPE IN SOUTHERN NEW URBAN AREA

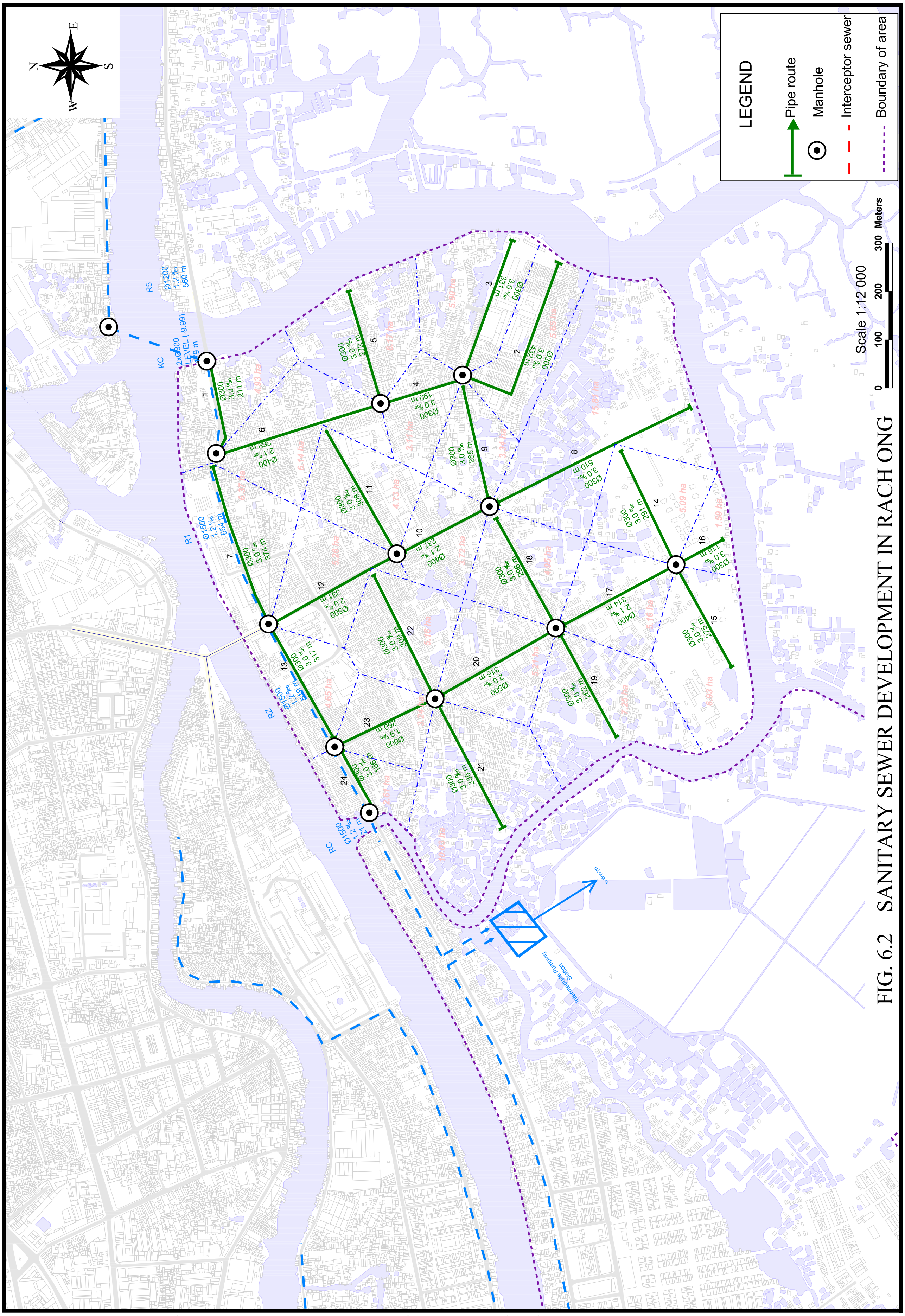


FIG. 6.2 SANITARY SEWER DEVELOPMENT IN RACH ONG

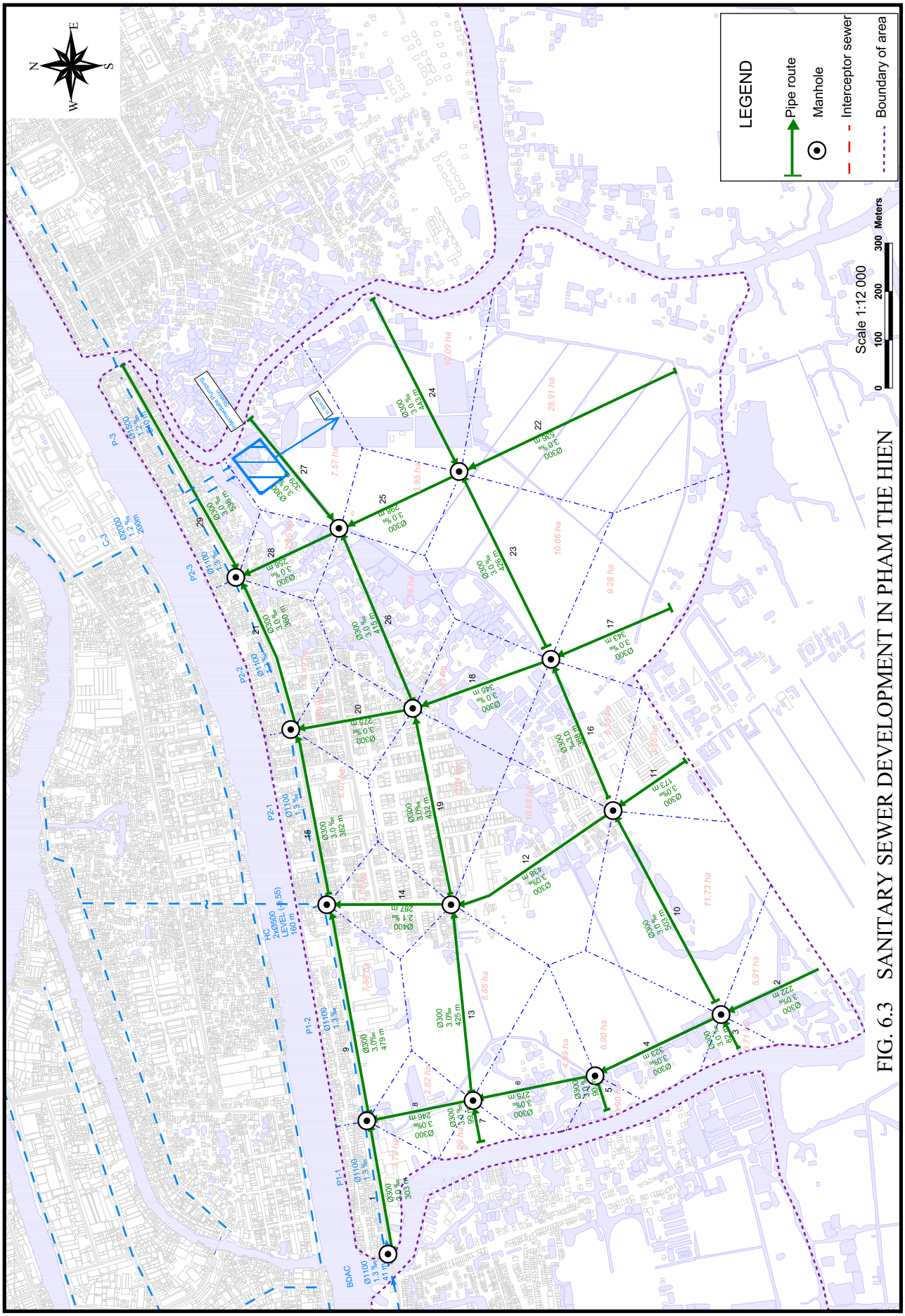


FIG. 6.3 SANITARY SEWER DEVELOPMENT IN PHAM THE HIEN

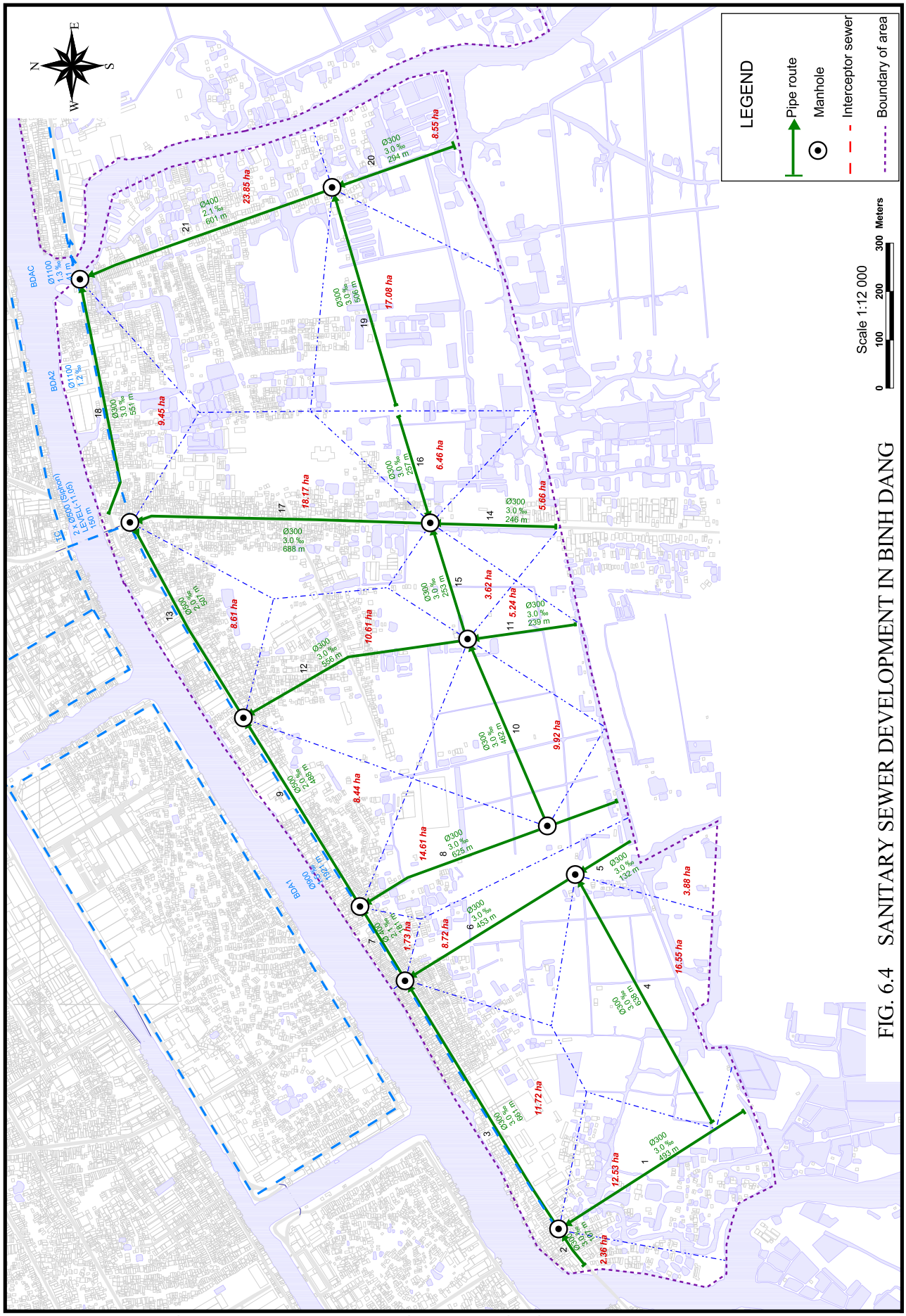


FIG. 6.4 SANITARY SEWER DEVELOPMENT IN BINH DANG

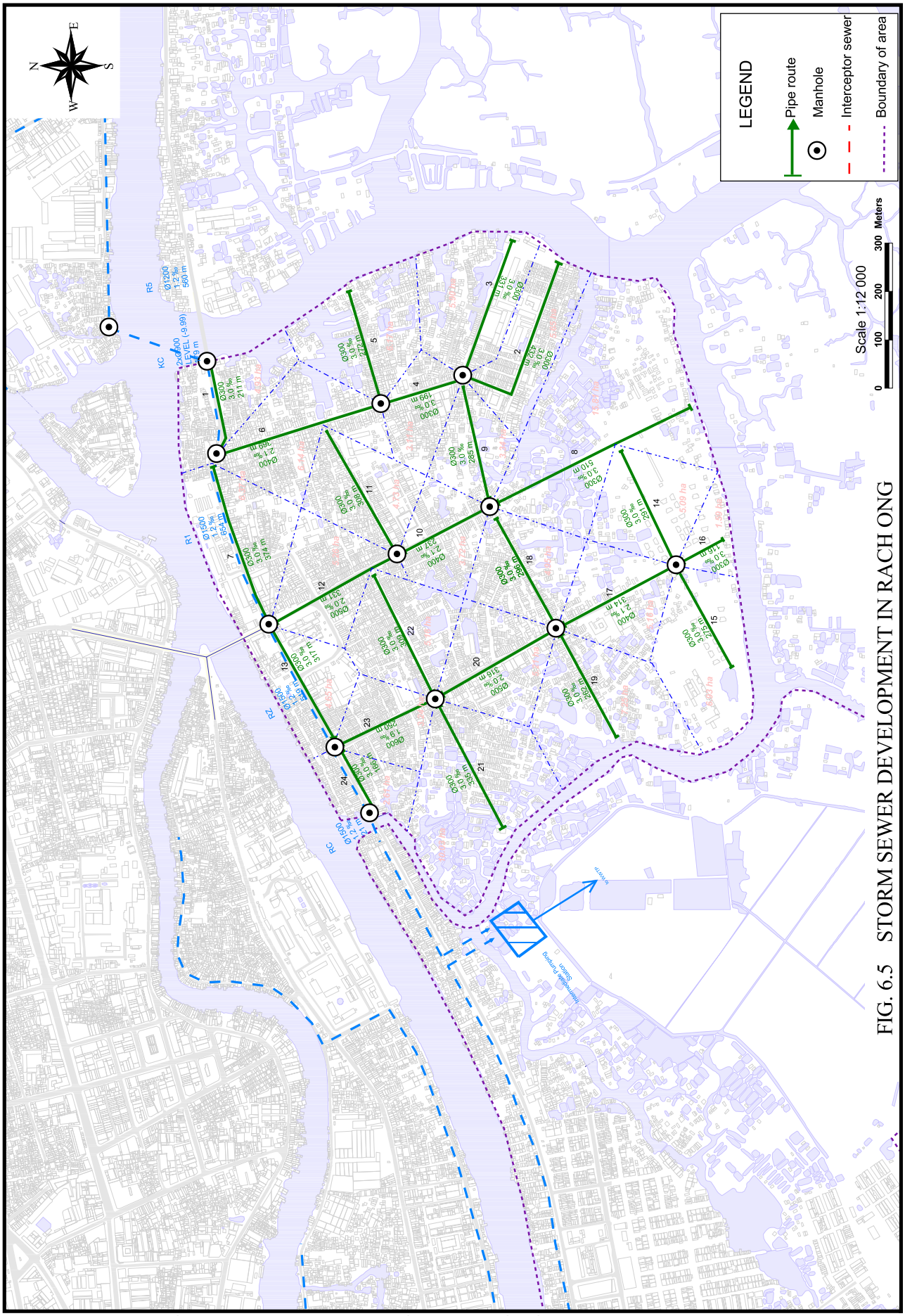


FIG. 6.5 STORM SEWER DEVELOPMENT IN RACH ONG

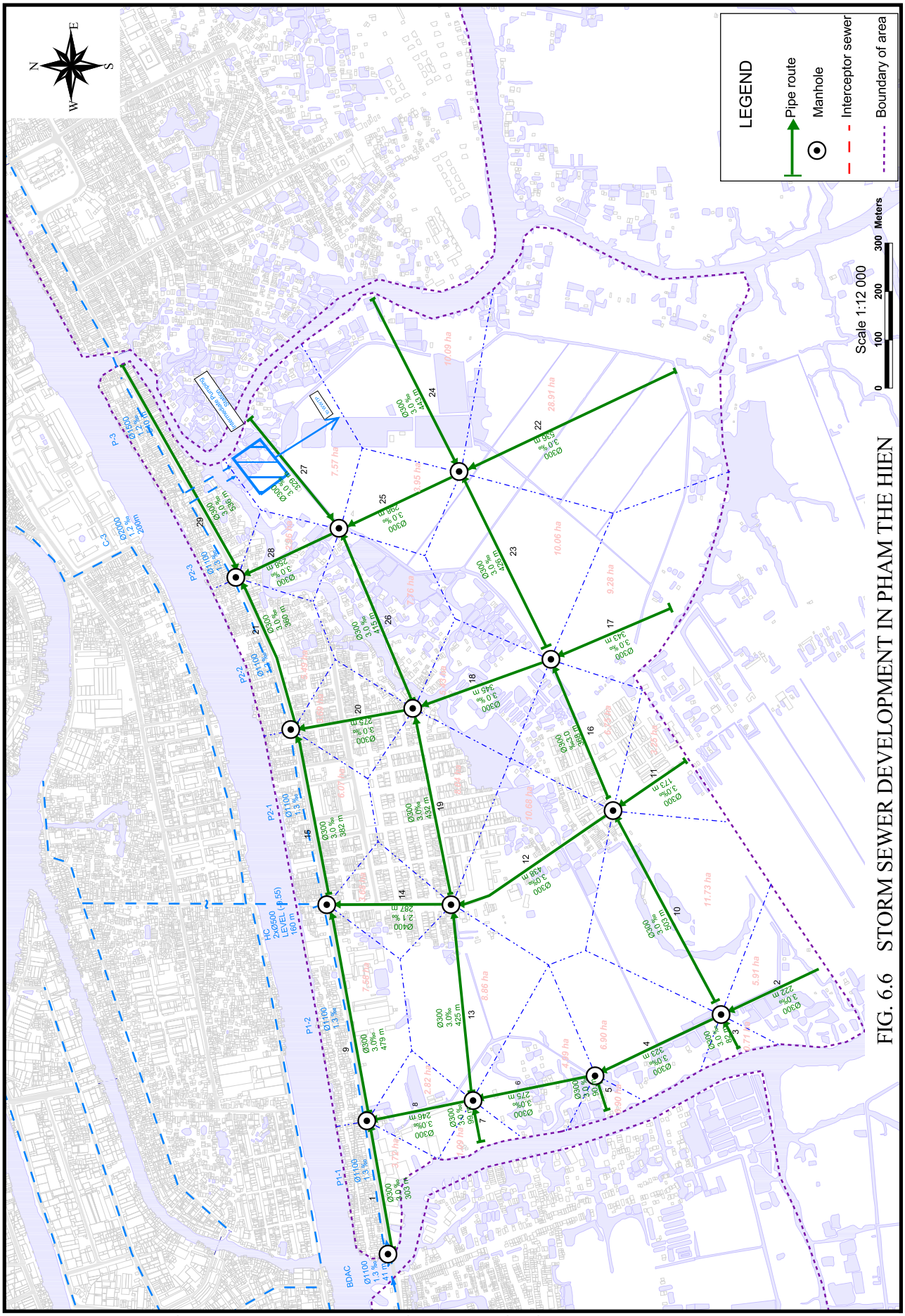


FIG. 6.6 STORM SEWER DEVELOPMENT IN PHAM THE HIEN

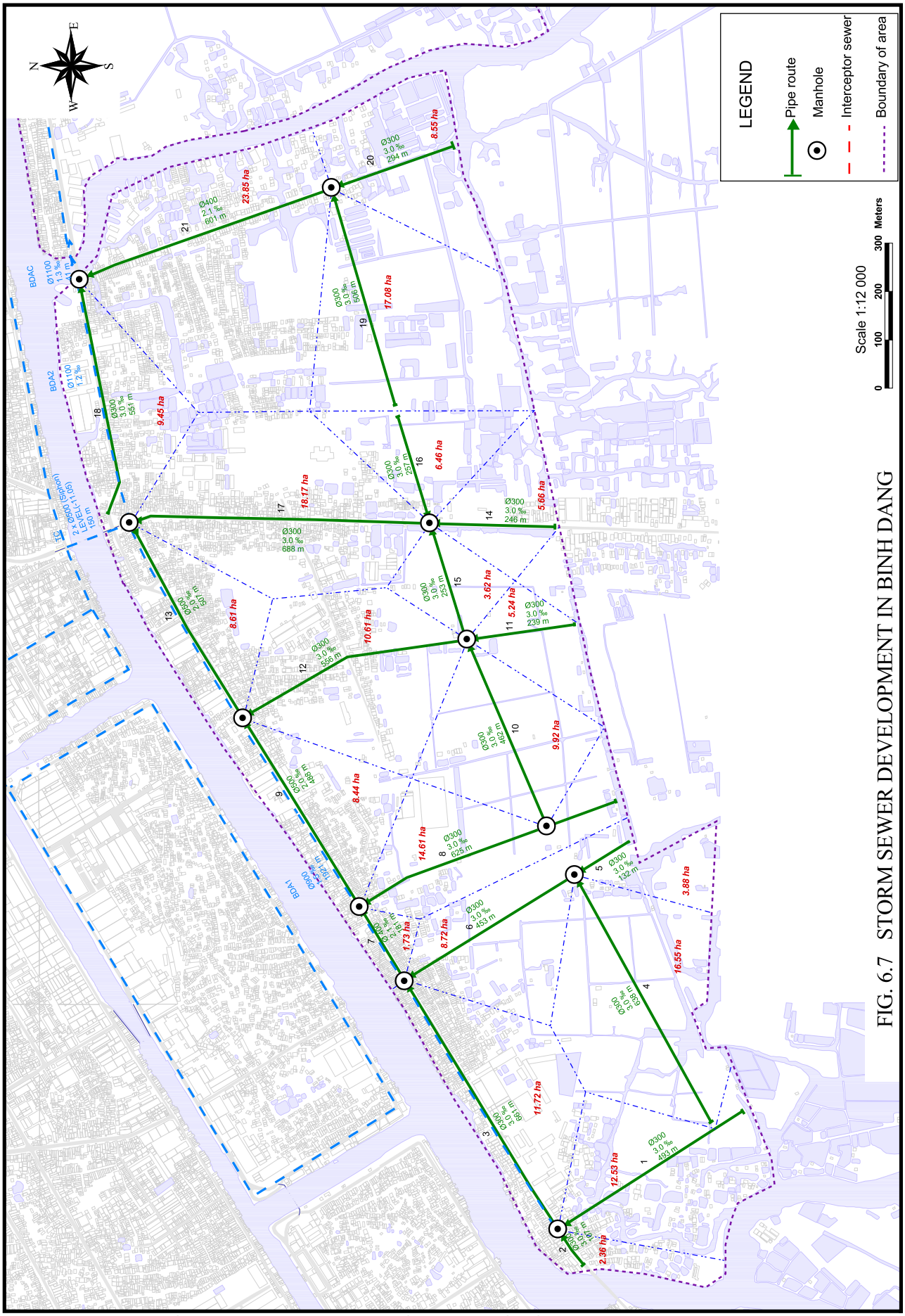


FIG. 6.7 STORM SEWER DEVELOPMENT IN BINH DANG