

## CASE

# Viability gap funding (As Samra, Jordan)

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## Supporting case for Business Model 19

Location:	As Samra, Amman, Jordan
Waste input type:	Wastewater
Value offer:	Treated wastewater, hydropower, biogas, carbon offsetting
Organization type:	Public-private partnership (PPP)
Status of organization:	New treatment plant completed in 2008 and extended between 2012 and 2015
Scale of businesses:	Large scale
Major partners:	Samra Wastewater Treatment Plant Company Limited; Millennium Challenge Corporation; Government of Jordan; Consortium of banks

## Executive summary

Water scarcity puts water reuse very high on Jordan's development agenda. The As Samra wastewater treatment plant (WWTP) which is the largest in the country was purposely designed to support agricultural production in the Jordan Valley that relies increasingly on treated wastewater for irrigation purposes. Set up as a public-private partnership (25-year BOT contract) the WWTP is located near Amman. Building on an older pond-based treatment plant, a new WWTP was constructed between 2003 and 2008 (phase 1) and expanded from 2012 to 2015 (phase 2) with financial support from the United States Agency for International Development (USAID; phase 1) and a Viability Gap Funding by the Millennium Challenge Corporation (MCC, phase 2), to reach a capacity of 364,000m<sup>3</sup> per day. Under the coordination of the Ministry of Water and Irrigation, the construction was facilitated by a 20-year commercial loan, the longest maturity that Jordanian banks have ever offered so far, and a comprehensive risk sharing arrangement. The contractual structure developed for the As Samra expansion (2012–2015) has a high replication potential elsewhere in the world, to allow projects that are economically and environmentally beneficial to be implemented and operated by the private sector also where such projects would otherwise be unaffordable to the public sector. The expanded As Samra Wastewater Treatment Plant was inaugurated in October 2015 to provide Jordan with up to 133 million cubic meters of treated water per year. Already today, treated wastewater is representing 13 percent of Jordan's entire renewable water resources, freeing up fresh water for more valuable uses. Ten percent of the country's agricultural water consumption comes from the As Samra plant. In addition, the As Samra plant is able to generate up to 95% of its energy needs, supported in part by a favorable topography. The production of renewable energies allows the plant to reduce its carbon footprint by about 300,000t of carbon dioxide (CO<sub>2</sub>e) per year.

**KEY PERFORMANCE INDICATORS (2015/16)**

Land use:	About 400 ha owned by the Ministry of Water and Irrigation (MWI)					
Water treated:	A design capacity of 364,000m <sup>3</sup> per day able to serve about 3.5 million capita					
Capital investment:	Phase-1 (2003–2008) USD 169 million; Phase-2 (2012–2015) about USD 223 million <sup>1</sup>					
Labor employment:	About 180–210 permanent local employees, of which about 70 are skilled workers; plus up to 2,500 during the construction phases					
Operation and maintenance cost:	Full cost recovery (at the time of study USD 1.3 million per month)					
Outputs:	364,000m <sup>3</sup> per day wastewater treatment capacity 90–95% energy self-sufficiency; 300,000t CO <sub>2</sub> e per year carbon savings 118t of dry sludge (DS) per day in 2011, to increase to 194t in 2025					
Potential social and/or environmental impact:	Significantly improved water quality, less contamination of soil and groundwater, reduced carbon foot print; treated water for irrigation; livelihoods support for irrigating farmers, plus 180–210 new jobs at the WWTP					
Financial viability indicators:	Bank loan back period:	13–20 years	Post-tax IRR:	10–18% (t.b.c.)	Gross margin:	undisclosed

**Context and background**

The Hashemite Kingdom of Jordan covers a territory of about 90,000 km<sup>2</sup>. Rainfall is confined largely to the winter season and ranges from around 660mm in the north-west of the country to less than 130mm in the eastern and southern deserts, which form about 90% of the surface area. Under low rainfall, high evaporation and increasing crop intensification, Jordan is since long over-exploiting its available water resources with severe consequences for the Lower Jordan River Basin and the Dead Sea where over the last decades decreasing amounts of water arrived (Courcier et al., 2005).

Wastewater collection and treatment services were provided to about 63% of the Jordanian population in 2013, producing about 137 million cubic meters (MCM) of treated wastewater annually that is being reused primarily in agriculture. The remaining population uses septic tanks and cesspits in rural and dispersed settlements. With the increasing population and the country's social and economic development, the amount of treated wastewater is growing. It is estimated that by 2030, the volume of treated wastewater will be 240 MCM. Currently, more than 70% of the wastewater treated in Jordan comes from the As-Samra wastewater treatment plant which underwent between 2003–2008 and 2012–2015 major construction work. The plant replaced an overburdened stabilization pond system which was despite some extension work no longer able to maintain effluent water quality at acceptable levels. Its treated effluent is collected in the King Talal Reservoir (KTR) which is supporting most of the farming in the Jordan valley. In the KTR, the wastewater gets mixed with rain/freshwater from the Zarqa river basin. The mixed water irrigates about 20,000 ha in the middle and lower Jordan Valley, replacing its dwindling freshwater flow (Seder and Abdel-Jabbar, 2011). The wastewater flow is facilitated by a favorable topographical situation, allowing a low-cost transfer of urban wastewater via As Samra to the irrigation areas (McCornick et al., 2004; Courcier et al., 2005). Amman, the capital of Jordan, produces the bulk of the wastewater treated in As Samra.

About 80% of the agricultural water consumption and production in the lower and middle Jordan valley depends on blended wastewater (World Bank, 2016). Fruits and other cash crops form the major component of reuse in the Jordan valley. Aside indirect wastewater reuse of treated wastewater mixed with fresh water, also direct use (i.e. of unmixed wastewater) exists to a smaller extent in the vicinity of As Samra.

## Market environment

While globally many WWTP have smaller reuse activities, As Samra is an example of a WWTP with a strong double value proposition (Wichelns et al., 2015), where the national water scarcity makes the production of water ‘fit for reuse’ of equal if not larger importance than the provided sanitation service.

The demand for the As Samra plant stimulated a range of institutional, financial and regulatory innovations to make the project happen. The plant represents the first private sector co-financed BOT project in Jordan, as well as the first public-private partnership in financing and management of a public infrastructure project in the country, using a mixed financing model that accommodates that neither water reuse nor the water tariff will be major revenue streams.

The market acceptance and penetration of mixed fresh/wastewater is high and competition is almost none as fresh water resources are fully exploited. Given population growth, which is expected to exceed 7.8 million by 2022, increasing fresh water abstraction or reallocation for domestic needs implies also more available wastewater for irrigation. The benefits of safely treated wastewater are well recognized by most stakeholder, especially in the public sector (Carr and Potter, 2013). In summary, the Jordanian market for further reuse-oriented WWTPs is very positive, and Jordan is not the only water-scarce country in the subregion.

## Macro-economic environment

The inclusion of wastewater reuse in the country’s National Water Strategy since 1998 was an important signal of placing high priority on the value of reclaimed water. The 2016–2030 National Water Strategy and the national substitution policy consider treated wastewater effluent as a core water resource that has been added to the water budget, with priority given to agriculture for unrestricted irrigation. The main pillars of the national substitution policy are public acceptance, suitability and adequacy of high-quality water, sustainability and enforcement of laws. As a result, treated wastewater has been used in place of fresh water (recommended in the National Wastewater Management Strategy) in accordance with the quality guidelines and standards of the World Health Organization (WHO) and Food and Agriculture Organization (FAO), to produce an effluent fit for reuse in irrigation (MWI, 2016). Table 55 shows the estimated value of water in different sectors. MWI strategy is to increase the use of unconventional and reclaimed water for industry and agriculture as much as possible in order to save fresh water for domestic use (which includes the tourist sector).

Jordan has also taken significant steps to encourage foreign investment. Several sectors have experienced key reforms in recent years. Foreign and domestic investment laws grant specific incentives to industry, agriculture, tourism, hospitals, transportation, energy and water distribution. The Public Private Partnership Law from 2014 aims to encourage the participation of the private sector in the Kingdom’s economic development and provides a legislative environment for joint projects (U.S. Department of State, 2015). Following sector reforms, agriculture in Jordan is now virtually free of

**TABLE 55. ECONOMIC BENEFIT FROM WATER USED, BY SECTOR**

SECTOR	FINANCIAL RETURN USD/M <sup>3</sup> OF WATER	JOB OPPORTUNITIES PERSON/MCM OF WATER
Agriculture	0.36	148
Tourism	25	1,693
Industry	40	3,777

Source: MWI, 2016; Closson et al., 2010.

restrictions and all direct subsidies have been removed. Credit to agriculture at low interest rates is the single most important conduit for government subsidies to agriculture.

Critical challenges to agricultural development are water scarcity and the need for increasing water use efficiency as Jordan is among the world's most water deficit-countries. Its per capita share of renewable water resources is according to different sources between 106 and 156m<sup>3</sup> per year, which is even lower than the "absolute water scarcity" threshold of 500m<sup>3</sup> per person per year (Rijsberman, 2006). Despite limited arable land (2.4%), the agricultural sector is the largest water user (65–75% of the country's water resources) absorbing almost all treated wastewater. Although the agricultural contribution to Jordan's GDP appears with about 4% small, an estimated 28% of the national GDP is considered agriculture-dependent due to strong upstream and downstream linkages. The arrival of the Arab Spring in early 2011 had a profound effect on market confidence in the region. While the events of the Arab Spring did not directly impact Jordan, they inevitably raised the risk bar and prolonged completion of the transaction.

### Business model

A public-private partnership (PPP) model was developed to finance the construction and operation of the As-Samra plant, with funding provided initially by USAID (construction phase I: 2003–2008), and for further expansion and technological upgrade by MCC (construction phase II: 2012–2016). The PPP is based on a 25-year Build-Operate-Transfer (BOT) contract signed in 2003 which was extended in 2012. Through this PPP, the government (MWI) delegates responsibilities to a private sector entity to finance, design, build, operate and maintain the facility for a 25-year period. The private sector entity is the Samra Wastewater Treatment Plant Company Limited (SPC), a private company whose investors include Morganti, an American affiliate of the Consolidated Contractors Group, Suez Environment, a Paris based utility company, and Infilco Degremont, an American company, since mid-2015 a subsidiary of Suez Environment. The Jordan-based Arab Bank arranged a consortium of nine local and international financial institutions to provide a commercial loan in local currency with a term of up to 20 years, the longest maturity in Jordan to date, with an initially fixed, then floating interest rate. Under this public-private partnership, the government of Jordan benefits from having the private sector both (i) raise the financing for and (ii) guarantee the high-quality construction, operation and maintenance of the facility. At the end of the concession period, in 2037, the facility will be transferred back to the government of Jordan in good working order and at no additional cost.

MCC funded USD 93 million of the USD 275<sup>2</sup> million cost of the As-Samra phase 2 expansion project, the Government of Jordan at least USD 19.8 million, the private sector sponsors contributed an equity injection of USD 8.6m (brownfield investment based on reinvesting phase 1 cash flows into the expansion) and the association of banks about \$148 million. The MCC support is leveraged through the lenders and private sector's co-financing of more than 50% of the expansion cost. By bringing down the capital costs, the MCC grant enabled the project to be financially viable, thus benefiting the government and local rate-payers, while making the project attractive for SPC and local Jordanian banks. However, MCC's grant does not subsidize the private sector, as the private investors earn a return only on their portion of invested capital. The As Samra WWTP was the first in the Middle East to use a combination of private, local government and donor financing, using a **Viability Gap Funding** scheme (see related Box in Business Model 19) to bring down the capital costs via the MCC contribution. Closing the financing of the expansion supported its feasibility and demonstrated the significant benefits of combining private sector financing with viability-gap grant funding.

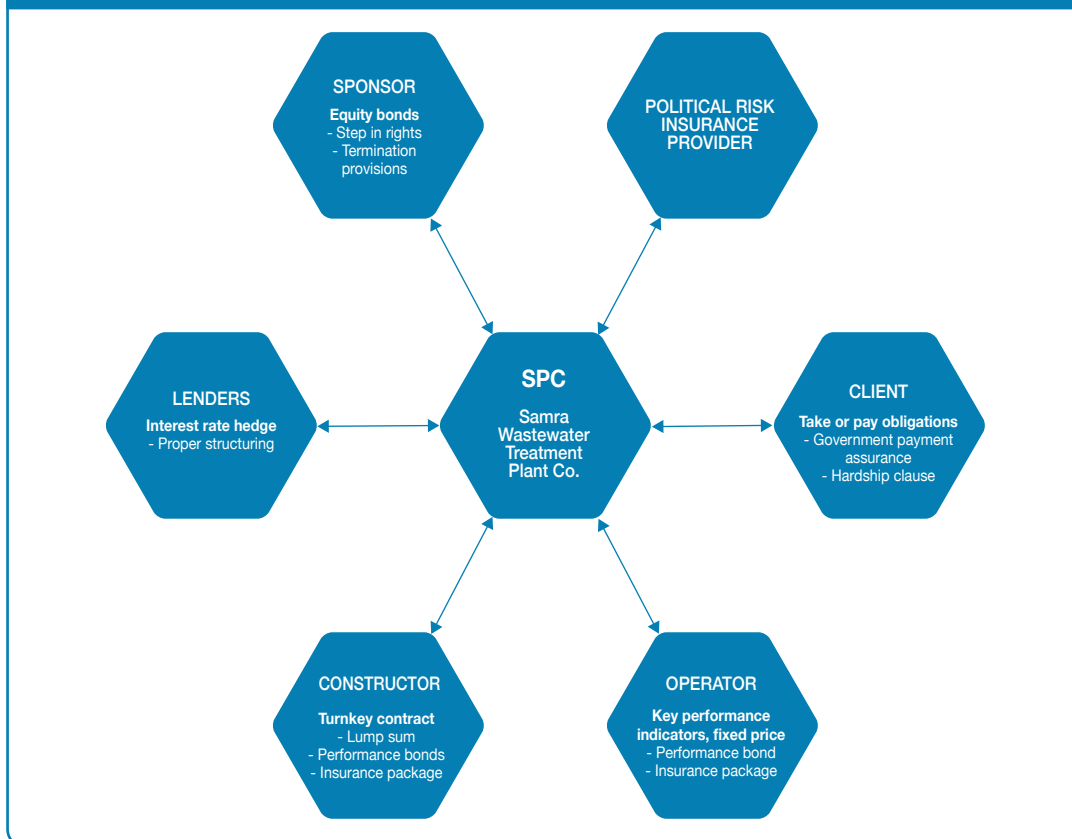
As unique as the template is, it has its challenges. The setup of the blended finance was complicated by MCC's inability to enter into any direct contractual relationships with the project sponsors (private

sector) or the lenders (banks). Moreover, both MCC and the lenders were reluctant to fund ahead of each other; as a result, financial close and satisfaction of the initial conditions to the MCC disbursement had to occur on the same day (Keenan and Norman, 2012). This situation is indicative of another cornerstone of the business model, which is **risk sharing** as a necessity to attract investors (Figure 233; adapted from SPC, 2014).

Given the size of the plant and the current water tariff and fee structure, the finance model does not rely to any significant degree on revenues from the wastewater-generating households, e.g. in Amman, Zarga and Russeifa, or fees from wastewater using farmers. In contrast, the applied finance model allows to keep the treatment tariffs very affordable (stated objective). This is supported by a significant measure to keep the WWTP energy efficient and in large self-sustainable and in this way the largest operational cost factor within limits.

Jordan's water tariff includes a wastewater levy which is based on the freshwater consumption. However, this is not sufficient to cover O&M cost of wastewater treatment, also if farmers water reuse fees are added. Farmers are charged differently depending on the scheme they are connected. Some pay per cubic meter consumed, others have an allocated amount of water and pay a lump sum. However, the fee for reclaimed water cannot exceed the one paid for the preferred freshwater (Rothenberger, 2010). According to Bahri (2008), farmers in the vicinity of WWTPs pay the MWI USD

FIGURE 233. SELECTED RISK MITIGATION COMPONENTS OF THE AS SAMRA BOT MODEL



143–286 per ha and year, while those using mixed water pay the Jordan Valley Authority (JVA) USD 0.07 per m<sup>3</sup>. During the rainy winter season, water is provided for free for salt leaching. However, the revenues of the JVA are so far not recorded at As Samra (or the Government) as the Water Authority of Jordan (WAJ) provides JVA with free supply of wastewater services from As Samra (OECD, 2014). Both authorities are reporting to the Ministry of Water and Irrigation.

### Value propositions

In the water stressed situation of Jordan, the essence of the business model is the double value proposition of wastewater treatment and the recovery of as much reclaimed water as possible for further usage, especially crop irrigation (an increase from 61 to 83%), that high quality freshwater can be reserved for domestic (including potable) purposes benefitting 2 million people. This objective has been achieved with an innovative blended finance and risk sharing mechanism which makes the capital investment attractive and bearable for all parties, and covers in addition the operational costs (through the BOT arrangement, supported by a high level of energy recovery and potentially carbon credits). The model allows the WWTP to achieve financial viability despite low user tariffs (Figure 234).

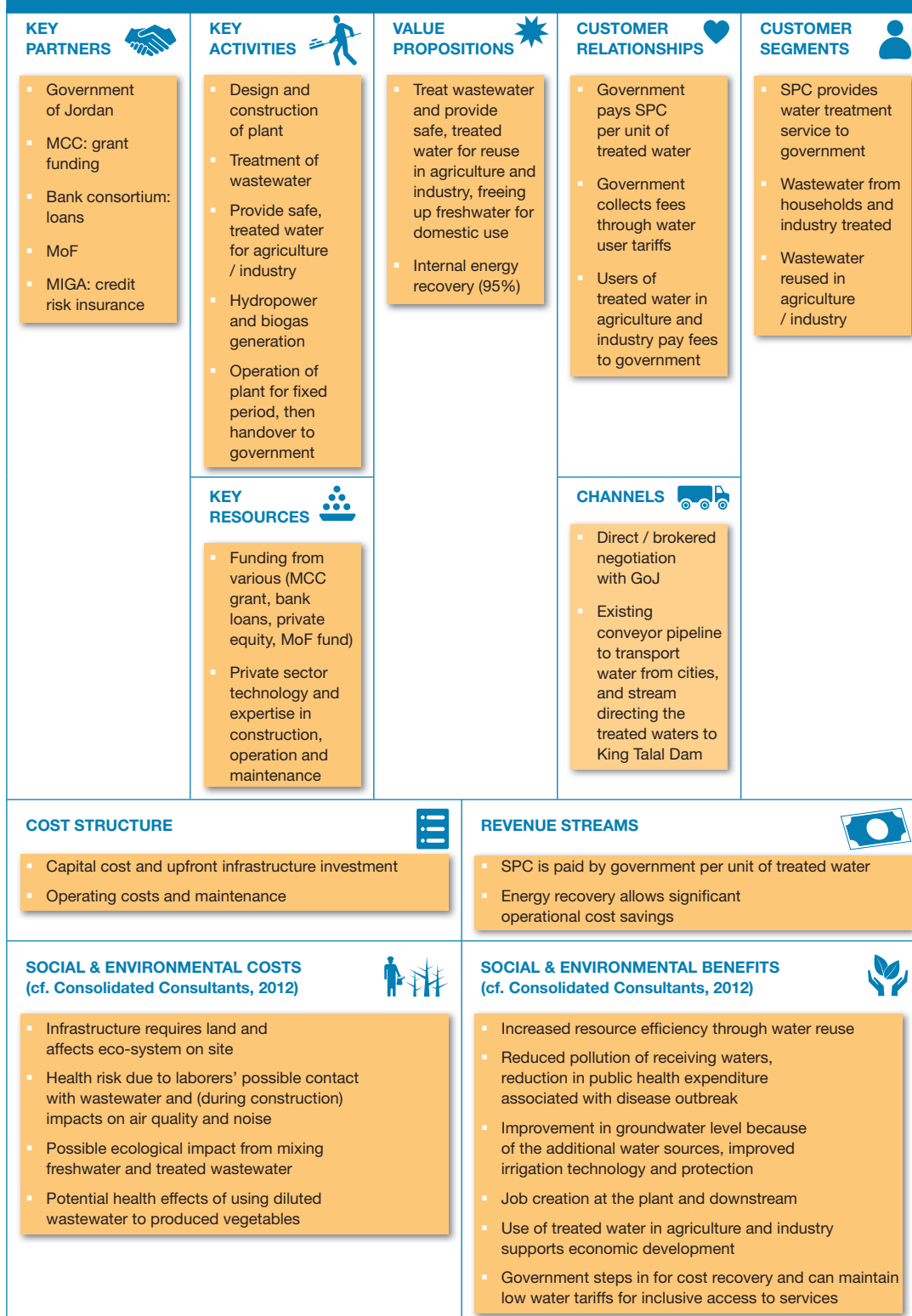
Asides the main objective of supporting irrigation in the Jordan Valley, the plant also offers its direct proximity job opportunities and water for irrigation. There are about 300–500 ha within and around the As Samra plant premises planted with forage crops (clover), olive trees and, for example, sorghum. Most farmers have irrigation water rights and contracts with the Ministry of Irrigation. The irrigation method applied is surface and drip irrigation, often gravity based. The amount of irrigated water used is open and there is no particular system in place to regulate use. In addition, many farmers pump water directly out of the Zarqa river without any formal arrangement with the MWI. There are periodical field inspections to prevent the cultivation of leafy vegetables.

Also livestock owners benefit. According to farmers, the availability of wastewater irrigated forage has simplified the production of sheep and goats instead of relying on natural grazing in the surrounding areas. This is a significant advantage given that the local area has a poor natural vegetation cover due to the scarcity of rainfall (Seder and Abdel-Jabbar, 2011).

The plant also produces sludge and (biogas) slurry with a high potential for soil amelioration (e.g. for forestry) or the cement industry, once the regulatory framework becomes supportive. Given the significant amount of sludge the WWTP will generate, the MCC considers local storage only a temporary solution. The plant operator and the Government of Jordan have agreed to work together to provide alternative solutions including related policies, procedures and standards for an environmentally and socially sound permanent disposal and/or re-use of sludge<sup>3</sup>. A viable market for sludge produced by the plant is yet to be found, given the restrictions that apply. Until this happens the parties will continue to store and dispose of sludge in accordance with the terms of the concession agreement.

### Institutional environment

The Ministry of Water and Irrigation (MWI) has overall responsibility for policies and strategies in the water sector, including water and wastewater supply and related projects, planning and management. Under MWI operate, among others, the (i) Water Authority of Jordan (WAJ) which is responsible for water supply and wastewater services, as well as for water resource planning and monitoring, construction, and operations; (ii) the Project Management Unit (PMU) within WAJ, which regulates water supply and wastewater utilities, promotes private sector participation in the water sector and carries tasks related to project planning and execution; and (iii) the Jordan Valley Authority (JVA) which manages water resources and provides bulk water in the Jordan Valley. The main institutions involved in the As Samra WWTP (Figure 235) and their roles are (SPC, 2014):

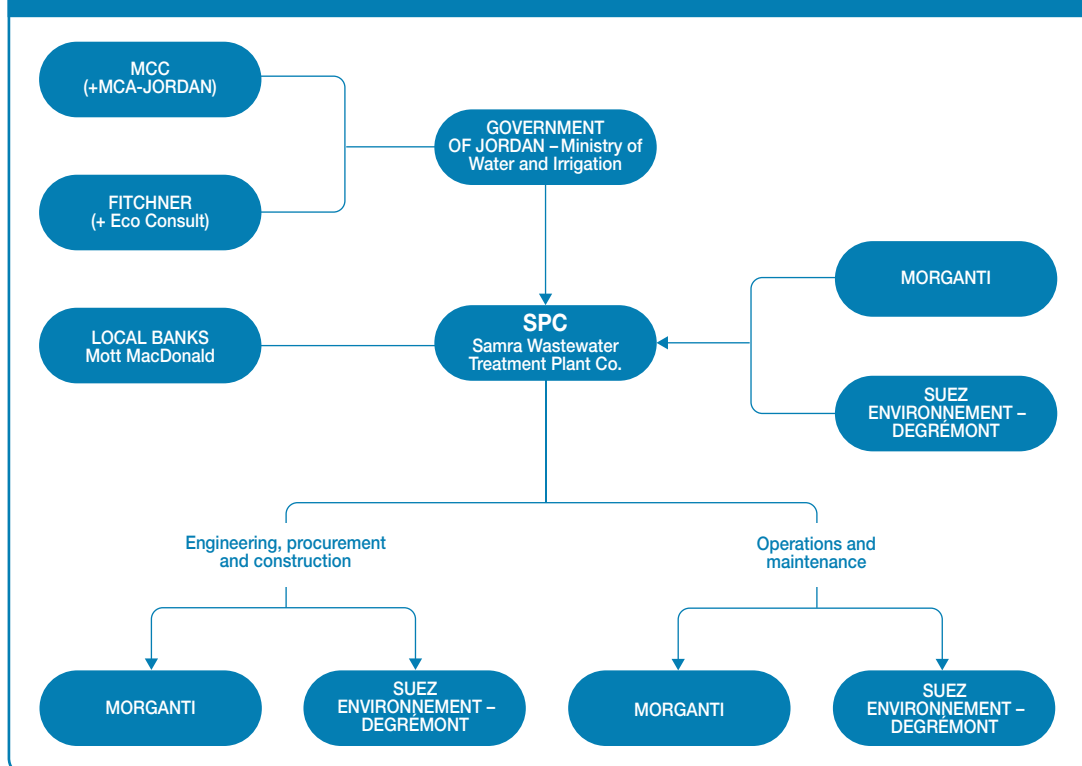
**FIGURE 234. BUSINESS MODEL CANVAS OF AS SAMRA WASTEWATER TREATMENT PLANT FROM THE PRIVATE SECTOR PERSPECTIVE (SPC)**



- Client: Government of Jordan; represented by the Ministry of Water and Irrigation (MWI).
- Donor (Phase 2): Millennium Challenge Corporation (MCC); U.S. foreign aid agency.
- Grant Fund Manager: Millennium Challenge Account (MCA-Jordan).
- Authorities Engineer: Fichtner (+ local consultant Eco Consult), also in charge of compliance monitoring with the health, safety and environment management plan.
- Project Companies: Samra Wastewater Treatment Plant Company Ltd. (SPC) and Samra Plant Operation and Maintenance Co. Ltd. (O&M).
- Sponsors: Suez Environment / Infilco-Degremont and Morganti- Consolidated Contractors Group.
- Lenders: Lender Syndicate led by Arab Bank; Lenders technical advisor: Mott MacDonald.
- Political risk insurance: Multilateral Investment Guarantee Agency (MIGA) of the World Bank.
- Beneficiaries: Mainly Amman, Russeifa and Zarqa populations as well as local towns in plant vicinity (e.g. Hashimiyya) and farmers irrigating crops with treated wastewater in the vicinity of the plant and across the Jordan valley.

An overview about relevant laws and bylaws, standards and regulations as well as the requirements of the funding agencies, of relevance for the WWTP, has been presented by Seder and Abdel-Jabbar (2011) and Consolidated Consultants (2012). Of particular relevance in the **agricultural** context are the 2006 standards for safe water reuse (JS 893/2006) which allow for a wide range of water reuse activities for highly treated reclaimed water for landscapes, cut flowers and high-value crops (except crops eaten uncooked), and for smaller scale treatment reuse activities with restricted cropping patterns. Reuse categories for treated wastewater are:

FIGURE 235. MAIN INSTITUTIONAL SET UP



Source: SPC, 2014



- Recycling of water for irrigation of vegetables that are normally cooked.
- Recycling of water used for tree crops, forestry and industrial processes.
- Discharges to receiving water such as wadis and catchment's areas.
- Use in artificial recharge to aquifers not used for drinking purposes.
- Discharge to public parks or recreational areas.
- Use in irrigation of animal fodder.
- Use of reclaimed water for cut flowers.

Although the 2006 standards were a big step forward (McCornick et al., 2004), Abdel-Jabbar (2009) argues that the existing water thresholds are often too stringent and less suitable than the multi-barrier risk reduction options promoted by WHO (2006). The author recommends updating JS 893/2006 towards a more accommodating model, supported by on- and off-farm risk mitigation measures. Although treated wastewater mixed with freshwater might no longer be labeled 'treated wastewater' (Carr and Potter, 2013) the government recommends that all crops irrigated with treated or mixed waters shall be analyzed and monitored periodically (MWI, 2010).

### Technology and processes

The wastewater generated for example in Amman, where 80% of the households are connected to a sewage network, is transported over about 40 km to As Samra by gravity through a conveyor pipeline. During the year 2010, the maximum inflow ranged between 210,000 and 230,000m<sup>3</sup>/day. Wastewater is under high pressure when arriving at the plant due to difference in elevation, and turbines have been installed to run on upstream wastewater flow, thereby generating renewable energy that is used on site. The same process is repeated after treatment where the effluent is used to power discharge hydraulic turbines generating additional energy before the water is released towards the KTR with its 86 MCM storage capacity.

The activated sludge treatment process consists of pretreatment and primary settling tanks, aerobic and anaerobic biological treatment, biomass settling and chlorination. Water quality changes between in- and outlets are shown in Table 56 (Consolidated Consultants, 2012; Suez, 2015).

Sludge from primary treatment and the aeration tanks undergoes thickening and anaerobic digestion, dewatering (target 18% dry solids) and sun drying (target 50% dry solids) (Suez, 2015). The daily sludge generation was in 2011 about 118 tons of dry sludge or 393 tons of sludge (at 30% dry solids). Given the current legal limitations for sludge reuse, MCC and SPC are given the exploration of alternative sludge disposal/reuse options, such as cement kiln or land application, highest priority (Consolidated Consultants, 2012) as space for future storage is declining and the potential negative environmental impact unacceptable for the WWTP's staff and people living in the area.

The company has implemented an energy management system as per ISO 50001 to evaluate and control its energy consumption. Between 80 and 95% of the plant's energy requirements are met using the in- and outflow turbines (1.7 and 2.5 megawatts, respectively) and the biogas generation from sludge (9.5 megawatts). An innovation was the use of hydraulic turbines on raw sewage water.

**TABLE 56. WATER TREATMENT QUALITY AS SAMRA**

WATER QUALITY INLET		WATER QUALITY OUTLET	
BOD <sub>5</sub>	637–708 mg/l	BOD <sub>5</sub>	5–30 mg/l
TSS	649–682 mg/l	TSS	15–30 mg/l
Total Nitrogen	100–107 mg/l	Total Nitrogen	15–30 mg/l

The expected increase of the wastewater inflows from the city of Zarqa will pose some challenges as its location is lower than the plant which will affect the power recovery ratio. This can in part be compensated by increasing the capacity of the biogas power generation system and a reduction of the power consumption by the aeration units.

### Funding and financial outlook

Like across the region, Jordanian water tariffs do neither cover the water production cost nor the wastewater treatment costs. While MWI (2010) suggests that wastewater charges, connection fees, sewerage taxes and treatment fees shall be set to cover at least the operation and maintenance costs (ultimately aiming at full cost recovery), the As Samra BOT blended finance model allows to keep the plant also under the current (social) tariff structure viable over the 25-year contract period. To achieve this, the government pays for SPC's provision of wastewater treatment services about USD 0.17/m<sup>3</sup> (pers. communication with the plant manager, 2014).<sup>4</sup> Running at the targeted capacity of 133MCM per year, this would result in an annual governmental subsidy of USD 22.6m. This can be partially recovered in various ways. Household (waste)water tariffs contribute the largest share of about 60% on average over all WWTPs (MWI, 2013). If As Samra would have its own account, it could probably break even as its O&M costs are much lower than of other WWTPs, given its energy efficiency (MWI, 2015). Lower contributions could be expected from the agricultural sector (see above) and potentially through the carbon market. The UNFCCC (2010) application for registration under the Clean Development Mechanism (GHG reduction of 296,704t of CO<sub>2</sub>e per year) is at the validation step.<sup>5</sup> Another (more lucrative) revenue source planned for 2021 is the possible sale of wastewater to Power Plants in the order of 22.5 MCM per year at USD 0.63/m<sup>3</sup> resulting in an estimated annual cost recovery of about USD 14million. Tariff adjustments would help reducing the governmental share. This applies more to As Samra (if budgeted separately) than other WWTPs in Jordan as in other cases energy tariff increases would undermine possible savings (MHI, 2013).

### Socio-economic, health and environmental impact

An environmental and social impact assessment (ESIA) was prepared in January 2012 for the Samra WWTP expansion. The project sponsors' consortium then prepared a health, safety and environment (HSE) management plan based on the standards of all (national and international) partners to mitigate potential environmental and social risks and impacts during the construction period, while during operations environmental and social risks and impacts are managed by the SPC based on their "Quality, occupational health, safety and environment" (QHSE) management system.

Positive impacts of the As Samra wastewater treatment plant largely accrue as a result of improved quality of domestic and industrial sewage effluents entering ultimately surface water bodies. The treatment plant reduces disposal of raw sewage, risks of groundwater pollution and the spread of excreta-related diseases. Since the commissioning of As Samra, water quality in the King Talal Reservoir and the Zarqa river have significantly improved despite some recontamination (Al-Omari et al., 2013; Abdel-Jabbar, 2009) allowing fish to return. The plant is providing directly about 170–180 new jobs, nearly exclusively used by national staff. As so far only 3% of all employees are female, women's associations were contacted to encourage the participation of women in public consultations about job opportunities, and to analyze and address the barriers of women employment at the Samra WWTP. Finally, the treated wastewater is supporting about 10,000 jobs in agriculture. At the aggregate level, the treatment plant has significant indirect benefits for the whole country as improvements in wastewater use deliver fresh water savings for domestic use by an estimated 2 million people, reduce aquifer extractions, support the tourist sector and related jobs, food security, and adaptation to the risks of climate change and migration. As Samra is also producing 103,000 kwh green energy per day, making the plant 90–95% energy self-sustainable.

A challenge is sludge management. The drying lagoons and bio-solid storage lagoons provide a favourable environment for mosquito, fly and insect growth. The ESIA states that 15% of flies that originate at the project site can reach the nearest residential areas. Mitigation measures like fumigation have been put in place, but an extension of sludge drying could reach acceptability limits. The As Samra plant is in general designed to ensure that no odor nuisance occurs and the plant obtained highest certificates for health and safety as well as environmental protection (Suez, 2015). Risks and impacts related to groundwater infiltration were considered as low due to the physical characteristics of the sludge and 80m deep groundwater table.

### Scalability and replicability considerations

The finance of water recovery and use becomes more favorable when treatment costs are low and the value proposition goes beyond recovering water from wastewater and includes for example the recovery of nutrients and energy (see below). In such cases, the likelihood of recovering both the fixed and variable costs of wastewater use, and parts of the operational and maintenance costs of the treatment process is improved. Technology choice is important, particularly in developing countries. Wastewater use, especially in agriculture, can be supported by relatively simple treatment processes of proven technology, with low investment costs and affordable operation and maintenance. Such processes are particularly suited to countries with warm climates, as biological processes perform better at higher temperatures. The investment costs for such simple or 'appropriate' treatment facilities are in the range of 20% to 50% of conventional treatment plants, and more importantly, the operation and maintenance costs are in the range of 5% to 25% of conventional activated sludge treatment plants. These cost differentials are substantial from a financial point of view (Libhaber and Orozco-Jaramillo, 2013). Appropriate technology processes include (but are not limited to) the following: lagoon treatment, upflow anaerobic sludge blanket (UASB) reactors, anaerobic baffled reactors (ABRs), constructed wetlands or stabilization reservoirs for wastewater use. Various combinations of these processes can be set up. In the context of fully exploited freshwater resources, the economic gain from treated wastewater can be significant. The business template developed in Jordan – namely, grant financing coupled with private finance from sponsors under a debt-to-equity ratio of 80:20, and debt finance raised on a limited-recourse basis with shared risks – offers significant potential for the development of much-needed infrastructure projects in developing countries in the future. The additional savings on operational costs through a high level of energy self-supply makes the model even more interesting. There is significant potential for its transfer to similar locations if a donor, such as USAID and MCC in this case, is ready to contribute to the overall costs. MCC expects to adapt the contractual structure developed for the As Samra expansion for use in upcoming infrastructure projects elsewhere in the world, thereby allowing projects that are economically and environmentally beneficial to be implemented and operated by the private sector where such projects would otherwise be unaffordable to the public sector (Keenan and Norman, 2012). The MHI capital investment program makes also reference to a possible third As Samra expansion phase for handling extra amounts of wastewater, budgeted with USD 324million (2020–2024).

### Summary assessment – SWOT analysis

The As Samra business case presents a multi-partner model to transform urban wastewater into several benefits for the society. The case required large initial capital investment which was managed through an innovative and multiple award-winning finance model using Viability Gap Funding and risks sharing model. However, the case points besides strength and opportunities also at weaknesses and potential threats for its future and replication (Figure 236).

FIGURE 236. SWOT ANALYSIS OF AS SAMRA BUSINESS CASE

	HELPFUL TO ACHIEVING THE OBJECTIVES	HARMFUL TO ACHIEVING THE OBJECTIVES
INTERNAL ORIGIN ATTRIBUTES OF THE ENTERPRISE	<b>STRENGTHS</b> <ul style="list-style-type: none"> <li>▪ Strong institutional and regulatory support</li> <li>▪ High profile partners</li> <li>▪ Excellent financing package offered by Arab Bank</li> <li>▪ No foreign exchange risk for Gov.</li> <li>▪ Innovative business model for infrastructure set up and O&amp;M cost reduction</li> <li>▪ Financial risk mitigation instruments facilitate multi-party investments</li> <li>▪ Favorable topography reduces pumping needs while allowing to generate energy</li> </ul>	<b>WEAKNESSES</b> <ul style="list-style-type: none"> <li>▪ Plant of significant size with high O&amp;M needs after BOT hand over</li> <li>▪ First co-financed BOT and PPP (for public infrastructure) in Jordan; i.e. it cannot build on lessons learnt</li> <li>▪ A similar favorable topography will be seldom to repeat the energy balance</li> <li>▪ Cost recovery from tariff system marginal, not to mention farmers</li> <li>▪ Long-term sludge/slurry disposal</li> <li>▪ Low job attraction for female workers</li> </ul>
EXTERNAL ORIGIN ATTRIBUTES OF THE ENVIRONMENT	<b>OPPORTUNITIES</b> <ul style="list-style-type: none"> <li>▪ Continuous supply of wastewater and demand for treated water</li> <li>▪ Virtually zero competition from fresh water due to water scarcity</li> <li>▪ Stable political environment</li> <li>▪ Leader in the regional Clean Development Programs</li> <li>▪ Job creation across sectors</li> <li>▪ Revision of national reuse guidelines based on WHO (2006)</li> </ul>	<b>THREATS</b> <ul style="list-style-type: none"> <li>▪ Political crisis</li> <li>▪ Non-compliance with safety plans resulting in human health risks and loss of image/trust/support</li> <li>▪ Increase in industrial effluent (salinity, metals)</li> <li>▪ Reuse restrictions</li> </ul>

### Contributors and resource persons

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*Case descriptions are based on primary and secondary data provided by case operators, insiders, literature and other stakeholders, and reflect our best knowledge at the time of the assessments 2014/16. Possible errors are solely of the authors, not their resource persons. As business operations are dynamic, data can be subject to change.*

## Notes

- Numbers vary between sources, depending e.g. on the inclusion of a Phase I loan.
- Approximately USD 42 million of the debt package was used to refinance the outstanding loan on Phase 1. All numbers vary to some degree from source to source, also as the bank contribution is in Jordanian Dinar.
- <https://assets.mcc.gov/content/uploads/2017/05/action-2012-002-1136-01-first-major-build-operate-transfer-project.pdf> (accessed 6 Nov. 2017).
- According to MWI (2015) the treatment cost per cubic meter of wastewater in As Samra is USD 0.28 with capital cost and depreciation included. The average treatment costs of other plants are USD 0.76–2.8/m<sup>3</sup>.
- <https://cdm.unfccc.int/Projects/Validation/DB/DNBGISCCSJ6174719S0D97R4DBWHVS/view.html> (accessed 6 Nov. 2017).