3.2 Operation and Maintenance Plan

3.2.1 Organization for Operation and Maintenance

MPWH will be the governmental body responsible for the maintenance of the bridges and roads consisting of approach road and access roads.

MPWH will carry out the periodic and ad hoc inspection as well as maintenance work and specific contractors will undertake rehabilitation work when required.

3.2.2 Inspection Items and Expected Maintenance Work

Table 3.2.1 Inspection & Maintenance

	Inspection Items	Expected Maintenance Work
Bridges (inspection per year)	Expansion joint Railing Lighting Bearing	Repairs of lighting and railings will be required in ad hoc occasions. In the case of railings, minor repairs will be made due to small damages.
Roads (inspection per year)	Pavement Slope Protection Drainage Lighting	Ordinarily, the replacement of lighting bulbs will be required. Overlay of pavement will be required every 10 years.
Riverbed Improvement	Dumped Stone	After floods, dumped stone should be inspected and any damages should be repaired.

Source: Study Team

3.2.3 Cost for Operation and Maintenance

As the costs required for the maintenance of the new bridge and roads are less than those of the existing bridge, the expense by MPWH will reduce after the completion of the Project.

Table 3.2.2 Maintenance Cost per Year

	Maintenance Item	Unit Cost for Maintenance (JD /Year)	Quantity	Annual Maintenance Cost (JD /Year)
Bridge	Painting of Bailey Truss	2.0/m^2	55 m^2	110
	Replacing of Wooden Decks	100/m^3	11 m^3	1,100
Road	Pavement Rehabilitation	0.6/m^2	36,000 m^2	21,600
	Maintenance of Road Lighting	30/each	260 nos.	7,800
TOTAL				30,610

Source: MPWH

3.3 Special Consideration for Construction of Bridge over Jordan River

The Project, which would be granted to the Jordan Government under Japan's Grant Aid Scheme, is to construct a bridge connecting Jordan and West Bank. In this regard, coordination work among Jordan, West Bank, and Japan is crucial until the completion of the Project. The coordination work covers many subjects for the study, design, and construction stages.

3.3.1 Required Arrangements

The following items would have to be conducted for the implementation of the Project:

i) Confirmation of the proposed location of the King Hussein Bridge

ii) The Project covers up to 20m of approach road on the West Bank side, and the construction work schedule of the Project should be well coordinated with the construction of the connection road from the conjunction of the said approach road to the border terminal of the West Bank.

iii) The working area of the King Hussein Bridge would have to be exclusively enclosed from the public by way of fences. The fence on the Jordan side should be installed by the Jordanian Government while that on the West Bank side by the concerned authorities of the West Bank.

iv) Permission of the concerned authorities of the West Bank for the entry into the site of the bridge on the West Bank side.

iv) Clearance of unexploded mines by defense forces near the proposed King Hussein Bridge.

3.3.2 Anticipated Items Required before Signing of E/N

At the onset of the Project implementation, the Jordanian Government would have to execute the clearing and grubbing work for the approach road segment in order to assure the clearance of unexploded mines. The Jordanian Government in March 1999 has completed this work.

In addition to the normal arrangements before signing the Exchange of Notes (E/N) between the Japanese and Jordanian governments as ordinary bi-lateral cooperation, involvement of the concerned authorities of the West Bank would have to be crucial in connection with the approach road (so-called "Connection Road") on the West Bank side.

A number of items would have to be considered before signing the E/N, and are summarized in Table 3.2.3.

Table 3.2.3 Required Items to be considered before E/N

	Japan	Jordan	W.B.
Confirmation/Agreement between Japan and Jordan, Included in E/N for Detailed Design and Construction			
- Common items included in ordinary E/N	O	O	
- Arrangements for construction yards, work areas, project offices on the Jordan side		O	
- Obligation of maintenance for bridges		O	
- Obligation of approach road maintenance on the Jordan side		O	
- Obligation of access road maintenance on the Jordan side		O	
- Request to W.B. for collaboration and coordination	O	O	
Confirmation/Agreement between Japan and Concerned Authorities of the W.B.			
- Explanation of E/N between Japan and Jordan	O		
- Land acquisition required for approach roads on the W.B. side			O
- Arrangements for work areas on the W.B. side			O
Confirmation/Agreement between Jordanian and Concerned Authorities of the W.B.			
- Land acquisition required for approach roads		O	O
- Clearance of unexploded mines		O	O
- Undertakings to be provided for work areas		O	O
- Obligation of coordination		O	O

Source: Study Team

Note: W.B. = West Bank

3.4 Required Arrangement for the Works on the West Bank Side

3.4.1 Installation of Fences around Construction Area

Soon after the commencement of the construction of the Project, fences should be installed to safeguard the working areas. The outline of such fences is as follows:

(1) Boundary of Fences in Transverse Direction of Bridge Alignment

The boundary of fences is determined by the requirements of riverbed protection (dumped stone). The outline of the fences on the West Bank side is shown in Figure 3.3.1.

Upstream side:	40 m from bridge centerline
Downstream side:	Approx. 30 m from bridge centerline and up to the existing median strip

(2) Boundary of Fences in Longitudinal Direction of Bridge Alignment

The areas of the fence boundary are determined taking into consideration the requirements for the construction of abutment and subsequent approach road. Such areas differ depending on the construction steps. The relation of the fence locations and construction steps is shown in Figure 3.3.2.

The main points of the fence locations are as follows:

i) At the onset of the construction, the minimum requirement of the abutment construction is 10m as shown in Figure 3.3.1.

ii) After completion of the abutment, the backfill and embankment works require 20m working space. The location of the fences during such earth works is shown in Figure 3.3.3.

iii) Finally, the pavement works follow. In this case, a construction joint would appear at the conjunction between the approach road by the Japan's grant and connecting road by the concerned authorities of the West Bank. To avoid such a construction joint, it is recommended that pavement of the connecting road by the concerned authorities of the West Bank expands up to the abutment. In this case, the location of the fences is as shown in Figure 3.3.4.

3.4.2 Temporary Detour Road

The approach roach on the West Bank side occupies the existing road in the vicinity of the Bailey bridge. When the earthwork is going on there, it may be difficult for public traffic to pass on the existing road.. Therefore, a temporary detour road would have to be constructed during the construction period. The location of the detour road is shown in Figure 3.3.1.

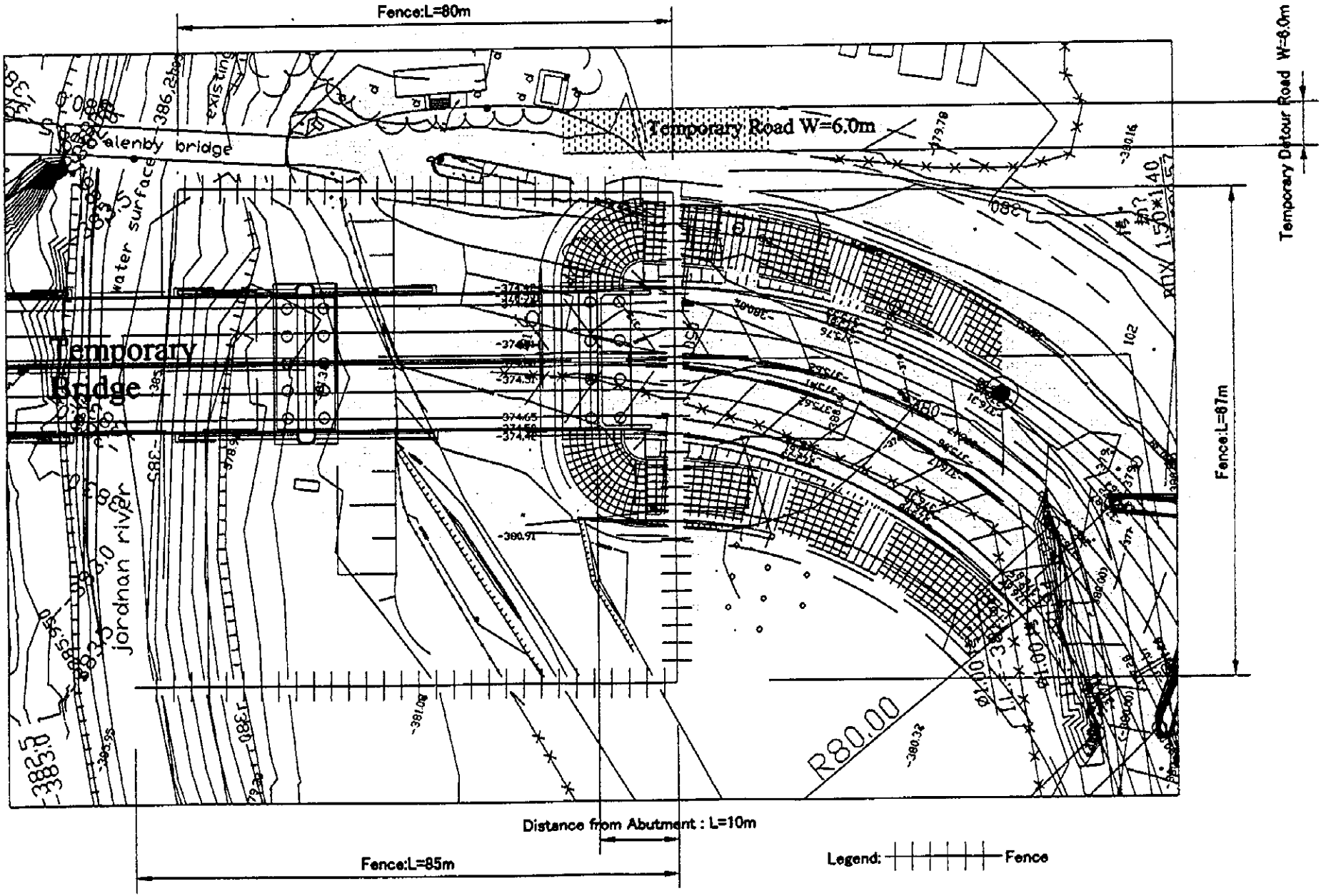


Figure 3.3.1 Fence Layout at the Onset

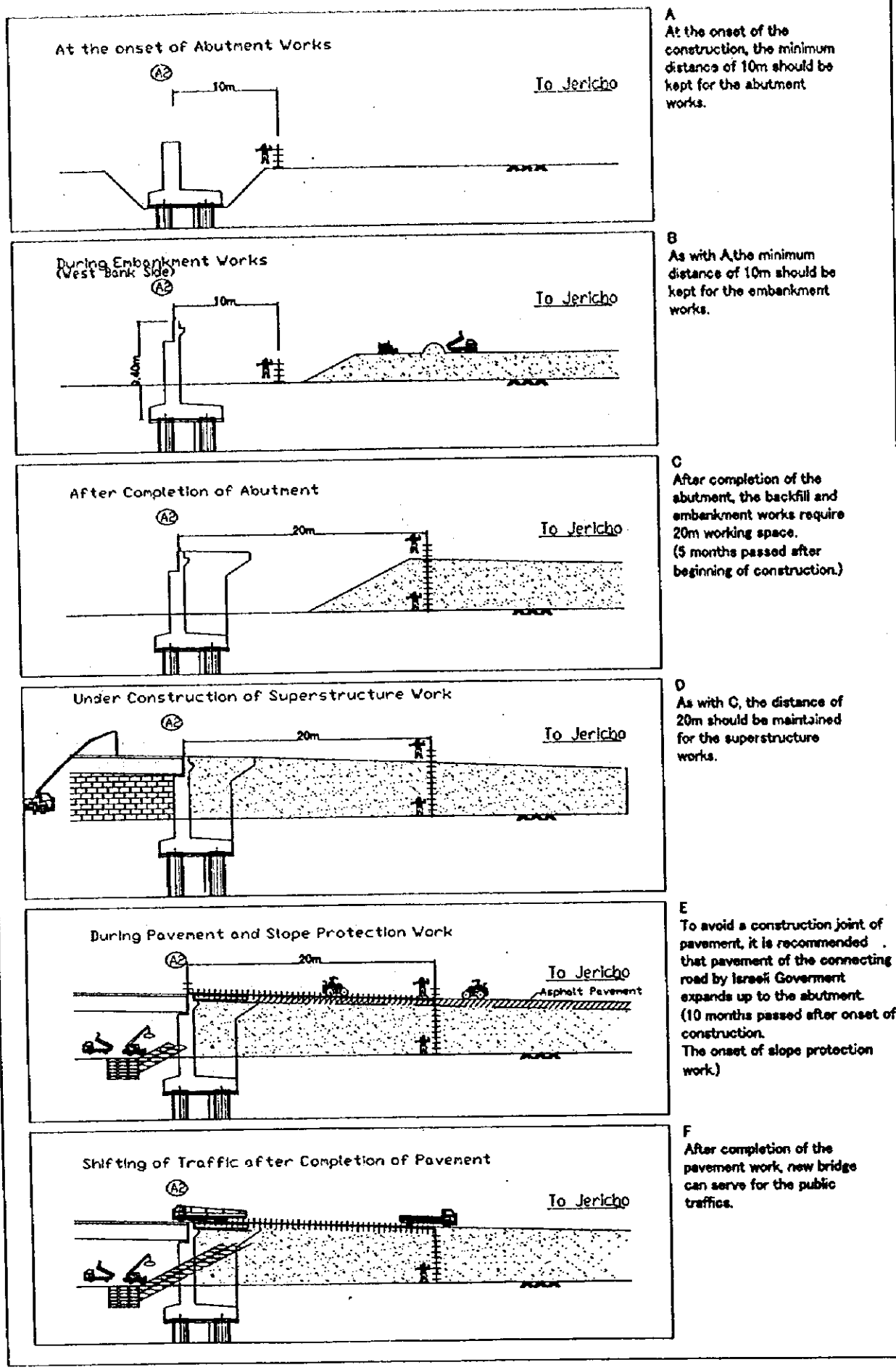
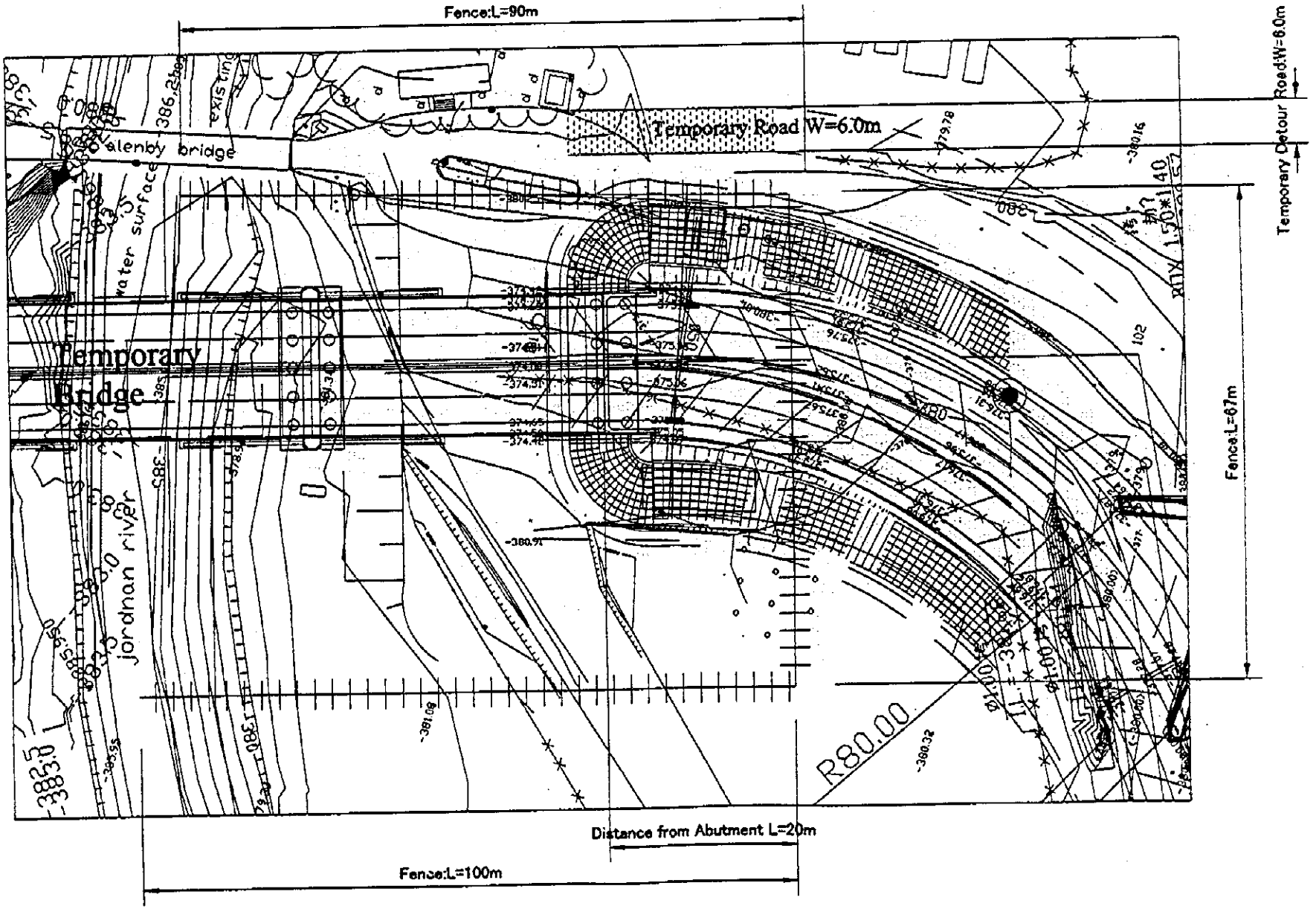
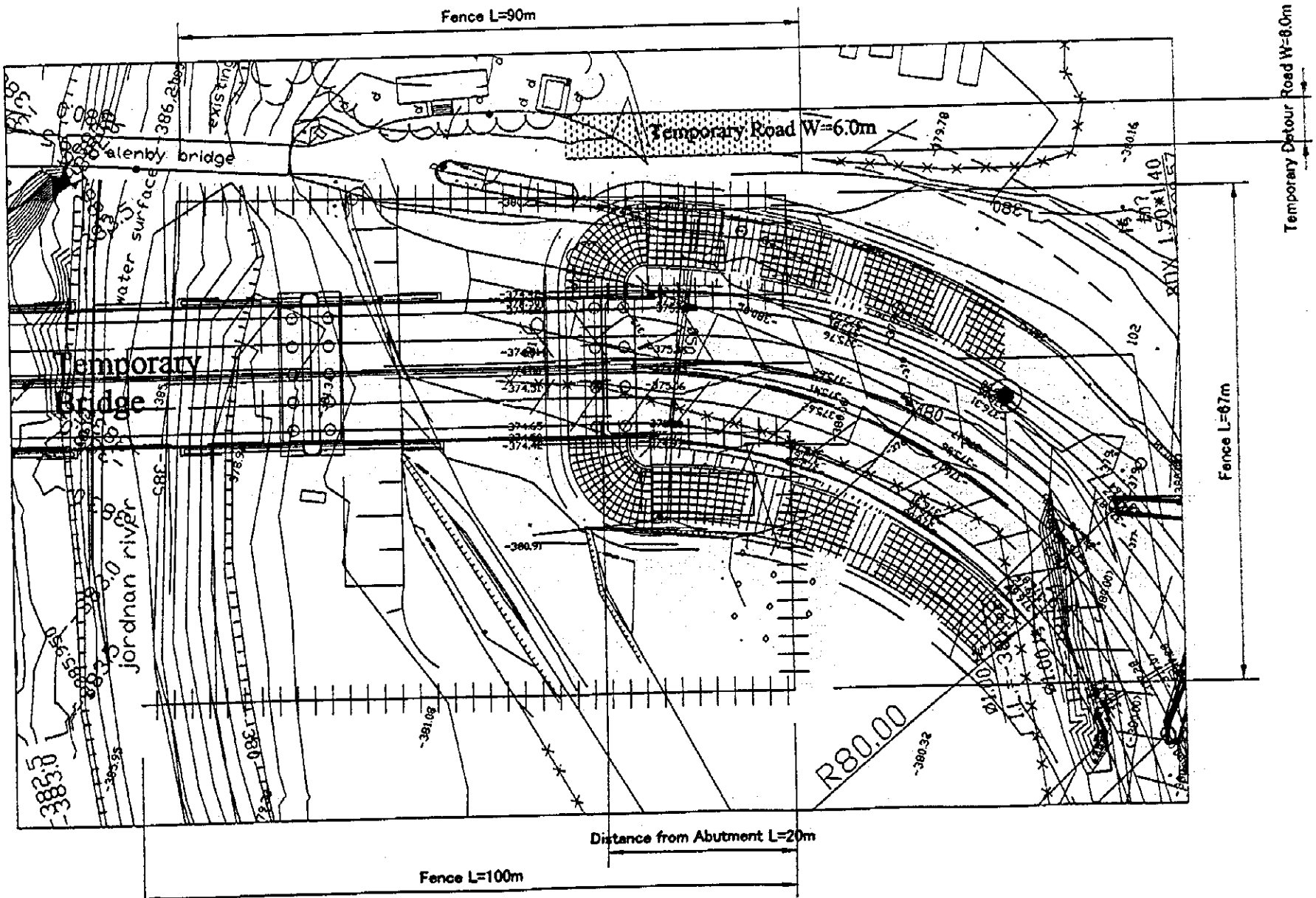


Figure 3.3.2 Fence Locations by Construction Stages



Remarks: 1.Boundary of Fences (L=257m=90+67+100)
2.Temporary Detour Road (W=6m)

Figure 3.3.3 Fence Layout after Completion of Abutment



Remarks : 1.Boundary of Fences(L=262m=95+67+100)
2.Temporary Detour Road (W=6m)

Figure 3.3.4 Fence Layout during Pavement Work

3.5 Special Measures for Public Traffics on Existing Road during Construction

Basically the alignment of the new access road was planned in parallel with the existing one as much as possible. The new construction portion would be on the right side from the beginning point at the South Shuna Intersection to the end point, except the portion near the Wadi at about Station 6.5km to Station 7.5km where the alignment should be shifted to the opposite side of the Wadi. Accordingly, the new construction portion would intersect the existing one each other at two places as shown in Figure 3.5.2.

3.5.1 Parallel Segments

Since the carriage way width of the existing road is reduced by the construction works, the existing shoulder should be temporarily paved by bituminous emulsion. As such, two lanes would be maintained during the construction.

The conceptual drawing is shown in Figure 3.5.1.

3.5.2 Intersection Segments

The intersection segments should be constructed at night in order to maintain public traffics on the existing access road.

The conceptual drawing is shown in Figure 3.5.2.

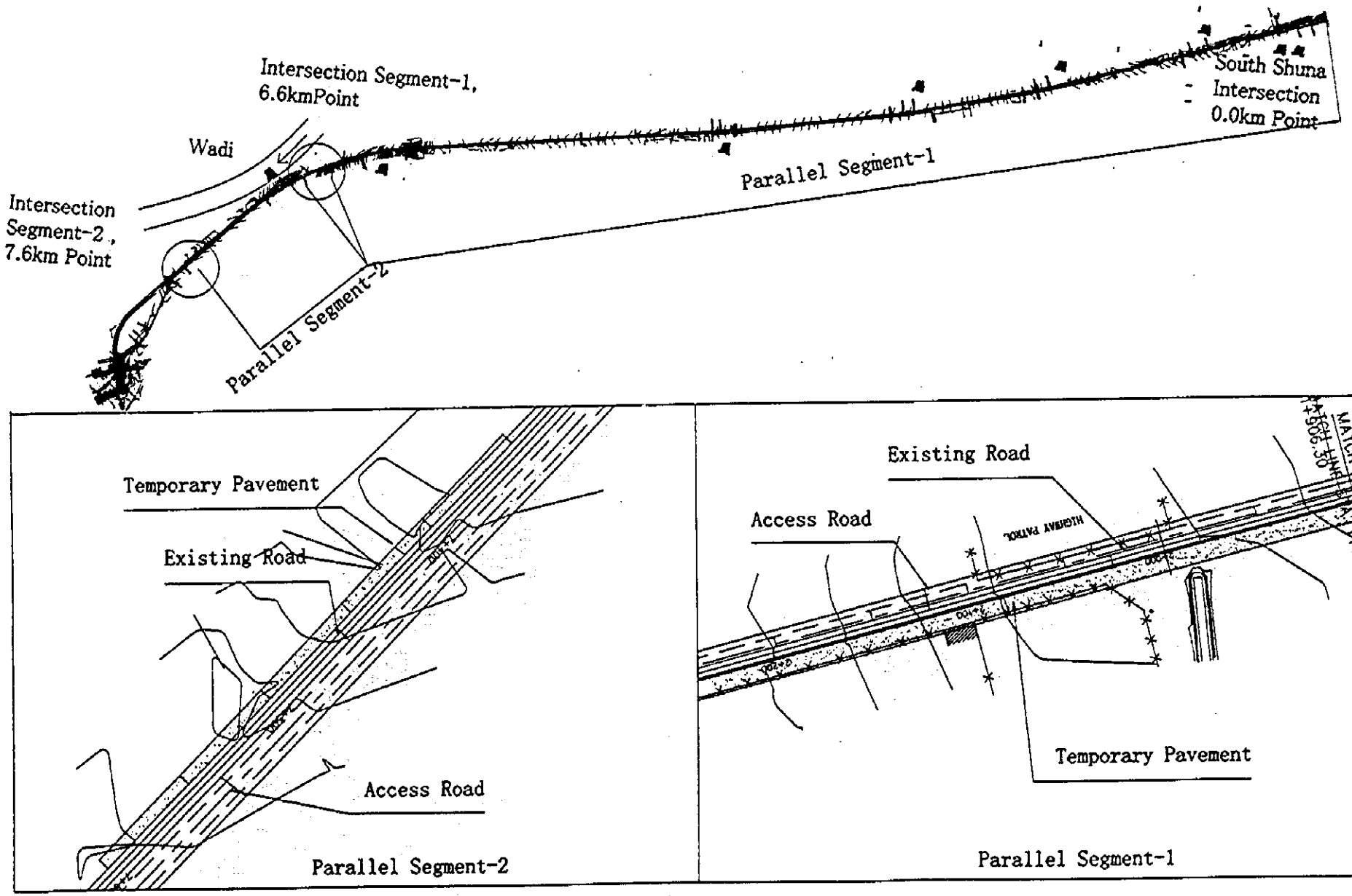
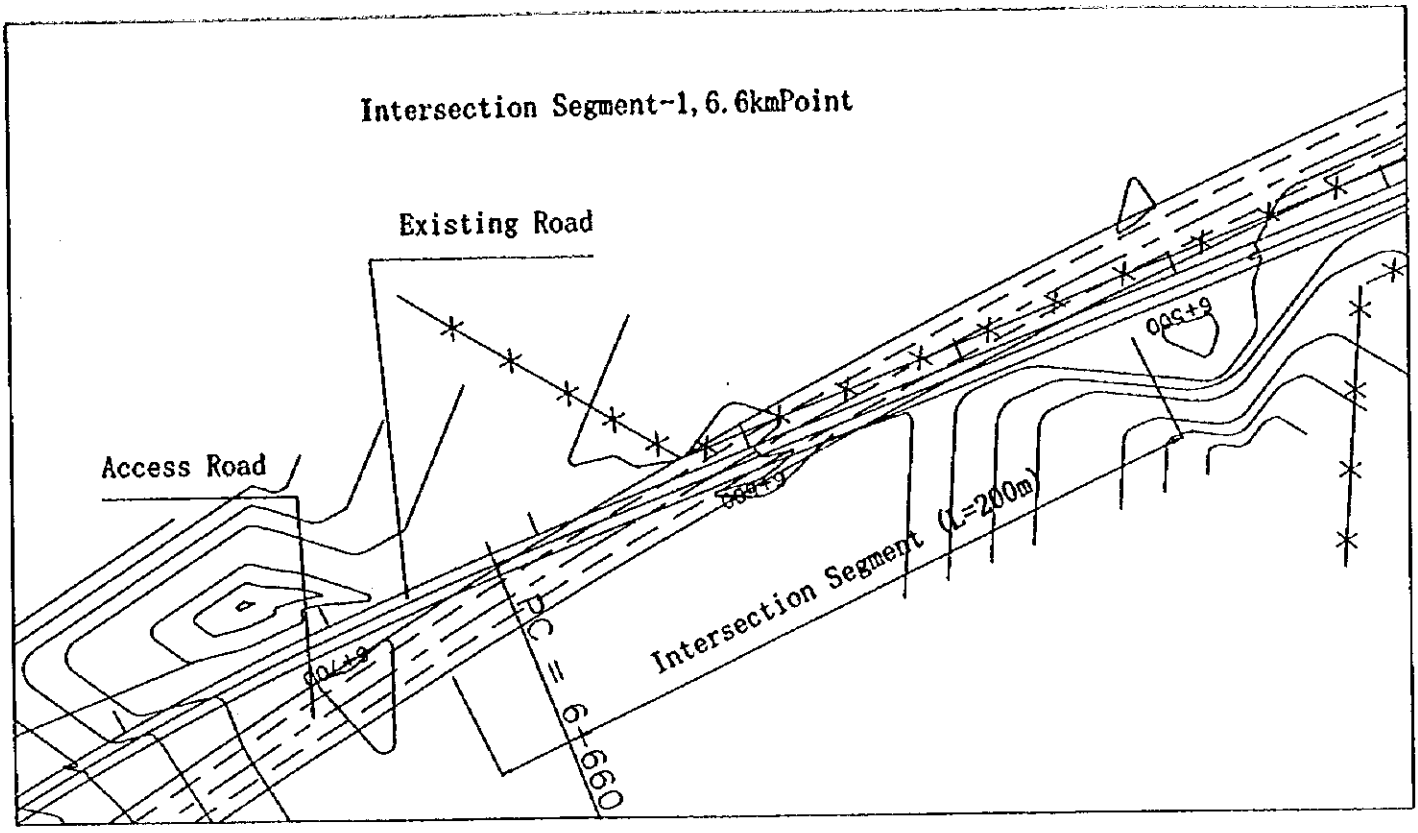


Figure 3.5.1 Conceptual Plan of Access Road and Its Parallel Segments



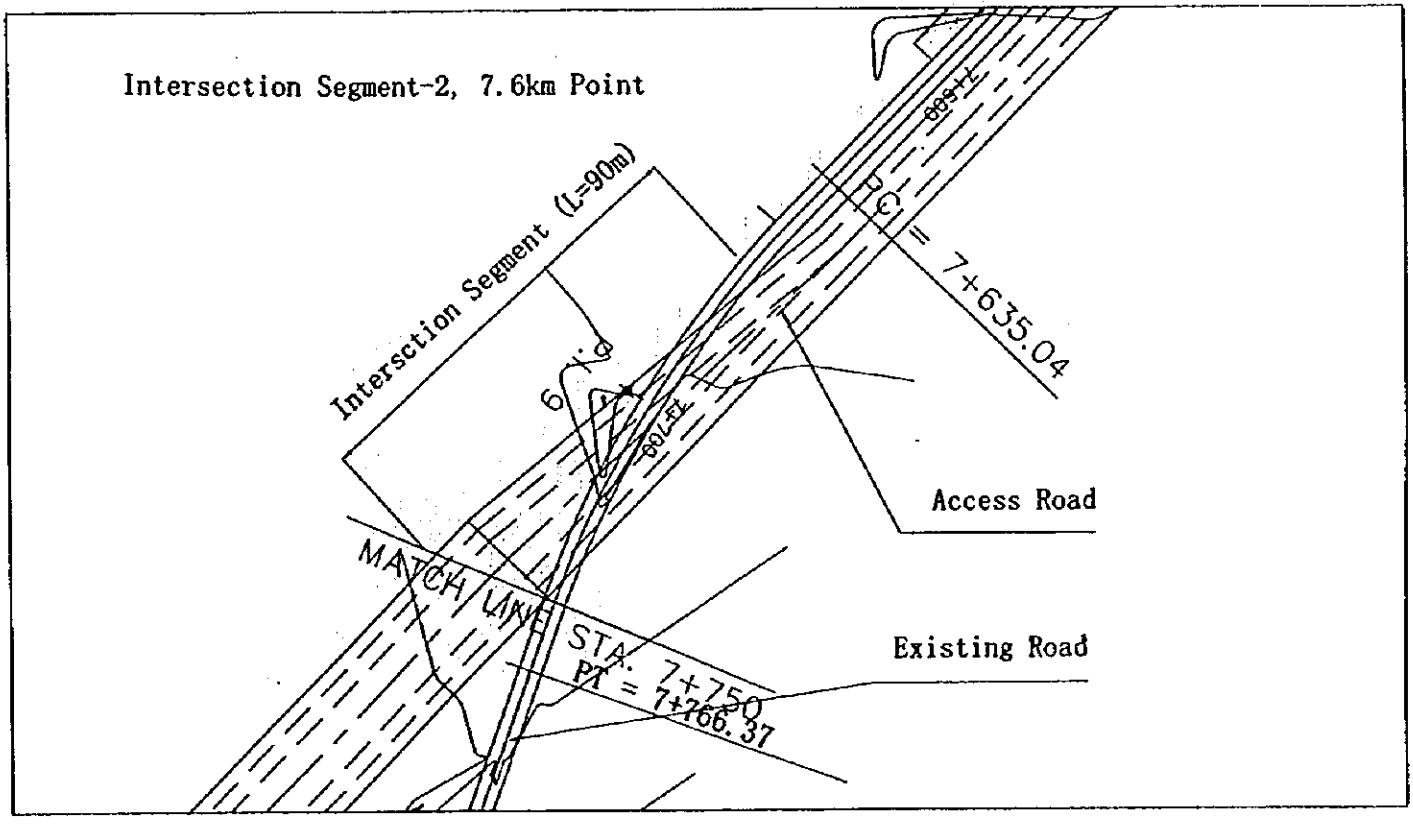


Figure-3.5.2 Conceptual Plan of Intersection Segments

CHAPTER 4 PROJECT EVALUATION AND RECOMMENDATION

4.1 Project Effect

It is expected that the Project will produce a great many socioeconomic effects on the surrounding areas. Tourism and export industries will be promoted with improved accessibility. Moreover, the Project will likely produce many other intangible benefits such as enhancement of communication and dissemination of information. These would result in promotion of a peaceful environment in the areas.

The following are the direct benefits after completion of the Project:

- Enlargement of Traffic Capacity
  The King Hussein Bridge would mainly carry the induced traffics between Jordan and Palestina by building a bridge and achieving a friendly international relation as a result of peaceful process. Traffic volumes on the bridge are estimated at 12,156 AADT for 2007, 26,536 AADT for 2017 and 59,863 AADT for 2027. The traffic capacity by completion of the Project would be sufficient for such future traffic volumes.

- No Disruption of Traffic Flow
  Since the existing bridge was sometimes closed once floods of the Jordan River had taken place, the completion of the Project provides the public traffics with continuous service throughout the year.

- Reduction of Vehicle Maintenance Cost
  The Project is to replace the existing temporary bridge having wooden-deck surface with a new permanent prestressed concrete bridge being paved by asphaltic concrete. As such, occurrence of flat tire accident or so would reduce in future.

- Reduction of Bridge Maintenance Cost
  The cost of replacing the wooden decks, painting the steel members and re-installing the metal fittings required for the maintenance work of the existing Bailey bridge would be not required.

- Beneficial Population

  People in Jordan and Palestine (especially in the West Bank) would be directly benefited by the Project. In addition, tourists from foreign countries would be benefited to use the new bridge.

Population of Jordan	:	4.4 million
Population of Palestine	:	2.4 million
Direct Beneficial Population	:	6.8 million

4.2 Need for Technical Cooperation

Various technologies regarding new bridge building works as well as bridge maintenance works will be transferred to Jordanian engineers during implementation of the Project through on-the-job-training. Moreover, it is desired to invite trainees, who are staff of MPWH, to Japan for a course in bridge building and maintenance. The course given to the Jordanian trainees in Japan might cover bridge design and quality control for bridge construction.

4.3 Recommendation

Completion of the Project is expected to enhance the smooth traffic flow between Jordan and West Bank over the Jordan River. Therefore, implementation of the Project is recommended in the quickest possible manner.

During the implementation period, coordination would have to be properly conducted among the concerned agencies.

As the number of vehicles crossing the bridge is, so far, controlled by the transport treaty between Jordan and Israel, it is crucial to de-regulate the control of such traffic in the future.

APPENDICES

- Appendix 1: Member List of the Survey Team
- Appendix 2: Survey Schedule
- Appendix 3: List of Party Concerned in the Recipient Country
- Appendix 4: Minutes of Discussions
- Appendix 5: Traffic Survey
- Appendix 6: Hydrological and Hydrographic Survey
- Appendix 7: Diagrams for Estimation of Scour Depth
- Appendix 8: Drawings other than shown in Chapter 2 and 3

Appendix 1: Member List

A.1.1 First Field Survey, November 1998 to December 1998

1)	Leader	Mr. KUMASHIRO Teruyoshi	Director, Second Project Study Division, Grant Aid Project Study Department, JICA
2)	Grant Aid Cooperation	Ms. OISHI Masami	Grant Aid Division, Economic Cooperation Bureau, Ministry of Foreign Affairs, Government of Japan
3)	Project Coordinator	Mr. KATAI Keiji	Second Project Study Division, Grant Aid Project Study Department, JICA
4)	Consultant Chief / Bridge Planner / Transport Planner	Mr. MATSUZAWA Katsufumi	Nippon Koei Co., Ltd.
5)	Construction Planner / Cost Estimator	Mr. UEYAMA Hiroaki	Nippon Koei Co., Ltd.

A.1.2 Explanation of Draft Report: April 1999

1)	Leader	Ms. OISHI Masami	Grant Aid Division, Economic Cooperation Bureau, Ministry of Foreign Affairs, Government of Japan
2)	Project Coordinator	Mr. KATAI Keiji	Second Project Study Division, Grant Aid Project Study Department, JICA
3)	Consultant Chief / Bridge Planner / Transport Planner	Mr. MATSUZAWA Katsufumi	Nippon Koei Co., Ltd.

Appendix 2: Survey Schedule

A2.1 Field Survey

Sr. No.	Date	Day	Travel	Stay at	Survey Activities
1	Nov. 27, 98	Fri	Mr. Kumashiro, Mr. Katai, Mr. Matsuzawa, Mr. Ueyama left Japan	London	
2	Nov. 28, 98	Sat	Ms. Oishi left Japan. All members arrived Amman	Amman	
3	Nov. 29, 98	Sun		Amman	Courtesy call to MOP, MPWH Courtesy call to EOJ Courtesy call to JICA Jordan Office
4	Nov. 30, 98	Mon		Amman	Discuss the contents of Inception Report
5	Dec. 1, 98	Tue		Amman	Site appreciation survey: Sheikh Hussein and King Hussein bridges
6	Dec. 2, 98	Wed	All members moved to Israel	Tel Aviv	Discuss at EOJ in Tel Aviv
7	Dec. 3, 98	Thu		Tel Aviv	Discuss at Ministry of Foreign Affairs of Israeli Government
8	Dec. 4, 98	Fri		Tel Aviv	Internal meeting Technical discussion at Israeli consultant's office
9	Dec. 5, 98	Sat	All members moved to Amman	Amman	Internal meeting
10	Dec. 6, 98	Sun		Amman	Discuss the contents of the Minutes of Discussions
11	Dec. 7, 98	Mon		Amman	Internal meeting
12	Dec. 8, 98	Tue	Ms. Oishi left Amman	Amman	Signing of Minutes of Discussions Report to EOJ and JICA Jordan Office
13	Dec. 9, 98	Wed	Mr. Kumashiro left Amman	Amman	Field survey
14	Dec. 10, 98	Thu	Mr. Kumashiro arrived Japan	Amman	Field survey and data collection
15	Dec. 11, 98	Fri		Amman	Data review
16	Dec. 12, 98	Sat	Mr. Katai, Mr. Matsuzawa, Mr. Ueyama arrived Israel	Tel Aviv	
17	Dec. 13, 98	Sun		Tel Aviv	Data collection and field survey Discuss with Israeli consultant
18	Dec. 14, 98	Mon	Mr. Katai, Mr. Matsuzawa, Mr. Ueyama arrived Amman	Amman	Discuss with Israeli consultant
19	Dec. 15, 98	Tue		Amman	Field survey and data collection
20	Dec. 16, 98	Wed	Mr. Katai left Amman	Amman	Report to EOJ and JICA Jordan Office
21	Dec. 17, 98	Thu	Mr. Katai arrived Japan	Amman	Field survey and data collection
22	Dec. 18, 98	Fri		Amman	Field survey and data collection
23	Dec. 19, 98	Sat		Amman	Field survey and data collection

24	Dec 20, 98	Sun		Amman	Field survey and data collection
25	Dec 21, 98	Mon		Amman	Field survey and data collection
26	Dec 22, 98	Tue		Amman	Field survey and data collection
27	Dec 23, 98	Wed		Amman	Field survey and data collection
28	Dec 24, 98	Thu		Amman	Report to EOJ and JICA Jordan Office
29	Dec 25, 98	Fri	Mr. Matsuzawa, Mr. Ueyama left Amman		
30	Dec 26, 98	Sat	Mr. Matsuzawa, Mr. Ueyama arrived Japan		

A2.2 Explanation of Draft Report

Sr. No.	Date	Day	Travel	Stay at	Survey Activities
1	Apr. 22, 99	Thu	Mr. Matsuzawa arrived Amman	Amman	Site appreciation survey and confirmation of de-mining
2	Apr. 23, 99	Fri	Ms Oishi, Mr. Katai left Japan and arrived Amman	Amman	Data review
3	Apr. 24, 99	Sat		Amman	Courtesy call to MOP and MPW Discuss the contents of Draft Report
4	Apr. 25, 99	Sun		Amman	Courtesy call to EOJ Courtesy call to JICA Jordan Office
5	Apr. 26, 99	Mon	All members arrived Israel	Tel Aviv	Discuss at EOJ in Tel Aviv
6	Apr. 27, 99	Tue		Tel Aviv	Discussion at Ministry of Foreign Affairs, Jerusalem
7	Apr. 28, 99	Wed	Arrived Amman	Amman	Discuss with Israel consultant Internal meeting
8	Apr. 29, 99	Thu		Amman	Signing of Minutes of Discussions Report to EOJ and JICA Jordan Office
9	Apr. 30, 99	Fri	Ms. Oishi and Mr. Katai left Amman.	Amman	Data collection and field survey
10	May 1, 99	Sat	Ms. Oishi and Mr. Katai arrived Japan	Amman	Data collection and field survey
11	May 2, 99	Sun		Amman	Discussion with Jordanian and Israeli officials at the site. Report to EOJ and JICA Jordan Office
12	May 3, 99	Mon	Mr. Matsuzawa left Amman		
13	May 4, 99	Tue	Mr. Matsuzawa arrived Japan		

Appendix 3: List of Party Concerned in the Recipient Country

A3.1 Field Survey

Organization, Name	Position
1. Ministry of Planning	
Mr. Naeeb Ammari	Minister
Mr. Salem Ghawi	Assistant Secretary General, International Affairs
Mr. Yousef Batshon	Director of Infrastructure Department
Dr. Nael Al Hajaj	Deputy Director, Bilateral Cooperation Dept.
Ms. Wafa Al Saket	Civil Engineer, Infrastructure Department
2. Ministry of Public Works and Housing	
Mr. Nasser Lozi	Minister
Mr. Bashir El-Jaghbeer	Secretary General
Mr. Abdel Majid Kabariti	Assistant Secretary General for Highways
Mr. Sami J. Halaseh	Highway Studies Director
Ms. Sanaa Nazer	Architect Engineer
Mr. Mahmod Khliefat	Highway Engineer
3. King Hussein Bridge	
Mr. Thabet Al Nasser	Police Department
4. Israel Side	
Mr. Arthur Avnon	Director, Jordan Division, MFA (Ministry of Foreign Affairs)
Mr. Ruth Kahanoff	Director, North-East Asia Division, MFA
Mr. Mark Regev	First Secretary, Jordan Division, MFA
Mr. Omer Caspi	Second Secretary, MFA
Mr. Zvi Tal	Counselor, Legal Division, MFA
Mr. Brig. General Yosef Mishlev	IDF Coordination Office
Mr. Oddedd Herrmann	IDF
Mr. Haim Eilam	Public Works Department
Mr. Shlomo Moshkovits	Head of Planning Department, Civil Administration in Judea & Samaria
Mr. Behruz Shimon Farhang	Consultant, LANDUSE Ltd.
5. Japanese Side in Jordan	
H.E. Mr. Koichi Matsumoto	Ambassador, Embassy of Japan
Mr. Masaya Tanaka	Second Secretary, Embassy of Japan
Mr. Yoshio Yabe	Resident Representative, JICA
Ms. Hiroe Ono	JICA
6. Japanese Side in Israel	
Mr. Katsuyoshi Hayashi	Counselor, Embassy of Japan
Mr. Kohei Sato	Second Secretary, Embassy of Japan
Mr. Shigeru Okamoto	Embassy of Japan
Mr. Toshiya Abe	Embassy of Japan

A3.2 Explanation of Draft Report

Organization, Name	Position
1. Ministry of Planning	
Dr. Nael Al Hajaj	Deputy Director, Bilateral Cooperation Dept.
Ms. Wafa Al Saket	Civil Engineer, Infrastructure Department
2. Ministry of Public Works and Housing	
Mr. Husni Abu Gheida	Minister
Mr. Bashir El-Jaghbeer	Secretary General
Mr. Abdel Majid Kabariti	Assistant Secretary General for Highways
Mr. Sami J. Halaseh	Highway Studies Director
Mr. Mahmod Khliefat	Highway Engineer
3. King Hussein Bridge	
Mr. Omar Al Zoub'i	Liaison Officer, Ministry of Defense
4. Israel Side	
Mr. Arthur Avnon	Director, Jordan Division, MFA (Ministry of Foreign Affairs)
Mr. Ruth Kahanoff	Director, North-East Asia Division, MFA
Mr. Opher Aviran	Deputy Director, Jordan Division
Mr. Mark Regev	First Secretary, Jordan Division, MFA
Mr. Omer Caspi	Second Secretary, MFA
Mr. Zvi Tal	Counselor, Legal Division, MFA
Mr. Brig. General Yosef Mishlev	Deputy Coordinator of Government Activities in the Territories (CGAT)
Mr. Moty Cristal	Civil Negotiations, CGAT
Mr. Lt. Colonel Oded Herrmann	Infrastructure Division, CGAT
Mr. Lt. Colonel Itzil Edri	Control Command, Engineering Corps, Israel Defense Forces (IDF)
Mr. Shlomo Moshkovits	Head of Planning Department, Civil Administration in Judea & Samaria
Mr. Haim Eilam	Consultant, Ministry of National Infrastructure (MNI)
Mr. Alex Sagi	Jerusalem District Manager, Public Works Department, MNI
Mr. Yoav Oren	Israel Airports Authorities, CCPO
Mr. Behruz Shimon Farhang	Consultant, LANDUSE Ltd.
Mr. Polak Shmuel	Consultant, Hydrologist, Hydromodul Co.
Mr. Michael Elbert	Licensed Land Surveyor
5. Japanese Side in Jordan	
H.E. Mr. Koichi Matsumoto	Ambassador, Embassy of Japan
Mr. Masaya Tanaka	Second Secretary, Embassy of Japan
Mr. Yoshio Yabe	Resident Representative, JICA
Mr. Kurakata	Assistant Resident Representative, JICA
6. Japanese Side in Israel	
Mr. Katsuyoshi Hayashi	Counselor, Embassy of Japan
Mr. Shigeru Okamoto	Embassy of Japan
Mr. Toshiya Abe	Embassy of Japan

Minutes of Discussions
on
the Study
on
the Project for the Construction of King Hussein Bridge
in
the Hashemite Kingdom of Jordan

In response to a request from the Government of the Hashemite Kingdom of Jordan (hereinafter referred to as "Jordan"), the Government of Japan has decided to conduct a study on the Project for the Construction of King Hussein Bridge (hereinafter referred to as "the Project") in Jordan and entrusted the study to the Japan International Cooperation Agency (hereinafter referred to as "JICA") succeeding to the results of "The Basic Design Study on the Project for Construction of King Hussein Bridge and Sheikh Hussein Bridge" which had been also conducted by JICA in 1996.

JICA sent to Jordan a Team (hereinafter referred to as "the Team") headed by Mr. Teruyoshi KUMASHIRO, Director, Second Basic Design Study Division, Grant Aid Project Study Department, JICA which is scheduled to stay in the country from November 28 to December 25, 1998.

The Team held discussions with the concerned officials of Jordan and conducted a field survey at the Project site.

In the course of discussions and field surveys, both parties confirmed the main items as described on the attached sheets. The Team will proceed to further works and prepare the Study Report.

Amman, 8 December, 1998

Teruyoshi Kumashiro
Leader
Study Team
JICA

Bashir Jaghbeer
Secretary General
Ministry of Public Works and Housing

Salem O. Ghawi
Assistant Secretary General
Ministry of Planning

ATTACHMENT

1. OBJECTIVE

The objective of the Project is to reconstruct the King Hussein Bridge which is a temporary bailey bridge in order to ensure basic transportation between Jordan and the West Bank.

2. PROJECT SITE

The site of the Project is shown in ANNEX-1.

3. RESPONSIBLE AND EXECUTING ORGANIZATION

The Ministry of Public Works and Housing (MPWH) is the responsible and executing organization of the Project. The organization chart of MPWH is shown in ANNEX-2.

4. MAJOR ITEMS REQUESTED BY THE GOVERNMENT OF JORDAN

(1) The Team explained contents of the Inception Report which includes the results of the previous Basic Design Study in 1996. The Government of Jordan has in principal agreed to the contents of the Inception Report.

(2) Major components of the Project is as follows ;

- King Hussein Bridge
  To construct 4 lane prestressed concrete bridge with 4 lane approach road.
- Access Road
  To Improve and Reconstruct the 2 lane road at one side from the centerline of right of way for the existing road, starting at South Shuna Intersection on the National Valley Highway and ending at the approach road of Jordanian side.

5. JAPAN'S GRANT AID SYSTEM

The Government of Jordan has understood the system of Japan's Grant Aid explained by the Team as described in ANNEX-3.

6. NECESSARY MEASURES TO BE TAKEN BY THE GOVERNMENT OF JORDAN

The Government of Jordan will take necessary measures described in ANNEX-4 for smooth implementation of the Project, on condition that the Grant Aid assistance by the Government of Japan is extended to the Project.

7. FURTHER SCHEDULE OF THE STUDY

(1) The Team will proceed to further studies in Jordan until December 25, 1998.

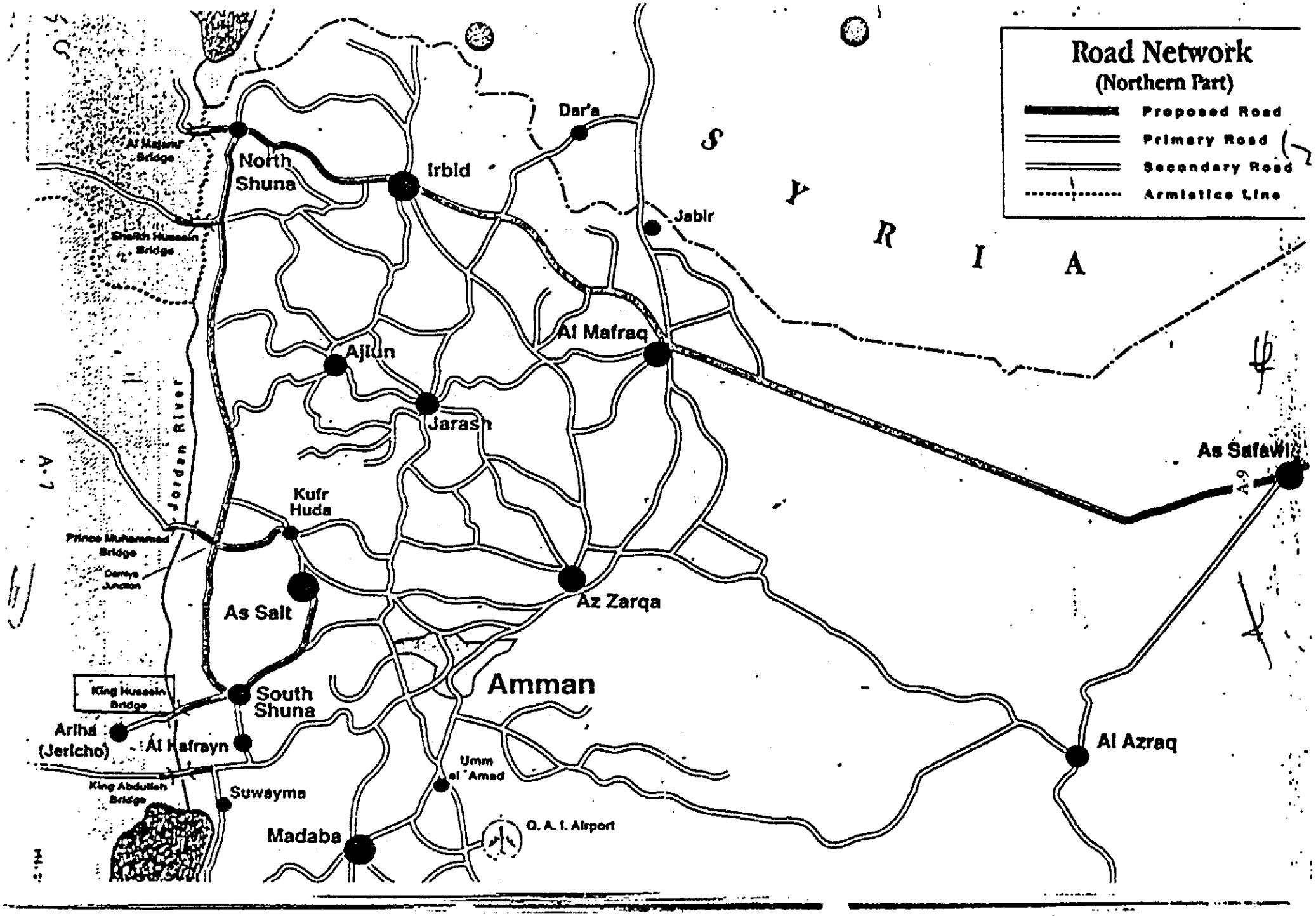
(2) Based on the results of the studies, JICA will prepare the Draft Study Report and dispatch a team at the beginning of March, 1999, in order to explain the contents.

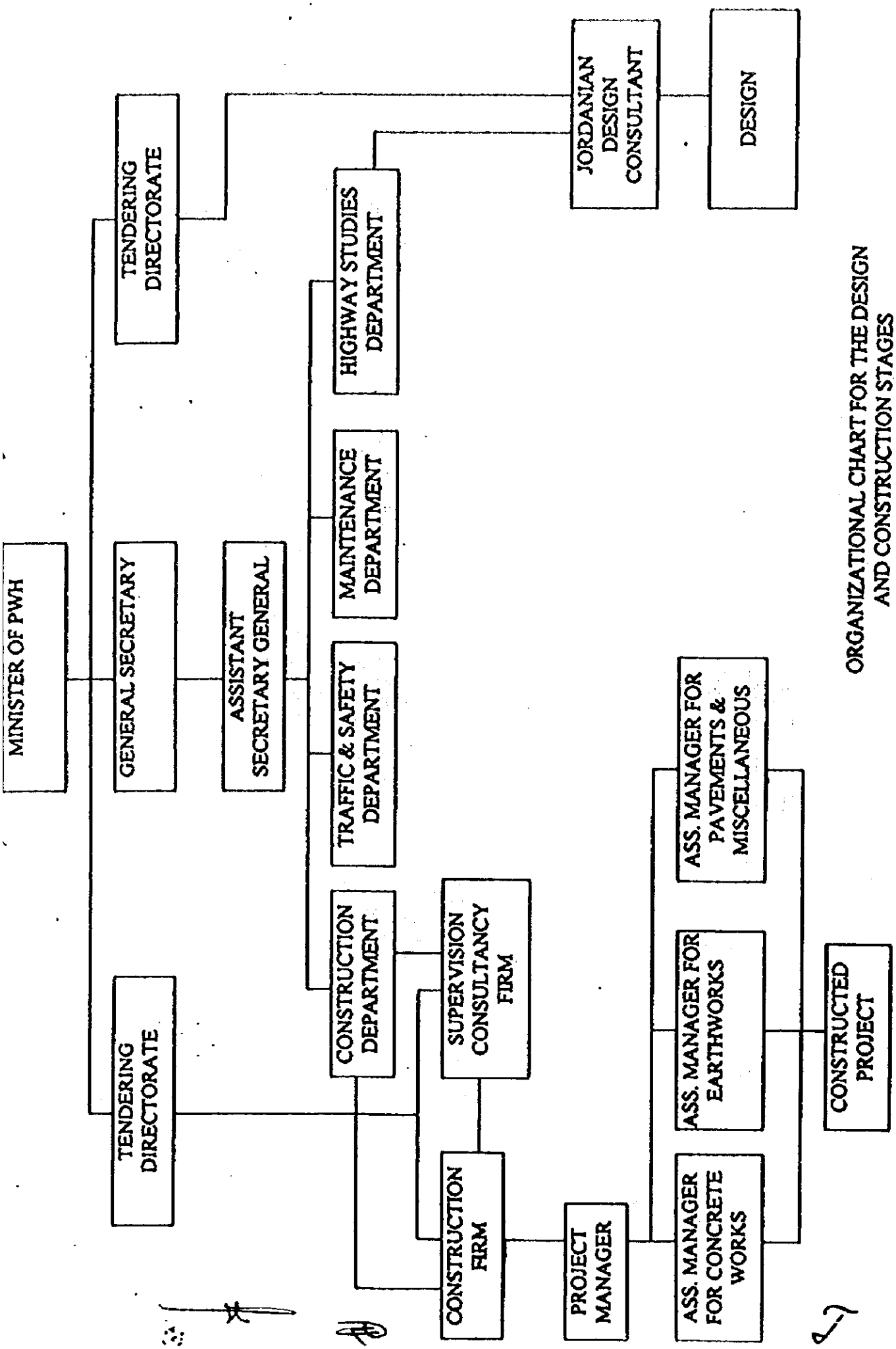
8. OTHER RELEVANT ISSUES

(1) The Government of Jordan will keep consultation with other concerned parties for smooth implementation of the Project.

(2) The Government of Jordan confirmed to finish grubbing of the approach road site of Jordanian side including clearance of unexploded mines by the end of February, 1999.

(3) MPWH in Jordan requested training of Jordanian counterpart engineer(s) in Japan.


Road Network
(Northern Part)
Proposed Road
Primary Road
Secondary Road
Armistice Line
S Y R I A
Dar'a
Irbid
North Shuna
Al Majami' Bridge
Sheikh Hussein Bridge
Jordan River
Jabir
Al Mafraq
Ajlun
Jarash
As Safawi
A-9
A-7
Kufr Huda
Prince Muhammad Bridge
Damya Junction
As Salt
Az Zarqa
Amman
King Hussein Bridge
South Shuna
Arihá (Jericho)
Al Kafrayn
King Abdullah Bridge
Suwayma
Umm al 'Amad
Madaba
Q. A. I. Airport
Al Azraq
PROJECT SITE
ANNEX-1



ORGANIZATIONAL CHART FOR THE DESIGN AND CONSTRUCTION STAGES

ANNEX-3 : JAPAN'S GRANT AID SCHEME

1. Grant Aid Procedures

1) Japan's Grant Aid Program is executed through the following procedures.

· Application	(Request made by the recipient country)
· Study	(Basic Design Study conducted by JICA)
· Appraisal & Approval	(Appraisal by the Government of Japan and Approval by the Cabinet)
· Determination of Implementation	(The Note exchanged between the Governments of Japan and the recipient country)

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Thirdly, the Government of Japan appraises the project to see whether or not it is suitable for Japan's Grant Aid Program, based on the Basic Design Study report prepared by JICA, and the results are then submitted to the Cabinet for approval.

Fourthly, the project, once approved by the Cabinet, becomes official with the Exchange of Notes signed by the Governments of Japan and the recipient country.

Finally, for the implementation of the project, JICA assists the recipient country in such matters as preparing tenders, contracts and so on.

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1) Contents of the study

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a) Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of agencies concerned of the recipient country necessary for the Project's implementation.

b) Evaluation of the appropriateness of the Project to be implemented under the Grant Aid Scheme from a technical, social and economic point of view.

c) Confirmation of items agreed on by both parties concerning the basic concept of the Project.

d) Preparation of a basic design of the Project.

e) Estimation of costs of the Project.

The contents of the original request are not necessarily approved in their initial form as the contents of the Grant Aid project. The Basic Design of the Project is confirmed considering the guidelines of the Japan's Grant Aid Scheme.

The Government of Japan requests the Government of the recipient country to take whatever measures are necessary to ensure its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization in the recipient country actually implementing the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country through the Minutes of Discussions.

2) Selection of Consultants

For smooth implementation of the Study, JICA uses (a) registered consultant firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms. The selected firm(s) carry(ies) out a Basic Design Study and write(s) a report, based upon terms of reference set by JICA. The consultant firm(s) used for the Study is(are) recommended by JICA to the recipient country to also work on the Project's implementation after the Exchange of Notes, in order to maintain technical consistency.

3. Japan's Grant Aid Scheme

1) What is Grant Aid?

The Grant Aid Program provides a recipient country with non-reimbursable funds to procure the facilities, equipment and services (engineering services and transportation of the products, etc.) for economic and social development of the country under principles in accordance with the relevant laws and regulations of Japan. Grant Aid is not supplied through the donation of materials as such.

2) Exchange of Notes (E/N)

Japan's Grant Aid is extended in accordance with the Notes exchanged by the two Governments concerned, in which the objectives of the Project, period of execution, conditions and amount of the Grant Aid, etc., are confirmed.

3) "The period of the Grant Aid" means the one fiscal year which the Cabinet approves the Project for. Within the fiscal year, all procedures such as exchanging of the Notes, concluding contracts with (a) consultant firm(s) and (a) contractor(s) and final payment to them must be completed. However, in case of delays in delivery, installation or construction due to unforeseen factors such as weather, the period of the Grant Aid can be further extended for a maximum of one fiscal year at most by mutual agreement between the two Governments.

4) Under the Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased.

When the two Governments deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country.

However, the prime contractors, namely, consulting, constructing and procurement firms, are

limited to "Japanese nationals." (The term "Japanese nationals" means persons of Japanese nationality or Japanese corporations controlled by persons of Japanese nationality.)

5) Necessity of "Verification"

The Government of recipient country or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be verified by the Government of Japan. This "Verification" is deemed necessary to secure accountability to Japanese taxpayers.

6) Undertakings required of the Government of the Recipient Country

In the implementation of the Grant Aid Project, the recipient country is required to undertake such necessary measures as the following:

(1) To secure land necessary for the sites of the Project and to clear, level and reclaim the land prior to commencement of the construction.

(2) To provide facilities for the distribution of electricity, water supply and drainage and other incidental facilities in and around the sites.

(3) To secure buildings prior to the procurement in case the installation of the equipment.

(4) To ensure all the expenses and prompt excursion for unloading, customs clearance at the port of disembarkation and internal transportation of the products purchased under the Grant Aid.

(5) To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which will be imposed in the recipient country with respect to the supply of the products and services under the Verified Contracts.

7) "Proper Use"

The recipient country is required to maintain and use the facilities constructed and the equipment purchased under the Grant Aid properly and effectively and to assign staff necessary for this operation and maintenance as well as to bear all the expenses other than those covered by the Grant Aid.

8) "Re-export"

The products purchased under the Grant Aid should not be re-exported from the recipient country.

9) Banking Arrangements (B/A)

a) The Government of the recipient country or its designated authority should open an account in the name of the Government of the recipient country in a bank in Japan (hereinafter referred to as "the Bank"). The Government of Japan will execute the Grant Aid by making payments in Japanese yen to cover the obligations incurred by the Government of the recipient country or its designated authority under the Verified Contracts.

b) The payments will be made when payment requests are presented by the Bank to the Government of Japan under an authorization to pay issued by the Government of the recipient country or its designated authority.

ANNEX-1

NECESSARY MEASURES TO BE TAKEN BY THE GOVERNMENT OF JORDAN

The following necessary measures should be taken by the Government of Jordan on condition that the Grant Aid by the Government of Japan is extended to the Project:

1. To provide data and information necessary for the Project.
2. To secure land necessary for the execution of the Project, such as land for roads and bridge, temporary offices, working areas, storage yards and others.
3. To clear the site and grub the approach road site of Jordanian side.
4. To clear unexploded mines at the site and certify the completion of the clearance in a written form.
5. To take the following measures for the working area;
   - Fences around the construction site to safeguard against third parties.
   - Certificate for the personnel to enter into the working area.
   - Permissions for the visitors who enter into the working area.
   - Securing safety.
6. To relocate the existing facilities such as water gage station, watch tower of Jordanian defense force and so on, which might become obstacle for construction of the bridge and approach, prior to the construction of the Project.
7. To relocate public utilities such as power cable and telephone prior to the construction of the Project.
8. To bear commissions to a Japanese bank for its banking services based upon the Banking Arrangement.
9. To ensure prompt unloading, tax exemption, customs clearance at the port of disembarkation in Jordan and prompt internal transportation of the materials and equipment for the Project purchased under the Grant Aid.
10. To exempt Japanese nationals engaged in the Project from customs duties, internal taxes and other fiscal levies which may be imposed in Jordan with respect to the supply of the products and services under the verified contracts.
11. To accord Japanese nationals whose services may be required in connection with the supply of products and the services under the verified contract, such facilities as may be necessary for their entry into Jordan and stay therein for the performance of their work.
12. To provide necessary permissions, licenses and other authorizations for implementing the Project, if necessary.
13. To provide facilities for distribution of electricity, water supply and other incidental facilities

for the execution of the Project.

11. To dismantle the existing Bailey bridge immediately after the bridge construction.

15. To maintain and use properly and effectively the facilities constructed under the Project.

16. To bear all the expenses, other than those to be borne by the Japan's Grant Aid within the scope of the Project.

17. To assign exclusive counterpart engineers and technicians for the Project.

18. To coordinate and solve any issues related to the Project which may be raised from third parties or inhabitants in the Project area during implementation of the Project.

Minutes of Discussions
on
the Study
on
the Project for Construction of King Hussein Bridge
in
the Hashemite Kingdom of Jordan

In November 1998, the Japan International Cooperation Agency (JICA) dispatched a Study Team on the Project for Construction of King Hussein Bridge (hereinafter referred to as "the Project") to the Hashemite Kingdom of Jordan (hereinafter referred to as "Jordan"), and through discussions, field survey, and technical examination of the results in Japan, JICA prepared the draft report of the study.

In order to explain and to consult Jordan on the components of the draft report, JICA sent to Jordan the Draft Report Explanation Team (hereinafter referred to as "the Team"), which is headed by Ms. Oishi, Grant Aid Division, Economic Cooperation Bureau, Ministry of Foreign Affairs, and is scheduled to stay in the country from April 23rd to May 3rd, 1999.

As a result of discussions, both parties have confirmed the main items described on the attached sheets.

Amman, April 29th, 1999

大石 雅美

Masami Oishi
Leader
Study Team
JICA

Bashir Jaghbeer
Secretary General
Ministry of Public Works and Housing

Nael Al Hajaj
Director, Multilateral Cooperation Department
Ministry of Planning

ATTACHMENT

1. COMPONENT OF THE DRAFT REPORT

The Government of Jordan agreed and accepted in principal the components of the draft report explained by the Team.

2. JAPAN'S GRANT AID SYSTEM

Jordanian side understands the Japan's Grant Aid Scheme and the necessary measures taken by the Government of Jordan as explained by the Team and described in Annex-1 and Annex-2.

3. SCHEDULE OF THE STUDY

JICA will complete the final report in accordance with the confirmed item and send it to the Government of Jordan by June, 1999.

4. OTHER RELEVANT ISSUES

(1) The Government of Jordan will keep consultations with the concerned authorities of the Project.
(2) The Government of Jordan will make due treatment (by excavation and dumped stone) of river-section to protect the bridge structures against the effects of local scour of the riverbed materials to the area which is not covered by the Japan's Grant Aid (as shown in Annex-3) within one year after completion of the project.
(3) For the sake of technology transfer on sustainable operation and maintenance, the Jordanian side pointed out the need for technical training of counterpart personnel in Japan. They also understood that another official request on technical cooperation should be submitted through diplomatic channel such as Embassy of Japan and/or JICA Jordan Office.

NA

ANNEX-1 : JAPAN'S GRANT AID SCHEME

1. Grant Aid Procedures

1) Japan's Grant Aid Program is executed through the following procedures.

- Application	(Request made by the recipient country)
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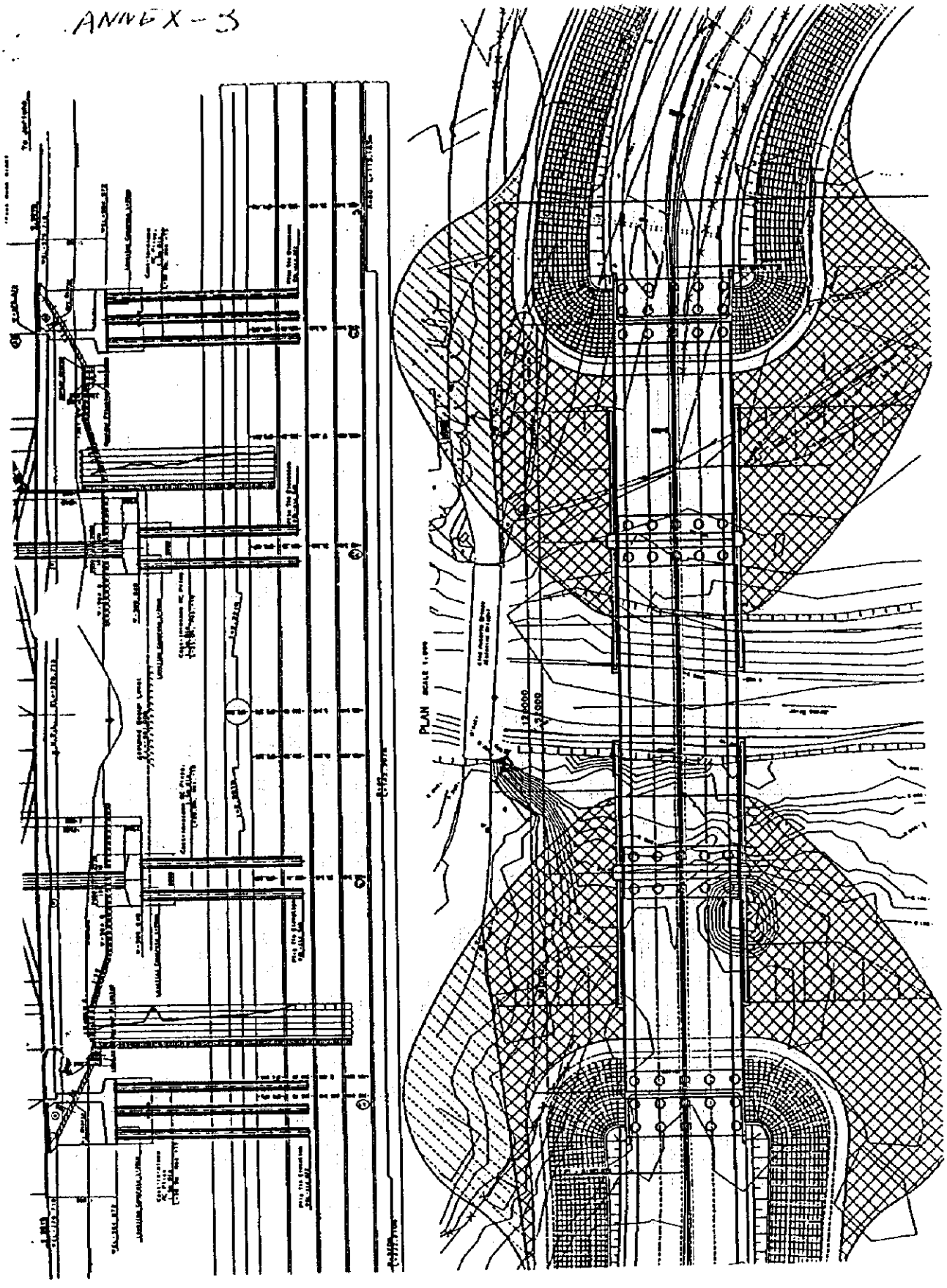
ANNEX - 3



The Area which is not covered by Japan's Grant Aid

NA

Appendix 5: Traffic Survey

A5.1 OD Comparison between Previous B/D Estimation and Actual Observation

Table-A5-1 OD Related Data and Observed Traffic Volume: Buss and Passenger Vehicles

	Countries specified		Distance (km)	Hour	GDP in 1995 (Million US$)		GDP in 1998 (Million US$)		Traffic Volume (Nos. per day)	
	O	D			O	D	O	D	Observed in 1995	Observed in 1998
1	Egypt	Saudi A.	2,100	35	35,540	140,397	37,715	166,270	0	-
2	Syria	Saudi A.	1,810	30	15,667	140,397	17,930	166,270	155	23,580
3	Lebanon	Saudi A.	1,920	32	7,944	140,397	11,371	166,270	5	990
4	Jordan	Syria	210	4	5,721	15,667	6,833	17,930	1,048	57,780
5	Jordan	Lebanon	320	5	5,721	7,944	6,833	11,371	30	180
6	Syria	UAE	2,110	35	15,667	33,050	17,930	38,260	25	3,900
7	Lebanon	UAE	2,220	37	7,944	33,050	11,371	38,260	0	180
8	Turkey	UAE	3,900	65	99,706	33,050	115,422	38,260	0	-
9	Saudi A.	Turkey	3,500	58	140,397	99,706	166,270	115,422	6	1,890
10	Syria	Kuwait	1,200	20	15,667	34,120	17,930	39,498	0	1,020
11	Lebanon	Kuwait	1,350	23	7,944	34,120	11,371	39,498	0	60
12	Syria	Palestine	300	5	15,667	2,468	17,930	3,245	1	300
13	Turkey	Jordan	900	15	99,706	5,721	115,422	6,833	3	30
14	Lebanon	Egypt	600	10	7,944	35,540	11,371	37,715	0	90

Source: Study Team

Table-A5-2 OD Related Data and Observed Traffic Volume: Cargo Tracks

	Countries specified		Distance (km)	Hour	GDP in 1995 (Million US$)		GDP in 1998 (Million US$)		Traffic Volume (Nos. per day)	
	O	D			O	D	O	D	Observed in 1995	Observed in 1998
1	Egypt	Saudi A.	2,100	35	35,540	140,397	37,715	166,270	-	30
2	Syria	Saudi A.	1,810	30	15,667	140,397	17,930	166,270	50	3,090
3	Lebanon	Saudi A.	1,920	32	7,944	140,397	11,371	166,270	46	750
4	Jordan	Syria	210	4	5,721	15,667	6,833	17,930	130	840
5	Jordan	Lebanon	320	5	5,721	7,944	6,833	11,371	126	330
6	Syria	UAE	2,110	35	15,667	33,050	17,930	38,260	13	830
7	Lebanon	UAE	2,220	37	7,944	33,050	11,371	38,260	13	120
8	Turkey	UAE	3,900	65	99,706	33,050	115,422	38,260	13	720
9	Saudi A.	Turkey	3,500	58	140,397	99,706	166,270	115,422	67	1,890
10	Syria	Kuwait	1,200	20	15,667	34,120	17,930	39,498	-	420
11	Lebanon	Kuwait	1,350	23	7,944	34,120	11,371	39,498	-	150

Source: Study Team

A5.2 Future Demand Forecast –1: Bus and Passenger Vehicle

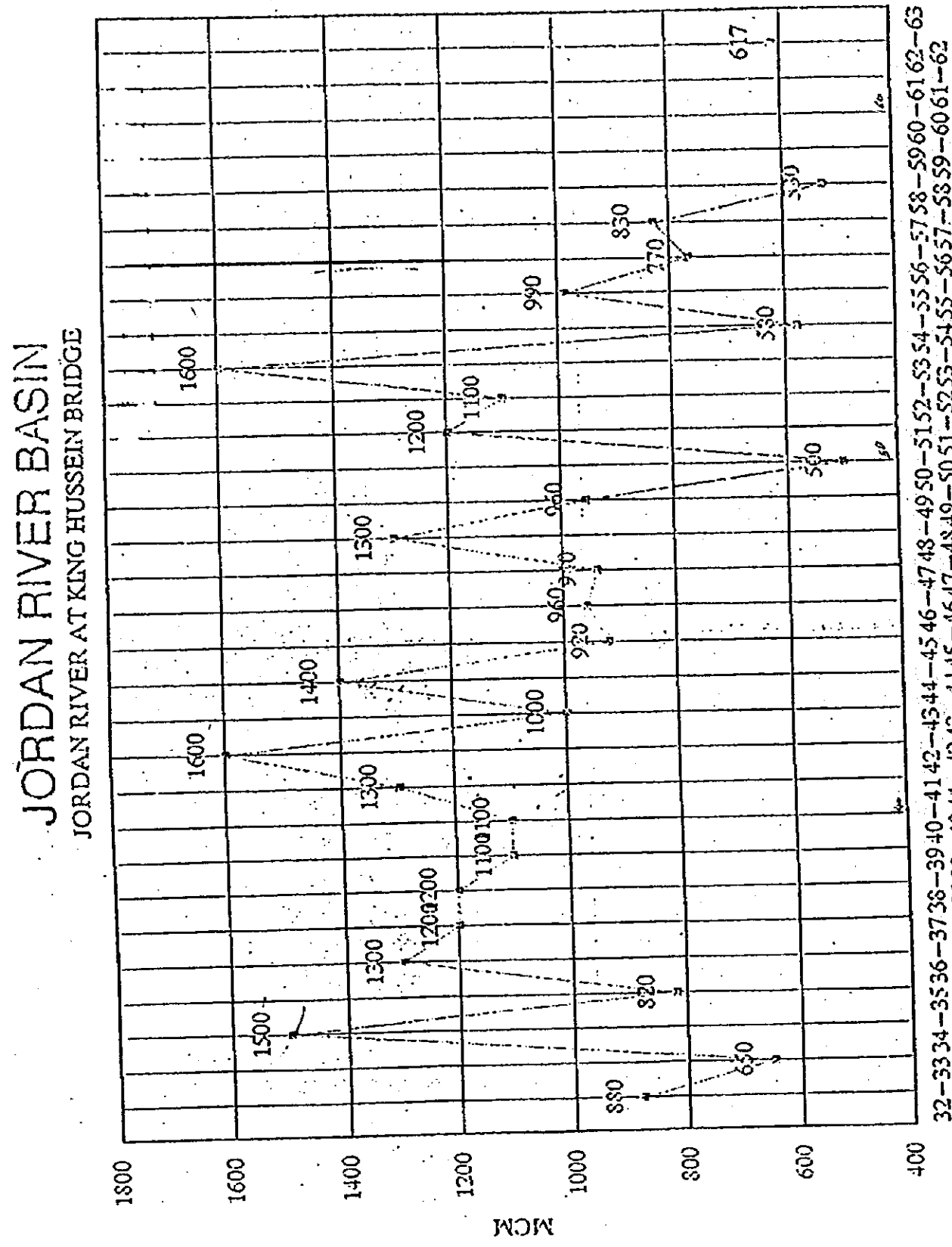
		2,000	2,007	2,017	2,027
Jordan	West Bank	1,044	1,936	4,682	11,321
Jordan	Gaza	97	196	537	1,475
Jordan	Israel	567	1,953	6,589	14,719
Jordan	Lebanon	252	284	661	2,039
West Bank	Iraq	19	37	91	227
West Bank	Saudi Arabia	7	13	34	90
West Bank	UAE	1	2	6	16
Gaza	Iraq	7	16	47	141
Gaza	Saudi Arabia	3	7	21	68
Gaza	UAE	0	1	3	10
Egypt	Saudi Arabia	74	141	228	353
Saudi Arabia	Turkey	1,974	2,054	2,303	2,911
Syria	West Bank	462	593	985	1,896
Syria	Saudi Arabia	1,172	1,174	1,179	1,193
Lebanon	Egypt	223	428	1,367	4,916
TOTAL		5,902	8,835	18,733	41,375

Source: Study Team

A5.3 Future Demand Forecast –2: Cargo Tracks

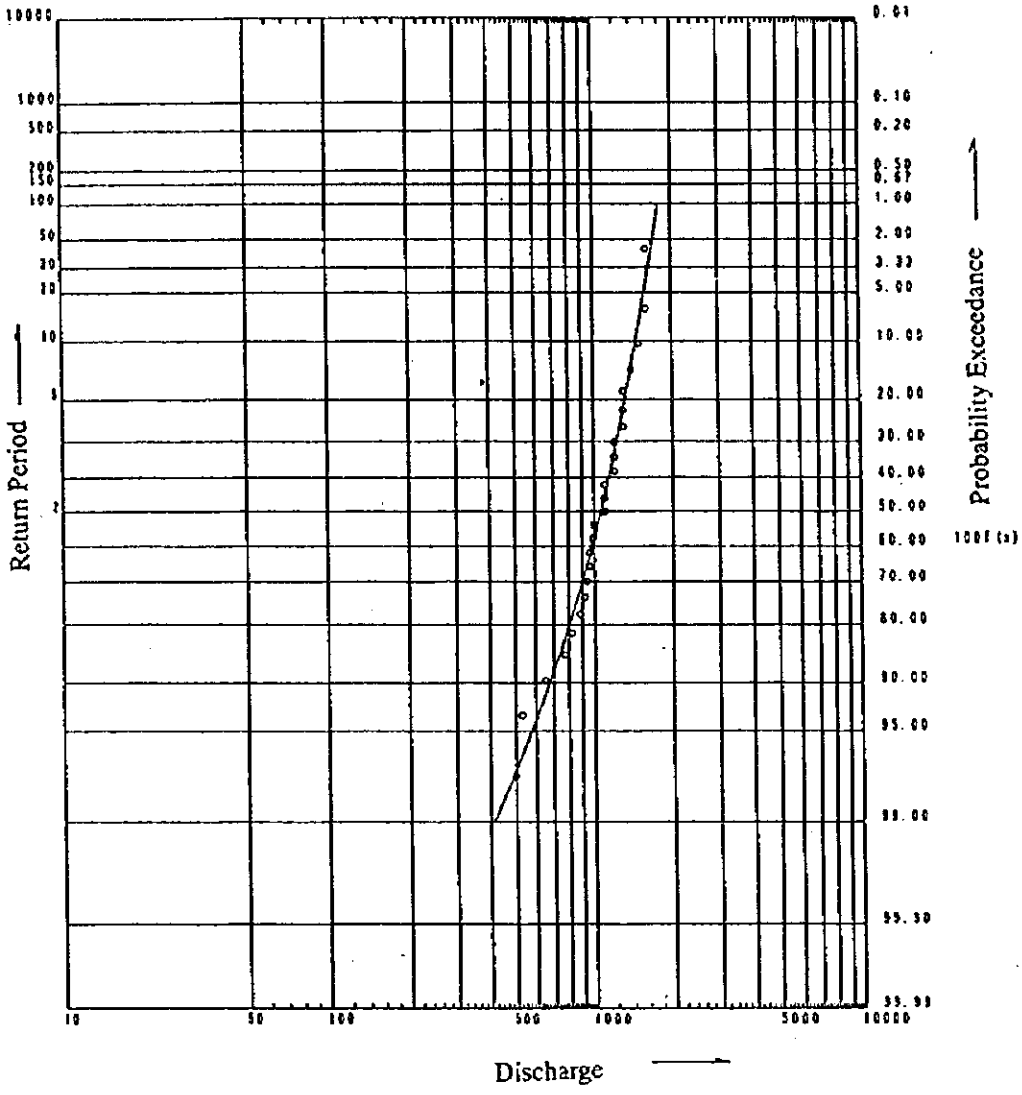
		2,000	2,007	2,017	2,027
Jordan	West Bank	1,044	1,936	4,682	11,321
Jordan	Gaza	89	179	493	1,352
Jordan	Israel	566	992	2,206	4,907
West Bank	Iraq	19	37	91	227
West Bank	Saudi Arabia	7	13	34	90
West Bank	UAE	1	2	6	16
Gaza	Iraq	6	14	41	124
Gaza	Saudi Arabia	3	6	19	60
Gaza	UAE	0	1	3	8
Egypt	Saudi Arabia	104	141	228	383
Israel	Iraq				
Israel	Saudi Arabia				
Israel	UAE				
TOTAL		1,839	3,321	7,803	18,488

A6.1 Discharge Record of Jordan River

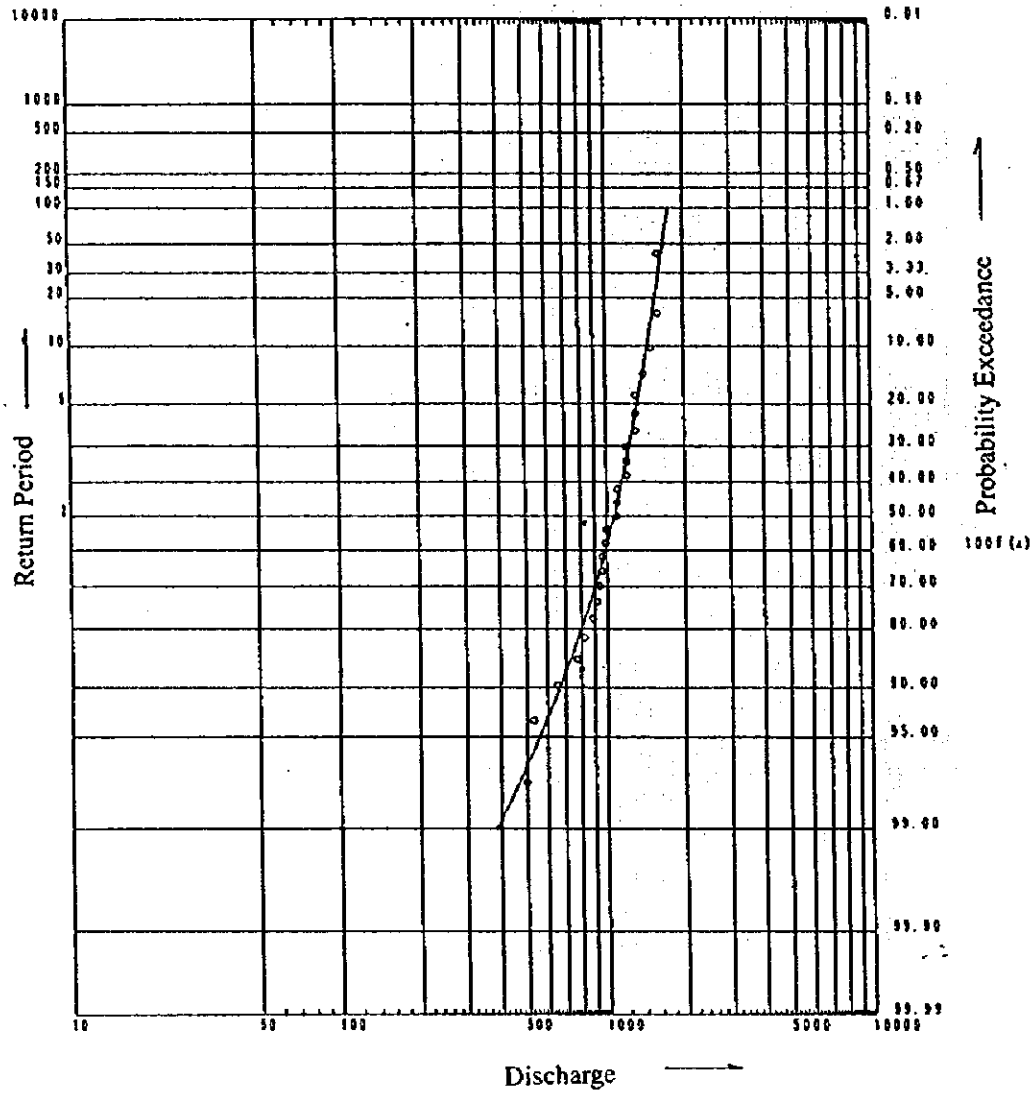


A6.2 Design Discharge by Probability Analysis

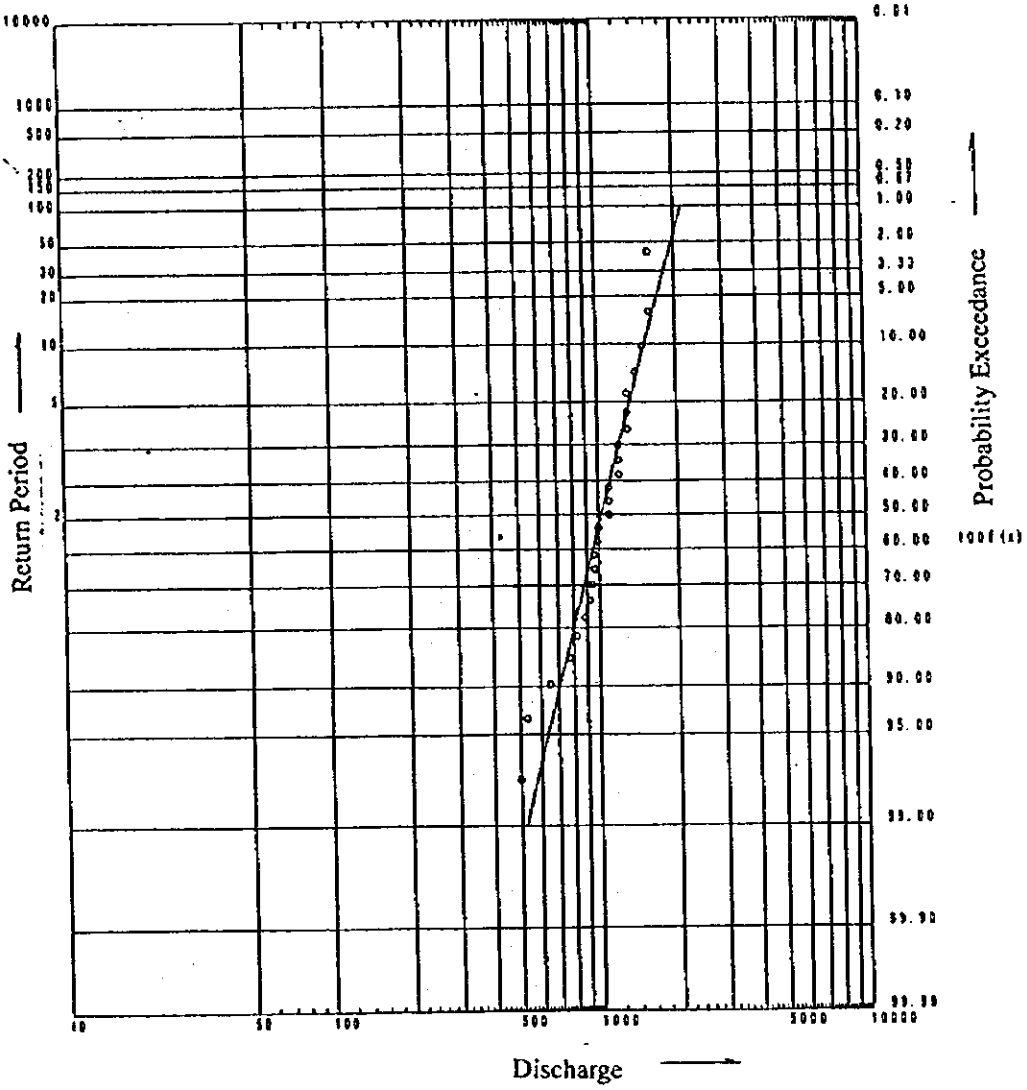
(1) Iwai Method



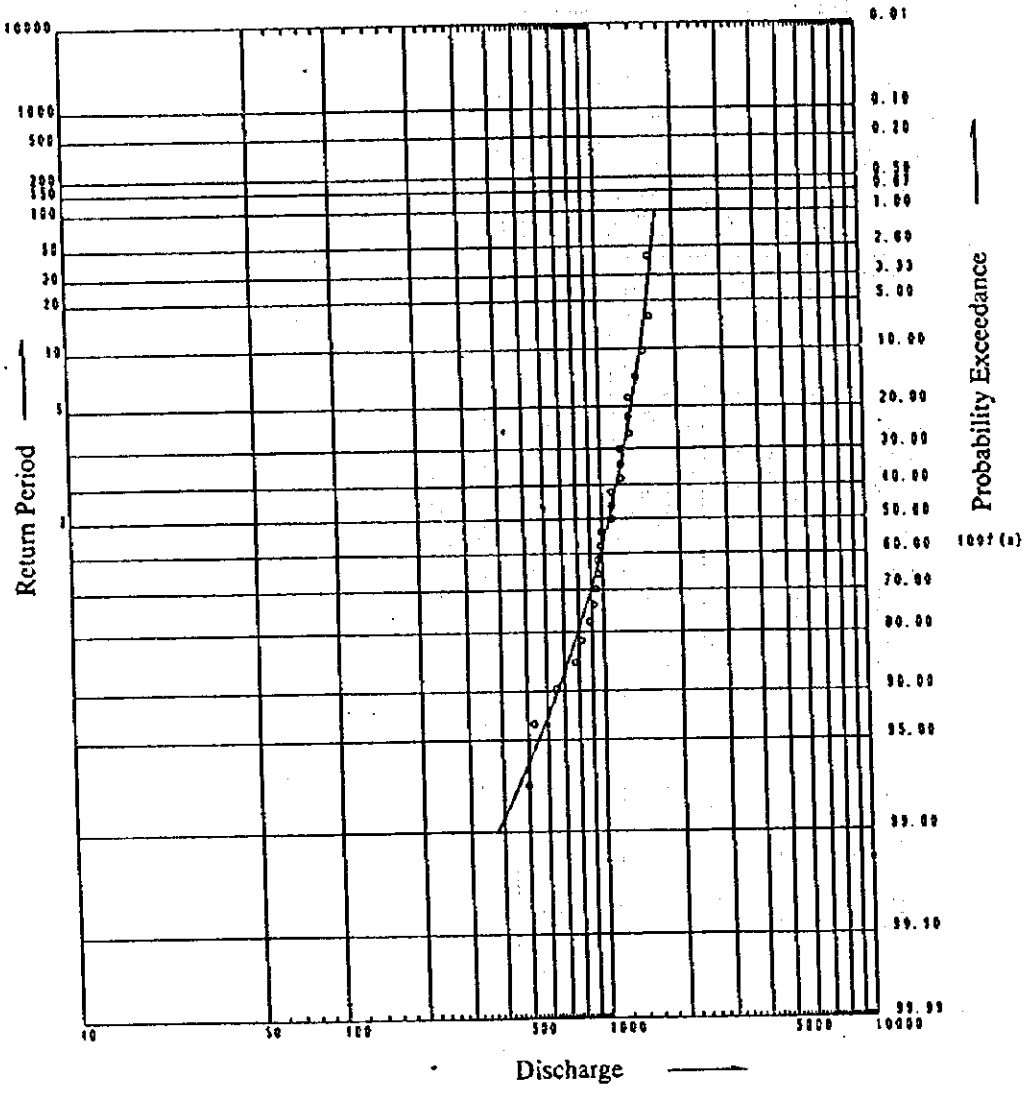
(2) Ishihara & Takase Method



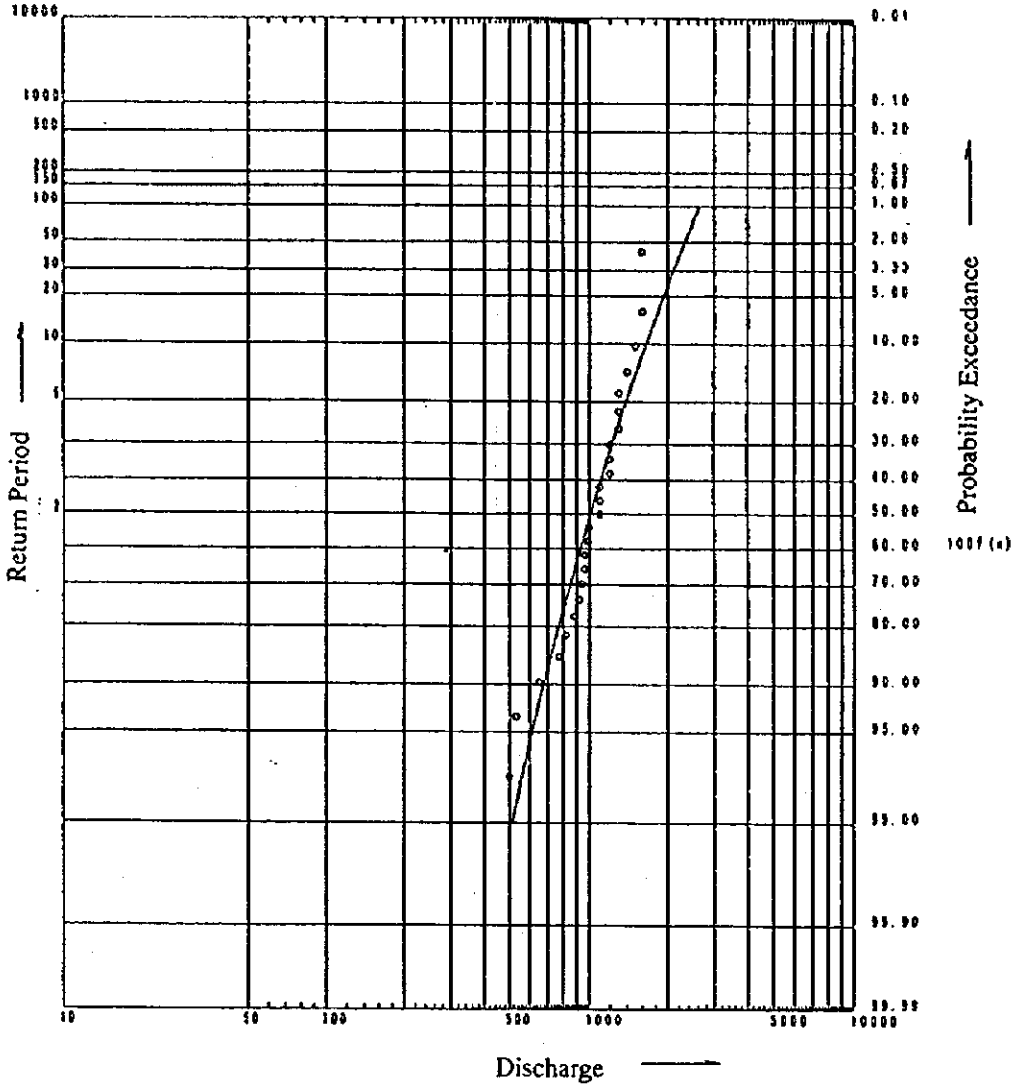
(3) Gumbel Method



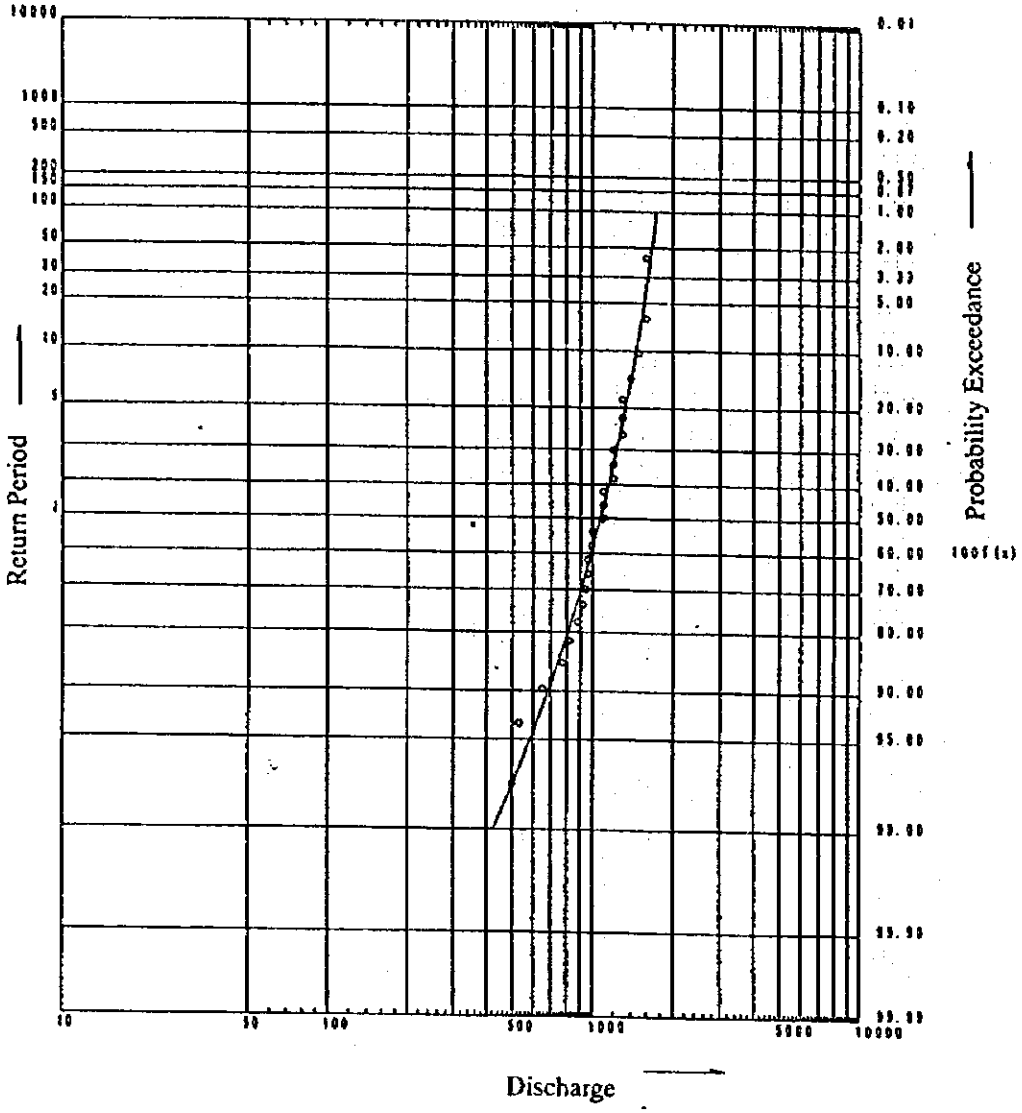
(4) Generalized Extreme Value Distribution



(5) Square Root Exponential Type Maximum Distribution



(6) Log Pearson Distribution



A6.3 Water Level

1 ********** BACK WATER CALCULATION WATER SURFACE PROFILE **********

RIVER NAME Jordan River

AT FIRST SECTION(DISCHARGE 1430.000 WATER LEVEL -377.705 (MANNING) COEFFICIENT OF ROUGHNESS .060)

0 CASE 1 ALL Q=1430m3/s

1995. Jan. Flood

0 SEC.NO.	DISTANCE	EL.MIN.	DISCHARGE	N.VALUE	AREA	W.L.	VELOCITY	DEPTH	C.W.D.
BR+100	.000	-387.100	1430.000	.060	3375.632	-377.705	.424	9.395	6.116
BR+ 75	25.000	-387.100	1430.000	.060	2743.114	-377.705	.521	9.395	6.782
BR+ 40	60.000	-387.100	1430.000	.060	2162.477	-377.704	.661	9.396	7.843
BR+ 25	75.000	-387.100	1430.000	.060	2909.998	-377.689	.491	9.411	7.072
BR+ 10	90.000	-387.100	1430.000	.060	3205.784	-377.684	.446	9.416	6.822
BR+ 0	100.000	-387.100	1430.000	.060	2478.780	-377.689	.577	9.411	7.332
BR- 10	110.000	-387.100	1430.000	.060	3168.656	-377.679	.451	9.421	6.854
BR- 25	125.000	-387.100	1430.000	.060	2782.731	-377.680	.514	9.420	7.250
BR- 50	150.000	-387.100	1430.000	.060	2799.177	-377.673	.511	9.427	7.240
BR- 75	175.000	-387.100	1430.000	.060	1773.894	-377.685	.806	9.415	7.341

AT FIRST SECTION(DISCHARGE 1720.000 WATER LEVEL -377.308 (MANNING) COEFFICIENT OF ROUGHNESS .060)

0 CASE 1 ALL Q=1720m3/s

B = 30 m

0 SEC.NO.	DISTANCE	EL.MIN.	DISCHARGE	N.VALUE	AREA	W.L.	VELOCITY	DEPTH	C.W.D.
BR+100	.000	-387.100	1720.000	.060	3772.266	-377.308	.456	9.792	6.233
BR+ 75	25.000	-387.100	1720.000	.060	3139.547	-377.309	.548	9.791	6.896
BR+ 40	60.000	-387.100	1720.000	.060	2559.526	-377.307	.672	9.793	7.926
BR+ 25	75.000	-387.100	1720.000	.060	3301.440	-377.293	.521	9.807	7.163
BR+ 10	90.000	-387.100	1720.000	.060	204.036	-377.574	8.430	9.526	9.897 *
BR+ 0	100.000	-387.100	1720.000	.060	215.166	-376.892	7.994	10.208	10.208 C
BR- 10	110.000	-387.100	1720.000	.060	226.974	-376.288	7.578	10.812	10.419
BR- 25	125.000	-387.100	1720.000	.060	7562.207	-372.900	.227	14.200	7.330
BR- 50	150.000	-387.100	1720.000	.060	7572.698	-372.900	.227	14.200	7.320
BR- 75	175.000	-387.100	1720.000	.060	7598.841	-372.900	.226	14.200	7.294

Loss Sudden Contraction $hsc = fsc*V^2/2g = 0.5 \times 7.578^2/(2 \times 9.8) = 1.465$ m

Sudden Enlargement $hse = (V1-V2)^2/2g = (8.430 - 0.521)^2/(2 \times 9.8) = 3.191$ m

H.W.L = WL(BR-25) + hsc + hse = -372.900 + 1.465 + 3.191 = -368.304 m

0 NO MARK SUB CRITICAL FLOW

* MARK SUPER CRITICAL FLOW

C MARK CONTROL SECTION

AT FIRST SECTION(DISCHARGE 1720.000 WATER LEVEL -377.308 (MANNING) COEFFICIENT OF ROUGHNESS .060)

0 CASE 1 ALL Q=1720m3/s

B = 50 m

0 SEC.NO.	DISTANCE	EL.MIN.	DISCHARGE	N.VALUE	AREA	W.L.	VELOCITY	DEPTH	C.W.D.
BR+100	.000	-387.100	1720.000	.060	3772.266	-377.308	.456	9.792	6.233
BR+ 75	25.000	-387.100	1720.000	.060	3139.547	-377.309	.548	9.791	6.896
BR+ 40	60.000	-387.100	1720.000	.060	2559.526	-377.307	.672	9.793	7.926
BR+ 25	75.000	-387.100	1720.000	.060	3301.440	-377.293	.521	9.807	7.163
BR+ 10	90.000	-387.100	1720.000	.060	255.107	-378.148	6.742	8.952	8.952 C
BR+ 0	100.000	-387.100	1720.000	.060	270.576	-377.647	6.357	9.453	9.144
BR- 10	110.000	-387.100	1720.000	.060	268.075	-377.487	6.416	9.613	9.353
BR- 25	125.000	-387.100	1720.000	.060	5432.278	-375.030	.317	12.070	7.330
BR- 50	150.000	-387.100	1720.000	.060	5443.438	-375.029	.316	12.071	7.320
BR- 75	175.000	-387.100	1720.000	.060	5668.606	-375.028	.303	12.072	7.096

Loss Sudden Contraction hsc = fsc*V^2/2g = 0.5 x 6.416^2/(2 x 9.8) = 1.050 m

Sudden Enlargement hse = (V1-V2)^2/2g = (6.742 - 0.521)^2/(2 x 9.8) = 1.975 m

H.W.L = WL(BR-25) + hsc + hse = -375.030 + 1.050 + 1.975 = -372.005 m

B = 70 m

0 SEC.NO.	DISTANCE	EL.MIN.	DISCHARGE	N.VALUE	AREA	W.L.	VELOCITY	DEPTH	C.W.D.
BR+100	.000	-387.100	1720.000	.060	3772.266	-377.308	.456	9.792	6.233
BR+ 75	25.000	-387.100	1720.000	.060	3139.547	-377.309	.548	9.791	6.896
BR+ 40	60.000	-387.100	1720.000	.060	2559.526	-377.307	.672	9.793	7.926
BR+ 25	75.000	-387.100	1720.000	.060	3301.440	-377.293	.521	9.807	7.163
BR+ 10	90.000	-387.100	1720.000	.060	283.242	-378.569	6.073	8.531	8.562 *
BR+ 0	100.000	-387.100	1720.000	.060	285.385	-378.305	6.027	8.795	8.795 C
BR- 10	110.000	-387.100	1720.000	.060	302.172	-377.873	5.692	9.227	8.987
BR- 25	125.000	-387.100	1720.000	.060	4544.299	-375.918	.378	11.182	7.330
BR- 50	150.000	-387.100	1720.000	.060	4556.264	-375.916	.378	11.184	7.320
BR- 75	175.000	-387.100	1720.000	.060	4583.883	-375.915	.375	11.185	7.294

Loss Sudden Contraction hsc = fsc*V^2/2g = 0.5 x 5.692^2/(2 x 9.8) = 0.827 m

Sudden Enlargement hse = (V1-V2)^2/2g = (6.073 - 0.521)^2/(2 x 9.8) = 1.573 m

H.W.L = WL(BR-25) + hsc + hse = -375.918 + 0.827 + 1.573 = -373.518 m

0 NO MARK SUB CRITICAL FLOW

* MARK SUPER CRITICAL FLOW

C MARK CONTROL SECTION

AT FIRST SECTION(DISCHARGE 1720.000 WATER LEVEL -377.308 (MANNING) COEFFICIENT OF ROUGHNESS .060)

0 CASE 1 ALL Q=1720m3/s

B = 90 m

0 SEC.NO.	DISTANCE	EL.MIN.	DISCHARGE	N.VALUE	AREA	W.L.	VELOCITY	DEPTH	C.W.D.
BR+100	.000	-387.100	1720.000	.060	3772.266	-377.308	.456	9.792	6.233
BR+ 75	25.000	-387.100	1720.000	.060	3139.547	-377.309	.548	9.791	6.896
BR+ 40	60.000	-387.100	1720.000	.060	2559.526	-377.307	.672	9.793	7.926
BR+ 25	75.000	-387.100	1720.000	.060	3301.440	-377.293	.521	9.807	7.163
BR+ 10	90.000	-387.100	1720.000	.060	408.535	-378.200	4.210	8.900	7.810
BR+ 0	100.000	-387.100	1720.000	.060	387.803	-378.205	4.435	8.895	8.034
BR- 10	110.000	-387.100	1720.000	.060	410.362	-377.985	4.191	9.115	8.004
BR- 25	125.000	-387.100	1720.000	.060	3521.589	-376.941	.488	10.159	7.330
BR- 50	150.000	-387.100	1720.000	.060	3535.913	-376.937	.486	10.163	7.320
BR- 75	175.000	-387.100	1720.000	.060	2220.383	-376.950	.775	10.150	7.454

Loss Sudden Contraction hsc = fsc*V^2/2g = 0.5 x 4.191^2/(2 x 9.8) = 0.448 m

Sudden Enlargement hse = (V1-V2)^2/2g = (4.210 - 0.521)^2/(2 x 9.8) = 0.694 m

H.W.L = WL(BR-25) + hsc + hse = -376.941 + 0.448 + 0.694 = -375.799 m

B = 100 m

0 SEC.NO.	DISTANCE	EL.MIN.	DISCHARGE	N.VALUE	AREA	W.L.	VELOCITY	DEPTH	C.W.D.
BR+100	.000	-387.100	1720.000	.060	3772.266	-377.308	.456	9.792	6.233
BR+ 75	25.000	-387.100	1720.000	.060	3139.547	-377.309	.548	9.791	6.896
BR+ 40	60.000	-387.100	1720.000	.060	2559.526	-377.307	.672	9.793	7.926
BR+ 25	75.000	-387.100	1720.000	.060	3301.440	-377.293	.521	9.807	7.163
BR+ 10	90.000	-387.100	1720.000	.060	482.554	-377.942	3.564	9.158	7.546
BR+ 0	100.000	-387.100	1720.000	.060	452.315	-377.971	3.803	9.129	7.820
BR- 10	110.000	-387.100	1720.000	.060	481.345	-377.807	3.573	9.293	7.694
BR- 25	125.000	-387.100	1720.000	.060	3406.738	-377.056	.505	10.044	7.330
BR- 50	150.000	-387.100	1720.000	.060	3421.542	-377.051	.503	10.049	7.320
BR- 75	175.000	-387.100	1720.000	.060	3452.007	-377.046	.498	10.054	7.294

Loss Sudden Contraction hsc = fsc*V^2/2g = 0.5 x 3.573^2/(2 x 9.8) = 0.326 m

Sudden Enlargement hse = (V1-V2)^2/2g = (3.564 - 0.521)^2/(2 x 9.8) = 0.472 m

H.W.L = WL(BR-25) + hsc + hse = -377.056 + 0.326 + 0.472 = -376.258 m

0 NO MARK SUB CRITICAL FLOW

* MARK SUPER CRITICAL FLOW

C MARK CONTROL SECTION

AT FIRST SECTION(DISCHARGE 1720.000 WATER LEVEL -377.308 (MANNING) COEFFICIENT OF ROUGHNESS .060)

0 CASE 1 ALL Q=1720m3/s

B = 110 m

0 SEC.NO.	DISTANCE	EL.MIN.	DISCHARGE	N.VALUE	AREA	W.L.	VELOCITY	DEPTH	C.W.D.
BR+100	.000	-387.100	1720.000	.060	3772.266	-377.308	.456	9.792	6.233
BR+ 75	25.000	-387.100	1720.000	.060	3139.547	-377.309	.548	9.791	6.896
BR+ 40	60.000	-387.100	1720.000	.060	2559.526	-377.307	.672	9.793	7.926
BR+ 25	75.000	-387.100	1720.000	.060	3301.440	-377.293	.521	9.807	7.163
BR+ 10	90.000	-387.100	1720.000	.060	562.086	-377.770	3.060	9.330	7.237
BR+ 0	100.000	-387.100	1720.000	.060	533.447	-377.782	3.224	9.318	7.485
BR- 10	110.000	-387.100	1720.000	.060	556.341	-377.688	3.092	9.412	7.371
BR- 25	125.000	-387.100	1720.000	.060	3330.389	-377.132	.516	9.968	7.330
BR- 50	150.000	-387.100	1720.000	.060	3345.548	-377.127	.514	9.973	7.320
BR- 75	175.000	-387.100	1720.000	.060	3376.378	-377.122	.509	9.978	7.294

Loss Sudden Contraction hsc = fsc*V^2/2g = 0.5 x 3.092^2/(2 x 9.8) = 0.244 m

Sudden Enlargement hse = (V1-V2)^2/2g = (3.060 - 0.521)^2/(2 x 9.8) = 0.329 m

H.W.L = WL(BR-25) + hsc + hse = -377.132 + 0.244 + 0.329 = -376.559 m

RIVER NAME Jordan River L=120m

AT FIRST SECTION(DISCHARGE 1720.000 WATER LEVEL -377.308 (MANNING) COEFFICIENT OF ROUGHNESS 0.060)

0 CASE 1 ALL Q=1720m3/s

0 SEC.NO.	DISTANCE	EL.MIN.	DISCHARGE	N.VALUE	AREA	W.L.	VELOCITY	DEPTH	C.W.D.
BR+100	0.000	-387.100	1720.000	0.060	3772.266	-377.308	0.456	9.792	6.233
BR+ 75	25.000	-387.100	1720.000	0.060	3139.563	-377.309	0.548	9.791	6.896
BR+ 40	60.000	-387.100	1720.000	0.060	2559.542	-377.307	0.672	9.793	7.926
BR+ 25	75.000	-387.100	1720.000	0.060	3301.457	-377.293	0.521	9.807	7.163
BR+ 10	90.000	-387.100	1720.000	0.060	649.659	-377.648	2.648	9.452	6.885
BR+ 0	100.000	-387.100	1720.000	0.060	591.339	-377.695	2.909	9.405	7.324
BR- 10	110.000	-387.100	1720.000	0.060	599.929	-377.642	2.867	9.458	7.305
BR- 25	125.000	-387.100	1720.000	0.060	3296.129	-377.166	0.522	9.934	7.330
BR- 50	150.000	-387.100	1720.000	0.060	3311.460	-377.161	0.519	9.939	7.320
BR- 75	175.000	-387.100	1720.000	0.060	3342.477	-377.156	0.515	9.944	7.294

Loss Sudden Contraction hsc = fsc*V^2/2g = 0.5 x 2.867^2/(2 x 9.8) = 0.210

Sudden Enlargement hse = (V1-V2)^2/2g = (2.648 - 0.521)^2/(2 x 9.8) = 0.238

H.W.L = WL(BR-25) + hsc + hse = -377.161 + 0.210 + 0.238 = -376.713

B = 130 m

O SEC.NO.	DISTANCE	EL.MIN.	DISCHARGE	N.VALUE	AREA	W.L.	VELOCITY	DEPTH	C.W.D.
BR+100	.000	-387.100	1720.000	.060	3772.266	-377.308	.456	9.792	6.233
BR+ 75	25.000	-387.100	1720.000	.060	3139.547	-377.309	.548	9.791	6.896
BR+ 40	60.000	-387.100	1720.000	.060	2559.526	-377.307	.672	9.793	7.926
BR+ 25	75.000	-387.100	1720.000	.060	3301.440	-377.293	.521	9.807	7.163
BR+ 10	90.000	-387.100	1720.000	.060	710.443	-377.587	2.421	9.513	6.746
BR+ 0	100.000	-387.100	1720.000	.060	673.463	-377.598	2.554	9.502	6.823
BR- 10	110.000	-387.100	1720.000	.060	699.727	-377.544	2.458	9.556	6.872
BR- 25	125.000	-387.100	1720.000	.060	3261.966	-377.200	.527	9.900	7.330
BR- 50	150.000	-387.100	1720.000	.060	3277.476	-377.195	.525	9.905	7.320
BR- 75	175.000	-387.100	1720.000	.060	2062.565	-377.210	.834	9.890	7.454

Loss Sudden Contraction hsc = fsc*V^2/2g = 0.5 x 2.458^2/(2 x 9.8) = 0.154 m

Sudden Enlargement hse = (V1-V2)^2/2g = (2.421 - 0.521)^2/(2 x 9.8) = 0.184 m

H.W.L = WL(BR-25) + hsc + hse = -377.200 + 0.154 + 0.184 = -376.862 m

O NO MARK SUB CRITICAL FLOW

* MARK SUPER CRITICAL FLOW

C MARK CONTROL SECTION

AT FIRST SECTION(DISCHARGE 1720.000 WATER LEVEL -377.308 (MANNING) COEFFICIENT OF ROUGHNESS .060)

O CASE 1 ALL Q=1720m3/s

B = 150 m

O SEC.NO.	DISTANCE	EL.MIN.	DISCHARGE	N.VALUE	AREA	W.L.	VELOCITY	DEPTH	C.W.D.
BR+100	.000	-387.100	1720.000	.060	3772.266	-377.308	.456	9.792	6.233
BR+ 75	25.000	-387.100	1720.000	.060	3139.547	-377.309	.548	9.791	6.896
BR+ 40	60.000	-387.100	1720.000	.060	2559.526	-377.307	.672	9.793	7.926
BR+ 25	75.000	-387.100	1720.000	.060	3301.440	-377.293	.521	9.807	7.163
BR+ 10	90.000	-387.100	1720.000	.060	852.036	-377.493	2.019	9.607	6.087
BR+ 0	100.000	-387.100	1720.000	.060	810.158	-377.501	2.123	9.599	6.195
BR- 10	110.000	-387.100	1720.000	.060	840.731	-377.465	2.046	9.635	6.328
BR- 25	125.000	-387.100	1720.000	.060	3230.150	-377.232	.532	9.868	7.330
BR- 50	150.000	-387.100	1720.000	.060	3245.836	-377.227	.530	9.873	7.320
BR- 75	175.000	-387.100	1720.000	.060	3277.199	-377.221	.525	9.879	7.294

Loss Sudden Contraction hsc = fsc*V^2/2g = 0.5 x 2.046^2/(2 x 9.8) = 0.107 m

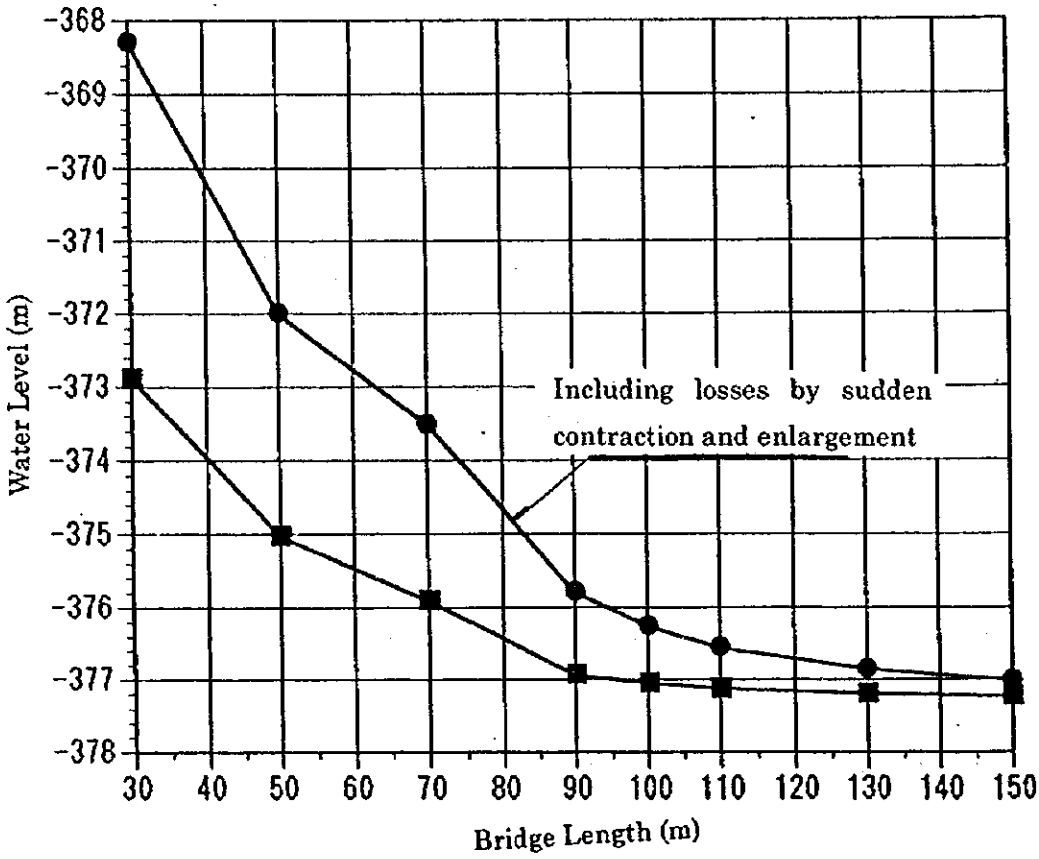
Sudden Enlargement hse = (V1-V2)^2/2g = (2.019 - 0.521)^2/(2 x 9.8) = 0.114 m

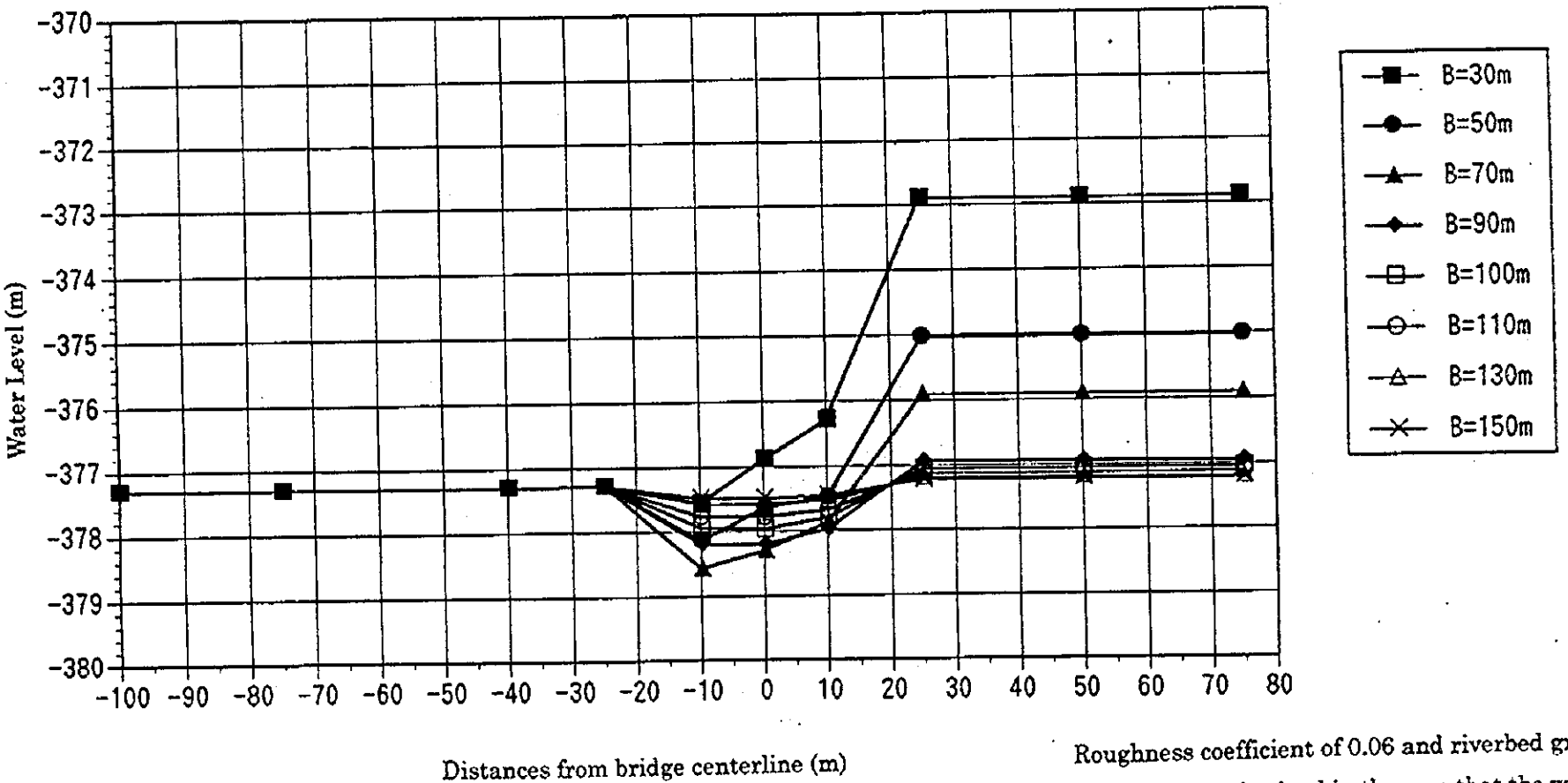
H.W.L = WL(BR-25) + hsc + hse = -377.232 + 0.107 + 0.114 = -377.011 m

O NO MARK SUB CRITICAL FLOW

* MARK SUPER CRITICAL FLOW

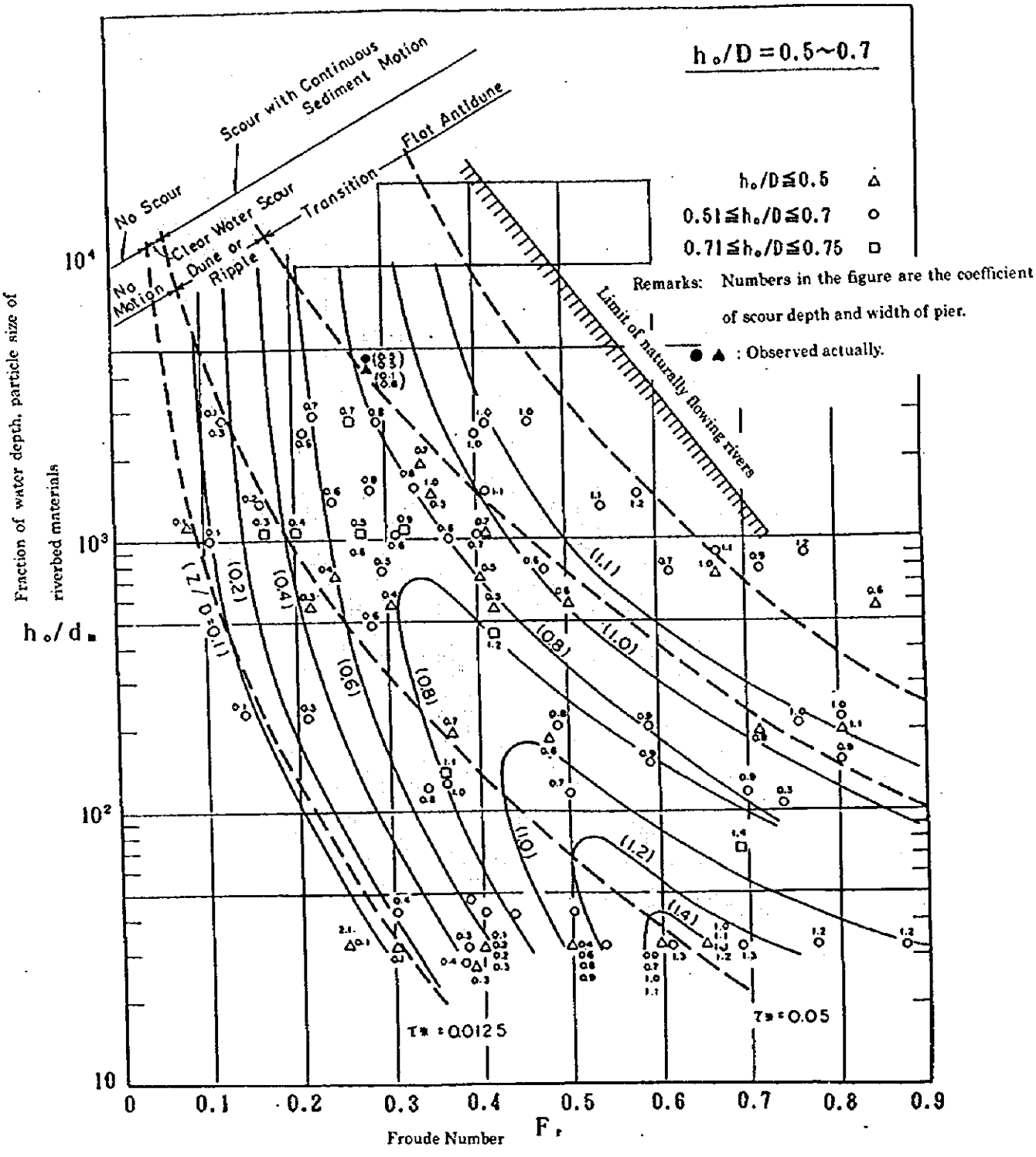
C MARK CONTROL SECTION


-368
-369
-370
-371
-372
-373
-374
-375
-376
-377
-378
Water Level (m)
Including losses by sudden contraction and enlargement
30
40
50
60
70
80
90
100
110
120
130
140
150
Bridge Length (m)

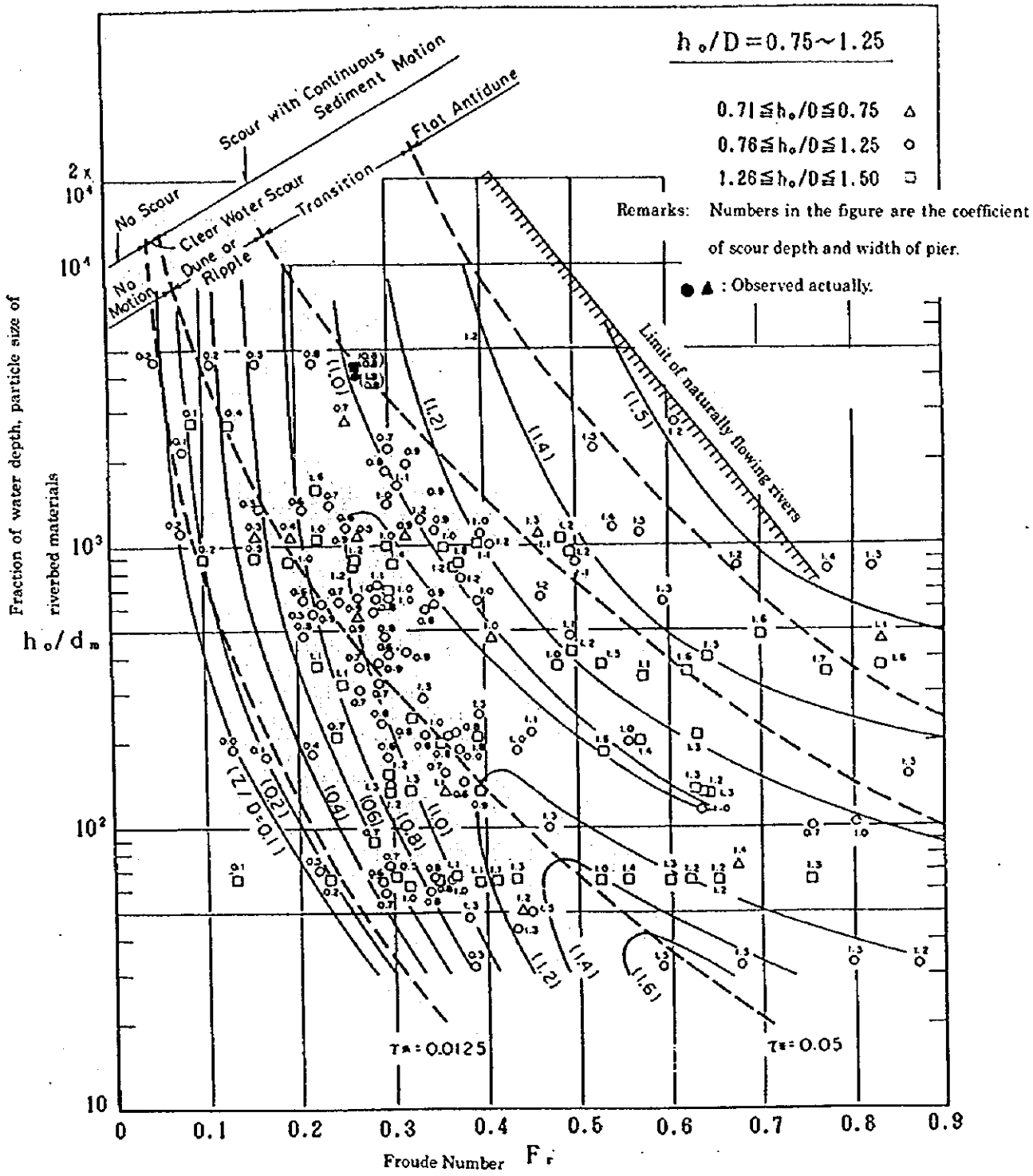


Roughness coefficient of 0.06 and riverbed grade of 1/7,750 are obtained in the case that the water level rises up to EL – 377.7m for the flood discharge of 1,430 m3/sec. Non-uniform flow calculation follows these coefficient and grade to estimate the relation between water levels and bridge lengths.

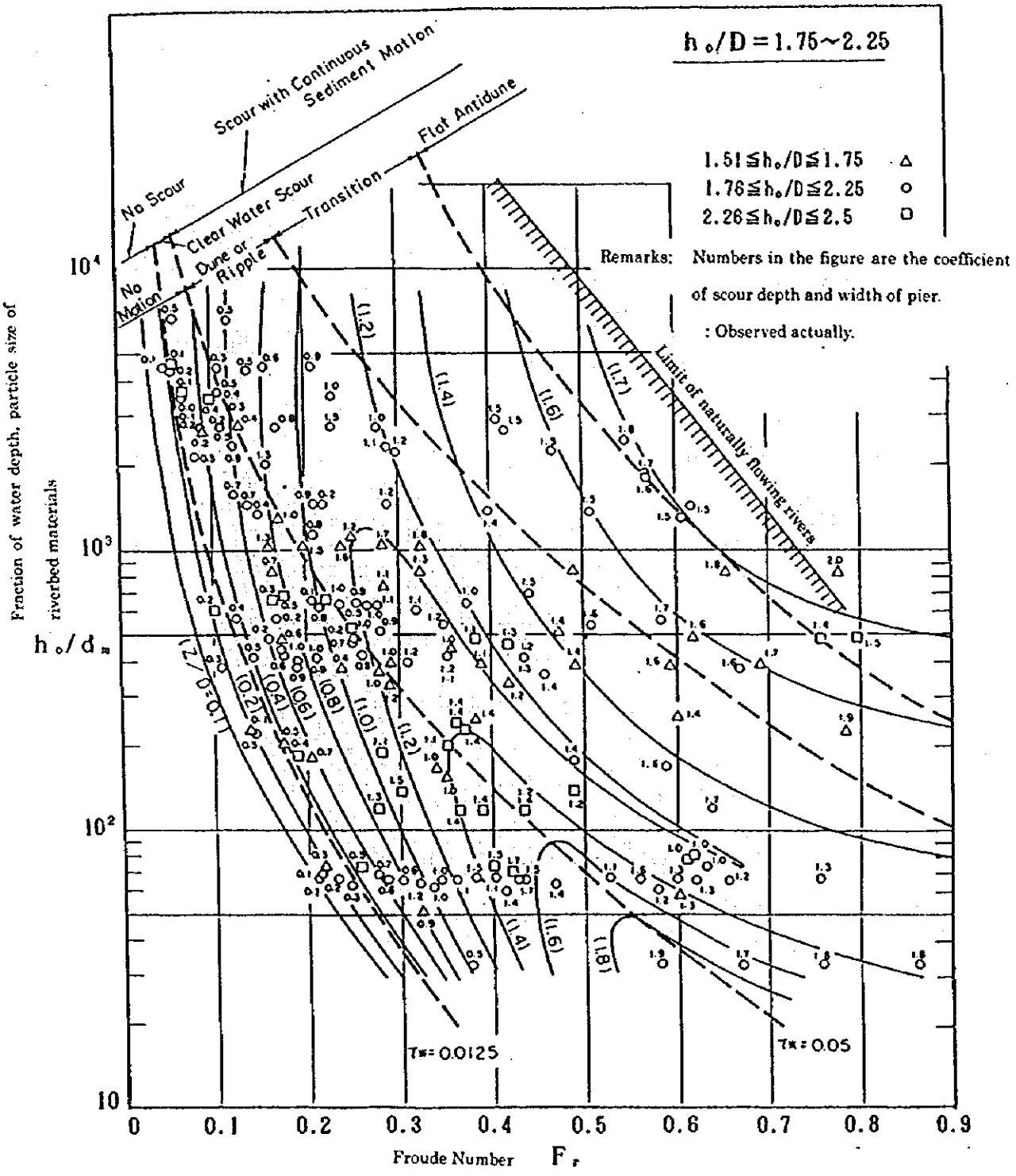
Appendix 7: Diagrams for Estimation of Scour Depth



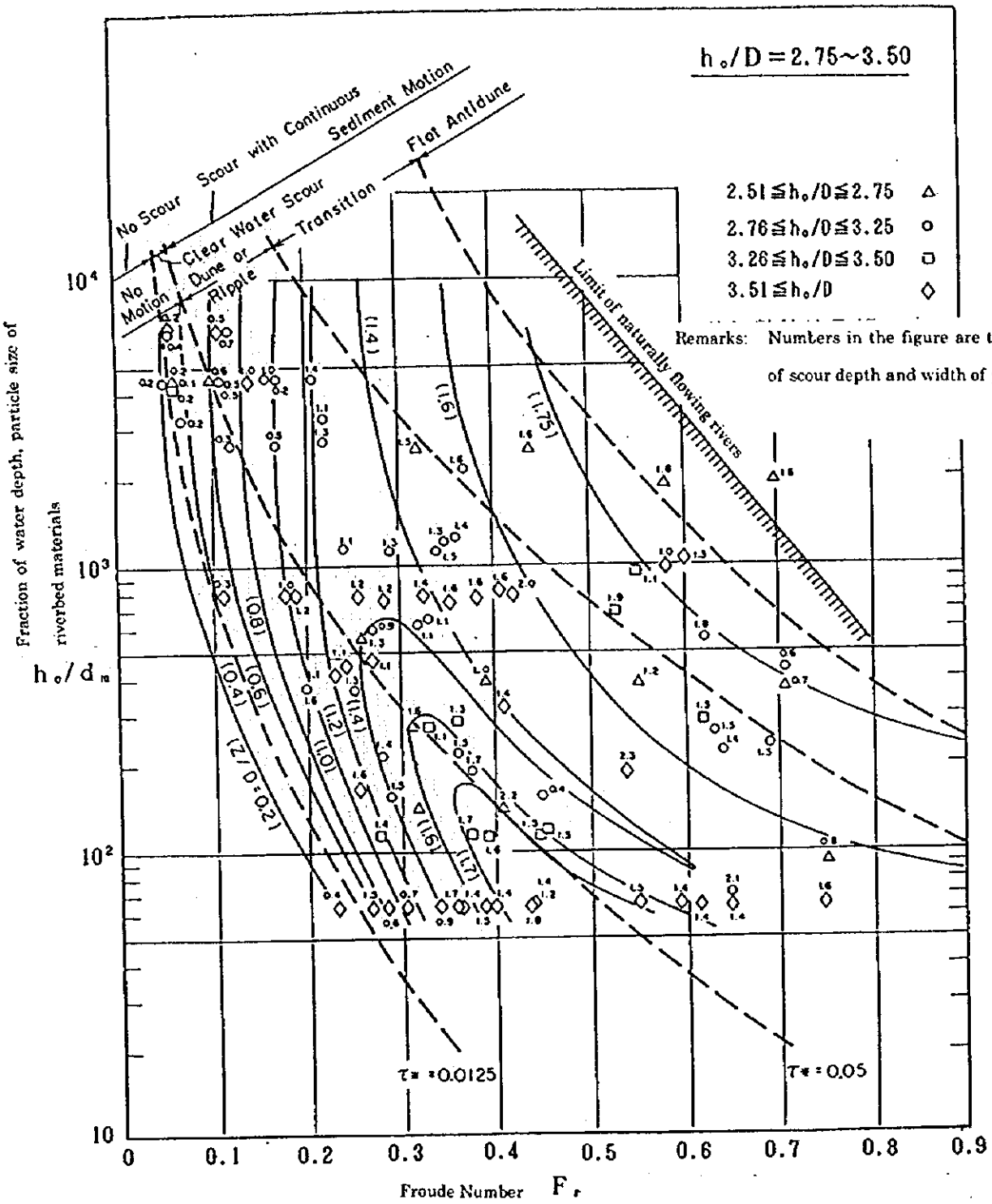
Nomogram for Scour Depth Estimation



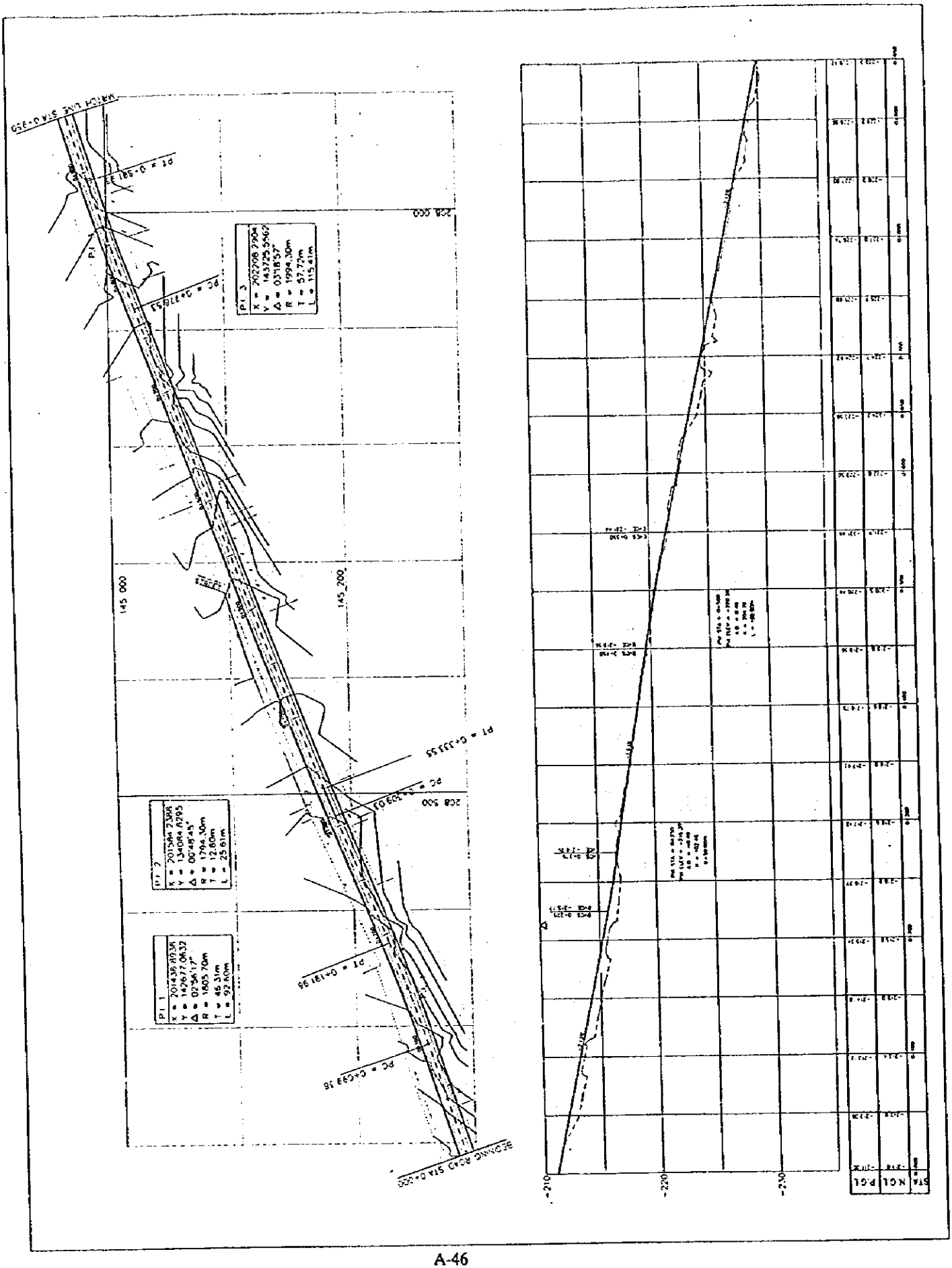
Nomogram for Scour Depth Estimation

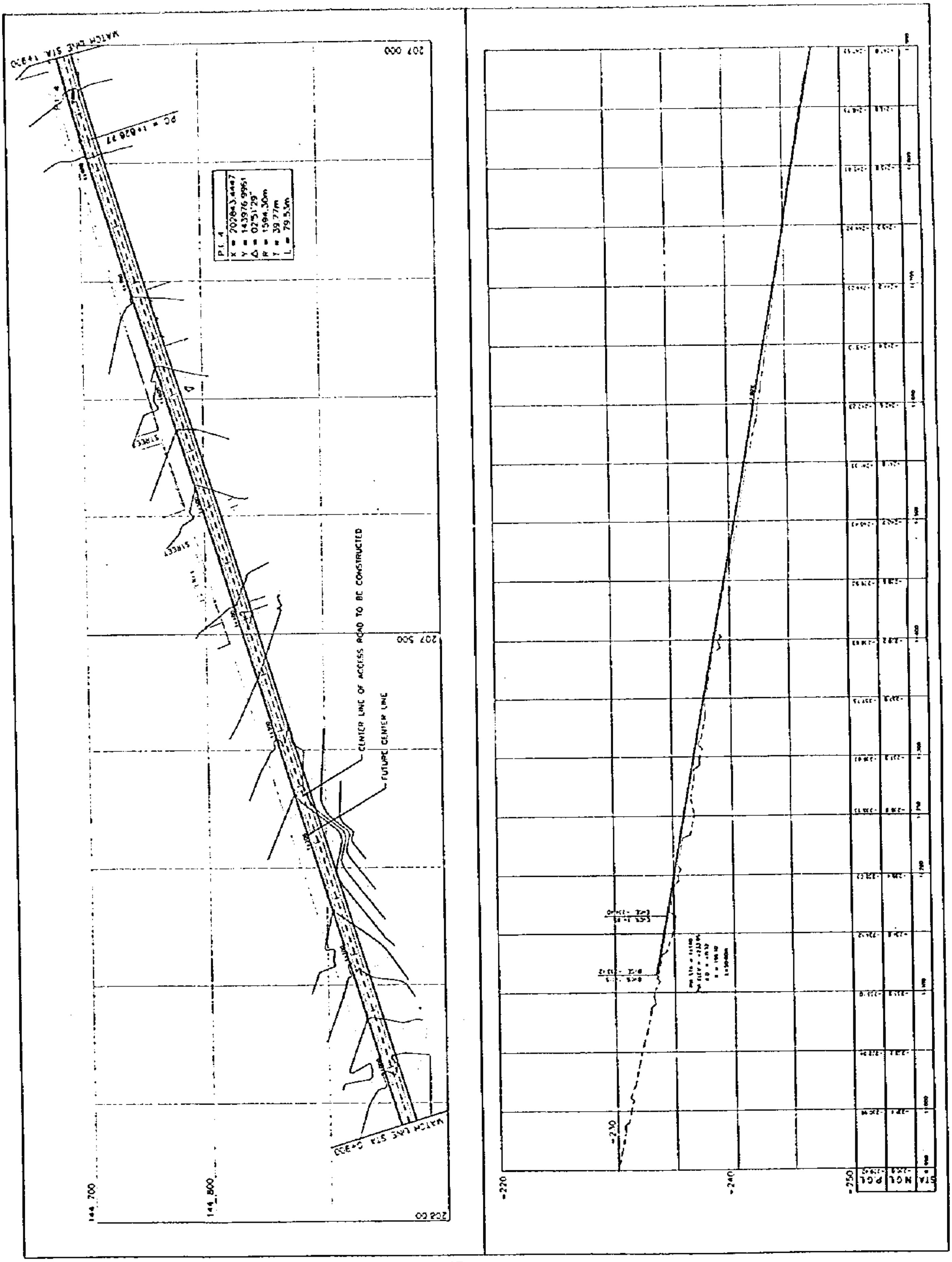


Nomogram for Scour Depth Estimation

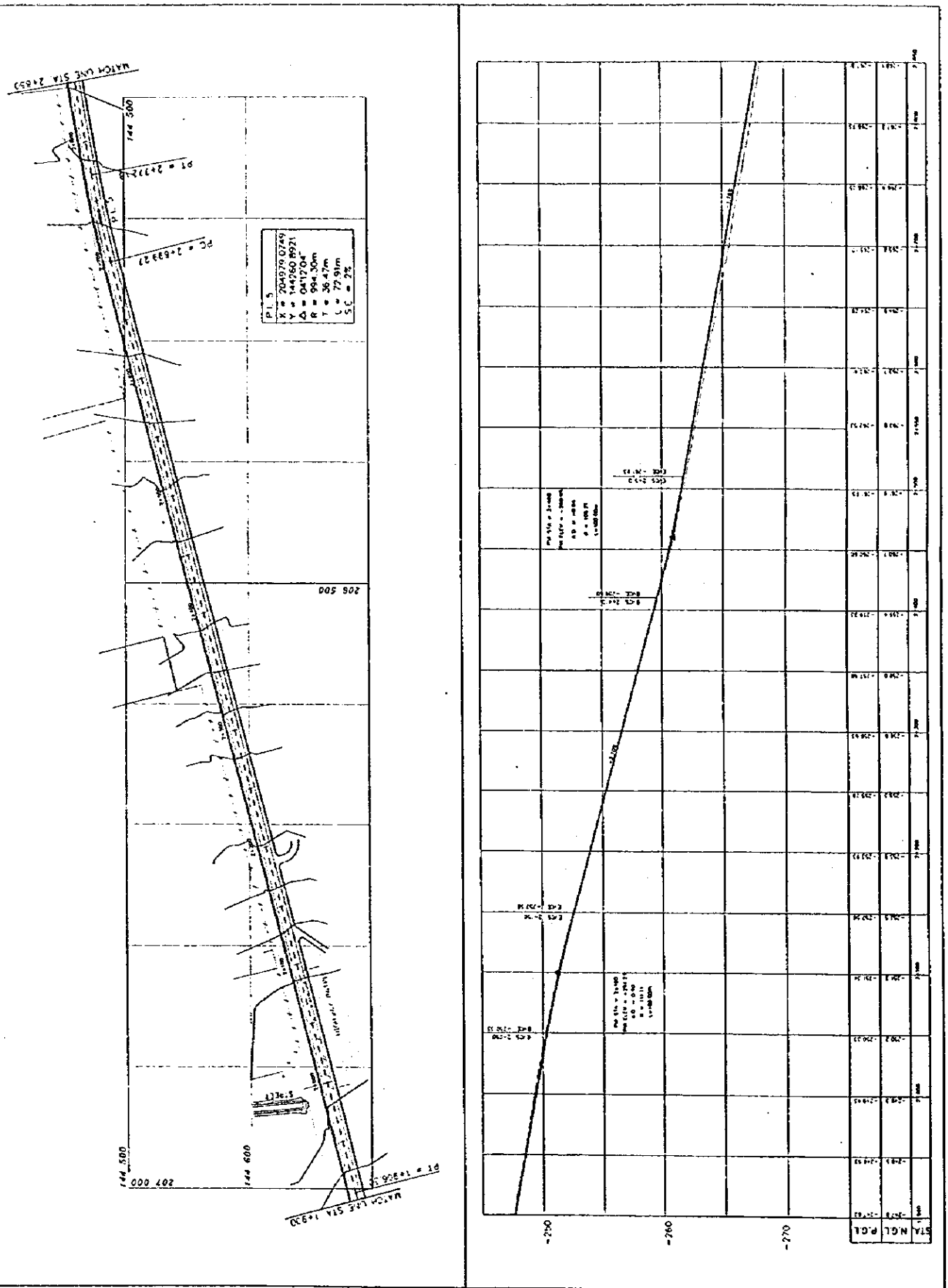

h₀/D = 2.75~3.50
2.51≦h₀/D≦2.75
2.76≦h₀/D≦3.25
3.26≦h₀/D≦3.50
3.51≦h₀/D
No Scour
Scour with Continuous Sediment Motion
Clear Water Scour
Flat Antidune
No Motion
Dune or Ripple
Transition
Limit of naturally flowing rivers
Remarks: Numbers in the figure are the coefficient of scour depth and width of pier.
Fraction of water depth, particle size of riverbed materials
h₀/dm
Froude Number Fr
τ* = 0.0125
τ* = 0.05
10⁴
10³
10²
10
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9

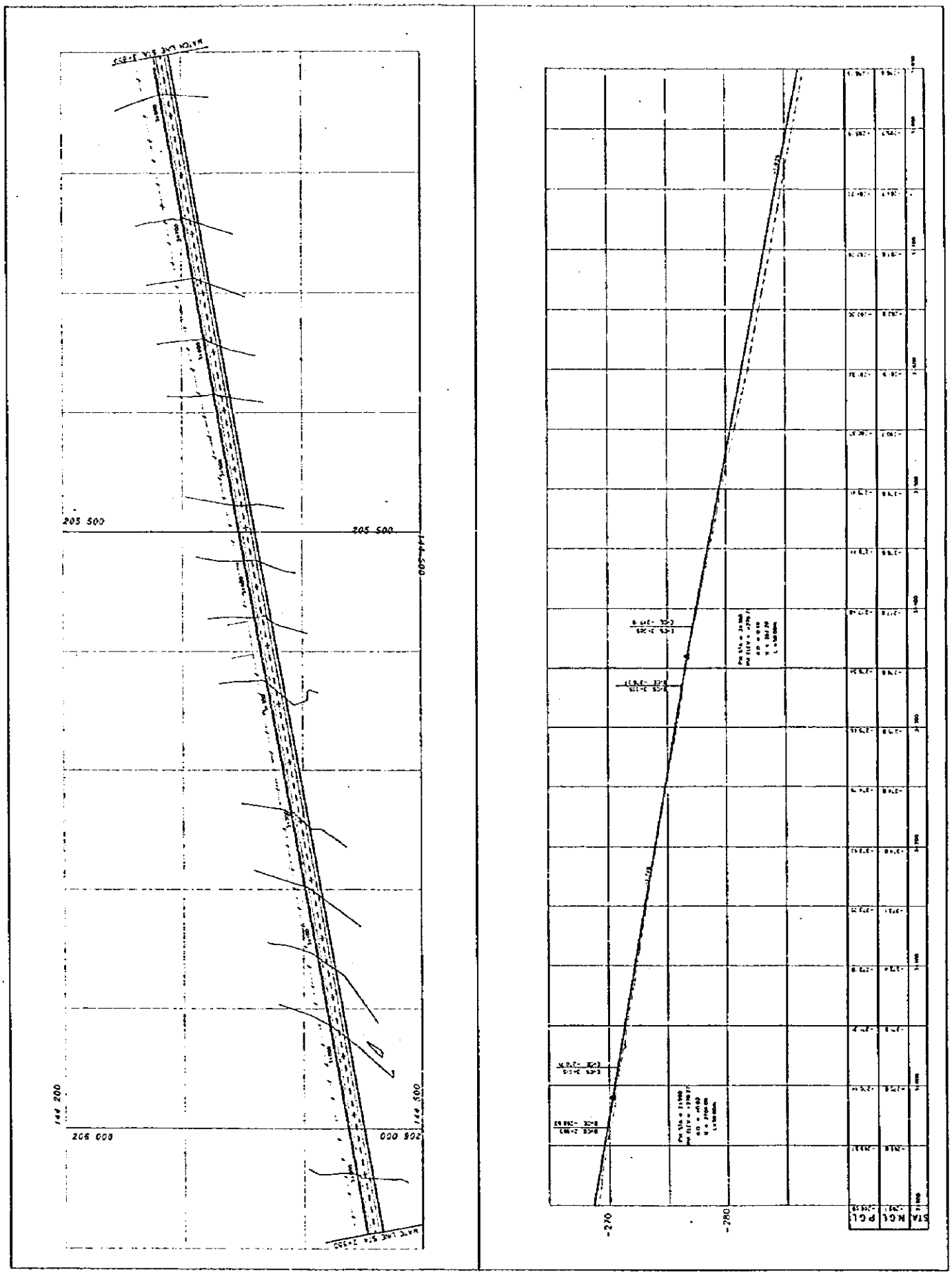
Appendix 8: Drawings other than shown in Chapter 2 and 3

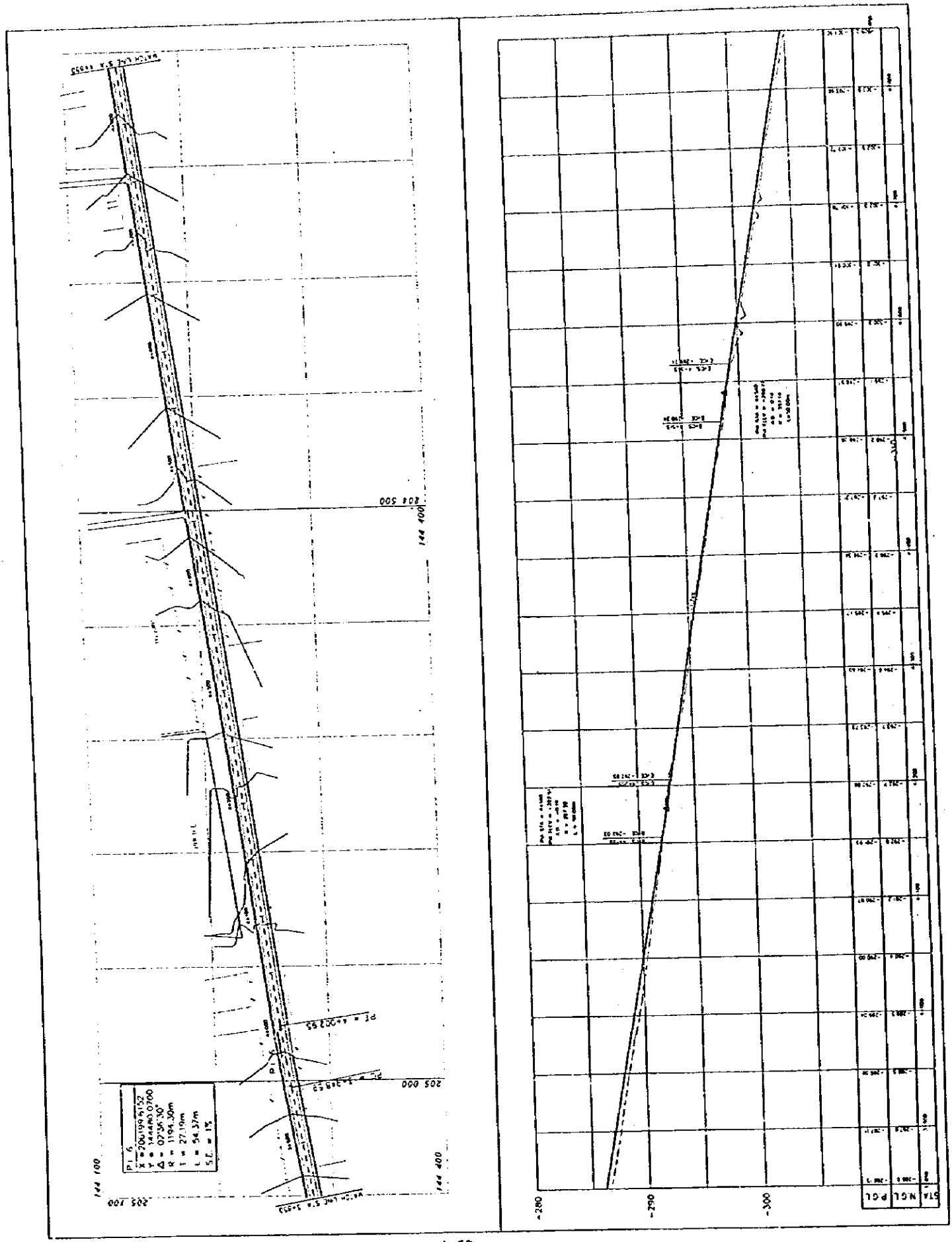


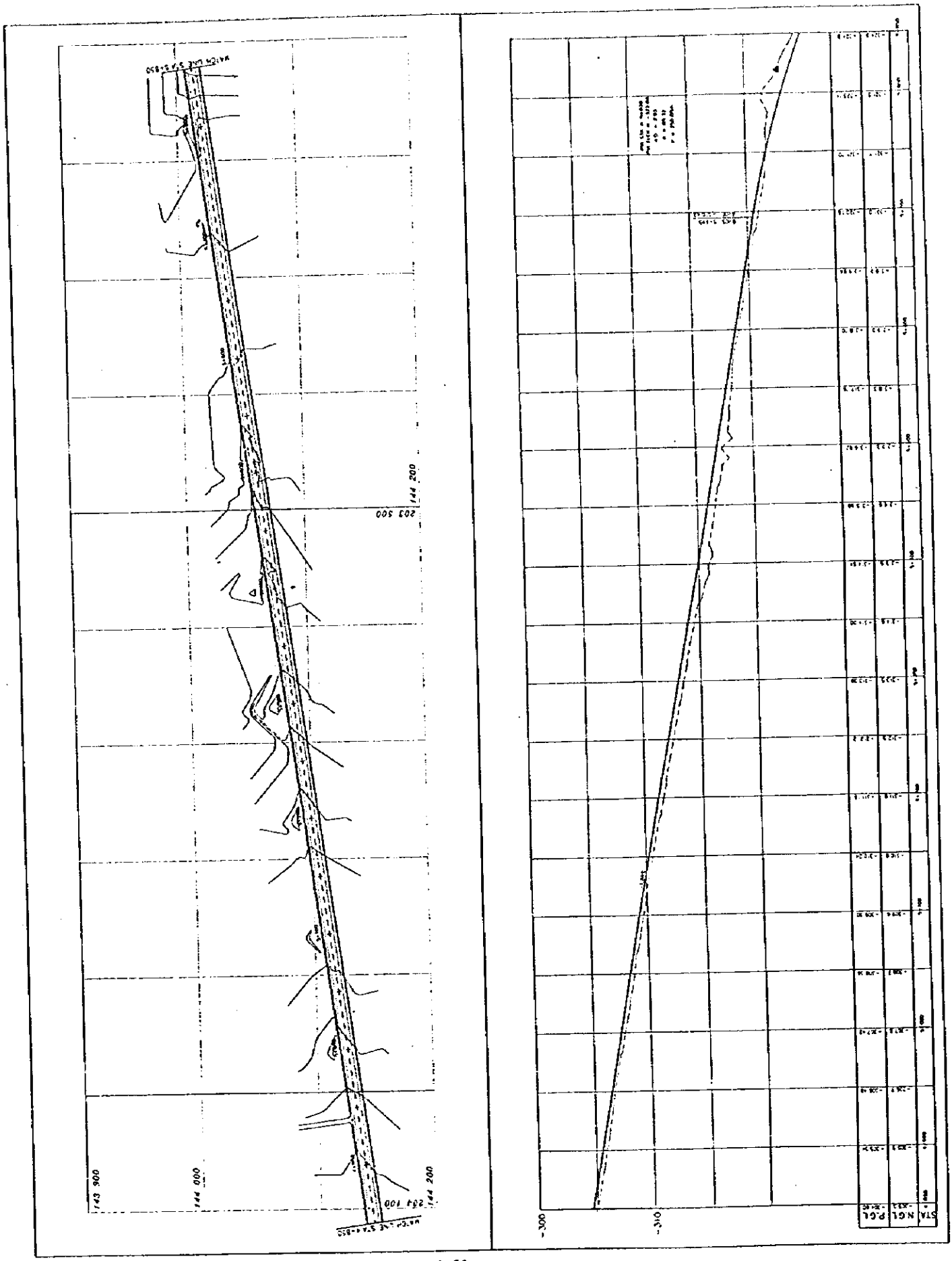


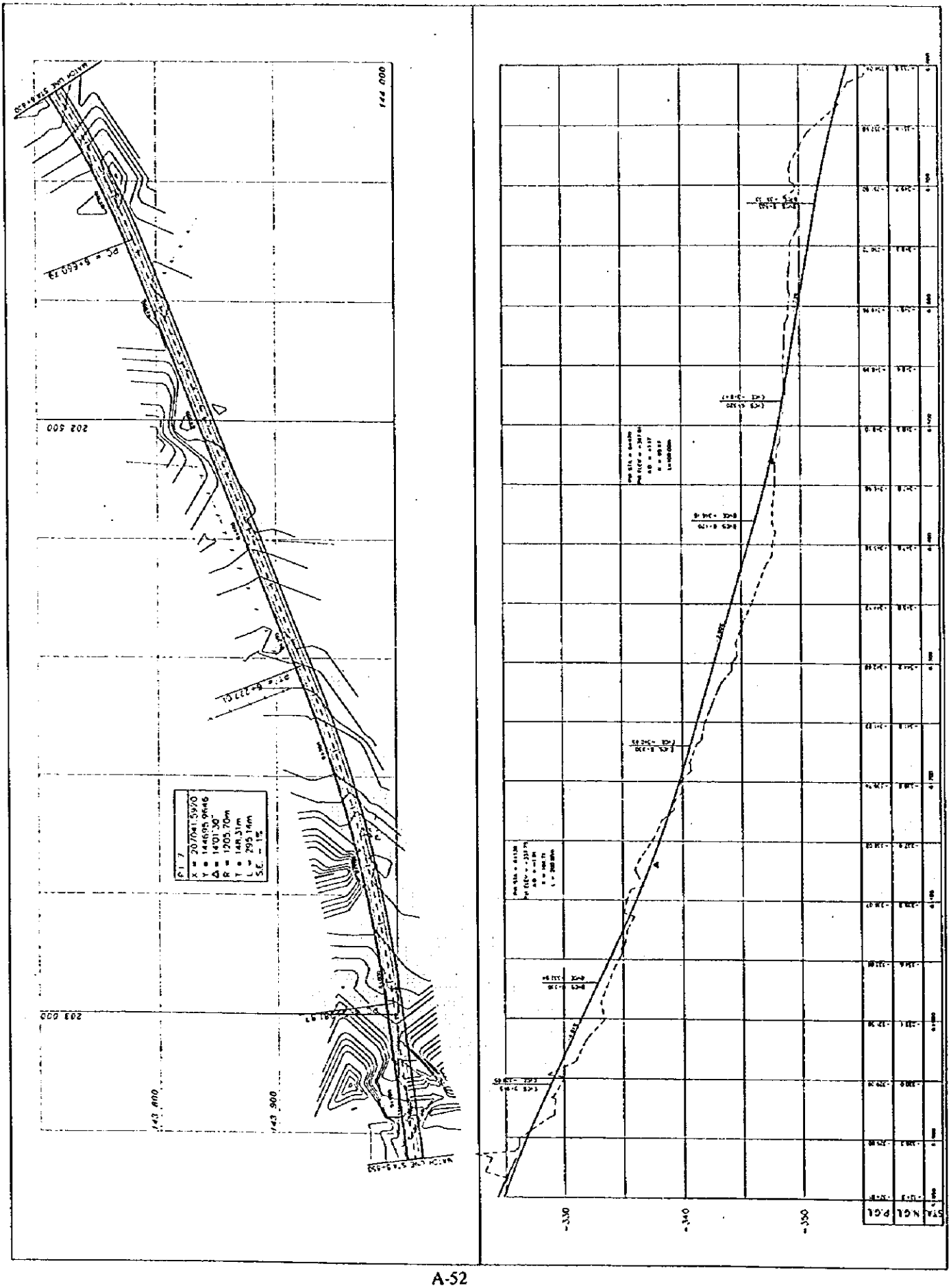
MATCH LINE STA 1+930
PC = 1+928.37
P.I. 4
X = 202843.4447
Y = 143976.9961
Δ = 02°51'29"
R = 1594.30m
T = 39.77m
L = 79.53m
207 000
207 500
STREET
CENTER LINE OF ACCESS ROAD TO BE CONSTRUCTED
FUTURE CENTER LINE
144 700
144 800
-220
-230
-240
-250
STA
N G L
P G L

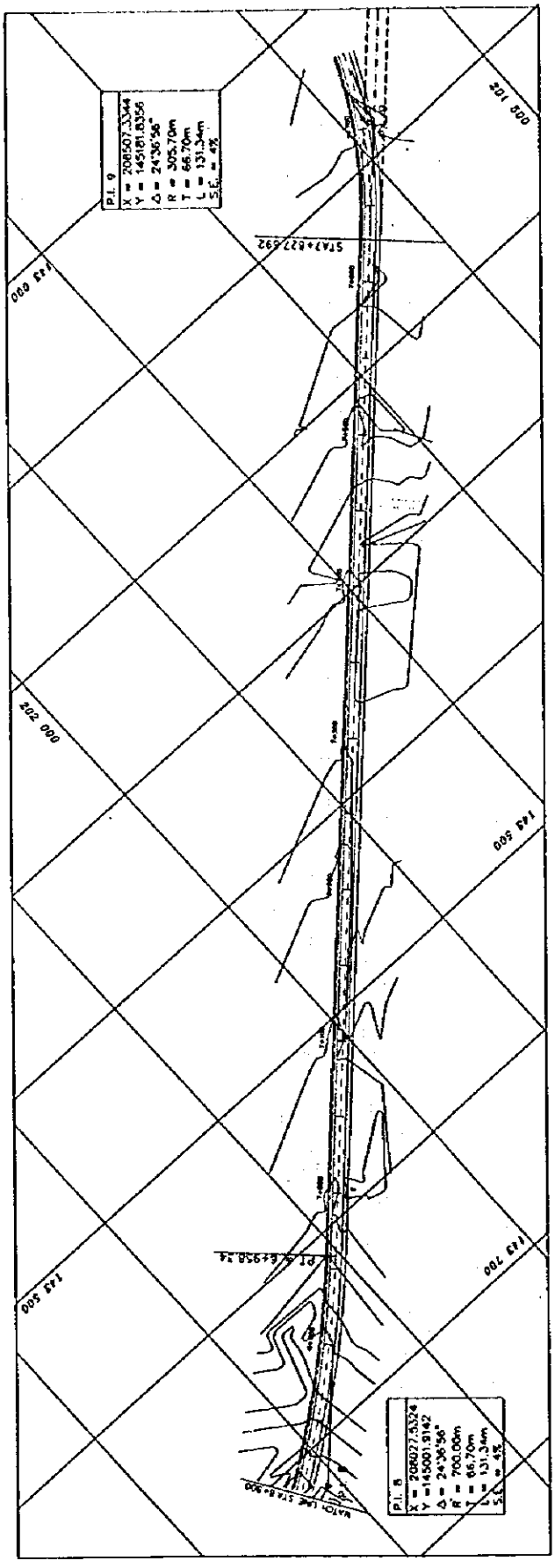

MATCH LINE STA 2+850
PT = 2+372.49
PC = 2+633.23
P.I. 5
X = 7049170.0749
Y = 1442601.8921
Δ = 041°20'04"
R = 994.30m
T = 36.47m
L = 72.91m
S.C. = 2%
144 500
206 500
144 600
207 000
MATCH LINE STA 1+330
PT = 1+506.32
-260
-270
STA
N.G.L.
P.G.L.

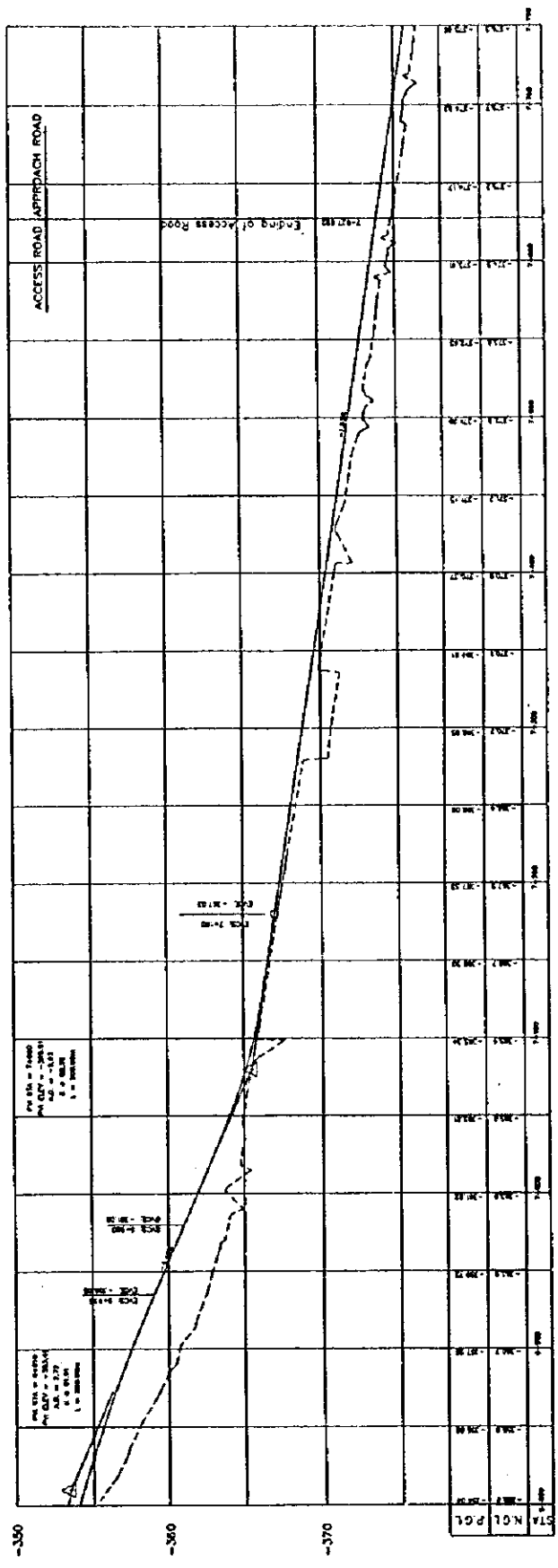

205 500
205 500
144 500
144 200
206 000
206 000
144 500
-270
-280


P.I. 6
X = 204199.6152
Y = 144480.0700
Δ = 07°36'30"
R = 1194.30m
l = 27.10m
L = 54.37m
S.E. = 1%
205 000
204 500
144 100
144 400
-280
-290
-300
STA
N.G.L.
P.G.L.

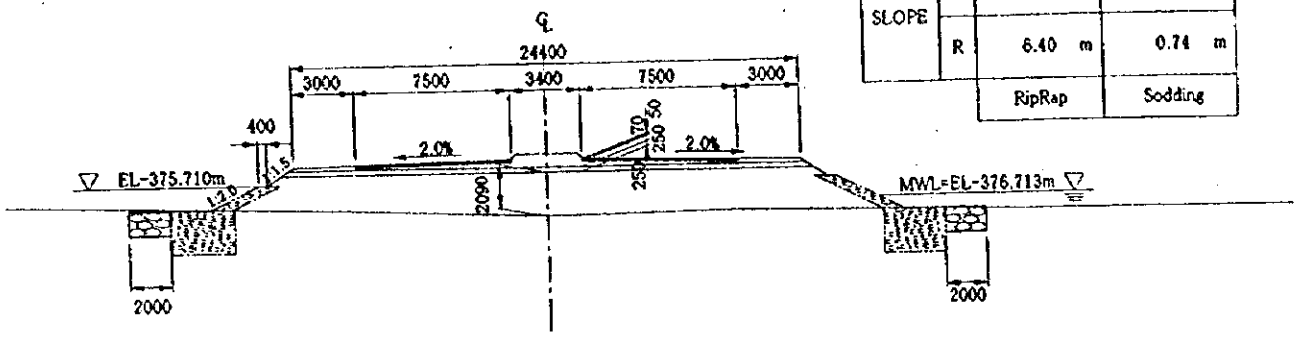





P.I. 9
X = 208507.3344
Y = 145181.8356
Δ = 24°36'56"
R = 305.70m
T = 66.70m
L = 131.34m
S.C. = 4%
STA 7+822.692
201 500
202 000
143 000
143 500
143 700
P.I. 8
X = 208027.5324
Y = 145001.9162
Δ = 24°36'56"
R = 700.00m
T = 152.80m
L = 300.68m
S.C. = 4%

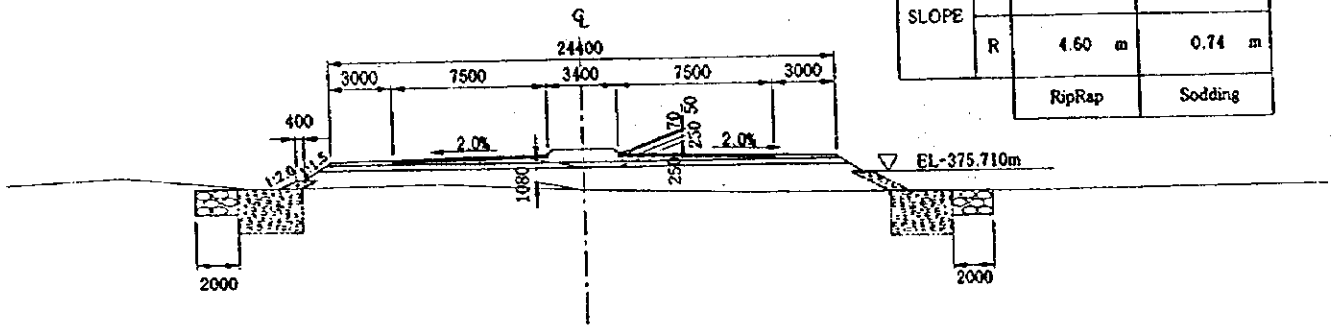

ACCESS ROAD APPROACH ROAD
Ending of Access Road
-350
-360
-370
STA
N.G.L.
P.G.L.

STATION 7+800
PH = -375.410
GH = -378.120



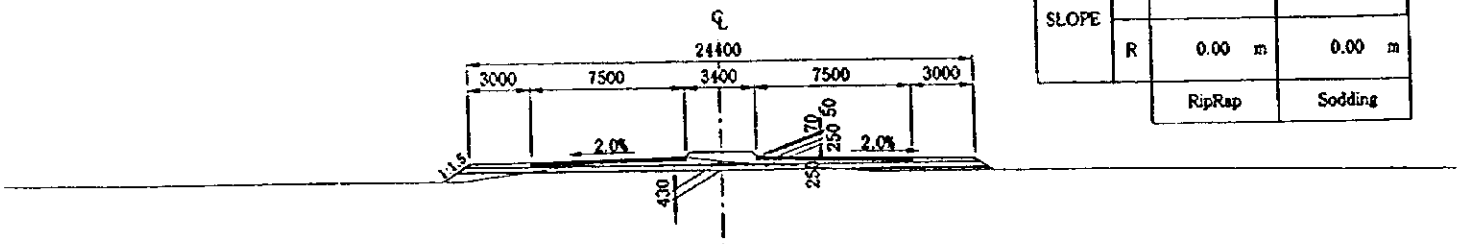
FILL		6.12 m²	
CUT		0.00 m²	
SLOPE	L	6.12 m	0.74 m
	R	6.40 m	0.74 m
		RipRap	Sodding

STATION 7+750
PH = -375.410
GH = -377.110



FILL		29.55 m²	
CUT		0.00 m²	
SLOPE	L	4.06 m	0.74 m
	R	4.60 m	0.74 m
		RipRap	Sodding

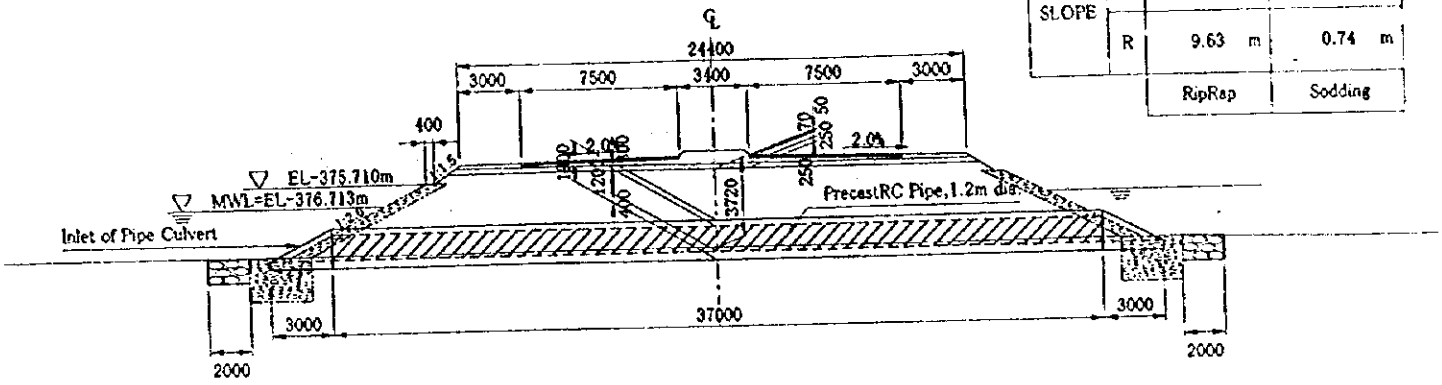
STATION 7+700
PH = -375.410
GH = -375.600



FILL		0.00 m²	
CUT		0.00 m²	
SLOPE	L	0.00 m	0.00 m
	R	0.00 m	0.00 m
		RipRap	Sodding

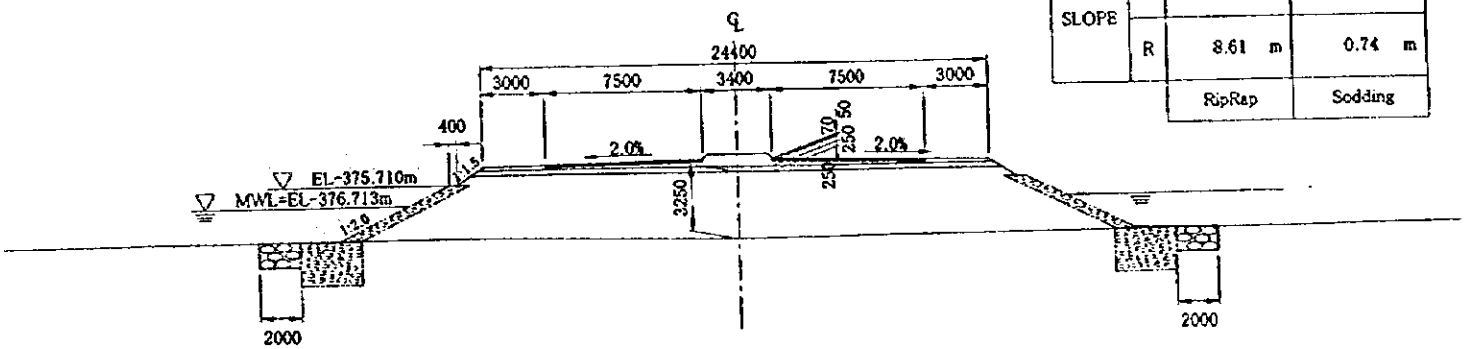
STATION 7+950
PH = -375.410
GH = -379.750

FILL		119.63	m^2
CUT		0.00	m^2
SLOPE	L	9.63 m	0.74 m
	R	9.63 m	0.74 m
		RipRap	Sodding



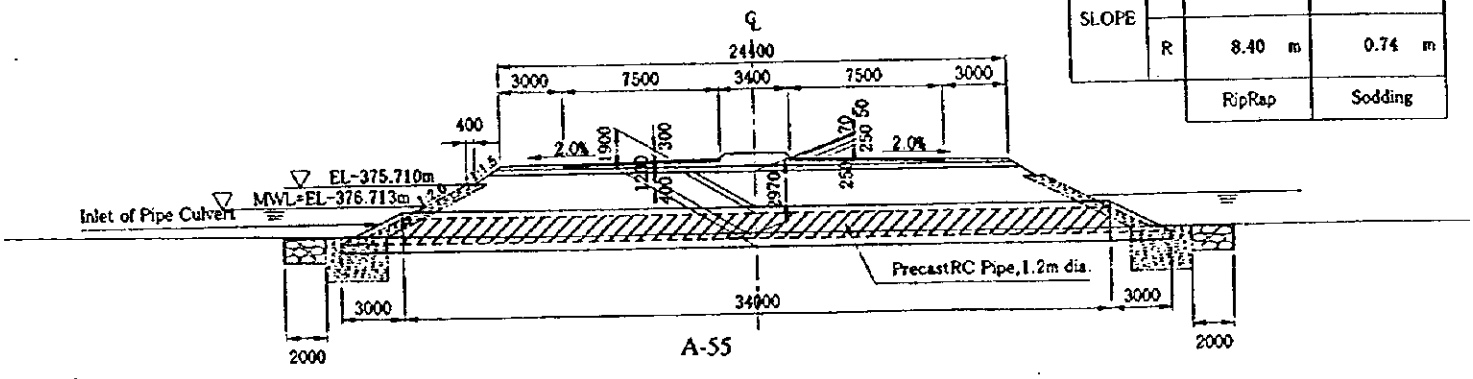
STATION 7+900
PH = -375.410
GH = -379.280

FILL		101.55	m^2
CUT		0.00	m^2
SLOPE	L	8.61 m	0.74 m
	R	8.61 m	0.74 m
		RipRap	Sodding

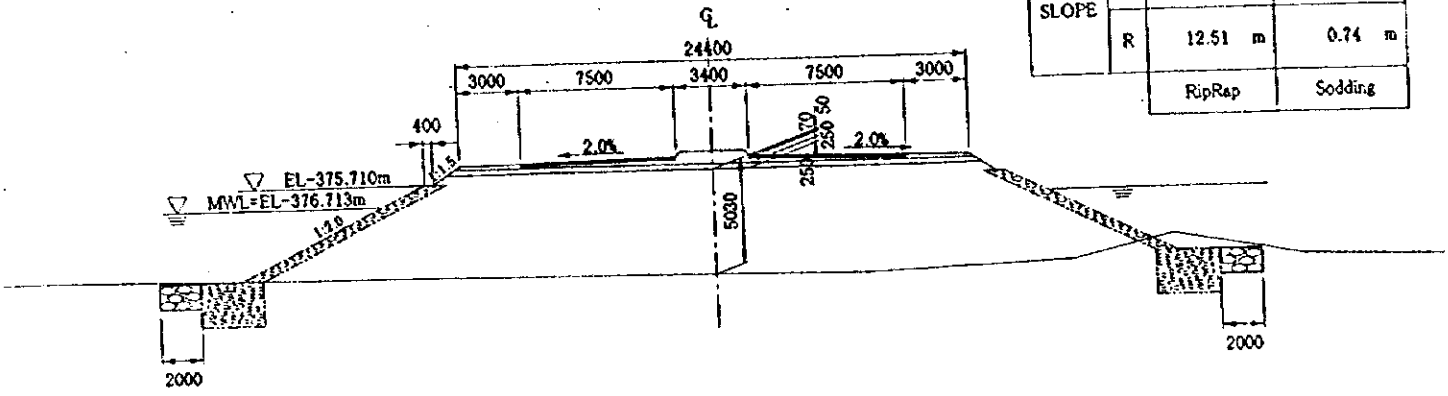


STATION 7+850
PH = -375.410
GH = -379.000

FILL		91.20	m^2
CUT		0.00	m^2
SLOPE	L	8.00 m	0.74 m
	R	8.40 m	0.74 m
		RipRap	Sodding

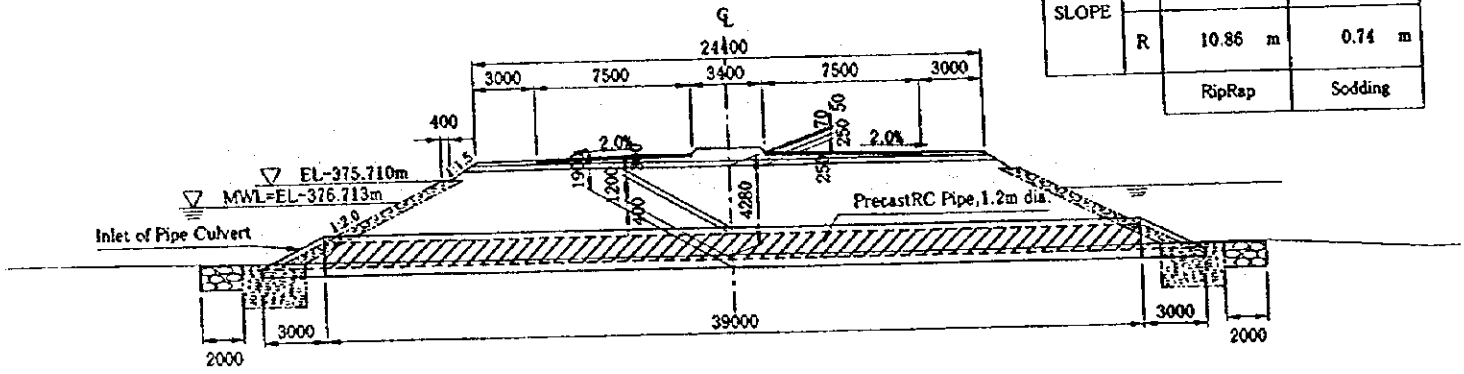


STATION 8+100
PH = -375.410
GH = -381.060



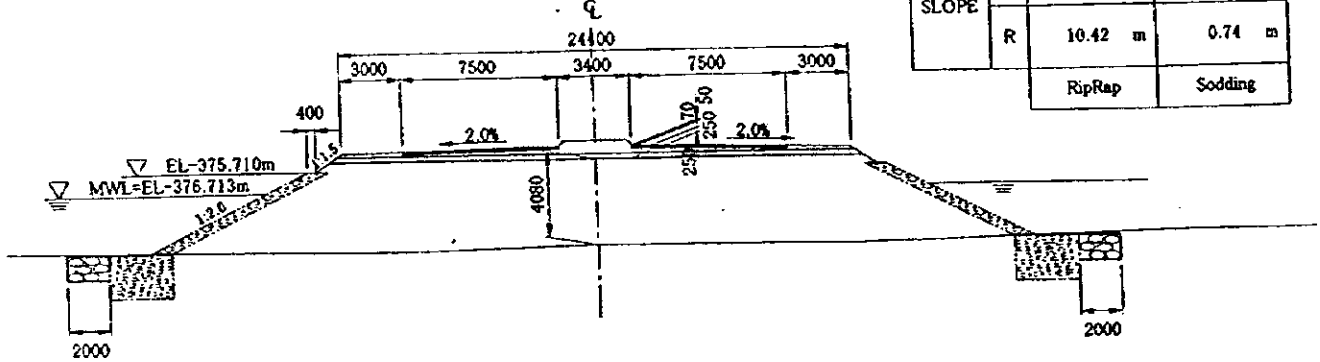
FILL		174.67	m^2
CUT		0.00	m^2
SLOPE	L	12.51 m	0.74 m
	R	12.51 m	0.74 m
		RipRap	Sodding

STATION 8+050
PH = -375.410
GH = -380.310



FILL		142.32	m^2
CUT		0.00	m^2
SLOPE	L	10.86 m	0.74 m
	R	10.86 m	0.74 m
		RipRap	Sodding

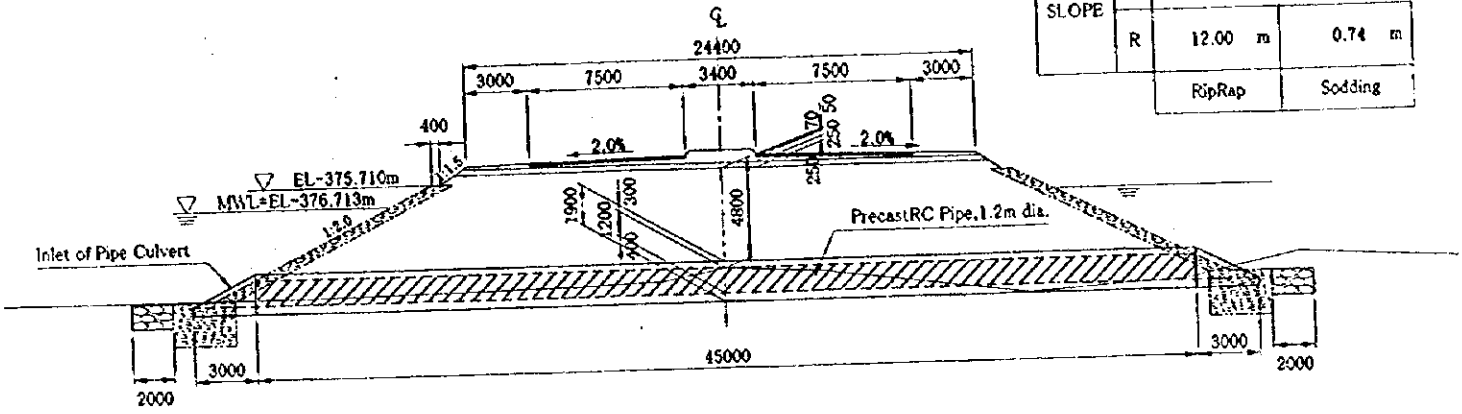
STATION 8+000
PH = -375.410
GH = -380.110



FILL		134.07	m^2
CUT		0.00	m^2
SLOPE	L	10.42 m	0.74 m
	R	10.42 m	0.74 m
		RipRap	Sodding

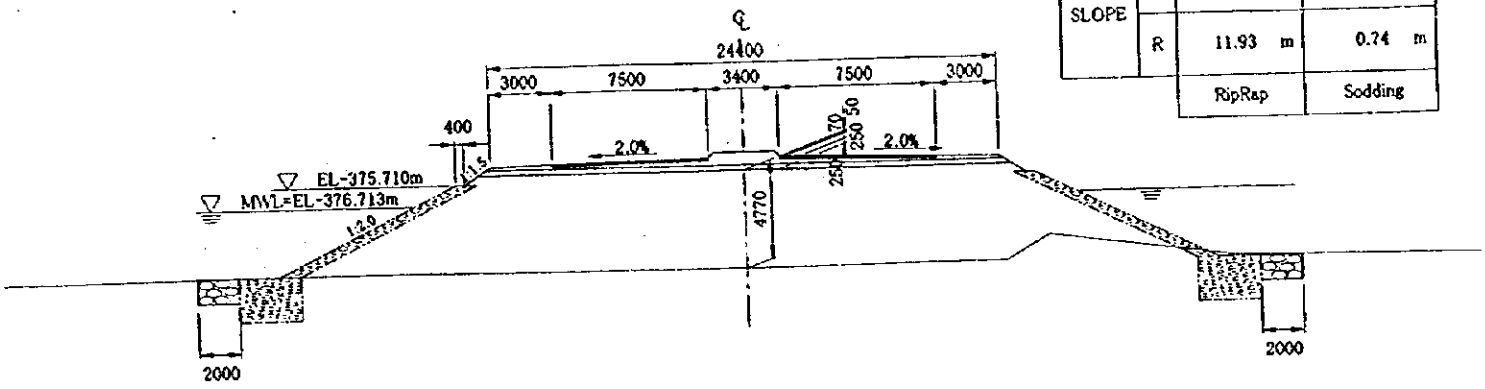
STATION 8+250
PH = -375.410
GH = -380.830

FILL		164.51	m^2
CUT		0.00	m^2
SLOPE	L	12.00 m	0.74 m
	R	12.00 m	0.74 m
		RipRap	Sodding



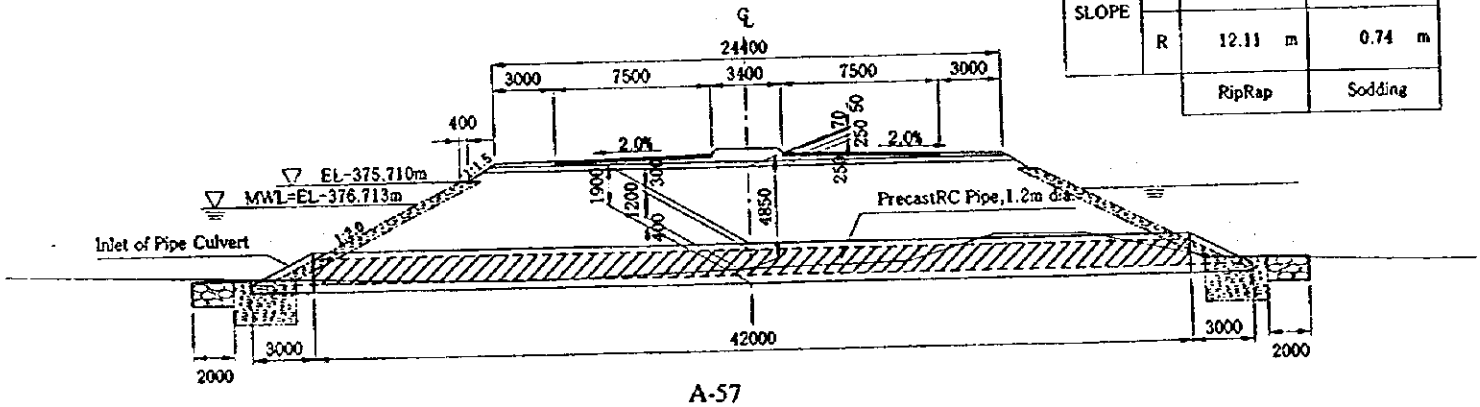
STATION 8+200
PH = -375.410
GH = -380.800

FILL		163.20	m^2
CUT		0.00	m^2
SLOPE	L	11.93 m	0.74 m
	R	11.93 m	0.74 m
		RipRap	Sodding

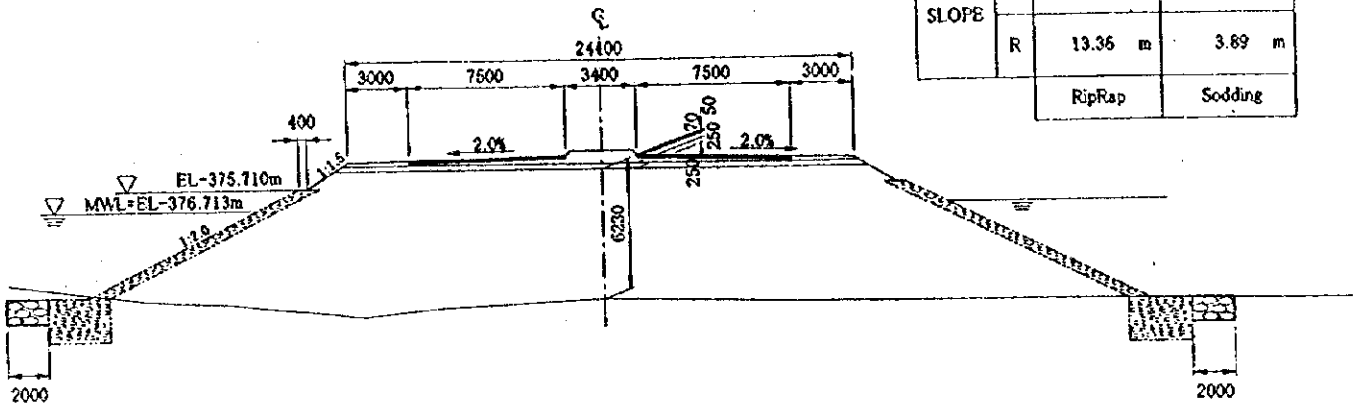


STATION 8+150
PH = -375.410
GH = -380.880

FILL		166.70	m^2
CUT		0.00	m^2
SLOPE	L	12.11 m	0.74 m
	R	12.11 m	0.74 m
		RipRap	Sodding

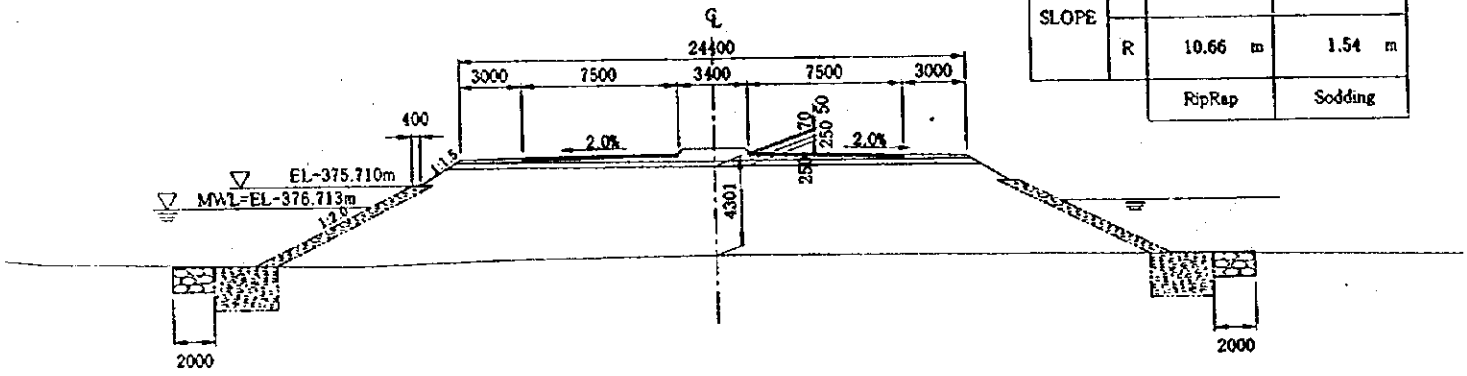


STATION 8+400
PH = -373.970
GH = -380.820



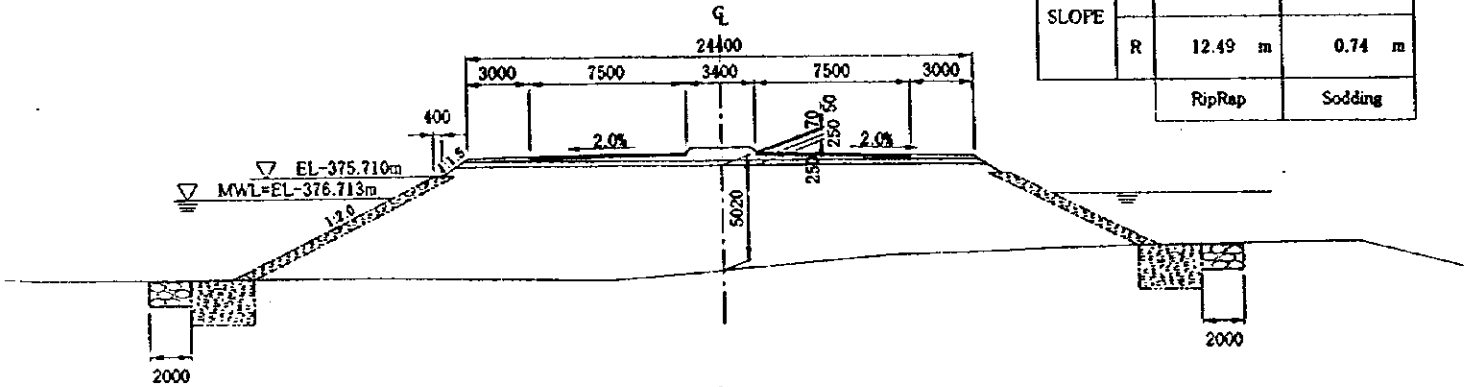
FILL		208.23 m²	
CUT		0.00 m²	
SLOPE	L	13.36 m	3.89 m
	R	13.36 m	3.89 m
		RipRap	Sodding

STATION 8+350
PH = -375.039
GH = -379.960



FILL		142.73 m²	
CUT		0.00 m²	
SLOPE	L	10.66 m	1.54 m
	R	10.66 m	1.54 m
		RipRap	Sodding

STATION 8+300
PH = -375.410
GH = -381.050



FILL		174.23 m²	
CUT		0.00 m²	
SLOPE	L	12.49 m	0.74 m
	R	12.49 m	0.74 m
		RipRap	Sodding