Annex to 3.4.1 Description Of Proposed Measures For Wastewater Collection, Treatment And Disposal

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28. NORTH QUEEN ALIA AIRPORT TREATMENT PLANT

1. Long term development in South Amman Area

According to the Consultants Study Report the long-term strategy for the South Amman Area foresees two independent sewerage schemes and two wastewater treatment plants:

- *North Queen Alia Airport Treatment Plant (eastern drainage area)*
  This treatment plant will receive the wastewater of the eastern drainage area.

- *Al Jeeza Treatment Plant (western drainage area)*
  This treatment plant will receive the wastewater of the western drainage area.

Details of proposed Al Jeeza system are given under Section 20.

2. Proposed North Queen Alia Airport Treatment Plant

Figure 28.1 shows the layout of the proposed sewerage system, which will be implemented in 3 Phases.

The project foresees the construction of the North Queen Alia Airport Treatment Plant designed for the wastewater production in 2020. It will be based on an extended aeration process including maturation ponds for tertiary treatment. Produced sludge will be treated by sludge holding tanks and drying beds. Figure 28.2 shows the proposed treatment system. The projection of the wastewater production is shown in the following table (acc. to Consultant's Study Report). The plant will be implemented in two phases, whereby the final capacity will be reached

in 2020: 28,500 m³/d (283,000 connected inhabitants)

The effluents could supply irrigation water for an area of about 460 ha in 2020 taking into account the demand for alfalfa, barley and sudan grass as summer crops and barley and ryegrass as winter crop (see following table). Suitable land for irrigation was identified northwest of the treatment plant. A 1.5 km long transmission main to areas will be constructed to discharge treated effluent by gravity to the land. Proposed wastewater reuse areas are presented in the Figure 28.3.

The investment costs (Phase 1, 2 and 3) excluding engineering and contingencies (based on 1994 prices) are:

Treatment plant	8.44 million JD
Local sewerage	22.46 million JD
Collector sewerage	5.71 million JD
Trunk sewerage	4.78 million JD
Irrigation facilities	2.83 million JD
Total capital costs	44.22 million JD

Investment costs subdivided in Phases 1 (2002/11), 2 (2012/20) and 3 (2021/26) are as follows:

(price basis 2000, in mio. JD)

	Phase 1	Phase 2	Phase 3
Treatment plant	18.04	3.99	4.77
Local sewerage	5.45	0.68	0.68
Collector sewerage	5.42	0.29	0
Trunk sewerage	8.06	0	2.01
Subtotal capital costs	36.98	4.96	7.47
Engineering +Contingencies (30 %)	11.09	1.49	2.24
Total	48.07	6.45	9.71

Consultant's Study Report:
Montgomery Watson: "Technical and economic Feasibility Study and detailed Final Design of the collection, treatment and reuse of wastewater from communities South of Amman. Feasibility Study", June 1995

Volume I: Main Report
Volume II: Drawings

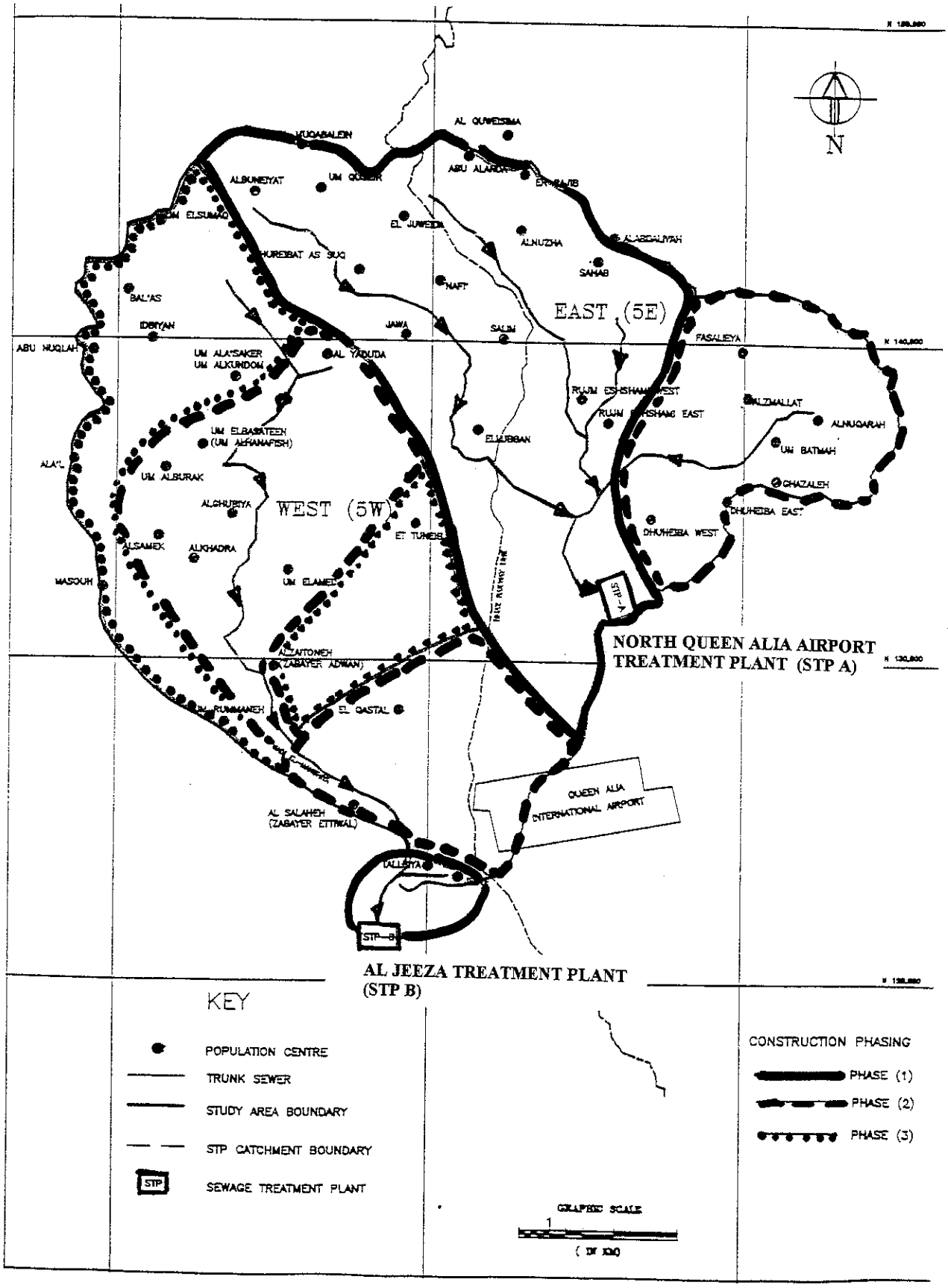


FIGURE 28.1: General Layout of Proposed Sewerage System - NORTH QUEEN ALIA AIRPORT

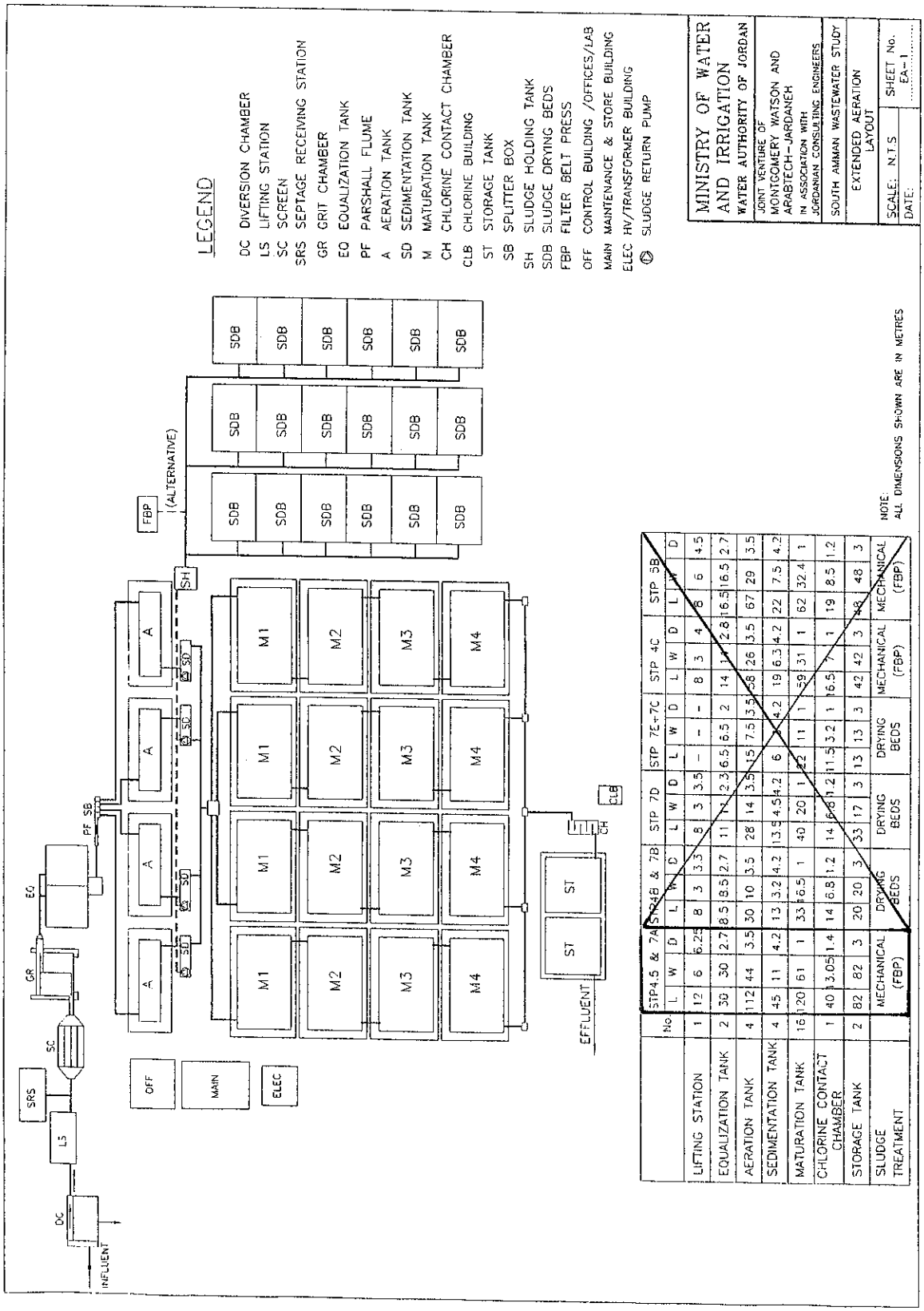


FIGURE 28.2: Layout of Proposed Wastewater Treatment Plant - NORTH QUEEN ALIA AIRPORT

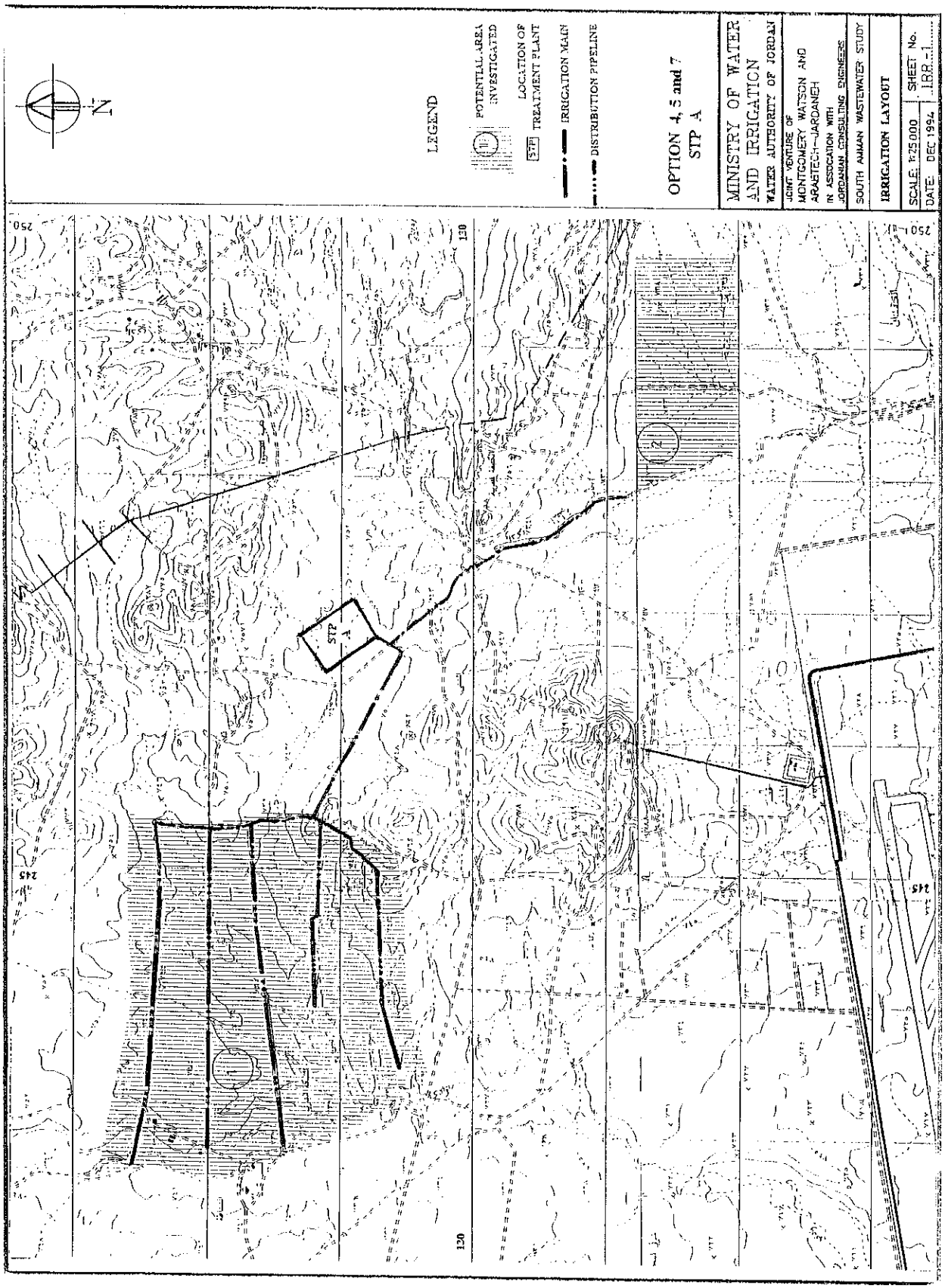


FIGURE 28.3a: Potential Reuse Areas - NORTH QUEEN ALIA AIRPORT (acc. to Montgomery)

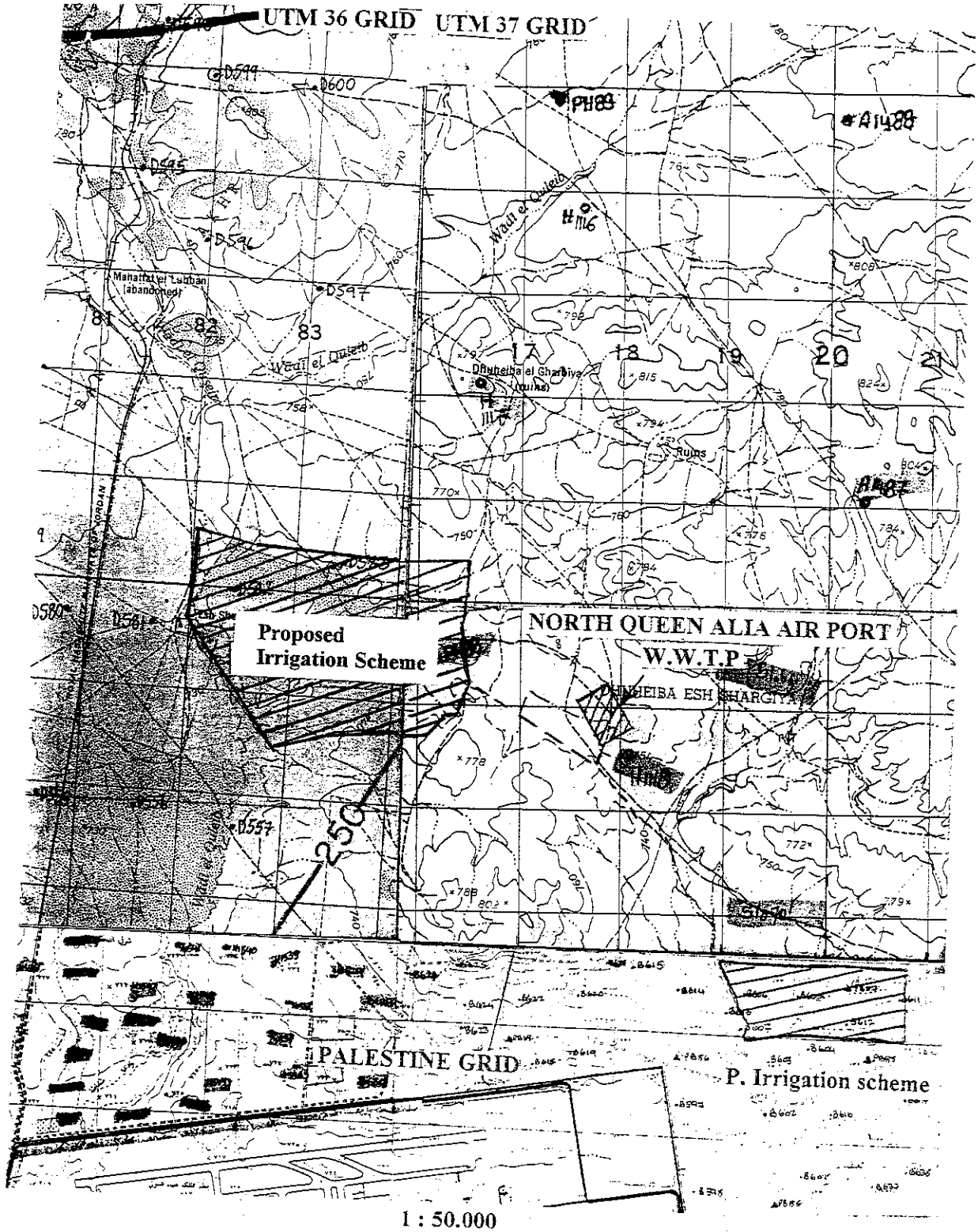


FIGURE 28.3b: Potential Reuse Areas - NORTH QUEEN ALIA AIRPORT (acc. to Min.of Agriculture)

PROJECTION OF WASTEWATER PRODUCTION OF TREATMENT PLANT: 28 NORTH QUEEN ALIA AIRPORT

SCENARIO 0 "Consultants' Study" (acc. to Consultant's Study Report of Montgomery Watson 1995)
Option 5: Sewage Treatment Plant A (STP A)

Basic data:

Population in 1994: 135.300

	Unit	1994	2000	2005	2010	2015	2020
Growth rate (previous period)	%	-	2,82	2,90	2,90	2,90	2,90
Spec.water demand	l/c/d	76	89	97	105	113	121
Commercial demand	m³/d						
Small industrial demand	m³/d						
Pastoral demand	m³/d						
Coverage	%	0	0	100	100	100	100
Return factor	-	0,85	0,85	0,85	0,84	0,84	0,83
Losses/inflow	%	0	0	0	0	0	0
Specific pollutional load	$gBOD_5/c/d$	65	65	65	65	65	65

	Unit	1994	2000	2005	2010	2015	2020
Population	c	135.300	159.869	184.434	212.773	245.468	283.185
Connected (sewerage)	c	0	0	184.434	212.773	245.468	283.185
Not connected (sewerage)	c	135.300	159.869	0	0	0	0
Water demand							
Domestic demand	l/c/d	76	89	97	105	113	121
	m³/d	10.283	14.228	17.890	22.341	27.738	34.265
Commercial demand	m³/d						
Small industrial demand	m³/d						
Pastoral demand	m³/d						
Total	m³/d	10.283	14.228	17.890	22.341	27.738	34.265
Wastewater production							
Return flow (w.demand)	m³/d	0	0	15.207	18.767	23.300	28.440
Losses/inflow	m³/d	0	0	0	0	0	0
Total	m³/d	0	0	15.207	18.767	23.300	28.440
	m³/month	0	0	456.197	562.998	698.993	853.209
	m³/a	0	0	5.550.394	6.849.811	8.504.418	10.380.714
Pollutional load							
Poll. load (dom.demand)	$kgBOD_5/d$	0	0	11.988	13.830	15.955	18.407
Poll. load (com.demand)	$kgBOD_5/d$						
Poll. load (small ind.)	$kgBOD_5/d$						
Others	$kgBOD_5/d$						
Total load	$kgBOD_5/d$	0	0	11.988	13.830	15.955	18.407
Reuse of wastwater							
Inflow to the treatment plant	m³/a	0	0	5.550.394	6.849.811	8.504.418	10.380.714
Losses in treatment plant	%	0	0	10	10	10	10
(due to infiltr./evap.)	m³/a	0	0	555.039	684.981	850.442	1.038.071
Effluent of treatment plant	m³/a	0	0	4.995.354	6.164.830	7.653.976	9.342.642
Net water demand per ha	m³/d/ha		55	55	55	55	55
Irrigable reuse area	ha	0	0	249	307	381	465

Water demand for irrigation Alfalfa, barley, ryegrass 55 m³/d/ha
MOA's proposal: Summer crops: Alfalfa, sudan grass
Winter crops: barley, ryegrass

29. NORTH JORDAN VALLEY TREATMENT PLANT

The proposed North Jordan Valley Scheme (Shuna North Scheme) area is located in the northern part of Jordan Valley extending from Adasiyyah in the north to Sleikhat in the south. Presently, there exists no sewerage system. The following communities will be connected to the proposed scheme:

Phase 1 (2001/03):	North Shuna, Sheikh Hussein, Zemalia, Tabquat Fahl, Masharie, Wadi El Yabis
Phase 2 (2008/10):	Manshiya, Waqqas, Merrazeh, Abu Habeil, El Qarn
Phase 3 (2018/20):	Adasiya, Sakneh, Fadin, Sleikhat

Figure 29.1 shows the layout of the proposed sewerage system (Study Report of Metcalf & Eddy). Without any alternative project proposals and studies the design considers an almost 40 km long main collector with 9 pump stations in the final phase.

This long trunk main will lead to enormous odor (among other) problems, because the flow time will be up to one day and the long term average monthly temperatures are rather high (between 14 and 30 °C).

The project foresees the construction of the North Jordan Valley Treatment Plant designed for the wastewater production in 2020. It will be based on an extended aeration process (modified Ludzak-Ettinger process) including nitrogen removal. Rapid sand filtration is proposed as tertiary treatment. Produced sludge will be treated by gravity thickeners and drying beds. Figure 29.2 shows the proposed treatment system.

The projection of the wastewater production is shown in the following table (acc. to Consultant's Study Report). The projection of collected wastewater considers continuously 24 l/c/d for infiltration/inflow allowance, which seems unrealistic because the groundwater table is generally 10 m below ground level. The plant will be implemented in two phases, whereby the final capacity will be reached

in 2025:	10,700 m³/d (112,000 connected inhabitants) and
in 2015:	7,700 m³/d (86,000 connected inhabitants)

The effluents could supply irrigation water for an area of about 500 ha in 2020 taking into account the demand for mixed crop pattern (see following table). Irrigable land is available south and west of the site. Treated effluent will be pumped to a elevated reservoir and from there discharged by gravity (1.1 km long pipeline) to the proposed land. Proposed wastewater reuse areas are presented in the Figure 29.3.

The investment costs based on 1999 prices are (Phase 1 measures only):

Treatment plant (primary and secondary treatment)	10.36 million JD
Networks	12.72 million JD
Reuse system	0.78 million JD

Misc. equipment	0.75 million JD
Total base costs	24.61 million JD
Physical contingencies	3.69 million JD
Engineering	2.92 million JD
Total investment costs	31.21 million JD

According to the Consultant's Study Report implementation of proposed construction measures is foreseen during the years 2001 to 2003 (Phase I).

Consultant's Study Report:

Metcalf & Eddy: "North Jordan Valley communities wastewater collection, transportation, treatment and reuse system. Project 1 – Phase I. Final Engineering Review Report", December 1999

Metcalf & Eddy: "North Jordan Valley communities wastewater collection, transportation, treatment and reuse system. Project 1 – Phase I. Final Preliminary Design Report", April 2000

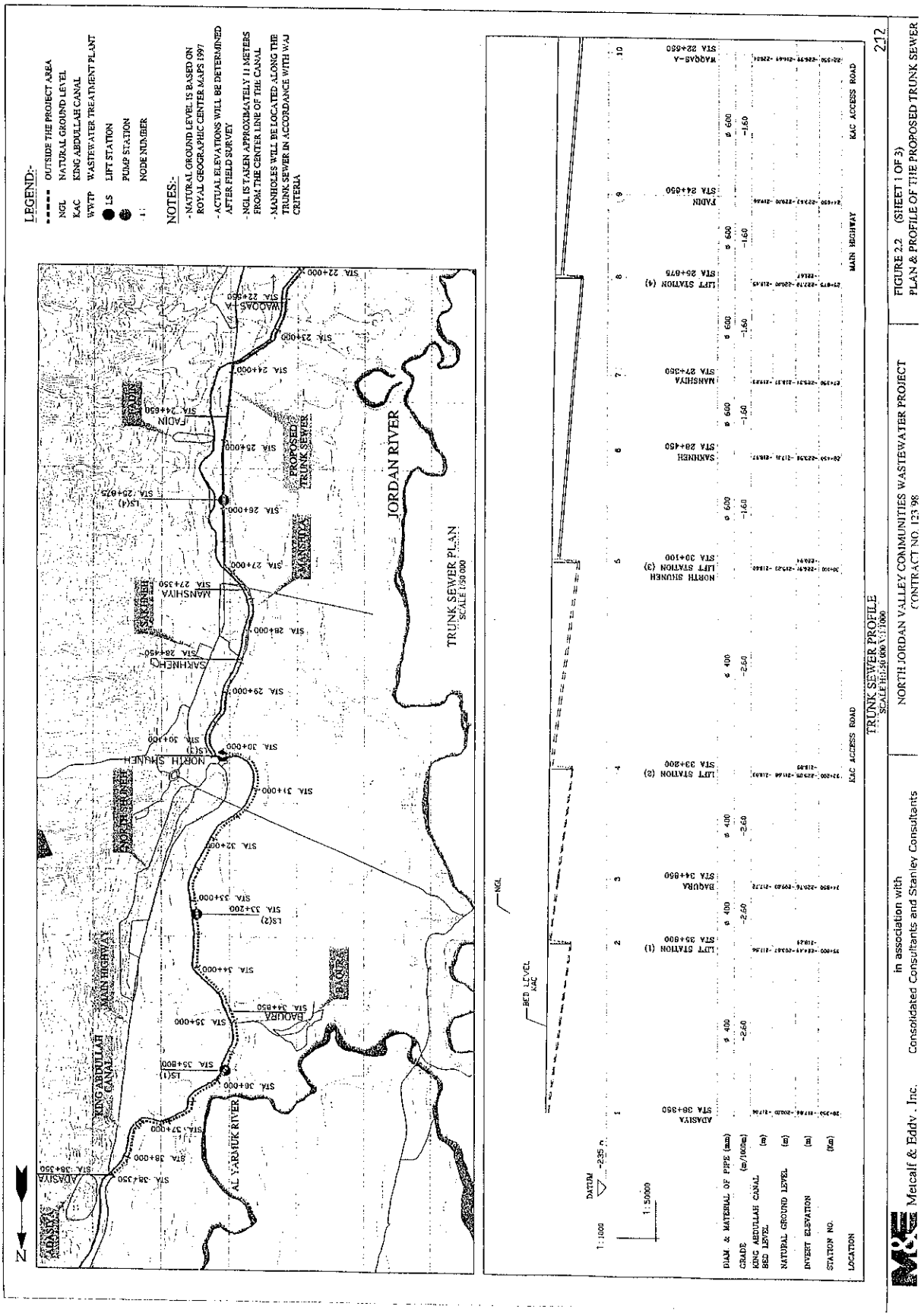


FIGURE 29.1a: General Layout of Proposed Sewerage System - NORTH JORDAN VALLEY

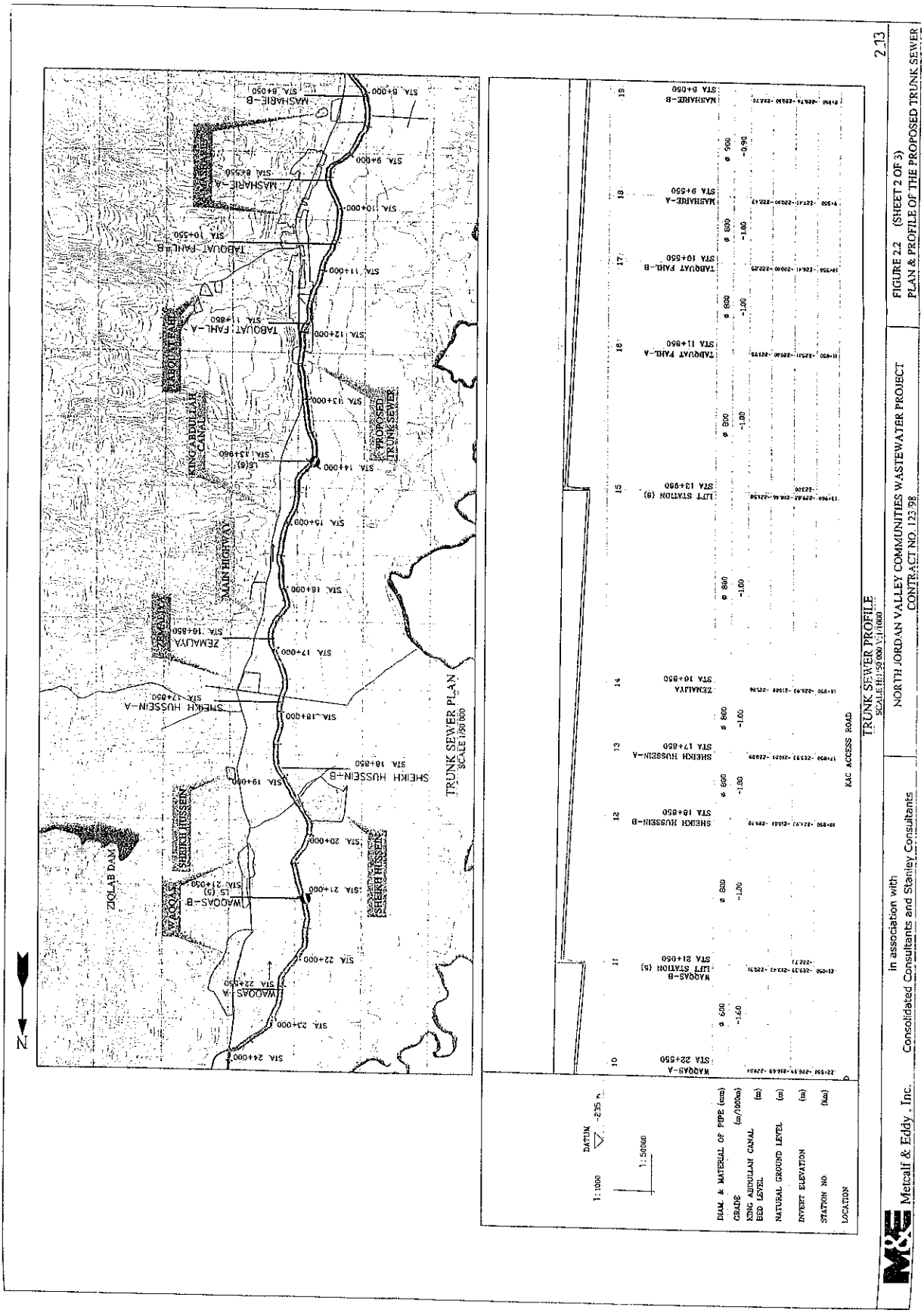


FIGURE 29.1b: **General Layout of Proposed Sewerage System - NORTH JORDAN VALLEY (continued)**

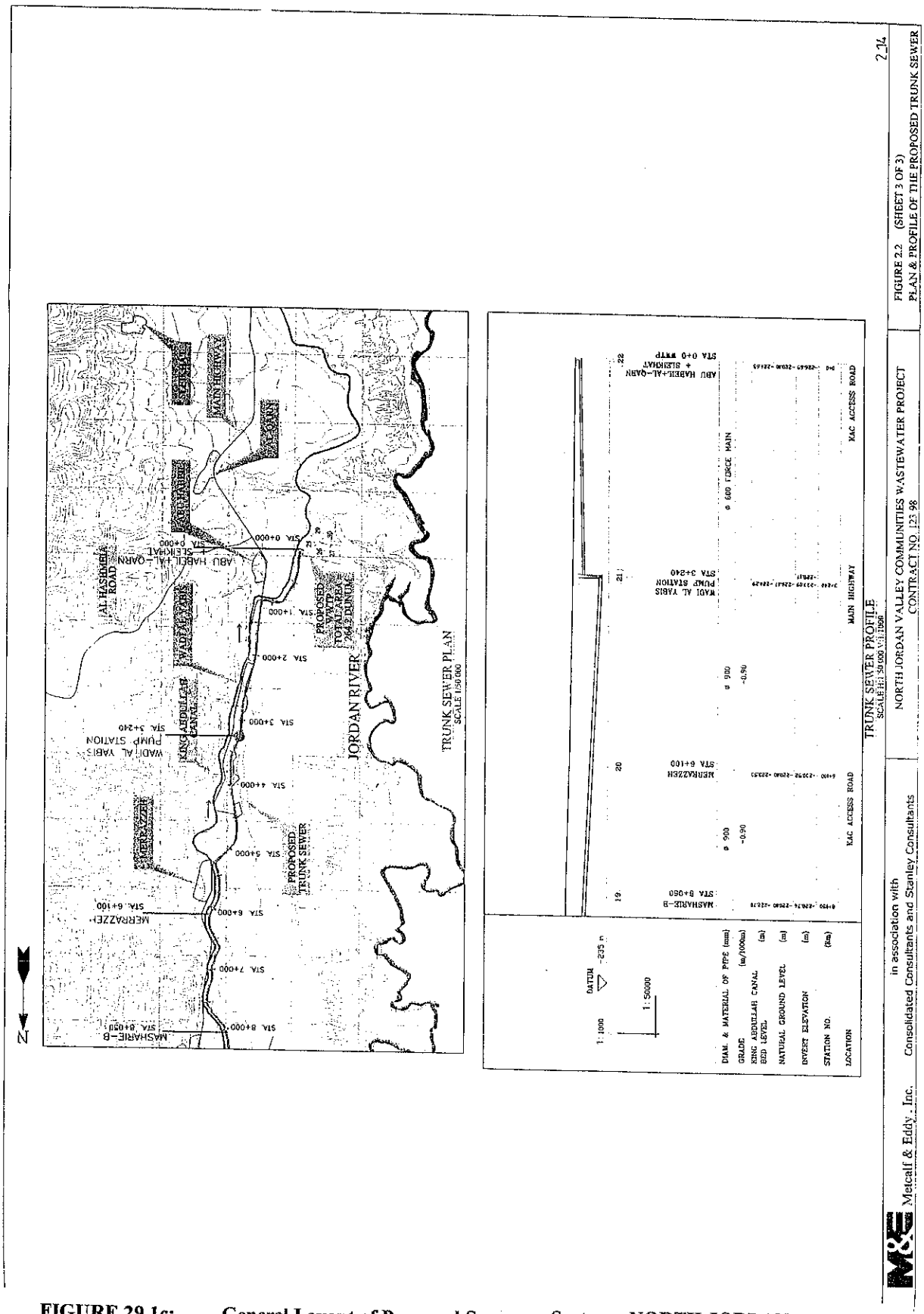


FIGURE 29.1c: **General Layout of Proposed Sewerage System - NORTH JORDAN VALLEY (continued)**

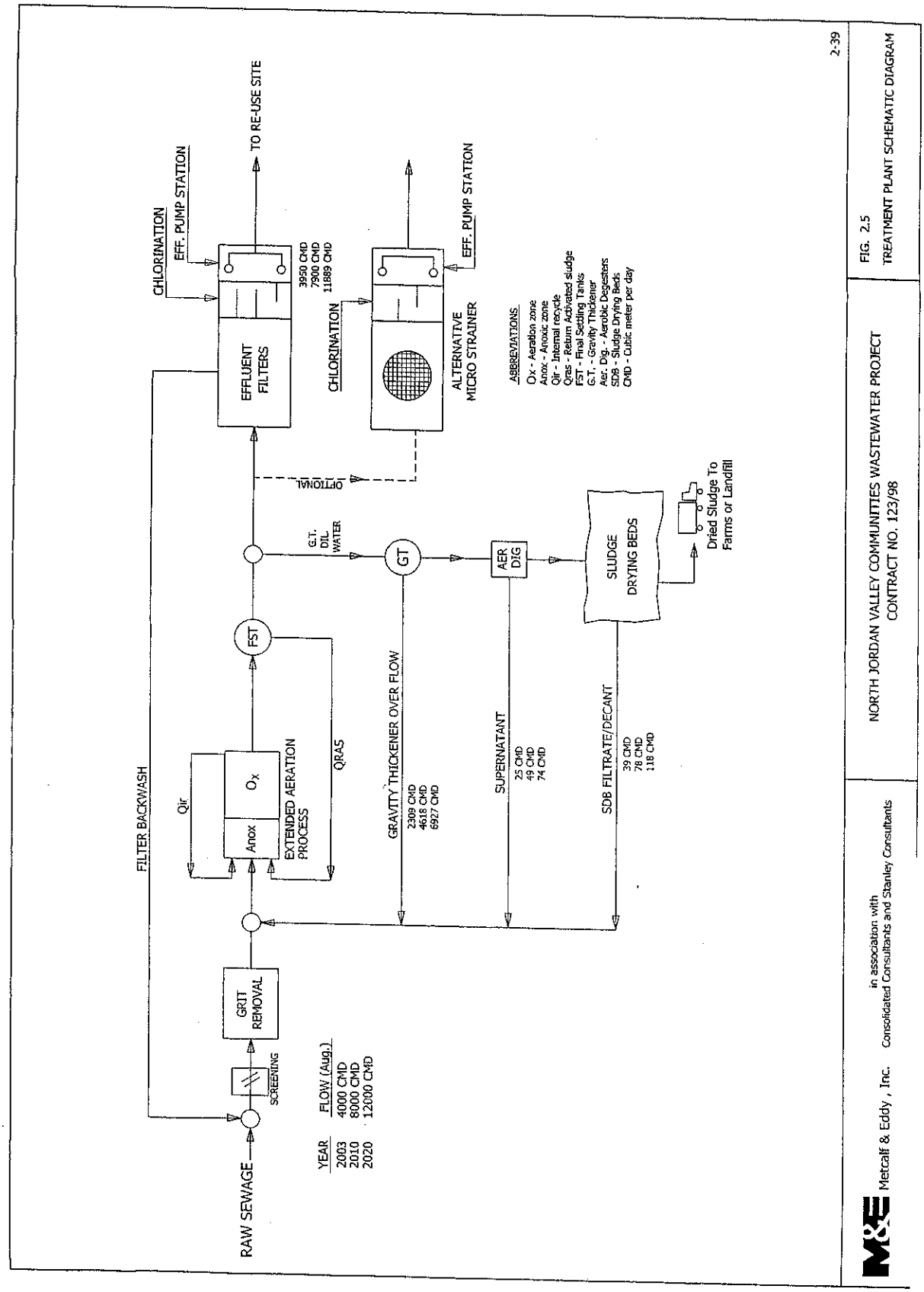


FIGURE 29.2: **Layout of Proposed Wastewater Treatment Plant - NORTH JORDAN VALLEY**

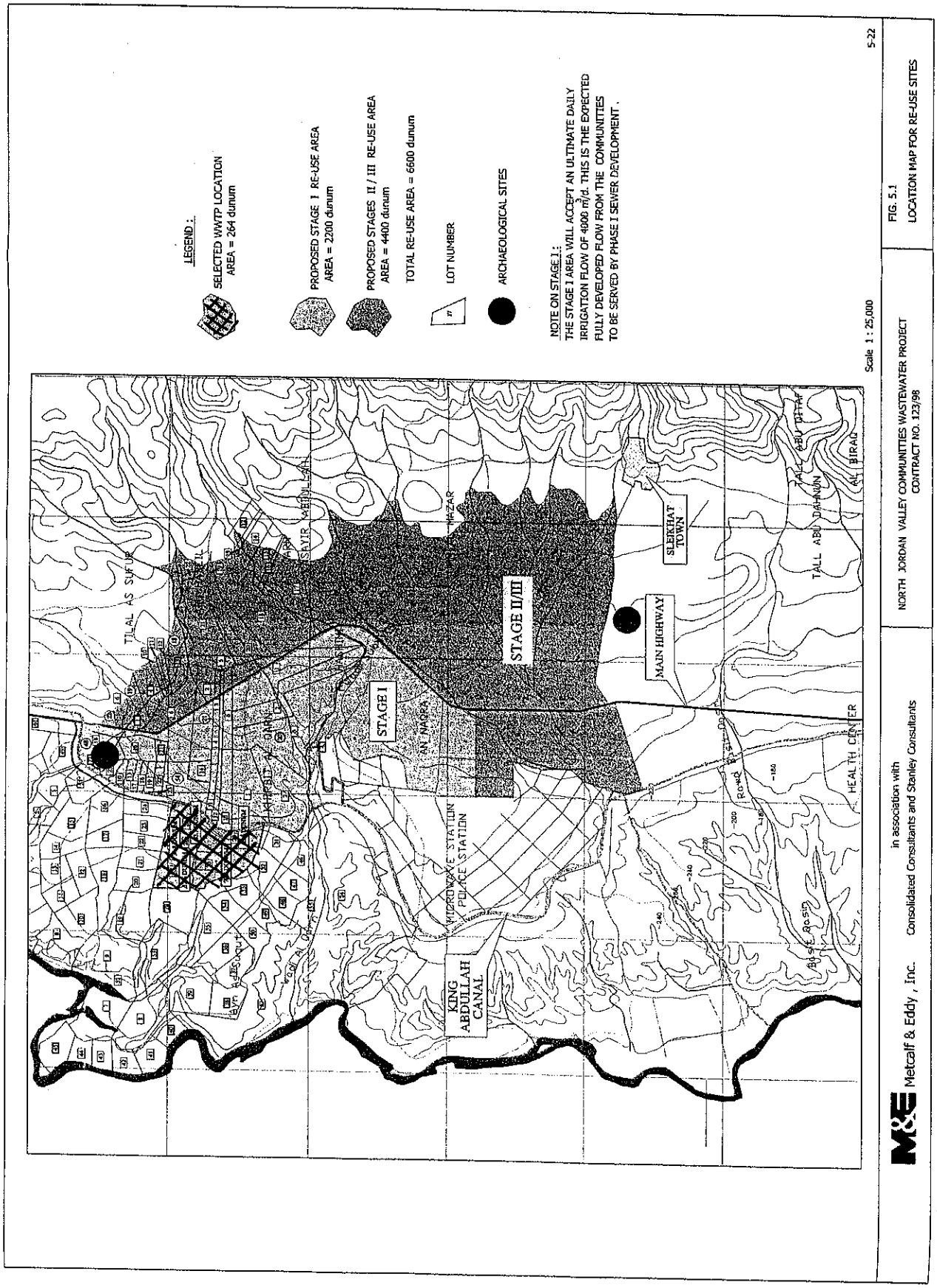


FIGURE 29.3: **Potential Reuse Areas - NORTH JORDAN VALLEY**

PROJECTION OF WASTEWATER PRODUCTION OF TREATMENT PLANT: 29 NORTH JORDAN VALLEY

SCENARIO 0 "Consultants' Study" (acc. to Consultant's Study Report of Metcalf & Eddy)

Basic data:

Population in 1994: 57.105

	Unit	1994	2000	2005	2010	2015	2020
Growth rate (previous period)	%	-	3,21	3,09	2,97	2,84	2,70
Spec.water demand	l/c/d	-	90	97	105	112	120
Commercial demand	m³/d						
Small industrial demand	m³/d						
Pastoral demand	m³/d						
Coverage	%	0	0	74	80	80	80
Return factor	-	0,8	0,8	0,8	0,8	0,8	0,8
Losses/inflow	%	0	33	31	29	27	25
Specific pollutional load	$gBOD_5/c/d$	65	65	65	65	65	65

	Unit	1994	2000	2005	2010	2015	2020
Population	c	57.105	69.025	80.369	93.011	106.965	122.224
Connected (sewerage)	c	0	0	59.473	74.409	85.572	97.779
Not connected (sewerage)	c	57.105	69.025	20.896	18.602	21.393	24.445
Water demand							
Domestic demand	l/c/d	-	90	97	105	112	120
	m³/d	0	6.212	7.796	9.766	11.980	14.667
Commercial demand	m³/d						
Small industrial demand	m³/d						
Pastoral demand	m³/d						
Total	m³/d	0	6.212	7.796	9.766	11.980	14.667
Wastewater production							
Return flow (w.demand)	m³/d	0	0	4.615	6.250	7.667	9.387
Losses/inflow	m³/d	0	0	1.431	1.813	2.070	2.347
Total	m³/d	0	0	6.046	8.063	9.737	11.733
	m³/month	0	0	181.373	241.889	292.121	352.005
	m³/a	0	0	2.206.709	2.942.981	3.554.144	4.282.724
Pollutional load							
Poll. load (dom.demand)	$kgBOD_5/d$	0	0	3.866	4.837	5.562	6.356
Poll. load (com.demand)	$kgBOD_5/d$						
Poll. load (small ind.)	$kgBOD_5/d$						
Others	$kgBOD_5/d$						
Total load	$kgBOD_5/d$	0	0	3.866	4.837	5.562	6.356
Reuse of wastwater							
Inflow to the treatment plant	m³/a	0	0	2.206.709	2.942.981	3.554.144	4.282.724
Losses in treatment plant	%	0	5	5	5	5	5
(due to infiltr./evap.)	m³/a	0	0	110.335	147.149	177.707	214.136
Effluent of treatment plant	m³/a	0	0	2.096.374	2.795.832	3.376.436	4.068.588
Net water demand per ha	m³/d/ha		22	22	22	22	22
Irrigable reuse area	ha	0	0	261	348	420	507

Water demand for irrigation Mixed crop pattern 22 m³/d/ha

30. SHUNA SOUTH TREATMENT PLANT

The proposed Shuna South Scheme area is located in the south of Jordan Valley extending from Karamah in the north to Al Jeld in the south. Presently, there exists no sewerage system. The following communities will be connected to the proposed scheme: Karameh Rawdhah, Jofet Al Kafrein, Sakanat Ashoeneh, South Shuna, Ramah, Kafreen Al Jeld and Hamred&Jarga. Figure 30.1 shows the layout of the proposed sewerage system.

The project foresees the construction of the Shuna South Treatment Plant designed for the wastewater production in 2020. It will be based on an extended aeration process including slow sand filtration as tertiary treatment. Produced sludge will be treated by gravity thickeners and drying beds. Figure 30.2 shows the proposed treatment system. The projection of the wastewater production is shown in the following table (acc. to Consultant's Study Report). The plant will be implemented in two phases, whereby the final capacity will be reached

in 2020: 6,500 m³/d (58,900 connected inhabitants)

The effluents could supply irrigation water for an area of about 100 ha in 2020 taking into account the demand for alfalfa and sudan grass (see following table). Downstream of the treatment plant is no land suitable for irrigation. Irrigable land is available north and west of the site. A pump station together with a 3 km long rising main will be constructed to discharge treated effluent to the land. Proposed wastewater reuse areas are presented in the Figure 30.3.

The investment costs based on 1998 prices are:

Treatment plant (primary and secondary treatment)	4.92 million JD
Networks	13.79 million JD
Tertiary treatment and pump station (reuse system)	1.72 million JD
Total base costs	20.42 million JD
Physical contingencies	2.04 million JD
Engineering	2.25 million JD
Total investment costs	24.71 million JD

According to the Consultant's Study Report implementation of proposed construction measures is foreseen during the years 2001 to 2003 (Phase I).

Consultant's Study Report:
TYPSA, Symonds Travers Morgan and Universal Engineering Consulting: "Wastewater collection, treatment, disposal and/or reuse systems project for the catchment area of Yarmouk River and Jordan River. Final Report", December 1998

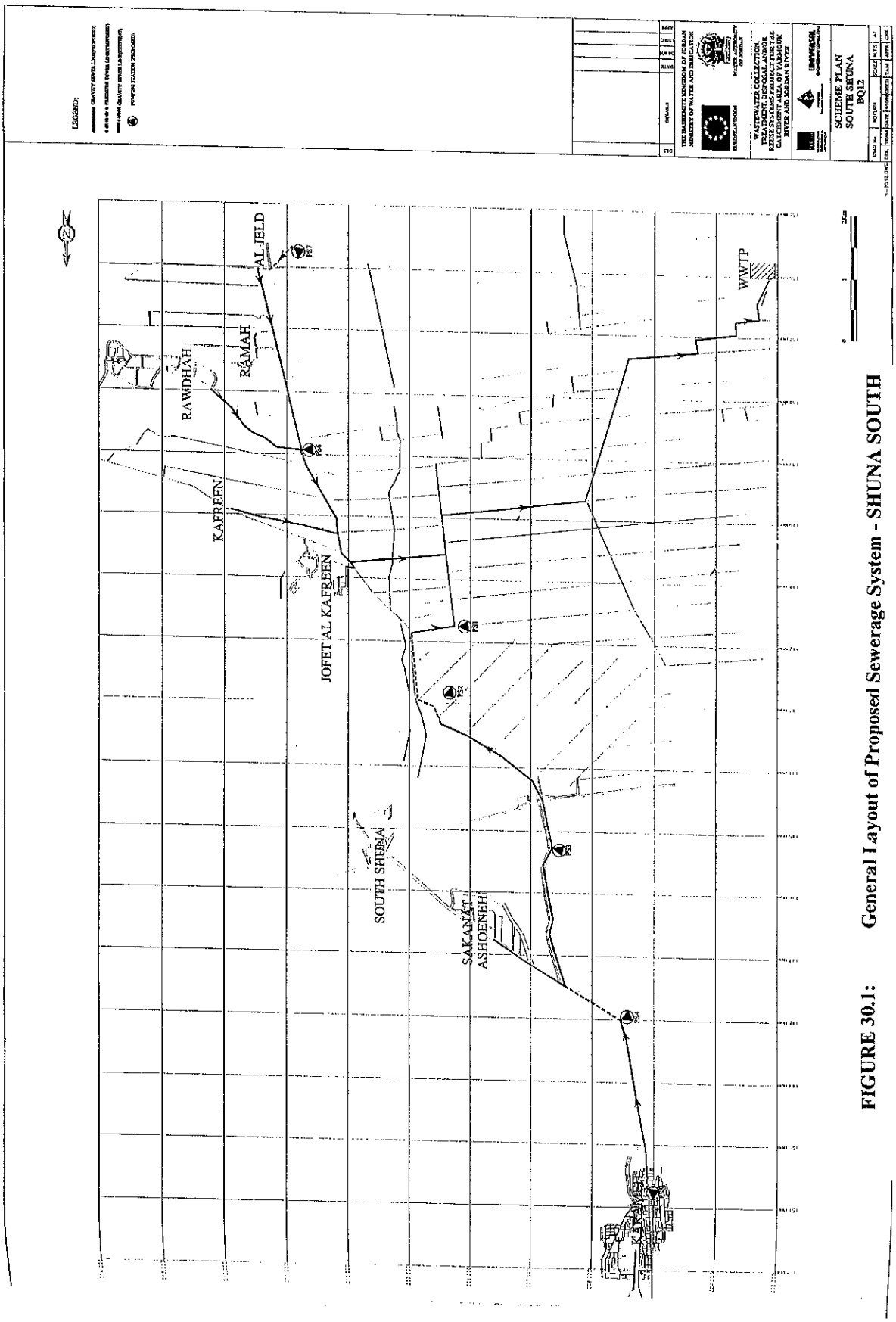


FIGURE 30.1: General Layout of Proposed Sewerage System - SHUNA SOUTH

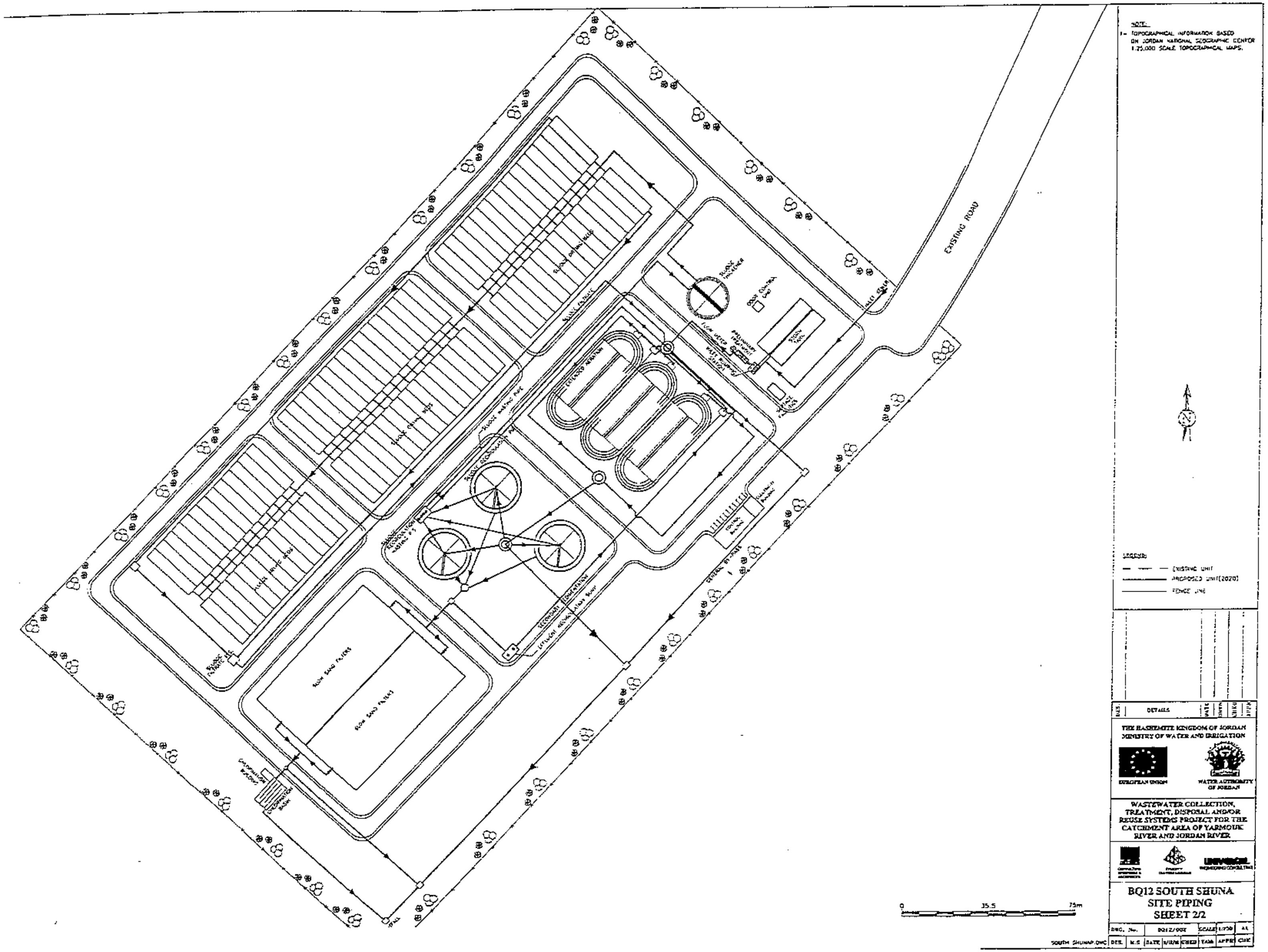


FIGURE 30.2: Layout of Proposed Wastewater Treatment Plant - SHUNA SOUTH

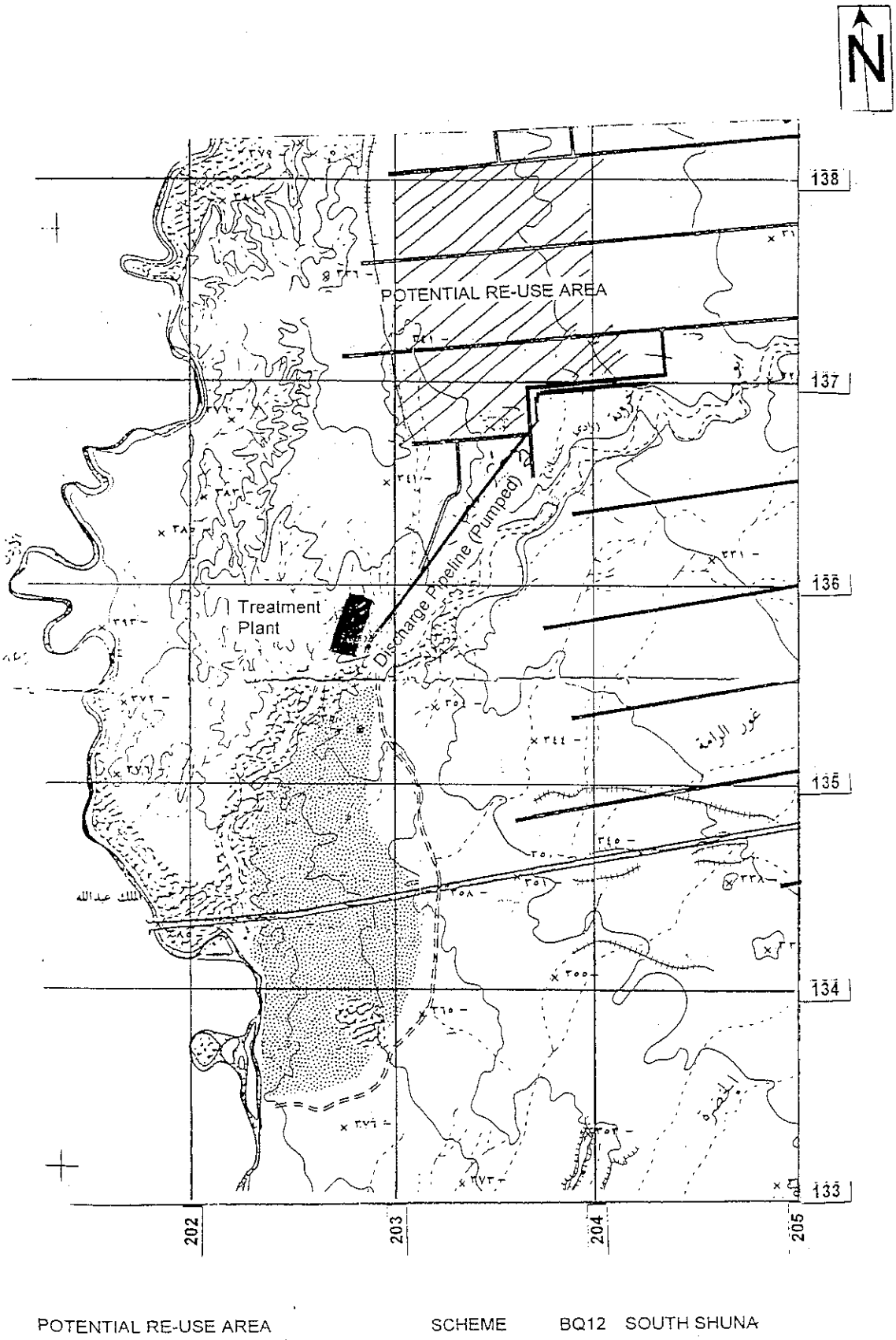


FIGURE 30.3: Potential Reuse Areas - SHUNA SOUTH

PROJECTION OF WASTEWATER PRODUCTION OF TREATMENT PLANT:
30 SHUNA SOUTH

SCENARIO 0 "Consultants' Study" (acc. to Consultant's Study Report)

Basic data:

Population in 1994: 31.970

	Unit	1994	2000	2005	2010	2015	2020
Growth rate (previous period)	%	-	3,02	3,02	3,02	3,02	3,02
Spec.water demand	l/c/d	-	138	138	138	138	138
Commercial demand	m³/d						
Small industrial demand	m³/d						
Pastoral demand	m³/d						
Coverage	%	0	0	85	85	85	85
Return factor	-	0,8	0,8	0,8	0,8	0,8	0,8
Losses/inflow	%	0	0	0	0	0	0
Specific pollutional load	$gBOD_5/c/d$	65	65	65	65	65	65

	Unit	1994	2000	2005	2010	2015	2020
Population	c	31.970	38.218	44.349	51.462	59.717	69.295
Connected (sewerage)	c	0	0	37.696	43.743	50.759	58.901
Not connected (sewerage)	c	31.970	38.218	6.652	7.719	8.957	10.394
Water demand							
Domestic demand	l/c/d	-	138	138	138	138	138
	m³/d	0	5.274	6.120	7.102	8.241	9.563
Commercial demand	m³/d						
Small industrial demand	m³/d						
Pastoral demand	m³/d						
Total	m³/d	0	5.274	6.120	7.102	8.241	9.563
Wastewater production							
Return flow (w.demand)	m³/d	0	0	4.162	4.829	5.604	6.503
Losses/inflow	m³/d	0	0	0	0	0	0
Total	m³/d	0	0	4.162	4.829	5.604	6.503
	m³/month	0	0	124.850	144.876	168.114	195.080
	m³/a	0	0	1.519.010	1.762.659	2.045.389	2.373.470
Pollutional load							
Poll. load (dom.demand)	$kgBOD_5/d$	0	0	2.450	2.843	3.299	3.829
Poll. load (com.demand)	$kgBOD_5/d$						
Poll. load (small ind.)	$kgBOD_5/d$						
Others	$kgBOD_5/d$						
Total load	$kgBOD_5/d$	0	0	2.450	2.843	3.299	3.829
Reuse of wastwater							
Inflow to the treatment plant	m³/a	0	0	1.519.010	1.762.659	2.045.389	2.373.470
Losses in treatment plant	%	0	5	5	5	5	5
(due to infiltr./evap.)	m³/a	0	0	75.950	88.133	102.269	118.673
Effluent of treatment plant	m³/a	0	0	1.443.059	1.674.526	1.943.120	2.254.796
Net water demand per ha	m³/d/ha		60	60	60	60	60
Irrigable reuse area	ha	0	0	66	76	89	103

Water demand for irrigation Alfalfa, barley 60 m³/d/ha

31. TORRA TREATMENT PLANT

The proposed Torra Scheme area is located some 15 km northeast of Irbid extending from Torra in the southeast to Donaya in the northwest. Presently, there exists no sewerage system. The following communities will be connected to the proposed scheme: Torra, Shjara, Amrawa and Donaya. Figure 31.1 shows the layout of the proposed sewerage system.

The project foresees the construction of the Torra Treatment Plant designed for the wastewater production in 2020. It will be based on an extended aeration process including slow sand filtration as tertiary treatment. Figure 31.2 shows the proposed treatment system. Produced sludge will be treated by gravity thickeners and drying beds. The projection of the wastewater production is shown in the following table (acc. to Consultant's Study Report). The plant will be implemented in 2010, whereby the design capacity will correspond to the wastewater production

in 2020: 5,600 m³/d (48,100 connected inhabitants)

The effluents could supply irrigation water for an area of about 90 ha in 2020 taking into account the demand alfalfa and sudan grass (see following table). As the treatment plant is located at the edge of the wadi it will be about 1km to a suitable elevation to allow distribution by gravity for irrigation. A pump station together with a 1 km long rising main will be constructed to discharge treated effluent to the land. Proposed wastewater reuse areas are presented in the Figure 31.3.

The investment costs based on 1998 prices are:

Treatment plant (primary and secondary treatment)	4.47 million JD
Networks	8.44 million JD
Tertiary treatment and pump station (reuse system)	0.99 million JD
Dam/storage (pond for reuse)	1.86 million JD
Total base costs	15.76 million JD
Physical contingencies	1.58 million JD
Engineering	1.73 million JD
Total investment costs	19.07 million JD

According to the Consultant's Study Report implementation of proposed construction measures is foreseen during the years 2010 to 2012.

Consultant's Study Report:
TYPSA, Symonds Travers Morgan and Universal Engineering Consulting: "Wastewater collection, treatment, disposal and/or reuse systems project for the catchment area of Yarmouk River and Jordan River. Final Report", December 1998

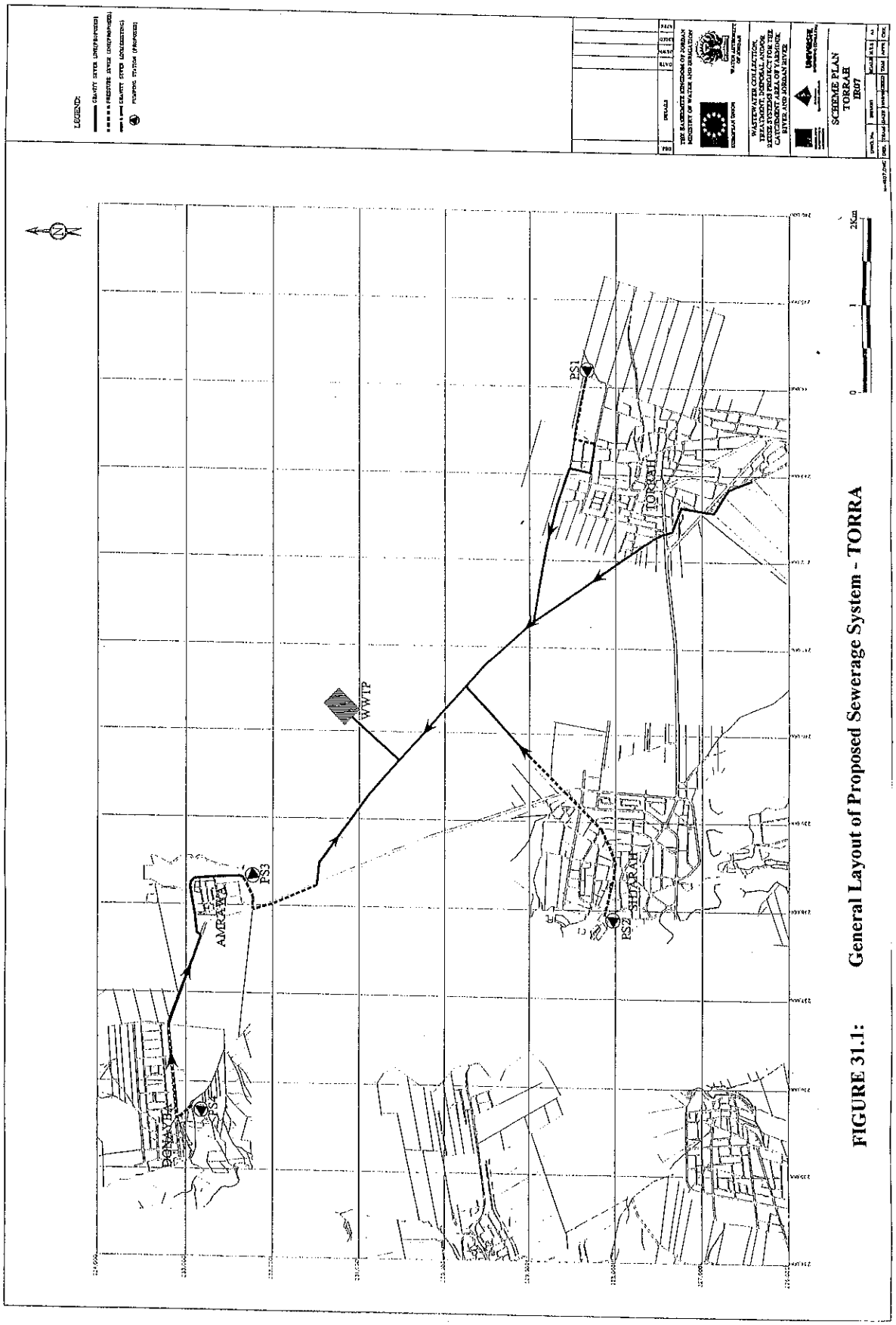


FIGURE 31.1: General Layout of Proposed Sewerage System - TORRA

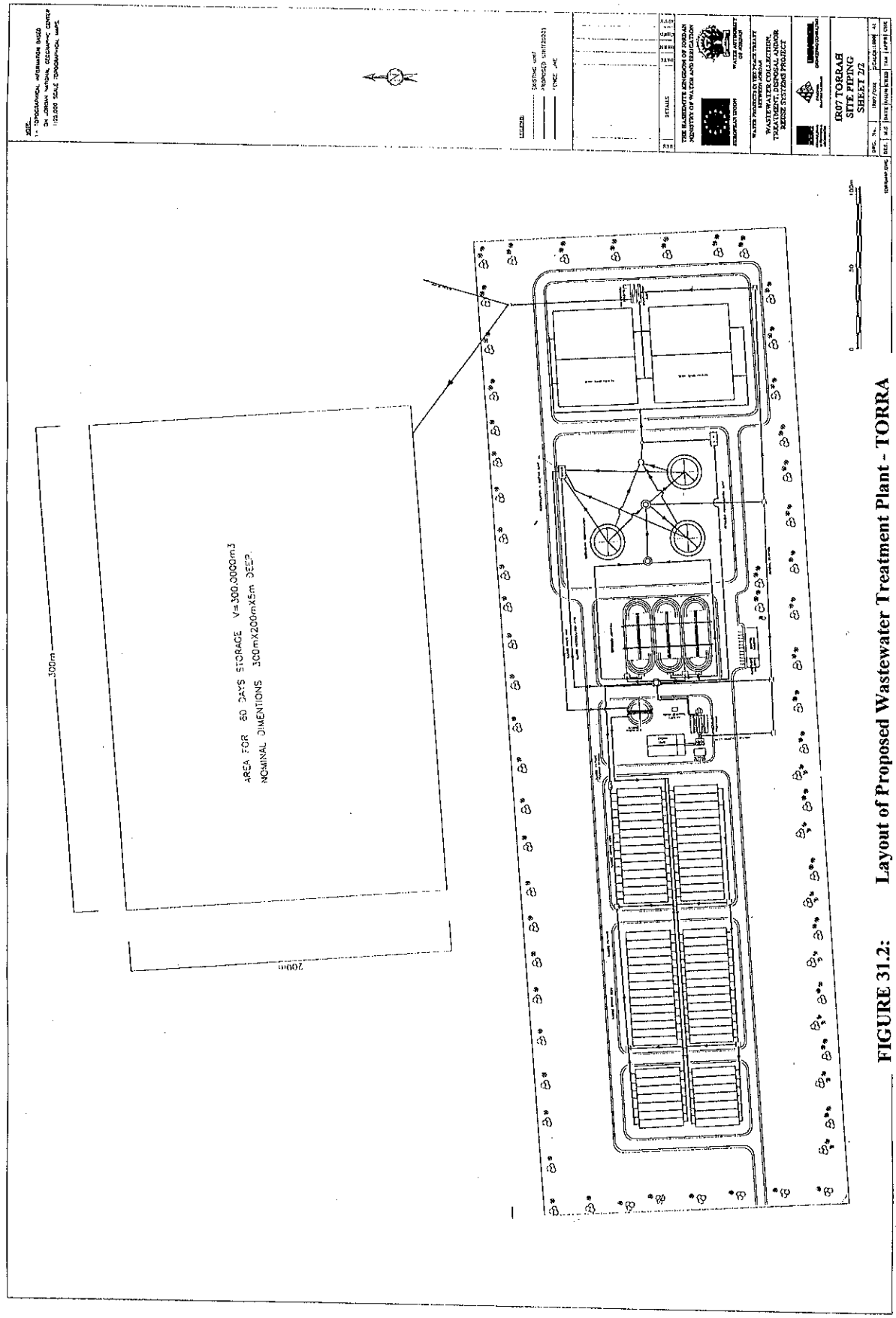


FIGURE 31.2: Layout of Proposed Wastewater Treatment Plant - TORRA

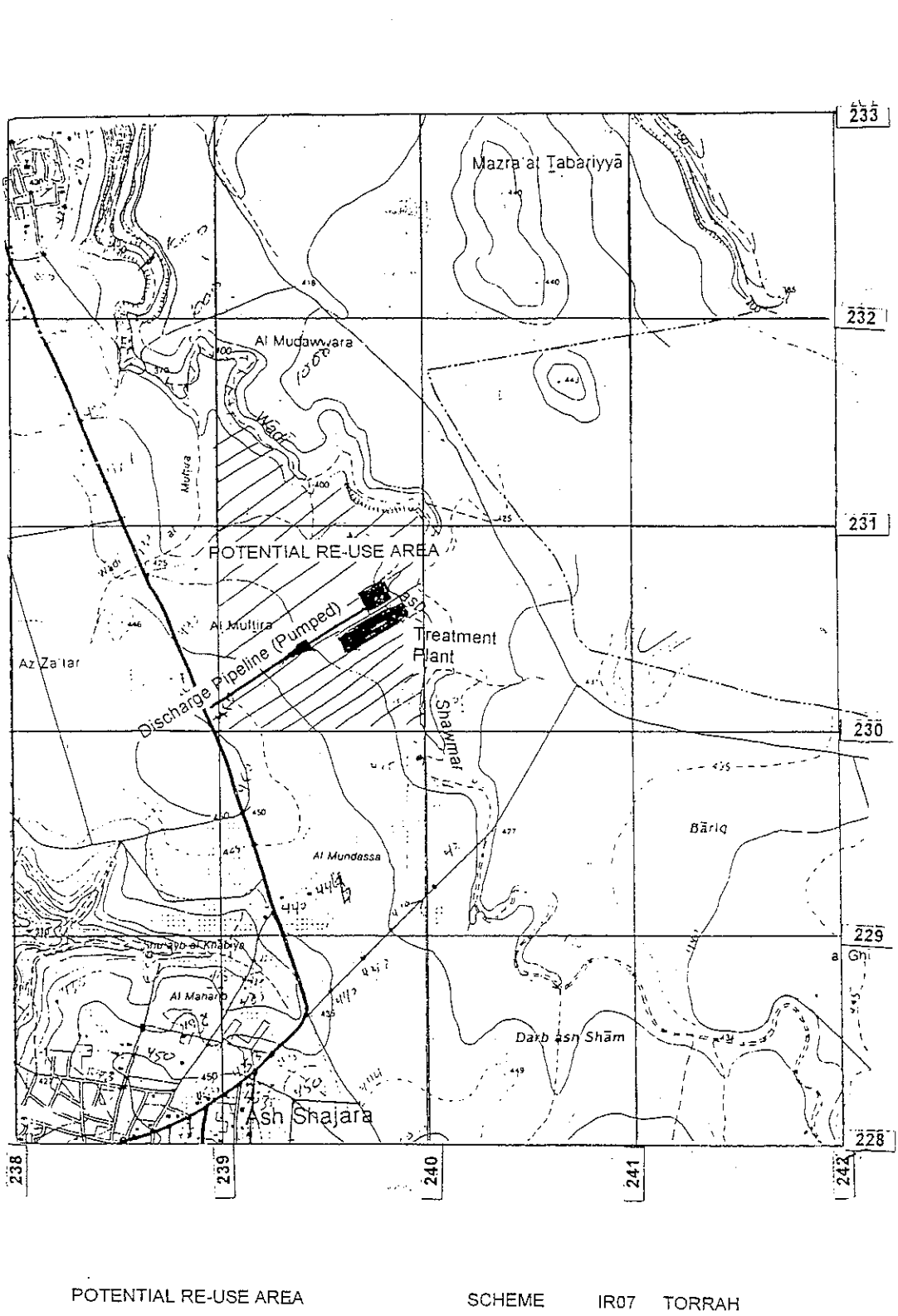


FIGURE 31.3: Potential Reuse Areas - TORRA

PROJECTION OF WASTEWATER PRODUCTION OF TREATMENT PLANT:
31 TORRA

SCENARIO 0 "Consultants' Study" (acc. to Consultant's Study Report)

Basic data:

Population in 1994: 25.465

	Unit	1994	2000	2005	2010	2015	2020
Growth rate (previous period)	%	-	3,12	3,12	3,12	3,12	3,12
Spec.water demand	l/c/d	-	146	146	146	146	146
Commercial demand	m³/d						
Small industrial demand	m³/d						
Pastoral demand	m³/d						
Coverage	%	0	0	0	0	85	85
Return factor	-	0,8	0,8	0,8	0,8	0,8	0,8
Losses/inflow	%	0	0	0	0	0	0
Specific pollutional load	$gBOD_5/c/d$	65	65	65	65	65	65

	Unit	1994	2000	2005	2010	2015	2020
Population	c	25.465	30.620	35.704	41.632	48.545	56.606
Connected (sewerage)	c	0	0	0	0	41.263	48.115
Not connected (sewerage)	c	25.465	30.620	35.704	41.632	7.282	8.491
Water demand							
Domestic demand	l/c/d	-	146	146	146	146	146
	m³/d	0	4.470	5.213	6.078	7.088	8.264
Commercial demand	m³/d						
Small industrial demand	m³/d						
Pastoral demand	m³/d						
Total	m³/d	0	4.470	5.213	6.078	7.088	8.264
Wastewater production							
Return flow (w.demand)	m³/d	0	0	0	0	4.820	5.620
Losses/inflow	m³/d	0	0	0	0	0	0
Total	m³/d	0	0	0	0	4.820	5.620
	m³/month	0	0	0	0	144.586	168.594
	m³/a	0	0	0	0	1.759.136	2.051.227
Pollutional load							
Poll. load (dom.demand)	$kgBOD_5/d$	0	0	0	0	2.682	3.127
Poll. load (com.demand)	$kgBOD_5/d$						
Poll. load (small ind.)	$kgBOD_5/d$						
Others	$kgBOD_5/d$						
Total load	$kgBOD_5/d$	0	0	0	0	2.682	3.127
Reuse of wastwater							
Inflow to the treatment plant	m³/a	0	0	0	0	1.759.136	2.051.227
Losses in treatment plant	%	0	0	0	0	5	5
(due to infiltr./evap.)	m³/a	0	0	0	0	87.957	102.561
Effluent of treatment plant	m³/a	0	0	0	0	1.671.179	1.948.666
Net water demand per ha	m³/d/ha		60	60	60	60	60
Irrigable reuse area	ha	0	0	0	0	76	89

Water demand for irrigation Alfalfa, barley 60 m³/d/ha

32. UM AL BASATEEN TREATMENT PLANT

Included in Al Jeeza Treatment Plant

33. WADI SHALLALA TREATMENT PLANT

Wadi Shallala Treatment Plant is part of the sewerage system considered by the long-term development in Greater Irbid Area (compare description of the Treatment Plant Irbid Central under No. 6).

The Wadi Shallala drainage area is part of the Yarmouk catchment area. The confluence of Wadi Shallala and the Yarmouk River are upstream of the planned Wahdah Dam, which is proposed to serve as a reservoir for water supply. Therefore, any discharge of untreated sewage into Wadi Shallala could cause severe health risks in the future.

In the sewerage sector, all infrastructure works have to be newly constructed including the collection system, the interceptors and the wastewater treatment to protect the water sources and to enable its reuse for the irrigation of crops, etc..

The interceptors SH to SH3 will be constructed with pipes of diameter DN 300 to DN 900 with a total length of 47 km. The sewer network for the following communities (see Figure 33.1) will be constructed from concrete pipes of diameter DN 200 to DN 400.

Irbid South- East	46 km
Aydun	54 km
Al Husn	69 km
As Sarih	69 km
Bushra	35 km
Huwwara	59 km
Mukh. Al Husn	45 km
Sal	32 km

The connection of Al Hasan Industrial Estate to the Wadi Shallala Plant cannot be recommended due to economic reasons.

The proposed project foresees the construction of the Wadi Shallala Treatment Plant designed for the capacity in 2015 with extension up to 2025. It will be based on extended aeration process including nutrient removal (nitrification, denitrification) and sand filtration. Figure 33.2 shows the proposed treatment system. The projection of the wastewater production is shown in the following table (acc. to Consultant's Study Report). The capacity of the plant will be

In 2015:	15,000 m³/d (172,000 inhabitants)
In 2025:	22,000 m³/d (240,000 inhabitants)

The proposed reuse facilities should be developed east of Sal. Reuse at the Yarmouk University of Science and Technology and in the Jordan Valley would be less economical and less environmentally sound.

According to the Consultant's proposal the treated wastewater will be pumped through a pipeline 2,300 m long to the reuse area east of Sal. A storage pond/dam will provide storage facilities for 2 or 20 days retention time. A concrete reservoir (14,000 m³) shall be

constructed at the highest Section of the irrigation area, as well as a service main 6 km long. Proposed wastewater reuse areas are presented in the Figure 33.3.

The reuse of treated wastewater for irrigation purposes implicates the construction of:

- a storage pond or dam (30,000 m³ storage capacity) for the treated wastewater (considered in the costs WWTP).
- two pumping stations
- a double pipeline DN 600 with a length of about 2,300 m
- a concrete reservoir with a storage capacity of 8,000 m³

The effluents could supply irrigation water for an area of about 360 ha in 2020 taking into account the demand for sudan grass as summer crop and barley and ryegrass as winter crop (see following table).

The investment costs based on 1998 prices are:

Treatment Plant Wadi Shallala	15.97 million JD
Interceptor, trunk sewers	5.23 million JD
Network and house connections	17.09 million JD
Reuse system	5.59 million JD
Vehicles	0.68 million JD
Engineering	5.10 million JD
Total Base Costs	49.66 million JD
Physical Contingencies	4.96 million JD
Financial Contingencies	2.71 million JD
Total Investment Costs	57.33 million JD

According to the Consultant's Study Report implementation of proposed construction measures were foreseen until end of 2002. However, this implementation schedule is not anymore valid. It is more realistic that the measures will be completed end of 2004.

In July 2000 the Ministry of Water and Irrigation prepared Terms of Reference for a study for reuse of treated wastewater for the Greater Irbid Area. It is proposed that the German Development Bank (Kreditanstalt fuer Wiederaufbau, KfW) will finance this study.

Consultant's Study Report:
RRI, DAR and Sigma: "Technical, economical and financial Feasibility Study. Phase B. Feasibility study of preferred alternatives for wastewater collection and treatment systems in the Greater Irbid area.", March 1992

DAR: "Update of the feasibility study. Wastewater collection and treatment systems in the Greater Irbid area. Stage 2. Wadi Shallala." November 1998.

FIGURE 33.1a: General Layout of Proposed Sewerage System - WADI SHALLALA

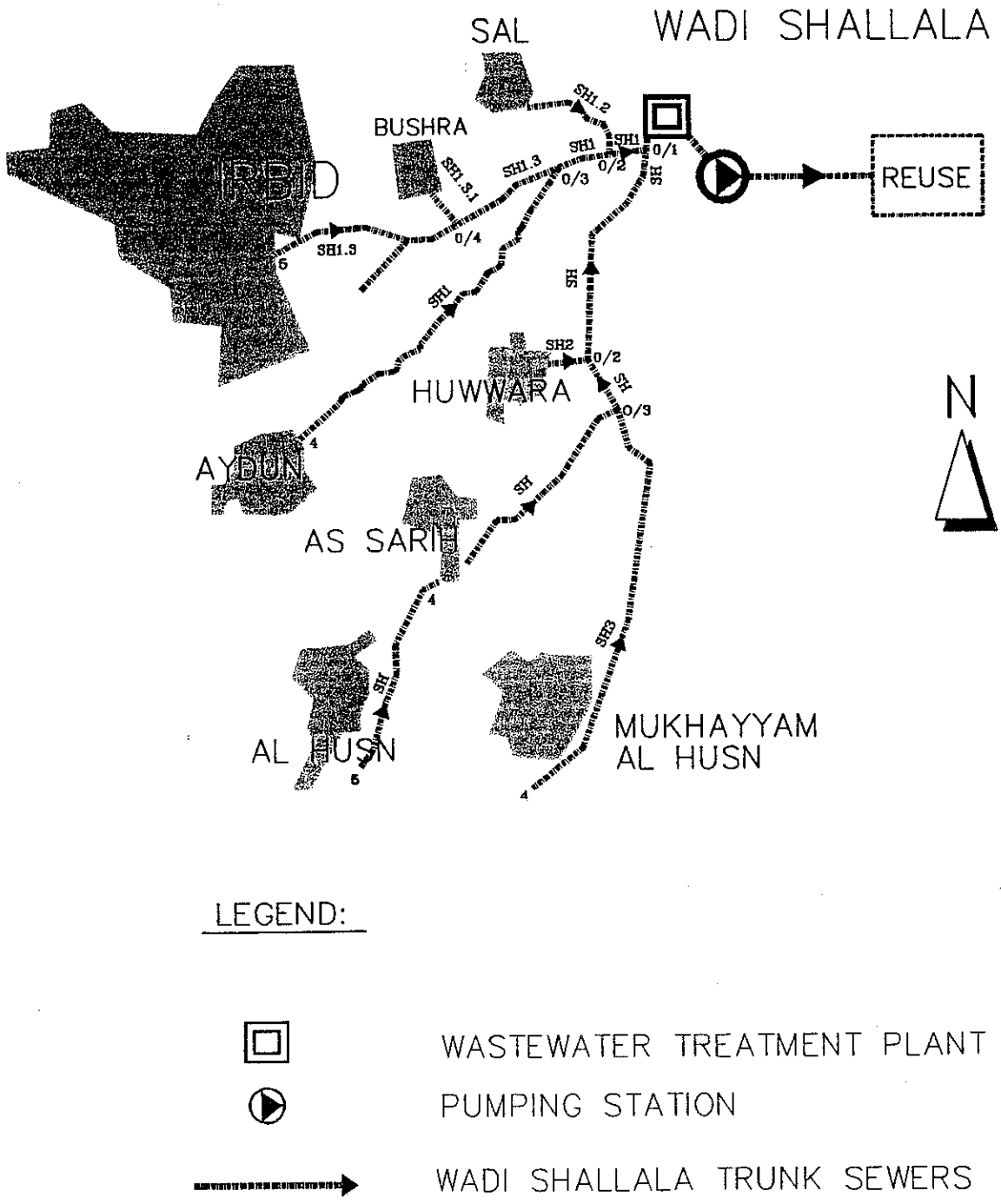


FIGURE 33.1b: Schematic Layout of Proposed Sewerage System - WADI SHALLALA

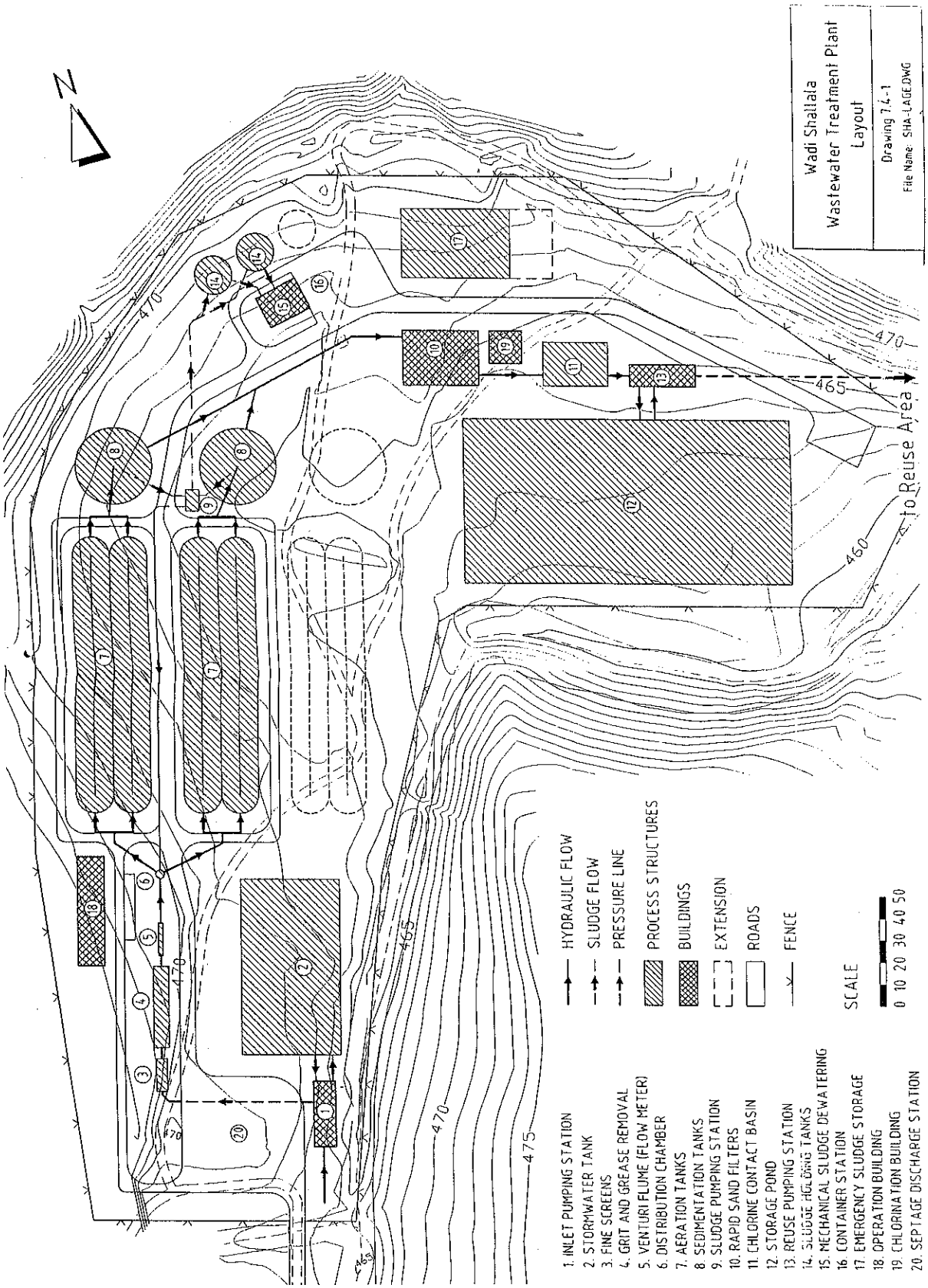


FIGURE 33.2: Layout of Wastewater Treatment Plant - WADI SHALLALA

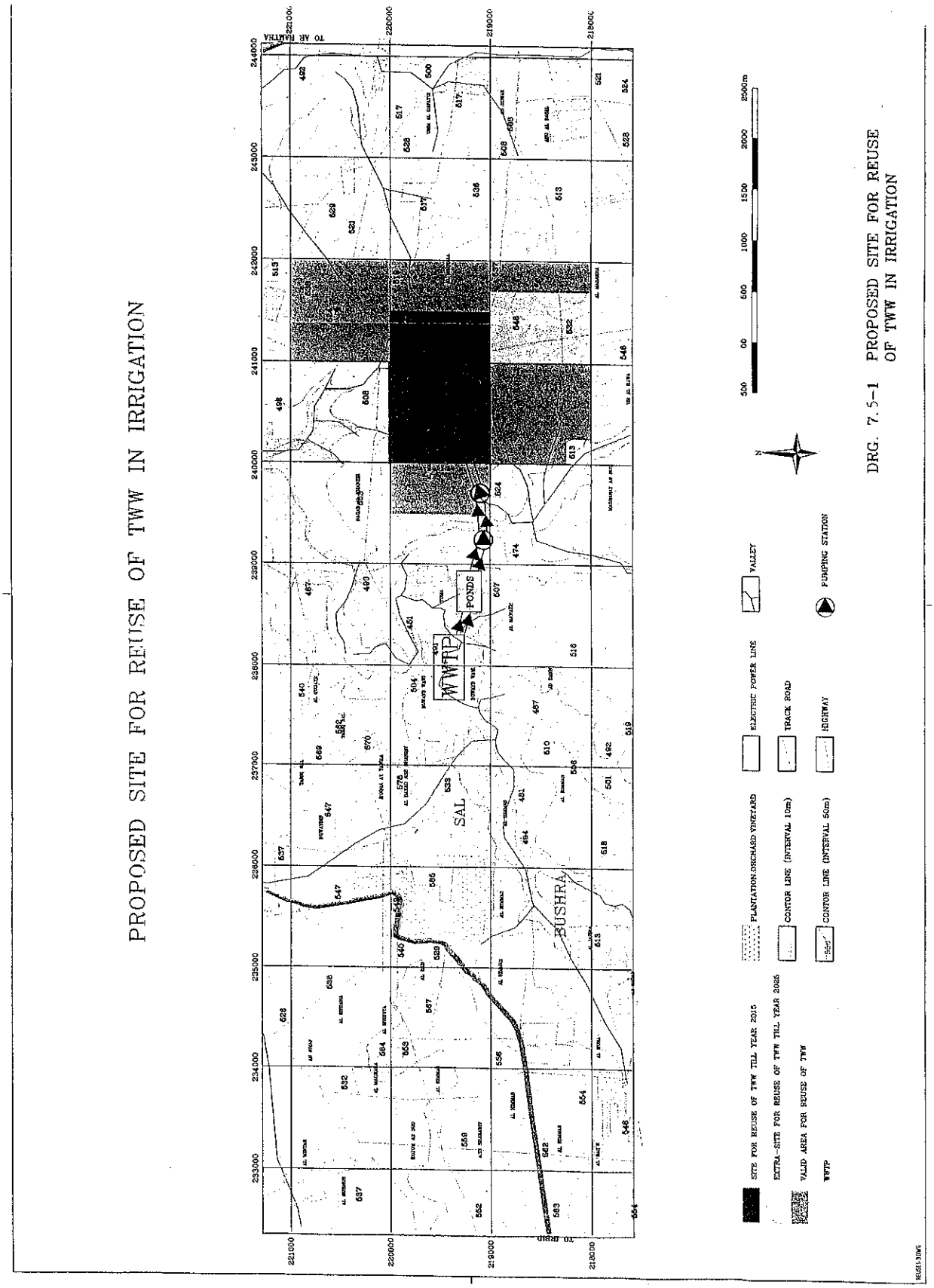
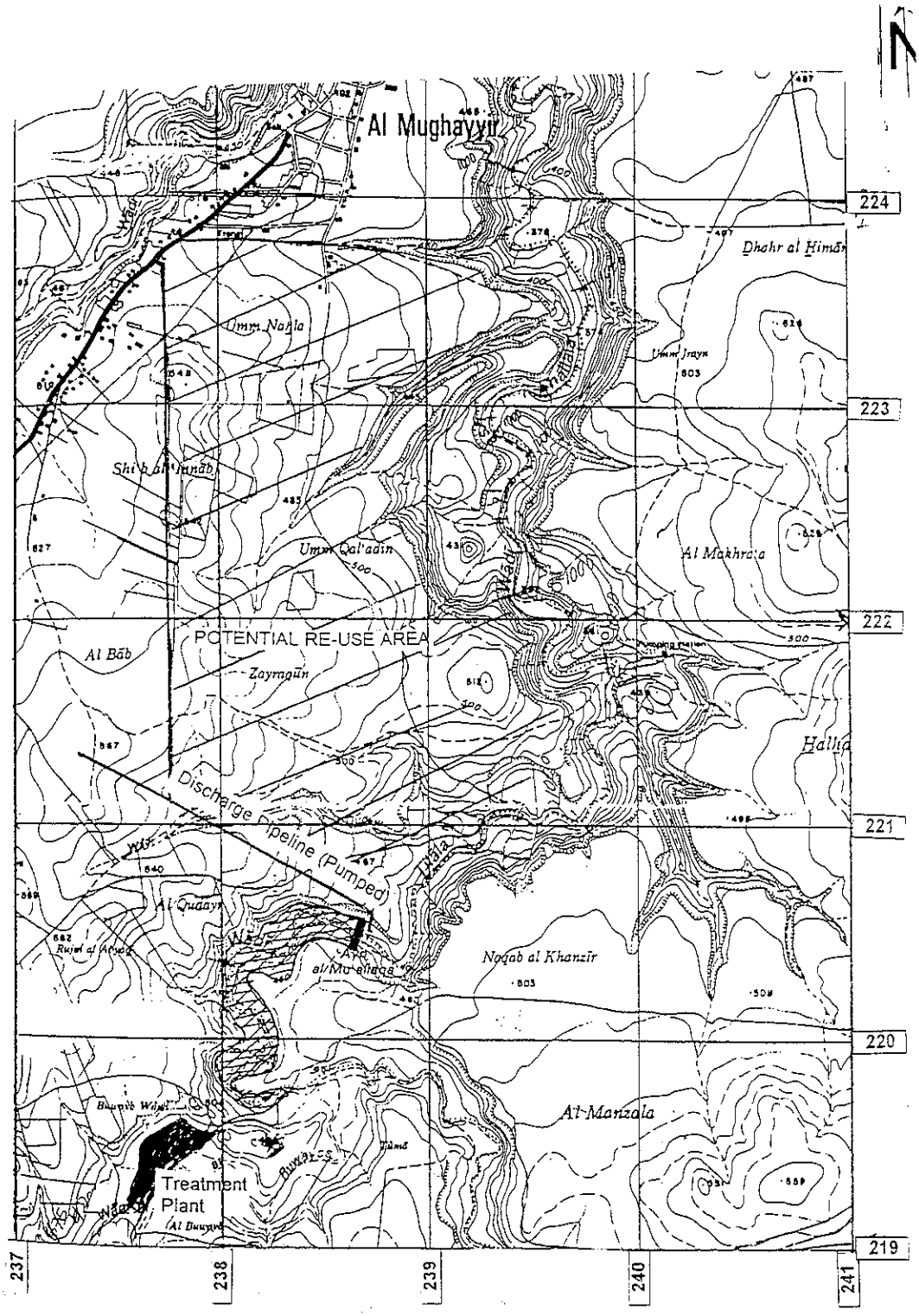


FIGURE 33.3a: **Potential Reuse Areas - WADI SHALLALA (acc. to Study of DAR)**



POTENTIAL RE-USE AREA SCHEME IR12 IRBID EAST

FIGURE 33.3b: Potential Reuse Areas - WADI SHALLALA (acc. to Study of TYPSA)

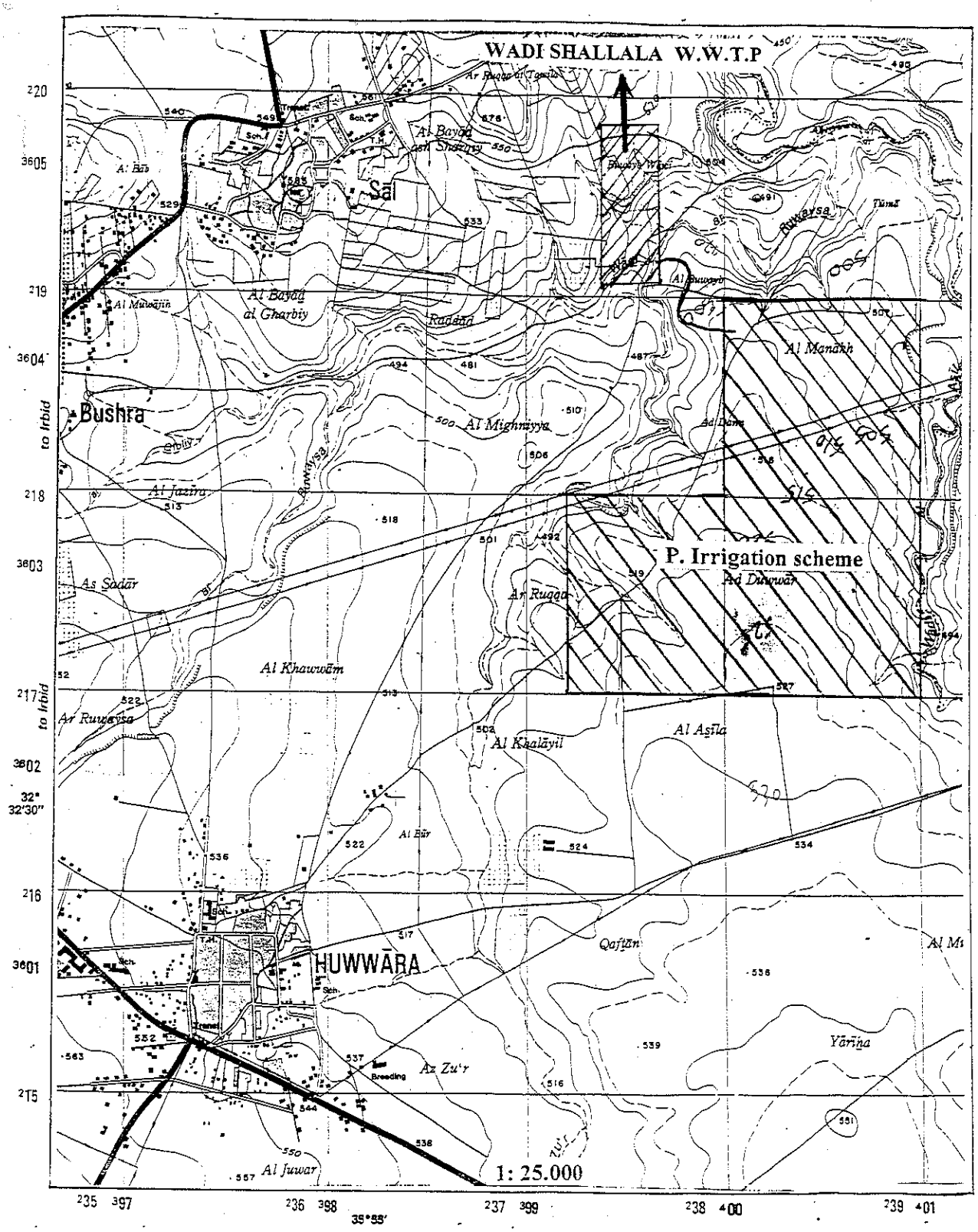


FIGURE 33.3c: Potential Reuse Areas - WADI SHALLALA (acc. to Min. of Ministry)

PROJECTION OF WASTEWATER PRODUCTION OF TREATMENT PLANT:
33 WADI SHALLALA

SCENARIO 0 "Consultants' Study" (acc. to Consultant's Study Report)

Basic data:

Population in 1994 96.809

	Unit	1994	2000	2005	2010	2015	2020
Growth rate (previous period)	%	-	3,76	3,48	3,40	3,29	3,34
Spec.water demand	l/c/d	93	98	103	106	109	112
Commercial demand	m³/d						
Small industrial demand	m³/d						
Pastoral demand	m³/d						
Coverage	%	0	0	86	86	86	86
Return factor	-	0,8	0,8	0,8	0,8	0,8	0,8
Losses/inflow	%	0	0	0	0	0	0
Specific pollutional load	$gBOD_5/c/d$	65	65	65	65	65	65

	Unit	1994	2000	2005	2010	2015	2020
Population	c	96.809	120.806	143.341	169.399	199.111	234.614
Connected (sewerage)	c	0	0	123.058	145.598	171.335	202.120
Not connected (sewerage)	c	96.809	120.806	20.283	23.801	27.776	32.494
Water demand							
Domestic demand	l/c/d	92,6	98	103,4	106	109	112
	m³/d	8.965	11.839	14.821	17.956	21.703	26.277
Commercial demand	m³/d						
Small industrial demand	m³/d						
Pastoral demand	m³/d						
Total	m³/d	8.965	11.839	14.821	17.956	21.703	26.277
Wastewater production							
Return flow (w.demand)	m³/d	0	0	10.179	12.347	14.940	18.110
Losses/inflow	m³/d	0	0	0	0	0	0
Total	m³/d	0	0	10.179	12.347	14.940	18.110
	m³/month	0	0	305.381	370.402	448.213	543.299
	m³/a	0	0	3.715.470	4.506.552	5.453.261	6.610.136
Pollutional load							
Poll. load (dom.demand)	$kgBOD_5/d$	0	0	7.999	9.464	11.137	13.138
Poll. load (com.demand)	$kgBOD_5/d$						
Poll. load (small ind.)	$kgBOD_5/d$						
Others	$kgBOD_5/d$						
Total load	$kgBOD_5/d$	0	0	7.999	9.464	11.137	13.138
Reuse of wastwater							
Inflow to the treatment plant	m³/a	0	0	3.715.470	4.506.552	5.453.261	6.610.136
Losses in treatment plant	%	0	10	10	10	10	10
(due to infiltr./evap.)	m³/a	0	0	371.547	450.655	545.326	661.014
Effluent of treatment plant	m³/a	0	0	3.343.923	4.055.897	4.907.935	5.949.123
Net water demand per ha	m³/d/ha		45	45	45	45	45
Irrigable reuse area	ha	0	0	204	247	299	362

Water demand for irrigation Barley, alfalfa 45 m³/d/ha

MOA's proposal: Summer crops: Alfalfa
Winter crops: barley, ryegrass