

JAPAN INTERNATIONAL COOPERATION AGENCY
THE GOVERNMENT OF THE KINGDOM OF MOROCCO

FEASIBILITY STUDY
ON WATER RESOURCES DEVELOPMENT
IN RURAL AREA
IN THE KINGDOM OF MOROCCO

FINAL REPORT

VOLUME IV

**SUPPORTING REPORT (2.A)
FEASIBILITY STUDY**

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The cost estimate is based on the price level and exchange rate of April 2000. The exchange rate is:
US\$ 1.0 = Moroccan Dirham (DH) 10.68 and
Japanese Yen 100.0 = Moroccan Dirham (DH) 9.90

ABBREVIATIONS

Abbreviations	ENGLISH	FRENCH
AEP	Potable Water Supply	Approvisionnement en Eau Potable
APD	Detailed Study	Avant Projet Détaillé
AUEA	Association of Agricultural Water Users	Association des Usagers de l' Eau Agricole
BAD	African Bank for Development	Banque Africaine de Développement
BM	World Bank	Banque Mondiale
CAM	Agricultural Cooperative of Morocco	Coopérative Agricole du Maroc
CDA	Agricultural Development Center	Centres de Développement Agricole
CERED	Center for demographic Research and Studies	Centre des études et de Recherche Démographiques
CLCA	Local Fund for Agricultural Credit	Caisse Locale de Crédit Agricole
CMV	Development Center	Centre de Mise en Valeur
CNCA	National Fund for Agricultural Credit	Caisse Nationale de Crédit Agricole
CNE	National Council of Environment	Le Conseil National de l' Environnement
CSEC	Superior Council for Water and Climate	Conseil Supérieur de l' Eau et du Climat
DAR	Directorate of Rural Affairs	Direction des Affaires Rurales
DCL	Directorate of Local Collectivities	Direction des Collectivités Locales
DCRF	Directorate of Forest Resources Conservation	Direction de la Conservation des Ressources Forestières
DDF	Directorate of Forest Development	Direction de Développement Forestière
DE	Directorate of Operation	Direction des Economiques
DELM	Directorate of Epidemiology and Abatement of Disease	Direction d' Epidémiologie et de Lutte Contre les Maladies
DEP	Directorate of Design and Planning	Direction de Planification et des Plans
DEPR	Division of Potable Rural Water Supply	Division d' Alimentation en Eau Potable en Milieu Rural
DERD	Decentralized Regional Directorate	Direction de l' Enseignement, de la Recherche et de Développement Rural
DF	Directorate of Finance	Direction des Finances
DGCL	General Directorate of Local Communities	Direction Générale des Collectivités Locales
DGH	Directorate General of Hydraulics	Direction Générale de l' Hydraulique
DH	Dirham	Dirham
DIEC	Division of Information, Education and Communication	Division d' Information, Education et Communication
DP	Provincial Directorate	Direction Provinciale

Abbreviations	ENGLISH	FRENCH
DPA	Provincial Directorate of Agriculture	Direction Provinciale d' Agriculture
DPA	Provincial Directorate of Animal	Direction Provinciales de l' Animale
DPTP	Provincial Directorate of Public Works	Direction Provinciale des Travaux Publiques
DPV	Directorate of Vegetable Production	Direction de la Production Végétale
DRD	Decentralized Regional Directorate	Direction Régionale Décentralisée
DT	Division of Works	Division du Travail
EIRR	Economic Internal Rate of Return	
EMP	Environmental Management Plan	Plan de Gestion Environnementale
FERTIMA	Moroccan Company of Fertilizers	Société Marocaine de Fertilisation
FV	Training Visit	Formation Visite
GH	Large Hydraulic	Grande Hydraulique
GPD	Gross Domestic Product	Produit National Brut
HCWC	High Council of Water and Climate	Conseil Supérieur de l' eau et du Climat
IBRD	International Bank for Reconstruction and Development	Banque Internationale pour la Reconstruction et le Développement
INH	National Institute of Hygiene	Institut Nationale de l' Hygiène
JBIC	Japan Bank for International Cooperation	Banque Japon de Coopération Internationale
JICA	Japan International Cooperation Agency	Agence Japonaise pour la Coopération Internationale
MADRPM	Ministry of Agriculture, Rural Development and Maritime Fishing	Ministère de l' Agriculture du Développement Rural et des Pêches Maritimes
MCEF	Ministry In Charge of Water and Forests	Ministère Chargé des Eaux et Forêts
MI	Ministry of Interior	Ministère de l' Intérieur
MOA	Ministry of Agriculture, Rural Development and Fishery	Ministère de l' Agriculture du développement Rural et des Pêches maritimes
MOE	Ministry of Equipment	Ministère de l' Equipement
MOI	Ministry of Interior	Ministère de l' Intérieur
MPW	Ministry of Public Works	Ministère des travaux Publics
MSL	Mean Sea Level	Niveau Moyen de La mer
MSP	Ministry of Public Health	Ministère de la Santé Publique
NG	Natural Ground	Sol Naturel
NPV	Net Present Value	Valeur Nette Actuelle
OECE	Overseas Economic Cooperation Fund (now JBIC)	Fond de Coopération Economique Etrangère
OMM	Operation, Maintenance and Management	Opérations de gestion et de maintenance
ONE	National Office of Electricity	Office National de l' Electricité
ONEP	National Office of Potable Water	Office National de l' Eau Potable

Abbreviations	ENGLISH	FRENCH
ONICL	Inter professional National Office of Cereals and Leguminous	Office National Inter professionnel des Céréales et Légumineuses
ORMVA	Regional Office for Agricultural Development	Office Régional de la Mise en Valeur Agricole
PAGER	Program of Grouped Supply of Rural Water	Programme d' Approvisionnement Groupé des Eaux Rurales
PAGI	Program of Large Irrigation Improvement	Programme d' Amélioration de la Grande Irrigation
PMH	Small and Medium-Scale Hydraulic	Petit et Moyenne Hydraulique
PNI	National Program of Irrigation	Programme National de l' Irrigation
PRV	Extension and Research Project	Projet de Recherche et de Vulgarisation
PSDA	Agricultural Development and Support Project	Projet de Support et de Développement Agricole
SE	Water Service at the Provincial Directorate of Public Works	Service Eau à la Direction provinciale de l' Equipement
SH	Section of Hydology	Service d'Hydraulogie
SIBE	Site of Biological and Ecological Interest	Site d' Intérêt Biologique et Ecologique
SMN	Service of National Meteorology	Service de la Météorologie Nationale
SONACOS	National Company of Seed Trade	Société Nationale de Commercialisation de Semences
UNCAM	National Union of Cooperatives of Morocco	Union Nationale de Coopératives du Maroc
UNDP	United Nations Development Program	Programme des Nations Unies pour le Développement (PNUD)

Conversion Factors

	Metric to Imperial		Imperial to Metric			
Length	1 cm	=	0.394 inch	1 inch	=	2.54 cm
	1 m	=	3.28 feet	1 feet	=	30.48 cm
	1 km	=	0.621 mile	1 mile	=	1.609 km
Area	1 m ²	=	10.76 sq.ft	1 sq.ft	=	0.0929 m ²
	1 ha	=	2.471 acre	1 acre	=	0.4047 ha
	1 km ²	=	0.386 sq.mile	1 sq.mile	=	2.59km ²
Volume	1 lit	=	0.22 gal (imp)	1 gal(imp)	=	4.55 lit
	1 m ³	=	35.3 cu.ft	1 cu.ft	=	28.33 lit
	1 MCM	=	811 acre-ft	1 acre-ft	=	1,233.5 m ³
Weight	1 kg	=	2.20 lb	1 lb	=	0.4536 kg
	1 ton	=	0.984 long ton	1 long ton	=	1.016 ton
Derived	1 m ³ /s	=	35.3 cusec	1 cusec	=	0.0283 m ³ /s
Measures	1 ton/ha	=	891 lb/acre	1 lb/acre	=	1.12 kg/ha
	1 m ³ /s	=	19.0 mgd	1 mgd	=	0.0529 m ³ /s
Temperature		=	(°F-32)x5/9	°F	=	1.8x +32
Local Measures	1 lit	=	0.22 gantang	1 gantang	=	4.55 lit
	1 kg	=	1.65 kati	1 kati	=	0.606 kg
	1 ton	=	16.5 pikul	1 pikul	=	60.6 kg

Rural Area in

*Feasibility Study on Water Resources Development in
the*

Kingdom of Morocco

Final Report

Volume IV Supporting Report (2.A)

Feasibility Study

Supporting Report IX

***Aero-photo and
Ground Survey***

**FEASIBILITY STUDY
ON
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IN
RURAL AREA
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FINAL REPORT

**VOLUME IV
SUPPORTING REPORT (2.A)
FEASIBILITY STUDY**

**SUPPORTING REPORT IX
AERO-PHOTO AND GROUND SURVEY**

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SUPPORTING REPORT IX
AERO-PHOTO AND GROUND SURVEY

IX1 Mapping Area

To prepare the topographic map as the basic data for the study work, topographic mapping was carried out at the following four sites.

- (1) No.5 N'Fifikh
- (2) No.9 Taskourt
- (3) No.10 Timkit
- (4) No.17 Azghar

IX2 Mapping Specification and Surveying Method

Topographic maps prepared in this work are divided into two scales. One is the 1/5,000 scale map, the another one is 1/500.

IX3 1/5,000 Mapping

IX3.1 General

1/5,000 mapping was carried out for the three sites, No.5 (N'Fifikh), No.9 (Taskourt) and No.17 (Azghar) by photogrammetric method. Those areas are shown in the Figure IX3.1. The work specifications of 1/5,000 map and mapping area are as follows:

Map Specification

No	Items	Description	
1	Geodetic reference ellipsoid	Clarke 1880	
2	Map projection	Lambert conical conformal	
3	Datum of height	Mean Sea level	
4	Map scale	1:5,000	
5	Contour interval	Index contour	25.0 m
		Intermediate contour	5.00 m
		Supplementary contour	2.50 m
		Sub-supplementary contour	1.25 m

Mapping Area

No	Location	Area (km ²)
1	No.5 (N'Fifikh)	78.5
2	No.9 (Taskourt)	109.2
3	No.17 (Azghar)	33.5
Total		221.2

IX3.2 Aerial Photography

IX3.2.1 Aerial Photography Specification

Aerial photography was carried out in the said three sites. The aerial photography specification is as follows.

Aerial Photography Specification

No	Items	Specifications
1	Photo Scale	1:15,000
2	Flight Height	Approximately 2,250m above the ground elevation
3	Aerial Camera	Wild RC10 (f length=153.25mm)
4	Photographing Date	No.5 N'Fifikh 4-Oct-2000 No.9 Taskourt 4-Oct-2000 No.17 Azghar 17-Oct-2000
5	Overlap	60 %
6	Sidelap	30 %

IX3.2.2 Work Volume

The total distance is 264.5km and the total exposure number is 219. These numbers satisfy the planned quantity. The planned flight distance was 213.9km and planned exposure number was 169. Total photographed quantity and work volume are shown in the following table:

Work Volume

Site	Line	Height Datum	Flying Height	Line Distance	Exposure Number
No. 5 N'Fifikh	C1	200m	2450m	27.8Km	22
	C2	300m	2550m	33.0Km	25
	C3	400m	2650m	14.2Km	12
	C4	100m	2350m	12.2Km	10
	C5	100m	2350m	11.4Km	9
Total				98.6Km	78
No. 9 Taskourt	C1	1200m	3450m	14.3Km	11
	C2	1100m	3350m	18.5Km	17
	C3	800m	3050m	25.1Km	20
	C4	700m	2950m	22.7Km	18
	C5	700m	2950m	23.0Km	19
	C6	700m	2950m	14.5Km	12
Total				118.1Km	97
No. 17 Azghar	C1	900m	3150m	24.1Km	23
	C2	900m	3150m	23.7Km	21
Total				47.8Km	44
Grand Total				264.5Km	219

IX3.2.3 Quality Control

All items of photograph quality were inspected about each photograph. In conclusion all the photographs satisfy the requisite. The details are as follows:

- (1) End lap and side lap
- (2) All photographs in the project area meet the requisite.
- (3) Crab
- (4) All photographs in the project area meet the requisite.
- (5) Displacement of flight line
- (6) There are some displacements of flight line from the planned course. However, whole plotting area is covered.

- (7) Cloud
- (8) All photographs are without clouds.
- (9) Fiducial Mark
- (10) The fiducial marks of all photographs are photographed clearly.
- (11) Others

One photograph is with scratch. However, the scratched part is outside of stereoscopic area and it doesn't affect the plotting work.

IX3.2.4 Results

The delivered results are as shown in the following table:

Results

Items	Qty	Notes
Negative Films (1/15,000)	1 set	Negatives were used for the plotting work.
Dia-Positive (1/15,000)	1 set	
Contact Prints (1/15,000)	3 sets	1 set was used for the photogrammetric work.
Two times enlargement photos	1 set	
Photo Index Map (1/50,000)	3 sets	
Meteorological Report and Flight Report	1 set	
Quality Control Sheet	1 set	
Camera Calibration Certificate	1 set	

IX3.3 Control Point Surveying

Control point surveying was carried out to establish the reference for the aerial triangulation. The surveying is divided into two types, horizontal control and vertical control.

IX3.3.1 Reconnaissance of existing points and selection of new point's site

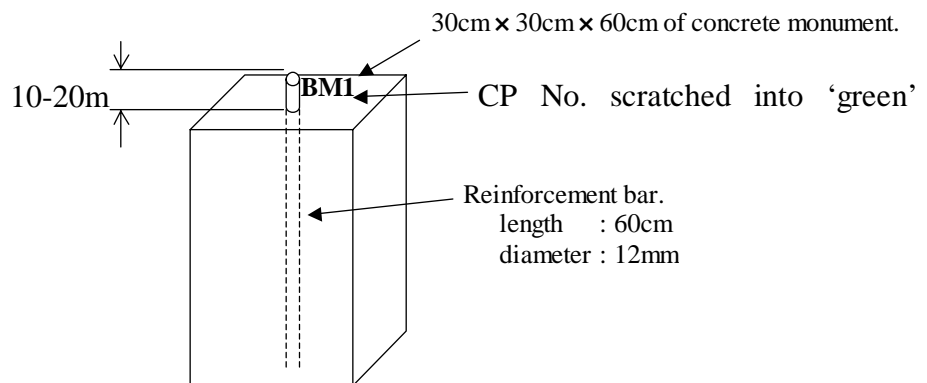
Distribution condition of existing triangulation stations and Bench Marks in the project area were investigated in the IGN (National Geographic Institute). All appropriate existing points for this work were investigated in the field. Some of them were disappeared or destroyed.

Based on the reconnaissance results of existing points, new points distribution was planned out. The appropriate sites for the new points were selected in the field.

The list of the available existing points and newly established points are shown in the Tables IX3.1 to IX3.3.

IX3.3.2 Monumentation

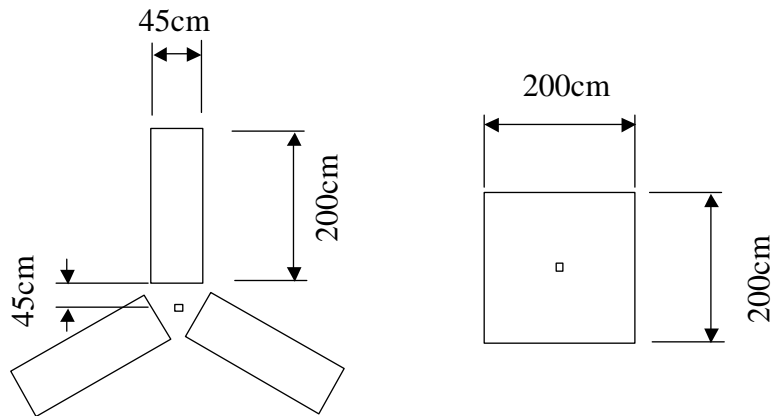
Some of new points, which are important for this project in the succeeding stage, are monumented. Those, which were monumented, are shown in the Tables IX3.1 to IX3.3. The monument size is as shown in the figure below:



IX3.3.3 Aerial Signalization

Horizontal control points, which are necessary for the aerial triangulation, were signalized. Those, which were signalized, are shown in the Tables A3.1 to A3.3.

The signalization was made by stone and painted with lime. The signal style is originally planed as three wings type. However, in the cultivated field, this type signal shall be damaged easily. To avoid the damage, the square type signal used in the cultivated field. The form and size is as shown in the figure below:



IX3.3.4 GPS Surveying

The signalized control points were surveyed their coordinates by GPS observation. The observation networks are shown in Figures IX3.1 to IX3.3. The instruments, observation method and other information are as follows:

No	Item	Description
1	Receiver	Trimble 4600 SL Three receivers were used.
2	Observation method	Static Observation Observation time : 1 hour as minimum Data acquisition epoch : 20 seconds Satellite Number More than 5 satellites Vertical angle of satellite More than 15 °
3	Required accuracy	Horizontal : $\pm 10\text{ppm} \times \text{Distance}$ (10cm per 10km) in trigonometrical closure Vertical : $\pm 20\text{ppm} \times \text{Distance}$ (20cm per 10km) in trigonometrical closure

The results of all items of GPS surveying meet the required accuracy. The calculated coordinates of newly established points are shown in the Tables IX3.1 to IX3.3.

IX3.3.5 Leveling

The signalized control points, existing triangulation stations and newly established bench marks were surveyed their elevation by leveling. Those points in the plane site were surveyed by direct leveling. The points in the mountainous area were surveyed by trigonometric leveling. The GPS observation results were adopted for the elevation of some points in the most difficult area.

The original plan of direct leveling was divided into two classes, third-order and minor order. However, all direct leveling observations was carried out by the third-order leveling, so all direct leveling points are of the third-order.

At first, the existing Bench Marks were surveyed to be confirmed their data. Many BMs in the N'Fifikh didn't coincide each other. So, the BMs to be used for the reference points were selected carefully. Carried out total leveling quantity is as follows:

- (1) Third order leveling : 562.2km
- (2) Trigonometric leveling : 194.0km

Pricking on the photograph to be used for the aerial triangulation was planned to carry out on the 2-times enlargement photographs. However, owing to the delay of flight permission acquisition the aerial photography was delayed, too. So the pricking was executed without photograph putting small stakes on the roadside and after aerial photography they are identified on the photographs.

The observation networks are shown in Figures IX3.1 to IX3.3. The observation requisite of third order leveling is as follows:

- (1) Duplicate observation shall be done.
- (2) Distance between staff and instrument shall not exceed 70m.
- (3) Distance between back-sight and foresight shall be equalized.
- (4) The observer shall avoid reading of the bottom 10cm and top 10cm of the staves.
- (5) Temporal Bench Marks shall be marked using paints at approx. 1km interval in the leveling route on the existing permanent structures.
- (6) Accuracy of observation shall be within $10\text{mm} \pm S$. (S= length in km)
- (7) The results of all items of third order leveling meet the required accuracy.
- (8) The results of leveling are shown Table IX3.1 to IX3.3.

IX3.4 Field Classification

Field classification was planned to carry out on the 2-times enlargement photographs. Only in the N'Fifikh area, plotting draft sheet was used for the classification work.

The field classification was carried out to investigate the river name, village name, width of the roads, classification of the roads, etc.

IX3.5 Aerial triangulation

On the basis of the results of ground control survey and leveling, the photo coordinates of pass points and tie points necessary for the stereo plotting were determined. The requisite of the aerial triangulation is as follows:

- (1) Aerial triangulation shall be done by using high precision analytical plotter or digital photogrammetric workstation (DPW).
- (2) The adjustment computation shall be carried out by the independent model method or bundle method.
- (3) Standard deviation of discrepancies of control points, pass points and tie points between adjacent model after adjustment shall be within 0.08 % of the flying altitude for both planimetry and height.

Aerial triangulation was carried out by independent model method using a high precision analytical plotter LICA SD-2000. All the aerial triangulation results meet the required accuracy.

IX3.6 Plotting

Based on the aerial triangulation results, plotting work was carried out by digital method. Three types of plotting instruments, LICA SD-2000, Wild B-8 with encoder System ADAMS and Wild B-8 with encoder TANGER were used.

IX3.7 Editing

After the plotting, the plotting draft sheet was checked. Using the corrected draft and field classification results, topographic features were edited on the display. Editing work was carried out using a CAD system "AUTOCAD". Marginal information was arranged in this process, too.

Originally the map size was planned as 60cm × 80cm at its neatline. However, map trimming with this sheet size is inconvenient for the study work.

Considering the convenience for the study work, the height of neatline was defined as 70cm.

It was too difficult to define the width because of meandering of the mapping area. To make an optimum trimming the width wasn't defined.

Final sheet number was 16 for N'Fifikh, 12 for Taskourt and 4 for Azghar.

In regard to the map symbol, the conventional map symbols were used to express the topographic features.

IX3.8 Fair Drawing

After the editing, original sheets were printed out on the transparent polyester base.

Digital map data saved in CD was delivered, too. The file was submitted in two types. Their extension name are "*.dwg" and "*.dxf".

IX4 1/500 Mapping

IX4.1 General

1/500 mapping was carried out for the four sites by direct surveying method. The work specification and volume of 1/500 map is as follows:

Map specification

No	Item	Specifications	
1	Geodetic reference ellipsoid	Clarke 1880	
2	Map projection	Lambert conical conformal	
3	Datum of height	Mean Sea level	
4	Map scale	1:500	
5	Contour interval	Index contour	5.0 m
		Intermediate contour	1.0 m
		Supplementary contour	0.5 m

IX4.2 Traversing

Traversing was carried out to establish the reference points for topographic surveying.

At first, two principal points were monumented at every site. Their coordinates were surveyed by GPS and the elevations were surveyed by third order leveling.

The Timkit site is too far from existing triangle stations and BMs to carry out GPS surveying and leveling. Fortunately another JICA project was carried out about ten years ago near this site and those maps could be used as the reference. The reference data were read from the existing map, so their coordinates and elevation are approximate naturally. However, to be secure, many points were read to orientation of the map and the results were satisfactory.

After establishing the two principal points, based on them secondary traversing was carried out around the site.

IX4.3 Topographic surveying

Based on the traverse points spot elevations were observed every 10m square mesh. However, in the dangerous part with strong accident, the density of spot elevation was thinner than 10m square. Adding to the spot elevation all topographic features as houses, cultivated land, footpath, and so on were observed.

IX4.4 Plotting

All observed points were plotted using the digital system and contour lines were generated automatically.

IX4.5 Editing

Plotted out draft were checked and edited. Automatic contour generation may generate incorrect contour easily. So, the contour line was checked and corrected carefully.

IX4.6 Fair Drawing

After the editing process, original sheets were printed out on the transparent polyester base.

Digital map data saved in CD was delivered, too. The file was submitted in two types. Their extension name are “*.dwg” and “*.dxf”.

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Supporting Report IX

Aero-photo and Ground Survey

Tables

**Table IX3.1: Control Points in the N'FIFIKH site
(A: Triangular Station)**

e	X	Y	Elevation		Note
72	326 653.90	348 981.38	77.751	3 rd	Used as a reference for GPS observation.
78	325 041.25	336 270.68	178.536	3 rd	
80	324 816.53	343 677.77	123.253	3 rd	Signalized.
108	342 168.54	317 761.68	327.959	3 rd	Signalized. Signalized.
109	344 655.30	317 717.66	290.443	Trig	The results of GPS calculation didn't coincide with the existing IGN coordinates. We considered that this station should be modified and adopted the new coordinates.
138	342 420.03	315 822.70	344.688	Trig	Signalized.
144	344 123.62	316 241.88	251.279	3 rd	Signalized.
145	345 476.04	314 107.14	372.13	Trig	Signalized.
150	342 891.76	317 161.52	198.323	Trig	Signalized.
159	344 482.30	319 703.10	338.731	Trig	Signalized.
166	341 797.10	320 132.90	320.833	Trig	Signalized. Signalized.
168	322,503.335,	343 363.05	120.283	3 rd	The results of GPS calculation didn't coincide with the existing IGN coordinates. We considered that this station should be modified and adopted the new coordinates. Signalized.
170	319 951.77	346 486.07	45.072 48.072	3 rd	45.072 is the ground elevation and 48.072 is the elevation of the roof.
195	340 486.51	327 177.85	308.504	Trig	Signalized.
200	340 760.20	324 026.20	314 259	GPS	Signalized.
220	338 474.60	330 017.70	213 335	GPS	Signalized.
230	329 781.10	333 014.00	222.508	3 rd	Signalized.
239	335 080.40	334 418.44	259.88	3 rd	
779B	337 437.57	331 508.00	272 651	Trig	Signalized.
904	340 758.98	321 262.36	311.297	Trig	Signalized.
3150			270.911		
4152	336 597.15	332 494.25	276.17	Trig	Signalized.
4153	334 488.47	333 174.15	258.302	Trig	

3rd : Third order leveling
Trig : Trigonometric leveling
GPS : GPS Observation

**Table IX3.1: Control Points in the N'FIFIKH site
(B: Newly established Control Point)**

Name	X	Y	Elevation		Note
CPN-1	338 546.26	325 244.82	215.647	Trig	Monumented and Signalized.
CPN-2	332 536.66	332 768.10	241.595	3 rd	Monumented and Signalized.
CPN-3	334 435.88	331 993.48	256.098	Trig	Monumented and Signalized.
CPN-4	327 870.06	336 803.44	181 166	GPS	Monumented and Signalized.
CPN-5	327 539.84	341 129.30	150.403	3 rd	Monumented and Signalized.
CPN-6	321 612.54	347 025.09	46.216	3 rd	Monumented and Signalized.
CPN-7	325 166.32	352 096.39	21.692	3 rd	Monumented and Signalized.
CPN-8	323 984.14	348 890.81	43.955	3 rd	Monumented and Signalized.
CPN-9	327 792.45	348 758.05	82.251	3 rd	Monumented and Signalized.
CPN-10	324 186.74	338 751.43	181.119	3 rd	Monumented and Signalized.
CPN-11	325 012.07	341 233.99	157.673	3 rd	Monumented and Signalized.
CPN-14	346 539.12	308 305.07	250 491	GPS	Monumented and Signalized.
CPN-15	347 790.36	309 267.28	253 871	GPS	Monumented and Signalized.

3rd : Third order leveling
Trig : Trigonometric leveling
GPS : GPS Observation

**Table IX3.1: Control Points in the N'FIFIKH site
(C: Existing Bench Mark - Third Order Leveling)**

Name	Elev.	Ignored Existing Data	Note
RN 41	82.032		Adopted as the reference BM.
RN 42	83.885	(83.900)	The leveling results of this BM didn't coincide with the existing Data. Therefore this wasn't adopted as reference BM.
RN 44	16.959		Adopted as the reference BM.
RN 44-	46.69		Adopted as the reference BM.
RN 45	66.095	(65.488)	The leveling results of this BM didn't coincide with the existing Data. Therefore this wasn't adopted as reference BM.
RN 46		(66.678)	The leveling results of this BM didn't coincide with the existing Data. Therefore this wasn't adopted as reference BM.
RN 46-I		(73.025)	The leveling results of this BM didn't coincide with the existing Data. Therefore this wasn't adopted as reference BM.
RNG 3	81.802		Adopted as the reference BM.
RNG 4	94.254		Adopted as the reference BM.
RNG 10	197.334	(197.429)	The leveling results of this BM didn't coincide with the existing Data. Therefore this wasn't adopted as reference BM.
RNG 12	235.908	(236.049]	The leveling results of this BM didn't coincide with the existing Data. Therefore this wasn't adopted as reference BM.
RNG 13	241.421	(241.591)	The leveling results of this BM didn't coincide with the existing Data. Therefore this wasn't adopted as reference BM.
RNG 15	249.625	(249.852)	The leveling results of this BM didn't coincide with the existing Data. Therefore this wasn't adopted as reference BM.

**Table IX3.1: Control Points in the N'FIFIKH site
(D: Newly established Bench Mark - Third Order Leveling)**

Name	X	Y	Elevation	Note
RN 1	 	 	131.505	Monumented.
RN 2	 	 	137.712	Monumented.
RN 3	 	 	152.197	Monumented.
RN 4	 	 	157.844	Monumented.
RN 5	 	 	173.274	Monumented.
RN 6	 	 	182.923	Monumented.
RN 7	 	 	188.777	Monumented.
RN 8	 	 	199.82	Monumented.
RN 9	345 494.93	312 159.60	234.948	Monumented and Signalized
RN 10	345 697.53	311 951.12	219.128	Monumented.

**Table IX3.2: Control Points in the TASKOURT site
(A: Triangulation Station)**

Name	X	Y	Elev.		Note
1	205 091,900	90 277,300	606.472	3 rd	Signalized
56	200 013,800	84 524,200	633.13	3 rd	Signalized
57	200 781,870	94 625,910	543.543	3 rd	Signalized
58	201 281.000	90 546.900	594 337	3 rd	Signalized
59	201 371,160	80 661.600	696 185	Trig	Signalized
60	201 636,863	86 342,778	635 729	3 rd	Signalized
63	204 352,740	78 650,390	783 043	Trig	Signalized
1406	203 841,800	83 462,500	685 419	Trig	Signalized
3489 (65)	205 107,950	85 958,950	647 335	3 rd	Signalized
6700	210 023,000	74 769,500			Small
3 rd	: Third order leveling				
Trig	: Trigonometric leveling				

**Table IX3.2: Control Points in the TASKOURT site
(B: Newly established Control Point)**

Name	X	Y	Elev.		Note
CPT - 1	203 362,795	89 073,906	610 052	3 rd	Monumented / Signalized
CPT - 2	200 132,853	89 267,949	598 134	3 rd	Monumented / Signalized
CPT - 8	207 026,808	85 121,872	694 491	3 rd	Monumented / Signalized
CPT - 10	212 145,904	76 325,507	914 748	Trig	Monumented / Signalized
CPT - 11	210 580,639	81 028,496	801 047	3 rd	Monumented / Signalized
CPT - 12	208 835,539	72 932,367	874 862	Trig	Monumented / Signalized
CPT - 13	209 594,228	72 819,669	984 967	Trig	Monumented / Signalized
CPT - 14	207 902,153	71 335,208	938 748	Trig	Monumented / Signalized
CPT - 15	205 897,692	69 242,047	958 128	3 rd	Monumented / Signalized
CPT - 16	205 064,108	69 355,143	1 036,251	Trig	Monumented / Signalized
CPT - 17	205 476,247	67 346,942	1 015,844	Trig	Monumented / Signalized
CPT - 18	203 153,101	62 162,431	1 134,103	Trig	Monumented / Signalized
CPT - 19	204 592,136	61 874,035	1 171,071	Trig	Monumented / Signalized
CPT - 20	208 566,449	77 901,010	895 194	Trig	Monumented / Signalized
CPT - 21	207 387,052	69 787,415	1 003,127	3 rd	Monumented / Signalized
CPT - 22	206 752,851	69 708,808	957 106	3 rd	Monumented / Signalized
CPT - 23	206 323,699	96 420,566	535 570	3 rd	Monumented / Signalized
CPT - 24	207 710,503	91 508,776	581,40	3 rd	Monumented / Signalized
CPT - 25	209 373,972	85 688,008	705 490	3 rd	Monumented / Signalized

3rd : Third order leveling
 Trig : Trigonometric leveling

**Table IX3.2: Control Points in the TASKOURT site
(C: Existing Bench Mark)**

Name	Elev	Note
RN 23	577.052	
RN 24	590.895	Adopted as the reference BM

**Table IX3.2: Control Points in the TASKOURT site
(D: Newly established Bench Mark)**

In the Taskourt area all points were surveyed their coordinates. Some of the control points were measured their elevation with third order leveling. They may serve as the third order Bench Mark, too.

**Table IX3.3: Control Points in the AZGHAR site
(A: Triangulation Station)**

Name	X	Y	Elev.		Note
3	599 091,648	359 563,830	993 615	GPS	GPS survey results didn't coincide with existing coordinates. Existing coordinates of this station were ignored in this computation.
12	586 100,310	353 634,950	1 214 137	Trig.	Signalized
13	596 684,330	354 866,060	917 593	Trig.	Signalized

**Table IX3.3: Control Points in the AZGHAR site
(B: Newly established Control Point)**

Name	X	Y	Elev.		Note
S - 11			825 860	3 rd	Signalized
S - 14	592 899,795	356 064,666	859 456	3 rd	Signalized
S - 17	593 046,482	353 558,863	772 589	3 rd	Signalized
S - 21			754 580	Trig.	Signalized
S - 23	585 562,623	350 362,752	871 305	Trig.	Signalized
S - 24	591 700,423	351 916,835	826 226	Trig.	Signalized
S - 25	598 717,771	354 342,798	861 728	3 rd	Signalized
S - 26	603 252,717	356 716,836	902 757	Trig.	Signalized
S - 26-1			901.246	Trig.	Signalized
S - 27	601 363,074	359 541,784	912 037	Trig.	Signalized

**Table IX3.3: Control Points in the AZGHAR site
(C: Existing Bench Mark)**

Name	Elev.	Note
RNG 72	495.621	Adopted as the reference BM
RNG 74	541.903	

**Table IX3.3: Control Points in the AZGHAR site
(D: Newly established Bench Mark)**

Name	X	Y	Elev.		Note
TBM 1	585 215,099	351 508,973	769.429	Trig	Monumented / Signalized
TBM 2	586 938,251	353 268,757	847.67	Trig	Monumented / Signalized
TBM 3	590 049,069	353 441,146	832.835	3 rd	Monumented / Signalized
TBM 4	595	356	849.967	3 rd	Monumented / Signalized
TBM 5	629,291	376,641	836.286	3 rd	Monumented / Signalized
TBM 6	595 629,291	356 376,641	829.957	3 rd	Monumented / Signalized
TBM 7	598 981,683	357 406,187	839.915	3 rd	Monumented / Signalized
TBM 8	601 284,715	357 833,163	878.681	3 rd	Monumented / Signalized
TBM 9	598 680,871	357 422,647			Monumente

Rural Area in

*Feasibility Study on Water Resources Development in
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Kingdom of Morocco

Final Report

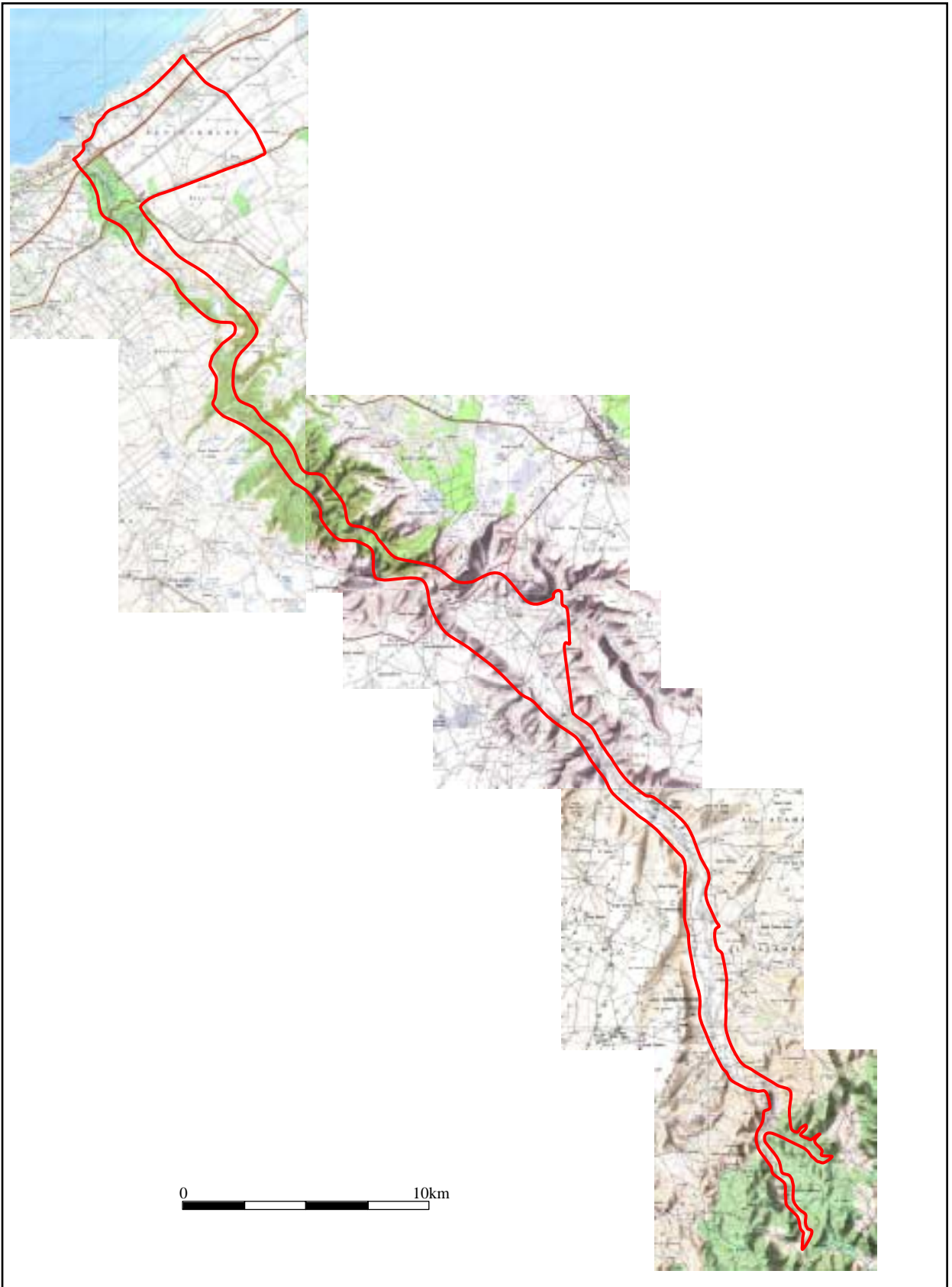
Volume IV Supporting Report (2.A)

Feasibility Study

Supporting Report IX

Aero-photo and Ground Survey

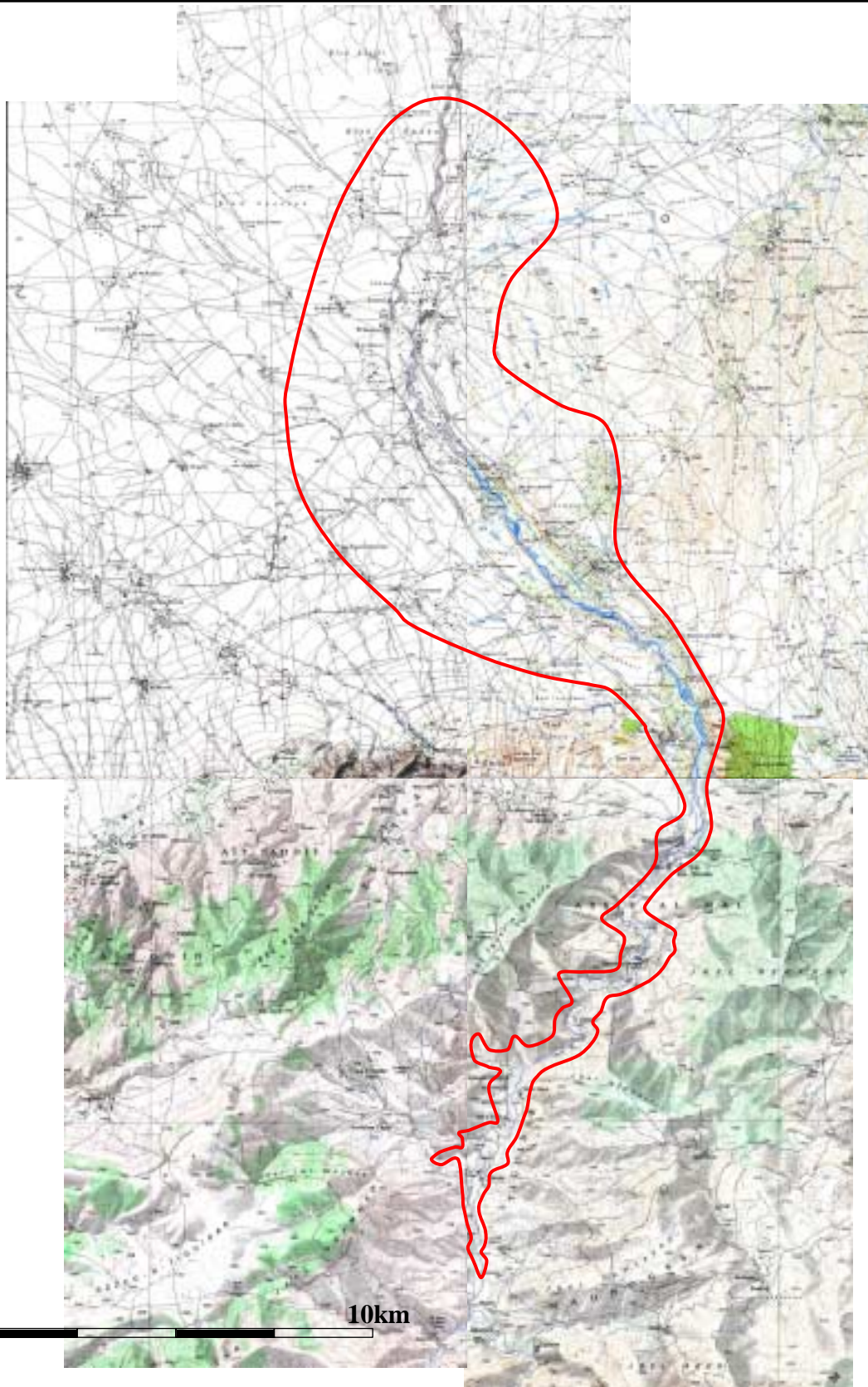
Figures



FEASIBILITY STUDY ON
 WATER RESOURCES DEVELOPMENT
 IN RURAL AREA

Figure IX3.1
A : Mapping Area of No. 5
N'Fifikh

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 IN RURAL AREA

Figure IX3.1
B : Mapping Area of No. 9
Taskourt

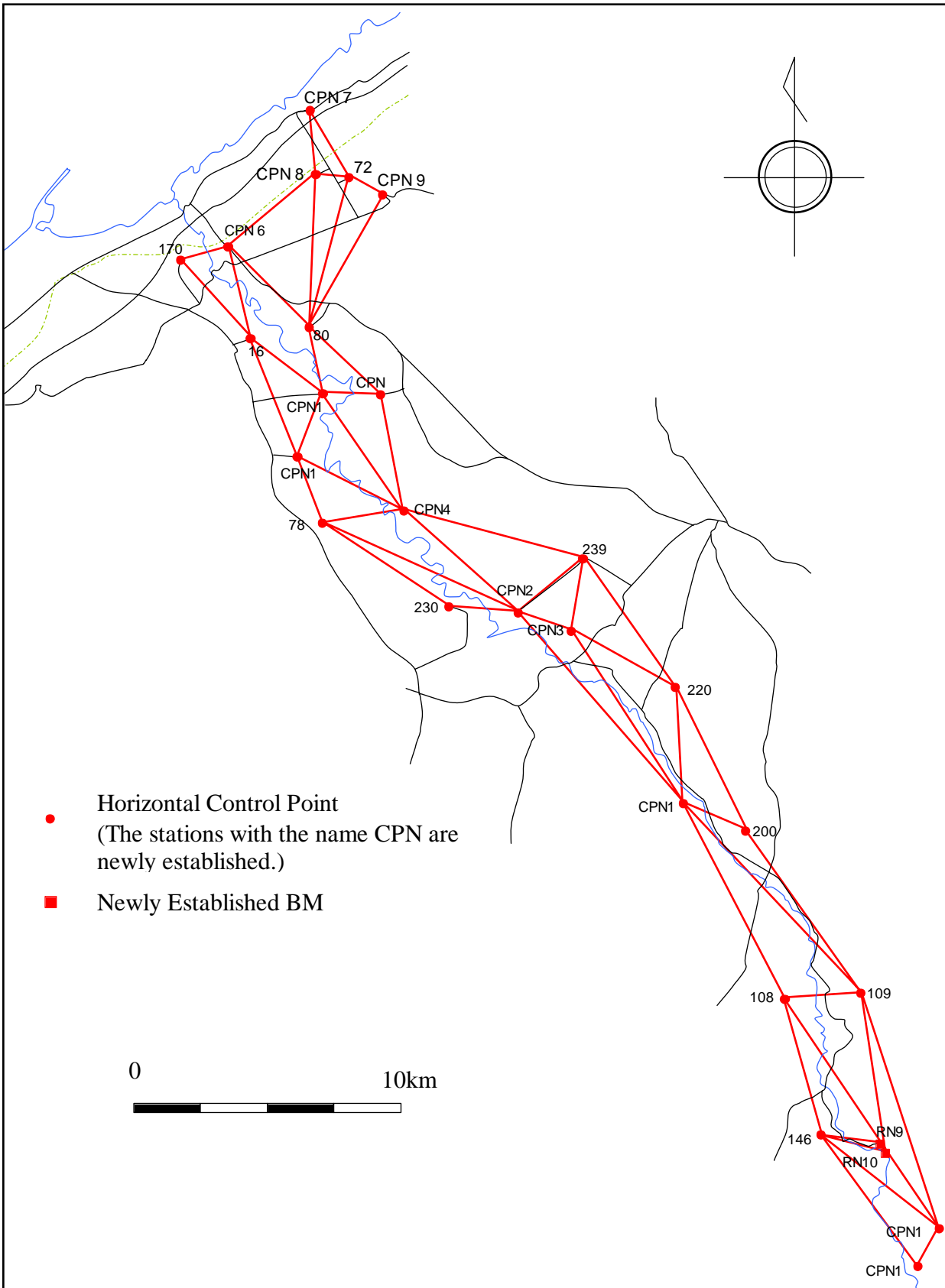
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 IN RURAL AREA

Figure IX3.1
C : Mapping Area of No. 17
Azghar

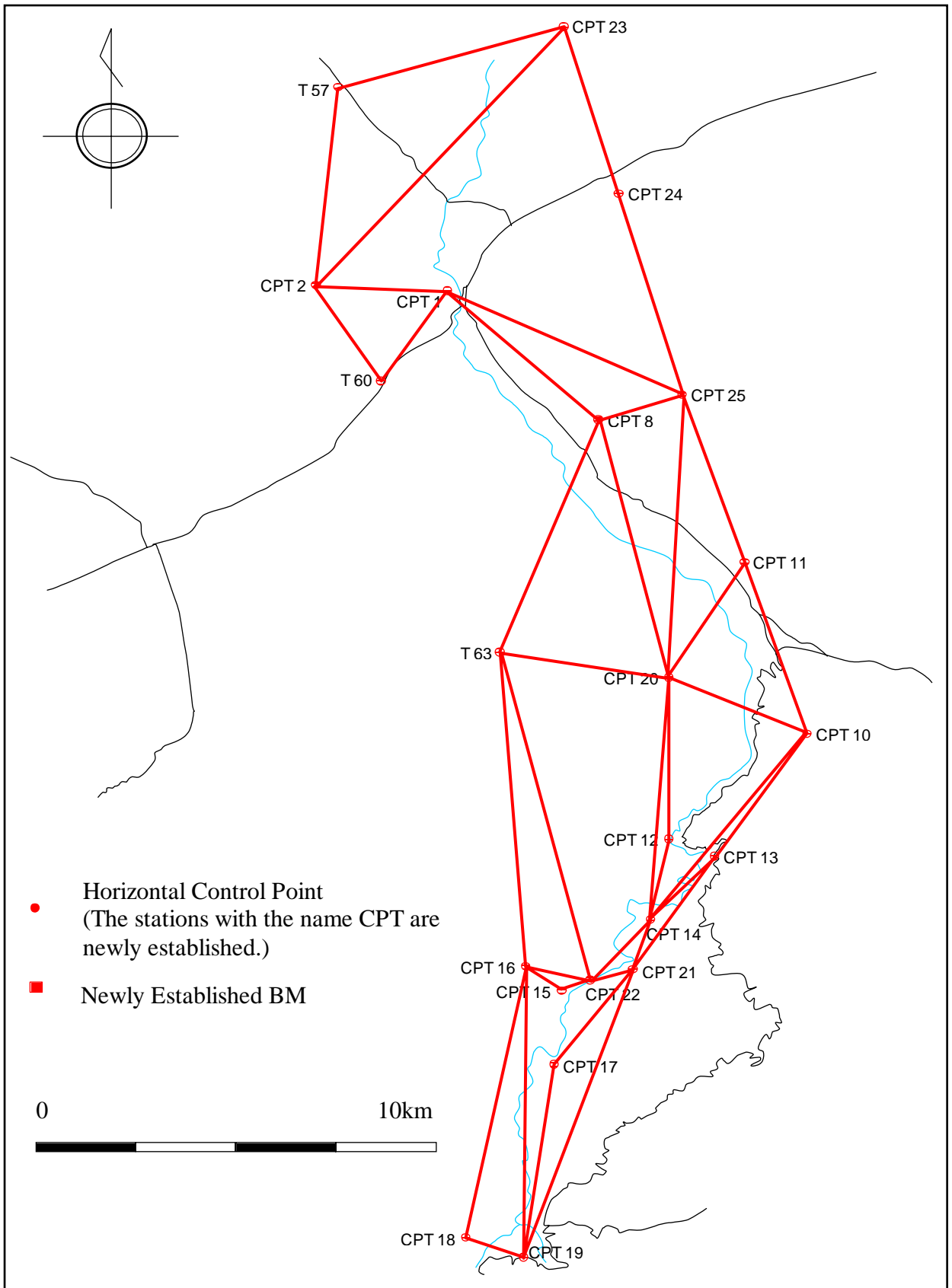
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 IN RURAL AREA

Figure IX3.2
A : GPS Observation
Network (N'Fifikh)

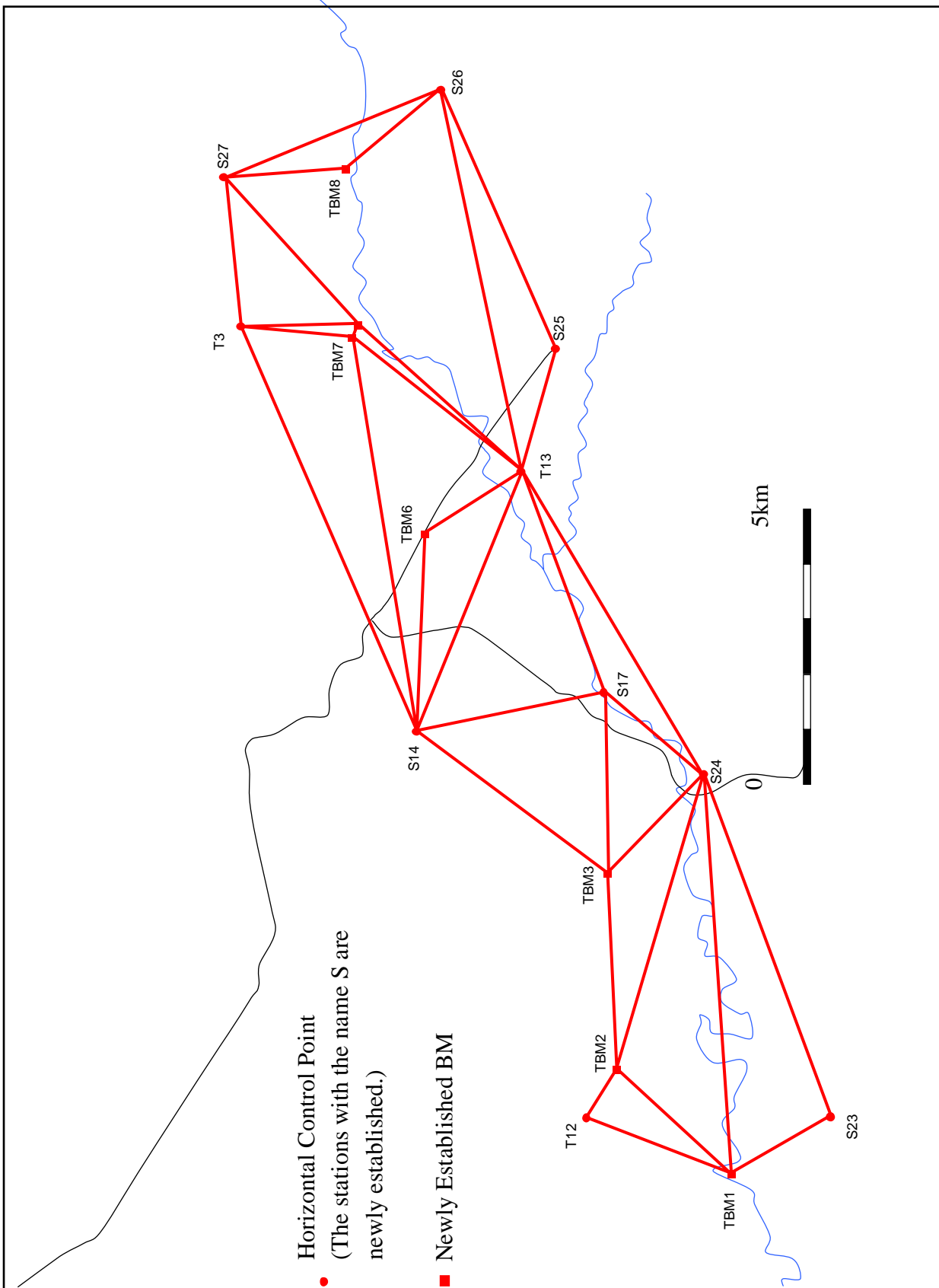
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IN RURAL AREA

Figure IX3.2
B : GPS Observation
Network (Taskourt)

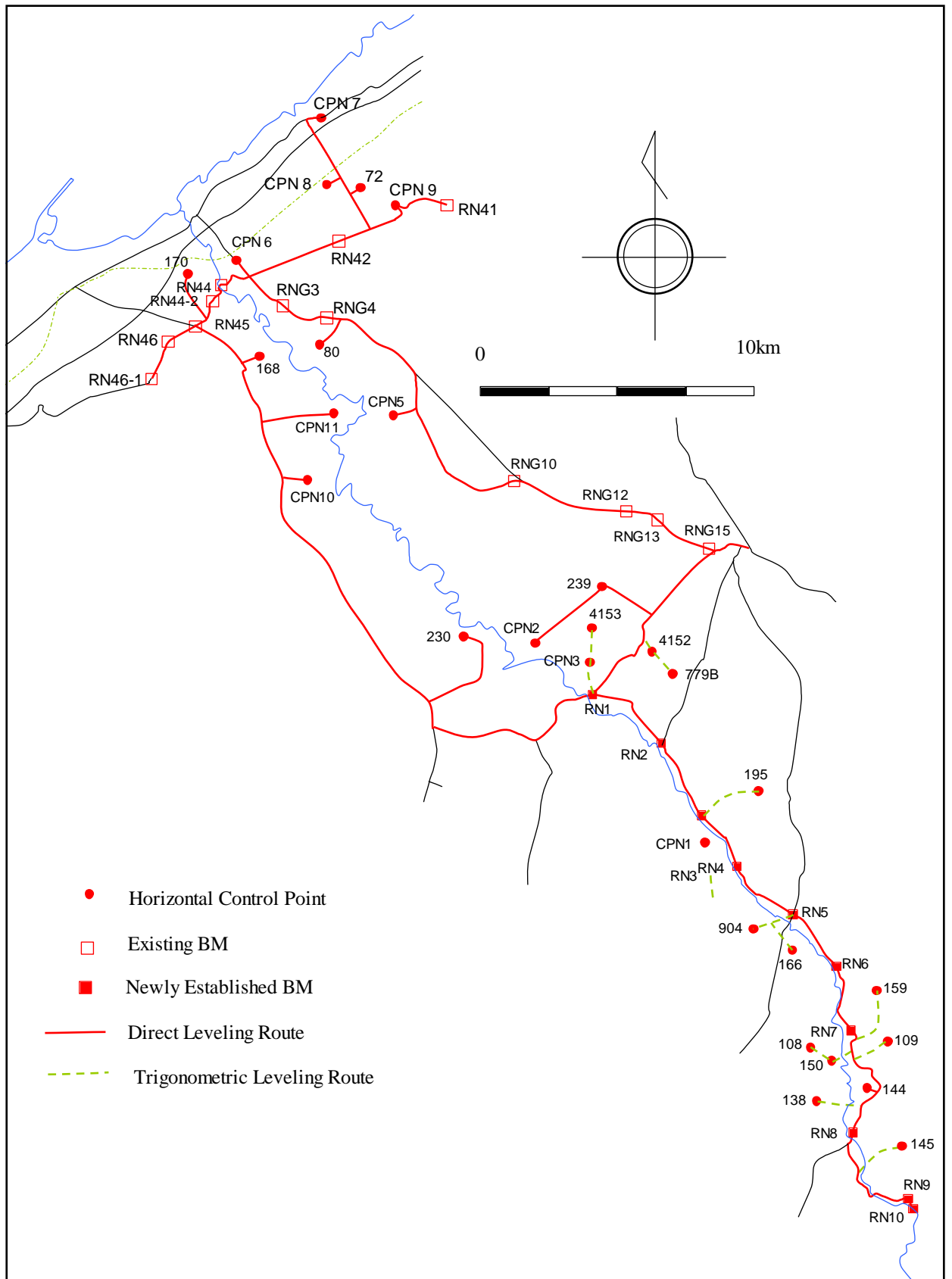
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IN RURAL AREA

Figure IX3.2
C : GPS Observation
Network (Azghar)

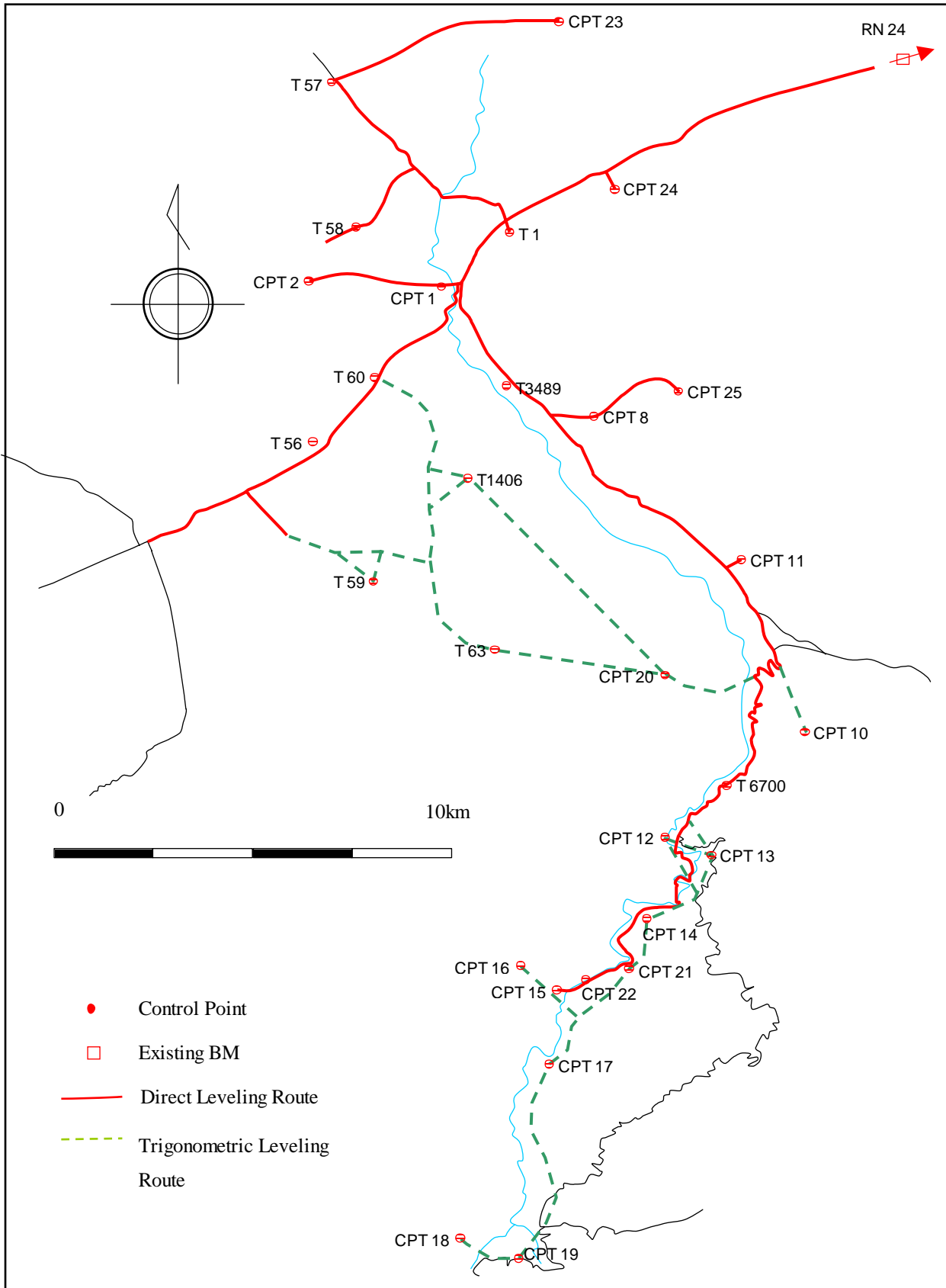
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Figure IX3.3
A : Leveling Network
(N'Fifikh)

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 WATER RESOURCES DEVELOPMENT
 IN RURAL AREA

Figure IX3.3
B: Leveling Network
(Taskourt)

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Figure IX3.3
 C : Leveling Network
 (Azghar)

