REGION 6

Jalaur River:

DREAM Ground Surveys Report

TRAINING CENTER FOR APPLIED GEODESY AND PHOTOGRAMMETRY

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List of Abbreviations

ADCP	Acoustic Doppler Current Profiler
AWLS	Automated Water Level Sensor
BM	Benchmark
DAC	Data Acquisition Component
DEM	Digital Elevation Model
DG	Depth Gauge
DOST	Department of Science and Technology
DPC	Data Processing Component
DREAM	Disaster Risk Exposure and Assessment for Mitigation
DVC	Data Validation Component
EGM 2008	Earth Gravitation Model 2008
FMC	Flood Modeling Component
GCP	Ground Control Point
GE	Geodetic Engineer
GIS	Geographic Information System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
LGUs	Local Government Units
NAMRIA	National Mapping and Resource Information Authority
PCG	Philippine Coast Guard
PDRRMC	Provincial Disaster Risk Reduction Management Council
PPA	Philippine Ports Authority
PPK	Post Processed Kinematic
RG	Rain Gauge
TCAGP	Training Center for Applied Geodesy and Photogrammetry
UTM	Universal Transverse Mercator
WGS84	World Geodetic System 1984

Introduction

Introduction

1.1 DREAM Program Overview

The UP training Center for Applied Geodesy and Photogrammetry (UP TCAGP) conducts a research program entitled "Nationwide Disaster Risk and Exposure Assessment for Mitigation" supported by the Department of Science and Technology (DOST) Grant-in-Aide Program. The DREAM Program aims to produce detailed, up-to-date, national elevation dataset for 3D flood and hazard mapping to address disaster risk reduction and mitigation in the country.

The DREAM Program consists of four components that operationalize the various stages of implementation. The Data Acquisition Component (DAC) conducts aerial surveys to collect LiDAR data and aerial images in major river basins and priority areas. The Data Validation Component (DVC) implements ground surveys to validate acquired LiDAR data, along with bathymetric measurements to gather river discharge data. The Data Processing Component (DPC) processes and compiles all data generated by the DAC and DVC. Finally, the Flood Modeling Component (FMC) utilizes compiled data for flood modeling and simulation.

Overall, the target output is a national elevation dataset suitable for 1:5000 scale mapping, with 50 centimeter horizontal and vertical accuracies, respectively. These accuracies are achieved through the use of state-of-the-art airborne Light Detection and Ranging (LiDAR) Systems collects point cloud data at a rate of 100,000 to 500,000 points per second, and is capable of collecting elevation data at a rate of 300 to 400 square kilometer per day, per sensor.

1.2 Objectives and target outputs

The program aims to achieve the following objectives:

a. To acquire a national elevation and resource dataset at sufficient resolution to produce information necessary to support the different phases of disaster management,
b. To operationalize the development of flood hazard models that would produce updated and detailed flood hazard maps for the major river systems in the country,
c. To develop the capacity to process, produce and analyze various proven and potential thematic map layers from the 3D data useful for government agencies,
d. To transfer product development technologies to government agencies with geospatial information requirements, and,
e. To generate the following outputs
    1. flood hazard map
    2. digital surface model
    3. digital terrain model and
    4. orthophotograph

1.3 General methodological framework

The methodology employed to accomplish the project's expected outputs are subdivided into four (4) major components, as shown in Figure 1. Each component is described in detail in the following sections.

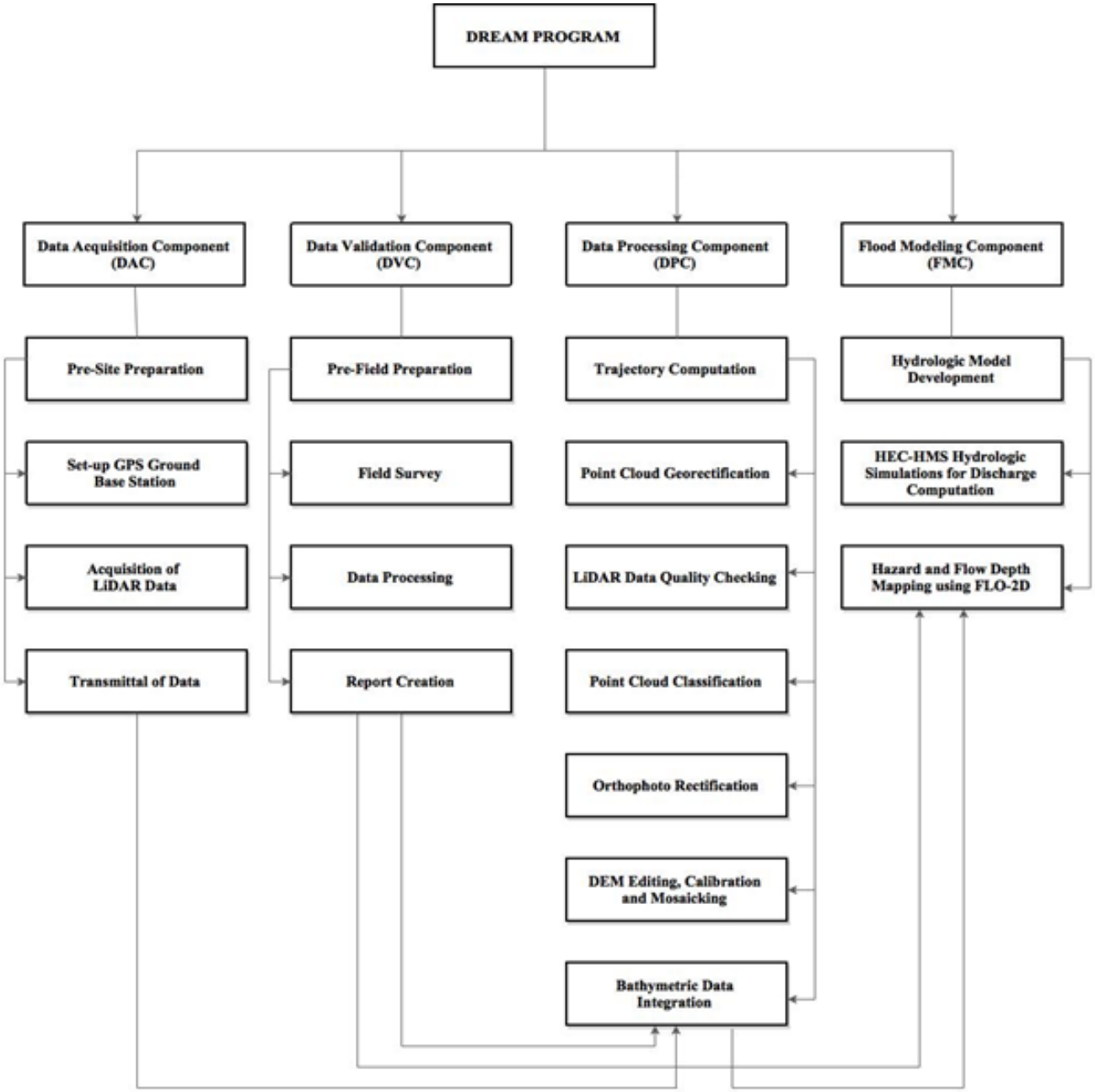


Figure 1. The General Methodological Framework of the Program

The Jalaur River Basin

The Jalaur River Basin

The Jalaur River Basin is located in the Island of Panay and covers the province of Iloilo. It is the second largest river in the island of Panay and the 17th largest river system in the Philippines in terms of drainage basin size. It has an estimated drainage area of 1,503 square kilometers and travels 123 kilometers from its source to its mouth in the Guimaras Strait. It drains the eastern portion of the island and traverses through Passi City and the towns of Leganes, Zarraga, Dumangas, Barotac Nuevo, Pototan, Dingle, Duenas, and Calinog.

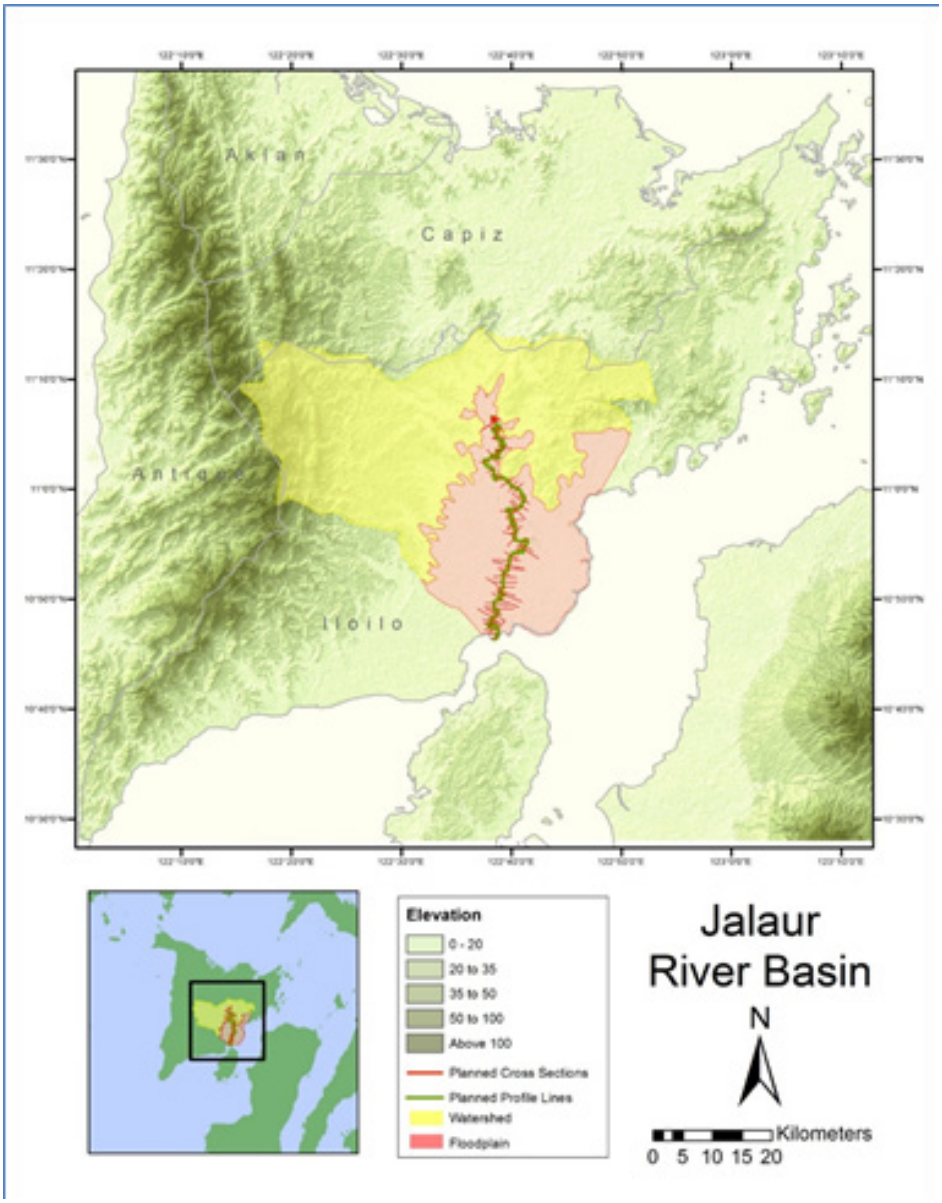
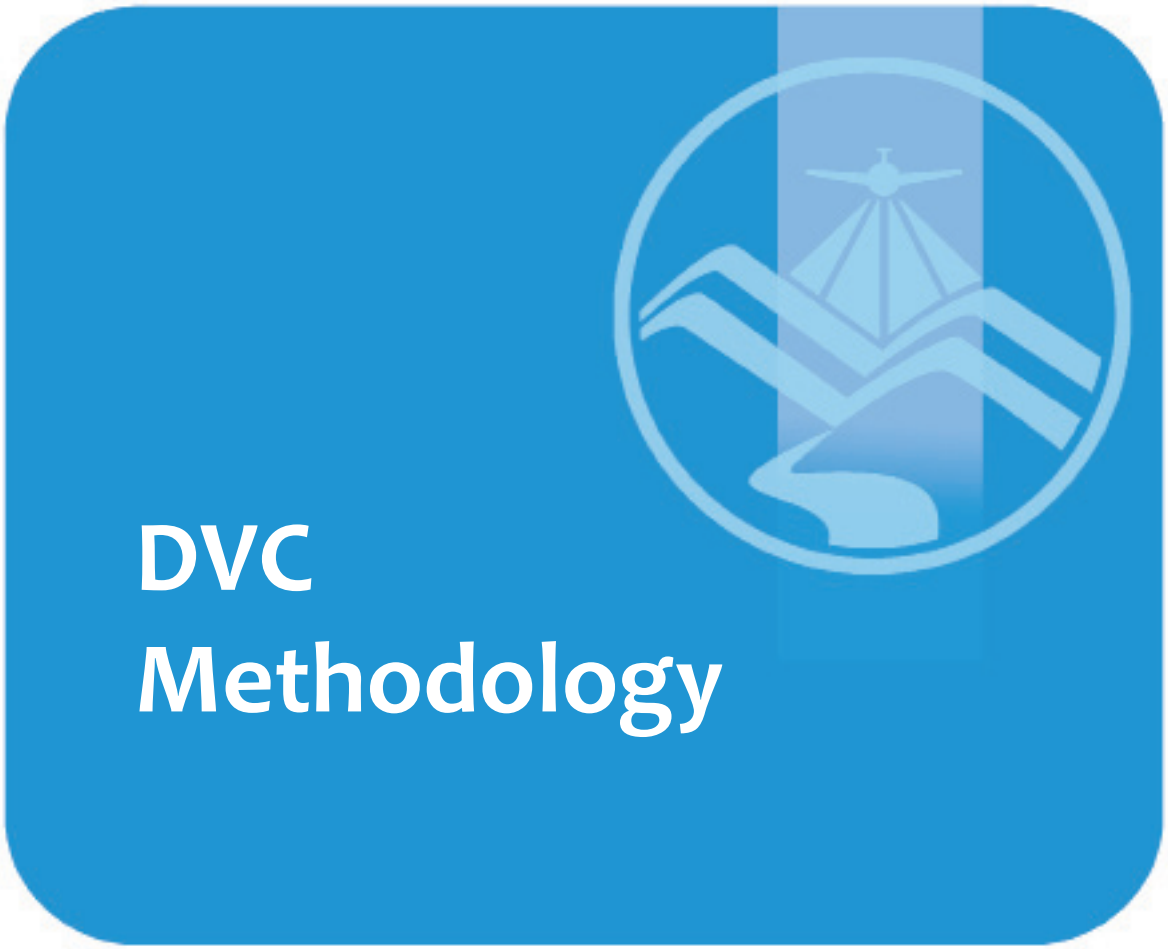


Figure 2. Jalaur River Basin Location Map

Some of the important parameters to be used in the characterization of the river basin (e.g. Manning's coefficient – a representation of the variable flow of water in different land covers) are the land cover and soil use. The shape files of the soil and land cover were taken from the Bureau of Soils, which is under the Department of Environment and Natural Resources Management, and National Mapping and Resource Information Authority (NAMRIA).



DVC Methodology

DVC Methodology

A set of activities were designed and implemented by DVC with four (4) main activities as shown in Figure 3.

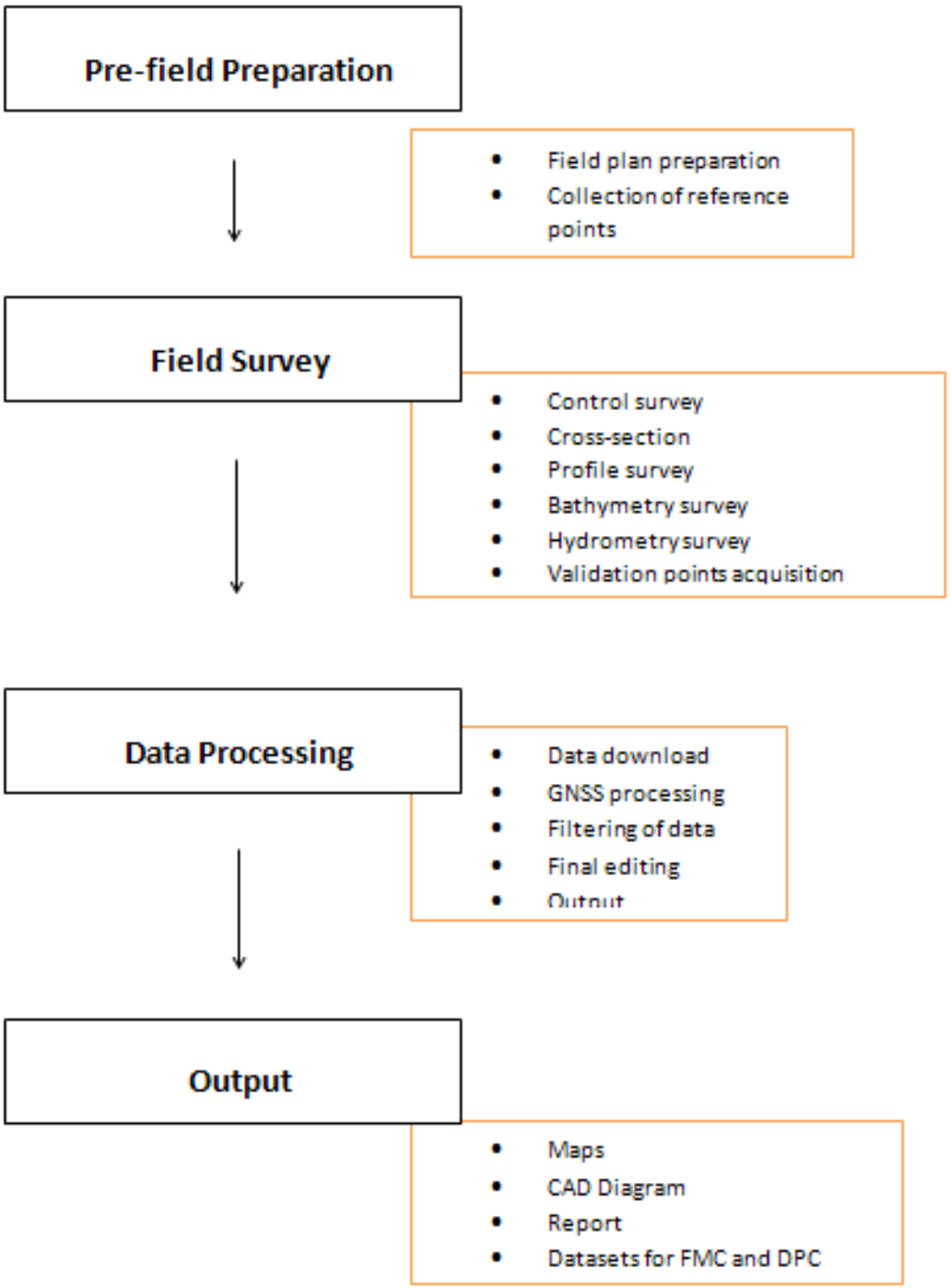


Figure 3. DVC Main Activities

DVC Methodology

3.1 Pre-field Preparation

3.1.1 Preparation of Field Plan

The planning for research fieldwork considers all the necessary technical and logistical concerns conceptualized in a field plan.

This serves as a basis and guide of the survey team in the implementation of the fieldwork activities and included the following activities:

- Delineation of bathymetry lines and determination of the river basin extent using Google Earth® images and available topographic maps;
- Listing and preparation of the survey equipment and other materials needed;
- Designation of tasks to DVC members for the field survey;
- Approximation of field duration and cost based on the delineated survey extent; and
- Assessment of the initial field plan by the program management for approval and implementation.

3.1.2 Collection of Reference Points

Technical data and other relevant information are collected from the National Mapping and Resource Information Authority (NAMRIA) such as locations and descriptions of established horizontal and vertical control points with a minimum of 2nd order accuracy. These ground control points and benchmarks are selected and occupied as primary reference points for the establishment of a GNSS network for the survey.

3.2 Field Surveys

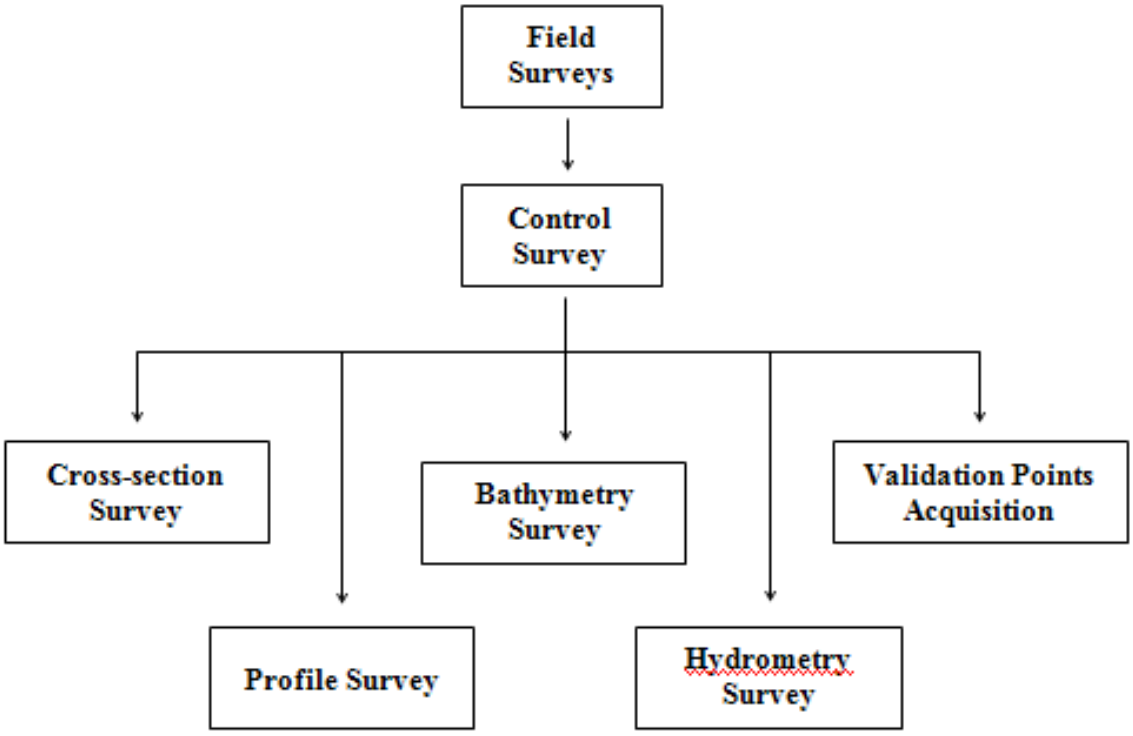


Figure 4. DVC Field Activities

3.2.1 Control Survey

A GNSS network is established through occupation of reference points with dual frequency GNSS receivers for four (4) hours. Reference points from NAMRIA only bear vertical coordinates (z or elevation value) and horizontal coordinates (x and y values) for benchmarks and ground control points, respectively.

Control survey aims to provide both the horizontal and vertical position for every control point established through network adjustment. Horizontal position is acquired through static survey while establishment of vertical position can be done either using a Total Station (TS) or digital level or through static survey.

For the vertical position control survey using a TS or Level, a double run is carried out connecting the nearest existing NAMRIA benchmarks (BMs) to the control point. A double run consists of a forward run (from BM to GCP) and backward run (from GCP to BM). The accuracy shall be assessed and accepted if it is within the third order differential leveling standard.

A benchmark may be used to refer elevation data to Mean Sea Level (MSL) within 20-km radius. Additional benchmarks are located for survey areas exceeding this 20-km radius.

Establishment of a GNSS network through control survey is pre-requisite for the conduct of other ground survey activities. Reference and control points occupied for the control survey may serve as base stations throughout the survey area.

3.2.2 Cross-section Survey

The objective of this activity is to derive a sectional view of the main river and the flood plain (right and left banks). Cross-sections are surveyed perpendicular to the riverbanks with an average length of 100 meters for each bank. The cross-section line shall follow the path of the nearby road or goat trails with a 10-meter interval for each point measurement. Additional points are obtained to describe apparent change in elevation along the cross-section line. Each cross-section is identified sequentially from upstream to downstream direction.

Cross-section surveys are done using dual frequency GNSS receivers and differential kinematic GNSS survey technique. The accuracy of the horizontal position and elevation of each individual cross-section surveys is within ±20 cm for horizontal and ±10 cm for vertical position residuals.

Areas where kinematic GNSS survey is not applicable due to the presence of obstructions such as tall structures and canopy of trees, conventional surveying techniques such as total stations and level are used to collect cross-sectional data.

3.2.3 Profile Surveys

Profile surveys are conducted to obtain the upper and lower banks of the river. This data is overlaid with LIDAR data to delineate the longitudinal extent of the river.

A profile survey consists of the Left Upper Bank (LUB) and Left Lower Bank (LLB), Right Upper Bank (RUB) and Right Lower Bank (RLB). An interval between successive profile points is approximately 10 meters. Additional points are gathered to describe apparent change in elevation along the profile line

Profile surveys are conducted using dual frequency GNSS receivers and kinematic survey technique with a prescribed vertical accuracies of ±20 cm for horizontal and ±10 cm for vertical position, respectively. Conventional surveying techniques such as total stations and level are used to collect profile data for areas where kinematic GNSS survey is not applicable due to obstructions such as tall structures and canopy of trees.

3.2.4 Bathymetric Survey

Bathymetric survey is performed using a survey-grade single beam echo sounder capable of logging time-stamped depth value in centimeter and dual frequency GNSS using kinematic survey technique, with prescribed vertical accuracies of ±20 cm for horizontal and ±10 cm for vertical position for rivers navigable by boat. Data acquisition is logged at one second intervals both for GPS positions and elevation and echo sounder depth reading

For portions of the river that is not navigable by boat due to shallow waterless than a meter, riverbed may be acquired using manual bathymetric survey. Manual bathymetric survey means manually acquiring riverbed points without the use of an echo sounder. It can be done using a GPS receiver, Total Station or Level.

3.2.5 Hydrometric Survey

Hydrometric survey consists of deployment of flow gathering sensors in order to produce a Stage-Discharge (HQ) computation for specific locations in the river such as in its upstream, tributaries, and downstream. This is done to determine the behavior of the river given specific precipitation levels.

The elements of discharge computation are the ff.:

- **River flow data –** river flow data can be acquired using an Acoustic Doppler Current Profiler (ADCP) or by mechanical or digital flow meters. River flow data sensors measure velocity of the river for a specific time period and interval.
- **Cross-section data –** cross section data is acquired using dual frequency GPS receivers to obtain the cross-section area of the river. Cross-section area of a river changes in time as influenced by water level change.
- **Water level change –** water level change is measured using either a depth gauge or an Automated Water Level Sensor (AWLS) installed by DOST. Depth gauges relates pressure to water level change while AWLS uses laser pulsed at specific time intervals for measurement.
- **Water surface elevation –** water surface elevation in MSL is measured near the banks of the river with dual frequency GPS receivers. This will refer the measured water level change to a corresponding elevation value in MSL in order to derive Stage or water level height a particular time.

Precipitation is the biggest factor influencing stage and river velocity. These two (2) sets of data must be synchronized by time in order to compute for its cross-section area, and subsequently, for discharge.

The element of time is crucial in determining the delay between the onset of precipitation and the time of significant water level change along key points of the river for early flood warning system of communities. The correlation of stage-discharge computation is used for calibrating flood-simulation programs utilized by the Flood Modeling Component (FMC).

The summary of elements for discharge computation is illustrated in Figure 5.

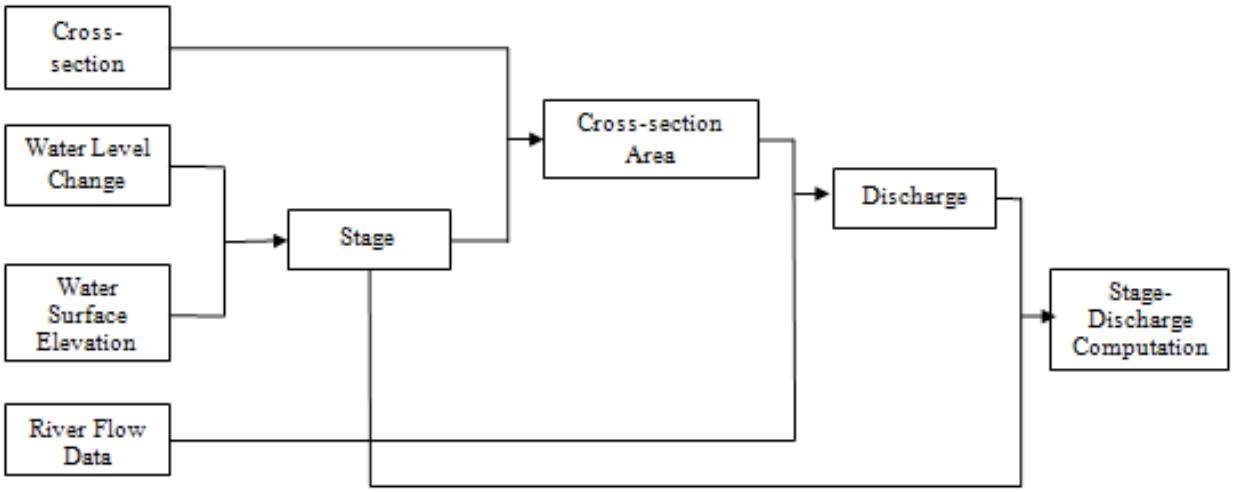


Figure 5. Flow Chart for Stage-Discharge Correlation Computation

3.2.6 Validation Points Acquisition Survey

Ground validation survey is conducted for quality checking purpose of the Aerial LiDAR data acquired by the Data Acquisition Component (DAC). A roving GNSS receiver is mounted on a range pole attached to a vehicle to gather points thru continuous topo method in a PPK Survey Technique. Points are measured along major roads and highway across the flight strips provided by DAC.

GNSS surveys setup used to accomplish DVC's field survey activities are illustrated in Figure 6.

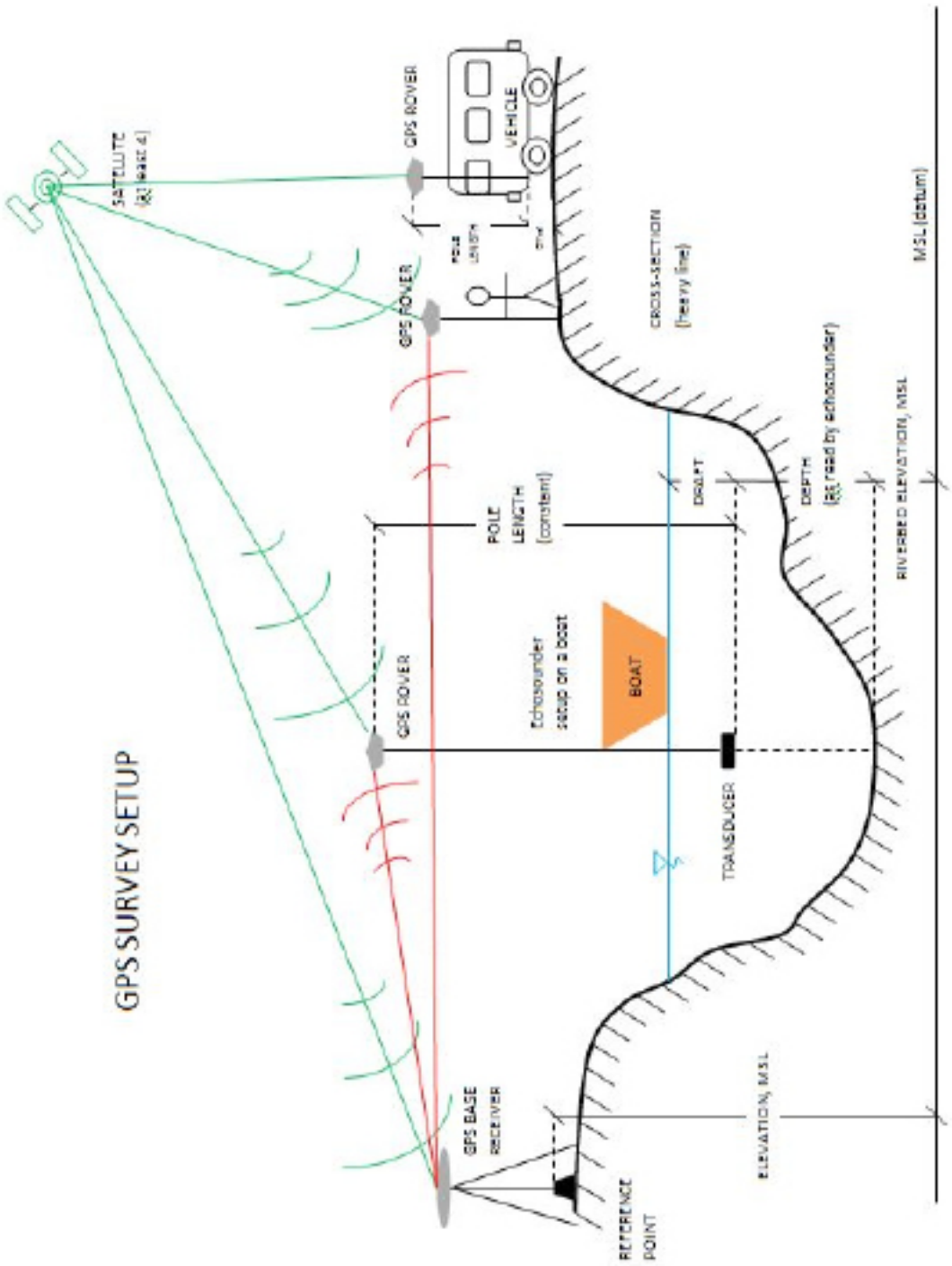


Figure 6. Set-up for GNSS Survey

3.3 Data Processing

Data processing procedures used by DVC are summarized in Figure 7.

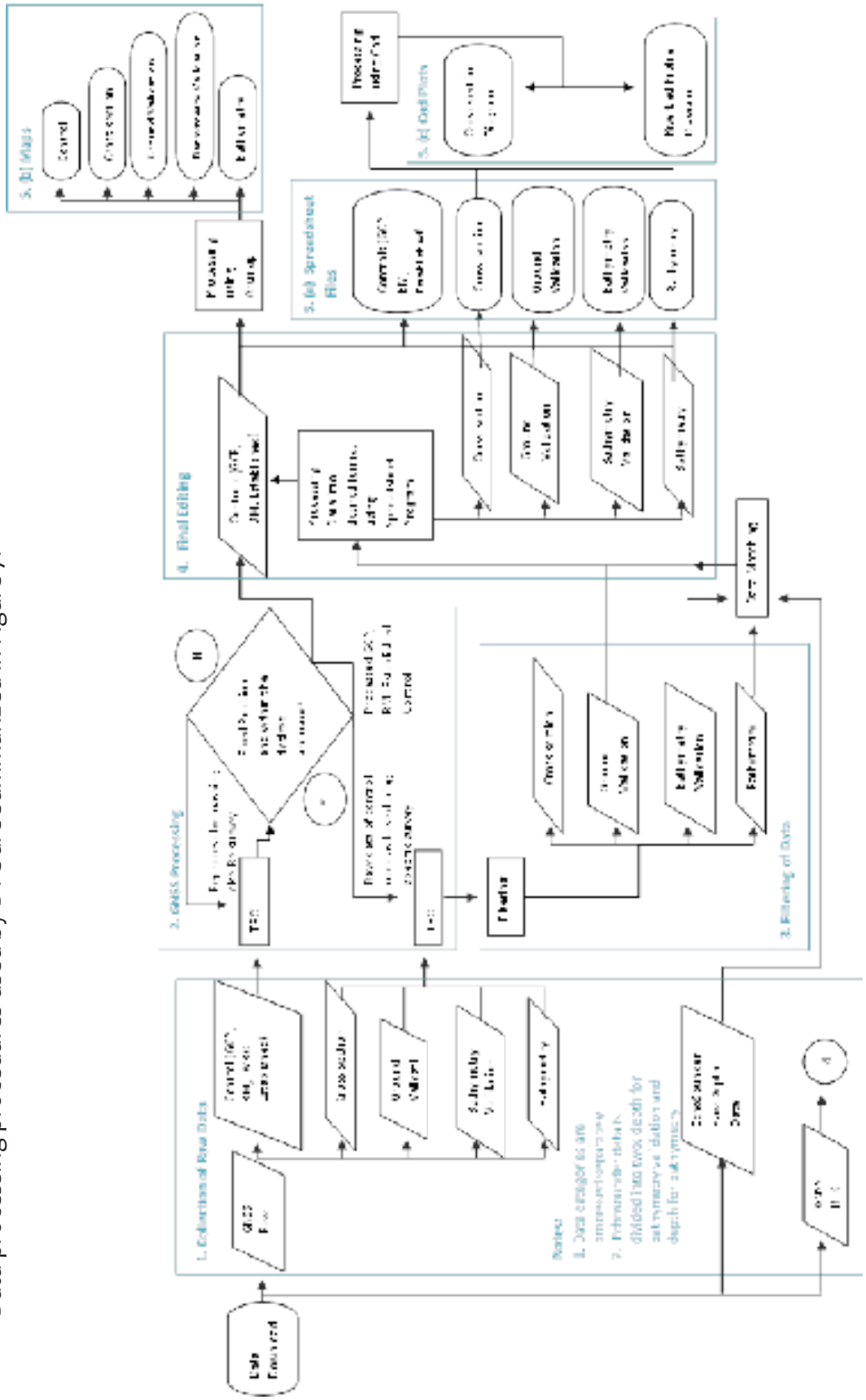


Figure 7. DVC Data Processing Methodology

3.3.1 Collection of Raw Data

GPS Raw data in (*.t02) format are downloaded from Trimble™ GPS receivers used in static, cross-section, LiDAR ground validation, and bathymetric surveys. Depth values in (*.som) files from bathymetric surveys are also downloaded from OHMEX® echo sounder.

3.3.2 Data Processing

Processing for GNSS Data

The horizontal and vertical coordinates of the reference point used as base station are held fixed, based on its NAMRIA certification, for the establishment of a GNSS network for the survey area. Coordinates of this fixed point is used to give horizontal and vertical coordinates for the other reference points occupied and control points established.

Data from GNSS control surveys are processed in Trimble™ Business Center (TBC) software and settings were set to the required accuracy of +/-10cm for vertical and +/-20cm for horizontal controls. The TBC coordinate system parameters were set to Universal Transverse Mercator (UTM) Zone 51 North, World Geodetic System of 1984 (WGS1984), and the geoid model EGM2008 for horizontal and vertical datum, respectively.

An offset is derived by comparing the MSL elevation of the benchmark stated in the NAMRIA certification and its elevation value that resulted from the processed and adjusted control survey. This offset is used to refer all elevation from other surveys into MSL (BM_Ortho).

The formulas used for offset and BM_Ortho computation are shown in Equations 1-2:

Computation for offset:

Equation 1:

$$OFFSET = BM - EGM$$

Computation for BM_ortho:

Equation 2:

$$BM_{\_ortho} = EGM_{\_ortho} \pm OFFSET$$

where:

OFFSET	= difference/offset between Geoid model, EGM 2008 and MSL datum. Can be a positive or negative value
BM	= MSL elevation of vertical control point certified by NAMRIA
EGM	= EGM2008 elevation of the same NAMRIA vertical control point derived from TBC software processing
EGM $_{Ortho}$	= elevation of points referred to geoid model, EGM 2008
BM $_{Ortho}$	= elevation of points referred to MSL

GNSS processing is also done for the other surveys with the coordinates from the occupied points for the control survey held fixed, depending on which base station is used for the survey.

Processed and adjusted data are exported to comma delimited (*.csv) file format with the ff. columns: Point Name, Latitude, Longitude, Ellipsoidal Height, Northing, Easting, and Elevation (EGM_Ortho). This file format can be accessed through Microsoft Excel/Spreadsheet program.

Depth Data Processing

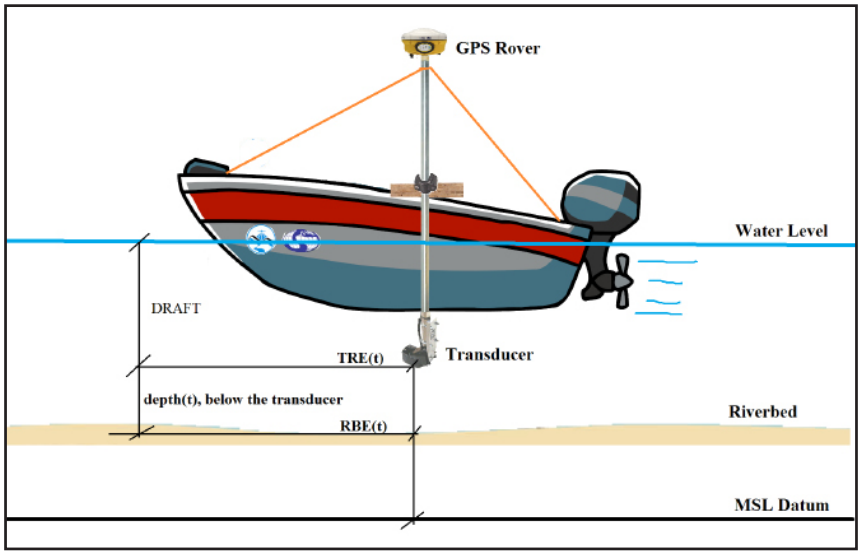


Figure 8. Illustration of Echo Sounder and GPS rover set-up for Bathymetric survey

There are two types of echo sounders used for bathymetric surveys – Hi-Target™ single beam echo sounder which is capable of recording depth data of one decimal place and the OHMEX™ single beam echo sounder capable of recording two-decimal places of depth data.

Raw depth data from Hi-Target™ single beam echo sounder is exported in (*.txt) file format with the ff. columns: Point No., Time, Depths H, Depths L, Draft, and Sound Velocity. This (*.txt) file is copied to a spreadsheet, retaining only the columns for Time and Depths H.

DVC Methodology

Raw depth data from OHMEX™ single beam echo sounder are exported in (*.som) file format. It is imported into SonarVista then exported into *.csv format with the ff. columns: Type, Date/Time, Sec, X/E, Y/N, Z/H, Tide, Depth and QA. SonarVista is used as file conversion tool only. The (*.csv) file opened using spreadsheet, making use of only the columns for Date/Time and Depth.

Data Matching for Bathymetric Data

Data matching is done by pairing an individual attribute of a bathymetric point to a depth data acquired using either OHMEX or HI-Target echo sounder. Matching is possible by ensuring that both bathymetric points and depth values acquisition has time stamp capability. These two sets of data are matched using VLOOKUP tool of a spreadsheet program, such that each point will have an accompanying (x,y,z) and depth data.

Below is the formula used for computing the elevation of the riverbed:

Equation 3:

$$RBE(t) = TRE(t) - Depth(t)$$

where:

RBE(t)	= elevation of the riverbed during time t,
TRE(t)	= transducer elevation (reckoned from EGM 2008)
Depth(t)	= depth recorded by the echo sounder at time t, with the assumption that depth is measured from the bottom of the transducer down to the riverbed

The resulting RBE(t) data are referred to MSL (BM_ortho) by applying the offset for the established network.

Final processed data are imported to Google Earth™ and Geographic Information Systems (GIS) software for viewing and checking horizontal position.

Hydrometry Data Processing

The processes done for Hydrometry data for HQ computation are described in the ff. steps:

1. **River Flow Data**

   a.) ADCP

   Data from the ADCP is logged internally and can be downloaded using either SonUtils™ or View Argonaut™ software. River velocity is recorded for a specified time duration and interval can be exported in a (*.csv) format.

   b.) Flow Meter

   Acquisition of river velocity using flow meters is done manually. Measurements for a specified time duration and interval is recorded in a field notebook and saved in a spreadsheet program.

2. **Cross Section and Water Surface Elevation Data**

   Cross Section data and water surface elevation data is acquired using GNSS receivers described in section 3.3.4 for GNSS data processing with a resulting file in (*.xls) format.

3. **Water Level Change-Stage**

   a.) Depth Gauge

   Data from depth gauge can be downloaded using HobowarePro™. Water level in meters are logged for a specific time interval and it can be exported in a (*.csv) format.

   b.) AWLS

   Data from installed AWLS can be accessed via the internet (http://repo.pscigrid.gov.ph/predict/). Water levels are logged in ten-minute time intervals and can be copied into a spreadsheet program.

4. **Discharge Computation**

   River flow data and water level change is synchronized by time. Parameters were preset in its respective programs so the deployment of each instrument will begin and end in the same time. All data in (*.csv) and (*.csv) format are combined in a single worksheet wherein the computation for the coefficient of determination or R2 are done.

The illustration in Figure 6 shows how each set of data from each instrument can be synchronized.

3.3.3 Filtering of Data

A processed point which resulted to float or did not meet the desired accuracy is filtered out. Resurveys are conducted immediately if data gaps are present for the ground surveys.

3.3.4 Final Editing

Final editing is performed to be able to come up with the desired data format: Point Value, Latitude, Longitude, Ellipsoidal Height, Northing, Easting, EGM_Ortho and BM_Ortho.

Processes discussed are valid for static, cross section, ground validation, and manual bathymetric surveys not employing echo sounders. For bathymetric surveys using a single beam echo sounder, the GPS rover is mounted on top of a 2m pole and a transducer at the bottom (see Figure 10). Figure is valid in both using OHMEX and HI-Target echo sounders. The GPS rover provides horizontal and vertical coordinates whereas the echo sounder transducer measures depth of the river from its bottom down to the riverbed.

3.3.5 Output

Filtered data are furthered processed into desired template using a spreadsheet program. Final data are generated into maps and CAD plots for cross-section, profile, and riverbed profiles. Cross-section, Profile, Validation Points, and Bathymetric data shall be turned-over to DPC while hydrometric data shall be turned-over to FMC.

Jalaur River Basin Survey

Jalaur River Basin Survey

The survey for Jalaur River Basin was conducted on February 5 to 23, 2013 with the following activities: control survey, cross-section, and hydrometric surveys.

The Jalaur River System runs through the provinces of Antique, Capiz and Iloilo. The headwaters start in Passi City. The survey was conducted from the headwaters down to its mouth towards Guimaras strait. AB Surveying and Development was outsourced to conduct the survey activities.

Another set of data gathering were conducted on October 24 – 27, 2013 for the five (5) installed AWLS on the mainstream (Jalaur River) namely Calinog, Passi, Moroboro dam, Pototan and Zaraga Bridges, and two (2) on the tributaries namely Ulian and Suage Bridges. ILO-66 at Dingle was occupied as base for the GPS surveying. The team established points on the concerned bridges and conducted static survey. The established points will serve as reference points with elevation above MSL.

4.1 Control Survey

The offset used for referring elevation to MSL was derived from an established GNSS Network in Iloilo for the Jalaur River cross-section reconnaissance, bathymetric, and flow measurements survey on February 5-23, 2013 is summarized in Table 1. Four control points were occupied for static observation to establish the position of reference base stations for the GNSS survey. The reference point ILO-66 was used to get horizontal and vertical coordinates to the established control points on the approach of bridges along the Jalaur River System.

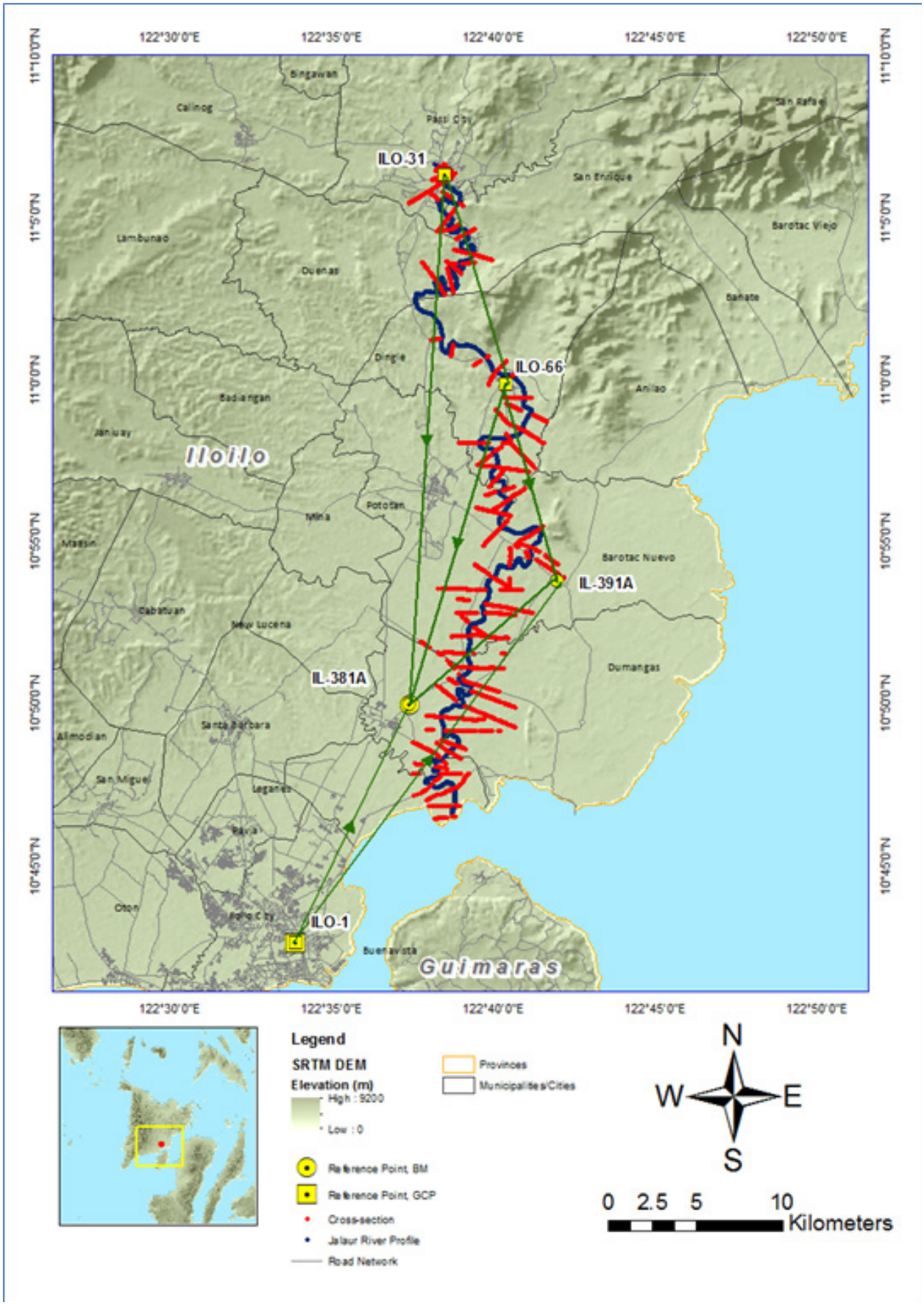


Figure 9. Location of control points established and cross section site

Table 1. Control points occupied during Hijo River Survey (Source: NAMRIA, UP-TCAGP)

Base Station	Order of Accuracy	Latitude	Longitude	Ellipsoidal Height (m)	Northing (m)	Easting (m)	Elevation (MSL) (m)
ILO-1	1st	10d42'36.468" N	122d33'53.592" E	83.433	1183962.237	452420.308	25.017
ILO-31	3rd	11d06'18.977" N	122d38'30.637" E	97.328	1227642.944	460887.352	39.198
IL-391A	1st	10d53'48.054" N	122d41'59.841" E	71.433	1204571.776	467210.527	12.837
IL-381A	1st	10d49'59.045" N	122d37'26.797" E	65.84	1197547.123	458913.159	7.513
ILO-66	2nd	10d59'51.744" N	122d40'23.877" E	84.815	1215745.274	464309.479	26.333

Figure 10. Static GNSS observation at ILO-1 on top of St. Clement's Bell Tower in Jaro District, Iloilo City

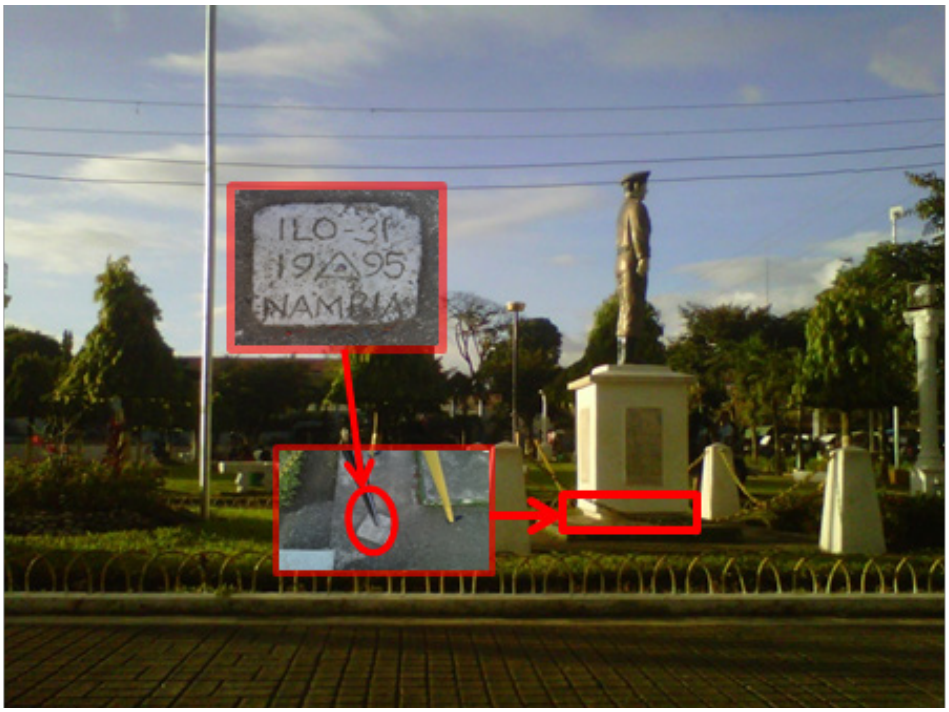


Figure 11. Static GNSS observation at ILO-31 in Passi City Plaza, Brgy. Poblacion, Passi City

Figure 12. Static GNSS observation at conrol point IL-391A along the Anilao-Zarraga National Highway in Barotac Nuevo

Figure 13. Recovery of the reference point ILO-66 in Brgy. Poblacion, Dingle

4.2 Reconnaissance of Cross-section and Profile Lines

Proposed cross-section lines in (*.gpx) file format were loaded in Garmin® Oregon 550 handheld GNSS receiver for the survey team to locate in site. The cross-section team started the ocular inspection from pre-determined starting points at the edge of the river bank. The team walked following the designed path for each cross-section line until reaching the pre-determined end point. The survey team took geo-tagged images of these pre-determined points and noted whether the design paths of each cross-section are traversable or not.

Cross-section reconnaissance was done by the team to determine the feasibility of proposed cross-section lines, to be outsourced later on for contractors. The designed path for cross-section lines will be followed by contractors to determine the horizontal position (Easting and Northing) and vertical (Elevation) measurements at a specific interval while traversing across the floodplain from the riverbanks.

Figure 14. Reconnaissance of start and end-points of planned cross-section lines

4.3 Bathymetric Survey

The underwater terrain of the river channel was determined using an echo sounding surveying technique. Hi-Target™ HD-370 Digital VF Single Beam echo-sounder was used for the bathymetric/hydrographic survey that measured the depth of the river. The Hi-TargetTMEchosounder has a Variable Frequency Technology which has the capability to adjust the frequency to a particular application in water sounding.

The coordinates of these points were measured using differential GNSS PPK mode in which a PPK base station was set-up on a known location at ILO-66 in Dingle and IL-319 in Barotac Nuevo, and a roving GNSS receiver, Trimble®SPS882, mounted above the transducer which determined the position of the points obtained by the echo-sounder. The GNSS rover was wirelessly connected to the Trimble®TSC3 GNSS controller which was used for logging and viewing the gathered GNSS points. Figure 15 shows the entire set-up for the bathymetry survey.

The entire bathymetry survey took twelve (12) days to accomplish from February 7 to 21, 2013. In order to fully capture the topography of the riverbed, the bathymetry survey was done in two directions, one is along the centerline which approximates the thalweg of the river while the other courses through the river in a zigzag fashion, from one bank to the other.

The echo sounder cannot measure data for waters whose depth is less than a meter. Manual bathymetry survey was conducted utilizing a Trimble® TSC3 GNSS controller and a Trimble® SPS882 GNSS rover mounted on a 2-m pole in shallow areas of the river. Data was processed using Trimble® Business Center Software.

Figure 15. The setup of instruments for bathymetry survey with Trimble®SPS882 mounted on top of the Hi-Target™Transducer

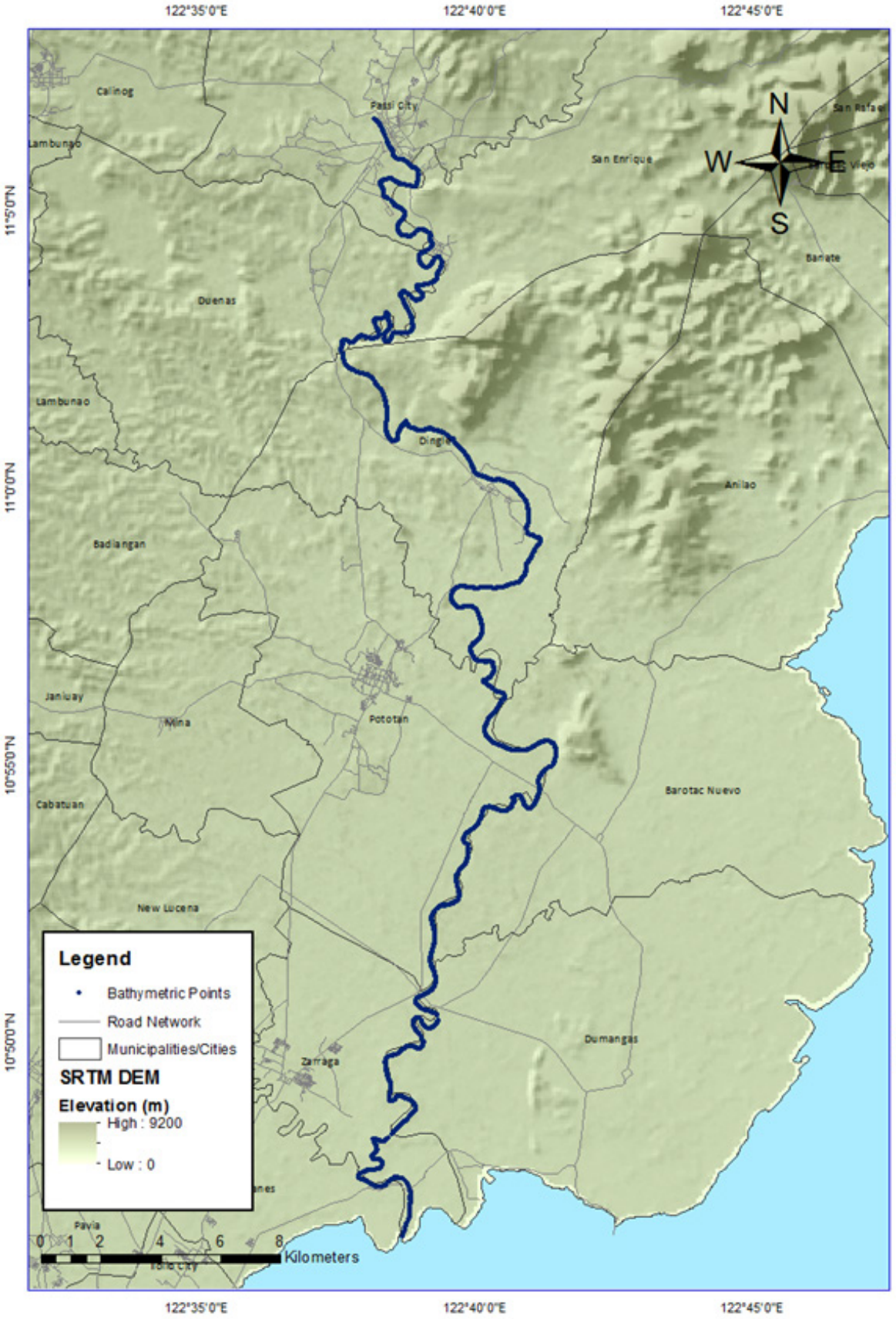


Figure 16. Bathymetric data in Jalaur River

4.4 Hydrometric Survey

The data gathered from the rain gauge show the distribution of rainfall within the observation period (February 9 to 18). Measurements were recorded every five (5) minutes. The first surge of rainfall, reaching 0.2 mm, was observed on February 9 at 12:00 AM. Rainfall peaked on February 11 at 1.4 mm. The highest amount of rainfall, at 1.4 mm, was observed on February 11 at 3:30 PM. Figure 18 shows peaks in the amount of rainfall corresponded with peaks in stage. Plotting of hydrometric data gathered for water velocity & rainfall and water level & velocity and stage are shown in Figure 19 and Figure 20, respectively. Discharge is also measured by multiplying the velocity of the river (measured by the ADCP) and the cross-sectional area within the polygon bounded by the stage and cross-section (Figure 21 and Figure 22).

The survey team deployed the ADCP and depth gauge along the six tributaries of the Jalaur River for one hour each for two days (See Table 2). Local hires were employed in Barangay Poblacion, Passi City to monitor the depth gauge, rain gauge and ADCP in Jalaur River. Three rain events were recorded after continuous data gathering for 11 days starting from February 8 to 18, 2013.

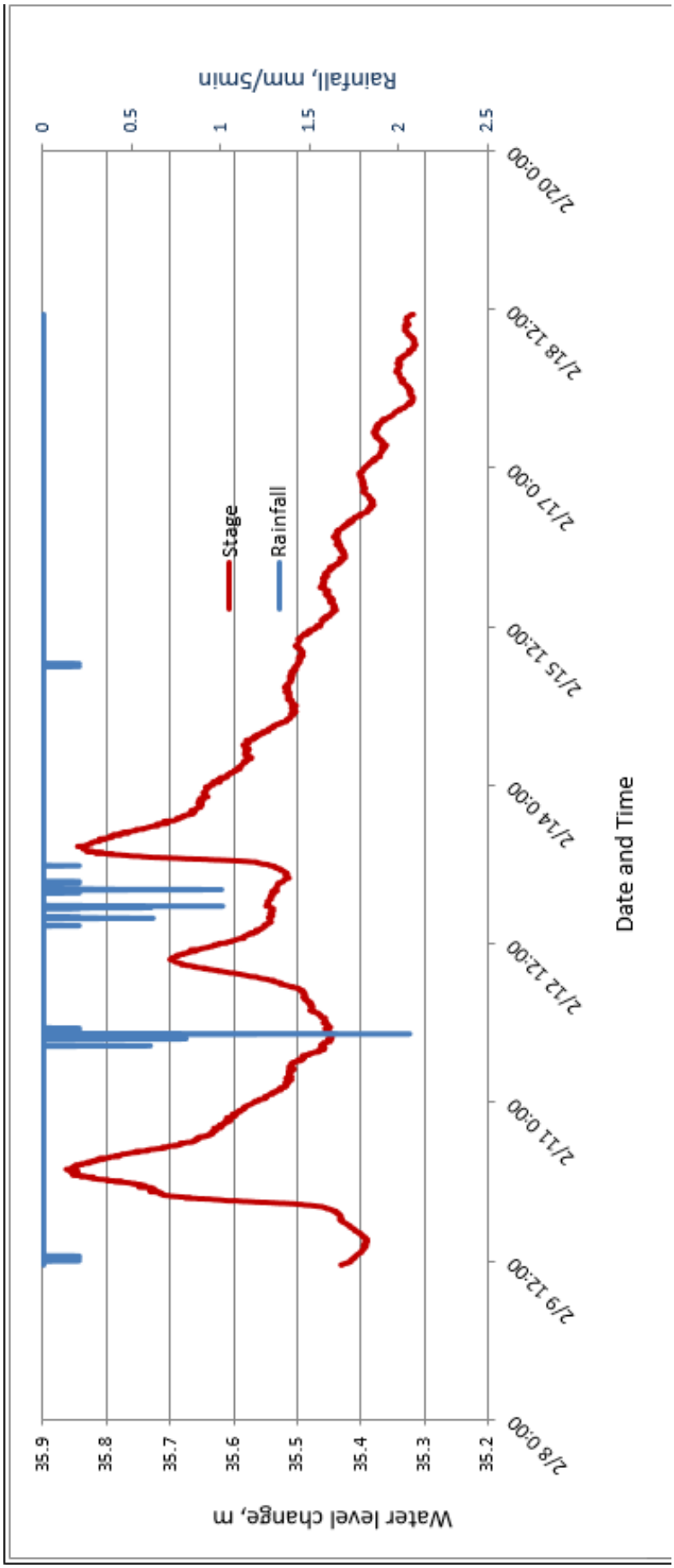


Figure 17. Graph showing the relationship between stage and rainfall of Jalaur River within the observation period

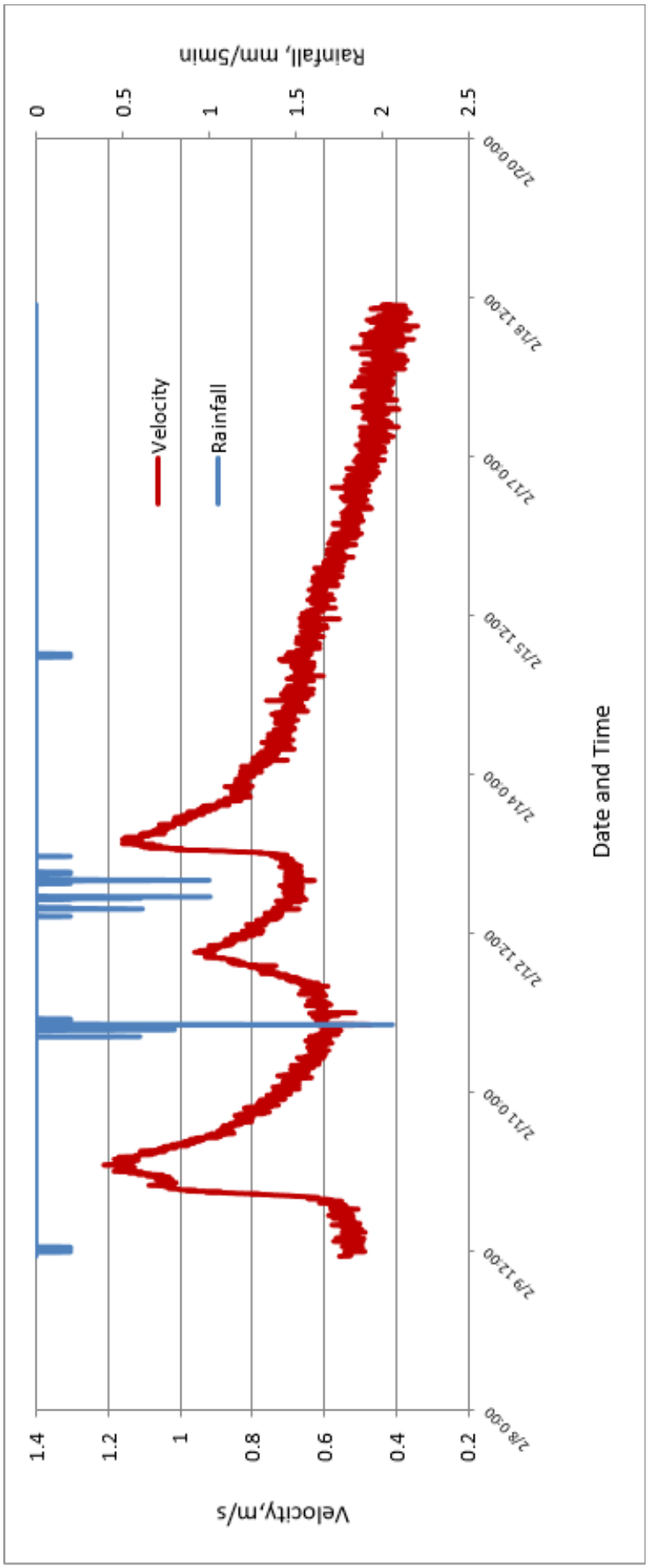


Figure 18. Graph showing the relationship between velocity and rainfall of Jalaur River within the observation period

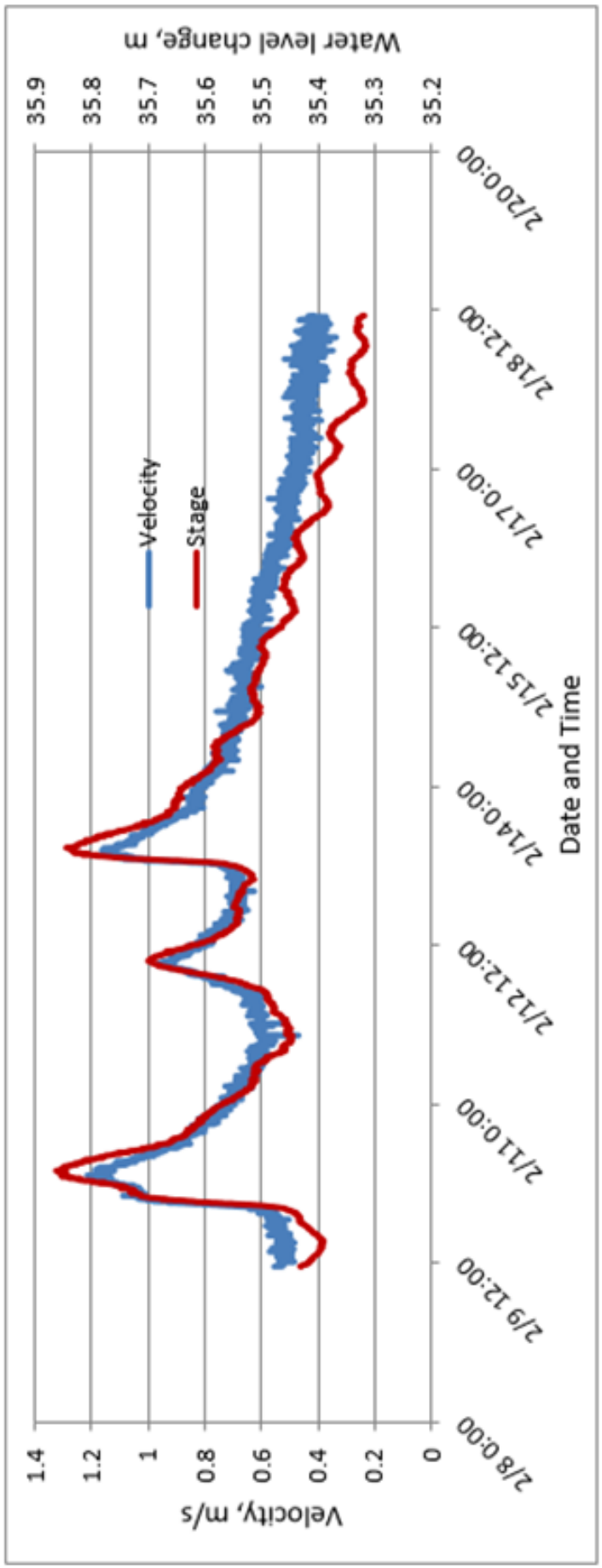


Figure 19. Graph showing the relationship between water velocity and stage of Jalaur River within observation period

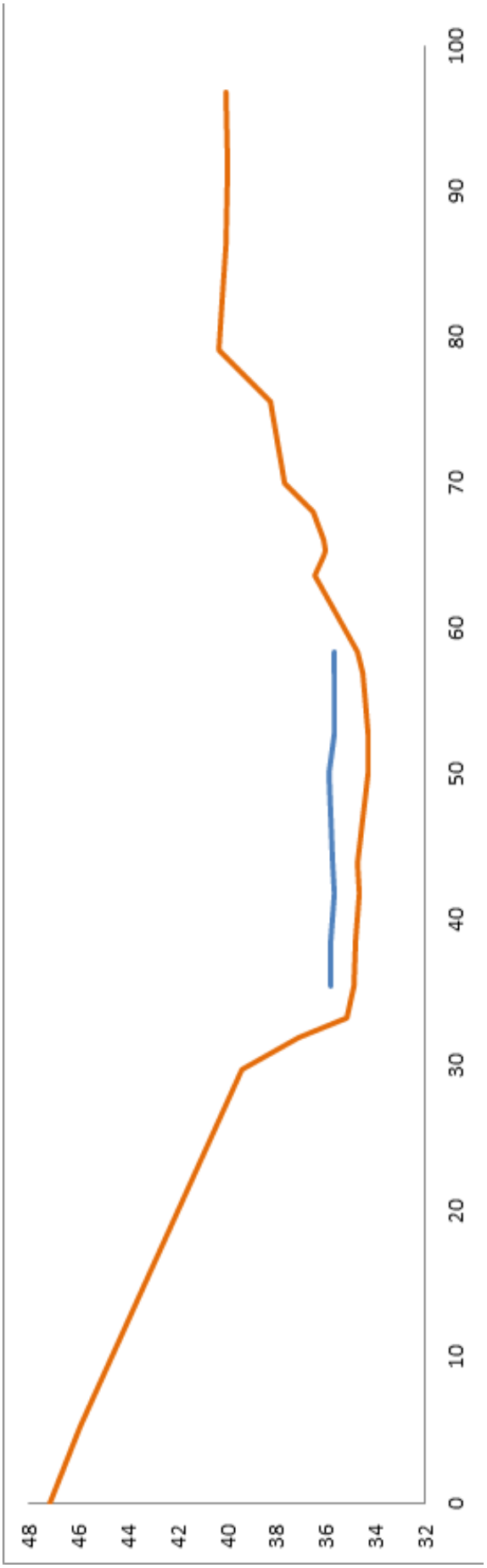


Figure 20. Graph showing the stage and cross section along the ADCP deployment site in Brgy. Poblacion, Passi City

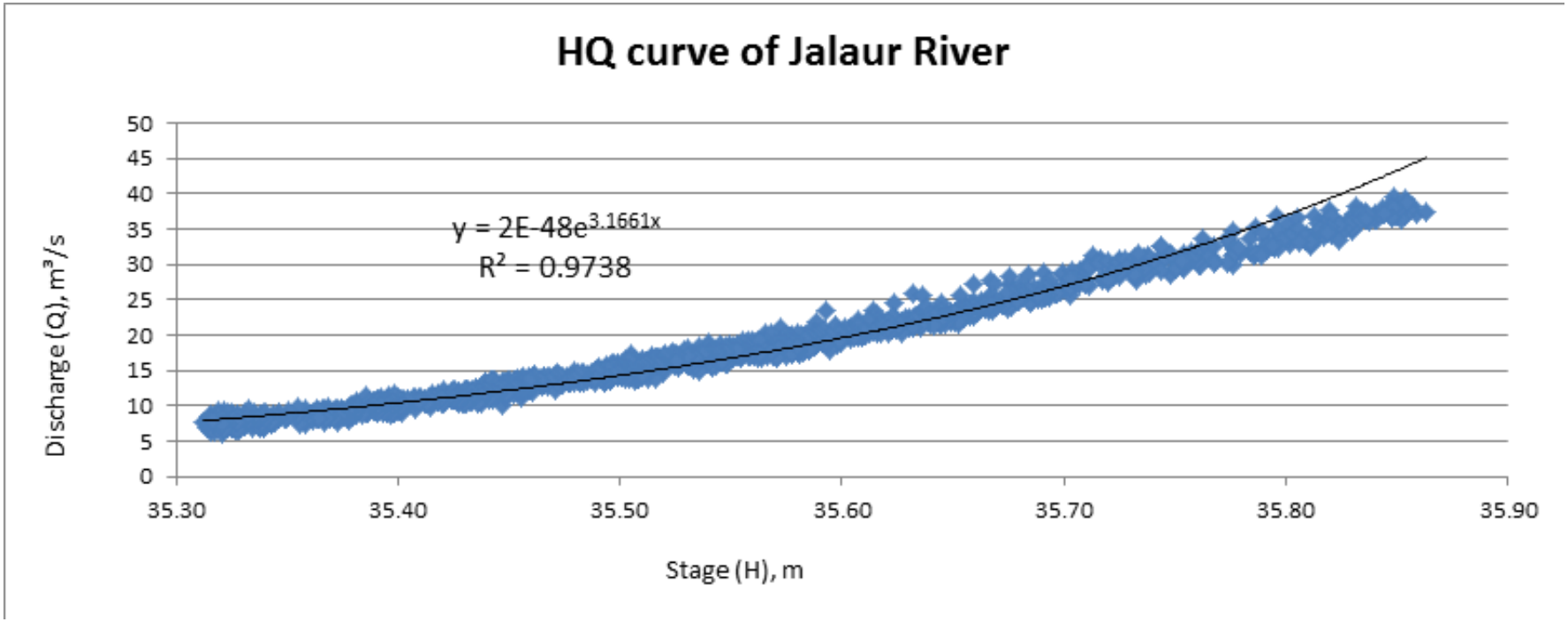


Figure 21. Graph showing the derived rating curve along Jalaur River

Two (2) local hires living within the vicinity of the bridge were employed to gather flow measurements. Two types of events were recorded by the team – (1) base flow or the normal stream flow, without the influence of a precipitation. In this scenario, local hires were tasked to record the velocity of the river for two hours each in the morning and afternoon for a single day; and (2) the flow of the river during the occurrence of a rain event.

Two rainfall events were needed prior retrieval of the flow meters. In this type of event, the water velocity was recorded for six-hours straight while precipitation was on-going, day and night. Continuous recording of flow measurements were done until two rain events were observed.

No rainfall event was observed for Cahigon and San Miguel Bridges. The flowmeter was entrusted to a local hire for flow data gathering as shown in Figure 19.

Figure 22. A series of pictures displaying the components and deployment of the ADCP in Maniniw River

Table 2. List of ADCP deployed and their respective locations

LOCATION			DATE	DURATION
DESCRIPTION	EASTING	NORTHING		
Jagdon River	459242	1220789	7-Feb-13	1 hour
Suage River	460139	1210175	7-Feb-13	1 hour
Maniniw River	463214	1210539	7-Feb-13	1 hour
Asisig River	464686	1227714	8-Feb-13	1 hour
Tambunac River	465828	1224693	8-Feb-13	1 hour
Ilajas River	464962	1216486	8-Feb-13	1 hour
Jalaur River	460399	1228120	Feb. 8-18 2013	11 days

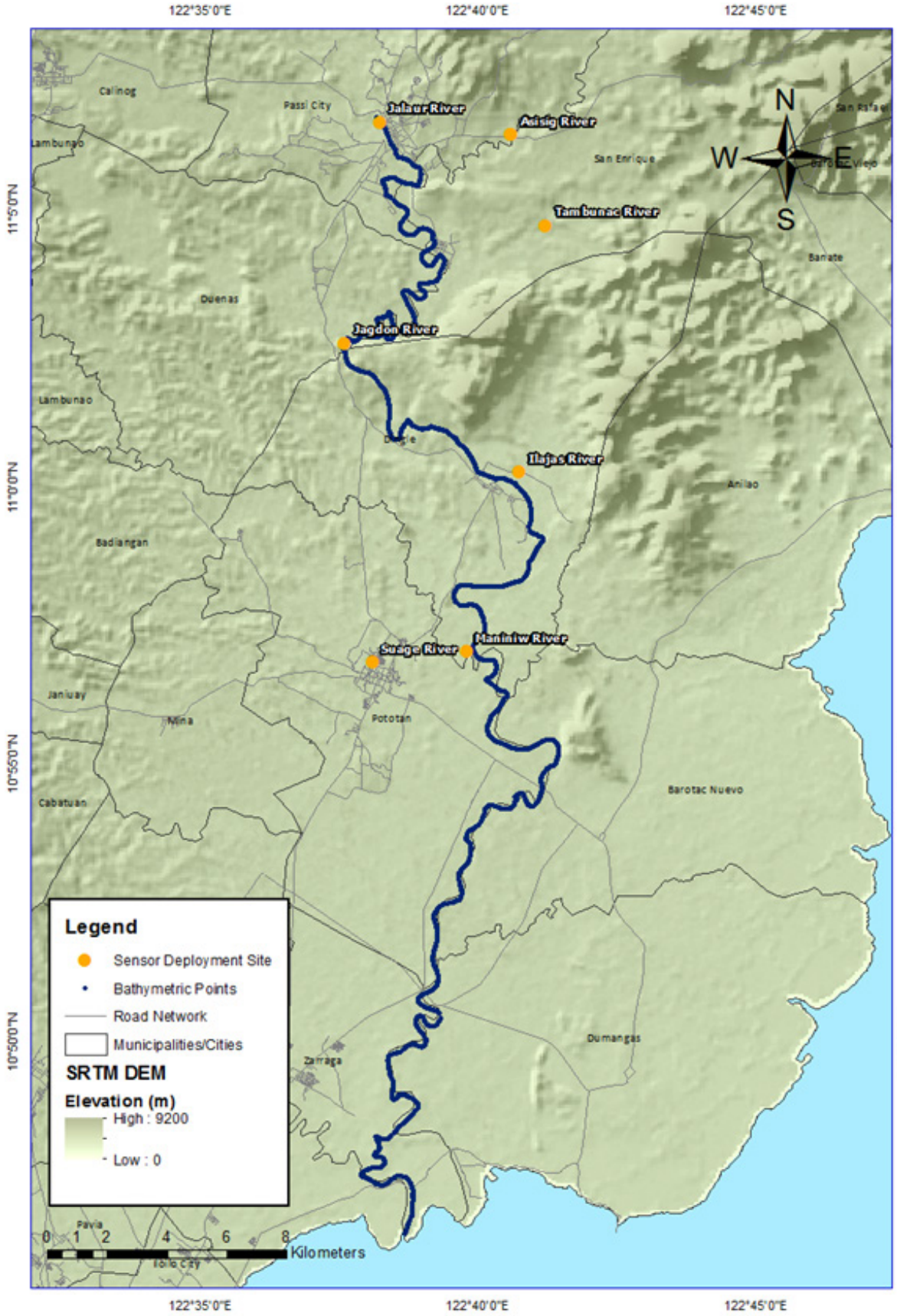


Figure 23. Location of ADCP sensors in Jalaur River

Jalaur River Basin Survey

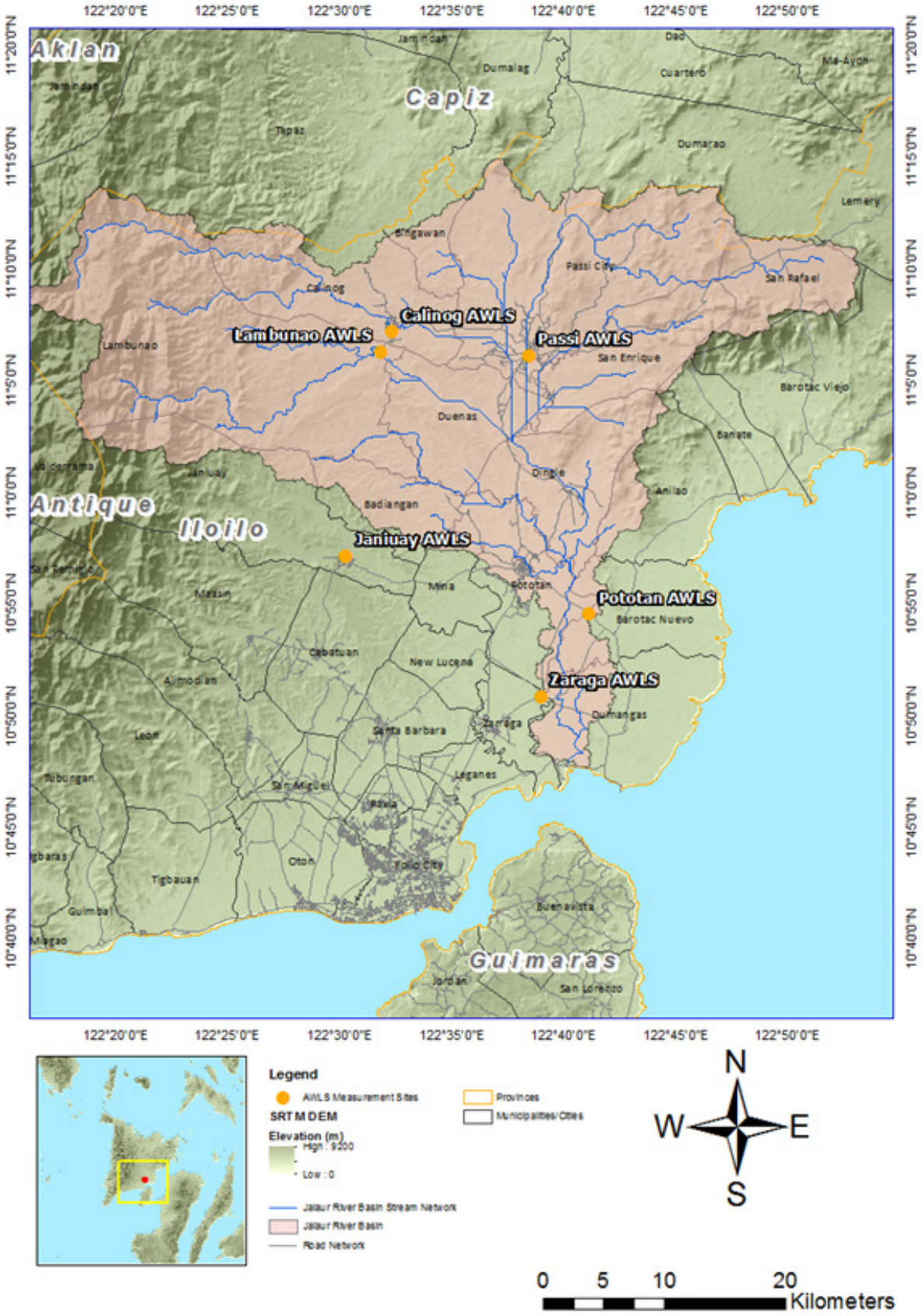


Figure 24. Jalaur River AWLS Survey Extent

Jalaur River Basin Survey

The data gathering were conducted on October 24 – 27, 2013 for the five (5) installed AWLS on the mainstream (Jalaur River) namely Calinog, Passi, Moroboro dam, Pototan and Zaraga Bridges, and two (2) on the tributaries namely Ulian and Suage Bridges. ILO-66 at Dingle was occupied as base for the GPS surveying. The team established points on the concerned bridges and conducted static survey. The established points will serve as reference points with elevation above MSL.

The following series of diagrams show the cross-sectional view with elevation in MSL of respective AWLS and water surface on specific date and time.

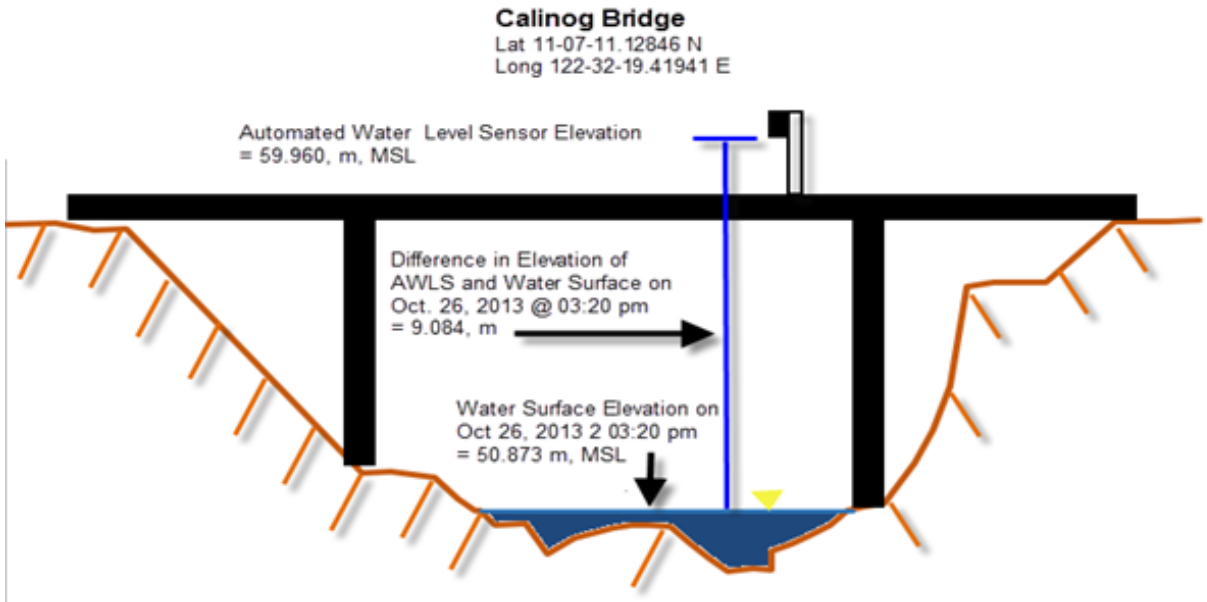


Figure 25. AWLS in Calinog Bridge, Calinog, Iloilo

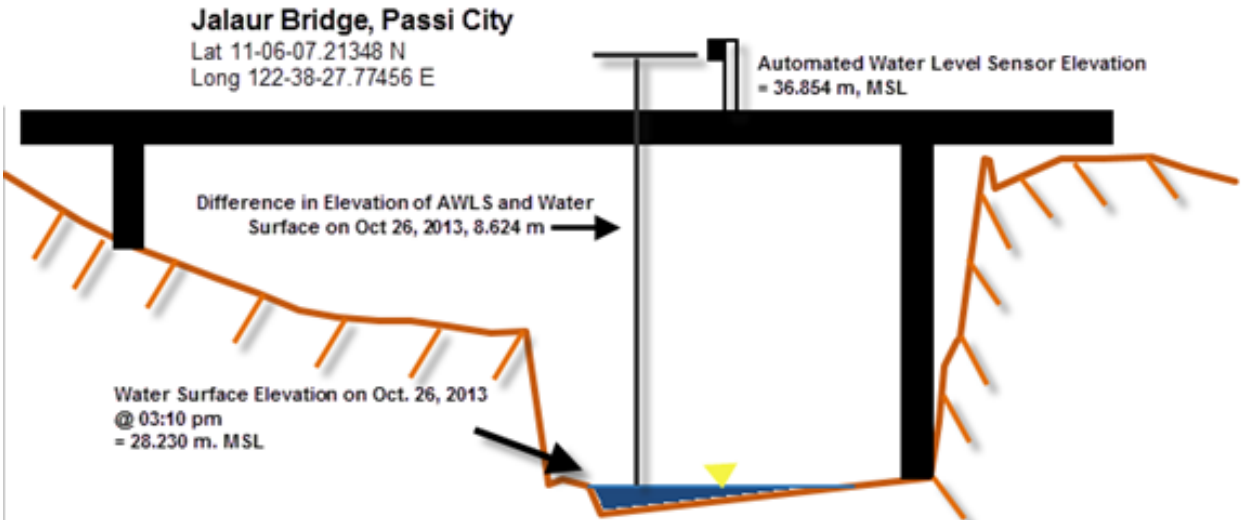


Figure 26. AWLS in Jalaur Bridge, Passi City, Iloilo

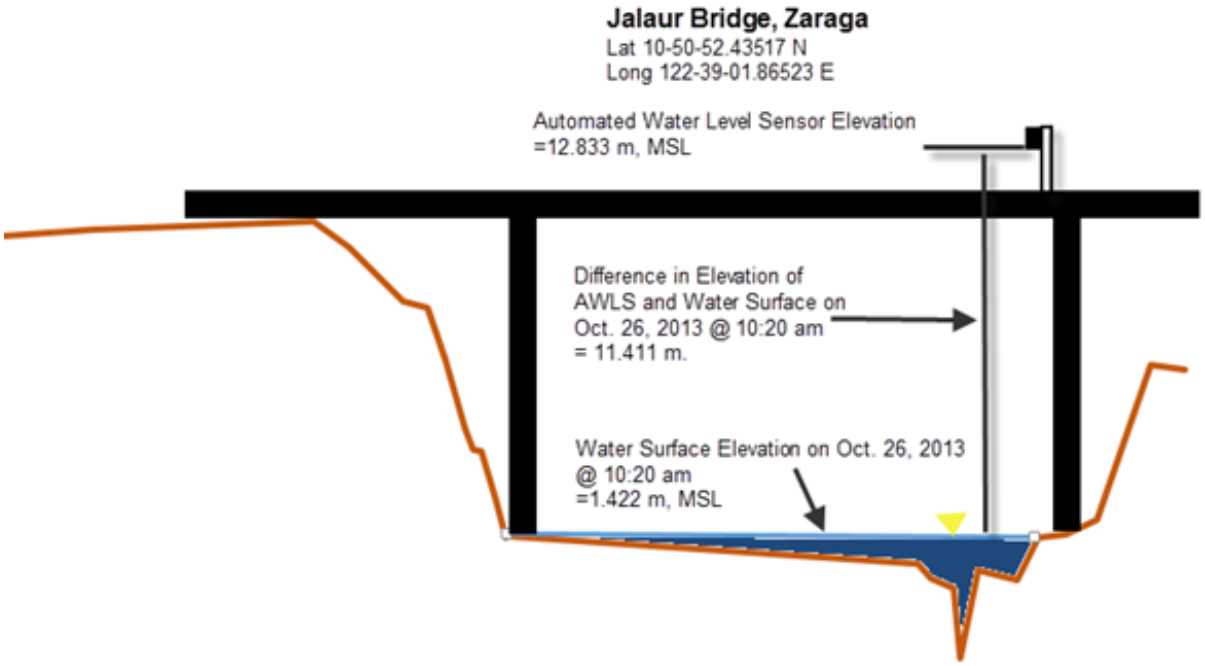


Figure 27. AWLS in Jalaur Bridge, Zaraga, Iloilo

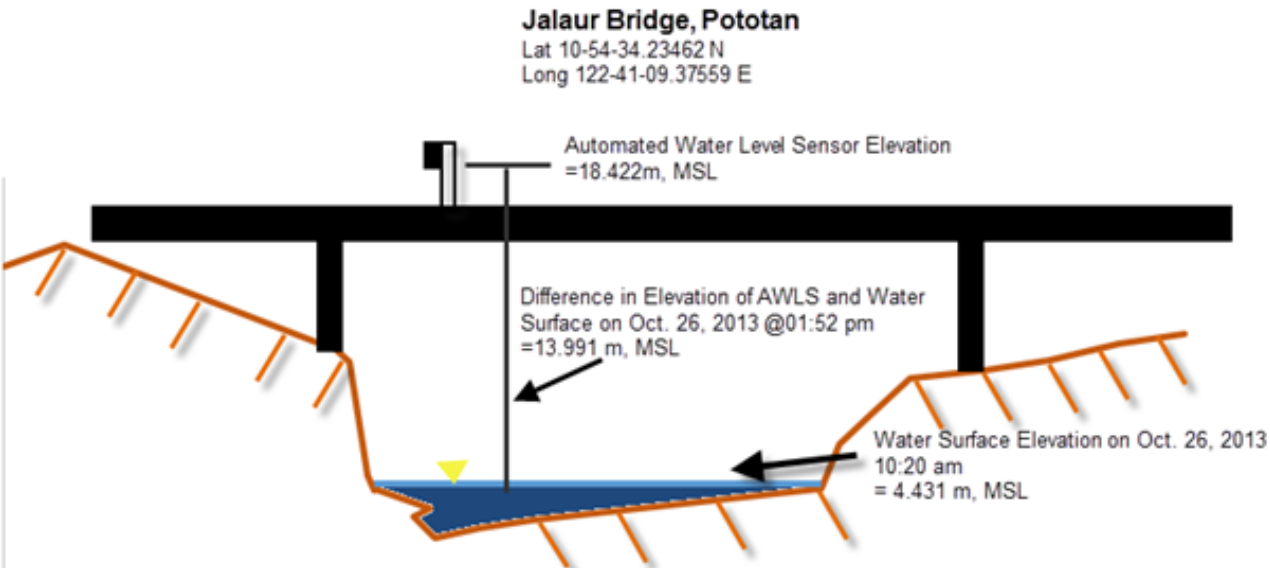


Figure 28. AWLS in Jalaur Bridge, Pototan, Iloilo

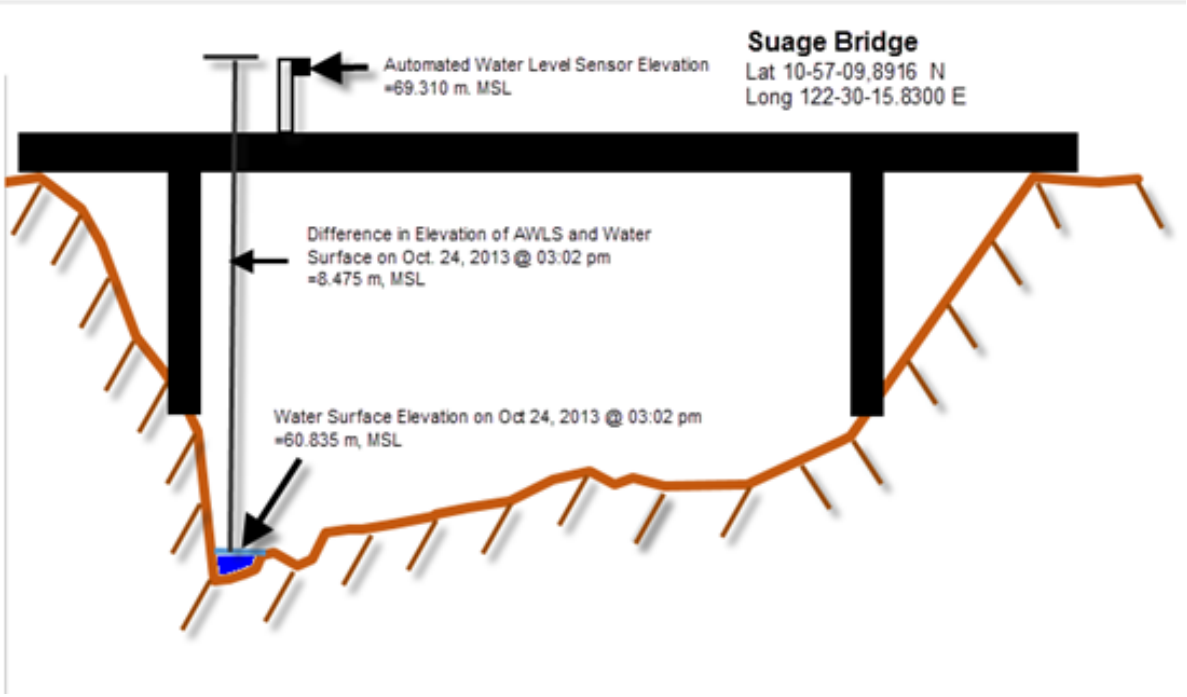


Figure 29. AWLS in Suage Bridge, Janiuay, Iloilo

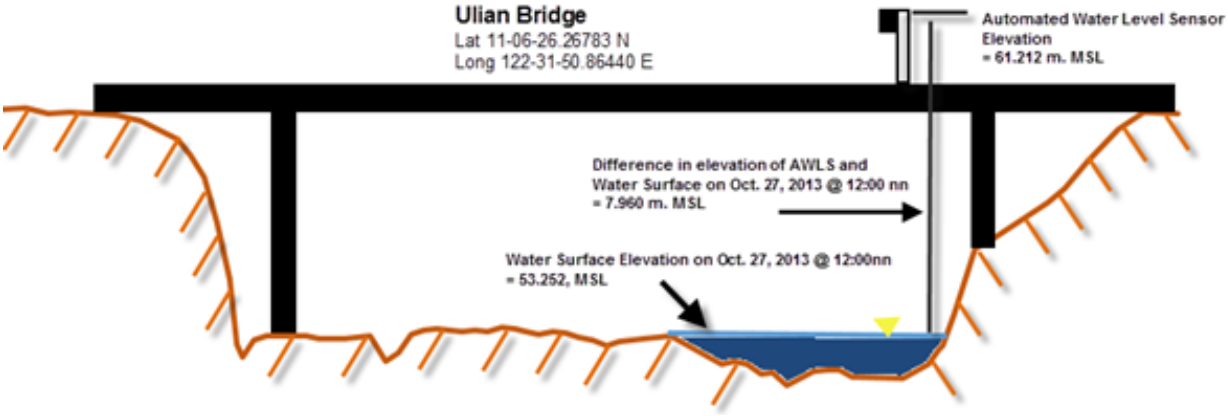


Figure 30. AWLS in Ulian Bridge, Lambunao, Iloilo

The following diagrams show the obtained hydrometric properties of Jalaur River at Calinog bridge, Jalaur bridges at Passi City and Pototan, Suage Bridge and Ulian Bridge.

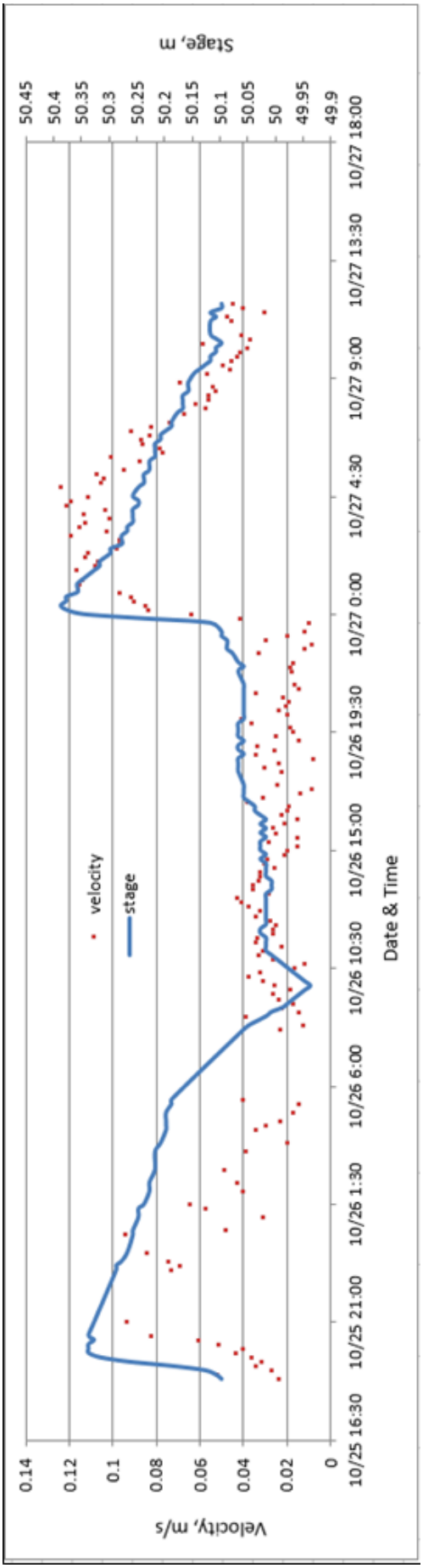


Figure 31. Relationship between Velocity vs Stage at Calinog Bridge

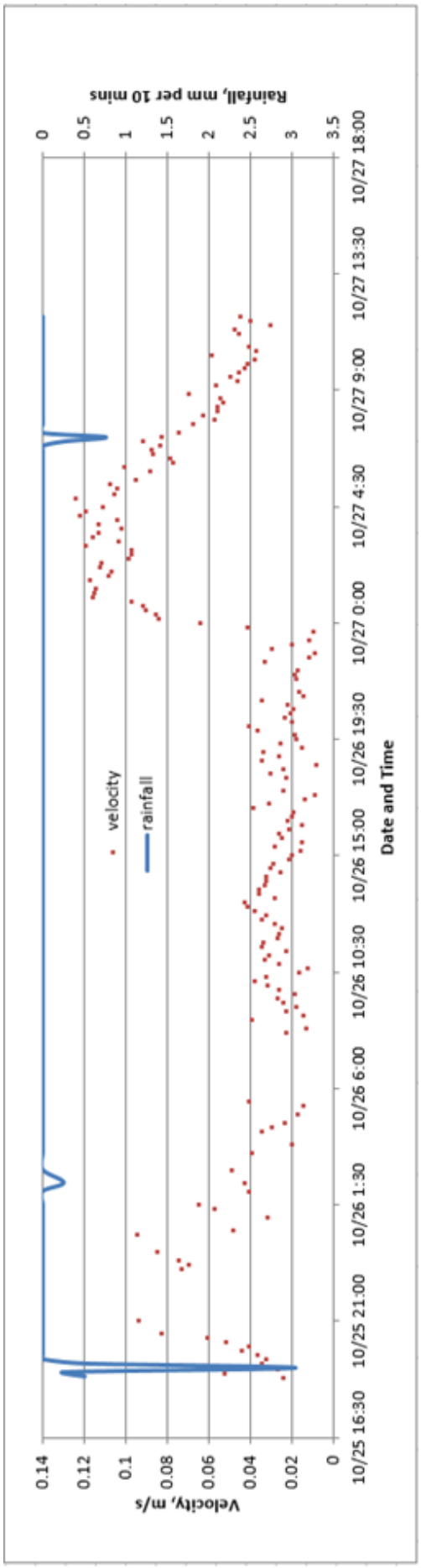


Figure 32. Relationship between Rainfall vs Velocity at Calinog Bridge

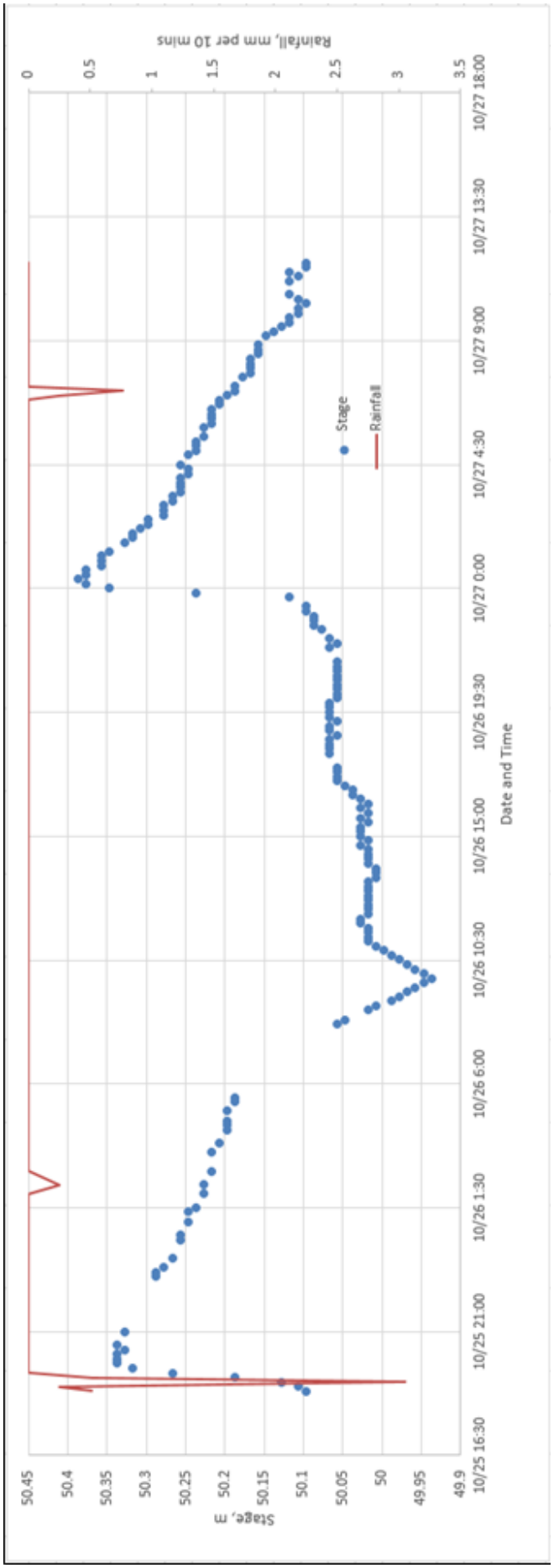


Figure 33. Relationship between Rainfall vs Stage at Calinog Bridge

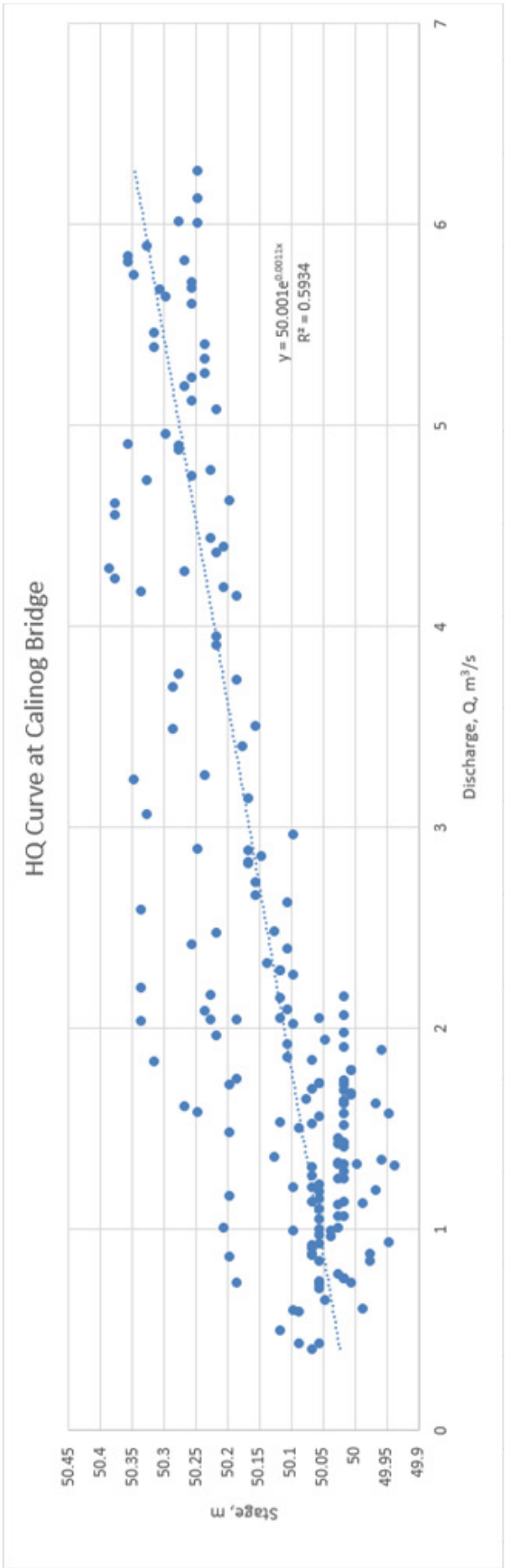


Figure 34. HQ Curve for at Calinog bridge

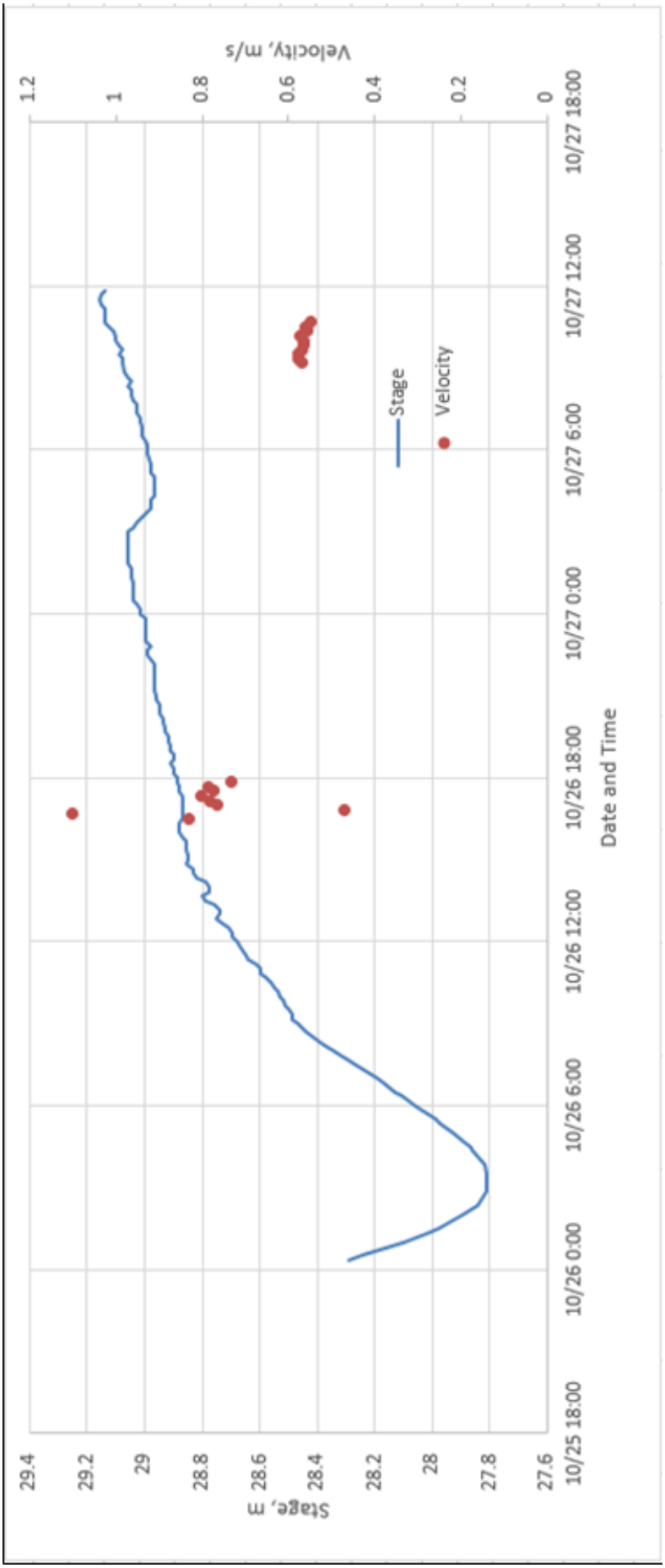


Figure 35. Relationship between Stage vs Velocity for Jalaur Bridge, Passi City

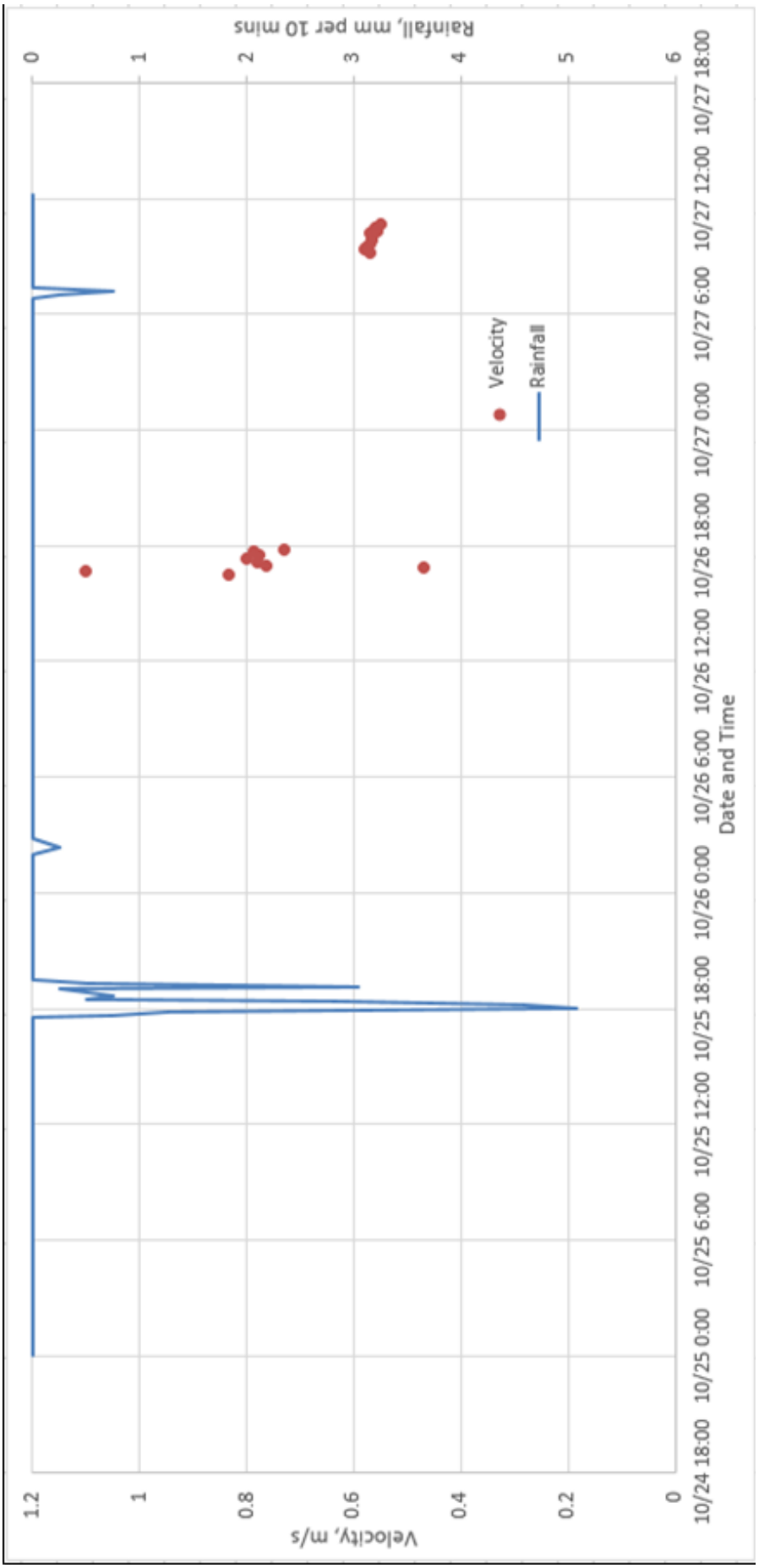


Figure 36. Relationship between Velocity vs Rainfall for Jalaur Bridge, Passi City

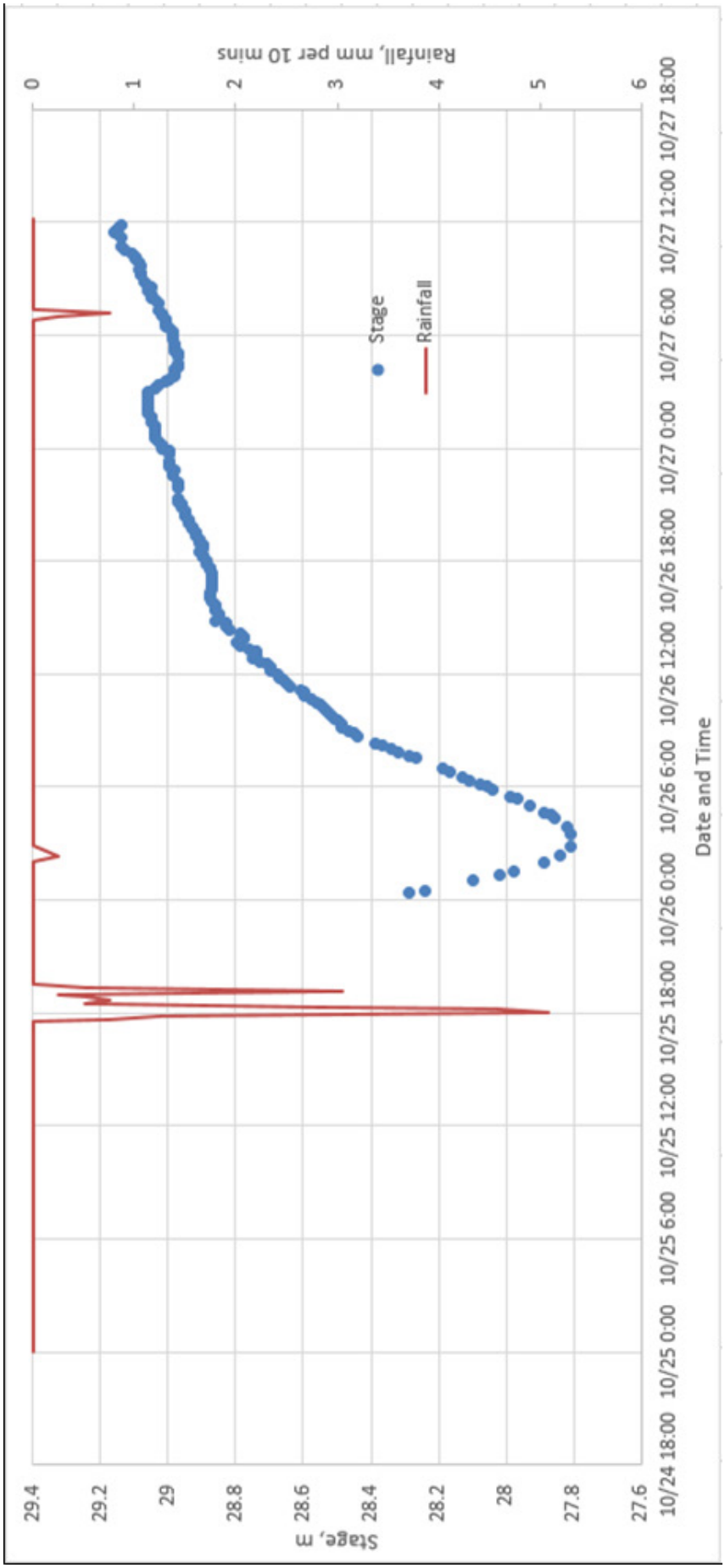


Figure 37. Relationship between Stage vs Rainfall for Jalaur Bridge at Passi City

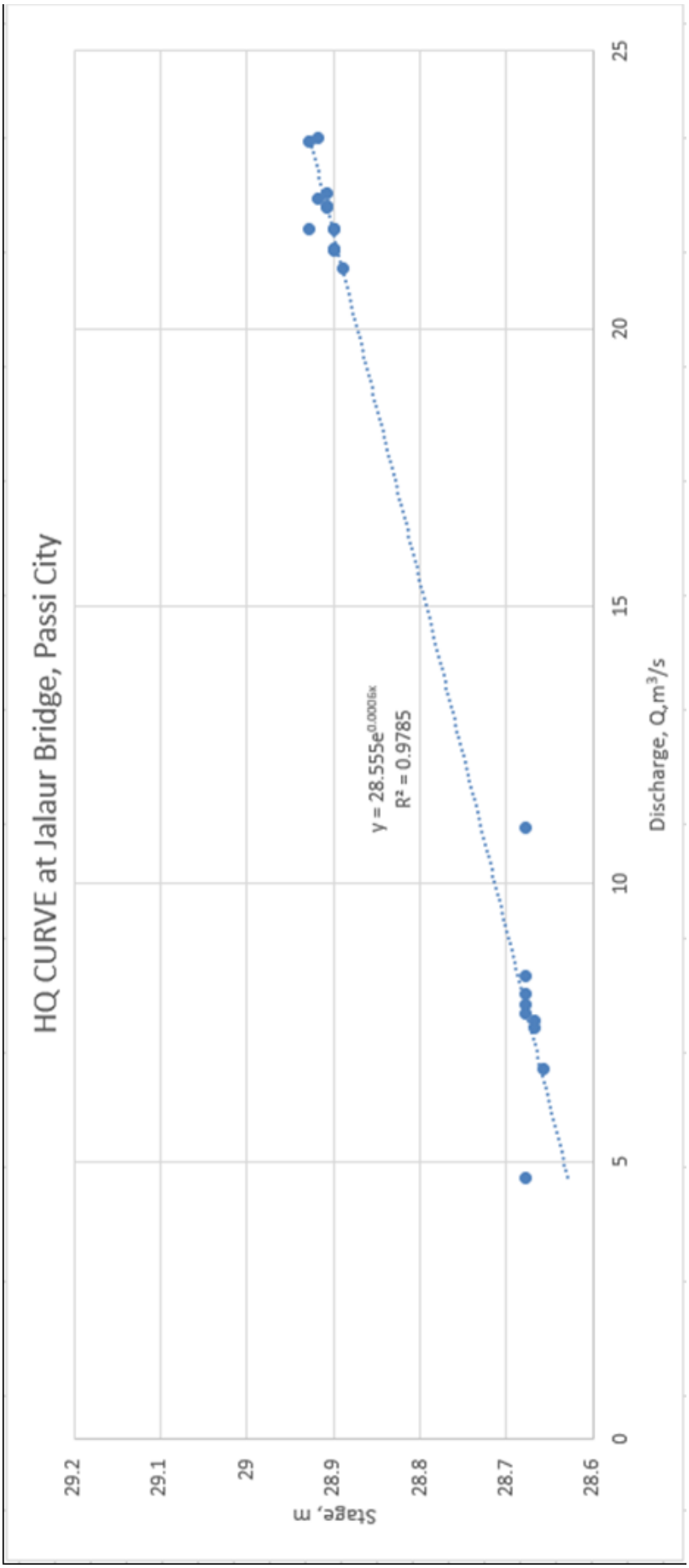


Figure 38. HQ curve at Jalaur Bridge, Passi city

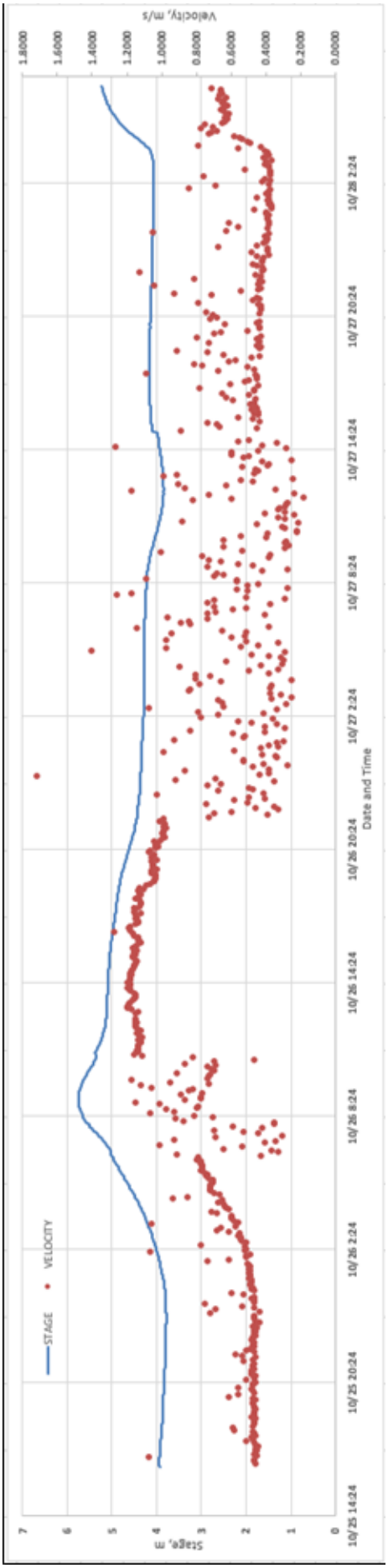


Figure 39. Relationship between Stage vs Velocity for Jalaur Bridge, Pototan

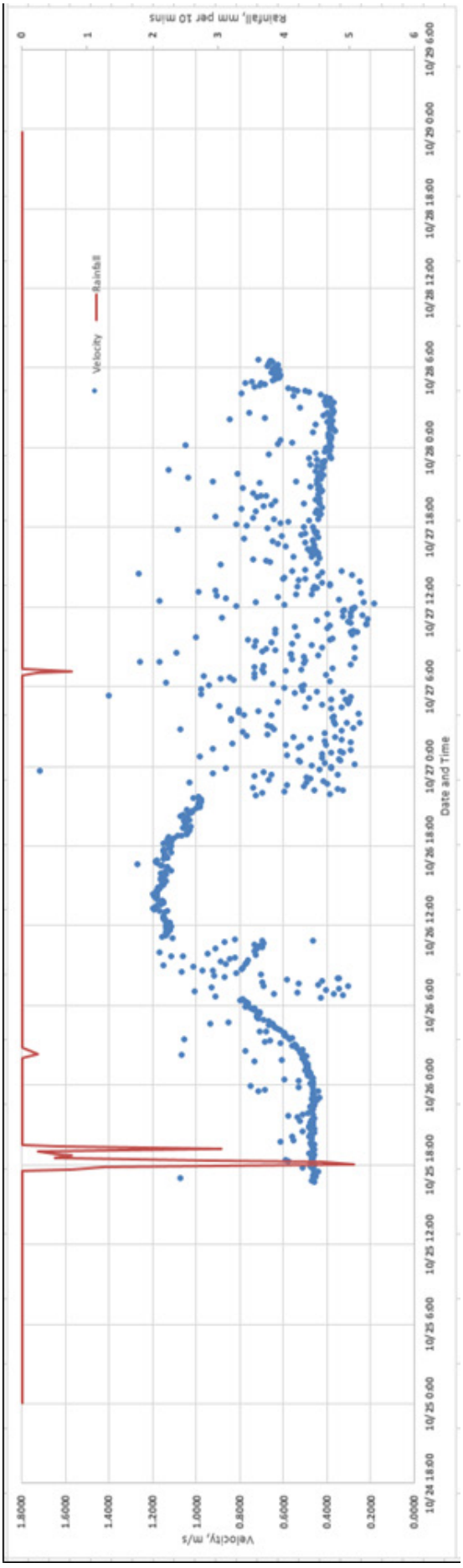


Figure 40. Relationship between Velocity vs Rainfall for Jalaur Bridge, Pototan

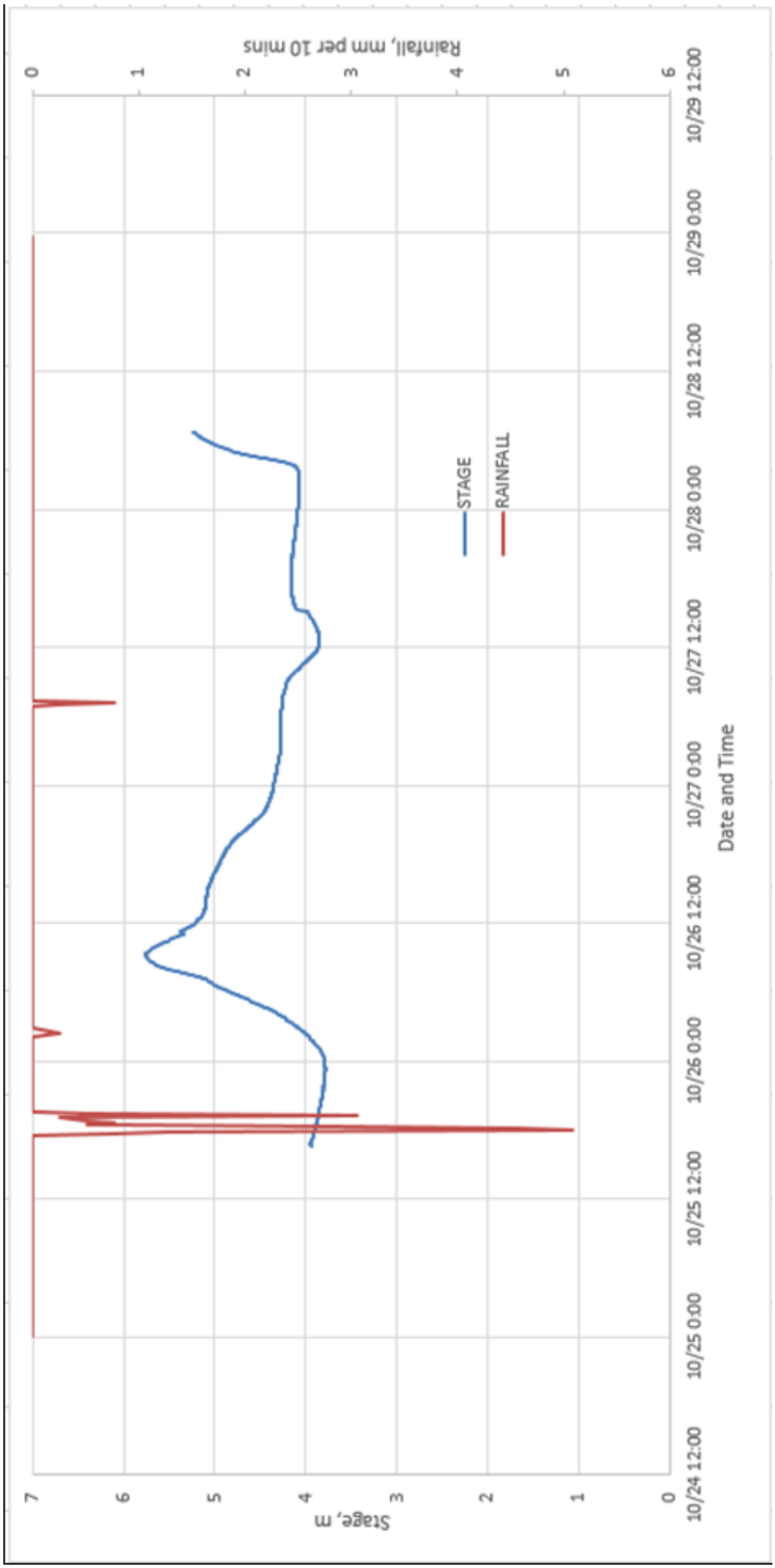


Figure 41. Relationship between Stage vs Rainfall for Jalaur Bridge, Pototan

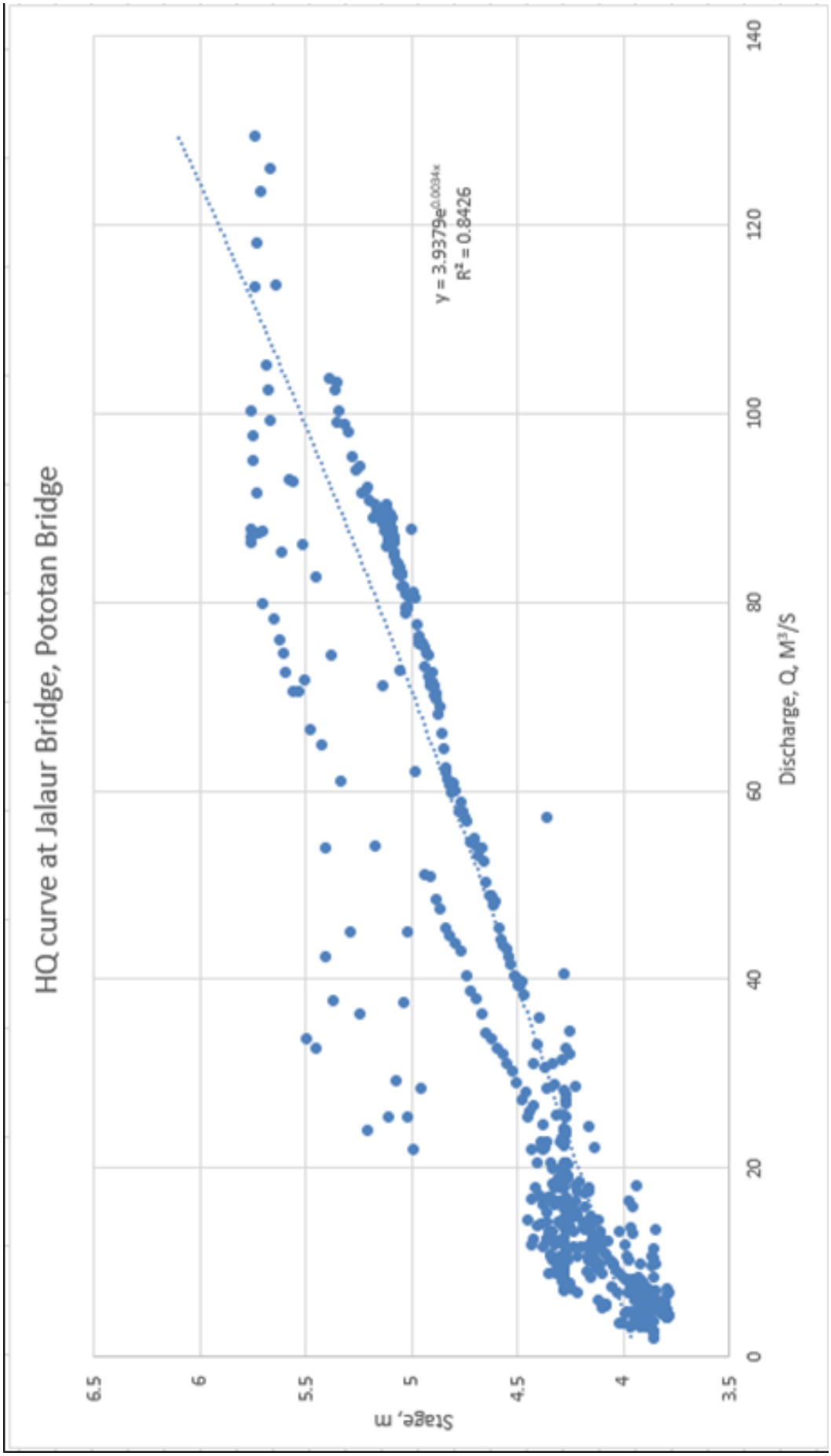


Figure 42. HQ curve for Jalaur Bridge, Pototan

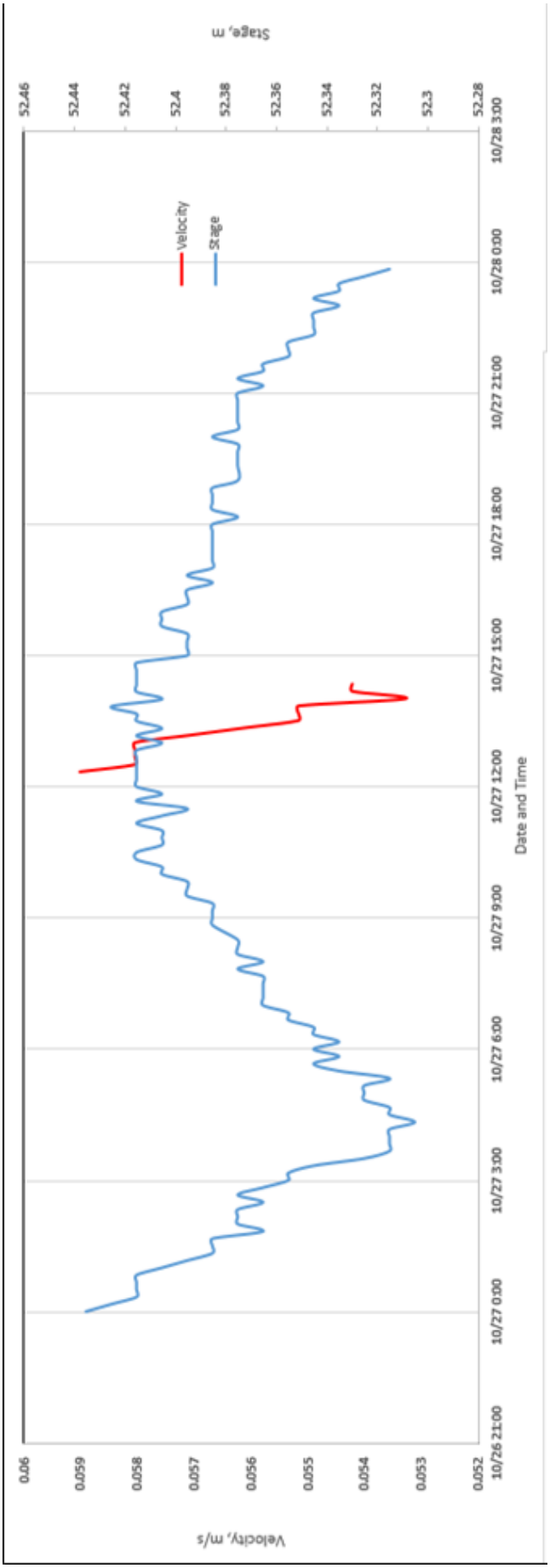


Figure 43. Relationship between Stage vs Velocity for Ulian bridge, Ulian

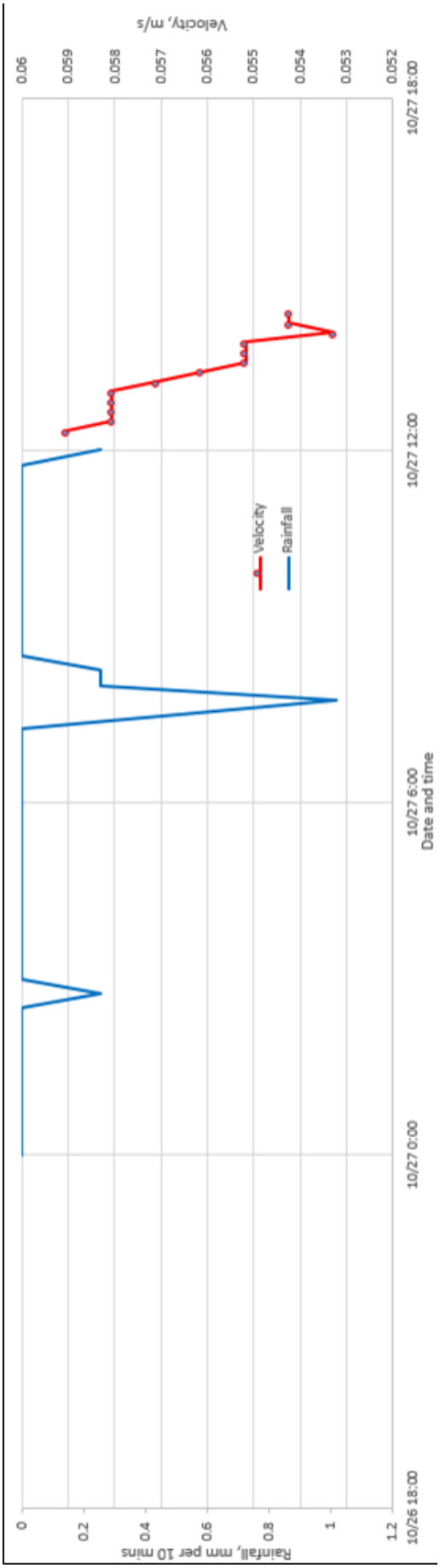


Figure 44. Relationship between Velocity vs Rainfall for Ulian Bridge, Ulian

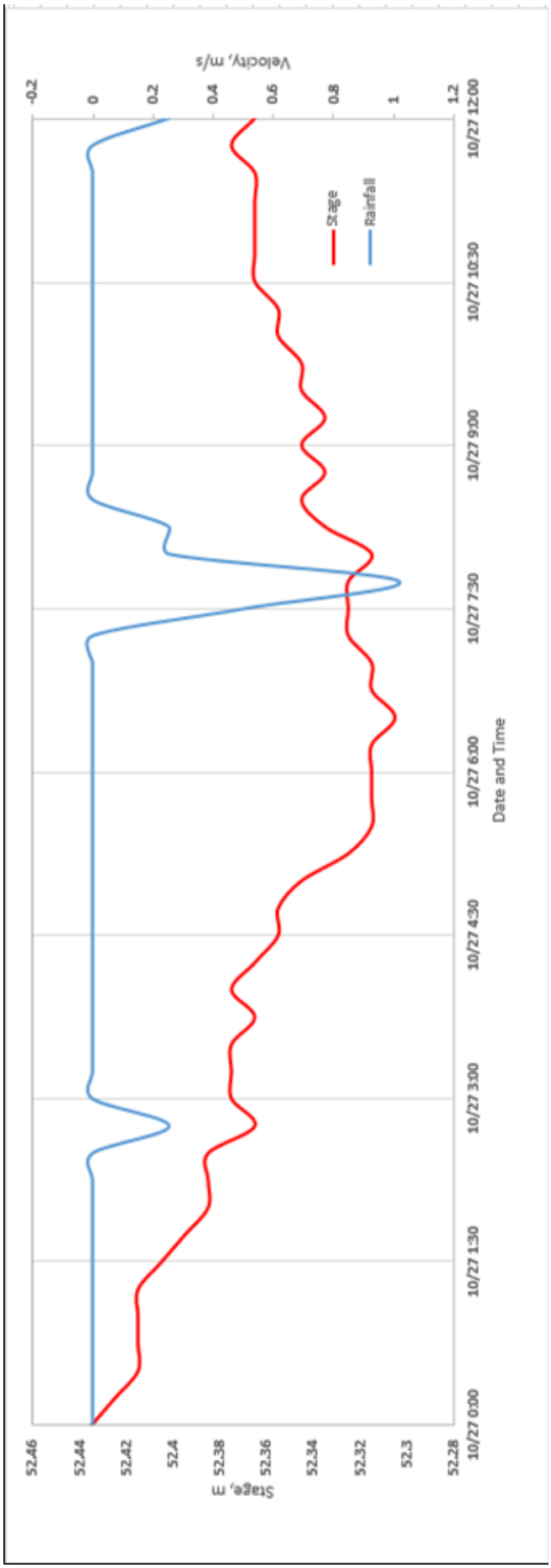


Figure 45. Relationship between Stage vs Rainfall for Ulian bridge, Ulian

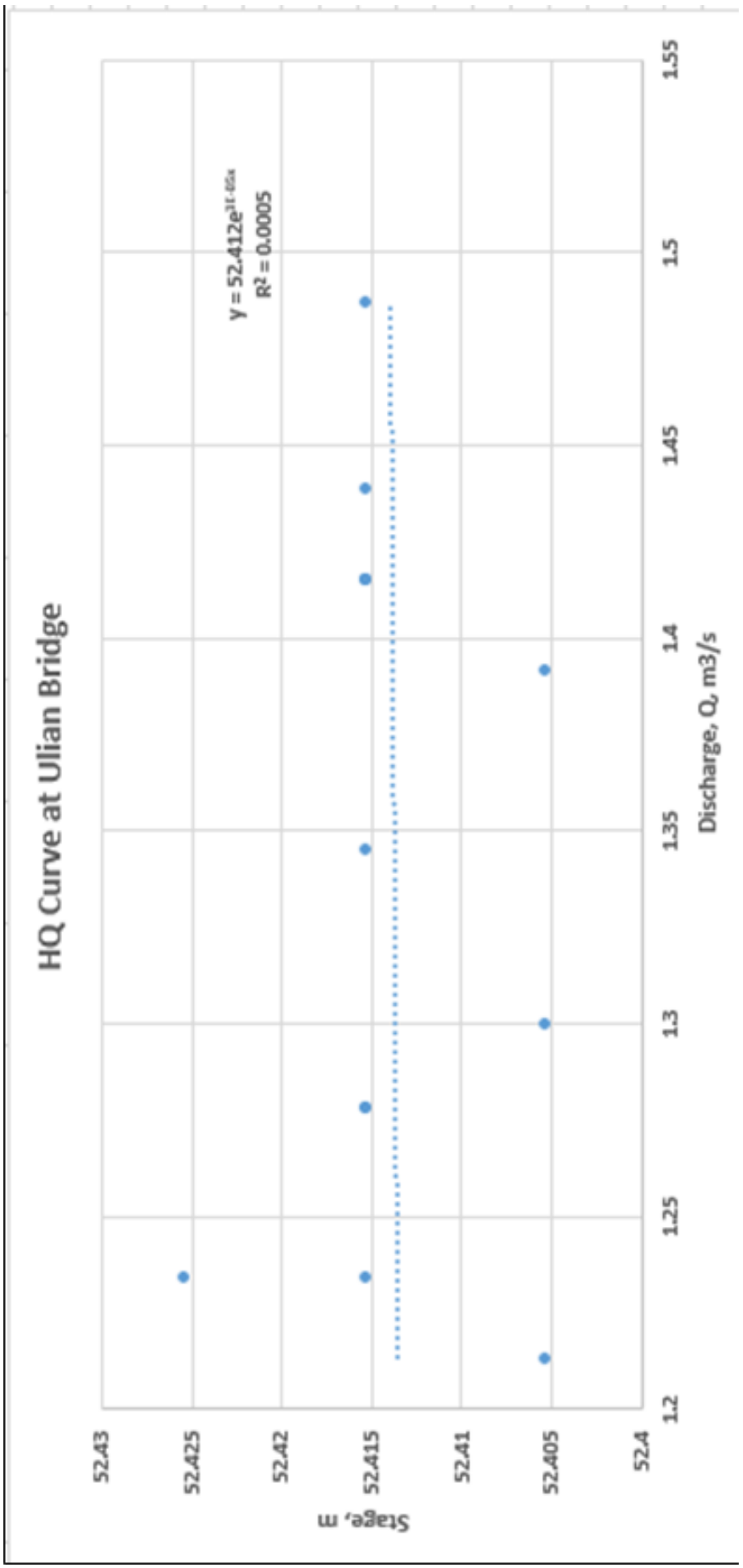


Figure 46. HQ Curve for Ulian bridge, Ulian

4.5 Validation Points Acquisition Survey

Validation points acquisition survey was conducted using a survey-grade GNSS Rover receiver, Trimble™ SPS 882, mounted on a pole which was attached in front of the vehicle utilizing PPK technique on a continuous topo mode. It was secured with a cable-tie to ensure that it was horizontally and vertically balanced. The survey began from the Municipality of Duenas to the Municipality of Barotac Nuevo. The validation survey garnered a total of 744 points.

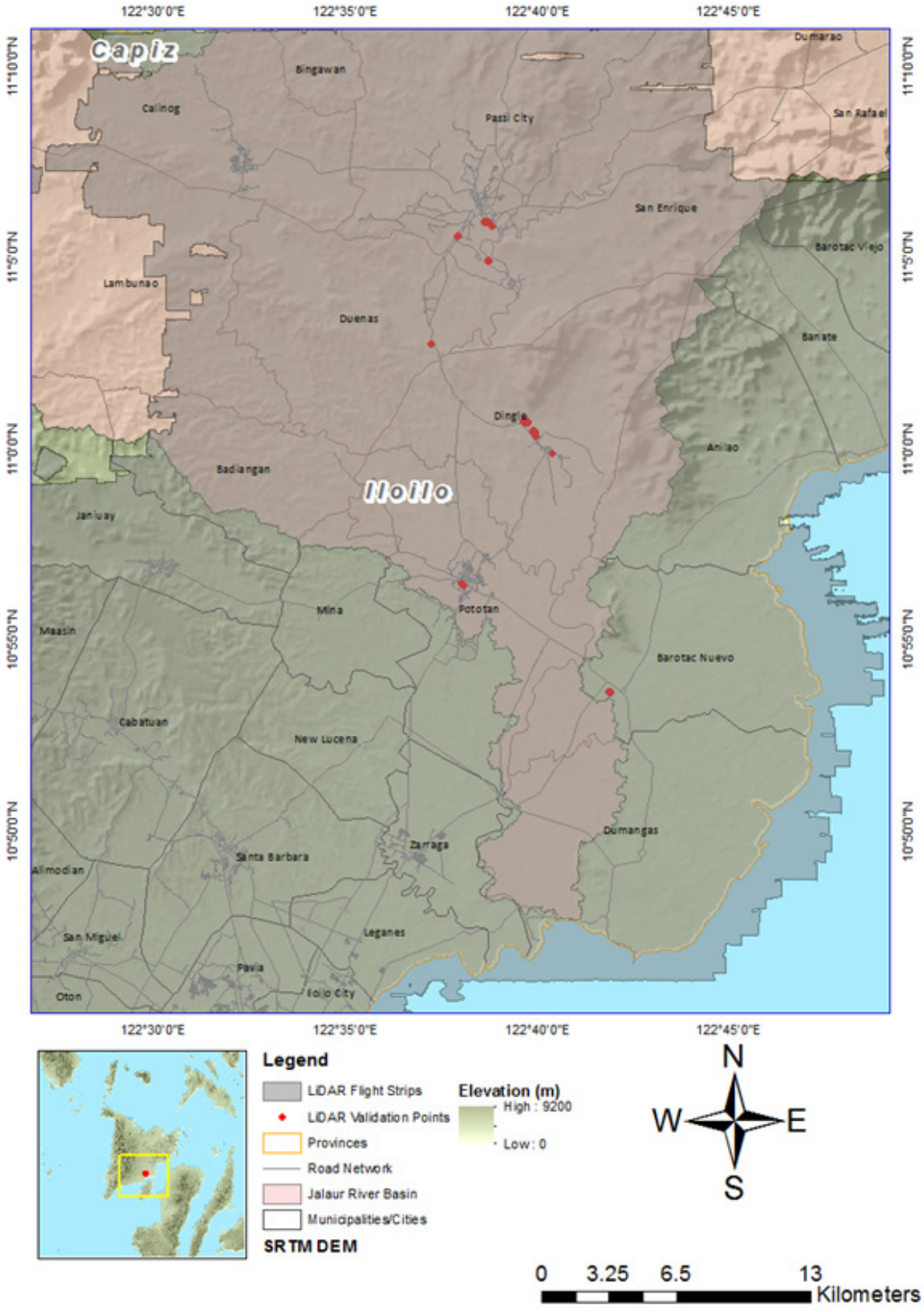


Figure 47. LiDAR Validation Survey Extent

Annexes

Annexes

ANNEX A. PROBLEMS ENCOUNTERED AND RESOLUTIONS APPLIED

The following shows the problems and limitations encountered during the fieldwork and the actions or solutions taken by the team.

Limitation/Problems	Solutions
1) The survey work started on the onset of the rainy days in Iloilo. It was also very dangerous to survey along the river during those times because of the threat of flash flooding.	
2) Fish cage owners prevented the survey team to conduct the cross-section surveys.	

Annexes

ANNEX B. LIST OF EQUIPMENT AND INSTRUMENTS

Type	Brand	Serial number	Owner	Quantity
GNSS Receiver (Base)	Trimble SPS852		UP-TCAGP	One (1) unit
GNSS Receiver (Rover)	Trimble SPS882		UP-TCAGP	Four (4) units
GNSS Controller	Trimble TSC3		UP-TCAGP	Four (4) units
Singlebeam				
Echosounder	Hi-Target		UP-TCAGP	One (1) unit with accessories
Acoustic Doppler Current Profiler (ADCP)	SonTek		UP- TCAGP	One (1) unit with accessories
Coupler-2B			UP- TCAGP	One (1) unit
Handheld GNSS	Garmin Oregon 550		UP-TCAGP	Two (2) units
Handheld GNSS	Garmin Oregon 650 Montana		UP-TCAGP	Two (2) units
Handheld GNSS AA-Battery Charger	Garmin Oregon 550		UP-TCAGP	Five (5) units
	Magellan		UP-TCAGP	Two (2) units
	Akari		UP-TCAGP	One (1) unit
Laptops	Dell Latitude E6430		UP-TCAGP	Two (2) units
Laptops	Dell Latitude E6420		UP-TCAGP	One (1) unit
Range Pole			UP-TCAGP	One (1) unit
Tripod	Trimble		UP-TCAGP	Two (2) units
Bipod	Trimble		UP-TCAGP	Three (3) units
Tribrach			UP-TCAGP	Three (3) units
Laser Range Finder	Bushnell		UP-TCAGP	One (1) unit
Installers	Trimble Business Center		UP-TCAGP	One (1) unit

Annexes

ANNEX C. THE SURVEY TEAM

Data Validation Component Sub-Team	Designation	Name	Agency/ Affiliation
Survey Coordinator	Chief Science Research Specialist (CSRS)	ENGR. JOEMARIE S. CABALLERO	UP TCAGP
Bathymetric Survey/Profile Reconnaissance Team	Senior Science Research Specialist	ENGR. MELCHOR REY M. NERY	UP TCAGP
	Research Associate	JOJO E. MORILLO	UP TCAGP
Cross Section, LiDAR Ground Validation, Sensor Deployment Team	Research Associate	JELINE M. AMANTE	UP TCAGP
	Research Associate	PATRIZCIA MAE P. DELA CRUZ	UP TCAGP
	Research Associate	CARL VINCENT CARO	UP TCAGP

Annexes

ANNEX D. NAMRIA CERTIFICATION

Republic of the Philippines
Department of Environment and Natural Resources
NATIONAL MAPPING AND RESOURCE INFORMATION AUTHORITY

April 26, 2013

CERTIFICATION

To whom it may concern:

This is to certify that according to the records on file in this office, the requested survey information is as follows -

Province: **ILOILO**
Station Name: **ILO-1**
Order: **1st**

Island: **VISAYAS**
Municipality: **ILOILO CITY**
Barangay: **LA PAZ**

PRS92 Coordinates

Latitude: **10° 42' 40.81004"** Longitude: **122° 33' 48.37076"** Ellipsoidal Hgt: **25.91600 m.**

WGS84 Coordinates

Latitude: **10° 42' 36.46758"** Longitude: **122° 33' 53.59289"** Ellipsoidal Hgt: **83.43300 m.**

PTM Coordinates

Northing: **1184436.277 m.** Easting: **452244.576 m.** Zone: **4**

UTM Coordinates

Northing: **1,184,021.70** Easting: **452,261.29** Zone: **51**

Location Description

ILO-1
From Iloilo Capitol Bldg., travel W towards Jaro for 2.2 km. along Luna St. in La Paz, Iloilo. The station is located on top of St. Clemente Church bell tower which is across Western Institute of Technology. Station mark; cross cut on top of a 0.15 m. x 0.01 m. dia. brass rod drilled on center top of concrete floor of St. Clemente Church bell tower with 0.30 cm. x 0.30 cm. cement patty, 0.01 m. above surface and inscribed on top with station name. Reference mark numbers 1, 3 and 4 are 0.05 m. dia. holes on top of ledge, reference number 2 is 0.07 m. dia. hole on top of ledge.

Requesting Party: **UP-TCAGP**
Pupose: **Reference**
OR Number: **3943584 B**
T.N.: **2013-0359**

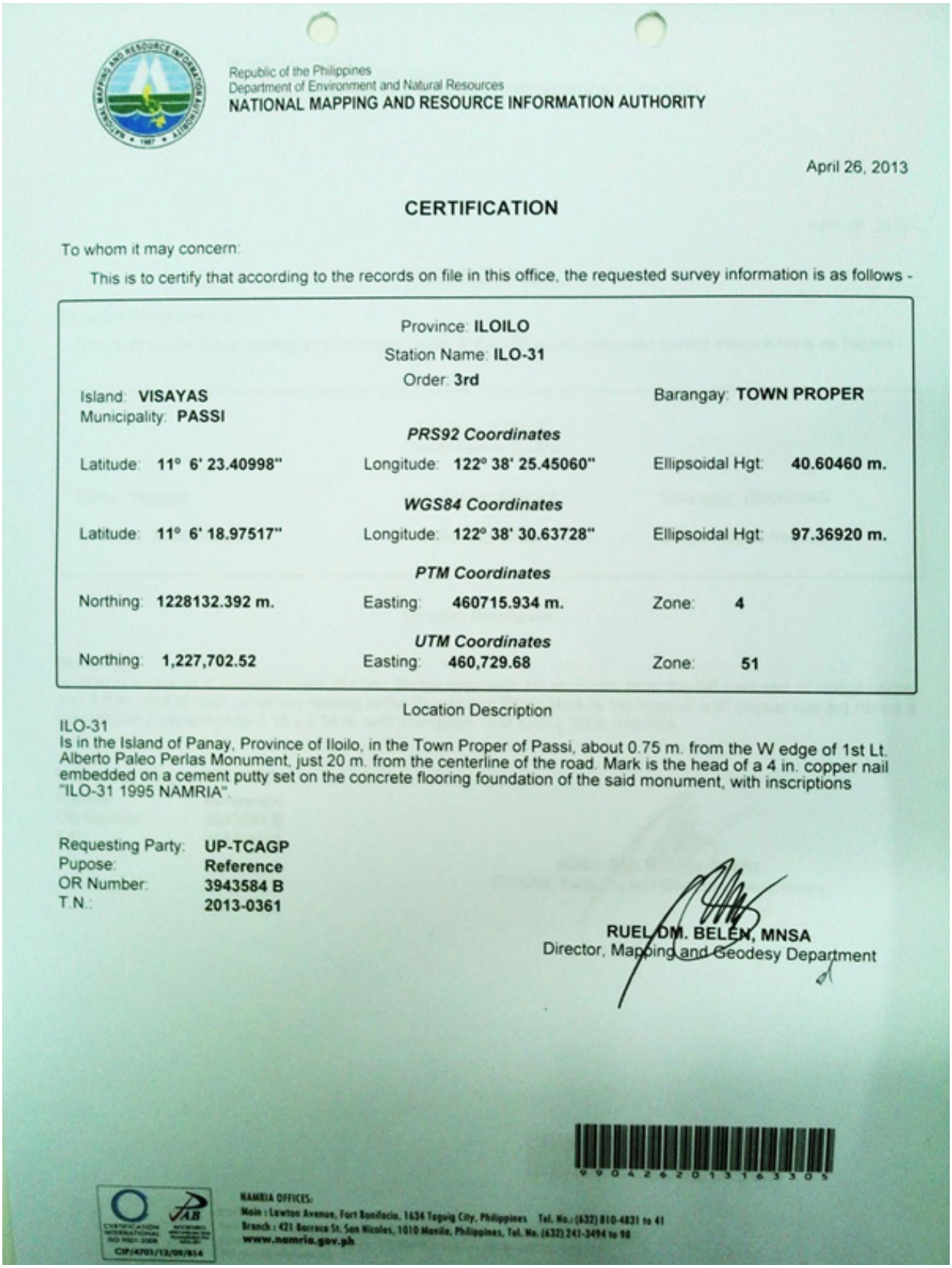
RUEL DM. BELEN, MNSA
Director, Mapping and Geodesy Department

9904262013163219

CIP/4701/12/09/814

NAMRIA OFFICES:
Main : Lawton Avenue, Fort Bonifacio, 1634 Taguig City, Philippines Tel. No.: (632) 810-4831 to 41
Branch : 421 Barraca St. San Nicolas, 1010 Manila, Philippines, Tel. No. (632) 241-3494 to 98
www.namria.gov.ph

Annexes



Republic of the Philippines
Department of Environment and Natural Resources
NATIONAL MAPPING AND RESOURCE INFORMATION AUTHORITY

April 26, 2013

CERTIFICATION

To whom it may concern:

This is to certify that according to the records on file in this office, the requested survey information is as follows -

Province: **ILOILO**
Station Name: **ILO-31**
Order: **3rd**

Island: **VISAYAS**
Municipality: **PASSI**
Barangay: **TOWN PROPER**

PRS92 Coordinates

Latitude: **11° 6' 23.40998"** Longitude: **122° 38' 25.45060"** Ellipsoidal Hgt: **40.60460 m.**

WGS84 Coordinates

Latitude: **11° 6' 18.97517"** Longitude: **122° 38' 30.63728"** Ellipsoidal Hgt: **97.36920 m.**

PTM Coordinates

Northing: **1228132.392 m.** Easting: **460715.934 m.** Zone: **4**

UTM Coordinates

Northing: **1,227,702.52** Easting: **460,729.68** Zone: **51**

Location Description

ILO-31
Is in the Island of Panay, Province of Iloilo, in the Town Proper of Passi, about 0.75 m. from the W edge of 1st Lt. Alberto Paleo Perlas Monument, just 20 m. from the centerline of the road. Mark is the head of a 4 in. copper nail embedded on a cement putty set on the concrete flooring foundation of the said monument, with inscriptions "ILO-31 1995 NAMRIA".

Requesting Party: **UP-TCAGP**
Pupose: **Reference**
OR Number: **3943584 B**
T.N.: **2013-0361**

RUEL DM. BELEN, MNSA
Director, Mapping and Geodesy Department

9904262013163305

NAMRIA OFFICES:
Main : Lawton Avenue, Fort Bonifacio, 1634 Taguig City, Philippines Tel. No.: (632) 810-4831 to 41
Branch : 421 Barraca St. San Nicolas, 1010 Manila, Philippines, Tel. No. (632) 241-3494 to 98
www.namria.gov.ph

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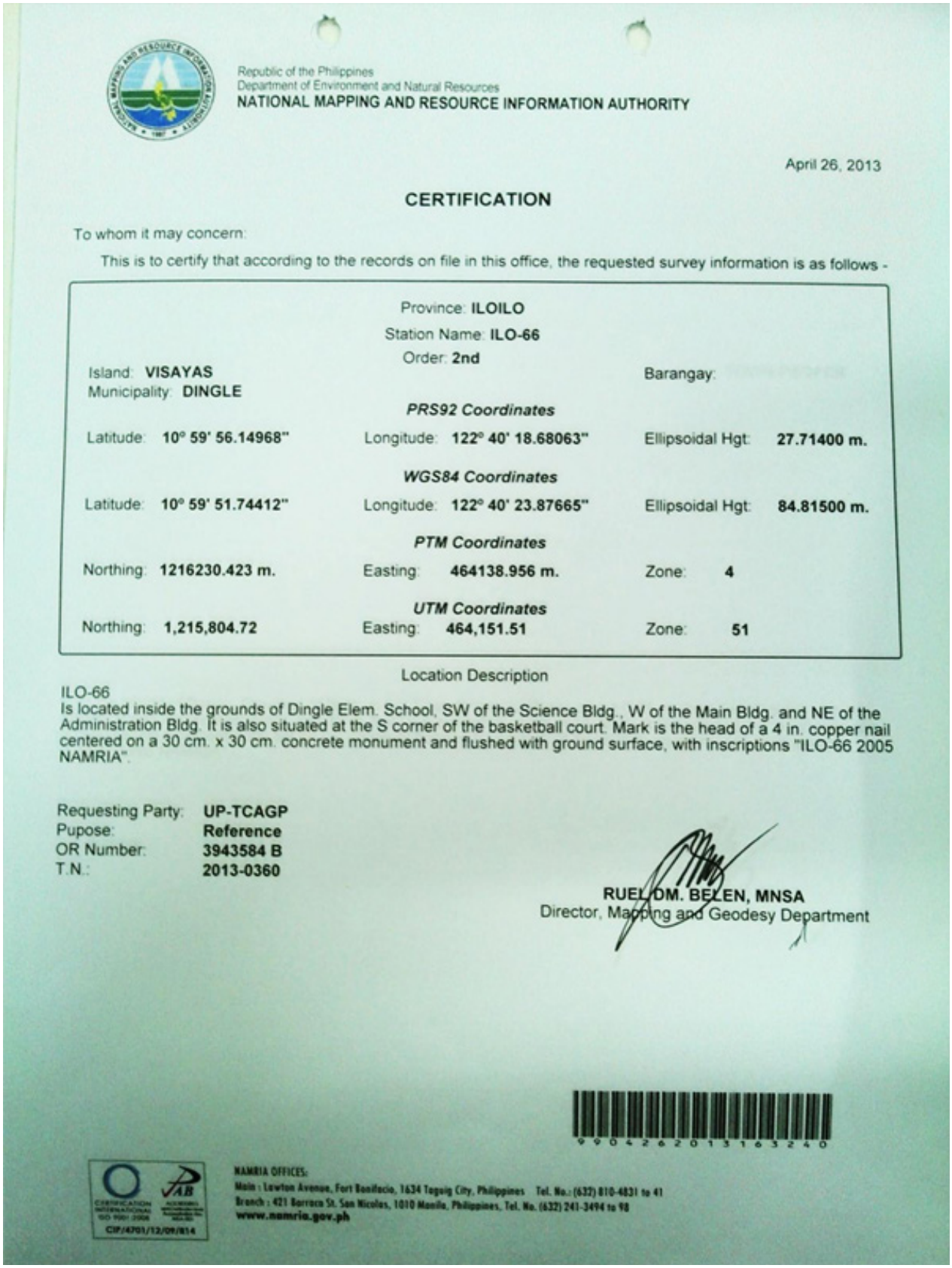

Republic of the Philippines
Department of Environment and Natural Resources
NATIONAL MAPPING AND RESOURCE INFORMATION AUTHORITY

April 26, 2013

CERTIFICATION

To whom it may concern:

This is to certify that according to the records on file in this office, the requested survey information is as follows -

Province: **ILOILO**
Station Name: **ILO-66**
Order: **2nd**

Island: **VISAYAS**
Municipality: **DINGLE**
Barangay:

PRS92 Coordinates

Latitude: **10° 59' 56.14968"** Longitude: **122° 40' 18.68063"** Ellipsoidal Hgt: **27.71400 m.**

WGS84 Coordinates

Latitude: **10° 59' 51.74412"** Longitude: **122° 40' 23.87665"** Ellipsoidal Hgt: **84.81500 m.**

PTM Coordinates

Northing: **1216230.423 m.** Easting: **464138.956 m.** Zone: **4**

UTM Coordinates

Northing: **1,215,804.72** Easting: **464,151.51** Zone: **51**

Location Description

ILO-66
Is located inside the grounds of Dingle Elem. School, SW of the Science Bldg., W of the Main Bldg. and NE of the Administration Bldg. It is also situated at the S corner of the basketball court. Mark is the head of a 4 in. copper nail centered on a 30 cm. x 30 cm. concrete monument and flushed with ground surface, with inscriptions "ILO-66 2005 NAMRIA".

Requesting Party: **UP-TCAGP**
Pupose: **Reference**
OR Number: **3943584 B**
T.N.: **2013-0360**

RUEL DM. BELEN, MNSA
Director, Mapping and Geodesy Department

9904262013163240

CIP/4701/12/09/814

NAMRIA OFFICES:
Main : Lawton Avenue, Fort Bonifacio, 1634 Taguig City, Philippines Tel. No.: (632) 810-4831 to 41
Branch : 421 Barraca St. San Nicolas, 1010 Manila, Philippines, Tel. No. (632) 241-3494 to 98
www.namria.gov.ph

Annexes

Republic of the Philippines
Department of Environment and Natural Resources
NATIONAL MAPPING AND RESOURCE INFORMATION AUTHORITY

February 08, 2013

CERTIFICATION

To whom it may concern:

This is to certify that according to the records on file in this office, the requested survey information is as follows -

Province: **ILOILO**
Station Name: **IL-391A**

Island: **Visayas**	Municipality: **BAROTAC NUEVO**	Barangay: **JT BRETAÑA**
Elevation: **12.1593 m.**	Order: **1st Order**	Datum: **Mean Sea Level**

Location Description

BM IL-391A

The station is in the Province of Iloilo, Municipality of Barotac Nuevo, Brgy. JT Bretaña, along the Zarraga-Anila National Highway. The station is located at the top of the sidewalk beside a lamp post fronting Ara Grace Food Store and 6m from the road centerline.

Mark is the head of a 4" copper nail set flushed on a 15cm x 15cm cement putty with inscriptions "IL-391A, 2012, NAMRIA".

Requesting Party: **UP-TCAGP**
Pupose: **Reference**
OR Number: **3910354 B**
T.N.: **2013-0104**

RUEL DM. BELEN, MNSA
Director, Mapping and Geodesy Department

9902082013153729

CIP/4701/12/09/814

NAMRIA OFFICES:
Main : Lawton Avenue, Fort Bonifacio, 1634 Taguig City, Philippines Tel. No.: (632) 810-4831 to 41
Branch : 421 Barraca St. San Nicolas, 1010 Manila, Philippines, Tel. No. (632) 241-3494 to 98
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Annexes

Republic of the Philippines
Department of Environment and Natural Resources
NATIONAL MAPPING AND RESOURCE INFORMATION AUTHORITY

February 08, 2013

CERTIFICATION

To whom it may concern:

This is to certify that according to the records on file in this office, the requested survey information is as follows -

Province: **ILOILO**
Station Name: **IL-381A**

Island: **Visayas**
Municipality: **ZARRAGA**
Barangay: **GINES**
Elevation: **6.9462 m.**
Order: **1st Order**
Datum: **Mean Sea Level**

Location Description

BM IL-381A is in the Province of Iloilo, Municipality of Zarrage, Brgy. Gines, along the Barotac Nuevo-Zarraga National Highway. The station is located on the top of a concrete pavement at the road junction to Phase 1B Grand Subdivision, 9m from the waiting shed and 15m from the road centerline.

Mark is the head of a 4" copper nail set flushed on a 15cm x 15cm cement putty with inscriptions "IL-381A, 2012, NAMRIA".

Requesting Party: **UP-TCAGP**
Pupose: **Reference**
OR Number: **3910354 B**
T.N.: **2013-0105**

RUEL DM. BELEN, MNSA
Director, Mapping and Geodesy Department

9902082013153828

CIP/4701/12/09/814

NAMRIA OFFICES:
Main : Lawton Avenue, Fort Bonifacio, 1634 Taguig City, Philippines Tel. No.: (632) 810-4831 to 41
Branch : 421 Barraca St. San Nicolas, 1010 Manila, Philippines, Tel. No. (632) 241-3494 to 98
www.namria.gov.ph

Annexes

ANNEX E. RECONNAISSANCE SUMMARY

Table 3 Below is the list of cross-section reconnaissance for both left and right banks of Jalaur River. Images were taken along the proposed lines by the survey team.

Xsec Right	Image	Barangay	City or Municipality	Remarks
1		Gines Viejo; Gemat-Y	Passi City	Traversable
2		Gemat-Y	Passi City	Traversable; will pass through sugar cane fields
3		Gemat-Y	Passi City	Traversable; will pass through sugar cane fields
4		Gemat-Y	Passi City	Traversable
5		Man-It; Gemat-Y	Passi City	Traversable
6		Man-it; Gemat-Y; Batu; Cadilang; Punong	Passi City	Traversable
7		Man-It	Passi City	Traversable; will pass through sugar cane fields
8		Batu; Man-it	Passi City	Traversable; will pass through rice fields

Annexes

Xsec Right	Image	Barangay	City or Municipality	Remarks
9		Punong	Passi City	Traversable
10		Punong	Passi City	Traversable
11		Punong	Passi City	Traversable; will pass through sugar cane fields
12		Tipolo	Duenas	Traversable; will pass through sugar cane fields
13		Tipolo	Duenas	Traversable; will pass through sugar cane fields
14		Tipolo; Monpon	Duenas	Traversable; will pass through sugar cane fields
15		Agutayan; Monpon	Duenas	Traversable; will pass through sugar cane fields
16		Agutayan; Pandan	Duenas	Traversable; will pass through sugar cane fields

Annexes

Xsec Right	Image	Barangay	City or Municipality	Remarks
17		Tinocuan	Duenas	Traversable
18		Tabugon; Tinocuan	Dingle	Traversable
19		Tabugon	Dingle	Traversable; will pass through banana plantations
20		Lincud; Licu-An	Dingle	Traversable
21		Licu-An	Dingle	Traversable
22		Licu-An	Dingle	Traversable
23		San Matias; San Jose	Dingle	Traversable
24		Poblacion; Dawis; San Jose	Dingle	Traversable; will pass through sugar cane fields

Annexes

Xsec Right	Image	Barangay	City or Municipality	Remarks
25		Ilajas; Siniba-An; San Jose	Dingle	Traversable; will pass through sugar cane fields
26		Siniba-An	Dingle	Traversable; will pass through sugar cane fields
27		Siniba-An; Tanghawan	Dingle	Traversable
28		Siniba-An; Pandan; Tanghawan	Dinge	Traversable
29		Abangay; Zarrague	Dingle; Pototan	Traversable
30		Abangay	Dingle	Traversable; will pass through sugar cane fields
31		Abangay	Dingle	Traversable; will pass through sugar cane fields
32		Ginalingan Nuevo; Cau-Ayan; Guibuangan	Dingle; Pototan	Traversable; will pass through sugar cane fields

Annexes

Xsec Right	Image	Barangay	City or Municipality	Remarks
33		Guibuangan	Pototan	Traversable; will pass through sugar cane fields
34		Matangharon; Guibuangan	Dingle; Pototan	Traversable; will pass through rice fields
35		Callan; Guibuangan; Dapitan	Dingle; Pototan	Traversable; will pass through rice fields
36		Polot-An; Barasan	Pototan	Traversable; will pass through rice fields
37		Tuburan; Polot-An	Pototan	Traversable; will pass through rice fields
38		Tuburan	Pototan	Traversable; will pass through rice fields
39		Tuburan	Pototan	Traversable
40		Monpon; Tuburan; Polot-An	Barotac Nuevo; Pototan	Traversable

Annexes

Xsec Right	Image	Barangay	City or Municipality	Remarks
41		Tumcon Ilaud	Pototan	Traversable
42		Tumcon Ilaud; Pajo; Naga	Pototan	Traversable
43		Cansilayan; Pajo; Naga	Pototan	Traversable
44		Cansilayan; Culob	Pototan	Traversable; will pass through rice fields
45		Cansilayan; Culob	Pototan	Traversable; will pass through rice fields
46		Nanga; Jebioc	Potoan	Travesable
47		Nanga; Donsol	Pototan	Traversable; will pass through rice fields
48		Balabag; Bongco	Dumangas; Pototan	Traversable; will pass through rice fields
49		Balabag; Bongco; Jalaud Norte; Dongsol; Jamabalud	Dumangas; Zarraga; Pototan	Traversable

Annexes

Xsec Right	Image	Barangay	City or Municipality	Remarks
50		Maquina; Balud I; Jalaud Norte	Dumangas; Zarraga	Traversable
51		Maquina; Balud I; Jalaud Sur	Dumangas; Zarraga	Traversable
52		Balud Lilo-An; Tuburan	Zarraga	Traversable
53		Compayan; Balud lilo-An	Dumangas; Zarraga	Traversable
54		Cayos; Balud Lilo-An	Dumangas; Zarraga	Traversable
55		Cayos; Balud Lilo-An; Tuburan	Dumangas; Zarraga	Traversable
56		Talauguis; Libongcogon; Pajo; Malunang	Zarraga	Traversable
57		Talauguis; Libongcogon	Zarraga	Traversable
58		Talauguis; Libongcogon; Nabitasan	Zarraga; Leganes	Traversable

Annexes

Xsec Right	Image	Barangay	City or Municipality	Remarks
59		Nabitasan	Leganes	Traversable
60		Tubigan; Nabitasan	Zarraga; Leganes	Traversable
61		Tubigan; Nabitasan	Zarraga; Leganes	Traversable
62		Nabitasan	Leganes	Traversable

Xsec Left	Image	Barangay	City or Municipality	Remarks
1		Poblacion Ilaya	Passi City	Traversable
2		Poblacion Ilaya	Passi City	Traversable
3		Poblacion Ilaya	Passi City	Traversable
4		Poblacion Ilaya; Poblacion Ilawod	Passi City	Traversable
8		Poblacion Ilawod	Passi City	Traversable

Annexes

Xsec Left	Image	Barangay	City or Municipality	Remarks
6		Poblacion Ilawod; Imbang Grande	Passi City	Traversable Traversable
7		Man-It; Imabang Pequeno; Camiri	Passi City; San Enrique	Traversable
8		Batu; Camiri	Passi City; San Enrique	Traversable; will pass through sugar cane fields
9		Camiri	San Enrique	Traversable; will pass through sugar cane fields
10		Punong: Camiri	Passi City; San Enrique	Traversable; will pass through rice fields
11		Poblacion Ilaya	San Enrique	Traversable
12		Tipolo; Compo; Palje	Duenas; San Enrique	Traversable
13		Tipolo; Compo	Duenas; San Enrique	Traversable

Annexes

Xsec Left	Image	Barangay	City or Municipality	Remarks
14		Tipolo; Compo	Duenas; San Enrique	Traversable; will pass through rice fields
15		Agutayan; Rumagayray; Lincud	Duenas; San Enrique; Dingle	Traversable; will pass through sugar cane fields
16		Agutayan; Rumagayray; Lincud	Duenas; San Enrique; Dingle	Traversable
17		Tinocuan; Liincud	Dingle	Traversable
18		Tabugon; Lincud	Dingle	Traversable
19		Tabugon; Lincud	Dingle	Traversable
20		Lincud	Dingle	Traversable
21		Moroboro	Dingle	Traversable
22		Moroboro; Camambugan	Dingle	Traversable
23		San Matias; Camambugan	Dingle	Traversable
24		Poblacion: Camambugan; Ilajas	Dingle	Traversable; will pass through sugar cane fields
25		Ilajas	Dingle	Traversable; will pass through rice fields
26		Calicuang; Santo Rosario	Dingle; Anilao	Traversable
27		Calicuang; Santo Rosario	Dingle; Anilao	Traversable

Annexes

Xsec Left	Image	Barangay	City or Municipality	Remarks
28		Calicuang; Ginalinan Nuevo; Matangharon	Dingle	Traversable
29		Pandan; Calicuang	Dingle	Traversable
30		Ginalinan Nuevo; Calicuang	Dingle	Traversable
31		Ginalinan Nuevo; Matangharon	Dingle	Traversable
32		Guibuangan; Ginalinan Nuevo	Pototan; Dingle	Traversable; will pass through rice cane fields
33		Guibuangan; Ginalinan Nuevo	Pototan; Dingle	Traversable; will pass through rice cane fields
34		Matangharon; Bagongbong	Dingle; barotac Nuevo	Traversable; will pass through rice cane fields
35		Callan; Patag	Pototan; Barotac Nuevo	Traversable; will pass through rice cane fields

Annexes

Xsec Left	Image	Barangay	City or Municipality	Remarks
36		Polot-An; Callan; Patag	Pototan; Barotac Nuevo	Traversable; will pass through rice cane fields
37		Sohoton	Barotac Nuevo	Traversable; will pass through rice cane fields
38		Tuburan; Tabucan	Pototan; Barotac Nuevo	Traversable; will pass through rice cane fields
39		Tabucan; Ilaya Poblacion; Ilaud Poblacion	Barotac Nuevo	Traversable
40		Monpon	Barotac Nuevo	Traversable; will pass through rice cane fields
41		Monpon	Barotac Nuevo	Traversable
42		Tumcud Ilaud; Monpon	Pototan; Barotac Nuevo	Traversable; will pass through rice cane fields
43		Monpon; Acuit	Barotac Nuevo	Traversable; will pass through rice cane fields
44		Cansilayan; Cabilauan; Acuit	Pototan; Barotac Nuevo	Traversable; will pass through rice cane fields

Annexes

Xsec Left	Image	Barangay	City or Municipality	Remarks
45		Cabilauan	Barotac Nuevo	Traversable; will pass through rice cane fields
46		Nanga; Cabilauan; Pagdugue	Pototan; Barotac Nuevo; Dumangas	Traversable; will pass through rice cane fields
47		Cabilauan; Pagdugue	Barotac Nuevo; Dumangas	Traversable; will pass through rice cane fields
48		Balabag; Pagdugue	Dumangas	Traversable; will pass through rice cane fields
49		Balabag; Pulao	Dumangas	Traversable
50		Balabag; Pulao; Patlad; Sulangan	Dumangas	Traversable
51		Maquina; Cayos; Patlad	Dumangas	Traversable

Annexes

Xsec Left	Image	Barangay	City or Municipality	Remarks
52		Balud; Compayan; Cayos	Dumangas	Traversable
53		Compayan; Cayos; Patlad	Dumangas	Traversable
54		Cayos	Dumangas	Traversable
55		Cayos; Talauguis; Tubigan	Dumangas; Zarraga	Traversable
56		Talauguis	Zarraga	Traversable
57		Talauguis	Zarraga	Traversable
58		Talauguis	Zarraga	Traversable
59		Nabitasan; Talauguis	Leganes; Zarraga	Traversable

Annexes

Xsec Left	Image	Barangay	City or Municipality	Remarks
60		Tubigan	Zarraga	Traversable
61		Tubigan	Zarraga	Traversable
62		Tubigan	Zarraga	Traversable

ANNEX F. OUTSOURCE CROSS-SECTION AND PROFILE

PROFILE AND CROSS SECTION SURVEYS IN JALAUR RIVER, ILOILO

DREAM
Disaster Risk and Exposure Assessment for Mitigation

Prepared by:

AB SURVEYING AND DEVELOPMENT
BLOCK 6, LOT 19, ROMAGNA ST. MAIA ALTA, SUBDIVISION, ANTIPOLO CITY TEL.# 639-47-83

Annexes

Annexes

Annexes

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Annexes

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GCP	Ground Control Point
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
NAMRIA	National Mapping and Resource Information Authority
UP-TCAGP	University of the Philippines – Training Center for Applied Geodesy and Photogrammetry
RTK	Real Time Kinematic
WGS-84	World Geodetic System of 1984
UTM 51N	Universal Transverse Mercator Zone 51 North
XS	Cross-Section
XSR	Cross-Section Right
XSL	Cross-Section Left
MSL	Mean Sea Level
EGM	Earth Gravitational Model


Introduction

Annexes

Jalaur River is the second largest river in the island of Panay. It is also considered the 17th largest river system in the Philippines. This river has many tributaries along, thus making this one of the largest drainage basin. The river drains on the southern portion of the island in the town of Dumanggas, Iloilo. The river traverses from north to south passing along Passi City, Leganes, Zarraga, Dumanggas, Barotac Nuevo, Pototan, Dingle, San Roque, Duenas, and Calinog towns with an approximate length of 123 kilometers. The river passes along a generally flat terrain and farmlands.

This river system is the source of irrigation for the farmlands along the river. It is also a source of potable water for all those living along the river. This makes the river a very important source in the economic activity in the island especially for farmers.
This river system, being a large drainage basin, is also potentially dangerous to the inhabitants living along the river banks. In cases where there is too much rain, the vicinity is very prone to flooding. Take the case of the recent flooding in December 2012 spawned by typhoon Quinta where several municipalities including Passi City were flooded. Many families were evacuated during the flooding.

Appropriate procedures and disaster management are needed to lessen the destructive effects of disasters hitting the country.

1.1 Background

The Notice of Award for the Cross-Section and Profile Survey of 68-km Jalaur River, Iloilo was issued to AB Surveying and Development by the President of University of the Philippines on 29th November, 2012. On the 3rd day of April 2013, the Contract Agreement was approved by the Chancellor of University of the Philippines, Diliman Hon. Caesar A. Saloma, Ph.D. On the 23rd day of April 20, 2013, the contract agreement was issued to Engr. Antonio Julian Ll. Botor, the General Manager of AB Surveying and Development.

Upon the receipt of the copy of approved Contract Agreement, survey parties of AB Surveying and Development were mobilized to commence field operation of the project. Although the Notice to Proceed was issued last May 9, 2013, the survey teams have started with the courtesy call to the affected LGU's of the field survey last April 26, 2013.

Annexes

1.2 Scope of Work

There are 18 major river systems that are identified to be flood-prone in the country, one of which is the Jalaur River located at the island of Panay. The scope of work for Jalaur River includes the execution of the following activities:

1.2.1. Scope 1: Ground Control Survey

Establishment of Ground Control Points (GCP) using differential Global Navigation Satellite System (GNSS)/GPS survey with single frequency receivers to obtain the geographic coordinates (northing and easting) and elevations. Accuracy criteria were based on the following:

Horizontal Position <=±3mm +0.5ppmx D
Vertical Position <=±5mm +0.5ppmx D

Where: D is the baseline distance between the control points from the GNSS base station in meters

The number of GCP's to be established depends on the distance between the GCP and the farthest cross-section and profile to be surveyed. The maximum distance is 10 km and the additional number of GCP's shall be established if a cross-section and profile are out of 10 km –range.

1.2.2. Scope 2: Profile Survey

Jalaur River profile is consist of left and right upper bank and left and right lower bank which has approximate length of 67.7km and 67km, respectively. Accuracy is within the following criteria:

Horizontal Position ±20 cm
Vertical Position ±10 cm

Successive profile point interval is 10m maximum. Additional points are needed to describe the apparent change in elevation along the profile line. Profile survey was conducted using dual frequency GNSS/GPS receivers and kinematic survey technique. In areas where kinematic GNSS/GPS survey is not applicable due to obstruction and canopy trees, conventional surveying techniques have been done.

1.2.3. Scope 3: River Cross Section Survey

The survey team conducted cross-sections survey using dual frequency GNSS/GPS receivers and differential kinematic GNSS/GPS survey techniques. Accuracy is within the following criteria:

Horizontal Position ±20 cm
Vertical Position ±10 cm

Conventional surveying techniques were done in areas where kinematic GNSS/GPS survey is not applicable due to the presence of buildings and canopy trees.

1.3 Professional Staffing and Implementation

A Licensed Geodetic Engineer (GE) serves as the chief of party for the survey team, tasked to monitor and supervise the whole project. The project coordinator serves to coordinate with the field staff and acts as the survey field team leader. In addition, a supervisor monitors and supervises data processing in the office.

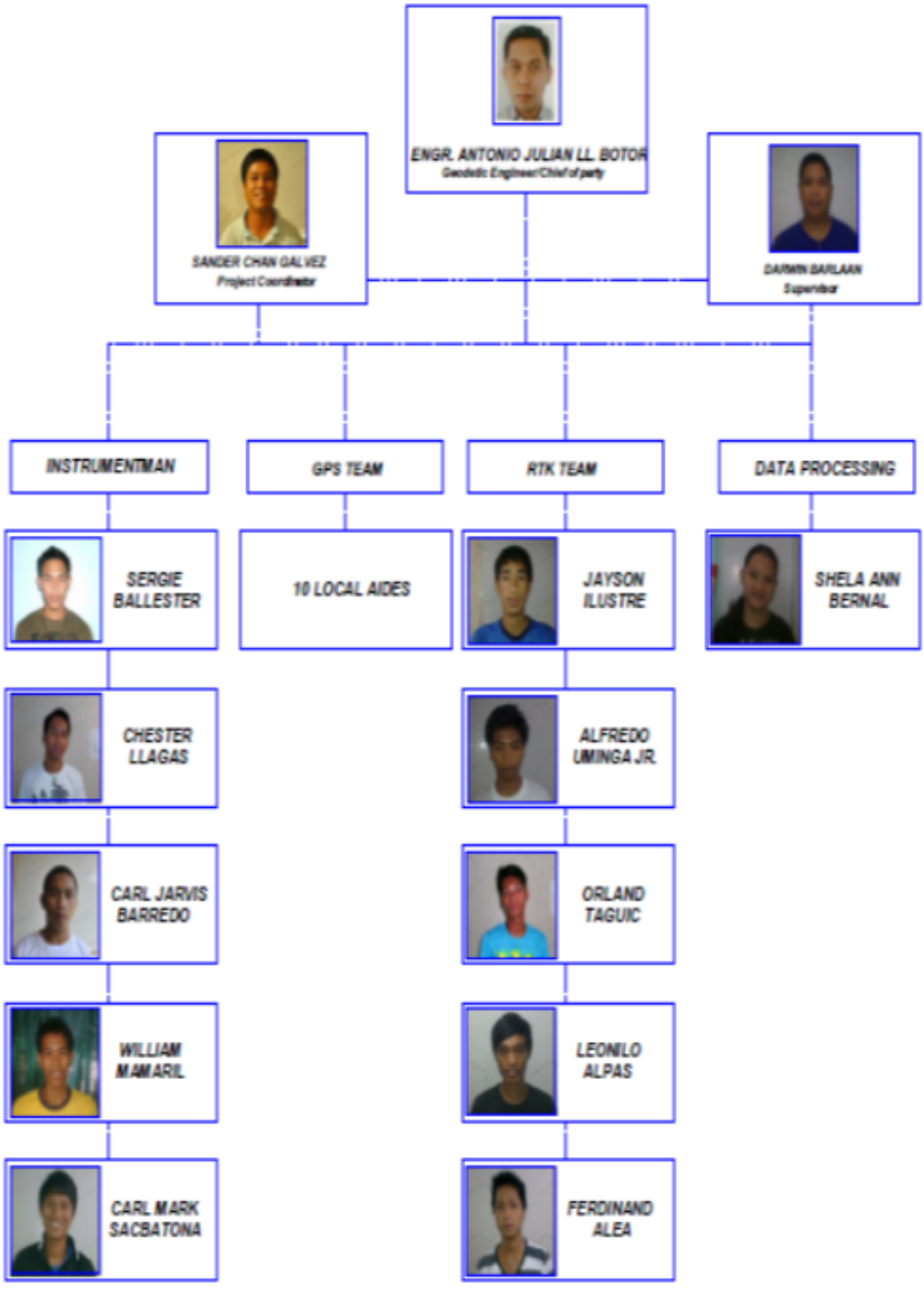

Figure 48: The Survey Team of Jalaur River

Field Survey Methodology

This is a work flow of fieldworks and office processing known also as project management plan.

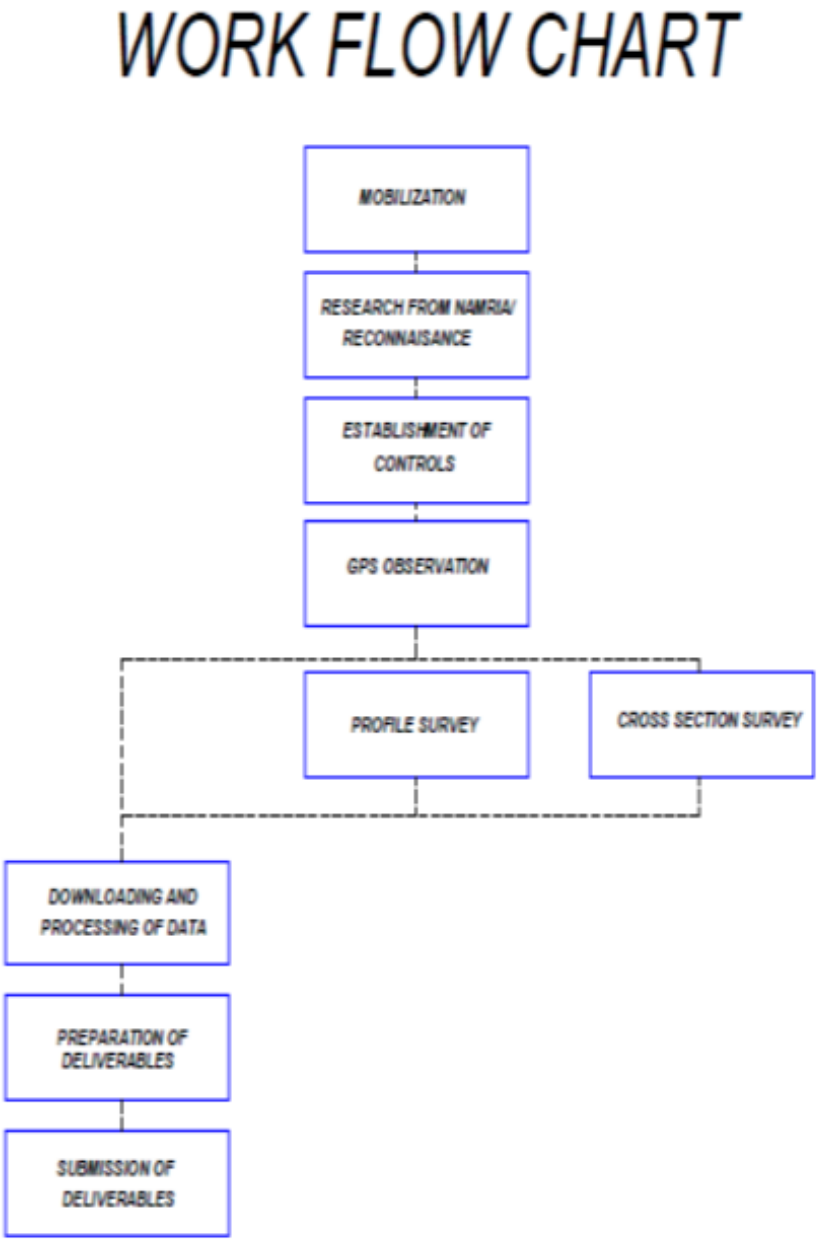

Figure 49: Work Flow Chart of Jalaur River

2.1. Field Plan

The survey team established 15 pairs of Ground Control Points (GCP) along the river. These control points were established based on the requirement that the maximum distance is 10km and an additional number of ground control points established if a cross-section and profile are out of 10km range to ensure the accuracy of the field survey. The 15 pairs of GCP were observed simultaneously with the reference control point by NAMRIA using the single frequency GPS. The raw data were processed using the *Spectra Precision Survey Office* software. After processing, the final coordinates were used in the profile and cross-section survey.

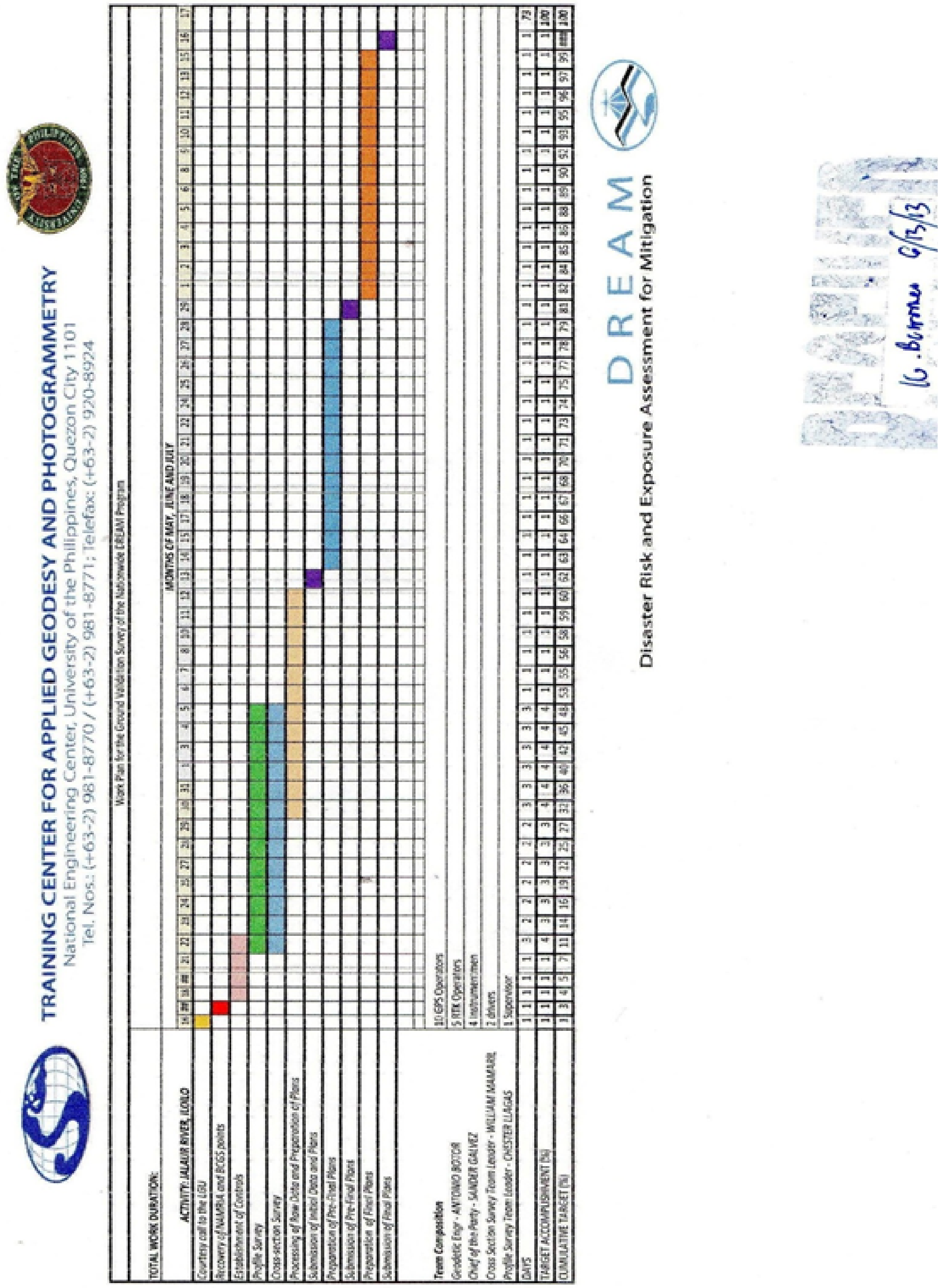

Figure 50: Work Plan of Jalaur River

Annexes

2.2 Research for Reference Points and Benchmarks

The established control points were referred to the Reference points and Benchmark, approved by NAMRIA and specified by the client for the project.

Table 4: Location of Established Control Points

CONTROL POINTS	BARANGAY	MUNICIPALITY
AB-1	MAN-IT	PASSI
AB-1A	POBLACION ILAWOD	PASSI
AB-2	CAMIRI	SAN ENRIQUE
AB-2A	CAMIRI	SAN ENRIQUE
AB-3	LUREA	SAN ENRIQUE
AB-3A	LUREA	SAN ENRIQUE
AB-4-DLE-1	POBLACION	DINGLE
AB-4A	POBLACION	DINGLE
AB-5	SANIBA-AN SITIO SIBUCAO	DINGLE
AB-5A	SANIBA-AN SITIO SIBUCAO	DINGLE
AB-6	CA-UAYAN	POTOTAN
AB-6A	CA-UAYAN	POTOTAN
AB-7	TUBURAN	POTOTAN
AB-7A	TUBURAN	POTOTAN
AB-8	MONPON	BAROTAC NUEVO
AB-8A	MONPON	BAROTAC NUEVO
AB-9	NANGA	POTOTAN
AB-9C	NANGA	POTOTAN
AB-9D	NANGA	POTOTAN
AB-10	BALIBAG	DUMANGAS
AB-10A	BALIBAG	DUMANGAS
AB-11	JALAUR	ZARRAGA
AB-11A	JALAUR	ZARRAGA
AB-12	FABRICA	LEGANES
AB-12A	FABRICA	LEGANES
AB-13	NABITASAN	LEGANES
AB-13A	NABITASAN	LEGANES
AB-14	NABITASAN	LEGANES
AB-14A	NABITASAN	LEGANES
AB-15	NABITASAN	LEGANES
AB-15A	NABITASAN	LEGANES

Annexes

Table 5: Reference point and Benchmark Used

Station Name	Order of Accuracy	Geographic Coordinates, World Geodetic System 1984(WGS84				
		Latitude	Longitude	Ellipsoidal_ Height (m)	Elevation (MSL)	Elevation (EGM08)
ILO-31	Third	N11°06'18.97517"	E122°38'30.63728"	97.369	39.65	39.239
IL-391A	First	N10°53'48.05187"	E122°41'59.84085"	71.457	12.159	26.349

Table 6: Established Ground Control Points

POINT NAME	LATITUDE	LONGITUDE	ELLIPSOIDAL HEIGHT	NORTHING	EASTING	ELEVATION(MSL)	ELEVATION (EGM08)
AB-1	N11°06'06.23643"	E122°38'25.78880"	96.114	1227251.78	460739.788	38.397	37.986
AB-10	N10°50'53.94782"	E122°39'00.54440"	71.652	1199230.032	461761.546	13.532	13.231
AB-10A	N10°50'50.89987"	E122°39'03.61775"	71.81	1199136.309	461854.75	13.683	13.383
AB-11	N10°49'26.57152"	E122°38'25.26590"	64.262	1196547.582	460687.272	6.175	5.835
AB-11A	N10°49'28.05819"	E122°38'30.32168"	63.001	1196593.063	460840.839	4.904	4.568
AB-12	N10°48'21.13953"	E122°38'30.78814"	63.16	1194537.693	460852.592	5.038	4.678
AB-12A	N10°48'19.89835"	E122°38'33.28482"	62.849	1194499.482	460928.361	4.721	4.363
AB-13	N10°47'33.72280"	E122°37'52.02488"	61.833	1193082.725	459673.759	3.766	3.358
AB-13A	N10°47'29.83330"	E122°37'57.80259"	61.854	1192963.051	459849.068	3.775	3.368
AB-14	N10°47'23.37709"	E122°38'49.39039"	64.933	1192762.911	461415.416	6.752	6.378
AB-14A	N10°47'21.59576"	E122°38'45.66188"	64.967	1192708.33	461302.127	6.793	6.415
AB-15	N10°46'27.48430"	E122°38'43.38550"	61.378	1191046.423	461231.075	3.185	2.774
AB-15A	N10°46'32.60909"	E122°38'42.84870"	60.843	1191203.845	461214.956	2.654	2.245
AB-1A	N11°06'08.58758"	E122°38'29.78621"	96.024	1227323.849	460861.138	38.302	37.889
AB-2	N11°04'33.18012"	E122°38'49.81451"	90.558	1224392.708	461465.237	32.769	32.331
AB-2A	N11°04'37.81184"	E122°38'51.09267"	88.551	1224534.924	461504.182	30.762	30.32
AB-3	N11°02'35.00240"	E122°37'38.49406"	93.135	1220765.54	459296.967	35.405	34.998
AB-3A	N11°02'39.50497"	E122°37'40.60373"	84.793	1220903.756	459361.151	27.062	26.652
AB-4=DLE-1	N11°00'12.81235"	E122°40'00.99919"	83.698	1216393.137	463615.952	25.696	25.26
AB-4A	N11°00'16.51287"	E122°40'04.49235"	83.725	1216506.679	463722.08	25.718	25.279
AB-5	N10°59'06.59576"	E122°40'58.25724"	78.116	1214357.449	465351.335	19.993	19.576
AB-5A	N10°59'05.37413"	E122°41'02.79515"	78.395	1214319.782	465489.01	20.264	19.848
AB-6	N10°57'16.00659"	E122°40'03.73970"	72.948	1210962.551	463693.116	14.866	14.501
AB-6A	N10°57'12.48734"	E122°39'59.78045"	72.491	1210854.592	463572.831	14.414	14.05
AB-7	N10°55'22.73716"	E122°41'14.87237"	70.847	1207481.249	465848.435	12.597	12.302
AB-7A	N10°55'20.93051"	E122°41'10.95935"	72.746	1207425.882	465729.603	14.502	14.209
AB-8	N10°54'16.22738"	E122°40'37.09808"	69.394	1205439.652	464699.662	11.181	10.902
AB-8A	N10°54'14.08222"	E122°40'31.92514"	69.234	1205373.933	464542.563	11.029	10.748
AB-9	N10°53'13.58134"	E122°39'45.99666"	69.363	1203517.214	463146.301	11.215	10.93
AB-9C	N10°52'40.59054"	E122°39'37.53147"	70.397	1202504.211	462888.185	12.251	11.968
AB-9D	N10°52'43.00321"	E122°39'31.42958"	70.639	1202578.522	462703.025	12.505	12.219

2.3 Reconnaissance

Before conducting the actual field survey, reconnaissance was done initially by courtesy meeting with the mayors of the municipalities that were affected by the project last April 24, 2013.The site inspection are necessary to familiarize the actual situation of the project area, distinguished location of cross-section lines where there obstructions and recovery of available horizontal and vertical controls of NAMRIA.

2.4 Establishment of Control points and GNSS Network

GPS method was used in the establishment of controls. An approximately 1 hour of simultaneous observation on the 15 pairs of GCS and the reference control (NAMRIA established) was done with post processing using the Spectra Precision Survey Office software to establish the final coordinates of the stations in the project area. The established control stations were permanently marked and were referred to NAMRIA Geodetic Control Point ILO-31 and the elevation of the established points was referred to NAMRIA Benchmark IL-391A.

When the control stations have been established and coordinates finalized, these were used as the reference controls for the survey. Total numbers of Ground Control Points established were 31 GCPs (see Table 4).

Field personnel ensured that there were no overhead structures near the stations, such as buildings, trees, radio towers and transmission lines.

For single Frequency Receivers, the baseline length (Distance between Stations) should not exceed ten (10) km. Occupy stations for at least one (1) hour per session. The longer the occupation, the better the processing results.

The static survey started last April 29, 2013 after 3 days of establishment of ground control points.

Table 7: Established Ground Control Points

POINT NAME	LATITUDE	LONGITUDE	ELLIPSOIDAL HEIGHT	NORTHING	EASTING	ELEVATION(MSL)	ELEVATION (EGM08)
AB-1	N11°06'06.23643"	E122°38'25.78880"	96.114	1227251.78	460739.788	38.397	37.986
AB-10	N10°50'53.94782"	E122°39'00.54440"	71.652	1199230.032	461761.546	13.532	13.231
AB-10A	N10°50'50.89987"	E122°39'03.61775"	71.81	1199136.309	461854.75	13.683	13.383
AB-11	N10°49'26.57152"	E122°38'25.26590"	64.262	1196547.582	460687.272	6.175	5.835
AB-11A	N10°49'28.05819"	E122°38'30.32168"	63.001	1196593.063	460840.839	4.904	4.568
AB-12	N10°48'21.13953"	E122°38'30.78814"	63.16	1194537.693	460852.592	5.038	4.678
AB-12A	N10°48'19.89835"	E122°38'33.28482"	62.849	1194499.482	460928.361	4.721	4.363
AB-13	N10°47'33.72280"	E122°37'52.02488"	61.833	1193082.725	459673.759	3.766	3.358
AB-13A	N10°47'29.83330"	E122°37'57.80259"	61.854	1192963.051	459849.068	3.775	3.368
AB-14	N10°47'23.37709"	E122°38'49.39039"	64.933	1192762.911	461415.416	6.752	6.378
AB-14A	N10°47'21.59576"	E122°38'45.66188"	64.967	1192708.33	461302.127	6.793	6.415
AB-15	N10°46'27.48430"	E122°38'43.38550"	61.378	1191046.423	461231.075	3.185	2.774
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AB-1A	N11°06'08.58758"	E122°38'29.78621"	96.024	1227323.849	460861.138	38.302	37.889
AB-2	N11°04'33.18012"	E122°38'49.81451"	90.558	1224392.708	461465.237	32.769	32.331
AB-2A	N11°04'37.81184"	E122°38'51.09267"	88.551	1224534.924	461504.182	30.762	30.32
AB-3	N11°02'35.00240"	E122°37'38.49406"	93.135	1220765.54	459296.967	35.405	34.998
AB-3A	N11°02'39.50497"	E122°37'40.60373"	84.793	1220903.756	459361.151	27.062	26.652
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AB-6	N10°57'16.00659"	E122°40'03.73970"	72.948	1210962.551	463693.116	14.866	14.501
AB-6A	N10°57'12.48734"	E122°39'59.78045"	72.491	1210854.592	463572.831	14.414	14.05
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AB-9C	N10°52'40.59054"	E122°39'37.53147"	70.397	1202504.211	462888.185	12.251	11.968
AB-9D	N10°52'43.00321"	E122°39'31.42958"	70.639	1202578.522	462703.025	12.505	12.219

2.5. Ground Surveys

2.5. 1 Static Survey

An approximately 1 hour of simultaneous observation on the 15 pairs of GCS and the reference control (NAMRIA established) was done with post processing using the Spectra Precision Survey Office software to establish the final coordinates of the stations in the project area. The established control stations were permanently marked and were referred to NAMRIA Geodetic Control Point ILO-31 and the elevation of the established points was referred to NAMRIA Benchmark IL-391A.

Figure 51: AB – 1 is located in Jalaur Bridge located at Passi City

Figure 52: AB – 1A is located in Jalaur Bridge in front of Passi Terminal located at Passi City

Figure 53: AB – 2A is located along the river at Barangay Camiri, San Enrique

Figure 54: AB – 4=DLE-1 is located in Dingle Bridge, Dingle

Figure 55: AB-13 is located at the riprap at Barangay Nabitasan, Leganes

Figure 56: The reference point ILO-31 is located in the Town Proper of Passi

2.5.2 Established Control Points

Figure 57: AB – 1 is located in Jalaur Bridge located at Passi City

Figure 58: AB – 1A is located in Jalaur Bridge in front of Passi Terminal located at Passi City

Figure 59: AB – 2 is located along the river at Barangay Camiri, San Enrique

Figure 60: AB – 2A is located along the river at Barangay Camiri, San Enrique

Figure 61: AB – 3 is located along the river at Barangay Lurea, San Enrique

Figure 62: AB – 3A is located along the river at Barangay Lurea, San Enrique

Figure 63: AB – 4 = DLE-1 is located in Dingle Bridge, Dingle

Figure 64: AB – 4A is located in Dingle Bridge, Dingle

Figure 65: AB – 5 is located along the river at Barangay Saniba-an, Dingle

Figure 66: AB – 5A is located along the river at Barangay Saniba-an, Dingle

Figure 67: AB – 6 is located along the river at Mun. of Pototan

Figure 68: AB – 6A is located along the river at Mun. of Pototan

Figure 69: AB – 7 is located along the river at Mun. of Barotac Nuevo

Figure 70: AB – 7A is located along the river at Mun. of Barotac Nuevo

Figure 71: AB – 8 is located along the river at Barangay Monpon, Barotac Nuevo

Figure 72: AB – 8A is located along the river at Barangay Monpon, Barotac Nuevo

Figure 73: AB – 9 is located along the river at Barangay Nanga, Pototan

Figure 74: AB – 9C is located along the river at Barangay Nanga, Pototan

Figure 75: AB – 9D is located along the river at Barangay Nanga, Pototan

Figure 76: AB – 10A is at Banga-Bante Bridge located at Barangay Balabag, Dumangas

Figure 77: AB – 10 is at Banga-Bante Bridge located at Barangay Balabag, Dumangas

Figure 78: AB – 11A is located along the river at Barangay Jalaur, Zarraga

Figure 79: AB – 11 is located along the river at Barangay Jalaur, Zarraga

Figure 80: AB – 12 is located along the river at Barangay Pabrica, Leganes

Figure 81: AB – 12A is located along the river at Barangay Pabrica, Leganes

Figure 82: AB – 13 is at the riprap located at Barangay Nabitasan, Leganes

Figure 83: AB – 13A is at the riprap located at Barangay Nabitasan, Leganes

Figure 84: AB – 14A is at Monfort-Halaur Bridge located at Barangay Nabitasan, Leganes

Figure 85: AB – 14 is at Monfort-Halaur Bridge located at Barangay Nabitasan, Leganes

Figure 86: AB – 15 is located along the river at Barangay Nabitasanl Leganes

Figure 87: AB – 15A is located along the river at Barangay Nabitasan, Leganes

Figure 88: Benchmark IL-391A is at the top of the sidewalk beside a lamp post fronting Ara Grace Food Store located at Barangay JT Bretaña, Barotac Nuevo

Figure 89: Reference point ILO-31 is located in the Town Proper of Passi

2.5.3 Cross-Section Survey

Cross-section survey started on May 9, 2013 and ended in June 20, 2013. There were a total of 62 cross sections that were surveyed on the 68-km Jalaur River. Cross- section 1 is located at Passi City and Cross section 62 is located at municipality of Leganes.

Real Time Kinematic (RTK) Horizon and Hi-target were the main equipment used in conducting the Cross-Section survey. The survey team used Total stations in areas that were not feasible for Real Time Kinematic (RTK).

There were 3 (RTK) Horizon operators, 2 Hi-Target (RTK) operators and 5 Instrument men with local aides.

The site Cad operator downloaded the survey data from the instrument used and sent through email for checking and processing.

Some deviations were made during the cross-section survey because some cross-section lines are not feasible in conventional survey and by using RTKs. There were many obstructions like houses and sugarcane plantations.

Table 8: Cross section with no data

Cross Section No.	Remarks	Solutions Applied
XSR-3	Area is a sugar cane field	area not survey
XSL-8	Area is a sugar cane field	area not survey
XS-17	Both cross section line are mountain area	area not survey
XS-18	Both cross section line are mountain area	area not survey
XSL-19	Area is a sugar cane field	area not survey
XSL-20	Area is a sugar cane field	area not survey
XS-21	Both cross section line are mountain area	area not survey

Annexes

Site pictures of cross-section with no data

Figure 90: Right Cross section 3 Sugar cane field

Figure 91: Left Cross section 8 Sugar cane field

Figure 92: Cross Section 17 Mountain Area

Figure 93: Cross Section 18 Mountain Area

Figure 94: Cross Section 19 Sugar cane field

Figure 95: Cross Section 20 Sugar cane field

Figure 96: Cross Section 21 Mountain Area

Site picture while conducting cross-section survey in Jalaur River

Figure 97: Conducting cross-section survey using Total Station at cross-section 7 at Brgy. Camiri, San Enrique

Figure 98: Conducting cross-section survey using Total Station at cross-section 2 at Brgy. Gemat-y, Passi City

Figure 99: Conducting cross-section survey using Total Station at cross-section 4 at Brgy. Poblcion Ilaya, Passi City

Figure 100: Conducting cross-section survey using Total Station at cross-section 3 at Brgy. Gemat-y, Passi City

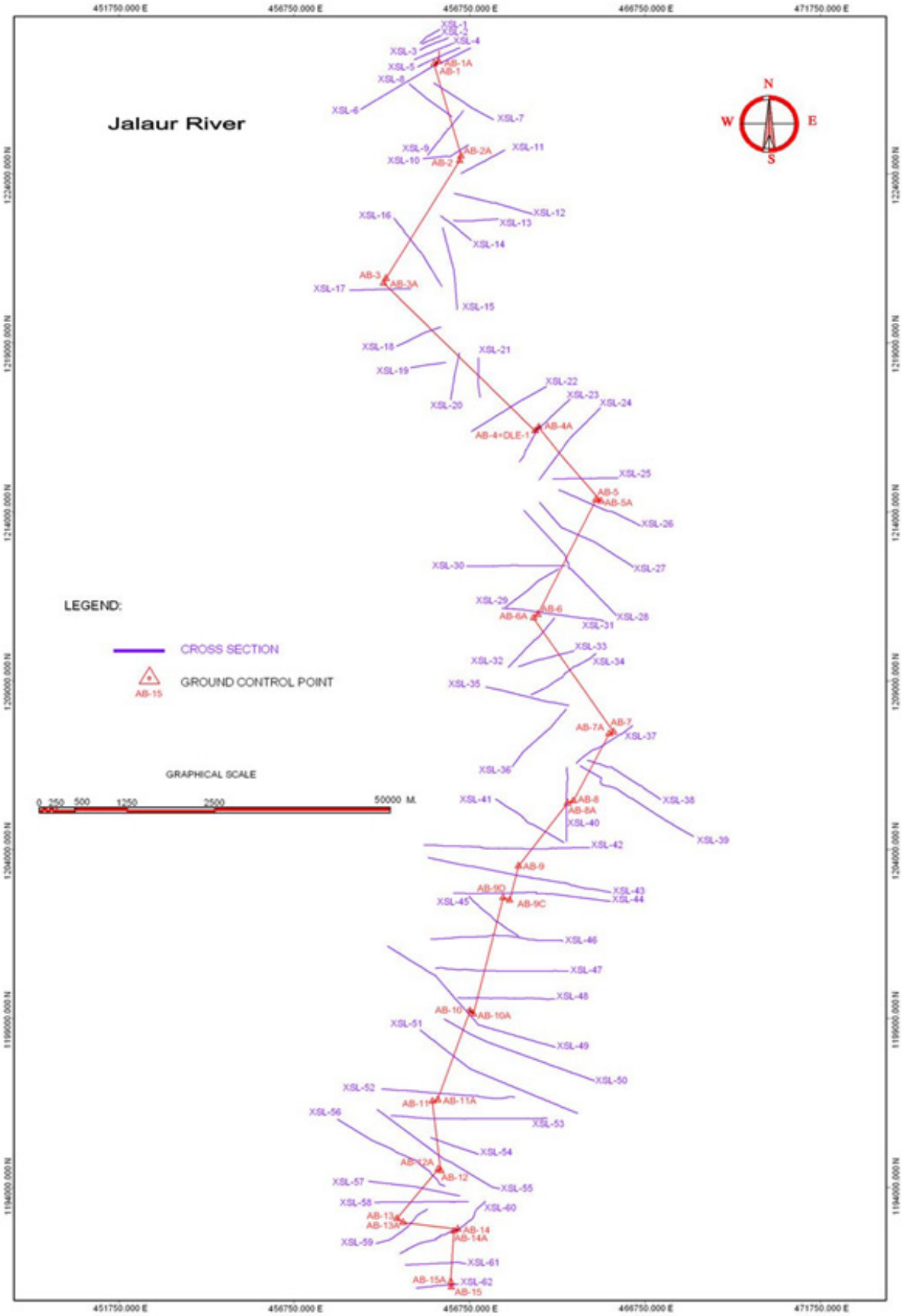


Figure 101: Cross Section of Jalaur River

2.5.4 Profile Survey

The profile survey of 68-km Jalaur River started on May 3, 2013 and ended on June 20, 2013. The start of profile survey was in Passi City down to municipality of Leganes and was conducted simultaneously with the cross-section survey.

Real Time Kinematic (RTK) Horizon and Hi-target were the main equipments in conducting the profile survey. Total stations were used to the areas that are not feasible for Real Time Kinematic (RTK). There were 3 (RTK) Horizon operators, 2 Hi-Target (RTK) operators and 5 Instrument men with local aides.

The site Cad operator downloaded the survey data from the instruments used and sent through email to the main office for checking and processing.

Site pictures of Profile in Jalaur River

Figure 102: Along cross section 17 located at Brgy. Tinocu-an, Dueñas

Figure 103: River is located at Brgy. Rumagayray, San Enrique

Figure 104: Hanging Bridge near the dam located between Brgy. Licu-an and Brgy. Morob-oro, Dingle.

Site picture while conducting profile survey

Figure 105: Conducting profile survey using Hi-Target Prismless at Brgy. Nabitasan, Leganes

Figure 106: Conducting profile survey using Hi-Target Prismless at Brgy. Tubigan, Zarraga

Figure 107: Conducting profile survey using Total Station at Brgy. Licu-an, Dingle

Figure 108: Conducting profile survey using Total Station at Brgy. Panda, Dueñas

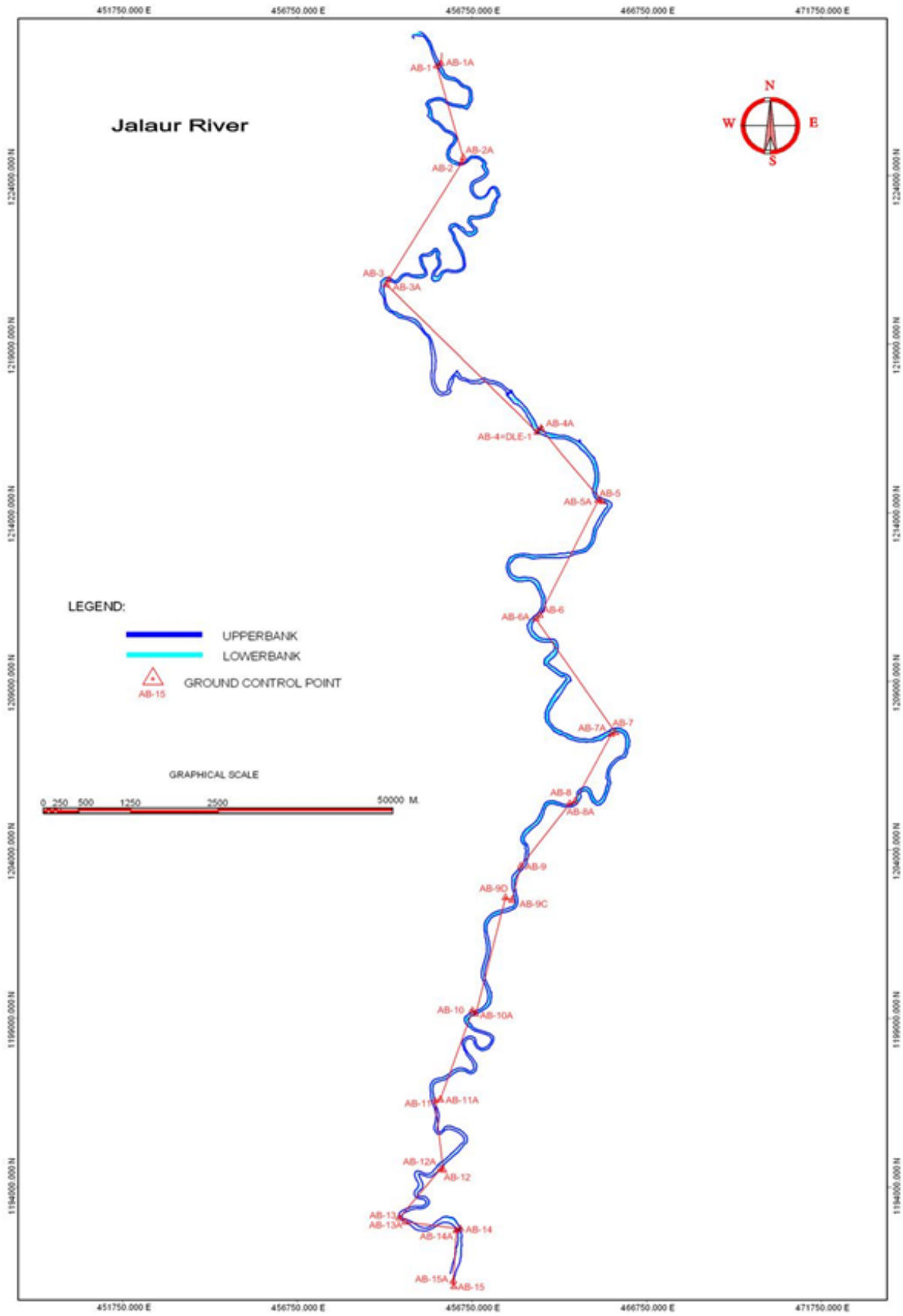


Figure 109: Jalaur River Profile

2.6 Data Processing

2.6.1 Profile Processing

From the site, the CAD Operator assigned, downloaded the survey data from the instrument used and sent through e-mail to the main office for processing. After opening the downloaded data in spreadsheet software, unnecessary data were deleted. Only Points, Northing, Easting, Elevation and Description were left and saved (PNEZD) in PRN format. This PRN file was imported in Softdesk 8 Software.

Using Softdesk 8 Software, elevations were adjusted and transformed to true coordinates by the reference / control (ILO-31, IL-391A) used and exported all the data in Softdesk. Exported data were converted to PRN format and imported in AutoCAD Civil 3d Software. Using this software, Upper and Lower Banks, Left and Right Descriptions were polylined and processed to generate surfaces and contours. Contour interval was 2m for Intermediate contour and 10m for Primary contour and created an alignment for the left and right of the upper and lower banks for the stationing. Start of the station must be on the upstream.

Profile of each upper and lower bank, left and right was with a horizontal scale of 1:10000 and vertical scale of 1:100. Cross Sections and Landmarks on the profile were located, especially the bridge that crosses the river. This profile was inserted on the plan with appropriate scale (1:10000, 1:100), title block and scale text to make it readable.

From the profile, points were exported and opened in a spreadsheet software for the tabulation of points and converted the coordinates Northing and Easting to Latitude and Longitude.

2.6.2 Cross Section Processing

Cross section processing started from gathering all the survey data from the site through e-mail. Gathered data were downloaded and opened in a spreadsheet software and saved in PRN format and imported in Softdesk 8 Software. Using Softdesk 8 Software, elevations were adjusted and moved to true coordinates using ILO-31 and IL-391A. Adjusted data were exported in Softdesk 8 and converted to PRN format, imported it to the file where profile was processed. After importing the data, cross section was polylined and deleted all unnecessary points then processed and generated surfaces and contours. Contour interval was 2m for Intermediate contour and 10m for Primary contour.

Alignment on each cross section was created and generated with appropriate scales, wherein Horizontal Scale was 1:2000 and Vertical Scale was 1:100. Landmarks such as roads and bridges were located along the cross section lines and inserted into the plan. Exported points of each cross section were opened in a spreadsheet software for the tabulation of points. Northing and Easting coordinates were converted using Expert GPS software.


Results and
Discussions

Annexes

3.1 Reconnaissance Survey

The survey team and the representative of the University of the Philippines – Training Center for Applied Geodesy and Photogrammetry (UP-TCAGP) conducted a field reconnaissance in Jalaur River located in the Province of Iloilo last April 24, 2013. The site inspection are necessary to familiarize the actual situation of the project area, distinguished location of cross-section lines for obstructions and recovery of available horizontal and vertical controls of NAMRIA.

The survey team was introduced by a representative of UP-TCAGP to the mayors of the municipalities that were affected by the project. The municipalities that were affected are Passi City, Leganes, Zarraga, Dumangas, Barotac Nuevo, Pototan, Dingle, San Enrique and Dueñas. Courtesy call up to barangay level were also conducted to ensure the safety of the team and to coordinate with those private properties affected by the project.

During the reconnaissance the survey teams cited problems that might affect the field survey.

Concerns regarding affected private properties are the following:

Table 9: Problems Encountered during Reconnaissance

Private Property		Actions Taken	Remarks / Solutions
1.	Fish cage owners	-provided formal letter and conducted meetings to discuss the purpose of the project	-did not permit the team -deviate the cross-section line
2.	Sugar cane and rice fields	-not surveyed	-not surveyed
3.	Cluster House	-not surveyed	-not surveyed
4.	Mountain area	-not surveyed	-not surveyed

Table 10: List of obstructed cross-section

Cross Section No.	Remarks	Solution Applied
XSR-3	Area is a sugar cane field	area not survey
XSL-8	Area is a sugar cane field	area not survey
XS-17	Both cross section lines fell in mountainous areas	area not survey
XS-18	Both cross section line are mountain area	area not survey
XSL-19	Area is sugar cane field	area not survey
XSL-20	Area is sugar cane field	area not survey
XS-21	Both cross section line fell in mountainous areas	area not survey

3.2 Actual Field Survey

3.2.1 Cross-section Survey

Cross-section survey started on May 9, 2013 and ended in June 20, 2013. There were a total of 62 cross sections that were surveyed on the 68-km Jalaur River. Cross- section 1 is located at Passi City and Cross section 62 is located at municipality of Leganes.

During the fieldwork some difficulties were encountered in project area. The survey team experienced 12 days of heavy rains during the fieldwork that caused the threat of flash flooding. Some fish cage owners prevented the team to perform the survey. One more thing that affected the fieldwork, the sugar cane and rice fields, mountainous areas, cluster of houses and the dam which is hundred meters upward.

During the rainy days the survey team was still working. Cloud cover during rainy days resulted to low satellite signal thus, making it difficult to secure a fixed satellite signal for the rovers, resulting to float data.

Real Time Kinematic (RTK) Horizon and Hi-target were the main equipment in conducting the Cross-Section survey. Total stations were used for areas that were not feasible for Real Time Kinematic (RTK).

There were 3 (RTK) Horizon operators, 2 Hi-Target (RTK) operators and 5 Instrument men with local aides. The site Cad operator downloaded the survey data from the instrument used and sent it through email for checking and processing.

Some deviations were made during the cross-section survey because some planned cross-section lines were not feasible in conventional survey and by using RTKs GPS Surveying Techniques. There were many obstructions like houses and sugarcane plantations.

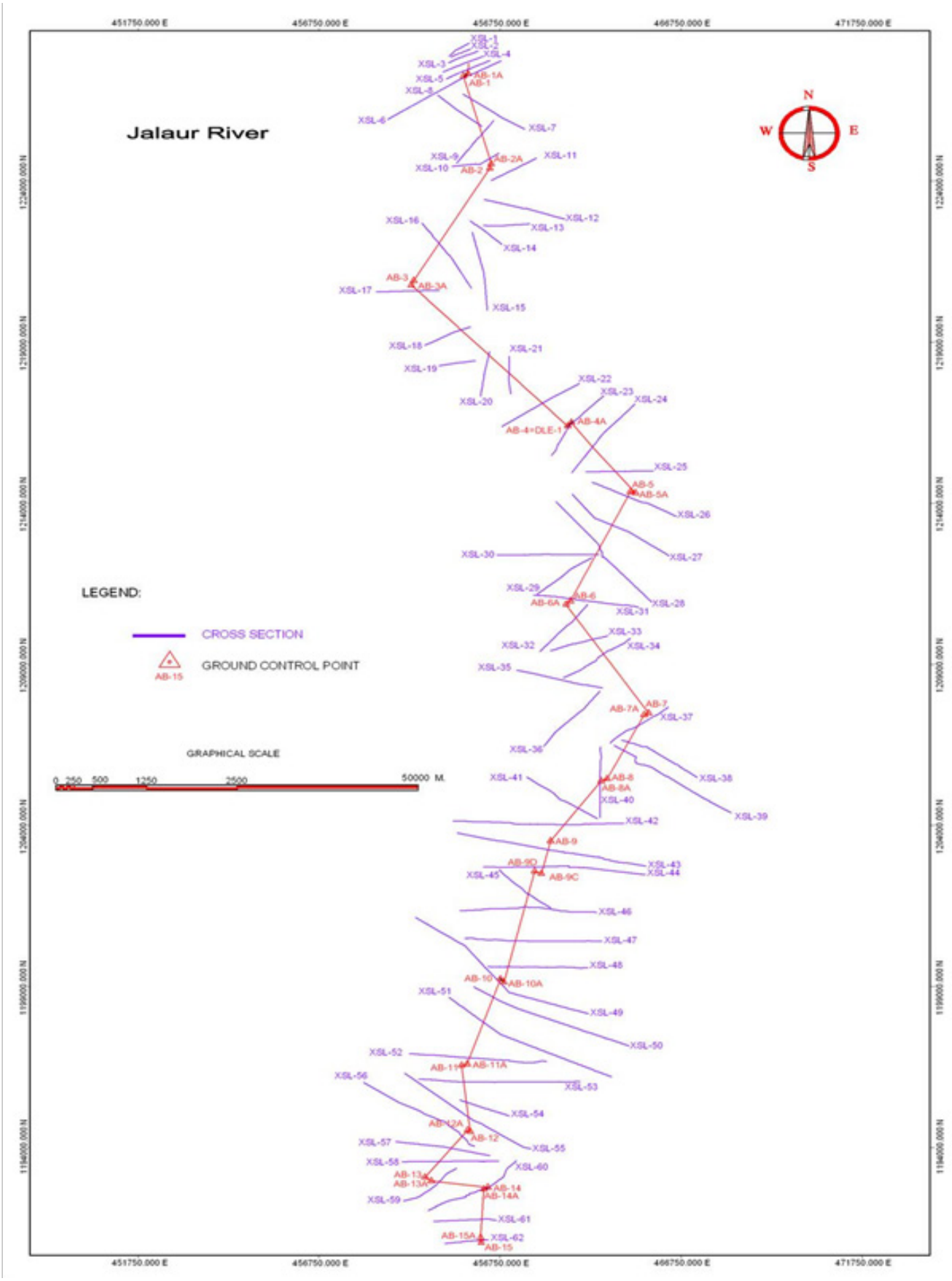


Figure 110: Actual Cross-section Survey of Jalaur River

3.2.2 Profile Survey

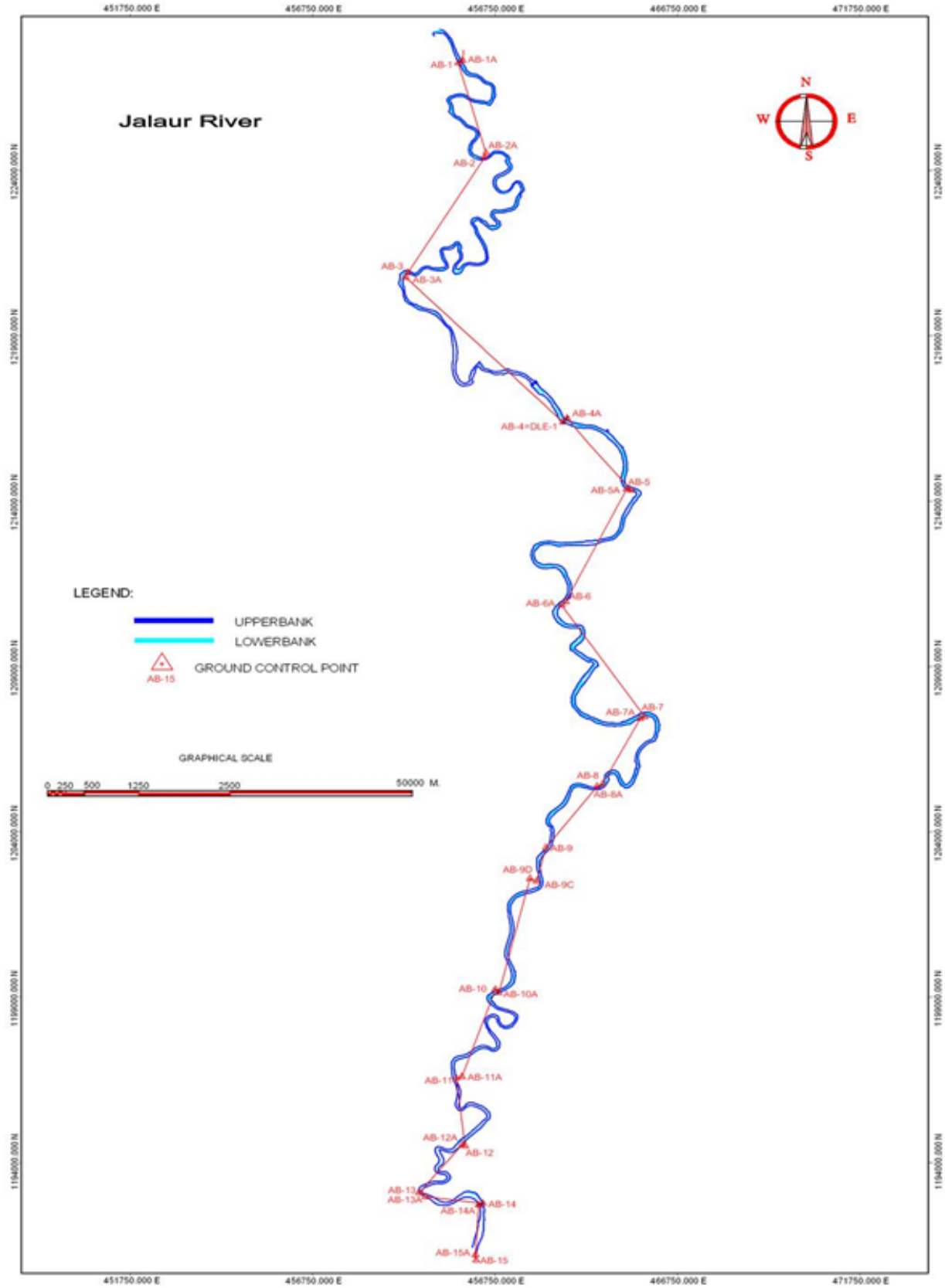


Figure 111: Actual Profile Survey of Jalaur River

3.3 Problems Encountered and Resolutions Applied

The survey work started on the onset of the rainy days in Iloilo. In fact, there were about 8 days during the fieldwork, where heavy rains hampered the team in doing the survey. It was also very dangerous to survey along the river during those times because of the threat of flash flooding.

Sometime in May, the cross-section survey teams were prevented by some fish cage owners near the river in the Municipality of Leganes to conduct the survey. The team had to formally ask the Mayor of Leganes for assistance. It took a week before the survey in that area resumed.

There were many cross-section lines that were near impossible if not impossible to survey. One instance was the cross-section that crossed the dam which is hundred meters up. The other sections crosses a 90 degree slope and in deep forest.

Table 11: Tabulation of cross-section and remarks for lacking data

Cross-section	Remarks	Solutions Applied
XSL-1	Portion of Right cross section line are sugar cane field	Not surveyed
XSL-2	Portion of Right cross section line are sugar cane field	Not surveyed
XSL-3	Right cross section line are sugar cane field	Not surveyed
XSL-6	Portion of Left cross section line are cluster of house	Not surveyed
XSL-7	Portion of Right cross section line are sugar cane field and portion of Left cross section line are mountain area	Not surveyed
XSL-8	Left cross section line are sugar cane field	Not surveyed
XSL-9	Portion of Left cross section line are mountain area	Not surveyed
XSL-10	Portion of Left cross section line are sugar cane field	Not surveyed
XSL-15	Portion of Left cross section line are mountain area	Not surveyed
XSL-16	Right cross section line are sugar cane field	Not surveyed
XSL-17	Both cross section line are mountain area	Not surveyed
XSL-18	Both cross section line are mountain area	Not surveyed
XSL-19	Left cross section line are sugar cane field	Not surveyed
XSL-20	Left cross section line are mountain area	Not surveyed
XSL-21	Both cross section line are mountain area	Not surveyed
XSL-22	Portion of Right cross section line are sugar cane field and portion of Left cross section line are mountain area	Not surveyed
XSL-23	Portion of Left and Right cross section line are sugar cane field	Not surveyed
XSL-24	Portion of Left and Right cross section line are sugar cane field	Not surveyed
XSL-25	Portion of Left cross section line are sugar cane field	Not surveyed
XSL-26	Portion of Right cross section line are bamboo trees	Not surveyed

XSL-28	Portion of Right cross section line are sugar cane field	Not surveyed
XSL-29	Portion of Left cross section line are sugar cane field	Not surveyed
XSL-36	Portion of Left cross section line are banana trees	Not surveyed
XSL-39	Portion of Left cross section line are cluster of house	Not surveyed
XSL-40	Portion of Left cross section line are sugar cane field	Not surveyed
XSL-42	Portion of Left cross section line are sugar cane field	Not surveyed
XSL-43	Portion of Right cross section line are poultry and rice field	Not surveyed
XSL-47	Portion of Left cross section line is river they can't passed	Not surveyed
XSL-55	Portion of Left and Right cross section line are sugar cane field	Not surveyed
XSL-56	Portion of Right cross section line are cluster of house	Not surveyed
XSL-57	Portions of Right cross section line are fishponds	Not surveyed
XSL-58	Portions of Right cross section line are fishponds	Not surveyed
XSL-59	Portion of Left cross section line is fishpond	Not surveyed

3.4 Processed Data

These are the data that were adjusted to true coordinates and elevations. Some of the raw data needed to be adjusted in coordinates and elevations that based on the Ground Control Points or reference from NAMRIA. The plotting of profile is from upstream to the downstream.

The upstream barangays are the Brgy. Poblacion Ilaya, Gemat-y, Man-it, Poblacion Ilawod of Passi City and Brgy. Imbang Pequeño, municipality of San Enrique.

The downstream barangays are the Brgy. Libongcogon, Talauguis, Tubigan of municipality of Zarraga and Brgy. Nabitasan, Leganes.

3.4. 1 Profile Plan of Jalaur River

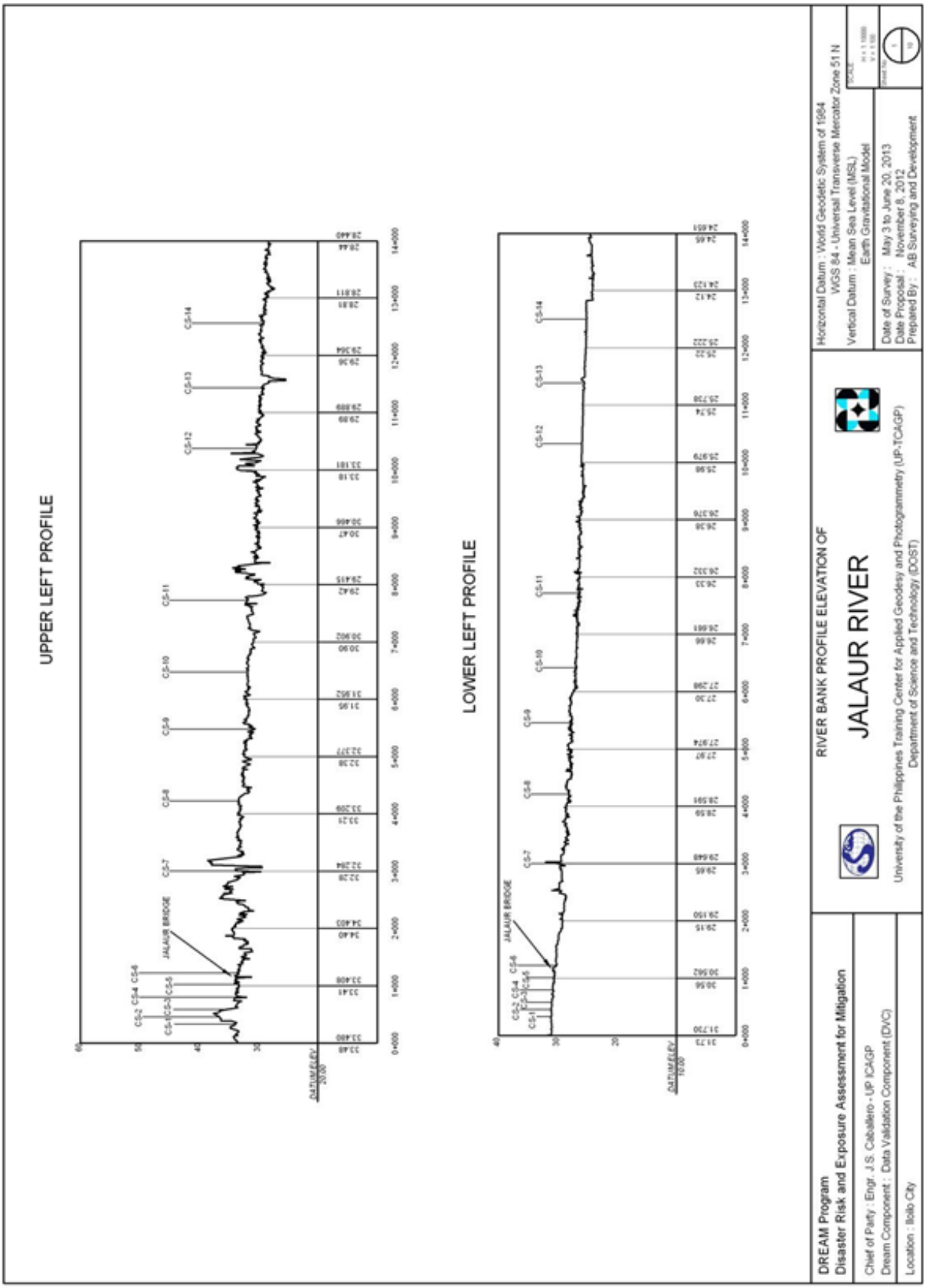


Figure 112: Sheet No. 1 Left River bank profile with relative location of bridge and cross-section

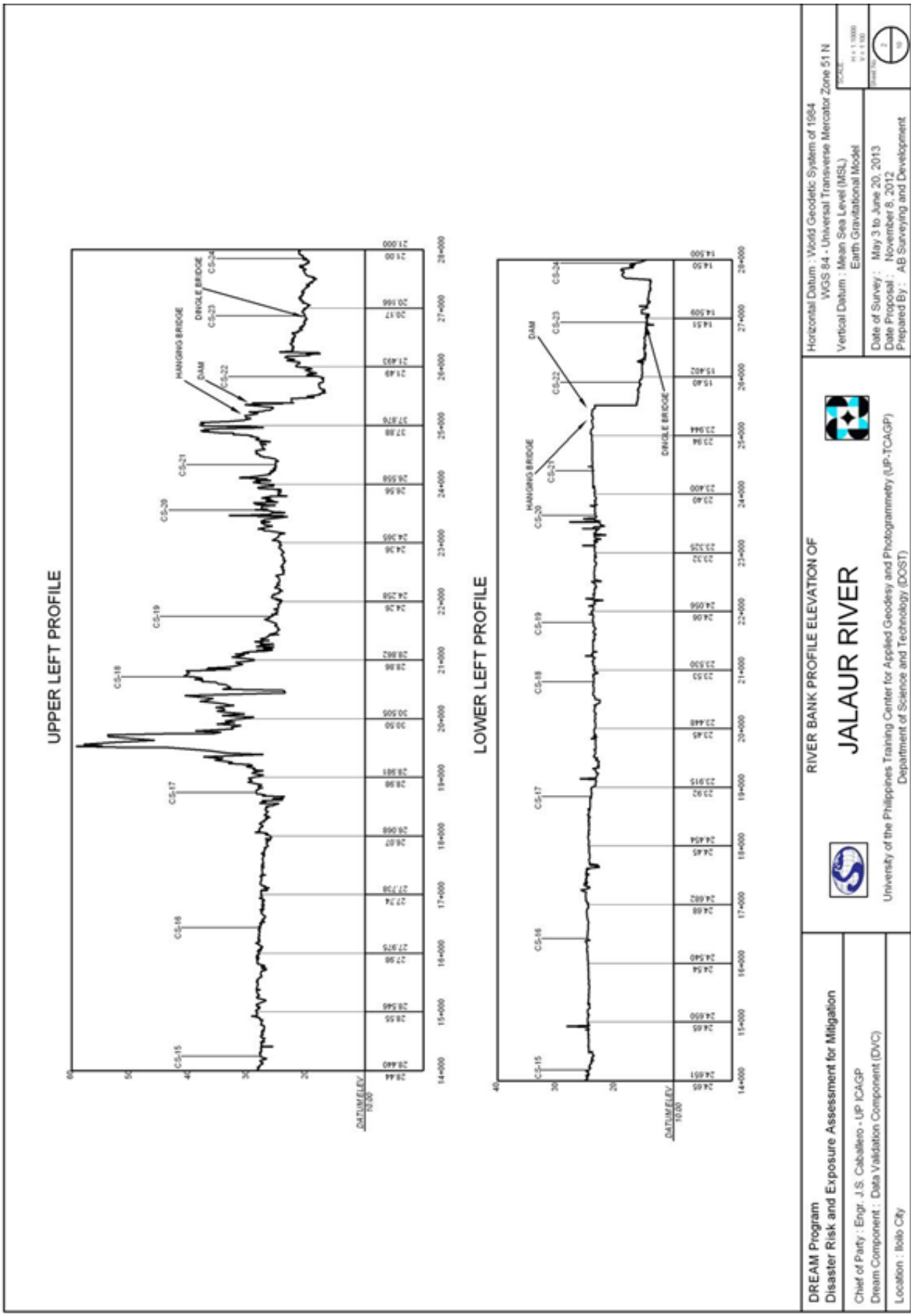


Figure 113: Sheet No. 2 Left River bank profile with relative location of bridge and cross-section

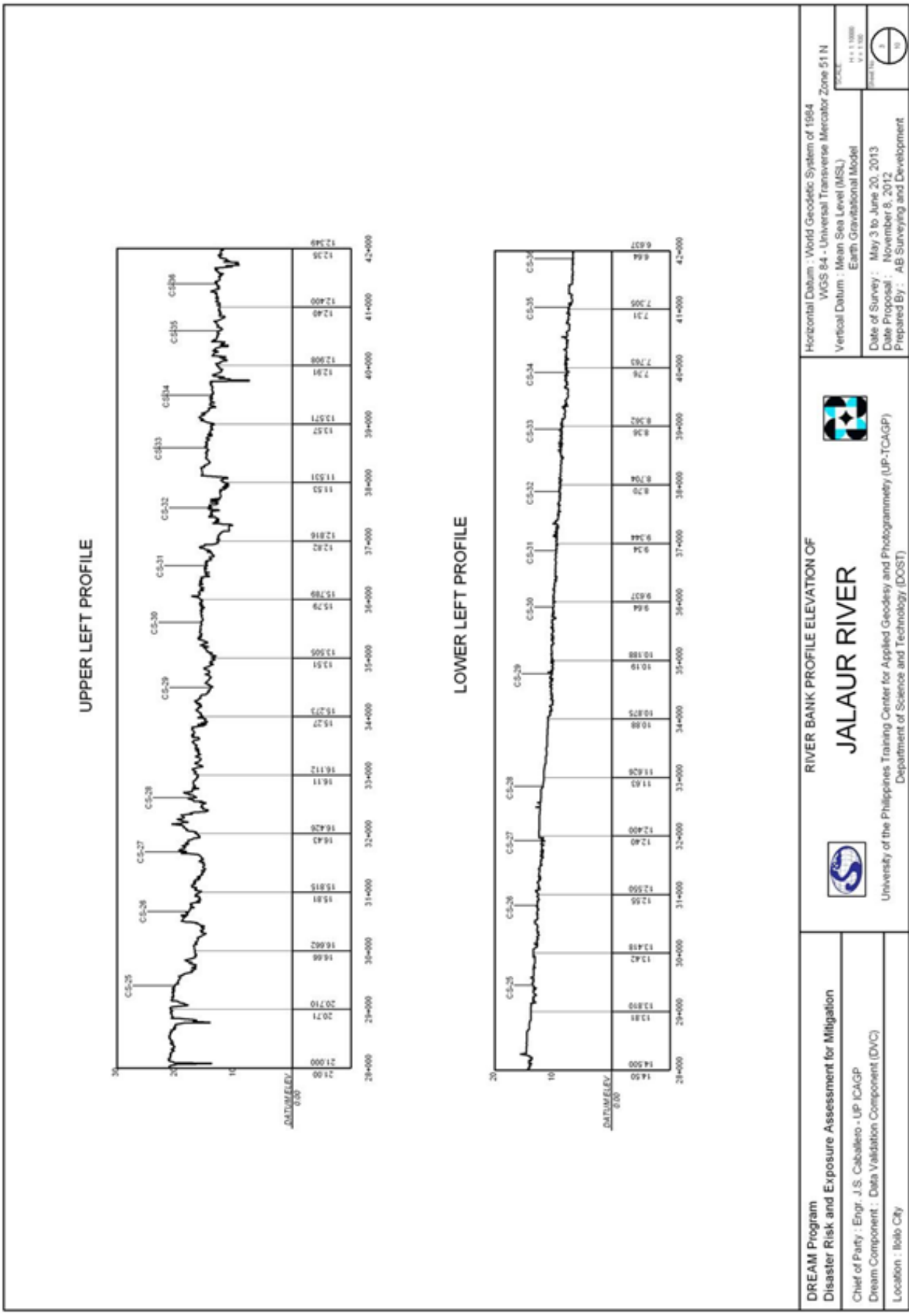


Figure 114: Sheet No. 3 Left River bank profile with relative location of bridge and cross-section

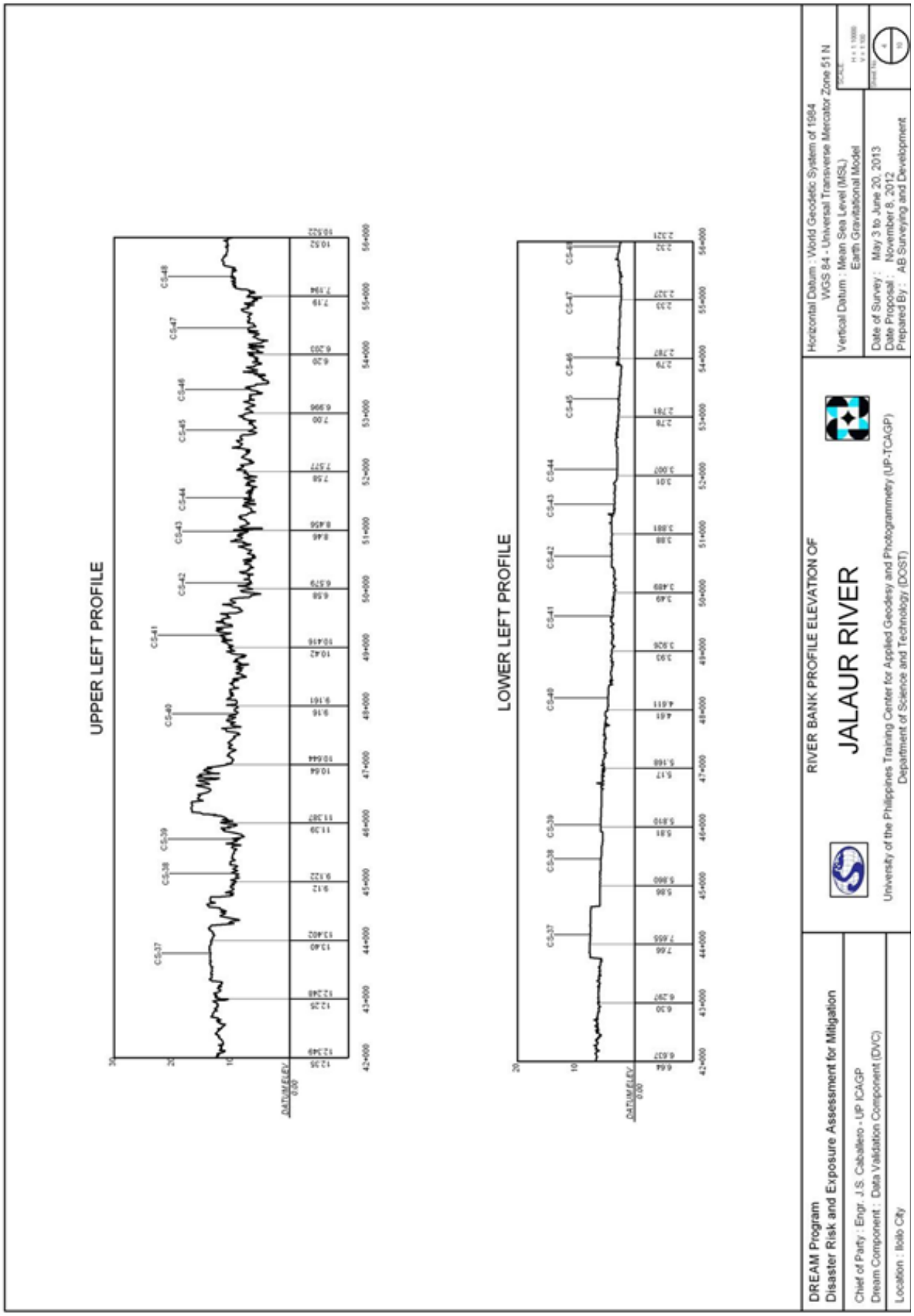


Figure 115: Sheet No. 4 Left River bank profile with relative location of bridge and cross-section

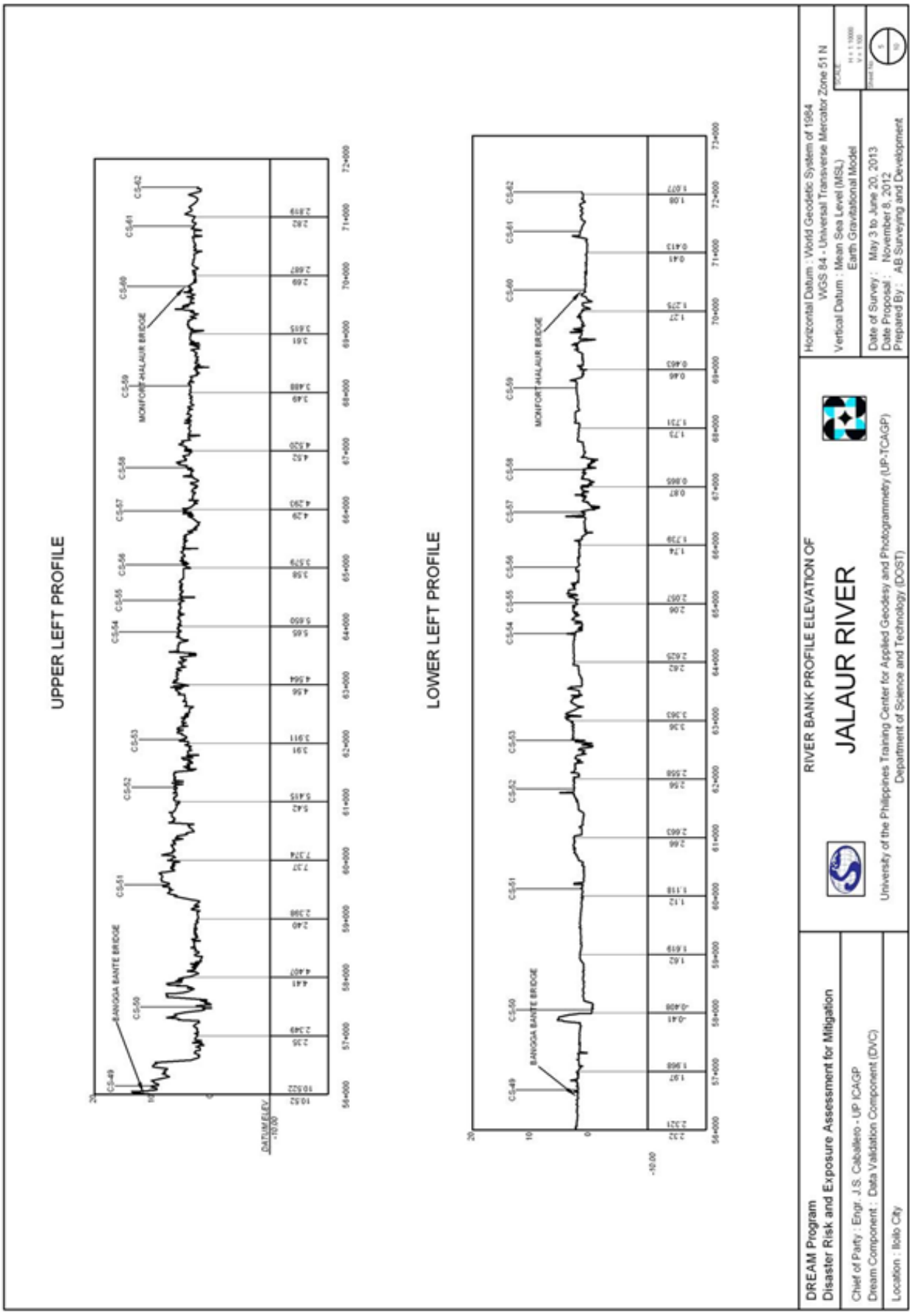


Figure 116: Sheet No. 5 Left River bank profile with relative location of bridge and cross-section

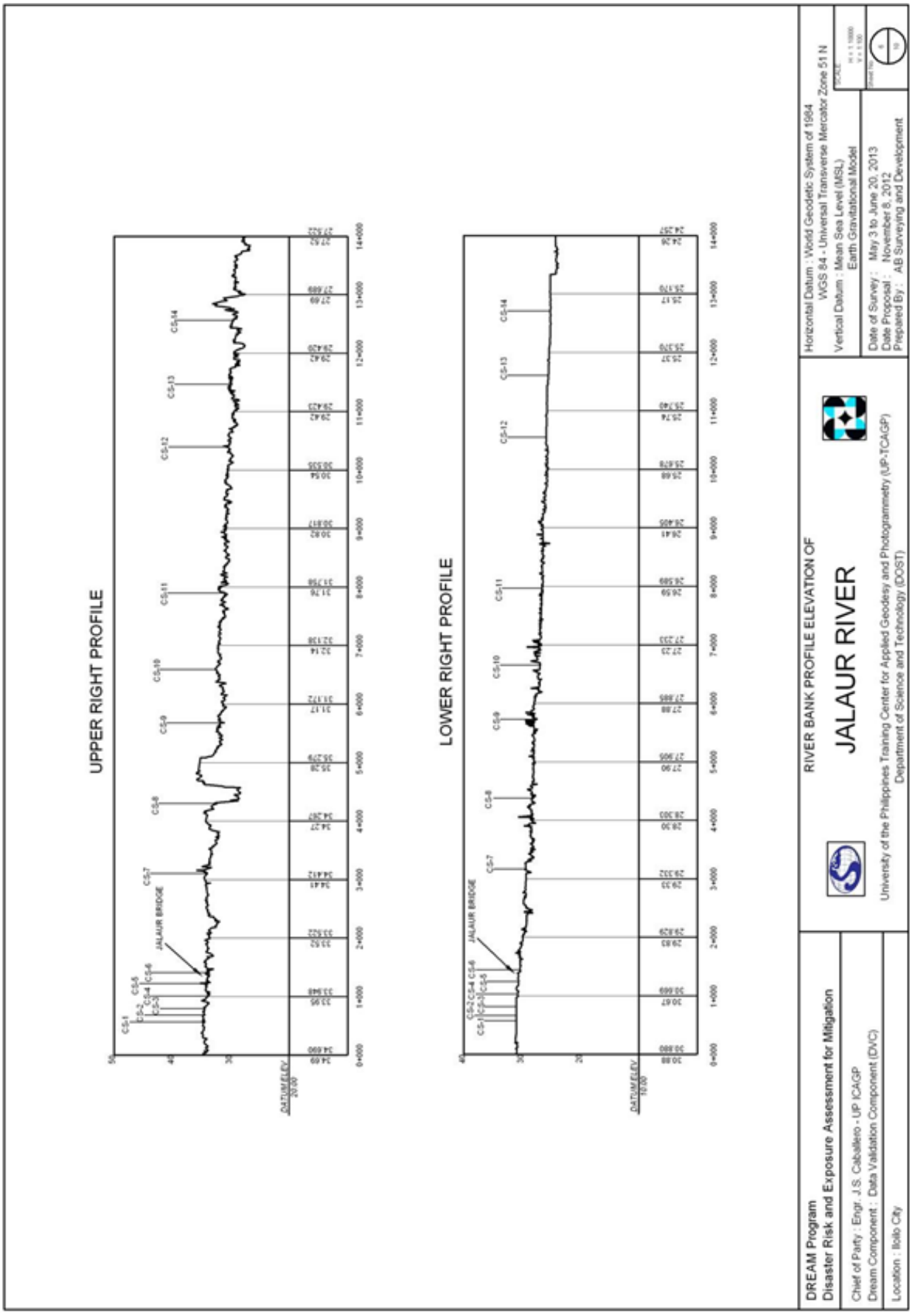


Figure 117: Sheet No. 6 Right River bank profile with relative location of bridge and cross-section

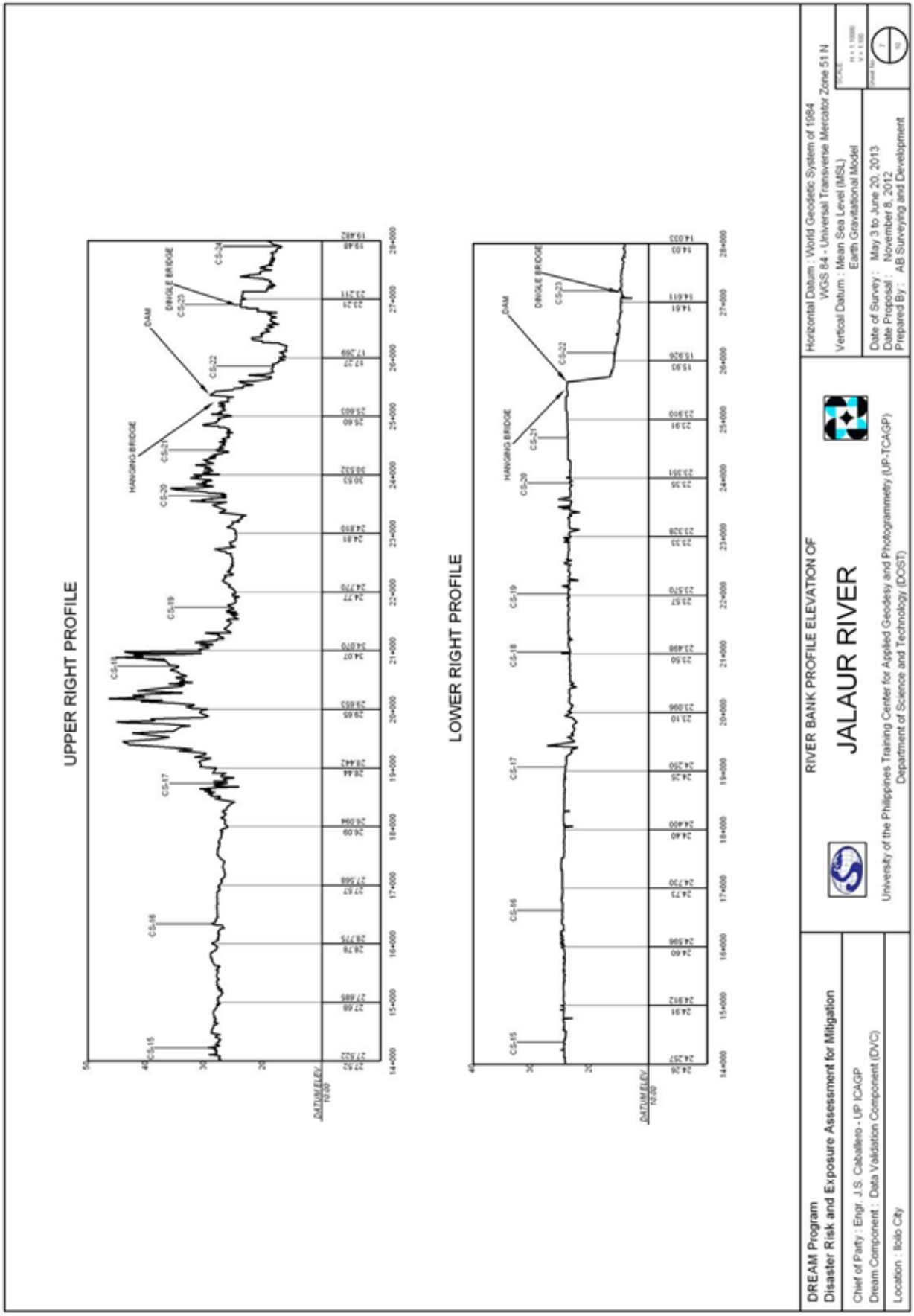


Figure 118: Sheet No. 7 Right River bank profile with relative location of bridge and cross-section

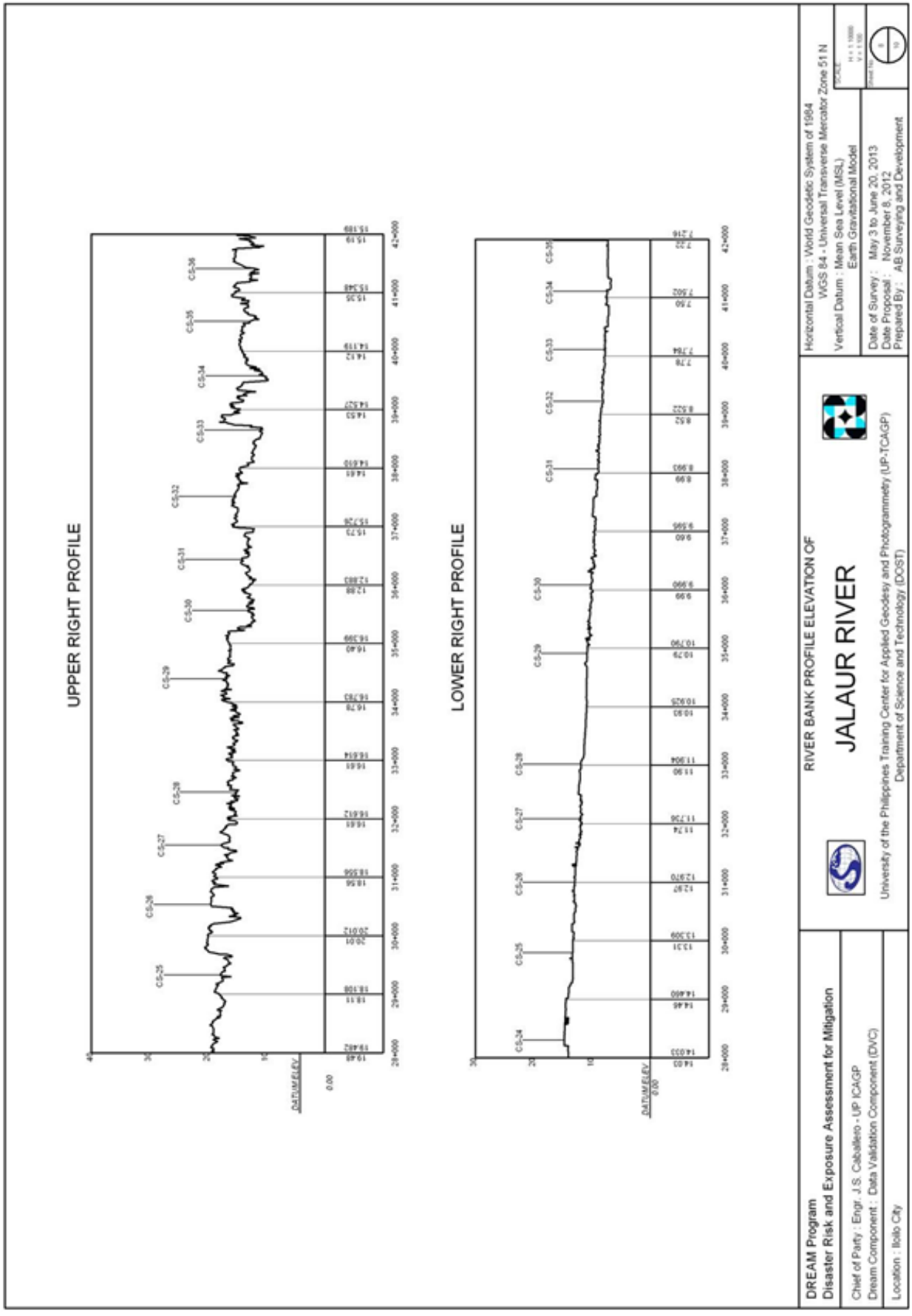


Figure 119: Sheet No. 8 Right River bank profile with relative location of bridge and cross-section

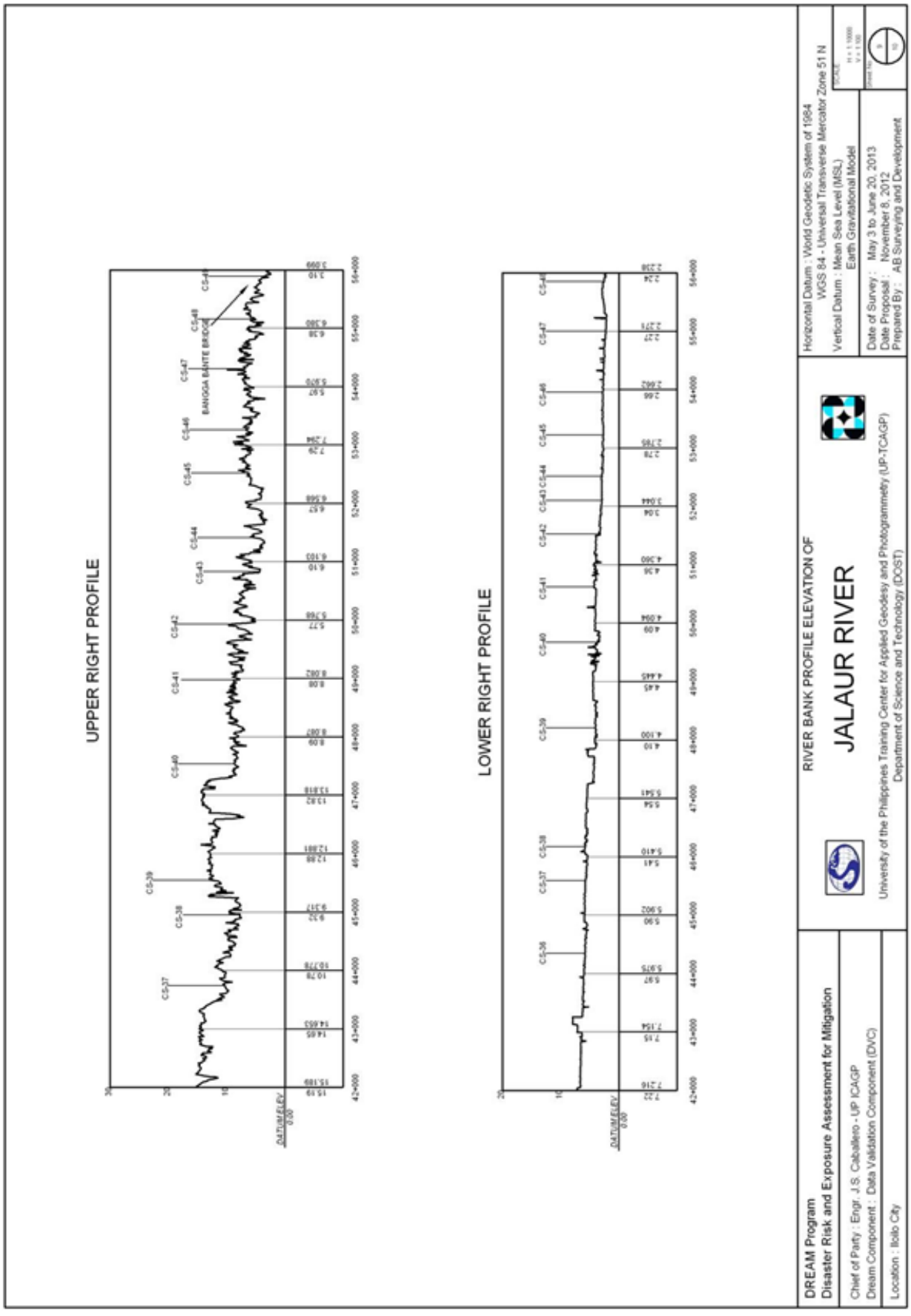


Figure 120: Sheet No. 9 Right River bank profile with relative location of bridge and cross-section

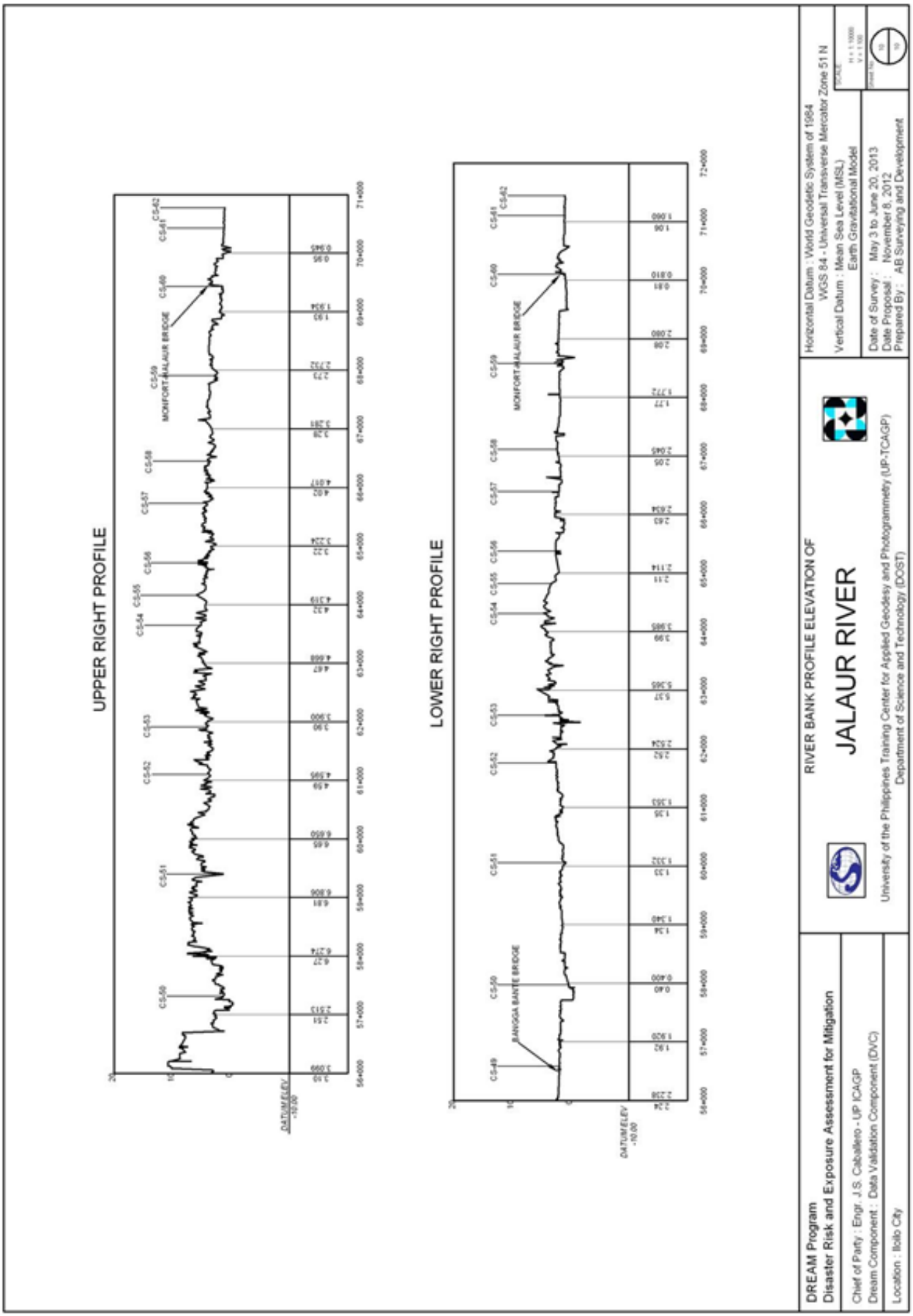


Figure 121: Sheet No. 10 Right River bank profile with relative location of bridge and cross-section

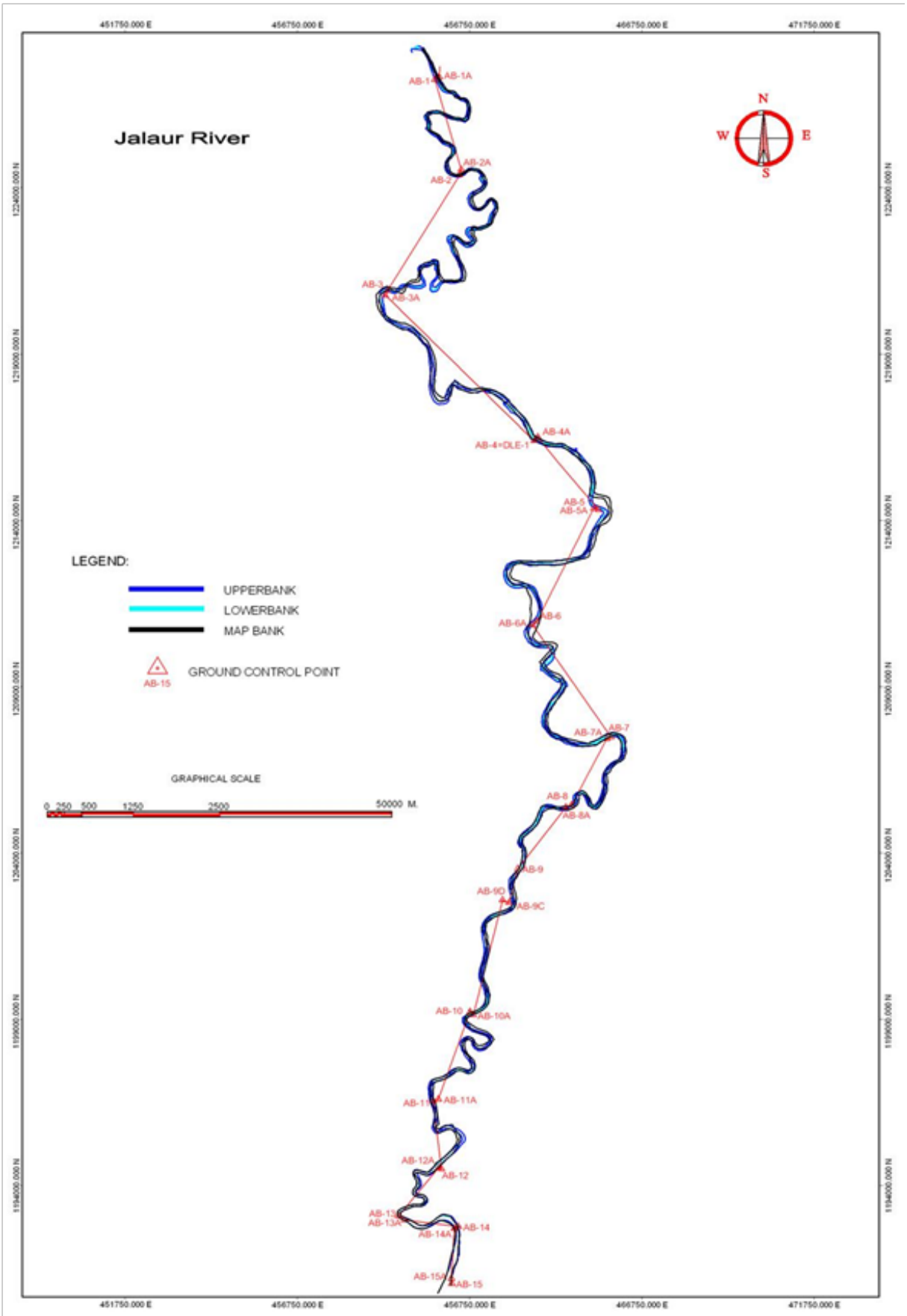


Figure 122: Actual Profile survey vs. Map for planned of Jalaur River

3.4. 2 Cross-Section Plan of Jalaur River

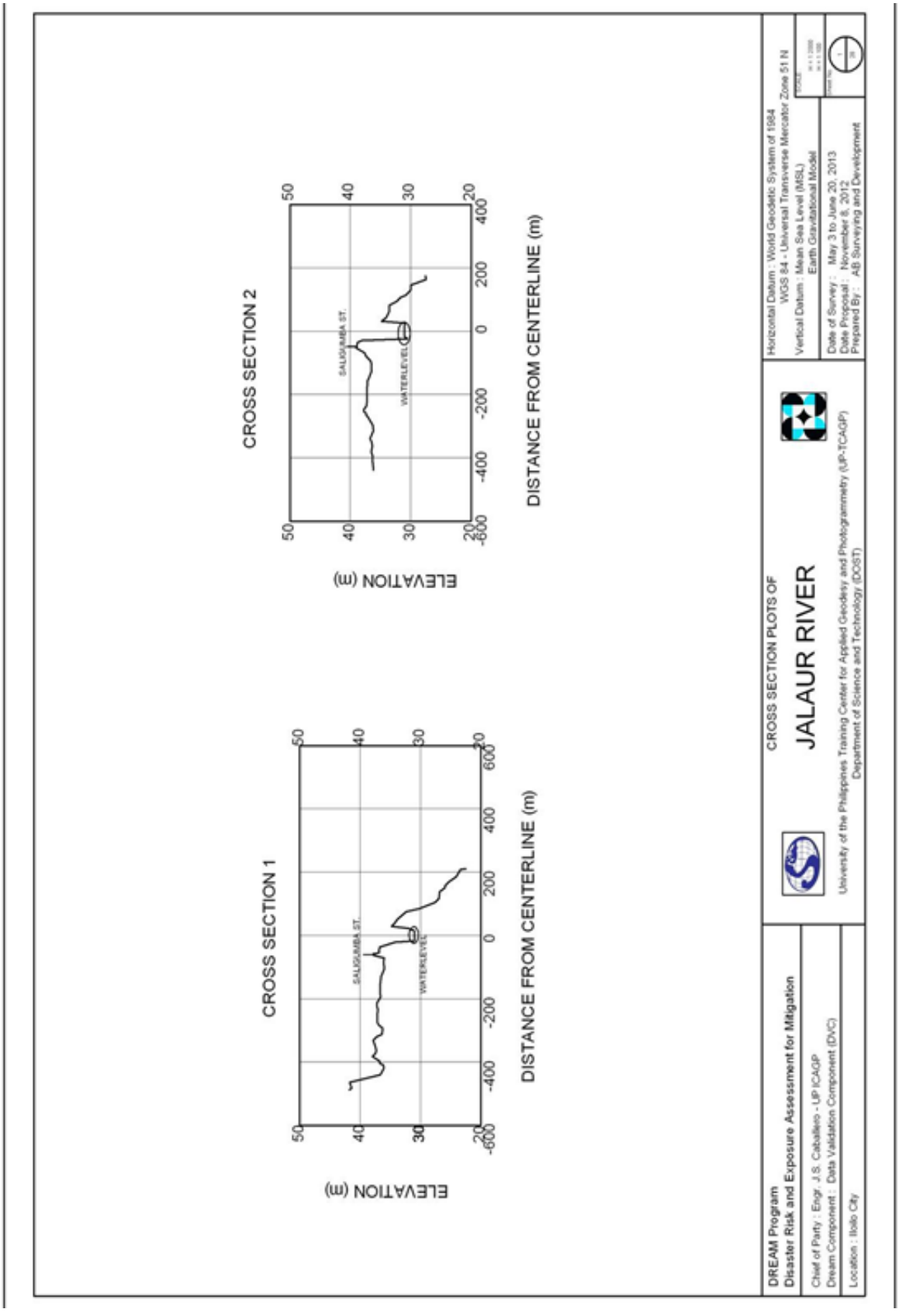


Figure 123: Sheet No.1 of the Cross-section plan of Jalaur River

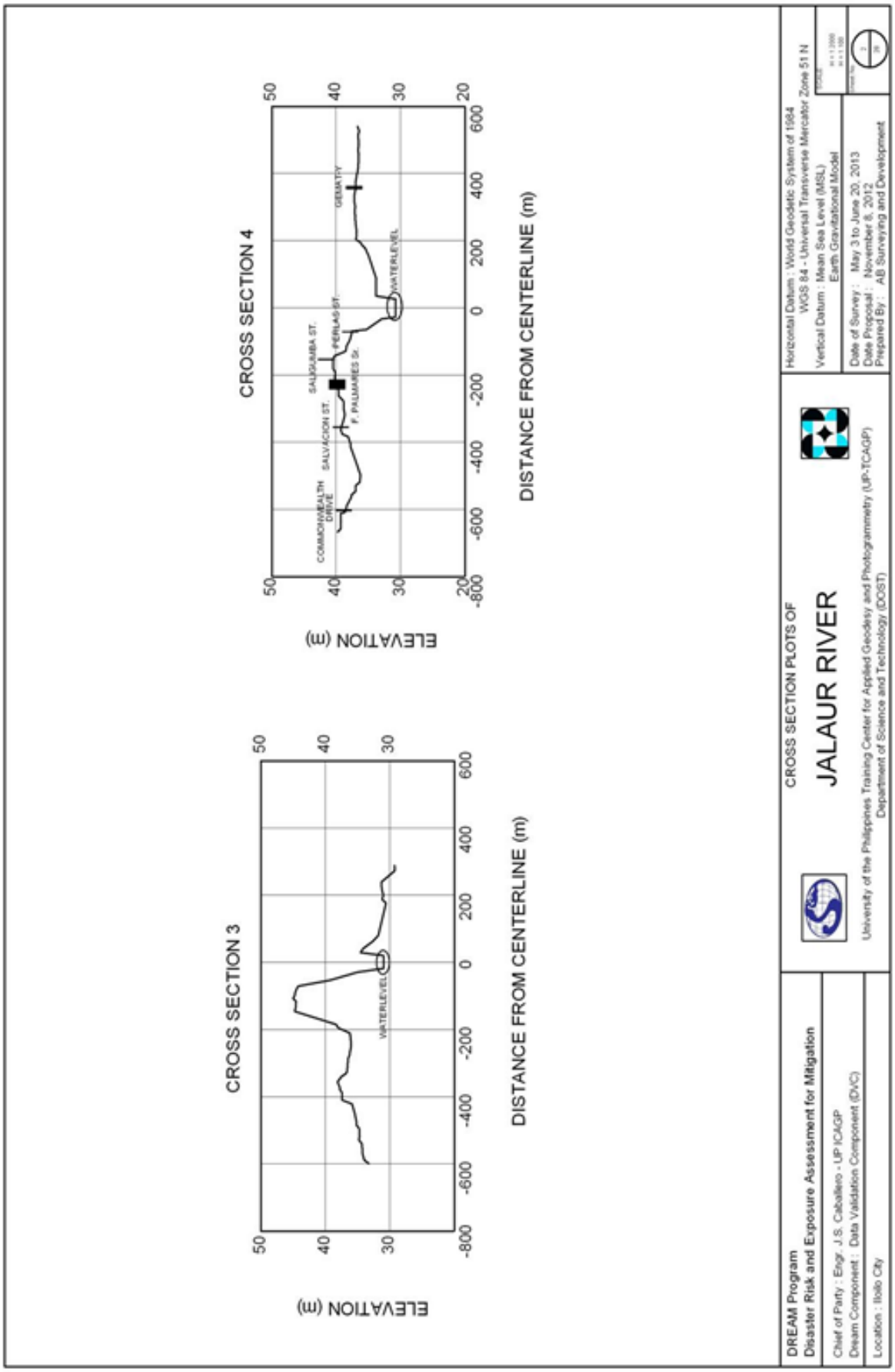


Figure 124: Sheet No.2 of the Cross-section plan of Jalaur River

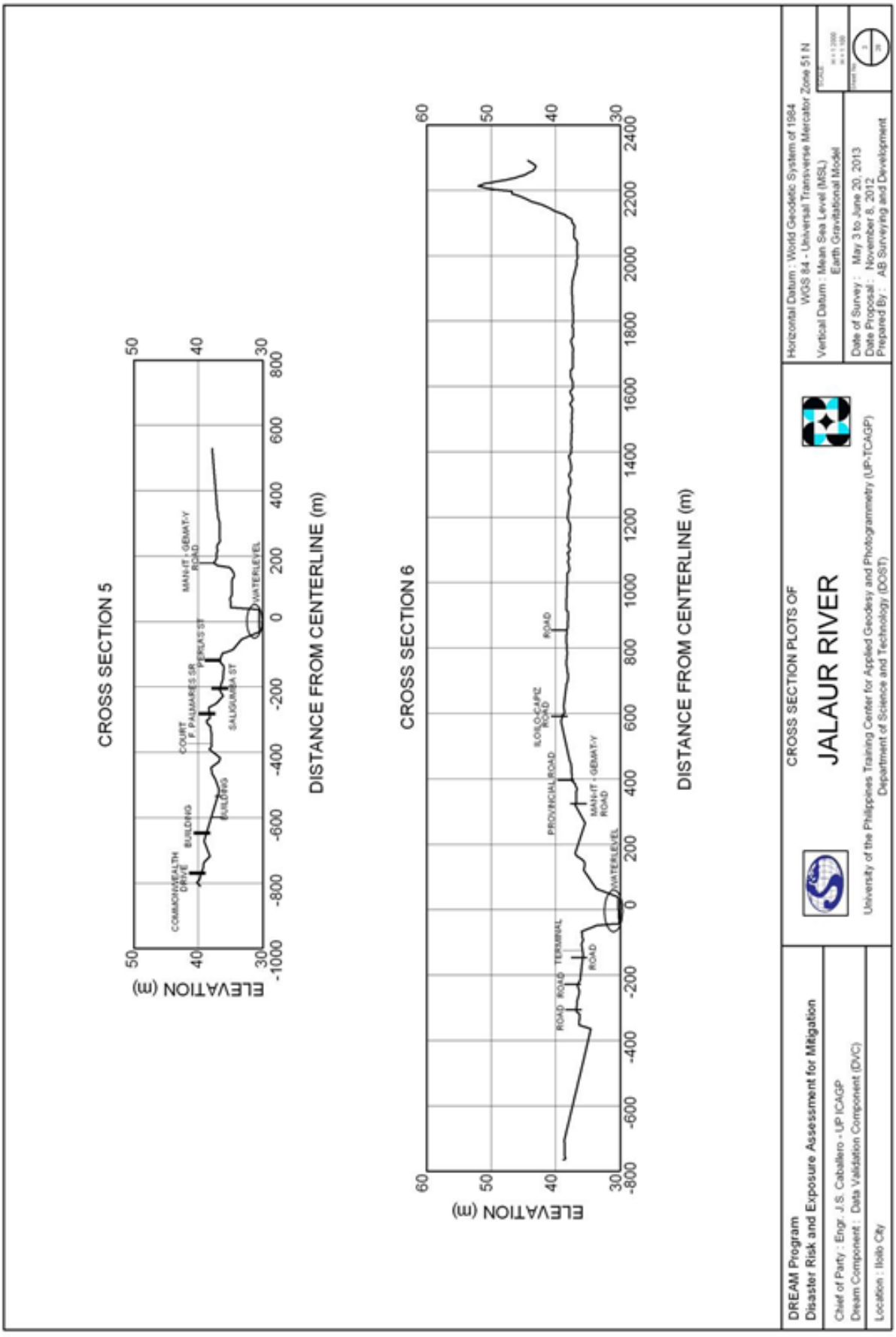


Figure 125: Sheet No.3 of the Cross-section plan of Jalaur River

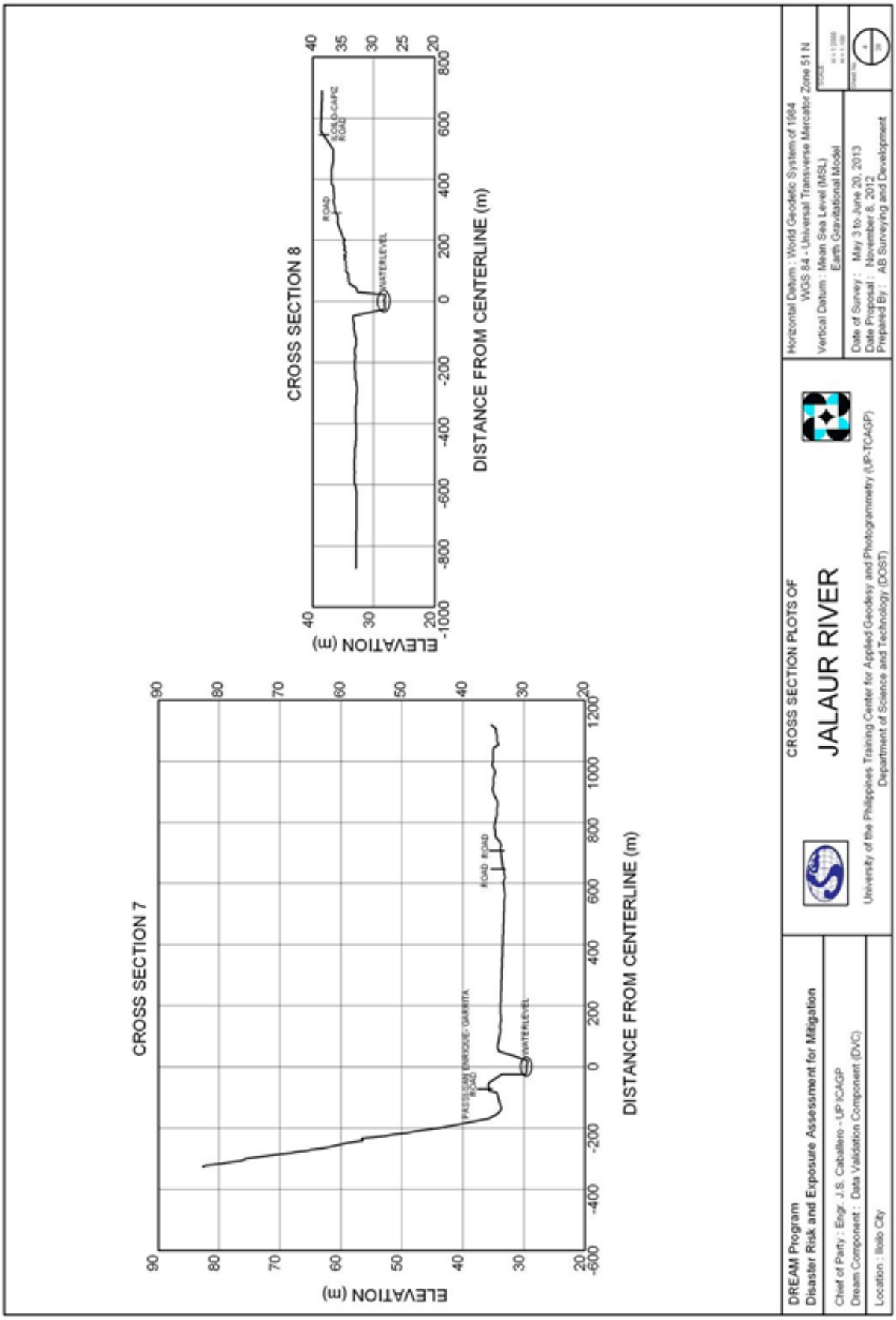


Figure 126: Sheet No.4 of the Cross-section plan of Jalaur River

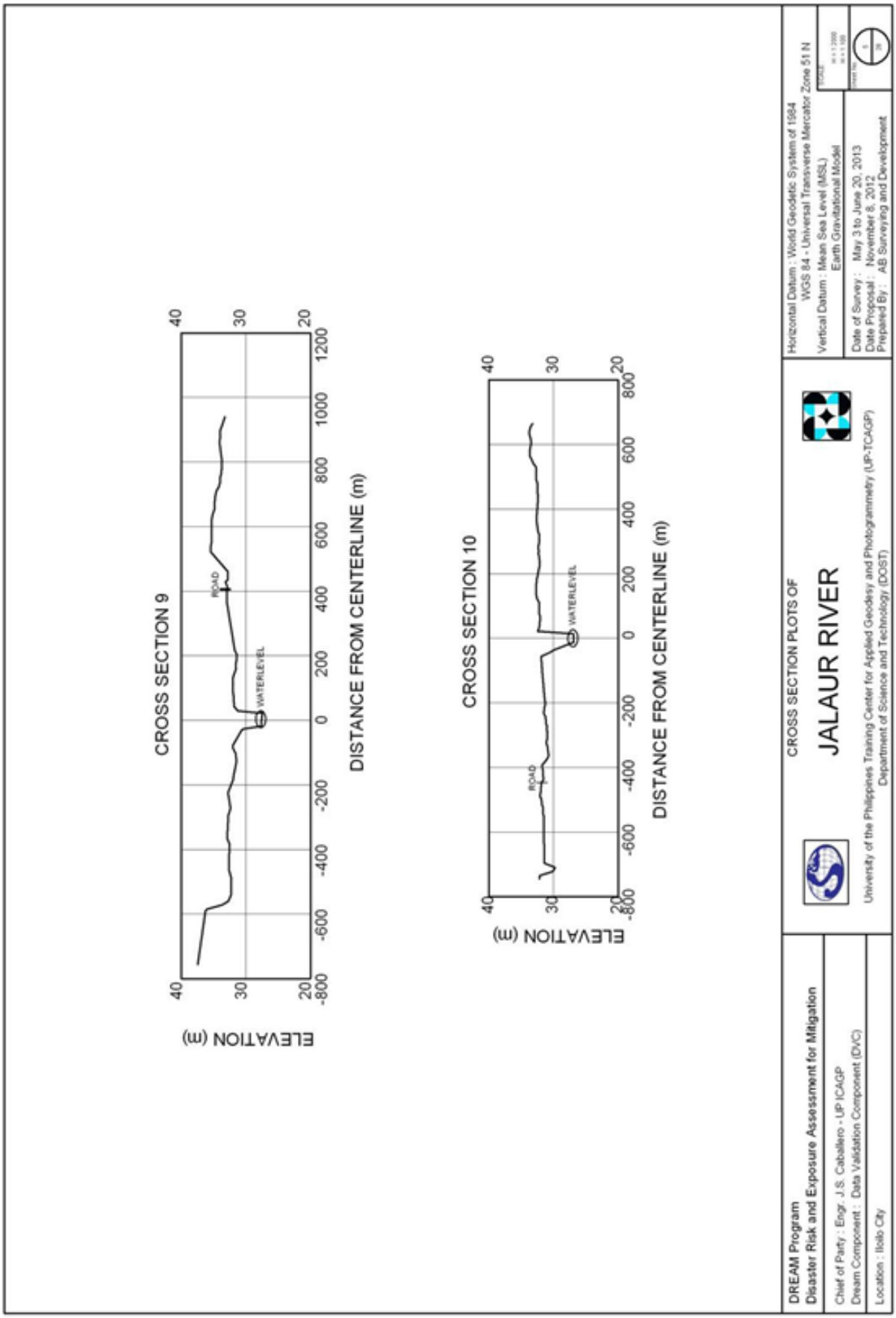


Figure 127: Sheet No.5 of the Cross-section plan of Jalaur River

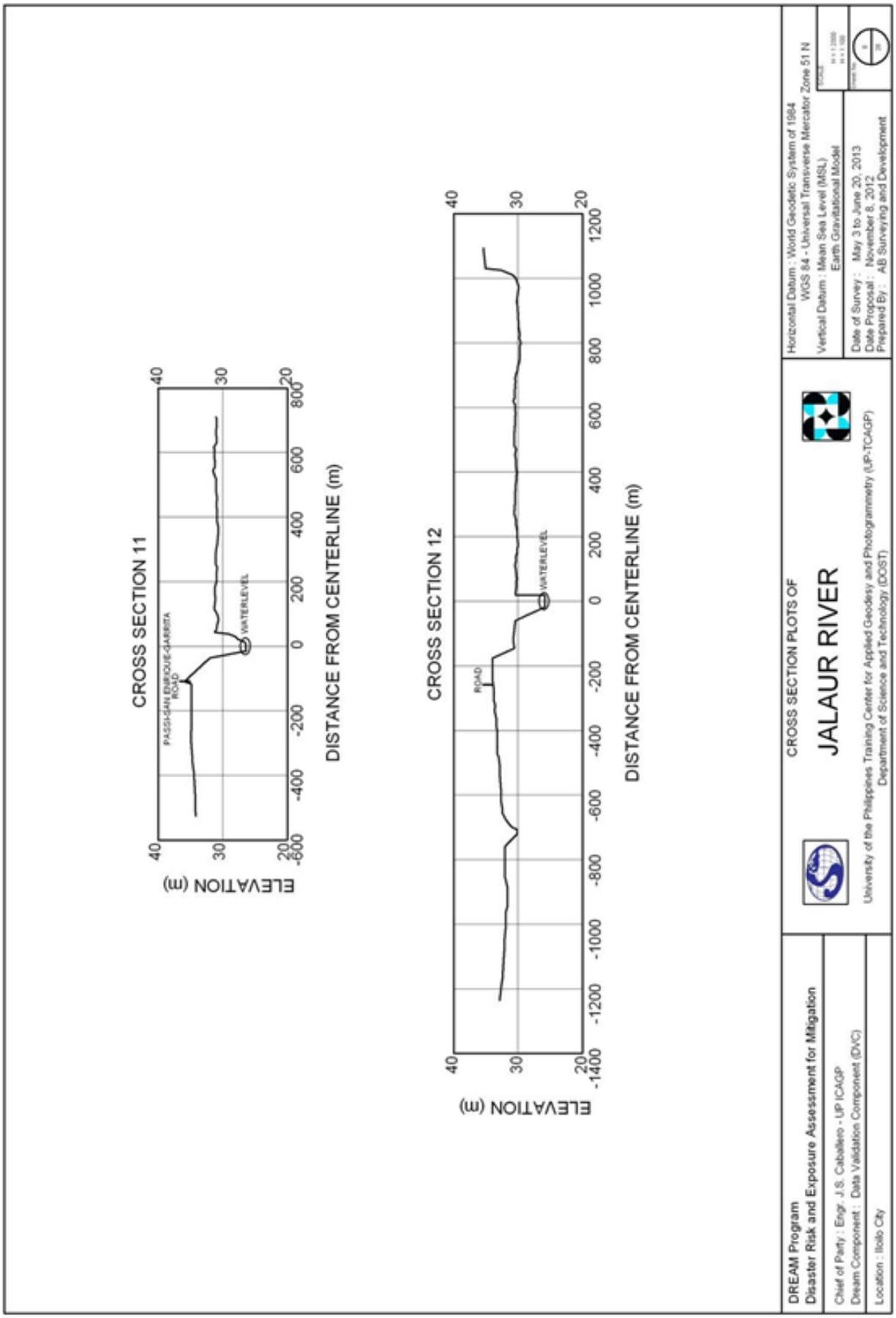


Figure 128: Sheet No.6 of the Cross-section plan of Jalaur River

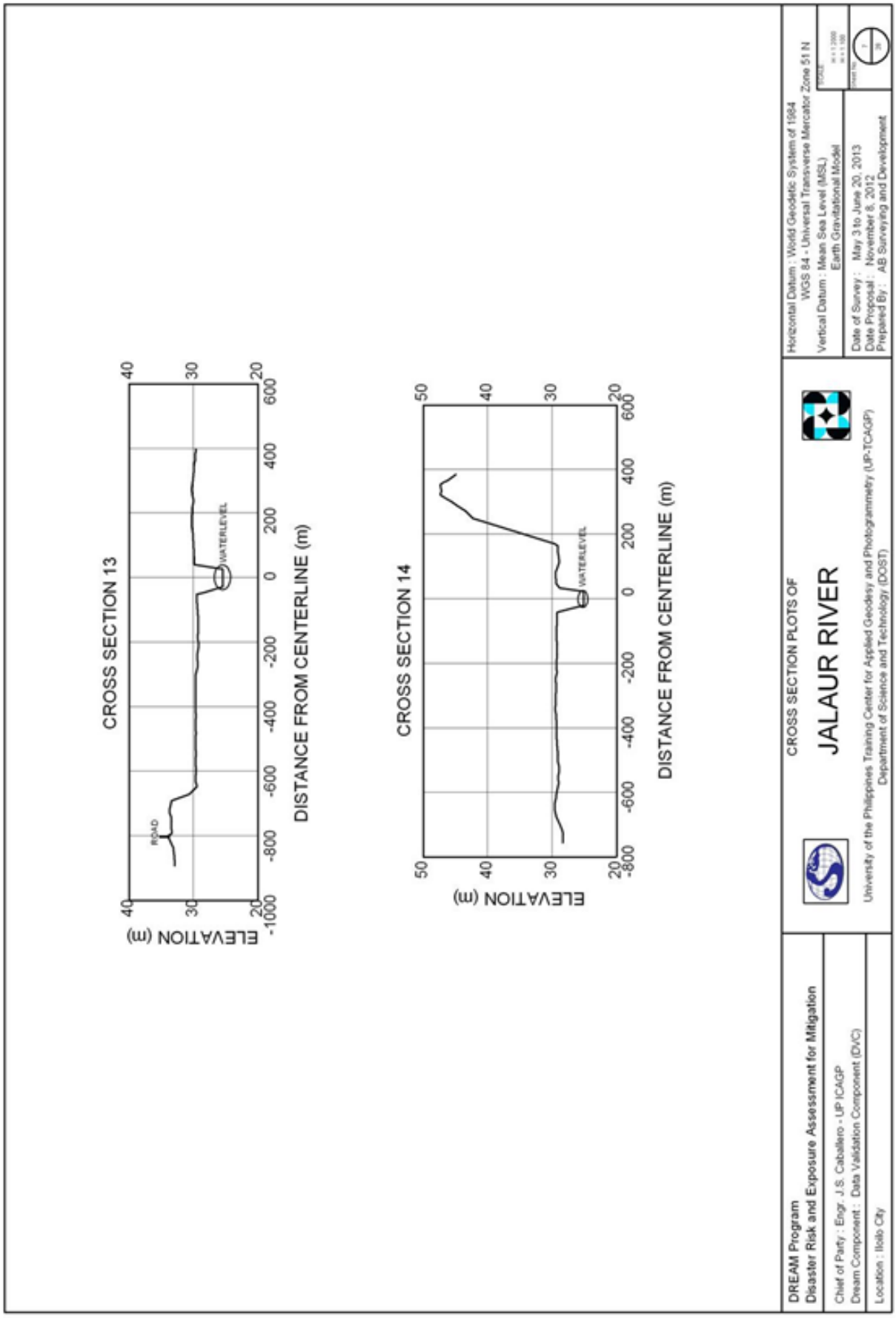


Figure 129: Sheet No.7 of the Cross-section plan of Jalaur River

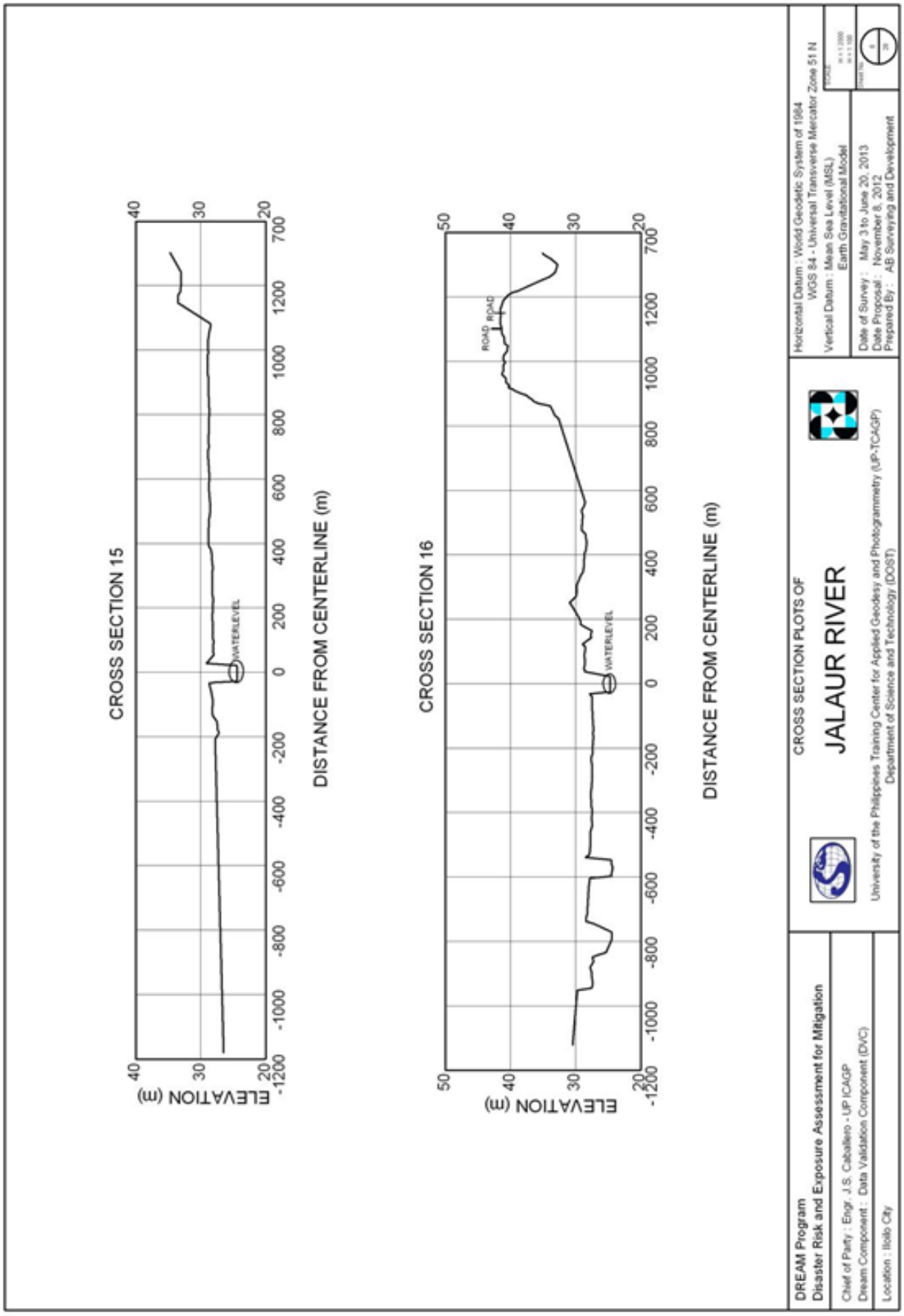


Figure 130: Sheet No.8 of the Cross-section plan of Jalaur River

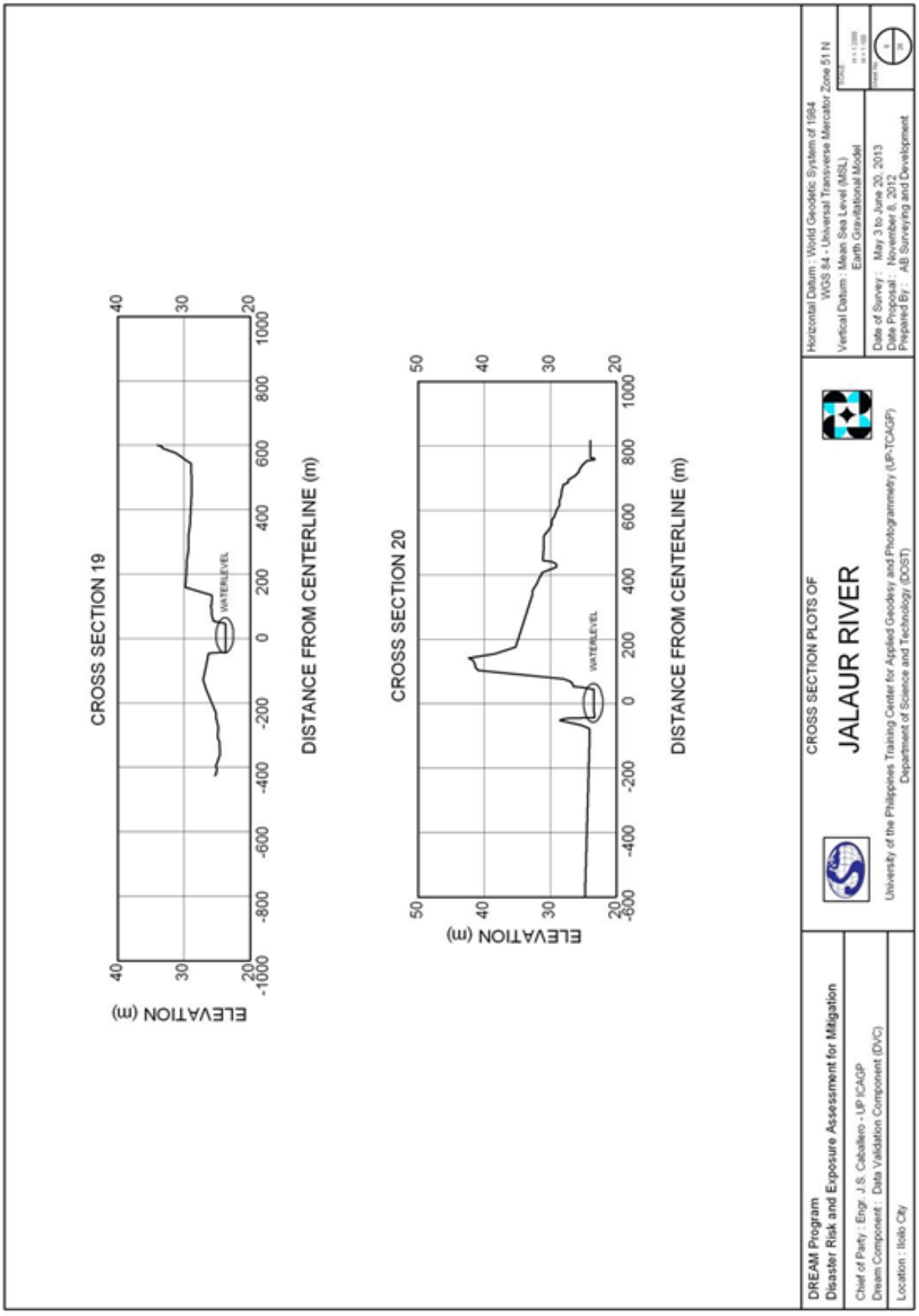


Figure 131: Sheet No.9 of the Cross-section plan of Jalaur River

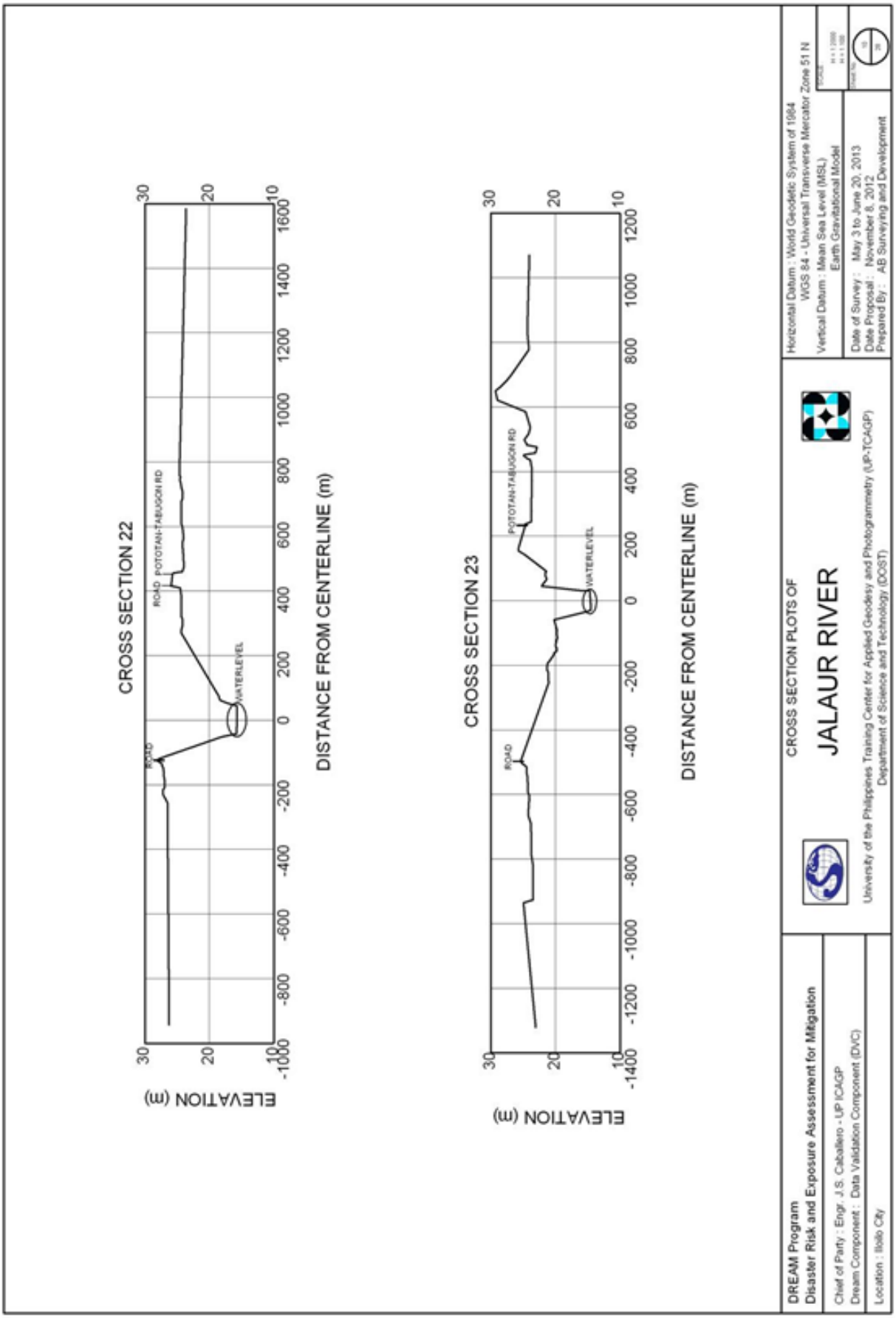


Figure 132: Sheet No.10 of the Cross-section plan of Jalaur River

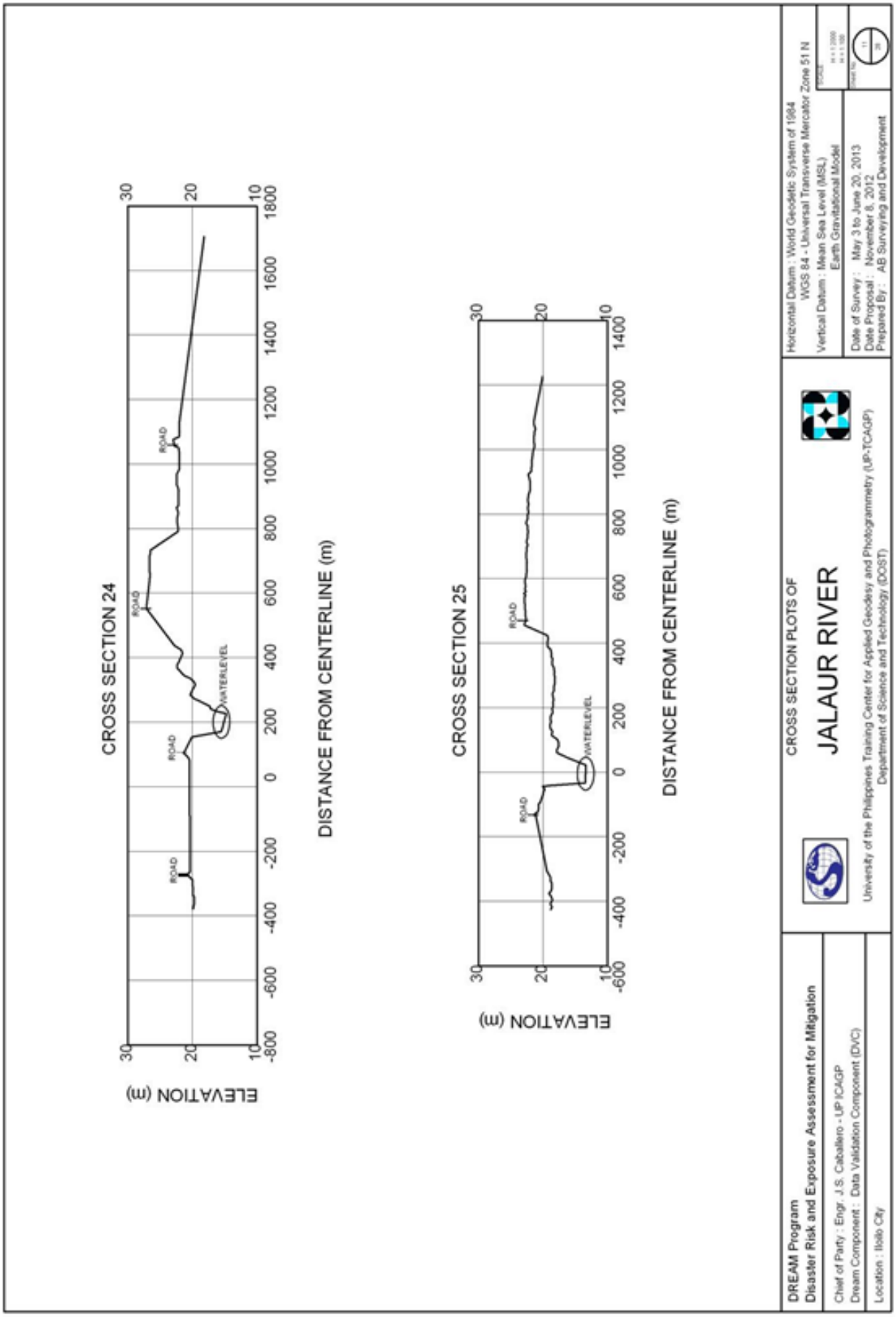


Figure 133: Sheet No.11 of the Cross-section plan of Jalaur River

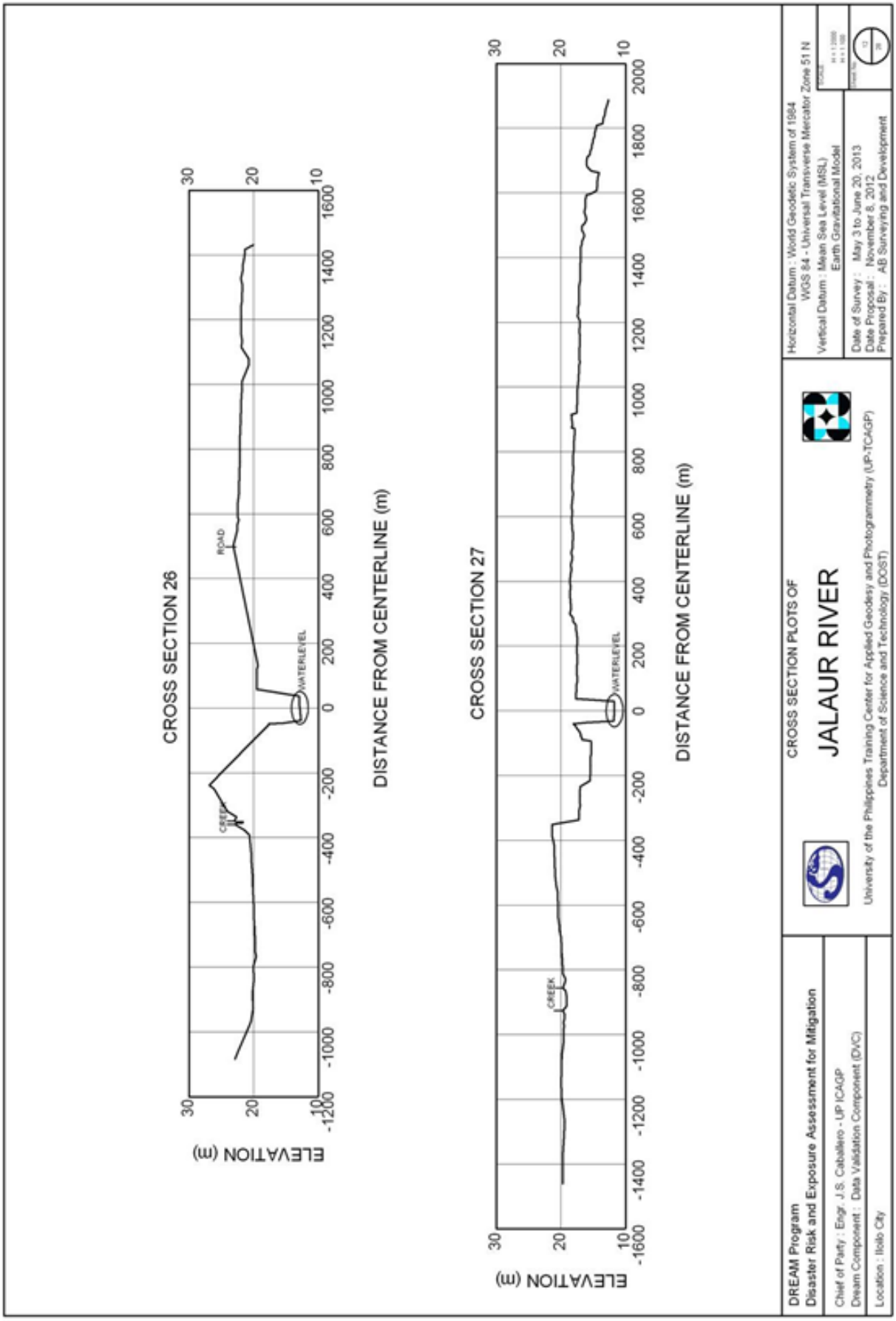


Figure 134: Sheet No.12 of the Cross-section plan of Jalaur River

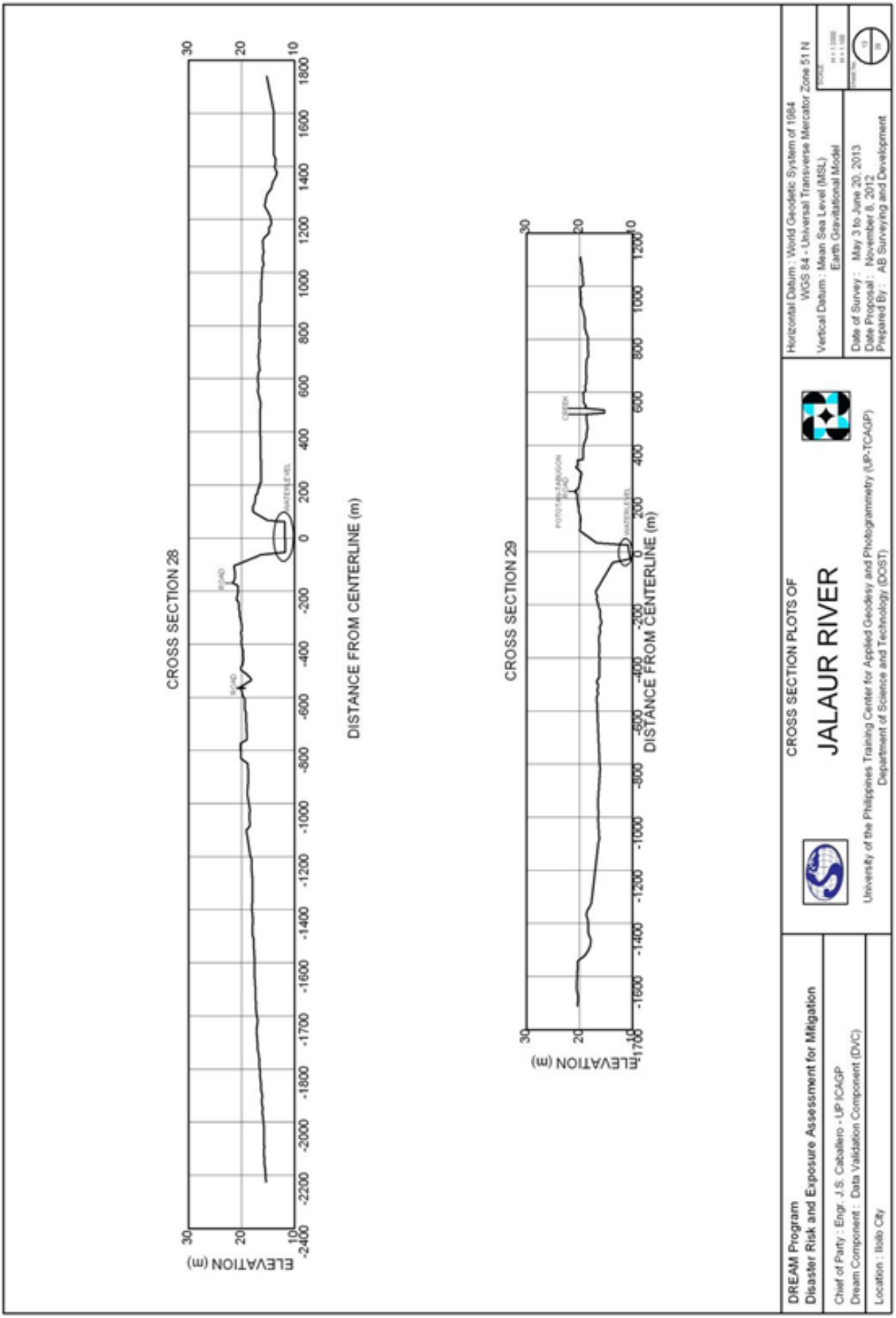


Figure 135: Sheet No.13 of the Cross-section plan of Jalaur River

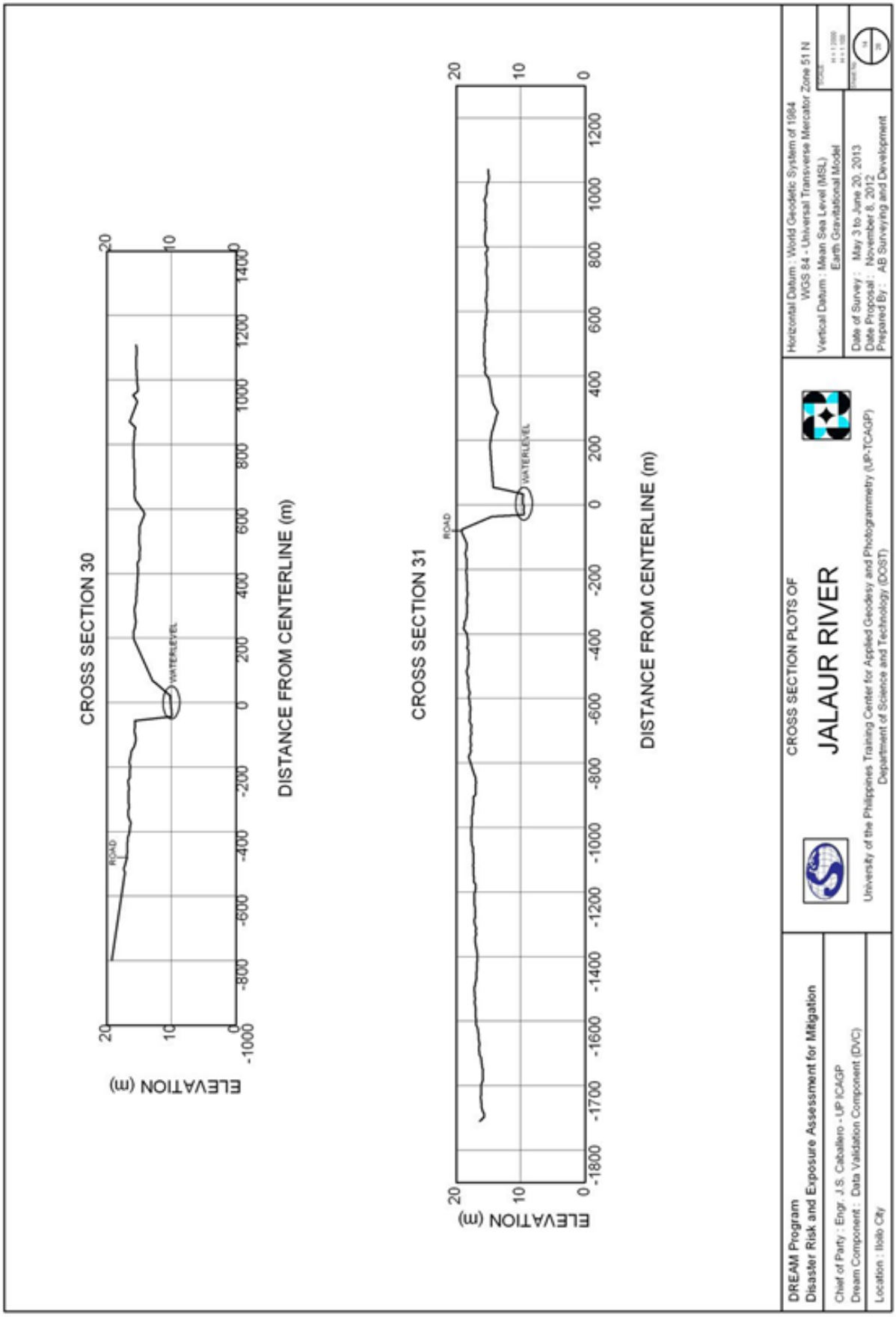


Figure 136: Sheet No.14 of the Cross-section plan of Jalaur River

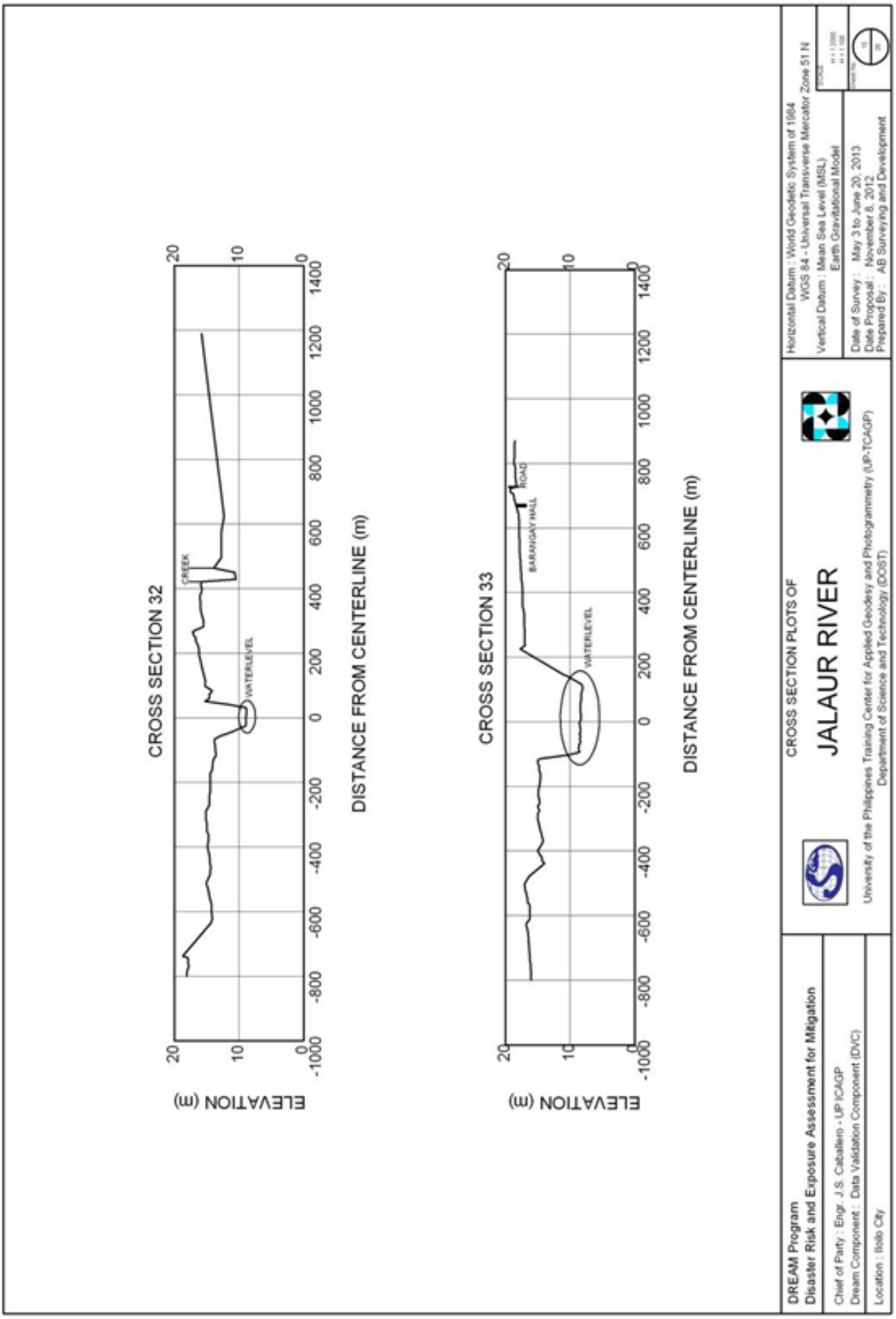


Figure 137: Sheet No.15 of the Cross-section plan of Jalaur River

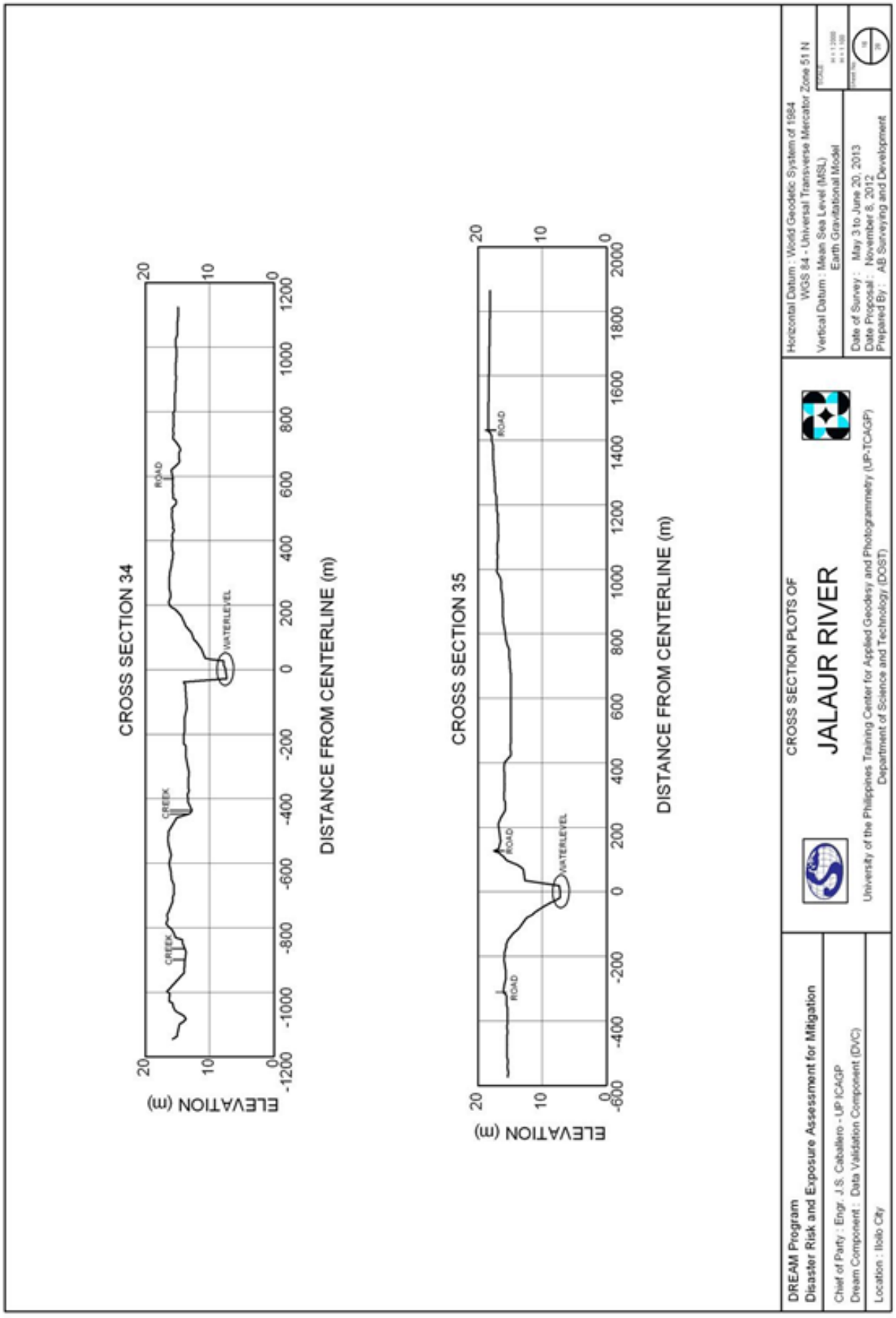


Figure 138: Sheet No.16 of the Cross-section plan of Jalaur River

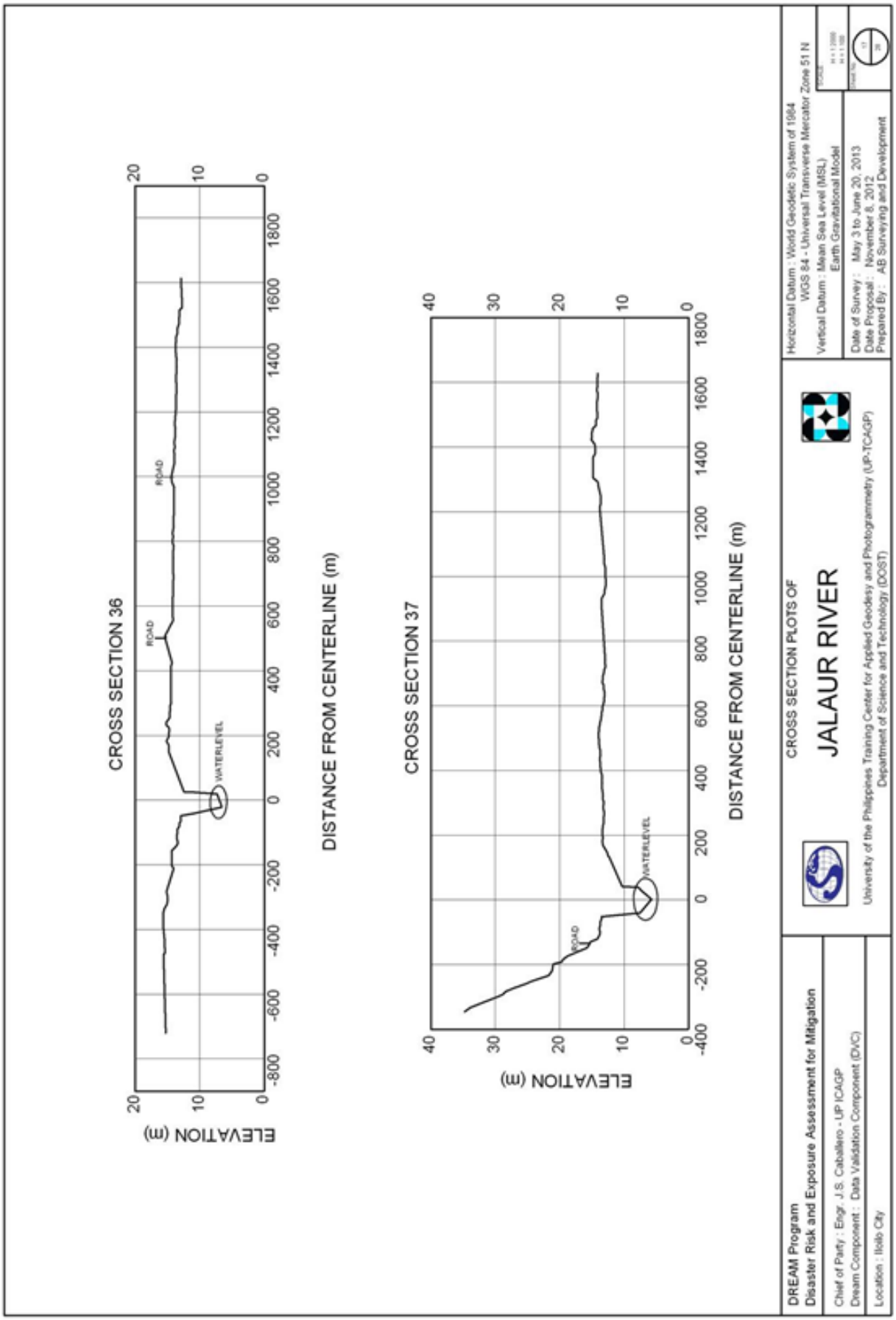


Figure 139: Sheet No.17 of the Cross-section plan of Jalaur River

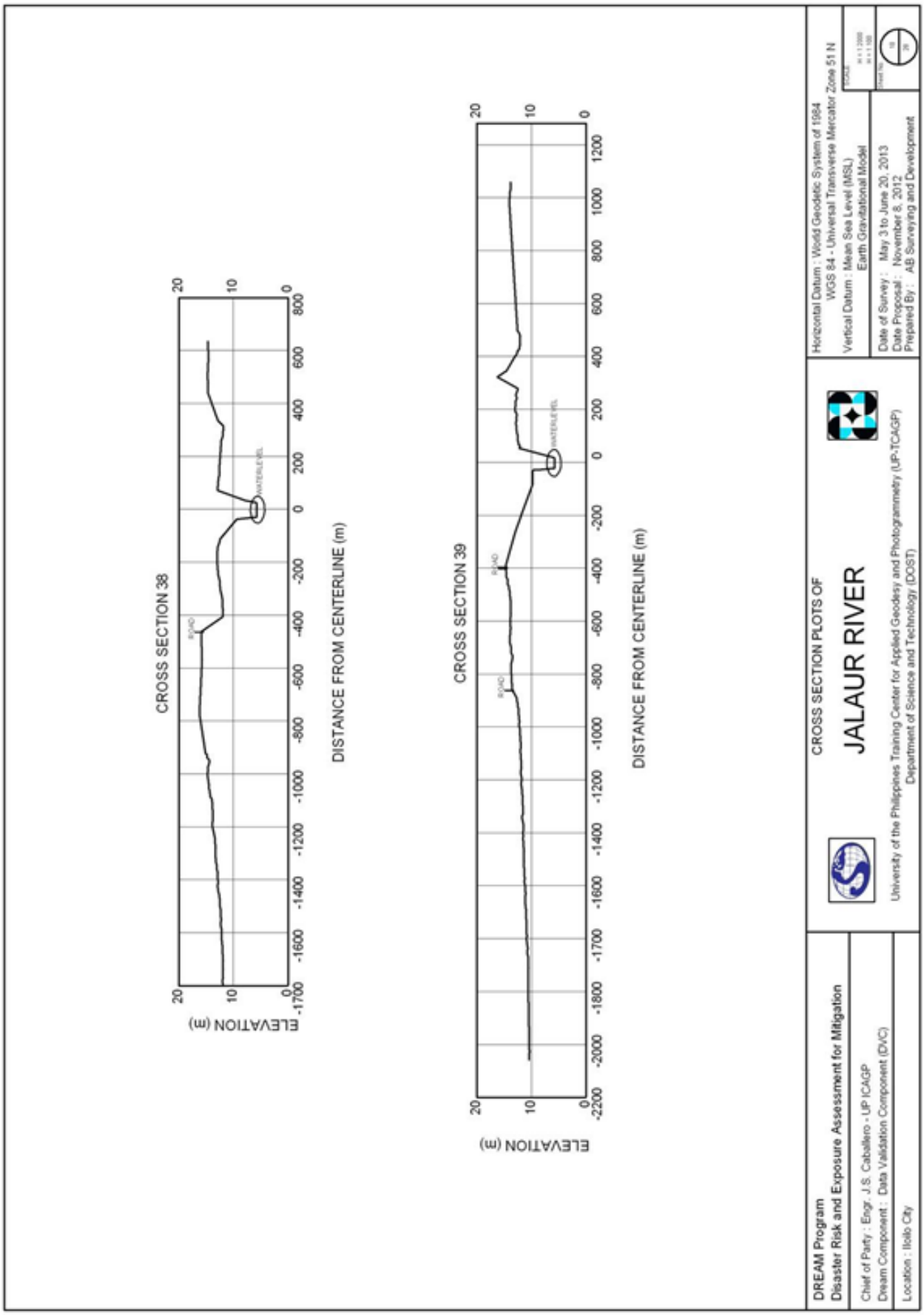


Figure 140: Sheet No.18 of the Cross-section plan of Jalaur River

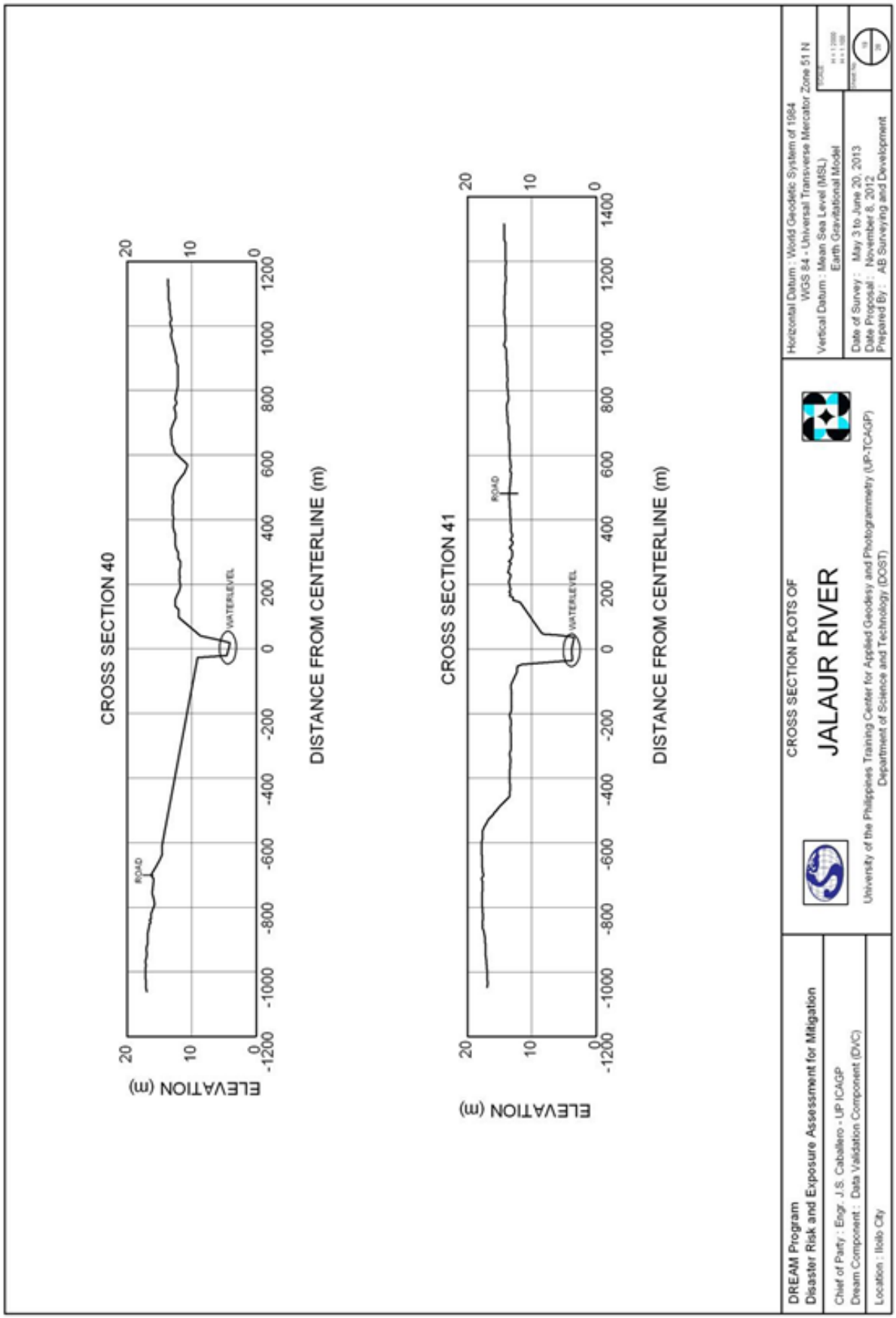


Figure 141: Sheet No.19 of the Cross-section plan of Jalaur River

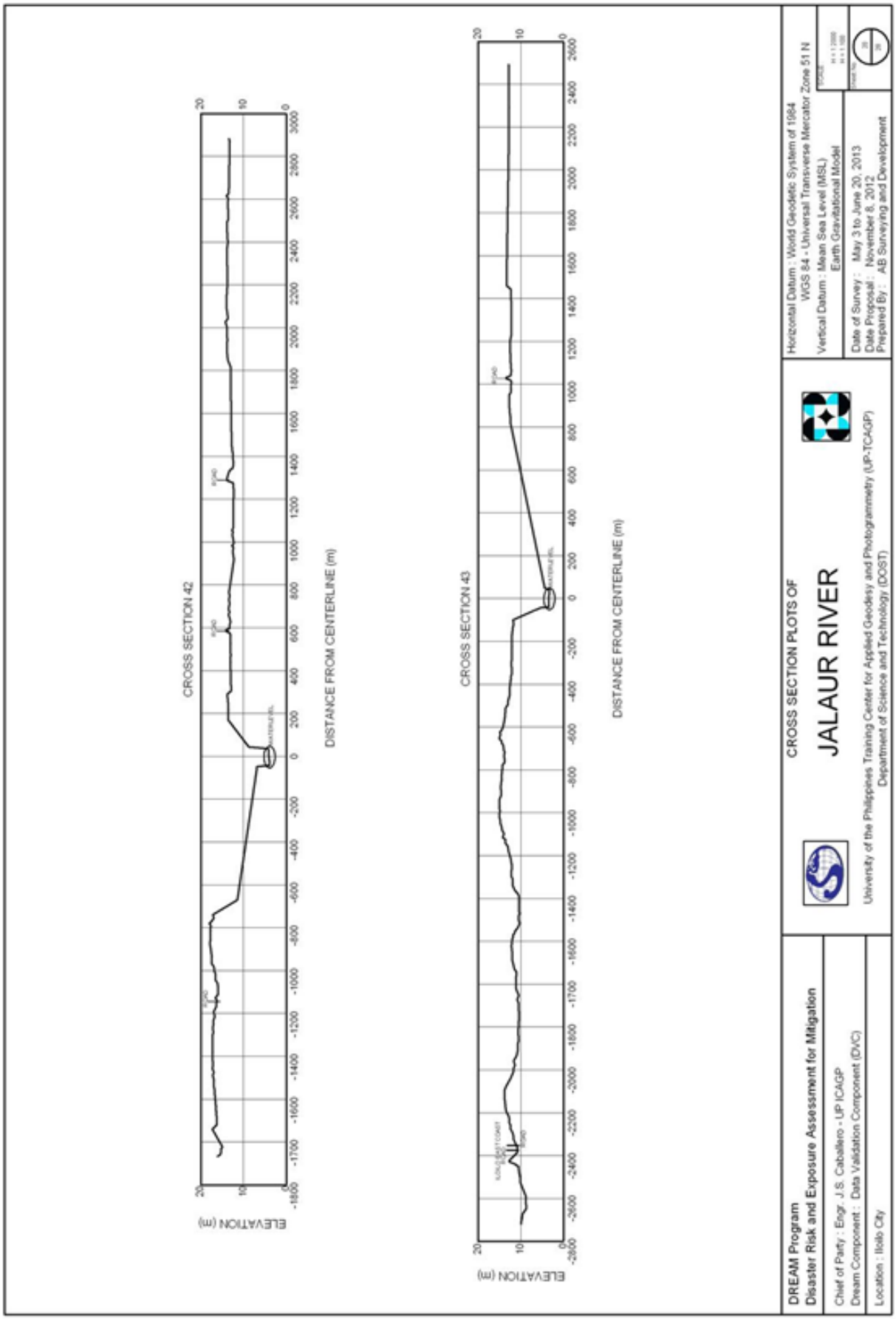


Figure 142: Sheet No.20 of the Cross-section plan of Jalaur River

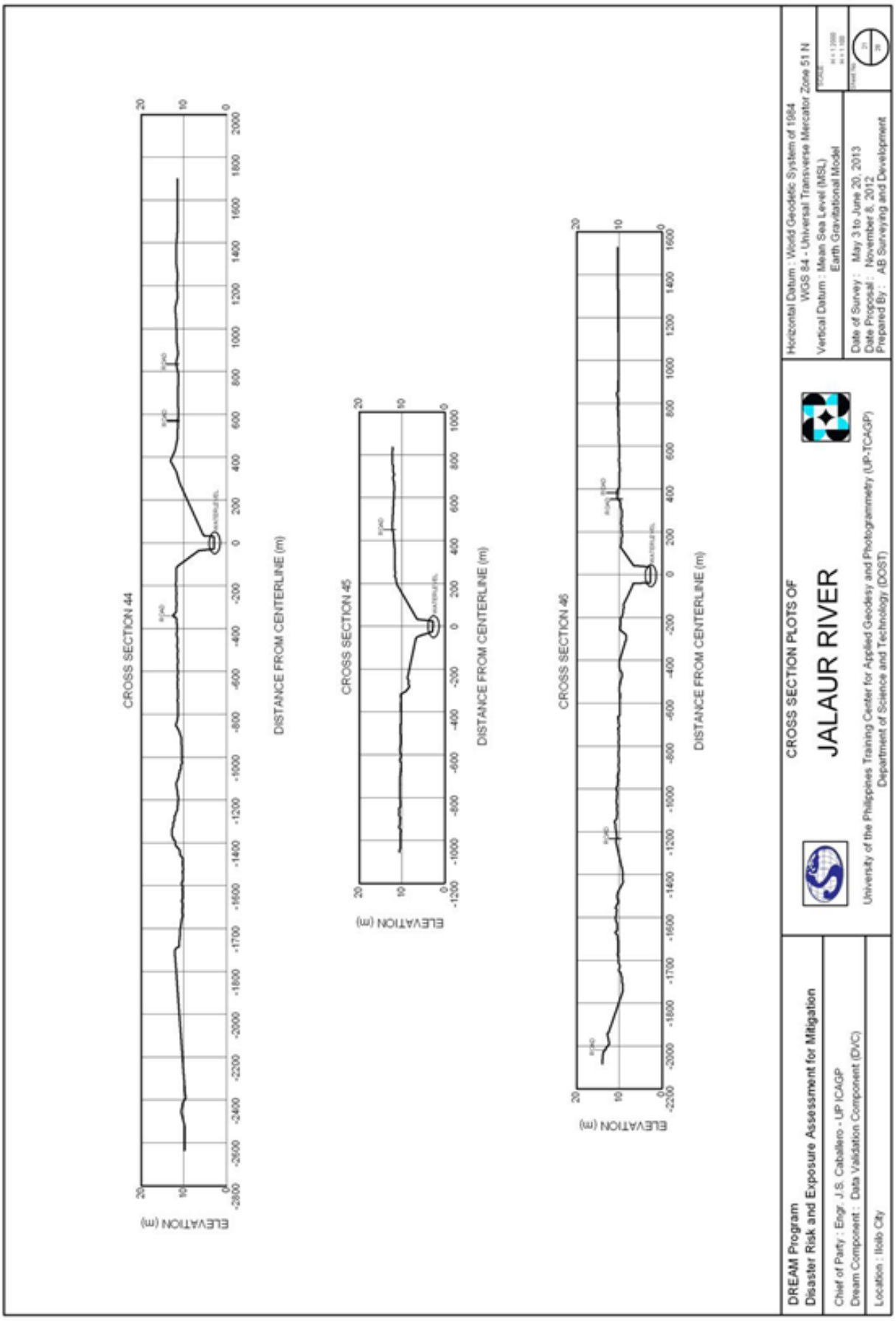


Figure 143: Sheet No.21 of the Cross-section plan of Jalaur River

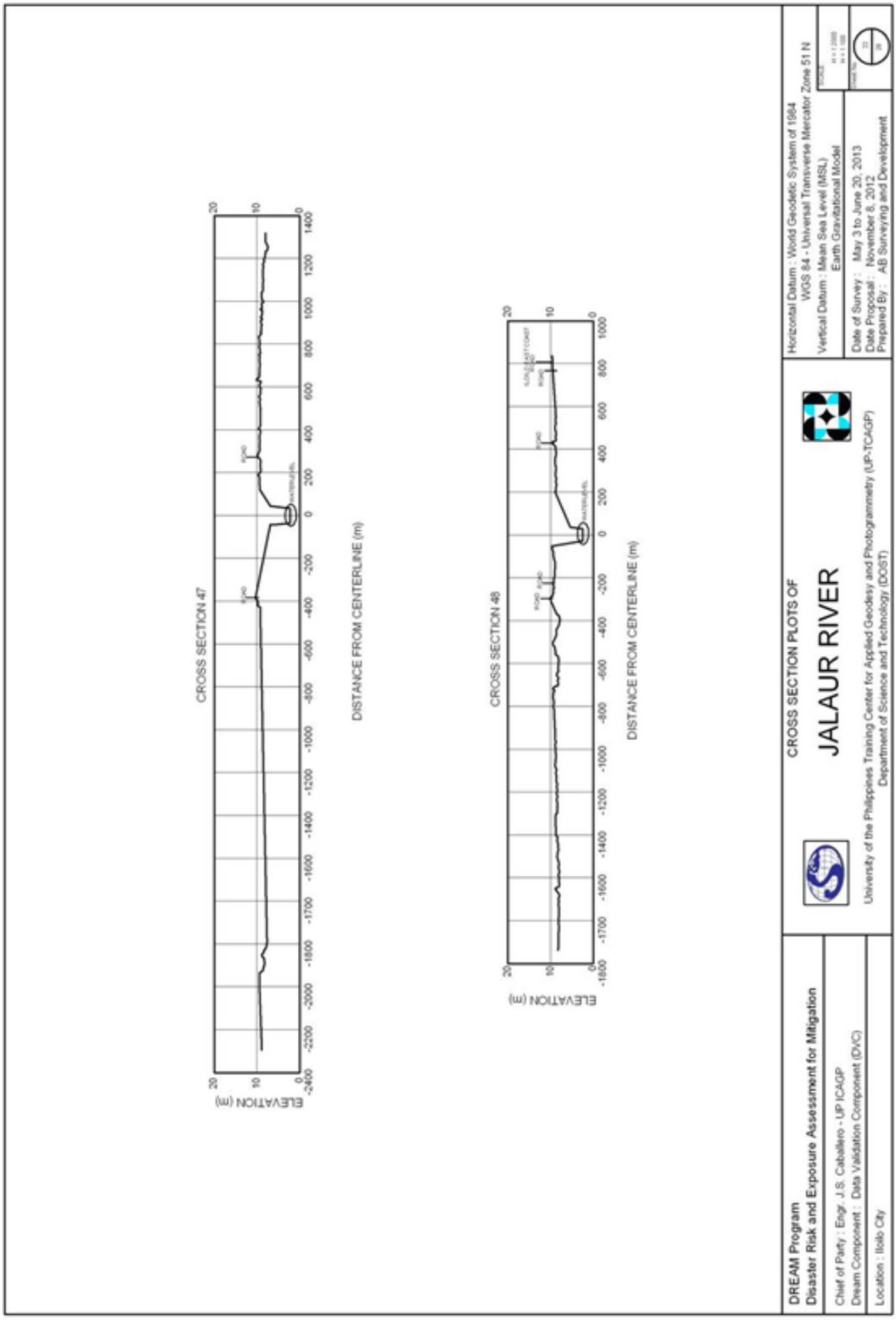


Figure 144: Sheet No.22 of the Cross-section plan of Jalaur River

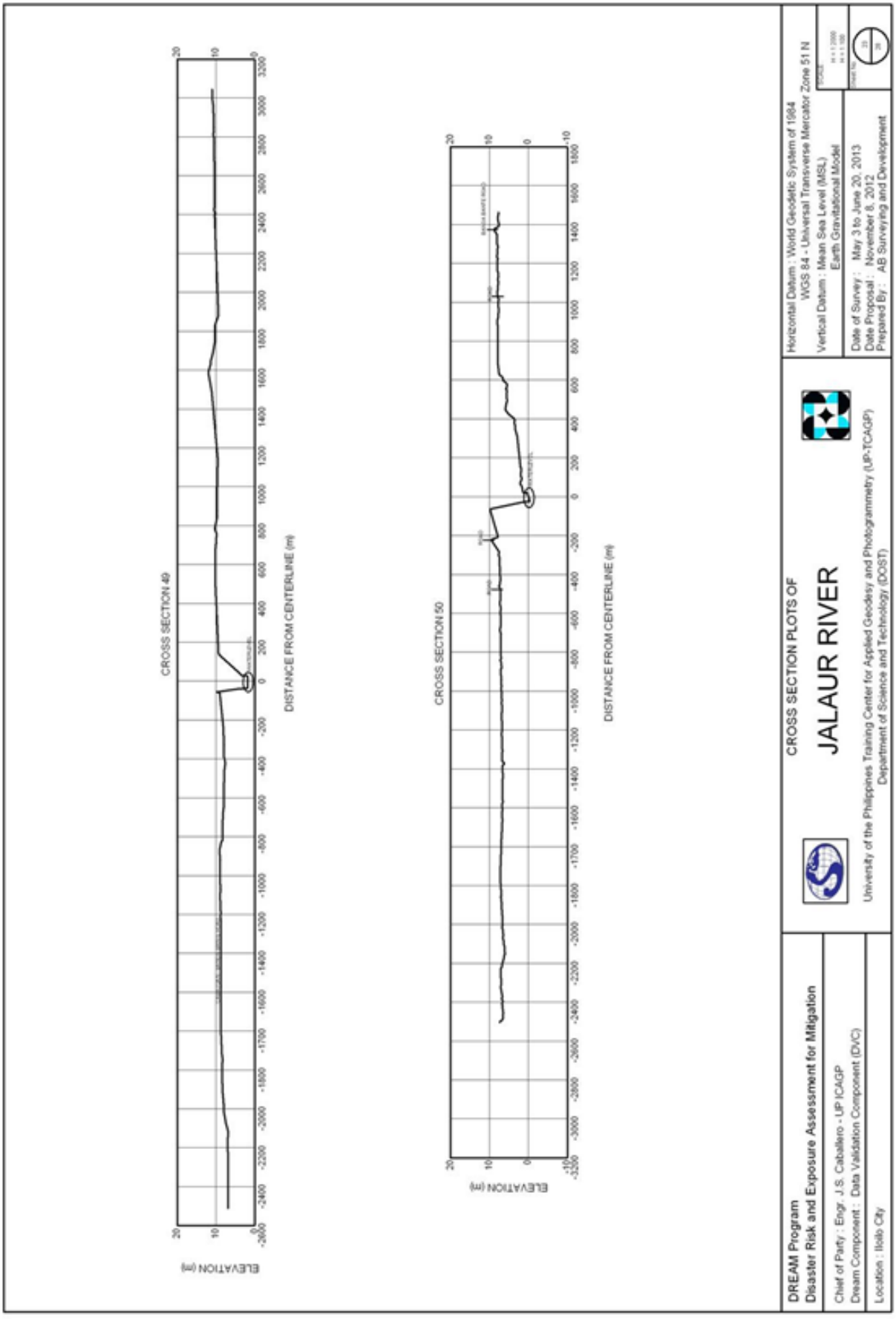


Figure 145: Sheet No.23 of the Cross-section plan of Jalaur River

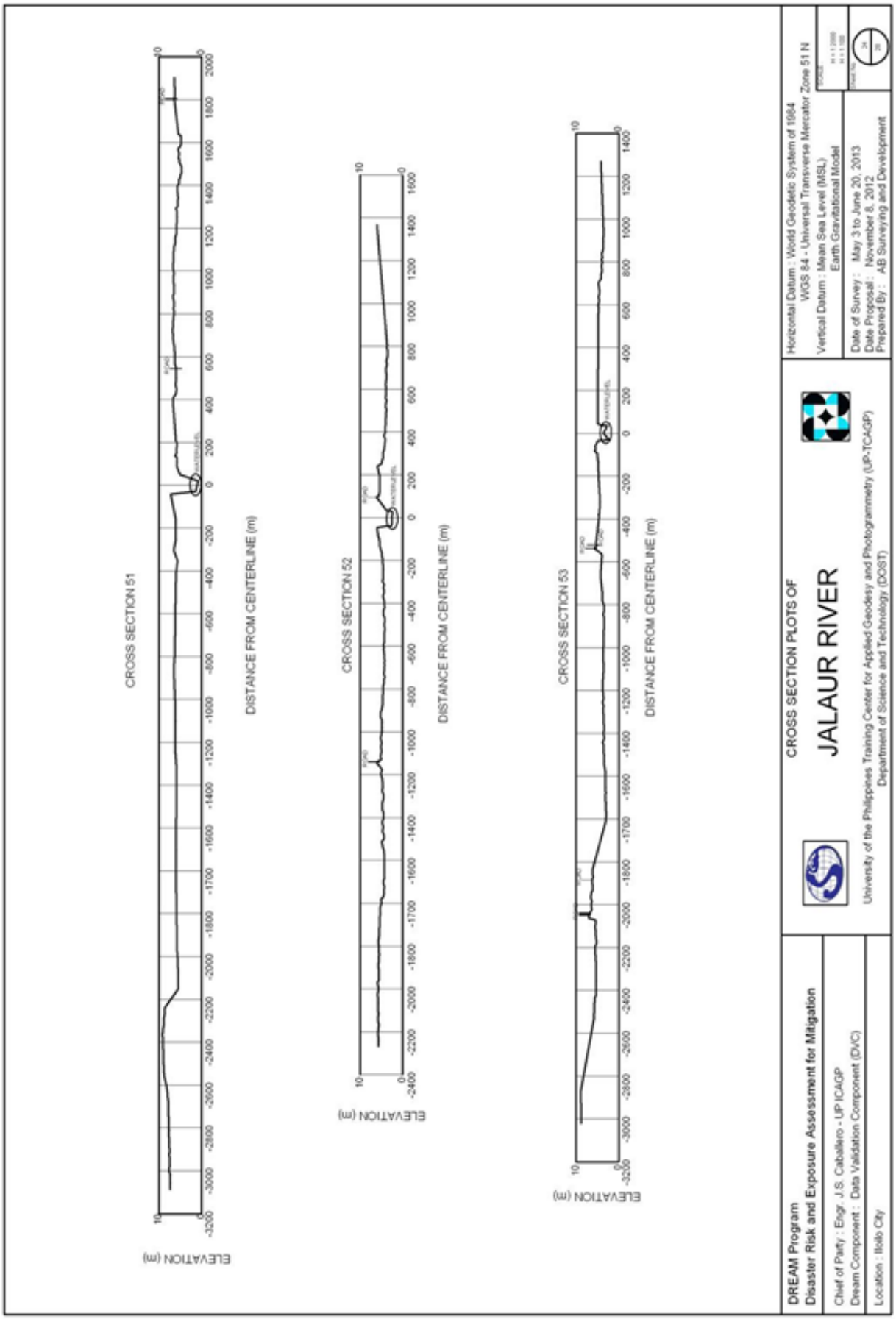


Figure 146: Sheet No.24 of the Cross-section plan of Jalaur River

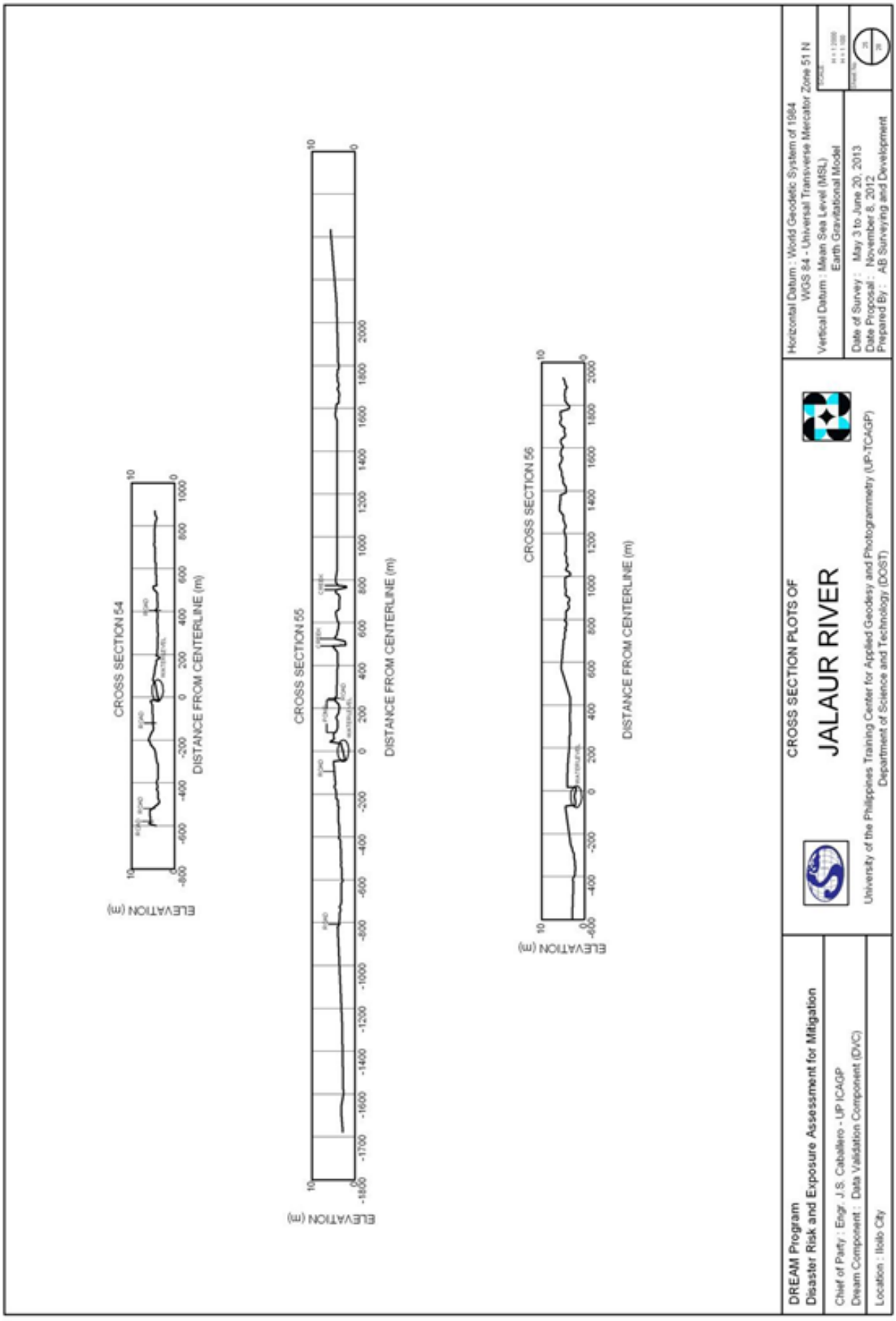


Figure 147: Sheet No.25 of the Cross-section plan of Jalaur River

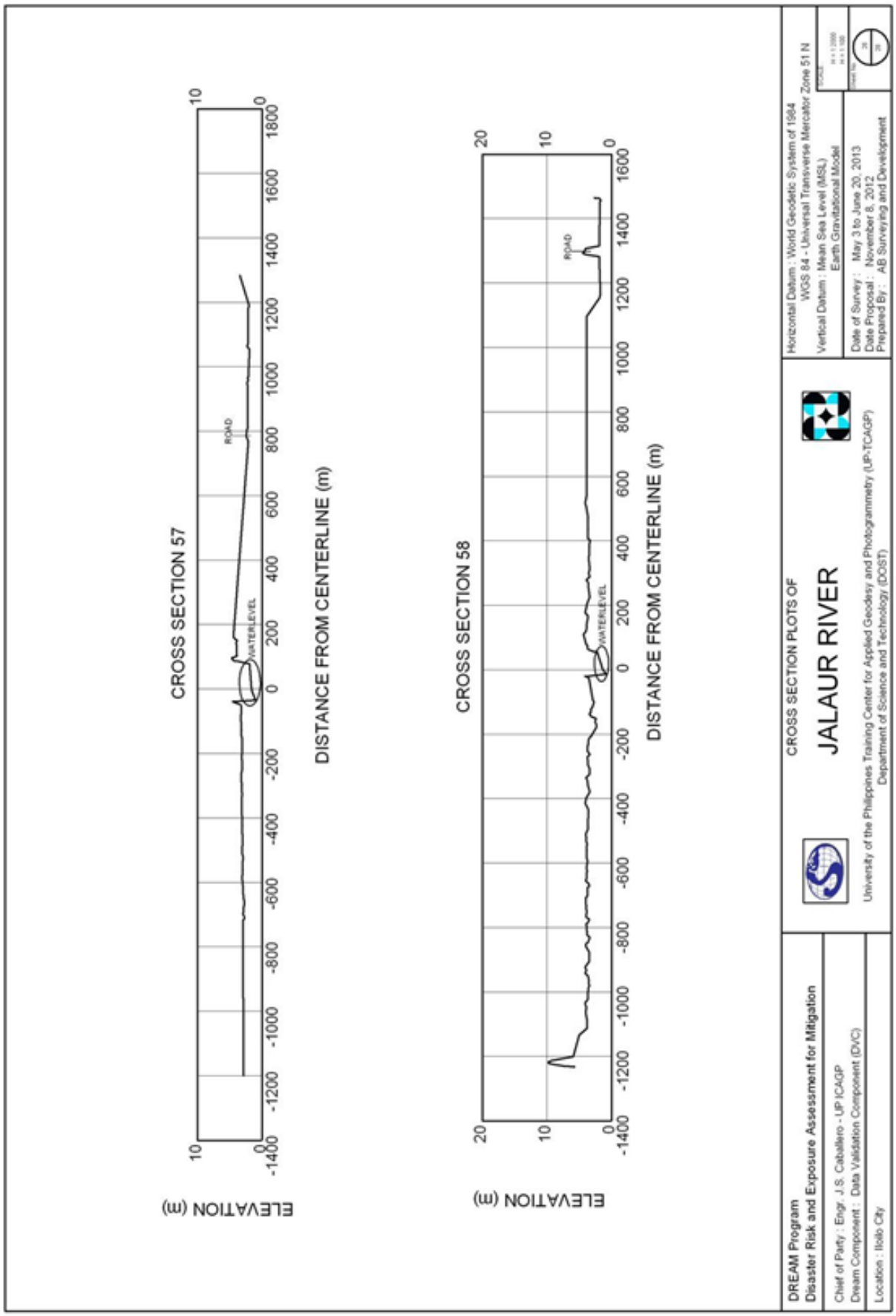


Figure 148: Sheet No.26 of the Cross-section plan of Jalaur River

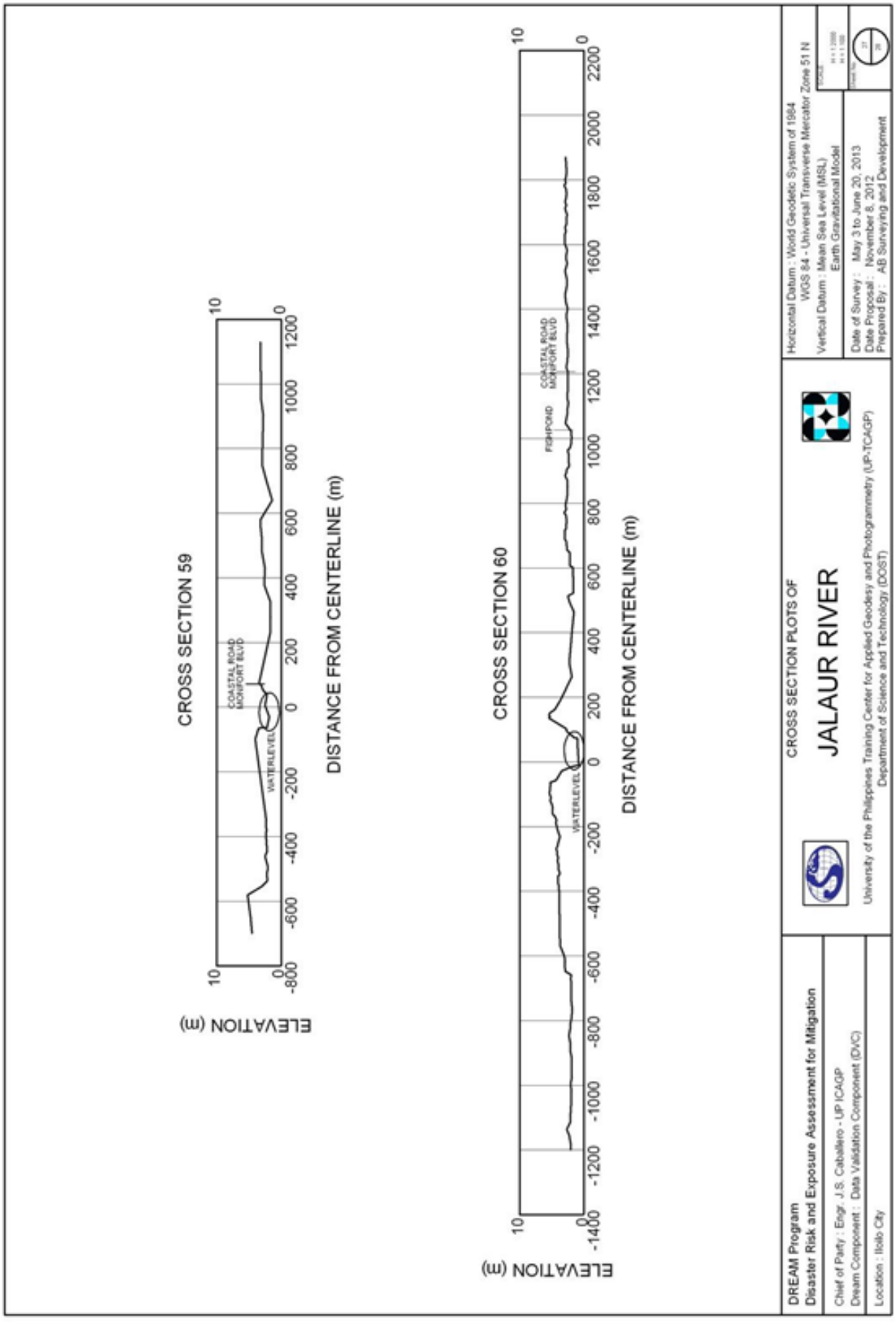


Figure 149: Sheet No.27 of the Cross-section plan of Jalaur River

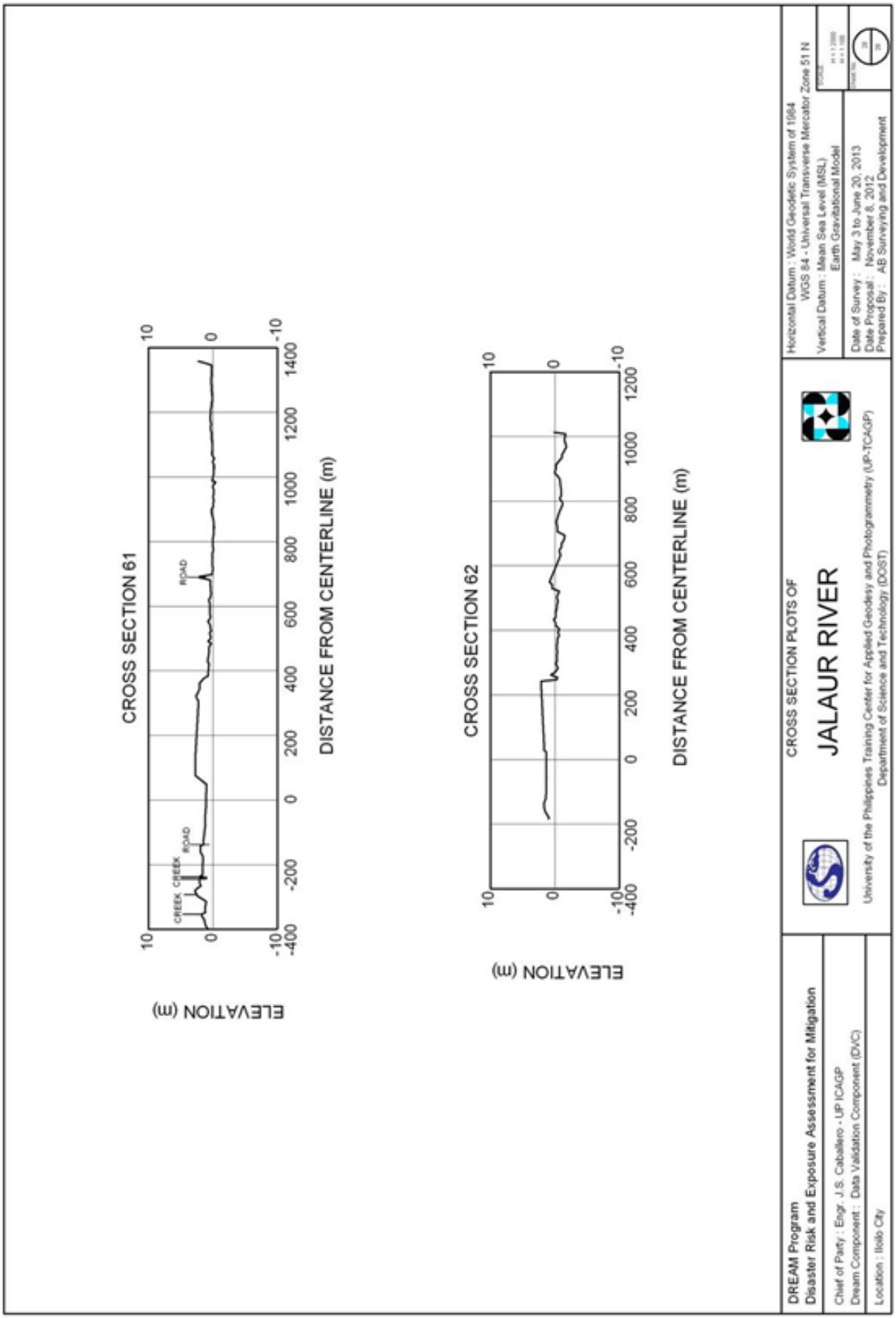


Figure 150: Sheet No.28 of the Cross-section plan of Jalaur River

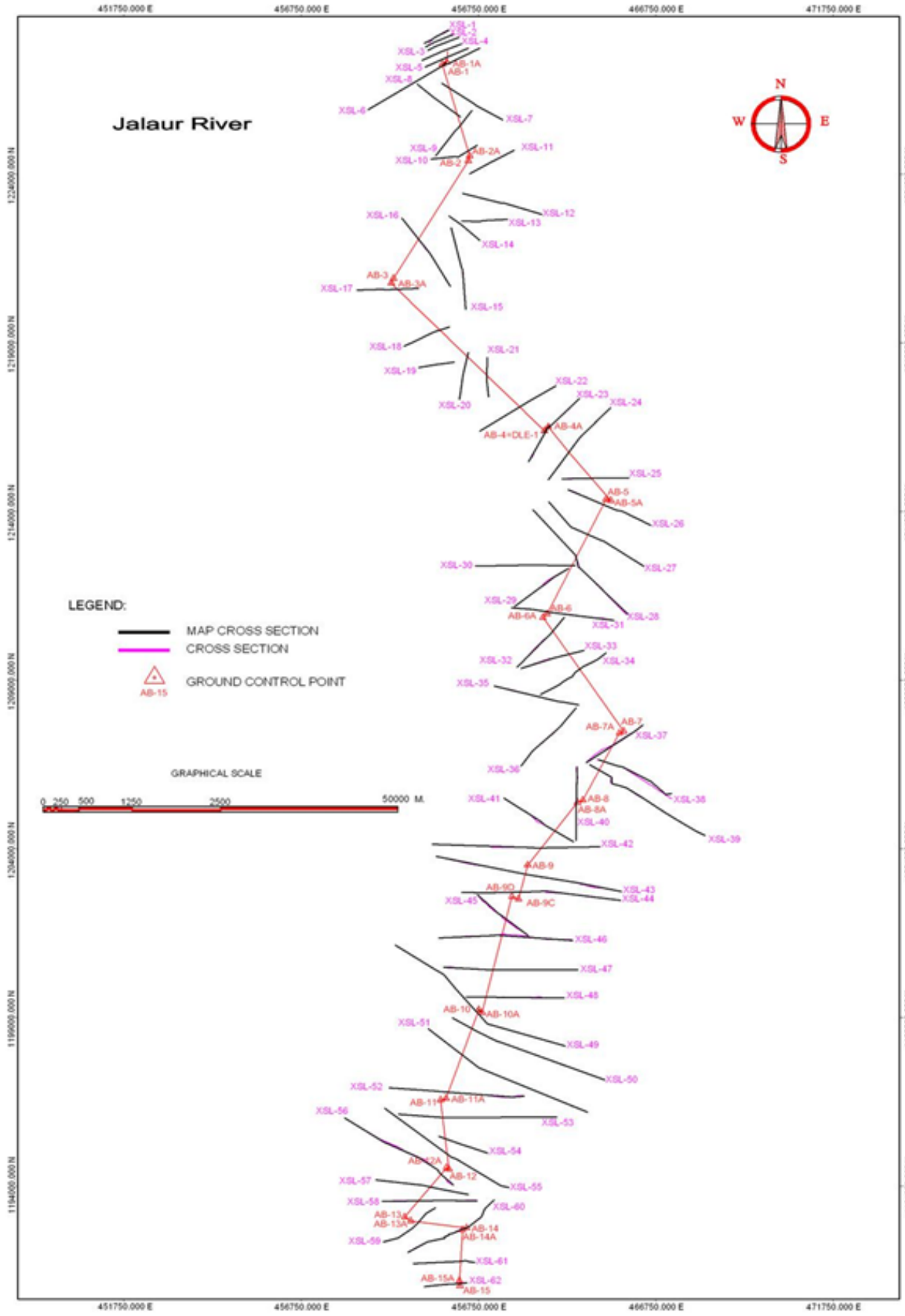


Figure 151: Actual Cross-section survey vs. Map for planned of Jalaur River

Annexes

Table 12: Summary details of the acquired cross-sections

Cross-section No.	Proposed	Actual	Remarks / Reasons
1	750 m = 75 pts	73	Portion of cross section line are sugar cane field
2	800 m = 80 pts	56	Portion of cross section line are sugar cane field
3	910 m = 91 pts	61	Portion of cross section line are sugar cane field
4	1.1 km = 110 pts	107	actual data was not exactly 10m intervals
5	1.3 km = 130 pts	106	actual data was not exactly 10m intervals
6	3.6 km = 360 pts	226	Portion of cross section line are cluster of house
7	1.9 km =190 pts	94	Portion of cross section line are sugar cane field & mountain
8	1.5 km = 150 pts	52	Portion of cross section line are sugar cane field
9	1.6 km = 160 pts	72	Portion of cross section line are mountain area
10	1.3 km = 130 pts	101	Portion of cross section line are sugar cane field
11	1.4 km = 140 pts	62	actual data was not exactly 10m intervals
12	2.3 km = 230 pts	144	actual data was not exactly 10m intervals
13	1.2 km = 120 pts	58	actual data was not exactly 10m intervals
14	1 km = 100 pts	60	actual data was not exactly 10m intervals
15	2.4 km = 240 pts	106	Portion of cross section line are mountain area
16	2.4 km = 240 pts	183	Portion of cross section line are sugar cane field
17	1.7 km = 170 pts	-	cross section line are mountain area
18	1.3 km = 130 pts	-	cross section line are mountain area
19	900 m = 90 pts	56	Portion of cross section line are sugar cane field
20	1.3 km = 130 pts	58	Portion of cross section line are mountain area
21	1 km = 100 pts	-	cross section line are mountain area
22	2.4 km = 240 pts	48	Portion of cross section line are sugar cane field & mountain
23	2.3 km = 230 pts	101	Portion of cross section line are sugar cane field
24	2.7 km = 270 pts	76	Portion of cross section line are sugar cane field
25	1.7 km = 170 pts	140	Portion of cross section line are sugar cane field
26	2.4 km = 240 pts	86	Portion of cross section line are bamboo trees
27	3.2 km = 320 pts	291	actual data was not exactly 10m intervals

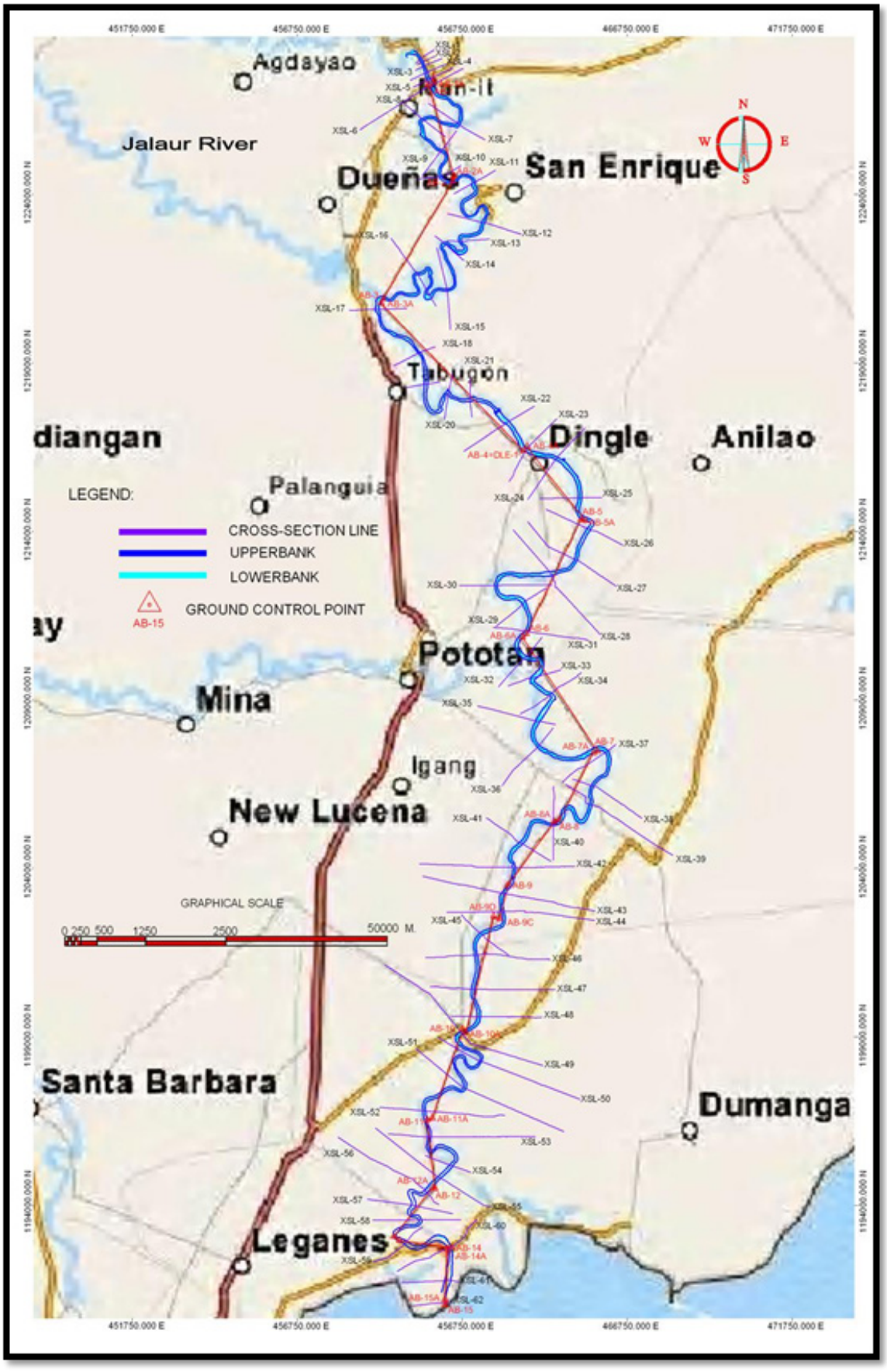
28	4 km = 400 pts	157	Portion of cross section line are sugar cane field
29	2.7 km = 270 pts	199	Portion of cross section line are sugar cane field
30	1.7 km = 170 pts	89	actual data was not exactly 10m intervals
31	2.6 km = 260 pts	293	actual data was not exactly 10m intervals
32	1.8 km = 180 pts	89	actual data was not exactly 10m intervals
33	1.7 km = 170 pts	124	actual data was not exactly 10m intervals
34	2.1 km = 210 pts	197	actual data was not exactly 10m intervals
35	2.3 km = 230 pts	136	actual data was not exactly 10m intervals
36	2.2 km = 220 pts	122	Portion of cross section line are banana trees
37	1.8 km = 180 pts	178	actual data was not exactly 10m intervals
38	2.2 km = 220 pts	113	actual data was not exactly 10m intervals
39	3.9 km = 390 pts	203	Portion of cross section line are cluster of house
40	2 km = 200 pts	114	Portion of cross section line are sugar cane field
41	2.3 km = 230 pts	153	actual data was not exactly 10m intervals
42	4.6 km = 460 pts	210	Portion of cross section line are sugar cane field
43	5.2 km = 520 pts	253	Portion of cross section line are poultry and rice field
44	4.4 km = 440 pts	201	actual data was not exactly 10m intervals
45	1.7 km = 170 pts	157	actual data was not exactly 10m intervals
46	3.7 km = 370 pts	292	actual data was not exactly 10m intervals
47	3.7 km = 370 pts	179	Portion of cross section line is river they can't passed
48	2.6 km = 260 pts	312	actual data was not exactly 10m intervals
49	5 km = 500 pts	120	actual data was not exactly 10m intervals
50	4.5 km = 460 pts	265	actual data was not exactly 10m intervals
51	5 km = 500 pts	206	actual data was not exactly 10m intervals
52	3.7 km = 370 pts	241	actual data was not exactly 10m intervals
53	4.4 km = 440 pts	259	actual data was not exactly 10m intervals
54	1.4 km = 140 pts	116	actual data was not exactly 10m intervals
27	3.2 km = 320 pts	291	actual data was not exactly 10m intervals
55	4.1 km = 410 pts	133	Portion of cross section line are sugar cane field
56	3.6 km = 360 pts	135	Portion of cross section line are cluster of house
57	2.5 km = 250 pts	91	Portions of cross section line are fishponds
58	2.6 km = 260 pts	140	Portions of cross section line are fishponds
59	1.7 km = 170 pts	34	Portions of cross section line are fishponds
60	2.9 km = 290 pts	202	actual data was not exactly 10m intervals
61	1.5 km = 150 pts	164	actual data was not exactly 10m intervals
62	1 km = 100 pts	86	actual data was not exactly 10m intervals

Note: Actual data was not exactly 10m intervals because the survey team did not staked out points in 10m interval using Total Stations

Annexes

Annexes

ANNEX A: MAP OF THE RIVER SYSTEM



Annexes

ANNEX B: THE SURVEY TEAM

Project Manager	Engr. Antonio Julian LL. Botor
Geodetic Engineer	Engr. Antonio Julian LL. Botor
Senior Surveyor	Sander Chan Galvez
Instrumentmen	Sergie Ballester
	Chester Llagas
	William Mamaril
	Mark Sacbatona
	Carlo Barredo
GPS Operator	10 local aides
Horizon RTK	Jason Ilustre
	Alfredo Uminga Jr.
	Orland Taguic
Hi-Target RTK	Leonilo Alpas
	Ferdinand Alea
Cadd Operator	Shela Ann Bernal

Annexes

ANNEX C: INSTRUMENT USED

TYPE OF EQUIPMENT	MODEL	SERIAL NO.	
HI-TARGET GPS	V30X STATIC	S/N1121334,S/N1121339, S/N1121341,S/N1121342, S/N1121344, S/N1121345, S/N1121348, S/N1121350, S/N1121609 S/N1121615	10 UNITS
HI-TARGET RTK	V30 GNSS		3 UNITS
Kronos 200 RTK GNSS ROVER	HKS-10000r	V1124742701, V1024730815gm V1124734806gm V124742700	4 UNITS
NIKON TOTAL STATION	NPR-332/PRISMLESS	S/N 020491	1 UNIT
	DTM-332	S/N 810251	1 UNIT
	ZTS-120R HI-TARGET PRISMLESS	S/N 210055, S/N 210049, S/N 210192	3 UNITS
HI-TARGET ECHOSOUNDER		3088	1 UNIT

1. **Hi-target static GPS –** was used in observation of Ground Control Points established to get the coordinates and elevation.
2. **Total stations –** was used in conducting the profile cross-section survey on the areas that are not feasible for Real Time Kinematic (RTK)
3. **Real Time Kinematic (RTK) Horizon and Hi-target –** were the main equipments in conducting the Profile and Cross-Section survey.
4. **Echo sounder –** was used in conducting bathymetric survey.

Annexes

ANNEX D: DAILY WORK ACTIVITIES

Date	Activities	Location
July 5, 2013	Mobilization at Agus River	
July 7, 2013	Recoinnassance	
July 9, 2013	Establishment of control points and Observation of GPS	
July 10, 2013	Observation of GPS and Start of Profile survey	Brgy. Poblacion West and Brgy. Nangka
July 11, 2013	Continuation of Profile survey and start of Crosssection survey	Brgy. Matampay
July 12, 2013	Continuation of Profile survey and Crosssection survey	Brgy. Adapun-Ali
July 13, 2013	Survey was cancelled	
July 22, 2013	Courtesy meeting with all Brgy. Captains of the affected Brgy. In the project	
July 25, 2013	Resume of the Profile survery and Crosssection survey	Brgy. Adapun-ALi
July 26, 2013	Continuation of the Crosssection survey	Brgy. Batolacongan
July 27, 2013	Continuation of the Crosssection survey	Brgy. Batolacongan
July 28, 2013	Continuation of the Crosssection survey	Brgy. Pacalundo and Brgy. Matampay
July 29, 2013	Survey was posponed	
July 30, 2013	Continuation of the Crosssection survey	Brgy, Poblacion West and Brgy. Matampay
July 31, 2013	Demobilization	

Annexes

ANNEX E: ADDITIONAL

Reference Point

APPENDIX 2

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS	DESIGNATION: ILO-31 PAGE:
THE POINT IS MEASURED AND PERMANENTLY MARKED	GEOGRAPHIC COORDINATES (WGS '84) Φ = 11°06'18.97517" N λ = 122°38'30.63728" E
ELEVATION OF NETWORK from to by order levelling	COORDINATES x = 460729.680 y = 1227702.520 ELLIPSOIDAL in the meter above mean sea level HEIGHT= 97.369

CONTROL POINT / BENCH MARK

ISLAND:	PANAY	**~~CITY~~ / MUNICIPALITY:**	PASSI
PROVINCE:	ILOILO	**BARANGAY:**	TOWN PROPER

The Station is located in the Town Proper of Passi, about 0.75 m. from the W edge of 1st Lt. Alberto Paleo Perlas Monument, just 20 m. from the centerline of the road. Mark is the head of a 4 in. copper nail embedded on cement putty set on the concrete flooring foundation of the said monument, with inscriptions "ILO-31 1995 NAMRIA".

SURVEYED / DESCRIBED BY:

DATE STABLISHED:

SKETCH

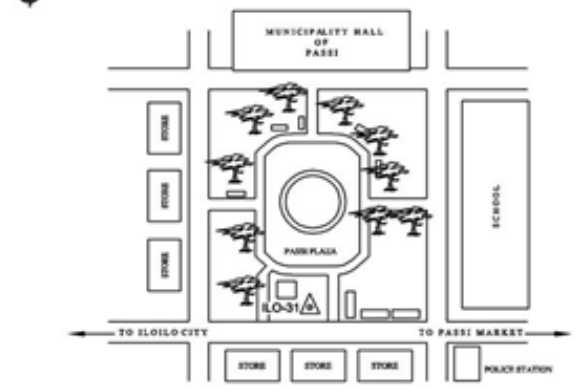
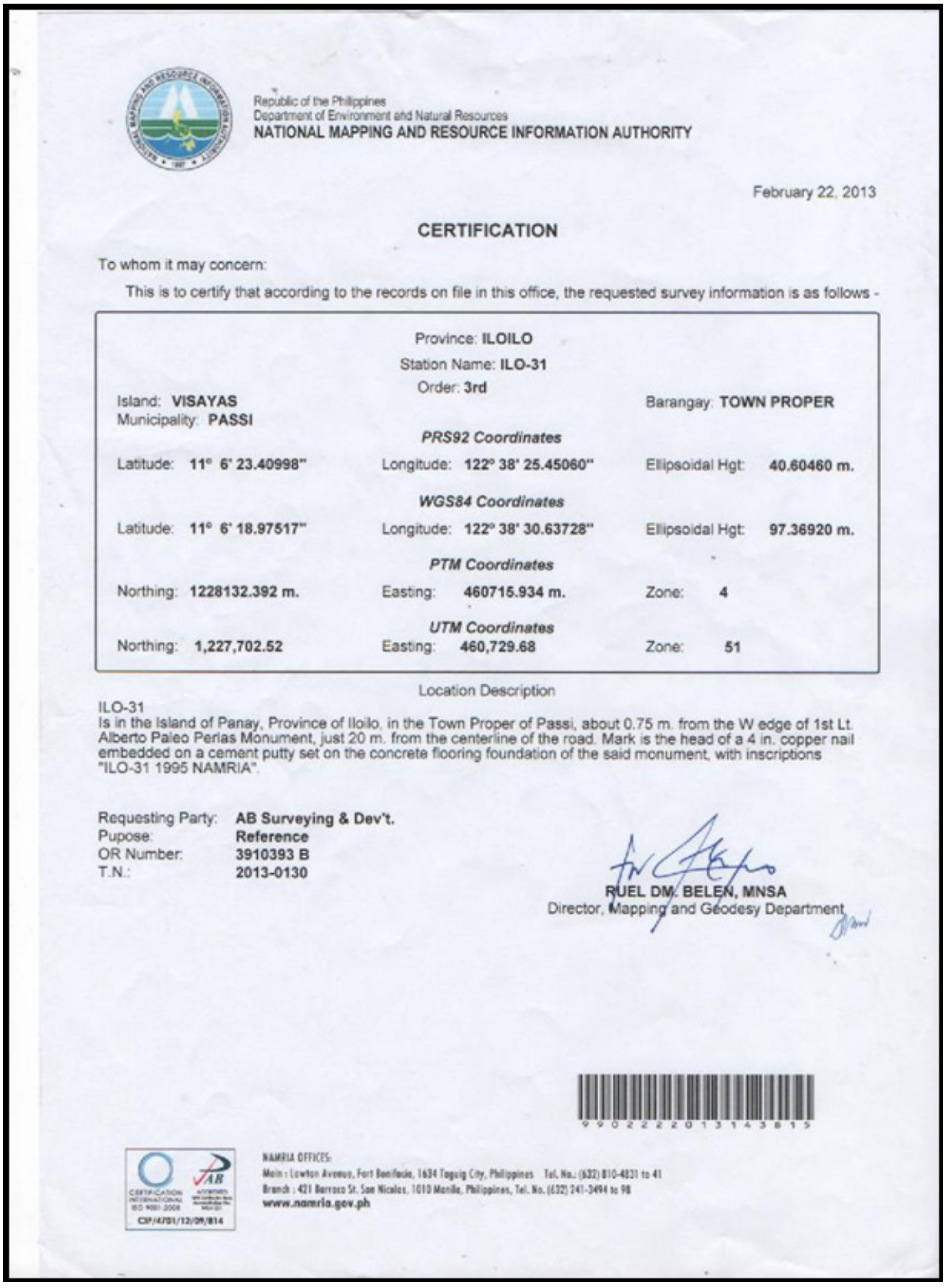


PHOTO / SKETCH

Figure 152: Sketch and description of reference point ILO-31



Republic of the Philippines
Department of Environment and Natural Resources
NATIONAL MAPPING AND RESOURCE INFORMATION AUTHORITY

February 22, 2013

CERTIFICATION

To whom it may concern:

This is to certify that according to the records on file in this office, the requested survey information is as follows -

Province: **ILOILO**
Station Name: **ILO-31**
Order: **3rd**

Island: **VISAYAS**
Municipality: **PASSI**
Barangay: **TOWN PROPER**

PRS92 Coordinates

Latitude: **11° 6' 23.40998"** Longitude: **122° 38' 25.45060"** Ellipsoidal Hgt: **40.60460 m.**

WGS84 Coordinates

Latitude: **11° 6' 18.97517"** Longitude: **122° 38' 30.63728"** Ellipsoidal Hgt: **97.36920 m.**

PTM Coordinates

Northing: **1228132.392 m.** Easting: **460715.934 m.** Zone: **4**

UTM Coordinates

Northing: **1,227,702.52** Easting: **460,729.68** Zone: **51**

Location Description

ILO-31
Is in the Island of Panay, Province of Iloilo, in the Town Proper of Passi, about 0.75 m. from the W edge of 1st Lt. Alberto Paleo Perlas Monument, just 20 m. from the centerline of the road. Mark is the head of a 4 in. copper nail embedded on a cement putty set on the concrete flooring foundation of the said monument, with inscriptions "ILO-31 1995 NAMRIA".

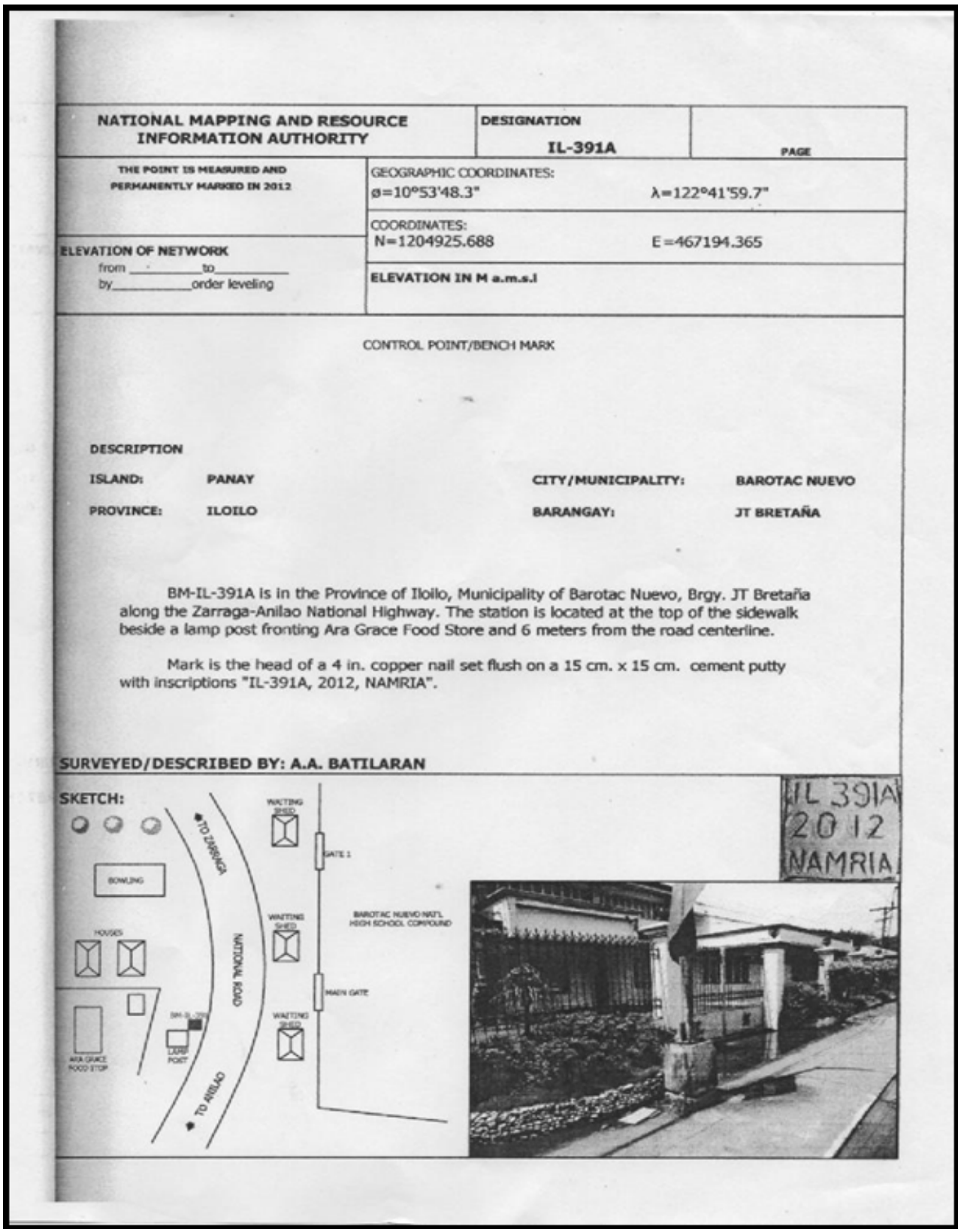
Requesting Party: **AB Surveying & Dev't.**
Pupose: **Reference**
OR Number: **3910393 B**
T.N.: **2013-0130**

RUEL DM. BELEN, MNSA
Director, Mapping and Geodesy Department

9902222013143815

NAMRIA OFFICES:
Main : Lawton Avenue, Fort Bonifacio, 1634 Taguig City, Philippines Tel. No.: (632) 810-4831 to 41
Branch : 421 Barraca St. San Nicolas, 1010 Manila, Philippines, Tel. No. (632) 241-3494 to 98
www.namria.gov.ph

Figure 153: NAMRIA certification of reference ILO-31



NATIONAL MAPPING AND RESOURCE INFORMATION AUTHORITY	DESIGNATION IL-391A	PAGE
THE POINT IS MEASURED AND PERMANENTLY MARKED IN 2012	GEOGRAPHIC COORDINATES: ø=10°53'48.3"	λ=122°41'59.7"
	COORDINATES: N=1204925.688	E=467194.365
ELEVATION OF NETWORK from ____ to ____ by ____ order leveling	ELEVATION IN M a.m.s.l	

CONTROL POINT/BENCH MARK

DESCRIPTION

ISLAND:	PANAY	CITY/MUNICIPALITY:	BAROTAC NUEVO
PROVINCE:	ILOILO	BARANGAY:	JT BRETAÑA

BM-IL-391A is in the Province of Iloilo, Municipality of Barotac Nuevo, Brgy. JT Bretaña along the Zarraga-Anilao National Highway. The station is located at the top of the sidewalk beside a lamp post fronting Ara Grace Food Store and 6 meters from the road centerline.

Mark is the head of a 4 in. copper nail set flush on a 15 cm. x 15 cm. cement putty with inscriptions "IL-391A, 2012, NAMRIA".

SURVEYED/DESCRIBED BY: A.A. BATILARAN

SKETCH:

Figure 154: Sketch and description of benchmark IL-391A

Republic of the Philippines
Department of Environment and Natural Resources
NATIONAL MAPPING AND RESOURCE INFORMATION AUTHORITY

February 20, 2013

CERTIFICATION

To whom it may concern:

This is to certify that according to the records on file in this office, the requested survey information is as follows -

Province: **ILOILO**
Station Name: **IL-391A**

Island: **Visayas** | Municipality: **BAROTAC NUEVO** | Barangay: **JT BRETAÑA**

Elevation: **12.1593 m.** | Order: **1st Order** | Datum: **Mean Sea Level**

Location Description

BM IL-391A

The station is in the Province of Iloilo, Municipality of Barotac Nuevo, Brgy. JT Bretaña, along the Zarraga-Anila National Highway. The station is located at the top of the sidewalk beside a lamp post fronting Ara Grace Food Store and 6m from the road centerline.

Mark is the head of a 4" copper nail set flushed on a 15cm x 15cm cement putty with inscriptions "IL-391A, 2012, NAMRIA".

Requesting Party: **AB Surveying & Dev't.**
Pupose: **Reference**
OR Number: **3910393 B**
T.N.: **2013-0131**

RUEL DM. BELEN, MNSA
Director, Mapping and Geodesy Department

NAMRIA OFFICES:
Main : Lawton Avenue, Fort Bonifacio, 1634 Taguig City, Philippines Tel. No.: (632) 810-4831 to 41
Branch : 421 Barraca St. San Nicolas, 1010 Manila, Philippines, Tel. No. (632) 241-3494 to 98
www.namria.gov.ph

Figure 155: NAMRIA certification of benchmark IL-391A

Annexes

ANNEX F: GNSS PROCESSING REPORT

Project Information		Coordinate System	
Name:	D:\JALAUR NEW.vce	Name:	UTM
Size:	1 MB	Datum:	WGS 1984
Modified:	10/1/2013 7:15:22 PM	Zone:	51 North
Reference number:		Geoid:	EGMPH08
Description:		Vertical datum:	

NETWORK ADJUSTMENT REPORT

Adjustment Settings

Set-Up Errors	
GNSS	
Error in Height of Antenna:	0.000 m
Centering Error:	0.000 m
Covariance Display	
Horizontal:	
Propagated Linear Error [E]:	U.S.
Constant Term [C]:	0.000 m
Scale on Linear Error [S]:	1.960
Three-Dimensional	
Propagated Linear Error [E]:	U.S.
Constant Term [C]:	0.000 m
Scale on Linear Error [S]:	1.960

Adjustment Statistics

Number of Iterations for Successful Adjustment:	2
Network Reference Factor:	2.25
Chi Square Test (95%):	Passed
Precision Confidence Level:	95%
Degrees of Freedom:	234
Post Processed Vector Statistics	
Reference Factor:	2.25
Redundancy Number:	234.00
A Priori Scalar:	1.00

Annexes

Adjusted Grid Coordinates

Point ID	Easting (Meter)	Easting Error (Meter)	Northing (Meter)	Northing Error (Meter)	Elevation (Meter)	Elevation Error (Meter)	Fixed
AB-1	460739.786	0.004	1227251.781	0.004	37.986	0.009	
AB-10	461761.547	0.009	1199230.030	0.008	13.231	0.028	
AB-10A	461854.751	0.009	1199136.307	0.008	13.383	0.024	
AB-11	460687.273	0.009	1196547.580	0.008	5.835	0.024	
AB-11A	460840.840	0.009	1196593.061	0.008	4.568	0.024	
AB-12	460852.593	0.009	1194537.691	0.008	4.678	0.027	
AB-12A	460928.362	0.009	1194499.480	0.008	4.363	0.024	
AB-13	459673.760	0.008	1193082.723	0.008	3.358	0.024	
AB-13A	459849.069	0.009	1192963.049	0.008	3.368	0.024	
AB-14	461415.417	0.009	1192762.909	0.008	6.378	0.025	
AB-14A	461302.129	0.009	1192708.327	0.008	6.415	0.025	
AB-15	461231.077	0.009	1191046.421	0.008	2.774	0.025	
AB-15A	461214.957	0.009	1191203.843	0.008	2.245	0.025	
AB-1A	460861.138	0.004	1227323.849	0.004	37.889	0.009	
AB-2	461465.240	0.005	1224392.706	0.005	32.331	0.011	
AB-2A	461504.182	0.006	1224534.925	0.006	30.320	0.018	
AB-3	459296.968	0.008	1220765.539	0.007	34.998	0.017	
AB-3A	459361.148	0.007	1220903.760	0.006	26.652	0.018	
AB-4	463615.953	0.006	1216393.136	0.005	25.260	0.017	
AB-4A	463722.081	0.006	1216506.677	0.006	25.279	0.026	
AB-5	465351.336	0.005	1214357.447	0.005	19.576	0.015	
AB-5A	465489.011	0.006	1214319.781	0.005	19.848	0.017	
AB-6	463693.118	0.006	1210962.549	0.005	14.501	0.018	
AB-6A	463572.832	0.006	1210854.590	0.006	14.050	0.019	
AB-7	465848.437	0.006	1207481.247	0.006	12.302	0.020	
AB-7A	465729.604	0.007	1207425.880	0.006	14.209	0.020	
AB-8	464699.663	0.007	1205439.650	0.006	10.902	0.020	
AB-8A	464542.564	0.007	1205373.931	0.006	10.748	0.021	
AB-9	463146.302	0.007	1203517.211	0.006	10.930	0.022	
AB-9C	462888.187	0.008	1202504.209	0.007	11.968	0.022	
AB-9D.	462703.026	0.007	1202578.520	0.007	12.219	0.021	
IL-391A	467210.508	0.008	1204571.704	0.007	12.850	0.021	
ILO-31	460887.340	?	1227642.871	?	39.239	?	LLh
ILO-66	464309.585	0.006	1215745.268	0.006	26.349	0.017	

Annexes

Adjusted Geodetic Coordinates

Point ID	Latitude	Longitude	Height (Meter)	Height Error (Meter)	Fixed	Elevation Error (Meter)	Fixed
AB-1	N11°06'06.23644"	E122°38'25.78875"	96.114	0.009		0.009	
AB-10	N10°50'53.94775"	E122°39'00.54445"	71.649	0.028		0.028	
AB-10A	N10°50'50.89980"	E122°39'03.61779"	71.807	0.024		0.024	
AB-11	N10°49'26.57145"	E122°38'25.26594"	64.260	0.024		0.024	
AB-11A	N10°49'28.05812"	E122°38'30.32172"	62.998	0.024		0.024	
AB-12	N10°48'21.13946"	E122°38'30.78818"	63.158	0.027		0.027	
AB-12A	N10°48'19.89828"	E122°38'33.28486"	62.847	0.024		0.024	
AB-13	N10°47'33.72273"	E122°37'52.02493"	61.831	0.024		0.024	
AB-13A	N10°47'29.83323"	E122°37'57.80263"	61.852	0.024		0.024	
AB-14	N10°47'23.37702"	E122°38'49.39043"	64.931	0.025		0.025	
AB-14A	N10°47'21.59569"	E122°38'45.66192"	64.965	0.025		0.025	
AB-15	N10°46'27.48423"	E122°38'43.38554"	61.375	0.025		0.025	
AB-15A	N10°46'32.60902"	E122°38'42.84875"	60.841	0.025		0.025	
AB-1A	N11°06'08.58758"	E122°38'29.78620"	96.024	0.009		0.009	
AB-2	N11°04'33.18009"	E122°38'49.81462"	90.558	0.011		0.011	
AB-2A	N11°04'37.81189"	E122°38'51.09267"	88.548	0.018		0.018	
AB-3	N11°02'35.00236"	E122°37'38.49408"	93.135	0.017		0.017	
AB-3A	N11°02'39.50510"	E122°37'40.60365"	84.792	0.018		0.018	
AB-4	N11°00'12.81232"	E122°40'00.99921"	83.700	0.017		0.017	
AB-4A	N11°00'16.51281"	E122°40'04.49238"	83.725	0.026		0.026	
AB-5	N10°59'06.59569"	E122°40'58.25727"	78.116	0.015		0.015	
AB-5A	N10°59'05.37407"	E122°41'02.79518"	78.395	0.017		0.017	
AB-6	N10°57'16.00652"	E122°40'03.73974"	72.946	0.018		0.018	
AB-6A	N10°57'12.48727"	E122°39'59.78050"	72.489	0.019		0.019	
AB-7	N10°55'22.73709"	E122°41'14.87242"	70.843	0.020		0.020	
AB-7A	N10°55'20.93044"	E122°41'10.95940"	72.744	0.020		0.020	
AB-8	N10°54'16.22731"	E122°40'37.09813"	69.392	0.020		0.020	
AB-8A	N10°54'14.08215"	E122°40'31.92518"	69.231	0.021		0.021	
AB-9	N10°53'13.58127"	E122°39'45.99670"	69.360	0.022		0.022	
AB-9C	N10°52'40.59047"	E122°39'37.53152"	70.394	0.022		0.022	
AB-9D.	N10°52'43.00314"	E122°39'31.42962"	70.637	0.021		0.021	
IL-391A	N10°53'48.05263"	E122°41'59.84061"	71.446	0.021		0.021	
ILO-31	N11°06'18.97517"	E122°38'30.63728"	97.369	?	LLh	?	LLh
ILO-66	N10°59'51.74395"	E122°40'23.88015"	84.831	0.017		0.017	

Annexes

Error Ellipse Components

Point ID	Semi-major axis (Meter)	Semi-minor axis (Meter)	Azimuth
AB-1	0.006	0.005	114°
AB-10	0.012	0.01	108°
AB-10A	0.011	0.01	108°
AB-11	0.011	0.01	107°
AB-11A	0.011	0.01	106°
AB-12	0.012	0.01	111°
AB-12A	0.011	0.01	107°
AB-13	0.011	0.009	109°
AB-13A	0.011	0.01	107°
AB-14	0.011	0.01	109°
AB-14A	0.011	0.01	109°
AB-15	0.011	0.01	110°
AB-15A	0.011	0.01	109°
AB-1A	0.006	0.005	113°
AB-2	0.007	0.006	114°
AB-2A	0.008	0.007	116°
AB-3	0.01	0.009	93°
AB-3A	0.009	0.007	114°
AB-4	0.008	0.006	114°
AB-4A	0.008	0.007	120°
AB-5	0.006	0.006	113°
AB-5A	0.007	0.007	113°
AB-6	0.007	0.006	112°
AB-6A	0.008	0.007	108°
AB-7	0.008	0.007	112°
AB-7A	0.009	0.008	98°
AB-8	0.009	0.007	107°
AB-8A	0.009	0.008	111°
AB-9	0.009	0.008	105°
AB-9C	0.01	0.008	109°
AB-9D.	0.009	0.008	110°
IL-391A	0.01	0.009	110°
ILO-66	0.008	0.007	111°

Annexes

Adjusted GPS Observations

Observation ID		Observation	A-posteriori Error	Residual	Standardized Residual
ILO-31 --> AB-3 (PV93)	Az.	192°57'07"	0.228 sec	-0.014 sec	-0.121
	ΔHt.	-4.234 m	0.017 m	0.026 m	3.627
	Ellip Dist.	7061.508 m	0.007 m	0.005 m	1.326
AB-5 --> AB-3A (PV5)	Az.	317°28'46"	0.133 sec	-0.073 sec	-0.619
	ΔHt.	6.677 m	0.018 m	0.004 m	0.24
	Ellip Dist.	8876.758 m	0.007 m	-0.021 m	-3.430
ILO-31 --> AB-2 (PV90)	Az.	169°50'56"	0.336 sec	-0.614 sec	-3.225
	ΔHt.	-6.811 m	0.011 m	0.001 m	0.1
	Ellip Dist.	3302.401 m	0.005 m	0.006 m	2.087
ILO-31 --> AB-4A (PV86)	Az.	165°39'00"	0.106 sec	0.112 sec	0.946
	ΔHt.	-13.644 m	0.026 m	-0.020 m	-0.523
	Ellip Dist.	11495.722 m	0.006 m	0.021 m	3.085
AB-13 --> AB-11 (PV46)	Az.	16°14'08"	0.202 sec	-0.211 sec	-1.146
	ΔHt.	2.429 m	0.009 m	0.059 m	3.069
	Ellip Dist.	3611.421 m	0.003 m	0.005 m	1.554
ILO-31 --> AB-3A (PV92)	Az.	192°41'30"	0.206 sec	0.090 sec	0.633
	ΔHt.	-12.577 m	0.018 m	-0.025 m	-2.148
	Ellip Dist.	6912.396 m	0.005 m	-0.011 m	-2.969
AB-5 --> AB-2A (PV7)	Az.	339°13'57"	0.125 sec	-0.117 sec	-0.783
	ΔHt.	10.432 m	0.020 m	0.033 m	1.353
	Ellip Dist.	10884.507 m	0.007 m	-0.021 m	-2.703
ILO-31 --> AB-5A (PV88)	Az.	160°52'37"	0.082 sec	0.053 sec	0.457
	ΔHt.	-18.974 m	0.017 m	-0.033 m	-0.686
	Ellip Dist.	14100.797 m	0.006 m	0.020 m	2.547
AB-9C --> AB-15 (PV64)	Az.	188°09'57"	0.090 sec	-0.014 sec	-0.097
	ΔHt.	-9.019 m	0.012 m	-0.039 m	-2.509
	Ellip Dist.	11581.426 m	0.004 m	-0.007 m	-0.918
AB-4 --> AB-3A (PV11)	Az.	316°36'29"	0.196 sec	-0.133 sec	-1.071
	ΔHt.	1.092 m	0.018 m	0.028 m	2.393
	Ellip Dist.	6203.101 m	0.007 m	0.006 m	1.337

AB-10 --> AB-11 (PV25)	Az.	201°45'34"	0.398 sec	-1.538 sec	-2.359
	ΔHt.	-7.390 m	0.018 m	0.015 m	0.652
	Ellip Dist.	2890.670 m	0.005 m	-0.009 m	-1.324
AB-5 --> AB-6A (PV54)	Az.	206°51'28"	0.210 sec	-0.345 sec	-2.312
	ΔHt.	-5.627 m	0.013 m	0.008 m	0.415
	Ellip Dist.	3930.007 m	0.004 m	0.001 m	0.518
AB-5 --> AB-3 (PV6)	Az.	316°33'55"	0.176 sec	0.095 sec	0.761
	ΔHt.	15.019 m	0.016 m	-0.024 m	-2.278
	Ellip Dist.	8819.212 m	0.008 m	0.003 m	0.591
AB-9C --> AB-10A (PV67)	Az.	196°59'40"	0.252 sec	-0.031 sec	-0.185
	ΔHt.	1.413 m	0.010 m	0.005 m	1.036
	Ellip Dist.	3524.238 m	0.004 m	0.006 m	2.223
AB-9C --> AB-14A (PV65)	Az.	189°07'59"	0.101 sec	0.097 sec	0.646
	ΔHt.	-5.430 m	0.012 m	-0.031 m	-2.056
	Ellip Dist.	9927.245 m	0.004 m	-0.010 m	-1.582
ILO-31 --> AB-2A (PV94)	Az.	168°42'19"	0.390 sec	-0.084 sec	-0.576
	ΔHt.	-8.821 m	0.018 m	-0.014 m	-1.976
	Ellip Dist.	3169.776 m	0.006 m	-0.004 m	-2.045
AB-5A --> AB-4A (PV14)	Az.	321°00'10"	0.304 sec	0.137 sec	1.054
	ΔHt.	5.330 m	0.023 m	0.025 m	1.996
	Ellip Dist.	2812.586 m	0.004 m	0.000 m	0.022
AB-5 --> IL-391A (PV96)	Az.	169°10'57"	0.120 sec	0.085 sec	0.564
	ΔHt.	-6.670 m	0.016 m	0.033 m	1.986
	Ellip Dist.	9964.633 m	0.005 m	0.002 m	0.293
AB-1 --> AB-2 (PV21)	Az.	165°41'36"	0.392 sec	0.519 sec	1.946
	ΔHt.	-5.556 m	0.011 m	0.001 m	0.073
	Ellip Dist.	2950.801 m	0.005 m	-0.004 m	-1.192
AB-9 --> AB-7A (PV110)	Az.	33°23'51"	0.264 sec	-0.461 sec	-1.913
	ΔHt.	3.384 m	0.015 m	-0.006 m	-0.431
	Ellip Dist.	4687.005 m	0.005 m	-0.001 m	-0.248

AB-5 --> AB-4 (PV116)	Az.	319°29'33"	0.299 sec	-0.271 sec	-1.606
	ΔHt.	5.584 m	0.011 m	0.011 m	1.862
	Ellip Dist.	2676.021 m	0.004 m	0.003 m	1.419
AB-1A --> AB-2 (PV2)	Az.	168°17'08"	0.390 sec	0.497 sec	1.859
	ΔHt.	-5.466 m	0.011 m	0.001 m	0.089
	Ellip Dist.	2993.889 m	0.005 m	-0.005 m	-1.506
AB-5 --> AB-5A (PV8)	Az.	105°14'26"	5.198 sec	-3.182 sec	-1.769
	ΔHt.	0.279 m	0.009 m	0.001 m	0.332
	Ellip Dist.	142.789 m	0.004 m	0.000 m	0.314
ILO-66 --> AB-7 (PV80)	Az.	169°23'23"	0.128 sec	0.256 sec	1.163
	ΔHt.	-13.989 m	0.014 m	-0.004 m	-0.239
	Ellip Dist.	8409.313 m	0.005 m	0.013 m	1.738
ILO-66 --> AB-6 (PV101)	Az.	187°16'57"	0.199 sec	0.400 sec	1.699
	ΔHt.	-11.885 m	0.012 m	-0.006 m	-0.666
	Ellip Dist.	4824.138 m	0.004 m	0.004 m	0.773
AB-5 --> ILO-66 (PV95)	Az.	323°02'47"	0.458 sec	-0.461 sec	-1.697
	ΔHt.	6.715 m	0.010 m	-0.001 m	-0.268
	Ellip Dist.	1735.976 m	0.004 m	0.000 m	0.022
AB-7 --> AB-9 (PV103)	Az.	214°13'18"	0.250 sec	0.459 sec	1.681
	ΔHt.	-1.482 m	0.015 m	0.013 m	0.956
	Ellip Dist.	4799.251 m	0.005 m	0.000 m	-0.096
AB-5 --> AB-7 (PV108)	Az.	175°48'17"	0.124 sec	0.032 sec	0.223
	ΔHt.	-7.273 m	0.013 m	-0.014 m	-0.391
	Ellip Dist.	6896.803 m	0.004 m	-0.007 m	-1.679
AB-9C --> AB-14 (PV66)	Az.	188°32'01"	0.102 sec	0.110 sec	0.759
	ΔHt.	-5.464 m	0.013 m	-0.029 m	-0.804
	Ellip Dist.	9855.772 m	0.004 m	-0.010 m	-1.675
AB-7 --> AB-8A (PV102)	Az.	211°43'36"	0.409 sec	-0.155 sec	-0.617
	ΔHt.	-1.611 m	0.014 m	0.015 m	1.668
	Ellip Dist.	2480.084 m	0.004 m	-0.003 m	-1.187

AB-5 --> AB-4A (PV15)	Az.	322°46'30"	0.310 sec	0.029 sec	0.215
	ΔHt.	5.609 m	0.023 m	-0.019 m	-1.631
	Ellip Dist.	2698.010 m	0.004 m	0.002 m	1.25
AB-6 --> AB-7 (PV100)	Az.	148°10'29"	0.176 sec	0.025 sec	0.082
	ΔHt.	-2.103 m	0.011 m	0.000 m	-0.009
	Ellip Dist.	4096.068 m	0.004 m	0.010 m	1.628
ILO-31 --> AB-1 (PV85)	Az.	200°36'07"	2.206 sec	1.534 sec	1.508
	ΔHt.	-1.255 m	0.009 m	0.001 m	0.227
	Ellip Dist.	418.159 m	0.004 m	0.001 m	0.339
ILO-31 --> AB-1A (PV91)	Az.	184°37'35"	2.852 sec	1.990 sec	1.507
	ΔHt.	-1.345 m	0.009 m	0.000 m	0.119
	Ellip Dist.	320.218 m	0.004 m	-0.001 m	-0.367
AB-6 --> AB-6A (PV55)	Az.	228°01'41"	4.337 sec	2.758 sec	1.498
	ΔHt.	-0.457 m	0.008 m	0.001 m	0.317
	Ellip Dist.	161.690 m	0.003 m	0.001 m	0.693
AB-5A --> AB-3 (PV9)	Az.	316°05'23"	0.181 sec	0.086 sec	0.592
	ΔHt.	14.740 m	0.017 m	-0.018 m	-1.488
	Ellip Dist.	8941.496 m	0.008 m	0.002 m	0.275
AB-13 --> AB-12 (PV44)	Az.	38°56'45"	0.571 sec	0.321 sec	1.455
	ΔHt.	1.327 m	0.014 m	-0.002 m	-0.324
	Ellip Dist.	1873.298 m	0.004 m	-0.001 m	-0.400
AB-4 --> AB-2A (PV13)	Az.	345°23'44"	0.176 sec	-0.239 sec	-0.958
	ΔHt.	4.847 m	0.021 m	0.041 m	1.423
	Ellip Dist.	8414.421 m	0.007 m	-0.005 m	-0.507
ILO-66 --> IL-391A (PV98)	Az.	165°23'02"	0.104 sec	0.028 sec	0.481
	ΔHt.	-13.386 m	0.017 m	-0.030 m	-1.406
	Ellip Dist.	11548.450 m	0.005 m	-0.004 m	-1.244
AB-5 --> AB-6 (PV17)	Az.	205°58'21"	0.168 sec	-0.079 sec	-0.955
	ΔHt.	-5.170 m	0.011 m	-0.017 m	-1.402
	Ellip Dist.	3779.683 m	0.003 m	-0.001 m	-0.563

AB-7 --> AB-8 (PV106)	Az.	209°18'24"	0.468 sec	0.094 sec	0.246
	ΔHt.	-1.451 m	0.013 m	-0.013 m	-1.366
	Ellip Dist.	2343.507 m	0.004 m	0.002 m	0.648
IL-391A --> AB-6 (PV99)	Az.	331°06'56"	0.164 sec	-0.068 sec	-0.343
	ΔHt.	1.500 m	0.016 m	0.009 m	0.719
	Ellip Dist.	7297.668 m	0.006 m	0.010 m	1.347
AB-6 --> AB-8 (PV58)	Az.	169°36'30"	0.170 sec	0.084 sec	0.541
	ΔHt.	-3.554 m	0.012 m	-0.010 m	-0.955
	Ellip Dist.	5616.028 m	0.004 m	-0.005 m	-1.338
AB-13A --> AB-11 (PV53)	Az.	13°05'34"	0.210 sec	0.083 sec	0.471
	ΔHt.	2.408 m	0.008 m	-0.008 m	-1.335
	Ellip Dist.	3682.630 m	0.004 m	0.000 m	0.056
ILO-31 --> AB-4 (PV87)	Az.	166°17'51"	0.103 sec	-0.120 sec	-0.834
	ΔHt.	-13.669 m	0.017 m	-0.065 m	-1.308
	Ellip Dist.	11580.345 m	0.006 m	-0.002 m	-0.249
AB-5 --> AB-7A (PV113)	Az.	176°48'58"	0.164 sec	-0.096 sec	-0.523
	ΔHt.	-5.372 m	0.014 m	0.015 m	1.291
	Ellip Dist.	6944.556 m	0.005 m	0.005 m	0.988
AB-11 --> AB-12A (PV37)	Az.	173°13'08"	0.371 sec	0.066 sec	0.256
	ΔHt.	-1.413 m	0.008 m	0.001 m	0.104
	Ellip Dist.	2063.026 m	0.004 m	0.003 m	1.283
AB-6 --> AB-9C (PV75)	Az.	185°22'24"	0.134 sec	-0.046 sec	-0.329
	ΔHt.	-2.551 m	0.015 m	-0.011 m	-0.770
	Ellip Dist.	8499.812 m	0.005 m	0.006 m	1.229
AB-10 --> AB-11A (PV24)	Az.	199°10'52"	0.415 sec	0.084 sec	0.161
	ΔHt.	-8.651 m	0.017 m	0.022 m	1.224
	Ellip Dist.	2794.148 m	0.005 m	-0.003 m	-0.621
AB-9C --> AB-12A (PV63)	Az.	193°41'36"	0.108 sec	-0.055 sec	-0.341
	ΔHt.	-7.548 m	0.010 m	0.007 m	0.567
	Ellip Dist.	8244.302 m	0.004 m	0.007 m	1.213

AB-9C --> AB-15A (PV72)	Az.	188°21'31"	0.090 sec	0.008 sec	0.05
	ΔHt.	-9.554 m	0.013 m	0.000 m	0.011
	Ellip Dist.	11427.938 m	0.004 m	-0.009 m	-1.208
AB-6 --> AB-7 (PV109)	Az.	148°10'29"	0.176 sec	-0.089 sec	-0.655
	ΔHt.	-2.103 m	0.011 m	0.019 m	0.766
	Ellip Dist.	4096.068 m	0.004 m	-0.004 m	-1.195
AB-5 --> AB-8 (PV57)	Az.	184°07'09"	0.117 sec	0.015 sec	0.093
	ΔHt.	-8.724 m	0.014 m	0.018 m	1.184
	Ellip Dist.	8945.018 m	0.004 m	-0.002 m	-0.402
AB-13 --> AB-13A (PV48)	Az.	124°15'01"	3.071 sec	-1.160 sec	-0.730
	ΔHt.	0.021 m	0.007 m	-0.004 m	-1.171
	Ellip Dist.	212.342 m	0.003 m	-0.001 m	-0.396
AB-9C --> AB-11 (PV71)	Az.	200°12'53"	0.134 sec	-0.001 sec	-0.006
	ΔHt.	-6.135 m	0.011 m	0.030 m	1.155
	Ellip Dist.	6352.659 m	0.004 m	0.005 m	1.054
AB-11 --> AB-10A (PV27)	Az.	24°12'25"	0.297 sec	0.175 sec	0.759
	ΔHt.	7.548 m	0.009 m	-0.005 m	-0.880
	Ellip Dist.	2840.893 m	0.004 m	0.004 m	1.149
AB-9C --> AB-10 (PV68)	Az.	198°55'27"	0.306 sec	0.001 sec	0.006
	ΔHt.	1.255 m	0.018 m	0.014 m	0.639
	Ellip Dist.	3463.920 m	0.004 m	-0.002 m	-1.095
AB-9D. --> AB-8A (PV82)	Az.	33°16'58"	0.303 sec	0.003 sec	0.016
	ΔHt.	-1.406 m	0.013 m	-0.008 m	-1.093
	Ellip Dist.	3347.659 m	0.005 m	-0.001 m	-0.513
AB-9C --> AB-11A (PV70)	Az.	199°02'23"	0.139 sec	-0.036 sec	-0.228
	ΔHt.	-7.396 m	0.010 m	0.008 m	0.864
	Ellip Dist.	6258.052 m	0.004 m	0.005 m	1.078
AB-10 --> AB-12 (PV23)	Az.	190°53'50"	0.260 sec	0.160 sec	1.072
	ΔHt.	-8.492 m	0.017 m	0.004 m	0.512
	Ellip Dist.	4781.389 m	0.005 m	-0.001 m	-0.551

AB-13 --> AB-14A (PV40)	Az.	102°52'46"	0.407 sec	0.272 sec	1.071
	ΔHt.	3.134 m	0.008 m	0.005 m	0.968
	Ellip Dist.	1671.491 m	0.004 m	0.001 m	0.233
AB-13 --> AB-15 (PV39)	Az.	142°31'23"	0.290 sec	-0.021 sec	-0.107
	ΔHt.	-0.455 m	0.008 m	0.005 m	1.036
	Ellip Dist.	2564.521 m	0.004 m	0.002 m	0.878
AB-5 --> AB-8A (PV83)	Az.	185°05'03"	0.119 sec	0.110 sec	0.757
	ΔHt.	-8.884 m	0.015 m	-0.014 m	-0.841
	Ellip Dist.	9023.321 m	0.005 m	-0.006 m	-1.013
AB-5 --> ILO-31 (PV89)	Az.	341°21'59"	0.071 sec	0.003 sec	0.039
	ΔHt.	19.253 m	0.015 m	0.030 m	0.993
	Ellip Dist.	14020.712 m	0.005 m	0.000 m	0.006
AB-15A --> AB-14A (PV30)	Az.	3°14'59"	0.562 sec	0.393 sec	0.979
	ΔHt.	4.124 m	0.009 m	0.004 m	0.68
	Ellip Dist.	1507.583 m	0.004 m	0.001 m	0.277
AB-6 --> AB-9D. (PV60)	Az.	186°40'20"	0.132 sec	-0.049 sec	-0.362
	ΔHt.	-2.309 m	0.015 m	-0.009 m	-0.609
	Ellip Dist.	8445.524 m	0.005 m	0.005 m	0.961
AB-9C --> AB-13A (PV61)	Az.	197°36'15"	0.087 sec	-0.068 sec	-0.505
	ΔHt.	-8.543 m	0.011 m	-0.013 m	-0.377
	Ellip Dist.	10017.311 m	0.004 m	0.006 m	0.955
IL-391A --> AB-4 (PV115)	Az.	343°01'48"	0.104 sec	-0.038 sec	-0.290
	ΔHt.	12.254 m	0.018 m	-0.020 m	-0.951
	Ellip Dist.	12360.613 m	0.006 m	0.004 m	0.442
AB-13 --> AB-12A (PV38)	Az.	41°27'26"	0.381 sec	-0.225 sec	-0.820
	ΔHt.	1.016 m	0.008 m	-0.004 m	-0.890
	Ellip Dist.	1893.133 m	0.003 m	0.002 m	0.662
IL-391A --> AB-7 (PV97)	Az.	334°51'25"	0.381 sec	0.012 sec	0.046
	ΔHt.	-0.603 m	0.015 m	0.007 m	0.89
	Ellip Dist.	3213.822 m	0.006 m	0.000 m	0.007

AB-9C --> AB-12 (PV69)	Az.	194°16'10"	0.144 sec	0.040 sec	0.255
	ΔHt.	-7.237 m	0.016 m	-0.003 m	-0.198
	Ellip Dist.	8225.615 m	0.004 m	-0.004 m	-0.888
AB-9 --> AB-8 (PV76)	Az.	38°52'30"	0.415 sec	0.164 sec	0.878
	ΔHt.	0.032 m	0.013 m	0.002 m	0.408
	Ellip Dist.	2472.528 m	0.004 m	0.001 m	0.419
AB-14 --> AB-15 (PV32)	Az.	186°03'49"	0.506 sec	0.294 sec	0.736
	ΔHt.	-3.555 m	0.008 m	-0.005 m	-0.853
	Ellip Dist.	1727.017 m	0.004 m	0.001 m	0.431
AB-14A --> AB-15 (PV31)	Az.	182°22'55"	0.519 sec	-0.328 sec	-0.842
	ΔHt.	-3.590 m	0.008 m	0.005 m	0.81
	Ellip Dist.	1664.059 m	0.004 m	0.000 m	0.027
AB-5 --> AB-9C (PV74)	Az.	191°40'45"	0.099 sec	0.121 sec	0.833
	ΔHt.	-7.721 m	0.016 m	-0.011 m	-0.569
	Ellip Dist.	12111.110 m	0.005 m	-0.003 m	-0.432
ILO-66 --> AB-4 (PV117)	Az.	312°59'02"	0.845 sec	-0.014 sec	-0.042
	ΔHt.	-1.131 m	0.011 m	0.004 m	0.833
	Ellip Dist.	949.500 m	0.004 m	-0.001 m	-0.815
AB-13 --> AB-10A (PV42)	Az.	19°44'38"	0.131 sec	-0.030 sec	-0.197
	ΔHt.	9.977 m	0.009 m	-0.007 m	-0.775
	Ellip Dist.	6436.937 m	0.004 m	0.004 m	0.812
AB-5 --> AB-9D. (PV59)	Az.	192°36'40"	0.097 sec	0.115 sec	0.807
	ΔHt.	-7.479 m	0.016 m	-0.009 m	-0.441
	Ellip Dist.	12077.610 m	0.005 m	-0.004 m	-0.576
AB-13 --> AB-14 (PV41)	Az.	100°20'10"	0.382 sec	0.181 sec	0.777
	ΔHt.	3.100 m	0.009 m	0.001 m	0.244
	Ellip Dist.	1771.451 m	0.004 m	0.000 m	-0.045
AB-9C --> AB-13 (PV62)	Az.	198°46'29"	0.075 sec	0.007 sec	0.101
	ΔHt.	-8.564 m	0.010 m	-0.010 m	-0.431
	Ellip Dist.	9958.543 m	0.003 m	-0.002 m	-0.767

AB-6 --> AB-7A (PV114)	Az.	150°00'10"	0.256 sec	-0.098 sec	-0.516
	ΔHt.	-0.202 m	0.011 m	-0.006 m	-0.733
	Ellip Dist.	4082.662 m	0.005 m	0.002 m	0.551
AB-6A --> AB-9 (PV77)	Az.	183°15'50"	0.165 sec	-0.029 sec	-0.128
	ΔHt.	-3.128 m	0.015 m	-0.003 m	-0.177
	Ellip Dist.	7352.584 m	0.005 m	0.004 m	0.702
AB-6 --> AB-9 (PV79)	Az.	184°08'15"	0.149 sec	-0.103 sec	-0.690
	ΔHt.	-3.585 m	0.014 m	-0.021 m	-0.651
	Ellip Dist.	7468.255 m	0.004 m	0.000 m	0.109
AB-13 --> AB-11A (PV45)	Az.	18°19'16"	0.204 sec	-0.114 sec	-0.602
	ΔHt.	1.168 m	0.008 m	-0.004 m	-0.678
	Ellip Dist.	3700.671 m	0.003 m	0.002 m	0.689
AB-9C --> AB-8A (PV81)	Az.	29°53'57"	0.315 sec	-0.034 sec	-0.179
	ΔHt.	-1.163 m	0.014 m	-0.005 m	-0.650
	Ellip Dist.	3313.713 m	0.005 m	-0.002 m	-0.685
AB-5 --> AB-1 (PV20)	Az.	340°15'36"	0.091 sec	0.039 sec	0.253
	ΔHt.	17.999 m	0.016 m	-0.014 m	-0.683
	Ellip Dist.	13699.416 m	0.006 m	0.005 m	0.537
AB-6 --> AB-8A (PV84)	Az.	171°17'40"	0.175 sec	0.041 sec	0.289
	ΔHt.	-3.715 m	0.014 m	0.007 m	0.676
	Ellip Dist.	5654.977 m	0.004 m	0.002 m	0.494
AB-6A --> AB-8 (PV56)	Az.	168°10'53"	0.193 sec	-0.086 sec	-0.366
	ΔHt.	-3.097 m	0.013 m	0.010 m	0.675
	Ellip Dist.	5533.067 m	0.004 m	0.000 m	0.016
AB-15A --> AB-15 (PV33)	Az.	174°05'13"	5.161 sec	1.727 sec	0.634
	ΔHt.	0.535 m	0.009 m	0.001 m	0.182
	Ellip Dist.	158.306 m	0.004 m	-0.001 m	-0.657
AB-13A --> AB-10 (PV51)	Az.	16°54'06"	0.179 sec	-0.298 sec	-0.653
	ΔHt.	9.797 m	0.018 m	0.002 m	0.043
	Ellip Dist.	6554.796 m	0.005 m	-0.007 m	-0.567

AB-11A --> AB-12A (PV36)	Az.	177°32'20"	0.381 sec	-0.024 sec	-0.082
	ΔHt.	-0.151 m	0.008 m	0.004 m	0.652
	Ellip Dist.	2096.208 m	0.004 m	-0.002 m	-0.607
AB-14 --> AB-15A (PV28)	Az.	187°15'38"	0.544 sec	-0.063 sec	-0.158
	ΔHt.	-4.090 m	0.009 m	0.004 m	0.633
	Ellip Dist.	1572.500 m	0.004 m	-0.002 m	-0.568
AB-5 --> AB-1A (PV4)	Az.	340°50'19"	0.091 sec	0.035 sec	0.232
	ΔHt.	17.908 m	0.016 m	-0.012 m	-0.632
	Ellip Dist.	13727.120 m	0.006 m	0.005 m	0.499
AB-11 --> AB-11A (PV18)	Az.	73°26'06"	4.211 sec	-1.295 sec	-0.520
	ΔHt.	-1.262 m	0.008 m	0.003 m	0.626
	Ellip Dist.	160.221 m	0.004 m	0.001 m	0.532
AB-6A --> AB-7A (PV112)	Az.	147°45'56"	0.270 sec	0.054 sec	0.278
	ΔHt.	0.256 m	0.012 m	0.002 m	0.307
	Ellip Dist.	4052.202 m	0.005 m	0.002 m	0.621
AB-13 --> AB-15A (PV47)	Az.	140°34'11"	0.307 sec	0.007 sec	0.031
	ΔHt.	-0.990 m	0.010 m	0.011 m	0.577
	Ellip Dist.	2431.044 m	0.004 m	0.000 m	0.162
AB-8 --> AB-7A (PV111)	Az.	27°20'51"	0.516 sec	-0.163 sec	-0.446
	ΔHt.	3.352 m	0.013 m	-0.005 m	-0.538
	Ellip Dist.	2238.246 m	0.005 m	0.001 m	0.272
AB-5 --> AB-9 (PV78)	Az.	191°26'15"	0.106 sec	0.085 sec	0.537
	ΔHt.	-8.755 m	0.016 m	-0.022 m	-0.506
	Ellip Dist.	11066.479 m	0.004 m	0.000 m	-0.008
AB-10A --> AB-11A (PV26)	Az.	201°40'12"	0.315 sec	-0.134 sec	-0.525
	ΔHt.	-8.809 m	0.008 m	-0.002 m	-0.362
	Ellip Dist.	2738.949 m	0.004 m	0.001 m	0.155
AB-5 --> AB-2 (PV3)	Az.	338°46'15"	0.128 sec	0.080 sec	0.503
	ΔHt.	12.442 m	0.017 m	-0.006 m	-0.351
	Ellip Dist.	10765.549 m	0.007 m	-0.003 m	-0.410

AB-9D. --> AB-9C (PV73)	Az.	111°48'10"	4.218 sec	-0.044 sec	-0.029
	ΔHt.	-0.242 m	0.012 m	0.002 m	0.435
	Ellip Dist.	199.592 m	0.005 m	0.000 m	-0.159
AB-13A --> AB-10A (PV50)	Az.	17°55'48"	0.138 sec	-0.039 sec	-0.257
	ΔHt.	9.955 m	0.009 m	-0.001 m	-0.155
	Ellip Dist.	6493.381 m	0.004 m	0.002 m	0.41
AB-7 --> AB-9C (PV104)	Az.	210°41'03"	0.201 sec	-0.004 sec	-0.016
	ΔHt.	-0.448 m	0.016 m	-0.010 m	-0.409
	Ellip Dist.	5793.080 m	0.005 m	0.001 m	0.117
AB-14 --> AB-14A (PV29)	Az.	244°12'35"	5.887 sec	0.215 sec	0.071
	ΔHt.	0.034 m	0.008 m	0.002 m	0.364
	Ellip Dist.	125.799 m	0.004 m	0.000 m	-0.172
AB-13 --> AB-10 (PV43)	Az.	18°41'23"	0.163 sec	0.022 sec	0.139
	ΔHt.	9.819 m	0.017 m	0.011 m	0.343
	Ellip Dist.	6494.641 m	0.004 m	0.000 m	-0.013
AB-3A --> AB-2A (PV1)	Az.	30°28'36"	0.372 sec	-0.015 sec	-0.069
	ΔHt.	3.755 m	0.020 m	0.004 m	0.331
	Ellip Dist.	4217.997 m	0.006 m	0.001 m	0.268
AB-13A --> AB-12A (PV49)	Az.	35°01'05"	0.403 sec	-0.043 sec	-0.155
	ΔHt.	0.995 m	0.007 m	0.000 m	-0.045
	Ellip Dist.	1878.345 m	0.004 m	0.001 m	0.329
AB-7 --> AB-9D. (PV105)	Az.	212°37'25"	0.196 sec	0.039 sec	0.181
	ΔHt.	-0.206 m	0.016 m	0.002 m	0.094
	Ellip Dist.	5827.214 m	0.005 m	0.002 m	0.298
AB-10A --> AB-12A (PV34)	Az.	191°13'58"	0.189 sec	-0.050 sec	-0.270
	ΔHt.	-8.961 m	0.009 m	-0.002 m	-0.200
	Ellip Dist.	4730.268 m	0.004 m	0.000 m	0.061
AB-13A --> AB-11A (PV52)	Az.	15°12'44"	0.213 sec	-0.013 sec	-0.069
	ΔHt.	1.146 m	0.008 m	-0.001 m	-0.161
	Ellip Dist.	3764.489 m	0.004 m	0.000 m	-0.104
AB-1 --> AB-1A (PV22)	Az.	59°13'32"	6.355 sec	-0.197 sec	-0.073
	ΔHt.	-0.090 m	0.009 m	0.000 m	0.038
	Ellip Dist.	141.193 m	0.004 m	0.000 m	0.022

Annexes

Covariance Terms

From Point	To Point		Components	A-posterio-ri Error	Horiz. Precision (Ratio)	3D Precision (Ratio)
AB-1	ILO-31	**Az.**	20°36'06"	2.206 sec	1 : 106727	1 : 106705
		ΔHt.	1.255 m	0.009 m		
		ΔElev.	1.253 m	0.009 m		
		Ellip Dist.	418.159 m	0.004 m		
AB-10	AB-13	**Az.**	198°41'35"	0.163 sec	1 : 1627102	1 : 1625678
		ΔHt.	-9.819 m	0.017 m		
		ΔElev.	-9.873 m	0.017 m		
		Ellip Dist.	6494.641 m	0.004 m		
AB-10	AB-13A	**Az.**	196°54'17"	0.179 sec	1 : 1417406	1 : 1416229
		ΔHt.	-9.797 m	0.018 m		
		ΔElev.	-9.863 m	0.018 m		
		Ellip Dist.	6554.796 m	0.005 m		
AB-10	AB-9C	**Az.**	18°55'20"	0.306 sec	1 : 874386	1 : 874601
		ΔHt.	-1.255 m	0.018 m		
		ΔElev.	-1.263 m	0.018 m		
		Ellip Dist.	3463.920 m	0.004 m		
AB-10A	AB-12A	**Az.**	191°13'58"	0.189 sec	1 : 1150111	1 : 1149813
		ΔHt.	-8.961 m	0.009 m		
		ΔElev.	-9.021 m	0.009 m		
		Ellip Dist.	4730.268 m	0.004 m		
AB-10A	AB-13	**Az.**	199°44'51"	0.131 sec	1 : 1678926	1 : 1678571
		ΔHt.	-9.977 m	0.009 m		
		ΔElev.	-10.026 m	0.009 m		
		Ellip Dist.	6436.937 m	0.004 m		
AB-10A	AB-13A	**Az.**	197°56'00"	0.138 sec	1 : 1588328	1 : 1587979
		ΔHt.	-9.955 m	0.009 m		
		ΔElev.	-10.015 m	0.009 m		
		Ellip Dist.	6493.381 m	0.004 m		
AB-10A	AB-9C	Az.	16°59'34"	0.252 sec	1 : 886894	1 : 886975
		ΔHt.	-1.413 m	0.010 m		
		ΔElev.	-1.416 m	0.010 m		
		Ellip Dist.	3524.238 m	0.004 m		
AB-11	AB-10	Az.	21°45'27"	0.398 sec	1 : 631517	1 : 630492
		ΔHt.	7.390 m	0.018 m		
		ΔElev.	7.396 m	0.018 m		
		Ellip Dist.	2890.670 m	0.005 m		

AB-11	AB-10A	Az.	24°12'25"	0.297 sec	1 : 722674	1 : 722464
		ΔHt.	7.548 m	0.009 m		
		ΔElev.	7.548 m	0.009 m		
		Ellip Dist.	2840.893 m	0.004 m		
AB-11	AB-11A	Az.	73°26'06"	4.232 sec	1 : 44723	1 : 44734
		ΔHt.	-1.262 m	0.008 m		
		ΔElev.	-1.267 m	0.008 m		
		Ellip Dist.	160.221 m	0.004 m		
AB-11	AB-12A	Az.	173°13'08"	0.371 sec	1 : 586086	1 : 585988
		ΔHt.	-1.413 m	0.008 m		
		ΔElev.	-1.472 m	0.008 m		
		Ellip Dist.	2063.026 m	0.004 m		
AB-11	AB-13	Az.	196°14'15"	0.202 sec	1 : 1092004	1 : 1091845
		ΔHt.	-2.429 m	0.009 m		
		ΔElev.	-2.477 m	0.009 m		
		Ellip Dist.	3611.421 m	0.003 m		
AB-11	AB-13A	Az.	193°05'39"	0.210 sec	1 : 1039707	1 : 1039570
		ΔHt.	-2.408 m	0.008 m		
		ΔElev.	-2.467 m	0.008 m		
		Ellip Dist.	3682.630 m	0.004 m		
AB-11	AB-9C	Az.	20°12'40"	0.134 sec	1 : 1682643	1 : 1682280
		ΔHt.	6.135 m	0.011 m		
		ΔElev.	6.133 m	0.011 m		
		Ellip Dist.	6352.659 m	0.004 m		
AB-11A	AB-10	Az.	19°10'46"	0.415 sec	1 : 615100	1 : 613901
		ΔHt.	8.651 m	0.017 m		
		ΔElev.	8.663 m	0.017 m		
		Ellip Dist.	2794.148 m	0.005 m		
AB-11A	AB-10A	Az.	21°40'06"	0.315 sec	1 : 690948	1 : 690765
		ΔHt.	8.809 m	0.008 m		
		ΔElev.	8.815 m	0.008 m		
		Ellip Dist.	2738.949 m	0.004 m		
AB-11A	AB-12A	Az.	177°32'20"	0.381 sec	1 : 592729	1 : 592733
		ΔHt.	-0.151 m	0.008 m		
		ΔElev.	-0.205 m	0.008 m		
		Ellip Dist.	2096.208 m	0.004 m		
AB-11A	AB-13	Az.	198°19'24"	0.204 sec	1 : 1111323	1 : 1111364
		ΔHt.	-1.168 m	0.008 m		
		ΔElev.	-1.210 m	0.008 m		
		Ellip Dist.	3700.671 m	0.003 m		

AB-11A	AB-13A	Az.	195°12'50"	0.213 sec	1 : 1053061	1 : 1053084
		ΔHt.	-1.146 m	0.008 m		
		ΔElev.	-1.200 m	0.008 m		
		Ellip Dist.	3764.489 m	0.004 m		
AB-11A	AB-9C	Az.	19°02'11"	0.139 sec	1 : 1654589	1 : 1654281
		ΔHt.	7.396 m	0.010 m		
		ΔElev.	7.400 m	0.010 m		
		Ellip Dist.	6258.052 m	0.004 m		
AB-12	AB-10	Az.	10°53'45"	0.260 sec	1 : 1032803	1 : 1032162
		ΔHt.	8.492 m	0.017 m		
		ΔElev.	8.553 m	0.017 m		
		Ellip Dist.	4781.389 m	0.005 m		
AB-12	AB-13	Az.	218°56'52"	0.571 sec	1 : 458368	1 : 458487
		ΔHt.	-1.327 m	0.014 m		
		ΔElev.	-1.320 m	0.014 m		
		Ellip Dist.	1873.298 m	0.004 m		
AB-12	AB-9C	Az.	14°15'58"	0.144 sec	1 : 1819718	1 : 1819234
		ΔHt.	7.237 m	0.016 m		
		ΔElev.	7.290 m	0.016 m		
		Ellip Dist.	8225.615 m	0.005 m		
AB-12A	AB-13	Az.	221°27'34"	0.381 sec	1 : 544438	1 : 544459
		ΔHt.	-1.016 m	0.008 m		
		ΔElev.	-1.005 m	0.008 m		
		Ellip Dist.	1893.133 m	0.003 m		
AB-12A	AB-13A	Az.	215°01'11"	0.403 sec	1 : 519888	1 : 519896
		ΔHt.	-0.995 m	0.007 m		
		ΔElev.	-0.995 m	0.007 m		
		Ellip Dist.	1878.345 m	0.004 m		
AB-12A	AB-9C	Az.	13°41'24"	0.108 sec	1 : 2078622	1 : 2078243
		ΔHt.	7.548 m	0.010 m		
		ΔElev.	7.605 m	0.010 m		
		Ellip Dist.	8244.302 m	0.004 m		
AB-13	AB-13A	Az.	124°15'01"	3.082 sec	1 : 64482	1 : 64478
		ΔHt.	0.021 m	0.007 m		
		ΔElev.	0.010 m	0.007 m		
		Ellip Dist.	212.342 m	0.003 m		
AB-13	AB-9C	Az.	18°46'09"	0.075 sec	1 : 3138108	1 : 3137437
		ΔHt.	8.564 m	0.010 m		
		ΔElev.	8.610 m	0.010 m		
		Ellip Dist.	9958.543 m	0.003 m		

AB-13A	AB-9C	Az.	17°35'57"	0.087 sec	1 : 2604311	1 : 2603822
		ΔHt.	8.543 m	0.011 m		
		ΔElev.	8.600 m	0.011 m		
		Ellip Dist.	10017.311 m	0.004 m		
AB-14	AB-13	Az.	280°20'21"	0.385 sec	1 : 472024	1 : 472102
		ΔHt.	-3.100 m	0.009 m		
		ΔElev.	-3.020 m	0.009 m		
		Ellip Dist.	1771.451 m	0.004 m		
AB-14	AB-14A	Az.	244°12'35"	5.911 sec	1 : 34779	1 : 34784
		ΔHt.	0.034 m	0.008 m		
		ΔElev.	0.037 m	0.008 m		
		Ellip Dist.	125.799 m	0.004 m		
AB-14	AB-15	Az.	186°03'49"	0.506 sec	1 : 462319	1 : 462145
		ΔHt.	-3.555 m	0.008 m		
		ΔElev.	-3.604 m	0.008 m		
		Ellip Dist.	1727.017 m	0.004 m		
AB-14	AB-9C	Az.	8°31'52"	0.102 sec	1 : 2302259	1 : 2301820
		ΔHt.	5.464 m	0.013 m		
		ΔElev.	5.590 m	0.013 m		
		Ellip Dist.	9855.772 m	0.004 m		
AB-14A	AB-13	Az.	282°52'56"	0.409 sec	1 : 442757	1 : 442845
		ΔHt.	-3.134 m	0.008 m		
		ΔElev.	-3.057 m	0.008 m		
		Ellip Dist.	1671.491 m	0.004 m		
AB-14A	AB-15	Az.	182°22'55"	0.518 sec	1 : 443797	1 : 443622
		ΔHt.	-3.590 m	0.008 m		
		ΔElev.	-3.641 m	0.008 m		
		Ellip Dist.	1664.059 m	0.004 m		
AB-14A	AB-9C	Az.	9°07'50"	0.101 sec	1 : 2311269	1 : 2310853
		ΔHt.	5.430 m	0.012 m		
		ΔElev.	5.553 m	0.012 m		
		Ellip Dist.	9927.245 m	0.004 m		
AB-15	AB-13	Az.	322°31'33"	0.290 sec	1 : 655799	1 : 655711
		ΔHt.	0.455 m	0.008 m		
		ΔElev.	0.584 m	0.008 m		
		Ellip Dist.	2564.521 m	0.004 m		
AB-15	AB-9C	Az.	8°09'46"	0.090 sec	1 : 2595604	1 : 2595063
		ΔHt.	9.019 m	0.012 m		
		ΔElev.	9.194 m	0.012 m		
		Ellip Dist.	11581.426 m	0.004 m		

AB-15A	AB-13	Az.	320°34'21"	0.307 sec	1 : 637152	1 : 637054
		ΔHt.	0.990 m	0.010 m		
		ΔElev.	1.112 m	0.010 m		
		Ellip Dist.	2431.044 m	0.004 m		
AB-15A	AB-14	Az.	7°15'37"	0.544 sec	1 : 426408	1 : 426033
		ΔHt.	4.090 m	0.009 m		
		ΔElev.	4.132 m	0.009 m		
		Ellip Dist.	1572.500 m	0.004 m		
AB-15A	AB-14A	Az.	3°14'59"	0.562 sec	1 : 407075	1 : 406694
		ΔHt.	4.124 m	0.009 m		
		ΔElev.	4.170 m	0.009 m		
		Ellip Dist.	1507.583 m	0.004 m		
AB-15A	AB-15	Az.	174°05'13"	5.158 sec	1 : 42639	1 : 42661
		ΔHt.	0.535 m	0.009 m		
		ΔElev.	0.529 m	0.009 m		
		Ellip Dist.	158.306 m	0.004 m		
AB-15A	AB-9C	Az.	8°21'21"	0.090 sec	1 : 2565796	1 : 2564978
		ΔHt.	9.554 m	0.013 m		
		ΔElev.	9.722 m	0.013 m		
		Ellip Dist.	11427.938 m	0.004 m		
AB-1A	AB-1	Az.	239°13'33"	6.378 sec	1 : 33512	1 : 33518
		ΔHt.	0.090 m	0.009 m		
		ΔElev.	0.097 m	0.009 m		
		Ellip Dist.	141.193 m	0.004 m		
AB-1A	AB-2	Az.	168°17'08"	0.390 sec	1 : 558341	1 : 558062
		ΔHt.	-5.466 m	0.011 m		
		ΔElev.	-5.558 m	0.011 m		
		Ellip Dist.	2993.889 m	0.005 m		
AB-1A	AB-5	Az.	160°49'50"	0.091 sec	1 : 2286053	1 : 2285057
		ΔHt.	-17.908 m	0.016 m		
		ΔElev.	-18.313 m	0.016 m		
		Ellip Dist.	13727.120 m	0.006 m		
AB-1A	ILO-31	Az.	4°37'35"	2.851 sec	1 : 80663	1 : 80617
		ΔHt.	1.345 m	0.009 m		
		ΔElev.	1.350 m	0.009 m		
		Ellip Dist.	320.218 m	0.004 m		
AB-2	AB-1	Az.	345°41'40"	0.392 sec	1 : 544579	1 : 544341
		ΔHt.	5.556 m	0.011 m		
		ΔElev.	5.655 m	0.011 m		
		Ellip Dist.	2950.801 m	0.005 m		

AB-2	AB-5	Az.	158°45'50"	0.128 sec	1 : 1618188	1 : 1617493
		ΔHt.	-12.442 m	0.017 m		
		ΔElev.	-12.755 m	0.017 m		
		Ellip Dist.	10765.549 m	0.007 m		
AB-2	ILO-31	Az.	349°51'00"	0.336 sec	1 : 654278	1 : 653948
		ΔHt.	6.811 m	0.011 m		
		ΔElev.	6.908 m	0.011 m		
		Ellip Dist.	3302.401 m	0.005 m		
AB-2A	AB-3A	Az.	210°28'50"	0.372 sec	1 : 685050	1 : 685359
		ΔHt.	-3.755 m	0.020 m		
		ΔElev.	-3.667 m	0.020 m		
		Ellip Dist.	4217.997 m	0.006 m		
AB-2A	AB-4	Az.	165°23'31"	0.176 sec	1 : 1202363	1 : 1201879
		ΔHt.	-4.847 m	0.021 m		
		ΔElev.	-5.060 m	0.021 m		
		Ellip Dist.	8414.421 m	0.007 m		
AB-2A	AB-5	Az.	159°13'32"	0.125 sec	1 : 1640893	1 : 1640010
		ΔHt.	-10.432 m	0.020 m		
		ΔElev.	-10.744 m	0.020 m		
		Ellip Dist.	10884.507 m	0.007 m		
AB-2A	ILO-31	Az.	348°42'23"	0.389 sec	1 : 553866	1 : 553341
		ΔHt.	8.821 m	0.018 m		
		ΔElev.	8.919 m	0.018 m		
		Ellip Dist.	3169.776 m	0.006 m		
AB-3	AB-5	Az.	136°33'17"	0.176 sec	1 : 1171322	1 : 1170715
		ΔHt.	-15.019 m	0.016 m		
		ΔElev.	-15.422 m	0.016 m		
		Ellip Dist.	8819.212 m	0.008 m		
AB-3	AB-5A	Az.	136°04'44"	0.181 sec	1 : 1140992	1 : 1140382
		ΔHt.	-14.740 m	0.017 m		
		ΔElev.	-15.150 m	0.017 m		
		Ellip Dist.	8941.496 m	0.008 m		
AB-3	ILO-31	Az.	12°56'57"	0.228 sec	1 : 949293	1 : 949203
		ΔHt.	4.234 m	0.017 m		
		ΔElev.	4.241 m	0.017 m		
		Ellip Dist.	7061.508 m	0.007 m		
AB-3A	AB-4	Az.	136°36'02"	0.197 sec	1 : 879464	1 : 879235
		ΔHt.	-1.092 m	0.018 m		
		ΔElev.	-1.393 m	0.018 m		
		Ellip Dist.	6203.101 m	0.007 m		

AB-3A	AB-5	Az.	137°28'08"	0.134 sec	1 : 1313554	1 : 1312925
		ΔHt.	-6.677 m	0.018 m		
		ΔElev.	-7.077 m	0.018 m		
		Ellip Dist.	8876.758 m	0.007 m		
AB-3A	ILO-31	Az.	12°41'20"	0.206 sec	1 : 1256436	1 : 1256259
		ΔHt.	12.577 m	0.018 m		
		ΔElev.	12.586 m	0.018 m		
		Ellip Dist.	6912.396 m	0.006 m		
AB-4	IL-391A	Az.	163°01'25"	0.104 sec	1 : 2001363	1 : 2000089
		ΔHt.	-12.254 m	0.018 m		
		ΔElev.	-12.410 m	0.018 m		
		Ellip Dist.	12360.613 m	0.006 m		
AB-4	ILO-31	Az.	346°18'09"	0.103 sec	1 : 2087640	1 : 2086344
		ΔHt.	13.669 m	0.017 m		
		ΔElev.	13.979 m	0.017 m		
		Ellip Dist.	11580.345 m	0.006 m		
AB-4	ILO-66	Az.	132°58'57"	0.847 sec	1 : 223950	1 : 224137
		ΔHt.	1.131 m	0.011 m		
		ΔElev.	1.089 m	0.011 m		
		Ellip Dist.	949.500 m	0.004 m		
AB-4A	ILO-31	Az.	345°39'18"	0.106 sec	1 : 1954931	1 : 1952966
		ΔHt.	13.644 m	0.026 m		
		ΔElev.	13.960 m	0.026 m		
		Ellip Dist.	11495.722 m	0.006 m		
AB-5	AB-1	Az.	340°15'36"	0.091 sec	1 : 2275684	1 : 2274825
		ΔHt.	17.999 m	0.016 m		
		ΔElev.	18.410 m	0.016 m		
		Ellip Dist.	13699.416 m	0.006 m		
AB-5	AB-4	Az.	319°29'33"	0.300 sec	1 : 632215	1 : 631317
		ΔHt.	5.584 m	0.011 m		
		ΔElev.	5.684 m	0.011 m		
		Ellip Dist.	2676.021 m	0.004 m		
AB-5	AB-4A	Az.	322°46'30"	0.311 sec	1 : 630959	1 : 629366
		ΔHt.	5.609 m	0.023 m		
		ΔElev.	5.703 m	0.023 m		
		Ellip Dist.	2698.010 m	0.004 m		
AB-5	AB-5A	Az.	105°14'26"	5.226 sec	1 : 38876	1 : 38903
		ΔHt.	0.279 m	0.009 m		
		ΔElev.	0.272 m	0.009 m		
		Ellip Dist.	142.789 m	0.004 m		

AB-5	AB-6	Az.	205°58'21"	0.168 sec	1 : 1434267	1 : 1433312
		ΔHt.	-5.170 m	0.011 m		
		ΔElev.	-5.075 m	0.011 m		
		Ellip Dist.	3779.683 m	0.003 m		
AB-5	AB-6A	Az.	206°51'28"	0.210 sec	1 : 1107526	1 : 1106743
		ΔHt.	-5.627 m	0.013 m		
		ΔElev.	-5.526 m	0.013 m		
		Ellip Dist.	3930.007 m	0.004 m		
AB-5	AB-7	Az.	175°48'17"	0.124 sec	1 : 1870432	1 : 1869287
		ΔHt.	-7.273 m	0.013 m		
		ΔElev.	-7.274 m	0.013 m		
		Ellip Dist.	6896.803 m	0.004 m		
AB-5	AB-7A	Az.	176°48'58"	0.164 sec	1 : 1494385	1 : 1493706
		ΔHt.	-5.372 m	0.014 m		
		ΔElev.	-5.367 m	0.014 m		
		Ellip Dist.	6944.556 m	0.005 m		
AB-5	AB-8	Az.	184°07'09"	0.117 sec	1 : 2239459	1 : 2237931
		ΔHt.	-8.724 m	0.014 m		
		ΔElev.	-8.674 m	0.014 m		
		Ellip Dist.	8945.018 m	0.004 m		
AB-5	AB-8A	Az.	185°05'03"	0.118 sec	1 : 1963584	1 : 1963101
		ΔHt.	-8.884 m	0.015 m		
		ΔElev.	-8.827 m	0.015 m		
		Ellip Dist.	9023.321 m	0.005 m		
AB-5	AB-9	Az.	191°26'15"	0.106 sec	1 : 2549362	1 : 2548005
		ΔHt.	-8.755 m	0.016 m		
		ΔElev.	-8.646 m	0.016 m		
		Ellip Dist.	11066.479 m	0.004 m		
AB-5	AB-9C	Az.	191°40'45"	0.099 sec	1 : 2349273	1 : 2348903
		ΔHt.	-7.721 m	0.016 m		
		ΔElev.	-7.608 m	0.016 m		
		Ellip Dist.	12111.110 m	0.005 m		
AB-5	AB-9D.	Az.	192°36'40"	0.097 sec	1 : 2385945	1 : 2385596
		ΔHt.	-7.479 m	0.016 m		
		ΔElev.	-7.357 m	0.016 m		
		Ellip Dist.	12077.610 m	0.005 m		
AB-5	IL-391A	Az.	169°10'57"	0.120 sec	1 : 1805619	1 : 1804838
		ΔHt.	-6.670 m	0.016 m		
		ΔElev.	-6.726 m	0.016 m		
		Ellip Dist.	9964.633 m	0.006 m		

AB-5	ILO-31	Az.	341°21'59"	0.071 sec	1 : 2975843	1 : 2974113
		ΔHt.	19.253 m	0.015 m		
		ΔElev.	19.663 m	0.015 m		
		Ellip Dist.	14020.712 m	0.005 m		
AB-5	ILO-66	Az.	323°02'47"	0.459 sec	1 : 443363	1 : 442507
		ΔHt.	6.715 m	0.010 m		
		ΔElev.	6.773 m	0.010 m		
		Ellip Dist.	1735.976 m	0.004 m		
AB-5A	AB-4A	Az.	321°00'10"	0.305 sec	1 : 645085	1 : 643667
		ΔHt.	5.330 m	0.023 m		
		ΔElev.	5.431 m	0.023 m		
		Ellip Dist.	2812.586 m	0.004 m		
AB-5A	ILO-31	Az.	340°53'06"	0.082 sec	1 : 2538345	1 : 2536881
		ΔHt.	18.974 m	0.017 m		
		ΔElev.	19.391 m	0.017 m		
		Ellip Dist.	14100.797 m	0.006 m		
AB-6	AB-6A	Az.	228°01'41"	4.347 sec	1 : 49134	1 : 49094
		ΔHt.	-0.457 m	0.008 m		
		ΔElev.	-0.451 m	0.008 m		
		Ellip Dist.	161.690 m	0.003 m		
AB-6	AB-7	Az.	148°10'29"	0.176 sec	1 : 1101168	1 : 1100770
		ΔHt.	-2.103 m	0.011 m		
		ΔElev.	-2.199 m	0.011 m		
		Ellip Dist.	4096.068 m	0.004 m		
AB-6	AB-7A	Az.	150°00'10"	0.256 sec	1 : 900585	1 : 900416
		ΔHt.	-0.202 m	0.011 m		
		ΔElev.	-0.292 m	0.011 m		
		Ellip Dist.	4082.662 m	0.005 m		
AB-6	AB-8	Az.	169°36'30"	0.170 sec	1 : 1458202	1 : 1457453
		ΔHt.	-3.554 m	0.012 m		
		ΔElev.	-3.599 m	0.012 m		
		Ellip Dist.	5616.028 m	0.004 m		
AB-6	AB-8A	Az.	171°17'40"	0.175 sec	1 : 1274537	1 : 1274199
		ΔHt.	-3.715 m	0.014 m		
		ΔElev.	-3.753 m	0.014 m		
		Ellip Dist.	5654.977 m	0.004 m		
AB-6	AB-9	Az.	184°08'15"	0.149 sec	1 : 1833517	1 : 1832792
		ΔHt.	-3.585 m	0.014 m		
		ΔElev.	-3.571 m	0.014 m		
		Ellip Dist.	7468.255 m	0.004 m		

AB-6	AB-9C	Az.	185°22'24"	0.134 sec	1 : 1717557	1 : 1717356
		ΔHt.	-2.551 m	0.015 m		
		ΔElev.	-2.534 m	0.015 m		
		Ellip Dist.	8499.812 m	0.005 m		
AB-6	AB-9D.	Az.	186°40'20"	0.132 sec	1 : 1741074	1 : 1740884
		ΔHt.	-2.309 m	0.015 m		
		ΔElev.	-2.282 m	0.015 m		
		Ellip Dist.	8445.524 m	0.005 m		
AB-6	IL-391A	Az.	151°06'34"	0.164 sec	1 : 1251887	1 : 1251654
		ΔHt.	-1.500 m	0.016 m		
		ΔElev.	-1.651 m	0.016 m		
		Ellip Dist.	7297.668 m	0.006 m		
AB-6	ILO-66	Az.	7°16'53"	0.199 sec	1 : 1148846	1 : 1147967
		ΔHt.	11.885 m	0.012 m		
		ΔElev.	11.848 m	0.012 m		
		Ellip Dist.	4824.138 m	0.004 m		
AB-6A	AB-7A	Az.	147°45'56"	0.271 sec	1 : 844921	1 : 844788
		ΔHt.	0.256 m	0.012 m		
		ΔElev.	0.159 m	0.012 m		
		Ellip Dist.	4052.202 m	0.005 m		
AB-6A	AB-8	Az.	168°10'53"	0.193 sec	1 : 1276189	1 : 1275623
		ΔHt.	-3.097 m	0.013 m		
		ΔElev.	-3.148 m	0.013 m		
		Ellip Dist.	5533.067 m	0.004 m		
AB-6A	AB-9	Az.	183°15'50"	0.164 sec	1 : 1616825	1 : 1616305
		ΔHt.	-3.128 m	0.015 m		
		ΔElev.	-3.120 m	0.015 m		
		Ellip Dist.	7352.584 m	0.005 m		
AB-7	AB-8A	Az.	211°43'36"	0.410 sec	1 : 563375	1 : 563472
		ΔHt.	-1.611 m	0.014 m		
		ΔElev.	-1.554 m	0.014 m		
		Ellip Dist.	2480.084 m	0.004 m		
AB-7	IL-391A	Az.	154°51'17"	0.381 sec	1 : 542506	1 : 542496
		ΔHt.	0.603 m	0.015 m		
		ΔElev.	0.548 m	0.015 m		
		Ellip Dist.	3213.822 m	0.006 m		
AB-8	AB-7	Az.	29°18'17"	0.469 sec	1 : 580186	1 : 580168
		ΔHt.	1.451 m	0.013 m		
		ΔElev.	1.400 m	0.013 m		
		Ellip Dist.	2343.507 m	0.004 m		

AB-8	AB-7A	Az.	27°20'51"	0.516 sec	1 : 449223	1 : 448799
		ΔHt.	3.352 m	0.013 m		
		ΔElev.	3.307 m	0.013 m		
		Ellip Dist.	2238.246 m	0.005 m		
AB-8	AB-9	Az.	218°52'40"	0.415 sec	1 : 597403	1 : 597582
		ΔHt.	-0.032 m	0.013 m		
		ΔElev.	0.028 m	0.013 m		
		Ellip Dist.	2472.528 m	0.004 m		
AB-9	AB-7	Az.	34°13'01"	0.250 sec	1 : 1045745	1 : 1045894
		ΔHt.	1.482 m	0.015 m		
		ΔElev.	1.372 m	0.015 m		
		Ellip Dist.	4799.251 m	0.005 m		
AB-9	AB-7A	Az.	33°23'51"	0.264 sec	1 : 853585	1 : 853336
		ΔHt.	3.384 m	0.015 m		
		ΔElev.	3.279 m	0.015 m		
		Ellip Dist.	4687.005 m	0.005 m		
AB-9C	AB-7	Az.	30°40'45"	0.202 sec	1 : 1127800	1 : 1127877
		ΔHt.	0.448 m	0.016 m		
		ΔElev.	0.334 m	0.016 m		
		Ellip Dist.	5793.080 m	0.005 m		
AB-9C	AB-8A	Az.	29°53'57"	0.315 sec	1 : 712595	1 : 712648
		ΔHt.	-1.163 m	0.014 m		
		ΔElev.	-1.219 m	0.014 m		
		Ellip Dist.	3313.713 m	0.005 m		
AB-9D.	AB-7	Az.	32°37'06"	0.196 sec	1 : 1158832	1 : 1158915
		ΔHt.	0.206 m	0.016 m		
		ΔElev.	0.083 m	0.016 m		
		Ellip Dist.	5827.214 m	0.005 m		
AB-9D.	AB-8A	Az.	33°16'58"	0.303 sec	1 : 736146	1 : 736187
		ΔHt.	-1.406 m	0.013 m		
		ΔElev.	-1.470 m	0.013 m		
		Ellip Dist.	3347.659 m	0.005 m		
AB-9D.	AB-9C	Az.	111°48'10"	4.238 sec	1 : 43930	1 : 43913
		ΔHt.	-0.242 m	0.012 m		
		ΔElev.	-0.251 m	0.012 m		
		Ellip Dist.	199.592 m	0.005 m		
ILO-66	AB-7	Az.	169°23'23"	0.128 sec	1 : 1738308	1 : 1737099
		ΔHt.	-13.989 m	0.014 m		
		ΔElev.	-14.047 m	0.014 m		
		Ellip Dist.	8409.313 m	0.005 m		

Annexes

ILO-66	IL-391A	Az.	165°23'02"	0.104 sec	1 : 2090673	1 : 2089309
		ΔHt.	-13.386 m	0.017 m		
		ΔElev.	-13.499 m	0.017 m		
		Ellip Dist.	11548.450 m	0.006 m		

Date: 10/1/2013 7:17:03 PM	Project: D:\JALAUR NEW.vce	Spectra Precision Survey Office

Baseline Processing Report

Session Details
ILO-31 - AB-3A (12:55:00 PM-2:53:15 PM) (S92)

Baseline Observation:	ILO-31 --- AB-3A (B92)
Processed:	10/1/2013 7:03:13 PM
Solution Type:	Fixed
Frequency used:	L1 only
Horizontal Precision:	0.006 m
Vertical Precision:	0.013 m
RMS:	0.016 m
Ratio:	2.396
Maximum PDOP:	2.695
Ephemeris used:	Broadcast
Antenna Model:	No phase table corrections applied.
Processing Start Time:	4/29/2013 12:55:00 PM (Local: UTC+8hr)
Processing Stop Time:	4/29/2013 2:53:15 PM (Local: UTC+8hr)
Processing Duration:	01:58:15

Vector Components (Mark to Mark)

From:	ILO-31				
Grid		**Local**		**Global**	
Easting	460887.040 m	**Latitude**	N11°06'19.18490"	**Latitude**	N11°06'19.18490"
Northing	1227649.313 m	**Longitude**	E122°38'30.62714"	**Longitude**	E122°38'30.62714"
Elevation	71.796 m	**Height**	129.926 m	**Height**	129.926 m

To:	AB-3A				
Grid		**Local**		**Global**	
Easting	459360.857 m	**Latitude**	N11°02'39.71561"	**Latitude**	N11°02'39.71561"
Northing	1220910.226 m	**Longitude**	E122°37'40.59378"	**Longitude**	E122°37'40.59378"
Elevation	59.227 m	**Height**	117.367 m	**Height**	117.367 m

Annexes

Vector:					
DEasting	-1526.184 m	**NS Fwd Azimuth**	192°41'30"	**DX**	586.861 m
DNorthing	-6739.087 m	**Ellipsoid Dist.**	6912.371	**DY**	1899.428 m
DElevation	-12.569 m	**DHeight**	-12.559	**DZ**	-6620.472 m

Standard Errors

Vector Errors:					
s DEasting	0.003 m	**s NS Fwd Azimuth**	0°00'00"	**s DX**	0.004 m
s DNorthing	0.002 m	**s Ellipsoid Dist.**	0.002 m	**s DY**	0.006 m
s DElevation	0.007 m	**s DHeight**	0.007 m	**s DZ**	0.002 m

Aposteriori Covariance Matrix (Meter²)

	X	Y	Z
X	0.0000145959		
Y	-0.0000146766	0.0000329775	
Z	-0.0000028838	0.0000073400	0.0000060103

Occupations

	From	**To**
Point ID:	ILO-31	AB-3A
Data File:	D:\JALAUR NEW\ILO-31.13O	D:\JALAUR NEW\AB-3A.13O
Receiver Type:	Rogue	Rogue
Receiver Serial Number:		
Antenna Type:	Unknown External	Unknown External
Antenna Serial Number:	--------	--------
Antenna Height (Measured):	1.479 m	1.414 m
Antenna Method:	Antenna Phase Center	Antenna Phase Center

Tracking Summary

Processing Style

Elevation Mask:	10.0 deg
Auto Start Processing:	Yes
Start Automatic ID Numbering:	AUTO0001
Continuous Vectors:	No
Generate Residuals:	Yes
Antenna Model:	Automatic
Ephemeris Type:	Automatic
Frequency:	Multiple Frequencies
Force Float:	No

Acceptance Criteria

Vector Component	Flag	Fail
Horizontal Precision >	0.050 m + 1.000 ppm	0.100 m + 1.000 ppm
Vertical Precision >	0.100 m + 1.000 ppm	0.200 m + 1.000 ppm

Ground Control Points

APPENDIX 2

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS	DESIGNATION: AB-1 PAGE:
THE POINT IS MEASURED AND PERMANENTLY MARKED IN 2013	GEOGRAPHIC COORDINATES (WGS '84) Φ = 11°06'06.23643" N λ = 122°38'25.78880" E
ELEVATION OF NETWORK from to by order levelling	COORDINATES x = 460739.788 y = 1227251.780 ELEVATION= 38.397 m (MSL)

CONTROL POINT / BENCH MARK

ISLAND:	PANAY	**~~CITY~~ / MUNICIPALITY:**	PASSI
PROVINCE:	ILOILO	**BARANGAY:**	-

The Station is located along national road, it is approximately 2.0 meters northeast of Jalaur Bridge located at Passi City.

Station is cement putty centered by concrete nail with inscriptions "2013-AB-1".

SURVEYED / DESCRIBED BY: AB SURVEYING	**DATE STABLISHED:** MAY 2013

SKETCH

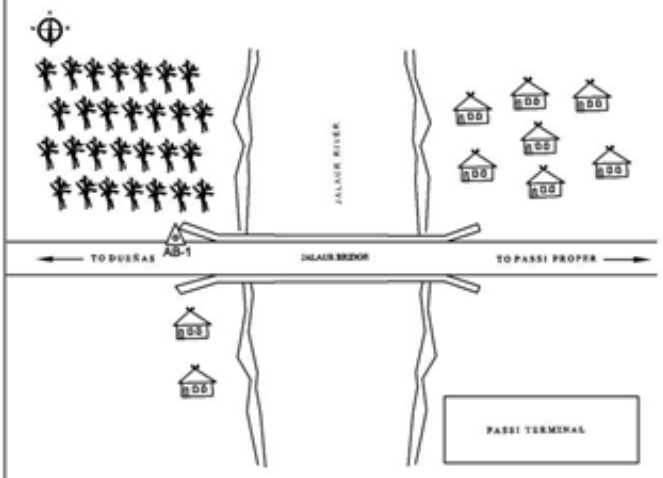


PHOTO / SKETCH

Figure 156: Sketch and description of established control point AB-1

APPENDIX 2

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS	**DESIGNATION:** AB-1A **PAGE:**
THE POINT IS MEASURED AND PERMANENTLY MARKED IN 2013	GEOGRAPHIC COORDINATES (WGS '84) Φ = 11°06'08.58758" N λ = 122°38'29.78621" E
ELEVATION OF NETWORK from to by order levelling	COORDINATES x = 460861.138 y = 1227323.849 ELEVATION= 38.302 m (MSL)

CONTROL POINT / BENCH MARK

ISLAND:	PANAY	**~~CITY~~ / MUNICIPALITY:**	PASSI
PROVINCE:	ILOILO	**BARANGAY:**	-

The Station is located along national road, it is approximately 2.0 meters northeast of Jalaur Bridge located at Passi City.

Station is cement putty centered by concrete nail with inscriptions "2013-AB-1A".

SURVEYED / DESCRIBED BY: AB SURVEYING	**DATE STABLISHED:** MAY 2013

SKETCH

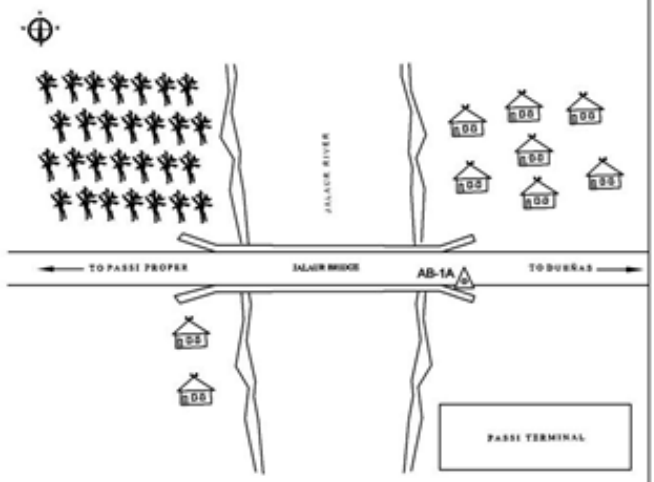


PHOTO / SKETCH

Figure 157: Sketch and description of established control point AB-1A

APPENDIX 2

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS	**DESIGNATION:** AB-2 **PAGE:**
THE POINT IS MEASURED AND PERMANENTLY MARKED IN 2013	GEOGRAPHIC COORDINATES (WGS '84) Φ = 11°04'33.18012" N λ = 122°38'49.81451" E
ELEVATION OF NETWORK from to by order levelling	COORDINATES x = 461465.237 y = 1224392.708 ELEVATION= 32.769 m (MSL)

CONTROL POINT / BENCH MARK

ISLAND: PANAY	**~~CITY~~ / MUNICIPALITY:** SAN ENRIQUE
PROVINCE: ILOILO	**BARANGAY:** CAMIRI

The Station is located along the river, it is approximately 5.0 meters northeast of the edge of Jalaur River.

Station is cement putty centered by concrete nail with inscriptions "2013-AB-2".

SURVEYED / DESCRIBED BY: AB SURVEYING **DATE STABLISHED:** MAY 2013

SKETCH

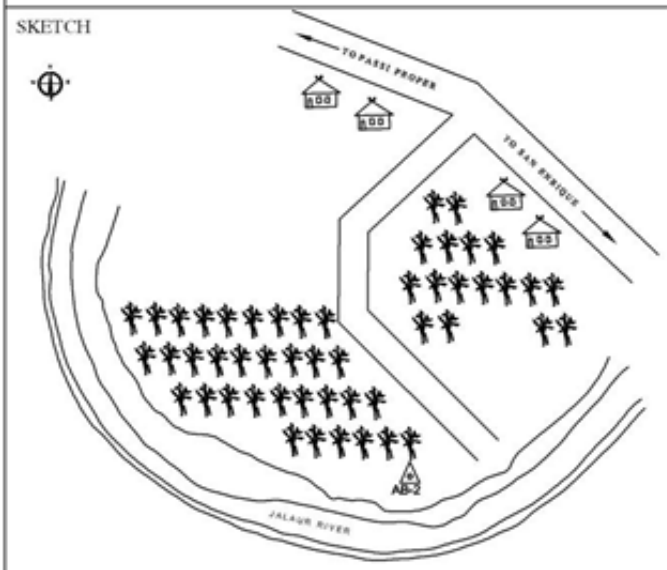


PHOTO / SKETCH

Figure 158: Sketch and description of established control point AB-2

APPENDIX 2

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS	**DESIGNATION:** AB-2A **PAGE:**
THE POINT IS MEASURED AND PERMANENTLY MARKED IN 2013	GEOGRAPHIC COORDINATES (WGS '84) Φ = 11°04'37.81184" N λ = 122°38'51.09267" E
ELEVATION OF NETWORK from to by order levelling	COORDINATES x = 461504.182 y = 1224534.924 ELEVATION= 30.762 m (MSL)

CONTROL POINT / BENCH MARK

ISLAND:	PANAY	**~~CITY~~ / MUNICIPALITY:**	SAN ENRIQUE
PROVINCE:	ILOILO	**BARANGAY:**	CAMIRI

The Station is located along the river, it is approximately 105.0 meters northwest of the edge of Jalaur River.

Station is cement putty centered by concrete nail with inscriptions "2013-AB-2A".

SURVEYED / DESCRIBED BY: AB SURVEYING **DATE STABLISHED:** MAY 2013

SKETCH

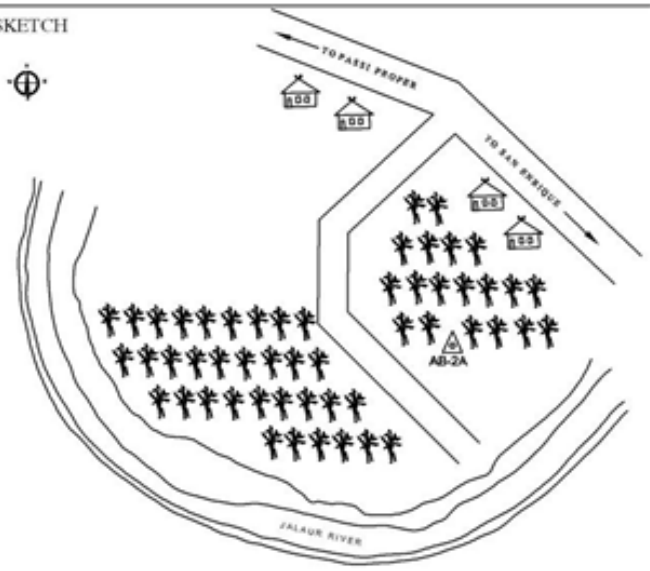


PHOTO / SKETCH

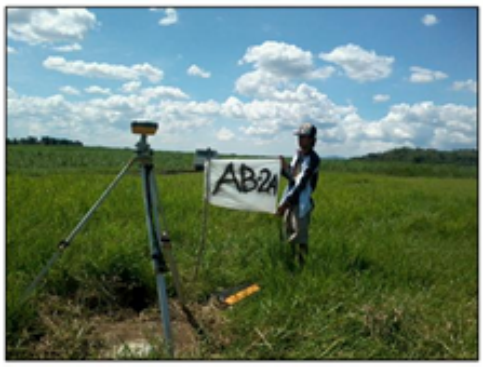


Figure 159: Sketch and description of established control point AB-2A

APPENDIX 2

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS	**DESIGNATION:** AB-3 **PAGE:**
THE POINT IS MEASURED AND PERMANENTLY MARKED IN 2013	GEOGRAPHIC COORDINATES (WGS '84) Φ = 11°02'35.00240" N λ = 122°37'38.49406" E
ELEVATION OF NETWORK from to by order levelling	COORDINATES x = 459296.967 y = 1220765.540 ELEVATION= 35.405 m (MSL)

CONTROL POINT / BENCH MARK

ISLAND:	PANAY	**~~CITY~~ / MUNICIPALITY:**	SAN ENRIQUE
PROVINCE:	ILOILO	**BARANGAY:**	LUREA

The Station is located along the river, it is approximately 45.0 meters southeast of the edge of Jalaur River.

Station is cement putty centered by concrete nail with inscriptions "2013-AB-3".

SURVEYED / DESCRIBED BY: AB SURVEYING	**DATE STABLISHED:** MAY 2013

SKETCH

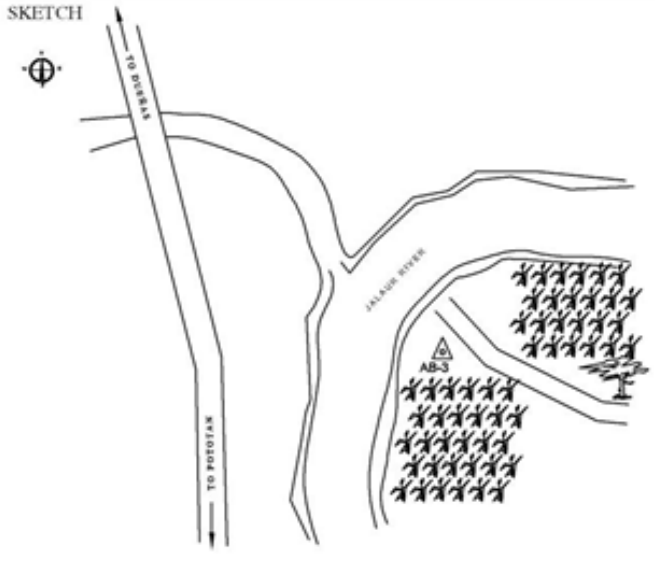


PHOTO / SKETCH

Figure 160: Sketch and description of established control point AB-3

APPENDIX 2

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS	**DESIGNATION:** AB-3A **PAGE:**
THE POINT IS MEASURED AND PERMANENTLY MARKED IN 2013	GEOGRAPHIC COORDINATES (WGS '84) Φ = 11°02'39.50497" N λ = 122°37'40.60373" E
ELEVATION OF NETWORK from to by order levelling	COORDINATES x = 459361.151 y = 1220903.756 ELEVATION= 27.062 m (MSL)

CONTROL POINT / BENCH MARK

ISLAND:	PANAY	**~~CITY~~ / MUNICIPALITY:**	SAN ENRIQUE
PROVINCE:	ILOILO	**BARANGAY:**	LUREA

The Station is located along the river, it is approximately 4.0 meters southwest of the edge of Jalaur River.

Station is cement putty centered by concrete nail with inscriptions "2013-AB-3A".

SURVEYED / DESCRIBED BY: AB SURVEYING **DATE STABLISHED:** MAY 2013

SKETCH

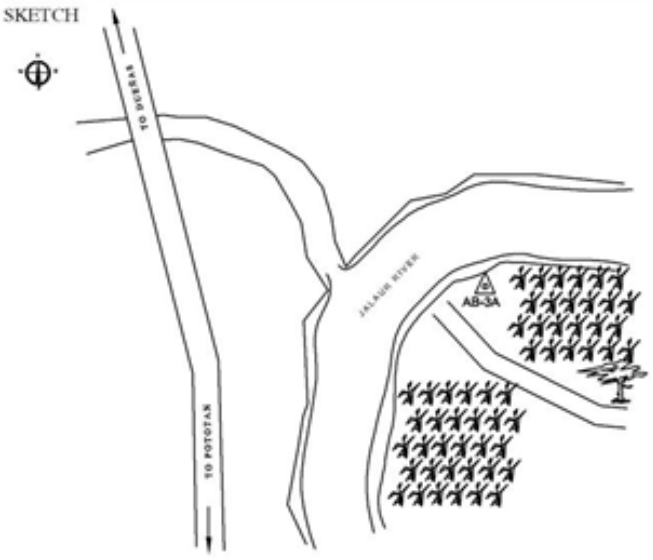


PHOTO / SKETCH

Figure 161: Sketch and description of established control point AB-3A

APPENDIX 2

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS	**DESIGNATION:** AB-4=DLE=1 **PAGE:**
THE POINT IS MEASURED AND PERMANENTLY MARKED IN 2013	GEOGRAPHIC COORDINATES (WGS '84) Φ = 11°00'12.81235" N λ = 122°40'00.99919" E
ELEVATION OF NETWORK from to by order levelling	COORDINATES x = 463615.952 y = 1216393.137 ELEVATION= 25.696 m (MSL)

CONTROL POINT / BENCH MARK

ISLAND:	PANAY	**~~CITY~~ / MUNICIPALITY:**	POTOTAN
PROVINCE:	ILOILO	**BARANGAY:**	-

The Station is located along national road, it is approximately 1.0 meter southeast of Dingle Bridge.

Station is cement putty centered by concrete nail with inscriptions "2013-AB-4=DEL=1".

SURVEYED / DESCRIBED BY: AB SURVEYING	**DATE STABLISHED:** MAY 2013

SKETCH

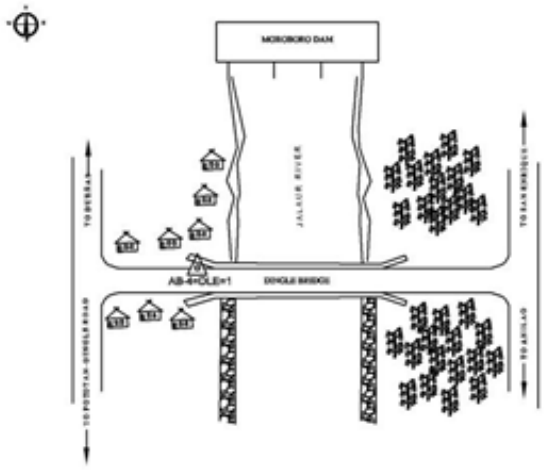


PHOTO / SKETCH

Figure 162: Sketch and description of established control point AB-4 = DEL=1

APPENDIX 2

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS	**DESIGNATION:** AB-4A **PAGE:**
THE POINT IS MEASURED AND PERMANENTLY MARKED IN 2013	GEOGRAPHIC COORDINATES (WGS '84) Φ = 11°00'16.51287" N λ = 122°40'04.49235" E
ELEVATION OF NETWORK from to by order levelling	COORDINATES x = 463722.080 y = 1216506.679 ELEVATION= 25.718 m (MSL)

CONTROL POINT / BENCH MARK

ISLAND:	PANAY	**~~CITY~~ / MUNICIPALITY:**	POTOTAN
PROVINCE:	ILOILO	**BARANGAY:**	-

The Station is located along national road, it is approximately 1.0 meter southeast of Dingle Bridge.

Station is cement putty centered by concrete nail with inscriptions "2013-AB-4A".

SURVEYED / DESCRIBED BY: AB SURVEYING	**DATE STABLISHED:** MAY 2013

SKETCH

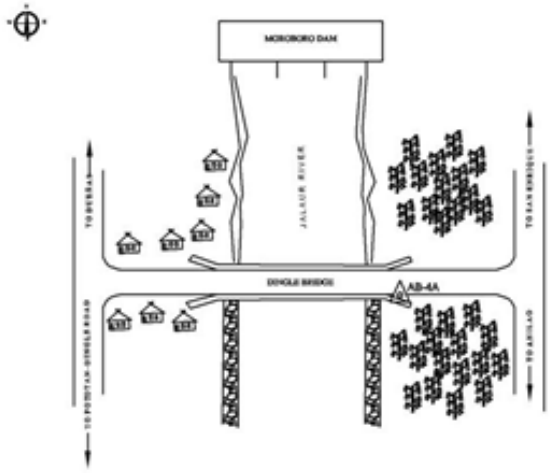


PHOTO / SKETCH

Figure 163: Sketch and description of established control point AB-4A

APPENDIX 2

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS	**DESIGNATION:** AB-5A **PAGE:**
THE POINT IS MEASURED AND PERMANENTLY MARKED IN 2013	GEOGRAPHIC COORDINATES (WGS '84) Φ = 10°59'05.37413" N λ = 122°41'02.79515" E
ELEVATION OF NETWORK from to by order levelling	COORDINATES x = 465489.010 y = 1214319.782 ELEVATION= 20.264 m (MSL)

CONTROL POINT / BENCH MARK

ISLAND:	PANAY	**~~CITY~~ / MUNICIPALITY:**	DINGLE
PROVINCE:	ILOILO	**BARANGAY:**	SANIBA-AN SITIO SIBUCAO

The Station is located along the river, it is approximately 5.0 meters southwest of the edge of Jalaur River.

Station is cement putty centered by concrete nail with inscriptions "2013-AB-5A".

SURVEYED / DESCRIBED BY: AB SURVEYING	**DATE STABLISHED:** MAY 2013

SKETCH

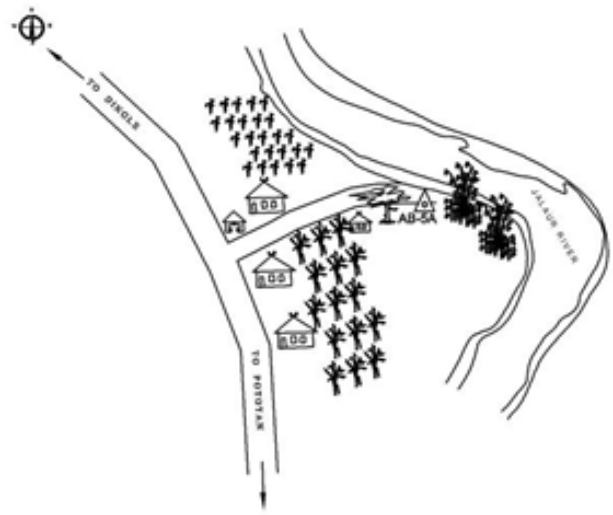


PHOTO / SKETCH

Figure 164: Sketch and description of established control point AB-5A

APPENDIX 2

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS	**DESIGNATION:** AB-5 **PAGE:**
THE POINT IS MEASURED AND PERMANENTLY MARKED IN 2013	GEOGRAPHIC COORDINATES (WGS '84) Φ = 10°59'06.59576" N λ = 122°40'58.25724" E
ELEVATION OF NETWORK from to by order levelling	COORDINATES x = 465351.335 y = 1214357.449 ELEVATION= 19.993 m (MSL)

CONTROL POINT / BENCH MARK

ISLAND:	PANAY	**~~CITY~~ / MUNICIPALITY:**	DINGLE
PROVINCE:	ILOILO	**BARANGAY:**	SANIBA-AN SITIO SIBUCAO

The Station is located along the river, it is approximately 27.0 meters southwest of the edge of Jalaur River.

Station is cement putty centered by concrete nail with inscriptions "2013-AB-5".

SURVEYED / DESCRIBED BY: AB SURVEYING	**DATE STABLISHED:** MAY 2013

SKETCH

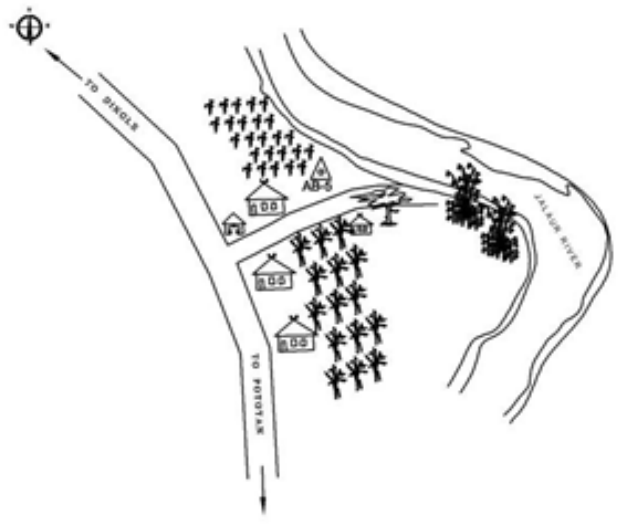


PHOTO / SKETCH

Figure 165: Sketch and description of established control point AB-5

APPENDIX 2

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS	**DESIGNATION:** AB-6A **PAGE:**
THE POINT IS MEASURED AND PERMANENTLY MARKED IN 2013	GEOGRAPHIC COORDINATES (WGS '84) Φ = 10°57'12.48734" N λ = 122°39'59.78045" E
ELEVATION OF NETWORK	COORDINATES x = 463572.831 y = 1210854.592
from to by order levelling	ELEVATION= 14.414 m (MSL)

CONTROL POINT / BENCH MARK

ISLAND:	PANAY	**~~CITY~~ / MUNICIPALITY:**	POTOTAN
PROVINCE:	ILOILO	**BARANGAY:**	

The Station is located along the river, it is approximately 1.0 meter northwest of the edge of Jalaur River.

Station is cement putty centered by concrete nail with inscriptions "2013-AB-6A".

SURVEYED / DESCRIBED BY: AB SURVEYING	**DATE STABLISHED:** MAY 2013

SKETCH

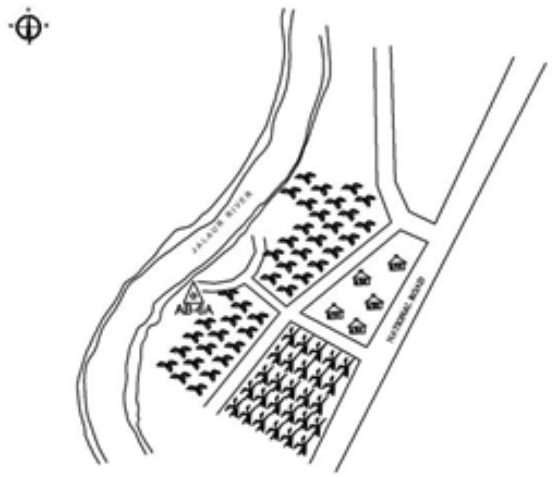


PHOTO / SKETCH

Figure 166: Sketch and description of established control point AB-6A

APPENDIX 2

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS	**DESIGNATION:** AB-6 **PAGE:**
THE POINT IS MEASURED AND PERMANENTLY MARKED IN 2013	GEOGRAPHIC COORDINATES (WGS '84) Φ = 10°57'16.00659" N λ = 122°40'03.73970" E
ELEVATION OF NETWORK from to by order levelling	COORDINATES x = 463693.116 y = 1210962.551 ELEVATION= 14.866 m (MSL)

CONTROL POINT / BENCH MARK

ISLAND:	PANAY	**~~CITY~~ / MUNICIPALITY:**	POTOTAN
PROVINCE:	ILOILO	**BARANGAY:**	-

The Station is located along the river, it is approximately 5.0 meters southeast of the edge of Jalaur River.

Station is cement putty centered by concrete nail with inscriptions "2013-AB-6".

SURVEYED / DESCRIBED BY: AB SURVEYING	**DATE STABLISHED:** MAY 2013

SKETCH

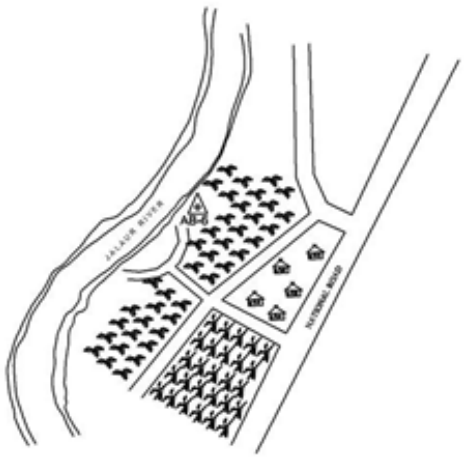


PHOTO / SKETCH

Figure 167: Sketch and description of established control point AB-6

APPENDIX 2

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS	DESIGNATION: AB-7A PAGE:
THE POINT IS MEASURED AND PERMANENTLY MARKED IN 2013	GEOGRAPHIC COORDINATES (WGS '84) Φ = 10°55'20.93051" N λ = 122°41'10.95935" E
ELEVATION OF NETWORK from to by order levelling	COORDINATES x = 465729.603 y = 1207425.882 ELEVATION= 14.502 m (MSL)

CONTROL POINT / BENCH MARK

ISLAND:	PANAY	**~~CITY~~ / MUNICIPALITY:**	BAROTAC NUEVO
PROVINCE:	ILOILO	**BARANGAY:**	-

The Station is located along the river, it is approximately 6.0 meters southeast of the edge of Jalaur River.

Station is cement putty centered by concrete nail with inscriptions "2013-AB-7A".

SURVEYED / DESCRIBED BY: AB SURVEYING	**DATE STABLISHED:** MAY 2013

SKETCH

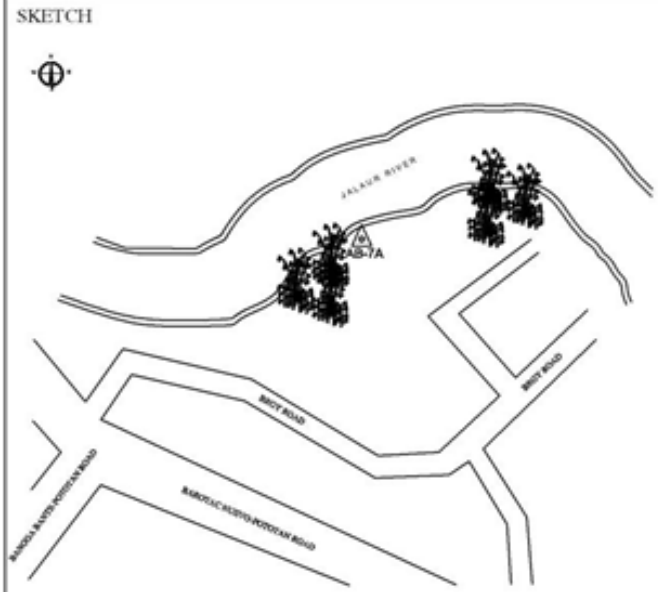


PHOTO / SKETCH

Figure 168: Sketch and description of established control point AB-7A

APPENDIX 2

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS	DESIGNATION: AB-7 PAGE:
THE POINT IS MEASURED AND PERMANENTLY MARKED IN 2013	GEOGRAPHIC COORDINATES (WGS '84) Φ = 10°55'22.73716" N λ = 122°41'14.87237" E
ELEVATION OF NETWORK from by to order levelling	COORDINATES x = 465848.435 y = 1207481.249 ELEVATION= 12.597 m (MSL)

CONTROL POINT / BENCH MARK

ISLAND:	PANAY	**~~CITY~~ / MUNICIPALITY:**	BAROTAC NUEVO
PROVINCE:	ILOILO	**BARANGAY:**	-

The Station is located along the river, it is approximately 10.0 meters southeast of the edge of Jalaur River.

Station is cement putty centered by concrete nail with inscriptions "2013-AB-7".

SURVEYED / DESCRIBED BY: AB SURVEYING	**DATE STABLISHED:** MAY 2013

SKETCH

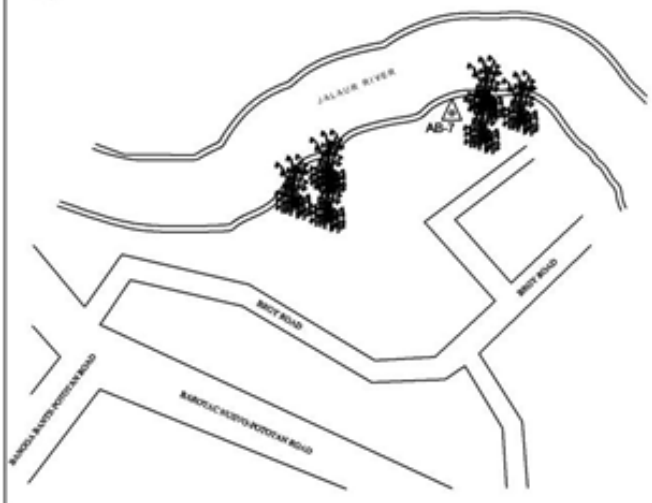


PHOTO / SKETCH

Figure 169: Sketch and description of established control point AB-7

APPENDIX 2

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS	DESIGNATION: AB-8A PAGE:
THE POINT IS MEASURED AND PERMANENTLY MARKED IN 2013	GEOGRAPHIC COORDINATES (WGS '84) Φ = 10°54'14.08222" N λ = 122°40'31.92514" E
ELEVATION OF NETWORK from to by order levelling	COORDINATES x = 464542.563 y = 1205373.933 ELEVATION= 11.029 m (MSL)

CONTROL POINT / BENCH MARK

ISLAND:	PANAY	**~~CITY~~ / MUNICIPALITY:**	BAROTAC NUEVO
PROVINCE:	ILOILO	**BARANGAY:**	MONPON

The Station is located along the river, it is approximately 26.0 meters northeast of the edge of Jalaur River.

Station is cement putty centered by concrete nail with inscriptions "2013-AB-8A".

SURVEYED / DESCRIBED BY: AB SURVEYING	DATE STABLISHED: MAY 2013

SKETCH

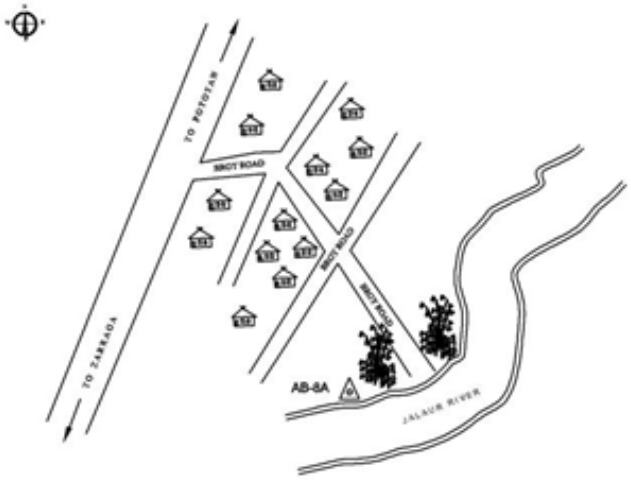


PHOTO / SKETCH

Figure 170: Sketch and description of established control point AB-8A

APPENDIX 2

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS	**DESIGNATION:** AB-8 **PAGE:**
THE POINT IS MEASURED AND PERMANENTLY MARKED IN 2013	GEOGRAPHIC COORDINATES (WGS '84) Φ = 10°54'16.22738" N λ = 122°40'37.09808" E
ELEVATION OF NETWORK from to by order levelling	COORDINATES x = 464699.662 y = 1205439.652 ELEVATION= 11.181 m (MSL)

CONTROL POINT / BENCH MARK

ISLAND: PANAY	~~CITY~~ **/ MUNICIPALITY:** BAROTAC NUEVO
PROVINCE: ILOILO	**BARANGAY:** MONPON

The Station is located along the river, it is approximately 5.0 meters northwest of the edge of Jalaur River.

Station is cement putty centered by concrete nail with inscriptions "2013-AB-8".

SURVEYED / DESCRIBED BY: AB SURVEYING	**DATE STABLISHED:** MAY 2013

SKETCH

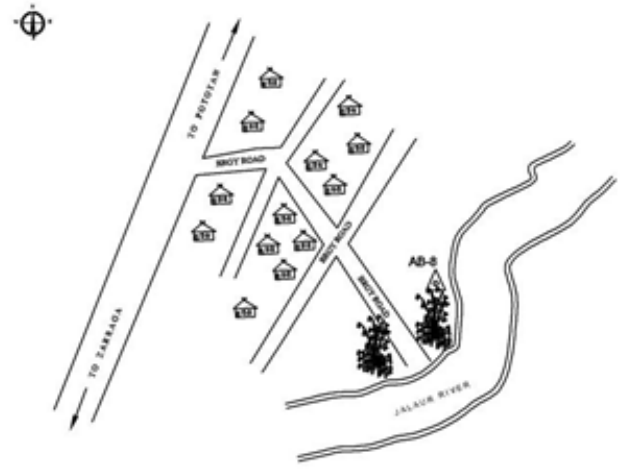


PHOTO / SKETCH

Figure 171: Sketch and description of established control point AB-8

APPENDIX 2

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS	**DESIGNATION:** AB-9 **PAGE:**
THE POINT IS MEASURED AND PERMANENTLY MARKED IN 2013	GEOGRAPHIC COORDINATES (WGS '84) Φ = 10°53'13.58134" N λ = 122°39'45.99666" E
ELEVATION OF NETWORK from to by order levelling	COORDINATES x = 463146.301 y = 1203517.214 ELEVATION= 11.215 m (MSL)

CONTROL POINT / BENCH MARK

ISLAND:	PANAY	**~~CITY~~ / MUNICIPALITY:**	POTOTAN
PROVINCE:	ILOILO	**BARANGAY:**	NANGA

The Station is located along the river, it is approximately 16.0 meters northwest of the edge of Jalaur River.

Station is cement putty centered by concrete nail with inscriptions "2013-AB-9".

SURVEYED / DESCRIBED BY: AB SURVEYING	**DATE STABLISHED:** MAY 2013

SKETCH

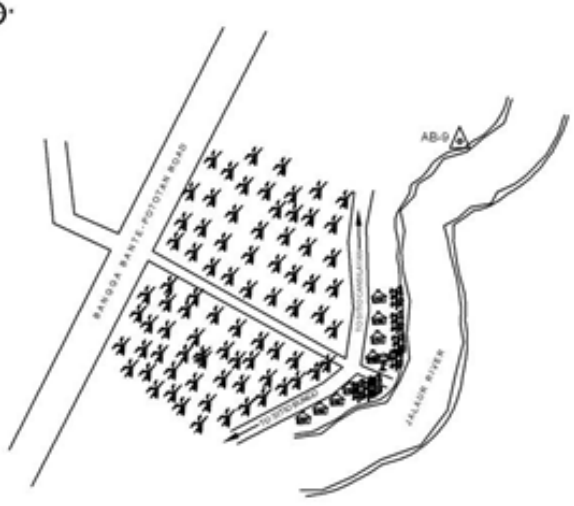


PHOTO / SKETCH

Figure 172: Sketch and description of established control point AB-9

APPENDIX 2

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS	**DESIGNATION:** AB-9C **PAGE:**
THE POINT IS MEASURED AND PERMANENTLY MARKED IN 2013	GEOGRAPHIC COORDINATES (WGS '84) Φ = 10°52'40.59054" N λ = 122°39'37.53147" E
ELEVATION OF NETWORK from to by order levelling	COORDINATES x = 462888.185 y = 1202504.211 ELEVATION= 12.251 m (MSL)

CONTROL POINT / BENCH MARK

ISLAND:	PANAY	**~~CITY~~ / MUNICIPALITY:**	POTOTAN
PROVINCE:	ILOILO	**BARANGAY:**	NANGA

The Station is located along the river, it is approximately 95.0 meters northwest of the edge of Jalaur River.

Station is cement putty centered by concrete nail with inscriptions "2013-AB-9C".

SURVEYED / DESCRIBED BY: AB SURVEYING	**DATE STABLISHED:** MAY 2013

SKETCH

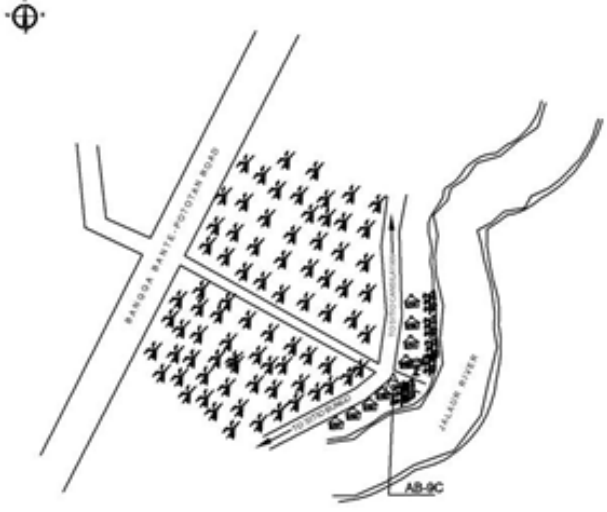


PHOTO / SKETCH

Figure 173: Sketch and description of established control point AB-9C

APPENDIX 2

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS	**DESIGNATION:** AB-9D **PAGE:**
THE POINT IS MEASURED AND PERMANENTLY MARKED IN 2013	GEOGRAPHIC COORDINATES (WGS '84) Φ = 10°52'43.00321" N λ = 122°39'31.42958" E
ELEVATION OF NETWORK from to by order levelling	COORDINATES x = 462703.025 y = 1202578.522 ELEVATION= 12.505 m (MSL)

CONTROL POINT / BENCH MARK

ISLAND:	PANAY	**~~CITY~~ / MUNICIPALITY:**	POTOTAN
PROVINCE:	ILOILO	**BARANGAY:**	NANGA

The Station is located along the river, it is approximately 270.0 meters northwest of the edge of Jalaur River.

Station is cement putty centered by concrete nail with inscriptions "2013-AB-9D".

SURVEYED / DESCRIBED BY: AB SURVEYING	**DATE STABLISHED:** MAY 2013

SKETCH

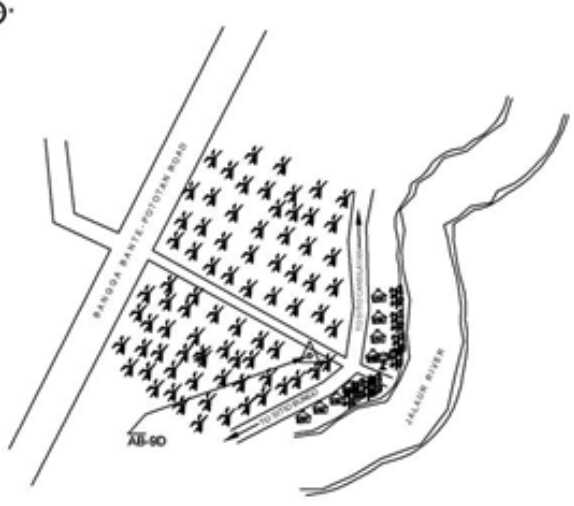


PHOTO / SKETCH

Figure 174: Sketch and description of established control point AB-9D

APPENDIX 2

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS	**DESIGNATION:** AB-10A **PAGE:**
THE POINT IS MEASURED AND PERMANENTLY MARKED IN 2013	GEOGRAPHIC COORDINATES (WGS '84) Φ = 10°50'50.89987" N λ = 122°39'03.61775" E
ELEVATION OF NETWORK from to by order levelling	COORDINATES x = 461854.750 y = 1199136.309 ELEVATION= 13.683 m (MSL)

CONTROL POINT / BENCH MARK

ISLAND:	PANAY	**~~CITY~~ / MUNICIPALITY:**	DUMANGAS
PROVINCE:	ILOILO	**BARANGAY:**	BALABAG

The Station is located along the river, it is approximately 1.0 meter northwest of Bangga Bante Bridge.

Station is cement putty centered by concrete nail with inscriptions "2013-AB-10A".

SURVEYED / DESCRIBED BY: AB SURVEYING	**DATE STABLISHED:** MAY 2013

SKETCH

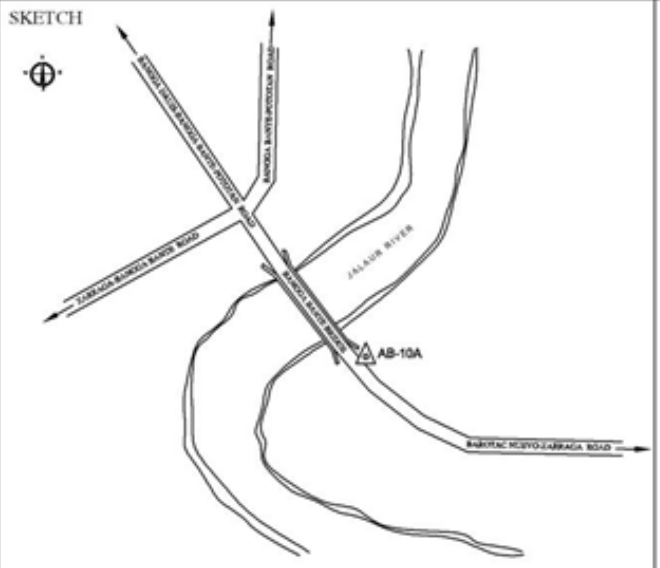


PHOTO / SKETCH

Figure 175: Sketch and description of established control point AB-10A

APPENDIX 2

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS	**DESIGNATION:** AB-10 **PAGE:**
THE POINT IS MEASURED AND PERMANENTLY MARKED IN 2013	GEOGRAPHIC COORDINATES (WGS '84) Φ = 10°50'53.94782" N λ = 122°39'00.54440" E
ELEVATION OF NETWORK from to by order levelling	COORDINATES x = 461761.546 y = 1199230.032 ELEVATION= 13.532 m (MSL)

CONTROL POINT / BENCH MARK

ISLAND: PANAY	**~~CITY~~ / MUNICIPALITY:** DUMANGAS
PROVINCE: ILOILO	**BARANGAY:** BALIBAG

The Station is located along the river, it is approximately 2.0 meters northwest of Bangga Bante Bridge.

Station is cement putty centered by concrete nail with inscriptions "2013-AB-10".

SURVEYED / DESCRIBED BY: AB SURVEYING	**DATE STABLISHED:** MAY 2013

SKETCH

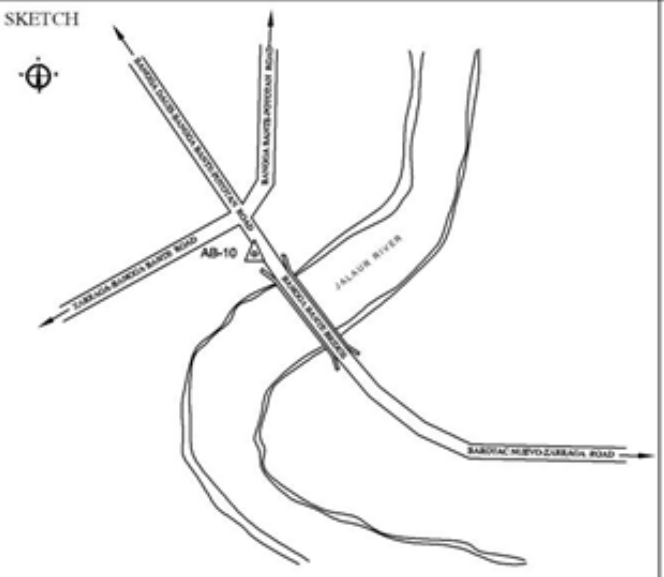


PHOTO / SKETCH

Figure 176: Sketch and description of established control point AB-10

APPENDIX 2

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS	**DESIGNATION:** AB-11 **PAGE:**
THE POINT IS MEASURED AND PERMANENTLY MARKED IN 2013	GEOGRAPHIC COORDINATES (WGS '84) Φ = 10°49'26.57152" N λ = 122°38'25.26590" E
ELEVATION OF NETWORK from to by order levelling	COORDINATES x = 460687.272 y = 1196547.582 ELEVATION= 6.175 m (MSL)

CONTROL POINT / BENCH MARK

ISLAND: PANAY	~~**CITY**~~ **/ MUNICIPALITY:** ZARRAGA
PROVINCE: ILOILO	**BARANGAY:** JALAUR

The Station is located along the river, it is approximately 12.0 meters northeast of the edge of Jalaur River.

Station is cement putty centered by concrete nail with inscriptions "2013-AB-11".

SURVEYED / DESCRIBED BY: AB SURVEYING	**DATE STABLISHED:** MAY 2013

SKETCH

PHOTO / SKETCH

Figure 177: Sketch and description of established control point AB-11

APPENDIX 2

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS	**DESIGNATION:** AB-11A **PAGE:**
THE POINT IS MEASURED AND PERMANENTLY MARKED IN 2013	GEOGRAPHIC COORDINATES (WGS '84) Φ = 10°49'28.05819" N λ = 122°38'30.32168" E
ELEVATION OF NETWORK from to by order levelling	COORDINATES x = 460840.839 y = 1196593.063 ELEVATION= 4.904 m (MSL)

CONTROL POINT / BENCH MARK

ISLAND:	PANAY	**~~CITY~~ / MUNICIPALITY:**	ZARRAGA
PROVINCE:	ILOILO	**BARANGAY:**	JALAUR

The Station is located along the river, it is approximately 161.0 meters northeast of the edge of Jalaur River.

Station is cement putty centered by concrete nail with inscriptions "2013-AB-11A".

SURVEYED / DESCRIBED BY: AB SURVEYING	**DATE STABLISHED:** MAY 2013

SKETCH

PHOTO / SKETCH

Figure 178: Sketch and description of established control point AB-11A

APPENDIX 2

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS	**DESIGNATION:** AB-12 **PAGE:**
THE POINT IS MEASURED AND PERMANENTLY MARKED IN 2013	GEOGRAPHIC COORDINATES (WGS '84) Φ = 10°48'21.13953" N λ = 122°38'30.78814" E
ELEVATION OF NETWORK from to by order levelling	COORDINATES x = 460852.592 y = 1194537.693 ELEVATION= 5.038 m (MSL)

CONTROL POINT / BENCH MARK

ISLAND: PANAY	**~~CITY~~ / MUNICIPALITY:** LEGANES
PROVINCE: ILOILO	**BARANGAY:** FABRICA

The Station is located along the river, it is approximately 13.0 meters southeast of the edge of Jalaur River.

Station is cement putty centered by concrete nail with inscriptions "2013-AB-12".

SURVEYED / DESCRIBED BY: AB SURVEYING	**DATE STABLISHED:** MAY 2013

SKETCH

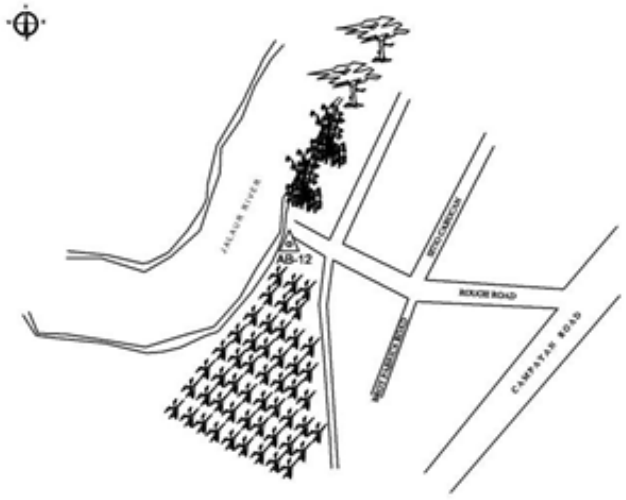


PHOTO / SKETCH

Figure 179: Sketch and description of established control point AB-12

APPENDIX 2

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS	**DESIGNATION:** AB-12A **PAGE:**
THE POINT IS MEASURED AND PERMANENTLY MARKED IN 2013	GEOGRAPHIC COORDINATES (WGS '84) Φ = 10°48'19.89835" N λ = 122°38'33.28482" E
ELEVATION OF NETWORK from to by order levelling	COORDINATES x = 460928.361 y = 1194499.482 ELEVATION= 4.721 m (MSL)

CONTROL POINT / BENCH MARK

ISLAND:	PANAY	**~~CITY~~ / MUNICIPALITY:**	LEGANES
PROVINCE:	ILOILO	**BARANGAY:**	FABRICA

The Station is located along the river, it is approximately 84.0 meters southeast of the edge of Jalaur River.

Station is cement putty centered by concrete nail with inscriptions "2013-AB-12A".

SURVEYED / DESCRIBED BY: AB SURVEYING	**DATE STABLISHED:** MAY 2013

SKETCH

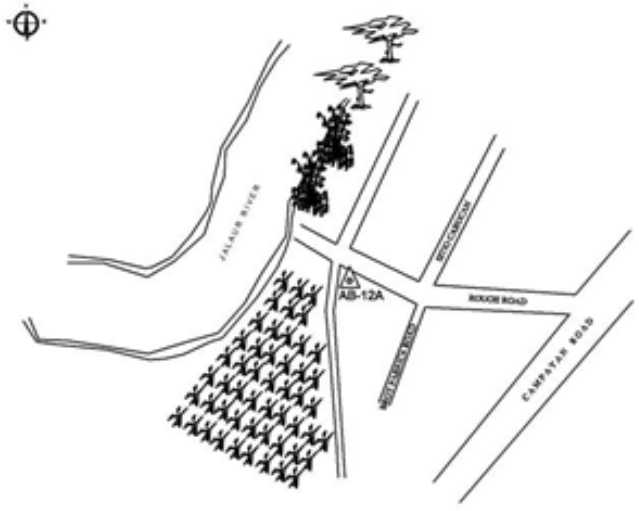


PHOTO / SKETCH

Figure 180: Sketch and description of established control point AB-12A

APPENDIX 2

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS	DESIGNATION: AB-13 PAGE:
THE POINT IS MEASURED AND PERMANENTLY MARKED IN 2013	GEOGRAPHIC COORDINATES (WGS '84) Φ = 10°47'33.72280" N λ = 122°37'52.02488" E
ELEVATION OF NETWORK from to by order levelling	COORDINATES x = 459673.759 y = 1193082.725 ELEVATION= 3.766 m (MSL)

CONTROL POINT / BENCH MARK

ISLAND:	PANAY	**~~CITY~~ / MUNICIPALITY:**	LEGANES
PROVINCE:	ILOILO	**BARANGAY:**	NABITASAN

The Station is located along the river, it is approximately 1.0 meter southwest of Riprap.

Station is cement putty centered by concrete nail with inscriptions "2013-AB-13".

SURVEYED / DESCRIBED BY: AB SURVEYING	**DATE STABLISHED:** MAY 2013

SKETCH

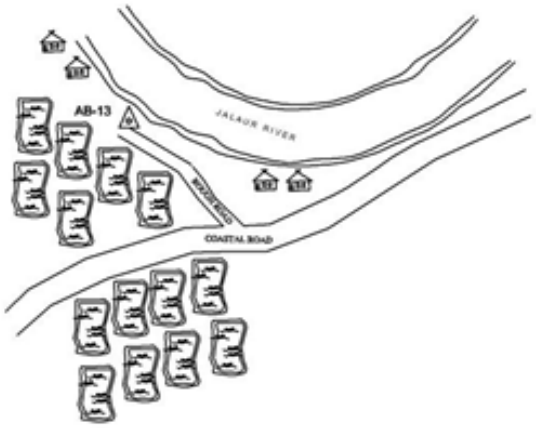


PHOTO / SKETCH

Figure 181: Sketch and description of established control point AB-13

APPENDIX 2

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS	**DESIGNATION:** AB-13A **PAGE:**
THE POINT IS MEASURED AND PERMANENTLY MARKED IN 2013	GEOGRAPHIC COORDINATES (WGS '84) Φ = 10°47'29.83330" N λ = 122°37'57.80259" E
ELEVATION OF NETWORK from to by order levelling	COORDINATES x = 459849.068 y = 1192963.051 ELEVATION= 3.775 m (MSL)

CONTROL POINT / BENCH MARK

ISLAND:	PANAY	**~~CITY~~ / MUNICIPALITY:**	LEGANES
PROVINCE:	ILOILO	**BARANGAY:**	NABITASAN

The Station is located along the river, it is approximately 1.0 meter southeast of Riprap and 7.0 meters northeast of the roughroad.

Station is cement putty centered by concrete nail with inscriptions "2013-AB-13A".

SURVEYED / DESCRIBED BY: AB SURVEYING	**DATE STABLISHED:** MAY 2013

SKETCH

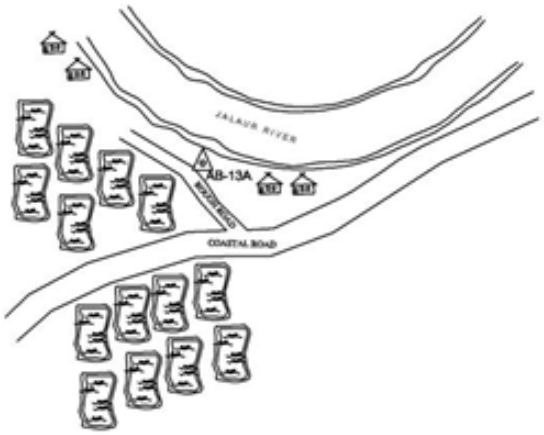


PHOTO / SKETCH

Figure 182: Sketch and description of established control point AB-13A

APPENDIX 2

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS	**DESIGNATION:** AB-14A **PAGE:**
THE POINT IS MEASURED AND PERMANENTLY MARKED IN 2013	GEOGRAPHIC COORDINATES (WGS '84) Φ = 10°47'21.59576" N λ = 122°38'45.66188" E
ELEVATION OF NETWORK	COORDINATES x = 461302.127 y = 1192708.330
from to by order levelling	ELEVATION= 6.793 m (MSL)

CONTROL POINT / BENCH MARK

ISLAND: PANAY	**~~CITY~~ / MUNICIPALITY:** LEGANES
PROVINCE: ILOILO	**BARANGAY:** NABITASAN

The Station is located along the river, it is approximately 1.0 meter northeast of Monfort-Halaur Bridge.

Station is cement putty centered by concrete nail with inscriptions "2013-AB-14A".

SURVEYED / DESCRIBED BY: AB SURVEYING **DATE STABLISHED:** MAY 2013

SKETCH

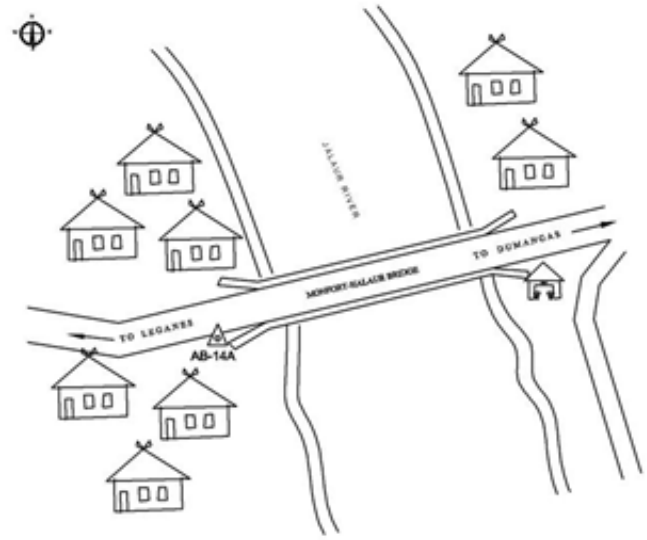


PHOTO / SKETCH

Figure 183: Sketch and description of established control point AB-14A

APPENDIX 2

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS	**DESIGNATION:** AB-14 **PAGE:**
THE POINT IS MEASURED AND PERMANENTLY MARKED IN 2013	GEOGRAPHIC COORDINATES (WGS '84) Φ = 10°47'23.37709" N λ = 122°38'49.39039" E
ELEVATION OF NETWORK from to by order levelling	COORDINATES x = 461415.416 y = 1192762.911 ELEVATION= 6.752 m (MSL)

CONTROL POINT / BENCH MARK

ISLAND:	PANAY	**~~CITY~~ / MUNICIPALITY:**	LEGANES
PROVINCE:	ILOILO	**BARANGAY:**	NABITASAN

The Station is located along the river, it is approximately 2.0 meters southwest of Monfort-Halaur Bridge.

Station is cement putty centered by concrete nail with inscriptions "2013-AB-14".

SURVEYED / DESCRIBED BY: AB SURVEYING	**DATE STABLISHED:** MAY 2013

SKETCH

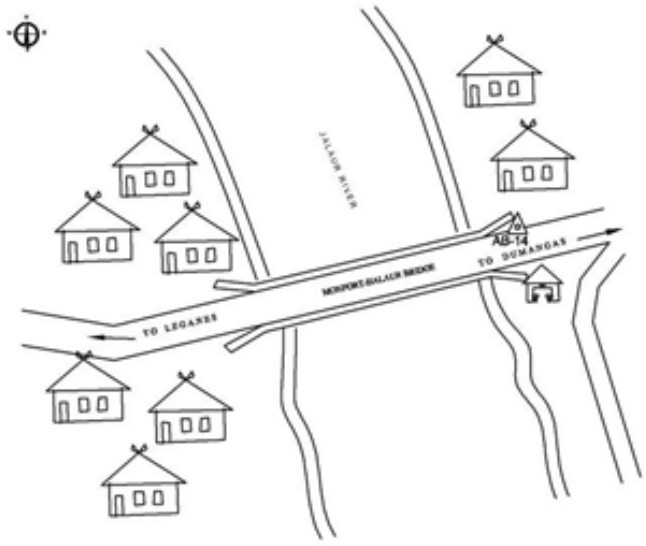


PHOTO / SKETCH

Figure 184: Sketch and description of established control point AB-14

APPENDIX 2

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS	**DESIGNATION:** AB-15A **PAGE:**
THE POINT IS MEASURED AND PERMANENTLY MARKED IN 2013	GEOGRAPHIC COORDINATES (WGS '84) Φ = 10°46'32.60909" N λ = 122°38'42.84870" E
ELEVATION OF NETWORK from to by order levelling	COORDINATES x = 461214.956 y = 1191203.845 ELEVATION= 2.654 m (MSL)

CONTROL POINT / BENCH MARK

ISLAND:	PANAY	**~~CITY~~ / MUNICIPALITY:**	LEGANES
PROVINCE:	ILOILO	**BARANGAY:**	NABITASAN

The Station is located along the river, it is approximately 6.0 meters southeast of the edge of Jalaur River.

Station is cement putty centered by concrete nail with inscriptions "2013-AB-15A".

SURVEYED / DESCRIBED BY: AB SURVEYING	**DATE STABLISHED:** MAY 2013

SKETCH

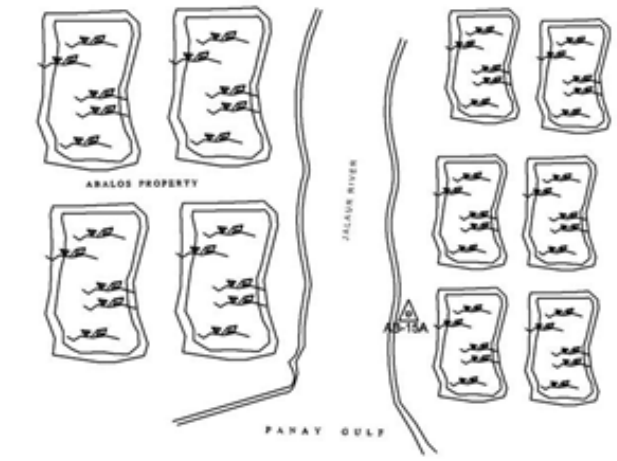


PHOTO / SKETCH

Figure 185: Sketch and description of established control point AB-15A

APPENDIX 2

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS	**DESIGNATION:** AB-15 **PAGE:**
THE POINT IS MEASURED AND PERMANENTLY MARKED IN 2013	GEOGRAPHIC COORDINATES (WGS '84) Φ = 10°46'27.48430" N λ = 122°38'43.38550" E
ELEVATION OF NETWORK	COORDINATES x = 461231.075 y = 1191046.423
from to by order levelling	ELEVATION= 3.185 m (MSL)

CONTROL POINT / BENCH MARK

ISLAND:	PANAY	**~~CITY~~ / MUNICIPALITY:**	LEGANES
PROVINCE:	ILOILO	**BARANGAY:**	NABITASAN

The Station is located along the river, it is approximately 27.0 meters southeast of the edge of Jalaur River.

Station is cement putty centered by concrete nail with inscriptions "2013-AB-15".

SURVEYED / DESCRIBED BY: AB SURVEYING	**DATE STABLISHED:** MAY 2013

SKETCH

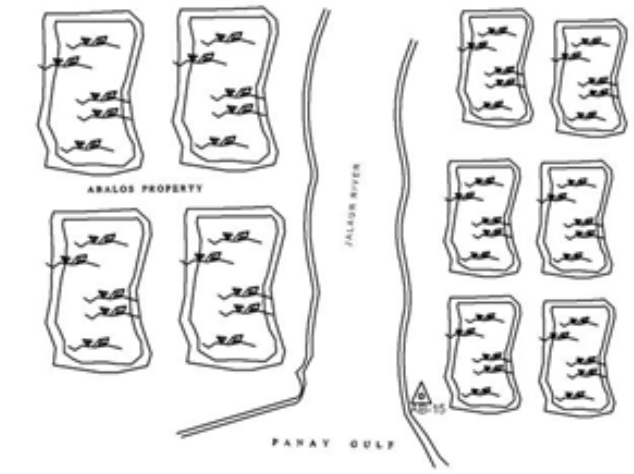


PHOTO / SKETCH

Figure 186: Sketch and description of established control point AB-15

Acknowledgement

Annexes

With much effort and willingness we had dedicated in this project, PROFILE AND CROSS SECTION SURVEYS IN JALAUR RIVER, ILOILO, it is our pride to extend our gratitude to all certain individuals, groups and organizations who had helped us accomplish this report.

It is just right to extend our sincerest gratitude to the management and staff of University of the Philippines-Training Center for Applied Geodesy and Photogrammetry (UP-TCAGP) for this great opportunity working with your good office and looking forward for another project.

To our company, AB SURVEYING AND DEVELOPMENT, thank you very much for the wonderful support you have given us, most especially to our President, Engr. Antonio Julian Botor. For sharing and imparting to us your skills and knowledge in this project, our deepest gratitude.

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To GOD ALMIGHTY, thank you for all the blessings!
Without your cooperation and support, this project would have not been possible. To all of you, THANK YOU VERY MUCH!

Bibliography

- Provincial Profile of the Province of Iloilo, Philippines. (n.d.). Retrieved October 29, 2015, from https://www.scribd.com/doc/33915404/Provincial-Profile-of-the-Province-of-Iloilo-Philippines#scribd

DREAM

Disaster Risk and Exposure Assessment for Mitigation