APPENDIX G

AEROPHOTOGRAMMETRIC AND TOPOGRAPHIC SURVEY

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Table of Contents

CHAPTER I AEROPHOTOGRAMMETRIC SURVEY

1.1 Outline

The Survey Works covered the topographic mapping works for the six (6) proposed sabo dam sites (Cura, Labugaon, Solsona No. 1, Solsona No. 2, Madongan, and Papa) and Laoag river basin area by means of photogrammetric mapping.

1.2 Contents and Quantities of Survey Works

(1) Preparation of 1/20,000 and 1/8,000 scale aerial photographs

(2) 1/10,000 scale photogrammetric mapping

- (a) Field verification (15 km^2)
- (b) Machine plotting (15 km^2)
- (c) Drawing (15 km^2)

(3) 1/1,000 scale photogrammetric mapping

(4) Setting up of photo control points (24 points: 6 sites, 4 points each)

(5) Photo pricking (24 points in total)

(6) GPS survey (24 new points in total)

(7) Leveling (15 km)

(8) Field verification (1.29 km^2 in total)

(9) Machine plotting (1.29 km^2 in total)

(10) Editing and drawing (1.29 km^2 in total)

1.3 Method of Survey

(1) Photo Control Point Survey (GPS Survey)

To ensure the accuracy of horizontal positions in photogrammetric mapping , GPS surveying was carried out with the existing GPS stations established by JICA in 1996 as given to obtain coordinates of 24 newly established points. Observations and computations to determine the coordinates were made in the following manner:

- (a) Five or more satellites were observed for signals with 3 receivers in simultaneous use.
- (b) The average height of satellites as observed was more than 15 degrees above the horizon.
- (c) Observation was made for a duration of more than one hour at a time at each station.
- (d) The results of initial computations were based on WGS-84 ellipsoid and, therefore, WGS-84 based coordinates were converted to Philippine standard Clark 1886 ellipsoid based coordinates by applying conversion parameters. After the conversion, they were made into plane coordinates of PTM Zone 3.

The GPS computation results were found to be within the specified limits of accuracy as shown below. The GPS survey network is presented in the ATTACHMENT.

- Horizontal Positions : ±2PPM × distance between two points observed simultaneously.

- Height : ±5PPM × distance between two points observed simultaneously.

(2) Field Verification

Field verification was conducted to identify and reaffirm in the field such items to be represented in photogrammetric mapping, including geographical names and administrative boundaries, based on the map symbols and their application rules. Findings were incorporated in the two-time enlarged aerial photographs and other related materials to help subsequent plotting and compilation. Prior to the field survey, aerial photographs and other related materials were studied for areas and features that were not clearly identifiable and needed to be clarified, which then were marked on the aerial photographs and other related materials with color dermatograph pencils. The findings of the field verification were edited on the two-time enlarged aerial photographs using color drafting pens to help the compilation work that followed.

(3) Plotting

Plotting was done by placing a pair of consecutive aerial photographs (diapositive films) side by side in the stereo-plotter and recreating the photographed features in stereo (by setting orientation elements of the aerial photographs involving positions, rotation, tilts, etc.). By observing the stereo images a topographic map was created and initially delineated to make plotting manuscript sheets.

Contour line intervals were delineated as follows:

Item	Contour Line Interval	Intermediate Contour Line Interval
(a) Scale 1/10,000		
Alluvium	2 m	1 m
Mountains and Hills	5 m	-
(b) Scale 1/1,000		
Alluvium	1 m	0.5 m
Mountains and Hills	2.5 m	-

(4) Compilation

The plotting manuscript sheets were edited according to the map symbols and their application rules and made into 1/10,000 and 1/1,000 scale compilation manuscript sheets with penciled representations.

(5) Drafting

Based on the compilation manuscript sheets, original topographic maps were drawn on the polyester base (#500) least subject to expansion/contraction in black ink by the standard drafting method (fair drawing) according to the map symbols and their application rules as agreed to by the Department of Public Works and Highways of the Philippine Government.

The same map design as that of the existing 1/10,000 scale topographic maps was applied.

1.4 Work Periods

The field survey was started on 21 January 1997 and completed on 6 March 1997, as originally planned.

- GPS Surveying	:	21 January 1997 to 15 February 1997
- Leveling	:	21 January 1997 to 15 February 1997
- Field Verification	:	21 January 1997 to 15 February 1997
- Stereo Plotting	:	21 January 1997 to 06 March 1997
- Drafting	:	21 January 1997 to 06 March 1997

1.5 Results of the Survey

All the results are compiled in the following maps.

(1) 1/10,000 scale topographic maps (3 sheets)

(2) 1/1,000 scale topographic maps at 6 proposed dam sites (Cura, Labugaon, SolsonaNo. 1, Solsona No. 2, Madongan and Papa)

CHAPTER II TOPOGRAPHIC SURVEY

2.1 Outline

Longitudinal profile and cross-sectional surveys were conducted for the drainage of Laoag City, the 6 proposed dams (Papa, Madongan, Solsona No. 1, Solsona No. 2, Cura, Labugaon), Cura River and Labugaon River.

2.2 Contents and Quantities of Survey Works

Contents and quantities of the survey works are summarized as follows:

(1) Leveling Survey (15 km for Daorao Creek)

(2) Longitudinal Profile and Cross-sectional Survey

River & Proposed Dam Sites	Longitudinal Survey Length (km)	No. of Cross-sections	Average Cross-section Width (m)	Total Cross-section Survey Length (km)
Daorao Creek & Tributary	13.43	61	50	3.05
Irrigation Canal	1.48	10	30	0.30
Labugaon & Cura River	12.70	23	400	9.20
Papa Dam	-	2	200	0.40
Madongan Dam	-	2	250	0.50
Solsona No. 1 Dam	1.50	7	100	0.70
Cura Dam	-	2	250	0.50
Labugaon Dam	-	1	200	0.20
Total	27.63	108		14.85

2.3 Method of Survey

2.3.1 Datum Height and Coordinates

The leveling survey was conducted based on the control points and bench marks established by JICA in 1996 as given below:

Point Name	Coordinates E	Coordinates N	Height	Remarks
ILN-1	457,278.457	2,034,691.882		existing GPS point
ILN-3	480,250.294	2,000,321.738	117.114	existing GPS point
FCP-1	460,051.435	2,002,070.770	30.809	established by JICA
FCP-2	454,693.509	2,006,942.481	12.255	ditto
FCP-3	450,198.027	2,011,698.032	2.989	ditto
FCP-4	453,575.167	2,016,709.293	3.206	ditto
FCP-5	462,711.610	2,016,421.710	25.504	ditto
FCP-6	462,154.555	2,008,388.811	10.449	ditto
FCP-7	469,802.942	2,014,350.172	64.197	ditto
FCP-8	469,875.894	2,009,308.932	45.896	ditto
FCP-9	473,176.291	2,010,091.260	45.119	ditto
FCP-10	479,041.395	2,005,007.217	74.381	ditto
FCP-12	475,009.671	1,996,919.224	49.380	ditto
FCP-13	467,849.803	2,005,679.219	22.431	ditto
FCP-14	468,090.910	1,998,722.829	31.207	ditto
FCP-15	465,312.131	1,992,785.510	53.127	ditto
FCP-16	470,378.350	1,989,111.157	87.993	ditto
FCP-17	468,395.324	1,983,408.292	163.955	ditto
FCP-18	464,307.048	1,981,544.604	127.702	ditto
FCP-19	463,637.191	1,983,265.863	103.906	ditto
FCP-20	463,739.865	1,986,499.597	61.288	ditto

The above surveys were performed with the following accuracy.

(1) Control point survey: closing error of coordinates : < 1 /5,000
(2) Benchmark leveling survey: error < 10 mm S, where, S : one-way distance (km)

2.3.2 Survey for Kilometer Post Installation

The kilo-posts were set up through the following procedures.

(1) The cross section lines were instructed by the JICA Study Team on the field.

(a) Daorao Creek (-0.1 km - 13.43 km) : 61 sites
(b) Irrigation Canal 10
(c) Cura River : 23
d) Proposed Dams (6) : 14

(2) Closing Error: < 1/3,000

2.3.3 Longitudinal Profile Survey

The longitudinal profile survey measured the elevation of the kilo-posts, tributary confluence, drainage culverts, intake and other major river structures.

The longitudinal profiles are drawn in the following scales:

	Horizontal Scale	Vertical Scale
Solsona Dam	1:5,000	1:600
Labugaon River	1:40,000	1:400
Cura River	1:40,000	1:600
Daorao Creek	1:40,000	1:200
Daorao Tributary	1:5,000	1:100

The survey was performed with the following accuracy:

Error < 20 mm S, where, S : one-way distance (km)

2.3.4 Cross-sectional Survey

The cross-sectional survey was carried out for the 66 river sections at kilo-post. The survey width in cross-sectional direction is as follows:

(1) Drainage Canal / Daorao Creek : Up to 10 m inland of the channel bank
(2) Alluvial Fan Area : Up to the proposed dike
(3) Dam Area : Up to 30 m higher than the riverbed

The cross-sections are drawn in the following scales:

	Horizontal Scale	Vertical Scale
Proposed Dam & Labugaon, Cura River	1:4,000	1:200
Daorao Creek	1:200	1:200
Daorao Tributary	1:100	1:100
Daorao mouth	1:400	1:100
Irrigation	1:100	1:100

The survey was performed with the following accuracy.

Distance : Error < 1/300

Elevation : Error < 5 cm + 15 cm S/100, where, S : survey length (m)

2.4 Work Period

All survey works were completed within one and a half (1.5) months from January 21 ,1997 to March 6, 1997.

2.5 Results of the Survey

All the results are compiled in the following maps, drawings, tables, notes and calculations.

River and Proposed Dam	Longitudinal A-1, A-3 size	Cross-Section A-1, A-3 size
Daorao Creek	1	61
Irrigation Canal	1	10
Cura River	1	23
Papa Dam	-	2
Madongan Dam	-	2
Solsona No. 2 Dam	1	7
Cura Dam	-	2
Labugaon Dam	-	1
Total	4	108

ATTACHMENT G

GPS SURVEY NETWORK

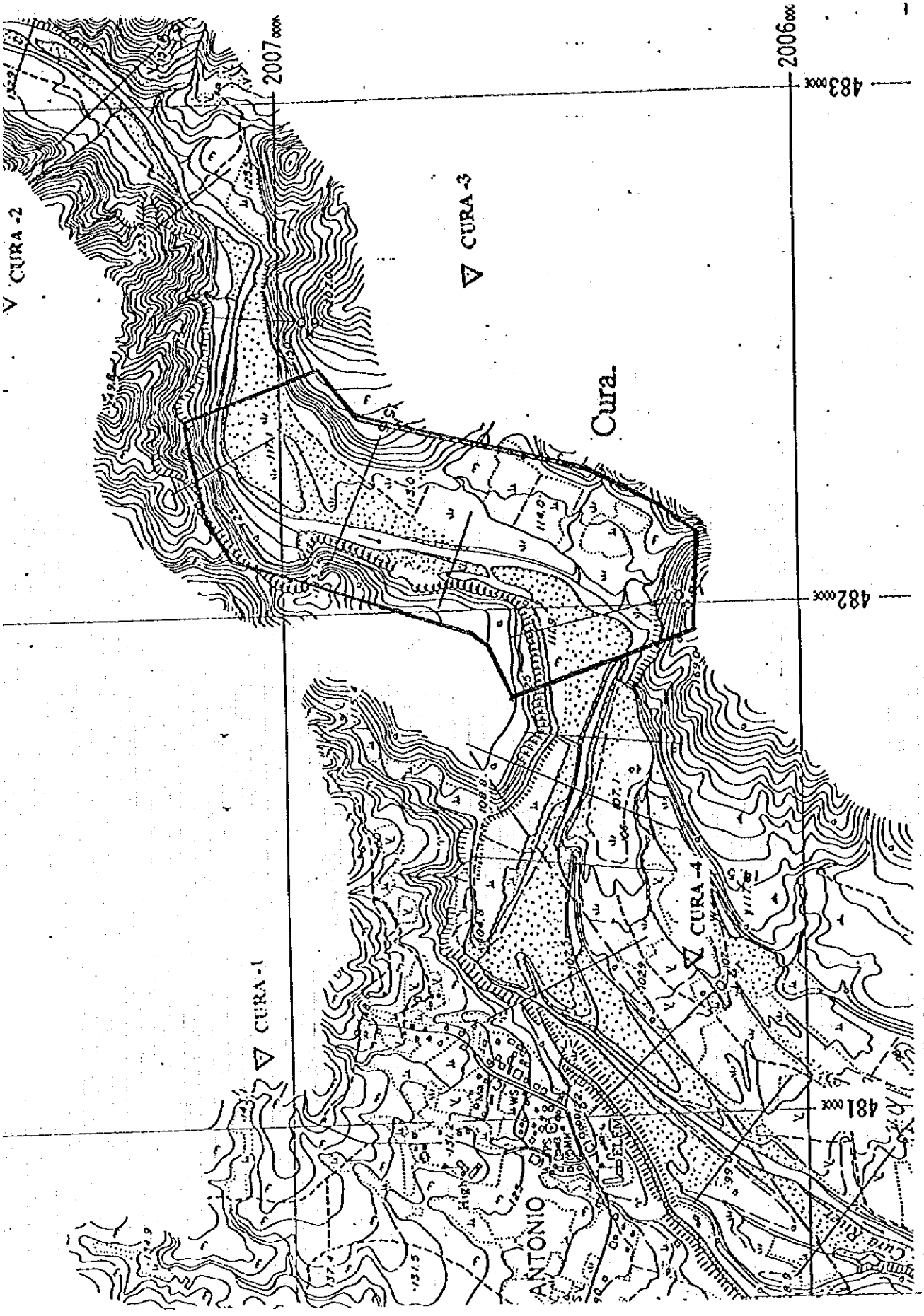
1. **Name and Coordinates of GPS Photo Control Point**
2. **Location of Control Point**
3. **Description of Control Point (Survey Mark)**
4. **Coordinates Adjustment Data of Control Point**

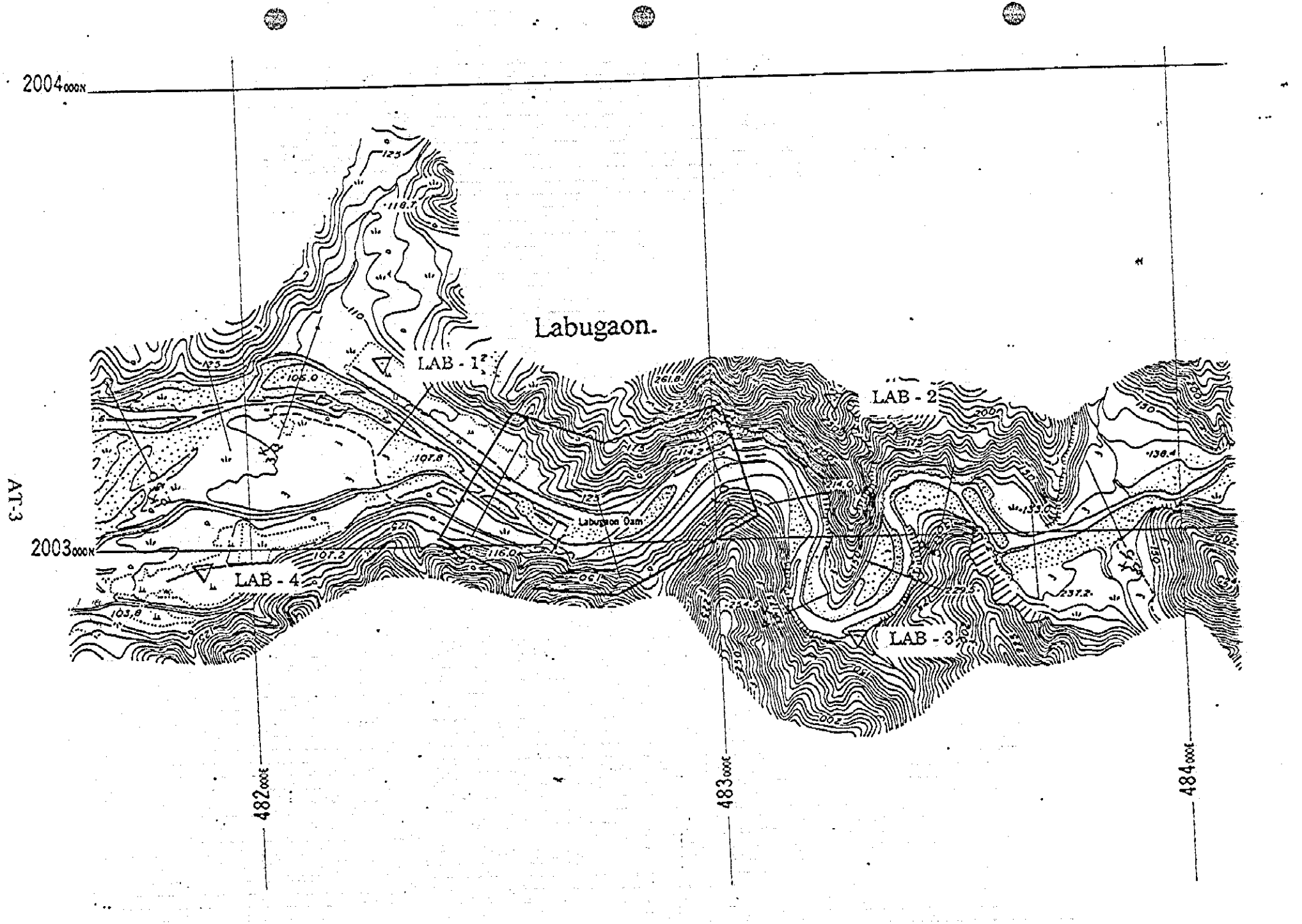
1. Name and Coordinates of GPS Photo Control Point

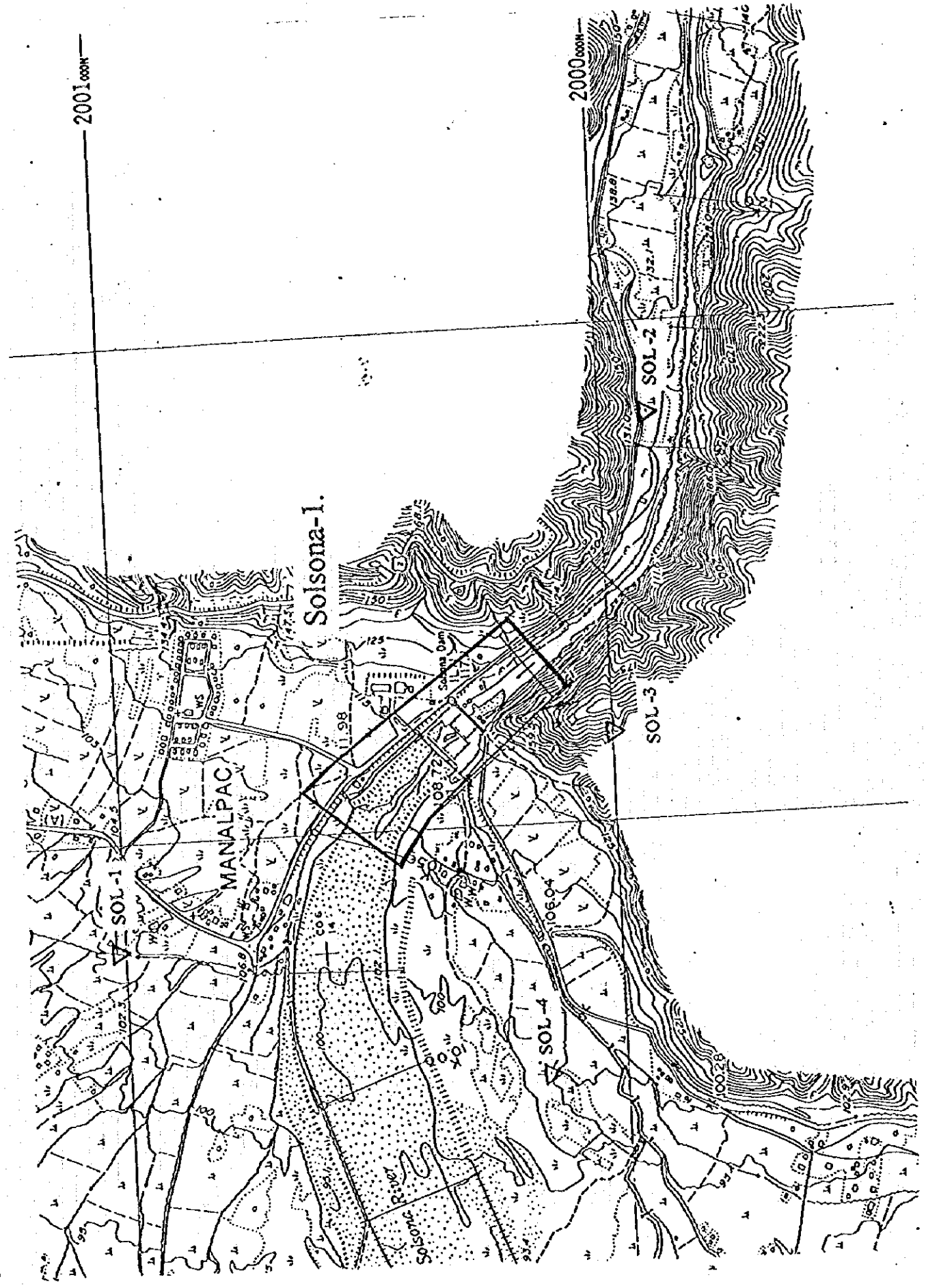
G P S Photo control point

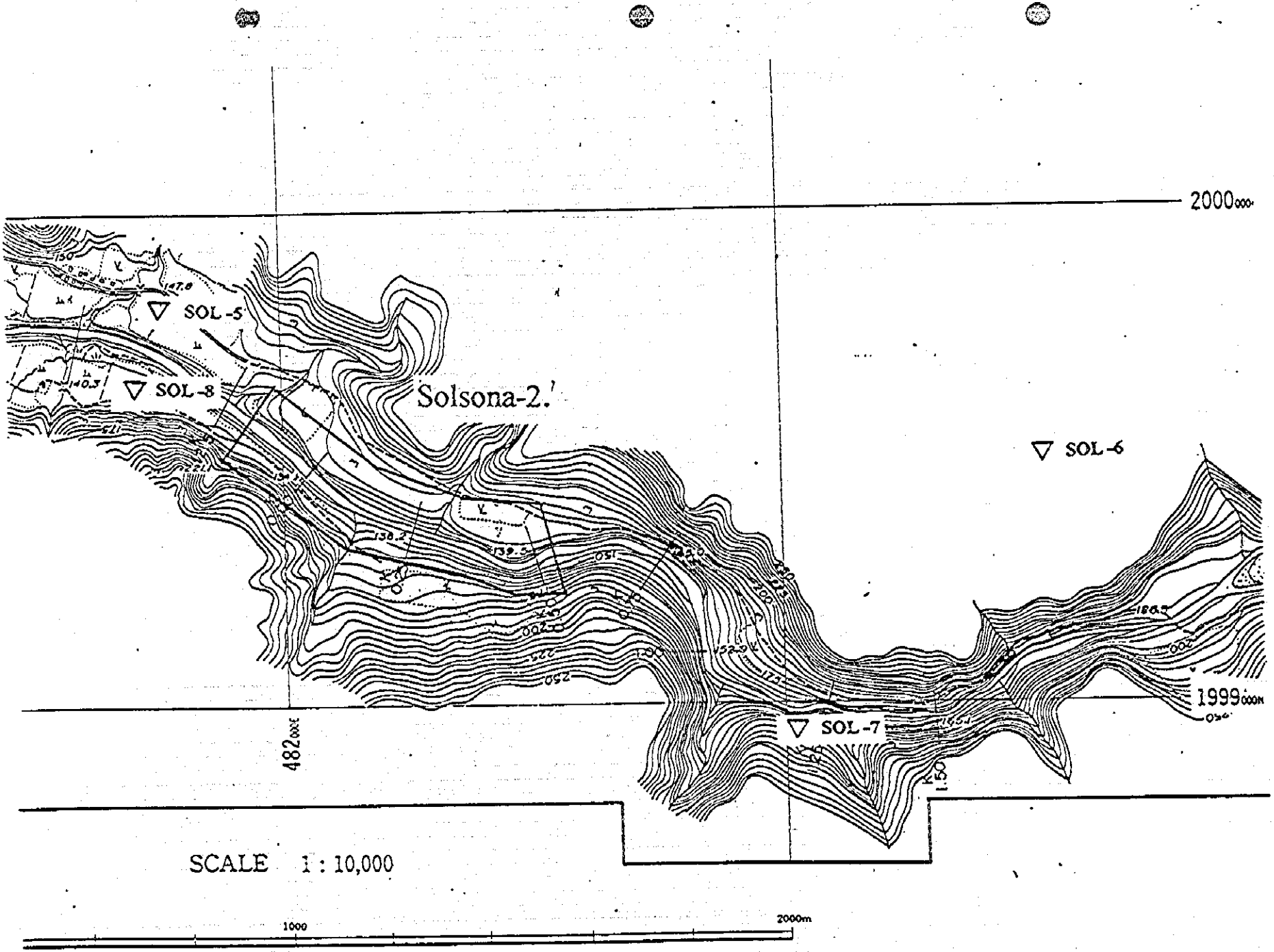
NAME	N	E	H
CURA-1	2007008.659	481137.286	163.059
CURA-2	2007590.109	482627.845	272.545
CURA-3	2006676.996	482724.063	243.207
CURA-4	2006232.717	481316.441	103.184
LAB-1	2003396.602	482293.886	110.334
LAB-2	2003323.802	483291.466	270.737
LAB-3	2002778.460	483300.845	123.941
LAB-4	2002959.086	481880.621	105.531
SOL-1	2001022.382	479779.891	103.627
SOL-2	1999870.238	480818.663	124.524
SOL-3	2000008.564	480233.257	210.379
SOL-4	2000168.308	479757.757	104.556
SOL-5	1999814.068	481775.860	145.895
SOL-6	1999515.754	483528.287	458.751
SOL-7	1998986.476	483019.975	159.977
SOL-8	1999662.643	481695.141	141.378
MAD-1	1992233.009	474365.023	147.109
MAD-2	1991838.304	475557.271	138.804
MAD-3	1991263.447	475178.215	136.257
MAD-4	1991439.970	474182.229	260.039
PAP-1	1987302.760	469804.660	109.907
PAP-2	1986935.197	471380.948	211.500
PAP-3	1986505.496	471469.911	141.112
PAP-4	1986350.932	469800.095	114.439

2. Location of Control Point

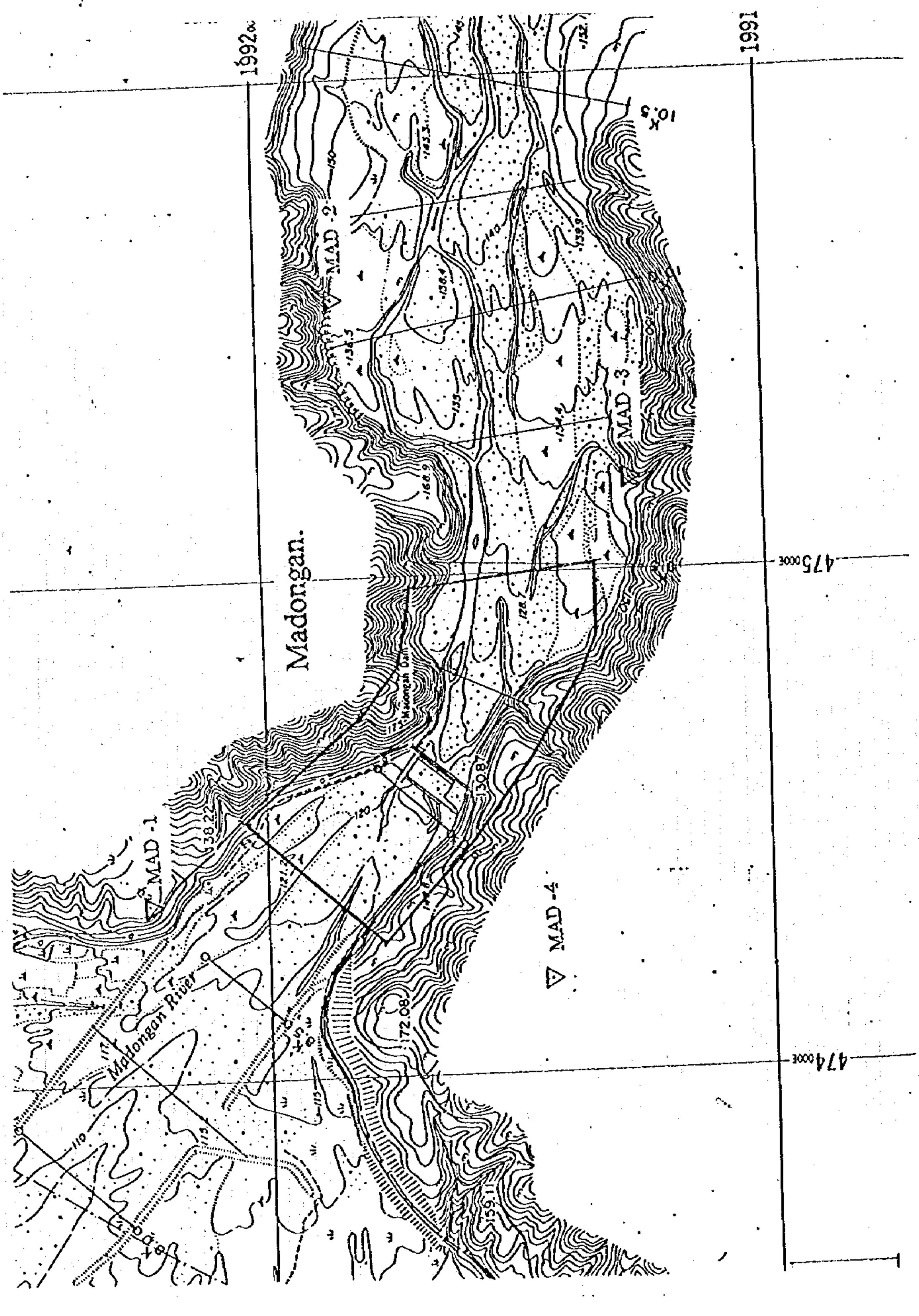


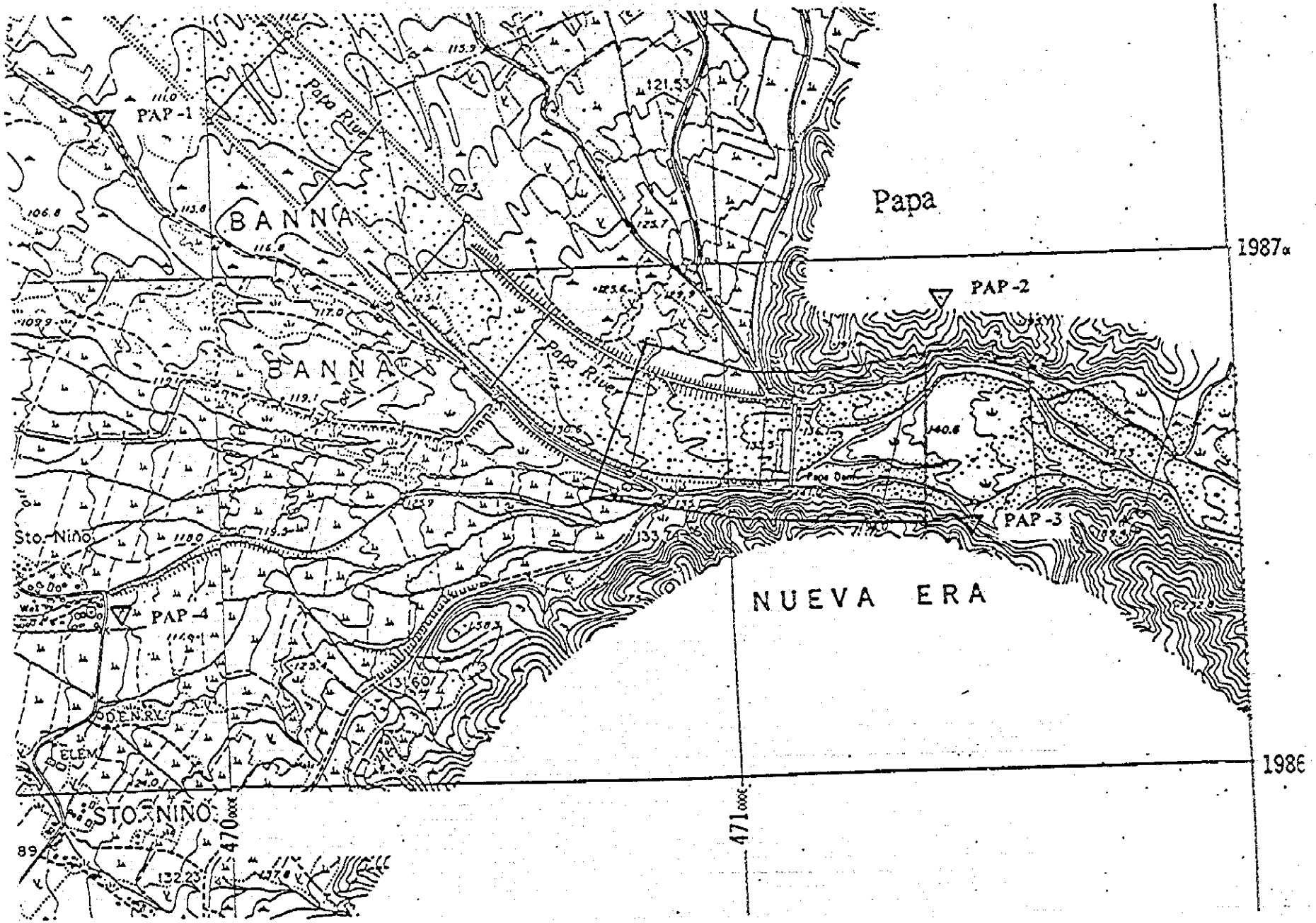

2004000N
2003000N
AT-3
Labugaon.
LAB - 1
LAB - 2
LAB - 3
LAB - 4
Labugaon Dam
482000E
483000E
484000E


2001 000N
2000 000N
Solsona-1.
SOL-1
SOL-2
SOL-3
SOL-4
MANALPAC
Solsona Dam
Solsona


2000000
SOL-5
SOL-8
Solsona-2.
SOL-6
SOL-7
1999000N
482000E
SCALE 1 : 10,000
1000
2000m

AT-5


1992
1991
Madongan.
MAD-1
MAD-2
MAD-3
MAD-4
Madongan River
Madongan Dam
475000E
474000E
138.22
130.81
172.08
159.11


PAP-1
PAP-2
PAP-3
PAP-4
Papa River
BANNA
Papa
NUEVA ERA
Sto. Niño
STO. NIÑO
ELEM.
1987
1986
470
471

AT-7

3. Description of Control Point (Survey Mark)

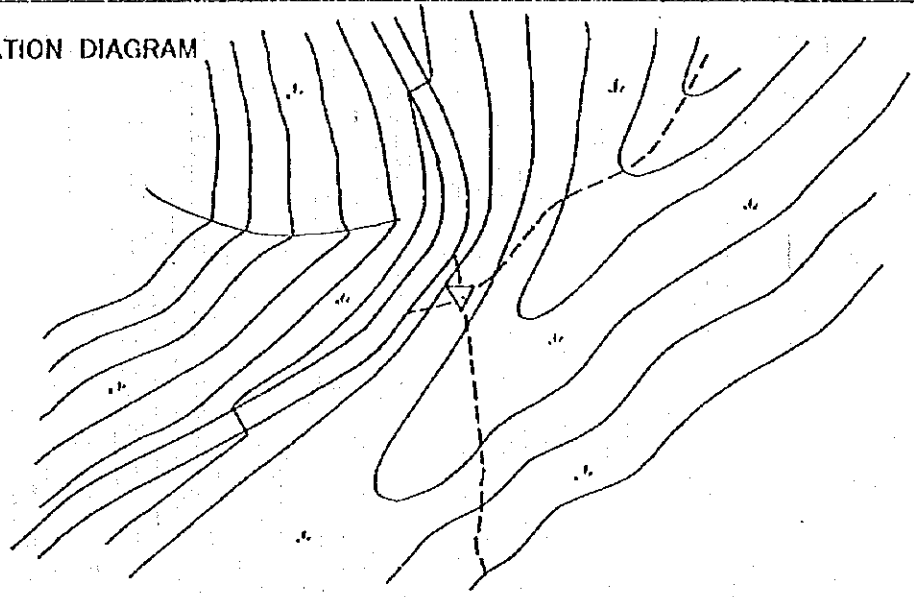
SURVEY MARK DESCRIPTION

PROPOSED DAM SITE

COUNTRY: PHILIPPIN POINT CURA-1

TYPE: G P S	DESCRIPTION:	PHOTO No.
MAP SHEET: CURA	DATE:	SURVEYOR:
NORTHINNG: 2,007,008.659	EASTING: 481,137.286	HEIGHT: 163.059

LOCATION DIAGRAM



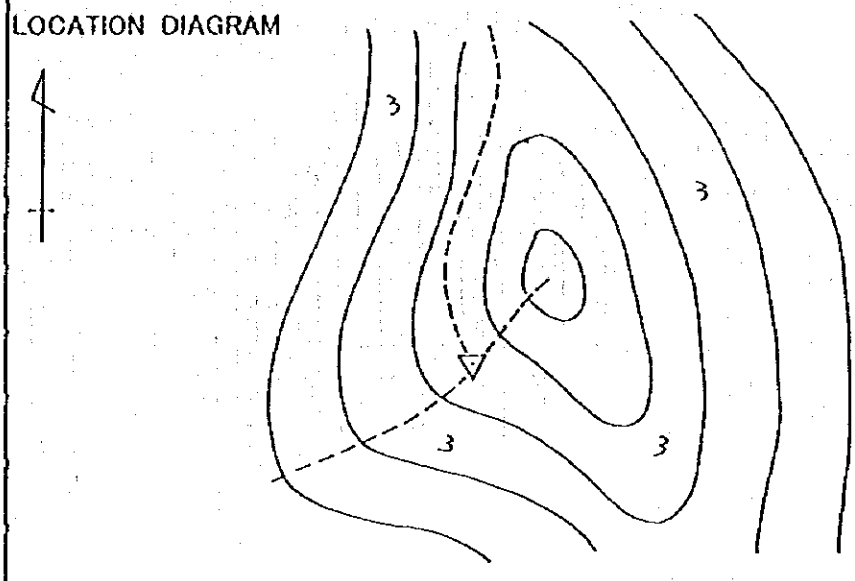
SURVEY MARK DESCRIPTION

PROPOSED DAM SITE

COUNTRY: PHILIPPIN POINT CURA-2

TYPE: G P S	DESCRIPTION:	PHOTO No.
MAP SHEET: CURA	DATE:	SURVEYOR:
NORTHINNG: 2,007,590.109	EASTING: 482,627.845	HEIGHT: 272.545

LOCATION DIAGRAM

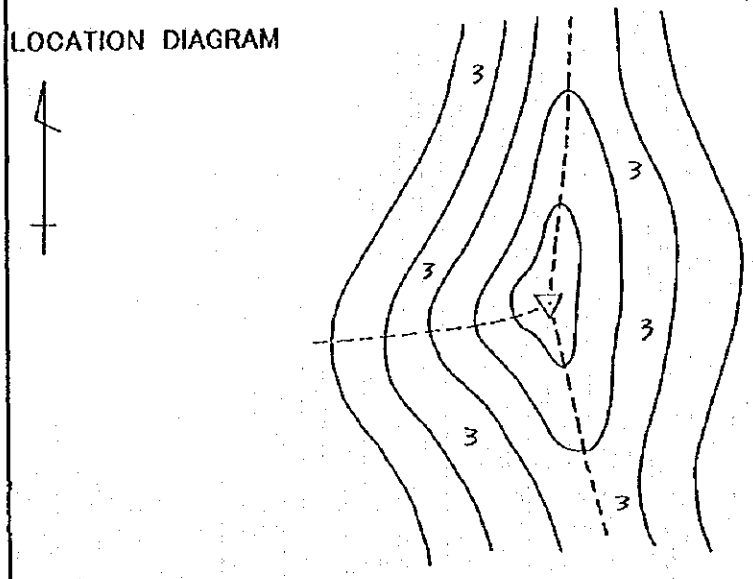


SURVEY MARK DESCRIPTION

PROPOSED DAM SITE

COUNTRY: PHILIPPIN	POINT CURA-3	
TYPE: G P S	DESCRIPTION:	PHOTO No.
MAP SHEET: CURA	DATE:	SURVEYOR:
NORTHINNG: 2,006,676.996	EASTING: 482,724.063	HEIGHT: 243.207

LOCATION DIAGRAM

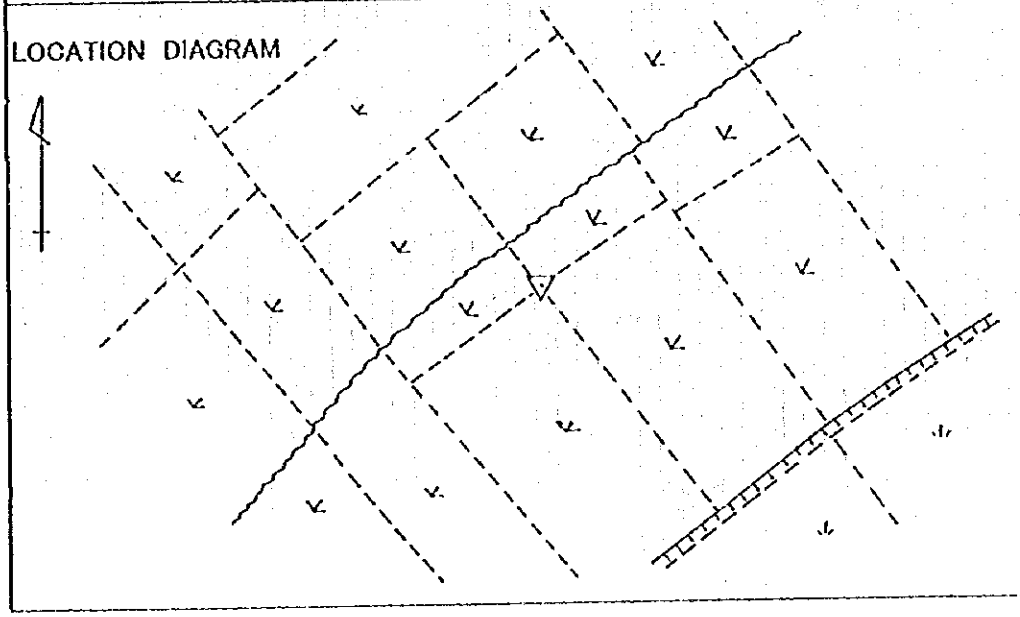


SURVEY MARK DESCRIPTION

PROPOSED DAM SITE

COUNTRY: PHILIPPIN	POINT CURA-4	
TYPE: G P S	DESCRIPTION:	PHOTO No.
MAP SHEET: CURA	DATE:	SURVEYOR:
NORTHINNG: 2,006,232.717	EASTING: 481,316.441	HEIGHT: 103.184

LOCATION DIAGRAM



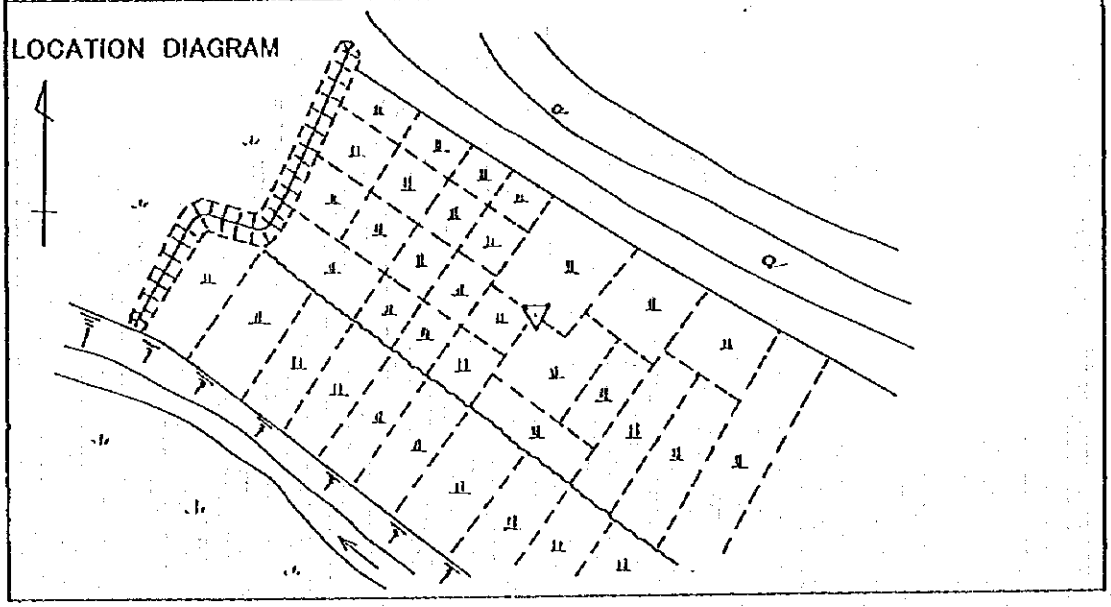
SURVEY MARK DESCRIPTION

PROPOSED DAM SITE

COUNTRY: PHILIPPIN POINT LAB-1

TYPE: G P S	DESCRIPTION:	PHOTO No.
MAP SHEET: LABUGAON	DATE:	SURVEYOR:
NORTHINNG: 2,003,396.602	EASTING: 482,293.886	HEIGHT: 110.334

LOCATION DIAGRAM



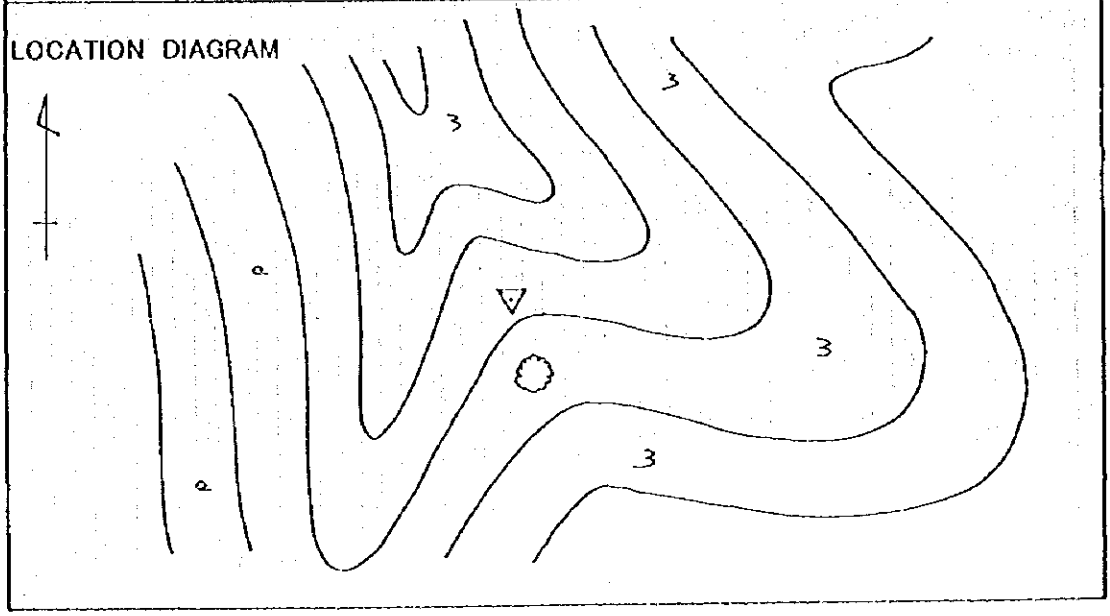
SURVEY MARK DESCRIPTION

PROPOSED DAM SITE

COUNTRY: PHILIPPIN POINT LAB-2

TYPE: G P S	DESCRIPTION:	PHOTO No.
MAP SHEET: LABUGAON	DATE:	SURVEYOR:
NORTHINNG: 2,003,323.802	EASTING: 483,291.466	HEIGHT: 270.737

LOCATION DIAGRAM

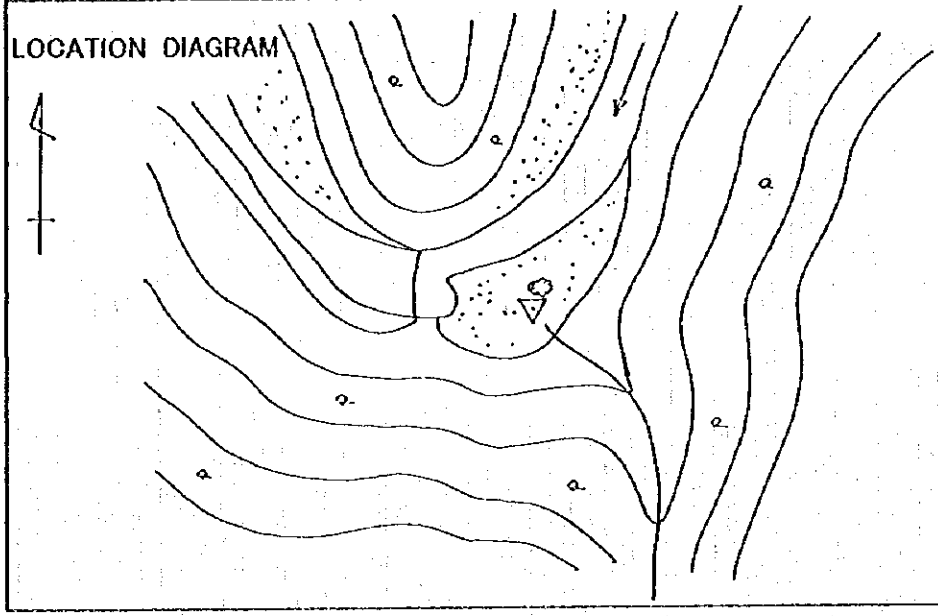


SURVEY MARK DESCRIPTION

PROPOSED DAM SITE

COUNTRY: PHILIPPIN	POINT LAB-3	
TYPE: G P S	DESCRIPTION:	PHOTO No.
MAP SHEET: LABUGAON	DATE:	SURVEYOR:
NORTHINNG: 2,002,778.460	EASTING: 483,300.845	HEIGHT: 123.941

LOCATION DIAGRAM

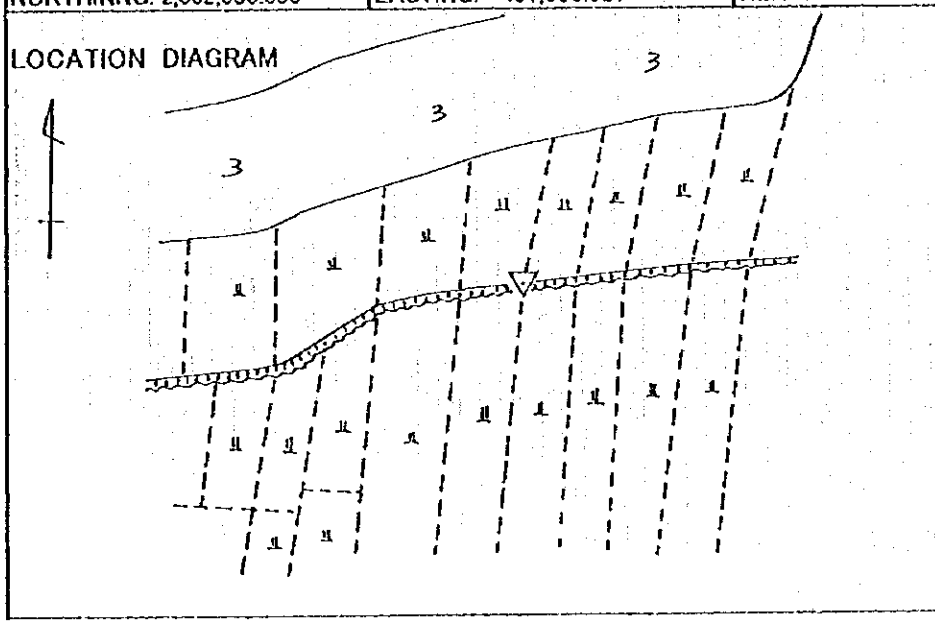


SURVEY MARK DESCRIPTION

PROPOSED DAM SITE

COUNTRY: PHILIPPIN	POINT LAB-4	
TYPE: G P S	DESCRIPTION:	PHOTO No.
MAP SHEET: LABUGAON	DATE:	SURVEYOR:
NORTHINNG: 2,002,959.086	EASTING: 481,880.621	HEIGHT: 105.531

LOCATION DIAGRAM

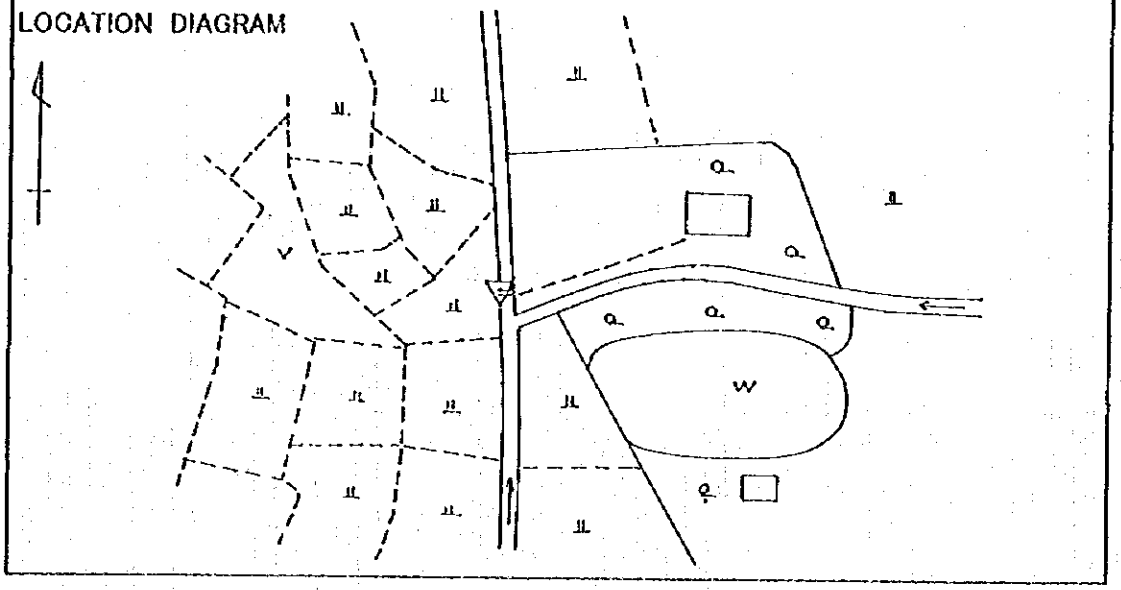


SURVEY MARK DESCRIPTION

PROPOSED DAM SITE

COUNTRY: PHILIPPIN	POINT SOL-1	
TYPE: G P S	DESCRIPTION:	PHOTO No.
MAP SHEET: SOLSONA	DATE:	SURVEYOR:
NORTHINNG: 2,001,022.382	EASTING: 479,779.891	HEIGHT: 103.627

LOCATION DIAGRAM

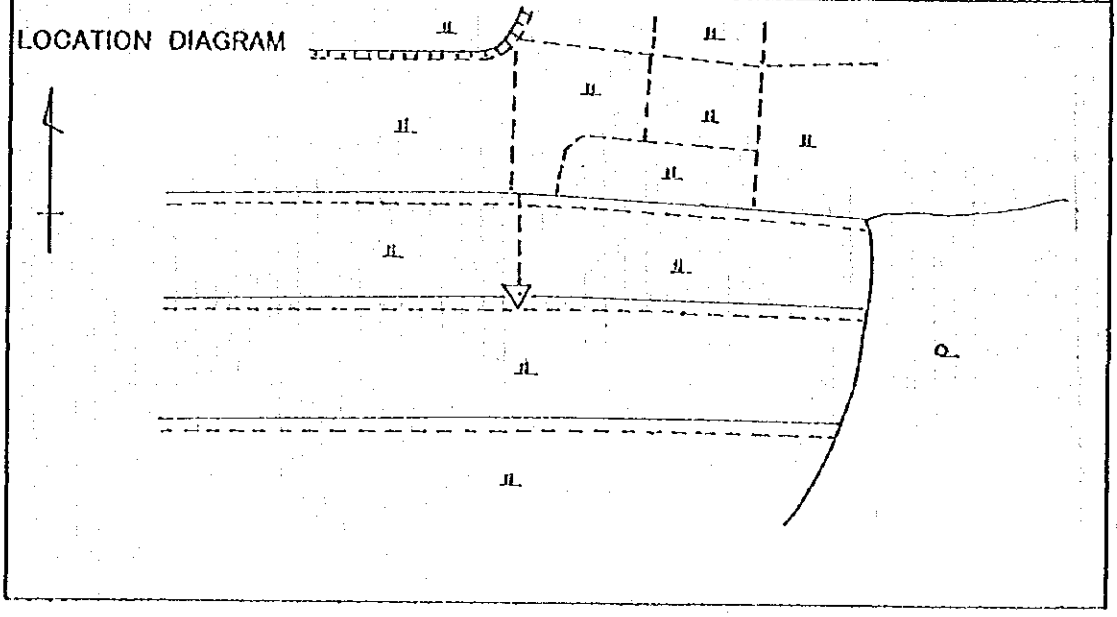


SURVEY MARK DESCRIPTION

PROPOSED DAM SITE

COUNTRY: PHILIPPIN	POINT SOL-2	
TYPE: G P S	DESCRIPTION:	PHOTO No.
MAP SHEET: SOLSONA	DATE:	SURVEYOR:
NORTHINNG: 1,999,870.238	EASTING: 480,818.663	HEIGHT: 124.524

LOCATION DIAGRAM



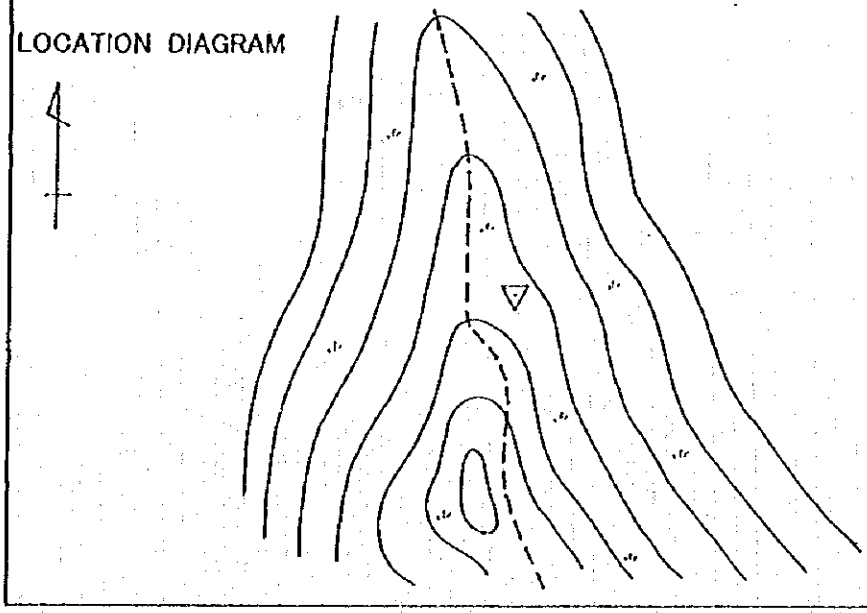
SURVEY MARK DESCRIPTION

PROPOSED DAM SITE

COUNTRY: PHILIPPIN POINT SOL-3

TYPE: G P S	DESCRIPTION:	PHOTO No.
MAP SHEET: SOLSONA	DATE:	SURVEYOR:
NORTHINNG: 2,000,008.564	EASTING: 480,233.257	HEIGHT: 210.379

LOCATION DIAGRAM



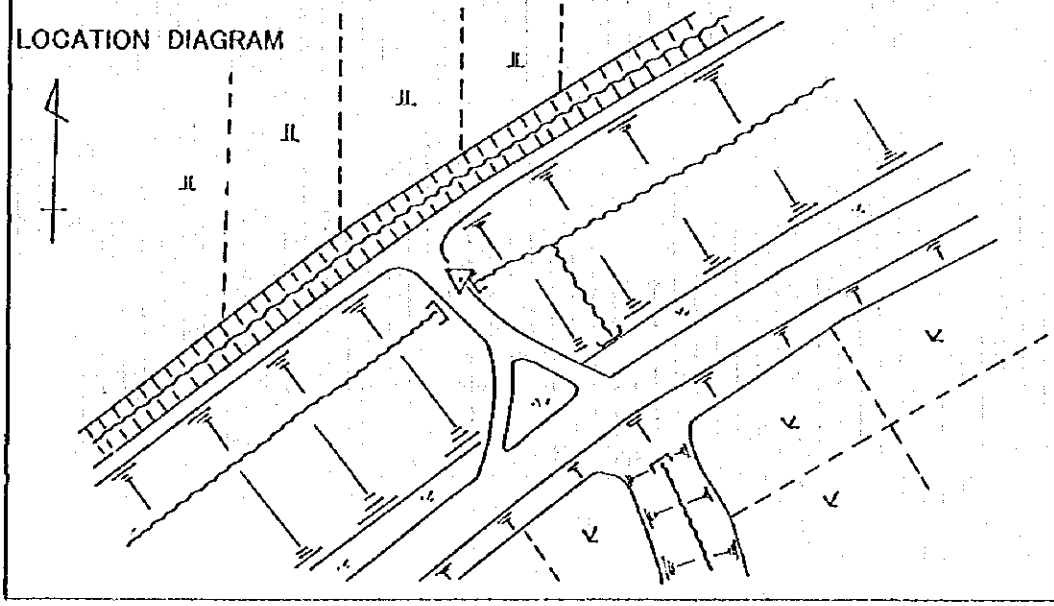
SURVEY MARK DESCRIPTION

PROPOSED DAM SITE

COUNTRY: PHILIPPIN POINT SOL-4

TYPE: G P S	DESCRIPTION:	PHOTO No.
MAP SHEET: SOLSONA	DATE:	SURVEYOR:
NORTHINNG: 2,000,168.308	EASTING: 479,757.757	HEIGHT: 104.556

LOCATION DIAGRAM

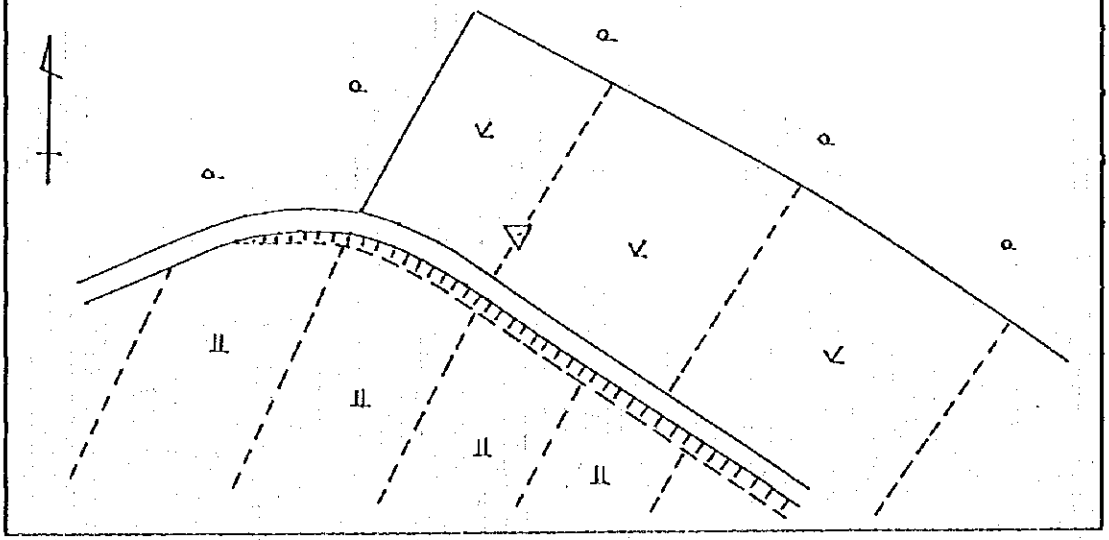


SURVEY MARK DESCRIPTION

PROPOSED DAM SITE

COUNTRY: PHILIPPIN	POINT SOL-5	
TYPE: G P S	DESCRIPTION:	PHOTO No.
MAP SHEET: SOLSONA	DATE:	SURVEYOR:
NORTHINNG: 1,999,814.068	EASTING: 481,775.860	HEIGHT: 145.895

LOCATION DIAGRAM

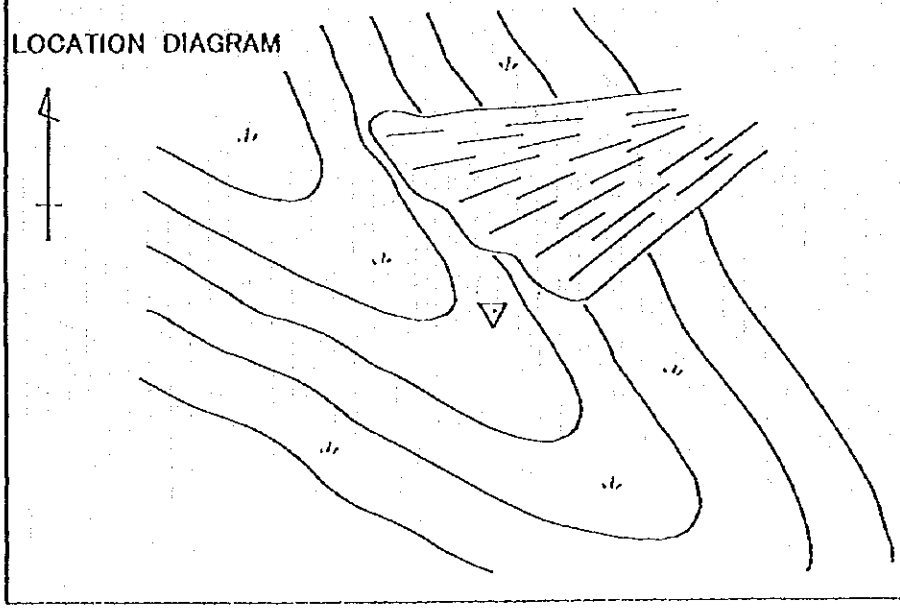


SURVEY MARK DESCRIPTION

PROPOSED DAM SITE

COUNTRY: PHILIPPIN	POINT SOL-6	
TYPE: G P S	DESCRIPTION:	PHOTO No.
MAP SHEET: SOLSONA	DATE:	SURVEYOR:
NORTHINNG: 1,999,515.754	EASTING: 483,528.287	HEIGHT: 458.751

LOCATION DIAGRAM



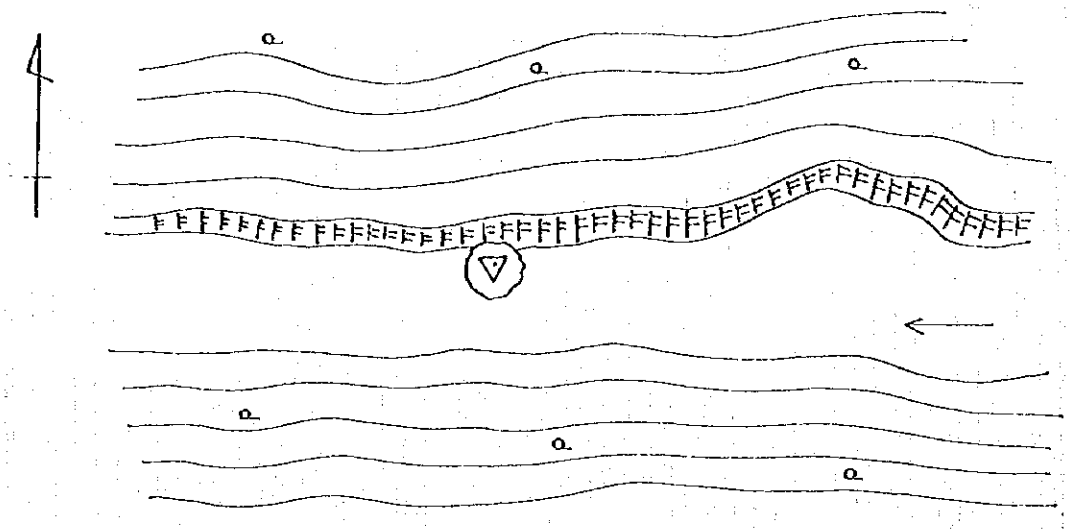
SURVEY MARK DESCRIPTION

PROPOSED DAM SITE

COUNTRY: PHILIPPIN POINT SOL-7

TYPE: G P S	DESCRIPTION:	PHOTO No.
MAP SHEET: SOLSONA	DATE:	SURVEYOR:
NORTHINNG: 1,998,986.476	EASTING: 483,019.975	HEIGHT: 159.977

LOCATION DIAGRAM



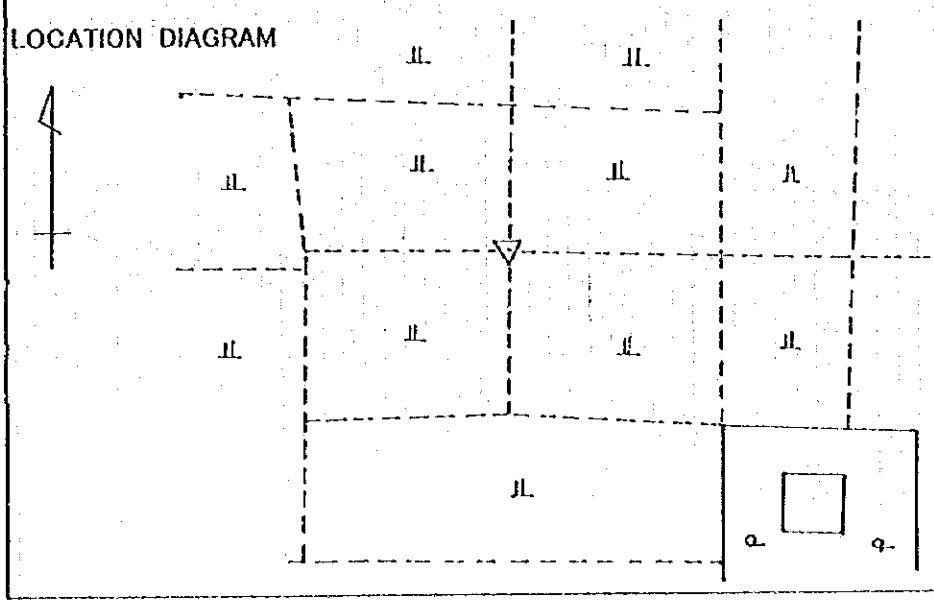
SURVEY MARK DESCRIPTION

PROPOSED DAM SITE

COUNTRY: PHILIPPIN POINT SOL-8

TYPE: G P S	DESCRIPTION:	PHOTO No.
MAP SHEET: SOLSONA	DATE:	SURVEYOR:
NORTHINNG: 1,999,662.643	EASTING: 481,695.141	HEIGHT: 141.378

LOCATION DIAGRAM



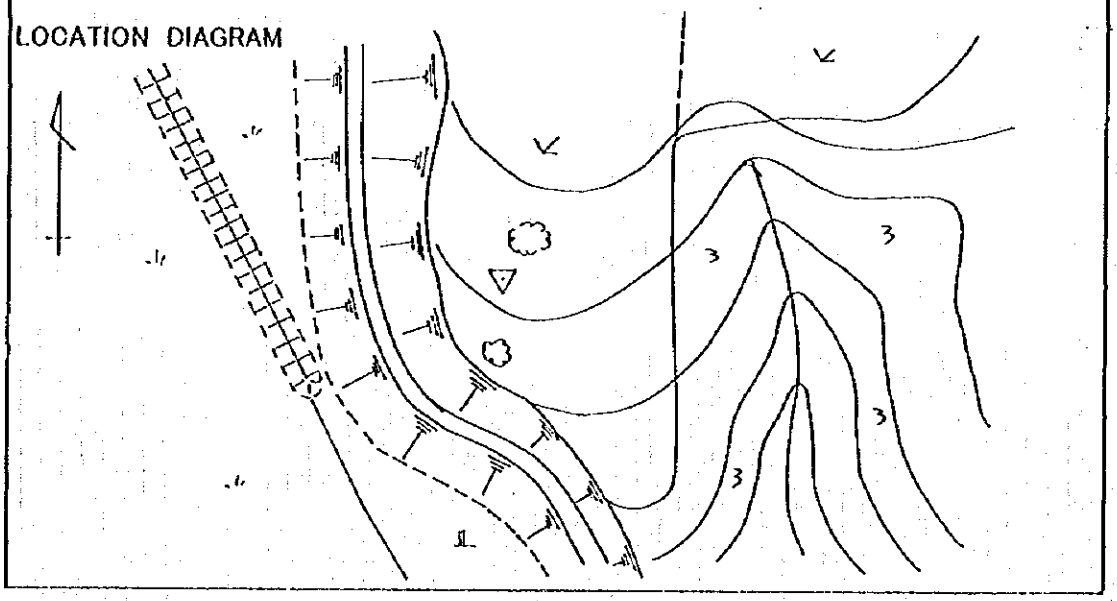
SURVEY MARK DESCRIPTION

PROPOSED DAM SITE

COUNTRY: PHILIPPIN POINT MAD-1

TYPE: G P S	DESCRIPTION:	PHOTO No.
MAP SHEET: MADONGAN	DATE:	SURVEYOR:
NORTHINNG: 1,992,233.009	EASTING: 474,365.023	HEIGHT: 147.109

LOCATION DIAGRAM



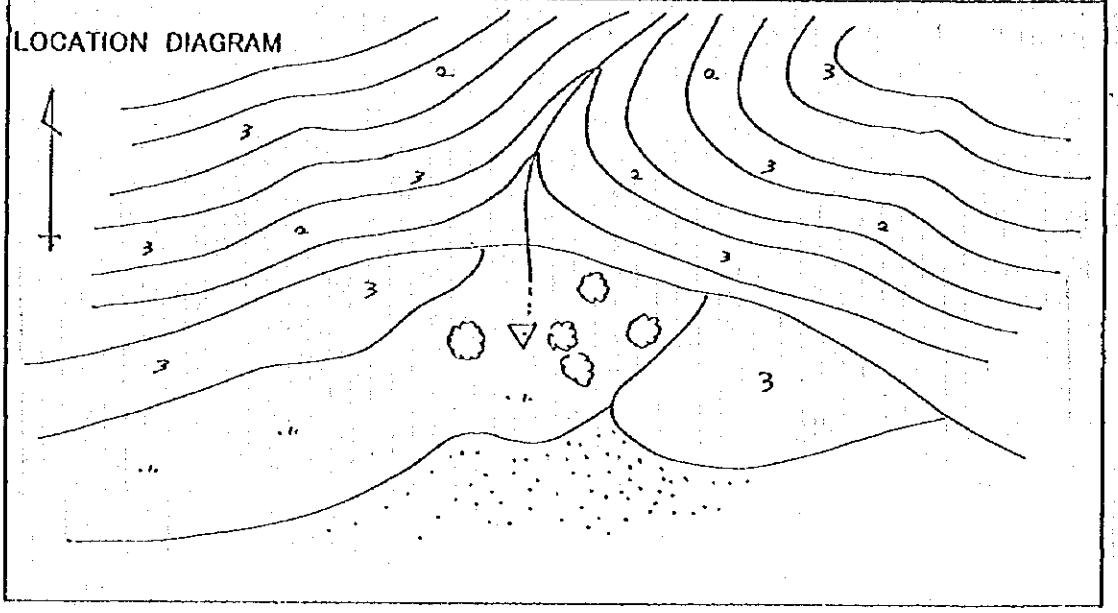
SURVEY MARK DESCRIPTION

PROPOSED DAM SITE

COUNTRY: PHILIPPIN POINT MAD-2

TYPE: G P S	DESCRIPTION:	PHOTO No.
MAP SHEET: MADONGAN	DATE:	SURVEYOR:
NORTHINNG: 1,991,838.304	EASTING: 475,557.271	HEIGHT: 138.804

LOCATION DIAGRAM

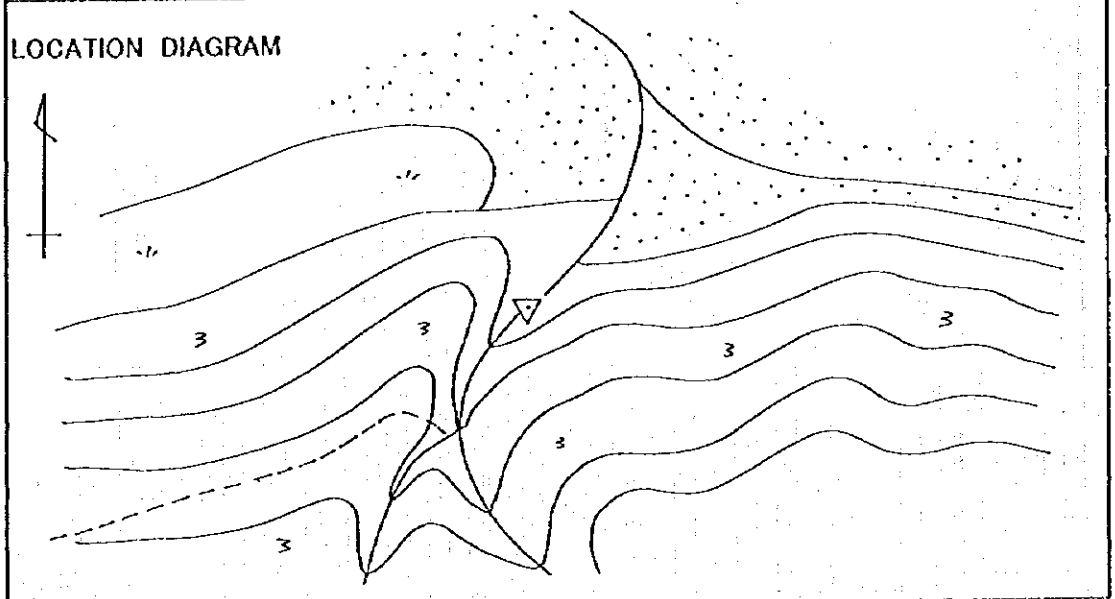


SURVEY MARK DESCRIPTION

PROPOSED DAM SITE

COUNTRY: PHILIPPIN	POINT MAD-3	
TYPE: G P S	DESCRIPTION:	PHOTO No.
MAP SHEET: MADONGAN	DATE:	SURVEYOR:
NORTHINNG: 1,991,263.447	EASTING: 475,178.215	HEIGHT: 136.215

LOCATION DIAGRAM

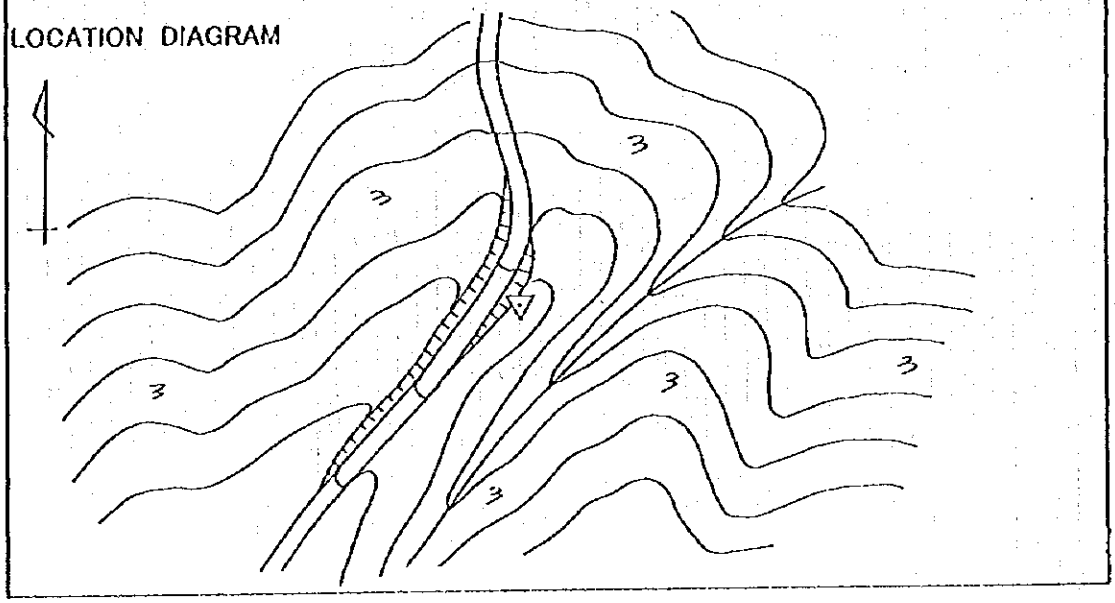


SURVEY MARK DESCRIPTION

PROPOSED DAM SITE

COUNTRY: PHILIPPIN	POINT MAD-4	
TYPE: G P S	DESCRIPTION:	PHOTO No.
MAP SHEET: MADONGAN	DATE:	SURVEYOR:
NORTHINNG: 1,991,439.970	EASTING: 474,182.229	HEIGHT: 260.039

LOCATION DIAGRAM



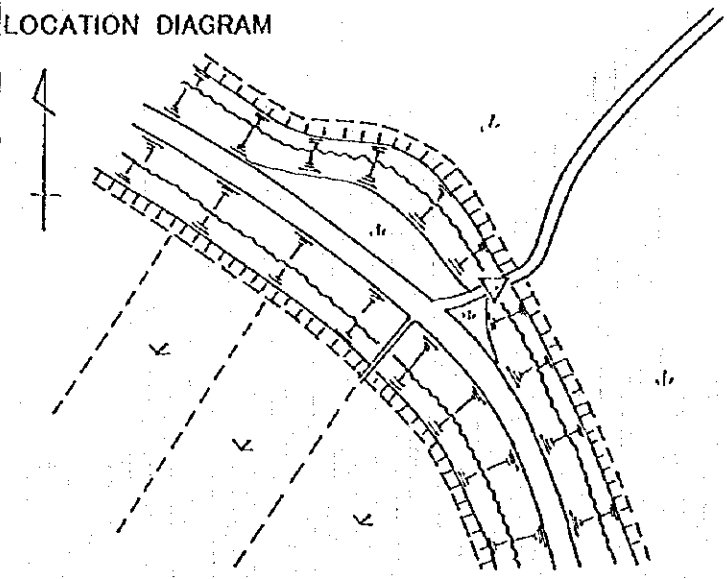
SURVEY MARK DESCRIPTION

PROPOSED DAM SITE

COUNTRY: PHILIPPIN POINT PAP-1

TYPE: G P S	DESCRIPTION:	PHOTO No.
MAP SHEET: PAPA	DATE:	SURVEYOR:
NORTHINNG: 1,987,302.760	EASTING: 469,804.660	HEIGHT: 109.907

LOCATION DIAGRAM



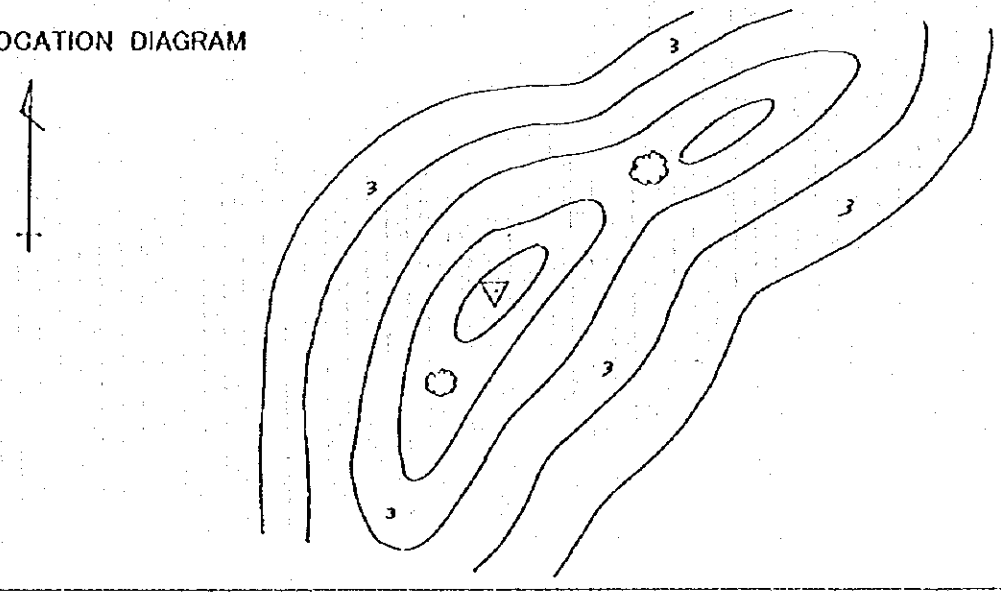
SURVEY MARK DESCRIPTION

PROPOSED DAM SITE

COUNTRY: PHILIPPIN POINT PAP-2

TYPE: G P S	DESCRIPTION:	PHOTO No.
MAP SHEET: PAPA	DATE:	SURVEYOR:
NORTHINNG: 1,986,935.197	EASTING: 471,380.948	HEIGHT: 211.500

LOCATION DIAGRAM

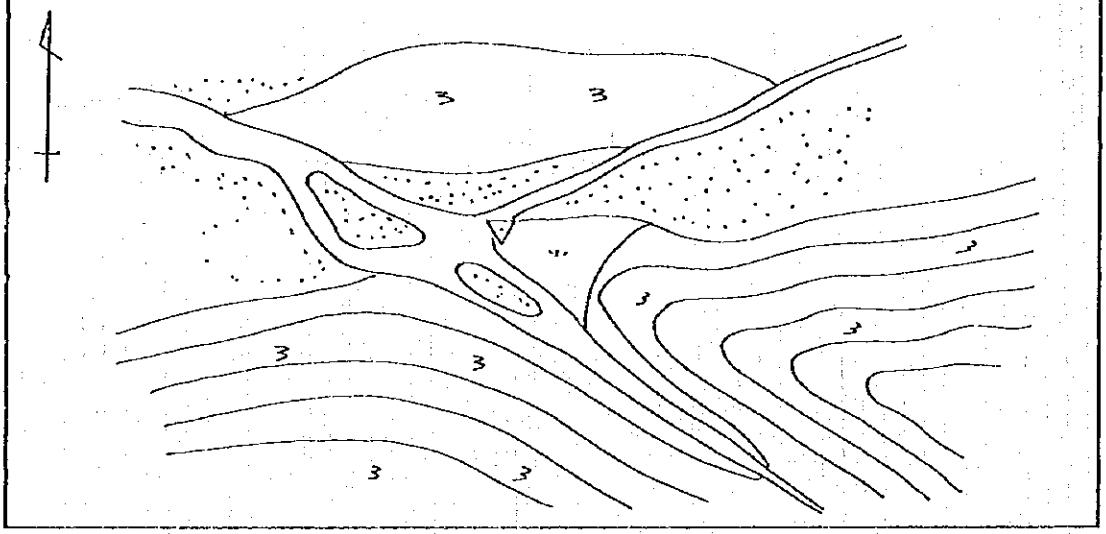


SURVEY MARK DESCRIPTION

PROPOSED DAM SITE

COUNTRY: PHILIPPIN	POINT PAP-3	
TYPE: G P S	DESCRIPTION:	PHOTO No.
MAP SHEET: PAPA	DATE:	SURVEYOR:
NORTHINNG: 1,986,505.496	EASTING: 471,469.911	HEIGHT: 141.112

LOCATION DIAGRAM

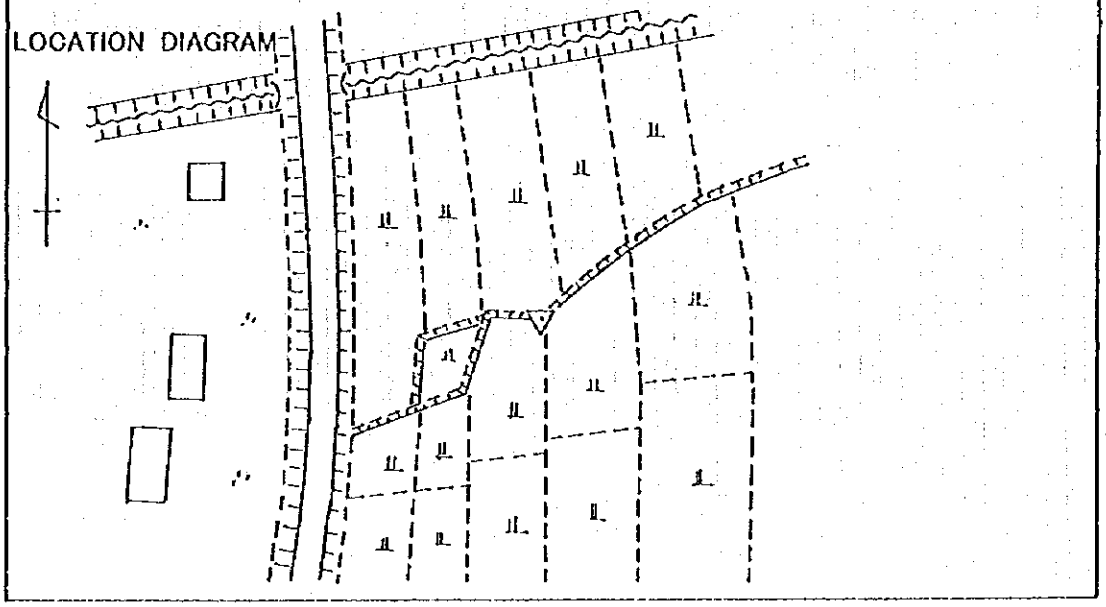


SURVEY MARK DESCRIPTION

PROPOSED DAM SITE

COUNTRY: PHILIPPIN	POINT PAP-4	
TYPE: G P S	DESCRIPTION:	PHOTO No.
MAP SHEET: PAPA	DATE:	SURVEYOR:
NORTHINNG: 1,986,350.932	EASTING: 469,600.095	HEIGHT: 114.439

LOCATION DIAGRAM



4. Coordinates Adjustment Data of Control Point

COORDS.LOG

FINAL RESULTS

COORDINATE ADJUSTMENT SUMMARY
NETWORK = cura
TIME = Mon Dec 9 17:04:01 1996

Datum = CLARKE
Coordinate System = User-Defined Transverse Mercator
Zone = 51

Network Adjustment Constraints:
2 fixed coordinates in y
2 fixed coordinates in x
2 fixed coordinates in H

POINT NAME		OLD COORDS	ADJUST	NEW COORDS	1.00
1 CUR1					
	Y=	2007008.6587	+0.0000	2007008.6587	0.035806m
	X=	481137.2855	+0.0000	481137.2855	0.041415m
	ELL HT=	163.0594	+0.0000	163.0594	0.060840m
	ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN
2 CUR2					
	Y=	2007590.1091	+0.0000	2007590.1091	0.530685m
	X=	482627.8450	+0.0000	482627.8450	1.843351m
	ELL HT=	272.5450	+0.0000	272.5450	1.131238m
	ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN
3 CUR3					
	Y=	2006676.9955	+0.0000	2006676.9955	0.044318m
	X=	482724.0633	+0.0000	482724.0633	0.048277m
	ELL HT=	243.2073	+0.0000	243.2073	0.067597m
	ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN
4 CUR4					
	Y=	2006232.7167	+0.0000	2006232.7167	0.031944m
	X=	481316.4410	+0.0000	481316.4410	0.036402m
	ELL HT=	103.1836	+0.0000	103.1836	0.055321m
	ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN
5 FC10					
	Y=	2005007.2170	+0.0000	2005007.2170	FIXED
	X=	479041.3950	+0.0000	479041.3950	FIXED
	ELL HT=	74.3810	+0.0000	74.3810	FIXED
	ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN
6 FC11					
	Y=	2000321.7380	+0.0000	2000321.7380	FIXED
	X=	480250.2940	+0.0000	480250.2940	FIXED
	ELL HT=	117.1140	+0.0000	117.1140	FIXED
	ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN

COORDS.LOG

COORDINATE ADJUSTMENT SUMMARY
NETWORK = Labugaon
TIME = Tue Dec 10 21:35:24 1996

Datum = CLARKE
Coordinate System = User-Defined Transverse Mercator
Zone = UTM51

Network Adjustment Constraints:
2 fixed coordinates in y
2 fixed coordinates in x
2 fixed coordinates in H

POINT NAME	OLD COORDS	ADJUST	NEW COORDS	1.00
1 FC10				
Y=	2005007.2170	+0.0000	2005007.2170	FIXED
X=	479041.3950	+0.0000	479041.3950	FIXED
ELL HT=	74.3810	+0.0000	74.3810	FIXED
ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN
2 ILN3				
Y=	2000321.7380	+0.0000	2000321.7380	FIXED
X=	480250.2940	+0.0000	480250.2940	FIXED
ELL HT=	117.1140	+0.0000	117.1140	FIXED
ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN
3 LAB1				
Y=	2003396.6023	+0.0000	2003396.6023	0.012648m
X=	482293.8858	+0.0000	482293.8858	0.014858m
ELL HT=	110.3340	+0.0000	110.3340	0.022205m
ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN
4 LAB2				
Y=	2003323.8016	+0.0000	2003323.8016	0.017521m
X=	483291.4660	+0.0000	483291.4660	0.019141m
ELL HT=	270.7373	+0.0000	270.7373	0.031399m
ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN
5 LAB3				
Y=	2002778.4596	+0.0000	2002778.4596	0.017834m
X=	483300.8454	+0.0000	483300.8454	0.018756m
ELL HT=	123.9411	+0.0000	123.9411	0.032352m
ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN
6 LAB4				
Y=	2002959.0856	+0.0000	2002959.0856	0.011331m
X=	481880.6214	+0.0000	481880.6214	0.012868m
ELL HT=	105.5308	+0.0000	105.5308	0.021193m
ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN

COORDS.LOG

COORDINATE ADJUSTMENT SUMMARY
NETWORK = solsonal
TIME = Fri Dec 13 18:05:20 1996

Datum = CLARKE
Coordinate System = User-Defined Transverse Mercator
Zone = solsonal

Network Adjustment Constraints:
2 fixed coordinates in y
2 fixed coordinates in x
1 fixed coordinates in H

POINT NAME	OLD COORDS	ADJUST	NEW COORDS	1.00
1 F111				
Y=	2000342.0530	+0.0000	2000342.0530	FIXED
X=	480151.2910	+0.0000	480151.2910	FIXED
ELL HT=	108.2907	+0.0000	108.2907	0.148113m
ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN
2 FC11				
Y=	2000321.7380	+0.0000	2000321.7380	FIXED
X=	480250.2940	+0.0000	480250.2940	FIXED
ELL HT=	117.1140	+0.0000	117.1140	FIXED
ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN
3 SOL1				
Y=	2001022.3822	+0.0000	2001022.3822	0.280178m
X=	479779.8909	+0.0000	479779.8909	0.333665m
ELL HT=	103.6270	+0.0000	103.6270	0.194126m
ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN
4 SOL2				
Y=	1999870.2383	+0.0000	1999870.2383	0.324710m
X=	480818.6630	+0.0000	480818.6630	0.309458m
ELL HT=	124.5239	+0.0000	124.5239	0.090086m
ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN
5 SOL4				
Y=	2000168.3076	+0.0000	2000168.3076	0.188701m
X=	479757.7574	+0.0000	479757.7574	0.153104m
ELL HT=	104.5556	+0.0000	104.5556	0.176100m
ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN
6 SOL1				
Y=	2001022.3619	+0.0000	2001022.3619	0.303335m
X=	479779.9548	+0.0000	479779.9548	0.352357m
ELL HT=	103.8784	+0.0000	103.8784	0.097317m
ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN
7 SOL3				
Y=	2000008.5635	+0.0000	2000008.5635	0.118195m
X=	480233.2570	+0.0000	480233.2570	0.151849m
ELL HT=	210.3786	+0.0000	210.3786	0.137701m
ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN

COORDS.LOG

COORDINATE ADJUSTMENT SUMMARY
NETWORK = SOLSONA2
TIME = Fri Dec 13 17:54:18 1996

Datum = CLARKE
Coordinate System = User-Defined Transverse Mercator
Zone = SOLSONA2

Network Adjustment Constraints:
1 fixed coordinates in y
1 fixed coordinates in x
1 fixed coordinates in H

POINT NAME		OLD COORDS	ADJUST	NEW COORDS	1.00
1 FC11					
	Y=	2000321.7390	+0.0000	2000321.7390	FIXED
	X=	480250.2940	+0.0000	480250.2940	FIXED
	ELL HT=	117.1140	+0.0000	117.1140	FIXED
	ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN
2 SOL5					
	Y=	1999814.0679	+0.0000	1999814.0679	0.005190m
	X=	481775.8599	+0.0000	481775.8599	0.006172m
	ELL HT=	145.8947	+0.0000	145.8947	0.016286m
	ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN
3 SOL7					
	Y=	1998986.4755	+0.0000	1998986.4755	0.018340m
	X=	483019.9749	+0.0000	483019.9749	0.012063m
	ELL HT=	159.9769	+0.0000	159.9769	0.027460m
	ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN
4 SOL6					
	Y=	1999515.7543	+0.0000	1999515.7543	0.006436m
	X=	483528.2873	+0.0000	483528.2873	0.007350m
	ELL HT=	458.7510	+0.0000	458.7510	0.017798m
	ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN
5 SOL8					
	Y=	1999662.6431	+0.0000	1999662.6431	0.006168m
	X=	481695.1407	+0.0000	481695.1407	0.007150m
	ELL HT=	141.3778	+0.0000	141.3778	0.015104m
	ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN

COORDS.LOG

COORDINATE ADJUSTMENT SUMMARY
NETWORK = Madongan
TIME = Fri Dec 20 10:28:19 1996

Datum = CLARKE
Coordinate System = User-Defined Transverse Mercator
Zone = Madongan

Network Adjustment Constraints:
1 fixed coordinates in y
1 fixed coordinates in x
Inner constraints in H

POINT	NAME	OLD COORDS	ADJUST	NEW COORDS	1.00
1	LF13				
	Y=	1991661.0790	+0.0000	1991661.0790	FIXED
	X=	474617.0390	+0.0000	474617.0390	FIXED
	ELL HT=	177.7531	+0.0000	177.7531	0.008560m
	ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN
2	MAD1				
	Y=	1992233.0089	+0.0000	1992233.0089	0.000954m
	X=	474365.0226	+0.0000	474365.0226	0.001175m
	ELL HT=	193.8793	+0.0000	193.8793	0.008557m
	ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN
3	MAD2				
	Y=	1991838.3037	+0.0000	1991838.3037	0.001134m
	X=	475557.2706	+0.0000	475557.2706	0.001329m
	ELL HT=	185.9280	+0.0000	185.9280	0.008306m
	ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN
4	MAD3				
	Y=	1991263.4466	+0.0000	1991263.4466	0.002884m
	X=	475178.2145	+0.0000	475178.2145	0.003508m
	ELL HT=	183.2757	+0.0000	183.2757	0.011536m
	ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN
5	MAD4				
	Y=	1991439.9703	+0.0000	1991439.9703	0.011774m
	X=	474182.2285	+0.0000	474182.2285	0.062340m
	ELL HT=	307.0104	+0.0000	307.0104	0.031068m
	ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN

COORDS.LOG

COORDINATE ADJUSTMENT SUMMARY
NETWORK = papa
TIME = Fri Dec 20 10:34:04 1996

Datum = CLARKE
Coordinate System = User-Defined Transverse Mercator
Zone = papa

Network Adjustment Constraints:
1 fixed coordinates in y
1 fixed coordinates in x
Inner constraints in H

POINT	NAME	OLD COORDS	ADJUST	NEW COORDS	1.00
1	LFCP-12				
	Y=	1986636.9500	+0.0000	1986636.9500	FIXED
	X=	471130.0760	+0.0000	471130.0760	FIXED
	ELL HT=	178.1641	+0.0000	178.1641	0.000179m
	ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN
2	PAP1				
	Y=	1987128.1616	+174.5984	1987302.7600	0.000147m
	X=	469945.5284	-140.8683	469804.6602	0.000175m
	ELL HT=	145.1351	-0.0002	145.1350	0.000306m
	ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN
3	PAP2				
	Y=	1986760.6300	+174.5673	1986935.1973	0.000121m
	X=	471521.8419	-140.8937	471380.9482	0.000094m
	ELL HT=	246.8986	+0.0001	246.8987	0.000245m
	ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN
4	PAP3				
	Y=	1986330.9524	+174.5437	1986505.4960	0.000135m
	X=	471610.8092	-140.8983	471469.9109	0.000104m
	ELL HT=	176.6698	+0.0003	176.6702	0.000263m
	ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN
5	PAP4				
	Y=	1986176.3844	+174.5476	1986350.9320	0.000157m
	X=	469940.9699	-140.8752	469800.0947	0.000188m
	ELL HT=	149.8487	-0.0002	149.8485	0.000333m
	ORTHO HT=	0.0000	+0.0000	0.0000	NOT KNOWN

APPENDIX H

RIVER MONITORING

APPENDIX II

RIVER MONITORING

Table of Contents

List of Tables

List of Figures

CHAPTER I GENERAL

River monitoring before/during/after the construction of the proposed project is needed to verify the effect of the project and to find the necessity of maintenance works of sabo/flood control structures. Monitoring works are as follows:

(1) Inspection of River Condition

To monitor the safety and functions of sabo/flood control structures such as sabo dams, embankment, revetments, groins and other related structures.

(2) River Morphological Survey

To monitor the fluctuation of riverbed inspecting the safety of bank protection structures such as revetment, toe protection and spur dike and verifying the flow capacity of each river.

(3) Hydrological Observation

To observe rainfall, water level and flow velocity during flood time, in daily, monthly and yearly.

Location, measures and organizational arrangement for the above monitoring works are explained hereinafter.

CHAPTER II INSPECTION OF RIVER CONDITION

2.1 Location

All the stretches to be improved in the proposed project for the Cura/Labugaon, Solsona, Madongan, Papa, Bongo and Laoag rivers should be inspected.

2.2 Measures

This inspection should be made once a year in dry season and also after flood according to the decision of DPWH District Engineering Office. The contents of inspection are description of failure, cause of failure and applicable countermeasure. Inspection sheet is tabulated in Table II.2.1. It is desirable to attach an illustration of damage.

Failure of embankment is generally classified into weathering, surface erosion, saturation failure, depression and scouring. Damage of concrete structure and wet masonry structure is classified into crack, pothole, depression and free fall.

CHAPTER III RIVER MORPHOLOGICAL SURVEY

3.1 Location

The Cura/Labugaon, Solsona, Madongan and Papa rivers in alluvial fan areas should be monitored because a riverbed aggradation or degradation may occur in alluvial fan areas. The survey in the Cura/Labugaon river will be conducted after the construction, because the present distributed river courses are planned to be integrated by the proposed project.

The survey at Cauplasan Bridge in Bongo River and at Gilbert Bridge in Laoag River should also be carried out to confirm the minor fluctuation of riverbed.

3.2 Measures

Installation of maintenance marker post or kilometer post should be firstly carried out on the bank of river together with the elevation survey of the top of post. Cross-sectional survey will be made at the location of kilometer post at one (1) kilometer interval. This survey should be made once a year at the same locations in dry season. A totaling of 45 sections will be surveyed.

Based on the above survey, riverbed fluctuation volume including water level, mean riverbed elevation and water surface width are recorded as shown in Table II.3.1. This table also shows the design highwater level as a datum water level and the volume of riverbed excavation for construction material.

CHAPTER IV HYDROLOGICAL OBSERVATION

Hydrological observation such as rainfall, water level and flow velocity will be carried out using automatic recording gauge to observe during heavy rainfall and flood time. Location, configuration of equipment and details of available automatic hydrological observation stations are described in Supporting Report Volume III-1 (Master Plan Study). The rainfall stations are located at Piddig, Solsona and Nueva Era. The stream gauge (water level and flow velocity) stations are placed at Gilbert Bridge, Cauplasan Bridge and Solsona Dam.

Required maintenance works are described hereinafter while hydrological observation is carried out automatically.

4.1 Maintenance Works of Rainfall Gauge

Recording chart and recording pen need to be changed every month, and dry battery needs to be changed every three (3) months. Whenever recording chart is changed, zero point of the recorder should be adjusted and time line of the chart is adjusted to the actual time. Also date and time when the new chart is inserted should be recorded on the new chart for convenience in reading recorded rainfall data.

The cleaning of equipment and in/around stations should be carried out every month. Also, the accuracy check should be made before rainy season. The sheet for these inspection is presented in Table H.4.1.

The daily rainfall data will be recorded in whole year as shown in Table H.4.2. A rainfall data berfore/during/after flood caused by typhoon will be recorded every 30 minutes as tabulated in Table H.4.3. The 30 minutes rainfall data will be used to analyze the relation between the rainfall intensity and the occurrence or the discharge of flood.

4.2 Maintenance Works of Stream Gauge (Water Level and Flow Velocity)

Recording charts, IC memory cards and recording pens installed in the stations should be changed every month together with the cleaning work in/around stations. Battery and other related equipment should be inspected monthly and changed due to the conditions.

Whenever recording chart is changed, zero point of the recorder should be adjusted and time line of the chart is adjusted to the actual time. Also date and time when the new chart is inserted should be recorded on the new chart for convenience in reading recorded data. When an IC memory card is inserted into the IC card logger, formatting and creation of a data file are required to be made.

To create a data file for water level, necessary items to be input are file name, data length (number/times of data to be stored), base time to store data and time interval/cycle to store in/write to IC card. To create a data file for flow velocity data, necessary items to be input are file name, data length and time interval/cycle to store/write to IC card.

The inspection sheets for the stations are prepared for water level and flow velocity as shown in Table H.4.4.

Water level and flow velocity data which are recorded in the IC memory card are retrieved using the software "M9711.EXE" provided on the computer. This program reads the data recorded in the IC memory card and makes text file.

The velocity data is directly recorded in the text file, but the water level data is recorded as the change of voltage in the IC memory card and therefore conversion of the voltage into the water level will be required using conversion factor 2.0 .

A daily and monthly mean water level/flow velocity is recorded using the data sheet shown in Table II.4.5. Table II.4.6 tabulates the record format of water level and flow velocity before/during/after flood caused by typhoon every 30 minutes.

CHAPTER V ADMINISTRATIVE ORGANIZATION

5.1 Required Staff and Period

To undertake the above activities, the following number of staff and period will be required:

Monitoring Items	Required Staff	Required Period
Inspection of River Condition	one civil engineer one or two assistants	one week in dry season annually *
River Morphological Survey	one civil engineer one survey expert three assistants	three weeks in dry season annually
Hydrological Observation	one civil engineer one assistant	two days monthly

* Inspection after flood will be undertaken according to the decision of the chief of the District Engineering Office.

5.2 Organizational Arrangement

The monitoring works explained above will be carried out by the DPWH District Engineering Office-1 because it is technically and financially capable of undertaking of the work. The district office has presently 61 staff consisting 17 civil engineers, 1 architects, 18 technical staff and 25 administrative staff as shown in Fig. II.5.1.

Table II.5.1 shows the cost of river monitoring including inspection of river condition, river morphological survey, hydrological observation and flood forecasting and warning. The annual budget in 1996 for flood control in the district office is 14.5 million pesos.

In case the required maintenance activities would exceed the technical and financial capability of the District Engineering Office-1, the office will request the necessary technical and financial assistance from the central office of DPWH through Regional Office-1.

TABLES

Table H.2.1 Inspection Sheet of River Condition

(1) Name of River: _____
(2) Date of Inspection: _____
(3) Date of Disaster: _____
(4) Outline of Inspection Results: _____

Location (Section No.)	Description of Failure	Cause of Failure	Applicable Countermeasure	Remarks

Prepared by _____

Checked by _____

Approved by _____

Table H.3.1 Fluctuation Record of Riverbed

(1) Name of River: _____
(2) Date of Survey: _____
(3) Date of Previous Survey: _____

Station (Kilometer Post)	Width of Water Surface	Mean Riverbed Elevation (1)	Width of Water Surface in Previous Survey	Mean Riverbed Elevation in Previous Survey (2)	Depth of Fluctuation (3)=|(1)-(2)|	Distance between Station (4)	Volume of Fluctuation (5)=(3)x(4)	Volume of Riverbed Excavation for Construction Material	Design Highwater Level

Prepared by _____

Checked by _____

Approved by _____

Table H.4.1 Inspection Sheet of Rainfall Gauge

(1) Name of Station: _____

(2) Date of Inspection: _____

(3) Recorder (Monthly Check)

Equipment	Portion	Maintenance	Problems & Measures	Results
Recorder	Exterior & Interior	Cleaning		
	Terminals	Tightening		

(4) Tipping Bucket (Monthly Check)

Equipment	Portion	Maintenance	Problems & Measures	Results
Tipping Bucket	Exterior Setting (Level)	Cleaning		
	Terminals	Tightening		

(5) Accuracy Check (before Rainy Season)

Number of Pulse[1)]	Reading of Recorder[2)]	Result
0	mm	
10	mm	
20	mm	

Note: 1) Pulse is given by moving the tipping bucket by hand.
2) Allowable error is within }0.5mm.

Prepared by _____ Checked by _____ Approved by _____

Table II.4.2 Daily Rainfall

Station _____

Year _____

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1												
2												
3												
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29												
30												
31												
Total												
Annual Total												
D.Max.												
R.Day												

Prepared by _____

Checked by _____

Approved by _____

Table H.4.3 (1/2) 30 Minutes Rainfall

Station _____

Month _____ 19

Date		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1	30																								
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Table H.4.3 (2/2) 30 Minutes Rainfall

Station _____

Month _____ 19

Date		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
17	30																								
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Prepared by _____

Checked by _____

Approved by _____

Table H.4.4 (1/3) Inspection Sheet of Water Level and Flow Velocity Gauges

(1) Name of Station: _____

(2) Date of Inspection: _____

(3) Equipment for Water Level Gauge

Equipment	Portion	Maintenance	Problems & Measures	Results
Rack		Cleaning		
Transformer	Exterior	Cleaning		
	Terminals	Tightening		
Power Supply	Exterior	Cleaning		
	Terminals	Tightening		
	Indicator			
Battery	Exterior	Cleaning		
	Terminals	Tightening		
Convertor	Exterior	Cleaning		
	Terminals	Tightening		
Portable Recorder	Exterior	Cleaning		
	Terminals	Tightening		
	Recording			
	Chart Feeding			
Transmitter-receiver	Exterior	Cleaning		
	Terminals	Tightening		
	Setting			
Temperature Sensor	Exterior	Cleaning		
	Terminals	Tightening		
	Setting			

Table II.4.4 (2/3) Inspection Sheet of Water Level and Flow Velocity Gauges

(4) Equipment for Flow Velocity

Equipment	Portion	Maintenance	Problems & Measures	Results
Convertor	Exterior	Cleaning		
	Interior	Cleaning		
	Terminals	Tightening		
Transformer	Exterior	Cleaning		
	Terminals			
Power Supply	Exterior	Cleaning		
	Interior	Cleaning		
	Indicator			
Battery	Exterior	Cleaning		
	Terminals	Tightening		
Portable Recorder	Exterior	Cleaning		
	Terminals	Tightening		
	Recording			
	Chart Feeding			

(5) Radio Wave Current Sensor

Equipment	Portion	Maintenance	Problems & Measures	Results
Sensor	Exterior	Cleaning		
	Terminals	Tightening		
	Angles	Adjustment		

Table H.4.4 (3/3) Inspection Sheet of Water Level and Flow Velocity Gauges

(6) Setting of Equipment

Item	Setting	Problem & Measures	Results
Number of Channels			
Range of Velocity	~ m/s		
Sampling Time	sec		
Times for Average			
Angles of Depression & Deviation	Deg. Deg.		
Output (Printing) Interval	min.		
Supplementary Output Interval	min.		
Writing Interval to IC Card	min.		
Specified Velocity	m/s		

(7) Power Supply Unit

Item	Criteria	Measured Voltage
AC Output Voltage	AC 90~110 V in AC Output Indicator	AC V
DC Output Voltage	DC 10.0~16.5 V in DC Output Indicator	DC V
AC Power Failure	Confirmation of power supply when power off	

Prepared by _____ Checked by _____ Approved by _____

Table H.4.5 (1/2) Daily Mean Water Level and Flow Velocity
(Water Level)

Station _____

Year _____

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1												
2												
3												
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30												
31												
Max.												

Prepared by _____

Checked by _____

Approved by _____

Table H.4.5 (2/2) Daily Mean Water Level and Flow Velocity
(Flow Velocity)

Station _____

Year _____

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1												
2												
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30												
31												
Max.												

Prepared by _____

Checked by _____

Approved by _____

Table H.4.6 (1/4) 30 Minutes Mean Water Level and Flow Velocity (Water Level)

Station _____

Month _____

Year _____

Date		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1	30																								
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Table H.4.6 (2/4) 30 Minutes Mean Water Level and Flow Velocity (Water Level)

Station _____

Month _____

Year _____

Date		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
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Prepared by _____

Checked by _____

Approved by _____

Table H.4.6 (3/4) 30 Minutes Mean Water Level and Flow Velocity (Flow Velocity)

Station _____

Month _____

Year _____

Date		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
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Table H.4.6 (4/4) 30 Minutes Mean Water Level and Flow Velocity (Flow Velocity)

Station _____

Month _____

Year _____

Date		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
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Prepared by _____

Checked by _____

Approved by _____

Table II.5.1 Cost of River Monitoring

I. Monitoring/Inspection of River Condition

	Unit	Quantity	Unit Cost	Amount (peso)
(1) Initial Cost				0
(2) Annual Cost				28,880
Remuneration				
River/Civil Engineer	month	0.5	15,000	7,500
Assitant Engineer	month	0.5	10,000	5,000
Typist	month	0.5	7,500	3,750
Transportation/Car Service	month	0.5	20,000	10,000
Contingency(10% of above)				2,630

II. River Morphological Survey/Observation

	Unit	Quantity	Unit Cost	Amount (peso)
(1) Initial Cost (every 10 years)				90,000
Kilometer post	post	45	2,000	90,000
(2) Annual Cost				68,920
Remuneration				
River/Civil Engineer	month	0.7	15,000	10,500
Survey Expert	month	0.7	12,000	8,400
Technical Assistant	month	1.4	10,000	14,000
Typist	month	0.7	7,500	5,250
Survey Equipment	month	0.7	15,000	10,500
Transportation/Car Service	month	0.7	20,000	14,000
Contingency(10% of above)				6,270

III. Hydrological Observation

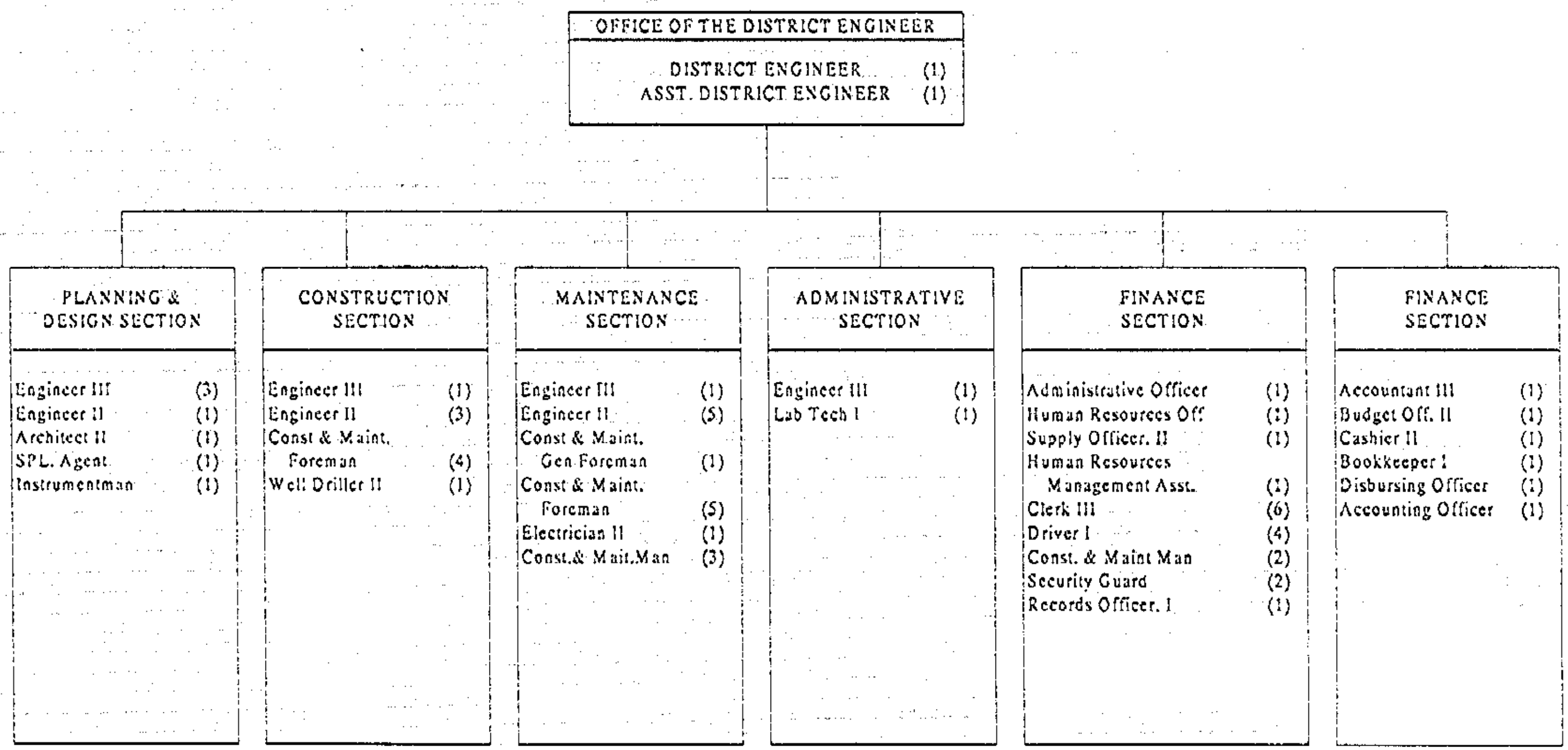
	Unit	M/M	Unit Cost	Amount (peso)
(1) Initial Cost (every 10 years)				0
(2) Annual Cost				46,750
Remuneration				
River/Civil Engineer	month	1.0	15,000	15,000
Typist	month	1.0	7,500	7,500
Transportation/Car Service	month	1.0	20,000	20,000
Contingency(12% of above)				4,250

IV. Flood Forecasting and Warning

	Unit	Quantity	Unit Cost	Amount (peso)
(1) Initial Cost (every 10 years)				368,000
Staff Gauge	site	6	8,000	48,000
Handy Telephone	site	10	5,000	50,000
Gauge Keeper's House	site	9	30,000	270,000
(2) Annual Cost				40,700
Remuneration				
Gauge Keeper	site	9	3,000	27,000
Operation of Telephone	site	10	1,000	10,000
Contingency(10% of above)				3,700

FIGURES

ORGANIZATIONAL CHART OF
DISTRICT ENGINEERING OFFICE 1
REGION 1, DPWH



Legend : ( ) No. of Positions

THE STUDY ON SABO AND FLOOD CONTROL IN THE LAOAG RIVER BASIN JAPAN INTERNATIONAL COOPERATION AGENCY	Fig.II.5.1 Organizational Chart of District Engineering Office 1 Region 1, DPWH