Annex to 3.4.1 Description Of Proposed Measures For Wastewater Collection, Treatment And Disposal

Contents

3. AS SAMRA TREATMENT PLANT

1. Long term development in Amman-Zarqa River Basin Area

According to the Consultants Study Report the long-term strategy for the Amman-Zarqa River Basin Area foresees the construction of two wastewater treatment plants:

- As Samra Treatment Plant (a new plant at the present As Samra plant site)
- Wadi Zarqa Treatment Plant (a new plant along Wadi Zarqa downstream of Sukhna)

The basic concept of the long-term development for Amman-Zarqa River Basin Area is shown in the Figure 3.1 (and also Figure 34.1).

Proposed As Samra Treatment Plant

This treatment plant will serve the majority of Amman area (belonging to Wadi Zarqa Basin). Collected sewage will be pretreated in Ain Ghazal pre-treatment facilities (AGTP) and then discharged by a new conveyor (DN 1500, 32 km, completed in 2001).

Proposed Wadi Zarqa Treatment Plant

The treatment plant will receive wastewater flows from the eastern portions of Amman (Tariq and Marka) as well as Zarqa, Russeifa and Hashimiyya vie a new gravity conveyance system. The Wadi Zarqa system will also collect and treat wastewater from the presently unsewered Sukhna Municipality. Details of Wadi Zarqa Plant are given under Section 34.

2. Proposed Treatment Plant As Samra

After completion of the proposed treatment plant in Wadi Zarqa the new Treatment Plant As Samra will receive wastewater from Amman area belonging to Wadi Zarqa Basin only via the conveyor (DN 1500) presently under construction (see Figure 3.1). Before entering the conveyor sewage will be pretreated by Ain Ghazal Pretreatment Plant (AGTP).

The new Treatment Plant As Samra will be constructed adjacent to the existing As Samra wastewater stabilization pond facility (for details of the existing system refer to Section 3 of Annex 3.1). Treatment facilities to be provided will be based on activated sludge/nitrification/denitrification process with tertiary treatment capability. Facilities providing for effective nitrogen removal were determined (according to Consultant's Study Report) to be required due to the high concentrations (80 to 100 mg/l) of ammonia in the wastewater from the drainage area. Without effective nitrogen removal, attainment of Jordanian Standards for discharge of wastewater effluent to wadis and catchment areas would not be possible and improvements in water quality along Wadi Zarqa and in the King Talal Reservoir would be limited. Also nitrogen removal will be required for effluent reuse for irrigation purposes assuming existing cropping pattern continues to prevail. Sludge generated at the facility will be thickened, digested anaerobically, dewatered (using

gravity drying beds) and stored on-site for 2 – 3 years prior to disposal through land application. Figure 3.2 shows the proposed new treatment system.

The projection of the wastewater production is shown in the following table (acc. to HARZA Study). Final capacity of the treatment plant will be reached

in 2015 (Phase 1): 267,000 m³/d (2,270,000 connected inhabitants)
in 2025 (Phase 2): 420,000 m³/d (3,310,000 connected inhabitants)

Total investment costs of Phase 1 and 2 (for future rehabilitation, expansion and development measures) based on preliminary design and 1997 prices (HARZA Study) are:

Treatment plant	142.12 million JD
Pre-treatment (Ain Ghazal pretreatment facility)	4,80 million JD
Conveyance (without collection system)	4.80 million JD
Total base costs	151.72 million JD
Physical contingencies	18.96 million JD
Engineering	18.96 million JD
Total investment costs	189.65 million JD
Collection system (Phase 1 and 2)	16.30 million JD

According to the HARZA Study Report proposed measures will be implemented between 2000 and 2015 (Phase 1) and between 2016 and 2025 (Phase 2).

The Ministry of Water and Irrigation intends to construct new treatment facilities in As Samra applying the Build-Operate-Transfer (BOT) method. Additionally, the contract will comprise the takeover, operation and maintenance of the conveyor pipeline from Ain Ghazal to As Samra including the pretreatment facilities in Ain Ghazal. Bidders for pre-qualification are invited in March 2000.

3. Proposed reuse options

Within the frame of the Project "Jordan Water Resource Policy Support" carried out by USAID/ARD presently opportunities are investigated for using the recycled water from the As Samra Wastewater Treatment Plant and other treatment plants that discharge into Wadi Zarqa. These opportunities were to be examined for the Amman-Zarqa, Jordan Valley, Wadi Zarqa, other Amman-Zarqa sources and groundwater recharge.

A. Amman-Zarqa

Four options for the Amman-Zarqa were examined (see Figure 3.3a):

- *Option HL#1: Hashimiyya, Zarqa and Russeifa project*

This option considers the reuse of treated effluents for industrial and other purposes. Reuse would take place along the axis of the towns Hashimiyya, Zarqa and Russeifa. The existing Thermal Power Plant and the planned one (both located close to the As Samra Treatment

Plant) will be included in the industrial facilities supplied by treated effluent. Location of the project area is shown in Figure 3.3a.

- *Option HL#2: Highlands irrigation project*

The HL#2 project, as shown in Figure 33.3b, is located approximately 5 km east of As Samra on either side of the Khaw to Mafraq highway, and could extend to at least 13,400 donums (1,340 ha). The basic components of the conceptual design are a pumping station at As Samra, a conveyance pipeline and an open reservoir on the north edge of the project area.

The estimated capital cost for the project is 19.1 mio. JD. The estimated annual cost is 2.6 mio. JD, which is about 0.21 JD/m³ not including on-farm inputs..

- *Option HL#3: Wadi Dhuleil and Khalidiyyeh irrigation project*

The Dhuleil and Khalidiyyeh irrigation project (Option HL#3), as shown in Figure 3.3c located approximately 14 km east of As Samra. The most southerly of the three tracts on Figure 3.3c approximately 10,000 donums of land owned by the Water Authority of Jordan (WAJ) and includes the existing Dhuleil irrigation project. The present water source (groundwater) for the project is no longer viable. It is anticipated that this would be the first phase of new irrigation project with future phases extending to the north, as indicated on Figure 3.3c. The basic components of the conceptual design for the first phase of the project are a pumping station at As Samra, a conveyance pipeline that follows the route of the existing oil pipeline and an open reservoir on the north edge of the project area. The existing irrigation infrastructure within this tract will reduce the development costs, but betterment of this system will be required.

The estimated capital cost for the project is 28.2 mio. JD. The estimated annual cost is 3.65 mio. JD, which is about 0.38 JD/m³ not including on-farm inputs..

- *Option HL#4: Highlands irrigation distribution network*

The highlands irrigation distribution network (Option HL#4) is located in the upper northeastern area of the Zarqa drainage basin, and is intended to convey water to existing irrigated farms to exchange for groundwater supplies (see Figure 3.3d). Clearly this is a very expensive option, involving a 40 km long pipeline to a storage reservoir located at an altitude of 300 m above As Samra, but it was considered important to investigate if the value of the groundwater saved is high enough. The conceptual design of the project comprises two pump stations, a network of large diameter pipes and at least three strategically placed reservoirs.

The estimated capital cost for the main components of this option, which are the pumping stations, conveyance pipeline and storage facilities, is estimated to be 44.3 mio. JD. Annual costs for the same main system will be around 5.7 mio. JD, or about 0.57 JD/m³. This does not include the extensive distribution system and upgrades to on-farm application systems.

Take into account the above mentioned facts ARD/USAID concludes the following: At was anticipated from the outset that the options would be relatively expensive, with the most expensive being located furthest from the treatment plant and highest elevation. However, because of limitations placed on the scale of the options due to land resources

(HL#2 and HL#3), and the volume of water presently used (HL#4), the unit cost for developing and operating each option is found to be higher than anticipated. The range of initial irrigation infrastructure costs is 18,000 – 36,000 JD/ha, and costs of delivery of water to field level are estimated at 0.21 – 0.57 JD/m^3.

Given these very substantial costs, the preliminary conclusion is that the options under consideration, or indeed the general concept of pumping recycled water into the highlands for agricultural use, do not appear economically viable unless the resulting savings in groundwater are given high values and high-profitable cropping regimes are developed. There may be only limited potential to offset costs through potential savings in groundwater. For example, the present 2.5 MCM of groundwater used at HL#3 is already saline (2,500 – 3,000 mg/l).

B. Jordan Valley

Effluent of the plant (excess water) not used for agricultural irrigation close to or upstream of the plant (e.g. in times where the irrigation demand in the upstream areas is low) will be discharged to the Wadi Dhuleil adjacent to the plant. Finally the treated wastewater will flow into the King Talal Reservoir. From there water will flow to the Jordan Valley for ultimate reuse.

Building on previous work, including WQIC, the GTZ Brackish Water Project and FORWARD, opportunities and constraints of increasing the use of treated wastewater for irrigation in the Jordan Valley are investigated.

C. Wadi Zarqa

A preliminary survey of the area has been undertaken, and arrangements have been made for the image analysis of the highlands to include this area. A preliminary overview of a potential water reuse option has been generated for this region.

D. Other Amman-Zarqa Sources

Existing documents have been reviewed with respect to water reuse practices at each of these sites. Investigation and input on the Mafraq water reuse situation by the team (ARD/USAID) was relevant to this activity with respect to the scale and potential options.

E. Groundwater Recharge

The public acceptability and technical feasibility of recycled water injection and groundwater recharge by surface application of wastewater are assessed. The level of treatment necessary and possible methods is determined. Opportunities for artificial recharge of groundwater are assessed in regions where groundwater depletion is advancing such as the highlands area and other areas.

Consultant's Study Report:

USAID/Harza: "Master plan and feasibility study for the rehabilitation, expansion and development of existing wastewater systems in Amman-Zarqa River Basin Area. Plan Year 2025", July 1997.

ARD/USAID: "Water resource policy support. Pre-feasibility study. Water reuse for agriculture and/ or forestry in the Amman-Zarqa Highlands (Internal Draft)", September 2000.

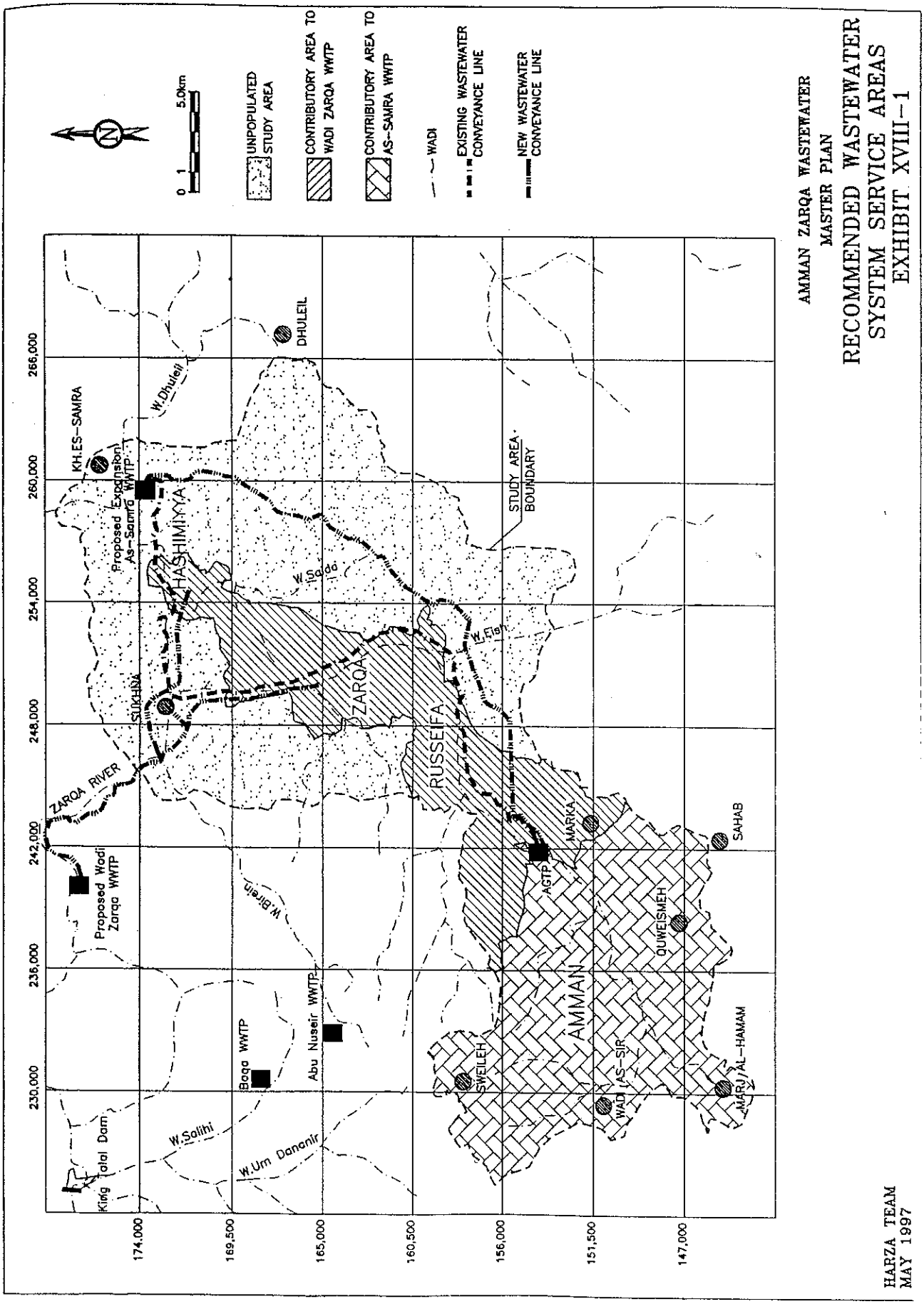

FIGURE 3.1: General Layout of Proposed Sewerage System - AS SAMRA

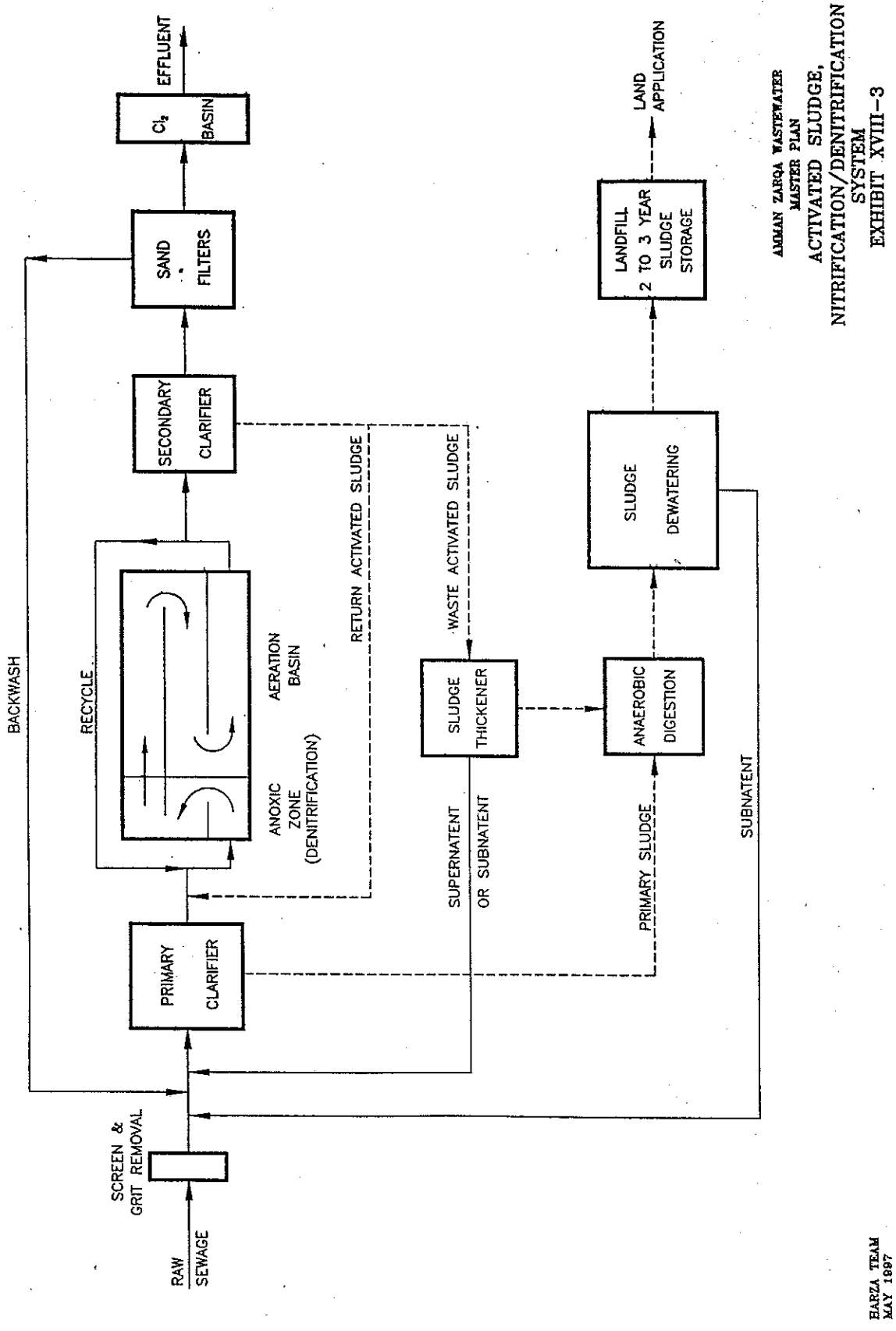

FIGURE 3.2: Layout of Proposed Wastewater Treatment Plant - AS SAMRA

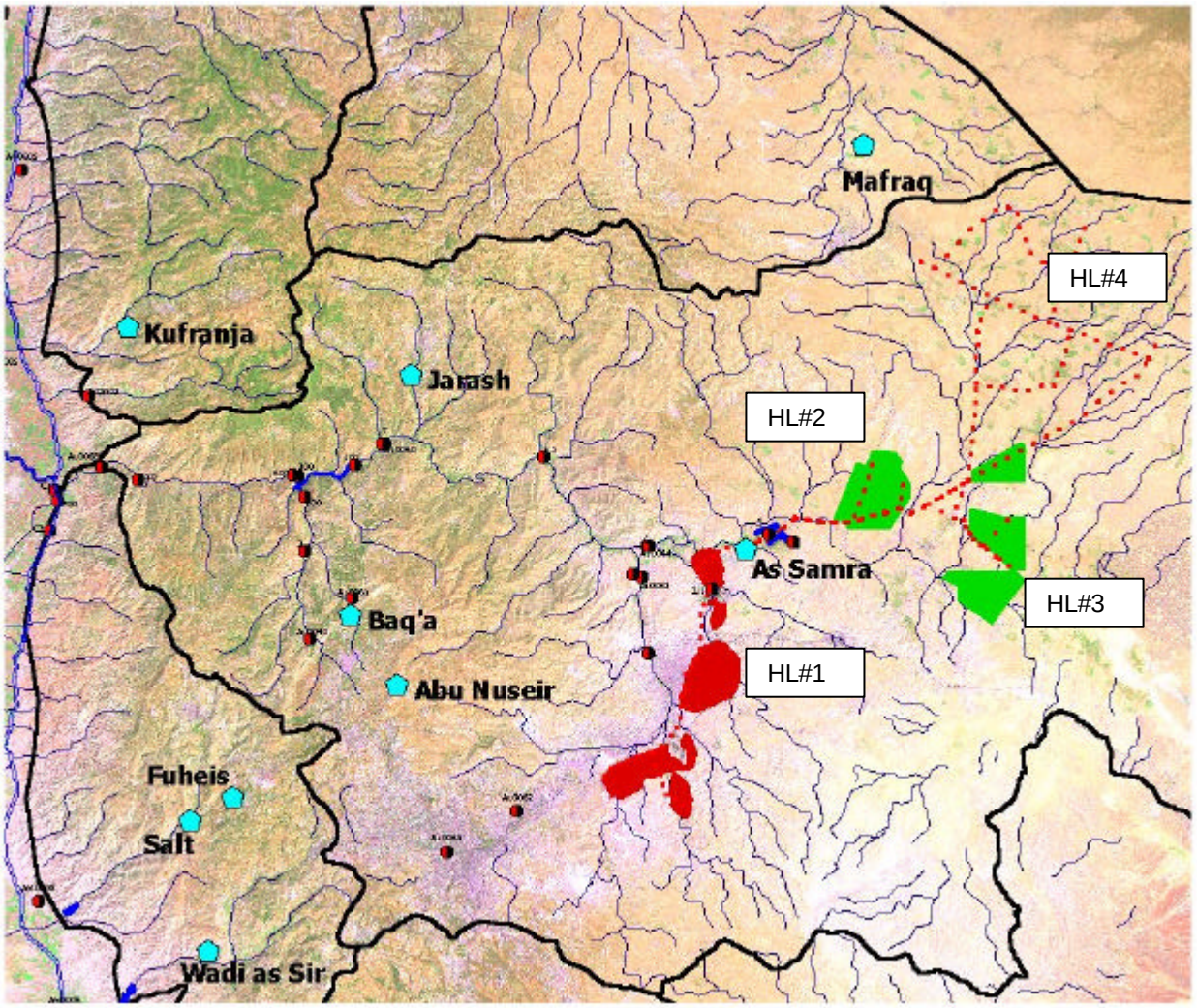

FIGURE 3.3a: Locations of potential reuse option in the highlands