9.3.10 Ma'an Governorate----------MA9-44
9.3.11 Tafileh Governorate----------MA9-46
9.3.12 Aqaba Governorate----------MA9-48
9.4 Financial Plan----------MA9-50
9.4.1 Preconditions----------MA9-50
9.4.2 Projected Financial Statements in Case I----------MA9-51
9.4.3 Projected Financial Statements in Case II----------MA9-55
9.5 Projects in the Master Plan and Implementation Schedule---------- MA9-59
9.5.1 Projects in the Master Plan----------MA9-59
9.5.2 Implementation Schedule of the Water Resources Management----- MA9-61
Master Plan and Cost Estimation
9.6 Evaluation of Water Resources Management Master Plan---------- MA9-69
9.6.1 Plan Evaluation----------MA9-69
9.6.1.1 Demand Control----------MA9-69
9.6.1.2 Water Resources Development----------MA9-70
9.6.2 Environmental Evaluation----------MA9-71
9.6.2.1 Natural Environment----------MA9-71
9.6.2.2 Social Environment----------MA9-72
9.6.3 Economic and Financial Evaluation----------MA9-74
9.6.4 Overall Evaluation----------MA9-77
9.7 Recommendation----------MA9-78

Chapter 10 Selection of Priority Projects for pre-Feasibility Study
10.1 Selection of Priority Projects for pre-Feasibility Study---------- MA10-1
10.1.1 Nomination of Candidate Projects----------MA10-1
10.1.2 Setting of Criteria for the Selection----------MA10-1
10.1.3 Establishment of the Rankings----------MA10-3
10.1.4 Selection of Priority Projects for pre-Feasibility Study---------- MA10-6
10.2 Donors Collaboration----------MA10-14
10.2.1 GTZ "Digital Water Master Plan"----------MA10-14
10.2.2 USAID "Water Resources Management Policy Support"---------- MA10-15
10.2.3 USAID "F/S on Zarqa Main-Amman Conveyer Project"---------- MA10-16

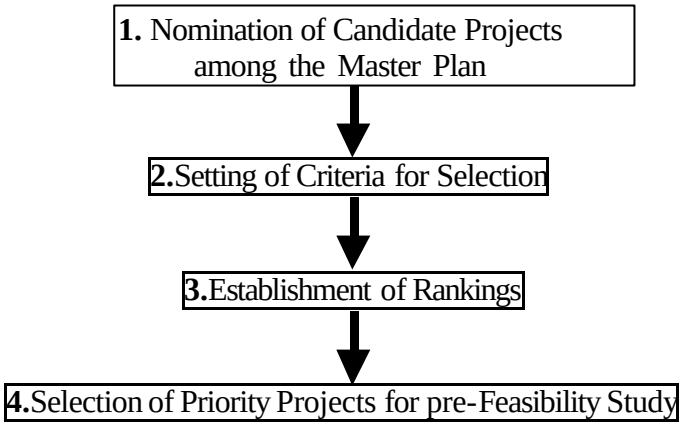
Chapter 11 Visualization of the Water Resources Management Master Plan
11.1 Outline of the Visualization----------MA11-1
11.2 DVS Navigation----------MA11-3
11.2.1 Navigation Chart----------MA11-3
10.2.2 NWMP Window----------MA11-4
10.2.3 Database Connecting Dialog----------MA11-4
10.2.4 Database Selecting Dialog ----------MA11-6
10.2.5 The Chart Type Selection Dialog----------MA11-6

CHAPTER 10
SELECTION OF PRIORITY PROJECTS FOR PRE-FEASIBILITY STUDY

CHAPTER 10 SELECTION OF PRIORITY PROJECTS FOR PRE-FEASIBILITY STUDY

10.1 Selection of Priority Projects for pre-Feasibility Study

The selection of the priority projects for pre-Feasibility Study has been done in the following manner:



10.1.1 Nomination of Candidate Projects

Candidate projects for the pre-Feasibility Study are selected from among the projects described in the Project List shown in Table 10-1(1) to Table 10-1(7) of Supporting Report Vol. VII. The location of the projects is also shown in Fig. 10-1(1) to Fig. 10-1(3) of Supporting Report Vol. VII by implementation term.

Nomination of the candidate projects is done based on the following terms :

-Projects for which Feasibility Study or Detailed Design has not been done

-Projects still in the conceptual stage are excluded from candidate projects for pre-Feasibility Study

Twenty (20) projects are nominated as candidate projects for pre-Feasibility Study from among the projects forming the Water Resources Management Master Plan listed in Table 10.1-2, based on the terms mentioned above. The asterisks are attached to the nominated candidate projects in Table 10.1-2.

10.1.2 Setting of Criteria for the Selection

Scores are given to the nominated candidate projects from the view-points of :

- Technical viability
- Economical viability
- Environmenta1 viability

-Political viability

Each criterion has 5 ranks by the point system, as explained in Table 10.1-1. Weighting between criteria has not been done and the total score of a project is calculated by a simple summation of points for each criterion.

Table 10.1-1 Criteria for the Selection of Priority Projects

Rank	Technical Viability	Economic Viability	Environmental Viability	Political Viability
5	Conventional technology is applicable, not affected by uncertain natural conditions such as drought and so on	Very low investment cost* in comparison with other projects, less than half	No negative impacts and contributes to environmental conservation	Completely agree with the Gov. Policy, clearly emphasized in Water Strategy or Policy Papers. Very urgent project
4	Conventional technology is applicable, but might be slightly affected by natural uncertain condition	Low investment cost in comparison with other projects, less than 30%	No negative impacts, no contribution to environmental conservation	Almost agree with the Gov. Policy, clearly mentioned in Water Strategy or Policy Papers. Urgent project
3	Conventional technology is basically applicable but special techniques is partly required, sometime affected by natural uncertain conditions	Almost same investment cost with other projects	Slight negative impacts such as noise, vibration during construction, no contribution to environmental conservation	No contradiction with the Gov. Policy, not mentioned in Water Strategy or Policy Papers but not supporting them. Not so urgent but necessary .
2	Conventional technology is almost not applicable, occasionally affected by natural uncertain conditions	High investment cost in comparison with other projects, more than 30%	Some negative impacts but not so serious, should be stopped in future, Ex. : renewable GW development	Some contradictions with the Gov. Policy, same parts are against Water Strategy and Policy Papers. Not urgent and it can wait.
1	Special skills or technology are required, greatly affected by uncertain natural conditions, almost impossible	Very high investment cost in comparison with other projects, more than double	Accompanied with serious and continuous negative impacts such as groundwater, surface water contamination,	Almost against the Gov. Policy, prohibited in Water Strategy and Policy Papers. It is not always necessary.

* : Investment cost : Project cost / Production amount

10.1.3 Establishment of the Rankings

The nominated candidate projects for pre-Feasibility Study are listed in Table 10.1-2. The description of the score given to each candidate project is also shown in the same table.

Table 10.1-2(1) Ranking of Candidate Projects

Project No.	Project Name	Implementation	Technical Viability	Economic Viability	Environmental Viability	Political Viability	Total Score
	Projects for Reuse of Treated Wastewater						
58	Upgrading Ma'an Treatment Plant	Short, Mid and Long Term	**5** Conventional technology can be applied	**4** Investment cost is very low compared with other TP projects (4JD/m^3)	**5** It contributes to improvement of environment	**5** Proper treatment of wastewater is clearly stated in Strategy and Policy, urgent	**19**
58'	Treated Wastewater Reuse Scheme of Ma'an Treatment Plant	Short, Mid and Long Term	**5** Conventional technology can be applied	**4** Investment cost is low (0.1JD/m^3)	**4** No negative impacts, but to be done carefully	**5** Reuse of waste water is clearly recommended in Strategy and Policies, urgent	**18**
W4	Treated Wastewater Reuse Scheme of Abu-Nuseir Treatment Plant	Short, Mid and Long Term	**5** Conventional technology can be applied	**4** Investment cost is low compared with irrigation water (0.1JD/m^3)	**4** No serious negative impacts, but the irrigation in Upland should be done carefully	**5** Reuse of waste water is clearly recommended in Strategy and Policies, urgent	**18**
W5	Treated Wastewater Reuse Scheme of Fuhis Treatment Plant	Short, Mid and Long Term	**5** Conventional technology can be applied	**5** Investment cost is very low compared with irrigation water (0.02JD/m^3)	**4** No serious negative impacts, but the irrigation in Upland should be done carefully	**5** Reuse of waste water is clearly recommended in Strategy and Policies, urgent	**19**
W6	Treated Wastewater Reuse Scheme of Tafielah Treatment Plant	Short, Mid and Long Term	**5** Conventional technology can be applied	**3** Investment cost is not low compared with irrigation water (0.2JD/m^3)	**4** No serious negative impacts, but the irrigation in Upland should be done carefully	**5** Reuse of waste water is clearly recommended in Strategy and Policies, urgent	**17**
W7	Treated Wastewater Reuse Scheme of Wadi Essir Treatment Plant	Short, Mid and Long Term	**5** Conventional technology can be applied	**5** Investment cost is very low compared with irrigation water (0.02JD/m^3)	**4** No serious negative impacts, but the irrigation in Upland should be done carefully	**5** Reuse of waste water is clearly recommended in Strategy and Policies, urgent	**19**
2	Wastewater Feasibility, Design and Assessment Studies	Mid Term	**3** Some technical difficulties might happen because it covers whole Jordan	***2*** This project is basically study project, it dose not bear benefit	**4** There might be no serious negative impacts, but project contents are unknown	**3** Reuse of waste water is clearly recommended in Strategy and Policies, but project contents are not clear	**12**

Table 10.1-2(2) Ranking of Candidate Projects

Project No.	Project Name	Implementation	Technical Viability	Economic Viability	Environmental Viability	Political Viability	Total Score
	Projects for Environmental Protection						
W13	Construction of Wadi Zarqa Treatment Plant	Mid Term	**4** Conventional technology can be applied, but it is large scale construction	**5** Investment cost is very low compared with other projects (1.1JD/m^3)	**5** No negative impacts, and contributing to improvement of environment	**4** Proper treatment of wastewater is clearly stated in Strategy and Policy, but initial cost is very high (about 60mil JD)	**18**
W9	Extension of Fuhis Treatment Plant	Mid Term	**4** Conventional technology might be applied, but project contents are unknown.	**3** The project cost is unknown	**4** No serious negative impacts, but the irrigation in Upland should be done carefully	**3** Reuse of waste water is clearly recommended in Strategy and Policies, but not so urgent	**14**
	Projects for Reduction of UFW						
M1	National Control System Integrating Surface and Groundwater	Short and Mid Term	**4** Advanced technology should be applied, but it is not difficult	**3** It dose not bear direct benefit but it will bring indirect benefit of reduct. of UFW	**5** No negative impacts, and contributing to reduct. of UFW and GW abstraction	**5** Monitoring is emphasized in Strategy and reduct. of UFW is emphasized in Utility Policy, urgent	**17**
8	Municipal Water Networks Rehabilitation (Several Cities)	Mid Term	**5** Conventional technology can be applied	**3** Investment cost is not so lower than other surface water projects	**4** No negative impacts	**5** Reduction of UFW is emphasized in Water Utility Policy, urgent	**17**
	Projects For Water Allocation (Conveyance)						
69	Al Wehda Dam Water Supply Project/Irbid	Mid Term	**5** Conventional technology can be applied	**4** Invest. cost is relatively lower than other supply projects (1.4JD/m^3)	**4** No negative impacts, but not contributing to improvement of environment	**5** Greater Irbid area will seriously suffer water shortage in near future, many confusing people	**18**
30	Miscellaneous Small Projects – Network Expansion	Mid Term	**3** Some technical difficulties might happen because it covers whole Jordan	***2*** Economic viability is uncertain because of lack of information	**3** There might be some negative impacts because project itself is not clarified.	**3** Although highest efficiency of distribution is stated in Strategy, but the project contents not clear.	**11**
31	Miscellaneous Small Projects – Supply Extension	Mid Term	**3** Some technical difficulties might happen because it covers whole Jordan	***2*** Capital cost is too high compared with development amount	***2*** This project includes the development of renewable groundwater.	**3** Although highest efficiency of distribution is stated in Strategy, but the project contents not clear.	**10**
C1	Disi Amman Water Conveyer Branch to Ma'an and Madaba	Mid Term	**4** Conventional technology can be applied, natural conditions may cause some difficulties	**5** Investment cost is very low compared with other projects (0.3JD/m^3)	**4** There is no negative impacts, but not contributing to improvement of environment	***2*** Highest efficiency of distribution is stated in Strategy, but it is not urgent	**15**

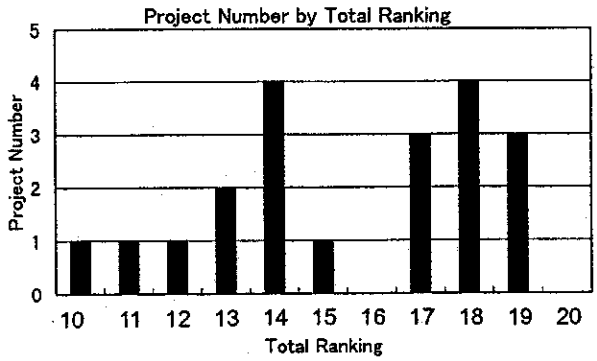
Table 10.1-2(3) Ranking of Candidate Projects

Project No.	Project Name	Implementation	Technical Viability	Economic Viability	Environmental Viability	Political Viability	Total Score
	Projects for Water Allocation (Conveyance)						
C2	Upgrading of Inter-Governorate Transfer Line Phase 1	Long Term	**4** Natural condition may cause some difficulties	**4** Invest. cost is lower than others (0.7JD/m^3)	**4** No negative impact, but not contributing to improvement of environment	***2*** Highest efficiency of distribution is stated in Strategy, but not urgent	**14**
C3	Upgrading of Inter-Governorate Transfer Line Phase 2	Long Term	**4** Natural condition may cause some difficulties	**4** Invest. cost is lower than others (1.0JD/m^3)	**4** No negative impact, but no improvement	***2*** Not stated in Strategy and Policies, not urgent	**14**
	Project for Water Resources Development						
17	Deep Groundwater Investigation	Mid Term	**3** This project is study project and implies many uncertainties	**3** Cost might be higher because of very deep aquifer develop.	**3** No data, negative impacts might be induced such as GW. depletion	**4** Full potential development is stated in Strategy, but not so urgent	**13**
18	Small Dams (Ibn Hamad, Karak, Meddien)	Mid Term	***2*** Development is highly dependent on unforeseeable precipitation	**4** Investment cost is relatively lower than other surface water projects	**4** Serious negative impacts are not foreseen	**4** Full potential development is stated in Strategy, but not so urgent	**14**
28	Desalination at Aqaba (Long Term)	Long Term	**4** Advanced technology for sea water desalination should be applied	***2*** Investment cost is high because of sea water desalination	**3** Negative impacts caused by brine disposal to the sea should be examined	**4** Desalination is recommended in Strategy and Policies, but not so urgent	**13**

Note : Name of Selected Projects for pre-F/S is written in boldface.

10.1.4 Selection of Priority Projects for Pre-Feasibility Study

In considering the indispensability of a project, projects which have been given a lower score of less than 2 points even in a single category are excluded from the selection because a score of less than 2 points constitutes a very negative condition for their implementation. Among the remaining candidate projects, the projects with the total score of more than fifteen (15) points are selected as the projects for pre-feasibility study as the nominated projects are clearly classified into two groups separated by the total score of sixteen (16) points as shown below.



Therefore, ten (10) projects belonging to the high score group of more than 15 points are selected as priority projects for pre-feasibility study.

The ten selected projects can be arranged into five groups of projects by putting together the same kind of projects. The five groups of projects are listed as follows:

1) Projects for Reuse of Treated Wastewater from Five Existing Plants

① Treated Wastewater Reuse Scheme of Five Existing Treatment Plants

-Ma'an (including expansion of treatment plant)---------- 58& 58'[1)]
-Abu-Nuseir---------- W4
-Fuhis---------- W5
-Tafila---------- W6
-Wadi Essir---------- W7

2) Project for Environmental Protection

② Construction of Wadi Zarqa Treatment Plant---------- W13

3) Projects for Reduction of Unaccounted for Water (UFW)

③ National Control System Integrating Surface and Groundwater---- M1

④ Municipal Water Networks Rehabilitation (Karak, Tafielah,--------- 8
Ma'an, Madaba and South Amman)

4) Project for Surface Water Conveyance and Supply

⑤ Al Wehda Dam Water Supply Project/Irbid---------- 69

1) : Project No.

(1) Treated Wastewater Reuse Scheme of Five Existing Treatment Plants

Groundwater has been profusely used for irrigation so far. This practice makes no sense in a water-scarce country like Jordan and is no longer allowed. As groundwater abstraction goes down, this precious resource must be increasingly replaced with treated wastewater. This is the irreversible current of the age.

As the large amount of treated wastewater effluent from the As-Samra and Zarqa treatment plants will not be reused for irrigation in the Upland area because of economical difficulties, small-scale reuse should be further promoted as much as possible in the vicinity of other existing treatment plants for the purpose of the groundwater resource conservation in the Upland area.

The proposed reuse amounts in the vicinity of each plant by 2020 are assumed as follows:

a. Abu-Nuseir	1.3MCM/a
b. Fuhis	1.2MCM/a
c. Ma'an	1.4MCM/a
d. Tafielah	1.1MCM/a
e. Wadi Essir	0.6MCM/a
Total	5.6MCM/a

Regarding the treated wastewater reuse scheme of the Ma'an treatment plant, the expansion of the treatment plant will be included in the reuse scheme because there is at present no plan for expansion. This expansion of the existing treatment plant comprises the construction of new treatment plant, collection system and pumping stations. The final capacity after the upgrading will be around 2MCM/a and an additional capacity by expansion will be around 1.5MCM/a. The financial unit water price of the expansion project is placed at 6th lowest and far below the average among the 25 proposed wastewater treatment projects as shown in Table 10.1-4.

To further reinforce the justification of the above selection, the results of financial/economic analysis for the five projects are shown in Table 10.1-3.

As Table 10.1-3 shows, "Fuhis", "Wadi Essir" and "Abu Nuseir" occupy the 1st, 3rd and 10th positions in terms of FIRR respectively among the entire proposed wastewater treatment projects. Even "Ma'an" is almost at par with the average line.

Table 10.1-3 Financial/Economic Analysis Results of Wastewater Reuse Projects

Wastewater Reuse Projects	FIRR (%) (10 Fils/m^3)	FIRR (%) (38 Fils/m^3)	Unit Water Price (Fils/m^3)	EIRR (%)	Remarks
Fuhis	**-**	**103**	**12**	**526**	***Not Yet**
North Queen Alia Airport	-	32	13	144	D/D
Wadi Essir	**-**	**32**	**20**	**175**	***Not Yet**
Kofur Assad	-	24	16	103	F/S
Kufranja	-	23	20	105	F/S
Na'ur	-	19	19	80	D/D
Wadi Mousa	-	17	19	55	D/D
Wadi Arab	-	17	20	70	D/D
Wadi Hassan	-	17	24	93	D/D
Abu Nuseir	**-**	**14**	**24**	**62**	***Not Yet**
Wadi Shallala	-	12	27	62	F/S
Karak	-	11	28	93	D/D soon
Madaba	-	9	33	49	D/D
Ramtha	-	9	34	55	D/D
As-Samra	-	7	37	38	*Not Yet
Average	**-**	**7**	**38**	**37**	
Dair Alla	-	6	39	38	F/S
Ma'an	**-**	**6**	**40**	**48**	***Not Yet**
Mazar, Mu'ta, Adnaniya	-	6	41	36	F/S soon
Al Jeeza	-	5	40	51	D/D
Torra	-	3	46	40	F/S
Irbid (Central and Wadi Arab)	-	3	47	39	D/D
Dair Abi Said	-	3	50	31	F/S
Mafraq	-	2	50	32	F/S
Tafielah	**-**	**-**	**52**	**42**	***Not Yet**
North Jordan Valley	-	-	55	35	D/D
Shuna South	-	-	57	34	D/D
Dead Sea East Coast	-	-	74	20	D/D
Aqaba	-	-	78	16	D/D
Aqaba South Coast	-	-	104	15	Not Yet

(2) Construction of Wadi Zarqa Treatment Plant

The Greater Amman area is expanding and its population is also increasing rapidly. The wastewater amount from this area is accordingly getting larger year by year. Although the expansion of the existing As-Samra treatment plant is under planning to meet the future increase of the wastewater, its capacity will be full by the year of 2005. The wastewater amount discharged from the Greater Amman area occupies nearly 60% of total amount in Jordan and serious environmental deterioration will take place in this area unless proper wastewater treatment is done in the future. Therefore, the new Wadi Zarqa Treatment Plant is planned to treat the increasing wastewater after 2005.

The Wadi Zarqa Treatment Plant is located in the part of the drainage system covering the Amman-Zarqa River Basin and will be constructed at a site along Wadi Zarqa. It will consist of a treatment plant and a conveyance system. The treated sewage effluent will be discharged to the King Talal Reservoir to be ultimately used in the Jordan Valley.

The implementation of the project will be in two phases: Phase 1 will be from 2006 to 2009 and Phase 2 will be from 2025 onwards. The estimated capacity and investment cost in Phase 1 are 53.3 MCM/a and 62.4 million JD, respectively. 5 MCM/a will be used in the vicinity of the treatment plant.

The results of preliminary financial/economic analysis have made it all the more clear that the Wadi Zarqa Treatment Plant project is worthwhile for pre-F/S, their financial unit water price being placed 4th lowest and far below the average among the 25 proposed wastewater treatment projects as shown in Table 10.1-4.

Table 10.1-4 Financial/Economic Analysis Results of Wastewater Treatment Projects

Wastewater Treatment Projects (Excl. On-Going Projects)	FIRR (%)	Unit Water Price (Fils/m^3)	EIRR (%)	Remarks
Abu Nuseir WWTP Upgrade & Expansion	7	146	19	D/D
Jordan Valley Community Waste Management Project	4	203	13	D/D
Aqaba Wastewater Project	3	225	13	D/D
Wadi Zarqa WWTP	**-**	**239**	**14**	***Not Yet**
Upgrading Mafraq WWTP	-	344	8	F/S
Upgrading Ma'an WWTP	**-**	**370**	**7**	***Not Yet**
Upgrading Tafielah WWTP	-	373	7	F/S
Upgrading and Expansion of Karak WWTP	-	439	6	D/D soon
South Amman Wastewater Project Phase I – Jiza/Talbiya	-	513	4	D/D
Average	**-**	**534**	**4**	
Upgrading Kufranja and Ajlun WWTP	-	564	3	F/S
Dead Sea Wastewater Infrastructure	-	565	3	D/D
Ramtha WWTP Upgrade & Expansion	-	575	3	D/D
South Amman Wastewater Project Phase I: Stage II	-	582	3	D/D
Madaba WWTP Upgrade and Expansion	-	591	3	D/D
Upgrading and Expansion of Samura WWTP	-	624	2	D/D
Na'ur and Adjacent Areas Wastewater Projects	-	845	-	D/D
Irbid Stage II	-	854	-	F/S
Sakeb Wastewater System		986	-	D/D
Community Infrastructure Wastewater Project	-	993	-	D/D
Jordan Valley Sanitation – North Shunah	-	1,006	-	D/D
Mazar, Mu'ta and Adnaniya Wastewater Projects	-	1,398	-	F/S soon
Miscellaneous Small Projects	-	-	-	D/D
Fuhis	-	-	-	*Not Yet
Wastewater Feasibility, Design and Assessment Studies	-	-	-	*Not Yet

(3) National Control System Integrating Surface and Groundwater

In view of the reality that about 50 to 60 percent of water produced is the so-called UFW, the seriousness and importance of this problem cannot be overemphasized. Every year a huge amount of this precious lifeline resource is lost in the dark. This reality must be squarely faced and remedial measures must be taken. Fortunately, the government has been seriously and energetically grappling with this problem. This project is a necessity almost without conditions.

Monitoring and controlling of the water conveyance system are indispensable for water resource management particularly for the reduction of unaccounted for water. Hence, it is proposed to formulate a control system for the water transfer system integrating surface and groundwater covering the whole nation.

This project comprises the construction of nation wide monitoring and control system of the main water trunk lines and should be implemented in two phases. The first phase will be implemented in the short term and the second phase will be implemented in mid term after the completion of the Disi-Amman Water conveyer. No study has been done on this project.

(4) Municipal Water Networks Rehabilitation (Several Cities)

The unaccounted for water (UFW) occupies more than 50% of the total amount of water supplied by the water supply network system and the reduction of UFW including physical losses is a very urgent task in the supply management as mentioned above. The Jordanian government has been tackling with this problem and has conducted series of rehabilitation works of the water supply system with the cooperation of the donor countries. The final target of the rehabilitation works is to reduce physical losses to less than 15%.

However, the rehabilitation of the existing water supply system has been started recently and even the rehabilitation plans have not yet been formulated for some major city areas as listed below:

- Karak Municipality
- Tafielah Municipality
- Ma'an Municipality
- Madaba Municipality
- South of Amman Municipality

It is understood that the cost of water development by rehabilitation (water saving cost) is generally lower than that of other water resources development. Actually, the FIRR and the unit water price of this kind of projects are better than the average of the water development projects as shown in Table 10.1-5. Therefore, it is concluded that a higher priority should be given to the rehabilitation projects from the viewpoint of financial/economic analysis and the pre-feasibility study of supply networks rehabilitation should be done for the city areas without rehabilitation plans listed above.

Table 10.1-5 Financial/Economic Analysis Results of Water Projects

Water Projects (excl. On-Going Projects)	FIRR (%)	Unit Water Price (Fils/m^3)	EIRR (%)	Remarks
Disi Amman Water Conveyor Branch to Ma'an and Madaba	23 - 69	211 – 250	86 - 241	*Not Yet
TannurDam	30	141	70	D/D
Lajoun Wells	29	234	79	D/D
Caradoor Water Supply Project	21	147	58	F/S
Wadi Zarqa Ma'in, Zara Springs Project	17	92	52	F/S
Small Dam (Ibn, Hamad, Karak, Meddien)	16	114	37	*Not Yet
Mujib Weir Conveyor and Southern Ghors Infrastructure	16	351	47	D/D
Inter-Governorate Transfer lines	2 - 18	214 – 384	20 - 73	*Not Yet
Wehda Dam	12	142	29	D/D
Al Wahda Dam Water Supply Project/Irbid	**9**	**331**	**43**	***Not Yet**
Dead Sea Water Treatment Plant	7	358	42	M/P
Wadi Al Arab-Irbid Municipal Water Supply	6	331	40	F/S
Deep Groundwater Investigation	6	401	17	*Not Yet
Desalination Conveyor to Urban Jordan (50+10 MCM)	5	383	30	F/S
Miscellaneous Water Networks Rehabilitation (Several Cities)	**5**	**409**	**17**	***Not Yet**
Water Development Projects Average	**4**	**426**	**18**	
Water Harvesting Badia Region	-	89	30	D/D
Feedan Dam	-	141	16	F/S
KAC Siphon Upgrading	-	220	36	F/S?
Rehabilitation of Southern Ghors Irrigation Stage I	-	221	33	F/S
Rehabilitation of Hisban-Kafrein Irrigation Project	-	254	15	F/S Soon
Storage on Jordan River and Side Wadis	-	283	7	F/S
Wadi Araba Development Project	-	378	5	D/D
Hisban and Kafrein Desalination Plant	-	449	19	*F/S done
Disi Amman Water Conveyor	-	804	5	D/D
Desalination at Aqaba (Short Term)	-	1,035	10	F/S
Desalination at Aqaba (Long Term)	-	1,035	10	*Not Yet
Miscellaneous Small Projects-Supply Expansion	-	2,065	-	*Not Yet
Miscellaneous Small Projects-Networks Expansion	-	-	-	*Not Yet

Note: The projects in italic letters are groundwater development projects.

(5) Al Wehda Dam Water Supply Project/Irbid

The country must rely to a great extent on the surface water development in the future because of the constraints being imposed on the abstraction of groundwater, another major source. The importance and preciousness of surface water will be more and more pronounced in the future as it is destined to become the No. One water supplier of the country. Accordingly, its proper allocation (conveyance) will be also very important in terms of water resources management.

There is currently a deficit of 21MCM/a in the Greater Irbid area. It is inferred that this deficit will rise to more than 25 MCM/a in 2025 in this area even after the reduction of the unaccounted for water and provision of additional water. Therefore, it is indispensable to supply new water resource to this area from the Wehda dam to be completed in 2005.

The total supply amount of this project may be around 25MCM/a. This project comprises the construction of transmission line and pumps of 2,850m^3/h in capacity, 580m in head and 27km in length, a treatment plant of 3,000m^3/h in capacity and a reservoir of 110,000m^3 in volume.

Although the hydraulic analysis study has been prepared in 1997/1998, any studies on this water supply project have not been done yet.

Table 10.1-5 shows the results of the financial/economic analysis for the proposed water projects including surface, ground and sea water development projects, facilities rehabilitation projects and water conveyance projects.

As Table 10.1-5 shows, there are five candidate projects which are above the average line in terms of FIRR. Of the four, "Disi Amman Water Conveyor Branch to Ma'an and Madaba" were dropped because they are not directly related to surface water development. Then, "Deep Groundwater Investigations" was also deleted because it is an underground development project. Thirdly, "Small Dam (Ibn, Hamad, Karak, Meddien)" was set aside because it is a minor project. Fourthly, "Miscellaneous Water Networks Rehabilitation (Several Cities)" is a rehabilitation project as its name shows. In this way, there remains only "Al Wehda Dam Water Supply Project/Irbid" as a representative surface water related project to be further studied by JICA. It is lucky that it has a high total score from the viewpoint of the four criteria for selection.

10.2 Donors Collaborations

10.2.1 GTZ "Digital Water Master Plan" (DWMP)

The GTZ planning tools consist of three (3) modules generating Scenario Tables Pool (STP), i.e. Demand Pre-processing Module, Resources Pre-processing Module, and Water Transfer Module and one (1) Balancing Module integrating all pre-processing modules. At the end of the Study, i.e. end of May, 2001, applications of the modules were almost completed as follows;

a. Demand Pre-processing Module
   - Municipal demand
   - Industrial demand
   - Touristic demand
   - Loss
   - Irrigation demand

b. Resources Pre-processing Module
   - Wastewater
   - Base flow
   - Groundwater
   - Flood flow

c. Water Transfer Module

d. Balancing Module

In the formulation of JICA's Water Resources Management Master Plan (WRMP), GTZ tools for demand calculation mentioned above were fully used. However, since the basic idea concerning the potential evaluation on water resources is different between JICA and GTZ, the potential of both groundwater resource and surface water resource were given as fixed value (static data) in WRMP despite that the surface water and groundwater potential are calculated based on the precipitation amount in the GTZ's modules. The water transfer plan is also given static data in WRPM.

All the static data of JICA's WRMP has been stored in the system of GTZ's DWMP in the form of shape files and they can be opened any time on the GTZ's System.

For further strengthening the commitment of the decision makers to the Water Management Master Plan, the output of JICA's WRMP are presented in a visual way using Ecxel and Arc-View softwares in the system of GTZ's DWMP. The visualized out-put can be automatically changed if the given data stored in the Ecxel sheets will be changed in future. For the detail of the visualization, refer to Chapter 11.

10.2.2 USAID " Water Resources Management Policy Support" (WRPS)

The Water Resource Policy Support (WRPS) activities is a two-year bilateral initiative (August, 1999 to August, 2001) between the Government of Jordan's Ministry of Water and Irrigation (MWI) and the United States Agency for International Development (USAID).

The WRPS has given JICA Study very important and useful suggestions and because it deals almost same tasks with JICA Study in the Amman/Zarqa Basin (AZB). JICA Study has been conducted in close relationship with WRPS project in order to make both activities much effective.

(1) Groundwater Reduction Program

The following five potential options for reducing groundwater abstraction in the AZB highland irrigation were proposed in WRPS. The abstraction amount in AZB highland irrigation is around 60MCM/a based on 1998 MWI abstraction data and it was estimated that the groundwater abstraction could be reduced to the safe yield which was less than half of present abstraction amount by implementing these options.

Irrigation Advisory Services (IAS, estimated reduction of 5MCM/a, about 8%)

Well buy-outs (15-20MCM/a, about 25% to 33%)

Enforcing abstraction limits (15-20MCM/a, about 25% to 33%)

Exchange of groundwater with recycled water (10-15MCM/a, about 17% to 25%)

Municipal and Industrial water reduction (10-30MCM/a)

For the detail of the options, refer to section 7.3.2.2.

(2) Water Reuse Plan for the Amman-Zarqa Basin and Jordan Valley

Within the frame of the Project "Jordan Water Resource Policy Support" carried out by USAID/ARD opportunities are investigated for using the recycled water in particular from the existing As Samra and proposed Wadi Zarqa Wastewater Treatment Plant and other treatment plants that discharge into Wadi Zarqa. These opportunities were to be examined for the Amman-Zarqa, Jordan Valley, Wadi Zarqa, other Amman-Zarqa sources and groundwater recharge.

According to the study of USAID, total annual discharges from the existing four (As Samra, Abu Nuseir, Baqa and Jerash East), and projected six (including the existing four plants and Wadi Zarqa, Jerash West) wastewater treatment plants in the Amman-Zarqa Basin (AZB) are projected to increase from 61 MCM in the year 2000, to 177 MCM in the year 2025.

Fifteen water reuse options were identified and are being characterized in WRPS. These include three options for irrigated agriculture in the Jordan Valley, seven options for irrigation in the Highlands, one option for irrigation in Wadi Zarqa downstream of As Samra, one industrial and municipal supply option upstream of As Samra, two

options for groundwater recharge, and one (composite) option for localized water reuse near the minor wastewater treatment plants.

10.2.3 Mujib-Zara/Ma'in Saline Water Treatment, Conveyance to Amman Project

"Mujib-Zara/Ma'in Saline Water Treatment, Conveyance to Amman Project" is a bilateral initiative between the Government of Jordan's Ministry of Water and Irrigation (MWI) and the United States Agency for International Development (USAID).

Draft Final Report has been completed by Harza, USA in 2001. Presently, the feasibility study and basic design are on-going for USAID Grant Aid Scheme. This project is to utilize the water from Wadi Mujib, brackish springs and side wadis in Zara/Ma'in area.

The brackish water collected in this area will be desalinated Sweima area and conveyed to Greater Amman Area through National Park pumping station. The outline of this project is as follows:

- Total development amount: raw water 52MCM/a, desalinated water 40MCM/a, brine 12MCM/a to Dead Sea
- Total estimated cost: 100 Million US Dollars (USAID grant: 85%)
- Transfer Line: about 90km in total length, 1,000m in lifting head
- Desalination (TDS 1500 – 2000mg/l, either by RO or ED process)
- Turnkey Basis Contract (design, construction for 2 years, and operation for 5 years)
- Estimated time of completion: 2004

CHAPTER 11
VISUALIZATION OF THE WATER RESOURCES MANAGEMENT MASTER PLAN

CHAPTER11 VISUALIZATION OF WATER RESOURCES MANAGEMENT MASTER PLAN

11.1 Outline of the Visualization

Full documentation of the visualization system is shown in Supporting Report Volume IIX.

The Ministry of Water and Irrigation (MOWI) in Amman is dealing with a large volume of detailed data for the water sector. Water relevant data includes various different data types such as construction data on wells, pipelines, economic data, time series (monitoring) data and spatial data. Simulated or projected data for periods in the future make the list complete.

Fortunately the non-spatial data is almost exclusively stored in the Oracle WIS database in a consistent manner, so that the data management is transparent and the development of tools for further processing is possible. Visualizing this data can be done using the Oracle WIS software, standard MS Access database, MS Excel or ArcView. Unfortunately the data aggregation is very complex and the user needs to have expertise in SQL and one of the mentioned programs.

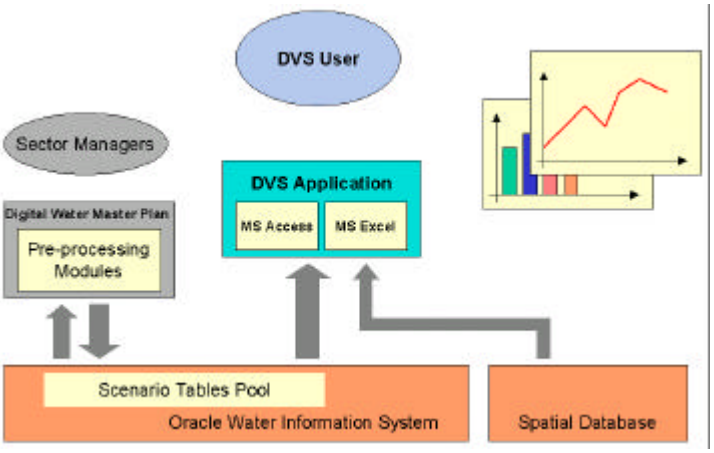
The spatial database is using the ESRI data formats, shapefiles and Arc/Info coverages. All water relevant spatial objects were digitized and stored in the database in vector format. The coding of the objects is the same consistend coding scheme as it is used in the Oracle WIS. Additionally, topographic information was added to the database for the compilation of maps. All spatial data is stored in the same co-ordinate projection JTM (Jordan Transverse Mercator). Exchanging spatial data with other organizations sometimes needs co-ordinate transformations as the Palestine Grid is a common projection in other agencies.

The project "Digital Water Master Plan" was launched to develop and implement computerized tools for the calculation of future water demand and availability of water resources. The tools enable the operators to develop the different scenarios. Based on the historical patterns and the different scenarios, demand and resources figures can be calculated for 8 planning horizons up to the year 2040. The output of these modules are stored in the scenario tables pool (STP) under the Oracle WIS database. 17 different result tables are available under Oracle. This projected data is important for future decision-making on the water sector of the Hashemite Kingdom of Jordan. Unfortunately Oracle does not provide easy-to-handle functions for post-processing, reporting and mapping the data.

The **Data Visualization System** enables the users to output the Oracle WIS data in a standardized format without the need of formulating SQL queries manually under ORACLE or MS Access. The DVS provides the users with functions of data aggregation with a graphical and tabular output. The DVS is easy to use and allows complex calculation on the rather detailed data of the WIS without any knowledge of the SQL database language, Oracle, MS Access or MS Excel. Thus it is a strong visualization tool but still easy to handle.

The DVS is using Oracle's strong functionality in data management and maintenance, a VBA programmed MS Access application as the command center for extraction and aggregation of the data from Oracle and MS Excel's functionalities for visualizing the data in charts and tables. As most of the data has a spatial context, the GIS data is integrated in the MS Access application as a GIS viewer using the software ESRI MapObject LT. The application was programmed using Microsoft Visual Basic for Applications (VBA) as programming language and the object library MapObjects LT. As the results are presented on common Excel spreadsheets, all the Excel functionality can be applied to modify the charts and tables for reporting. For every query result, a new Excel window is started, which can be saved or simply closed without saving after the data was viewed.

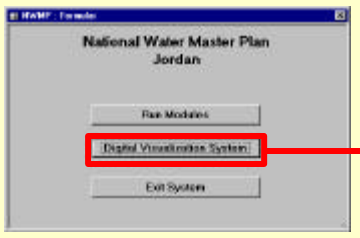
For the detail of the data types and chart types, please refer to Supporting Report to Chapter 11.



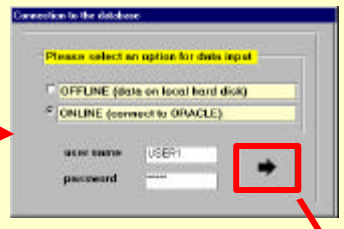
11. 2 DVS Navigation

11.2.1 Navigation Chart

Enter DVS

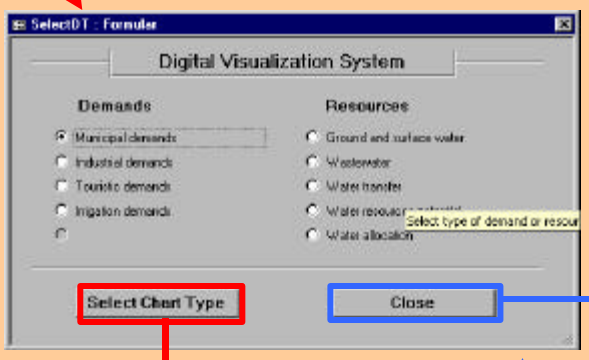


Step 1:
Start of Digital Visualization System



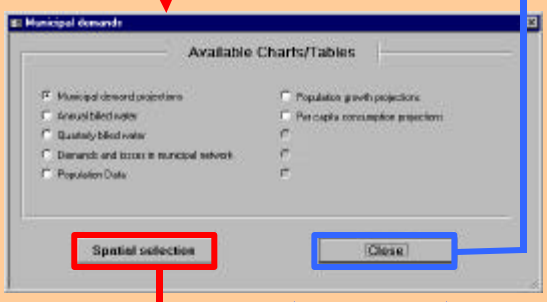
Step 2:
Offline: Working locally in an Access database
Online: Connect to Oracle WIS. You need to enter your user name and your password. You need read access to the tables you want to work with

Step 3:
Chose the data type for visualization.

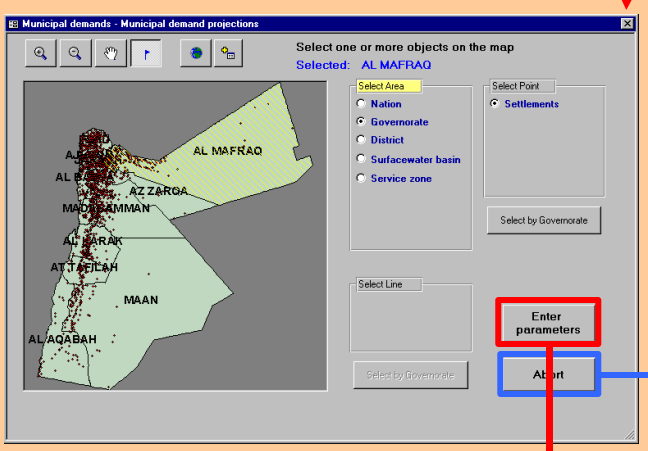


Exit DVS

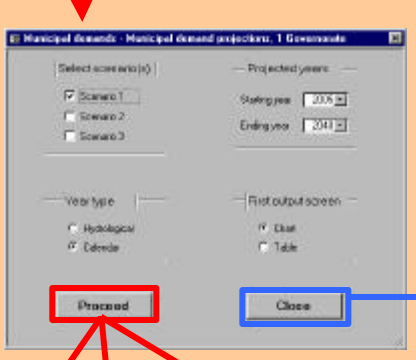
Step 4:
Chose the chart type for visualization.

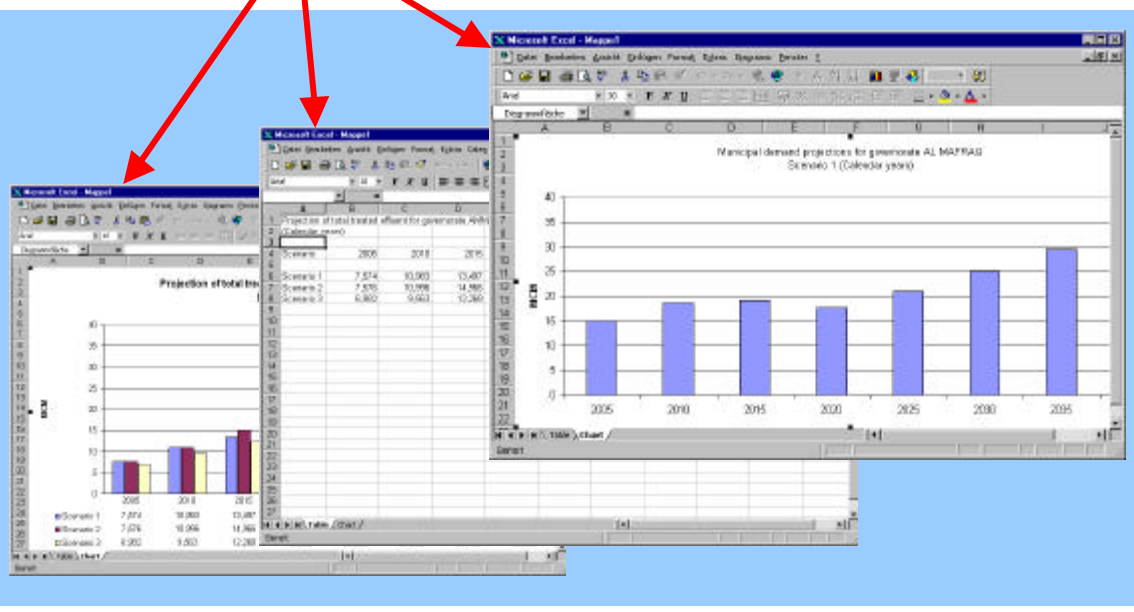


Step 5:
Chose the objects for visualization. You can visualize data for administrative units or for objects like settlements or treatment plants. The choice is given by the data type and chart type.

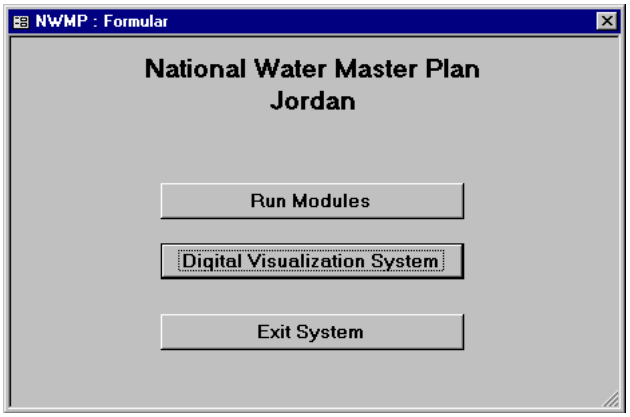


Step 6:
Choose the parameters for the visualization.





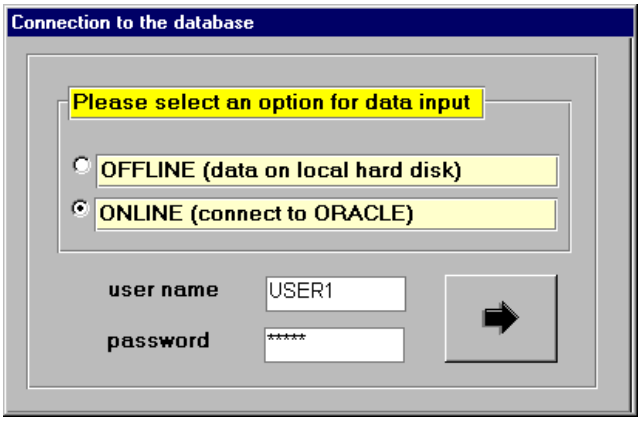
11.2.2 NWMP Window



After launching the application, the first window for the user is the NWMP window. From here the sector managers can start the pre-processing modules (if they are installed locally on the computer).

All other users use the –button to start the Digital Visualization System.

11.2.3 Database Connection Dialog



In principle, there are two different access modes to the data available: The direct link to the Oracle Wis database (ONLINE) and the access to a copy of the WIS which was stored locally on the disk (OFFLINE). The method of accessing the data is not only a question of speed, it also depends on the Oracle access rights of the users, the type of DVS installation and the availability of a network connection. The table below gives an overview of the advantages and disadvantages of both types of database access.

	ONLINE	OFFLINE
Additional installation requirements		the WIS MS Access database and the spatial data have to be installed on the computer.
Access rights	The user has to have access rights on the Oracle WIS tables he wants to use for visualization (see Oracle Access rights).	No access rights are necessary.
Processing speed	Visualizing online data can be very time-consumptive, dependent on the available network performance.	The processing speed is only limited by the computer system you are using (mainly processor speed and RAM).
Recency of data	The data comes directly from the Oracle database and is always up to date.	The data was transferred from the Oracle WIS to a MS Access database and was stored on the computer locally. It is a copy of the data this copy was made in the past. Updates made to the original data later are not reflected in the MS Access database, thus the visualization my give thus .
Network availability	The database is directly linked. Thus, a network connection is compulsory.	The database connection is not necessary, if also the spatial data was stored locally and the system was configured to use the local data sets.

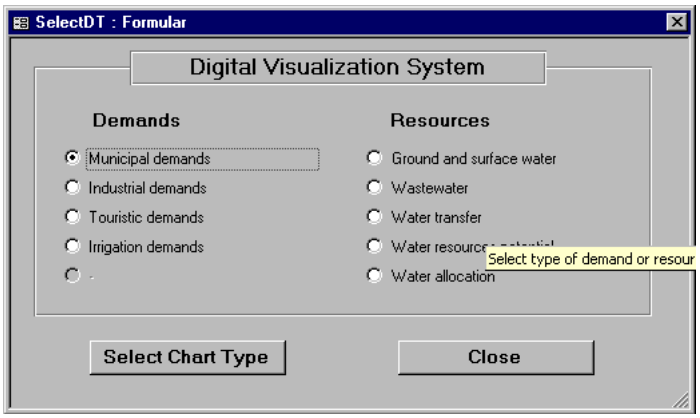
To continue to the DVS, you have to enter a user name and a password, if you work online. The minimum length of each string is three characters. Your user name and password have to be valid for the Oracle system (ask the Oracle administrator for assistance). If you work locally (OFFLINE), entering of user name and password is not necessary.

Click  the – button to continue to the Digital Visualization System.

The system will continue with the Date Type Selection dialog.

11.2.4 Data Type Selection Dialog

This dialog is the main window of the DVS. Closing this window, you quit the DVS and come back to the NWMP window. In the data type selection dialog, there are 4 different demand types and 4 different resources types to chose from. Additionally, transfer can be selected as a data type. You press the ***Select Chart Type***-button to continue to the Chart Type Selection Dialog. Depending on your choice of data type in this dialog, the set of possible chart types will vary.



11.2.5 The Chart Type Selection Dialog

The Chart Type Selection Dialog is a dynamic window. Depending on the data type chosen in the Data Type Selection Dialog, the set of available chart types is different. With selecting a chart type, the user chooses a specified format for the Excel output of the data. The data type "Municipal Demands", for instance, offers you 7 different chart types to choose.

Choosing a certain chart type, you define which data you want to have visualized under MS Excel. The DVS module will formulate the SQL query which extracts exactly what you need to have presented and this query will be sent to the Oracle WIS (or the MS Access database in OFFLINE mode). The database work is done mainly by the ODBC driver and the database (Oracle or MS Access). The result table coming from the WIS will be rearranged by the DVS program and sent to MS Excel for further processing. You will find standardized charts and the underlying data tables. Of course, the Excel charts can be changed manually with a certain extent of Excel skills. Colors, sizes, texts can and sometimes should be edited using the common Excel functionality.

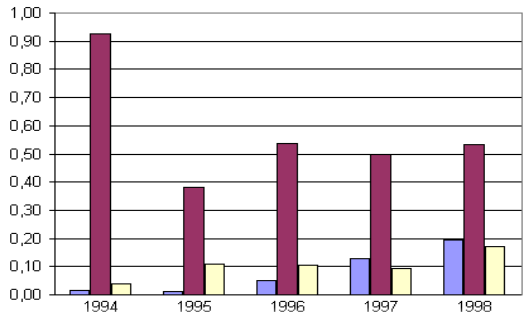
In Supporting Report Volume IIX, all available chart types are discussed one by one as the set of available charts is different for every data type. Sample result charts are shown for an easier understanding of the charting theory. Please be aware that the sample diagrams were not added to this report to give you exact numbers for the chosen data type. The time, these charts where created, the WIS database might still have been

incomplete. Using the DVS to create these charts might give different results now, because some data in the database might have been changed, added or deleted.

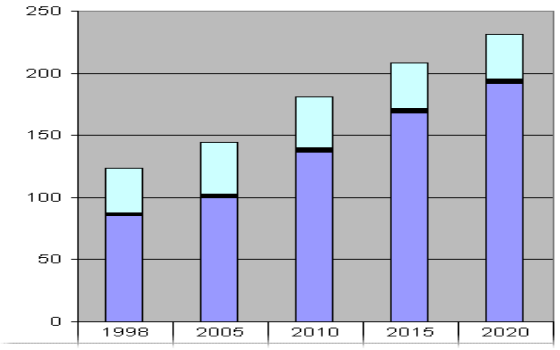
The philosophy of the DVS is to get an easy and standardized access to this data so that plotting and charting the content of the database can be done by any user by any time. The DVS was not developed only to be a kind of "digital report". It was developed to be used frequently to visualize the database as a tool for the decision makers as well as for the sector managers. It is an impressive and fast way to visualize the huge amount of detailed data in the WIS database.

Restrictions

MS Excel allows the plotting of two series in one chart. If you plot several years in a bar chart you still have one parameter to visualize if there is the need (clustered column and stacked column charts). This parameter can be the set of three scenarios, 3 types of year, three different salinity classes or simply a set of settlements, industries, governorates etc. (multiple spatial selection). You can visualize these two-dimensional series in Stacked Column or Clustered Column charts. But Excel does not allow the visualization of more series. In practice this means, the first series always is the series of several years and for the second series you can either make a multiple selection in the spatial selection window and then you are restricted to one scenario, one salinity class etc. or you select only one object spatially and then you have the freedom to visualize either 3 scenarios or several salinity classes etc. As every chart type allows different parameters to set, the restrictions, if there are any, are described in the according chapter. The program however has been implemented in a way that it guides you and does not allow any violation of these rules.



Excel's clustered column chart



Exel's stacked column chart