

TECHNICAL REPORT NO. 9

Delineation of Groundwater Protection Zones for the Lajjun, Qatrana, Sultani and Ghweir Wellfields

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Summary

The Lajjun, Qatrana, Sultani and Ghweir wellfields are important sources for the water supply of Amman as well as for Karak. These wellfields are located in the central part of Jordan, about 15 to 35 km east of Karak and 75 to 100 km south of Amman. While in 2004 groundwater abstraction reached a peak of 14.5 MCM, the Lajjun wells currently provide only 8.4 MCM/a from the A7/B2 and Disi aquifers for technical reasons.

Because of its importance the German-Jordanian Technical Cooperation project "Groundwater Resources Management" have chosen these wellfields as one of its working areas for the delineation of groundwater protection zones according to the issued Jordanian "Guidelines for Drinking Water Resources Protection" (July 2006). The proposed groundwater protection areas have been subdivided into three zones, which require different degrees of landuse restrictions.

The characteristics of the working area had already been investigated by the MWI-BGR project within the framework of the mapping of groundwater vulnerability so that many parts of this document are adopted from this report (MARGANE et al., 2005). The required facts were updated whenever possible and necessary. The study area is part of the Wadi Mujib catchment. Therefore facts concerning the Wadi Mujib catchment area were also adopted from a recent report prepared by the BGR-MWI project for the delineation of the surface water catchment of the Wadi Mujib dam (MARGANE et al., 2008).

During the field work to the current report several risks to the drinking water supply provided by the Lajjun, Qatrana, Sultani and Ghweir wellfields were identified. They partly arise from deficits in the construction and upkeep of the water supply infrastructure, from a lack of access barriers to the protection zone 1 (partly missing fences), from a lack of awareness of the guards (free access to protection zone 1 through open gate) and from pollution risks in protection zones 2. Protection zone 3 covers one of the major future potential oilshale exploitation areas in Jordan and is therefore currently in the focus of public interest as there is a clear conflict of interest between economic benefits of oilshale exploitation and the urgent need for clean drinking water supply.

Some of the Lajjun, Qatrana, Sultani and Ghweir wells have already been affected by bacteriological contamination. It is, however, often unknown which, because sampling often takes place at the pumping station and only some selected wells but not at all individual wells. In order to find out where bacteriological contamination occurred, it is proposed to conduct regular sampling campaigns at all Lajjun, Qatrana, Sultani and Ghweir wells, if possible at least once a year. Analyses should include all relevant radiological components possibly associated with the B2 phosphorites because high levels of gross alpha and gross beta radiation have already been found in some shallow (A7/B2 aquifer) and deep wells (Ram Group aquifer).

The report proposes several corrective measures in order to reduce the contamination risk of the drinking water source. It is important that these

measures are implemented as soon as possible. Concerning protection zone 1, WAJ will have to enlarge the well perimeter of some wells so that the distance from the well to the fence will always be 25 m, as required by the guideline for drinking water resources protection. WAJ also should install an overlapping well cap with a conduit box to avoid direct access to the well, repair the damaged pipe network and physically block entrance to the installations. In most cases the concrete foundation of the wellhead is not raised high enough above the ground so that flooding of the wellhead may occur. WAJ employs guards for groups of wells. They usually live right next to a well from where they take electricity and water. But they also grow crops, raise animals and dispose of their wastewater and waste in too close vicinity of the wells. Guards may only be allowed to live outside protection zone 2. Proper wastewater collection systems should be installed for these guards at a distance of not less than 100 m from the well. These must be regularly emptied. Moreover, the guards must be taught not to keep their animals or grow crops at distances less than 100 m from the wells.

In case the mining and processing of oilshale will be regarded as feasible in the future in the Lajjun and/or Sultani areas, a comprehensive and thorough environmental impact assessment (EIA) for all proposed activities, which are potentially hazardous to groundwater, has to be done so that, before approving the final location, the groundwater resources will not be put at risk. The groundwater vulnerability map, prepared by the BGR-MWI project in 2005 (MARGANE et al.) may be useful in this process. However, a more detailed investigation of the suitability of the envisaged site will be indispensable. The EIA should focus on how to operate the facility and how to dispose of the mine tailings without contaminating the groundwater and surface water resources.

Another potential threat to the drinking water resources is the treatment of domestic and industrial wastewater. Domestic wastewater from rural communities in the districts of Karak and Qatrana is treated at the "Lajjun Liquid waste disposal site", operated by WAJ. This site, in its current condition, poses a grave risk to the Lajjun wells because it is located upstream of the wellfield and releases an effluent, the quality of which is well above the limits defined in the domestic wastewater standard (JISM standard JS 893/2006 – Reclaimed Domestic Wastewater). The BGR-MWI project already in 2005 recommended to close the site or modify the protection of the underground and install an appropriate treatment technology, however, this has not been done so far. Another site for treatment of wastewater is located at the industrial estate Al Hussein Bin Abdullah II (herein referred to as Karak Industrial Estate). This site for industrial and domestic wastewater treatment is under the supervision of WAJ and is currently upgraded by the operator because its capacity is insufficient and some parameters of the industrial wastewater standard (JISM standard JS 202/2007 – Industrial Reclaimed Wastewater) are exceeded. Also the effluent of this WWTP may infiltrate into the groundwater and reach wells of the Lajjun wellfield currently used for drinking water supply. Therefore the capacity and efficiency of both wastewater treatment plants must to be upgraded as soon as possible, otherwise the groundwater resources in the Lajjun area are severely at risk.

Another wastewater treatment plant is planned east of Mazar for treatment of wastewater from the villages of Mu'ta, Mazar, Adnaniyyeh, Merwed and Median. Current planning foresees that the treatment plant is built upstream of the Ghweir wellfield, which provides drinking water to Karak. During design and operation it must be ensured that the Ghweir wellfield cannot be contaminated by this new WWTP site.

The number of chicken farms in the Qatrana and Lajjun areas has grown tremendously over the past decade. Many of these were established without license. Waste is deposited on the domestic landfill of the Karak municipality, liquid waste seems to be dumped partly there as well but also illegally next to the Lajjun liquid waste disposal. It must be regularly controlled that solid and liquid waste is only deposited at predestined sites.

During the process of phosphate mining and processing large amounts of site fine-grained sediment are produced at the Abyad phosphate mine. This sediment is flushed in a small nearby wadi in northerly direction towards the village of Sultani. The nearby Sultani wells may be affected by contamination of components contained in the sludge, such as, among others, uranium and radium.

Since the implementing agency concerning groundwater protection zones 2 is the Ministry of Environment, the responsible staff will need to control the enforcement of the proposed measures.

In order to avoid further contamination risks in the future, it is seen as important that the landuse planning authorities closely coordinate their activities in the project area with the Ministry of Water and Irrigation as well as with the Water Authority of Jordan. This pertains especially to industrial and commercial activities, the permissions to establish residential areas and the site selection for waste disposals. An appropriate waste disposal site for Karak is urgently needed not only because the maximum capacity of the currently used site is almost reached but also because this site is directly located on the A7/B2 aquifer without technical barrier so that leachate from the Karak municipal waste site directly contaminates the main aquifer.

Also WAJ must coordinate its work in the project area with MWI. This especially pertains to wastewater treatment.

The project will carry out workshops for awareness building and provide training for the implementation agencies.

Protection zone 3 encloses the entire groundwater contribution zone of the wellfields. Environmentally sound practices for all activities have to be implemented.

Development in the Karak – Lajjun area is presently rather limited. The area, however, provides excellent opportunity for development, especially in terms of infrastructure and water resources availability. The groundwater vulnerability map, prepared by the BGR-MWI project in 2005, may serve as a tool for an improved landuse planning and for an optimal development and protection and

management of the groundwater resources. This map shows that groundwater resources are vulnerable especially in the area around and south of Al Lajjun.

The groundwater vulnerability map should be used for future landuse decisions, e.g. for the preliminary selection of sites for potentially hazardous activities, such as waste disposals, industrial and commercial sites, etc. In any such case, however, it is recommended to conduct more detailed site investigations before a final decision about the location and design of such a site is taken. Such landuse planning decision have to take into consideration the landuse restrictions defined in the groundwater protection zones, set out in chapter 11 of this report.