

*L'étude de Faisabilité Pour Le Développement des Ressources En Eau
Par Les Barrages Moyens Dans Le Milieu Rurale Au
Royaume Maroc
Rapport Final
Volume III Rapport de Soutien (1)
sur Étude de Base*

Rapport de Soutien VII:

***Developpement
des Projets***

**L'ETUDE DE FAISABILITE
POUR
LE DEVELOPPEMENT DES RESSOURCES EN EAU
PAR
LES BARRAGES MOYENS DANS LE MILIEU RURALE
AU ROYAUME MAROC**

RAPPORT FINAL

**VOLUME III
RAPPORT DE SOUTIEN (1)
SUR ÉTUDE DE BASE**

**RAPPORT DE SOUTIEN VII
DEVELOPPEMENT DES PROJETS**

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RAPPORT VII

DEVELOPPEMENT DE LA TAILLE DES PROJETS

VII1 Résultats de l'Etude

Les plan de développement des barrages, des superficies irriguées et de l'AEP pour chaque projet déterminés par l'Etude, sont présentés dans les Tableaux et Figures ci-jointes.

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Tables

Table VIII.1.1 Plan de Developpement pour le Projet Propose (No.1 NECKOR)

General (Dam Site)								
Objective	Zone	Watershed	River	Province	(1:50,000)	Coordinate	Location	Study level
sediment retaining for El Khattabi large dam	I	Neckor A=710km ²	Neckor	Al Hoceima	Al Hoceima	X=649.000 Y=496.035	5 km from Beni Bouayach and 1.5 Km by walk	F/S terminated (APD terminee)
Hydrology								
Catchment of dam			Flow Station		Annual Flow	Flow Pattern		
(1)			(2)		(3)	(4)		
Basin area (Adam): 710 km ² River system: Neckor River			Name: Takenfoust Asta: 292 km ² (Asta/Adam: 0.4) Data period: 6 yrs.		0.37 m ³ /s 11.7 Mm ³ /yr 16 mm/yr	Peak flow in: Dec, Mar High flow in: 9 mon.(Oct-Jun) 50%-flow day: 99 days		
Geology								
Left Abutment of Damsite	Riverbed		Right Abutment			Reservoir		
(11)	(12)		(13)			(14)		
Weathered Rock: Ep=8m	Alluvial deposits: Ep=max.32m Bedrock is weathered in general.		Weathered Rock: Ep=16m Overburden: Ep=about 10m			River deposits: very thick Overburden: develops well as Talus and Colluvial deposits Terrace deposits: developing along both banks Bedrock: Alternation of Schist, Sandstone and Quartzite		
Comment	The river is on some geologically tectonic zone so that the sedimentation on the river bed is much and very thick. Dam body is to be on the foundation of alluvial deposits, then the bearing capacity and permeability is the problem. Basement rocks consist of sandy schist and quartzite with many quartz vein strongly folded and mineralized by iron.						Note: Ep: Thickness	
Dam Planning								
Dam Type			Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.
(21)			(22)	(23)	(24)	(25)	(26)	(27)
The dam-site has very deep alluvium deposits (about 20 m) under the wide river bed. A homogeneous fill dam which can be possible to place mostly on them is suitable			356m/36.45m	1,577,000 m ³	15.6MCM	183.00 NGM	R.P.:1000 year, Qin=4500m ³ /s, Qout=3740m ³ /s	
Comment	There demands sub-dam by fill type dam on the left abutment. The main dam and sub-dam are required to dig deep excavation in the core trench . At the actual construction stage the excavation for deep alluvium foundation might demand careful work and treatment against emersion of ground water. The spillway may planned on the left abutment of rock foundation being located between main dam and sub-dam.							
Agriculture (Based on the data on beneficial commune(s))								
Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)
Nekor	1	5,994	590	836	-	-	-	-
Comment	No Irrigation Scheme Project							
Irrigation Planning								
Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation	Design Discharge m ³ /s	Main Canal	Secondary Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)	(43)	(44)	(45)	(41)	(41)
-	-	-	-	-	-	-	-	-
Water Supply Planning								
Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm ³ /year)	Facilities	Others
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)
-	-	-	-	-	-	-	-	-
Comment	This project includes no water supply scheme.							
Flood and Sediment Control								
Disasters			Suffering object	Effects of dam		Reservoir sedimentation	Others	
(61)			(62)	(63)		(64)	(65)	
Sedimentation problem of El Kattabi dam. No serious flood damage after dam completion.			El Kattabi dam.	Sediment control for El Kattabi dam		DS: 3333 m ³ /km/yr VS: 3.800 Mm ³ /yr		
Comment	Alternative studies are not available for the measures to cope with the sedimentation problem of El Kattabi dam.							

Table VIII.1.2 Plan de Developpement pour le Projet Propose (No.2 TIZIMELLAL)

General (Dam Site)									
Objective	Zone	Watershed	River	Province	(1:50,000)	Coordinate	Location	Study level	
sediment retaining for Al Wahda dam, irrigation		Oulgha, tributary of Sebou, A=170km ²	Oued Mengou	Al Hoceima	Targuist	X=592.650 Y=471.900	direct distance 13 km from Targuist	F/S terminated	
Hydrology									
Catchment of dam			Flow Station			Annual Flow	Flow Pattern		
(1)			(2)			(3)	(4)		
Basin area (Adam): 170 km ² River system: Sebou/ Mengou River			Name: Tamchachete Asta: 138 km ² (Asta/Adam: 0.8) Data period: 7 yrs.			1.22 m ³ /s 38.4 Mm ³ /yr 226 mm/yr	Peak flow in: Feb High flow in: 6 mon.(Dec-May) 50%-flow day: 48 days		
Geology									
Left Abutment of Damsite		Riverbed		Right Abutment			Reservoir		
(11)		(12)		(13)			(14)		
Weathered Rock: Ep=2 to 3m, sometimes over 30m Bedrock: Upper Portion is more cracky than that of Right Abutment		Alluvial deposits: Ep=1 to 2m Upper zone of relatively sound rock(Vp=1.9): Ep=2 to 3m Fresh Rock: Vp=4.4		Loosened rock(Vp=0.5 to 0.7): Ep=about 4m Mid hard relatively sound rock(Vp=2.6): gradually deeper reaching up to 20m as proceeding to mountain side			River/Terrace deposits: along river course Talus deposits: thick Bedrock: 2/3 of the area is argillaceous and pelitic, remains 1/3 is Schist and Quartzite.		
Comment	The dam site is a ravine with both abutments of vertical cliff. No problems is identified on strength of foundation and leakage since the foundation rocks are hard and massive.							Note: Ep: Thickness	
Dam Planning									
Dam Type				Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.
(21)				(22)	(23)	(24)	(25)	(26)	(27)
The site ia V shape valley. The good foundation rock is out-cropped in the river-bed.. A concrete gravity type,RCC, is suitable.				233.3 m/78.0 m	150,000 m ³	21.28MCM	1090.00 NGM	R,P;10000 year, Qin=2500m ³ /s Qout=2000m ³ /s	
Comment									
Agriculture (Based on the data on beneficial commune(s))									
Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)	
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	
Targuist	1	453	2	61	2,339	Barley Soft Wheat Almond	1) Wheat 2) Olive 3) Almond 4) Fodder 5) Vegetable	14,200	
comment	Very limited irrigable area Hilly cultivated area								
Irrigation Planning									
Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation		Design Discharge m ³ /s	Main Canal	Secondary Canal	Headwork	Other Facility
(41)	(42)	(43)	(41)		(43)	(44)	(45)	(41)	(41)
-	-	-	-		-	-	-	-	-
Water Supply Planning									
Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm ³ /year)	Facilities	Others	
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)	
-	-	-	-	-	-	-	-	-	
comment	This project includes no water supply scheme.								
Flood and Sediment Control									
Disasters			Suffering object		Effects of dam		Reservoir sedimentation	Others	
(61)			(62)		(63)		(64)	(65)	
No serious flood damage.			Farmlands		Sediment control effect to Al Wahdas will be negligible small.		DS: 2876 m ³ /km/yr VS: 0.489 Mm ³ /yr		
Comment	Judging from catchment size and distance from Al Wahda dam, sediment control effect will be negligible small.								

Table VIII.1.3 Plan de Developpement pour le Projet Propose (No.3 AIT BATDDU)

General (Dam Site)								
Objective	Zone	Watershed	River	Province	(1:50,000)	Coordinate	Location	Study level
sediment retaining for Sidi Driss		Oum Er R'bia A=194km ²	Oued Ta'Init	Azilal	Tannant	X=353.600 Y=140.000	Azilal	P/S terminated
Hydrology								
Catchment of dam		Flow Station			Annual Flow	Flow Pattern		
(1)		(2)			(3)	(4)		
Basin area (Adam): 194 km ² River system: Oum Er R'bia/ Tesaout/ Lakhdar Rivers		Name: Ait Segmine Asta: 461km ² (Asta/Adam: 2.4) Data period: >20 yrs.			0.89 m ³ /s 27.9 Mm ³ /yr 144 mm/yr	Peak flow in: Mar, Jul High flow in: 9 mon.(Nov, Jan-Aug) 50%-flow day: 25 days		
Geology								
Left Abutment of Damsite	Riverbed	Right Abutment			Reservoir			
(11)	(12)	(13)			(14)			
<u>Overburden</u> : very thin surface soil	<u>Overburden</u> : few meters silty soil	<u>Overburden</u> : Talus/Terrace deposits, reddish brown silty soil <u>Travertine</u> : covering bedrock at the foot			<u>Travertine/Colluvial deposits</u> : mainly in the right bank slope <u>Bedrock</u> : Alternation of Limestone and Marly Limestone <u>Karst</u> : some possibility in Limestone			
Comment	Basement rocks are composed of the alternation of limestone and marly limestone. It is observed that the bedding plane is sometimes soluble then leakage may occur. Some springs are observed in the upstream side and the downstream side.							
Dam Planning								
Dam Type			Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.
(21)			(22)	(23)	(24)	(25)	(26)	(27)
Both abutments are moderate. The foundation rock is relatively soft. However a gravity type dam is possible.			220m/54m	360,000 m ³	12.44 MCM	790.00 NGM		
Comment	The foundation of dam site and reservoir is limestone. In the reservoir area there exist several springs utilized for local society. Leakage from reservoir will be anticipated.							
Agriculture (Based on the data on beneficial commune(s))								
Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)
Ait Baddou	2	10,890	427	2,867	2,281	Soft Wheat Hard Wheat Fodder Almond	1) Wheat 2) Olive 3) Almond 4) Vegetable 5) Fodder	10,700
Comment	Very limited irrigable area 20ha of farmland will be inundated by dam construction							
Irrigation Planning								
Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation	Design Discharge m ³ /s	Main Canal	Secondary Canal	Headwork	Other Facility
(41)	(42)	(43)	(41)	(43)	(44)	(45)	(41)	(41)
-	-	-	-	-	-	-	-	-
Water Supply Planning								
Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm ³ /year)	Facilities	Others
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)
-	-	-	-	-	-	-	-	-
comment	This project includes no water supply scheme.							
Flood and Sediment Control								
Disasters		Suffering object		Effects of dam		Reservoir sedimentation		Others
(61)		(62)		(63)		(64)		(65)
Flooding, but not so serious.		Sidi Driss dam with severe sedimentation problem, and farmlands		Sediment control for Sidi Driss dam, and flood control for local farmlands.		DS: 1200 m ³ /km/yr VS: 0.250 Mm ³ /yr		
Comment								

Table VIII.1.4 Plan de Developpement pour le Projet Propose (No.4 AIN KAWACHIYA)

General (Dam Site)									
Objective	Zone	Watershed	River	Province	(1:50,000)	Coordinate	Location	Study level	
irrigation		Slopes toward Atlantic, A=162 km ²	Oued Khellata	Ben Siimene	Temara	X=360.200 Y=353.500	3km from Sidi Yahia, 5.5km on trail	F/S terminated	
Hydrology									
Catchment of dam		Flow Station			Annual Flow	Flow Pattern			
(1)		(2)			(3)	(4)			
Basin area (Adam): 162 km ² River system: Iquem/ Khellata River		Name: Cheikh Reguig Asta: 518 km ² (Asta/Adam: 3.2) Data period: >20 yrs.			0.21 m ³ /s 6.6 Mm ³ /yr 41 mm/yr	Peak flow in: Jan High flow in: 5 mon.(Oct, Dec-Mar) 50%-flow day: 9 days			
Geology									
Left Abutment of Damsite		Riverbed		Right Abutment		Reservoir			
(11)		(12)		(13)		(14)			
Colluvial Top layer: Ep=1 to 3m Weathered rock: very loosened rubble Schist, Ep=2 to 3m		Generally covered by gravel tracing silty cohesive soil, thickness of which 3 to 4m.		Top soil: very thin		Bedrock: Sandy Schist, Micaceous Sandstone, Quartzite, Limestone and Cglomerate Bedding and Schistosity: crossing right to river course(N140 to N180), vertical			
Comments	Foundation is mainly composed of Sandy Schist and alternating with Quartzite. Both banks are covered by surface 1m thick soil and 2 to 3m thick of bedrock is very weathered underlain by slightly weathered rocks. Some meters of cohesive soils sediment in the bottom of valley. Fresh Quartzite outcrops crossing with the river in low angle.							Note: Ep: Thickness	
Dam Planning									
Dam Type			Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.	
(21)			(22)	(23)	(24)	(25)	(26)	(27)	
The design discharge is not large. And both abutments have moderate slopes. Fill dam ia rather preferable than RCC.			212.5m/29.5m	RCC:78,000 m ³	11.0 MCM	185.00 NGM	R.P.;1000year Qin=450m ³ /s Qout=250m ³ /s		
Comment	For the case of fill type dam a spillway may be placed on the right abutment to obtain the sound foundation with less excavation. A gravity dam by RCC (dam volume; 78,000m ³) is also possible. However, sands and gravel for concrete are not easily taken nearby. Final selection of dam type should be done								
Agriculture (Based on the data on beneficial commune(s))									
Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)	
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	
Sidi Yahia Zaer	1	15,926	883	1,281	8,508	Soft Wheat Vegetables Grapes Fodder	1) Wheat 2) Vegetable 3) Olive 4) Grape 5) Fodder	9,700	
Comments	Limited groundwater for irrigation Farms are damaging by salt accumulation in soil Greenhouse are commonly facilitated. High potential for marketability								
Irrigation Planning									
Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation		Design Discharge m ³ /s	Main Canal	Secondary Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)		(43)	(44)	(45)	(41)	(41)
500 ha	41	3.5 MCM	Furrow Border Basin		0.5 m ³ /s	-	5 km	Weir : 1 Pump Station : 1	5 nos
Water Supply Planning									
Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm ³ /year)	Facilities	Others	
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)	
Irrigation area and suuounding area of the dam			100	Ministry of Equipment	Commune or farmers' association	0.001	Filter facility, Reservoir, Transmission line, Stand pipes		
Comments	Domestic water supply within the irrigation area and surrounding area of the dam is considered. Irrigation facilities will be utilized for water conveyance								
Flood and Sediment Control									
Disasters		Suffering object		Effects of dam		Reservoir sedimentation		Others	
(61)		(62)		(63)		(64)		(65)	
Flooding.		Sidi Yahya town, public facilities and farmlands		Flood control for Sidi Yahya town and surrounding areas.		DS: 1049 m ³ /km/yr VS: 0.170 Mm ³ /yr			
Comment									

Table VII1.1.5 Plan de Developpement pour le Projet Propose. (No.5 N'FIFIKH)..

General (Dam Site)									
Objective	Zone	Watershed	River	Province	(1:50,000)	Coordinate	Location	Study level	
irrigation, flood controle		A=300 km2	Oued Daliya	Ben Slimene	Al Gara	X=345.820 Y=311.930	direct distance 25 km from Ben Slimane	not yet	
Hydrology									
Catchment of dam			Flow Station			Annual Flow	Flow Pattern		
(1)			(2)			(3)	(4)		
Basin area (Adam): 300 km2 River system: N'fifikh River			Name: Feddane Taba Asta: 606 km2 (Asta/Adam: 2.0) Data period: >20 yrs.			0.28 m3/s 8.8 Mm3/yr 7 mm/yr	Peak flow in: Feb High flow in: 5 mon.(Nov-Mar) 50%-flow day: 6 days		
Geology									
Left Abutment of Damsite	Riverbed		Right Abutment			Reservoir			
(11)	(12)		(13)			(14)			
No Cover	River deposit: sand and gravel Alluvial Terrace deposit: along right bank side, fine sand to sandy silt, Ep=2 to 3m		No Cover			River deposits: on the river Terrace deposits: extending widely Bedrock: mainly the alternation of Sandstone and Schist, interbedded with Quartzite			
Comment	Along dam axis, bedrock is composed of rightstanding Quartzite bar of approximately 10 m thickness. In both of the upstream and downstream side, the alternation of quartzitic sandstone and schistosed slate of unit layer of 2 to 20 cm thickness form bedrock. Those are strongly folded, and Slate is fissile. In the case of concrete dam, the foundation may be unstable due to the thickness of Quartzite not enough.						Note: Ep: Thickness		
Dam Planning									
Dam Type				Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.
(21)				(22)	(23)	(24)	(25)	(26)	(27)
Both abutments have moderate slopes, and are somewhat, especially for the left abutment, deep to reach the sound foundation rock. A zoned fill type might be preferable. Spillway could be on the right abutment				250m/33m	420,000 m3	8 MCM	NGM 238.5	R.P.:1000year Qin=693m3/s R.P.:5000year Qin=941m3/s	
Comment	The site of N'Fifikh downstream has progressed studies. But the site recommended by our JICA team is N'Fifikh upstream, and its comparative study has performed only. To proceed to F/S geological and topographical surveys are required. Final selection of dam type should be done after the comparative study.								
Agriculture (Based on the data on beneficial commune(s))									
Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)	
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	
N'Fifikh	3	32,797	913	3,504	6,462	Soft Wheat Hard Wheat Legume Vegetables Fodder	1) Wheat 2) Vegetable 3) Olive 4) Grape 5) Fodder	11,700	
Comment	Irrigable are located in river basin. High potential for marketability								
Irrigation Planning									
Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation		Design Discharge m3/s	Main Canal	Secondary Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)		(43)	(44)	(45)	(41)	(41)
800 ha	85	5.7 MCM	Furrow Border Basin		0.8 m3/s	10 km	8 km	Weir : 2	8 nos
Water Supply Planning									
Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm3/year)	Facilities	Others	
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)	
Irrigation area and surrounding area of the dam			200	Ministry of Equipment	Commune or farmers' association	0.002	Filter facility, Reservoir, Transmission line, Stand pipes		
Comment	Domestic water supply within the irrigation area and surrounding area of the dam is considered. Irrigation facilities will be utilized for water conveyance as maximal as possible for securing its economy.								
Flood and Sediment Control									
Disasters			Suffering object		Effects of dam		Reservoir sedimentation		Others
(61)			(62)		(63)		(64)		(65)
Flooding and bank erosion.			Settlement and farmlands.		Flood control and stabilization of river channel.		DS: 319 m3/km/yr VS: 0.098 Mm3/yr		
Comment									

Table VIII.1.6 Plan de Developpement pour le Projet Propose (No.6 TAZARANE).

General (Dam Site)									
Objective	Zone	Watershed	River	Province	(1:50,000)	Coordinate	Location	Study level	
irrigation, sediment retaining for Al Wahda dam		Oulgha, tributary of Sebou, A=30km ²	Oued Malha	Chefchaouen	Tamorot	X=540.100 Y=484.000	55km from Chefchaouen via Bab Bered	F/S terminated	
Hydrology									
Catchment of dam			Flow Station			Annual Flow	Flow Pattern		
(1)			(2)			(3)	(4)		
Basin area (Adam): 30 km ² River system: Sebou/ Aoudour River			Name: Tabouda Asta: 861km ² (Asta/Adam: 28.7) Data period: 18 yrs.			0.38 m ³ /s 11.9 Mm ³ /yr 398 mm/yr	Peak flow in: Feb High flow in: 6 mon.(Nov-Mar, May) 50%-flow day: 16 days		
Geology									
Left Abutment of Damsite	Riverbed		Right Abutment			Reservoir			
(11)	(12)		(13)			(14)			
No Cover <u>Weathered Rock</u> : loose rock, Vp=2.9, Ep=around 20m <u>Bedrock</u> : Alternation of Black Schist and gray Sandy schist, phyllitic	<u>Alluvial deposits</u> : Ep=1 to 3m <u>Weathered Rock</u> : Vp=1.4 to 3.0, Ep=5 to 8m <u>Fresh rock</u> : Vp=4.2, normally homogeneous, sometimes interbedded with thin Quartzite		<u>Overburden</u> : argillaceous Colluvium, Ep=3 to 4m <u>H.Weathered rock</u> : Vp=0.4, Ep=about 1m <u>Cracky rock</u> : Vp=2.5 <u>Fresh rock</u> : Vp=4.5, below 40m from the top			<u>Alluvial deposits</u> : covering 1/3 of the area, mainly rock blocks, sand and gravel <u>Colluvial deposits</u> : relatively thick, silty soil and rock fragments of schist <u>Bedrock</u> : Schist			
Comment	Dam foundation consists of weathered schist. Loose rocks are found even at the portions washed by the river water.						Note: Ep: Thickness Vp: Primary Seismic Velocity		
Dam Planning									
Dam Type			Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.	
(21)			(22)	(23)	(24)	(25)	(26)	(27)	
Schist of dams site is weathered deeply and may not have enough strength for the foundation of gravity type. Slopes of both abutments are moderate. A zoned rock fill dam is recommendable.			215 m / 64 m	416000 m ³	9.2 MCM	580.00 NGM	R.P.;10000year Qin=950m ³ /s Qout=780m ³ /s		
Comment	Schist material around the site is not suitable for dam embankment because of its laminating structure. Most of rock materials may be brought some quarry site. Impervious materials are not abundant near the dam-site, but probably they are obtained in the reservoir area. Concrete facing is also considerable in case core materials is not available nearby. In any case the cost of the dam is somewhat higher than ordinary dam.								
Agriculture (Based on the data on beneficial commune(s))									
Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)	
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	
Tazarane	3	11,758	940	4,117	3,234	Soft Wheat Hard Wheat Almond	1) Wheat 2) Olive 3) Almond 4) Fodder 5) Vegetable	13,300	
Comment	Traditional irrigation facilities are existing. Removing gravels and rocks from farms are necessary in some area Well managed cooperative activities								
Irrigation Planning									
Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation		Design Discharge m ³ /s	Main Canal	Secondary Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)		(43)	(44)	(45)	(41)	(41)
900 ha	315	6.7 MCM	Furrow Border Basin		0.9 m ³ /s	-	9 km	Weir : 2	9 nos
Comment									
Water Supply Planning									
Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm ³ /year)	Facilities	Others	
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)	
Irrigation area and surrounding area of the dam			700	Ministry of Equipment	Commune or farmers' association	0.005	Filter facility, Reservoir, Transmission line, Stand pipes		
Comment	This project is located in Rif Mountains where ground water resource is very scarce; therefore domestic water supply within the irrigation area and surrounding area of the dam is considered. Irrigation facilities will be utilized for water conveyance as maximal as possible for securing its economy.								
Flood and Sediment Control									
Disasters			Suffering object		Effects of dam		Reservoir sedimentation	Others	
(61)			(62)		(63)		(64)	(65)	
No serious flood damage.			Farmlands		Sediment control effect to Al Wahdas will be negligible small.		DS: 3800 m ³ /km/yr VS: 0.114 Mm ³ /yr		
Comment	Judging from catchment size and distance from Al Wahda dam, sediment control effect will be negligible small.								

Table VIII.1.7 Plan de Developpement pour le Projet Propose (No.7 AMEZMIZ)

General (Dam Site)									
Objective	Zone	Watershed	River	Province	(1:50,000)	Coordinate	Location	Study level	
irrigation		Tensift, A=80km ²	Oued Anougal	El Haouz	Azegour	X=226.500 Y= 65.400	Amez Miz	F/S terminated	
Hydrology									
Catchment of dam			Flow Station			Annual Flow	Flow Pattern		
(1)			(2)			(3)	(4)		
Basin area (Adam): 80 km ² River system: Tensift/ N'fiss River			Name: Sidi Hssain Asta: 115 km ² (Asta/Adam: 1.4) Data period: 8 yrs.			0.49 m ³ /s 15.5 Mm ³ /yr 194 mm/yr	Peak flow in: Mar, Dec High flow in: 7 mon.(Oct, Dec-May) 50%-flow day: 82 days		
Geology									
Left Abutment of Damsite		Riverbed		Right Abutment			Reservoir		
(11)		(12)		(13)			(14)		
No Cover		River deposits: sand, gravel of Quartzite, Schist and Granite, Ep=around 10m max.		No Cover			River deposits: relatively thick <u>Overburden</u> : Talus deposits in unstream of Left Bank, relatively thick <u>Bedrock</u> : red color fine Conglomerate, Sandstone, and Shale with gentle bedding dip		
Comment	Dam site is in a steep narrow V-shape valley, however the upper side becomes gentle. Foundation is of relatively fresh Schist and Microgranite dyke which has enough strength. Their joint contacts closely. They are overlain by soft rocks which may necessary to be eliminated.							Note: Ep: Thickness	
Dam Planning									
Dam Type				Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.
(21)				(22)	(23)	(24)	(25)	(26)	(27)
Both abutments have steep slopes with exposures of hard foundation rocks which may bear high stress. Concrete gravity is suitable type. RCC is one of prospective dam type.				265.5m/72.5m	main dam: 241,800m ³ , sub-dam(fill):40,000 m ³	11 MCM	1356.00 BGM	R.p.;1000year Qin=750m ³ /s	
Comment	The site has effective topography to store water. However, on the left abutment it is necessary to settle a sub-dam. Sands and gravel materials are very abundant in the river-bed. To make a economical dam such materials should be utilized. As the dam is fairly large, high stress will act inside the dam body.								
Agriculture (Based on the data on beneficial commune(s))									
Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)	
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	
Amez Miz	3	11,213	5,178	1,986	2,323	Barley Vegetables Olive	1) Wheat 2) Olive 3) Almond 4) Vegetable 5) Fodder	10,600	
Comment	Traditional irrigation facilities are existing. Removing gravels and rocks from farm are necessary in some area High potential for marketability								
Irrigation Planning									
Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation		Design Discharge m ³ /s	Main Canal	Secondary Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)		(43)	(44)	(45)	(41)	(41)
1,500 ha	266	14.2 MCM	Furrow Border Basin		1.5 m ³ /s	16 km	15 km	Weir : 1	11 nos
Water Supply Planning									
Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm ³ /year)	Facilities	Others	
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)	
irrigation area and surrounding			900	Ministry of Equipment	Commune or farmers' association	0.007	Filter facility, Reservoir, Transmission line, Stand pipes		
Comment	This project is located in Atlas Mountains where ground water resource is very scarce; therefore domestic water supply within the irrigation area and surrounding area of the dam is considered. Irrigation facilities will be utilized for water conveyance as maximal as possible for securing its economy.								
Flood and Sediment Control									
Disasters			Suffering object		Effects of dam		Reservoir sedimentation	Others	
(61)			(62)		(63)		(64)	(65)	
Flooding, but not so serious.			Farm lands, settlements, public facilities and livestock.		Flood control, and sediment control of Lalla Takercoust dam.		DS: 280 m ³ /km/yr VS: 0.025 Mm ³ /yr		
Comment									

Table VIII.1.8 Plan de Developpement pour le Projet Propose (No.8 BOULAOUANE.)

General (Dam Site)									
Objective	Zone	Watershed	River	Province	(1:50,000)	Coordinate	Location	Study level	
irrigation		Tensift, A=565km ²	Seksaoua A=565km ²	Chichaoua	Imin Tanoute	X=176.000 Y= 70.000	Sidi Bou Othmane	P/S terminated	
Hydrology									
Catchment of dam			Flow Station		Annual Flow	Flow Pattern			
(1)			(2)		(3)	(4)			
Basin area (Adam): 565 km ² River system: Tensift/ El Rhira River			Name: Illoudjane Asta: 436 km ² (Asta/Adam: 0.8) Data period: 19 yrs.		1.33 m ³ /s 41.8 Mm ³ /yr 74 mm/yr	Peak flow in: Mar, Nov High flow in: 11 mon.(Oct-Aug) 50%-flow day: 51 days			
Geology									
Left Abutment of Damsite	Riverbed		Right Abutment			Reservoir			
(11)	(12)		(13)			(14)			
No Cover	River deposits: relatively thick, mainly sand and gravel Terrace deposits: extending widely		Overburden: Talus deposits, few meters at the foot of slope, loosely cemented by lime partly			River deposits: relatively thick Overburden: Talus deposits, relatively thick Bedrock: Schist, schistose Sandstone, Conglomerate, Dolomite, Limestones and Marl with Gypsum and Anhydrite			
Comments	Both banks of dam axis is composed of the same vertical limestone bars interbedding argillaceous and arenaceous limestone. They are rightstanding. The bedding plane and the joint plane are commonly open which leakage may occur. Careful foundation treatment shall be necessary.							Note: Ep=Thickness	
Dam Planning									
Dam Type				Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.
(21)				(22)	(23)	(24)	(25)	(26)	(27)
A gravity dam is suitable as the right is thin in width. In the riverbed of proposed reservoir sands and gravel deposits are abundant. They are useful materials for RCC.				335m/50.5m	274,000 m ³	10 MCM	786.5 NGM	R.P.;1000year Qin=1740m ³ /s Qout=1610m ³ /s	
Comment	The dam site has a limestone foundation. The dam axis and dam height should be carefully studied considering the formation of limestone layer against leakage of reservoir water. Somewhat costly grouting work will be anticipated. Geological drilling surveys (around 20 holes) has just commenced by Ministry of Equipment.								
Agriculture (Based on the data on beneficial commune(s))									
Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)	
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	
Douirane	1	6,975	4,064	1,428	1,797	Barley Olive Almond	1) Wheat 2) Olive 3) Almond 4) Vegetable 5) Fodder	11,100	
Comments	Traditional irrigation facilities are existing. Removing gravels and rocks from farms are necessary at most of the project area.								
Irrigation Planning									
Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation		Design Discharge m ³ /s	Main Canal	Secondary Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)		(43)	(44)	(45)	(41)	(41)
900 ha	184	8.5 MCM	Furrow Border Basin		0.9 m ³ /s	15 km	9 km	Weir : 1	10 nos
Water Supply Planning									
Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm ³ /year)	Facilities	Others	
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)	
Irrigation area and surrounding			1,000	Ministry of Equipment	Commune or farmers' association	0.007	Filter facility, Reservoir, Transmission line, Stand pipes		
Comments	This project is located in Atlas Mountains where ground water resource is very scarce; therefore domestic water supply within the irrigation area and surrounding area of the dam is considered. Irrigation facilities will be utilized for water conveyance as maximal as possible for securing its economy.								
Flood and Sediment Control									
Disasters			Suffering object		Effects of dam		Reservoir sedimentation	Others	
(61)			(62)		(63)		(64)	(65)	
Flooding and bank erosion			Farmlands, irrigation facilities and settlements.		Flood control and stabilisation of river channel.		DS: 283 m ³ /km/yr VS: 0.160 Mm ³ /yr		
Comment									

Table VII.1.9 Plan de Developpement pour le Projet Propose (No.9 TASKOURT)

General (Dam Site)									
Objective	Zone	Watershed	River	Province	(1:50,000)	Coordinate	Location	Study level	
irrigation		Tensift A=439km ²	Oued Al Mal	Marrakech	Azegour	X=207.000 Y= 69.800	Sidi Bou Othmane	P/S on going	
Hydrology									
Catchment of dam			Flow Station		Annual Flow	Flow Pattern			
(1)			(2)		(3)	(4)			
Basin area (Adam): 439 km ² River system: Tensift/ Assif El Ma R.			Name: Sidi Bouathmane Asta: 510 km ² (Asta/Adam: 1.2) Data period: 11 yrs.		1.17 m ³ /s 37.0 Mm ³ /yr 84 mm/yr	Peak flow in: Mar, Nov High flow in: 6 mon.(Oct-Dec, Feb-Apr) 50%-flow day: 41 days			
Geology									
Left Abutment of Damsite	Riverbed		Right Abutment			Reservoir			
(11)	(12)		(13)			(14)			
Bedrock: mainly hard Sandy rock	River deposits: large volume, very thick, sand and gravel.		Overburden: Talus deposits, few meters, covering the slope Bedrock: Alternation of Sandy Schist and balck Pelitic Schist			River deposits: very thick Weathered rocks: sometimes lying deeply Bedrock: mainly Quartz-Micaceous Schist, Pelitic Schist with many sheared/ fractured zones			
Comments	The river may flow around the geologically tectonic zone so that the much sedimentation on the river bed is observed. Foundation of dam axis is of quartzitic sandstone and pelitic schist showing left bank rightstanding, right bank steep slope and wide riverbed. The joint in the left bank inclines towards river side,								
Dam Planning									
Dam Type			Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.	
(21)			(22)	(23)	(24)	(25)	(26)	(27)	
A gravity dam is suitable as the site is V shape valley with hard rock foundation. In the river-bed of proposed reservoir, sands and gravel deposits are abundant. They are useful materials for RCC			356m/98m	720,000 m ³	106 MCM	1028.0.00 NGM	R.P.;1000year Qin=1130m ³ /s		
Comment	The dam site is located in the deep of mountain. But the river-bed can be used for access. To make a economical dam such materials should be utilized. As the dam is fairly large, high stress will act inside the dam body. A careful study and test for concrete quality, especially for RCC, will be required.								
Agriculture (Based on the data on beneficial commune(s))									
Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)	
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	
Taskoourt	2	13,584	7,684	2,611	1,731	Barley Soft Wheat Olive	1) Wheat 2) Fodder 3) Almond 4) Olive 5) Vegetable	11,200	
Comments	Traditional irrigation facilities are existing. High irrigated occupancy Large scale irrigation will be available. Removing of gravel and rocks from farms are								
Irrigation Planning									
Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation		Design Discharge m ³ /s	Main Canal	Secondary Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)		(43)	(44)	(45)	(41)	(41)
4,600 ha	884	43.5 MCM	Furrow Border Basin		4.6 m ³ /s	30 km	46 km	Weir : 1	20 nos
Comment									
Water Supply Planning									
Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm ³ /year)	Facilities	Others	
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)	
irrigation area and surrounding			2,400	Ministry of Equipment	Commune or farmers' association	0.017	Filter facility, Reservoir, Transmission line, Stand pipes		
Comments	This project is located in Atlas Mountains where ground water resource is very scarce; therefore domestic water supply within the irrigation area and surrounding area of the dam is considered. Irrigation facilities will be utilized for water conveyance as maximal as possible for securing its economy.								
Flood and Sediment Control									
Disasters			Suffering object		Effects of dam	Reservoir sedimentation		Others	
(61)			(62)		(63)	(64)		(65)	
Flooding and bank erosion			Farmlands and settlements.		Flood control and stabilisation of river channel.	DS: 280 m ³ /km/yr VS: 0.120 Mm ³ /yr			
Comment									

Table VIII.1.10 Plan de Developpement pour le Projet Propose (No.10 TIMKIT)

General (Dam Site)									
Objective	Zone	Watershed	River	Province	(1:50.000)	Coordinate	Location	Study level	
irrigation, recharge for ground water		Rheris A=592km ²	Assif N'ifer	Errachidia	Tinejdad	X=507.250 Y=115.450	Tinjdad	F/S terminated	
Hydrology									
Catchment of dam		Flow Station			Annual Flow	Flow Pattern			
(1)		(2)			(3)	(4)			
Basin area (Adam): 592 km ² River system: Rheris/ Ferklo R.		Name: Ait Bouijane Asta: 702 km ² (Asta/Adam: 1.2) Data period: >20 yrs.			0.68 m ³ /s 21.4 Mm ³ /yr 36 mm/yr	Peak flow in: Oct, Jun. High flow in: 12 mon. (Sep-Aug) 50%-flow day: 96 days			
Geology									
Left Abutment of Damsite		Riverbed		Right Abutment		Reservoir			
(11)		(12)		(13)		(14)			
No Cover		River deposits: relatively thick (probably few meters), sand and grvael (medium grain size 5 to10cm) with 1 to 2m size large rock		No Cover		Bedrock: thin alternation of Dolomitic Limestone partly interbedded with many thin layers of Marl.			
comment	Dam site is composed of limestone layered, crystalline, and hard. Some layers are closely jointed, however some layers develop karst well. Their distribution shall be carefully checked for prohibiting leakage from the dam. In the downstream exists Siltstone which has a possibility to seal leakage. Limestone is strong								
Dam Planning									
Dam Type			Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.	
(21)			(22)	(23)	(24)	(25)	(26)	(27)	
The site is V shape valley with hard rock foundation. The dam has a big design discharge. A gravity dam is suitable for the site.			183 m/56m	136,500 m ³	14 MCM	1251.00 NGM	R.P.;1000year Qin=2000m ³ /s Q=1390m ³ /s		
Comment	The site has good topography for storage. The foundation is limestone with open fissures. But beneath of it, rock formation with less fissures are conformed. This could be reduce the leakage from reservoir..								
Agriculture (Based on the data on beneficial commune(s))									
Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)	
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	
Timkit	4	3,195	2,572	3,514	9,160	Hard Wheat Dates Vegetables Fodder	1) Wheat 2) Fodder 3) Dates 4) Olive 5) Vegetable	9,200	
Comment	Traditional oasis agriculture. High irrigated occupancy Farms are strongly damaged by occasional drought. Groundwater has been exhausted by over pumping								
Irrigation Planning									
Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation		Design Discharge m ³ /s	Main Canal	Secondary Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)		(43)	(44)	(45)	(41)	(41)
1,300 ha	1,430	13.5 MCM	Furrow Border Basin		1.3 m ³ /s	-	13 km	Weir : 3	8 nos
Water Supply Planning									
Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm ³ /year)	Facilities	Others	
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)	
Irrigation area and surrounding area of the dam			2,100	Ministry of Equipment	Commune or farmer's organization	0.015	Filter facility, Reservoir, Transmission line, Stand pipes		
comment	Domestic water supply within the irrigation area and surrounding area of the dam is considered. Irrigation facilities will be utilized for water conveyance as maximal as possible for securing its economy.								
Flood and Sediment Control									
Disasters		Suffering object		Effects of dam		Reservoir sedimentation		Others	
(61)		(62)		(63)		(64)		(65)	
Flooding and bank erosion		Riverine farm lands and settlements.		Flood control		DS: 338 m ³ /km/yr VS: 0.200 Mm ³ /yr			
Comment									

Table VIII.1.11 Plan de Developpement pour le Projet Propose (No.11 TADIGHOUST)

General (Dam Site)									
Objective	Zone	Watershed	River	Province	(1:50,000)	Coordinate	Location	Study level	
irrigation		Rheris A=2239km ²	Rheris	Errachidia	Goulmima	X=541.300 Y=139.200	Tadighoucht	P/S terminated	
Hydrology									
Catchment of dam			Flow Station			Annual Flow	Flow Pattern		
(1)			(2)			(3)	(4)		
Basin area (Adam): 2239 km ² River system: Rheris R.			Name: Tadighoust Asta: 2345 km ² (Asta/Adam: 1.0) Data period: >20 yrs.			1.17 m ³ /s 36.8 Mm ³ /yr 16 mm/yr	Peak flow in: Oct, Lun High flow in: 11 mon.(Sep-Jun, Aug) 50% -flow day: 9 days		
Geology									
Left Abutment of Damsite		Riverbed		Right Abutment			Reservoir		
(11)		(12)		(13)			(14)		
Overburden: Talus deposits, thick, large rock blocks		Alluvial deposits: Ep=few meters, sand and gravel showing medium grain size 5 to 8cm <u>Alluvial Terrace deposit:</u>		Overburden: Talus deposits			Bedrock: Sedimentary Rocks, Siltstone, Sandstone, Conglomerate, Marl, Limestone, Dolomite, Phonolite		
Comment	Almost horizontally layered alternation of hard limestone and relatively soft marly rock consist the dam site foundation. Folding and fault is relatively few however vertical joints develop and be open in the layer near by ground surface. Karst is relatively few. Both bank							Note: Ep: Thickness	
Dam Planning									
Dam Type				Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.
(21)				(22)	(23)	(24)	(25)	(26)	(27)
A gravity dam is inevitable because of huge design flood. There exist thick and wide deposits of sands and gravel. They are useful to RCC.				558.2m/68.5m	604,000 m ³	54 MCM	1142.00 NGM	R.P.:1000year Qin=8090m ³ /s Qout=7470M ³ /s	
Comment	It is necessary to remove thick and wide alluvium deposit. This will make a high dam cost.								
Agriculture (Based on the data on beneficial commune(s))									
Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)	
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	
Tadighoust	4	2,471	2,232	3,629	9,575	Hard Wheat Dates Fodder	1) Wheat 2) Fodder 3) Dates 4) Olive 5) Vegetable	9,100	
Comment	Traditional oasis agriculture. High irrigated occupancy Farms are well managed by farmers' cooperatives.								
Irrigation Planning									
Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation		Design Discharge m ³ /s	Main Canal	Secondary Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)		(43)	(44)	(45)	(41)	(41)
1,500 ha	2,203	15.6 MCM	Furrow Border Basin		1.5 m ³ /s	-	15 km	Weir : 3	9 nos
Water Supply Planning									
Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm ³ /year)	Facilities	Others	
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)	
Irrigation area and surrounding area of the dam			2,100	Ministry of Equipment	Commune or farmer's organization	0.015	Filter facility, Reservoir, Transmission line, Stand pipes		
Comment	Domestic water supply within the irrigation area and surrounding area of the dam is considered. Irrigation facilities will be utilized for water conveyance as maximal as possible for securing its economy.								
Flood and Sediment Control									
Disasters			Suffering object		Effects of dam		Reservoir sedimentation	Others	
(61)			(62)		(63)		(64)	(65)	
Flooding and bank erosion.			Riverine farmlands and settlements.		Flood control		DS: 335 m ³ /km/yr VS: 0.750 Mm ³ /yr		
Comment									

Table VIII.1.12 Plan de Developpement pour le Projet Propose (No.12 TIOUZAGUINE)

General (Dam Site)									
Objective	Zone	Watershed	River	Province	(1:50,000)	Coordinate	Location	Study level	
irrigation, potable water supply		Guir A=258km ²	tributary of Guir	Errachidia	Gourrama	X=618.071 Y=206.923	Gourrama	P/S terminated	
Hydrology									
Catchment of dam			Flow Station			Annual Flow	Flow Pattern		
(1)			(2)			(3)	(4)		
Basin area (Adam): 258 km ² River system: Guir R.			Name: Tazouguert Asta: 2392 km ² (Asta/Adam: 9.3) Data period: >20 yrs.			0.13 m ³ /s 4.1 Mm ³ /yr 16 mm/yr	Peak flow in: Nov, Apr High flow in: 7 mon.(Sep-Jan, Apr-May) 50%-flow day: 5 days		
Geology									
Left Abutment of Damsite		Riverbed		Right Abutment			Reservoir		
(11)		(12)		(13)			(14)		
Overburden: Talus deposits		River deposits: Ep=approx.15m, sand and gravel Travertine: located on the Right Banks side		Travertine: relatively thick, forming terrace, usually loose and porous, height reaching 27m			Overburden: Terrace deposits, River deposits Travertine: extending in the area Bedrock: red Mudstone, Basalt, Limestone; Many karsts and travertine are observed.		
Comment	Bedrock is composed of limestone relatively closely jointed. Loose travertine are observed in the right bank side. As a foundation it is strong enough, however travertine shows some the solubility limestone. Careful study shall be necessary.							Note: Ep: Thickness	
Dam Planning									
Dam Type				Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.
(21)				(22)	(23)	(24)	(25)	(26)	(27)
A gravity dam is suitable as the site consists of relatively hard rock foundation.				174m/58.7m	128,000 m ³	10.2 MCM	1565.00 NGM	Qin=2200m ³ /s	
Comment	The foundation of site is limestone which may be somewhat soluble. A possibility of leakage should be carefully examined,								
Agriculture (Based on the data on beneficial commune(s))									
Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)	
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	
Gourrama	1	2,359	1,283	1,390	6,964	Hard Wheat Soft Wheat Dates Fodder	1) Wheat 2) Fodder 3) Dates 4) Olive 5) Vegetable	11,700	
Comment	Traditional oasis agriculture. High irrigated occupancy Farms are located narrow riverbeds.								
Irrigation Planning									
Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation		Design Discharge m ³ /s	Main Canal	Secondary Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)		(43)	(44)	(45)	(41)	(41)
150 ha	88	1.6 MCM	Furrow Border Basin		0.2 m ³ /s	10 km	2km	-	7 nos
Comment	The above planning is for the case that water supply to Gourrama is included. Without such water supply scheme, beneficiary area of irrigation can be extended to 220 ha								
Water Supply Planning									
Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm ³ /year)	Facilities	Others	
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)	
Gourrama	1		2,800	ONEP	ONEP	0.2	Pumping station, Treatment plant, Reservoir, Transmission line		
Comment	Reinforcement of potable water supply for Gourrama (0.2Mm ³ /year) by exploiting surface water is considered. It is noted, however, that recharging of ground water from Tiouzaguine Dam may also contribute to AEP supply in future, therefore exploitation of ground water is still required to be studied as economical alternative. Other than the above, domestic water supply within the irrigation area and surrounding area of the dam (0.004Mm ³ /year) is								
Flood and Sediment Control									
Disasters			Suffering object		Effects of dam		Reservoir sedimentation	Others	
(61)			(62)		(63)		(64)	(65)	
Flooding and bank erosion.			Riverine farmlands, settlements and irrigation facilities.		Flood control		DS: 543 m ³ /km/yr VS: 0.140 Mm ³ /yr		
Comment									

Table VII1.13 Plan de Developpement pour le Projet Propose (No.13 KHENG GROU).

General (Dam Site)									
Objective	Zone	Watershed	River	Province	(1:50,000)	Coordinate	Location	Study level	
Irrigation, recharge for ground water		Guir A=4,900km ²	Oued Kheng Grou	Figuig	Bouanane	X=716.000 Y=194.050	Bouanane	F/S terminated	
Hydrology									
Catchment of dam			Flow Station		Annual Flow	Flow Pattern			
(1)			(2)		(3)	(4)			
Basin area (Adam): 4900 km ² River system: Guir/ Bouanane R.			Name: Beni Yatti Asta: 6788 km ² (Asta/Adam: 1.4) Data period: >20 yrs.		2.08 m ³ /s 65.5 Mm ³ /yr 13 mm/yr	Peak flow in: Apr, Oct High flow in: 7 mon.(Sep-Jan, Apr-May) 50%-flow day: 3 days			
Geology									
Left Abutment of Damsite	Riverbed		Right Abutment			Reservoir			
(11)	(12)		(13)			(14)			
No Cover	River deposits: Ep=about 15m, mainly sand and gravel, medium grain size 3 to 5cm		No Cover			Covers: silt and marly soil Bedrock: mainly Limestone			
Comment	Basement rocks is blackish gray limestone hard to medium hard, and almost horizontally layered. Joints develop crossing right angle to the bedding and slightly open. Both banks are rightstanding. Some leakage may happen.							Note: Ep: Thickness	
Dam Planning									
Dam Type				Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.
(21)				(22)	(23)	(24)	(25)	(26)	(27)
A gravity dam is suitable as the abutments are very steep slopes with hard rock foundation.				155m/70m	325,000 m ³	90 MCM	1023.50 NGM	Qin=9300m ³ /s Qout=5400m ³ /s	
Comment	The foundation rock develops joints. This can be treated by groutings.								
Agriculture (Based on the data on beneficial commune(s))									
Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)	
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	
Benit Tadjite	1	4,756	1,265	924	5,278	Dates Barley Fodder Vegetable	1) Wheat 2) Vegetable 3) Dates 4) Olive 5) Fodder	13,400	
Comment	Small irrigable areas are scattered on the riverbeds. Many farms are left as fallow land.								
Irrigation Planning									
Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation		Design Discharge m ³ /s	Main Canal	Secondary Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)		(43)	(44)	(45)	(41)	(41)
1,210 ha	235	12.6 MCM	Furrow Border Basin		1.2 m ³ /s	-	12 km	Weir : 1	5 nos
Water Supply Planning									
Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm ³ /year)	Facilities	Others	
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)	
Irrigation area and suourounding area of the dam			400	Ministry of Equipment	Commune or farmers' association	0.003	Filter facility, Reservoir, Transmission line, Stand pipes		
Comment	Domestic water supply within the irrigation area and surrounding area of the dam is considered. Irrigation facilities will be utilized for water conveyance as maximal as possible for securing its economy.								
Flood and Sediment Control									
Disasters			Suffering object		Effects of dam	Reservoir sedimentation		Others	
(61)			(62)		(63)	(64)		(65)	
Flooding and bank erosion.			Riverine farmlands, settelment and irrigation facilities.		Flood control	DS: 333 m ³ /km/yr VS: 1.500 Mm ³ /yr			
Comment									

Table VII1.1.14 Plan de Developpement pour le Projet Propose (No.14 ADAROUCHE)

General (Dam Site)								
Objective	Zone	Watershed	River	Province	(1:50,000)	Coordinate	Location	Study level
supplementary supply of potable water, irrigation		Sebou ,A=630km2	Oued Tigrigra	Ifrane	Bouchaber	X=489.800 Y=316.500	Azrou	F/S terminated
Hydrology								
Catchment of dam			Flow Station		Annual Flow	Flow Pattern		
(1)			(2)		(3)	(4)		
Basin area (Adam): 630 km2 River system: Sebou/ Beht/ Tigriga R.			Name: Sidi Mokhfi Asta: 282 km2 (Asta/Adam: 0.4) Data period: 6 yrs.		2.04 m3/s 64.4 Mm3/yr 102 mm/yr	Peak flow in: Mar, Oct High flow in: 7 mon.(Oct, Dec-May) 50%-flow day: 101 days		
Geology								
Left Abutment of Damsite	Riverbed		Right Abutment			Reservoir		
(11)	(12)		(13)			(14)		
Weathered zone: Ep=5m	Alluvial deposits: very thin, Ep=0.5m Terrace deposits: discontinuous, sandy Weathered zone: Ep 1 to 2m		Weathered zone: Ep=around 18m, 5 to 8m in highly weathered zone			Bedrock: Alternating beds, basically flysch deposits between Limestone Massif, sometimes intruded by Granite		
Comment	There may be no serious problem except that there is a possibility of slaking of slate and leakage from conglomerate.							Note: Ep: Thickness
Dam Planning								
Dam Type			Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.
(21)			(22)	(23)	(24)	(25)	(26)	(27)
The site has moderate slopes on both abutment. But it has hard rock foundations in shallow depth with narrow river-bed. The site will be suitable to gravity type.			263m/51m	130,000 m3	48 MCM	873.00 NGM	R.P.;1000year Qin=700m3/s Qout=310m3/s	
Comment	Sands and gravel materials can not obtained in the vicinity of dam site. However, access is very easy as the site is closed to principal national route.							
Agriculture (Based on the data on beneficial commune(s))								
Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)
Adarouch	2	25,337	5,193	2,542	4,146	(Livestock Farm) Hard Wheat Barley Fodder	1) Wheat 2) Olive 3) Almond 4) Fodder 5) Vegetable	12,400
Comment	All of irrigable areas are located in livestock farming company. Removing gravels and stones from farms are necessary in some area.							
Irrigation Planning								
Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation	Design Discharge m3/s	Main Canal	Secondary Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)	(43)	(44)	(45)	(41)	(41)
1,200 ha	120	8.9 MCM	Furrow Border Basin	1.2 m3/s	13 km	12 km	Weir : 1	9 nos
Comment	The above planning is for the case that water supply to Kansara dam is included. Without such water supply scheme, beneficiary area for irrigation can be extended to 2,200 ha.							
Water Supply Planning								
Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm3/year)	Facilities	Others
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)
Khemisset and Tiflet	2		130,000	ONEP	ONEP	5	Pumping station, Treatment plant, Reservoir, Transmission line	
Comment	Water supply for potable water in Khemisset and Tiflet through Kansera Dam (5 Mm ³ /year) is considered. As the reinforcement of water supply facilities by ONEP is to be implemented by another project with assistance of BAD (Bank of Africa for Development), no provision of facilities is considered in this							
Flood and Sediment Control								
Disasters			Suffering object	Effects of dam		Reservoir sedimentation		Others
(61)			(62)	(63)		(64)		(65)
No serious damage.			Farmlands and livestock.	Flood protection for farmlands and livestock. Sediment control effect for El Kansera dam is not large		DS: 317 m3/km/yr VS: 0.200 Mm3/yr		
Comment	Because of long distance and small catchment, sediment control effect for El Kansera dam is not large. Coordination with Oujet Sontane dam program may also be needed.							

Table VIII.1.15 Plan de Developpement pour le Projet Propose (No.15 SIDI OMAR)

General (Dam Site)									
Objective	Zone	Watershed	River	Province	(1:50,000)	Coordinate	Location	Study level	
Irrigation		Boureg Reg A=350km ²	Oued Tabahart	Khemisset	Sebt Ait Ikkou	X=425.100 Y=336.100	Maaziz	P/S terminated	
Hydrology									
Catchment of dam			Flow Station			Annual Flow	Flow Pattern		
(1)			(2)			(3)	(4)		
Basin area (Adam): 350 km ² River system: Bou Regreg/ Tabahart R.			Name: Sidi Amar Asta: 329 km ² (Asta/Adam: 0.9) Data period: 18 yrs.			0.88 m ³ /s 27.8 Mm ³ /yr 79 mm/yr	Peak flow in: Jan High flow in: 3 mon.(Dec-Feb) 50%-flow day: 9 days		
Geology									
Left Abutment of Damsite	Riverbed		Right Abutment			Reservoir			
(11)	(12)		(13)			(14)			
<u>Overburden</u> : thin Top soil	<u>Alluvial deposits</u> : sand to silt with cobble and gravel of schist, sandstone, and limestone		<u>Overburden</u> : thin <u>Bedrock</u> : Schist is phyllitic at dam axis.			<u>Overburden</u> : Colluvial deposits, developed rarely <u>Bedrock</u> : Schist interbedded Sandstone overlain by Conglomerate, fine Conglomerate, Sandstone and red Mudstone			
Comment	Site is in the hilly area with relatively wide river bed and alluvial terrace. Bedrocks are composed of the alternation of schistosed sandstone and slate. Right bank side is more schistosed, folded and partly sheared. This kind of zone may lie under the river deposits.								
Dam Planning									
Dam Type			Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.	
(21)			(22)	(23)	(24)	(25)	(26)	(27)	
A gravity dam is probably suitable as the site has hard rock foundation in shallow depth.			260m/59m	222,000 m ³	35 MCM	310.00 NGM	R.p.;5000year Qin=1735m ³ /s		
Comment	There is a possibility that a wide fault is existing closed to the dam site. IN such case a fill type dam may be prospective. Selection of dam type depends on the further analysis of geology.								
Agriculture (Based on the data on beneficial commune(s))									
Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)	
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	
Maaziz	1	6,459	358	795	3,966	Soft Wheat Vegetables Fodder	1) Wheat 2) Vegetable 3) Olive 4) Grape 5) Fodder	14,200	
Comment	Wide and flat areas are located at irrigable area. Dam site is located relatively far away from irrigable area.								
Irrigation Planning									
Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation		Design Discharge m ³ /s	Main Canal	Secondary Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)		(43)	(44)	(45)	(41)	(41)
1,500 ha	185	10.6 MCM	Furrow Border Basin		1.5 m ³ /s	27 km	15 km	Weir : 1	18 nos
Water Supply Planning									
Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm ³ /year)	Facilities	Others	
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)	
Irrigation area and surrounding area of the dam			300	Ministry of Equipment	Commune or farmers' association	0.002	Filter facility, Reservoir, Transmission line, Stand pipes		
Comment	Domestic water supply within the irrigation area and surrounding area of the dam is considered. Irrigation facilities will be utilized for water conveyance as maximal as possible for securing its economy.								
Flood and Sediment Control									
Disasters			Suffering object		Effects of dam		Reservoir sedimentation	Others	
(61)			(62)		(63)		(64)	(65)	
Flooding and bank erosion.			Local farmlands and settlements.		Flood control for farmlands and settlements, and stabilization of river channel.		DS: 649 m ³ /km/yr VS: 0.230 Mm ³ /yr		
Comment									

Table VIII.1.16 Plan de Developpement pour le Projet Propose (No.16 TIOUINE)

General (Dam Site)									
Objective	Zone	Watershed	River	Province	(1:50,000)	Coordinate	Location	Study level	
Irrigation, flood control		Draa A=1,540km ²	Oued Iriri	Ouarzazate	Tikirt	X=323.572 Y=438.525	Ouarzazate	P/S terminated	
Hydrology									
Catchment of dam			Flow Station		Annual Flow	Flow Pattern			
(1)			(2)		(3)	(4)			
Basin area (Adam): 1540 km ² River system: Draa R.			Name: Tamdrouste Asta: 1693 km ² (Asta/Adam: 1.1) Data period: >20 yrs.		3.07 m ³ /s 96.8 Mm ³ /yr 63 mm/yr	Peak flow in: Mar, Jun High flow in: 7 mon.(Nov-Apr, Jun) 50%-flow day: 17 days			
Geology									
Left Abutment of Damsite		Riverbed		Right Abutment		Reservoir			
(11)		(12)		(13)		(14)			
Bedrock: very hard Rhyolite forming very high cliff mineralized by mangano-iron ore		River deposits: very thin, sand to boulder Some salt-gypsum powder can be observed along the water course.		Bedrock: Rhyolite changing to somewhat andesite with some faults and sheared zone as far away from the dam axis		Bedrock: Rhyolitic to Andesitic rock; massive and hard Conglomerate and Sandstone; loose and porous, with many piping hole, cavittiful			
Comments	Both banks consist of very hard Rhyolite of Precambrian forming rightstanding high cliffs. Many iron and manganese layers are interbedded. River deposit is relatively few. Highly permeable conglomerate layers exist in the left bank side of reservoir area, then its distribution have to be checked.								
Dam Planning									
Dam Type				Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.
(21)				(22)	(23)	(24)	(25)	(26)	(27)
The site is U shape valley. A gravity dam is suitable as both abutments have upstanding slopes with extremely hard rock foundation.				165.0m/68.5m	405,530 m ³	102.9 MCM	1320.00 NGM	Q _{in} =4400m ³ /s Q _{out} =1580m ³ /s	
Comment	The site has topographically good storage. Sands and gravel materials are abundant in the vicinity of dam site. But, in the reservoir there spreads very pervious conglomerate near to left abutment. In case it connects to outside of reservoir, leakage problem is not negligible.								
Agriculture (Based on the data on beneficial commune(s))									
Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)	
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	
Tiwine	2	2,048	1,813	1,517	9,229	Barley Soft Wheat Fruits Fodder Vegetables	1) Wheat 2) Vegetable 3) Olive 4) Dates 5) Fodder	9,300	
Comments	High irrigated occupancy Removing gravels and stones from farms are necessary in some area.								
Irrigation Planning									
Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation		Design Discharge m ³ /s	Main Canal	Secondary Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)		(43)	(44)	(45)	(41)	(41)
2,000 ha	1,481	21.3 MCM	Furrow Border Basin		2.0 m ³ /s	11 km	20 km	Weir : 1	8 nos
Comment									
Water Supply Planning									
Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm ³ /year)	Facilities	Others	
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)	
Irrigation area and suourounding area of the dam			2,100	Ministry of Equipment	Commune or farmers' association	0.015	Filter facility, Reservoir, Transmission line, Stand pipes		
Comments	Domestic water supply within the irrigation area and surrounding area of the dam is considered. Irrigation facilities will be utilized for water conveyance as maximal as possible for securing its economy.								
Flood and Sediment Control									
Disasters			Suffering object		Effects of dam		Reservoir sedimentation	Others	
(61)			(62)		(63)		(64)	(65)	
Flooding.			National road		Flood control, stabilisation of river course, and sediment control		DS: 700 m ³ /km/yr VS: 1.000 Mm ³ /yr		
Comment									

Table VIII.1.17 Plan de Developpement pour le Projet Propose (No.17 AZGHAR)

General (Dam Site)									
Objective	Zone	Watershed	River	Province	(1:50,000)	Coordinate	Location	Study level	
irrigation		Sebou A=295 km ²	Oued Zloul	Sefrou	Al Khayr	X=598.800 Y=357.000	Sefrou	P/S terminated	
Hydrology									
Catchment of dam			Flow Station		Annual Flow	Flow Pattern			
(1)			(2)		(3)	(4)			
Basin area (Adam): 295 km ² River system: Sebou/ Zloul R.			Name: Dar Hmra Asta: 670 km ² (Asta/Adam: 2.3) Data period: 12 yrs.		1.24 m ³ /s 39.1 Mm ³ /yr 133 mm/yr	Peak flow in: Mar High flow in: 5 mon.(Dec-Apr) 50%-flow day: 19 days			
Geology									
Left Abutment of Damsite		Riverbed		Right Abutment		Reservoir			
(11)		(12)		(13)		(14)			
Weathered zone: up to the depth approximately 2.5m		River deposits: very thin, sand and gravel Alluvial terrace: extending in Right Bank side, sand, gravel and cobble, Ep=1.5m		Bedrock: same as Left Bank		Overburden: Colluvial deposits, relatively few Bedrock: mainly Schist interbedded with calcareous Sandstone			
Comment	The dam axis is located at the hilly area with wide river bed. The right bank of the river consist of alluvial terrace and cliff. The foundation rocks are the alternation of black limestone and argillaceous limestone. The dip is gentle towards downstream.							Note: Ep: Thickness	
Dam Planning									
Dam Type			Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.	
(21)			(22)	(23)	(24)	(25)	(26)	(27)	
Both abutments has moderate slopes with hard rock foundation. The river-bed is somewhat wide. Both of gravity and zoned fill are prospective and competitive.			425m/53m	1,600,000m ³	40 MCM	869.50 NGM	Qin=700m ³ /s Qout=250m ³ /s		
Comment	The foundation rock is good and considered to be less pervious. No special problem is anticipated.								
Agriculture (Based on the data on beneficial commune(s))									
Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)	
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	
Igheznane	1	7,420	321	1,639	2,457	Hard Wheat Barley Almond	1) Wheat 2) Olive 3) Almond 4) Fodder 5) Vegetable	14,100	
Comment	Strong request from farmers for irrigation facilities. Suitable land for irrigation								
Irrigation Planning									
Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation		Design Discharge m ³ /s	Main Canal	Secondary Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)		(43)	(44)	(45)	(41)	(41)
1,600 ha	353	11.9 MCM	Furrow Border Basin		1.6 m ³ /s	7 km	16 km	-	9 nos
Comment									
Water Supply Planning									
Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm ³ /year)	Facilities	Others	
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)	
Irrigation area and suuounding area of the dam			600	Ministry of Equipment	Commune or farmers' association	0.004	Filter facility, Reservoir, Transmission line, Stand pipes		
Comment	Domestic water supply within the irrigation area and surrounding area of the dam is considered. Irrigation facilities will be utilized for water conveyance as maximal as possible for securing its economy.								
Flood and Sediment Control									
Disasters			Suffering object		Effects of dam		Reservoir sedimentation	Others	
(61)			(62)		(63)		(64)	(65)	
Flooding and bank erosion			Farmlands		Flood control and channelstabilization.		DS: 441 m ³ /km/yr VS: 0.130 Mm ³ /yr		
Comment									

Table VIII.1.18 Plan de Developpement pour le Projet Propose (No.18 BOUKARKOUR)

General (Dam Site)									
Objective	Zone	Watershed	River	Province	(1:50,000)	Coordinate	Location	Study level	
irrigation, potable water supply, flood control		Slopes toward Atlantic, A=1120 km ²	Zamrine	Settat	Mggarto	X=341.350 Y=291.000	Ben Ahmed	F/S terminated	
Hydrology									
Catchment of dam		Flow Station			Annual Flow	Flow Pattern			
(1)		(2)			(3)	(4)			
Basin area (Adam): 1120 km ² River system: Mellah/ Zamrine R.		Name: Feddane Taba Asta: 606 km ² (Asta/Adam: 2.0) Data period: >20 yrs.			1.04 m ³ /s 32.9 Mm ³ /yr 29 mm/yr	Peak flow in: Feb High flow in: 5 mon.(Nov-Mar) 50%-flow day: 6 days			
Geology									
Left Abutment of Damsite	Riverbed		Right Abutment			Reservoir			
(11)	(12)		(13)			(14)			
No Cover	River deposits: sand and gravel Talus deposits: at the foot of Banks Colluvial deposits: at the foot of Banks		No Cover			Terrace deposits: mainly sand and gravel, extending in the upstream Colluvial deposits: relatively few Bedrock: mainly Schist sometimes interbedded with			
Comment	Bedrocks are composed of the alternation of Sandstone and Mudstone. The foundation of dam axis is of very hard Quartzite including much iron ore layered of thickness 5 to 100 cm. As a foundation, it is strong enough, but joints of which are little open around the surface, however their treatment may be done								
Dam Planning									
Dam Type			Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.	
(21)			(22)	(23)	(24)	(25)	(26)	(27)	
A gravity dam is suitable as the site has narrow river-bed with hard rock foundation.			213m/59.5m	172,000 m ³	30.1 MCM	330.00 NGM	R.P.;1000 year Qin=1900m ³ /s		
Comment	Surface rocks are pervious. This can be easily treated by grouting.								
Agriculture (Based on the data on beneficial commune(s))									
Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)	
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	
Boukatkaour	2	26,663	175	3,222	3,431	Hard Wheat Soft Wheat Vegetables	1) Wheat 2) Vegetable 3) Olive 4) Almond 5) Fodder	14,700	
Comment	Removing gravels and stones from farms are necessary in some area.								
Irrigation Planning									
Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation		Design Discharge m ³ /s	Main Canal	Secondary Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)		(43)	(44)	(45)	(41)	(41)
1,000 ha	121	7.1 MCM	Furrow Border Basin		1.0 m ³ /s	8 km	10 km	Pump Station : 1	10 nos
Water Supply Planning									
Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm ³ /year)	Facilities	Others	
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)	
Irrigation area and surrounding area of the dam			200	Ministry of Equipment	Commune or farmers' association	0.002	Filter facility, Reservoir, Transmission line, Stand pipes		
Comment	Domestic water supply within the irrigation area and surrounding area of the dam is considered. Irrigation facilities will be utilized for water conveyance as maximal as possible for securing its economy.								
Flood and Sediment Control									
Disasters		Suffering object		Effects of dam		Reservoir sedimentation		Others	
(61)		(62)		(63)		(64)		(65)	
Flooding and bank erosion, but not serious.		Farmlands and rural road		Flood control for local farmlands, stabilization of river channel, and sediment control		DS: 100 m ³ /km/yr VS: 0.112 Mm ³ /yr			
Comment	This dam does not have direct effects on flood control for Mohamedia city and national road, because Mellah dam exists downstream.								

Table VIII.1.19 Plan de Developpement pour le Projet Propose (No.19 AOULAI)

General (Dam Site)									
Objective	Zone	Watershed	River	Province	(1:50,000)	Coordinate	Location	Study level	
irrigation, sediment retaining for Al Wahda dam		Oulgha, tributary of Sebou A=490km ²	Oued Oulai	Taounate	Tamrot	X=542.150 Y=467.850	Ain Aicha	P/S terminated	
Hydrology									
Catchment of dam		Flow Station			Annual Flow	Flow Pattern			
(1)		(2)			(3)	(4)			
Basin area (Adam): 490 km ² River system: Sebou/ Ouergha/ Aoulai R.		Name: rhafsai Asta: 770 km ² (Asta/Adam: 1.6) Data period: >20 yrs.			5.63 m ³ /s 177.7 Mm ³ /yr 363 mm/yr	Peak flow in: Feb High flow in: 7 mon.(Nov-May) 50%-flow day: 21 days			
Geology									
Left Abutment of Damsite	Riverbed		Right Abutment			Reservoir			
(11)	(12)		(13)			(14)			
<u>Overburden</u> : Top soil, residual soil of Schist with rock fragments	<u>Alluvial deposits</u> : River/Terrace deposits, mainly sand and gravel <u>Terrace deposits</u> : generally rounded gravel and cobbles in a		<u>Overburden</u> : Ep=3m <u>Terrace deposits</u> : extending 400m in the downstream			<u>Unconsolidated deposits</u> : Terrace deposits, Colluvial deposits, and River deposits <u>Bedrock</u> : Schist interbedded with Black Limestone of around 10cm thickness			
Comment	Bedrock of the dam is mainly slate. Slaking is prominent and as a whole weathering is predominant. Strength of foundation rocks is uncertain. There is a failure on the right bank slope.						Note: Ep: Thickness		
Dam Planning									
Dam Type			Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.	
(21)			(22)	(23)	(24)	(25)	(26)	(27)	
A gravity dam which can install a spillway on dambody is suitable as design flood is fairly big.			390m/66m	388,000 m ³	145 MCM	340.00 NGM	R.P.;10000year Qin=2500m ³ /s		
Comment	It is possible to place the dam in the rock foundation. However, the rock is not highly bearing foundation here. Deep excavation or somewhat moderate dam-slope is expected.								
Agriculture (Based on the data on beneficial commune(s))									
Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)	
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	
Ratba	1	4,847	14	1,565	1,886	Soft Wheat Hard Wheat Olive	1) Wheat 2) Olive 3) Almond 4) Fodder 5) Vegetable	14,600	
Comment	Wide alluvial area is located at irrigable area.								
Irrigation Planning									
Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation		Design Discharge m ³ /s	Main Canal	Secondary Canal	Headwork	Other Facility
(41)	(42)	(43)	(41)		(43)	(44)	(45)	(41)	(41)
5,000 ha	1,605	37.2 MCM	Furrow Border Basin		5.0 m ³ /s	45 km	50 km	-	50 nos.
Water Supply Planning									
Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm ³ /year)	Facilities	Others	
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)	
Irrigation area and surrounding area of the dam			2,100	Ministry of Equipment	Commune or farmers' association	0.015	Filter facility, Reservoir, Transmission line, Stand pipes		
Comment	This project is located in Rif Mountains where ground water resource is very scarce; therefore domestic water supply within the irrigation area and surrounding area of the dam is considered. Irrigation facilities will be utilized for water conveyance as maximal as possible for securing its economy.								
Flood and Sediment Control									
Disasters		Suffering object		Effects of dam		Reservoir sedimentation		Others	
(61)		(62)		(63)		(64)		(65)	
Flooding and bank erosion, but not so serious		Rural road		Flood control for local farmlands. Sediment control effect to		DS: 863 m ³ /km/yr VS: 0.430 Mm ³ /yr			
Comment									

Table VIII.1.20 Plan de Developpement pour le Projet Propose (No.20 SIDI ABBOU)

General (Dam Site)									
Objective	Zone	Watershed	River	Province	(1:50,000)	Coordinate	Location	Study level	
		Sebou A=363km ²	Lebene	Taounate	Tissa	X=585.000 Y=424.700	Ain Aicha	P/S on going	
Hydrology									
Catchment of dam			Flow Station		Annual Flow	Flow Pattern			
(1)			(2)		(3)	(4)			
Basin area (Adam): 363 km ² River system: Sebou/ Lebene R.			Name: Boukarkour/Tissa Asta: 736 km ² (Asta/Adam: 2.0) Data period: 10 yrs.		1.10 m ³ /s 34.8 Mm ³ /yr 96 mm/yr	Peak flow in: Feb High flow in: 5 mon.(Dec-Apr) 50%-flow day: 13 days			
Geology									
Left Abutment of Damsite		Riverbed		Right Abutment		Reservoir			
(11)		(12)		(13)		(14)			
<u>Bedrock</u> : sometimes forming as Conglomerate and Sandstone		<u>River deposits</u> : gravel, sand, and rock blocks of 2m size, filling the depression of bedrock		<u>Bedrock</u> : joints dipping toward river side, very big Karsts developing along joints or faults on the downstream		<u>Unconsolidated Sediments</u> : River deposits, Alluvial terrace deposits, widely extending in the area <u>Bedrock</u> : mainly Marl interbedded with Limestone			
Comment	Dam site is in narrow and long gorge of limestone. The lower portions are fresh and hard, however in the upper portions rocks are slightly weathered and the joint are filled by muddy material. Partly observed large karst.								
Dam Planning									
Dam Type				Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.
(21)				(22)	(23)	(24)	(25)	(26)	(27)
For the site where geological surveys were performed, a gravity dam is suitable as the site is narrow gouge with hard rock foundation.				55m/40m	32,000 m ³	58 MCM	338.00 NGM		
Comment	Although the site has a good topography to store the reservoir water, it has karsts in the dam foundation. Leakage problem is anticipated. A fill dam with inclined core and horizontal impervious blanket will be prospective for the mouth of gorge. Further geological surveys are expected.								
Agriculture (Based on the data on beneficial commune(s))									
Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)	
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	
Sidi Abbou	2	16,680	491	2,103	2,395	Soft Wheat Hard Wheat Olive	1) Wheat 2) Olive 3) Almond 4) Fodder 5) Vegetable	14,100	
Comment	No definitive formulation of irrigation scheme								
Irrigation Planning									
Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation		Design Discharge m ³ /s	Main Canal	Secondary Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)		(43)	(44)	(45)	(41)	(41)
2,000 ha	252	14.9 MCM	Furrow Border Basin		2.0 m ³ /s	29 km	20 km	Weir : 1	20 nos
Water Supply Planning									
Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm ³ /year)	Facilities	Others	
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)	
Irrigation area and suourounding area of the dam			400	Ministry of Equipment	Commune or farmers' association	0.003	Filter facility, Reservoir, Transmission line, Stand pipes		
Comment	Domestic water supply within the irrigation area and surrounding area of the dam is considered. Irrigation facilities will be utilized for water conveyance as maximal as possible for securing its economy.								
Flood and Sediment Control									
Disasters			Suffering object		Effects of dam		Reservoir sedimentation	Others	
(61)			(62)		(63)		(64)	(65)	
Flooding and bank erosion.			Settlements and farmlands		Flood control and stabilization of river channel		DS: - m ³ /km/yr VS:- Mm ³ /yr		
Comment									

Table VIII.1.21 Plan de Developpement pour le Projet Propose (No.21 SIDI EL MOKHFI)

General (Dam Site)									
Objective	Zone	Watershed	River	Province	(1:50,000)	Coordinate	Location	Study level	
Irrigation		Oulgha, tributary of Sebou A=378km ²	Oued Amzez	Taounate	Ghafsay	X=558.450 Y=448.300	Sidi El Mokhfi	P/S terminated	
Hydrology									
Catchment of dam			Flow Station		Annual Flow	Flow Pattern			
(1)			(2)		(3)	(4)			
Basin area (Adam): 378 km ² River system: Sebou/ Amezetz R.			Name: Galez Asta: 440 km ² (Asta/Adam: 1.2) Data period: 13 yrs.		5.75 m ³ /s 181.4 Mm ³ /yr 480 mm/yr	Peak flow in: Feb High flow in: 7 mon.(Nov-May) 50%-flow day: 21 days			
Geology									
Left Abutment of Damsite	Riverbed		Right Abutment			Reservoir			
(11)	(12)		(13)			(14)			
<u>Overburden</u> : Colluvial deposits, Ep=2 to 5m <u>Weathered Zone</u> : Ep=1 to 2m	<u>River deposits</u> : Ep=2 to 5m		<u>Talus deposits</u> : few meters <u>Terrace deposits</u> : 1 to 2m <u>Weathered Zone</u> : Ep=1m			<u>Bedrock</u> : mainly Marl <u>Terrace/River deposits</u> : extending on the area <u>Watertightness</u> : probably good			
Comment	Bedrock is massive, medium hard, and closely jointed black Limestone and calcareous Slate. Faults are inferred at just upstream of dam axis. Slope around there is steep and looks unstable partly land slided.							Note: Ep: Thickness	
Dam Planning									
Dam Type			Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.	
(21)			(22)	(23)	(24)	(25)	(26)	(27)	
There exist exposures of hard foundation rocks on the right abutment and the river bed. The topography of right abutment is thin in width. A gravity is suitable.			260 m/64.5m	376,000 m ³	36.7 MCM	313.00 NGM	1500m ³ /s		
Comment	Sands and gravel materials deposit in the river of dam site and its main river Ouergh. RCC is prospective. Just upstream of the dam site a fault running through the river will exist. The dam axis should be avoid a meeting with this fault.								
Agriculture (Based on the data on beneficial commune(s))									
Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)	
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	
Sidi El Mokhfi	3	13,355	105	4,327	1,556	Soft Wheat Hard Wheat Olive	1) Wheat 2) Olive 3) Almond 4) Fodder 5) Vegetable	15,000	
Comment	Irrigable areas are located hilly area								
Irrigation Planning									
Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation		Design Discharge m ³ /s	Main Canal	Secondary Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)		(43)	(44)	(45)	(41)	(41)
3,600 ha	1,166	26.8 MCM	Furrow Border Basin		3.6 m ³ /s	11 km	36 km	Weir : 1	8 nos
Water Supply Planning									
Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm ³ /year)	Facilities	Others	
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)	
Irrigation area and surrounding area of the dam			1,500	Ministry of Equipment	Commune or farmers' association	0.011	Filter facility, Reservoir, Transmission line, Stand pipes		
Comment	This project is located in Rif Mountains where ground water resource is very scarce; therefore domestic water supply within the irrigation area and surrounding area of the dam is considered. Irrigation facilities will be utilized for water conveyance as maximal as possible for securing its economy.								
Flood and Sediment Control									
Disasters		Suffering object		Effects of dam		Reservoir sedimentation		Others	
(61)		(62)		(63)		(64)		(65)	
Flooding and bankerosion, but not so serious.		Public facilities and farmlands		Flood control for local farmlands. Sediment control for Al Wahda dam.		DS: - m ³ /km/yr VS: - Mm ³ /yr			
Comment									

Table VIII.1.22 Development Plan for the Proposed Project (No.22 N'OUANTZ)

General (Dam Site)									
Objective	Zone	Watershed	River	Province	(1:50,000)	Coordinate	Location	Study level	
irrigation, water supply for livestock		Oum Er Rbia A=204km ²	N'Ouantz	Beni Mellal	Aghbala	X=471.664 Y=206.696	Aghbala	F/S terminated	
Hydrology									
Catchment of dam			Flow Station			Annual Flow	Flow Pattern		
(1)			(2)			(3)	(4)		
Basin area (Adam): 204 km ² River system: Oum Er Rbia/ El Abid R.			Name: Tizi N'isly Asta: 1444 km ² (Asta/Adam: 7.1) Data period: >20 yrs.			0.57 m ³ /s 17.8 Mm ³ /yr 87 mm/yr	Peak flow in: Mar, Nov High flow in: 6 mon.(Nov, Jan-May) 50%-flow day: 54 days		
Geology									
Left Abutment of Damsite		Riverbed		Right Abutment		Reservoir			
(11)		(12)		(13)		(14)			
River deposits: very thin, distributed locally		Alluvial deposits: mainly silt, Ep=1.5 to 2.0m Terrace deposits: sand and gravel with silt		Alluvium: Ep=few meters, sand and gravels with rock blocks		Overburden: Alluvium and Colluvium Bedrock: Silty Sandstone, covered by Alluvium and Colluvium			
Comment	Foundation of dam site is composed of sandstone interbedding with thin argillaceous rocks showing red color. Impermeability may be no problem. In case concrete facilities will be constructed on this foundation, some detail study may be necessary.							Note: Ep: Thickness	
Dam Planning									
Dam Type				Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.
(21)				(22)	(23)	(24)	(25)	(26)	(27)
A fill type is suitable as both abutments are very gentle and soft rock foundations.				270m/35.5m	75,200 m ³	2.92 MCM	1440.00 NGM	R.P.;1000year Qin=650m ³ /s	
Comment	A homogeneous fill is suitable as the dam height is small.								
Agriculture (Based on the data on beneficial commune(s))									
Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)	
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	
N'ountz	2	14,042	1,551	1,698	4,928	Soft Wheat Hard Wheat Fodder Citrus	1) Wheat 2) Olive 3) Almond 4) Citrus 5) Fodder	8,000	
Comment	High irrigated occupancy Irrigation is presently by groundwater. Very limited irrigable area								
Irrigation Planning									
Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation	Design Discharge m ³ /s	Main Canal	Secondary Canal	Headwork	Other Facility	
(41)	(42)	(43)	(41)	(43)	(44)	(45)	(41)	(41)	
-	-	-	-	-	-	-	-	-	
Water Supply Planning									
Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm ³ /year)	Facilities	Others	
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)	
-	-	-	-	-	-	-	-	-	
Comment	This project includes no water supply scheme.								
Flood and Sediment Control									
Disasters			Suffering object		Effects of dam		Reservoir sedimentation	Others	
(61)			(62)		(63)		(64)	(65)	
No serious flood damage			Farmlands, settlements, public facilities and livestock.		Little effect for flood control.		DS: 392 m ³ /km/yr VS: 0.080 Mm ³ /yr		
Comment	The reservoir will be full of sediment within 50 years								

Table VIII.1.23 Plan de Developpement pour le Projet Propose (No.23 IGUIN'OUAQA)

General (Dam Site)									
Objective	Zone	Watershed	River	Province	(1:50,000)	Coordinate	Location	Study level	
irrigation, recharge for ground water		Souss A=161km ²	Aguerd	Taroudant	Igli	X=187.380 Y=416.250	Taroudant	F/S terminated	
Hydrology									
Catchment of dam		Flow Station			Annual Flow	Flow Pattern			
(1)		(2)			(3)	(4)			
Basin area (Adam): 161 km ² River system: Souss/ Aguerd R.		Name: Amsoul Asta: 480 km ² (Asta/Adam: 3.0) Data period: 19 yrs.			0.26 m ³ /s 8.3 Mm ³ /yr 52 mm/yr	Peak flow in: Jan, Nov High flow in: 6 mon.(Nov-Apr) 50%-flow day: 12 days			
Geology									
Left Abutment of Damsite	Riverbed	Right Abutment			Reservoir				
(11)	(12)	(13)			(14)				
Overburden: rock blocks accumulated at the foot of the cliff	River deposits: few or 10meters, rock blocks, sand and gravel	No Cover			Terrace deposits: existing widely Bedrock: mainly Marl interbedded with Limestone, Fine conglomerate, Sandstone and Mudstone There are many karsts.				
Comments	Dam axis is in the gorge mainly of limestone which karst is commonly developed. Leakage is the main problem after constructing dam.								
Dam Planning									
Dam Type			Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.	
(21)			(22)	(23)	(24)	(25)	(26)	(27)	
The site is very narrow gorge with hard limestone. Both abutments are mostly up right . An arch type is suitable.			300m/57m	186,200 m ³	10.5 MCM	764.00 NGM	R.P.:1000year Qin=630m ³ /s		
Comment	Karsts are observed in the foundation. Treatments for leakage will be tough works. Access for dam site is not easy. The construction cost for access road and compensation road will be high.								
Agriculture (Based on the data on beneficial commune(s))									
Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)	
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	
Iguin' Quaqa	4	15,161	7,561	2,942	5,409	Barley Soft Wheat Vegetables Olive Fodder	1) Wheat 2) Vegetable 3) Olive 4) Almond 5) Fodder	12,900	
Comments	High irrigated occupancy No definitive formulation of irrigation scheme								
Irrigation Planning									
Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation		Design Discharge m ³ /s	Main Canal	Secondary Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)		(43)	(44)	(45)	(41)	(41)
600 ha	116	6.4 MCM	Furrow Border Basin		0.6 m ³ /s	10 km	6 km	Weir : 1	8 nos
Water Supply Planning									
Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm ³ /year)	Facilities	Others	
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)	
Irrigation area and suurounding area of the dam			300	Ministry of Equipment	Commune or farmers' association	0.002	Filter facility, Reservoir, Transmission line, Stand pipes		
Comments	Domestic water supply within the irrigation area and surrounding area of the dam is considered. Irrigation facilities will be utilized for water conveyance as maximal as possible for securing its economy.								
Flood and Sediment Control									
Disasters		Suffering object		Effects of dam		Reservoir sedimentation		Others	
(61)		(62)		(63)		(64)		(65)	
Flooding and bank erosion.		Farmlands, settlement and irrigation facilities.		Flood control and stabilisation of river channel.		DS: 460 m ³ /km/yr VS: 0.075 Mm ³ /yr			
Comment									

Table VIII.1.24 Plan de Developpement pour le Projet Propose (No.24 AMOONT ABDEL MOUMEN)

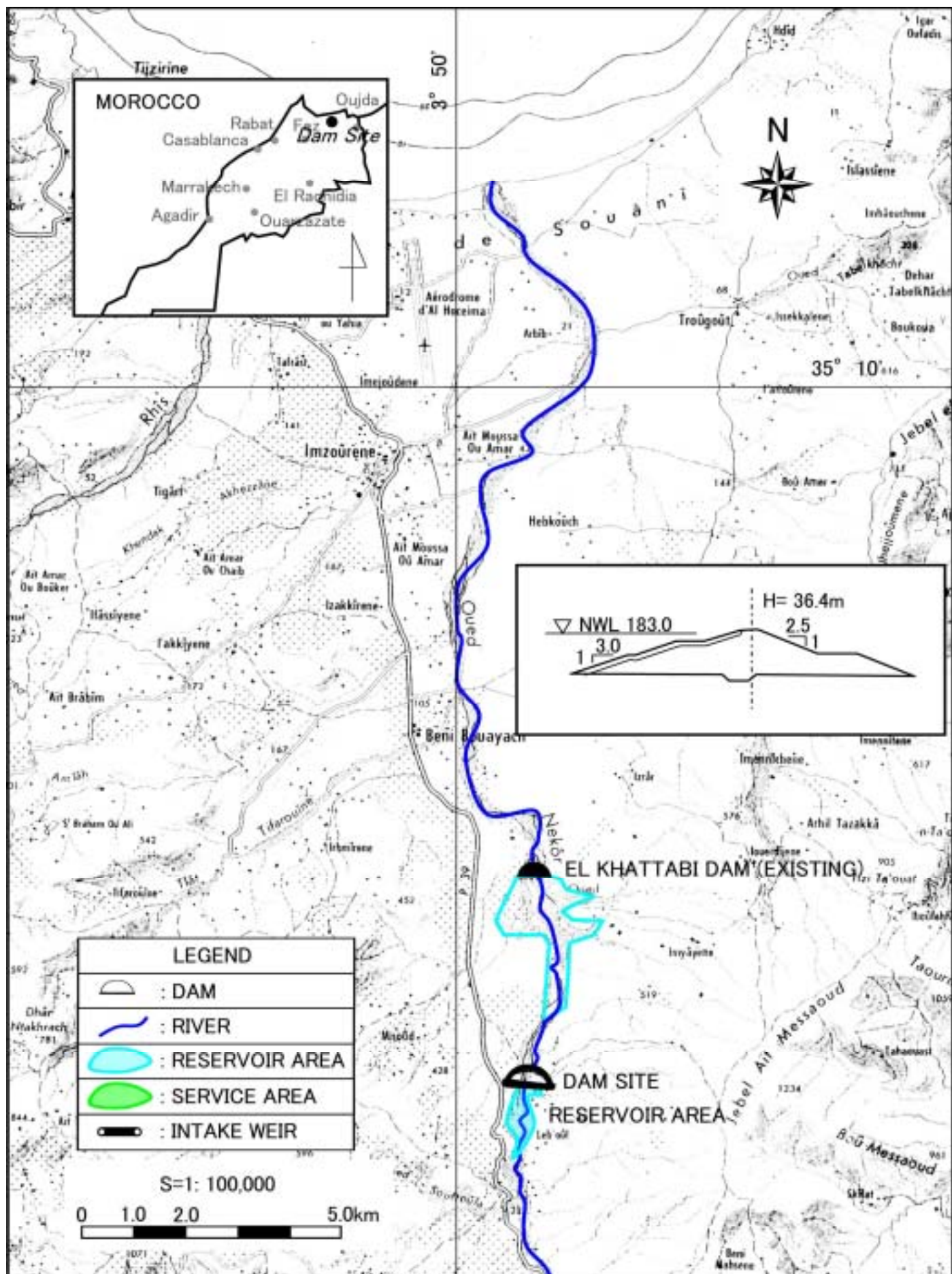
General (Dam Site)										
Objective	Zone	Watershed	River	Province	(1:50,000)	Coordinate	Location	Study level		
compensation for Abdelmoumen Dam		Assif, tributary of Souss A=938km ²	Oued Issene	Taroudant	Imourer Ida Ou-Tanane	X=146.400 Y=426.800	Argana	P/S on going		
Hydrology										
Catchment of dam			Flow Station			Annual Flow	Flow Pattern			
(1)			(2)			(3)	(4)			
Basin area (Adam): 938 km ² River system: Souss/ Issen R.			Name: Aguenza Asta: 1130 km ² (Asta/Adam: 1.2) Data period: 17 yrs.			1.90 - m ³ /s 59.8 - Mm ³ /yr 64 mm/yr	Peak flow in: Mar, Nov High flow in: 6 mon.(Nov-Apr) 50%-flow day: 23 days			
Geology										
Left Abutment of Damsite		Riverbed		Right Abutment			Reservoir			
(11)		(12)		(13)			(14)			
No Cover		River deposits: relatively few, almost rock blocks and cobbles		No Cover			Bedrock: almost same as the dam site, conglomerate layers including permeability			
Comments	Both banks along dam axis are rightstanding. Foundation is composed of generally red colored sandstone, argillaceous rocks, and conglomerates which are monoclinic dipped gently downstream side. Folding is very few. Conglomerates have sometimes open joint which leakage may occur. Part of slope along									
Dam Planning										
Dam Type				Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.	
(21)				(22)	(23)	(24)	(25)	(26)	(27)	
A gravity is suitable as both abutments have steep slopes with rock foundation.				not yet decided						
Comment	Land sliding around the site should be studied.									
Agriculture (Based on the data on beneficial commune(s))										
Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)		
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)		
Amont Abdelmoumen	2	1,360	339	1,131	3,724	Barley Soft Wheat Olive Almond	1) Wheat 2) Vegetable 3) Olive 4) Almond 5) Fodder	14,600		
Comments	No Irrigation Scheme Project									
Irrigation Planning										
Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation		Design Discharge m ³ /s	Main Canal	Secondary Canal	Headwork	Other Facility	
(41)	(42)	(43)	(41)		(43)	(44)	(45)	(41)	(41)	
-	-	-	-		-	-	-	-	-	
Water Supply Planning										
Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm ³ /year)	Facilities	Others		
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)		
-	-	-	-	-	-	-	-	-		
Comments	This project includes no water supply scheme.									
Flood and Sediment Control										
Disasters			Suffering object		Effects of dam		Reservoir sedimentation	Others		
(61)			(62)		(63)		(64)	(65)		
-			Abdelmoumen dam with technical problem.		Complement of functions of Abdelmoumen dam		DS: 161 m ³ /km/yr VS: 0.151 Mm ³ /yr			
Comment	Alternative studies are not available for the measures to complement the functions of Abdelmoumen dam. Study is still ongoing.									

Table VIII.1.25 Plan de Developpement pour le Projet Propose (No.25 SIDI ABDELLAH)

General (Dam Site)									
Objective	Zone	Watershed	River	Province	(1:50.000)	Coordinate	Location	Study level	
irrigation, recharge for ground water		Souss A=233km ²	Oued Ouaar	Taroudant	Igli	X=171.700 Y=408.600	Taroudant	F/S terminated	
Hydrology									
Catchment of dam		Flow Station			Annual Flow	Flow Pattern			
(1)		(2)			(3)	(4)			
Basin area (Adam): 233 km ² River system: Souss/ L'ouaar R.		Name: Amsoul Asta: 480 km ² (Asta/Adam: 3.0) Data period: 19 yrs.			0.38 m ³ /s 12.0 Mm ³ /yr 52 mm/yr	Peak flow in: Jan, Nov High flow in: 6 mon.(Nov-Apr) 50%-flow day: 12 days			
Geology									
Left Abutment of Damsite	Riverbed		Right Abutment			Reservoir			
(11)	(12)		(13)			(14)			
Overburden: Talus deposits at the foot	Alluvial deposits: Ep=few meters, rock blocks, cobbles, and sand, medium size 20 to 30cm		Overburden: Talus deposits at the foot			River deposits: relatively few Terrace deposits: mainly along Right Bank side Bedrock: Shale, Sandstone, Conglomerate, and Limestone Bar sometimes karstified			
Comments	Hard basalt dyke runs obliquely crossing with river bed. Foundation is mainly of shale very brittle and low strength. While the upper abutment is the limestone highly karstified underlain by shale. The talus deposit lies on the relatively thick terrace deposit at the foot of right bank.								
Dam Planning									
Dam Type			Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.	
(21)			(22)	(23)	(24)	(25)	(26)	(27)	
The right abutment has thick soil layer. The foundation rock is mainly brittle schist. A zoned fill type is suitable.			381.3m/69m	2,055,000 m ³	10.37 MCM	534.00 NGM	Qin=900m ³ /s Qout=528m ³ /s		
Comment	Materials for the fill dam can be obtained in the vicinity of the site. Access is easy.								
Agriculture (Based on the data on beneficial commune(s))									
Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)	
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	
Sidi Abdellah	5	9,897	5,953	2,352	5,877	Barley Soft Wheat Vegetables Olive	1) Wheat 2) Vegetable 3) Olive 4) Almond 5) Fodder	12,400	
Comments	High irrigated occupancy No definitive formulation of irrigation scheme								
Irrigation Planning									
Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation		Design Discharge m ³ /s	Main Canal	Secondary Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)		(43)	(44)	(45)	(41)	(41)
600 ha	143	6.4 MCM	Furrow Border Basin		0.6 m ³ /s	12km	6 km	Weir : 1	8 nos
Water Supply Planning									
Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm ³ /year)	Facilities	Others	
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)	
Irrigation area and surrounding area of the dam			400	Ministry of Equipment	Commune or farmers' association	0.003	Filter facility, Reservoir, Transmission line, Stand pipes		
Comments	Domestic water supply within the irrigation area and surrounding area of the dam is considered. Irrigation facilities will be utilized for water conveyance as maximal as possible for securing its economy.								
Flood and Sediment Control									
Disasters		Suffering object		Effects of dam		Reservoir sedimentation		Others	
(61)		(62)		(63)		(64)		(65)	
Flooding and bank erosion.		Farmlands, settlement and irrigation facilities.		Flood control and stabilisation of river channel.		DS: 430 m ³ /km/yr VS: 0.103 Mm ³ /yr			
Comment									

*L'étude de Faisabilité Pour Le Développement des Ressources En Eau
Par Les Barrages Moyens Dans Le Milieu Rurale Au
Royaume Maroc
Rapport Final
Volume III Rapport de Soutien (1) sur Étude de Base
Rapport de Soutien VII
Developpement des Projets*

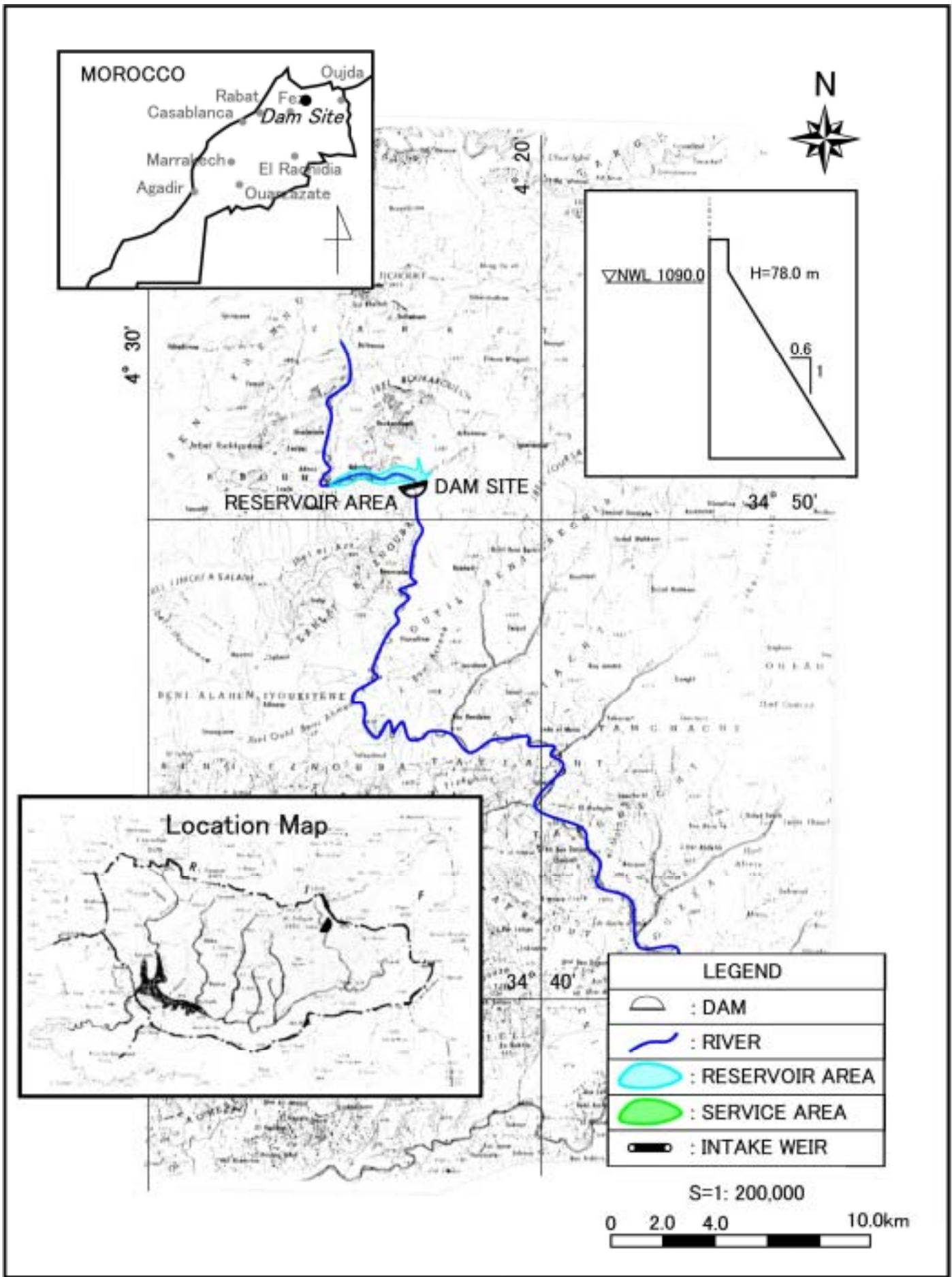
Figures

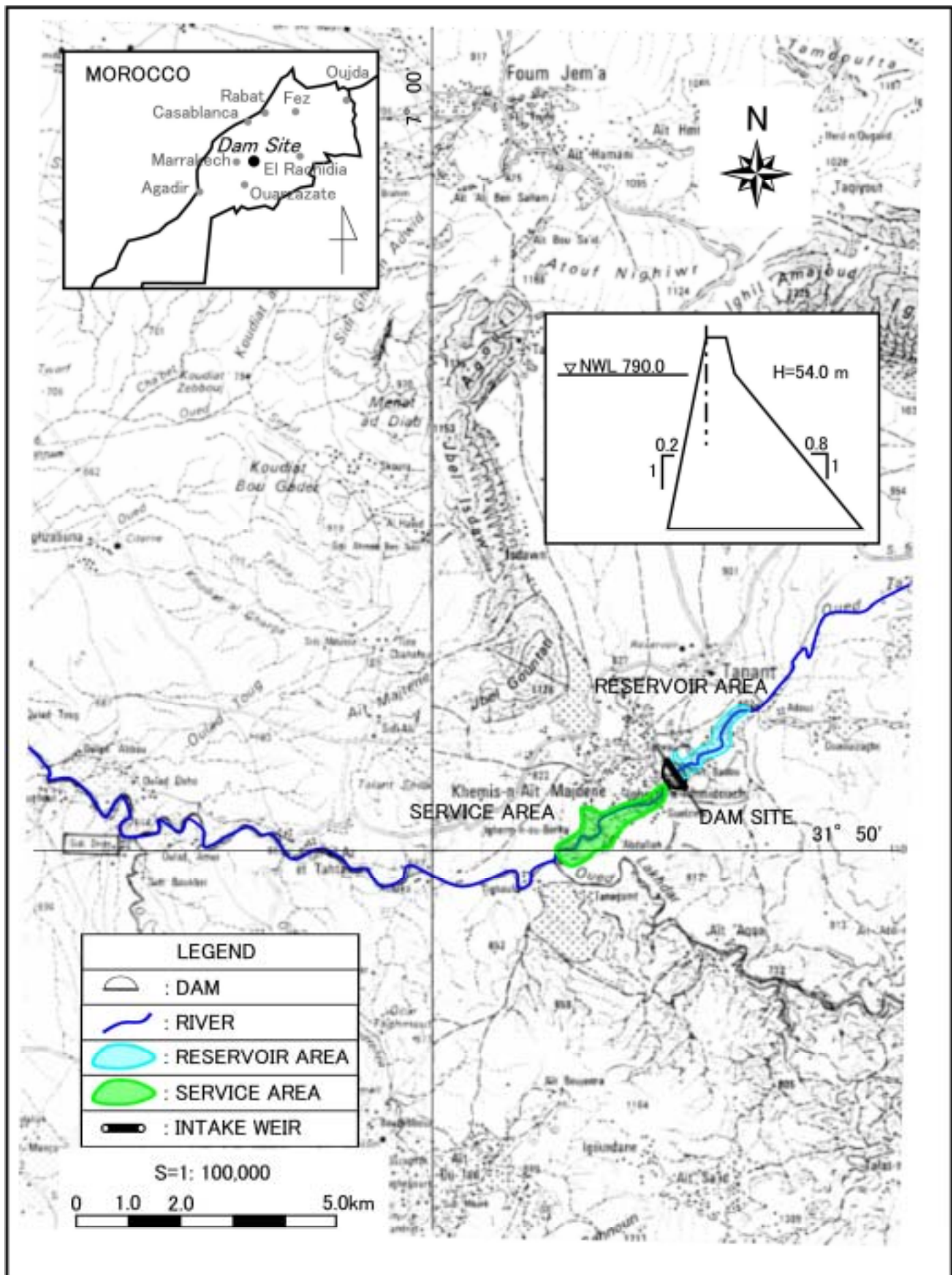


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Figure VIII.1.1
General Plan of NECKOR (No.1)

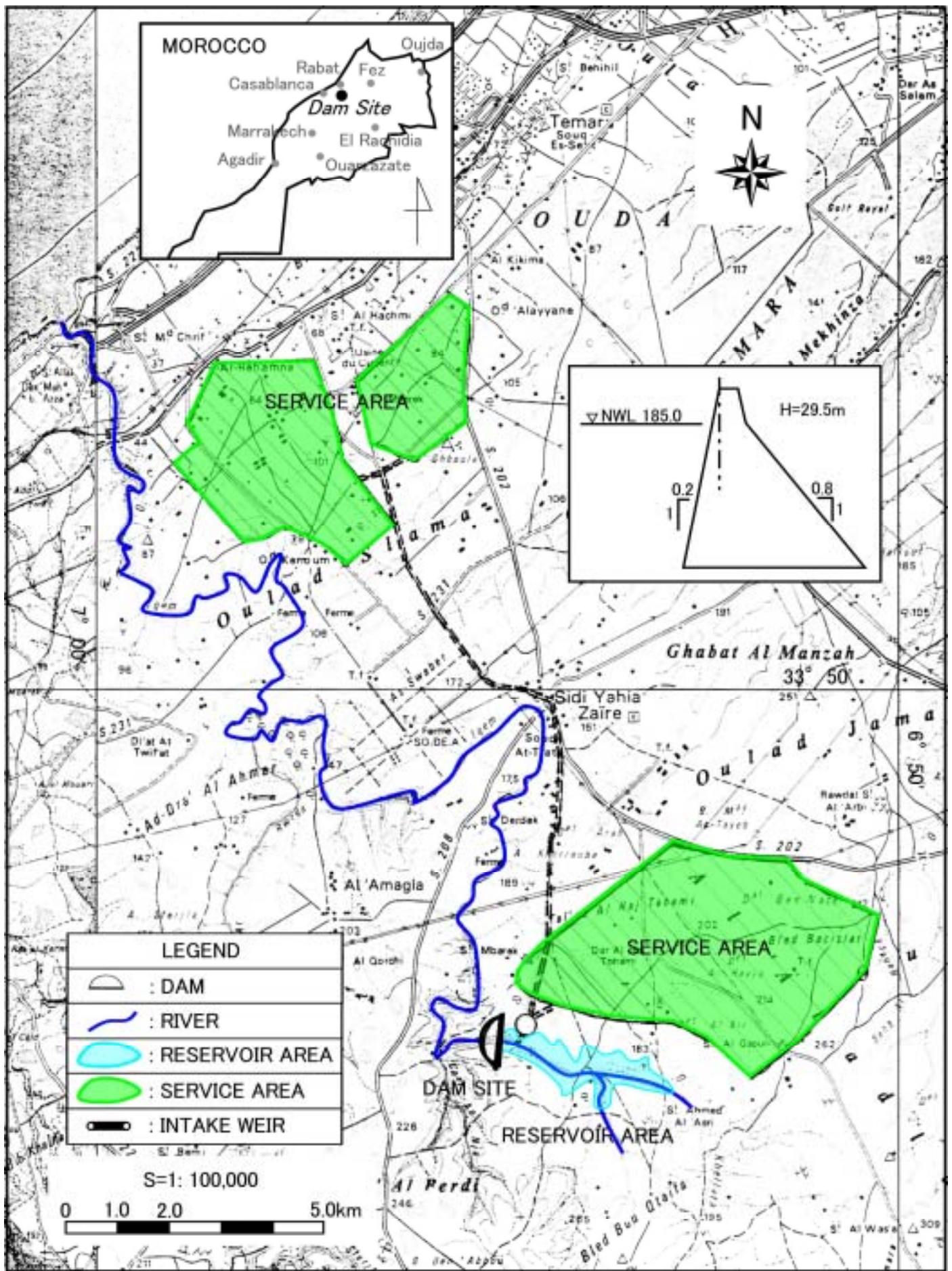




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Figure VIII.1.3
General Plan of AIT BADDOU (No.3)

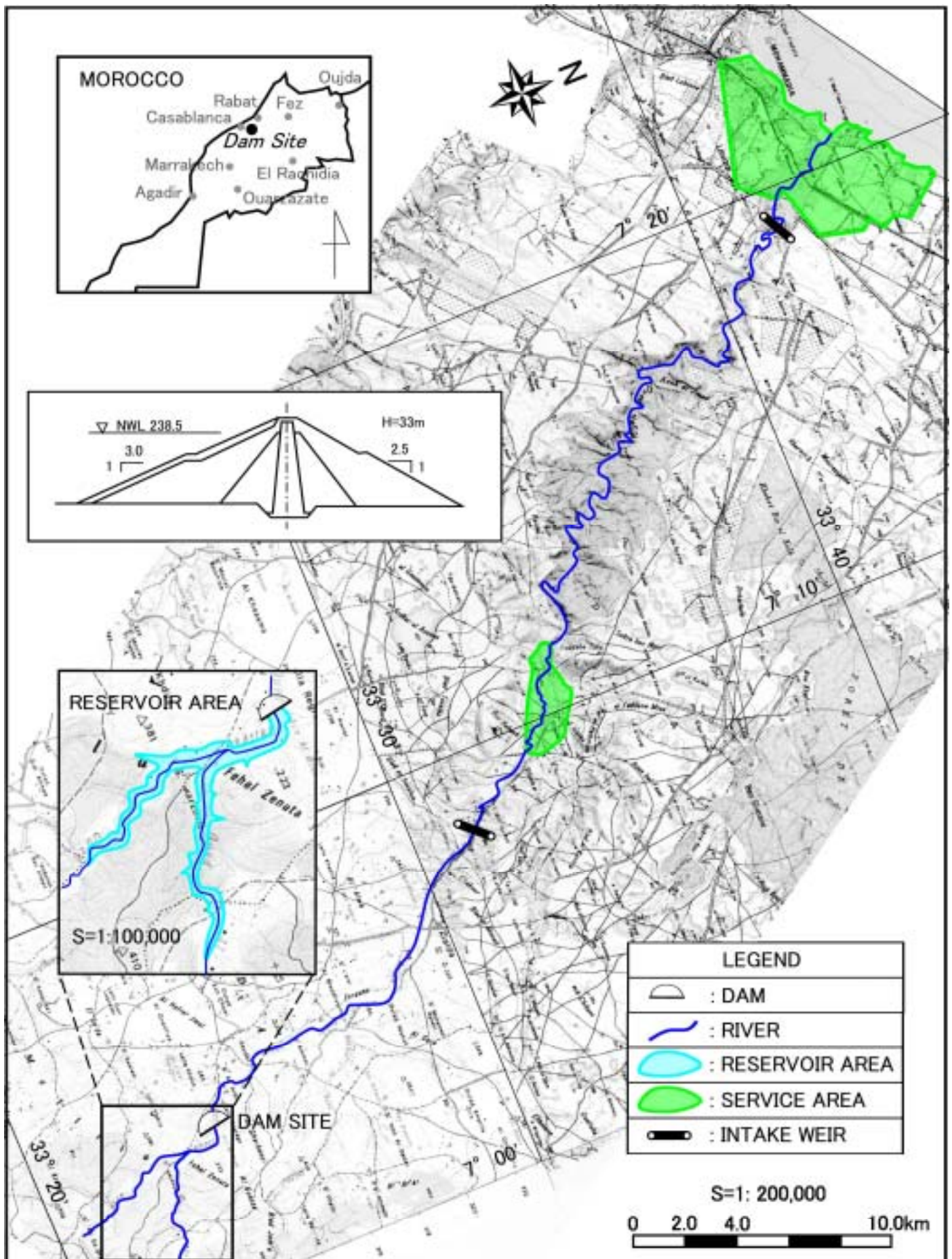


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Figure VIII.1.4

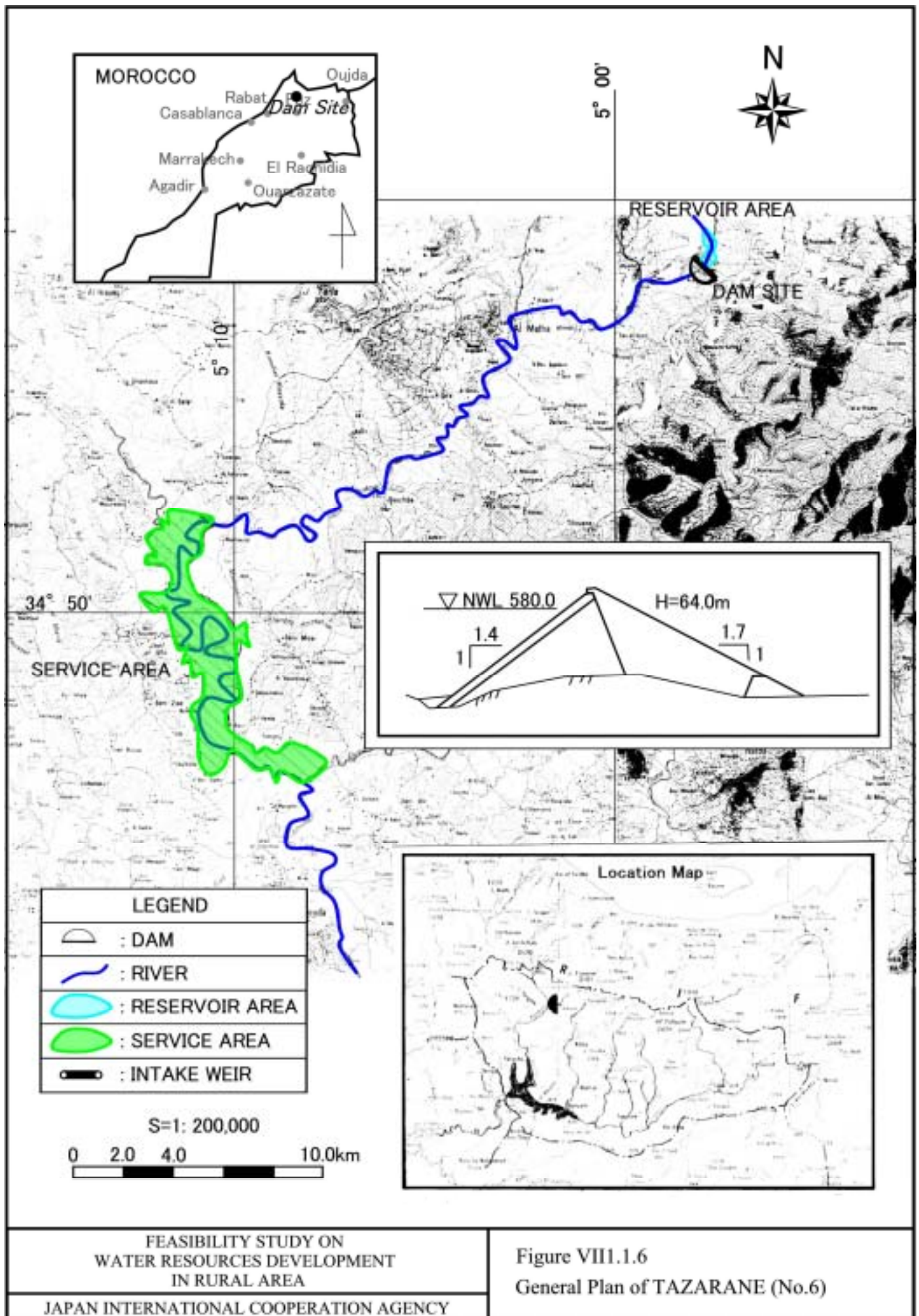
General Plan of AIN KWACHIYA (No.4)

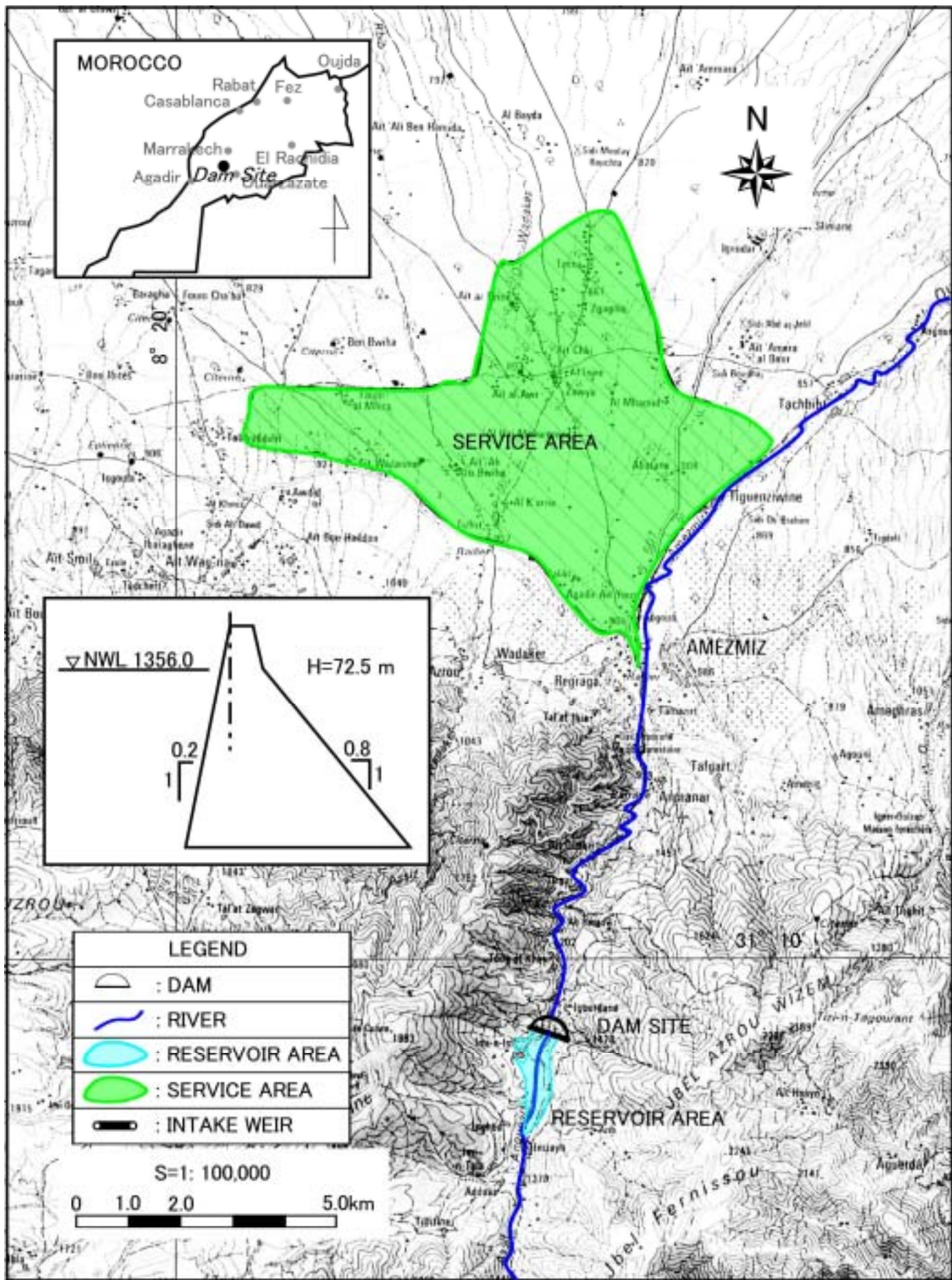


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Figure VIII.1.5
General Plan of N'FIFIKH (No.5)

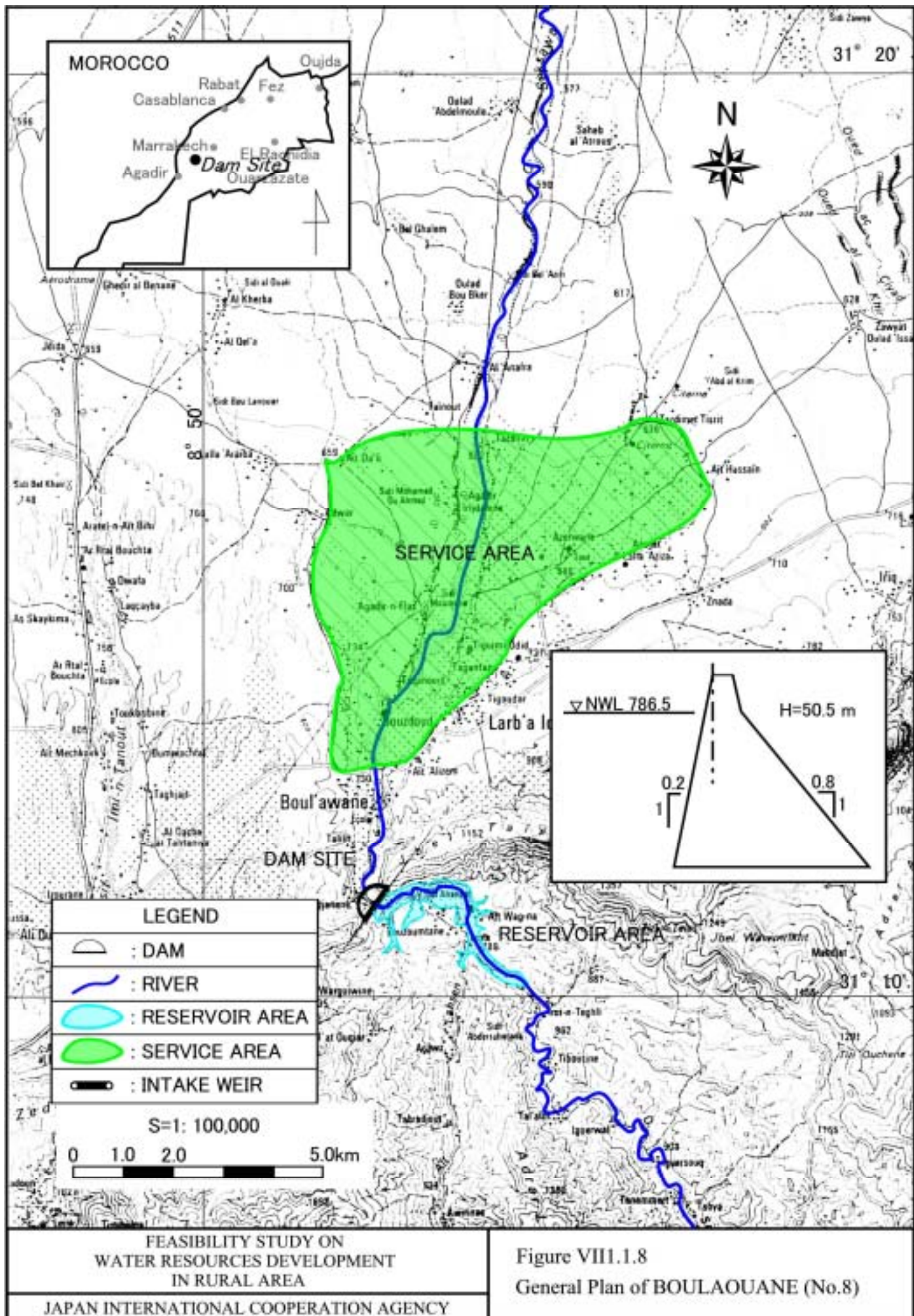


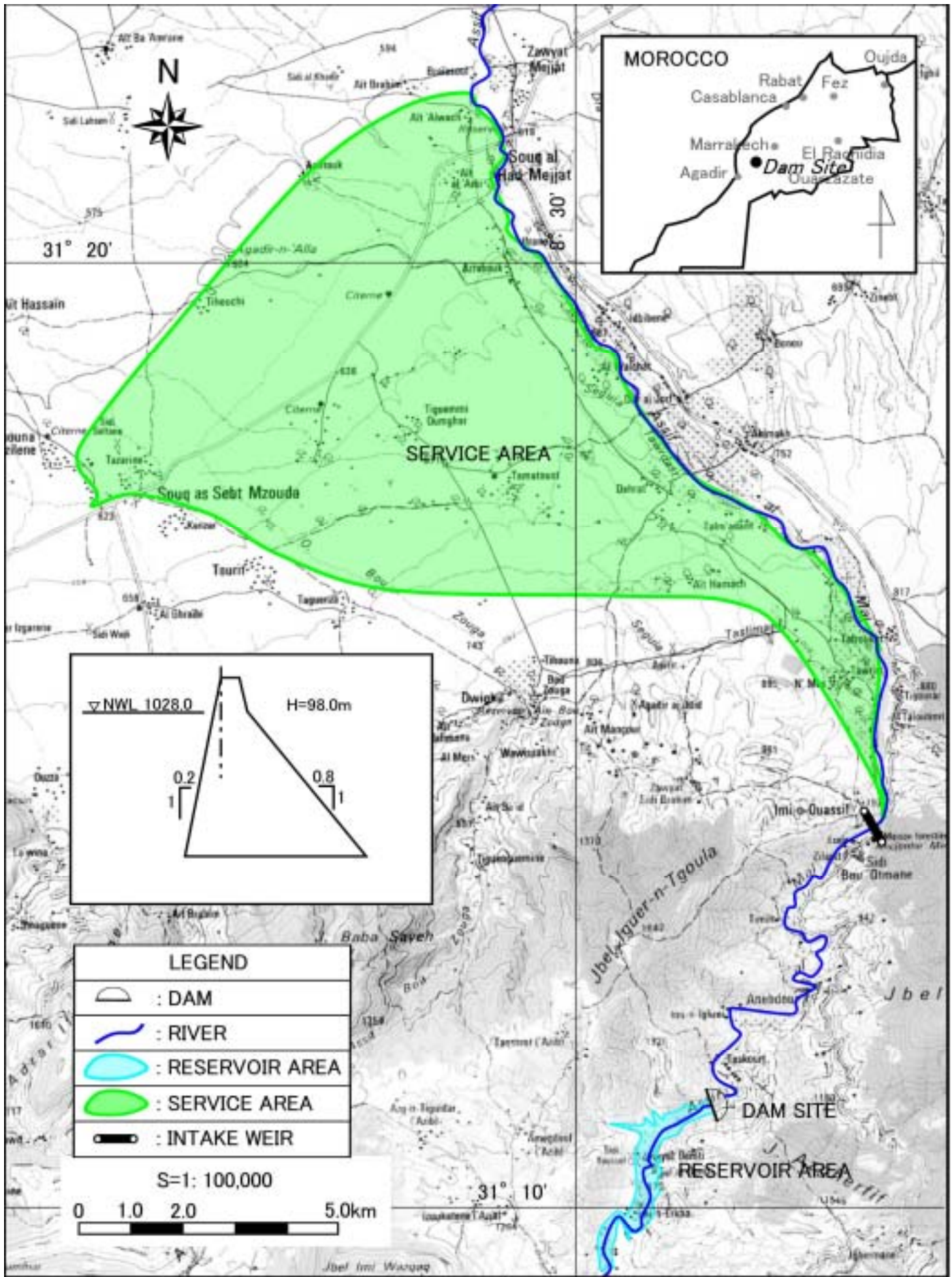


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Figure VIII.1.7
 General Plan of AMEZMIZ (No.7)

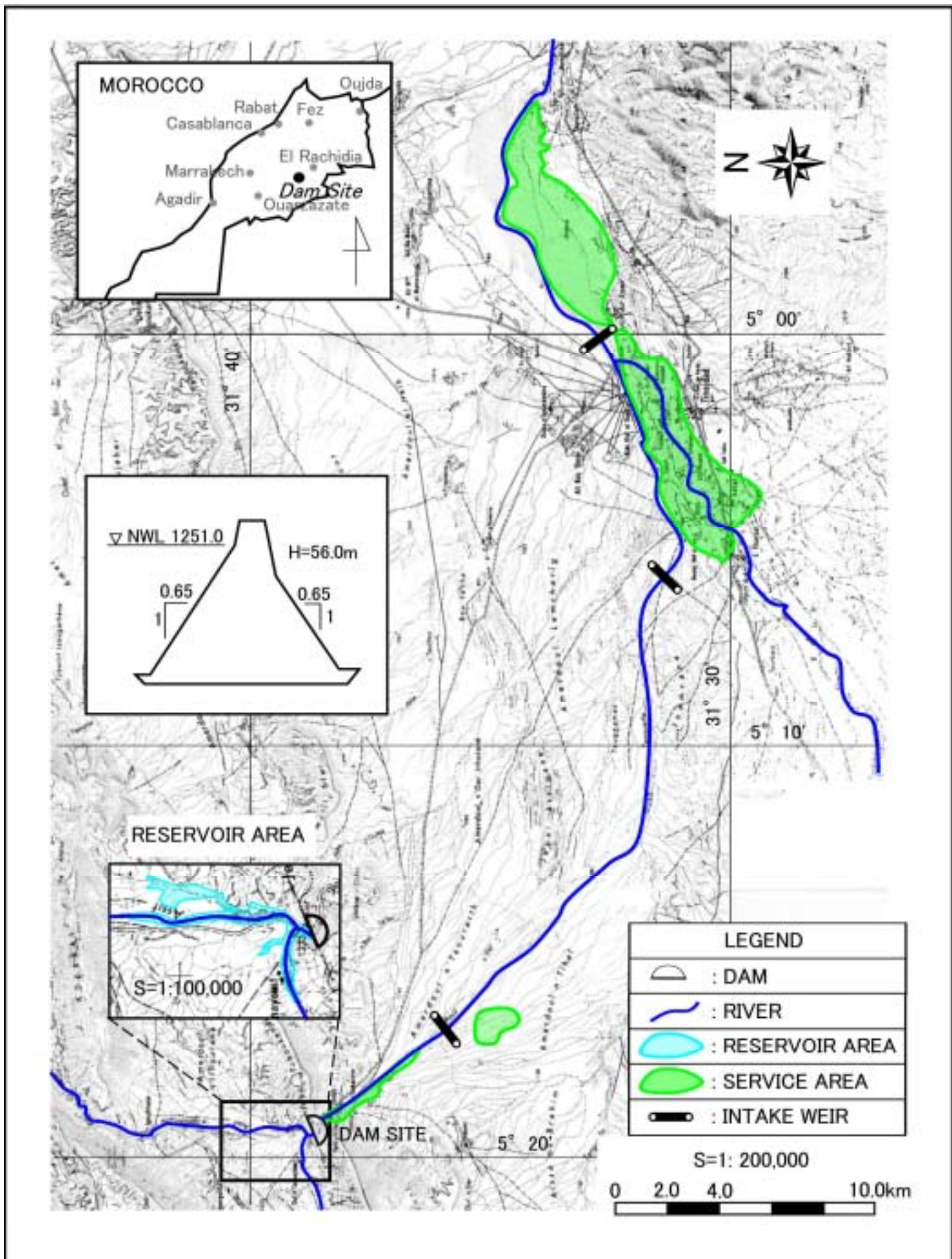




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Figure VIII.1.9
General Plan of TASKOURT (No.9)



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Figure VIII.1.10
General Plan of TIMKIT (No.10)