Pre-Feasibility Study & Capacity Building Assistance

for Waste-to-Value – Integrated Sustainable Sanitation in Tyre – Rashidieh / Lebanon

Final Report

Clients/Partners

Tyre Municipality Union/ Lebanon
Tyre / Lebanon
Rashidieh Camp Committee
Tyre / Lebanon
UNRWA Lebanon
Beirut / Lebanon
Bill & Melinda Gates Foundation
Seattle / USA

Vendor

UPM Umwelt-Projekt Management GmbH

[17 June 2019]

This **Pre-Feasibility Study & Capacity Building Assistance** for Waste-to-Value – Integrated Sustainable Sanitation in Tyre – Rashidieh / Lebanon consists of 2 Volumes:

VOLUME 1 – Final Report

VOLUME 2 – Detailed Findings from On-site Assessment

This material is based on research funded by the Bill & Melinda Gates Foundation. The findings and conclusions contained within are those of the authors and do not necessarily reflect positions or policies of the Bill & Melinda Gates Foundation.

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Abbreviations

foundation	Bill and Melinda Gates Foundation
GoL	Government of Lebanon
LATA	Lebanon Appropriate Technology Association
MoE	Ministry of Environment
MSW	Municipal Solid Waste
NGO	Non-Governmental Organization
PRS	Palestinian Refugees from Syria
PRL	Palestinian Refugees in Lebanon
UNRWA	United Nations Relief and Works Agency for Palestine Refugees in the Near East

PART 1 – Executive Summary

1. Introduction

The Bill and Melinda Gates Foundation (the foundation) is working with a variety of partners (Governments, Donors, UN, NGOs and Industries) in the Middle East and Africa to improve the living conditions of displaced populations, refugees and their hosting communities. One objective of the present consultancy assignment is to provide direct support to the Foundation in the following ways:

- Visit Foundation grantees and partners on behalf of the Foundation for technical reviews and progress visits
- Provide support on developing terms of reference for Foundation grants based on the consultant's own expertise and learning from the above work with grantees and partners

The second objective of this assignment is to provide Technical Assistance to the Foundation partners in the Middle East and Africa for the following:

- Identification, evaluation and demonstration of innovative toilets and sanitation innovation for refugee settings;
- Capacity building of partners for procuring "waste-to-value" technologies, training and operation and project management.

During the "Pre-Feasibility Assessment of Faecal Sludge Treatment in Refugee Contexts" which took place in Jordan and Lebanon from November 2016 to April 2017, UNWRA-supported refugee camp Rashidieh and the host municipality of Tyre were identified as potential partners of the Bill and Melinda Gates Foundation to be supported for the development of a Partnership proposal "Integrated sustainable sanitation project in Tyre – Rashidieh".

These support services are provided by a core team of experts, responsible for overall supervision and reporting on the provided Technical Assistance. Each technical assistance, once approved by the Foundation, is led by Core Team members, together with additional subcontracted international experts selected based on the required scope of work. This project would assist UNRWA and the Lebanese government in achieving their mandates by providing alternative and sustainable solutions that are highly beneficial for both the Lebanese host communities and the refugee settlements.

For the work in Lebanon, the Lebanon Appropriate Technology Association (LATA) was selected as the UPM consultant team partner to bring in local expertise, translation into Arabic, logistics and contacts.

The main priority for the proposed integrated environmental sanitation improvement of the Tyre-Rashidieh camp and surrounding area is targeting infrastructure improvement in line with environmental protection to reduce the environmental impact on the greater host community of Tyre (ecological footprint), and to maintain and protect the surrounding natural areas. The challenge was to find alternative solutions that could lead to the success of the sanitation component in Rashidieh, whilst adding to the integrated sustainable coastal development of the larger municipal area. To this end a number of workable solutions were developed.

Implementing the proposed solutions leads to big improvements in the fundamental quality of life of the refugee community in Rashidieh and will have a positive impact on the surrounding environment as well as the hosting communities. Better services and better quality of life will contribute to reducing the continued movement of refugees toward Europe or USA and Canada by extending development measures such as infrastructure development and investment in education and employment. For this reason, the study highlights the significance of capacity building activity expansion. A special initiative "Training and Awareness" focuses on new, targeted and networked cooperation between the different stakeholders including the targeted communities to ensure sustainability and impact.

The improved sanitation technologies and environmental concepts will enable the greater Tyre-Rashidieh area to act as a pilot location for sustainable sanitation, waste management and

environmental education. There is an opportunity through this initiative for transferring successful newly introduced concepts as best practice flagship projects to other camps in Lebanon and other countries where UNRWA is active,, and in other hosting communities in other areas in Lebanon as well.

2. Summary of Findings from Assessment

In recent years, the arrival of displaced Syrians (currently over a million persons) and Palestinian refugees from Syria (PRS) (April 2018: 32,058 persons) seeking refuge from conflict in neighbouring Syria, has impacted the Lebanese economy and exacerbated the precarious conditions of the "host community" of Palestine refugees in Lebanon (PRL). In December 2017, the Government of Lebanon (GoL) launched its report on the census of Palestinian refugees conducted in Lebanon; a total of 174,422 Palestinian refugees were counted to be living in the 12 official Palestine Refugee Camps and the 156 gatherings. 63% of PRL reside in the 12 official Palestine refugee camps of Lebanon, the most southern is Rashidieh.

Also 55% of PRS reside in the 12 official Palestine refugee camps. 48% of the PRL and 54% of the PRS populations in Lebanon are younger than 25 years. There are still officially 31,478 registered Palestinian in the Rashidieh camp (census 2013) but many of them – especially the younger generation - have left towards Europe, USA or Canada. It is understood that refugees leaving Lebanon because of the pressure of the Syrian crisis and the hope of better perspectives abroad.

The city of Tyre (Arabic: صور) is part of the Tyre Municipality Union, which groups 62 municipalities in the Southern Lebanon Region (Sour district), with the aim of developing this area for economical, tourism, agricultural and environmental purposes. Today it is the fourth largest city in Lebanon and houses one of the nation's major ports. Tyre (Sour) district has a sandy coastline considered one of the most beautiful and largest of Lebanon. Tyre city juts out from the coast of the Mediterranean and is located about 80 km south of Beirut. Its surface area is 418 km^2. The name of the city means "rock" after the rocky formation on which the town was originally built.

According to the United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNWRA) sanitation teams in the Rashidieh camp, in 2018 about 14,500 people (estimated 3,700 households as 3,700 roof water tanks were counted in February 2018) are permanently living in 3,052 buildings (lots) inside the 43.5ha camp area. A temporary population increase occurred when Palestinian refugee families arrived from Syria. In peak years (as in 2013), population density in Rashidieh was 72,530 habitants/km^2; at present there are 33,400 habitants/km^2 - still a figure between Dhaka and Mumbai as the world's most crowded cities.

The main sanitation infrastructure issues in Rashidieh camps area are: (i) wastewater pumping station no. 1 ("New Camp") not fully operational, and (ii) wastewater pumping station no. 2 ("Old Camp") was never constructed, for both people have complained or are still complaining about the set-up location. From the total number of 2,254 buildings in the camp (all of them have been visited and analysed in 2018 - organized through the consultant team), 813 buildings (36%) were even not considered to be connected in the sewage network plan (in the Old Camp and the coastal area of the New Camp). The gravity sewer in the "New Camp" site connects nowadays 1,441 building (1,845 shelters), only 739 shelters are connected black and grey water. 424 (18.8%) shelters are ready to be connected for black water while connected for grey water (back water ratio to grey water is 1:10~1:15), but this was never done as the connection was not included in the financial budget for the sewer coverage. Only 41 (1.8%) of the habitants refused a connection although it was technically possible. Still the connection of 641 shelters is not easily possible for connection of the black water as the shelters are still using percolation pits for black water within the plot limit and the residents are not motivated to make diversions to the new sewage network.

The two pumping stations and the sewer network were financed by KfW, but works have been stopped as the municipal wastewater treatment plant is not yet operational and population's resistance regarding the location of the second pumping station.

During the 4 field missions conducted by the consultants in 2017 and 2018, and in several field assessments, workshops and meetings with authorities from the host community Tyre, Rashidieh Camp Population Committees, and UNRWA, the following environmental challenges and impacts were identified and analysed – for detailed analysis refer to Volume 2.

Table 1: Environmental challenges and impacts identified at the site

No.	Challenges	Impacts
1	Unsafe fresh water supply	Leakage from overflows at storage levels (roof top household tanks, usually 500 to 1,000l capacity per household); leakages due to deteriorated water network pipes; excessive pressure or presence of salty water (corrosion); average public water storage capacity of 15l per person is insufficient and forces to pump directly water from boreholes to networks.
2	Insufficient spring or borehole protection	Due to sea water intrusion, wastewater and surface pollutants, all water supplied has to be treated before distribution. Ras El Ain and Rashidieh springs are the main sources of water in Tyre (estimated volume of 10,000 to 15,000m^3/d and 6,600m^3/d, respectively). Ras El Ain Spring, the most significant water source of Tyre, feeds 7 main reservoirs: 2 are used for irrigation of Tyre's coastal plains located in the southern parts of the district, 1 for the distribution of potable water by Tyre Water Treatment Plant (WTP), 4 in close neighbourhood to Rashidieh Palestinian Camp.
3	Incomplete sanitation and wastewater infrastructure	Continuous efforts and dedication of resources are needed to complete, modernize, and maintain toilets and sanitation sewer infrastructure that does not feature a sustainable cost-recovery mechanism as it is usual practice for government managed investments.
4	No proper storm water management	Systematic paving has improved hygiene conditions and road access inside the camps, but it has created the need for evacuation of larger volumes of storm water due to the absence of opportunities for natural infiltration. Pollution occurs therefore through the infiltration of surface wastewater and storm water into the water supply network.
5	Incomplete solid waste management	Absence of solid waste segregation at household level which is in part due to limited awareness and solid waste facilities in the camps. Only MSW is collected; industrial waste, e-waste, slaughterhouse waste, medical waste, toxic waste, construction and demolition waste, bulky waste, expired goods, and used tires are not yet collected, neither mixed with MSW. The most promising solution seems to be the reduction of waste through minimization of waste generation, recycling and re-use inside and outside the camp, composting and utilization of waste-derived-fuel, in addition to investing in awareness raising among the population
6	Deteriorating environmental conditions	Environmental health hazards (odour, sound pollution) are often found near solid waste collection points and generators are associated with numerous negative health impacts. Degradation of air quality is a growing environmental concern in Lebanon and has become a major danger to public health in the last three years.

No.	Challenges	Impacts
7	Required protection of the directly neighbouring natural heritage area	Tyre Coast Nature Reserve[1] as unique historic / cultural (and environmental educational) site: Access to the sandy north and south beach threatened by tourism development projects. Areas currently being degraded require protection.
8	Worsening climate conditions	Climate change might affect the availability of water in the region, and it has to be decided whether steps should be taken now to incorporate climate change projections into water resource development planning. In terms of precipitation, micro-climatic variations and the frequency of extreme events might be taken into consideration, as well as droughts impacting the aquifer recharge. It might be necessary to calculate possible aquifer recharge, rainwater harvesting, and renewable energy applications to prevent threats of natural disasters.
9	Insufficient housing conditions in quality and density	Rashidieh consists of two parts: one part built in 1936 by the French colonial government for Armenian refugees which was later used for Palestinian refugees; and a second part built by UNWRA in 1963 to host Palestinian refugees evacuated from the Gouraud Baalbek camp. Now shelters need serious rehabilitation. Lebanese authorities prohibit or delay camp entry of construction materials with subject to military permission, which is not always granted. Camp inhabitants tend to stretch the use of the limited material (e.g. limited use of cement for concrete) resulting in uncontrolled and unmaintained construction. This further amplifies vulnerability in the camps, increasing deterioration of building quality. The average population density, based on total area of the camp, is 0.09 people/m^2. Restricted by demarcated boundaries and the sea, Rashidieh camp cannot expand. New buildings are constructed within these boundaries, compromising shared spaces in the camp such as football fields, the seashore, and farmland.
10	Limited camp area - accessibility and development perspective	For decades, Palestinian refugees are not officially recognized by the Lebanese state, which has long refused to define them legally. As such, they are denied basic rights accessible to Lebanese citizens, including the right to work and the right to own property. For people living in the camps freedom of movement is heavily curtailed. Rashidieh camp is surrounded by Lebanese Army and has limited access to outside with only one entrance/exit checkpoint along with surveillance points on the seashore. The camps are overcrowded ghettos: narrow streets divide clumps of overlapping houses with poor sewerage and other infrastructure services.; sunlight and fresh air are limited.

[1] Due to its diverse flora and fauna, the Tyre Coast Nature Reserve is a designated Ramsar* Site. It is an important nesting site for migratory birds and the endangered loggerhead and green sea turtle and the shelter of the Arabian spiny mouse and many other important creatures (including wall lizards, common pipistrelle, and European badger). Plant species include the cattail, sea daffodil, and sand lily. Established in 1998, is an important sanctuary for wildlife and includes a public beach with yellow sand. The reserve is bisected by the Rashidieh Palestinian refugee camp.
** The Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat is an international treaty for the conservation and sustainable use of wetlands. It is also known as the Convention on Wetlands. It is named after the city of Ramsar in Iran, where the initial Convention was signed in 1971.*

No.	Challenges	Impacts
11	Fossil household energy dominates	Almost all shelters in the camp are ventilated and are supplied with water and electricity; all have private toilets. Electricity in the camps and gatherings is provided by Electricité du Liban (EDL), Lebanon's industrial and commercial electricity provider. The percentage of refugees receiving electricity is around 98%. However, electricity infrastructure for refugee camps is still under-developed compared to the rest of Lebanon: electricity cables in the camps are untended and hang dangerously low over the homes. Private generator owners fill the gap between Lebanon's energy supply and demand, leaving citizens without power from the official grid for 3 to 12h/d. Because these generators are located in dense urban areas, their emissions significantly increase inhalation of harmful substances. The most commonly bought household items are, in order of highest percentage: television sets, refrigerators and washing machines. However, a mounting groundswell of support for renewable energy and a global boom in solar technology is beginning to erode these gaps. The country sees more than 300 sunny days a year, ideal conditions for solar energy (for electricity, hot water and cooking).
12	Insufficient service provision	Because Lebanese labour laws distinguish between Lebanese and non-Lebanese workers, Palestinian refugees residing in Lebanon should abide by the laws that govern the work of foreigners. Some professions remain forbidden to Palestinians, such as legal professions, engineering and medical professions. Furthermore, the lack of access to state services, such as education and health care, puts Palestinian refugees in a very difficult position as well as one which binds them to UNWRA protection programs; UNRWA being the sole service provider and one of the main employers and generator of jobs for the refugee communities. However, UNRWA with its limited resources is only able to offer minimum benefits and basic services. This situation created a relationship of dependence on UNRWA services and subsistence handouts. Furthermore, Palestine refugees are mainly able to find seasonal work in agriculture and construction. Students often drop out of school in order to support their families, although GoL allows Palestinians to enrol in Lebanese public schools, educational institutes as well as the Lebanese University. UNRWA statistics show that 60% of Palestinian refugees in Lebanon are living below the poverty line while 36% do not have any own source of income.

No.	Challenges	Impacts
13	Knowledge and awareness	The camp is not perceived as a permanent home but 'permanently impermanent'. Building permanent infrastructure is strongly controversial, both to Palestinians and Lebanese, as it appears to give a sign of acceptance and normalization of the status quo. There is therefore a constant trade-off between the political need to prevent the permanent installation of Palestinians in Lebanon, and the everyday needs of ordinary people for development, sanitation and a healthy environment. Hygiene behaviour can be looked at in three key spaces (UNWRA 2016): household, public space inside the camps and public space outside the camps. The population requires continuous sensitization and environmental education to maintain a minimum hygiene level, particularly in public spaces within the camp given the high-density and deprived socio-economic environment. To maintain the proposed camp improvements (see challenges 1-12), trained technicians and worker are needed. This should be done in training-on-the-job and through developing / adapting the curricula at the UNRWA's vocational training centre in Sibline.

3. Summary of Proposals for Improvements & Investments

Together with local stakeholders and based on the findings from an intensive assessment, 9 topics, which would require implementation support, have been identified. Implementation and design studies were developed - refer to details in Vol. 3. Technology packages were elaborated and discussed with the community; here is the list of the identified projects as proposals for improvements and investments. After being endorsed by UNWRA, and the Tyre Municipality or the Rashidieh community, a detailed implementation study with its associated Environmental and Social Impact Assessment (ESIA) for each project would follow.

1. Improving storm water management with infiltration areas (green spaces with reforestation or gardening)

   The most efficient way for high flow storm water run-off treatment is large volume retention wetlands. These store the water and either settle or filtrate the water or both. An overall wetland area of 1% of the drained area may be used as a rule of thumb for the necessary retention and filter surface (DWA-A 178 Draft, 2017). With a roughly calculated 43.5ha drained area a retention wetland of about 4,350m² would be able to treat the storm water outfalls of the camp with a hydraulic efficiency of 80%. Since all outfalls are evenly spread along the shore the best option would be a green buffer strip between shore and the settling area. Considering the total length of the shoreline with 1,300 m a green wetland strip would have a width of 3.3 m in order to reach the desired surface area for treatment.

   Design rules: (a) Mix of storm water in wastewater should be avoided, (b) Mix of wastewater in storm water should be avoided, (c) Storm water flow should be free of garbage, and channels should be cleaned regularly.

2. Street Environment

   There is a lot of dust and sandy/earthy material on the streets. The waste that has been washed away contributes to the pollution of the coast. It is doubtful whether clean roads can be achieved only by raising awareness. As a rule, a combination of avoiding waste and organized waste collection (putting up and regularly emptying containers in the street) and street cleaning is required. Only when the streets are thoroughly maintained and cleaned, and citizens are aware of hygiene

and environmental impact, can it be expected that the residents will change their waste management behaviour. Until a condition of cleaner environment is achieved again a cycle of poor maintenance and condition can be expected.

It is proposed to purchase a compact road sweeper capable of operating in narrow streets. It is important to ensure that this machine can bind the road dust and that water used is carefully managed and is recycled.

3. Renewable energy
    a. 2,200 photovoltaic home systems for lighting, fan, TV, PC, Mobile phone, and radio
    b. 2,200 solar heaters
    c. 1,000 solar cooker and solar boxes
    d. 20 electrical tuk-tuk with solar charging station, introduced as business loan
    e. 2,000 Rice cookers (gas or electric or solar)
4. Grey water treatment

    In order to protect and secure the fresh water supply, design rules for grey water treatment and re-use are as follows: (1) Only water from hand washing, showers, and laundry washing machines should be considered to be re-used locally for gardening after simplified treatment. (2) Construction of a French drain filter with nutrient recycling through plants at the end of the filter. (3) Health-based targets: health protection through prevention of exposure to pathogens in excreta and grey water in a system achieved by treatment barriers. (4) Barriers verified by monitoring esp. of large-scale systems. (5) Green wall / living wall: potential for 400 spaces for treated grey water reuse for vertical drip irrigation.

5. Community facilities demonstration, Public and School toilets

    Design improving for the existing toilet design and its connection to treatment systems in the public areas, Toilet cubicles at 4 Schools, 6 Mosques, 2 Football spaces, 2 beaches (North and South), 1 cemetery; targets: Avoid wastewater infiltrations by percolation pits (groundwater only 6 m deep!), Support gender dignity

6. Coastal protection

    Initiate and support complementary activities to the coastal protection planning along the Rashidieh housing coastal area, 53 houses in danger in the next 20 years. There is a need for a comprehensive solution including the not yet managed bulky, construction debris; recommendation are needed on shore and beach cleaning although financing is available. Sand drifting should be stopped to protect the RAMSAR area and the water resources. But UNRWA's authority and mandate is limited to the Camp and does not extend to the surrounding areas including the nature reserve.. Therefore, at local level mutual understanding is used for resolving issues. There are interlinkages between environmental education and awareness raising and the role of the RAMSAR nature reserve in Rashidieh as well as in the area in general. This is a significant opportunity to expand knowledge and action for environment awareness, partnership and cooperation between the different stakeholders in Tyre.

7. Wastewater management
    a. Develop complementary, appropriate and innovative wastewater collection systems in densely populated areas (“old camp”), and for relative flat topography (“new camp”),
    b. Design innovative decentralized wastewater pre-treatment systems in the Rashidieh housing area. One (1) central point (pumping station) needs underground (pre-)treatment plant (DEWATS) for all wastewater from Rashidieh.
    c. 1,441 houses need to be connected to the gravity sewer but are lower sited (liftings and vacuum sewer system)

d. 2,254 houses need water leaking repair measures (water tank swimmer stops, piping repair package, and water saving accessories)

e. Assumption is: daily flow of 1,000m^3 wastewater maximum, and 500m^3 wastewater as minimum

f. Flexible in the Degree of Centralization – depending on settlement structure and topography

8. Household based Solid Waste Management

   There is a need to analyse further "waste-to-value" (and closed loop) recovery options in the surrounding Tyre area, mainly related to not-yet-managed or by planning steps tackled waste streams. Planning faecal sludge recovery and treatment, combining it with organic household waste resulting in a sludge treatment process with value recovery. All sorted recyclables are finally taken by a formal waste collector who works at a sorting facility in Tyre. Through the solid waste camp management project, families find new innovative opportunities to generate income.

   a. Collected: nowadays 6 t/day – after non-formal recycling in the camp

   b. Waste treatment alternatives

   c. Procure mobile electromechanical shredding system

   d. Plastic to Oil: capacity 1 t/day (Use multifuel genset's in 6 UNWRA gensets - 24 tons fuel/year)

   e. Pelletizing Solid Waste (MSW) System

9. Tyre Nature Reserve Support

   a. Support the protection of RAMSAR and other protected natural reservation areas,

   b. Integrated Beach Waste and Water Management

   c. Public toilets at beach

   d. Coastal protection

   e. Ground water (spring, boreholes) protection

In addition, the need for specific practical capacity and awareness building measures on some of the above-mentioned topics were identified and elaborated in participatory approaches with local stakeholders, prior or in parallel to any study activity. All aspects should be integrated with each other and aligned with MoE's and Tyre Municipality's development plan objectives. Any final design report on each solution (project) must be endorsed by the various local stakeholders.

Project 6 and 9, "Coastal protection" and "Tyre Nature Reserve Support" needs further planning steps with related stakeholders and it is recommended to integrate both packages in one implementation plan.

4. Recommended actions to increase knowledge and awareness

This scope of work has been developed as part of the "Integrated Sustainable Environmental Sanitation" Pre-Feasibility Study to present the conceptual design for an integrated education and awareness *component*. Activities under this *component* will support individuals and groups to independently identify, prioritize, and engage in long-term commitments to attitude and behaviour change relating to environment and sanitation. *Integrated Education and Awareness* is comprised of two distinct sub-components: 1) Awareness Building; and 2) Primary and Secondary School Education.

Effectiveness and sustainability of the proposed solutions towards improved health and environment quality in and around the camp depends on the level of environmental awareness of the community and their willingness to engage and initiate behaviour change. Therefore, knowledge and awareness

comprise an essential component of the "Integrated Sustainable Environmental Sanitation Approach" proposed by this Pre-Feasibility Study.

Behaviour change requires long-term engagement with the community through an inclusive, participatory integrated awareness raising and education strategy geared towards increasing environmental knowledge, changing current negative attitudes and perceptions and promoting environmentally sound practices on individual, community and organizational level in the camp. More specifically, the proposed approach seeks to:

- Improve general environmental awareness in the Tyre-Rashidieh area to make the environment a priority and to communicate the links between environmental health and other individual and community priorities.
- Raise awareness and promote pro-environmental behaviour as a social practice among the Tyre-Rashidieh community including men, women, youth and children and improving hygiene and sanitation practices especially in public space.
- Encourage and promote informed choices for innovative and appropriate echo-sanitation and solid waste management and to ensure sustainability of these proposed technical solutions through acceptance, ownership and community mobilization.
- Promote waste-to-value concepts as tools to enhance environmental awareness and encourage behaviour change in a way that also brings financial benefit to the community. (both organic waste and solid waste (e.g. upcycling).
- Identify opportunities and promote linkages between the local natural heritage assets, including the Tyre Nature Reserve, with other “green” initiatives in Tyre Rashidieh to enhance environmental awareness and promote pro-environment behaviour.

The proposed approach is in line with UNRWA's 2016-2021 environmental health strategy for the Palestine refugee camps in Lebanon which was developed by the Environmental Health Unit (EHU) of the Field Infrastructure and Camp Improvement Program (FICIP) to provide strategic guidance in relation to environmental health interventions in the camps with focus on efficient resource management, sustainability and innovative approaches. It comprises two integrated components:

- community-based awareness and outreach engaging individuals, households and organizations and engaging women, men, boys and girls.
- a knowledge and education component targeting all 4 schools in the camp through capacity building of the teachers, integrating environment education in school curricula, and hands-on pro-active and practical extra-curricular activities linking the school to the community and the camp to the Nature Reserve.

The FICIP working group plays a key role in this respect. Therefore, capacity building of the members of the working group is essential to equip them with the necessary knowledge and skills to lead. in addition, collaboration between UNRWA and all stakeholders contributing to knowledge, awareness and education is key to create synergies and enhance impact. The main stakeholders identified during the course of the Pre-Feasibility Study include the Nature Reserve, ANERA, UNRWA schools, Innodev.

5. Entrepreneurial Development

The “Integrated Sustainable Environmental Sanitation” Pre-Feasibility Study includes a conceptual design for an Entrepreneurial Development component that contributes to a sustainable and pro-environment waste management system. The primary objective of this component is to support residents of Rashidieh camp to identify and carry-out innovative waste-to-value opportunities, including sorting, recycling and upcycling, which generate sustainable income.

The *Entrepreneurship* component aims at both, strengthening existing enterprises in the waste-to-value chain; and supporting the development of new waste-to-value concepts. The Pre-Feasibility Study

identified gender gaps in terms of work opportunities and economic participation of women in Rashidieh, therefore, part of the innovation of this component lays in identifying waste-to-value entrepreneurial opportunities for women and developing women's entrepreneurial skills to enhance their economic participation and income generation.

The pre-feasibility study identified UNRWA's vocational centre in Sibline as an important potential counterpart for the design and implementation of various training workshops. UNRWA's vocational training centre in Sibline is an important training facility which provides professional and semi-professional long and short-term training for Palestine refugees in South Lebanon. Its program is based on the German modules system and includes modules that can be adapted to fit the needs identified in the feasibility study. In addition to the regular two-year vocational programs, the centre currently offers a variety of short-term courses of 4, 6 or 9 months.

The Centre management has committed fully to cooperate with the proposed training and innovation and indicated willingness to develop tailor-made training modules that meet the specific needs of the Rashidieh integrated project if funding is available. This includes training modules on the technical components of the proposed program (operation and maintenance), as well as business management, project planning and environmental education training for UNRWA school teachers, and to integrate environmental awareness and the concepts of waste for value and the 3Rs in their education packages.

Developing such training modules in Sibline Vocational Training provides training opportunities for a large number of Palestine Refugees to participate and contributes to broader outreach and impact. The proposal to the Siblin Training Centre in Saida, Southern Lebanon, is to include in the Technical and Vocational Education and Training Programme (TVET) the following capacity building modules and courses. All modules should provide Lebanese-recognized certificates of completion.

No.	Basic Trainings needed
A	Business Management module
B	Coastal protection management aspects
C	Environmental sanitation modules (basics and innovations in sanitation, water, waste, emission, laws and guidelines, hygiene)
D	Establishing Bill of Quantities (BoQ's)
E	Occupational and household safety and health care, first aid
F	Training of trainers' modules (pedagogical aspects)

No.	Professional Modules needed
A	Solar electric technician
B	Inhouse plumbing technician
C	Sewer and Run-off technician
D	Environmental teacher and educator training (supplementary)
E	Restroom and community toilet designer and manager
F	Environmental oriented civil construction designer
G	Landscape technician
H	Wastewater and solid waste technician
I	Gardeners

PART 2 – Proposals for Improvements & Investments

1. Summary of Proposals for Improvements & Investments

Together with local stakeholders and based on the findings from an intensive assessment, 9 interventions, which would require implementation support, have been identified. Implementation and design studies were developed. Technology packages were elaborated and discussed with the community as listed below. For details concerning targeted improvements, estimated investments and implementation aspects refer to Chapters 4 through 6 in the present Vol. 3.

Table 2: Brief description of proposed improvements and investments

No.	Title	Description	estimated CAPEX	Chapter
1	Improved storm water management in 7 areas applying infiltration spaces such as green spaces with reforestation or gardening	The most efficient way for high flow storm water run-off treatment is large volume retention wetlands. These store the water and either settle or filtrate the water or both of it. An overall wetland area of 1% of the drained area may be used as a thumb rule for the necessary retention and filter surface (DWA-A 178 Draft, 2017). With a roughly calculated 43.5ha drained area, a retention wetland of about 4,350m² would be able to treat the storm water outfalls of the camp with a hydraulic efficiency of 80%. Since all outfalls are evenly spread along the shore the best option would be a green buffer strip between shore and settling area. Considering the total length of the shoreline with 1,300m, a green wetland strip would have a width of 3.3m in order to reach the desired surface area for treatment. Design rules: (a) Mix of storm water in wastewater should be avoided, (b) Mix of wastewater in storm water should be avoided, (c) Storm water flow should be free of garbage, and channels should be cleaned regularly.	140,000 USD	3.1
2	Street Environment	There is a lot of dust and sandy material in the streets. Waste, which is washed away, pollutes the coast. It is doubtful whether clean roads can be achieved by raising awareness alone. As a rule, a combination of avoiding waste and organized waste collection incl. regular emptying of containers in the streets, and street cleaning is required. Only when the streets are thoroughly cleaned it could be expected that residents will change their behaviour. It is proposed to purchase a compact road sweeper capable of operating in narrow streets. It is important to ensure that this machine can bind the street dust and that water is recycled.	90,000 USD	3.2
3	Renewable energy	a. 2,200 photovoltaic home systems for lighting, fan, TV, PC, Mobile phone, and radio b. 2,200 solar heaters c. 1,000 solar cookers and solar boxes	5,000,000 USD	3.3

No.	Title	Description	estimated CAPEX	Chapter
		d. 20 electrical tuk-tuks with solar charging station, introduced as business loan e. 2,000 Rice cookers (gas or electric or solar)		
4	Grey water treatment	In order to protect and secure the fresh water supply, design rules for grey water treatment and re-use are as follows: (1) Only water from hand washing, showers, and laundry washing machines should be considered to be re-used locally for gardening after simplified treatment. (2) Construction of a French drain filter with nutrient recycling through plants at the end of the filter. (3) Health-based targets: health protection through prevention of exposure to pathogens in excreta and grey water in a system achieved by treatment barriers. (4) Barriers verified by monitoring esp. of large-scale systems. (5) Green wall / living wall: potential for 400 spaces for treated grey water reuse as vertical drip irrigation.	2,200,000 USD	3.4
5	Public and School toilets	Improving the existing toilet design and its connection to treatment systems in the public areas, Toilet cubicles at 4 schools, 6 mosques, 2 football pitches, 2 beaches (North and South), 1 cemetery; Target: Avoid wastewater infiltration by percolation pits because groundwater is only at 6m depth; promote gender dignity.	700,000 USD	3.5
6	Coastal protection	Initiate and support complementary activities to the coastal protection planning along the Rashidieh housing coastal area, 53 houses in danger in the next 20 years! There is a need for a comprehensive solution including the not yet managed bulky, construction debris; recommendation are needed on shore and beach cleaning although financing is available. Sand drifting should be stopped to protect the RAMSAR area and the water resources. But UNRWA doesn't have the authority to impose its decisions on the entire public. Therefore, at local level mutual understanding is used for resolving local issues. There are interlinkages between environmental education and awareness raising and the role of the RAMSAR staff in Rashidieh as well as in the area in general.	1.500,000 USD	3.6
7	Wastewater management	a. Develop complementary, appropriate and innovative wastewater collection systems in densely populated areas ("old camp"), and for relative flat topography ("new camp"), b. Design innovative decentralized wastewater pre-treatment systems in the Rashidieh housing area. One (1) central point (pumping station) needs underground (pre-) treatment plant (DEWATS) for all wastewater from Rashidieh. c. 1,441 houses need to be connected to the gravity sewer but are lower sited (liftings and vacuum sewer system)	2,200,000 USD	3.7

No.	Title	Description	estimated CAPEX	Chapter
		d. 2,254 houses need water leaking repair measures (water tank swimmer stops, piping repair package, and water saving accessories) e. Assumption is: daily flow of 1,000m^3 wastewater maximum, and 500m^3 wastewater as minimum f. Flexible in the Degree of Centralization – depending on settlement structure and topography		
8	Household based Solid Waste Management	Analyse further "waste-to-value" (and closed loop) recovery options in the surrounding Tyre area, mainly related to not-yet-managed or by planning steps tackled waste streams. Planning faecal sludge recovery and treatment, combining it with organic household waste resulting in a sludge treatment process with value recovery. All sorted recyclables are finally taken by a formal waste collector who works at a sorting facility in Tyre. Through the solid waste camp management project, families are finding new innovative ways to make a living. a. Collected: nowadays 6 t/day – after non-formal recycling in the camp b. Waste treatment alternatives c. Procure mobile electromechanical shredding system d. Plastic to Oil: capacity 1 t/day (Use multifuel genset's in 6 UNWRA gensets - 24 tons fuel/year) e. Pelletizing or Charing Solid Waste (MSW) System	1,600,000 USD	3.8
9	Tyre Nature Reserve Support	a. Support the protection of RAMSAR and other protected natural reservation areas, b. Integrated Beach Waste and Water Management c. Public toilets at beach d. Coastal protection (avoid sand transport) e. Ground water, springs, and boreholes protection	500,000 USD	3.9

In addition, needs for the development of specific skills, as well as capacity and awareness building activities were identified and elaborated in a participatory manner with local stakeholders, prior or in parallel to any study activity – refer to Chapters 3.10, 3.11, 4 and 5. All aspects need to be integrated and aligned with the objectives defined in MoE's and Tyre Municipality's development plan. Any final design for each of the proposed improvements and investments should be endorsed by local stakeholders and should include an element of increasing knowledge and skill and awareness raising.

2. Proposed Improvements & Investment

This chapter provides details on the above listed and briefly described proposals for improvements, and estimations of required investments. It elaborates in detail on strategies, actions and activities to be

carried out for raising awareness, increasing knowledge and skills, as well as to develop entrepreneurship – all related to the proposed improvements and investments 1 through 9.

2.1 Improving storm water management in 7 key areas

The most efficient way for high flow storm water run-off treatment is large volume retention wetlands, or infiltration spaces such as green spaces with reforestation or gardening. These store the water and either settle or filtrate the water or both of it. An overall wetland area of 1% of the drained area may be used as a rule of Thumb for the necessary retention and filter surface (DWA-A 178 Draft, 2017). With a roughly calculated 43.5ha drained area a retention wetland of about 4,350m² would be able to treat the storm water outfalls of the camp with a hydraulic efficiency of 80%. Since all outfalls are evenly spread along the shore the best option would be a green buffer strip between shore and the settling area. Considering the total length of the shoreline with 1,300m a green wetland strip would have a width of 3.3m in order to reach the desired surface area for treatment.

Design rules should include: (a) Mix of storm water in wastewater should be avoided, (b) Mix of wastewater in storm water should be avoided, (c) Storm water flow should be free of garbage, and channels should be cleaned regularly.

The general concept for storm water management in the Rashidieh camp site is to protect the buildings from increasing flood risks, and to reduce the organic and nutrient load discharge to the sea. Additional ecological and micro-climate benefits are provided by measures that involve treatment and storage of water in combination with vegetation.

The following Table provides an overview on cost estimation for seven areas, both as preliminarily estimated by the consultant and revised by the stakeholders.

Table 3: Cost estimation for components of improved storm water management in 7 areas

No.	System component	Training need (with Siblin) / UNWRA	estimated CAPEX USD	Revised estimation USD
1	Engineering & re-construction for 7 main drains	Y		
2	Rainwater harvesting design	Y		
3	Green roof designing	Y		
4	Gullies re-design & construction	Y		
5	Constructed wetland design & construction	Y		
6	Construction material per m^2 area to protect			
7	Construction material for civil measures			
8	Recycling of debris for construction			
9	Establishing wetlands for 4 outfalls			
10	Nursery to produce green/blue plants for roofing	Y		
11	Labour force from the camp			
12	Management, supervision, guidance and monitoring	UNWRA		

13	Awareness raising & capacity building = 15%	21,000.00		
	TOTAL		140,000.00	

2.1.1 Decentral measures

Any infiltration and hold-back measures near the source area (i.e. roof or street) can help to reduce run-off volumes for preventing flood extremes. At the same time, the application of potential treatment techniques and technologies is enhanced by a longer retention time of storm water before flowing into the sea.

- **Blue or Green Roofs**

Given the present population density in the camp, it can be assumed that roof areas account for at least 50% of the sealed area. For this reason, the greatest potential for reduction of run-off volumes exists here, especially since most roofs are currently unused spaces.

This topic has been addressed at the workshop. Initially, the opinion was expressed that the houses are generally being expanded by more stories in order to create living space for growing families. Conversely, this means that new roofs are also being built there. These can be designed from the outset in such a way that water retention and greening are possible. It has also been reported that most roofs are leaking water and that there are no proper materials for sealing easily available.

The survey among the participants, including all inhabitants of the camp, revealed that if a corresponding subsidy program would be set up, everyone would participate in the construction of green roofs. Due to the special situation in the camp, all materials are extremely expensive.

Another difficulty is the lack of specialist knowledge. Such measures can only be implemented here if the residents of the houses receive competent construction support and advice during planning.

It is therefore proposed to develop a program for the promotion of 100 green roofs. This would work as follows: Publication of the conditions of support for green roofs on private and public buildings, organization of an information event / introductory workshop for interested house owners, training of 10 voluntary experts, individual consultation and planning for the houses of the volunteers, determination of costs and financial support, production of the first 10 green roofs, joint evaluation of experiences, planning and implementation of the next green roofs with the help of local experts.

The work includes preparation of structure (concrete reparations), geo-textile, 2 mm HDPE-liner (UV-resisting), drainage layer built from crushed building materials (concrete), substrate layer from crushed bricks added with 10-30% of humus earth or 30% bio-char or light weight aggregates if available, new water intake for overflow water and vegetation as preferred.

This measure could create a small economic sector for the trained experts in the camp. At the same time, building demolition waste, which is a major problem here because it must not be taken out of the camp, can be recycled. This requires the purchase of shredding machines. Recycling of debris is one of the major tasks for creating a circular economy in this camp.

Additional benefits include a cooling effect and the ecological upgrading of the sealed areas. It has been shown that such areas also contribute to increasing biodiversity significantly.

The construction costs per roof (100 m²) incl. labour may roughly be estimated at 5,000 USD.

- **Rain-Water cisterns and underground infiltration**

For the intermediate storage and possible use of rainwater, cisterns can be built in the courtyards if a green roof is not possible. The size should allow the storage of up to 50 mm precipitation. A roof area of 100 m² would therefore require 5 m³ storage volume. If the water is not subsequently used (e. g. for toilet flushing) it should be slowly drained into the ground by means of a throttle valve. The cistern then only has to store the amount of water that cannot be seeped away during a short heavy rainfall.

Combined storage and infiltration shafts are possible. Even if the throttle flow would have to be discharged to the storm water channels, the reduced flow has a positive effect for those channels where a final (end of pipe) treatment is provided before entering the Mediterranean Sea.

For the realization of cisterns or infiltration systems, an identical program can be set up as proposed for the distribution of green roofs. The price per roof may similarly be estimated at 5,000 USD.

2.1.2 Central Measures

These are measures in public area and include fixing of storm water inlets to the drainage channels as well as maintenance and operation of roads and drainage systems. Regular cleaning of roads drastically reduces the water pollution. This is one of the simplest and most effective measures. Effective, especially before the beginning of the rainy season.

- **Gullies**

Road gullies must be designed in such a way that garbage cannot enter, high drainage is guaranteed, and fine substances and gravel are retained. For this purpose, technical variants with high efficiency were developed in Germany. However, it has been shown that simple measures such as drains with integrated sludge buckets are in themselves very effective. In general, it is a prerequisite that there is complete coverage of the sewerage system when big amounts of dirt are expected. While most of the roads in the new camp have been newly paved and the rainwater inlets have been rehabilitated, there is still considerable demand in the old camp for such improvements.

It is recommended to systematically check all rainwater inlets in the camp and to optimize them if necessary:

- Renew the inlet grille,
- Install slurry tanks/ baskets
- Provide systematic, regular cleaning of the inlets

- **Retention wetland**

The most efficient way for high flow storm water run-off treatment is large volume retention wetlands. These store the water and either settle or filtrate the water or both.

An overall wetland area of 1% of the drained area may be used as a rule of the thumb for the necessary retention and filter surface (DWA-A 178 Draft, 2017). With a roughly calculated 43ha drained area a retention wetland of about 4,300 m² would be able to treat the storm water outfalls of the camp with a hydraulic efficiency of 80%. Since all outfalls are evenly spread along the shore the best option would be a green buffer strip between shore and the settling area. Considering the total length of the shoreline with 1,300 m a green wetland strip would have a width of 3.3 m in order to reach the desired surface area for treatment.

As long as buildings in the New Camp are not removed from the beach there is no chance for any treatment in this area. Other measures preventing any discharge of untreated greywater have to be taken here (-> see Greywater treatment)

Especially for the outfalls No. 2, 3, 4, 5 as displayed in Figure 1, wetlands could be an option for the near future since here buildings remain behind the shore. When visiting the place, it became obvious that the region south of outfall No. 2 is badly devastated from construction debris and garbage which needs to be mitigated. A branch of outfall 3 has been deviated to the north presumably in order to protect the camp´s beach behind the cemetery from discharge of untreated combined sewage. This branch (3.2) is a concrete channel going about 90 m north along the shore line. It is already leaching and in a bad shape.

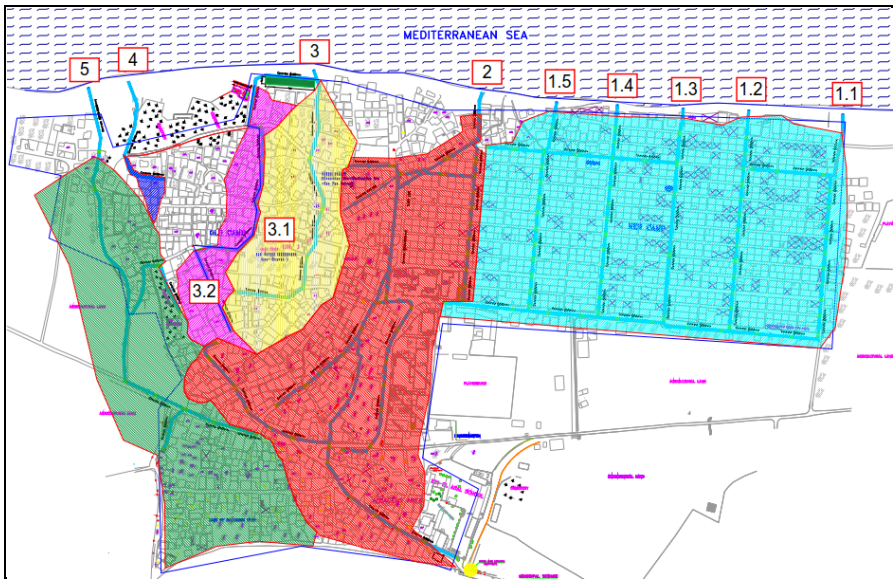


Figure 1: Storm water drainage areas (estimated)

Estimated sizes for storm water treatment wetlands are as follows:

Table 4: Wetland sizes

	Run-off area	**Wetland**
Outfall	**ha**	**m²**
2	12.6	1260
3		620
3.1	4.3	430
3.2	1.9	190

Figure 2: Indicated area for storm water retention wetland at outfall No. 3

The entire area could be restructured by cleaning the beach from debris. The existing branch of the concrete channel (3.2) could be used for feeding a retention wetland. Without any buildings on it, a land surface of 9 x 70m would provide sufficient space for treating the waters from outfall No. 3.

The area connected to outfall No. 4 seems to be quite small considering the inclination of the area, if no unknown connections exist. A reasonable retention wetland size would be about 400m². This outfall stream has a natural character. A useful area of approx. 500m² near outfall No. 3 was identified. Ownership has to be clarified.

Outfall No. 5 drains 8.2ha of land. For this part with less building density a run-off coefficient of 0.5 is assumed. For outfall No. 5, water retention and water mitigation can be integrated into a nature adapted flooding zone.

Figure 3: River retention and flooding zone with natural character, 100 m length

2.2 Street cleaning

There is a lot of dust, sand and earth in the streets, especially around construction sites. Obviously, it's difficult to keep the streets clear of garbage. The waste which is washed away contributes to the pollution of the coast. It is doubtful whether clean roads can be achieved only by raising awareness. As a rule, a combination of avoiding waste and organized waste collection - installing and regular emptying of waste containers along the roads, and street cleaning is required in addition to awareness raising. Only when the streets are thoroughly cleaned it could be expected that the residents will change their behaviour. Without these measures, it is unrealistic to expect behaviour change.

Figure 4: Compact sweepers (Schmidt Company, Germany)

It is proposed to purchase a compact road sweeper capable of operating in narrow streets. It is important to ensure that this machine can bind the road dust and that water is recycled. Such machines are available in Germany in good quality at relatively low prices on the market for second hand (used) municipal vehicles. For the purchase at least 30,000 USD should be budgeted.

Table 5: Cost estimation for components of improved road cleaning

No.	System component	Training need (with Siblin) / UNWRA	estimated CAPEX USD	Revised estimation USD

1	Purchase costs (second hand) for Sweeper(s) including spare part package for one year and capacity to of 30 km dense street sweeping every second day		30,000.00	
2	Waste containers (50) for public places and street crosses		25,000.00	
3	Training of sweeper drivers	UNWRA		
5	Overall Management, supervision, guidance and monitoring	UNWRA		
6	Awareness raising & capacity building = 15%	13,500.00		
	TOTAL		90,000.00	

2.3 Renewable energy

Renewable energy on household level as well as on intermedium level could play an important role in the entire energy supply system of the camp. Resources are theoretically available in sufficient scale. However, to promote commercially viable and competitive solutions essential prerequisites must be met. It is proposed to install

- 2,200 photovoltaic home systems for lighting, fan, TV, PC, mobile phone, and radio
- 2,200 solar heaters
- 1,000 solar cookers and solar boxes
- 20 electrical vehicles (tuk-tuk) with solar charging station, introduced as business loan
- 2,000 rice cookers – either gas, electric or solar

Options for renewable energy to be used on household level in Rashidieh camp should either be based on solar energy or on biogas production. Both technologies have been identified as potential sources of renewable energy. Hydropower within the premises of Rashidieh is no option. Geothermal power would be available, but its complexity to use is compared to solar and bioenergy not worth to consider. Wind energy on large scale is not possible due to space constraints. However, at small scale – i.e. roof top wind power generators for battery charging is an option.

2.3.1 Prerequisites for the use of solar energy

With a global horizontal irradiance (GHI) of 1,700 to 1,800kWh/m^2 Lebanon physically provides perfect conditions for the use of solar energy. Averaging at 4.8kWh/m^2 per day and 3,000 hours per year, Lebanon enjoys an abundance of solar radiation. These favourable conditions render the use of solar energy in Lebanon favourable option, thus offering an attractive substitute to e.g. conventional biomass, electricity and LPG-fuelled cooking methods (*solargis.com*).

Solar energy applications suitable for local implementation are:

- Photovoltaic (PV);
- Solar water heaters (SWH);
- Solar cookers (e.g. on roofs in combination with roof gardens).

From these three solar energy options the SWH presents the most realistic form of application. Low investment costs, almost no operation cost and easy maintenance and operation, as well as a remarkable reduction of electricity demand in an average household are the biggest advantages for both

solar water heaters and solar cookers. Solar PV is more complex and especially initial investment for PV systems is much higher, but once installed it is almost free of maintenance and operation cost.

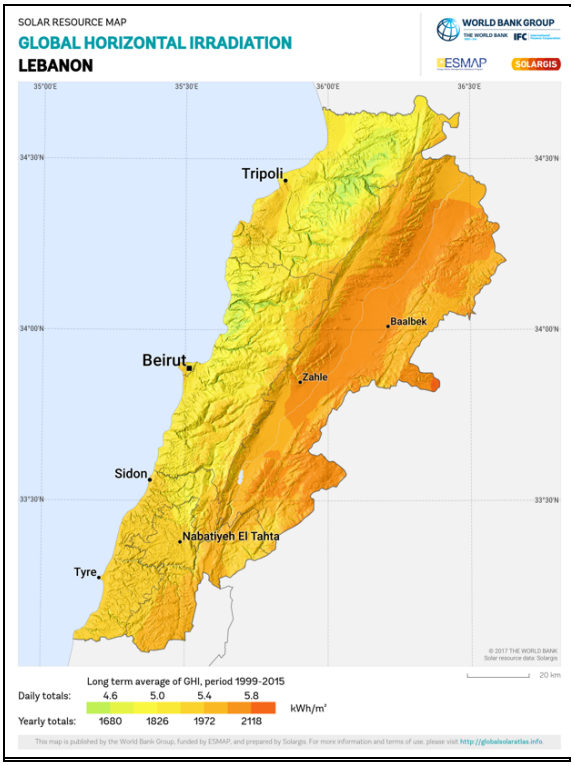


Figure 5: Global Horizontal Irradiation for Lebanon (solargis.com)

Photovoltaic (PV) systems

Investment cost and system integration are quite complex and require professional skills for safe installation to achieve high-level benefits. Nevertheless, market prices for such systems are nowadays low and further decrease is expected. Available PV-systems are offered as one-in-all solutions, making installation and operation convenient.

PV is considered as a very good opportunity to develop a sustainable and independent energy supply on household level as well as on camp level. However, the current free-of-charge situation for electricity supply in the camp will most likely block any activity towards a relevant dissemination of PV systems. It is expected, that any suggestion towards an independent electricity supply will not find the necessary acceptance and support among the residents as well as by UNRWA. There are too many other big issues to be resolved, thus an initially cost-intensive investment without direct benefit for camp improvement will not be accepted.

Another obstacle for the implementation of PV systems is the unclear situation of feed-in-grid regulations. No feed-in-grid regulation or guidance for setting up those regulations exist in the camp.

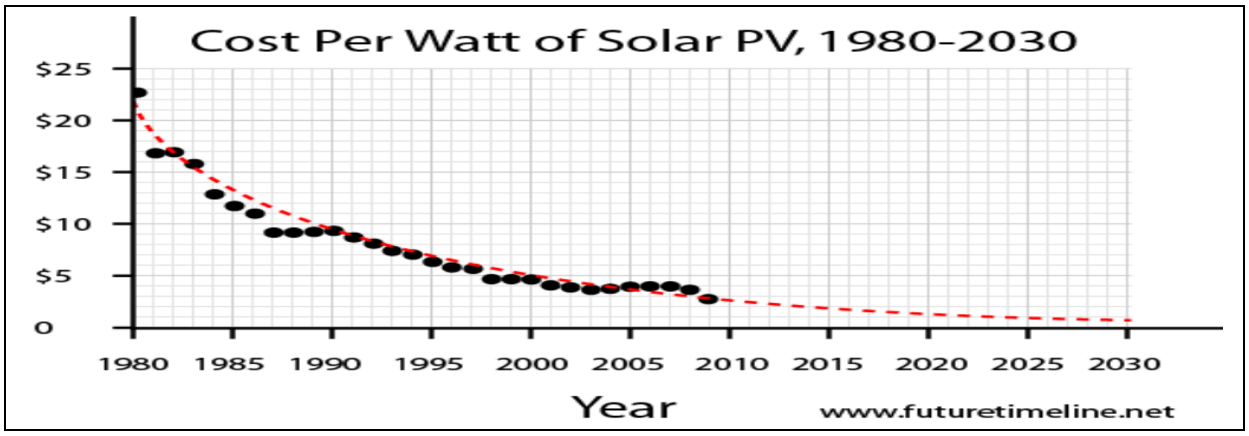


Figure 6: Cost per Watt of PV systems, 1980 – 2030 (international statistics)

Figure 7: Example for photovoltaic installations to solve energy supply issues in densely populated areas

Solar water heaters

A household solar water heater (SWH) could reduce a family's total annual energy consumption by around 42% (World Bank, 2009), thus reducing significantly the overall electricity demand in the camp.

Stakeholders met during the assessment mission confirmed their awareness and the potential of SWHs despite currently existing barriers. These barriers are summarized as follows:

- High investment costs and the absence of incentives and financing mechanisms for SWHs;
- Long payback periods for SWHs compared to conventional systems and water heating with free-of-charge electricity;
- Lack of customer services inside the camp;
- Possible restrictions to bring the units inside the camp.

In addition, a World Bank report states that SWH technology in Lebanon in general encounters the following constraints (World Bank, 2009):

- Low quality of SWHs distributed on the Lebanese market;
- Reluctance of end users to pay their bank loans when systems break down;
- Reluctance of bankers to finance SWHs without proof of a guarantee;
- Absence of national standards and labelling.

One solar water heater should be sufficient for a household of up to 8 people.

Figure 8: Solar water heaters in Rashidieh camp

Solar cookers

Cooking on roofs in combination with roof gardens could be enhanced by simple solar cookers constructed from basic materials for a total cost of 5-7 USD (SCI, 2017; Solar Cooking Wiki, 2017). Complex and large-scale solar cookers can also be built to match specific performance requirements or to be used in community kitchens (Cuce, E., 2013; Otte, P.P., 2014). The implementation and diffusion of solar cookers in different areas, under different operational settings, could be supported by the versatile characteristics of these devices. Additionally, the dissemination of solar cookers in Lebanon could address environmental, health, economic and safety challenges faced by the country.

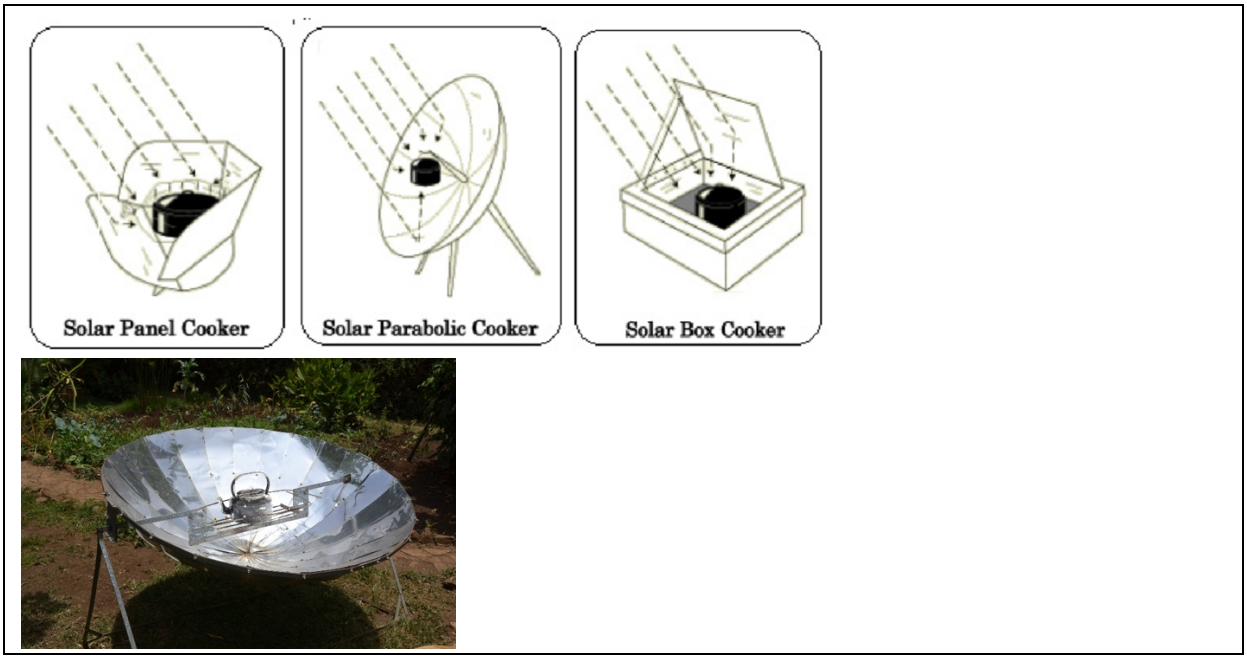


Figure 9: Types of solar cookers (Touma J., 2016) (left– sketches), and – right: a parabolic solar cooker in operation for 8 years in Tanzania

The dissemination of low-cost solar cookers, in addition to large-scale communal ones, among refugees, could constitute an affordable and practical solution to the problems faced by these families and their host communities. The use of solar cookers in the country, in particular in rural areas, which are prone to frequent fuel shortages could play an important role to mitigate these shortages. Solar cookers could be promoted as outdoor kit, able to satisfy the users' needs, while preventing forest fires and protecting the environment.

2.3.2 Prerequisite for the production and use of biogas

The production of biogas depends on the availability of suitable organic matter. The source of organic matter could vary, but organic material from waste streams fits best in the concept of waste-to-value.

Inside the camp, untreated but collected wastewater from both existing and future sewer systems could provide sufficient organic matter to feed several medium scale biogas plants of 60 to 100m^3 volume each. In combination with organic waste from households, assuming an efficient collection and sorting system would be in place, biogas production would be secured. Residues from agricultural activities could also be fed into the biogas digester(s). However, although these potential feedstock sources exist, no statistics about their availability are so far available. A comprehensive evaluation of biomass residues is needed in order to work with reliable data, if biogas system(s) should be designed.

Energetic values could be generated from organic components of the wastewater as well as of the organic fraction in municipal solid waste (MSW). The separation and use of organic material for energy production would be supportive to a holistic sanitation concept for the camp. It is assumed that with the complete collection of organic matter from these two sources of organic feedstock for biogas production they could potentially produce 540m³ biogas per day. A pilot or demonstration system should be the initial showcase for this technology and the required logistic to display that any biogas installation should be conveniently integrated in daily life activities.

This could be smoothly done when connecting a biogas plant to the existing sewage system. Such digester would operate as an intermediate settler in which solid particles contained in the waste water settle, forming a bottom sludge which produces biogas. Main target of this kind of system is the biogas production; thus, desludging would only be necessary partially and after many years of operation. The gas produced can be used for several households as cooking energy, or in a restaurant or bakery where at one location all biogas could be used. The quantity of biogas produced, depends on the number of households attached to the sewer system. As rough orientation: for 10 sewer attached households, one household can be served with biogas. Biogas production depends also on the ambient temperature, thus in winter gas will be less while in summer gas will be more.

From the section of the camp which will potentially be served with a vacuum sewer system, the amount of biogas produced could range between 15 and 20m³ per day. Digester volume should there be 100m³ to provide cooking energy to 10 families. Gas production could be enhanced by adding kitchen waste into the digester through the inlet.

If biogas yields are achieved as expected, it could be considered to use any organic waste for biogas production and increase the volumes of further constructed biogas systems. However, it will be difficult to find enough spaces for larger constructions in the camp. One option would be the area near the location where sewage from the old camp would be pumped to enter the sewer system of the new camp.

The demonstration model for a biogas system could be similar to the one sketched in the following figure:

- The entire structure is built underground with 4 manhole covers which allow for access and emptying – if needed, and a displacement canal
- The location is proposed in accordance to the planned point to which sewage from the old camp is pumped.
- Instead of entering the sewage pipe from the new camp the sewage flows into the biogas digester to produce biogas under anaerobic conditions.
- The overflow is guided to the existing sewer system.
- The Waste-to-Value concept is realized through the production of biogas and its use.

The use of the effluent as organic and liquid fertilizer could also be demonstrated on site, with the consent of the owner of an agricultural or gardening plot and a small pump. However, this would require a post treatment of the effluent in a constructed wetland or French drain.

This technology has a combined effect and targets a variety of issues including: sanitation, renewable energies and food production. Therefore, it can be considered as a fine-tuned waste-to-value concept.

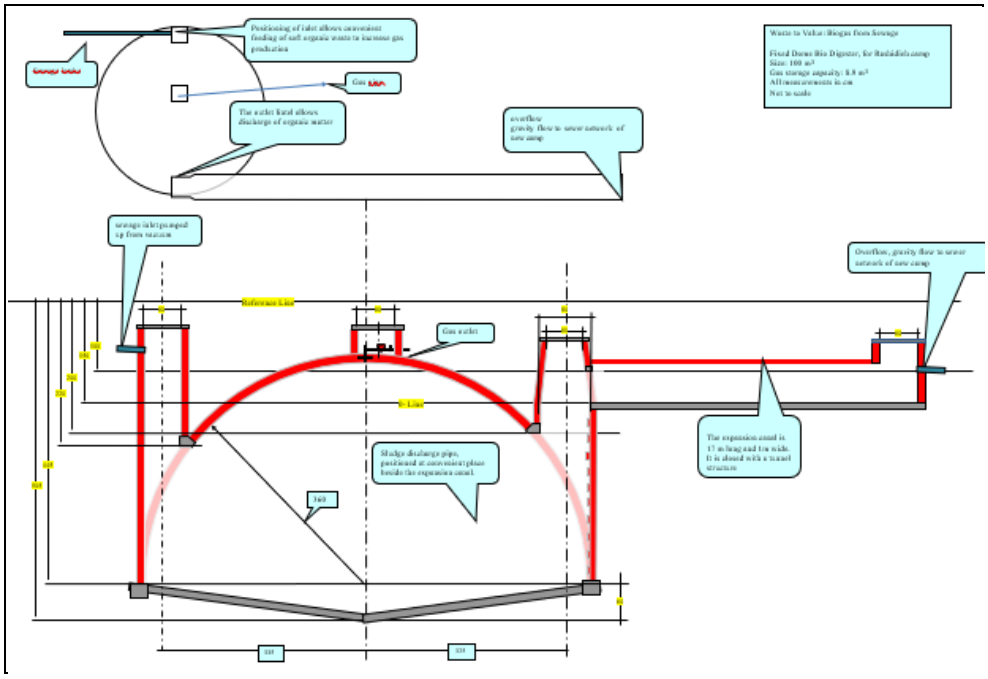


Figure 10: Basic drawing of a biogas digester with displacement channel

As proposed in the map below, a centralized biogas digester with displacement canal could be located in the camp. However, it should be noted that this is only a technology-based idea without having identified the owner of the place and without having negotiated any roadmap for implementation.

Figure 11: Identified potential location for initial biogas plant (red dot = digester; red rectangle = displacement canal)

2.3.3 Renewable Energy Promotion Action Plan

Since 2009 (UNDP/GEF, 2009), Lebanon is promoting the use of renewable energy by various activities. According to the same report, NEEAP (MoE, 2012), the second NEEAP (MoE, 2016) and the NREAP (MoE, 2012) are building a strong supporting structure. In combination with the National Energy Efficiency and Renewable Energy Action (NEEREA), financing mechanisms for needed infrastructure should be in place. However, according to UNRWA, none of these programs have ever been used to actively promote renewable energy in any of the Palestinian camps. Any promotion strategy should

carefully consider to which extent any activity in the camp would affect also the surroundings of the camp, respectively energy policy and energy supply of Lebanon.

The following proposal of a strategy could be applied for the promotion of Renewable Energy (RE) in the camp:

(1) Status quo: Renewable energy technologies are not present in the camp

(2) Challenges: There are three barriers for the application of renewable energies in the camp:

a. Free-of-charge energy supply counteracts the need for investment in renewable energy technologies

b. Regulative restrictions could make it difficult for the residents of Rashidieh to invest in respective private infrastructure

c. Limited motivation for investment due to the refugee status and the perception of life in the camp as a temporary situation.

(3) Options for introducing renewable energy technologies

- Solar cookers: In combination with greening the roofs solar cookers could be introduced. The international market offers packaged systems (https://www.indiamart.com/brahmadip-enterprise/solar-cooker.html), which can be assembled in the camp (1 cooker/ 1 person/ 1 day). This could become a business.
- Biogas demo plant integrated in the technical solutions for sewage collection, transport via sewer pipes and disposal for exposure visits, training and demonstration. It would go along with a 6 weeks training program with theoretical and practical components.
- Introduction of a “100 solar water heater demo program” with the objective to create awareness and demand. This could be supported by UNRWA as electricity bill reduction.
- Schools could be equipped with PV systems for educational purposes and to establish acceptance for the technology.

For any of the suggested technologies it has to be considered that optionally the technology could be promoted inside the camp to address the needs of its residents and/ or outside the camp to address the needs of the hosting communities (or beyond). Promotion at both sites would have additional advantages and would increase the value of the project idea.

Paving the way for renewable energies inside the camp should be approached from two sides:

- Inside camp promotion includes:
    a. Environmental awareness building
    b. Promotion of advantages of RE: environment, reliability, independence, free-of-charge electricity might be not permanently secured, etc.
    c. Capacity building through installation of demonstration plants
        i. One initial biogas plant using waste water from the existing waste-water collection system: biogas pilot plant, job creation, waste-to-value, biogas expertise could lead to develop a biogas company, etc.
        ii. Distribution of 100 Solar Water Heaters at least among women-led households
        iii. Workshop on how to use solar cookers with a selected group of residents at least among women-led households
    d. Job creation: RE technologies – installation, maintenance and operation services: e.g. construction of biogas plants, production of solar water heaters and cookers
- Outside camp promotion includes:
    e. International funding opportunities to be identified

f. Developing an overall renewable-energy-camp-strategy

g. Offering opportunities to be part of a solution (CSR engagement of corporations)

h. Involvement of the Lebanese government

Table 6: Cost estimation for components of improved application of renewable energies

No.	System component	Training need (with Siblin) / UNWRA	estimated CAPEX USD	Revised estimation USD
1	Purchase of Solar water heater			
2	Purchase of solar electric components			
3	Purchase of tools and installation equipment			
4	Purchase of solar charging stations (for all kind of electrical devices)			
4	Purchase of electrical TUK-TUKs			
5	Business plan for private managed public transport	UNWRA		
6	Establishing Workshop in the camp to produce solar cooker, cooking bags, solar boxes	Y		
7	Establishing solar electric service structure in the camp	Y		
9	Establishing solar plumbing service in the camp	Y		
10	Solar technology design & engineering	Y		
11	Built up Biogas service technicians	Y		
12	Built up solar technician capacity	Y		
13	Solar mini grid design study	Y		
14	Application of the Lebanon RE Action Plan in the camp (solar application systems for schools, public buildings, woman led households …..)	UNWRA		
15	Anaerobic pre-treatment (100 m3 digester volume) of concentrated wastewater, collected by vacuum sewer from the coastal area in the new camp biogas cooking use for 20 households, kitchen waste adding			

16	Anaerobic pre-treatment (400 m3 digester volume) of concentrated wastewater, collected by vacuum sewer for the old camp area, biogas cooking use for 80 households, kitchen waste adding			
17	Management, supervision, guidance and monitoring	UNWRA		
18	Awareness raising & capacity building = 15%	750,000.00		
	TOTAL		5,000,000.00	

2.4 Grey water treatment

In order to protect and secure the fresh water supply, design outlines for grey water treatment installations and its re-use are as follows:

(1) Only water from hand washing, showers, and laundry washing machines should be considered to be re-used locally for gardening after simplified treatment.

(2) Nutrient recycling through the construction of a so-called French Drain filter with plants at the end of the filter.

(3) Health-based targets: health protection through setting up treatment barriers in order to prevent the exposure to pathogens contained in excreta and grey water.

(4) Barriers verified by monitoring esp. of large-scale systems.

(5) Green wall / living wall: potential for 400 spaces for the re-use of treated grey water in vertical drip irrigation systems.

Re-use of treated grey water

Wherever water is a scarce resource, it should be used several times according to its quality and with respect to the purpose. Obviously, water for flushing toilets doesn´t need to be potable, i.e. flush water could be soapy grey water collected from handwashing or laundry washing devices. Water re-use in Rashidieh camp is mainly proposed for (grey water. For this category, water treatment has to fulfil only basic requirements. The following options for direct greywater re-use are proposed:

- Flushing toilets
- Cooling houses (transpiration / evaporation)
- Watering green areas / gardens in the dry period

For all these purposes, grey water from hand and laundry washing, separately collected from waters used in toilets or passed through kitchen sinks, could be treated for safe and convenient re-use. Grey water contains few nutrients such as ammonium and phosphorus, few carbons and has a lower Chemical Oxygen Demand (COD). Grey water is usually treated in decentralized biological systems (biofilm) with or without active aeration. The water quality should be safe for any use without personal contact. It should be clear and without any odour.

COD removal has priority in order to prevent smell from greywater storage systems and from it's re-use. This treatment can be carried out in small vertical flow wetlands or technical trickling filters along facades - so-called living or green walls, or in roof gardens. These systems could be designed with integrated cooling functions. The following measures can be carried out in buildings and private estates:

- Green roofs designed as treatment wetland
- Green facades, making use of vegetated vertical flow containers with recirculation

- Trickling filter facades, using watered plastic strips in curtain walls

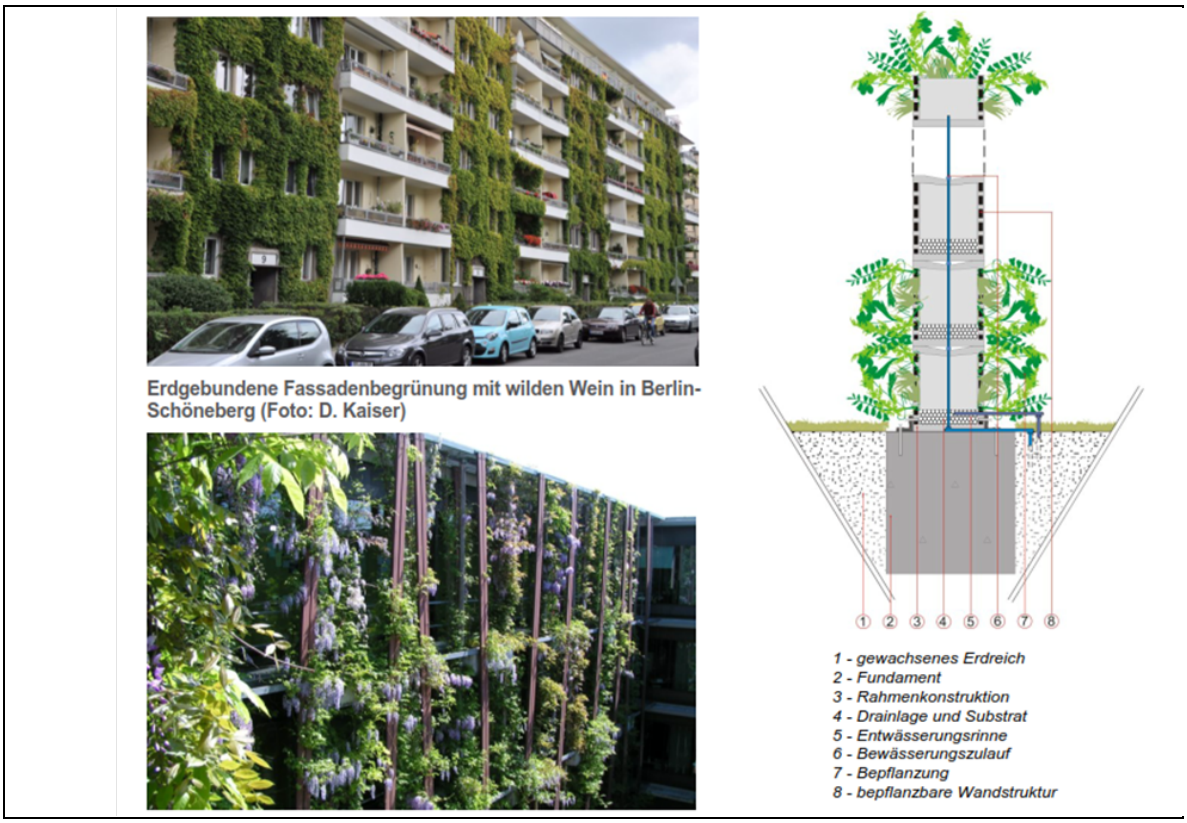


Figure 12: An example of green walls by grey water use: water is trickling through substrate containers leading to cooling of facades by shade and evapotranspiration effects (KURAS, 2017) – an example from Berlin/Germany

Green walls

A green wall, also known as a vertical garden, is a plant growth system attached to the walls of buildings. It includes all forms of vegetated wall surfaces. The advancement of green wall technologies provides a broad range of options for designers to realize multiple objectives, and to bring freestanding design features on the interior and exterior of buildings. One of the options is to integrate a building's infrastructure as a component of on-site grey water treatment, so at the same time green wall plants obtain water and nutrients from the system.

The Technical University of Berlin has investigated at Campus El Gouna in Egypt highly innovative solutions for combined grey water treatment and cooling by trickling filters. These techniques consist of wall curtains, filled with strips for biofilm growth. Grey water is fed one or several times per day from the top whereas air is blown upstream. Air temperature behind the curtains was 10°C less than in the ambient.

During a one-hour batch cycle of feeding, recirculation, and settling COD was less than 100mg/l and the Grade A Quality for Irrigation (equivalent to Jordanian Standard 893/2006) was met.

The integration of such a treatment system with green wall technology provides many environmental and financial benefits: it is an additional layer which acts as an insulator reducing both the need for cooling energy during summer and heating energy during winter, respectively. It is also aesthetically appealing and improves air quality by reducing the CO_2 level and increasing oxygen. Moreover, a green wall designed for urban agriculture can provide the basis for healthier community interaction (community gardening) and improving access to fresh food.

Figure 13: WMAL Irbid - Water Treatment in Façade Structures for Cooling and Urban Green (Carsten Riechelmann - TU-Berlin – Campus El Gouna - Water Engineering Department)

The consultant team recommends creating show or demonstration cases in the Rashidieh camp with green roofs, facades, walls and garden systems for grey water treatment and re-use.

Wetlands

When water evaporates, heat energy is being extracted from the environment (latent heat LET). The specific λ is 2,453 MJ/kg of produced steam. The converted heat in a wetland system is thus calculated from the total evaporation ET in mm/d multiplied by the density of water ρ and the special heat λ. The evapotranspiration rate of roof wetlands may reach 15 to 20 mm/d. In that case cooling energy, up to 50,000 MJ per square meter and day could be expected: LET = λ*ρ*ET [MJ/m²/d]

The driving force is the water vapor pressure gradient between the boundary layer water/air and the air masses above. If the air is already saturated (100% humidity), no more evaporation takes place. In order for continuous evaporation, the water vapor must constantly be taken away from natural winds or from blower systems (in technical coolers).

Constituents re-use

- ***Nutrients:*** Direct re-use of nutrients takes place if treated sewage is used for watering gardens or fields. For hygienic reasons a good treatment is necessary before re-use. Biological pathogen removal in constructed and natural wetlands combined with slow sand filtration is very effective. Combined vertical and horizontal flow systems may reduce E. coli by 3 to 5 log units. UV-units could be added as well.
- ***Carbon:*** use raw sewage and/or sludge as energy source; anaerobic digesters for wastewater and sludge treatment to generate methane (CH_4); build a showcase incl. post treatment on the pump station site.
- ***Sewage network:*** Increase percentage of shortcut connected percolation pits by installation of vacuum sewer system; use vacuum systems as very cost-effective measure; enlarge connected area.
- ***Central treatment:*** Finalize connection of pumping stations to Tyre WWTP and use anaerobic system for greywater treatment.

Water springs, open basins

The wells and fresh water sources need better protection. As an immediate measure they must be completely cleaned and protected against all kinds of pollution. The community must be involved in this

process. A slogan like “Rashidieh Water is our pride” could help to manifest the importance of such measures.

Rashidieh Water is our pride **المياه الراشدية هي فخرنا**

- All fresh water sources captured in the camp must be cleaned and protected in accordance to international standards of spring eye and borehole protection.
- The community must be informed that such springs are the source of their own sustenance, health and well-being.
- The cleanliness of these locations must be a priority for the UNWRA Sanitation team.
- Sign posts should explain the importance of the water streams to children and adults using appropriate formulations and pictograms.
- This water is labelled with signs as “no drinking water”, and “don’t play with fresh water”.

Surface waters

Any natural spring where water leaves the underground creates a natural stream. A part of this stream is used for drinking water purposes. The overflow of such a source may be continuous over the year or just temporary. The total flow of a natural stream also includes surface run-off.

- The spill ways of wells and borehole water are, where possible, guided through the camp in clean canals or nature like flow beds from which people can fetch water for gardening and flowers.

Use this water for flowers and garden, not for drinking
استخدام هذه المياه للزهور والحديقة، وليس للشرب

- Where possible and necessary (topographic check!), the streams should be joined and guided into less channels and their primary flow direction is guided to the north flowing through the new camp.
- Natural water should become and stay visible and clean. A combined use of storm water run-off channels is only useful, if this is guaranteed clean rain water. It must not be mixed with any sewage from toilet, kitchen, shower or washing machine.
- Area or spring responsible persons or groups have to be assigned to keep the fresh water streams clean and free of any contamination from the source to the channels.
- Where possible the course of spring and rainwater streams should be integrated in a nice, green and clean urban design. Water is always the best source for creating beautiful urban environments.

Underground water resource

Preferably within the catchment area of the drinking water wells, groundwater must be protected from the risk of contamination. The following measures should be taken:

- Use the existing geo-hydrological survey in order to determine and mark the catchment areas of each well in the camp and the surrounding area.
- Define protection measures according to possible contamination pathways described in the individual stream surveys.
- Close percolation pits by connecting these households to a new sewer system in the old camp.
- Check workshops (garages, fridge repair, and paint shops) regularly for pathways and storage of cleaning oil and grease separators; establish register template.

Central Water distribution network

- Publish the monitored water quality regularly (e.g. E. coli, nitrate, organics, chlorine)
- Stop leakages (from filling roof top storage tanks, pipe connections), prepare house-to-house photo survey
- Install water flow meters (if paid or not) and start regular monitoring of water production / consumption.

Table 7: Cost estimation for components of improved greywater treatment

No.	System component	Training need (with Siblin) / UNWRA	estimated CAPEX USD	Revised estimation USD
1	Establishing 400 green trickling walls			
2	Establishing 400 French drain in existing house gardens			
3	Select 400 (pilot) buildings to separate grey and black water (re-construction work)			
4	Purchasing water saving sets for 2500 houses			
5	Establish Nursery for plants			
6	Botanical training for plant selection	Y		
7	Construct XXX wetlands only for grey water (and storm water)			
8	Design and construction of wetlands	Y		
9	Built up Greywater and water saving technical know how	Y		
10	Water saving devises	Y		
11	Management, supervision, guidance and monitoring	UNWRA		
12	Awareness raising & capacity building = 15%	330,000.00		
	TOTAL		2,200,000.00	

2.5 Public and School toilets

Improving the existing toilet design and its connection to treatment systems in public areas, and toilet cubicles at 4 schools, 6 mosques, 2 football pitches, 2 beaches (north and south), and at 1 cemetery. Design targets:

(1) Avoid wastewater infiltration from percolation pits because groundwater is only at 6 m depth.

(2) Guarantee gender dignity and cultural norms in relation to the use of public toilets.

A public toilet is a room or building with one or more toilet cubicles or urinals, accessible to the general public, customers and employees. School toilets, as one kind of public toilets, have similar functions esp. for children and students.

In some of the observed settings of toilet facilities, wastewater from these toilets pollutes surface water and groundwater, and represents high risks for public health. An appropriate sanitation facility is the first barrier for pathogen infection prevention. Therefore, a functional toilet facility is very important for public health.

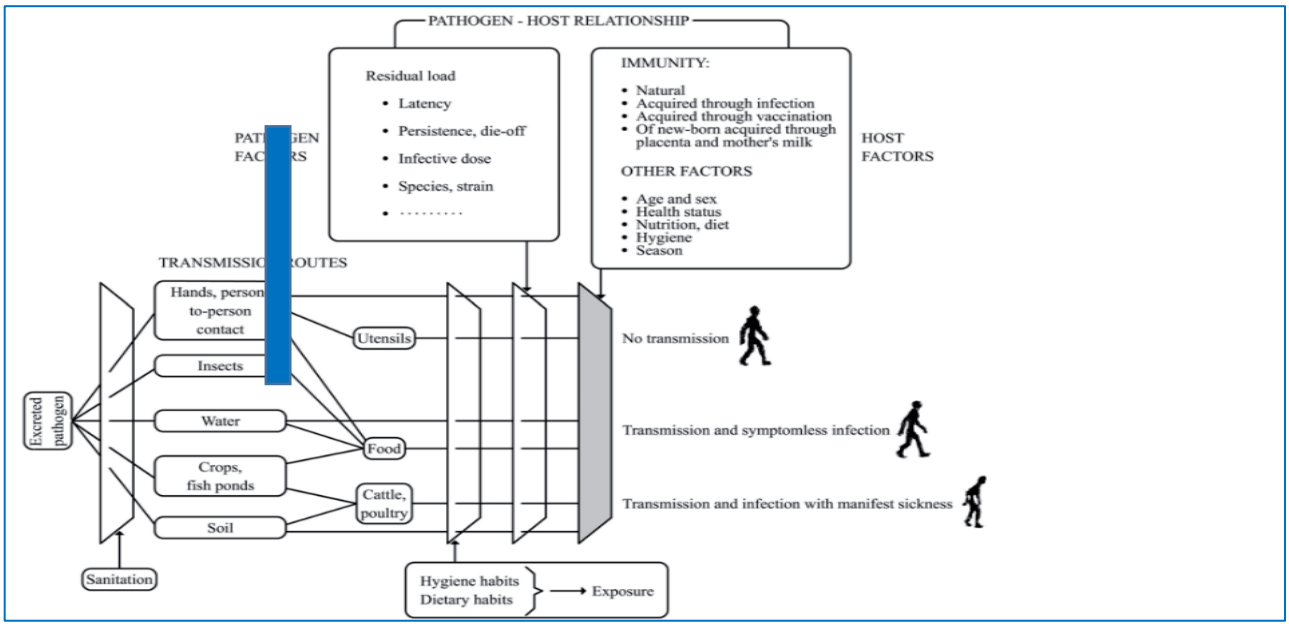


Figure 14: The spread of pathogens from excreta of an infected individual to a healthy individual (Source: Carr, 2001)

The next figure displays the way the effluent of and infiltration from pit and VIP latrines pollutes groundwater. Pathogen, viruses and nitrates from liquid waste of toilets can be carried to drinking water wells directly if the sanitation facilities are not designed and managed properly. Poor setting criteria for toilets increase the general risk of groundwater contamination.

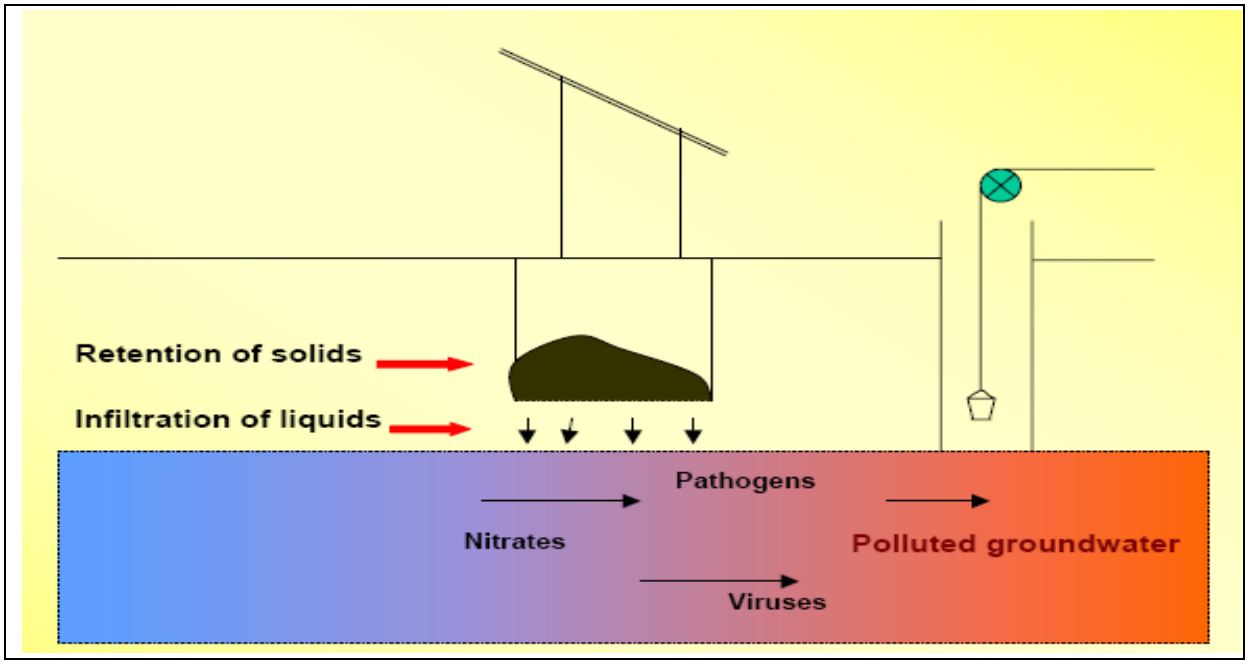


Figure 15: Schematic of unsafe pit or VIP latrines

For a qualified public or school toilet design, at least the following criteria should be considered:

- Width of the toilet pans
- Height of urinals

- Height of hand washing facilities (taps, soaps, etc. are reachable)
- Distance between the footrests of squatting platforms
- Height of door handles

Besides, children of different ages, adults and old people have different physical strengths and skills, often requiring special solutions. Following aspects must be considered and measured:

- Height of doorknobs and locks
- Height of steps and handrails of stairs
- Weight of the doors
- Strength needed to open taps, fetch water, etc.
- Diameter of the squatting hole (needs oftentimes also psychological considerations because of fear of falling through)

In the camp schools, because of lack of sewer or drainage network, stand-alone toilet systems were developed for public or school usages, which could address basic sanitation needs and promote economic, social, and environmental sustainability through strategies that may include minimizing resource consumption (e.g. water, energy) and converting human waste to a safe output product. Such system will be either manufactured as one package or as a set of prefabricated elements designed to be assembled without further fabrication or modification that influences the system function. For a complete toilet system, it should be composed of several components such as toilet, storage, transportation, treatment, reuse and disposal units.

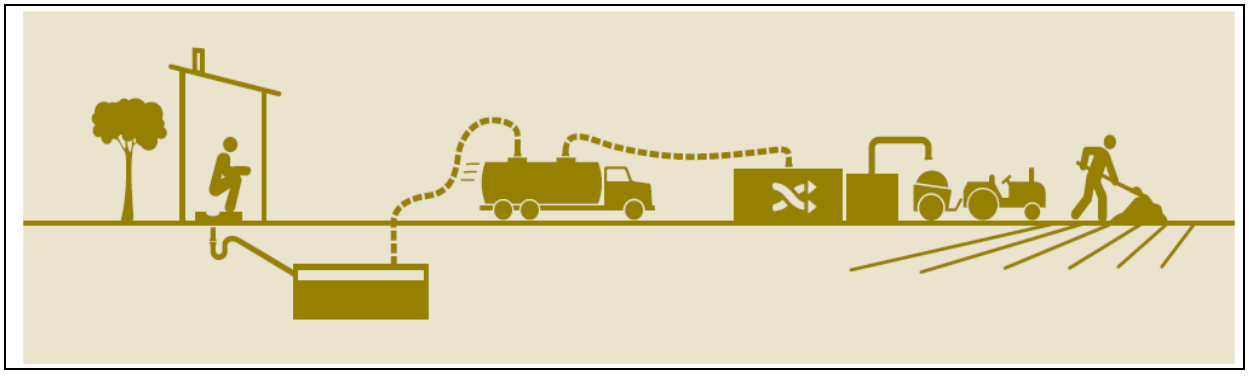


Figure 16: Faecal sludge treatment development chain (courtesy of BMGF, modified)

Older, inefficient toilets that use as much as 9-12 litres per flush are a major source of wasted water in schools. For the selection of toilet system designs such models should be avoided. Among the internationally newly developed toilet models (Reinvent the Toilet Challenge – BMGF) more efficient toilets are offered:

- Water saving toilet uses maximum 6 litres per flush while still providing equal or superior performance. Also, dual button flush toilet could be installed for further water saving.
- Micro-flush toilet uses 2 litres per flush or even less by implementation of different control facilities such as pressure valve, vacuum system, pour flush manner.
- Waterless or water free toilets do not flush excreta with water; this provides sanitation technologies with little infrastructure and are recommended in regions prone to droughts.

Besides, urine separation toilets and waterless urinals are also an option for water saving.

For public or school toilet design, if toilet type is selected and determined, then the relevant follow-up components should be decided for storage and treatment. For a stand- alone toilet system, there are several technology options for follow-up treatment such as DEWATS system, Water recycling toilet system - MBR treatment unit as key component, Water recycling toilet system - Electric-Chemical

treatment unit as key component, Water recycling toilet system – mechanical composting unit as key component.

Table 8: Cost estimation for components of improved public and school toilet designs

No.	System component	Training need (with Siblin) / UNWRA	estimated CAPEX USD	Revised estimation USD
1	Purchase re-construction material for 15 school and public toilets			
2	Design and construction of 15 school and public toilet interfaces			
3	Training in Application of ISO30500 ("Non-sewered Sanitation Systems with prefabricated integrated treatment")	Y		
4	Create demonstration space for new innovative public toilet facilities (RTTC)			
5	Sustainable plumbing courses	Y		
6	Design of vandalism proof public toilets respecting gender issues	Y		
7	Management, supervision, guidance and monitoring	UNWRA		
8	Awareness raising & capacity building = 15%	105,000.00		
	TOTAL		700,000.00	

2.6 Coastal protection

There is a need for a comprehensive solution including the not yet managed bulky, construction debris; recommendations are needed on shore and beach cleaning although financing is available. Sand drifting should be stopped to protect the RAMSAR area and the water resources. But UNRWA's authority and mandate is limited to the Camp and does not extend to the surrounding areas including the nature reserve. Therefore, at local level mutual understanding is used for resolving issues. There are interlinkages between environmental education and awareness raising and the role of the RAMSAR nature reserve in Rashidieh as well as in the area in general. This is a significant opportunity to expand knowledge and action for environment awareness, partnership and cooperation between the different stakeholders in Tyre.

2.6.1 The Integrated Coastal Zone Planning Process

1. The Formal Model (process as taught)

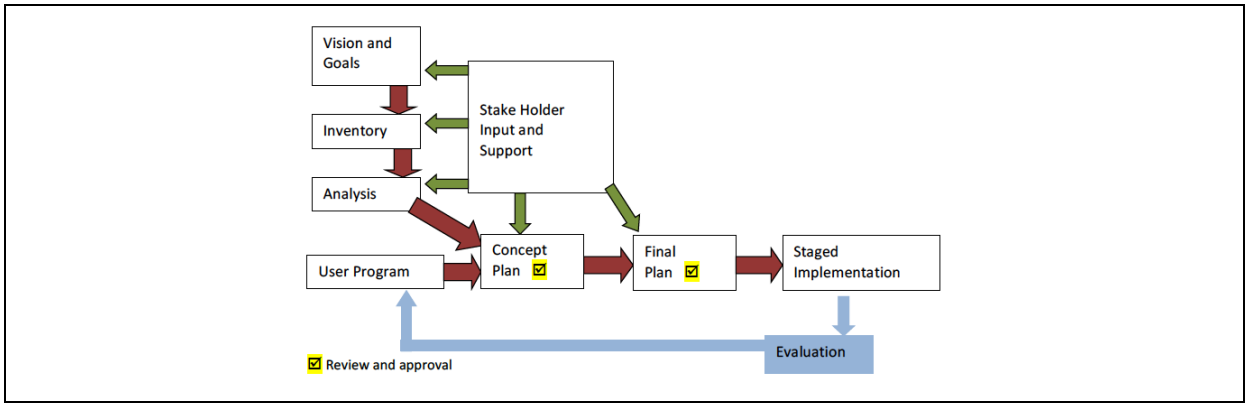


Figure 17: The Formal Model

While this formal model is proven, it is often time consuming and expensive. Development actions are generally delayed until the final plan is approved. Also, although experienced field scientists are able to focus research efforts on likely useful outcomes, extensive data may be gathered that later proves to have less value to the planning decisions.

Coastal Zone planning for the Tyre Nature Reserve and for the camp itself has used little environmental action planning to date. Where followed, the system designers have used a more or less standard process, which may be called the formal approach. While this process begins with some creative, intuitive statement of goals, objectives and desired vision, it is primarily driven by a civil engineering/works project management inventory and analyses of relevant data to establish significance which is then used to decide actions and decisions.

In creating an integrated Tyre-Rashidieh protected, multiple use landscape and coastal zone protection and enhancement project, cultural, scenic, quality of life issues is most relevant. In RAMSAR (category 3- protected integrated coastal seascapes) understanding cultural and scenic values and creating conservation livelihoods for local communities is more relevant than detailed knowledge of flora and fauna, which have been modified by many generations of human activity.

2. Integrated Coastal Zone Comprehensive Model

While a formal approach to coastline planning could also be primarily driven by a scientific inventory and analyses for relevant data to establish significance which is used as a basis for decision making. The subjects of research depend upon project goals. For example, development of a management plan for Ministry of Environment, Tyre Nature Reserve on Coastal Zone Protection (strict nature reserve and wilderness) would focus upon the study of natural factors supporting indigenous flora and sea life. Cultural factors such as past and present human use and land tenure would also be considered. Study of scenic or aesthetic resources may not be relevant, although these would be important to planning a RAMSAR category or nature reserve project.

3. The Tyre-Rashidieh Comprehensive Model

The Comprehensive Model is preferred for Tyre-Rashidieh Integrated Coastal Zone, focusing on specific areas of conservation or development. Some terms are important here:

- The term “master planning” is used to describe planning for physical development of tangible assets like roads, buildings and carparks.
- “Strategic planning” usually means financial planning for sustainable operation of planned improvements and programs.
- “Operational planning” relates to the allocation of human and other resources for day-to-day and seasonal operational needs.
- Management of wetlands and coastal nature reserves requires planning for all three areas:

physical assets, operational programs and financial sustainability.

This approach will begin with vision, goals and objectives, followed by resource inventory and analysis, and the development of a physical development concept and supporting programs. This concept will be tested with strategic (financial) and operational analysis and implementation concepts. Physical, programmatic, strategic and operational concepts are then integrated into a comprehensive plan. When approved, this plan would develop in stages; each stage having balanced physical, strategic and operation aspects. Evaluation and improvement should follow each major implementation stage.

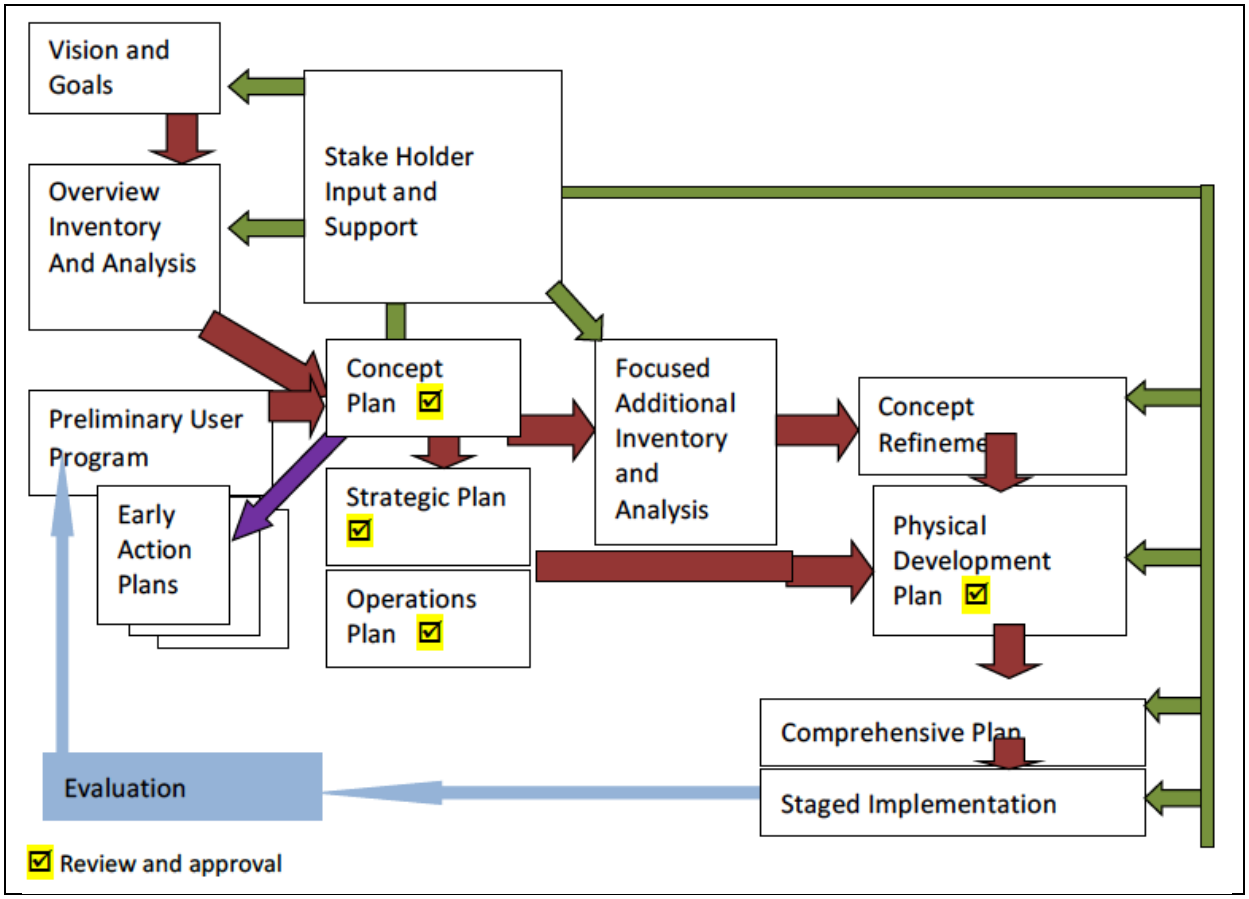


Figure 18: The Tyre-Rashidieh Comprehensive Model

The planning processes displayed are useful road maps for guiding environmental protection of the coastal zone and camp area development. As each project is unique the planning method selected as well as the balance of areas investigated, and plans developed depend upon the goals and resources available for each phase in the project.

4. Natural Solutions-Tyre Rashidieh Coastal Protection and Enhancement

Figure 19: Current shore view, southern margin of Rashidieh, beach to right of image

Figure 20: Camp shore looking north towards Ramsar/Tyre Nature Reserve site (left) and beachfront of Camp looking south towards Organic Farming zone

2.6.2 Considerations for dense housing in coastal areas

53 houses along the coast are in danger to tumble down within the next 20 years. Therefore, complementary activities to the coastal protection planning along the Rashidieh housing coastal area should be initiated and supported as a matter of priority.

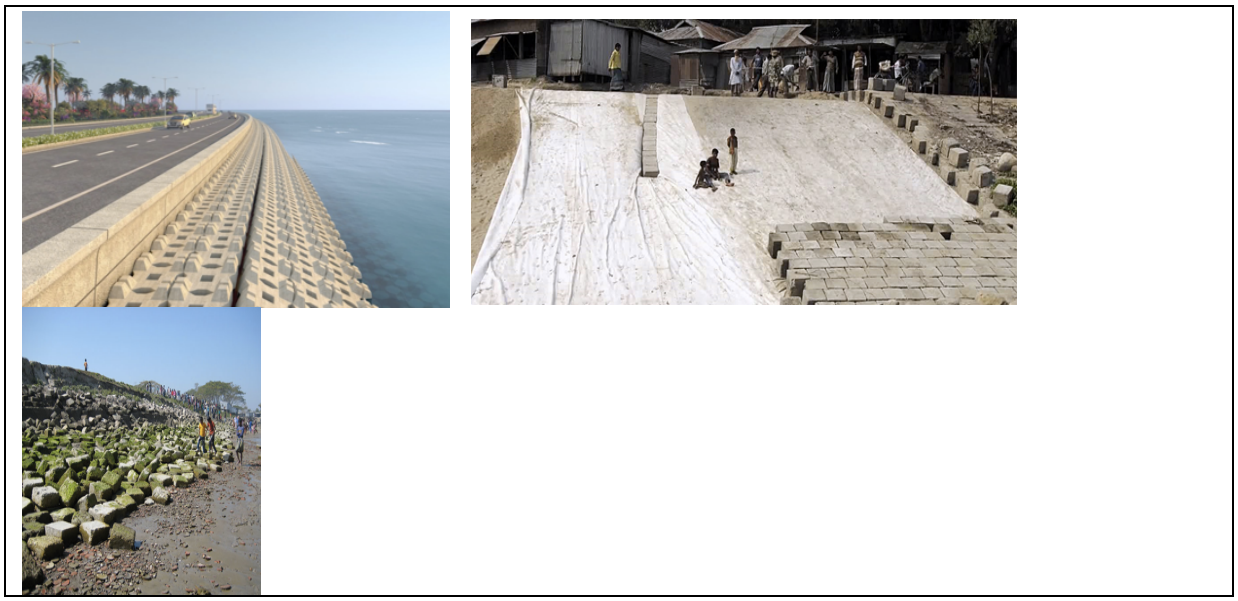


Figure 21: Examples for coastal protection mesures seen in Bangladesh

Figure 22: Coastal impacts on beaches and houses – some impressions

The following picture, too, gives evidence that high tide, waves and wind are eating away the coastline of Rashidieh. Some houses were built too close to the shore and are no longer habitable or have already collapsed.

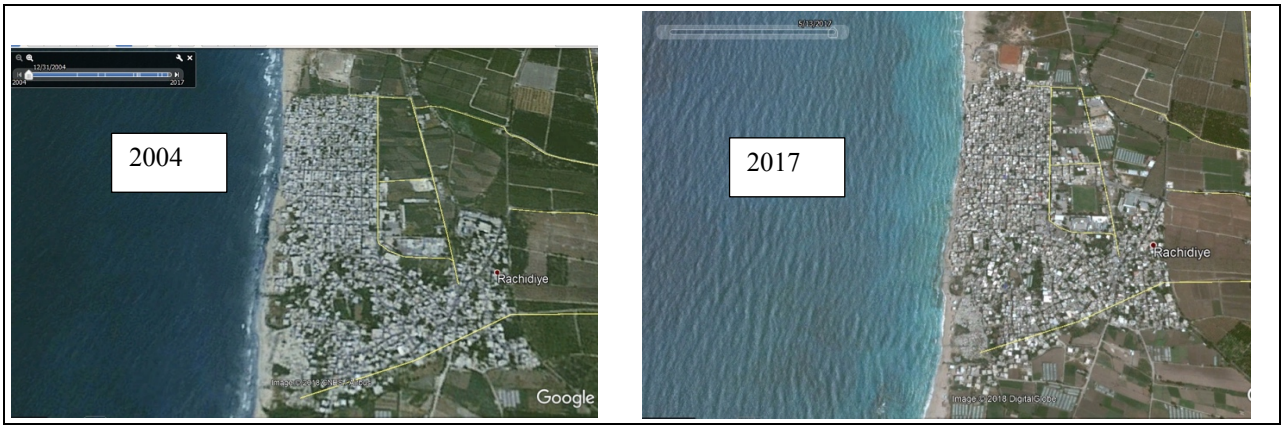


Figure 23: Coastal development – aerial view 2004 and 2017

In addition, this comparison of images of 2004 and 2017 shows that the green dots in the camp have reduced in size.

Table 9: Cost estimation for components of coastal protection

No.	System component	Training need (with Siblin) / UNWRA	estimated CAPEX USD	Revised estimation USD
1	Temporary (1.5 years) technical specialists (marine, shore engineering, environment education,			
2	Purchase offshore marine equipment			
3	Construction of a management and educational information centre near the existing pumping station			
4	Planning restoration and protection for the entire camp coastline (up to 53 vulnerable houses)			
5	Botanical training for coastal restoration	Y		
6	Establishing Nursery and ecological restauration materials			
7	CDW crushing machine set (movable)			
8	Compaction equipment (movable)			
9	Gabion machines			
10	Design and construction of 1 km gabions with CDW for coastal protection			

No.	System component	Training need (with Siblin) / UNWRA	estimated CAPEX USD	Revised estimation USD
11	Purchase of beach waste bins and furniture			
12	Training of operators	Y		
13	Accompanying scientific monitoring studies for marine and onshore			
14	Management, supervision, guidance and monitoring	UNWRA		
15	Awareness raising & capacity building = 15%	225,000.00		
	TOTAL		1,500,000.00	

2.7 Waste water management

1. Develop complementary, appropriate and innovative waste water collection systems in densely populated areas ("old camp"), and for relative flat topography ("new camp"),
2. Design innovative decentralized wastewater pre-treatment systems in the Rashidieh housing area. One (1) central point (pumping station) needs underground (pre-) treatment plant (DEWATS) for all wastewater from Rashidieh.
3. 1,441 houses need to be connected to the gravity sewer but are lower sited (liftings and vacuum sewer system)
4. 2,254 houses need water leakage repair measures (water tank swimmer stops, piping repair package, and water saving accessories)
5. Assumption is: daily flow of 1,000m^3 only household wastewater maximum, and 500m^3 wastewater as minimum
6. Flexible in the Degree of Centralization – depending on settlement structure and topography

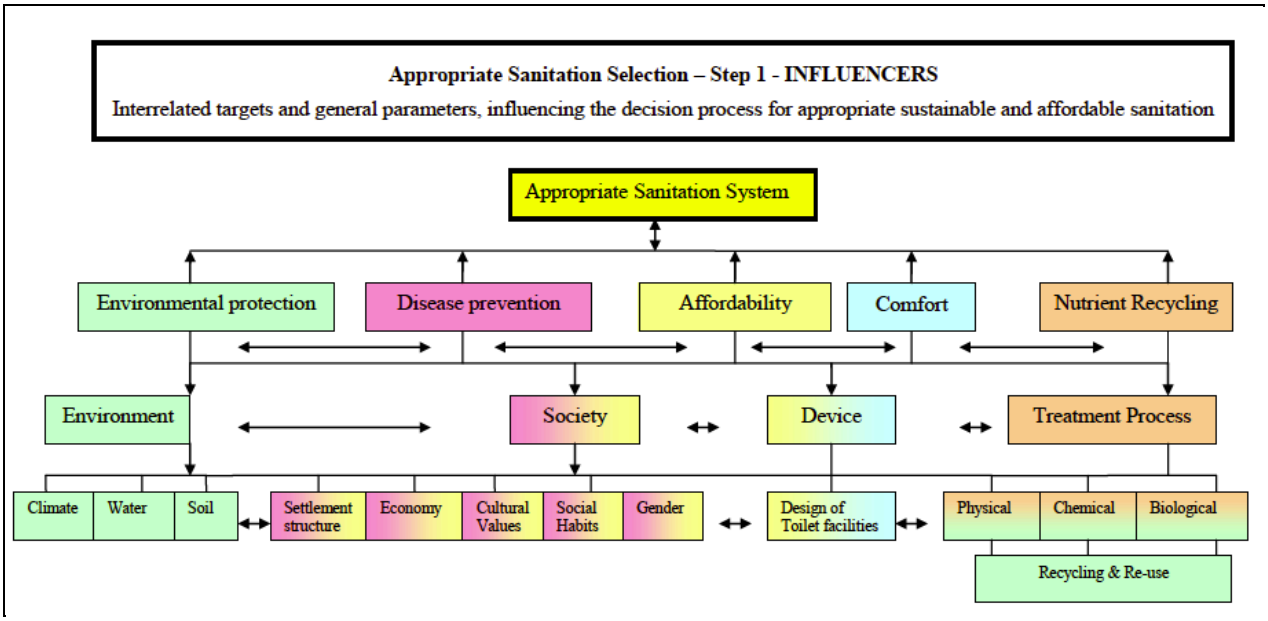


Figure 24: Flowchart for selection of appropriate sanitation system

The five principal targets of any sanitation system are interrelated. Societal and environmental aspects influence the technological choice of appropriate devices and treatment processes. All aspects must be considered and cross-checked to ensure that the characteristics of a proposed sanitation system correspond with the sanitation targets. The colour patterns within the figure above indicates the interrelations.

Improved sanitation furthermore turns waste directly to value. Before re-use can take place, wastewater needs to be treated and transported safely. Its constituents may be regarded as precious (reuse of nutrients, carbon) or as dangerous (pathogens, heavy metals, nutrients in clear water). If substances in wastewater are harmful for the receiving water body, they have to be removed as good as possible. And the Mediterranean Sea is a sensitive water body with high need for protection.

For this reason, in general a discharge of well treated wastewater by the central WWTP north of Tyre is a good solution for this part of the sea as this means nearly Zero Emission by deviation to less sensitive water bodies. However, as long as water constituents are to be recycled on site, decentralized integrated solutions are available. This also applies to the use of water itself.

The top priority in the Rashidieh Camp is to improve the Sanitation and Wastewater Situation in the Old Camp and some buildings on the Coastal Line.

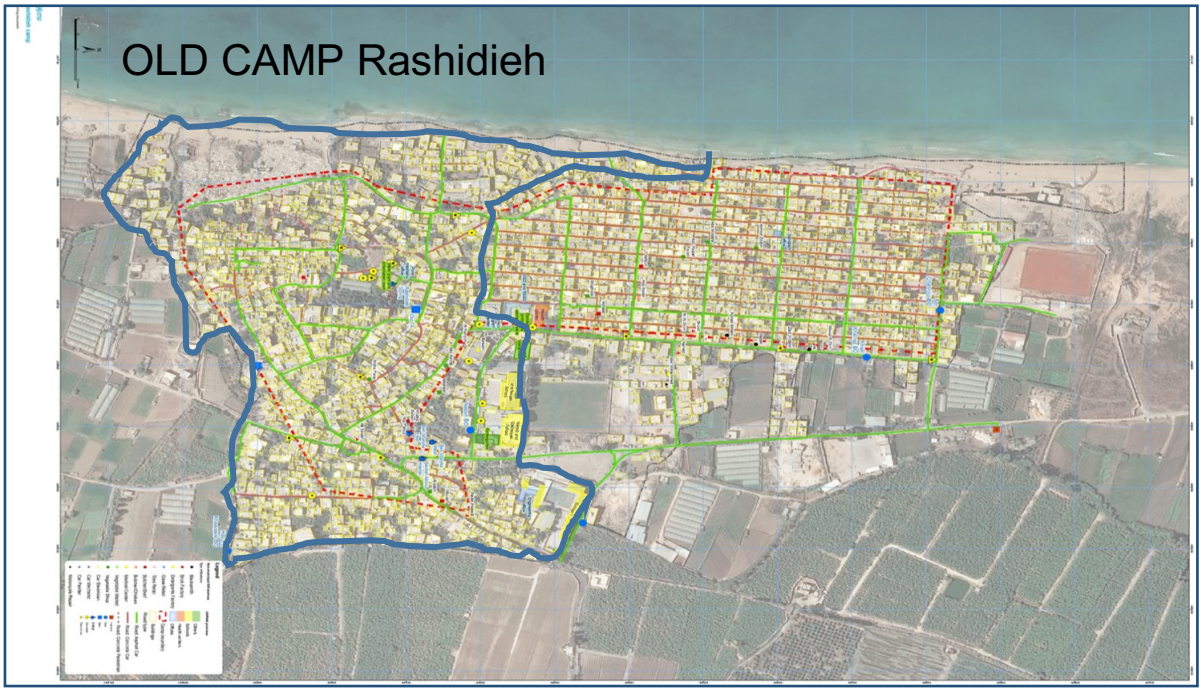


Figure 25: Map of the old camp Rashidieh

Some of the reasons to design a new sewer system are as follows:

- Coastal Protection through clean water aquifers entering the sea. Clean water is good for the breeding of the turtles.
- Reduction of smell and open channels with pathogens in the community
- Protection of water aquifers and spring for drinking water and irrigation
- Collect all greywater from all sanitary appliances in a closed system and not polluting the storm water
- By-pass the percolation pits in every household
- Waste-to-Value

Table 10: Comparison between different sewerage systems

Requirements	Traditional Gravity Sewer	Vacuum Sewerage System	Grinder Pumps	Septic System
Electrical Requirements	Electricity required only at the pump station, and a number of pump stations may be required to service a single catchment	Power is only required at the pump station. A single pump station is usually all that is required to cover a large area. The containerized pump station can be located next to the generator and treatment facility keeping all utilities in one section. Pumps only run on average 3h/d, so power consumption is lower than by other systems	Grinder pumps require power at each unit. Power cables must be run to each pump unit from the central generator. Some pumps require constant power	No power required
Collection Point	No restriction on connections	Collection points can be above ground units	Must be located below ground and not able to handle high flows	Must be located below ground or to a common trench
Manholes	Every change of direction and between 40m and 60m	None - it is a closed system. No solid waste discharge to the system.	None	Every change of direction and between 40m and 60m
Extended power outage	System will continue to operate. Backup generators can be supplied at multiple pump stations.	The interface valve and collection pit require no power, a single standby generator can be hooked into the main pump station and the system will continue to operate.	It is not possible for the system to operate.	No impact

Requirements	Traditional Gravity Sewer	Vacuum Sewerage System	Grinder Pumps	Septic System
Exfiltration	A broken pipe will go unnoticed for many months and the depth of the gravity lines will make detection difficult and expensive to repair.	Since vacuum is maintained within the mains at all times there is no chance of exfiltration of sewage. Operators immediately alerted of a leak in the main due to longer vacuum pump run times; leaks can quickly be found and repaired.	As all pipework is under pressure then a break in the pipe will lead to large exfiltration. Not suitable in environmentally sensitive areas.	Exfiltration is a common occurrence
Maintenance	Lower initial costs but higher long-term costs due to multiple pump stations and deep gravity mains.	If service is required, a single operator takes on average 10-15 minutes to complete any service required. No special equipment is required. As all services are above ground, accessibility is not an issue. 10 years warranty.	Most callouts require the pump to be pulled out. An electrician is needed in the service team. Access is difficult as all equipment is on the owner's property. 1-year warranty only for certain components. Sand and grit will cause faster wear on the grinder cutters	Clean up and pump out costs can be high.
Environmental Impact	Trenches need to be dug and pipework laid. This can impact on local flora and water table. Risk of leakages. High cost of digging up pipework and disinfection	Small and narrow trenches. Low impact. Pack all equipment and pipework into containers.	Trenches and holes for the pits need to be dug. Risk of leaks. Dig up pipework and pumps.	Trenches and holes for the pits need to be dug. High Risks of health issues and environmental damage. High risk of contamination.

Based on the above comparison between the different systems the vacuum sewerage system offers the most environmental advantages.

Vacuum Sewerage System – Advantages

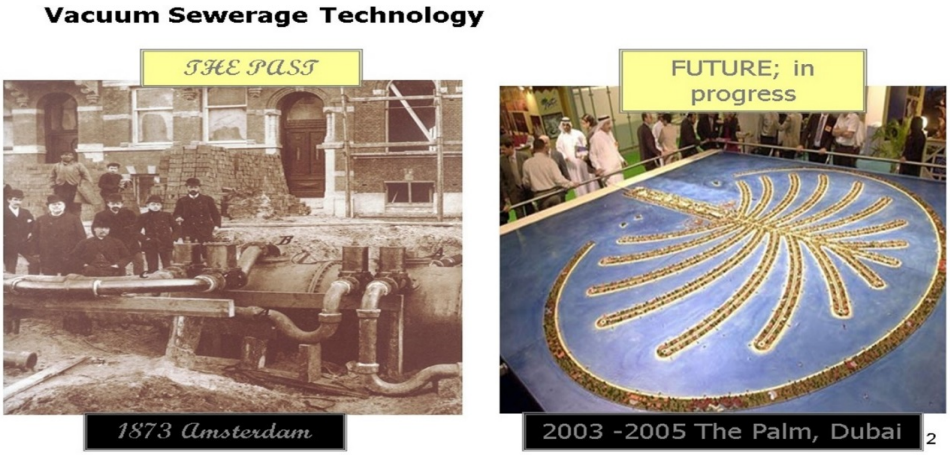
- No Manholes required – no possibility of throwing house waste into the sewer
- Narrow and Low Trenches. Water pipes are allowed to be installed in same trench
- All Maintenance can be done from above ground
- No Clogging of vacuum collection pipes due to high velocity (4-6m/s sewage, 8-10m/s air) in the sewer pipes
- No Water Flush Tanks required – Very Significant Water Saving
- Segregation of Black & Greywater water possible. Re-use.
- Reduction in Maintenance, Operating Equipment & Infrastructure
- No Ground Water Pollution – No Exfiltration because of permanent vacuum in sewer pipes
- No Storm Water Infiltration - Smaller Sewage Treatment plant required
- No Smell from System because it is closed system. The transport air will be treated in a biofilter and discharged to the atmosphere.
- Local small scale (no heavy equipment is needed) contractor can do the installation with one of the vacuum sewerage Manufacturer

The vacuum sewerage technology is not a new technology; it was first introduced in 1863 in Amsterdam and other European Cities. Since the late 1960s, more than 1800 Vacuum Sewer Systems have been installed worldwide for example for

- Island communities
- Towns, communities and residential buildings
- Holiday resorts
- Environmental sensitive areas
- Factories

The main manufacturer of the vacuum sewer components are the following internationally operating companies:

- AirVac (USA)
- Roediger (Germany)
- REDVAC (Great Britain)
- FloVac (Netherlands and Australia)
- QuaVac (Netherlands)
- Iseki (mainly Japan)
- Jets (Norway) mainly indoor + ships
- EVAC (International) only indoor



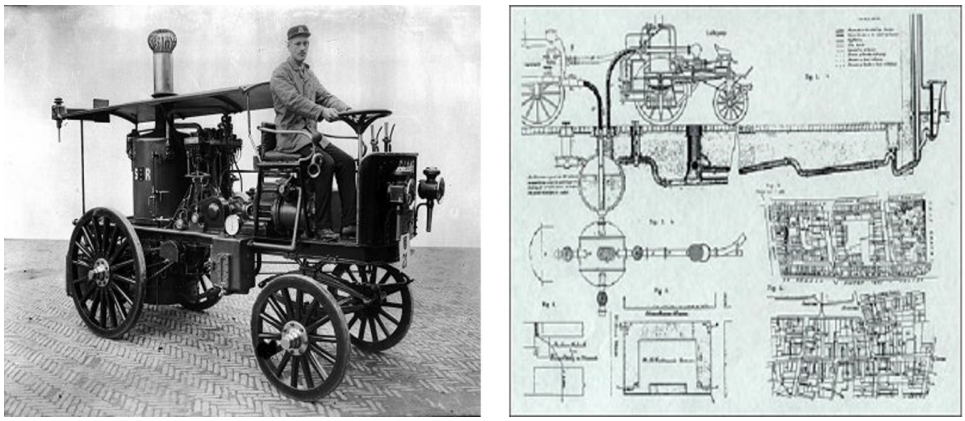


Figure 26: Vacuum sewer technology – historical and modern examples

The vacuum sewer system manufacturers are in reality vacuum sewer component manufacturers e.g.

- Vacuum valve and vacuum collection chambers
- Vacuum station with piping, and internationally known vacuum pumps; sewage pumps electro-mechanical devices and panels.

The vacuum tank(s) can often be manufactured locally, and the pipes and fittings can also be supplied by local manufacturers and suppliers.

Most of the International vacuum sewer manufacturer will support the contractor and consulting engineers in designing the system, giving guarantees for the operation of the vacuum system after everything has been installed according to their design.

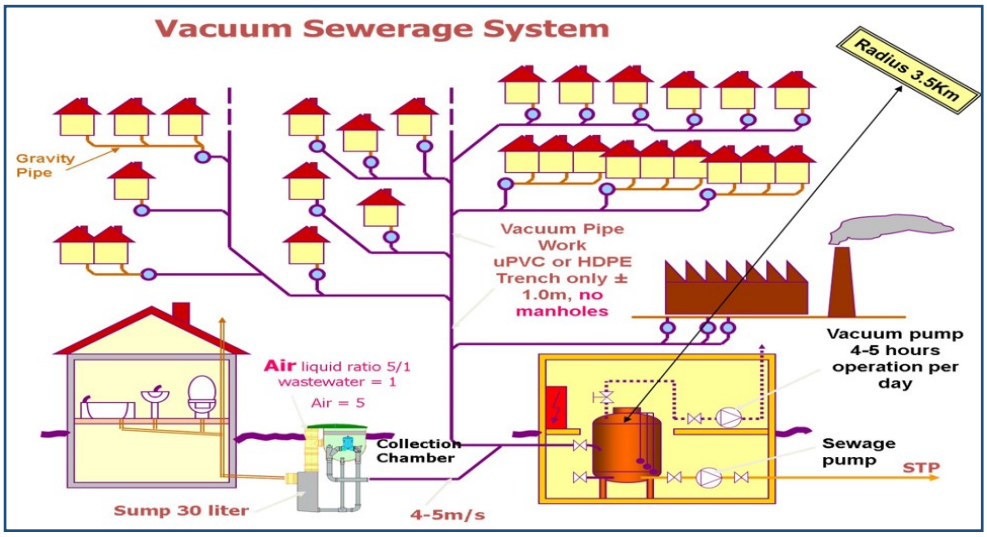


Figure 27: Flow diagram of vacuum sewer system

A vacuum sewer system is a “Negative Pressure” sewerage system as the operating pressure in the system is between 35Kpa - 60KPa below atmospheric pressure.

The heart of the system is the central Vacuum Station. Two or more vacuum pumps will generate the necessary negative pressure in the vacuum tank, as well as in the complete reticulation network. Air is evacuated from the system by these pumps, which enters the system via the collection chambers located underground, in convenient locations, nearby the houses.

Waste water flows via gravity pipe from the houses to the collection chamber / sump. When a predetermined volume is collected (for example 30 litres), the interface valve opens, and the waste water will be evacuated into the vacuum pipe by the atmospheric air pressure. Together with the quantity of water, about 5-times more air will be sucked into the system. This air is needed as the transport medium for the water. Thus, the transport velocity in the system is about 4-6m/s sewage (8-10m/s air).

Air and waste water are ultimately 'sucked' into the vacuum tank. The vacuum pumps evacuate the air from the tank into the atmosphere, through a biofilter. Discharge pumps transport the waste water from the tank, via pressure line to the STP or a sewer main.

The pipeline network consists of flexible small diameter PVC or HDPE pipes. They should be located in small trenches into the frost-free zone (about 1.2m deep) and are laid in a saw-tooth profile. Limited lift of 3 to 4m is therefore possible.

So, the contour of the piping is more or less horizontal and is according to the topography. The pipe follows the surface in a depth of about 1.2m. No deep and dangerous trenching is necessary. Pipes can be installed higher if no heavy-duty traffic is expected.

Influence on sewage treatment plant (STP)

Quantity

The Vacuum Sewerage System (VSS) as a collection system of (mostly) community waste water from households, residential areas, restaurants, and commercial areas etc. The waste water will be transported, ideally, direct to the next Sewage Treatment Plant (STP) or via local gravity sewer. Because the Vacuum Sewerage System is a closed system, no storm or surface water will infiltrate. Conditions for the effective operation of the STP are, therefore ideal: The quantities are relatively easy to calculate and the layout of the STP will be determined with both reduced average as well as peak capacities. No storm water will dilute the sewage. Storm water does not have to be treated in an STP so there is no need for over design, efficiency of the STP is higher, and more pollutants will be extracted.

Quality

In addition, the "quality" of the waste water arriving at the STP is much better than with gravity systems. It is obvious that movement of sewage through the vacuum system is faster as the negative pressure is strong (about – 60 KPA) and the velocity in the pipe higher (about 4-6 m/s). Furthermore, the air in the system (about 5 – 6 times more than water) which transports the waste water to the vacuum station, keeps the water "fresh". Oxygen in the air prevents the water from fouling.

Cost reduction

A significant cost reduction is possible if the VSS is installed in areas containing the above-mentioned criteria. The following example shows the relevant cost savings. A village in Botswana has been equipped with a vacuum system. The cost reduction was as a result of several factors:

- Two central vacuum stations have replaced 10 lifting stations in the area.
- The small diameter PVC pipes (diameter 75 to 250) with a total length of 55km are much cheaper as bigger diameter gravity pipes.
- The trenches for the vacuum pipes are only about 1.2 m deep and very narrow. Only a small quantity of soil must be moved. Small TLBs and manpower substitute larger machinery. This is even more important in difficult ground conditions (rock). 2 meters of Trenches for Gravity pipes were excavated in the same time as 30 meters for Vacuum Sewer pipes.
- More local employment has been created.
- Maintenance for two VS is less than for 10 pumping stations.
- No additional flush tanks were needed - 10 tanks have been cancelled. Thus, no precious fresh water will be spoiled just for flushing gravity pipelines frequently.
- No "dry sewers" will appear. Thus, there is no wear in the pipes.
- In the case of installing a new reticulation network for fresh water as well as for sewerage the pipes may be installed into the same trench. This reduces the cost of a separate trench!

Proposed Vacuum Sewerage System for the "Old Camp" in Rashidieh

The "Old Camp" has many important sites for both camps and the neighbourhood. All the plots have different measurements and there are many "green" plots; normally these plots are bigger than in the "New Camp".

Figure 28: Gardens in the community

Table 11: Cost estimation for improved wastewater treatment system(s)

No.	System component	Training need (with Siblin) / UNWRA	estimated CAPEX USD	Revised estimation USD
1	Purchase Vacuum sewerage material for 900 buildings (700 old camp, 200 new camp coast line)			
2	Training on Vacuum sewerage material	Y		
3	Design vacuum sewer systems, with the priority to capture only black water			
4	Installing/ constructing Vacuum sewerage material			
5	Decommissioning 1500 infiltration pits			
6	Bypassing 1500 houses to sewer network			
7	Plumber training for sewer systems	Y		
8	Management, supervision, guidance and monitoring			
9	Awareness raising & capacity building = 15%	330,000.00		
	TOTAL		2,200,000.00	

2.8 Household Solid Waste Management

There is a need to analyse further “waste-to-value” (and closed loop) recovery options in the surrounding Tyre area, mainly related to not-yet-managed or by planning steps tackled waste streams. Planning faecal sludge recovery and treatment, combining it with organic household waste resulting in a sludge treatment process with value recovery. All sorted recyclables are finally taken by a formal waste collector

who works at a sorting facility in Tyre. Through the solid waste camp management project, families are finding new innovative ways to make a living. Collected: nowadays 6t/day – after non-formal recycling in the camp, includes 2 tons pure organics (kitchen waste) daily, 1-ton plastic per day. Plastic based fuel used in multifuel genset's in 6 UNWRA gensets – need is 24t fuel/y.

The Cycle Economy which was legally introduced in Germany in 1994 is a good example for how a precautionary environmental policy can contribute to environmental protection, efficiency in use of resources, preservation of the climate and at the same time can facilitate economic profitability.

Also, hazardous waste components can be found in different waste fractions defined by their origin: the household waste, the commercial and industrial waste, waste from hospitals, waste from agricultural activities, etc. Domestic hazardous waste includes batteries or chemicals used in households, fluorescence tubes, computer monitors, and paints. Some examples for industrial hazardous wastes are waste from dry cleaners containing halogenated hydrocarbons, used oils from car shops, acid and alkaline solutions, metal sludge from electroplating companies, waste from chemical manufacturers, or waste cooking oil from restaurants. Hospital waste includes among others medical drugs. Pesticides as well as their containers mainly originate from agricultural activities.

Requirements for the treatment of waste from settlements are less stringent than those for hazardous waste, for example in terms of leachate control. Untreated hazardous waste therefore must not be mixed with waste from settlements (household or municipal waste).

Most of the energy gained via incineration of MSW results from burning highly calorific fractions such as paper, plastics, tyres, and synthetic textiles while the "wet fraction" of biodegradable waste reduces overall energy efficiency. Therefore, why not to separate in four fractions: (1) plastic to oil, (2) organics to biogas, (3) direct recyclables, (4) remaining MSW.

To manage organics, see example India: Established in 1945, Wipro Ltd is a large business international conglomerate, with a revenue of over USD 7.3 billion and more than 75,000 employees in India. Wipro Ltd provides comprehensive IT solutions and services, including systems integration; information systems outsourcing; IT-enabled services; package implementation; software application, development and maintenance and research and development services to corporations globally and also produces lighting, engineering, personal and medical products. Wipro operates a large canteen catering to 5,000 to 5,500 employees in their Bangalore headquarters and generates about 1,500 kg of canteen and kitchen waste per day. As a part of its corporate social responsibility, Wipro supported the initiative to convert kitchen and food waste from the employee's canteen to biogas for cooking in the canteen.

Wipro partnered with Mailhem Engineers Pvt Ltd, a waste management technology firm, to install, operate and maintain the biogas plant capable of treating three tons per day (1,095 tons/year) of canteen waste. Mailhem has indigenously developed bio-methanation technologies with modified upward anaerobic sludge blanket technology that treat all types of solid and liquid waste having large percentage of suspended solids. About 69,300 to 74,250 m3 of biogas is produced annually. The biogas has replaced Liquefied Petroleum Gas (LPG) as the cooking fuel, saving four 19-kg LPG cylinders per day, leading to annual fuel cost saving of USD 24,480 at price of USD 17 per 19-kg cylinder for commercial applications and an increase in brand equity along with generating employment for four people. Around 108 tons of bio-sludge is generated annually, which is used as manure in the gardens on Wipro's campus and 3 m3/day of overflow water is fed to sewage treatment plant in the premises.

To process other municipal solid waste, see example Sri Lanka: ICL MSW Treatment System is a fully automated technological process that is able to process and convert MSW to either high-energy fuel pellets in less than One Hour! The technology subjects the MSW to several equipment and processes that effectively treat and process the organic & inorganic waste, makes it bacteria and pathogens free to form high energy fuel pellet as the end-product using hi-tech technology.

With its revolutionary Plastic2Oil (P2O) technology from Canada's company Plastic2Oil Inc. has pioneered the development of a process that derives ultra-clean, ultra-low sulphur fuel which does not require further refining, directly from unwashed, unsorted waste plastics.

Table 12: Cost estimation for improved household solid waste management

No.	System component	Training need (with Siblin) / UNWRA	estimated CAPEX USD	Revised estimation USD
1	Establish Waste statistics and 3R strategy			
2	Procure mobile electromechanical shredding system			
3	Procure Pelletizing and Charring Solid Waste System (i.e. ICL Group, India, Bahrain, USA)			
4	Procure plastic to oil manufacturing machine set (Pyrolysis Oil Plant) (i.e. P2O - Canada)			
5	Procure containerised food waste biogas plant (i.e. Mailhem Ikos Environment Pvt. Ltd. – India)			
6	Waste management technicians needed	Y		
7	Machine operator training	Y		
8	Management, supervision, guidance and monitoring	UNWRA		
9	Awareness raising & capacity building = 15%	240,000.00		
	TOTAL		1,600,000.00	

2.9 Tyre Nature Reserve Support

1. Support the protection of RAMSAR and other protected natural reservation areas,
2. Integrated Beach Waste and Water Management
3. Public toilets at beach
4. Coastal protection (avoid sand transport)
5. Ground water (spring, boreholes) protection

This chapter provides a detailed design of integrated environmental protection, nature conservation and heritage protection.

2.9.1 Environment Action Plan Part 1: Planning

1. Coastal Area Enhancement

Shoreline, beach and dune environments next to Rashidieh are the product of dynamic coastal processes, including waves, wind and sediment transport. They are also highly sensitive to human activities. The proposal is for natural coastal defences with rehabilitated structures, dune reconstruction, or revegetation and eco-education zone for maximum social, environmental and economic benefits.

The nature and scale of the proposed activities take into account protection to the Ramsar Site, Nature Reserve, Marine Protect Area beach and shore whilst protecting the camp and enhancing quality of life. Proposed KfW and Gates interventions in Rashidieh need to be assessed in three areas: 1) Offshore, 2) Intertidal, 3) Hind shore.

A coastal protection solution is required for both southern and frontal beach and existing walls, special areas in front of the camp for innovative protection and restoration and recreation, and the northern beach zone. UPM could prepare an environmental solution, building on technical studies already done by KFW consultant in September 2017. UPM will prepare the detailed design and work with relevant experts and focal points from Tyre-Rashidieh Camp and UNWRA, KfW, UPM, universities and Government of Lebanon according to the below physical component based approach.

<table>
<tr><td rowspan="2">Nature Reserve and Organic Farming Zone</td><td>Component 2: Southern recreation and ecology restoration zone</td><td>Component 3: Repair existing structures above maximum tide and restore beach as natural wave break. Hard structural options rehabilitation here.

Component 4: There will still be sites within this zone for mini-beach restoration and eco-education as well as small looking-out and viewing, educational sites. Soft biological and natural options here.</td><td>Component 1: Ecology and Education Zone, Marine Rescue and Turtle Base, Eco-Sanitation Hub</td><td rowspan="2">Nature Reserve, Lebanese Military and Turtle Hatching Zone</td></tr>
<tr><td colspan="3">Rashidieh Camp</td></tr>
</table>

Component 1: Northern Beach Zone: ecological education, children and school groups, Renewable Energy and Waste Innovation Area, with Marine/Turtle protection and Rescue Centre.

Component 2: Southern Beach Zone: There is an opportunity to consider needs to be given to the full life environmental impacts of the scheme. This includes impact on source area for materials, rock quarry, offshore, impact of transport to the site, trapping of seaweed and other debris, impact of damaged or life-expired materials on the foreshore (geotextiles etc.), long term evolution of beach.

Component 3: Restoration of existing horizontal structures, above high-water mark in the existing camp (i.e. outside the public beach and foreshore domain); Rehabilitation work.

Component 4: Micro-Sites along coast; Inside the camp, along the coast, identify most vulnerable sections, for restoration using participatory approaches, and enhancing the existing natural geology, beach, and hardpans.

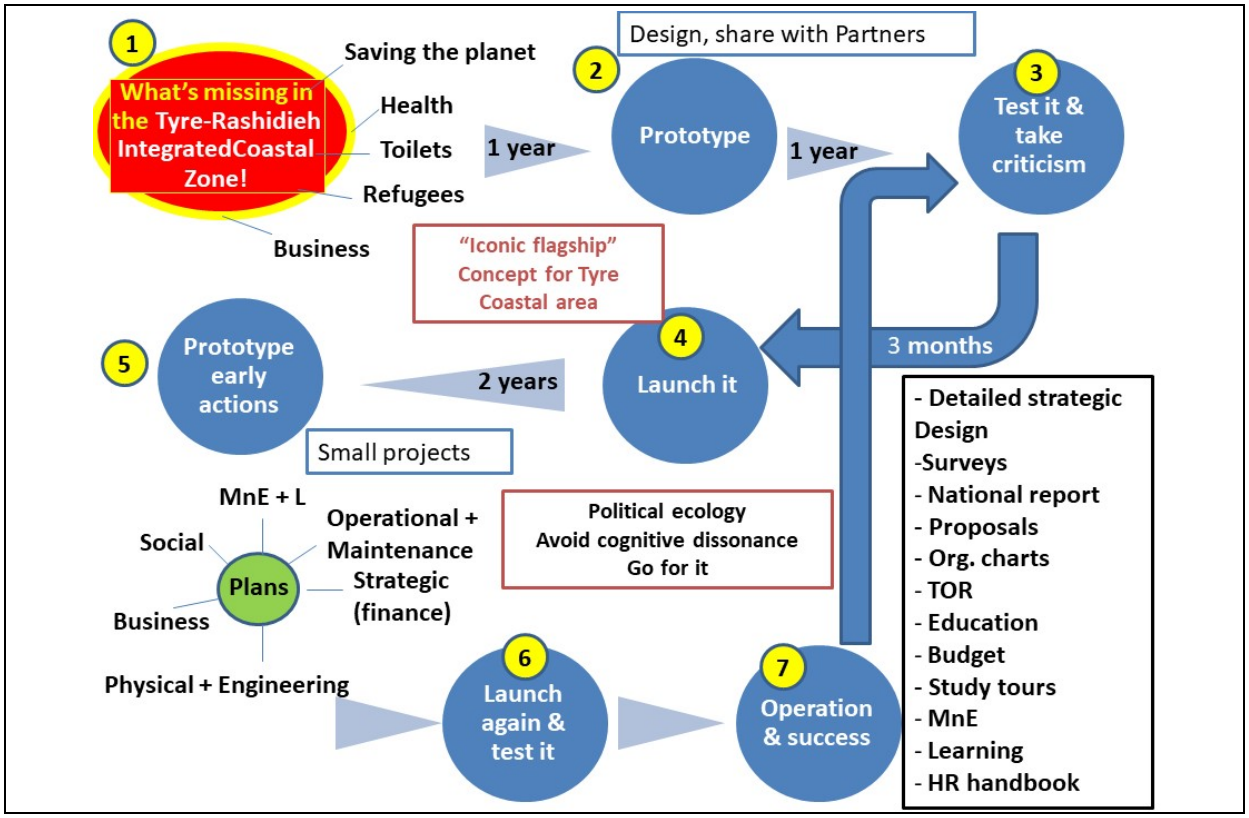


Figure 29: Integrated Environmental Plan for Tyre Nature Reserve as developed in January 2018 under Feasibility Study by Tyre Nature Reserve staff and Rashidieh Camp local communities

2.9.2 Environment Action Plan Part 2: Coastal Zone Restoration and Heritage Conservation Action Plan

Key Topics:

- Summary of 4-Component solution
- Maps
- Training and Awareness component

The action plan contains the following standardised and internationally recognised sections

1) General site conditions
2) Topography
3) Land cover and social considerations:
    - Current land uses: including sensitive areas such as housing, schools, recreation areas
    - Physical/spatial planning policies or zoning
    - Areas or features designated for nature conservation
    - Landscape and existing structures on site inventory
    - History
    - Cultural and agricultural relevance
4) Water features including groundwater:
    - Coastline Assessment
    - Coastal Environment Summary
    - Flood protection zones
    - Coastal processes and hazards

- Assets

5) Coastal erosion problems: determine the exact rates of erosion, the causes and impacts
6) Proposed Protection Structures
7) Sea level rise
8) Minimum crest elevation
9) Plants and materials
10) Development EIA and SIA be considered in terms of:
    - Minor works
    - Works eligible for exemption
    - Works that require license from authorities
11) Impacts needed to be considered in terms of:
    - Ecological values
    - Protection offered by coastal features to adjacent infrastructure and use
    - Establishment of buffer zones to minimize the impacts of erosion and tidal inundation
    - Physical shoreline response to coastal protection structures, compared to soft responses, such as beach nourishment
    - Impact of development on recreational opportunities highly valued by the Rashidieh community
    - Scenic values
    - Beach nourishment
12) Drainage infrastructure and other pipes leading into sea
13) Vegetation clearing
14) Dune fencing
15) Pipes and cables to be laid
16) Removal of materials, general works
17) Sources of materials to be used in the restoration
18) Access tracks, road and car parking
19) Swimming enclosures, lifesaving towers
20) Construction Cost Proposal
21) Cost-Benefit Scenarios
22) Impacts on camp dwellers of adopting the status quo
23) Impacts on infrastructure of adopting the status quo
24) Preferred Option
25) Project Feasibility Remarks

Detailed Workplan

Deliverables	**Month 1**	**Month 2**	**Month 3**	**Month 4**
Preliminary Proposal Report				
Full Report Draft (Environmental, Social, Cultural)				
Component 1 & 2 Detailed Design				
Checklist of environmental factors report				
Component 3 Detailed design				
Component 4 Designs and Innovations Report Development				
Consultation workshops and final presentation				

2.9.3 Action plan Part 3: Master Plan Camp Environment, and beachfront

Here is presented an Integrated Tyre-Rashidieh Coastal Zone Protection and Heritage Conservation Management Plan Outline. Why introduce such a detailed management outline at this stage in the feasibility? In environmental planning, the early agreement on strategic planning and strategic processes that everyone will follow is considered the key factor in subsequent success of the eventual project and programmes.

Overall plan organizing concepts:

A) Executive summary and introduction: The important stuff up front such as "why is this important and needed?", "How is this different and improved?" and "What are the 'plans' key recommendations. Give just enough background to provide general context, but no more.

B) Main body of report. Then present management plan recommendations in detail beginning with broad concepts and quickly moving to detailed local programs and projects.

C) Appendices. Put the fact-finding, survey, meeting note summary and important progress records and background reference material in the back where it is available to those who want it.

Report Outline

1. **Executive summary or Overview**
2. **Introduction**
    - 2.1. Brief overview
    - 2.2. Need (justification)
    - 2.3. Critical Success Factors
        - 2.3.1. Access to local leadership
        - 2.3.2. Progressive, consistent and long-term local leadership
        - 2.3.3. Peace and security
        - 2.3.4. Undivided community
        - 2.3.5. Local partners
            - 2.3.5.1. Expand skill and resource base
            - 2.3.5.2. Additional access to local leaders
            - 2.3.5.3. Support from local and national expat community
        - 2.3.6. Regional support
            - 2.3.6.1. Tyre Mayor's and/or Ministry of Environment focal point office
            - 2.3.6.2. Local and regional schools and universities
            - 2.3.6.3. Regional ministries, MOE and another agency support
            - 2.3.6.4. National ministries, MOE and another agency support
        - 2.3.7. MOE capacity (both skills and staffing numbers)
            - 2.3.7.1. Local UNWRA capacities
                - 2.3.7.1.1. Value of local recruitment
                - 2.3.7.1.2. Training and support of local staff
                - 2.3.7.1.3. Building a long-term local base
            - 2.3.7.2. National UNRWA
            - 2.3.7.3. International UNRWA
            - 2.3.7.4. Other UN programmes and resources
        - 2.3.8. Funding
        - 2.3.9. Exit strategy
    - 2.4. Planning process
        - 2.4.1. Bottom-up community-based action plan
        - 2.4.2. Top-down alignment with policies and national strategies

3. **The plan** (*may be published in three stages*): 1) Summary of Integrated Coastal Zone master plan, 2) After completion of initial early action projects, 3) After further projects and when UNRWA moves on.
    - 3.1. Regional Coastal framework
        - 3.1.1 Ramsar Site
        - 3.1.2 Beach protection corridor recommendations
        - 3.1.3 Regional partners, university, ANERA, Tyre Tourist Office
        - 3.1.4 Regional bio-physical setting (*summary and references*)
            - 3.1.4.1 Three Management Zones for Tyre Nature Reserve
                - 3.1.4.1.1 Offshore
                - 3.1.4.1.2 Shore
                - 3.1.4.1.3 Backshore zone
    - 3.2 Camp Greening plans
        - 3.2.1 Leadership profile and summary of project history
            - 3.2.1.1 Previous history (summary)
            - 3.2.1.2 Project history
            - 3.2.1.3 Critical success features at local scale
            - 3.2.1.4 Local planning process summary *(timeline, meetings, workshops, Shuras; - details, minutes and other records in appendix)*
        - 3.2.2 Coastal Zone Management Plans
            - 3.2.2.1 Goals, objectives, 'wish list' as articulated by local leaders or during work shops
            - 3.2.2.2 Summary maps
                - 3.2.2.2.1 Existing conditions (natural and cultural), opportunities and constraints
                - 3.2.2.2.2 Landscape master plan
            - 3.2.2.3 Development program *(overall schedules, projects, budgets, interrelationships, partners, funding)*
            - 3.2.2.4 Cooperative projects with other villages
        - 3.2.3 Individual projects: summaries *(spreadsheet as well as narratives and photos, suitable for insertion in other publications)*
            - 3.2.3.1 Camp approach and entry features
            - 3.2.3.2 Eco centres
            - 3.2.3.3 Eco tourism
            - 3.2.3.4 Green schools
            - 3.2.3.5 Camp nurseries and woodlots
            - 3.2.3.6 Camp agricultures orchards and similar activities
            - 3.2.3.7 Micro-tourism projects and programs
            - 3.2.3.8 Eco-san projects
            - 3.2.3.9 Other village improvement projects *(drinking water, roads, bridges and access)*
            - 3.2.3.10 Other local enterprise projects
            - 3.2.3.11 Marine area projects
            - 3.2.3.12 Local heritage enhancement (UNESCO projects)
            - 3.2.3.13 Local disaster and climate change preparedness
            - 3.2.3.14 Local training programs
                - 3.2.3.14.1 UNRWA
                - 3.2.3.14.2 Partners
                - 3.2.3.14.3 MOE
            - 3.2.3.15 Project evaluations summary
            - 3.2.3.16 Photo/video record
            - 3.2.3.17 Additional Section on: Finance, local administrative and due diligence, NGO

law, local government law, how practically this plan links to national systems and opportunities such as the Ministry of Energy and Water and Mayor Office local governance plans

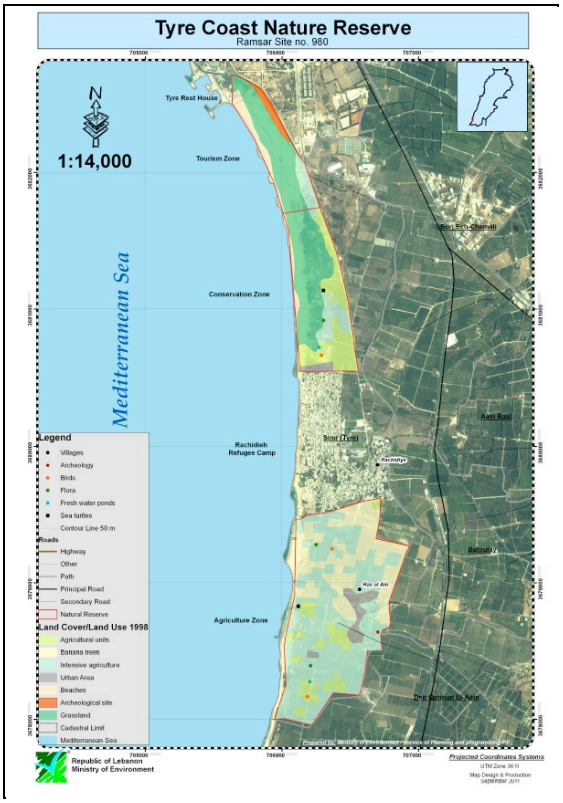


Figure 30. Overview map of integrated environmental and sanitation nature protection measures

Table 13: Cost estimation for Tyre Nature Reserve

No.	System component	Training need (with Siblin) / UNWRA	estimated CAPEX USD	Revised estimation USD
1	Temporary (1.5 years) technical specialists (marine, shore engineering, environment education,		85,000	
2	Purchase offshore marine equipment		50,000	
3	Enhancing of the existing management and educational information centre at the Nature Reserve		50,000	
4	Planning restoration and protection for the Nature Reserve, marine and coastline (initial study)		10,000	
5	Botanical training for coastal restoration	Y	5,000	
6	Establishing Nursery and ecological restauration materials		100,000	
7	Purchase of beach waste bins and furniture		20,000	

No.	System component	Training need (with Siblin) / UNWRA	estimated CAPEX USD	Revised estimation USD
8	Establishing 2 public toilets (considering ISO30500)		30,000	
9	Waste-to -energy demonstration (biogas sanitation unit)		30,000	
10	Application of ISO30500	Y		
11	Accompanying scientific monitoring studies for marine and onshore		20,000	
12	Management, supervision, guidance and monitoring	Municipality & MoE	100,000	
13	Awareness raising & capacity building = 15%	75,000.00		
	TOTAL		500,000.00	500,000

3. Strategies and activities to increase awareness, knowledge, and entrepreneurship for proposed improvements 1 through 9

3.1 Strategies and activities to increase knowledge and awareness

This scope of work has been developed as part of the “Integrated Sustainable Environmental Sanitation” (Pre-) Feasibility Study to present the conceptual design for an integrated education and awareness component. Activities under this component will support individuals and groups to independently identify, prioritize, and engage in long-term commitments to attitude and behaviour change relating to environment and sanitation. Integrated Education and Awareness is comprised of two distinct sub-components: 1) Awareness Building; and 2) Primary and Secondary Education.

Effectiveness and sustainability of the proposed solutions towards improved health and environment quality in and around the camp depends on the level of environmental awareness of the community and their willingness to engage and initiate behaviour change. Therefore, knowledge and awareness comprise an essential component of the "Integrated Sustainable Environmental Sanitation Approach".

Behaviour change requires long-term engagement with the community through an inclusive, participatory integrated awareness raising and education strategy geared towards increasing environmental knowledge, changing current negative attitudes and perceptions and promoting environmentally sound practices on individual, community and organizational level in the camp. More specifically, the proposed approach seeks to:

- Improve general environmental awareness in the Tyre-Rashidieh area to make the environment a priority and to communicate the links between environmental health and other individual and community priorities.
- Raise awareness and promote pro-environmental behaviour as a social practice among the Tyre-Rashidieh community including men, women, youth and children, and improving hygiene and sanitation practices.

- Encourage and promote informed choices for innovative and appropriate eco-sanitation and solid waste management and to ensure sustainability of the proposed technical solutions through acceptance, ownership and community mobilization.
- Promote waste-to-value concepts as tools to enhance environmental awareness and encourage behaviour change in a way that also brings financial benefit to the community; including both organic waste and solid waste through re- and upcycling.
- Identify opportunities and promote linkages between the local natural heritage assets, including the Tyre Nature Reserve, with other "green" initiatives in Tyre Rashidieh to enhance environmental awareness and promote pro-environment behaviour.

The proposed approach is in line with UNRWA's 2016-2021 environmental health strategy for the Palestine refugee camps in Lebanon which was developed by the Environmental Health Unit (EHU) of the Field Infrastructure and Camp Improvement Program (FICIP) to provide strategic guidance in relation to environmental health interventions in the camps with focus on efficient resource management, sustainability and innovative approaches. It comprises two integrated components:

- Community-based awareness and outreach engaging individuals, households and organizations and engaging women, men, boys and girls.
- A knowledge and education component targeting all 4 schools in the camp through capacity building of teachers, integrating environment education in school curricula, and hands-on pro-active and practical extra-curricular activities linking the school to the community and the camp to the Nature Reserve.

The FICIP working group plays a key role in this regard. Therefore, capacity building of the members of the working group is essential to equip them with the necessary knowledge and skills to lead. In addition, collaboration between UNRWA and all stakeholders contributing to knowledge, awareness and education is key to create synergies and enhance impact. The main stakeholders identified during the (Pre-) Feasibility Study include the Nature Reserve, ANERA, UNRWA schools, and INNODEV. However, this list is not exhaustive. The role and contribution of each of these stakeholders and linkages and possible synergies will be discussed below.

1. Community-based awareness and outreach

This component seeks to raise awareness and mobilize the community towards sustainable pro-environment practices through an outreach program engaging individuals, households and organizations in the camp in collaboration with other relevant stakeholders.

Approach

In 2017 ANERA implemented an integrated flagship solid waste management project in Rashidieh. ANERA's approach towards community mobilization and raising environmental awareness is inspired by the *Social Ecological Model*[2]. In spite of the short project life, it succeeded to introduce the concept of "sorting at source" on the level of the households and to mobilize the community towards a more sustainable waste management.

In light of the positive experience and encouraging results from the ANERA approach to community-based solid waste management, it is recommended to continue or enhance collaboration with them and other similar organizations. Interventions should build on the successes and lessons learned from the ANERA project to inform a broader community-based environmental awareness and outreach strategy for Rashidieh. The approach should integrate environmental sanitation and waste management with knowledge & awareness activities, all targeting empowerment, capacity building and community mobilization. Linkages with economic opportunities, such as waste-to-value entrepreneurship, greening

[2] A theoretical framework for understanding the linkages and inter-relations between the individual, the community and the environment.

projects, education initiatives, and natural heritage assets, such as the TCNR, should also be considered within such an integrated approach to environmental awareness.

Actors

To achieve the intended results, UNRWA and its environmental awareness partners need to engage with the Working Group (WG) in Rashidieh as a key stakeholder in this process. As UNRWA's counterpart for the CIP, the WG functions as a platform that convenes all major community stakeholders. It gained legitimacy to work with UNRWA and other external stakeholders providing services in the camp. The WG contribution includes assessing needs of the community; endorsing projects; and monitoring implementation. Engaging the WG and its member organizations requires capacity building in the fields of planning, communication, knowledge management and monitoring and evaluation. In addition to the WG there is also a need to develop youth initiatives and to target and empower women as a main driver of change in the community. Engaging mosques and religious figures in communicating environmental messages, creating economic incentives through environmental activities can be effective tools to reach out to men.

Recommendations for interventions for outreach and awareness include:

(1) **Training and capacity building of main stakeholders including WG members, volunteers and, women neighbourhood committees responsible for waste separation, cleaning and outreach, and staff of youth and women organizations**. The purpose of the training is to empower the stakeholders and raise their environmental awareness and develop their skills to communicate, reach out and mobilize their community. The training is also supposed to be the first step towards developing an outreach strategy.

(2) **Design and implementation of a three-year participatory community-based outreach strategy involving all relevant stakeholders. The purpose of this strategy is to raise environmental awareness and mobilize the community to encourage sustainable pro-environment behaviour on the individual and collective levels.** To enhance outreach it is important that the strategy includes .an information campaign, using multiple media outlets and activities (TV, radio, Facebook, etc.); Other components include undertaking community-based camp improvement projects (cleaning, painting walls, planting... etc.), organizing competitions, developing a master plan for green spaces, and implementing small greening projects as part of the campaign; make use of the nature reserve as an educational asset through organizing cleaning campaigns and environmental awareness tours on the beach and in the reserve.

(3) **Develop model projects or best examples in order to motivate behaviour change** and link environmental awareness with other priorities (e.g. gardens, “Green Mosque,” public pools/foundations, green roofs, etc.);

(4) **Develop good practice waste-to-value initiatives that can serve as models and incentives especially for women and youth** and encourage entrepreneurship in this field and expose business-oriented people to opportunities for funding. This also requires training and capacity building of the participants and a guarantee of market outlets.

2. Environmental Education

This component will support the integration of environmental issues into primary and secondary school curricula by developing relevant teaching tools, enhancing environmental awareness among education stakeholders, and facilitating experiential learning opportunities with local actors.

Approach

As the educational component aims primarily to strengthen formal educational institutions, its approach is first and foremost to build on the types of teaching tools or models already in use and effective. For example, the *Human Rights and Conflict Resolution Toolkit* should be assessed as a potential guide for a similar *Environmental Toolkit* or should be strengthened through the inclusion of environmental issues.

Other existing tools not currently in use, such as the *WASH* toolkit that was developed in 2016 in collaboration with UNDP, should be identified and assessed for relevance and incorporation.

In addition, because environment is not currently a standalone course in UNRWA schools but is instead integrated as a cross-cutting issue throughout school curricula, activities to strengthen environmental education must be similarly integrative. Ongoing developments in UNRWA curricula and links to the FICIP Environmental Health Strategy must therefore be mapped out, along with needs and opportunities to integrate or improve environmental education in a variety of subjects. This approach aims not to overburden schools with new teaching requirements, but on the contrary, to ensure that materials for environmental education are available, relevant, and complementary to existing models.

Actors

Actors already engaged in education and environment will be key proponents of these activities. Primary actors will be teachers, teacher trainers, and curriculum officers who are directly responsible for ensuring the quality and compliance of education packages with UNRWA and Lebanese standards. Actors for promoting experiential environmental education will include the TCNR and NGOs working in environment and sanitation in Tyre-Rashidieh, including but not limited to ANERA and INNODEV, which has supported both ANERA and the TCNR with educational resources and training capacity. Educational stakeholders should also include national or international environment institutions (i.e. IUCN, MoE, etc.) that are committed on a broader scale to environmental awareness and education and that work locally through the TCNR. For activities within the camp and that link formal education with community awareness, the WG will be a key stakeholder and should contribute through assessing needs of the community, endorsing projects, and monitoring implementation.

Recommendations for Environmental Education activities include:

(1) **Training and capacity building for education stakeholders in environment and sanitation issues (i.e. UNRWA teachers, trainers, and local environmental organizations engaged in outreach)**. The purpose of capacity building is: a) to enhance the ability of education stakeholders to identify and respond to environmental education needs and opportunities; and b) to promote commitment, sustainability, and behaviour change through increased awareness at all levels of education. Training partners might include NGOs, such as INNODEV, or other national or global environmental education institutions with experience in the refugee context.

(2) **Design of Environmental Toolkit(s) that directly complements UNRWA's school curricula, for implementation at both the primary and secondary school levels.** The purpose of the Toolkit is to facilitate integrated environmental education by providing concrete lessons, activities, and tools that are directly related to core subjects and curricula. The Toolkit should be developed in collaboration with UNRWA's education office, with consideration for extra-curricular experiential learning with local partners. The Toolkit modelled after (or developed in support of) the Human Rights and Conflict Resolution Toolkit must be designed for use at all Lebanese UNRWA schools and clearly adaptable at the local (i.e. school or community) level.

(3) **Design and/or support the implementation of experiential learning activities in coordination with local environment actors (i.e. Tyre Coast Nature Reserve).** The purpose of these activities is to link environmental education in the classroom with relevant, real-life experiences. Activities should consider opportunities for primary and secondary students to understand, enjoy, and contribute to local natural heritage sites in a measurable way. Support establish or support existing, long-term linkages between schools and local environment actors.

(4) **Enhance the role of local schools in promoting environmental behaviour change by developing a series of events that engage students, parents, and teachers.** These activities should aim to use schools as a platform for broader community awareness, giving students the opportunity to demonstrate their learning about the environment and parents the opportunity to engage and benefit from greater environmental knowledge. Projects such as gardens, theatre, or "healthy snack days" (already practiced) should be identified as opportunities to affect behaviour change in parents, teachers and students alike.

3. Support for Environmental Knowledge Management and Learning

A centralized system, network, or process for environmental knowledge management and learning (KML) should be established with the following aims:

1) To ensure that all activities undertaken as part of the Project are integrated, coordinated, and communicated to relevant stakeholders; and

2) To ensure informed choice, facilitate community buy-in and support sustainability. This system should be developed in coordination between UNRWA, the WG, and technical experts. Initial ideas for KML developed through the feasibility study include:

- establishing an environmental improvement communication forum to coordinate relevant internal (in Rashidieh) and external stakeholders, lead outreach efforts, and disseminate new information;
- Establishing an environment "eco-centre" to house relevant information, ideas, technical specifications, capacity building, and innovation.

3.2 Strategies and actions for entrepreneurial development

The "Integrated Sustainable Environmental Sanitation" (Pre-) Feasibility Study includes a conceptual design for an Entrepreneurial Development component that contributes to a sustainable and pro-environment waste management system. The primary objective of this component is to support residents of Rashidieh camp to identify and carry out innovative waste-to-value opportunities, including sorting, recycling and upcycling, in order to generate sustainable income.

The *Entrepreneurship* component aims at both, to strengthen existing enterprises in the waste-to-value chain and to support the development of new waste-to-value concepts. The (Pre-) Feasibility Study identified gender gaps in terms of work opportunities and economic participation of women in Rashidieh; therefore, part of the innovation of this component lays in identifying waste-to-value entrepreneurial opportunities for women and developing women's entrepreneurial skills to enhance their economic participation and income generation.

Waste-to-value concepts can play a central role in encouraging and sustaining environmental behaviour change while strengthening local economic opportunities for men and women and community commitment. In the case of Rashidieh, the importance of waste-to-value enterprises is augmented by constrained employment opportunities and strict regulations regarding the flow of material in and out of the camp. In the face of immediate economic concerns, the environment in Rashidieh has been generally de-prioritized. With this in mind, waste-to-value entrepreneurship concepts represent an important link between environmental behaviour change and the alleviation of underlying structural challenges, such as poverty and unemployment particularly among youth and women.

The main objectives of the Waste-to-Value Entrepreneurship component are as follows:

- Support a sustainable waste management system (i.e. reduce, reuse, recycle) by raising recycling rates, cutting the amount of plastic litter and any further waste.
- Support a sustainable waste management system (i.e. Reduce, Reuse, Recycle) by raising recycling rates, cutting the amount of plastic litter and other waste, improving separation collection, reducing dependency on virgin resources/externally produced goods, and by creating new products (like compost).
- Encourage long-term behaviour change, sustainability, and environmental awareness by promoting a circular economy in which improved waste management enhances household economic conditions in addition to income generation opportunities.
- Promote waste-to-value concepts as tools to enhance environmental awareness and encourage behaviour change in a way that also brings financial benefit to the community - both organic waste and solid waste (e.g. upcycling)

- Identify opportunities and develop business cases suitable for women to participate in the formal and informal waste-to-value chain and to generate economic benefits from their activities linking formal commercial waste-to value activities in Rashidieh with informal small-scale activities including informal waste-pickers and women small-scale sorting and upscaling activities in the camp to enhance effectiveness.

This component complements and supports UNRWA's FICIP EH strategy, which identifies waste management as central to camp improvement and encourages innovative approaches to efficient resource management.

Importantly, this component targets both existing, commercial-scale waste-to-value enterprises, such as the currently operating recycling centre, as well as potential waste-to-value concepts that provide economic opportunities for women and other informal waste pickers. The ANERA solid waste management project which was implemented in Rashidieh in 2017, showed that women can successfully act as the key drivers of sorting at source on household level. While women in Rashidieh are not participating in any commercial-scale waste-to-value and recycling enterprises, the feasibility study the awareness, willingness and potential of women to participate in waste-to-value activities either as small-scale entrepreneurs working as part of the waste-to-value chain particularly in sorting and up-cycling, or as workers in larger scale enterprises. For these reasons, close coordination between the FICIP working group, business community members, and UNRWA will be essential to ensure full stakeholder participation. Waste is an important part of the FICIP. While they implement their strategy, UPM's approach will be additional and supportive in areas, which FICIP is not considering enough or not able to tackle.

Approach

This component builds on past and ongoing waste collection and waste-to-value activities in Rashidieh. These include the ANERA community-based solid waste management project as well as the privately owned and operated community recycling centre - and when- and wherever possible, the FICIP program.

Feasibility Study research indicates that the ANERA project succeeded in introducing the concept of "sorting at source" at the household level and that residents continue to sort materials that are accepted and purchased at the recycling centre. Interventions should build on the successes and lessons learned from the ANERA project with regard to household sorting practices and should explore further opportunities to link those practices with productive economic activity.

In contributing to the FICIP EH Strategy and the ongoing UNRWA solid waste management policy, activities under the Entrepreneurship SoW will facilitate solid waste inventorying, reduction of waste at the household level, and capacity building.[3]

Activities that fall under the Waste-to-Value component should also be integrated with Awareness activities that aim to link environmental behaviour with economic development and that promote environmental consciousness more broadly.

Actors

Actors currently or previously engaged in sorting and waste-to-value will be key proponents of these activities can be understood as falling into two groups: 1) existing, commercial-scale enterprises; and 2) individuals, particularly women and other informal waste-pickers, who are directly involved in waste management at the household or community scale and who face constrained livelihood opportunities. As such part of the activities will be geared towards equipping women with entrepreneurial, management and marketing skills and coaching them for developing innovative small waste-to-value income generating enterprises. With this in mind, the CIP Working Group should play a central role in facilitating community-level needs and opportunities, endorsing projects, and monitoring implementation, as well as serving as platform for information exchange and actualization.

[3] UNRWA FICIP EH Strategy 2016-2021.

In addition, UNRWA will collaborate with qualified NGOs working in solid waste management (including but not limited to ANERA and INNODEV) to provide technical guidance and expertise.

Recommendations for Waste-to-Value Entrepreneurship activities include:

1. **Comprehensive assessment of ongoing Tyre-Rashidieh waste-to-value entrepreneurial activities.** This activity will include a systematic mapping of all informal, individual-scale; formal, business-scale; and formal with external support activities in and or connected to Rashidieh and identifying new potential actors. The assessment will also include baseline product assessments in order to understand the current types, volumes, and values of waste-to-value products and to facilitate measuring change or improvement over time.
2. **Provision of capacity building in business development, specifically designed to train participants (at both individual and commercial scales)** (see above) **in the global standards of the Business Model Canvas.** The purpose of this activity is to provide participants with the foundational tools to engage responsibly and realistically with the market both during and after project completion. Capacity building will be tailored to different types and scales of entrepreneurship, though should enable all participants to identify the following:
    - Who are the key partners/suppliers?
    - Key activities: What key activities do our value proposition require?
    - Key Resources: What key resources do our value proposition require?
    - Value Proposition: What value do we deliver to the customers? Which one of our customer's problems are we helping to solve?
    - Customer relationship: What type of relationship does each of our customer segment expect us to establish and maintain with them?
    - Channels: Through which channels do our customer segments could / want to be reached?
    - Customer Segments: For whom are we creating value? Who are our most important customers?
3. **Provision of capacity building in Financial Management.** The purpose of this activity is to enhance the ability for individuals and enterprises to plan, invest, and report on their business activities. Capacity building will be tailored to various scales and types of entrepreneurship but, broadly, will including the following key concepts:
    - Cost structure: What are the most important costs inherent in our business model? Which key resources/activities are most expensive/cheap?
    - Revenue Streams: For what value are the customers really willing to pay? How would they prefer to pay? How much does each revenue stream contribute to overall revenues?
    - Legal requirements and constraints particular to the Rashidieh context
4. **Support for the development of business cases in incubator or "innovation lab" setting.** This activity will support entrepreneurs of varying types and scales in developing and proposing business cases that target: 1) needed equipment or goods for individual or personal use (preferable inside the camp); and 2) the production of equipment or goods for the market. This activity should provide structured mentorship and potentially financial incentive to prepare feasible business proposals for funding and implementation.
5. **Establishment of a coop, working group, or committee that supports ongoing capacity-building, market linkages, and innovation for small-scale waste-to-value entrepreneurs, particularly women.** The purpose of this activity is to establish a network of knowledgeable waste-to-value entrepreneurs who act as leaders in: a) identifying sustainable waste management and upcycling concepts; 2) market assessments and business case development; 3) sourcing and production of up-cycled goods; 4) basic accounting and investment; and 5) the marketing and distribution of goods. The specific organizational structure of this group should be identified through a participatory process that ensures the group's self-regulation and sustainability.

6. **Establishment of both formal and informal partnerships,** market linkages, including marketing materials, and linking up with competitors and suppliers, and exploring new markets

3.3 Proposed Training Programs and Partners

Training and capacity building are essential components of the environmental sanitation and solid waste strategy proposed in this feasibility study. Introducing new innovative technical solutions requires the development of specific tailor-made training programs targeting UNRWA's sanitation and technical staff in Rashidieh. This includes training modules on the application, operation and maintenance of the proposed technical solutions to ensure long-term operation, effectiveness and sustainability of the services in the camp.

Capacity building of the local community in Rashidieh on individual, collective and institutional level is necessary to mobilize the community towards behaviour change and to develop income generating opportunities and encourage entrepreneurship especially in relation to waste-for-value which is an essential component of the proposed overall scheme as a tool to enhance sustainability and to reduce the adverse environmental impact of waste management in the camp by decreasing the volume of waste and giving it economic value.

3.3.1 Training Partners

UNRWA's vocational training centre in Sibline is an important training facility which provides professional and semi-professional long and short-term training for Palestine refugees in South Lebanon. Its program is based on the German modules system and includes modules that can be adapted to fit the needs identified in the feasibility study. In addition to the regular two-year vocational programs, the centre currently offers a variety of short-term courses of 4, 6 or 9 months. The Centre management indicated interest in training and innovation and willingness to develop tailor-made training modules that meet the specific needs of the Rashidieh integrated project if funding is available. This includes training modules on the technical components of the proposed program (operation and maintenance), as well as business management, project planning and environmental education training for UNRWA school teachers, and to integrate environmental awareness and the concepts of waste for value and the 3Rs in their education packages. Developing such training modules in Sibline Vocational Training provides training opportunities for a big number of Palestine Refugees to participate and contributes to broader outreach and impact.

In addition to Sibline, ANERA and INNODEV were also identified as potential training partners both for school teachers and the community specifically in relation to sorting at source, waste-to-value, and environmental education and awareness. Both organizations have capacity and experience to conduct community and school-based training and capacity building as part of an integrated outreach and awareness raising strategy (see 4.1.7).

UNRWA's partnership with ANERA and UNICEF to implement a community-based solid waste management in Rashidieh in 2017 already included knowledge, training and capacity building components that can be developed further or adapted to meet the purpose; including: Building the capacities of sanitation workers, informal waste pickers and local organizations; training of youth volunteers to conducted base-line assessments, awareness sessions, FGDs, door-to-door monitoring; and training and awareness of community members on environment friendly approaches to household waste management.

INNODEV is committed to increase environmental knowledge and awareness among youth and children in particular as it believes they are the driver towards a better environment in Lebanon. It provides professional expertise and uses innovative methods to enhance knowledge and awareness both in Palestine refugee camps and hosting communities in Lebanon. INNODEV's in house expertise, their innovative approach, their outreach and linkages with the hosting communities and the Tyre Nature Reserve in particular is an asset particularly for capacity building and environmental education and teacher training in particular in partnership with other stakeholders particularly the 4 schools at

Rashidieh, UNRWA's education environment, and health departments as well as the Tyre Nature Reserve.

3.3.2 Curriculum development, management and implementation

The training and capacity building component will be managed by UNRWA's relevant departments and the Rashidieh CIP team in cooperation with the identified partners. The training curricula will be developed by experts in cooperation with the partners and under the supervision of UNRWA and the respective UPM experts. The overall training process will be managed and monitored by UNRWA while technical assistance and part of the training will be provided by the UPM experts.

Training modules divided in categories:

Category I: Sanitation and sewage management:

1) Training for the Vacuum sewerage collection system for consultants and site agents. This includes introduction to vacuum sewerage collection system, background technologies, design Considerations, Designing and tendering.

2) Training for the Vacuum sewerage collection system for Rashidieh contractors and plumbers including introduction to vacuum sewerage collection system, background technologies, explaining different pipes &fittings, vacuum pot functions and maintenance procedure, and pipe testing procedure and exercises

3) Training for the eradication of the percolation pits for different craftsmen and traders including knowledge of dry wall installation, exercises with dry walls and introduction to different sanitary appliances e.g. showers, wall hang toilets etc.

4) Developing and conducting a series of hands-on, practical, participatory and problem solving oriented 3-day training workshops for all UNRWA sanitation workers divided in groups based on a SWOT analysis of the status of sanitation in Rashidieh camp to identify bottlenecks and to test solutions for the improvements identified during the training.

Category II: Solid waste management & waste-to-value

1) Three-week workshop: WASTE-To-Value Practice for interested community members including identification of suitable products (with low (or zero) cost for resources needed as well as low (or zero) cost in production). Training should include the whole cycle from selection of raw material through production to delivery/payment, i.e. products selection & production, product packing and presentation on existing Up-Cycling platforms, marketing and payment and taxes. The workshops should be led by experienced up-cycling experts from Rashidieh as well as national (or international) experts, and products can be exhibited for sale within the camp. A follow-up workshop can be organized 4 or 6 months later to discuss bottlenecks, share success stories and discuss lessons learned.

2) Three-week practical training on composting for sanitation workers and interested men and women in the camp. This requires the identification of a location and availability of water. The training includes composting, compost soil and exploring marketing possibilities.

3) Six-week biogas construction training is offered in case biogas technology is applied in the camp. The training is a mix of theory and practice and can provide know-how for a group extending biogas technology professionally in Lebanon.

Category III: Knowledge, education and awareness:

1) Training and capacity building of the CIP working group members including communication and mobilization skills, participatory needs assessment & leading FGD, project management and planning, monitoring and evaluation and fundraising & proposal writing.

2) Practical and innovative environmental education and integrating environmental education in curriculum and teaching methods and developing teaching materials for selected teachers in all 4 UNRWA schools and staff of UNRWA education department (Tyre and Beirut).

3) Two-day training workshop with ANERA-team and ANERA volunteers to revisit the 3+2=1 campaign (3Rs: Reduce/Reuse/Recycle) and explore to the 8R-concept (Refuse, Reduce, Reuse, Regift, Repair, Recycle, Recover —> Rethink!) and how to further involve schools/student as multiplier. The training can also include ways to extend recycling to up-cycling through demonstrating the concept in the camp as a source of income for youth and women especially those who are already active in this field on small scale.

4) Business Model Development for Up-Cycling Production and Marketing training for women and youth led by a start-up consultant and coach on how to develop a business-plan, based on the simplified business model canvas concept

5) ToT on effective methods for behaviour change and developing strategies for awareness raising on individual and collective responsibility towards pro-environment waste management practices. This ToT targets member organizations of the CIP working group, ANERA's integrated solid waste management neighbourhood committees and volunteers as drivers for change. The training is a first step towards developing a 3-years collaborative community- based focusing on environmental behaviour change in the community on all levels.

Proposal to the Siblin Training Centre in Saida

To include in the Technical and Vocational Education and Training Programme (TVET) the following capacity building modules and courses to facilitate the implementation of proposed environmental sanitation projects in refugee context. All modules should end with certificates recognized by the Lebanese authorities.

Basic trainings needed:

1. Business management module
2. Coastal protection management aspects
3. Environmental sanitation modules (basics and state of art in sanitation, water, waste, emission, laws and guidelines, hygiene)
4. Establishing BoQs
5. Occupational and household safety and health care, First aid
6. Training of trainers' modules (pedagogical)

No.	Modules needed	Credit hours needed	Existing curriculum Y/N
A	**Solar electric technician**		
	Produce solar cooker, cooking bags, solar boxes		
	Solar electric services		
	Solar electric mini grid		
	Solar technology design basics		
	Training of machine operators		
B	**Inhouse plumbing**		
	Green trickling walls		
	Greywater and water saving		
	Hot water plumbing		
	Separate grey and black water		
	Solar technology design basics		

No.	Modules needed	Credit hours needed	Existing curriculum Y/N
	Sustainable plumbing courses		
	Water saving devises		
	Biogas mini gas grids		
C	**Sewer and Run-off technician**		
	Design and Operation of Pumping stations		
	French drains		
	Green trickling walls		
	Gullies re-design & construction		
	Infiltration areas & hydraulics		
	Main sewer systems		
	Rainwater harvesting design		
	Separate grey and black water		
	Training of machine operators		
	Training on Vacuum sewerage material		
D	**Environmental teacher and educator training**		
	Biogas services		
	Educational information methodologies		
	Solar technology design & engineering basics		
	Water saving devises		
E	**Restroom and community toilet manager**		
	Design of vandalism proof public toilets respecting gender issues		
	Environmentally friendly restroom management		
	Training in Application of ISO30500 (“Non-sewered Sanitation Systems with prefabricated integrated treatment”)		
F	**Environmental civil construction designer**		
	Biogas basics and services		
	Design of vandalism proof public toilets respecting gender issues		
	French drains		
	Green trickling walls		
	Green/blue roof designing		
	Rainwater harvesting design		
	Recycling of debris for construction		
	Separate grey and black water		

No.	Modules needed	Credit hours needed	Existing curriculum Y/N
	Training in Application of ISO30500 (“Non-sewered Sanitation Systems with prefabricated integrated treatment”)		
G	**Landscape technician**		
	Engineering & re-construction for main drains of storm water		
	Green/blue roof designing		
	Infiltration area and hydraulic		
	Planning restoration and protection for the Nature Reserve, marine and coastline		
	Training of machine operators		
H	**Wastewater and solid waste technician**		
	Biogas basics and services		
	Charring solid waste or sludges		
	Constructed wetland design & construction		
	Electromechanical shredding system		
	Main sewer systems		
	Pelletizing solid waste or sludge		
	Training of machine operators		
	Training on Vacuum sewerage material		
	Wastewater treatment basics		
	Waste to energy & Plastic to Oil		
I	**Gardeners**		
	Botanical Nursery		
	Botanical training for coastal restoration		
	Botanical training for plant selection		
	Composting and biochar application		
	Educational information methodologies		
	Training of machine operators		

4. Implementation and operational planning

4.1 Recommended actions to increase knowledge and awareness

UNRWA CIP Office

The UNRWA CIP Office (Rashidieh) will be the main proponent of Environmental Knowledge and Awareness Activities and will be responsible for procuring all relevant goods and services and managing all related vendors, partners, and contractors. The CIP office in Rashidieh will report to the FICIP Director of Work and FICIP Office in Beirut.

Collaboration with CIP Working Group

For awareness activities based within the camp, the Rashidieh CIP Office will work collaboratively with the CIP Working Group to remobilize volunteer and community groups that worked with ANERA's solid waste management project. The CIP office will also oversee the Working Group in developing MoUs that define the relationship between the Working Group and implementing partners working in Rashidieh on Environmental Knowledge and Awareness activities. MoUs will determine the Working Group's specific roles and responsibilities for project development, endorsement and monitoring.

Environmental Outreach and Awareness Committee

The Rashidieh CIP Office, with support from the CIP Working Group, will facilitate the establishment of an Environmental Outreach and Awareness Committee (EOAC). This committee will be responsible for designing the community-based outreach strategy, including proposals for model projects and waste-to-value initiatives, and for maintaining coordination between stakeholders. The Rashidieh CIP office will establish a timeline and structure for reporting EOAC activities, and a specific ToR should be developed to define EOAC roles and responsibilities.

Collaboration with the UNRWA Education and Environmental Health Departments

UNRWA will contract with a qualified organization to support the development of the Environmental Education Toolkit. The selected partner will report directly to the FICIP Office and to the UNRWA's Education Department, which will oversee the toolkit's development and ensure compliance with UNRWA curricula and relevant Lebanese standards.

All Environmental Education and Awareness activities should also align with and support UNRWA's Environmental Health Strategy. A structured process of review and validation should therefore be established with the Environmental Health Department.

Local school directors – environmental engagement plan and experiential learning package

UNRWA will contract with a qualified organization to support the development of the Environmental Engagement Plan and Experiential Learning Package for Rashidieh schools. That partner will report directly to the FICIP office. Once developed, local school directors and environmental organizations will be responsible for the implementation of these activities and a tailored monitoring and reporting structure should be instituted to ensure long-term sustainability.

TCNR and other Environmental Actors

It is likely that certain implementing partners will report simultaneously to UNRWA's FICIP department and to TCNR, which will oversee any environmental awareness or experiential learning activities within the Reserve. Structured coordination between UNRWA and TCNR (or other relevant environmental actors outside the camp) will be necessary to ensure that activities are developed and operationalized in compliance with all relevant standards and regulations.

4.1.1 Training implementation and management

Overall Management

The proposed training program will be implemented throughout the project's lifetime. The overall responsibility for the management and quality control of the proposed training workshops lies by UNRWA.

Implementation

Implementation of the training workshops under all three proposed categories is the responsibility of the partners and experts and will be done under the supervision of and in collaboration with UNRWA's relevant departments and the Rashidieh CIP team. Selection of participants in each training workshop will be done by the Rashidieh CIP team in consultation with partners and the CIP working Group. The feasibility study identified UNRWA's vocational centre in Sibline as an important potential counterpart for the design and implementation of various training workshops.

Curriculum development

UNRWA's training partners will be responsible to identify and contract qualified experts for the task of Training design, curriculum development and for conducting the actual training workshop.

Role of UPM expert

UPM experts will provide supervision, technical assistance and mentorship throughout the process and will provide part of the training in some of the workshops.

4.1.2 Institutional framework and linkages including roles and responsibilities

The proposed project will be implemented by national, intermediate and local partners over a four-year period. Key stakeholders from UNRWA, national and municipal government and the Tyre-Rashidieh camp authorities will be closely assisted by technical experts to work and communicate together throughout the project. This will help to ensure that the different drivers and assumptions on how best to link the UNRWA and national plans and policies to the specific needs of the camp with practical actions in the coastal marine, and community areas within the camp can take place.

Following project endorsement, the Integrated Environment Project will enter the inception phase, at which point the hiring process for additional project staff will start. At the request of key stakeholders identified during the feasibility study, the project will use the same institutional management partners, as currently, with an additional chief technical advisor, local coordinator, and team members, seconded from local entities.

A project management unit will be set up within UNRWA, with key Ministry of Environment, Ministry of Energy and Water, and UNRWA, as well as NGO and Camp colleagues. A biannual strategic meeting will take place between senior management and programme team, for discussion on work planning, operational, and programmatic activities, as well as monitoring and evaluation and quality assurance. The main project staff will meet on a weekly basis for regular project delivery, operational and field activity controls, as well as reporting and discussion on outputs.

Project implementation arrangements will build on those for the UNRWA Environmental Health Strategy team project. This will ensure coordination and complementarity. The implementation arrangements comprise:

- Project Steering Committee (PSC) to provide oversight and support to the project
- Project Management Unit (PMU) to execute the project
- Local Project Coordinator (LPC), who heads the PMU
- Project Senior Advisor (PSA), who will provide day-to-day guidance to the project team on executing the project
- Technical Advisors
- Camp Coordination Teams

- Administrative and Financial Assistant(s)
- Consultants (national and international).

The main role of the PSC will be to: i) guide and oversee the technical progress and performance of the project; ii) enhance and optimize the contributions of various partner organizations through coordination of all activities and inputs; and iii) consider and approve annual work and procurement plans and review project reports and deviations from the approved plans.

All decisions taken by the PSC will be communicated to all parties concerned by the PMU. The PSC will include high-level representatives from MOE, MEW, UNRWA, and the Foundation. It will be chaired by the UNRWA Representative. The PSC will meet twice a year, with ad hoc meetings held when necessary to discuss the project key performance indicators and provide future guidance. At the discretion of this initial committee, members of relevant implementing NGOs may be invited to sit on the PSC to ensure local ownership and guidance for the project. The secretarial role of the PSC will be filled by the LPC.

A full-time Local Project Coordinator (LPC) will be hired for day-to-day management of the project. He/She will head the PMU and will be liaise with the Project Senior Advisor (PSA) in terms of execution support. The LPC will report to the Head of UNRWA and to the PSA. The LPC will also provide significant technical input into the relevant technical components of the project, playing both an oversight role and a hands-on role through training, production of documents and facilitation of consultant activities relevant to the LPCs area of expertise. The management role of the LPC will be to ensure that the project is managed in a transparent and effective manner, and that it is in line with all budget and work plans in accordance with guidelines from both the Foundation and UNRWA. The PSC will work closely with Ministry of Environment officials and national coordinators to ensure that project implementation closely adheres with national priorities and is facilitated by existent government structures.

Project supervision will take an adaptive management approach. The UNRWA Task Manager will develop a project supervision plan at the inception of the project which will be communicated to the project partners during the inception workshop. The emphasis of the Task Manager supervision will be on outcome monitoring but without neglecting project financial management and implementation monitoring. Progress vis-à-vis delivering the agreed project sanitation and environmental benefits will be assessed with the Steering Committee at agreed intervals. Project risks and assumptions will be regularly monitored both by project partners and UNRWA. A project implementation review will take place periodically, ideally each 6 months. Risk assessment and rating is an integral part of the Project Implementation Review (PIR). The quality of project monitoring and evaluation will also be reviewed and rated as part of the PIR. Key financial parameters will be monitored quarterly to ensure cost-effective use of financial resources.

A mid-term management review will be conducted half way through the project as indicated in the project milestones. The review will include all parameters recommended by the Monitoring and Evaluation team for terminal evaluations and will verify information gathered through the UNRWA tracking tools, as relevant. The review will be carried out using a participatory approach whereby parties that may benefit or be affected by the project will be consulted. Such parties were identified during the Feasibility Study Phase analysis (see Stakeholder Analysis section of the project document, Volume 1). The Project Steering Committee will participate in the mid-term review and develop a management response to the evaluation recommendations along with an implementation plan. It is the responsibility of the UNRWA Task Manager to monitor whether the agreed recommendations are being implemented.

The following table highlights key management, and activity roles and responsibilities for all partners in this project. All monitoring and evaluation of the project outcomes, outputs and activities will be led by the project technical, reporting and quality assurance team, in the project management group at UNRWA and MOE.

Outcome	Output	Lead Institution	Key Partners	Key responsibilities
Outcome 1: Institutional and technical capacity strengthened to address environmental sanitation	1.1 Freshwater interventions	UNRWA and MOEW	Tyre Rashidieh Municipality, Tyre Nature Reserve	Formulate ToRs of the Project Steering Committee to include mainstreaming of sanitation and environment into local coastal zone improvement plans and nature restoration into policies/strategies. Convene regular (e.g. quarterly/bi-annual) meetings to facilitate dialogue, water resource integration into UNRWA strategies/policies and mobilization of funds for the implementation of Oversee monitoring and evaluation of the impact of the level interventions.
	1.2 Recommended activities for sanitation	UNRWA	Min of Energy and Water, Min of Environment, NGOs, Camp Authorities	Review outputs of the Feasibility Study process to identify entry points, opportunities and barriers for integrated environmental sanitation integration. Recommend revisions to policies and strategies to mainstream ecological sanitation approach. Develop proposed work programmes and budgets for line ministries/agencies based on the recommended interventions.
	1.3 Promote renewable energy	UNRWA	MOE	Consult with policy- and decision-makers and planners to identify opportunities and barriers for upscaling EBA. Develop an upscaling strategy to catalyse EBA through forest management and watershed management. Review the outputs of the LDCF-1 training needs assessment (TNA) process to identify knowledge and capacity gaps. Develop policy briefs and technical guidelines on using an EBA approach. Disseminate policy briefs and technical guidelines to policy- and decision-makers, planners and technical government staff.
	1.4 Entrepreneurial Development	UNRWA	AUB Environment Department and Nature Conservation Centre	Develop and conduct training for municipality and district-level staff on planning and implementing entrepreneurial activities in the Tyre Camp and Coastal Zone.
Outcome 2: Coastal Ecosystem protection and enhancement	2.1 Coastal restoration approaches demonstrated in degraded areas of the coast in front of Tyre	MOE, UNRWA	Technical experts, NGOs, CDCs, *Local Authorities*	Establish community conservation zones to provide safe, and clean coastal zone Restore green space on shore side and in Nature Reserve in degraded beach zones, through an

Outcome	Output	Lead Institution	Key Partners	Key responsibilities
				integrated Coastal Zone Management Approach.
	2.2 Additional livelihoods – including woodlots and kitchen gardens – introduced in selected sites within degraded camp areas.	UNRWA	Camp authorities, and NGOs	Identify fast-growing tree species for planting in woodlots. Establish community greenspace in the camp and nature reserve to increase awareness for environment and reduce pressure on beach areas. Establish demonstration kitchen gardens to improve food security and enhance nutrition. Strengthen value chains for waste products.
Outcome 3: Increased knowledge and behaviour change	3.1 Public awareness programmes on climate change impacts and eco-sanitation approaches designed and delivered.	UNRWA	MoE, universities, technical experts, NGOs and local media	Develop knowledge and awareness products on climate change impacts and sanitation/ecology approach. Undertake a public awareness programme on ecological sanitation impacts and coastal sanitation.
	3.2 Training and education modules developed on sanitation and coastal conservation approaches for Tyre Nature Reserve and Rashidieh Camp	MOE, with UNRWA	Schools, camp authorities, local NGO groups	Identify entry points for integrating sanitation and environment into school and college subjects. Develop and pilot training for school teachers and pupils as well as university lecturers and students.

4.2 Stakeholder Participation and Linkages

Intensive consultations and dialogues took place with international, national and local-level stakeholders in the targeted sites in Tyre-Rashidieh during the Feasibility phase. These consultations built on previous government and NGO field project engagement experience that has taken place in Tyre-Rashidieh and other camps, under previous camp improvement and development programmes which have focused on economic and social development.

Table 14: Environment and Sanitation Project Management Structure and Linkages:

Funding (UNRWA, KfW, BMGF)				Implementing Agency (UNRWA)	
Directly Executing			Execution Support		
Project Steering Committee					
Government Partners		Task Manager		Other Partners	
Local Project Coordinator			Senior Advisor		
Finance and Admin Assistant			National Technical Advisors		Camp Authorities,

					Universities, NGOs
			2 Field coordinators, International Technical Advisors		
					Government, Partners (national, municipal, camp, and local MOE staff)
	Project Management Unit				

4.3 Mentorship - formal and informal key persons and entities

Technical assistance and mentorship are key to ensure quality and effective implementation of the proposed interventions. This includes the proposed innovative technical solutions, maintenance and operation as well as training an all other interventions which aim at increasing knowledge, environmental awareness and education. In addition to UNRWA's education, environment and health departments and the FICIP, mentoring tasks will be fulfilled mainly by UNRWA's partners and other relevant counterparts. Formal mentorship terms and conditions need to be laid out in partnership agreements and MoUs. This includes mentorship in relation to the training, knowledge, awareness and education components of the program. Potential partners in this respect include UNRWA's vocational training centre in Sibline, ANERA, INNODEV in house experts, TCNR, IUCN, UNDP and any other entity or individual Palestinian, Lebanese or international experts identified by UNRWA and / or its partners. It is also important to note that both the Lebanese Ministry of Environment and Ministry of Education have an important mentoring role particularly in relation to knowledge and education. Formal mentorship can also be partly provided by the UPM experts - each in their particular field of expertise. Partners and other relevant stakeholders can also provide informal mentorship to contribute to the quality of awareness and environmental education interventions and enhance outreach and impact. These key actors include members of the Working Group, religious figures and educators.

Another important mentorship function of UPM lies in its capacity to convene relevant local and national stakeholders for the purpose of coordination and knowledge sharing and knowledge management.

4.4 Ownership, operation and maintenance responsibilities:

The Rashidieh community is the ultimate owner of this project. The project's effectiveness and sustainability depend directly on the awareness of the community, their willingness to adopt innovation, capacity to manage it, and commitment to associated behaviour change. The feasibility study thus highlights the need for participatory decision-making throughout the project cycle and points to a community-based approach to awareness raising and outreach, which will ensure long-term sustainability. Likewise, support for capacity building and training will enable community stakeholders to make informed choices, and in doing so, enhance community sense of responsibility and ownership of the proposed solutions. The UNRWA FICIP working group in Rashidieh was identified as a key stakeholder in this regard, as it represents local formal and informal community and political groups in the camp and functions as a partner for UNRWA's interventions in the CIP. Youth and Children are also key change drivers towards sustainability of pro-environment practices. Youth groups, civil society organizations, as well as educational institutions should therefore be considered important assets and owners of project activities. The more that youth lead environmental behaviour change, through

engagement in educational settings, recreational experiences, or volunteer activities, the more self-sustaining project outcomes will be.

It is also necessary to stress the importance of addressing the need for accountability, knowledge sharing and collaboration among all relevant stakeholders to identify best practices, bottlenecks and to enhance synergies and collaboration to raise effectiveness and sustainability and to consolidate achievements of the project approach.

4.5 Milestone Schedule: Education and Awareness

4.5.1 Community-based awareness and outreach

Activity	Milestones
Training and capacity building of main stakeholders including WG members, volunteers and, women neighbourhood committees responsible for waste separation, cleaning and outreach, and staff of youth and women organizations.	Kick-off workshop: Month 1 Training complete: Month 6
Design and implementation of a three- year participatory community-based outreach strategy involving all relevant stakeholders. The purpose of this strategy is to raise environmental awareness and mobilize the community to encourage sustainable pro-environment behaviour on the individual and collective levels.	Remobilization of community and volunteer groups: Month 3 Establishment of Outreach Committee/formalization of roles/monitoring mechanism: Month 6 Partner selection and campaign design: Month 6 Kick-off and implementation: month 6-12
Develop model projects or best examples in order to motivate behaviour change	Model Project Plan Developed: Month 6 Model projects implemented: Month 6-36
Develop good practice waste-to-value initiatives that can serve as models and incentives especially for women and youth	Kick-off workshop: Month 1 Training complete: Month 3 Market Assessment and business plan development: Month 6

4.5.2 Environmental Education

Activity	Milestones
Training and capacity building for education stakeholders in environment and sanitation issues (i.e. UNRWA teachers, trainers, and local environmental organizations engaged in outreach).	Kick-off workshop: Month 1 Training complete: Month 3
Design of Environmental Toolkit(s) that directly complements UNRWA's school curricula, for implementation at both the primary and secondary school levels	Environmental Toolkit Finalized; Month 9 Educators Trained: Month 12 Lessons Learned Workshop: 1X per year
Design and/or support the implementation of experiential learning activities in coordination with local environment actors (i.e. Tyre Coast Nature Reserve).	Experiential Learning Package developed and approved by local environmental actors: Month 6 Experiential Learning Activities: 2x per year Lessons Learned Workshop: 1x per year
Enhance the role of local schools in promoting environmental behaviour change by developing a series of events that engage students, parents, and teachers	School-led Environmental Engagement Plan developed: Month 4 Implementation: 1x per semester Lessons Learned Workshop / Annual planning: 1x / year

4.5.3 Linkages

Activity	Milestones
Establish environmental improvement communication forum to coordinate relevant internal (in Rashidieh) and external stakeholders, lead outreach efforts, and disseminate new information;	Month 6
Establish environment "eco-centre" or desk to manage relevant information, ideas, technical specifications, capacity building, and innovation;	Year 2

4.6 Milestone schedule: Waste-to-Value Entrepreneurship

Activity	Milestones
Comprehensive assessment of ongoing Tyre-Rashidieh waste-to-value entrepreneurial activities.	Month 6
Provision of capacity building in business development, specifically designed to train participants (at both individual and commercial scales) in the global standards of the Business Model Canvas.	Identification of participants by Month 2 Capacity building by month 6
Provision of capacity building in Financial Management.	Month 6: Financial Management assessment, continuing support and development 2x / year
Support for the development of business cases in incubator or "innovation lab" setting	Lab begins Month 6 following BD capacity building Support begins for qualified business cases in Year 2 with 2 rounds of business case development and support per year
Establishment of a coop, working group, or committee that supports ongoing capacity-building, market linkages, and innovation for small-scale waste-to-value entrepreneurs, particularly women.	Month 6 kick-off following BD capacity building Adoption of formal procedures/bylaws by Month 9 1x/year organizational review
Through Working Group established in Activity 5, develop formal and informal partnerships and market linkages, including marketing materials, and linking up with and exploring collaboration with the Palestinian communities in the diaspora.	Month 6 kick-off following BD capacity building Mission and basic monitoring framework developed by Month 9 1x/year organizational review

4.6.1 Proposed Training Programs

Activity	Milestones
Category I: Sanitation and sewage management	
Training for the Vacuum sewerage collection system for consultants and site agents. This includes introduction to vacuum sewerage collection system, background technologies, design Considerations, Designing and tendering.	
Training for the Vacuum sewerage collection system for Rashidieh contractors and plumbers including introduction to vacuum sewerage collection system, background technologies, explaining different pipes	

Activity	Milestones
&fittings, vacuum pot functions and maintenance procedure, and pipe testing procedure and exercises	
Training for the eradication of the percolation pits for different craftsmen and traders including knowledge of dry wall installation, exercises with dry walls and introduction to different sanitary appliances e.g. showers, wall hang toilets etc.	
Developing and conducting a series of hands-on, practical, participatory and problem solving oriented 3-day training workshops for all UNRWA sanitation workers divided in groups based on a SWOT analysis of the status of sanitation in Rashidieh camp to identify bottlenecks and to test solutions for the improvements identified during the training.	
Category II: Solid waste management & waste-to-value	
1) Three-week workshop Waste-to-value (and experience exchange / bottleneck identification after 6 months): 1. Activity: Workshop with main interested stakeholders including WG members, volunteers and, women neighbourhood committees on market evaluation, available resources and possible product-groups	One-day Kick-off workshop; (week 1) To-Do list resources and markets to be answered by workshop participants within 1 week. Market evaluation
2. Activity: Community to identify and define initial product-groups suitable for onsite demand and possible camp-export as well as basics of production arrangements and labour-safety	Workshop; end of week 1
3. Activity: Workshop on marketing, sale, shipment and payment requirements; week 3	Product evaluation workshop; (week 2) List of identified product groups and possible markets Description of production requirements Basics of Marketing guidelines Offering selected products on international sales-platforms manual Payments-partner selection guideline Model of strategic partnerships (camp-export) description Legal requirements guideline (Workshop in week 3) (Activity 1-3 Month 1+2)
4. Activity (after 8 months): Evaluation workshop on experience made and lessons learned; Exhibition of product-variety	Training complete Leaflet on elaborated guidelines and lessons learned; (month 10)
2) Three-week practical training on composting for sanitation workers and interested men and women in the camp. This requires the identification of a location and availability of water. The training includes composting, compost soil and exploring marketing possibilities.	
3) 6 weeks biogas construction training is offered in case biogas technology is applied in the camp. The training is a mix of theory and practice and can provide	Identify trainees and conduct one-week practical and theoretical training workshops

Activity	Milestones
know-how for a group extending biogas technology professionally in Lebanon.	– start working on practical training object (Month 3) Complete practical training object (month 5)
Category III: Knowledge, education and awareness	
1) Training and capacity building of the CIP working group members including communication and mobilization skills, participatory needs assessment & leading FGD, project management and planning, monitoring and evaluation and fundraising & proposal writing.	Refer to milestones of Community-based awareness and outreach
2) Practical and innovative environmental education and integrating environmental education in curriculum and teaching methods and developing teaching materials for selected teachers in all 4 UNRWA schools and staff of UNRWA education department (Tyre and Beirut).	Refer to milestones Environmental Education
3)Two-day training workshop with ANERA-team and ANERA volunteers to revisit the 3+2=1 campaign (3Rs: Reduce / Reuse / Recycle) and explore to the 8R-concept (Refuse, Reduce, Reuse, Regift, Repair, Recycle, Recover —> Rethink!) and how to further involve schools/student as multiplier. The training can also include ways to extend recycling to up-cycling through demonstrating the concept in the camp as a source of income for youth and women especially those who are already active in this field on small scale.	Developing training materials on 3R and 8R concepts (month1-2) Conducting training workshop (Month 2) Follow-up (month3-6)
4) Business Model Development for Up-Cycling Production and Marketing training for women and youth led by a start-up consultant and coach on how to develop a business-plan, based on the simplified business model canvas concept	Developing training material on upcycling production and marketing (Month 2 +3) Identifying potential entrepreneurs for starter trainees both women and youth (Month 3) Training workshop (Month 4) developing and coaching individual business plans (month 5 -Month 12)

ANNEX

Revised format for Summary Table including Responses to UNRWA and Rashidieh Communities, Ministry of Environment

FICIP comments about UPM recommendations made by in the feasibility study (sustainable sanitation in Rashidieh)

OKRs (objectives and key results)

Table 15: Brief description of proposed improvements and investments

No. Previous number now in (brackets)	Title	Description	Estimated CAPEX	Resource Breakdown including Economic opportunities	FICIP Remarks	UPM Response
Category 1: WATER MANAGMENT						
1 (7)	Wastewater management	a. Develop complementary, appropriate and innovative wastewater collection systems in dense populated areas ("old camp"), and for relative flat topography ("new camp"), b. Design innovative decentralized wastewater pre-treatment systems in the Rashidieh housing area. One (1) central point (pumping station) needs underground (pre-)treatment plant (DEWATS) for all wastewater from Rashidieh. c. 1,441 houses need to be connected to the gravity sewer but are lower sited (liftings and vacuum sewer system)	2,200,000 USD		UNRWA welcomes a feasible and applicable technical solution to connect shelters of the old camp to a sewage network and abolishing the current individual septic tanks, but the proposed vacuum system is a high sophisticated technical approach, ever implemented in Lebanon, and lacks O&M spare parts and expertise, making risks in sustainability and operation. (water tank swimmer stops, piping repair package, and	Simple well designed DEWATS demonstration at one school site (can be even one block). Two branch Vacuum System to include non-connected section in the Old Camp, plus a single branch of low-lying Zone below the mainline pipe in the new camp. Vacuum technologies to be installed at Pumping Station 1, along with 3-5 km of pipe.

No. Previous number now in (brackets)	Title	Description	Estimated CAPEX	Resource Breakdown including Economic opportunities	FICIP Remarks	UPM Response
		d. 2,254 houses need water leaking repair measures (water tank swimmer stops, piping repair package, and water saving accessories) e. Assumption is: daily flow of 1,000m^3 wastewater maximum, and 500m^3 wastewater as minimum f. Flexible in the Degree of Centralization – depending on settlement structure and topography			water saving accessories) No availability of space for the proposed (pre-)treatment plant (DEWATS) of all wastewater from Rashidieh which is considered as plan B, if the municipal sewage network in Tyre is delayed, in addition to sustainability of O&M. Strong promises that Tyre WWTP will be soon in operation. **<u>Recommended after discussion in Mission 5 as 2 key problem areas (Old Camp and below pipe on seashore in New Camp).</u>**	
2 (1)	Improved storm water management in 7 areas applying infiltration spaces such as green spaces with	The most efficient way for high flow storm water run-off treatment is large volume retention wetlands. These store the water and either settle or filtrate the water or both of it. An overall wetland area of 1% of the drained area may be used as a	1,140,000 USD	Horticulture Water Management	Most of the open areas and public domain lands are occupied, and will be difficult to evacuate. UNRWA or the local authority in the camp are not in the position to secure the needed lands.	Selection of green spaces will only use existing green space, run-off and recharge green areas

No. Previous number now in (brackets)	Title	Description	Estimated CAPEX	Resource Breakdown including Economic opportunities	FICIP Remarks	UPM Response
	reforestation or gardening	thumb rule for the necessary retention and filter surface (DWA-A 178 Draft, 2017). With a roughly calculated 43.5 ha drained area, a retention wetland of about 4,350m² would be able to treat the storm water outfalls of the camp with a hydraulic efficiency of 80%. Since all outfalls are evenly spread along the shore the best option would be a green buffer strip between shore and settling area. Considering the total length of the shoreline with 1,300m, a green wetland strip would have a width of 3.3m in order to reach the desired surface area for treatment. Design rules: (a) Mix of storm water in wastewater should be avoided, (b) Mix of wastewater in storm water should be avoided, (c) Storm water flow should be free of garbage, and channels should be cleaned regularly.		Spring Protection Project at Ras Al Ain	Paying compensation to occupants to evacuate the lands is not inclusive in UNRWA mandate. **After review, this shall be recategorised as smaller physical area.**	
3 (4)	Grey water treatment	In order to protect and secure the fresh water supply, design rules for grey water treatment and re-use are as follows: (1) Only water from hand washing, showers, and laundry washing machines should be considered to be re-	2,200,000 USD	•	It is not a feasible project, as most the piping system inside the shelters are combined, this require large scale of work to separate systems from inside	Some Water-Saving measures, primary treatment of greywater AND/OR treatment of greywater through Vacuum removal of greywater from decentralized problem sites.

No. Previous number now in (brackets)	Title	Description	Estimated CAPEX	Resource Breakdown including Economic opportunities	FICIP Remarks	UPM Response
		used locally for gardening after simplified treatment. (2) Construction of a French drain filter with nutrient recycling through plants at the end of the filter. (3) Health-based targets: health protection through prevention of exposure to pathogens in excreta and grey water in a system achieved by treatment barriers. (4) Barriers verified by monitoring esp. of large-scale systems. (5) Green wall / living wall: potential for 400 spaces for treated grey water reuse as vertical drip irrigation.			shelters and construction of new separate external networks. A practical alternative option, could be the utilization of existing water springs and streams in the camp for watering plants on green walls and roofs. **After review, it is agreed to include this section as a „demonstration" green areas element in the overall 9 intervention solutions.**	
Clean Energy, Integrated Waste Management and Pollution Control Measures						
4 (3)	Renewable energy	a. 2,200 photovoltaic home systems for lighting, fan, TV, PC, Mobile phone, and radio b. 1000 solar heaters c. 1,000 solar cookers and solar boxes d. 20 electrical tuk-tuks with solar charging station, introduced as business loan e. 2,000 Rice cookers (gas or electric or solar)	5,000,000 USD		**Though recommended but, the following risks are to be considered:** Risks in Sustainability, due to difficulty in protection the systems, and no sponsor for future O&M to keep the operation of photovoltaic and solar heaters.	**E-Transport solutions to be used for public and social-use vehicles.** **Carbon foot-printing to be highlighted in all RE elements.** **Wind, natural and propane/butane gas power for water.**

No. Previous number now in (brackets)	Title	Description	Estimated CAPEX	Resource Breakdown including Economic opportunities	FICIP Remarks	UPM Response
		f. BARCO gas-propane			Distribution of tuk-tuks for private business will make problems and tensions among the community about selective criteria, and risks of misuse of the machinery for the intended purpose. Could be utilized for SLs in some camps for the SW transportation.	
5 (8)	Solid Waste and Value	Analyze further "waste-to-value" (and closed loop) recovery options in the surrounding Tyre area, mainly related to not-yet-managed or by planning steps tackled waste streams. Planning faecal sludge recovery and treatment, combining it with organic household waste resulting in a sludge treatment process with value recovery. All sorted recyclables are finally taken by a formal waste collector who works at a sorting facility in Tyre. Through the solid waste camp management project, families are finding new innovative ways to make a living.	1,600,000 USD	•	Proposal for mobile electromechanical shredding system is feasible and welcomed at household levels. Concerns about transferring the combined output of sludge and organic wastes into value recovery (composting..) , in the absence of outlets in the local markets. The proposal to convert plastic into **oil is not feasible**, due to difficulty in obtaining clearance from the concerned authorities, applied restrictions over	Shredding machines for wood/plastic/ Waste streams to be recycled (glass) Haz-Mat and E-Waste solutions Pyrolysis Unit to be used together with Service Provider on electricity and fuel

No. Previous number now in (brackets)	Title	Description	Estimated CAPEX	Resource Breakdown including Economic opportunities	FICIP Remarks	UPM Response
		a. Collected: nowadays 6 t/day – after non-formal recycling in the camp b. Waste treatment alternatives c. Procure mobile electromechanical shredding system d. Plastic to Oil: capacity 1 t/day (Use multifuel genset's in 6 UNWRA gensets - 24 tons fuel/year) e. Pelletizing or Charing Solid Waste (MSW) System			entry and exit of materials from the camp, and no availability of final outlet/ markets for the products. **After review, this section to be implemented as a demonstration value intervention, with key local business partners, and taking into consideration sensitive local relations and ownership to ensure sustainability.**	
Demonstration facilities and Greenways						
6 (2)	Street Environment	There is a lot of dust and sandy material in the streets. Waste, which is washed away, pollutes the coast. It is doubtful whether clean roads can be achieved by raising awareness alone. As a rule, a combination of avoiding waste and organized waste collection incl. regular emptying of containers in the streets, and street cleaning is required. Only when the streets are thoroughly	90,000 USD	•	Road sweepers are not functional in camps streets, due to exiting of bumps, no straightness in roads alignments, crowdedness, absence of pedestrian sidewalks, etc... Logistic problem due access difficulty in narrow roads.	Change to Public Demonstration and Flagship facilities, including mobile unit, and street environment and street greening and air quality.

No. Previous number now in (brackets)	Title	Description	Estimated CAPEX	Resource Breakdown including Economic opportunities	FICIP Remarks	UPM Response
		cleaned it could be expected that residents will change their behavior. It is proposed to purchase a compact road sweeper capable of operating in narrow streets. It is important to ensure that this machine can bind the street dust and that water is recycled.			Risks in sustainability as UNRWA has no financial capacity for the O&M **<u>After discussion,</u>** **<u>can be implemented taking into consideration street landscape. And rephrasing the section as "Street Environment".</u>**	
7 (5)	Public facilities and toilets	Improving the existing toilet design and its connection to treatment systems in the public areas, Toilet cubicles at 4 schools, 6 mosques, 2 football pitches, 2 beaches (North and South), 1 cemetery; Target: Avoid wastewater infiltration by percolation pits because groundwater is only at 6m depth; promote gender dignity.	700,000 USD	•	Not needed in UNRWA facilities, as Toilets in two UNRWA schools have been connected to sewage networks, and it is planned to connect the others in close time. Other public places like clubs, mosques, etc,,, can be potential targets for interventions, wherever sustainability of O&M is ensured by users. **<u>(Recommended only for the public places is subject to further commitment from the community to O&M of the facilities).</u>**	One combined with DEWATS in one school. Environmental Health and Safety activities Including electrical, sanitation and air quality UNRWA CIP projects from2019 will require ESO (environment safety) activities with main responsibility ensuring activities in camps are standard on impact

No. Previous number now in (brackets)	Title	Description	Estimated CAPEX	Resource Breakdown including Economic opportunities	FICIP Remarks	UPM Response
					Agreed after final discussions in Mission 5.	assessment on H&S, with impacts on environment. Reporting directly to Management. New project in Burj-e Barajneh Winterization/Summer issues Vector control in the summer. (temperatures and weather) and summer (extreme temperatures and air quality and water, including garbage collection)
Integrated Environment and Coastal Zone Management						
8 (6)	Coastal protection	Initiate and support complementary activities to the coastal protection planning along the Rashidieh housing coastal area, 53 houses in danger in the next 20 years! There is a need for a comprehensive solution including the not yet managed bulky, construction debris; recommendation are needed on shore and beach cleaning although financing is available. Sand drifting should be stopped to protect the RAMSAR area and	1.500,000 USD	•	The project is vital and feasible, and will ensure protection for the shelters in risks at the seashore. UNRWA welcomes all interventions for the education and raising support for environmental awareness especially for RAMSAR role.	Detailed restoration plan using gabions and preparing wave-energy support including coastal and beach protection,

No. Previous number now in (brackets)	Title	Description	Estimated CAPEX	Resource Breakdown including Economic opportunities	FICIP Remarks	UPM Response
		the water resources. But UNRWA doesn't have the authority to impose its decisions on the entire public. Therefore, at local level mutual understanding is used for resolving local issues. There are interlinkages between environmental education and awareness raising and the role of the RAMSAR staff in Rashidieh as well as in the area in general.			Interventions for coastal protection are in need for high level coordination with the concerned Lebanese authorities as of MOE. Nature Reserve, Tyre Municipality, LAF, etc... **(Is Recommended).**	
9	Tyre Nature Reserve Support	a. Support the protection of RAMSAR and other protected natural reservation areas, b. Integrated Beach Waste and Water Management c. Public toilets at beach d. Coastal protection (avoid sand transport) e. Ground water, springs, and boreholes protection	500,000 USD	•	Environmental protection whether inside or outside the camp is welcomed, inclusive the proposed shore protection, RAMSAR Area, Ground water, springs, and boreholes protection. UNRWA can only provide awareness campaigns regarding, beach waste and water management as well as for public toilets at beach, O&M are to be ensured by users, and compliance with the resource protection is the responsibility of the ruling authorities in the camp.	Implementation of RAMSAR and IUCN action plans for 4 areas (tourist zone, protection and restoration zone and farming zone) U Using a mix of solutions from 1-7 and combined with 8. Political and MoE support and LAF meetings.

No. Previous number now in (brackets)	Title	Description	Estimated CAPEX	Resource Breakdown including Economic opportunities	FICIP Remarks	UPM Response
					Coordination with the Lebanese authorities is needed for any public facilities activities. Unfortunately, UNRWA has no means to prevent breaches from sand transport, but UNRWA supports any awareness campaigns instead. **(Recommended taking into consideration the above points).**	