

## REUSE OF DRAINAGE WATER IN IRAQ

### RÉUTILISATION DES EAUX DE DRAINAGE EN IRAQ

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#### ABSTRACT

*The Strategy for Water and Land Resources in Iraq was prepared to identify projects that would not only optimize water and land usage but also address the need for food and energy security and sustain the environment. To this extent, the re-use of drainage waters was part of the strategy and analyzed three options for the re-use of irrigation drainage water in Central and South Iraq: i) the provision of water for re-injection into the oil fields of southern Iraq, ii) the provision of water for the development of green belts around cities; and iii) the increment of the flow to Hammar Marshes and the Shatt Al Arab. The analysis showed that re-use of drainage water would greatly expand the ability of Iraq of meeting its water based development objectives.*

#### RÉSUMÉ

*Le Plan stratégique pour les eaux et les terres de l'Irak fut préparé dans le but d'identifier les projets qui permettraient d'optimiser l'usage des ressources hydriques et foncières tout en adressant les problèmes liés à la sécurité alimentaire et énergétique et la préservation de l'environnement. Dans ce cadre, la réutilisation des eaux de drainage était une composante de la stratégie et trois options de réutilisation furent analysées : i) la réinjection dans les puits de pétrole ii) l'irrigation des green belts autour des villes iii) l'augmentation des débits d'approvisionnement des marais de Hammar et du Shatt Al Arab. L'analyse démontre que la réutilisation des eaux de drainage favoriserait l'atteinte des objectifs de développement que s'est posé l'Irak dans le secteur de l'eau.*

**Keywords:** Iraq – Reuse – Drainage - Strategy

#### 1. Introduction

In 2015, Iraq has begun a steady decline in its ability to meet its water needs. By as early as 2020, the country will hit a wall: it will not have enough quantity and good quality fresh water to meet its development needs. This alarming trajectory can be averted only with major reform of water usage and allocation, The Strategy for water and Land Resources in Iraq – SWLRI project was realized by a consortium of International consultants from 2011 to 2014 for the Government of Iraq (GoI). A significant challenge in SWLRI was the identification of projects that would not only optimize water and land usage but also address the need for food and energy security and sustain the environment. To this extent, the re-use of drainage waters was part of the strategy.

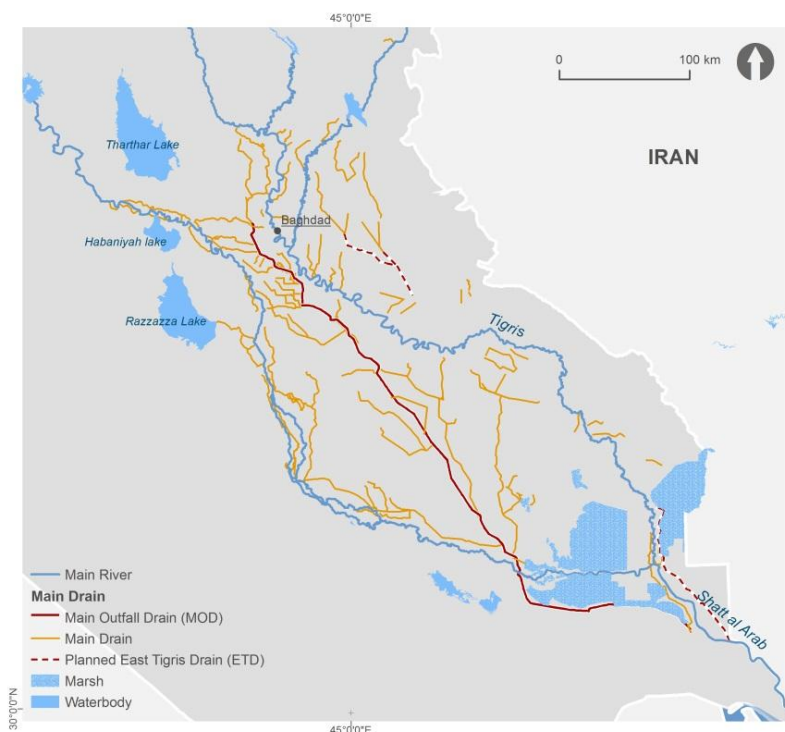
##### 1.1 Current Status

While irrigation is important and essential to agricultural production in most of Iraq, poor drainage of irrigation water can create significant problems for the health and fertility of agricultural soil. Inadequate drainage leads to rising levels of salinity in the soil, with the eventual result that the soil becomes too saline for crop production. Under present conditions, it

is estimated that the water used in irrigation in Iraq is approximately 50 BCM/year. Due to the low overall irrigation efficiency, a large proportion of this water is returned to the rivers and only a portion of it is collected and disposed into the Tigris Euphrates Main Outfall Drain, or MOD. Called the third river, the MOD is fully constructed and operational. It runs along a length of 568 km starting from a point North West of Baghdad and ending in Basrah where it delivers the drainage water into the Shatt al Basrah. Designed to carry over 6.9 BCM of drainage water yearly it actually carries no more than 3.8 BCM per year under present conditions.

### 1.2 Future Needs

If fully implemented, the Strategy assumes that by 2035, Iraq’s irrigation projects will release an average of 9.3 BCM per year of drainage water, which if not properly collected, will impair the water quality of the rivers and cause incommensurable damage to the environment and society at large. If a proper drainage and collection system is implemented, then water salinity will range from annual average values of 1,000 – 1,200 mg/l for projects located in the northeastern part of the country and will reach as high as 18,000 mg/l for the projects in the South. The average value for Iraq drainage water is 3,600 mg/l. Considering such high range of salinity, drainage water might need to be treated before it is re-used. Furthermore, water quantities along the main drains are not guaranteed year-round since they follow a seasonal pattern that is largely dependent on the irrigation schedule applied to each project.



### 2. Opportunities and Strategies

In addition to the existing MOD, the Strategy assumes that by 2020, Iraq will fully develop the East Tigris Drain (ETD) and the Razzaza Drainage System. A schematic of the drainage system is shown aside.

The MOD system and the East Tigris Drain will gather a large portion of the total 9.3 BCM of drainage water per year that Iraq will have to dispose by 2035. A total of 4.556 BCM per year will be collected and made available for reuse from the MOD, ETD Center and ETD South as per the following **Erreur! Source du renvoi introuvable.**

*The Main Outfall Drainage system and the Planned East Tigris Drain*

The Strategy has analyzed three options for the re-use of agriculture drainage water in Central and South Iraq:

1. Provision of water for re-injection into the oil fields of southern Iraq;
2. Provision of water for the development of green belts around cities;
3. Augment the flow to Hammar Marshes and the Shatt al Arab (via the use of the water from the East Tigris Drain).

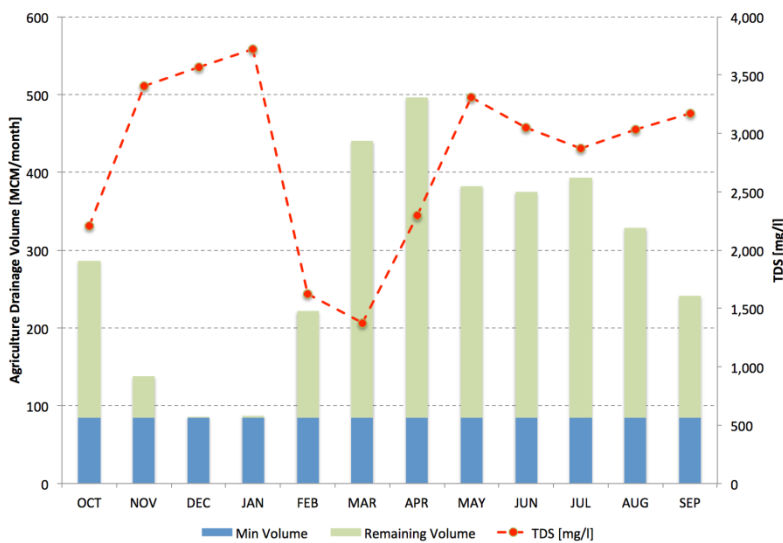
	2015	2020	2025	2030	2035
MOD	3.781	3.686	3.951	3.700	3.474
ETD Center		0.620	0.687	0.689	0.673
ETD South		0.116	0.178	0.278	0.408
Drainage Water Discharged into Evaporation Ponds	2.290	1.276	0.722	0.637	0.668
Return Flow to the Rivers	6.507	5.359	4.568	4.193	4.076
<b>Total Drainage Water</b>	<b>12.578</b>	<b>11.057</b>	<b>10.107</b>	<b>9.497</b>	<b>9.300</b>
<b>Total Drainage Water potentially available for re-use</b>	<b>3.781</b>	<b>4.423</b>	<b>4.817</b>	<b>4.667</b>	<b>4.556</b>

Annual Drainage Outflow [BCM] after full implementation of the system

### 2.3 Water Supply for Oil Field Re-injection

In a water-scarce future Iraq, there is no justification to use freshwater to support oil production. Instead, the country will have to rely heavily on the re-use of treated water to support the energy and industrial sectors. This Strategy assumes that 69.2% or 1.227 BCM per year of the water needs for the oil industry will be provided by alternative sources of water. The cumulative need for the oil sector is 1.773 BCM/year (or 3.25% of the total available fresh water)

Future water injection plans in southern Iraq involve the construction of a Common Seawater Supply Facility (CSSF), which would treat seawater from the Gulf and pump it more than 100 km inland for use in the oil production areas. This solution is strongly favored over other water sourcing alternatives: it provides a secure water supply, independent of future water availability; it reduces stress on freshwater resources, freeing them for other uses; and it achieves economies of scale, through the construction and operation of a single facility to provide the bulk of southern oilfield water needs. The anticipated capacity of the CSSF is 680 Mm<sup>3</sup> per year, which will be built in phases. Because the date of completion of the CSSF remains unknown, the SWLRI Strategy is suggesting using a portion of the MOD as well as water from other main drains to be used for water re-injection into the oil field for a total of up to 0.550 BCM per year by 2035.



During the next two decades, as the Gol implements the SWLRI recommendations, quantity and quality of water in the MOD will change significantly. In order to understand the potential water available for oil field re-injection, only the minimum flow that will be guaranteed year-round should be used, as oil fields must be provided with guaranteed flows. The figure aside provides the monthly volume of water that is projected at the tail end of the MOD assuming that the recommendations made by SWLRI will be implemented by the year 2035. The graph shows that a total of to 3.474 BCM per year will flow into the southern reach of the MOD and a minimum volume of drainage water of approximately 80 MCM per month or about 0.96 BCM per year could be guaranteed year-round which, in conjunction with the CSSF will serve 100% of our proposed Strategy.

Projected amount and quality of the drainage water available at the tail end of the Main Outfall Drain in the year 2035

### 2.4 Supply the Green Belts around the Major Cities in Iraq with Treated Drainage Water

Green belts have been proposed for development around cities to mitigate the effects of wind erosion, thereby preventing desertification and reducing other negative impacts of dust storms. Moreover, green belts serve multiple purposes by providing shelter and habitat for wildlife, supporting biodiversity, and create a space that can be used for as parks for recreation. Because of the limitation in available water, a large number of Iraq's green belts should be irrigated in part with drainage water collected by the MOD system. Green belts are proposed for implementation around the perimeter of governorate and district capital cities.

Trees will be irrigated with drip irrigation methods, whereas bushes will not be irrigated but will benefit from the local humidity and soil moisture present as a result of irrigating the other trees. Water will be filtered and will have the minimum salinity in order to not compromise the belt's growth. Because of the possibility of the fruit bearing trees providing a source of revenue, irrigation of the olive and date palms will be matched to the crop water requirements. In total, over 28,000 hectares are proposed for Iraq's urban green belts, requiring approximately 0.313 BCM of water per year for irrigation.

The volumes of water required to support the green belts are globally much lower than the projected volumes that will be made available by the drainage outflows. On a national level, 9.3 BCM of return flows are expected from the drainage systems after completion of the Strategy in 2035 (of which 4.556 BCM/y will be collected by the main drains), compared to the 0.313 BCM required for the green belts. The planners will have to go into detail, looking at the topographic, environmental, and infrastructural aspects that would allow each of these cities to reuse the drainage outflows of the nearest irrigation project. This Strategy does not enter into the details of the selection of the exact location of the green belts. Precise location and characteristics of each green belt should be defined in a future dedicated detailed study.

## 2.5 Drainage Water Supply for Environmental Purposes

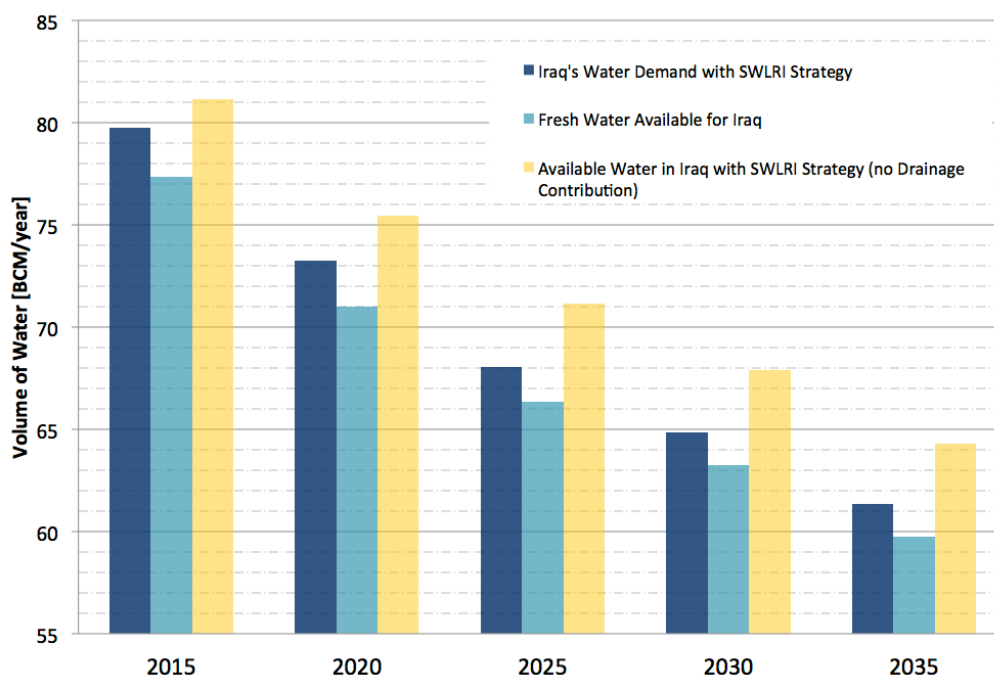
Net from the re-use of water for oil field re-injection (0.550 BCM/y) and the proposed green belts program (0.313 BCM/y), the MOD will still provide an additional 2.611 BCM annually from the drainage of irrigation projects. It is proposed that this volume of water is diverted into Hammar Marshes to help augment the later extension of the largest among the three marshes of southern Iraq. Excess water would then be routed back into the MOD via a newly built channel and then to the Shatt al Basrah.

This Strategy also suggests re-using irrigation drainage water along the Shatt al Arab River. The proposed East Tigris Drain will drain water from the proposed Amarah and Shatt al Arab Irrigation Projects. An existing water control structure on the Swaib River provides ways to divert water from the Haweizeh Marshes into the new drain at a constant rate of 20 m<sup>3</sup>/s. The drain, which at full capacity will carry over 80 m<sup>3</sup>/s, will discharge into the Shatt al Arab River near Abu flus, at the border of Iran and Iraq. The salinity of the drain will range between 1,300 mg/l to 3,000 mg/l. The Shatt al Arab River requires a minimum of 50 m<sup>3</sup>/s of fresh water from the Tigris River in order to prevent salinity from the sea from reaching the city of Basrah. If carefully monitored and controlled, the flow of the East Tigris Drain would help in controlling the flow.

## 3. Conclusions

The modernization of the irrigation sector hinges on the collection of drainage water. Extensive reclamation works are proposed within this Strategy where sub-surface on-farm drainage is included in all irrigated land in the center-south of Iraq. Whenever possible, drainage water has to be routed to the MOD and the East Tigris Drain as a strategy to reduce salinization and improve water quality of the Euphrates and Tigris Rivers.

At the same time, as the projections of a lack of water availability clearly show, the re-use of drainage water can be a strategic asset to help meet Iraq's 2035 development goals. Topography and poor water quality limit the options of re-using drainage water in agriculture so other options have been investigated. Among others, the possibility of re-using drainage water for sustaining the development of green belts around cities, re-injecting water into oil field and supporting the lateral extension of Hammar Marshes and supporting the minimum flow along the Shatt al Arab River were all included in this Strategy. As the following graph clearly depicts, the re-use of drainage water greatly expand the ability of Iraq of meeting its objectives for 2035 and beyond



Water Balance – with and without the re-use of the agriculture drainage water