**CASE STUDY: The Jordan River and Dead Sea Watershed, Jordan, Israel & Syria**

*Prepared by Devin Rowell, University of Virginia*



**General Overview**

The Dead Sea is currently lowering about 1m a year. This drop in the Sea’s level is caused by reduced flow into the Dead Sea from the Jordan River due to heavy water extractions, and by diversion and evaporation of water from the Dead Sea itself. While municipal, industrial, and agricultural uses remove water from the Jordan River, the primary water use in the Dead Sea is industry extraction.

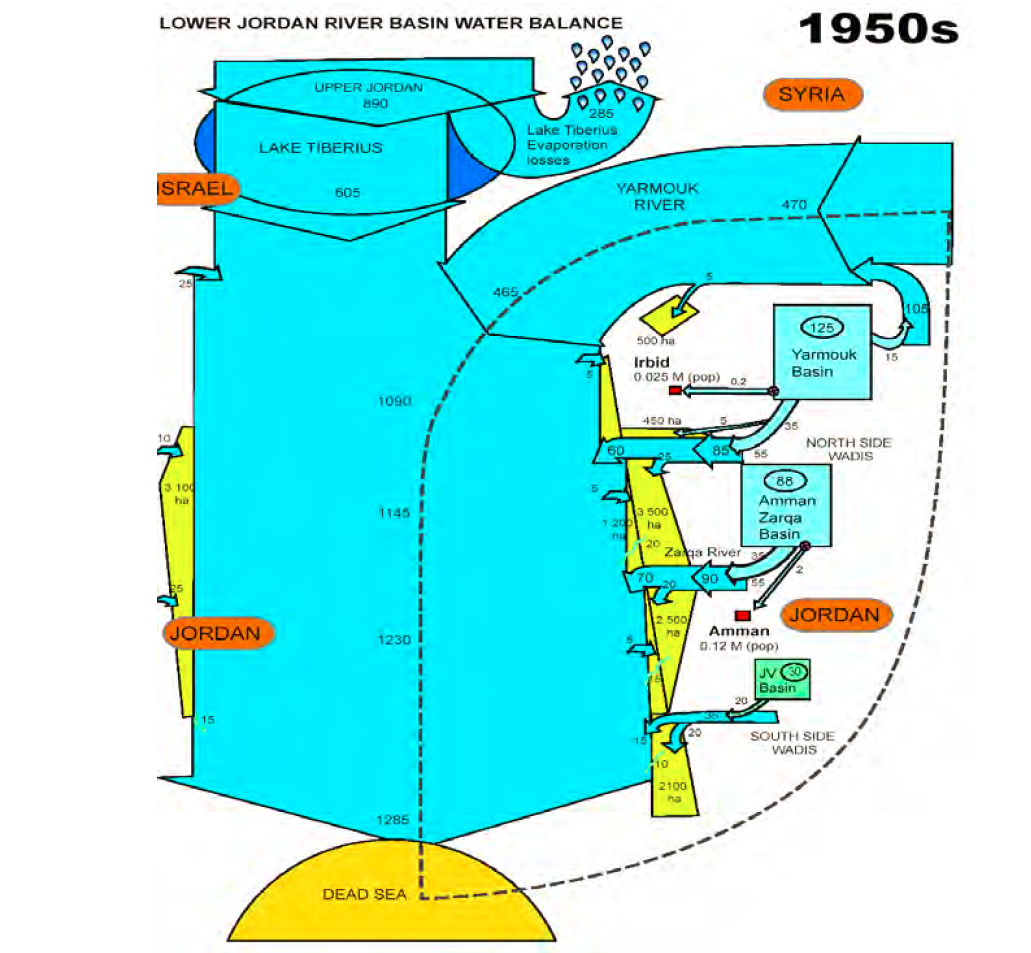
The Dead Sea exists in an area where it is dry and sunny most of the year. Over-extraction of water puts stress on the ecosystem and its water availability, creating shortages for the people in the surrounding areas. Many conflicts have existed between Jordan, Syria, and Israel over water. There is also pressure from the massive numbers of refugees fleeing Syria into Jordan. Because of these refugees and the increase in Jordan’s population, water is being wasted and water quality is poor because of excessive water extraction. The agriculture, tourism, and other industries are pressured for water because of the scarcities as well. The only environmental group able to work with the Arab-Israeli divide is Friends of the Earth Middle East. Proposed at the moment is an agreement called “Red to Dead” between Jordan and Israel. It created an agreement to trade desalinized water between countries to alleviate pressures from the lack of drinking water and the shrinking of the Dead Sea. The Israelis and Jordanians have a history of noncompliance, but this agreement is a sign that cooperation in the future may improve.

**Water Budget**

(adapted from

During the 1950s the Jordan River closely resembled its historic natural water balance, not yet

much influenced by artificial human interception: about 605 MCM (Million Cubic Meters) was discharged into the Jordan River from the Sea of Galilee and 455 MCM originated from the Yarmouk River in Jordan. Additional inflow came from the Yarmouk basin as well as from the Zarqa river basin in the East Bank, as well as from annual rain floods from the West Bank. The outflow of the Jordan River in 1950 into the Dead Sea was about 1285 MCM. This amount was about equal to the total evaporation from the surface of the Dead Sea, leading to an average a stable surface water table of the Dead Sea.



**Approximate water flows in the Lower Jordan River in 1950**

By the year 2000 the water balance had changed drastically and substantial flows were meanwhile diverted by the riparian countries of the Jordan River Basin:

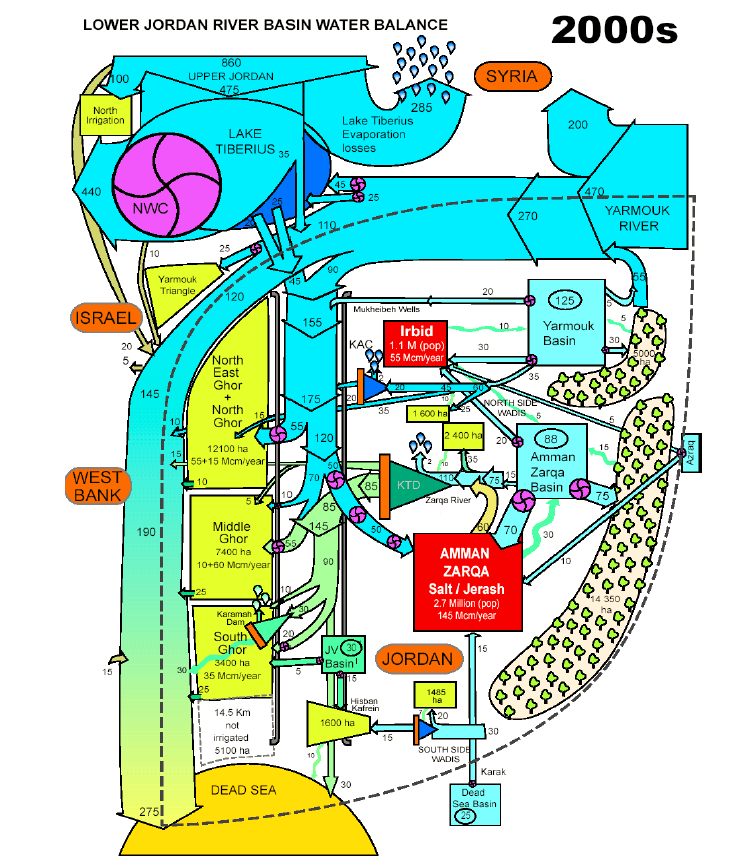
* About 100 MCM per year was diverted by Israel from the Upper Jordan river system, which reduced the inflow into the Sea of Galilee (Lake Tiberius)
* About 440 MCM per year was diverted by Israel from the southern mouth of Lake Tiberius, at the Degania Dam, to feed to Israeli National Water Carrier (NWC).
* About 155 MCM per years is withdrawn by Jordan from the Yarmouk River to feed the Amman, the Zarqa Region and to irrigate the East Bank.
* Brackish water from springs north and west of the Sea of Galilee were diverted through the Salt Water Carrier to the Alumot Dam, from which it flows into the Jordan River.

The Yarmouk River Basin is shared by Syria and Jordan, and it heavily exploited on both sides of the border. The sharing of the waters of the Yarmouk River between the two countries is governed by the 1987 treaty that set up a Jordanian-Syrian Yarmouk River Basin Higher Committee, and included plans for the development of the Unity Dam, or Wihdeh Dam along the border. The construction of the Dam was completed in 2006. According to the treaty, the downstream Syrian farmers are entitled to use 6 MCM per year from the Dam’s reservoir, but there are Jordanian claims the actual Syrian consumption is substantially higher.

By the year 2000 the river had become a well defended international border between Israel / West Bank and Jordan, with very limited public accessibility, military zones and various mines fields along its shoreline. The reduction in the flow regime caused changes in the morphology of the river as well, since lower flows lead to reduction of meanders and thus shortening of the stream length and steeper gradient, as well as a dramatic decline of the Dead Sea.

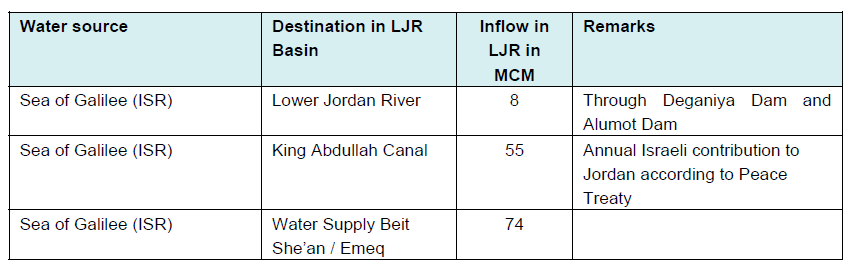
The flow rates in the Lower Jordan River have decreased sharply in the last 50 years due to the construction of a series of infrastructure and diversion schemes established in the basin. For instance, the mean annual historic flow of the Yarmouk that was estimated at 450-500 MCM in the 1950s has today decreased to 83-99 MCM. The current annual discharge of the Lower Jordan River into the Dead Sea is estimated at 30 - 100 MCM compared to the historic 1,300 MCM.

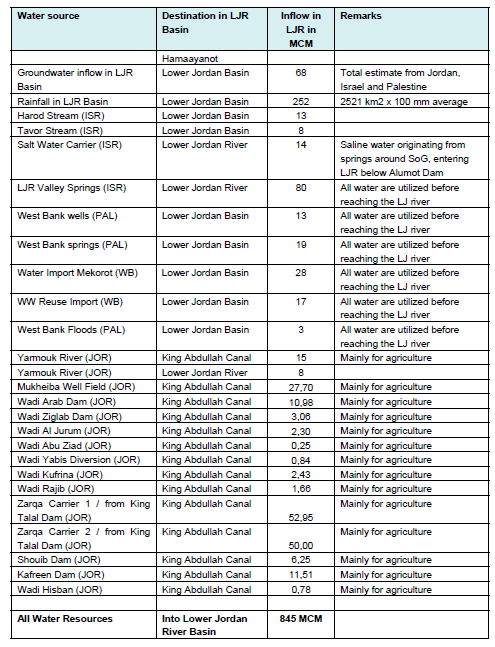
The quality of water in the Jordan River has severely deteriorated in recent decades. While the headwaters upstream of the Alumot Dam are unaffected, the lower sections of the river consist primarily of untreated sewage and agricultural return flows, groundwater seepage, as well as brackish water from springs diverted into the river away from the Sea of Galilee.



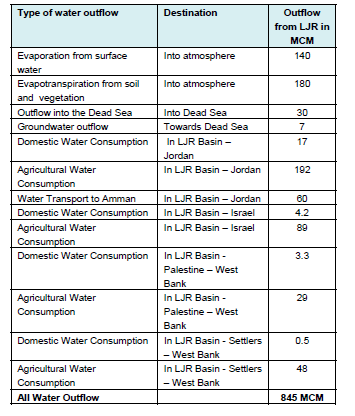
**Approximate water flows in the Lower Jordan River in 2000**

**Water Inputs into Lower Jordan River Basin (LJR), in million cubic meters (MCM)**





**Consumptive Uses of Water in Lower Jordan River Basin (LJR), in millions of cubic meters (MCM)**



**Temporal Variability in Water Availability**

The Dead Sea is a rapidly shrinking body of water that receives less than 40 million cubic meters of direct rainfall onto the Sea each year. Evaporation from the Sea greatly exceeds precipitation, and the major source of inflow to the Sea, the Jordan River, has been contributing less and less water each year. The Dead Sea experiences its driest climate from about May until October. These are the months when the water scarcity in the Dead Sea is the most intense. The lessened flow from the Jordan River is due to increased extraction from the North and the addition of dams reducing the flow of water in the Jordan. Water level in the Dead Sea has been decreasing by about 1 meter a year, which created a change in the watershed’s storage of about 891 million cubic meters in 2010.

**Water Tools**

**Desalination:** A process that involves removing salts and other minerals from brackish or salty water. Desalination is an expensive process due to the amount of electricity it requires. If ocean desalination could meet some of the water needs in the Jordan River watershed, and extractions from the Jordan River could be reduced accordingly, a rebalancing of the Dead Sea’s water budget might be attained.

**Water Importation:** There are proposed plans in Jordan to channel water from the Red Sea to the Dead Sea to reduce its depletion. There is concern that the Dead Sea ecosystem would not be able to handle the mixing of the waters.

**Water Storage:** Dams have been built upstream in the Jordan River watershed to increase the amount of water available for use. Water can also be stored underground to prevent excessive evaporation of the supplies.

**Water Reuse:** This involves recycling used freshwater. Water reuse can be expensive because the removal of undesirable substances in the wastewater requires a lot of energy. Israel reuses about 80% of all water it withdraws from freshwater sources, which makes them a global leader in this area.

**Watershed management:** The Dead Sea is an important watershed for many of the surrounding countries and there are often disagreements over who gets to use the water. The Dead Sea suffers from intense evaporation in the summer and the Jordan River does not supply as much water as it used to. One watershed management practice is analyzing the potential benefits to be gained through vegetation management, such as by increasing the amount of short rooted plants in order to decrease the amount of water they extract from the soil and thus increase the amount available for the watershed.

**Water Conservation:** Irrigation is a large consumptive water use in the Dead Sea and Jordan River watershed. While Israel is a world leader in irrigation efficiency, water savings might be realized through improved irrigation efficiency in other areas of the watershed.

**Water Stakeholders**

The Dead Sea lies in one of the “most complicated and conflict-ridden regions on Earth” (Schwartzstein, 2014). Within the Jordan River-Dead Sea watershed, the largest stakeholders are Jordan and Israel, two countries with a history of disagreement.

**World Bank**: The Bank has trying to advance a “Red to Dead” plan that would have Jordan trading desalinized water to southern Israel, with Israel passing water to refugee–laden northern Jordan.

**Farmers:** Farmers within the Jordan River-Dead Sea watershed are being forced to look elsewhere for water to irrigate crops due to the scarcity imposed by refugees fleeing from Syria into Jordan.

**Environmentalists:** The only environmental group willing and able to reach across the Israeli-Arab divide is the Friends of the Earth Middle East. Their main goal is to encourage cooperation and promote the protection of the shared environmental heritage between Palestinians, Jordanians, and Israelis.

**Tourism industry:** Hotel operators in the Dead Sea region are concerned about shortages of water for visiting tourists and the recession of the Dead Sea that leaves hotels at considerable distance from the water’s edge.

**Chemical industry:** There are many potash and industrial salt factories that extract water from the Dead Sea.

**Appendix 1 – General References**

About Us. (n.d.) *EcoPeace Friends of the Earth Middle East*. Retrieved April 27, 2014, from http://foeme.org/www/?module=about\_us

Schwartzstein, P. (2014, February 22). Biblical waters: Can the jordan river be saved?. *National Geographic*, Retrieved from http://news.nationalgeographic.com/news/2014/02/140222-jordan-river-syrian-refugees-water-environment/?utm\_source=feedburner&utm\_medium=feed&utm\_campaign=Feed%3A ng%2FNews%2FNews\_Water %28National Geographic News - News Water%29

The Dead Sea Region as a Health Resort. (n.d.). *The Dead Sea Region*. Retrieved April 27, 2014, from http://www.cfcenter.co.il/dsinfo.htm

**Appendix 2 – Water Budget Documentation**

Integrated Trans-boundary Regional NGO Master Plan for the Lower Jordan River Basin, Baseline Report. Royal HaskoningDHV in partnership with CORE Associates Palestine, MASAR Jordan, DHVMED Israel, FoEME - Friends of the Earth Middle East, SIWI - Stockholm International Water Institute, GNF - Global Nature Fund, EU – SWIMP. February 2014