	MEDA WATER PROGRAMME ***Euro-Mediterranean Regional Programme for Local Water Management*** **IRWA** Improvement of Irrigation Water Management in Lebanon and Jordan ***ME8/AIDCO/2001/0515/59776-P 007***

Technical Report

Installation of 4 self cleaning grids at the Turn Outs (91 (P21), 92 (G22), 95 (P95), 95 (G25)) of the King Abdullah Canal, Jordan

By Francesco Amigoni - September 16th, 2008

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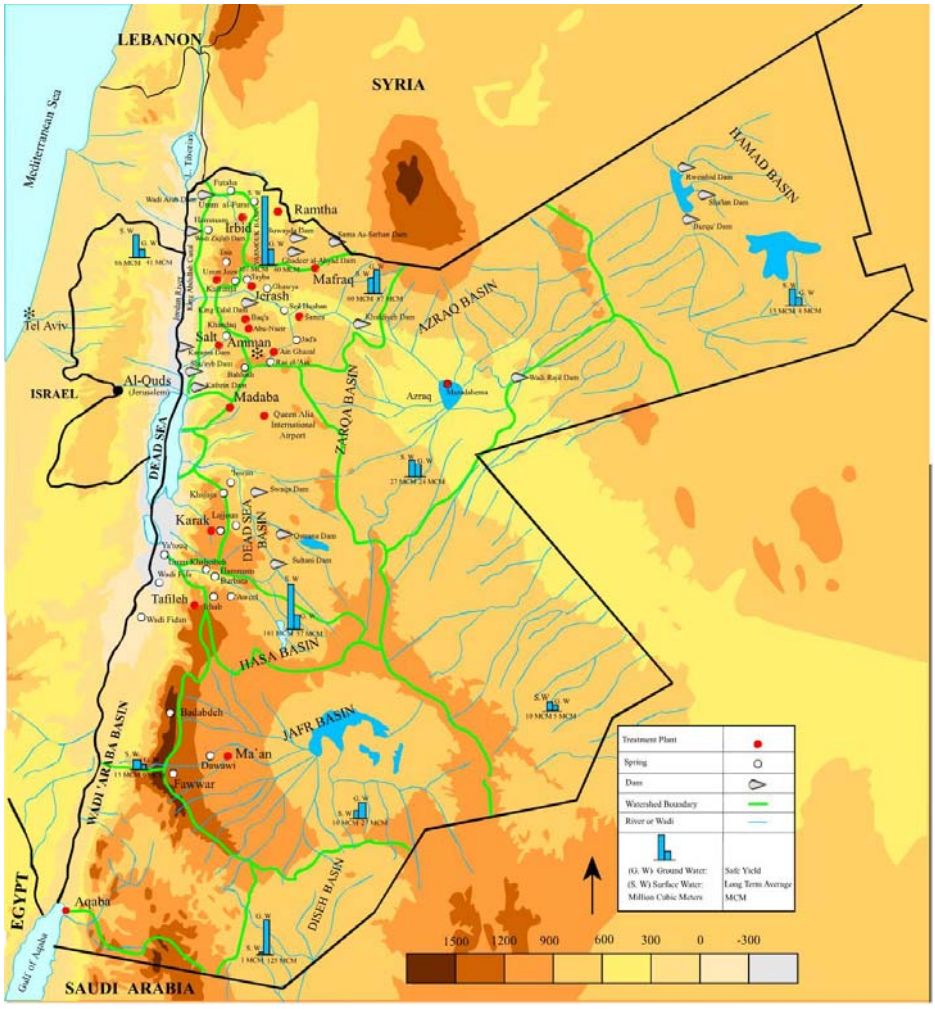
1. General Context

With less than 170 m³ of annual water per capita, Jordan is one of the most water stressed country in the world. The annual allocation of water is expected to drop to 90 m³ in 2010 as a result of the disproportional increase of population compared with the water resource development, increasing socio-economic and environmental problems. Moreover, agricultural sector remains the main water consumer with an allocation of more than 70% of the national water resources. Despite all the efforts engaged by the Jordan government and the international donors in building a comprehensive water strategy, the management, cost recovery and availability are not fully addressed.

JORDAN WATER MAP



The Jordan Valley, as one of the main crop production area, is highly competing for water usage with urban areas. Furthermore, despite the massive switch from surface to drip irrigation, small scale farmers do not have the technical knowledge or the financial capacity

to invest in efficient irrigation materiel increasing water losses drastically. Efficient micro irrigation is in fact linked with an important technical apparatus in terms of pumps, design, filters and fertilizers requiring specific expertise to be used properly.

In this context, reclaimed water represents a precious and unique source for agriculture, on which Jordanian Authorities will have more and more to rely for reducing the deficit in water supply which despite a direct contribution of only 3,8% to GDP reaches 29% in indirect contribution (services, manufacturing, process) Furthermore, the agricultural sector remains a strategic sector for the economical support of rural communities and for preservation of the social equilibrium in the Jordan Valley.

Reclaimed water is the most important alternative source of water for agriculture and the rehabilitation of As Samra water treatment plant represents will lead to increased availability and quality of reclaimed water. Presently there are indications that the problem of algae is possibly going to worsen in the next years as a consequence of the improvement of the treatment plant of As Samra: water with better chemical quality and lower turbidity can in fact constitute an ideal environment for algae growing, so that, even if the improved chemical quality represents an important achievement for the use of reclaimed water in agriculture, the modified physical quality can on the contrary produce heavy impacts on the irrigation systems of the farmers of the area (increase in clogging of systems). Four turn out of King Abdullah Canal, located in the area of reclaimed water distribution, still don't have any filtration system increasing the clogging risk of the network.

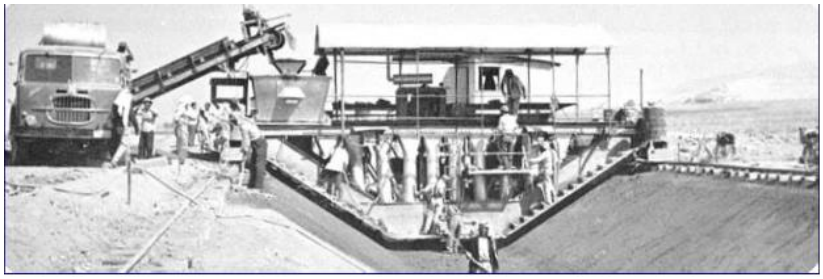
Farmers' associations (and especially Water Users Associations) can play a key role in: develop way of farmers participation in water distribution, facilitate access of small farmers to market and services, providing grassroots approach to the organization of extension services. Farmers, especially small scale farmers, need technical assistance and financial support to be able to shift to more efficient water use and to adopt agricultural techniques appropriate to the characteristics of water.

2. Specific Context:

Nevertheless the Jordan Valley being the most important agricultural area in Jordan it suffers from significant lack of water. The main source of water for irrigation is the King Abdullah Canal that crosses the Jordan Valley from North to South for 110 Kilometres.

The King Abdullah Canal was built in the sixties and it conveys the water from the Yarmouk River located in the Northern part of the Jordan Valley.

The Jordan Valley suffers both from scarce rain fall and the competition with the urban area on the water resources available. 80% of the potable water coming from the Jordan Valley is diverted to Amman for domestic use while the Valley receives back from the cities treated water for agricultural use.



Between 1957 – 1961 the jordanian built their 110Km long East Ghor Canal
Renamed recently King Abdullah Canal

The water of the King Abdullah Canal is partly composed by waste water and partly by rain water. Therefore the quality of the water changes each season following the variation in the quantity precipitation. The quality of the water of the KAC is also affected by the high temperatures that generate an intense development of algal flora in the water and grassy-shrubby vegetation.

View of the KAC in northern Jordan Valley area

The King Abdullah Canal crosses several villages and populated areas along the Valley and as result the Canal collects also rubbish and anomalous suspended elements in general.

Along the Canal are located at regular intervals Turn Outs controlled by penstocks (gates) to convey water into the irrigation systems of individual farms.
Since the first site visit made with the technicians of JVA we have identified the Turn Out functioning as the critical points to focus the intervention in order to improve the water management of the area and the water quality for the local farmers at the same time. The irrigation system is affected by clogging and deterioration due to the poor quality of the water also at the farmer level.

Basically, the water of the Canal transports two kinds of materials. The first are heavy materials which are dragged along the bed of the canal, the second is floating material washed along by the water flow. The first kind consists of rough materials and sludge which often emerge on the surface encountering obstacles or water turbulences. Such events generate water turbidity.

Floating materials are usually vegetation residues such as grass, foliage, small branches, paper, and cellulose together with algae torn by the water flow from the canal's surfaces

Floating Material – T.O. 91 (p21) – July 2007

In the issue of water quality and irrigation management Turn Outs are the strategic points for any intervention in the Jordan Valley system. Turn Outs are the points of the JVA irrigation network closest to the farmers and the intake of the farmers' irrigation system. According to the new government policy the technical responsibility to manage the Turn Outs will be handed over to water users associations (WUA).

The first survey implemented by the Expert Dr Rosati reached the conclusion of installing a self cleaning grids system at Turn Out 70 - one station filter composed of 4 automatic self-cleaning filters with 10 mesh grid (1500 micron) positioned in parallel. Dr Rosati proposal has been abandoned by the new Irwa project management and in consultations with JVA officials due to high costs and inappropriate technical solution.

At the end of the new assessment phase, the new Irwa project management and JVA agreed on a new technical solution and in particular the installation of 4 self cleaning grids at Turn Outs 91 (p21), Turn Out 92 (g22), Turn out 95 (p95), Turn out 95 (g25) Turn out . The self cleaning grid installation (2 for each Turn Out) aims both to filter the water direct to the JVA Pumping station protecting the intakes of the Turn Out and to keep the water canal clean removing the superficial waste and rubbish. The double task of the self cleaning grids add an environmental impact of the operation

Site Visit – July 2007 – Turn Out 91 (p21)

Site Visit – July 2007 – Turn Out

3. Description of the technical functioning

a. Turn Out status quo:

The Turn Out is made of reinforced concrete and connected to the canal's right embankment through a trapezoidal connection with a 7.00 m base, it ends in a short canal of 3.00 x 1.40 m in size, and 2.60 m in depth.

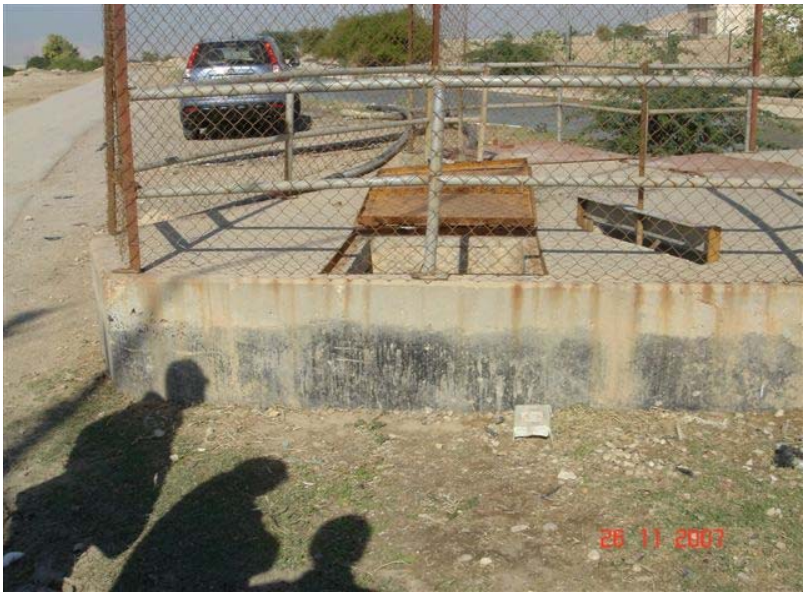
This turn-in consist of two diverted canals measuring 1.00 x 1.80 x 2.60 m, which bring the water to a settling basin. The two canals are separated by a reinforced concrete block of 1.00 x 2.60 m width. The shut-off gates enable the water supplies to be excluded, in accordance with specific needs or maintenance requirements.

Besides being separated by the gates, the 2.50 x 1.60 x 2.60 m settling basin is also separated by a 55 cm ground weir structure. This enables the exclusion or reduction of materials hauled or washed along the canal bed. The basin can be inspected through appropriate openings in the roof slab.

Central of water derivation

After a further partition, designed to reduce the flow rate, and which demarcates a space of 1.25 x 1.60 x 2.60 m in conjunction with another sluice, the two water courses join and flow into the loading basin of the 600 mm Ø fibro cement main pipeline described above.

Site visit – November 2007 – Turn Out 95 (G25)



Site visit – November 2007 – Turn Out 95 (G25)

The irrigation network connecting the canal which each farms is made-up of a main pipeline in fiber reinforced cement, which starts at the canal's Turn Out with a 600 mm Ø, and continues throughout the higher area with diameters progressively tapering down to 400, 300, 250, and 200 mm.

Sub-main pipes usually single and straight, are connected to the main line in order to supply each farm in its highest point, and their diameters taper from 150 to 100 mm.
The secondary network features valves in order to supply the due quantities at each Farm Turnout Assembly (FTA).

As the agricultural surfaces have the same dimensions (farm units of 3 ha), a standard continuous flow of about 8 l/s for 8 hours a day is provided at each FTA, as confirmed by the Jordan Valley Authority staff during the field investigations.

The work therefore concerns the derivation of a highly disturbed water flow, improving its physical quality by excluding suspended or floating matter and preventing intake of the fine material originating from surface erosion in the collecting basins.
The proposed solution determine the types of irrigation-distribution system to be adopted.
There do not appear to be any difficulties with regard to the first objective which will be achieved by dynamic screening at the derivation inlet.

The seasonal and long-term performance remains a statistically unknown quantity; the only information we have concerning the conditions of the water are the verbal reports of the on-site personnel.

As regards other general problems and as has been seen, screening should be followed by preliminary filtering (Mesh 10) of the derived water prior to final filtering (Mesh 120-200) on the various channel distribution branches.

b. Self Cleaning Grid

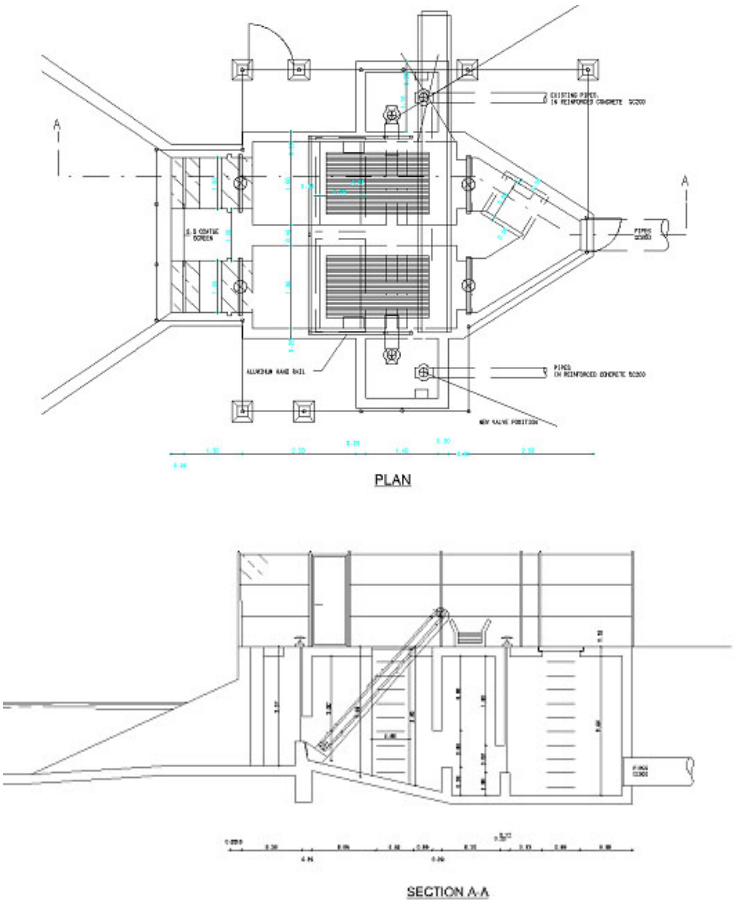
The choice of this type of grid and how to install, was done in close collaboration with the JVA and with the technical support of “MWH Arabtech Jardan ("MWHAJ")”,

Next to the intake, a metal plate barrier is installed leaning against the upper edge of the canal, thereby enabling the exclusion of the upper waters from intake.

Through the use of a roof slab window, a twin "screening tool" in the settling basin is proposed, installed downstream from the gate that excludes the incoming flow; the tool will be protected by gates which allow entry, work and maintenance to be carried out.

The twin grid is made-up by a barrier of AISI 304 mm 25x6 stainless steel plates, with a free inter-space of mm 14.

Downstream, on the rear of the barrier, a series of cleaning plates (rakes) move bottom-top: they anchored laterally to a handling chain, guided by U-type sockets, and top and bottom supported by sliding pulleys of a diameter of 250 mm.



Tecnichal drawing by “MWH Arabtech Jardaneh (MWHAJ)”

The cleaning rake in stainless steel removes the materials stuck to the bars by a scraping action. The upward direction carries the removed materials to the upper end of the grid and then releases them on the rear-side of the grid, so that they fall to the lower level.
On this, and inside an appropriate (60 cm) flat gutter-shaped base, a conveyor belt that transport the removed materials to the trash disposal basin, designed for a tow-able wheeled container to remove the waste.

Due to the presence of the cm 55 ground weir structure described above, the heavy materials hauled along the bottom of the canal will not be able to enter the diversion.
In order to operate the cleaning system, the project requires an electric engine of approx. 2 HP for the handling of the screening belt and another engine of 1 HP for the handling of the belt which takes the extracted materials away.
Another grid with mesh 10 was positioned behind the self cleanning screen. The task of these will be to stop floating smaller material passing the first mesh. The cleaning of the grid will be done manually. Only standard and light maintenance work is required by the system.

Self Cleaning grid – phase of assembly. Friulana Costruzioni –Italy - December 2007

Conveyor belt – phase of assembly - Friulana Costruzioni – Italy – December 2007

Turn Out 95 (p95) Phase of assembly - King Abdullah Canal – Jordan – March 2008

Turn Out 92 (G22) – Testing - King Abdulla Canal – Jordan – March 2008

Turn Out 95 (g25) King Abdulla Canal – Jordan – May 2008

Turn Out 91 (p21)
King Abdulla Canal – Jordan
– May 2008

Turn Out 95 (p25) – Detail of ramp garbage container
King Abdulla Canal – Jordan – May 2008

Turn Out 95 (p25) – Detail Control Pannel
King Abdulla Canal – Jordan – May 2008

Turn Out 95 (p25) – Detail Grids with mash 10 installed in additional at self cleanning grids for greater protection to the pumping station (extra work contract)
King Abdulla Canal – Jordan – August 2008

Turn Out 95 (p25) – Detail Grids with mash 10 installed in additional at self cleanning grids Cleaning is done manualy)
King Abdulla Canal – Jordan – August 2008

Turn Out 95 (p25) – Detail mainhole inspection
King Abdulla Canal – Jordan – August 2008

Implementation schedule

Analysis of the study carried out by Ing. Rosati. The study was abandon after consultation among the new management of the project, JVA technicians and representatives of the WUA. The solution proposed was considered to expensive and technically inappropriate.	March 2006
A new survey was carried out by JVA technicians with the representatives of Water User Association in collaboration with the project staffs. All actors finally agreed on the installation of the grids at the points of derivation of the channel. The technical committee selected the Turn Out located in the southern part of the canal where the problems of floating material are more severe and urgent	July 2006
Tender supervision: Consulting services for project review, tender technical documentation and works supervision for rehabilitation of 4 turn outs – TO91 (P21), TO92 (G22), TO95 (P95)- With the installation of self cleaning grids.- Contract award: MWHAJ (MWH Arabtech Jarde) ; € 23.499,00	March 2007
Tender execution: Installation of Self Cleaning Grids at four turnouts – TO91 (P21), TO92 (G22), TO95 (P95), TO95 (G25)- With the installation of self cleaning grids at King Abdullah Canal Contract Award: - All tenderers were over Budget – Cancelled	September 2007
Tender execution: Installation of Self Cleaning Grids at four turnouts – (P21), TO92 (G22), TO95 (P95 TO95 (G25)- at King Abdulla Canal Contract award: Nabil Ayoub Wakileh & Co. (NAW) ; €284,750.00	November 2007
Addendum of Contract: A new Addendum has been signed with: Nabil Ayoub Wakileh & Co. (NAW) for the installation of grids. The value of the Addendum was 24.694,00 Euro that added to the new amount of the original contract of 275.135,00 Euro give a new total amount of the contract equal to 299.829,00 Euro.	March 2008
A new *extra contract* has been signed for the execution of extra works for a total amount of 11.000,00 Euro.	June 2008
Hand Over	August 2008

I. Tender table:

Ref	Procedure	Date	Deadline	Tender Description	Procedure Steps	Contract Awads
Irwa/3.4.5/Filtration Grids at KAC turnouts/ Serv/2007	Negotiated Procedure	21/03/2007	12/07/2007	Consulting services for project review, tender technical documentation and works supervision for ehabilitation of 4 turn outs – With the installation of self cleaning grids	Closed	MWHAJ (MWH Arabtech Jardaneh) ; 23.499,00 Euro
Irwa/3.4.5.BIS/Installation of self cleaning grids at KAC turnouts/Work/2007	Negotiated Procedure	11/10/2007	01/11/2007	Installation of Self Cleaning Grids at four turnouts – TO91 (P21), TO92 (G22), TO95 (P95 TO95 (G25)- at King Abdulla Canal	Closed	Nabil Ayoub Wakileh & Co. (NAW) ; 284,750.00 Euro

Note : - The purchase was made following "Guide linee 2006" of European Union with Competitive negotiated procedure for Works.

II. Financial Table:

Desciption		**Original value**	**Revised value**	**Addendum**	**Total (new value plus add.)**
1. Contractor – Nabil Wakile	First Contract	284.750,00	275.135,00	24.694,00	299.829,00
	Second contract	11.000,00			11.000,00
				Tot	**310.829,00**
2.Supervisor – MWH Arabtech Jordaneh	First contract	23.499,00		1.300,00	**24.799,00**
				Grand Total	**335.628,00**

5. Final consideration and Recommendations

The close collaboration among all the actors involved in the operation has been the key element for the good results of the Irwa grid operation. In the first phase of the survey was essential the collaboration with the *Water User Associations* following the participatory approach of the Irwa project. The preliminary survey phase of the operation was particularly complex due both to the complexity of the operation on the ground and the variety of opinions of the local actors involved about the solutions to adopt. Almost two years have been spent by Dr Rosati without reaching an agreed plan with JVA.
Additionally, the turn over of the Irwa staffs have influenced the delay of the preliminary phase. A first tender to implement the solution suggested by Dr Rosati was cancel. At the end of the second assessment a tender to select the supervisor company was completed and the consultancy Company MWH Arabtech Jordaneh was engaged also to prepare the technical document of the new service tender. The second tender for the execution of the grids installation was open but the evaluation commission of the tender was obliged to cancel it because the offers received exceed the budget available.
Afterward a third tender was open and it was successfully completed with the signature of the contract with NAW Nabil Ayoub end Wakileh Company on November 1st 2008.

The winner company NAW immediately began the execution of the contract keeping regularly informed the actor involved in the operation. The delivery of the good was delayed due to the transport and custom duties but the contractor immediacy finalise the installation once arrived. The execution of the works has been finalised giving attention to details and in cooperation with the technicians of IRWA and the JVA.

The grids installed require little maintenance but is important its consistency by JVA technicians in order to exploit the full potential of the system. A full coordinator with the farmer associations in the management and planning of the machines is also suggested. There are no particular risks if the equipment is adequately monitored and maintained. In the event of abnormal natural events (flooding or abnormal precipitations) the grids have automatic security system to temporary interrupt the functioning.