CHAPTER 3

INVESTIGATION AND ANALYSIS

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3.1 Photogrammetric Mapping, Topographic and River Survey

3.1.1 Aerial Photography and Mapping

(1) Aerial Photography

Aerial photography at a scale of 1:8,000 and covering approximately 64 line kilometer in total was started after obtaining permission from the Central Survey and Mapping ABRI (PUSSURTA ABRI).

The results of the aerial photography are as follows:

Total No. of Films	1 Roll
Total Flight Runs	12 Runs
Total Exposures	156 Photos
Overlap and Side Lap	55% and 35%

The aerial photographs were taken by using Semarang Airport as a base, and processing of film and printing of aerial photos were done in Jakarta. The aerial photos were developed for mapping after checking navigation routes. The extent of the aerial photograph and navigation routes are shown in Fig.3.1.1.

(2) Uncontrolled Mosaic

Using aerial photographs that are newly taken at a scale 1:8,000 in 1997, uncontrolled mosaic photo at a scale of 1:10,000 was established for the area of 35 km^2 in total. The uncontrolled mosaic are shown in Fig.3.1.2.

(3) Photo Control Point Survey

Photo control point survey was conducted by Global Positioning System (GPS), and spirit leveling started from the photo control points and bench marks (BMs) for the above-mentioned photogrammetry and the existing national control points and Tanda Tinggi Geodesi (TTGs). (refer to Fig.3.1.1)

(a) Control Point Survey

The control point survey by GPS was executed to determine the X and Y coordinates of a minimum two (2) existing control points to be used for the photogrammetric mapping, cross section survey, longitudinal profile and topographic survey. Final results of all photo control points by GPS are shown in Table 3.1.1.

(b) Datum Coordinates

The Indonesian Government changed the surveying datum in 1997 from the Indonesian Datum 1974 (ID74) ellipsoid to the World Geodetic System in 1984 (WGS 84).

Two (2) existing GPS stations having the new Indonesian Datum, namely N1.0259 and N.0004, which were established by Badan Koodinasi Survey Dan Pemetaan National (Bakosurtanal) in 1994, were chosen and applied as the X and Y geographical coordinates datum for this study by the JICA Study Team.

(c) GPS Observation

At least four (4) satellites were simultaneously observed for one hour for all the control points. In general, the base line lengths were planned between two (2) to five (5) kilometers.

(d) Post-processing

The post-processing was done using GPS survey software to obtain the best independent baseline solutions for all the GPS sessions. With the existing two stations (N1.0259, N.0004) fixed as the planimetric control on the modified WGS ellipsoid and the same stations serving as the vertical control for mean sea level height, the whole GPS network was constrained and adjusted by the GPS surveying software.

(e) Accuracy of GPS Survey

Accuracy of trigonometric closures for coordinates and height were checked to be less than 10 PPM (10/1,000,000) between the control points (refer to Figs. 3.1.3 and 3.1.4).

(4) Leveling

Minor order leveling was executed to obtain the heights of control points necessary for the topographic survey, cross section survey and longitudinal profile survey.

Leveling survey was conducted by means of closed loops and double runs, and temporary bench marks were established at every 2 km interval on the leveling routes. Also temporary bench marks were established at 49 points in Semarang City. And a total distance of the leveling survey was approximately 105 km.

The leveling works are described below:

(a) Datum Height

Government bench marks obtained from the Mean Sea Level of Indonesia as established by Bakosurtanal are applied for the leveling survey.

(b) Checking of Government Bench Marks

Before starting leveling survey, heights of three government bench marks namely TTG446, TTG449 and TTG449 were checked by the local contractor.

Leveling Loops	Distance	Misclosure
TTG449 to TTG447	4.601 km	14 mm
TTG447 to TTG446	5.095 km	-201 mm

From the above, it was judged by the JICA Study Team that TTG446 shall be ignored because TTG446 had ground subsidence about 20 cm from 1983.

The JICA Study Team decided to use TTG447 as the bench mark for topographic survey, river cross section survey and longitudinal profile survey in this project.

(c) Accuracy of Leveling

As show in Figs. 3.1.5 and 3.1.6, any misclosure of leveling does not exceed $20\sqrt{S}$ between bench marks and/or control points (S: a single distance between bench marks in kilometer). And Standard division was 3.80 mm/km.

(5) Field Verification

Using two (2) times enlarged aerial photographs, the keys for interpretation required for plotting and cartography was done by verifying them in the field. The work quantity was 35 km^2 for mapping with the scale of 1:2,000 and 1 km^2 for mapping with the scale of 1:1,000. The area of field verification are shown in Fig.3.1.7.

(6) Aerial Triangulation

The implication and purpose of Aerial Triangulation work are to obtain the coordinates (X, Y, Z) of the aerial photo points necessary for the orientation process of each stereo model on the plotting instrument for the purpose of topographic map on the scale of 1:2,000 and 1:1,000 applying coordinates (X, Y, Z) of ground control points resulting from field measurement (GPS and leveling) (refer to Figs. 3.1.8 and 3.1.9).

(a) Aerial Triangulation and Block Adjustment

The sequence of works to be carried out is as follows:

(i) Quantity

119 models of aerial triangulation work was carried out, and the quantity of models for each flight run was as follows:

Run Number	Number of Photo	Number of Model
Run 1(Semarang Area)	10 PCs	9 Models
Run 2(Semarang Area)	14 PCs	13 Models
Run 3(Semarang Area)	13 PCs	12 Models
Run 4(Semarang Area)	13 PCs	12 Models
Run 5(Semarang Area)	13 PCs	12 Models
Run 6(Semarang Area)	11 PCs	10 Models
Run 7(Semarang Area)	18 PCs	17 Models
Run 8(Semarang Area)	19 PCs	16 Models
Run 9(Semarang Area)	17 PCs	6 Models
Run 11(Semarang Area)	9 PCs	6 Models
Run 12(Semarang Area)	9 PCs	6 Models
Total	146 PCs	119 Models

(ii) Data Collection

All necessary data such as flight index, control point coordinate and calibration of the aerial photographic camera were collected.

(iii) Planning

Preparation of aerial triangulation was carried out as follows:

Selection of the Aerial Photos

Total sheets of aerial photos for Ungaran Area : 12 models

Total sheets of the aerial photos for Semarang Area : 107 models.

Control Point Selection

Total control points were 22, consisting of 5 horizontal and 17 vertical control points for aerial triangulation processing at Ungaran area.

Total control points of 74, consisting of 21 horizontal and 53 vertical control points for aerial triangulation processing at Semarang area.

(iv) Preparation

The preparation stages were carried out as follows:

Point selection and numbering

Pass points and tie points were selected within the triple overlap area with the circle notation on the index model.

Numbering system for aerial triangulation

Ex. Model number : 8011*1*

Where:

8011 : First two digits show the number of flight run as shown and last two digits show the number of aero photographs.

1 : Tie point number

The horizontal and vertical control points were annotated on the index models as a square, and vertical control points were annotated as triangle.

The point selection and numbering were carried out on the 1:2,000 and 1: 1,000 scale of aerial photographs by using mirror stereoscope.

(v) Point Transfer

The selected and control points on the diapositive film were marked and then transferred to adjacent diapositive film by using Wild PUG-4 instrument. This process was carried out until the last photo.

(vi) Index Model

The index model on 1:50,000 scale, where all point numbers were plotted showing the relationship between each point, was produced.

(vii) Measurement of Coordinates

Photo coordinates were observed and measured by using an analytical stereoplotter Leica SD-2000. All points including fiducial marks were measured.

(viii) Adjustment

The final step of the aerial triangulation is the block adjustment using PATM-GPS software.

(ix) Result

<u>Block adjustment of Ungaran Area</u>

Sigma Naught in the model system is as below.

Sigma naught for horizontal block = 21.064 micron
Sigma naught for vertical block = 14.773 micron

Weight root mean square values and check value of residual of Photogrammetric observations.

Model Points	RMS. (meter) Terrain system	RMS. (micron) Model system	CHV VXY/Z Model system
OBS X/Y	0.090	11.216	47.586
OBS z	0.063	7.888	23.664
Projection center	RMS. (meter) Terrain system	RMS. (micron) Model system	CHV VXY/Z Model system
OBS X/Y	0.120	14.975	65.532
OBS z	0.094	11.750	73.658

<u>Block adjustment of Semarang Area</u>

Sigma Naught in the model system, is as below.

Sigma naught for horizontal block = 18.890 micron

Sigma naught for vertical block = 20.353 micron

Weight root mean square values and check value of residual of Photogrammetric observations.

Model Points	RMS. (meter) Terrain system	RMS. (micron) Model system	CHV VXY/Z Model system
OBS X/Y	0.094	12.118	51.411
OBS z	0.080	10.273	30.820

Projection center	RMS. (meter) Terrain system	RMS. (micron) Model system	CHV VXY/Z Model system
OBS X/Y	0.254	32.718	138.809
OBS z	0.130	13.292	39.875

(x) Equipment

The equipment used in Aerial Triangulation is as follows:

Stereoscope	2 units
Point transfer Wild PUG-4	1unit
Analytical Stereoplotter Leica SD-2000	1 unit
Computer	1 unit
PATM-GPS Software	1 unit

(7) Plotting and Editing

The implication and purpose of stereo plotting and editing work are drawing details and contour lines using aerial photo diapositives, which are placed on the plate holders of the stereo plotter instrument (refer to Figs.3.1.10 to 3.1.13).

The sequences of the plotting and editing works are as follows:

(a) Data collection

All the following necessary data were collected and prepared for stereo plotting.

- Model index of aerial triangulation
- Print out of aerial triangulation adjustment
- Vertical control points and description on two (2) times enlarged aerial photographs
- Field identification on two(2) times enlarged aerial photographs

(b) Planning

Preparation of stereo plotting was carried out as follows:

(i) Control sheets

Total control sheets of the stereo plotting topographic map are:

- 48 sheets for 1:2,000 scale of Semarang topographic map (including 4 sheets of sounding survey result);
- 4 sheets for 1:2,000 scale of Ungaran topographic map; and
- 26 sheets for 1:1,000 scale of channel topographic map

(ii) Models

Total models of stereo plotting are:

- 52 models for 1:2,000 scale of Semarang topographic map
- 4 models for 1:2,000 scale of Ungaran topographic map
- 12 models for 1:1,000 scale of channel topographic map

(c) Preparation of Control Sheets

Control sheets were produced by block adjustment result of aerial triangulation on polyester base material.

(d) Plotting

Plotting manuscript at the scale of 1:2,000 and 1:1,000 were produced from aerial photos at the scale of 1:8,000 by using second order precision plotter.

The sequences of the stereo plotting works are as follows:

- Inner Orientation;
- Relative Orientation;
- Absolute Orientation; and
- Plotting of details, spot height, vegetation boundary and contour lines.

Contour intervals for intermediate contour line are 1 m both maps with the scale of 1:2,000, and 1:1,000.

Editing works was carried out on the plotting manuscript by compiling result of field identification, such as symbol annotation etc.

(e) Result

The final manuscript was used for the fair drawing work and the number of sheets plotting manuscript are as below.

- 48 sheets plotting manuscript at scale of 1:2,000 for Semarang area (including 4 sheets of sounding survey result)
- 4 sheets plotting manuscript at scale of 1:2,000 for Ugarang area
- 26 sheets plotting manuscript at scale of 1:1,000 for channel area

(f) Equipment

The equipment used for plotting and editing are:

Computer	2 units
Roland Plotter	1 unit
Stereo Plotter, Wild A-8	2 units
Plotter Wild AG-1	1 unit
Stereo Plotter, Leica SD-2000	1 unit
Drafting Table	3 units

(8) Fair Drawing

The implication and purpose of fair drawing work are drawing details using symbols and contour lines with tracing method from the plotting manuscript and other additional data and information.

The sequence of the fair drawing were carried out as follows:

(a) Data Collection

All necessary data were collected and prepared for fair drawing such as:

- Plotting manuscript
- Vertical control points and description on two (2) times enlarged aerial photographs
- Field identification results on two (2) times enlarged aerial photographs

(b) Planning

Preparation for fair drawing were carried out as follows:

(i) Drawing sheets

Total sheets of fair drawing are 78 sheets, consisting of 48 sheets of

Semarang map (including 4 sheets of sounding survey result) and 4 sheets of Ungaran map at the scale of 1:2,000; 26 sheets of map at scale of 1:1,000.

(ii) Legend and Symbol

Legend, symbols and annotation used for the map are as approved by the JICA Study Team. Legend and symbol are as shown in Table 3.1.2.

(c) Preparation

The preparations were carried out as follows:

(i) Drawing sheets

Drawing sheets were made using computer PC on polyester base. The sheet's size is A1 (60 cm ~ 85 cm). Numbering system is as follows:

Sheet number 45-*12*

Where:

45 = Total sheets

12 = Sheet number

(d) Fair drawing

Fair drawing was carried out with tracing method using drafting pen and black ink from plotting manuscript at scale of 1:2,000 and 1:1,000.

Fair drawing works are as follows:

- Drawing details
- Spot heights and contour lines
- Symbols and annotations, on the map symbols must be matched to legend
- Vegetation boundary

Contour interval for intermediate contour lies are 1 m for map at scale of 1:2,000 and 1 m for map at scale of 1:1,000.

(e) Results

The final results of the fair drawing are:

- 48 sheets of topographic map at scale of 1:2,000 for Semarang area,
- 4 sheets of topographic map at scale of 1:2,000 for Ugarang area,
- 26 sheets of topographic map at scale of 1:1,000 for Channel area,
- 48 sheets duplicate at scale of 1:2,000 for Semarang area,
- 4 sheets duplicate at scale of 1:2,000 for Ugarang area, and
- 26 sheets duplicate at scale of 1:1,000 for channel area.

The equipment used for the fair drawing works are:

- Computer : 2 units
- Roland plotter : 1 unit
- Drafting table : 9 units
- Drafting tools : 9 units

3.1.2 Ground Survey

(1) River Longitudinal Profile and Cross-Section Survey

(a) Installation of Kilometer Post

Prior to the commencement of the river longitudinal profile survey, kilometer posts of wooden pegs were installed on the right and left banks of West Floodway/Garang river. When the location of a kilometer post is very close to such structures as bridges, water intake and water pipes, kilometer posts were shifted to the center line of these structures. The position of a kilometer post was decided by traverse method in the field. All coordinates data are as shown in Table 3.1.3.

(b) Longitudinal Profile Survey

The river longitudinal profile survey (the profile survey) by direct leveling was executed to obtain heights of kilometer posts for the river cross section survey and to prepare longitudinal profile sections. Leveling routes were formed by closed loops and double-runs. A total distance of the leveling survey covering West Floodway, Garang, Semarang, Asin and Baru rivers was 41 km.

The datum height was applied for the longitudinal profile survey including river cross section survey and auxiliary leveling. The heights of TTGs bench marks are applied to the kilometer posts by direct leveling.

All results of heights of kilometer posts by the profile survey, the deepest height of the river cross section survey, names of bridge and others were edited by Auto CAD system.. The longitudinal profile sections at a horizontal scale of 1:2,000, 1:1,000 and vertical scale of 1:100 were prepared on the draft plotting paper sheets using the longitudinal profile data. Final longitudinal profile data as shown in Table 3.1.4.

(c) River Cross Section Survey

Heights and distance of slope changing points, roads, channels, etc. along the cross section lines were measured by using a Total Station System, levels and Electric Distance Meter (EDM).

Water levels and depths of the rivers were measured using a survey rod, and the distance of these measured simultaneously. The bridges, irrigation intakes and water pipes of all rivers were also measured. A total number of cross sections surveyed are approximately 814.

(d) Checking of Longitudinal Profile

(i) The check results of differences in height closure between the kilometer posts did not exceed $20\sqrt{S}$ (S: length of single run in kilometer) as specified in the Technical Specifications.

(ii) Checking of River Cross Sections

At the same kilometer posts checked above, river cross section lines were measured. The check results of height of these cross section line points did not exceed ±50 mm and distance errors between the cross section line points are less than 1/300 as specified in the Technical Specifications.

Longitudinal profile and cross-section were surveyed along West Floodway/Garang river and two (2) tributary channels along Garang River.

West Floodway and Garang River

Work Item	Volume	Drawing		Remarks
		No. of Sheets	Scale	
Longitudinal Profile	9.598 km	5	H=1/2,000 V=1/100	Sheet Size: A1
Cross-Section Survey	204 sections	104	H=1/200 V=1/100	Sheet Size: A1

Cengkek River (tributary of Garang River)

Work Item	Volume	Drawing		Remarks
		No. of Sheets	Scale	
Longitudinal Profile	0.499 km	1	H=1/1,000 V=1/100	Sheet Size: A1
Cross-Section Survey	15 sections	8	H=1/200 V=1/100	Sheet Size: A1

Kalito River (tributary of Garang River)

Work Item	Volume	Drawing		Remarks
		No. of Sheets	Scale	
Longitudinal Profile	0.498 km	1	H=1/1,000 V=1/100	Sheet Size: A1
Cross-Section Survey	12 sections	6	H=1/200 V=1/100	Sheet Size: A1

3.1.3 Topographic Survey

Topographic survey was carried out for Jatibarang Dam site, Simongan Weir, Asin Pumping Station, West and East Bandarharjo Pumping Station, West and East Bandarharjo Drainage area, a bridge across Semarang River and a water gate at Baru River.

The work quantities carried out are as follows:

(a) Scale 1:200

Simongan Weir	9.0 ha
Asin Pumping Station	9.0 ha
West Bandarharjo Pumping Station	6.0 ha
East Bandarharjo Pumping Station	3.0 ha
Bridge (Semarang River)	0.5 ha
Water gate (Baru River)	1.0 ha

(b) Scale 1:500

Jatibarang Dam Site	15.0 ha
West Bandarharjo Drainage Area	2.8 ha
East Bandarharjo Drainage Area	3.2 ha

(c) Scale 1:1,000

Jatibarang Dam Site	15.0 ha

3.1.4 Sounding Survey

(1) Location and Quantity

The location is shown in Fig.3.1.14. The work quantities are 3 km^2, consisting of 16 survey lines and 1 km per line.

(2) Setting of Base Survey Line

Base survey line was established along the coastline for 3 km eastward from the mouth of West Floodway by GPS, traversing and spirit leveling. All control monuments were set at 200 m interval along the base survey line.

Misclosure of leveling does not exceed $20\sqrt{S}$ between bench mark and control points (S: a single distance in kilometer between control points).

(3) Measuring Interval of Survey Line

From the control point, water depth of each line 1 km offshore were measured at 30 m interval. Water surface was also measured.

(4) Equipment

Echo sounder and survey rod for water depth measurement, GPS and Total Station Surveying System for positioning were used.

(5) Chart Drawing

Charts were interpolated in the 1:2,000 scale topographic map.

3.1.5 Land Subsidence

Recently land subsidence is observed at the coastal and the central area of Semarang City. Subsidence is caused mainly by excessive development of ground water.

In the urban and coastal areas of Semarang City, for many years, it has been pointed out that local subsidence is a problem, yet there has been no careful examination to determine the actual levels of this subsidence.

During this study period, leveling measurements were conducted between TTGs to more accurately grasp the actual magnitude of subsidence.

As a result of these measurements, no subsidence was found in the western part of the study area. However in the eastern port of the city and study area, considerable subsidence was found with a maximum measure of –0.972m observed.

For future examination, 49 permanent bench marks were established in this study period. The amount of annual subsidence can more easily be checked by re-examining these points at regular intervals. The survey result as shown in Fig.3.1.15.

3.2 Geological and Soil Mechanical Investigation

The geological and soil mechanical surveys conducted in the D/D Study stage consist of : (1) core drilling and testing in bore hole, and (2) laboratory testing.

Borings were carried out at the locations along the river and at the major proposed structures to know the geological features and soil properties of the typical sub-base layers. Laboratory tests were conducted for the soil samples taken out from boring cores as well.

3.2.1 Boring and Tests

(1) Scope of Work and Method

Core drilling was carried out to obtain the subsurface geology of ground along West floodway/Garang River, i.e. soil type, thickness, sequence and physical conditions. During the drilling, the standard penetration test (SPT) was executed to gain soil's haardness/consistency.

Core drilling was performed according to the hydraulic deed rotary drilling method.

Single tube core barrels and tungsten bits were used in order to gain good quality of core sample. The core samples were sequentry arranged into core boxes from top to bottom, representing soil types and layer distribution.

The scope of works are as follows:

(a) West Floodway/Garang River

Bore holes of 52 with a total depth of 870 m. SPT was performed in the bore hole by every 1.0 m depth with a total of 824 tests. A total length of 118 m core samples were taken and arranged in core boxes.

(b) Simongan Weir Site

6 bore holes with a total depth of 120 m was performed. A total number of SPT is 88.

The location of borings is shown in Fig. 3.2.1 and test data are presented in Table 3.2.1.

(2) Geological features along West Floodway/Garang River

Fig. 3.2.2 shows the geological stratification profile along West Floodway/Garang River, which was made based on the boring test results mentioned above. The base layer consists of Damar Formation formed in tertiary to early quaternary period. Damar Formation forms a hilly land in the upstream area of Simongan Weir, and distributes below the flood plain of West Floodway/Garan River.

Damar Formation along Garang River spreads 5 to 15 m below the riverbed in the river stretch between Simongan Weir and the river section WF140 (7,300 m from river mouth), and exposes to the riverbed in the upper reaches from WF140. On the other hand, Damar Formation lowers drastically its position having the depth of more than 30 m from the ground surface in the lower reaches from Simongan Weir. So, the alluvium and diluvial deposit layers account for all of the ground of flood plain area.

Damar Formation geologically consists of sedimentary rock including conglomerate sand rock and silty rock, and volcanic detritus, which covers a wide range of area in Garang River basin.

The diluvial layer in the flood plain spreads with a thickness of more than 10 m under the alluvium soft ground. This layer is a mix of considerably hard layers of clay, sand and gravel, having a N-value of more than 30. This layer can be a bearing layer of heavy structures such as bridge, weir, tall building and so on.

The alluvium layer, widely deposited in the low-lying area, is characterized as high compressible soft ground, consisting of mainly clay, silt and organic soil. Sandy layers are partially exists in the thick clayey layer. The thickness of layer is 15 to 25 m in the downstream coastal area and 5 to 15 m in the middle reaches covering Simongan Weir. N-value of clayey layer is mostly less than 8, while that of sandy layer ranges from 5 to 20.

(3) Geological Features of Simongan Weir Area

Regarding the geological features of Simongan Weir area, there is a big difference in geological composition and layer's distribution between downstream and upstream sections. Namely, Damar Formation forms a kind of mound and its top elevation is situated at the riverbed in the downstream section, while Damar Formation forms a valley shape and alluvium layers are piled up in the valley in the upstream section. These alluvium layers are river deposits, sandy layer with medium hardness, soft layer of sandy silt from the top position. There exists a diluvium hard sand layer with the N-value of more than 50 below the alluvium layer. Fig. 3.2.3 shows the geological profile of immediate upstream section of the existing weir.

3.2.2 Geological Condition and Soil Properties

(1) Laboratory Test

The laboratory test was conducted to determine the physical and mechanical properties of soil sample. The test followed the standard method of ASTM. The test items and quantity are shown in the table below.

Item	Standard Method	Quantity
Gradation Analysis	ASTM D422	200
Moisture Content	ASTM D4959	200
Specific Gravity	ASTM D854	200
Liquid and Plastic Limits	ASTM D431	200
Density	USBR 5370	200
Unconfined Compression Test	ASTM D2435	25
Triaxial Compression Test (UU)	ASTM D2850	59

(2) Soil Types and Property of Sub-base Layers at Simongan Weir Site

Based on the boring and laboratory test results, the soil layer at the Simongan Weir site can classified into 1) riverbed deposit (**Rd**), 2) Embankment fill (**B**), 3) Fine coarse sand (**As**), and 4) Very soft clay (**Ac**).

(a) Embankment (**B**) consists of earthfill and it is found at the left and right wings of Simongan Weir. The thickness of this layer is about 6 m.

(b) Riverbed deposit (**Rd**) consists of sand and gravel, dense to very dense, having the N value of 20 to 50. This riverbed deposit is found at the borehole SB-2, SB-4, SB-5 and SB-6.

(c) Fine grain sand (**As**) consists of fine medium grain sand and intercalated with clay and silt, loose to very dense. This layer is found at the boreholes SB-1, SB-2 and SB-3, lying beneath the embankment or riverbed deposit. The thickness of this layer varies from 8.5 m to 10 m.

(d) Clay and sandy clay (**Ac**) is lying beneath **As** layer. It is gray, consisting of clay and sandy clay, soft to medium stiff clay with the N value range of 11 to 20. This layer is found at the boreholes SB-1, SB-2 and SB-3 at the elevation of approximately –10 m.

(e) Intercalation of Volcanic and Sedimentary rocks are considered as the base rock at this area. It is fractured, poor RQD and very weak rock.

(3) Soil Types and Soil Mechanical Properties of Sub-base Layer in West Floodway

(a) The top layer is made of embankment fill (**B**) with a thickness of 2 to 3 m.

(b) Very soft clay layer (**Ac**) is exists beneath the embankment. This layer consists of clay and sandy clay containing shells. N-value ranges 1 to 5.

(c) The lenses layer (**As**) consists of fine to medium grain sand and it is intercalated with clay and silt. The layer is very loose with average N-value of 6. The thickness of this lenses is about 1 to 3 m.

(d) Hard clay layer (**Dc**) with lenses of gravelly sand (**Da**) lies beneath **Ac** layer. The layer **Dc** is dark brown and the surface part is characterized by oxidation, containing coral limestone. The average N-value of this layer is 25.

(e) The sedimentary rock (Da) consists of alternation of conglomerate, sandstone, mudstone, having a N-value of more than 50.

(4) Soil Types and Soil Mechanical Properties of Sub-base Layer in Garang River

The soil profile along this section consists of embankment fill (B), very soft clay (Ac) and sedimentary rock (Da) from the surface to the bottom.

(a) The surface ground is covered by embankment fill with a thickness of 2 to 3 m and average N-value of 15.

(b) Riverbed deposit (Rd) consists of sand and clay. The thickness is 1 to 2 m.

(c) Soft clay layer (Ac) is found beneath the embankment (B) or river deposit, consisting of clay and sandy clay. Ac is medium stiff with average N-value of 12. The thickness is 2 to 4 m.

(d) The lenses layer (As) lies between Ac and sedimentary rock Da. It consists of fine to medium grain sand, and intercalated with clay and silt. The thickness is very thin of around 1 m.

(e) The bottom part of boreholes is sedimentary rock consisting of alternation of conglomerate, sandstone and mudstone. SPT gives a N-value of 40 or more.

The results of the mechanical and physical tests for the above layers are presented in Table. 3.2.2. In designing structures, soil test results shall be used. If there is no available data regarding physical test of soil, the N-value will be used for the estimation of necessary soil parameters.

3.3 Hydrological Analysis

3.3.1 Data Collection and Compilation

The location of Garang River basin and hydrological observatories are shown in Fig.2.1.1 and the conditions of data recording are presented in Table 3.3.1. These observatories are operated by Provincial Public Works Services (DPUP), Center of Meteorology and Geophysics (BMG), or Institute of Hydraulic Engineering (IHE).

Hourly rainfall data are available at two(2) automatic rainfall stations, namely BMG-Semarang station in lowland and Kaligading station in highland. Manual rainfall stations have only daily rainfall data. The stations shown in the table and figure were selected in the Feasibility Study in 1993.

There are three(3) automatic water level stations in the Garang river system. One is Panjangan station which is located at immediately downstream of the confluence of Garang River and Kreo River. It was set up in 1983, but the data before 1986 are not available. The others are Patemon station in Garang River upstream and Kalipancur station in Kreo River. Those were both set up in 1992.

Besides, intermittent water level data at Simongan Weir recorded manually at flood time are available.

The kinds and periods of the hydrological data added in this study stage are shown in the right part of Table 3.3.1 as "Additional Data" ranging from 1991 to 1996. The hydrological analyses, which are necessary for the flood control plan and water use plan, are supposed to be updated using the additional data.

3.3.2 Probable Rainfall

(1) Annual Maximum Rainfall

Hourly rainfall data are available at BMG-Semarang station and Kaligading station. Of the two, the latter has shorter record period of 17 years and contains many missing data. And it was found in the Feasibility Study that probable rainfall by the latter is smaller than that by the former. Therefore, the former, which has longer record period and contains less missing data, is adequate to be adopted.

Annual maximum rainfall for each duration (5, 10, 15, 30, 45, 60, 120 minutes, 3, 6, 12 hours and 1 day) at BMG-Semarang station in 28 years until 1996 are extracted and tabulated in Table 3.3.2.

(2) Probable Rainfall

Gumbel Method was employed to calculate probable rainfalls. The results are shown in Table 3.3.3 and Figs.3.3.1 and 3.3.2. One(1) hour probable rainfall of 100-year return period was calculated at 144.6 mm, and one(1) day rainfall of 100-year at

319.4 mm. These values are bigger than that of Feasibility Study by some 10 percent (refer to the lower part of Table 3.3.3).

(3) Rainfall Intensity Formula

As to Rainfall Intensity Formula, the Horner Type equation is used as well as the Feasibility Study. The results of calculation are shown in Tables 3.3.4 and 3.3.5 and Fig.3.3.3. Two types of rainfall intensity curves are presented in Fig. 3.3.3 for short duration less than two (2) hours which is used for planning urban drainage and long duration more than one (1) hour which is used for planning dams.

(4) Design Storm

The length of One(1) day is appropriate to the duration of design storm to be used in the flood control plan, considering actual rainfall patterns, the size of river basin and the kind of flood control facilities.

Hourly distribution pattern of the design storm should be made from hourly rainfall data of actual storms. Hourly rainfall data of annual maximum rainfalls in the past 10 years at BMG-Semarang station are tabulated in Table 3.3.6. The ratio of each hourly rainfall to total are calculated, and shifted so that the peak ratio can locate in center time. Shown in Table 3.3.7 are the results. The average ratio of 10 storms are adopted to express the hourly distribution ratio of the design storm.

The design storm of each return period is calculated from probable one(1) day rainfall multiplied by the hourly distribution ratio (refer to the lower part of Table 3.3.7). One(1) hour rainfall at peak time accounts for 39 percent of one(1) day rainfall. Illustrated in Fig.3.3.4 is the design storm of 100-year return period.

3.3.3 Probable Peak Discharge

(1) Annual Maximum Flood Discharge

In the case which has less flood discharge data, probable flood discharge is calculated by a flood run-off model with input design storm. However, in the case of Garang River, probable flood discharge can be calculated directly from the peak discharge data at flood time.

Annual maximum water levels at Simongan Weir have been recorded manually from

1961 to 1996 at present. Annual maximum discharges are able to be converted from these water level data with the discharge formula for overflow as a rating curve.

Simongan Weir consists of flood discharge section at center portion with fixed weir and side portions with flushing gates on both sides. The gates are closed even at flood time, and the river water overflows above the gates with the same overflow depth as that of center portion.

Different discharge coefficients were applied to the center portion and side portions of the weir. Shown in Table 3.3.8 are annual maximum discharges at Simongan Weir in the past 36 years calculated by the overflow discharge formula.

(2) Probable Peak Discharge

Gumbel Method was employed to calculate probable flood discharges, with annual maximum discharges shown in Table 3.3.8. The results of calculation are shown in Table 3.3.9 and Fig.3.3.5.

According to this, 100-year probable discharge is 1,010 m^3/s, and 25-year probable discharge is 790 m^3/s (rounded up from raw value of 785 m^3/s). Compared with those of the Feasibility Study, 100-year probable discharge increased by 30 m^3/s, and 25-year discharge by 20 m^3/s.

3.3.4 Flood Run-off Model

(1) Outline of Storage Function Method

Probable peak discharges have been estimated as described in Section 3.3.3. In addition to the peak discharge, discharge hydrograph is necessary to establish a flood control plan with dams. Accordingly, a flood run-off model, which can converts input hyetograph into discharge hydrograph, is needed.

The Storage Function Method is recommended to be employed as a flood run-off model. This method receives wide recognition as the de-facto standard method in planning flood control with dams.

The Storage Function Method has been developed to express non-linear characteristics of run-off phenomena. This method can give the process of transformation from rainfall to run-off on the assumption that there is a one-to-one functional relation between the volume of storage and run-off. Calculations of the run-off from rainfall are made through the use of the volume of storage as medium function. The relationship between the volume of storage of a basin and the discharge is expressed as follows:

$$S = K * q^P$$

where,	S :	Depth of storage (mm)
	q :	Depth of run-off (mm/hr)
	K, P :	Constants

This relation formula is used as a substitution for the solution of equation of motion. That is, this formula establishes that the run-off is proportional to the exponent of the volume of storage. This is equivalent to the thinking in which the phenomena of rainfall and run-off are considered to be similar to the run-off from a notch in a container filled up with water.

Run-off calculations are performed by the combination of this equation of motion with the following equation of continuity.

$$dS/dt = F * Ra(t) - q(t+TL)$$

where, F	:	Inflow coefficient
Ra(t)	:	Average rainfall in a watershed (mm/hr)
q(t+TL)	:	Depth of run-off with lag time (mm/hr)
TL	:	Lag time (hr)
t:	:	Time

When making the run-off calculations for a basin, it is necessary to make calculations of effective rainfall. With the Storage Function Method, it is thought that coefficient (F) is not related to rainfall (Ra) but to the catchment area (A). Namely, it is thought that F=F1 in the early stages of rainfall (termed the primary run-off rate) and that only the area F1*A (called the run-off zone) causes the run-off. When cumulative rainfall exceeds Rsa (saturated rainfall), then F=1 (this is termed the saturated run-off rate), and the run-off may occur even from the remaining part (1-F1)*A (infiltration zone) due to the rainfall exceeding Rsa.

However, both the run-off zone and infiltration zone should be calculated separately for the run-off until the end of the flood. The volume of run-off from the basin should be the sum of run-off from both zones plus base run-off. Run-off (m^3/s) from the basin (including the base run-off) is given by the following formula:

$$Q(t) = F1*A*qt(t)/3.6 + (1-F1)*A*qs(t)/3.6 + Qb$$

where, Q(t) : Run-off (m^3/s)

F1 : Primary run-off rate

A : Catchment area (km^2)

qt(t) : Run-off by total rainfall (mm/hr)

qs(t) : Run-off by rainfall after saturation (mm/hr)

Qb : Base flow (m^3/s)

(2) Hourly Data of Rainfall and Discharge at Flood Time

Hourly discharges are able to be calculated from the water level data recorded manually at Simongan Weir at flood time intermittently, with the same rating curve as calculation of annual maximum discharge mentioned before. Discharge hydrograph of major floods are available to be used as check data for the calibration of flood run-off model.

Five(5) annual maximum floods since 1987 were selected as the calibration data of flood run-off model considering the response between rainfall and discharge. The basin average daily rainfalls during those floods are calculated with Thiessen Polygon (refer to Fig.3.3.6) and shown in Table 3.3.10.

It is appropriate that hourly rainfall data of Kaligading station in highland are used after its total daily rainfalls have being adjusted to the basin average daily rainfalls already shown in Table 3.3.10.

The following data in five(5) floods are contained in Table 3.3.11.

(a) hourly water levels
(b) hourly discharges by a)
(c) hourly rainfalls at Kaligading station
(d) basin average hourly rainfalls proportional to c)

(3) Calibration of Flood Run-off Model

If the whole Garang river basin is expressed by sole basin model of Storage Function Method, the parameters in the model (namely K, P, TL, F) can be counted backward analytically using the data mentioned above. The results of backward analysis are shown in Table 3.3.12 and Fig.3.3.7.

(4) Flood Run-off Model for Garang River Basin

The flood run-off model should be divided so that it can express the effects of flood control by dams and the confluence of tributaries. Sub-basin division for the Garang river basin is shown in Fig.3.3.8. Shown in Fig.3.3.9 is the model diagram for flood run-off calculation which consists of basin units and channel units

The parameters in the flood run-off model by Storage Function Method are tabulated in Table 3.3.13. Here, the main parameters for basin units are determined by the average values from backward analysis shown in Table 3.3.12. For channel units, only the time lag of flow down is taken into account, because the storage effect in the river channel seems little, considering from the size of the river channels.

(5) Area Reduction Factor

The hydrograph of probable flood are obtained from the flood run-off model with design storm as input. However, the peak discharge in hydrograph becomes bigger than the probable discharge estimated directly from annual maximum discharges in Section 3.3.3.

The difference between the peak discharge in hydrograph and the probable discharge is adjusted by the area reduction factor which means the ratio of basin average rainfall to point rainfall. The area reduction factors, which depend on the catchment area and the magnitude of storm, were estimated at Simongan Weir site as shown in the table below. And the distribution curves of the area reduction factor for catchment area are shown in Fig.3.3.10. Here, the area reduction factor is 1.0 at catchment area of zero, and 0.75 at catchment area of 204 km^2 in the case of 100-year return period.

Return Period	5-year	10-year	25-year	50-year	100-year
Area Reduction Factor	0.667	0.697	0.723	0.738	0.750

(at Simongan Weir A=204 km^2)

3.3.5 Flood Control Plan

(1) Design Flood Discharge for River Improvement

The design storm multiplied by area reduction factor was inputted into the flood run-off model by Storage Function Method and then the flood routing calculation by Jatibarang Dam was carried out. The results are shown in Tables 3.3.14 to 3.3.16 and Fig.3.3.11, and the summary is shown in the table below.

Return Period (year)	Peak Discharge at Dam			Peak Discharge at	
	Inflow (m^3/s)	Outflow (m^3/s)	Out-max. (m^3/s)	without Dam (m^3/s)	with Dam (m^3/s)
5	150	20	60	520	400
10	180	30	70	640	500
25	220	30	90	790	620
50	260	40	100	900	700
100	290	40	120	1,010	790

Note : Discharge figures were rounded up to the nearest 10 m^3/s

The design scale of Garang River/West Floodway is 100-year return period and the 100-year probable discharge is 1,010 m^3/s. The design discharge of river channel at the downstream of confluence was calculated at 790 m^3/s with the flood control by Jatibarang Dam. This design discharge is equivalent to 25-year probable discharge without the dam.

The distribution diagram of the design flood discharges in the Garang river system is shown in Fig.3.3.12.

(2) Flood Control Capacity of Jatibarang Dam

Since the catchment area of Jatibarang Dam is as small as 53.0 km^2, it is difficult to operate flood gates properly under the fast flood run-off from basin. So, the no-gate-discharging system is employed as the flood control system of Jatibarang Dam.

The flood control outlet shapes open spillway whose crest elevation equals the normal water level of the reservoir. The width of over flow section is determined at 15 m so that the peak discharge of 100-year return period at Simongan Weir site should be 790 m^3/s with the flood control by the dam. The outflow and storage conditions used in the flood routing calculation are shown in Table 3.3.15.

The net value for the flood control capacity required of Jatibarang Dam is estimated at 2,505,000 m^3 as shown in Table 3.3.14. Therefore, the flood control capacity of Jatibarang Dam is determined at 3,100,000 m^3 including 20 percent allowance in accordance with "Manual for River Works in Japan".

3.3.6 Low Flow Analysis

(1) Daily Rainfall

Low flow analysis aims to convert a series of daily rainfalls into a series of daily discharges. The daily rainfall data at Sumurjurang station (No.65c), which is located in the middle reaches of the Garang river basin, are used as a representative daily rainfall pattern. The rainfall data at Sumurjurang station in the past 30 years (from 1967 to 1996) are tabulated monthly in Table 3.3.17 (after supplementation of missing data).

The basin average daily rainfalls are calculated by multiplying daily rainfalls at Sumurjurang and the modification coefficient together (refer to Table 3.3.20) based on the Thiessen polygon shown in Fig.3.3.6.

(2) Water Balance and Annual Loss

The data at three(3) automatic water level stations (namely, Panjangan, Patemon and Kalipancur stations) in the Garang river basin are available as daily average discharge. Those discharge data are compiled monthly in Table 3.3.18. Fig.3.3.13 shows daily discharge fluctuation at Panjangan station in the past 10 years (from 1987 to 1996).

Flow regime and water balance by observed discharge are tabulated in Table 3.3.19. According to this, Annual loss (= annual rainfall - annual runoff depth) at Panjangan station amounts 1,181 mm in average. This amount of loss corresponds to 73 percent of pan evaporation, and it seems pertinent amount from a hydrological view. Compared with this, annual loss at Kalipancur station makes extremely small amount at 408 mm. It seems to be caused by the rating curve being used.

(3) Selection of Calibration Data

The daily discharge data at Jatibarang Dam and Simongan Weir sites are necessary in water use simulation mentioned later. Simongan Weir site is located very near Panjangan station. Therefore, the discharges at Simongan Weir should be calculated from the discharges at Panjangan multiplying by the catchment area ratio (=204.0/192.6km^2).

On the other hand, although Kalipancur station is located near Jatibarang Dam in

Kreo River, the data at Kalipancur has a problem about accuracy as mentioned above. Therefore, it is appropriate that the discharges at Jatibarang Dam also should be calculated from the discharges at Panjangan multiplying by the catchment ratio (=53.0/192.6km^2).

Accordingly, the available daily discharge data observed at Panjangan station in the past 10 years are used in low flow analysis as calibration data for a run-off model.

(4) Outline of Tank Model Method

The Tank Model Method is applied to low water run-off calculations. This method incorporates calculations of direct run-off during rainfall as well as other elements such as the separation of infiltrated rainwater, evapotranspiration, and oozing-out of groundwater.

Serial storage type model, which is called the Tank Model, is used for run-off calculations in which the catchment is replaced with containers having several run-off holes on their sides and bottoms (refer to Fig.3.3.14). Rainwater is placed in the top container of the model. Containers below the top one receive water from the hole in the bottom of a higher container. Part of water in each container runs off to the outside through the holes on the side, while the remaining water moves to a lower container. The sum of run-off from the holes on the sides of containers of all stages becomes the discharge of a river.

(5) Tank Model Simulation

Daily rainfalls at Sumurjurang multiplied by modification coefficient 0.99 are inputted into Tank Model. Evaporation amount, which is subtracted daily from Tanks, is 1,181 mm by annual total, and monthly pattern of evaporation is assumed to be proportioned to pan evaporation pattern (refer to Table 3.3.21).

The parameters of Tank Model, which include run-off holes, seepage holes and initial storage depths, were determined by trial simulation so that the calculation discharges can simulate the observed ones well. The parameters are finally determined as shown in Fig.3.3.14.

The flow regime of calculated discharges and observed discharges in the past 10 years are compared in Table 3.3.22, and the simulation plottings of discharges in the past 30 years are shown in Fig.3.3.15, where the calculated discharges and observed discharges in the latest 10 years are plotted by comparison. It is obvious that the Tank Model simulation resulted in success.

As to the discharge data which should be used in water use simulation described later, the observed discharges in the latest 10 years, and the calculated discharges by Tank Model in the previous 20 years, are adopted. The flow regime and water balance at Simongan Weir site in the past 30 years are shown in Table 3.3.23. The average annual loss in 30 years became exactly 1,200 mm finally.

(6) 5-days Discharge for 30 years

The water use simulation described later are carried out with 5-days intervals. The data of 5-days discharges in the past 30 years are contained in Table 3.3.24.

3.3.7 Design Tidal Level at River Mouth

The design tidal levels at the river mouth were determined based on the tidal data observed at Semarang Harbour. Since the tidal data observed in the past has been affected by land subsidence in the low lying area, the most recent data of April 1997 to August 1997, which is considered less affected, is used for the tidal analysis.

The mean high water level at river mouth is defined as the average monthly maximum tide level. Similarly, the mean low water level is defined as the average monthly minimum tide level. Applying these definitions to the said monthly data, the mean high and low water levels are given as presented in Table 3.3.25. Then, by relating the chart datum of the water level gauge to the M.S.L of Jakarta Harbour, the basic tidal levels such as mean high level, mean low water level and mean sea level of Semarang Port were determined as follow:

Kind of Water Level	Elevation (TTG)
Highest High Water Level (HHWL)	EL. +0.450 m
Mean High Water Level (MHWL)	EL. +0.250 m
Mean Sea Level (MSL)	EL. -0.230 m
Mean Low Water Level (MLWL)	EL. -0..700 m
Lowest Low Water Level (LLWL)	EL. -0..900 m

For the non-uniform flow calculation in the event of flooding, the mean high water level of EL. +0.250 m is used as the starting water level at the river mouth.

TABLES

CHAPTER 3

INVESTIGATION AND ANALYSIS

Table 3.1.1 FINAL RESULT OF CONTROL POINTS

DATUM : WGS84
PROJECTION : U.T.M.
ZONE : 49
SEMI-MINOR AXIS : 6,378,137.0000
MINI-MINOR AXIS : 6,356,752.3143
FLATTERING : 298.2572236
SCALE FACTOR : 0.9996000
LATITUDE OF OI : 0° 0' 0" 0ı
LONGITUDE OF (: 111° 0' 0" 0ı

STATION	NORTHING	EASTING	LATITUDE	LONGITUDE	ELEVATION	REMARKS
N.0004	7° 4' 7.0809 " S	110° 28' 55.856 " S	9,218,632.118	442,814.138		
NI.0259 (JP-7	6° 59' 1.5641 " S	110° 24' 34.282 " S	9,228,004.682	434,777.817	4.362	
JP-1	6° 56' 51.327 " S	110° 25' 6.6671 " S	9,232,005.355	435,766.570	0.922	
JP-2	6° 56' 289296 " S	110° 26' 41.964 " S	9,232,696.655	438,690.025	1.015	
JP-3	6° 56' 47.216 " S	110° 23' 32.077 " S	9,232,127.943	432,863.829	0.926	
JP-4	6° 57' 46.846 " S	110° 25' 59.398 " S	9,230,302.408	437,386.684	0.744	
JP-5	6° 58' 38.309 " S	110° 26' 54.603 " S	9,228,724.049	439,082.490	2.999	
JP-6	6° 58' 26.135 " S	110° 23' 40.153 " S	9,229,090.579	433,115.536	0.986	
JP-8	6° 59' 9.3077 " S	110° 25' 43.672 " S	9,227,769.509	436,907.230	2.864	
JP-9	6° 59' 46.084 " S	110° 23' 22.693 " S	9,226,634.706	432,582.979	33.702	
JP-10	7° 0' 19.071 " S	110° 26' 56.307 " S	9,225,629.835	439,138.413	7.980	
JP-11	7° 0' 18.851 " S	110° 25' 40.332 " S	9,225,633.799	436,807.342	14.416	
JP-12	7° 0' 22.165 " S	110° 24' 30.875 " S	9,225,529.384	434,676.387	86.673	
JP-13	7° 0' 44.328 " S	110° 22' 14.317 " S	9,224,834.319	430,487.408	60.949	
JP-14	7° 1' 23.127 " S	110° 23' 19.32 " S	9,223,654.479	432,483.354	34.648	
JP-15	7° 1' 32.24 " S	110° 22' 46.351 " S	9,223,372.085	430,551.770	90.953	
JP-16	7° 1' 37.649 " S	110° 20' 54.44 " S	9,223,202.528	428,038.896	184.599	
JP-17	7° 3' 1.1278 " S	110° 21' 33.513 " S	9,220,640.610	429,241.206	204.198	
JP-18	7° 3' 1.4915 " S	110° 19' 36.619 " S	9,220,624.394	425,654.959	219.344	
JP-19	7° 3' 34.459 " S	110° 20' 5.4294 " S	9,219,613.256	426,540.306	218.583	
JP-20	7° 4' 15.283 " S	110° 20' 28.568 " S	9,218,360.582	427,251.956	212.435	
BM-13	6° 57' 52.112 " S	110° 24' 38.519 " S	9,230,137.634	434,905.154	0.349	

Table 3.1.2 (1/3) MAP SYMBOLS

Symbol	Description	Symbol	Description
	Triangulation Point		Market
	GPS Point		Transformer house
	Bench Mark TTG		Bank
	Minor Order leveling		Gas station
	Spot elevation		Telephone office
	Minor order BM		Government office
	House/Building		Hotel
	Factory		Main road
	Public hall		Road >2m
	Public station		Road 1-2m
	Mosque		Road under construction
	Church		Footpath
	Temple		Median strips
	Hospital		Road and strips
	Fire Station		Cutting and embankment
	Post Office		Iron and concrete bridge
	School		Wooden bridge

Table 3.1.2 (2/3) MAP SYMBOLS

	Foot bridge bamboo bridge		Cultivation land boundary
	Culvert		Rice field
	Railway	V	Farm/cultivated
	Railway bridge		Sugar cane
st	Station		Palm plantation
	Intersecting railway		Rubber plantation
Water/oil	Water/Oil Pipe	a	Teak plantation
Water/oil	Water/Oil Tank		Coffee plantation
G	Automatic waterlevel gauge	Co	Cacao plantation
	Electricity power		Orchard
	Wall hedge/fence		Other plantation
	Monument	Q	Bush
	Moslem graves		Grass field
	Christian cemetery	Q	Trees/Forest
	Chinese graves		Dead trees
	Buddha graves		Bore land
	Vegetation boundary		Bamboo copse

Table 3.1.2 (3/3) MAP SYMBOLS

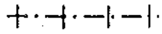
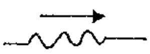
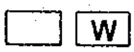
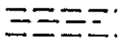
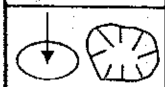
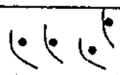
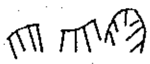
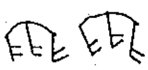
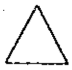
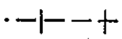
	River(a), rivulet(b), direction(c)		Kecamatan boundary
	Channel		
	Water fall		
	Small/large revetment		
	Small/large weir		
	Small/large watergate		
	Sand(a), shore line(b)		
	Saltarn		
	Fishpond/Pond, Lake		
	Swamp		
	Depression		
	Rocks		
	Precipice, Land slide		
	Cliff		
	Contour		
	Storages		
	Kabupaten boundary		

Table 3.1.3 (1/8) COORDINATES OF CROSS SECTION POINT

WEST FLOODWAY

STATION	NORTHING	EASTING	ELEVATION	DISTANCE	ACCUM.DIS	STATION	NORTHING	EASTING	ELEVATION	DISTANCE	ACCUM.DIS
WF.-9L	9232169.780	432894.394	0.765	0.00	0.00						
WF.-8L	9232158.066	432901.499	0.747	13.70	13.70						
WF.-7L	9232115.138	432926.953	0.611	49.91	63.61						
WF.-6L	9232074.061	432951.733	0.965	47.97	111.58						
WF.-5L	9232027.812	432979.706	0.829	54.05	165.63						
WF.-4L	9231986.758	433004.490	0.892	47.96	213.59						
WF.-3L	9231943.797	433030.118	0.968	50.02	263.61						
WF.-2L	9231900.990	433055.925	1.164	49.98	313.59						
WF.-1L	9231858.601	433082.465	0.442	50.01	363.61						
WF.0L	9231815.846	433108.376	0.462	49.99	413.60	WF.0R	9231907.759	433291.856	0.214	0.00	0.00
WF.1L	9231773.085	433134.135	0.475	49.92	463.52	WF.1R	9231859.923	433293.931	0.778	47.88	47.88
WF.2L	9231729.761	433159.760	0.413	50.33	513.85	WF.2R	9231823.179	433313.404	0.294	41.58	89.47
WF.3L	9231689.008	433192.834	0.692	52.48	566.34	WF.3R	9231774.871	433332.644	0.696	52.00	141.46
WF.4L	9231646.605	433217.404	1.046	49.01	615.35	WF.4R	9231720.612	433352.893	0.688	57.91	199.38
WF.5L	9231597.273	433245.801	1.157	56.92	672.27	WF.5R	9231662.905	433381.815	0.830	64.55	263.93
WF.6L	9231555.016	433264.350	1.267	46.15	718.42	WF.6R	9231600.276	433376.999	1.652	62.81	326.74
WF.7L	9231512.402	433282.977	1.150	46.51	764.92	WF.7R	9231559.956	433394.364	1.933	43.90	370.64
WF.8L	9231467.334	433304.101	1.128	49.77	814.70	WF.8R	9231511.476	433416.047	2.267	53.11	423.75
WF.9L	9231423.067	433327.455	1.052	50.05	864.75	WF.9R	9231471.635	433435.061	2.775	44.15	467.90
WF.10L	9231377.213	433347.574	0.662	50.07	914.82	WF.10R	9231427.965	433461.435	2.565	51.02	518.91
WF.11L	9231332.093	433368.951	0.459	49.93	964.75	WF.11R	9231388.974	433485.796	2.135	45.98	564.89
WF.12L	9231286.520	433388.883	0.208	49.74	1014.49	WF.12R	9231355.193	433530.922	0.709	56.37	621.26
WF.13L	9231240.914	433409.396	1.784	50.01	1064.50	WF.13R	9231303.505	433545.565	1.249	53.72	674.98
WF.14L	9231195.017	433429.741	1.398	50.20	1114.70	WF.14R	9231267.500	433561.255	1.541	39.28	714.25
WF.15L	9231152.785	433459.230	0.409	51.51	1166.21	WF.15R	9231206.293	433589.024	0.340	67.21	781.47
WF.16L	9231106.938	433478.304	0.048	49.66	1215.87	WF.16R	9231151.723	433620.576	0.630	63.04	844.50
WF.17L	9231060.338	433495.984	0.307	49.84	1265.71	WF.17R	9231110.977	433632.417	0.933	42.43	886.93
WF.18L	9231012.435	433510.555	0.852	50.07	1315.78	WF.18R	9231062.464	433646.692	1.042	50.57	937.50
WF.19L	9230957.154	433534.263	0.236	60.15	1375.93	WF.19R	9231002.847	433664.649	1.064	62.26	999.76
WF.20L	9230916.892	433541.171	1.274	40.85	1416.78	WF.20R	9230953.067	433680.526	1.041	52.25	1052.02
WF.21L	9230868.472	433551.868	1.322	49.59	1466.37	WF.21R	9230901.801	433698.221	1.191	54.23	1106.25
WF.22L	9230819.358	433561.096	1.930	49.97	1516.34	WF.22R	9230852.244	433715.786	1.327	52.58	1158.83
WF.23L	9230770.257	433571.042	1.184	50.10	1566.44	WF.23R	9230803.154	433731.352	1.121	51.50	1210.33

Table 3.1.3 (2/8) COORDINATES OF CROSS SECTION POINT

STATION	NORTHING	EASTING	ELEVATION	DISTANCE	ACCUM.DIS	STATION	NORTHING	EASTING	ELEVATION	DISTANCE	ACCUM.DIS
WF.24L	9230721.207	433580.955	1.253	50.04	1616.48	WF.24R	9230762.355	433745.148	1.435	43.07	1253.39
WF.25L	9230672.770	433594.508	1.261	50.30	1666.78	WF.25R	9230724.870	433757.382	1.443	39.43	1292.83
WF.26L	9230625.403	433610.161	1.113	49.89	1716.66	WF.26R	9230677.241	433770.657	1.204	49.44	1342.27
WF.27L	9230578.492	433624.282	1.163	48.99	1765.65	WF.27R	9230621.738	433786.835	1.505	57.81	1400.08
WF.28L	9230528.461	433637.434	0.999	51.73	1817.38	WF.28R	9230569.362	433803.228	1.402	54.88	1454.96
WF.29L	9230480.870	433651.284	1.354	49.57	1866.95	WF.29R	9230514.423	433811.021	1.484	55.49	1510.45
WF.30L	9230431.588	433658.513	0.608	49.81	1916.76	WF.30R	9230460.330	433821.259	1.070	55.05	1565.51
WF.31L	9230377.760	433662.183	0.769	53.95	1970.71	WF.31R	9230405.099	433830.733	1.017	56.04	1621.54
WF.32L	9230331.589	433665.974	0.880	46.33	2017.04	WF.32R	9230348.248	433849.902	1.928	60.00	1681.54
WF.33L	9230281.638	433669.033	1.227	50.04	2067.08	WF.33R	9230291.301	433849.444	1.221	56.95	1738.49
WF.34L	9230231.576	433671.454	1.935	50.12	2117.20	WF.34R	9230233.169	433856.449	1.322	58.55	1797.04
WF.35L	9230181.702	433675.803	1.427	50.06	2167.27	WF.35R	9230195.552	433860.904	1.324	37.88	1834.92
WF.36L	9230131.625	433679.044	0.968	50.18	2217.45	WF.36R	9230157.472	433861.705	1.545	38.09	1873.01
WF.37L	9230081.953	433682.812	1.118	49.81	2267.26	WF.37R	9230109.515	433869.462	1.503	48.58	1921.59
WF.38L	9230032.044	433685.872	1.371	50.00	2317.26	WF.38R	9230061.998	433876.133	2.152	47.98	1969.57
WF.39L	9229982.213	433689.810	1.093	49.99	2367.25	WF.39R	9230002.017	433879.699	1.220	60.09	2029.66
WF.40L	9229932.472	433694.915	1.060	50.00	2417.25	WF.40R	9229961.498	433883.501	1.126	40.70	2070.36
WF.41L	9229883.125	433702.451	1.231	49.92	2467.17	WF.41R	9229904.295	433876.713	0.374	57.60	2127.96
WF.42L	9229833.820	433711.791	0.930	50.18	2517.35	WF.42R	9229852.847	433885.940	1.189	52.27	2180.23
WF.43L	9229784.375	433718.618	1.226	49.91	2567.27	WF.43R	9229806.828	433887.558	0.695	46.05	2226.28
WF.44L	9229735.389	433728.165	1.203	49.91	2617.18	WF.44R	9229755.591	433889.164	1.107	51.26	2277.54
WF.45L	9229685.882	433736.089	1.241	50.14	2667.31	WF.45R	9229699.913	433882.931	0.313	56.03	2333.56
WF.46L	9229636.365	433742.389	1.523	49.92	2717.23	WF.46R	9229647.800	433890.737	0.936	52.69	2386.26
WF.47L	9229586.624	433748.667	1.648	50.14	2767.37	WF.47R	9229603.612	433892.551	0.902	44.23	2430.49
WF.48L	9229537.068	433755.078	2.282	49.97	2817.33	WF.48R	9229550.709	433897.489	2.521	53.13	2483.62
WF.49L	9229487.475	433761.330	2.098	49.99	2867.32	WF.49R	9229497.081	433898.411	1.651	53.64	2537.25
WF.50L	9229438.130	433768.858	2.028	49.92	2917.24	WF.50R	9229449.531	433899.152	1.274	47.56	2584.81
WF.51L	9229388.364	433774.740	2.273	50.11	2967.35	WF.51R	9229403.240	433901.582	1.595	46.35	2631.16
WF.52L	9229338.832	433780.563	2.197	49.87	3017.22	WF.52R	9229354.317	433902.621	2.322	48.93	2680.10
WF.53L	9229289.110	433786.398	2.328	50.06	3067.28	WF.53R	9229300.283	433904.461	2.545	54.07	2734.16
WF.54L	9229239.436	433791.772	1.813	49.96	3117.25	WF.54R	9229245.278	433904.497	1.336	55.00	2789.17
WF.55L	9229189.911	433798.837	1.382	50.03	3167.27	WF.55R	9229198.571	433906.081	2.163	46.73	2835.90
WF.56L	9229140.065	433803.348	1.993	50.05	3217.32	WF.56R	9229148.164	433909.011	2.329	50.49	2886.39
WF.57L	9229090.445	433810.098	2.250	50.08	3267.40	WF.57R	9229097.242	433904.326	1.414	51.14	2937.53

Table 3.1.3 (3/8) COORDINATES OF CROSS SECTION POINT

STATION	NORTHING	EASTING	ELEVATION	DISTANCE	ACCUM.DIS	STATION	NORTHING	EASTING	ELEVATION	DISTANCE	ACCUM.DIS
WF.58L	9229040.839	433817.653	2.227	50.18	3317.58	WF.58R	9229044.035	433913.136	2.376	53.93	2991.46
WF.59L	9228991.332	433824.965	2.598	50.04	3367.62	WF.59R	9228999.490	433914.047	2.626	44.55	3036.02
WF.60L	9228942.315	433827.275	2.668	49.07	3416.70	WF.60R	9228947.972	433914.895	2.237	51.53	3087.54
WF.61L	9228891.644	433833.565	2.757	51.06	3467.76	WF.61R	9228893.107	433919.685	2.041	55.07	3142.62
WF.62L	9228841.837	433837.015	2.707	49.93	3517.68	WF.62R	9228845.212	433922.004	2.289	47.95	3190.57
WF.63L	9228791.716	433840.511	3.153	50.24	3567.92	WF.63R	9228800.231	433926.630	2.452	45.22	3235.78
WF.64L	9228742.006	433847.326	1.870	50.18	3618.10	WF.64R	9228746.918	433931.960	3.200	53.58	3289.36
WF.65L	9228691.960	433846.581	4.592	50.05	3668.15	WF.65R	9228698.437	433944.467	4.625	50.07	3339.43
WF.66L	9228640.869	433852.543	4.363	51.44	3719.59	WF.66R	9228648.198	433939.062	3.553	50.53	3389.96
WF.67L	9228590.396	433856.134	4.368	50.60	3770.19	WF.67R	9228594.031	433940.931	3.938	54.20	3444.16
WF.68L	9228542.572	433860.047	4.656	47.98	3818.17	WF.68R	9228548.056	433942.961	4.207	46.02	3490.18
WF.69L	9228492.656	433866.249	4.567	50.30	3868.47	WF.69R	9228500.562	433952.868	3.562	48.52	3538.70
WF.70L	9228442.951	433871.523	4.994	49.98	3918.46	WF.70R	9228450.046	433962.260	3.742	51.38	3590.08
WF.71L	9228391.680	433875.042	4.738	51.39	3969.85	WF.71R	9228399.221	433960.452	3.260	50.86	3640.93
WF.72+22L	9228318.747	433899.846		77.04	4046.88	WF.72+22R	9228303.423	433962.338	2.156	95.82	3736.75
WF.72L	9228342.941	433887.834	2.186	27.01	4073.90	WF.72R	9228337.836	433961.357	2.501	34.43	3771.18
WF.73+33L	9228258.025	433887.590	5.244	84.92	4158.81	WF.73+33R	9228265.746	433973.460	5.098	73.10	3844.28
WF.73L	9228291.039	433895.222	2.471	33.88	4192.70	WF.73R	9228283.689	433967.270		18.98	3863.26
WF.74L	9228240.949	433891.167	4.409	50.25	4242.95	WF.74R	9228246.129	433978.465	4.628	39.19	3902.45
WF.75L	9228191.959	433902.966	4.136	50.39	4293.34	WF.75R	9228197.283	433976.747	4.242	48.88	3951.33
WF.76L	9228142.654	433903.874	4.277	49.31	4342.65	WF.76R	9228146.848	433979.075	4.823	50.49	4001.82
WF.77L	9228091.875	433905.687	4.512	50.81	4393.47	WF.77R	9228093.803	433989.667	5.101	54.09	4055.91
WF.78L	9228041.998	433908.375	4.688	49.95	4443.42	WF.78R	9228051.101	433991.584	5.465	42.74	4098.65
WF.79L	9227992.710	433916.714	4.341	49.99	4493.40	WF.79R	9228006.551	433996.744	5.448	44.85	4143.50
WF.80L	9227942.940	433921.077	4.185	49.96	4543.36	WF.80R	9227945.059	434006.242	5.378	62.22	4205.72
WF.81L	9227892.913	433923.323	4.573	50.08	4593.44	WF.81R	9227895.077	434009.476	5.579	50.09	4255.81
WF.82L	9227843.430	433924.120	5.391	49.49	4642.93	WF.82R	9227847.536	434013.334	5.654	47.70	4303.51
WF.83L	9227793.333	433930.922	5.100	50.56	4693.49	WF.83R	9227796.997	434018.734	5.912	50.83	4354.33
WF.84L	9227744.037	433929.515	5.523	49.32	4742.81	WF.84R	9227749.015	434021.781	5.938	48.08	4402.41
WF.85L	9227691.219	433937.972	5.073	53.49	4796.29	WF.85R	9227694.293	434026.420	6.030	54.92	4457.33
WF.86L	9227642.376	433938.205	5.659	48.84	4845.14	WF.86R	9227643.140	434030.880	6.276	51.35	4508.68
WF.87L	9227592.475	433944.821	5.499	50.34	4895.48	WF.87R	9227597.780	434031.428	6.032	45.36	4554.04
WF.88L	9227542.973	433949.175	5.410	49.69	4945.17	WF.88R	9227547.631	434036.395	5.690	50.39	4604.43
WF.89L	9227493.468	433950.191	5.743	49.52	4994.69	WF.89R	9227497.740	434039.015	6.120	49.96	4654.39

Table 3.1.3 (4/8) COORDINATES OF CROSS SECTION POINT

STATION	NORTHING	EASTING	ELEVATION	DISTANCE	ACCUM.DIS	STATION	NORTHING	EASTING	ELEVATION	DISTANCE	ACCUM.DIS
WF.90L	9227443.775	433956.295	5.707	50.07	5044.75	WF.90R	9227447.129	434039.912	5.924	50.62	4705.01
WF.91L	9227393.548	433957.062	5.520	50.23	5094.98	WF.91R	9227390.783	434048.027	6.354	56.93	4761.94
WF.92L	9227343.699	433955.134	5.782	49.89	5144.87	WF.92R	9227340.082	434044.489	6.308	50.82	4812.76
WF.93L	9227293.738	433955.032	5.772	49.96	5194.83	WF.93R	9227292.959	434045.273	6.626	47.13	4859.89
WF.94+23L	9227220.568	433965.258	3.650	73.88	5268.71	WF.94+23R	9227217.118	434034.987	3.871	76.54	4936.43
WF.94L	9227243.884	433955.815	6.952	25.16	5293.87	WF.94R	9227246.835	434040.306	6.597	30.19	4966.62
WF.95L	9227194.698	433947.106	6.178	49.95	5343.82	WF.95R	9227191.477	434040.413	6.697	55.36	5021.98
WF.96L	9227144.917	433945.111	6.348	49.82	5393.64	WF.96R	9227147.881	434043.694	7.056	43.72	5065.70
WF.97L	9227094.991	433943.724	6.736	49.95	5443.59	WF.97R	9227096.646	434042.924	7.551	51.24	5116.94
WF.98L	9227045.034	433943.004	6.744	49.96	5493.55	WF.98R	9227042.774	434043.451	8.092	53.88	5170.81
WF.99L	9226994.991	433942.468	7.504	50.05	5543.60	WF.99R	9226992.027	434044.036	8.887	50.75	5221.56
WF.99+30L	9226965.233	433944.660		29.84	5573.43	WF.99+30R	9226964.124	434037.665		28.62	5250.18
GARANG RIVER											
WF.100L	9226945.269	433949.563	8.634	20.56	5593.99	WF.100R	9226939.702	434036.468	8.602	24.45	5274.63
WF.101L	9226895.318	433950.427	9.442	49.96	5643.95	WF.101R	9226890.365	434027.203	7.180	50.20	5324.83
WF.102L	9226845.352	433948.253	9.305	50.01	5693.96	WF.102R	9226832.377	434023.855	7.579	58.08	5382.92
WF.103L	9226795.694	433942.422	9.638	50.00	5743.96	WF.103R	9226779.918	434027.480	7.606	52.58	5435.50
WF.104L	9226747.292	433929.819	9.160	50.02	5793.98	WF.104R	9226719.692	433997.377	7.920	67.33	5502.83
WF.105L	9226700.959	433910.965	9.279	50.02	5844.00	WF.105R	9226673.402	433975.772	8.053	51.08	5553.92
WF.106L	9226654.536	433892.355	9.176	50.01	5894.01	WF.106R	9226632.468	433957.445	9.079	44.85	5598.77
WF.107L	9226609.241	433870.899	9.711	50.12	5944.13	WF.107R	9226583.362	433935.177	7.604	53.92	5652.68
WF.108L	9226558.950	433857.251	11.033	52.11	5996.24	WF.108R	9226528.314	433925.459	11.893	55.90	5708.58
WF.109L	9226516.185	433835.840	13.222	47.83	6044.07	WF.109R	9226492.787	433910.209	12.509	38.66	5747.25
WF.110L	9226465.004	433839.899	14.000	51.34	6095.41	WF.110R	9226445.572	433895.695	12.604	49.40	5796.64
WF.111L	9226422.466	433812.911	11.854	50.38	6145.79	WF.111R	9226399.590	433883.906	10.427	47.47	5844.11
WF.112L	9226400.574	433787.122	10.431	33.83	6179.62	WF.112R	9226363.460	433878.550	9.972	36.52	5880.63
WF.113L	9226371.291	433772.646	10.500	32.67	6212.28	WF.113R	9226314.127	433886.430	9.473	49.96	5930.59
WF.114L	9226346.152	433751.309	10.275	32.97	6245.26	WF.114R	9226269.446	433909.510	9.447	50.29	5980.88
WF.115L	9226329.473	433723.400	10.663	32.51	6277.77	WF.115R	9226225.323	433931.648	7.739	49.36	6030.25
WF.116L	9226300.127	433706.203	10.748	34.01	6311.78	WF.116R	9226175.350	433936.826	10.811	50.24	6080.49
WF.117L	9226272.141	433688.828	10.896	32.94	6344.72	WF.117R	9226131.001	433914.010	11.009	49.87	6130.36
WF.118L	9226247.861	433677.072	10.797	26.98	6371.70	WF.118R	9226093.800	433879.903	9.201	50.47	6180.83
WF.119L	9226224.272	433664.014	10.879	26.96	6398.66	WF.119R	9226055.795	433849.531	9.721	48.65	6229.48
WF.120L	9226200.718	433650.883	11.122	26.97	6425.63	WF.120R	9226015.528	433820.669	11.046	49.54	6279.03

Table 3.1.3 (5/8) COORDINATES OF CROSS SECTION POINT

STATION	NORTHING	EASTING	ELEVATION	DISTANCE	ACCUM.DIS	STATION	NORTHING	EASTING	ELEVATION	DISTANCE	ACCUM.DIS
WF.121L	9226176.849	433638.221	11.096	27.02	6452.65	WF.121R	9225975.401	433790.725	10.826	50.07	6329.09
WF.122L	9226153.253	433624.600	11.269	27.25	6479.89	WF.122R	9225944.413	433752.100	11.159	49.52	6378.61
WF.123L	9226129.614	433612.153	11.264	26.72	6506.61	WF.123R	9225950.138	433702.533	11.333	49.90	6428.51
WF.124L	9226106.040	433599.326	11.202	26.84	6533.45	WF.124R	9225963.709	433654.434	11.253	49.98	6478.49
WF.125L	9226085.199	433582.522	11.379	26.77	6560.22	WF.125R	9225974.151	433606.475	11.203	49.08	6527.57
WF.126L	9226049.864	433539.931	11.082	55.34	6615.56	WF.126R	9225960.643	433558.088	11.344	50.24	6577.81
WF.127L	9226037.603	433491.518	11.018	49.94	6665.50	WF.127R	9225929.193	433516.764	11.008	51.93	6629.74
WF.128L	9226024.929	433443.172	11.140	49.98	6715.48	WF.128R	9225900.257	433498.914	10.889	34.00	6663.73
WF.129L	9226005.091	433397.479	11.223	49.81	6765.29	WF.129R	9225873.351	433483.732	11.120	30.89	6694.63
WF.130L	9225971.446	433360.744	10.450	49.81	6815.11	WF.130R	9225865.354	433478.686	11.209	9.46	6704.08
WF.131L	9225938.804	433322.716	10.884	50.12	6865.22	WF.131R	9225828.304	433458.240	11.548	42.32	6746.40
WF.132L	9225904.348	433286.442	10.592	50.03	6915.25	WF.132R	9225819.145	433451.223	11.598	11.54	6757.94
WF.133L	9225859.010	433268.229	11.592	48.86	6964.11	WF.133R	9225814.568	433413.787	8.710	37.72	6795.65
WF.134L	9225810.154	433257.910	11.589	49.93	7014.05	WF.134R	9225783.911	433398.651	11.232	34.19	6829.84
WF.135L	9225762.268	433242.662	11.763	50.26	7064.30	WF.135R	9225712.379	433333.556	11.396	96.72	6926.56
WF.136L	9225725.615	433208.666	12.589	49.99	7114.29	WF.136R	9225650.800	433305.109	8.903	67.83	6994.39
WF.137L	9225693.570	433170.229	13.351	50.04	7164.34	WF.137R	9225509.765	433296.492	11.686	141.30	7135.69
WF.138L	9225664.773	433129.818	13.576	49.62	7213.96	WF.138R	9225401.682	433289.185	12.845	108.33	7244.02
WF.139L	9225623.040	433099.117	12.231	51.81	7265.77	WF.139R	9225354.975	433233.692	8.533	72.53	7316.55
WF.140L	9225606.343	433048.607	13.213	53.20	7318.97	WF.140R	9225315.852	433174.392	9.960	71.04	7387.60
WF.141L	9225572.999	433010.666	12.527	50.51	7369.48	WF.141R	9225359.922	433094.676	12.399	91.09	7478.68
WF.142L	9225563.179	432961.797	11.730	49.85	7419.32	WF.142R	9225447.430	432989.209	12.767	137.04	7615.73
WF.143L	9225566.098	432911.513	10.144	50.37	7469.69	WF.143R	9225479.549	432897.636	13.089	97.04	7712.77
WF.144L	9225580.085	432863.481	11.310	50.03	7519.72	WF.144R	9225496.731	432837.600	12.983	62.45	7775.22
WF.145L	9225602.176	432818.926	11.409	49.73	7569.45	WF.145R	9225501.048	432792.167	13.367	45.64	7820.85
WF.146L	9225596.673	432768.095	10.129	51.13	7620.58	WF.146R	9225500.098	432770.921	13.410	21.27	7842.12
WF.147L	9225591.498	432720.254	10.381	48.12	7668.70	WF.147R	9225505.157	432733.888	13.183	37.38	7879.50
WF.148L	9225593.188	432670.552	12.112	49.73	7718.43	WF.148R	9225509.533	432683.164	13.537	50.91	7930.41
WF.149L	9225587.550	432620.423	10.940	50.44	7768.87	WF.149R	9225511.246	432617.394	13.474	65.79	7996.20
WF.150L	9225585.447	432570.587	11.190	49.88	7818.75	WF.150R	9225506.446	432584.507	11.184	33.23	8029.44
WF.151L	9225557.722	432529.613	10.415	49.47	7868.23	WF.151R	9225493.524	432572.394	13.409	17.71	8047.15
WF.152L	9225530.528	432502.078	11.319	38.70	7906.93	WF.152R	9225479.956	432565.967	13.388	15.01	8062.16
WF.153L	9225491.820	432471.820	11.660	49.13	7956.06	WF.153R	9225457.230	432542.154	13.477	32.92	8095.08
WF.154L	9225434.664	432477.820	8.570	57.47	8013.53	WF.154R	9225423.407	432525.404	13.604	37.74	8132.82

Table 3.1.3 (6/8) COORDINATES OF CROSS SECTION POINT

STATION	NORTHING	EASTING	ELEVATION	DISTANCE	ACCUM.DIS	STATION	NORTHING	EASTING	ELEVATION	DISTANCE	ACCUM.DIS
WF.155L	9225385.983	432461.352	8.655	51.39	8064.92	WF.155R	9225371.671	432516.706	13.831	52.46	8185.29
WF.156L	9225342.449	432443.769	8.906	46.95	8111.87	WF.156R	9225309.860	432506.024	13.960	62.73	8248.01
WF.157L	9225297.674	432411.266	8.971	55.33	8167.20	WF.157R	9225260.972	432476.855	14.137	56.93	8304.94
WF.158L	9225255.270	432381.234	9.124	51.96	8219.16	WF.158R	9225218.608	432452.983	14.165	48.63	8353.57
WF.159L	9225212.422	432360.570	9.650	47.57	8266.73	WF.159R	9225174.080	432431.150	14.337	49.59	8403.16
WF.160L	9225164.235	432336.425	9.321	53.90	8320.63	WF.160R	9225113.825	432406.006	14.482	65.29	8468.45
WF.161L	9225131.772	432315.528	11.042	38.61	8359.23	WF.161R	9225092.254	432392.577	14.240	25.41	8493.86
WF.162L	9225087.655	432280.670	14.569	56.23	8415.46	WF.162R	9225040.565	432368.008	14.354	57.23	8551.09
WF.163L	9225038.614	432265.975	9.910	51.19	8466.66	WF.163R	9224991.895	432345.090	14.523	53.80	8604.89
WF.164L	9225000.911	432246.728	10.005	42.33	8508.99	WF.164R	9224960.304	432333.179	14.301	33.76	8638.65
WF.165L	9224952.333	432234.662	10.174	50.05	8559.04	WF.165R	9224934.337	432318.556	14.266	29.80	8668.45
WF.166L	9224911.142	432227.430	11.504	41.82	8600.86	WF.166R	9224928.254	432318.146	14.246	6.10	8674.55
WF.167L	9224865.671	432248.469	10.597	50.10	8650.97	WF.167R	9224889.390	432328.869	14.093	40.32	8714.87
WF.168L	9224828.219	432289.914	9.814	55.86	8706.83	WF.168R	9224861.421	432347.867	14.073	33.81	8748.68
WF.169L	9224784.048	432313.259	9.314	49.96	8756.79	WF.169R	9224808.773	432377.113	14.204	60.23	8808.90
WF.170L	9224736.620	432329.047	9.475	49.99	8806.77	WF.170R	9224758.219	432403.999	14.260	57.26	8866.16
WF.171L	9224688.170	432341.591	9.527	50.05	8856.82	WF.171R	9224700.477	432420.031	14.279	59.93	8926.09
WF.172L	9224638.461	432346.688	9.531	49.97	8906.79	WF.172R	9224652.086	432428.033	14.313	49.05	8975.14
WF.173L	9224588.486	432348.263	10.319	50.00	8956.79	WF.173R	9224576.367	432436.979	14.340	76.24	9051.38
WF.174L	9224534.541	432338.602	10.271	54.80	9011.59	WF.174R	9224525.236	432442.573	11.828	51.44	9102.82
WF.175L	9224492.955	432323.214	10.936	44.34	9055.94	WF.175R	9224467.371	432434.719	11.843	58.40	9161.21
WF.176L	9224446.499	432337.080	12.210	48.48	9104.42	WF.176R	9224430.582	432410.625	10.271	43.98	9205.19
WF.177L	9224396.832	432351.388	12.403	51.69	9156.10	WF.177R	9224383.372	432415.023	11.603	47.42	9252.60
WF.178L	9224349.331	432336.728	13.089	49.71	9205.81	WF.178R	9224320.942	432425.755	12.327	63.34	9315.95
WF.179L	9224302.777	432320.616	13.701	49.26	9255.08	WF.179R	9224250.062	432311.767	12.267	134.23	9450.18
WF.180L	9224250.068	432311.727	12.149	53.45	9308.53	WF.180R	9224251.145	432405.201	11.827	93.44	9543.62
WF.181L	9224200.981	432320.537	12.541	49.87	9358.40	WF.181R	9224217.837	432388.190	12.318	37.40	9581.02
WF.182L	9224155.363	432340.911	13.004	49.96	9408.36	WF.182R	9224177.967	432389.718	12.108	39.90	9620.92
WF.183L	9224111.114	432380.337	11.624	59.27	9467.63	WF.183R	9224137.693	432408.575	12.066	44.47	9665.39
WF.184L	9224081.346	432420.065	11.915	49.64	9517.27	WF.184R	9224110.205	432443.725	12.877	44.62	9710.01
WF.185L	9224053.432	432461.402	11.738	49.88	9567.15	WF.185R	9224088.553	432481.771	13.965	43.78	9753.78
WF.186L	9224041.165	432510.517	10.530	50.62	9617.78	WF.186R	9224071.138	432522.691	14.434	44.47	9798.26
WF.186L+27	9224035.586	432536.461	9.850	26.54	9644.31	WF.186R+27	9224060.335	432542.301	12.188	22.39	9820.64
WF.186L+35	9224028.028	432550.124	14.654	15.61	9659.93	WF.186R+35	9224062.005	432559.004	15.151	16.79	9837.43

Table 3.1.3 (7/8) COORDINATES OF CROSS SECTION POINT - CENGKEK RIVER

STATION	NORTHING	EASTING	ELEVATION	STATION	NORTHING	EASTING	ELEVATION	ACCUM. DIS	STATION	NORTHING	EASTING	ELEVATION	DISTANCE
CE.0L	9225944.110	433421.945	7.00	CEC-0	9225955.386	433423.177	0.00	0.00	CE.0R	9225966.662	433424.409	6.33	22.69
CE.0+28L	9225940.280	433449.460	6.13	CEC-0+28	9225942.297	433455.382	34.76	34.76	CE.0+28R	9225944.313	433461.304	8.49	12.51
CE.1L	9225919.372	433442.184	7.28	CEC-1	9225917.590	433451.455	25.02	59.78	CE.1R	9225915.808	433460.726	8.18	18.88
CE.2L	9225870.719	433430.669	7.53	CEC-2	9225869.782	433436.582	50.07	109.85	CE.2R	9225868.845	433442.495	6.90	11.97
CE.3L	9225820.951	433426.515	8.49	CEC-3	9225821.676	433439.430	48.19	158.04	CE.3R	9225822.402	433452.345	11.56	25.87
CE.4L	9225767.238	433438.304	8.87	CEC-4	9225770.758	433446.044	51.35	209.38	CE.4R	9225774.278	433453.783	10.72	17.00
CE.5L	9225725.058	433450.524	9.16	CEC-5	9225728.285	433459.667	44.60	253.99	CE.5R	9225731.513	433468.810		19.39
CE.6L	9225685.098	433479.339		CEC-6	9225689.580	433483.118	45.26	299.24	CE.6R	9225694.063	433486.898	8.25	11.73
CE.7L	9225657.461	433521.967	8.55	CEC-7	9225662.556	433525.395	50.18	349.42	CE.7R	9225667.651	433528.822	9.52	12.28
CE.8L	9225628.609	433557.367	10.31	CEC-8	9225633.200	433565.747	49.90	399.32	CE.8R	9225637.791	433574.127	10.78	19.11
CE.9L	9225579.645	433569.665	10.49	CEC-9	9225581.738	433578.370	52.99	452.31	CE.9R	9225583.831	433587.076	10.37	17.91
CE.10L	9225537.985	433596.944	10.99	CEC-10	9225541.243	433602.754	47.27	499.58	CE.10R	9225544.502	433608.564	10.99	13.32

Table 3.1.3 (8/8) COORDINATES OF CROSS SECTION POINT - KALITO RIVER

STATION	NORTHING	EASTING	ELEVATION	STATION	NORTHING	EASTING	DISTANCE	ACCUM. DIS	STATION	NORTHING	EASTING	ELEVATION	DISTANCE
KA.0L	9225369.666	433261.624	7.95	KAC-0	9225374.777	433270.312	0.00	0.00	KA.0R	9225379.888	433279.000	12.52	20.16
KA.1L	9225323.472	433248.879	9.76	KAC-1	9225317.909	433260.899	57.64	57.64	KA.1R	9225312.346	433272.919	9.22	26.49
KA.2L	9225278.131	433227.837	10.18	KAC-2	9225273.130	433238.736	49.96	107.61	KA.2R	9225268.130	433249.634		23.98
KA.3L	9225230.858	433211.194	10.55	KAC-3	9225227.386	433218.771	49.91	157.52	KA.3R	9225223.913	433226.349	10.84	16.67
KA.4L	9225186.178	433188.748	10.61	KAC-4	9225182.440	433196.743	50.05	207.57	KA.4R	9225178.701	433204.738	10.51	17.65
KA.5L	9225138.537	433188.190	10.66	KAC-5	9225142.885	433195.680	39.57	247.14	KA.5R	9225147.233	433203.169	10.61	17.32
KA.6L	9225092.447	433204.709	10.67	KAC-6	9225089.868	433214.507	56.26	303.40	KA.6R	9225087.288	433224.306	10.79	20.26
KA.7L	9225054.973	433172.154	10.96	KAC-7	9225053.256	433177.845	51.81	355.21	KA.7R	9225051.539	433183.536	10.73	11.89
KA.8L	9225007.998	433156.633	10.89	KAC-8	9225008.239	433162.956	47.42	402.63	KA.8R	9225008.480	433169.280	10.89	12.66
KA.9L	9224967.295	433181.645	11.07	KAC-9	9224972.286	433187.034	43.27	445.90	KA.9R	9224977.277	433192.422	11.15	14.69
KA.10L	9224922.285	433200.877	11.12	KAC-10	9224924.917	433209.837	52.57	498.47	KA.10R	9224927.549	433218.797	11.33	18.68

Table 3.1.4 (1/5) LONGITUDINAL PROFILE WEST FLOODWAY/GAGANG RIVER

LINE	ACCM. DIS	DIS	LEFT Elevation	LEFT Δ width	LEFT Back Land	LEFT Dike Crown	LEFT River Bank	CENTER Lowest	CENTER Water Level	CENTER Width	RIGHT River Bank	RIGHT Dike Crown	RIGHT Back Land	RIGHT Elevation	RIGHT Δ width	Total WIDTH	REMARKS	
-9	-413.60	-13.70	0.64	58.10	0.63	0.63	0.63	-1.62	-0.40	361.18					361.18	780.46	97/9/30	11:45
-8	-399.90	-49.91	0.62	55.07	0.89	0.59	0.59	-1.44	-0.40	361.81					361.81	778.69	"	10:48
-7	-349.99	-47.97	0.50	53.50	1.04	0.77	0.77	-1.48	-0.43	380.22					380.22	813.94		
-6	-302.02	-54.05	0.89	52.78	1.09	0.75	0.75	-1.50	-0.40	380.39					380.39	813.56	"	10:25
-5	-247.97	-47.96	0.74	50.59	1.09	0.76	0.76	-1.68	-0.35	335.38					335.38	721.35	"	9:37
-4	-200.01	-50.02	0.82	49.59	1.02	0.75	0.75	-1.95	-0.52	337.82					337.82	725.23	"	9:00
-3	-149.99	-49.99	0.90	50.13	1.02	0.72	0.72	-2.02	-0.46	289.56					289.56	629.25	97/9/29	14:18
-2	-100.00	-50.01	1.12	49.92	1.07	0.75	0.75	-2.06	-0.49	274.50					274.50	598.92	"	13:34
-1	-49.99	-49.99	0.40	52.86	1.17	0.40	0.40	-2.02	-0.38	374.08					374.08	801.02	"	11:47
0	0.00	0.00	0.46	54.40	0.41	0.40	0.40	-2.17	-0.36	205.21	0.08			0.21	53.81	313.42	"	10:35
1	47.39	47.39	0.48	52.61	0.37	0.40	0.40	-2.26	-0.33	181.87	-0.01	0.72	0.00	0.78	52.55	287.03	97/07/28	8:20
2	93.33	45.95	0.41	53.77	0.29	0.41	0.41	-2.56	-0.31	179.81	-0.03	0.35	-0.16	0.29	59.27	292.85	"	9:10
3	144.98	51.64	0.69	50.00	1.57	1.57	0.48	-2.86	-0.30	164.07	-0.03	0.63	0.02	0.70	57.51	271.58	"	10:30
4	198.25	53.27	1.05	51.48	1.71	1.89	0.81	-2.78	-0.26	154.38	0.01	0.63	-0.22	0.69	57.90	263.76		
5	258.96	60.71	1.16	51.41	2.69	1.78	0.91	-2.96	-0.17	151.02	0.66	0.75	0.55	0.83	55.95	258.38	97/07/28	13:26
6	311.85	52.89	1.27	50.00	2.96	2.08	0.93	-2.95	-0.28	121.40	1.29	1.59	0.83	1.65	51.78	223.18	"	14:15
7	357.06	45.20	1.15	50.00	2.06	1.84	0.73	-3.20	-0.33	121.11	0.52	1.87	1.07	1.93	42.47	213.58		
8	408.50	51.44	1.13	50.00	2.00	1.79	0.85	-3.21	-0.37	120.33	0.45	2.40	1.16	2.27	53.52	223.85	97/07/28	15:22
9	455.58	47.09	0.88	50.00	2.06	1.87	0.53	-3.22	-0.42	118.06	0.24	2.73	1.14	2.78	52.83	220.89		
10	506.02	50.44	0.66	50.00	2.13	1.85	0.25	-3.28	-0.33	124.66	0.15	2.47	0.62	2.57	51.79	226.45	97/07/29	8:10
11	553.89	47.87	0.46	50.00	2.16	1.89	-0.11	-3.26	-0.37	129.95	0.12	2.09	0.50	2.14	51.50	231.45		
12	605.20	51.31	0.21	50.00	1.44	1.44	0.21	-3.22	-0.32	157.77	0.41	0.72	0.16	0.71	52.34	260.11	97/07/29	
13	656.93	51.73	1.78	52.61	2.00	2.01	1.32	-3.26	-0.35	149.87	0.03	1.20	0.48	1.25	52.47	254.95	"	10:50
14	701.67	44.74	1.40	51.57	0.62	1.92	1.32	-3.52	-0.42	150.17	0.17	1.63	0.25	1.54	55.93	257.67	"	11:30
15	760.78	59.11	0.41	85.29	-0.04	1.04	0.24	-4.66	-0.22	140.39	0.71	2.57	4.17	0.34	81.28	306.96	Bridge 1997/7/30	9:40
16	817.01	56.23	0.05	50.00	0.77	0.96	0.14	-3.12	-0.33	149.15	0.40	1.61	0.14	0.63	40.94	240.09		
17	863.11	46.10	0.31	50.00	0.63	1.05	0.49	-3.24	-0.34	145.53	0.31	1.61	-0.08	0.93	54.73	250.26	97/07/29	14:30
18	913.43	50.32	0.85	50.00	0.74	1.38	0.10	-2.75	-0.30	145.04	0.41	1.61	0.17	1.04	59.67	254.71		
19	974.54	61.11	0.24	50.00	1.00	1.65	0.22	-3.41	-0.37	138.16	0.04	1.55	0.34	1.06	57.13	245.29	97/07/29	15:20
20	1020.98	46.44	1.27	50.00	1.01	1.54	0.13	-3.03	-0.40	143.97	0.17	1.58	0.06	1.04	53.67	247.64	97/07/31	10:10
21	1072.80	51.83	1.32	50.00	0.97	1.50	0.54	-2.76	-0.33	150.10	0.03	1.62	0.39	1.19	58.32	258.42	97/07/30	11:45
22	1123.92	51.12	1.93	50.00	0.96	1.57	0.34	-2.75	-0.43	158.15	0.21	1.66	0.05	1.33	53.08	261.23		
23	1174.65	50.73	1.18	50.03	0.94	1.73	0.68	-2.55	-0.37	163.65	0.17	1.72	0.17	1.12	57.89	271.57	97/08/01	9:58
24	1221.11	46.46	1.25	50.00	0.97	1.65	0.39	-2.55	-0.36	169.27	0.25	1.75	0.45	1.44	51.44	270.71		
25	1265.96	44.85	1.26	51.91	1.00	1.85	0.43	-2.51	-0.41	171.00	0.46	1.83	0.17	1.44	54.85	277.76	97/07/30	13:55
26	1315.62	49.65	1.11	50.00	1.02	1.82	0.36	-2.75	-0.35	168.66	0.32	1.85	0.15	1.20	46.01	264.67	"	14:30
27	1369.02	53.40	1.16	50.00	0.84	1.78	0.29	-2.74	-0.10	168.21	0.41	1.84	0.07	1.51	53.43	271.64		
28	1422.31	53.29	1.00	50.00	0.80	1.79	0.29	-2.75	-0.12	170.76	0.29	1.85	0.13	1.40	71.59	292.35	97/07/31	11:05
29	1474.70	52.40	1.35	50.12	0.94	1.98	0.70	-2.78	-0.18	163.22	0.16	1.90	0.30	1.48	54.99	268.33	"	13:15
30	1527.12	52.42	0.61	50.00	0.55	2.25	0.52	-2.65	-0.21	165.26	0.64	1.88	0.03	1.07	56.70	271.96	97/08/11	14:45
31	1582.05	54.92	0.77	55.84	0.51	2.26	0.17	-2.78	-0.28	170.75	0.28	1.92	0.01	1.02	54.52	281.11	97/07/31	15:00
32	1634.82	52.78	0.88	54.73	0.59	2.20	0.93	-2.64	-0.28	184.68	0.27	1.84	0.82	1.93	53.51	292.92		
33	1688.29	53.47	1.23	53.48	0.73	2.24	0.50	-2.91	-0.28	180.67	0.40	2.11	0.22	1.22	55.77	289.92	97/07/31	15:45
34	1742.59	54.30	1.93	50.00	0.56	1.85	0.49	-2.27	-0.14	185.00	0.44	2.16	0.28	1.32	57.72	292.72	97/08/02	13:12
35	1786.55	43.97	1.43	51.40	0.51	1.92	0.49	-2.89	-0.10	185.62	0.47	2.20	0.50	1.32	55.03	292.05	"	14:00
36	1830.68	44.13	0.96	54.03	0.71	2.18	0.56	-2.95	-0.15	184.48	0.49	2.20	0.48	1.55	56.76	295.27	"	14:59
37	1879.83	49.15	1.12	50.00	0.71	2.17	0.91	-2.77	-0.25	188.67	0.60	2.31	0.43	1.50	52.64	291.31	97/08/04	8:15
38	1928.79	48.96	1.37	50.00	0.73	2.20	0.65	-2.51	-0.26	192.60	0.32	2.41	0.29	2.15	44.16	286.76	"	8:46
39	1983.84	55.05	1.09	50.00	0.79	2.34	0.91	-2.24	-0.32	190.92	0.63	2.39	0.96	1.22	50.33	291.25	"	9:20
40	2029.18	45.35	1.06	50.00	0.83	2.28	0.64	-2.47	-0.32	190.81	0.52	2.42	0.98	1.13	54.64	295.45		
41	2082.46	53.28	1.23	57.68	1.08	2.39	0.71	-2.33	-0.25	175.54	0.68	2.36	1.04	0.37	58.32	291.54	97/08/04	10:25
42	2133.69	51.22	0.93	59.47	0.98	2.47	0.73	-2.16	-0.32	175.19	0.63	2.52	1.12	1.19	59.52	294.18	"	11:30
43	2181.60	47.92	1.23	53.91	1.11	2.50	0.82	-2.05	-0.32	170.43	0.82	2.51	1.14	0.70	43.85	268.19	"	14:30
44	2232.03	50.42	1.20	49.85	1.33	2.64	1.06	-2.17	-0.29	162.26	0.53	2.61	1.33	1.11	35.16	247.27	"	15:30
45	2284.62	52.60	1.24	54.08	1.48	2.62	1.22	-2.21	-0.32	147.51	0.49	2.62	1.45	0.31	39.55	241.14	97/08/05	8:18
46	2335.93	51.30	1.52	54.91	1.70	2.81	1.60	-2.30	-0.20	148.79	0.73	2.65	1.60	0.94	43.56	247.26	"	8:57
47	2383.07	47.14	1.65	39.17	1.93	3.00	1.33	-2.47	-0.17	144.88	0.51	2.73	1.66	0.90	16.59	200.64	"	9:45
48	2434.61	51.54	2.28	41.91	1.88	3.05	2.16	-2.18	-0.21	143.06	0.73	2.80	1.77	2.52	11.12	196.09		
49	2486.34	51.74	2.10	50.00	1.99	3.31	0.83	-2.38	-0.40	137.42	0.96	2.88	1.92	1.65	15.07	202.49	97/08/05	10:12
50	2534.97	48.62	2.03	38.82	1.80	2.97	2.19	-2.25	-0.21	130.79	0.63	2.97	2.04	1.27	18.09	187.70	"	11:23
51	2583.17	48.21	2.27	50.00	1.84	3.14	2.23	-2.18	-0.35	127.71	0.75	3.03	2.09	1.60	13.24	190.95	"	14:15
52	2632.52	49.35	2.20	54.99	1.80	3.19	2.27	-2.14	-0.37	123.04	0.97	3.08	2.04	3.32	27.24	205.27	"	15:30
53	2684.54	52.02	2.33	50.00	1.79	3.03	2.37	-2.13	-0.35	118.59	0.91	3.09	2.12	2.55	33.85	202.44	97/08/06	8:20
54	2736.95	52.41	1.81	52.66	1.99	3.29	0.95	-2.36	-0.46	112.88	1.05	3.22	2.12	1.34	41.90	207.44	"	11:45
55	2785.26	48.31	1.38	58.03	1.91	3.10	1.11	-1.95	-0.21	107.59	0.85	3.32	2.10	2.16	17.36	182.98	"	14:17
56	2835.52	50.27	1.99	50.00	2.40	3.27	0.89	-2.19	-0.53	105.97	1.56	3.31	2.33	2.33	15.59	171.56	"	15:12
57	2885.81	50.28	2.25	50.00	2.67	3.24	0.83	-2.02	-0.52	94.47	1.39	3.46	2.54	1.41	52.55	197.02	"	16:00
58	2937.86	52.05	2.23	28.73	2.52	3.22	1.12	-2.20	-0.48	95.54	0.66	3.52	2.69	2.38	43.65	167.92	97/08/07	8:20
59	2985.06	47.21	2.60	54.18	2.77	3.41	0.84	-2.28	-0.53	89.45	1.23	3.45	2.73	2.63	17.15	160.78	"	9:31

Table 3.1.4 (2/5) LONGITUDINAL PROFILE WEST FLOODWAY/GAGANG RIVER

LINE	ACCM. DIS	DIS	LEFT					CENTER			RIGHT					Total	REMARKS	
			Elevation	Δ width	Back Land	Dike Crown	River Bank	Lowest	Water Level	Width	River Bank	Dike Crown	Back Land	Elevation	Δ width	WIDTH		
60	3035.36	50.29	2.67	50.00	3.03	3.40	0.20	-2.31	-0.55	87.80	0.78	3.59	2.91	2.24	15.81	153.61	•	10:20
61	3088.42	53.06	2.76	50.00	3.06	3.54	1.27	-2.64	-0.52	86.13	0.52	3.62	2.91	2.04	55.51	191.64	97/08/11	8:30
62	3137.35	48.94	2.71	50.00	3.05	3.59	0.26	-2.68	-0.49	85.06	0.99	3.66	3.17	2.29	33.41	168.47	97/08/07	11:39
63	3185.08	47.72	3.15	50.00	3.22	3.65	0.89	-2.64	-0.47	86.54	1.52	3.65	3.30	2.45	53.08	189.62	•	14:01
64	3236.94	51.87	1.87	50.00	3.42	3.79	1.55	-2.78	-0.51	84.78	1.55	3.84	3.79	3.20	31.28	166.06	•	14:35
65	3286.56	49.61	4.59	205.08	4.59	4.59	0.28	-2.11	-0.43	98.10	1.62	4.69	4.69	4.63	210.57	513.75	Rail Way*	15:30
66	3337.22	50.67	4.36	50.00	4.47	4.36	0.48	-2.29	-0.46	86.83	1.63	4.20	4.28	3.55	14.94	151.77		
67	3389.61	52.39	4.37	56.22	4.52	4.24	1.36	-2.41	-0.48	84.87	1.41	4.19	4.26	3.95	13.37	154.46	97/08/11	9:10
68	3436.61	46.99	4.66	50.70	4.65	4.52	0.36	-2.27	-0.42	83.10	1.56	4.13	4.12	4.21	15.13	148.93		8:45
69	3485.98	49.37	4.57	50.00	4.87	4.47	0.95	-2.67	-0.45	86.99	1.83	3.97	4.06	3.56	24.59	161.57	97/08/11	10:41
70	3536.62	50.64	4.99	50.00	4.86	4.90	1.15	-2.86	-0.50	91.01	1.84	3.96	4.05	3.74	45.17	186.18	•	11:25
71	3587.68	51.06	4.74	50.00	4.73	4.69	1.28	-3.05	-0.47	85.74	1.97	3.93	3.78	3.26	38.28	174.02	•	13:22
72	3643.16	55.49	2.19	44.69	4.98	5.51	1.80	-4.47	-0.51	73.70	1.49	4.07	4.12	2.50	40.70	159.09	97/08/12	8:45
72+22	3671.98	28.81		69.51	6.28	4.28	1.42	-3.22	0.28	65.38	1.85	4.24	6.24	2.16	68.01	202.90	Bridge *	9:35
72+39	3688.12	16.14		57.63	8.04	4.09	2.14	-2.82	0.26	67.28	1.42	4.09	6.10	2.46	55.58	180.49	Bridge *	9:55
74	3740.58	43.97	4.41	50.00	4.14	4.36	1.73	-1.91	-0.45	87.45	1.96	4.55	4.74	4.63	14.33	151.78	•	10:40
75	3789.75	49.18	4.14	50.00	4.04	4.06	1.17	-2.08	-0.41	73.97	1.83	4.93	5.13	4.24	14.78	138.75	•	11:15
76	3839.65	49.90	4.28	34.09	4.23	4.18	2.26	-2.21	-0.42	75.32	2.32	5.16	5.28	4.82	28.10	137.51	•	13:10
77	3891.93	52.28	4.51	50.00	4.36	4.23	1.67	-2.35	-0.45	84.00	1.77	4.97	5.18	5.10	26.10	160.10	•	
78	3938.28	46.35	4.69	50.00	4.39	4.59	2.41	-2.32	-0.48	83.71	3.03	5.35	5.38	5.47	16.14	149.85	97/08/12	14:00
79	3985.68	47.40	4.34	50.00	4.52	4.31	2.41	-2.19	-0.55	81.22	1.41	5.35	5.47	5.45	22.87	154.09	•	14:30
80	4041.74	56.06	4.19	52.13	4.84	4.08	2.52	-1.94	-0.49	85.19	0.61	5.31	5.43	5.38	20.01	157.33	97/08/13	8:00
81	4091.82	50.08	4.57	50.00	4.95	4.49	2.97	-1.86	-0.48	86.18	0.64	5.44	5.54	5.58	20.86	157.04		
82	4140.38	48.56	5.39	50.00	5.33	5.35	3.14	-1.99	-0.54	89.31	0.89	5.57	5.65	5.65	10.79	150.10	97/08/13	
83	4191.07	50.69	5.10	50.00	5.43	5.07	3.19	-2.06	-0.61	87.89	1.38	5.81	5.84	5.91	24.06	161.95	•	
84	4239.71	48.65	5.52	50.00	5.46	5.40	3.13	-1.90	-0.50	92.40	1.47	5.85	5.84	5.94	51.23	193.63	•	
85	4293.88	54.17	5.07	50.00	5.38	5.02	3.11	-1.74	-0.46	88.50	1.86	5.67	5.96	6.03	10.31	148.81	•	
86	4343.93	50.05	5.66	50.00	5.54	5.53	3.05	-1.90	-0.17	92.68	2.22	6.17	6.08	6.28	23.18	165.86	•	
87	4391.70	47.77	5.50	50.00	5.59	5.43	1.82	-1.90	-0.21	86.77	2.27	5.91	5.99	6.03	12.50	149.27	97/08/14	
88	4441.74	50.04	5.41	50.00	5.59	5.30	1.52	-1.81	-0.21	87.34	1.54	5.97	5.99	5.69	12.02	149.36	97/08/14	
89	4491.47	49.73	5.74	50.00	5.63	5.63	3.14	-1.86	-0.22	88.93	1.60	6.07	6.14	6.12	12.39	151.32	•	
90	4541.75	50.27	5.71	50.00	5.78	5.63	2.09	-1.94	-0.28	83.68	1.51	5.84	6.25	5.92	22.95	156.63	97/08/13	11:05
91	4595.22	53.47	5.52	50.00	5.71	5.42	2.26	-2.00	-0.26	91.01	1.71	6.30	6.43	6.35	9.22	150.23		
92	4645.57	50.35	5.78	50.00	5.73	5.65	2.94	-2.11	-0.25	89.43	1.84	6.21	6.41	6.31	21.00	160.43		
93	4694.11	48.54	5.77	26.18	6.01	6.01	2.70	-1.76	-0.46	90.24	1.57	6.53	6.52	6.63	28.09	144.51		
94	4742.15	48.03	6.95	34.51	6.94	6.98	2.79	-2.06	-0.50	84.54	1.68	6.55	6.71	6.60	17.07	136.12	97/08/13	14:00
94+23	4768.54	26.40	3.65	55.61	6.95	3.95	3.95	-2.90	-0.24	69.81	4.62	4.62	6.65	3.87	60.48	185.90	Bridge *	15:00
95	4794.59	26.05	6.18	27.31	7.39	6.08	2.85	-1.32	-0.46	93.36	6.49	6.62	6.70	6.70	11.17	131.84	97/08/16	8:10
96	4841.29	46.69	6.35	35.90	8.51	6.28	2.62	-1.12	-0.15	98.63	4.05	6.85	7.11	7.06	7.75	142.28	•	8:47
97	4891.88	50.59	6.74	29.55	8.73	6.63	1.79	-1.34	-0.18	99.21	3.91	7.42	7.52	7.55	14.31	143.07	•	9:45
98	4943.79	51.92	6.74	21.52	7.58	6.83	3.01	-2.80	-0.10	100.47	5.05	7.97	8.33	8.09	34.86	156.85	•	10:17
98+21			River Bed H=-1.44														•	10:55
98+23			River Bed H=0.99														•	11:35
99	4994.19	50.40	7.50	41.32	8.91	7.42	5.96	1.54	1.68	101.61	5.88	9.16	9.36	8.89	41.91	184.84	•	13:20
99+29	5023.04	28.85	8.49	31.24	8.53	8.43	8.43	5.16		92.96	8.41	8.41	7.41	8.61	31.70	155.90	Simongan Weir *	14:00
99+29			WFC-99+29 River Bed H=-1.22														•	15:02
100	5045.21	22.17	8.63	12.21	8.54	9.37	9.37	1.10	4.94	87.08	5.94	9.42	8.60	8.60	34.23	133.52	97/08/18	8:00
101	5095.03	49.82	9.44	1.57	10.20	9.44	6.90	3.57	4.97	76.94	6.96	9.97	9.45	7.18	16.37	94.88	•	8:42
102	5149.08	54.05	9.31	16.51	9.26	10.19	6.37	3.54	4.97	76.71	6.84	10.00	9.55	7.58	29.28	122.50	•	9:20
103	5200.15	51.07	9.64	14.22	9.56	10.29	6.48	3.65	5.00	86.51	7.16	10.08	9.59	7.61	17.04	117.77	•	10:30
104	5258.51	58.36	9.16	11.35	8.59	10.28	5.71	3.77	5.01	72.98	7.42	10.19	9.63	7.92	20.63	105.46	•	11:15
105	5309.05	50.54	9.28	17.69	8.78	10.35	8.34	4.30	5.03	70.42	7.65	10.22	9.65	8.05	77.49	165.60	•	13:10
106	5356.47	47.42	9.18	13.15	9.04	10.43	6.05	4.21	5.05	68.73	8.96	10.34	9.53	9.08	28.32	110.20	•	14:00
107	5408.49	52.02	9.71	14.38	9.50	10.47	7.01	3.96	5.12	69.29	7.00	11.42	10.78	7.60	24.93	108.60	97/08/19	8:10
108	5462.44	53.95	11.03	21.25	10.95	10.50	7.80	3.38	5.10	74.77	6.82	11.96	11.58	11.69	40.26	136.28	•	10:15
109	5505.67	43.23	13.22	20.01	13.52	13.12	7.67	3.20	5.13	77.96	12.04	12.46	12.04	12.51	20.77	118.74	•	11:10
110	5555.14	49.48	14.00	34.51	13.88	13.91	9.43	3.66	5.12	59.08	12.28	12.51	12.23	12.60	16.89	110.48	•	14:20
111	5603.46	48.32	11.86	13.34	12.32	11.85	7.06	2.80	5.08	74.59	10.02	10.38	10.51	10.43	43.06	130.99	97/08/20	8:30
112	5636.39	32.93	10.49	39.26	8.13	10.35	7.30	1.78	5.08	98.67	6.49	10.64	8.40	9.97	29.36	167.29		
113	5675.83	39.45	11.11	12.30	8.19	10.46	7.10	3.45	4.99	127.34	6.90	10.65	9.32	9.47	36.61	176.25	97/08/20	
114	5710.76	34.92	11.17	23.15	8.27	10.18	7.18	3.02	4.93	175.82	7.08	10.77	9.33	9.45	74.12	273.09	•	
115	5741.29	30.54	11.23	9.50	8.44	10.61	7.58	3.09	4.99	232.84	7.74	10.65	10.55	7.74	14.79	257.13		
116	5781.40	40.11	11.29	29.37	8.77	10.69	7.12	2.87	4.95	262.21	8.44	10.72	10.83	10.81	57.77	349.35		
117	5822.78	41.38	10.90	38.65	8.01	10.79	7.58	2.29	5.11	265.76	7.64	10.89	11.14	11.01	26.26	330.67		
118	5861.13	38.35	10.85	53.79	7.81	10.71	7.15	2.25	5.16	254.71	9.14	9.31	11.00	9.20	17.40	325.90		
119	5898.82	37.68	10.86	53.66	7.97	10.76	7.91	2.85	5.15	250.60	9.25	9.74	10.61	9.72	3.85	308.11	97/08/20	
120	5937.01	38.20	10.34	61.85	8.04	11.00	8.87	3.96	5.12	251.24	6.94	11.01	10.01	11.05	20.85	333.94		
121	5975.45	38.44	10.28	12.45	8.88	11.03	9.02	4.37	5.00	252.66	7.34	10.76	9.51	10.83	26.88	291.99		
122	6013.23	37.78	10.26	64.25	8.49	11.15	8.46	4.15	4.85	244.68	7.73	11.11	9.91	11.16	4.95	313.88		

Table 3.1.4 (3/5) LONGITUDINAL PROFILE WEST FLOODWAY/GAGANG RIVER

LINE	ACCM. DIS	DIS	LEFT Elevation	LEFT Δ width	LEFT Back Land	LEFT Dike Crown	LEFT River Bank	CENTER Lowest	CENTER Water Level	CENTER Width	RIGHT River Bank	RIGHT Dike Crown	RIGHT Back Land	RIGHT Elevation	RIGHT Δ width	Total WIDTH	REMARKS
123	6045.51	32.27	10.30	58.81	8.72	11.07	7.29	4.29	5.20	200.95	7.49	11.26	9.82	11.33	7.76	267.52	
124	6076.38	30.87	11.27	52.70	10.13	11.10	7.83	4.36	5.17	152.63	7.83	11.18	8.32	11.25	10.20	215.53	
125	6109.17	32.80	11.38	50.00	10.50	11.19	7.31	4.45	4.94	113.60	7.35	11.13	8.67	11.20	12.32	175.92	97/08/20
126	6160.80	51.63	11.08	32.06	10.26	11.03	7.37	3.63	4.92	91.05	7.64	11.22	9.35	11.34	11.55	134.66	•
127	6210.71	49.91	11.02	22.51	10.68	11.02	8.44	3.96	4.95	111.31	7.61	10.91	9.11	11.01	96.94	230.76	•
128	6249.81	39.09	11.14	28.81	10.46	11.14	6.68	4.18	4.94	136.57	6.39	10.83	7.70	10.89	19.18	184.56	•
129	6288.18	38.38	11.22	40.33	11.12	11.56	7.60	3.61	4.94	157.46	6.71	11.11	8.08	11.12	37.81	235.60	
130	6317.68	29.50	10.45	22.90	11.19	11.55	8.02	2.38	5.08	158.64	7.81	11.14	7.85	11.21	49.11	230.65	
131	6363.16	45.49	10.88	53.70	11.15	11.50	7.56	2.72	5.03	174.86	6.82	11.46	8.20	11.55	48.76	277.32	
132	6393.89	30.73	10.59	52.87	10.59	11.53	7.24	4.06	5.08	185.51	7.93	11.52	7.64	11.60	33.18	271.56	9:50
133	6431.27	37.38	11.59	41.79	9.41	11.43	8.42	4.17	5.07	152.19	7.77	8.70	8.47	8.71	36.26	230.24	10:54
134	6473.01	41.74	11.59	55.42	9.12	11.47	8.10	3.73	5.14	143.17	7.57	11.11	8.58	11.23	55.46	254.05	11:35
135	6544.98	71.97	11.76	56.25	9.18	11.61	7.84	3.95	5.05	103.69	8.84	11.25	10.06	11.40	10.58	170.52	13:30
136	6603.18	58.20	12.59	60.48	8.94	12.45	10.09	4.11	4.98	122.06	7.63	10.27	10.04	8.90	14.78	197.32	14:35
137	6692.86	89.68	13.35	59.56	9.11	13.23	10.95	4.25	5.01	222.99	10.94	11.68	12.19	7.84	54.00	336.55	97/08/28 8:20
138	6765.34	72.48	13.58	34.91	10.45	13.38	10.62	4.37	5.11	307.60	9.25	12.76	12.83	12.85	33.13	375.64	• 9:30
139	6827.08	61.75	12.23	51.14	12.61	12.03	11.67	4.40	5.20	299.95	9.81	11.13	10.62	12.72	25.89	376.98	97/08/28 11:15
140	6888.68	61.59	13.21	51.15	9.86	13.12	7.40	4.80	5.22	316.55	6.73	11.30	9.72	9.96	14.70	382.40	
141	6947.75	59.07	12.53	62.86	9.87	12.42	8.81	4.13	5.22	229.04	8.48	12.37	8.98	12.77	44.29	336.19	
142	7034.14	86.39	11.73	48.67	10.98	11.63	7.26	4.39	5.27	118.95	8.67	12.71	9.27	12.68	50.45	218.07	
143	7107.20	73.06	10.14	43.05	10.19	10.07	7.09	3.71	5.21	87.65	8.56	12.95	9.23	13.09	55.02	185.72	
144	7163.44	56.24	11.31	4.44	11.95	11.19	7.74	3.16	5.21	87.28	8.00	12.99	10.56	12.98	41.51	133.23	97/08/30 8:50
145	7210.33	46.89	11.41	34.56	11.61	11.33	6.19	3.89	5.19	104.61	8.10	13.22	11.38	13.37	49.27	188.44	• 10:40
146	7246.51	36.18	10.13	31.34	10.23	10.05	5.77	4.48	5.19	96.62	9.25	13.31	11.93	13.41	55.39	183.35	
147	7288.95	42.44	10.38	51.26	11.48	12.03	5.99	4.31	5.24	87.41	8.84	13.11	11.91	13.18	50.14	188.81	• 14:27
148	7339.25	50.31	12.11	51.20	11.78	12.02	5.56	3.45	5.21	84.80	8.34	13.48	11.99	13.54	53.55	189.35	• 15:50
149	7397.24	57.98	10.94	48.86	11.88	12.47	8.49	3.76	5.27	76.36	9.23	13.37	12.32	13.47	52.48	177.70	97/10/07 14:58
150	7438.74	41.51	11.19	53.11	11.38	12.45	7.44	3.12	5.29	80.22	7.83	14.31	12.96	11.18	18.07	151.40	97/10/08 10:15
151	7472.17	33.43	10.42	42.76	11.50	12.50	9.80	4.63	5.26	77.15	8.45	13.28	11.78	13.41	49.14	169.05	
152	7498.70	26.53	11.32	38.63	11.62	12.58	11.25	4.87	5.27	81.48	8.18	13.38	11.03	13.39	53.13	173.24	97/08/29 9:50
153	7539.62	40.92	11.66	69.12	11.64	12.70	10.81	4.84	5.33	78.38	8.04	13.49	11.28	13.48	50.40	197.90	• 8:25
154	7585.42	45.81	8.57	76.33	11.58	12.74	7.92	4.62	5.28	48.90	10.10	13.53	12.04	13.60	46.42	171.65	97/08/09 9:40
155	7637.18	51.76	8.66	99.00	11.74	12.72	8.51	4.36	5.30	57.17	10.35	13.81	11.28	13.83	66.88	223.05	• 10:15
156	7691.72	54.54	8.91	83.85	11.31	12.14	8.82	4.42	5.31	70.27	10.89	13.92	11.53	13.96	56.55	210.67	• 10:40
157	7747.79	56.07	8.97	66.92	11.92	12.79	8.12	4.57	5.32	75.16	11.03	14.15	10.89	14.14	54.16	196.24	• 12:20
158	7798.02	50.23	9.12	45.28	12.26	12.86	9.02	4.60	5.31	80.57	8.60	14.20	12.46	14.17	52.55	178.40	• 13:45
159	7846.60	48.58	9.65	26.44	13.04	13.19	9.56	4.62	5.32	80.32	7.83	14.32	12.05	14.34	40.32	147.08	
160	7906.16	59.56	9.32	41.31	13.50	13.39	10.51	5.08	5.33	85.92	11.16	14.31	10.97	14.48	49.43	176.66	
161	7938.17	32.01	11.04	38.38	14.58	15.48	10.09	4.58	5.40	86.59	8.95	14.24	10.74	14.24	54.41	179.38	97/08/09
162	7994.54	56.37	14.57	49.11	14.78	14.50	10.68	4.16	5.45	99.22	11.04	14.39	10.95	14.35	38.36	186.69	97/08/26 10:10
163	8046.89	52.35	9.91	38.64	15.54	15.40	9.77	4.99	5.47	91.88	10.97	14.52	11.65	14.52	25.32	155.84	15:10
164	8084.88	37.99	10.01	34.78	15.28	14.88	9.83	5.61	5.99	95.51	9.57	14.30	11.25	14.30	26.54	156.83	
164+28	8112.88	28.00	14.92	11.48	15.10	14.91	9.77	5.48	6.04	107.87	10.10	14.12	11.15	14.13	52.12	171.47	Water Guage 1997/8/27 9:10
165	8124.47	39.59	10.17	32.06	14.98	14.98	9.90	5.17	6.09	85.80	9.97	14.20	14.20	14.25	57.35	175.21	
166	8148.41	23.94	11.50	46.70	14.20	11.41	7.99	5.23	6.07	92.32	10.38	14.25	11.03	14.27	38.52	177.54	
167	8193.47	45.06	10.60	51.27	10.54	10.52	9.13	5.03	6.10	83.83	10.77	14.03	11.16	14.09	33.90	169.00	13:45
168	8238.00	44.53	9.81	48.39	9.77	9.73	9.73	5.21	6.11	66.79	10.81	14.07	11.38	14.07	8.91	124.09	
169	8293.09	55.09	9.31	48.85	11.65	9.18	9.18	5.23	6.12	68.47	10.38	14.14	11.71	14.20	55.64	172.96	97/08/26 14:10
170	8346.53	53.44	9.48	44.85	11.96	9.40	9.40	4.97	6.15	78.00	10.34	14.21	12.17	14.26	54.47	177.32	97/09/05 9:45
171	8401.51	54.98	9.53	47.66	10.38	9.24	9.24	5.21	6.06	79.40	9.36	14.18	11.71	14.28	57.78	184.84	
172	8451.00	49.49	9.53	54.00	9.78	9.71	8.20	5.06	6.06	82.48	9.29	14.19	12.61	14.31	15.14	151.62	
173	8514.07	63.07	10.32	53.44	10.88	10.19	10.19	5.03	6.05	89.54	9.36	14.28	12.28	14.34	57.37	200.35	97/08/27 8:55
174	8566.64	52.58	10.56	57.12	11.10	10.46	10.21	4.81	6.07	104.39	9.51	14.47	12.47	11.83	40.99	202.50	14:35
174+18	8584.64	18.00	10.20	95.34	11.09	10.20	9.00	6.12	4.89	64.60	9.52	9.73	10.85	9.73	95.40	255.34	Toll Way 1997/9/2 10:58
175	8617.71	33.07	10.94	50.28	11.66	10.88	10.88	5.26	6.37	114.40	9.48	11.72	12.70	12.88	27.04	191.72	97/08/25 13:50
176	8659.64	41.94	12.21	54.94	12.18	11.98	8.92	5.91	6.61	75.25	9.52	10.21	13.36	10.58	10.03	140.22	• 13:18
177	8708.98	49.33	12.40	15.22	13.08	12.28	12.28	5.96	6.65	65.04	9.58	11.50	12.61	10.67	6.08	86.34	• 11:30
178	8763.98	55.00	13.09	37.83	13.00	12.97	12.97	5.81	6.78	93.44	10.77	12.27	11.87	12.01	60.90	192.17	• 11:14
179	8822.00	58.02	13.70	53.92	13.57	13.73	13.73	6.42	7.00	98.23	10.24	11.69	11.96	11.80	27.33	179.48	•
180	8851.65	29.65	12.15	55.19	12.14			6.54	6.79	93.45			11.75	11.83	51.81	200.45	97/10/26 15:14
181	8893.05	41.40	12.54	56.82	12.51			6.42	6.97	69.67			12.23	12.32	28.24	154.73	• 14:40
182	8937.18	44.13	13.00	52.83	12.97			6.56	7.07	53.83			12.01	12.11	6.72	113.38	• 11:43
183	8988.51	51.34	11.62	29.98	11.54			6.51	7.21	50.50			12.06	12.01	11.68	92.16	• 11:11
184	9035.64	47.13	11.92	4.51	11.89			6.78	7.42	37.42			12.74	12.88	14.47	56.40	• 10:54
185	9082.44	46.79	11.74	1.74	11.67			7.52	7.72	40.66			13.88	13.97	22.78	65.18	• 10:34
186	9129.84	47.40	10.53	6.81	12.65			7.28	7.76	32.37			14.37	14.43	6.81	45.99	• 10:13
186+27	9156.67	26.83	16.98	49.83	9.27			8.82	9.10	41.62			16.97	17.00	62.23	153.68	• 9:55
186+35	9165.16	8.50	17.96	58.70	12.24			9.49	9.14	51.91			17.76	18.03	32.46	143.07	• 9:14

Table 3.1.4 (4/5) LONGITUDINAL PROFILE - CENGKEK RIVER

LINE	DISTANCE	ACCM.DIS	LEFT					CENTER			RIGHT					Total	REMARKS
			Elevation	D width	Backland	Dike Crown	River Bank	Lowest	Water Level	Width	River Bank	Dike Crown	Back Land	Elevation	D width	WIDTH	
0	0.00	0.00	7.00	15.01				4.99	5.15	22.58				6.33	38.98	76.57	
0+28	34.76	34.76	6.13	14.29	7.00			5.18	5.30	12.51			8.31	8.49	19.78	46.58	
1	25.02	59.78	7.28	17.10	7.06			5.33	5.65	18.88			8.16	8.18	15.02	51.00	
2	50.07	109.85	7.53	14.85	7.47			5.45	5.71	11.99			7.30	6.90	16.82	43.66	
3	48.19	158.04	8.49	11.37	8.31			5.74	5.91	25.87			8.32	11.56	16.19	53.43	
4	51.35	209.38	8.87	11.71	10.75			5.90	6.24	16.95		11.50	10.72	10.72	11.61	40.27	
5	44.60	253.99	9.16	1.04	7.94	9.16		3.80	6.30	19.71			6.70	6.91	1.28	22.03	
5+22	22.00	275.99	10.42	11.90	10.33	10.42		6.36	6.48	15.81		10.42	10.25	10.42	23.19	50.90	
6	23.26	299.25	8.83	0.61	8.83			6.63	6.75	11.54			9.20	8.25	1.94	14.09	
7	50.18	349.42	8.55	0.82	8.27			6.99	7.11	12.31			9.39	9.52	2.36	15.49	
8	49.90	399.32	10.31	25.95	10.20			7.21	7.32	19.15		10.78	10.75	10.78	16.92	62.02	
8+5	5.00	304.32	10.52	14.88	10.29	10.52		7.22	7.33	18.67		10.70	11.89	10.70	15.60	49.15	
9	47.99	452.31	10.49	22.06	10.45			7.29	7.50	18.02			10.64	10.37	0.67	40.75	
9+28	28.00	280.31	11.11	21.76	10.74	11.11		7.99	8.07			11.47	11.47		9.90	31.66	
10	19.27	499.58	10.99	12.78	10.95	10.92		7.82	8.11	13.10			8.34	10.99	0.42	26.30	

Table 3.1.4 (5/5) LONGITUDINAL PROFILE - KALITO RIVER

LINE	DISTANCE	ACCM.DIS	LEFT					CENTER			RIGHT					Tatal	REMARKS
			Elevation	D width	Backland	Dike Crown	River Bank	Lowest	Water Level	Width	River Bank	Dike Crown	Back Land	Elevation	D width	WIDTH	
0	0.00	0.00	7.95	16.23	7.92			5.78	6.11	20.16			12.52	12.52	8.13	44.52	
1	57.64	57.64	9.76	9.48	10.24	10.95		5.92	6.17	26.49		9.83	9.96	9.22	8.04	44.01	
2	49.96	107.61	10.18	4.62	10.11	10.92		6.06	6.35	23.98						28.60	
2+27	27.00	134.61	11.88	24.77	11.78			6.55	6.68	10.53			11.78	11.90	38.93	74.23	
3	22.91	157.52	10.55	10.71	10.48	10.73		6.67	6.89	16.67		10.72	10.72	10.84	2.12	29.50	
4	50.05	207.57	10.61	12.27	10.50	10.87		6.08	6.90	17.65		10.74	10.70	10.51	8.23	38.15	
5	39.57	247.14	10.66	11.35	9.74	11.04		6.84	7.10	17.32		10.97	10.07	10.61	10.47	39.14	
6	56.26	303.40	10.67	13.70	10.65	10.57		7.00	7.20	20.26		11.18	10.80	10.79	21.17	55.13	
7	51.81	355.21	10.96	2.45		10.42		7.12	7.48	11.89		11.30	9.67	10.73	10.26	24.60	
8	47.42	402.63	10.89	4.03	10.75	10.45		7.23	7.64	12.66		11.42	10.24	10.89	8.90	25.59	
9	43.27	445.90	11.07	3.19	10.67	11.58		7.70	7.82	14.69		11.58		11.15	0.99	18.87	
10	52.57	498.47	11.12	5.54	10.92	11.79		7.26	8.35	18.68		11.67		11.33	3.75	27.97	