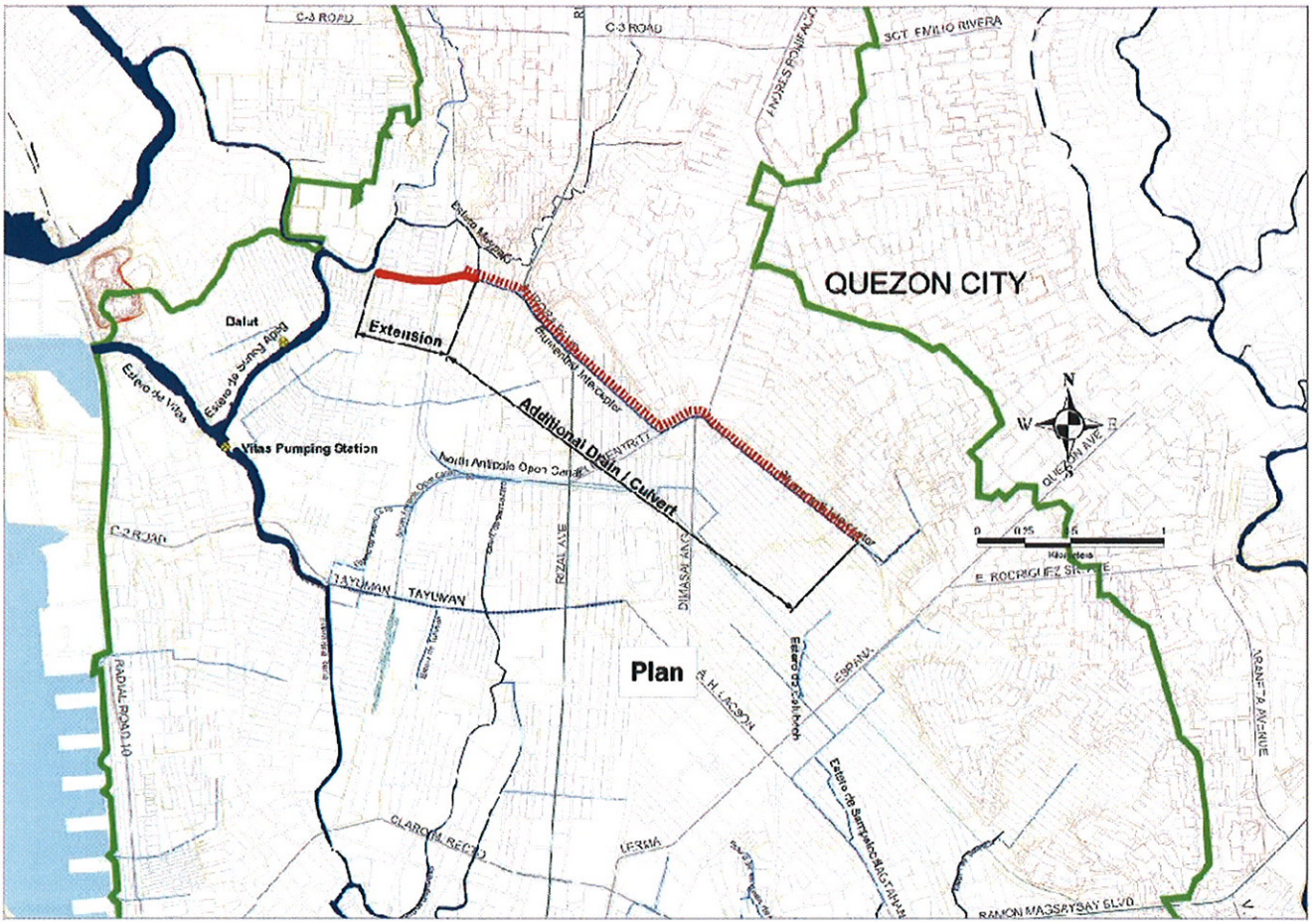
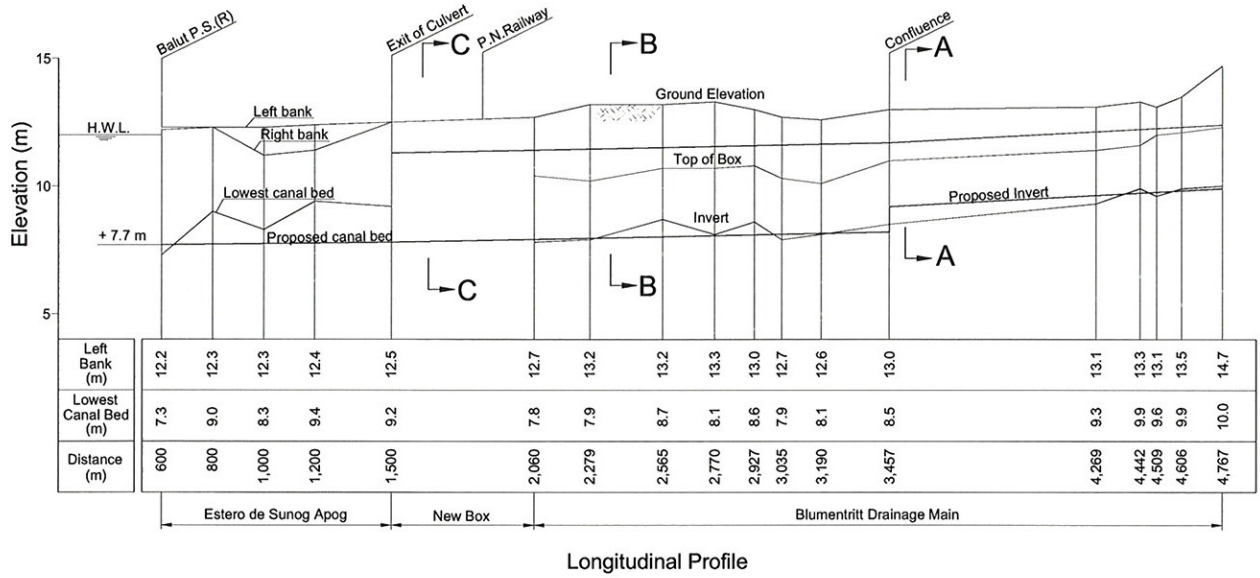
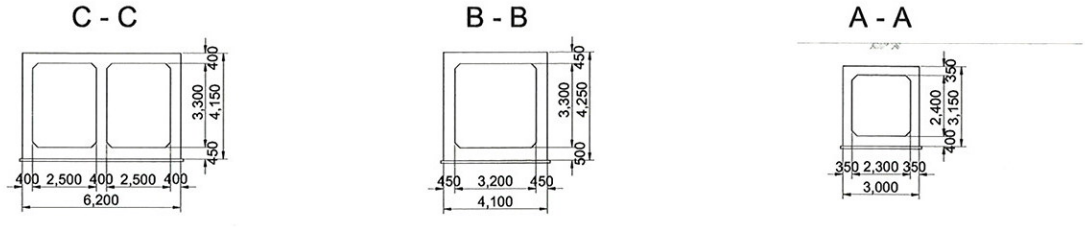
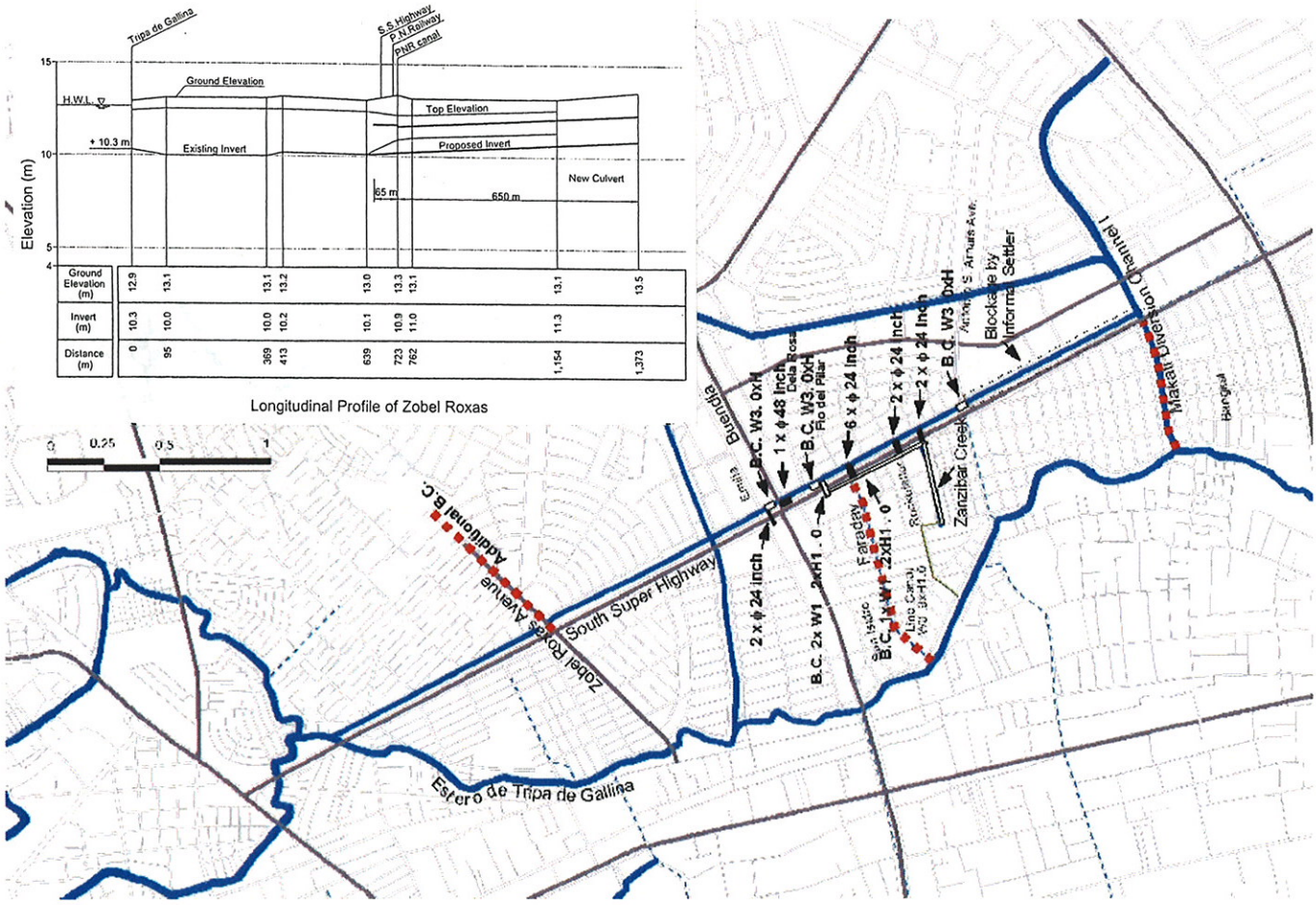


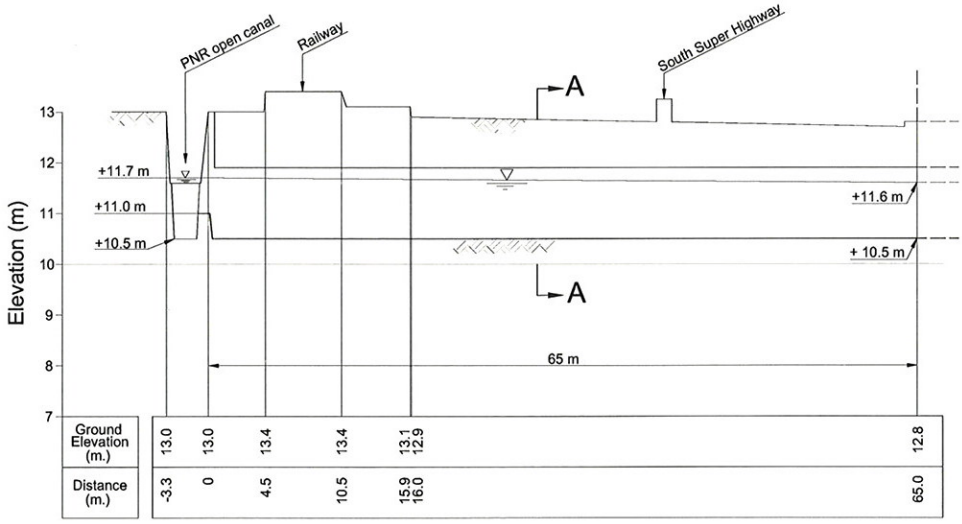


Longitudinal Profile



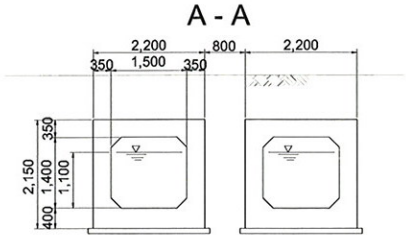
Cross-section



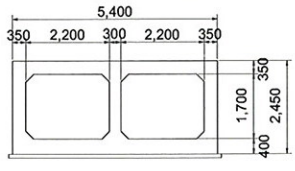


Longitudinal Profile of Culvert Box crossing P.N.R. and South Super Highway

Cross-section of P.N.R. - South Super Highway



Cross-section of Faraday D.M.



Cross-section of Makati Diversion

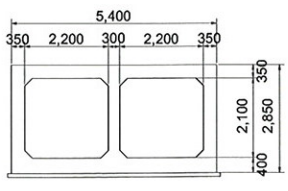
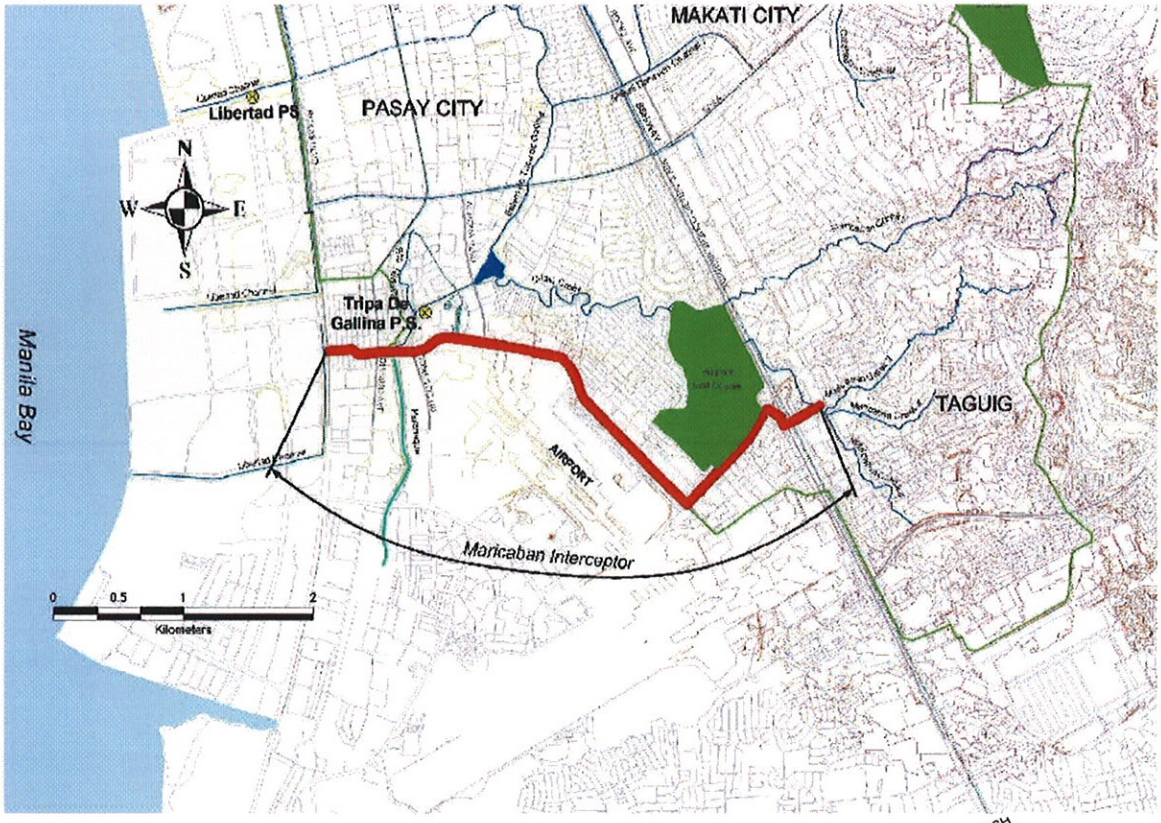
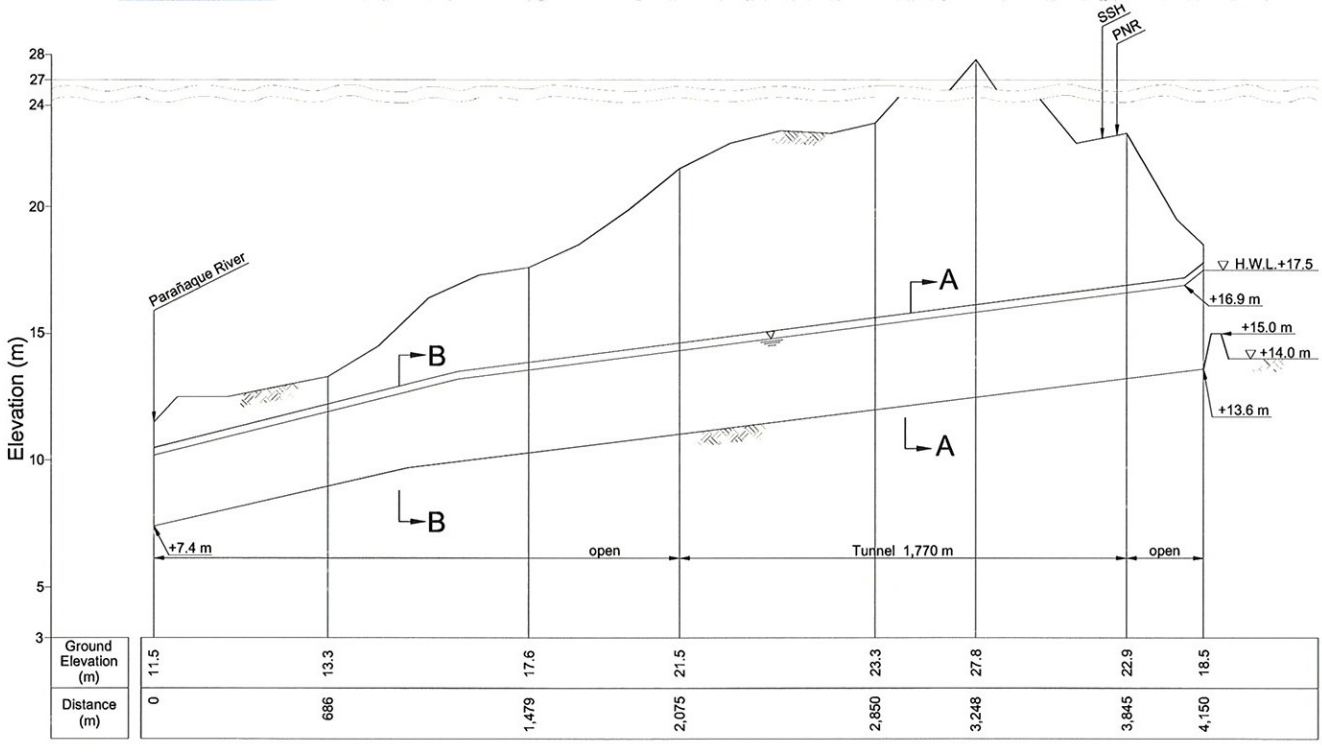
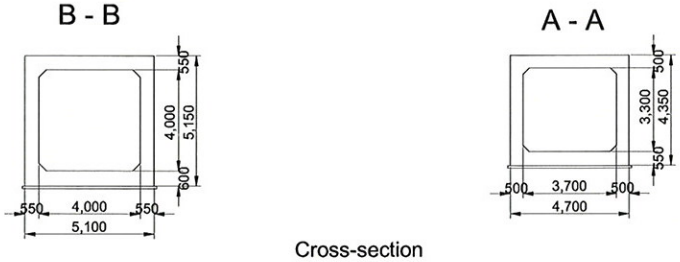


Fig. Additional Works for Severer Inundation Area of San Isidro - San Antonio - Pio del Pilar

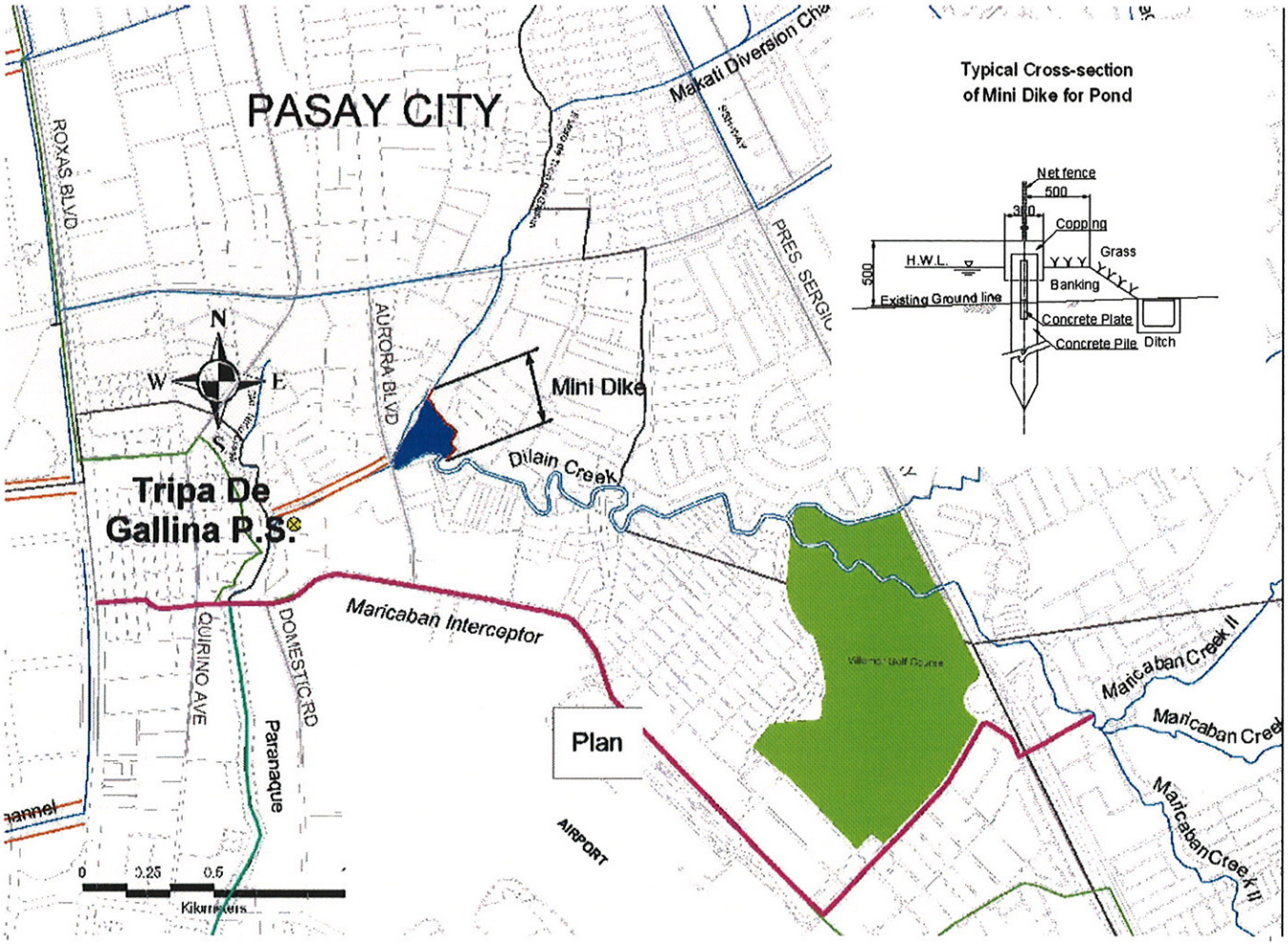


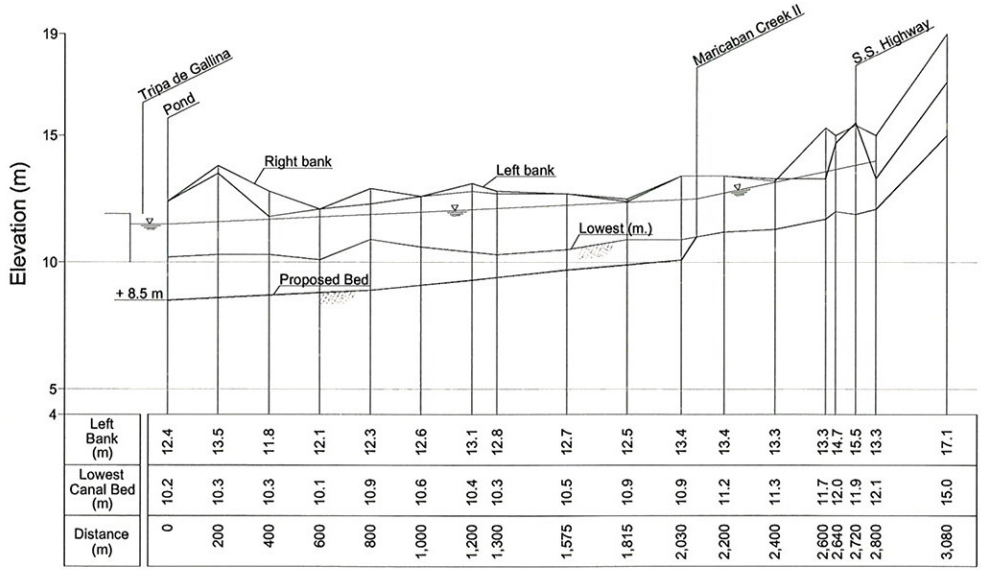


Longitudinal Profile of Maricaban Interceptor



Cross-section





Left Bank (m)	12.4	13.5	11.8	12.1	12.3	12.6	13.1	12.8	12.7	12.5	13.4	13.4	13.3	13.3	14.7	15.5	13.3	17.1
Lowest Canal Bed (m)	10.2	10.3	10.3	10.1	10.9	10.6	10.4	10.3	10.5	10.9	10.9	11.2	11.3	11.7	12.0	11.9	12.1	15.0
Distance (m)	0	200	400	600	800	1,000	1,200	1,300	1,575	1,815	2,030	2,200	2,400	2,600	2,640	2,720	2,800	3,080

Longitudinal Profile of Dilain Creek for Alt - 2

ANNEX E.5

ALTERNATIVE STUDY

ANNEX E.5 ALTERNATIVE STUDY

(1) ALTERNATIVE STUDY FOR ADDITIONAL WORKS OF AVILES DRAINAGE AREA

According to the proposed drainage scheme, total drainage area of Quiapo-Aviles drainage block becomes 6.2 km^2. On the other hand, the total design drainage area determined in the original design for Aviles and Quiapo pumping stations in 1978 was 5.8 km^2. Considering this, some additional measures should be applied within Quiapo-Aviles drainage block to compensate the increase of the drainage area from the original scheme.

There are two alternatives as follows:

Alternative 1:

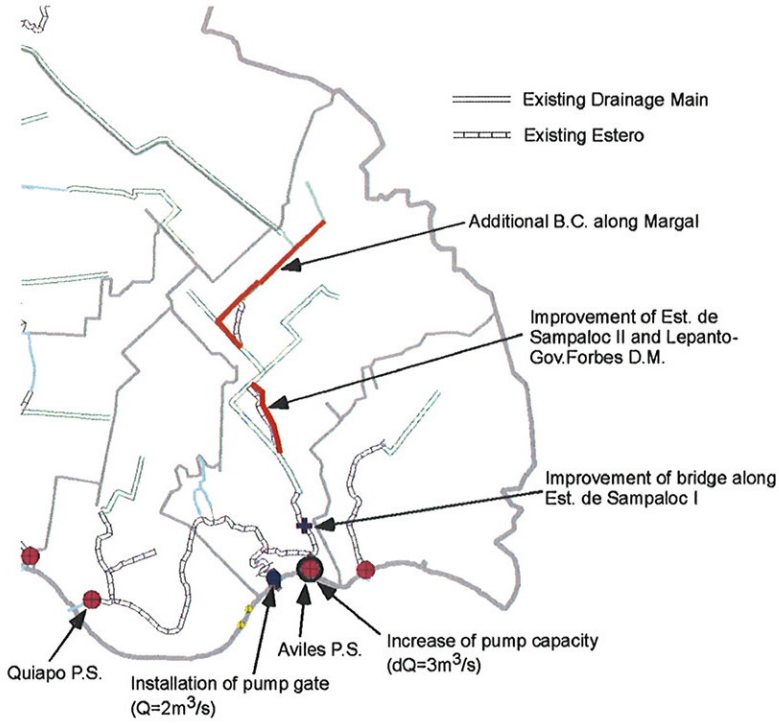
To increase pump and channel capacities of Quiapo-Aviles drainage block

Alternative 2:

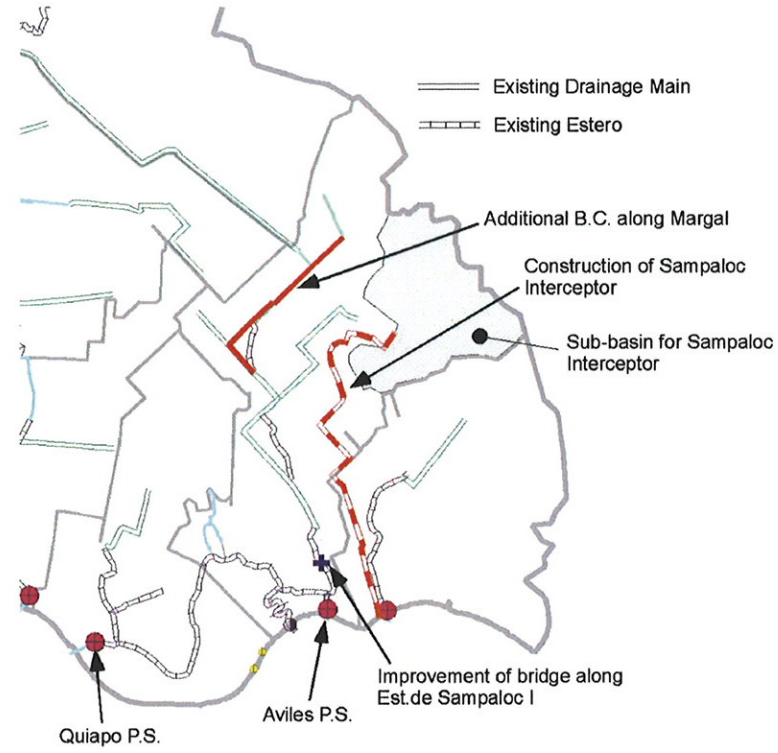
Construction of Sampaloc Interceptor that may drain the stormwater from the uppermost sub-basin of Aviles drainage basin to the Pasig River by gravity

Outlines of the alternatives are shown in Figure A.E.5.1.

Table A.E.5.1 summarizes the results of the preliminary design for respective alternatives. Based on this, *Alternative 1,* which utilizes present system effectively and is technically sound, is selected as the appropriate plan in view of less social negative impact and less project total cycle cost under the condition that benefit accrued from the both alternatives is almost same.



Alternative 1



Alternative 2

Figure A.E.5.1 Outline of Alternatives for Additional Works of Aviles Drainage Area

Table A.E.5.1 Alternative Study for Additional Works of Aviles drainage Area

Alternative	Alternative 1		Alternative 2	
Item	To increase pump and channel capacities of Quiapo-Aviles drainage block		Construction of Sampaloc Interceptor that may drain the stormwater from the uppermost sub-basin of Aviles drainage basin to the Pasig River by gravity	
Proposed Plan	1. **Construction of Additional B.C. along Margal** to drain the stormwater in the uppermost sub-basin of the existing Blumentritt Interceptor through Quiapo-Aviles drainage block 2. **Improvement of a Brdige along estero de Sampaloc I** to improve flow capacity of channel to Aviles P.S. 3. **Improvement of estero de Sampaloc II and Lepanto-Gov.Forbes D.M.** to increase flow capacity of the channels to Aviles P.S. to cope with increase of drainage area of Quiapo-Aviles drainage block 4. **Increase of pump capacity at Aviles P.S.** to cope with increase of drainage area of Quiapo-Aviles drainage block 5. **Installation of Pump gate at Uli-Uli floodgate** to cope with increase of drainage area of Quiapo-Aviles drainage block		1. **Construction of Additional B.C. along Margal** to drain the stormwater in the uppermost sub-basin of the existing Blumentritt Interceptor through Quiapo-Aviles drainage block 2. **Improvement of a Brdige along estero de Sampaloc I** to improve flow capacity of channel to Aviles P.S. 3. **Construction of Sampaloc Interceptor** to reduce discharge toward Aviles P.S.	
Dimension	1. Construction of Additional B.C. along Margal 2. Improvement of a Brdige along estero de Sampaloc I 3. Improvement of estero de Sampaloc II and Lepanto-Gov.Forbes D.M. 4. Increase of pump capacity at Aviles P.S. 5. Installation of Pump gate at Uli-Uli floodgate	W3.8mxH2.1mxL1330m LS LS 3 m³/s 2 m³/s	1. Construction of Additional B.C. along Margal 2. Improvement of a Brdige along estero de Sampaloc I 3. Construction of Sampaloc Interceptor (design discharge) 3-1. Culvert 1 3-2. Culvert 2 3-3. Culvert 3	W3.8mxH2.1mxL1330m LS (15 m³/s) 2xW2.8mxH2.7mxL1,000m 2xW2.7mxH2.6mxL1,000m 1xW3.2mxH2.7mxL700m
Project cycle cost	A. Main works cost 1. Construction of Additional B.C. along Margal 2. Improvement of a Brdige along estero de Sampaloc I 3. Improvement of estero de Sampaloc II and Lepanto-Gov.Forbes D.M. 4. Increase of pump capacity at Aviles P.S. 5. Installation of Pump gate at Uli-Uli floodgate (Sub Total) B. O/M cost for 50 years 1. Maintenance cost 2. Running cost of pump facilities 3. Replacement cost of pump facilities (Sub Total) C. Total cycle cost	(million Pesos) 266 10 263 120 160 819 205 24 200 429 **1,248**	A. Main works cost 1. Construction of Additional B.C. along Margal 2. Improvement of a Brdige along estero de Sampaloc I 3. Construction of Sampaloc Interceptor 3-1. Culvert 1 3-2. Culvert 2 3-3. Culvert 3 (Sub total) B. O/M cost for 50 years 1. Maintenance cost (Sub Total) C. Total cycle cost	(million Pesos) 266 10 385 360 199 1,220 305 305 **1,525**
Technical and construction aspects	- Excess water is drained by gravity system and finally by drainage pumping station. - Construction of culvert is made by conventional open excavation method with 4 m average excavation depth. Construction technically, it is simple and easy. - During construction works, a half width of the street will be partially closed. - Excavation and disposal volumes are small compared with Alternative 2. - Existing system can be fully utilized in combination with additional channel.		- Excess water is drained by gravity system. - Interceptor to be constructed in the underground of the street crosses some existing drainage culverts, open channels, water supply pipes, LRT, flyover, etc., accordingly excavation depth becomes bigger. - Construction of interceptor is made by conventional open excavation method with 8 m average excavation depth. Construction technically, it is far difficult, because the above underground facilities must be supported (as underpinning method) during construction stage - During construction, streets on the proposed route will be partially closed. - Excavation and disposal volumes are considerably large	
Operation and maintenance aspect	- Maintenance of channels and facilities is easily compared with Alternative 2. - Running cost for additional pump equipment is small - Accordingly, total project cycle cost is smaller than that of Alternative 2.		- Maintenance of interceptor is far difficult compared with Alternative 1. - No running cost is needed. - Total project cycle cost (initial cost) is larger than that of Alternative 1.	
Social negative impact (Traffic interruption, resettlement)	- During construction, a half width of the questioned street can be operated for public use. - Traffic congestion is limited locally. - No resettlement will be needed.		- During construction, the questioned street can be operated by temporary covering of street surface on the excavated part. - Traffic congestion is expanded regionally - No resettlement will be needed.	
Economical aspect	- Less cost compared with Alternative 2		- Costly compared with Alternative 1	
Overall evaluation	Recommendable		Not recommendable	

Note:

(Maintenance cost) =0.5% x (Mainwork cost) x 50years

(Running cost) = ((Cost for fuel) + (Labor cost for increased pump capacity)) x 50years

= (35,000 pesos/year + 450,000 pesos/year) x 50 years = 24,250,000 pesos/year

(Cost for fuel) =35,000 pesos/year (7,000pesos/year/(m^3/s) x 5 m^3/s is assumed based on actual amount in Valencia and Quiapo pumping stations)

(Labor cost for increased pump capacity) = 300pesos/day x 25day/month x 12month x 5 persons = 450,000pseos/year

(Replacement cost) = 40,000,000 pesos/(m^3/s) x 5 m^3/s = 200,000,000pesos

(2) Alternative Study for Additional Works of Dilain/Maricaban Creek Area

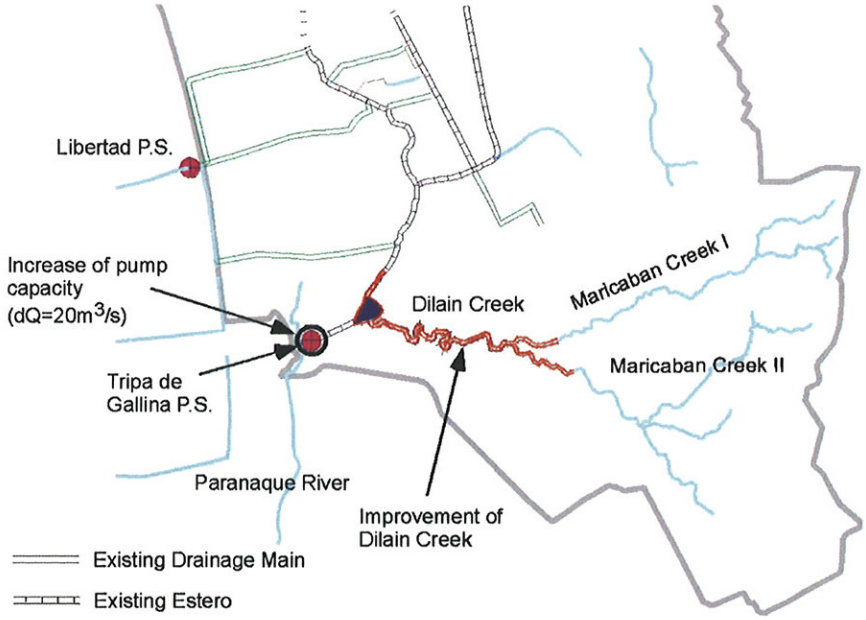
Expected future urban development in the upper sub-basin of Maricaban Creek will result in increase of run-off and it will affect the inundation condition in Libertad –Tripa de Gallina drainage block. There are two alternatives for this problem.

Alternative 1: Improvement of Dilain Creek and installation of additional drainage pump at Tripa de Gallina pumping station

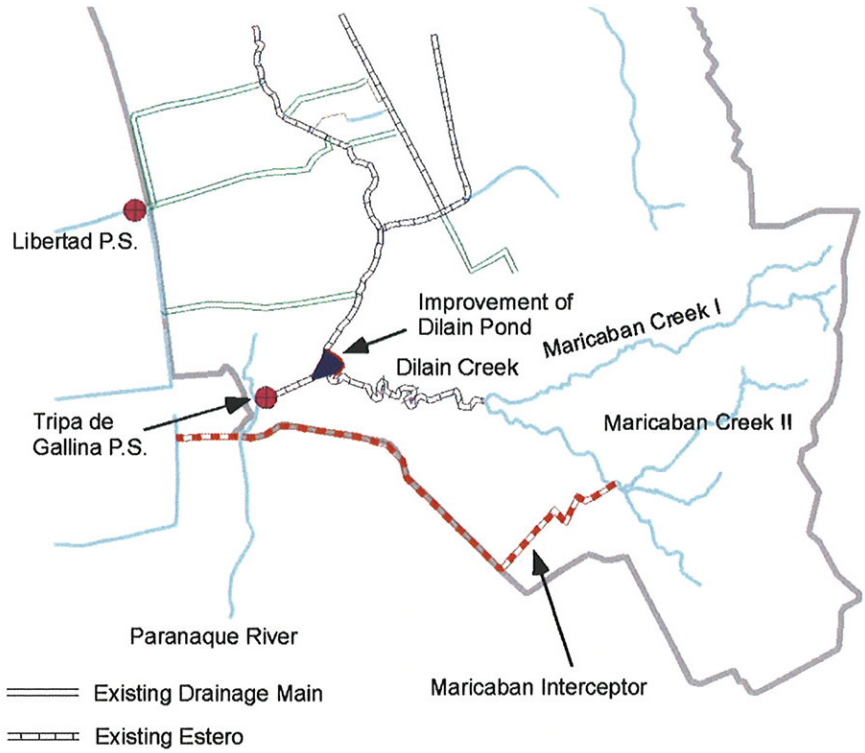
Alternative 2: Construction of new Maricaban Interceptor with improvement of Dilain Pond

Outlines of the alternatives are shown in Figure AE.5.2.

Table A.E.5.2 summarizes the results of the preliminary design for respective alternatives. Based on this, *Alternative 2*, which is technically sound with less project total cycle cost, is selected as an appropriate plan under the condition that benefit accrued from the both alternatives is almost same.



Alternative 1



Alternative 2

Figure A.E.5.2 Outline of Alternatives for Additional Works of Dilain/Maricaban Creek Area

Table A.E.5.2 Alternative Study for Additional Works of Dilain/Maricaban Creek Area

Alternative	Alternative 1		Alternative 2	
Item	Improvement of Dilain Creek and increase of pump capacity at Tripa de Gallina P.S.		Construction of Maricaban interceptor	
Proposed plan	1. **Improvement of Dilain Creek** to prevent overflow from Dilain Creek to the surroundings 2. **Increase of pump capacity at Tripa de Gallina P.S.** to cope with increase of runoff from upper maricaban basin		1. **Construction of Maricaban Interceptor** to reduce flood risk caused by future urbanization in upper Maricaban Creek basin 2. **Improvement of Dilain Pond** to prevent reverse flow from Est. de Tripa de Gallina to the surroundings	
Countermeasures	1. Improvement of Dilain Creek (Design discharge) 1-1. Improvement works 1-2. Reconstruction of bridge 2. Increase of pump capacity at Tripa de Gallina P.S. 2-1. Increase by replacement of existing pump 2-2. Increase by newly installation	 (105 m³/s) H1.8mx5,800 m 2 bridges 10 m³/s 10 m³/s	1.Maricaban interceptor (Design discharge) 1-1. Culvert 1 1-2. Culvert 2 1-3. Culvert 3 2. Improvement of Dilain Pond -Construction of parapet wall along Tripa de Gallina pond	 (40 m³/s) 2xW3.5mxH3.3mxL460m W3.7mxH3.3mxL2,550m W4.0mxH4.0mxL1,600m H0.5mxL350m
Project cycle cost	A.Main works cost 1. Improvement of Dilain Creek 1-1. Improvement works 1-2. Reconstruction of bridge 2. Increase of pump capacity at Tripa de Gallina P.S. 2-1. Increase by replacement of existing pump 2-2. Increase by newly installation (Sub total) B.O/M cost for 50 years 1. Maintenance cost 2. Running cost of pump facilities 3. Replacement cost of pump facilities (Sub total) C.Total cycle cost	(million Pesos) 232 21 400 1,100 1,753 438 52 800 1,290 **3,043**	A.Main works cost 1.Maricaban interceptor 1-1. Culvert 1 1-2. Culvert 2 1-3. Culvert 3 2. Improvement of Dilain Pond (Sub total) B.O/M cost for 50 years 1. Maintenance cost (Sub total) C.Total cycle cost	(million Pesos) 159 625 592 5 1,381 345 345 **1,726**
Technical and construction aspects	- Excess water is drained by gravity system and finally by drainage pumping station. - Large scale improvement works of Dilain creek within the existing channel width is needed. - Construction technically, it is conventional one. - The creek is running densely populated areas and no road runs along creek, accordingly access to site is not easy. - Additional drainage capacity will be 20 m³/s with larger scale.		- Excess water is drained by gravity system. - Iterceptor to be constructed in the underground of the street is constructed by conventional open excavation method with 5.5 m average excavation depth. - Construction technically, it is conventional one. - Excess water is drained by existing creek and new interceptor, therefore, no improvement of the Dilain creek is needed.	
Operation and maintenance aspect	- Maintenance of channels and facilities is easily compared with Alternative 2. - Running cost for additional pump is costly. - Accordingly, total project cycle cost is larger than that of Alternative 2.		- Maintenance of interceptor is not so difficult (as ordinary case). - No running cost for interceptor is needed. - Total project cycle cost is smaller than that of Alternative 1.	
Social negative impact (Traffic interruption, resettlement)	- During construction, traffic congestion will be brought about in and around site. - Some Resettlements of river line area will be needed to keep yard for construction.		- During construction, a half width of the questioned street can be operated for public use. However, traffic condition will be brought about in and around site. - No resettlement will be needed.	
Economical aspect	Costly compared with Alternative 2		Less cost compared with Alternative 1	
Overall evaluation	Not recommendable		Recommendable	

Note:

(Maintenance cost) =0.5% x (Mainwork cost) x 50years

(Running cost) = ((Cost for fuel) + (Labor cost for increased pump capacity)) x 50years

= (140,000 pesos/year + 900,000 pesos/year) x 50 years = 52,000,000 pesos/year

(Cost for fuel) =140,000 pesos/year (7,000pesos/year/(m^3/s) x 20 m^3/s is assumed based on actual amount in Valencia and Quiapo pumping stations)

(Labor cost for increased pump capacity) = 300pesos/day x 25day/month x 12month x 10 persons = 900,000pseos/year

(Replacement cost) = 40,000,000 pesos/(m^3/s) x 20 m^3/s = 800,000,000pesos