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STAGE THREE

Yemen Water Sector

Damage Assessment Report of Twelve Water Supply and Sanitation Local Corporations (LCs) and their Affiliated Branch Offices and Utilities

Part 2: Situation Assessment Report

Acknowledgment

Yemen is one of the most water-stressed countries with an availability of only about 125 m^3 per person annually. The already critical supply situation has been dramatically aggravated by the armed conflict and its escalation following the interventions of regional actors since 2015. In 2018, an estimated 16 million Yemenis need humanitarian assistance to establish or maintain access to safe water, basic sanitation and hygiene facilities, out of which 11.6 million are in acute need. Water supply and sanitation services in the major urban centres, including the capital Sana'a, are only to a very limited extent being maintained. Part of the infrastructure is destroyed, and the electric power supply is failing to a large extent.

The Local Water Corporations (LCs) are weakened financially and regarding their personnel; they are less and less able to secure the necessary financial and human resources. The remaining skilled workers and specialists in the LCs face difficulties to secure the necessary administrative procedures as well as to plan and implement measures for maintenance and rehabilitation of the destroyed infrastructure. Overall, Yemen urgently requires support from the international community to cope with the crisis-related challenges in the water sector.

In this complex and challenging environment, the Yemeni – German Water Sector Program, commissioned by the German Federal Ministry for Economic Cooperation and Development (BMZ), was destined to assist the LCs to restore water & sanitation services and build resilience by resuming the third sequential stage of the Damage Assessment Study 'DAS III'. The study went into more assessment details and a deep investigation on the institutional setup, condition and performance; as well as on the physical condition of the water and sanitation infrastructure of each LC. The assessment results with the respective recommended measures are outlined in the:

a) Technical Assistance Plans to enhance the staff capacity, improve the performance and financial capacity and investigate alternative options to the existing system; and

b) Investment Plans to restore, rehabilitate and extend the water and sanitation system and switch to renewable energy sources.

DAS III would not have been possible without the indispensable collaborative efforts of the Ministry of Water & Environment and the involved Water Supply and Sanitation Local Corporations and their Affiliated Branch Offices and Utilities, who have cordially contributed in the process of developing this study with the assistance of the international consulting firm 'Dorsch International Consultants'.

To seize this remarkable opportunity, I would like to present my profound appreciation to the team of the Ministry of Water & Environment for sharing their insights, dedication and full support during the course of the study.

Also, just wishing to extend my deep sense of gratitude for all our development and humanitarian partners and sector stakeholders whose exemplary coordination and follow-up proved to be a milestone at every point in the accomplishment of this task.

Christine Werner
Program Director of the Institutional Development of the Water Sector in Yemen III – Addressing Basic Needs

STAGE THREE

Yemen Water Sector

Damage Assessment Report of Twelve Water Supply and Sanitation Local Corporations (LCs) and their Affiliated Branch Offices and Utilities

Part 1: Resilience Strategy Report – Enhancing the Resilience of the LCs during Conflict and in Post-conflict Scenario

Part 2: Situation Assessment Report and Development of Technical Assistance and Investment Plans for the Infrastructure Rehabilitation and Restoration of Water Supply and Sanitation Services

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Abbreviations

ABR	Anaerobic Baffled Reactor
AU	Autonomous Utility
AWD	Acute Watery Diarrhea
BMZ	German Federal Ministry of Economic Cooperation and Development
BoD	Board of Directors
CBO	Community Based Organization
COCA	Central Organization for Control and Auditing
CSS	Customer Subscriber Survey
DAS	Damage Assessment Study
EM	Electro-mechanic
EUR	Euro
FC	Financial Cooperation
GDP	Gross Domestic Product
GIS	Geographic Information System
GIZ	Gesellschaft für Internationale Zusammenarbeit GmbH
GoY	Government of Yemen
HR	Human Resources
IDP	Internally Displaced People
IFI	International Financing Institutions
IT	Information Technology
JAR	Joint Annual Review
KfW	Kreditanstalt für Wiederaufbau
LAC	Local Advisory Committee
LC	Local Corporations
lpcd	litre per capita and day
MAI	Ministry of Agriculture and Irrigation
MIS	Management Information System
MMS	Maintenance Management System
MoCS	Ministry of Civil Service
MoF	Ministry of Finance
MoM	Minutes of Meeting
MWE	Ministry of Water and Environment
M & E	Monitoring and Evaluation
NGO	Non Government Organization
NWRA	National Water Resource Authority
NWSA	National Water and Sanitation Authority
NWSSIP	National Water Sector Strategy and Investment Plan
OCHA	Office for the Coordination of Humanitarian Affairs
OMS	Operation Management Support
O & M	Operation and Maintenance
PIIS	Performance Indicator Information System
QF	Questionnaire forms (DAS Stage III)
TA	Technical Assistance
ToR	Terms of Reference
UFW	Unaccounted for Water
USD, US$	American Dollar
WASH	Water, Sanitation and Hygiene
WFP	World Food Programme
WHO	World Health Organization
WSP	Water Sector Programme in the Republic of Yemen
WSLC	Water and Sanitation Local Corporation
WU	Water LCs
WWTP	Wastewater Treatment Plant
YER, YR	Yemen Rial
QF	Questionnaire forms (DAS Stage III)
TA	Technical Assistance
TNA	Technical Need Assessment
UAE	United Arabic Emirates
UNOCHA	United Nations Office for the Coordination of Humanitarian Affairs
USD, US$	American Dollar
UWSS	Urban Water Supply and Sanitation
WASH	Water, Sanitation and Hygiene
WEC	Water and Environment Center
WFP	World Food Programme
WHO	World Health Organization
WSLC	Water and Sanitation Local Corporation
WSP	Water Sector Programme in the Republic of Yemen
WSS	Water Supply and Sanitation
WSSP	Water Sector Support Program
WU	Water Utilities
WWTP	Wastewater Treatment Plant
YER, YR	Yemen Rial

Executive Summary

Background

In accordance with a request from the Ministry of Water and Environment (MWE) and the Yemeni Water and Sanitation Local Corporations (LCs), GIZ supported a damage assessment study (DAS) of the current situation in 12 selected LCs.

This study was undertaken in three stages. Stage I investigated the prevailing situation over a five-month period in 2015. In June 2016, a Stage II report presented scenarios and made recommendations to maintain and improve water and sanitation services in 12 of the largest LCs. The two reports from Stage I and Stage II were complemented by a KfW review of the LCs technical infrastructure. The complementary Technical Needs Assessment Report of KfW was finalized in December 2015.

The Stage I and Stage II assessment and the KfW supported Technical Needs Assessment Report confirmed the difficult situation of the LCs in the current crisis. However, the situation among the different LCs is not uniform. While some of the LCs could maintain their physical infrastructure, others were heavily affected by violent conflicts. Frequent power cuts, increasing fuel prices and lack of equipment have seriously affected the performance of the LCs. In addition, the majority of the LCs are facing the internal displacement of Yemeni people and suffer from a severe reduction in revenue collection rates and all have difficulties in paying the basic running costs like fuel and salaries.

The GIZ funded Damage Assessment Study, Stage III was carried out from January 2017 to April 2018 and concludes the previous studies of Stage I and II (2015 / 2016). An assessment was conducted on the current situation of the following major twelve Water and Sanitation Local Corporations (LCs) and affiliated six Autonomous Utilities and five Branches offices, presented in the Table 1 below.

Nos.	Local Corporation / Autonomous Utility / Branch	Served cities
1	Abyan LC	Zinjibar, Ja'ar, Al-Husn, Al-Kood, Al-Rwa, Al-Makhzan
2	Aden LC	Aden
3	Amran LC	Amran
4	Dhamar LC	Dhamar
	LC Hadramout Coastal Area	
5	AU Mukalla	Mukalla
6	AU Al-Shehr	Al-Shehr
7	Hajjah LC	Hajjah
8	Harad Branch	Harad
9	Abs Branch	Abs
10	Kahlan Afar Branch	Kahlan Afar
11	Mabian Branch	Mabian
12	Hudaydah LC	LC Hodeida
13	Al-Mansouriah AU	Al-Mansouriah
14	Bait Al-Faqi AU	Bait Al-Faqi
15	Bajil AU	Bajil
16	Zabid AU	Zabid
17	Ibb LC	Ibb
18	Lahij LC	Al-Hawhah, Tuban
19	Sa'ada LC	Sa'ada
20	Sana'a LC	Sana'a
21	Taiz LC	Taiz
22	Al-Mukha Branch	Al-Mukha
23	Turbah Branch	Turbah

TABLE 1: ASSESSED LCS WITH SERVED CITIES

Assessment Results

The Consultant investigated on one hand the institutional setup, condition and performance and on the other hand the physical condition of the water and sanitation infrastructure of each LC. Objective of the study is to enhance the resilience of the selected LCs, Utilities and Branches by providing Technical Assistance and Investment Plans for the rehabilitation. Therefore, the Consultant identified the needed Technical Assistance measures for the prevailing conflict scenario and for a post-conflict scenario.

Furthermore, the Consultant investigated in parallel the urgent, short term (2 – 3 years) and long-term investments for the restoration of the water and sanitation infrastructure. The detailed results are presented in Annex 1 to 20 of this report.

The outcome of the assessment can be summarized as follows:

- The **water service coverage** decreased from average 68 % before crisis (2014) to 59 % (2017). The wastewater service coverage decreased from average 52 % before crisis (2014) to 44 % (2017). While the population within the service areas increased by 11 % (from 6.6 million to 7.4 million) the network extension and particular new house connections installation were neglected due to lack of finances / materials, security issues and terminated projects.

- The **collection efficiency** differs significantly from LC to LC. While Abyan and Lahji have collected negligible amount, Ibb reaches 92 % collection efficiency. The low collection efficiencies caused the receivable amount, (amount of outstanding debts payable by customers) to increase significantly within the last few years. The low paying moral, poor economic situation of customers, absence of functional water meter, inability of LCs to conduct the reading, billing and collection sufficiently are the main reasons for the low revenue collection.

- The **water and sanitation tariff** is between 25 YER/m³ in Lahij and 300 YER/m³ [1] in Dhamar for the domestic customers. The low tariff in many LCs results in low revenues and subsequent financial inability to cover the O & M expenses.

- The gap between tariff and recurrent cost per m³ produced water is significant. Therefore utilities are not able to cover the O & M costs. The low collection efficiency aggravates the financial capacity of the LCs. At the same time the LCs have to spend higher budget on the electricity (fuel for generators) which increases the water production and wastewater management cost.

- The **financial liabilities** in form of salary, electricity, fuel, taxes, insurance and other payable amounts reaches significant amounts of up to 5.52 billion YER (Sana'a LC) as of March 2017. However, the debts of the customers towards the LCs are more than double of the financial liabilities. It is not feasible that these debts will be compensated due to the huge liabilities in both directions. This leaves the LCs in poor financial condition.

- With an average of 15.8 staff per 1000 water connections the utilities are rather overstaffed. Otherwise employees are not able to attend to work due to the crisis in some LCs. Less than 20 % of the employees have an academic degree. The unskilled personnel and overstaffed departments lead to inefficient operation. The situation aggravated where utilities face lack of IT and office equipment and facilities.

- The frequent or complete power cuts forces the LCs to spend higher budget on fuel for generators. The expenses on salary, fuel and electricity reaches between 75 to 97 % of the total spending, leaving less fund for operation and maintenance. The LCs are not able to maintain the water and sanitation infrastructure properly which leads to deterioration of the network and equipment and dysfunctional systems.

- Although the **water consumption** (availability of water to customers) is in average sufficient with 41 lpcd, in some LCs like Sana'a (6 lpcd) and Hajjah (24 lpcd) the condition is alarming. The low water production is mainly caused by the power cuts, insufficient financial capacity of LC for generator operation accompanied by increasing fuel prices and pump failure resulting in reduced pump operation and subsequent less water production.

- The **non-revenue water** is in the range of 24 % to 48 % and did not change considerably compared to pre-crisis. The low water production combined with

1 Official international exchange rate on 19 April 2018: 309 YER per EUR

the huge water loss leads to the insufficient water supply condition.

The analysis of the shortcomings and problems of the LCs directs to the required technical assistance and investment measures to support the utilities to improve their performance with regards to water and sanitation system operation.

Technical Assistance

The Technical Assistance measures were categorized into detailed "Conflict" and "Post-conflict" activities, with related cost estimates and provided for each Local Corporation, Utility and Branch outlined in Annex 1 to 20. The conflict measures are covering the major needs of the LCs and are proposes to be implemented within the next 1 – 2 years depending on the development of the conflict in Yemen. The post-conflict measures are required once state of peace is declared, yet it is completely vague when this will happen.

The needed Technical Assistance (TA) measures to be implemented during the conflict period and / or post-conflict era are determined and grouped into the following **Technical Assistance (TA) packages**:

1) TA Package 1: Financial Support – support for salary, insurance pension and energy supply during **conflict**.

2) TA Package 2: Capacity Building / Training courses – for Board of Directors (BoD) / Local Advisory Committee (LAC) members, managers and key staff in **conflict and post-conflict**:

   a) Courses for BoD / LAC members and BoD / LAC secretaries about governance principles; control mechanisms and accountability;

   b) Training for utility managers and key staff on crisis management, contingency (emergency) planning, strategic planning, leadership concepts;

   c) Training for department managers and key staff on specific technical, administrative and financial themes,

   d) Training of technical key staff on resilience orientation of technical infrastructure (water conservation, renewable energies, energy saving, sustainable sanitation).

3) TA Package 3: Office Equipment and IT – Upgrading and enhancing offices in **conflict and post-conflict**:

   a) Enable power supply during working hours through solar systems;

   b) Furnishing of departments with IT equipment and furniture;

   c) Maintenance and upgrade the existing software and suggest extensional applications;

   d) Improvement of IT systems and databases;

   e) Control of staff attendance and work performance.

4) TA Package 4: Coaching and Consultancy Services – support of managers, key staff in form of specific institutional support in **conflict and post-conflict**:

   a) Support in re-organization of the LCs and HR development;

   b) Support for reduction of administrative water losses;

   c) Coaching for tariff adjustment to increase revenues;

   d) Consultancy services on individual feasibility studies, planning and design projects and other special required services.

5) TA Package 5: Operation and Management Support – implementation of a comprehensive GIS based information system in **post-conflict**:

   a) Implementation / upgrading of GIS system;

   b) Comprehensive customer subscriber survey;

   c) Comprehensive network updating;

   d) Installation of Maintenance Management System application;

   e) Establish customer service centre.

6) TA Package 6: Gender Supporting WASH Projects – in **conflict**:

   Support with small equipment for schools, hospitals, camps, public places to improve water and sanitation service particular for women, children and marginalized people.

7) TA package 7: Public Relation and Awareness – improve customer relationship, build awareness for hygiene issues, safe water and wastewater disposal, water saving in **conflict and post-conflict**:

   a) Establish and train Awareness Campaign Committee;

   b) Comprehensive public awareness campaigns;

   c) Gender related awareness campaigns.

Beside the Technical Assistance Plan with its packages which were developed for each LC, it is recommended to install a Management Information System at post-crisis. This system will enable the ministry and the LCs to enhance the monitoring and control of the LCs performance and allow for timely response.

The required amount for the proposed Technical Assistance measures has been estimated for the conflict and post conflict scenario for each Local Corporation, Utility and the Branches and according to the above outlined seven TA packages:

Infrastructure Rehabilitation and Restoration

Depending on the extent of previous (and still ongoing) crisis, the damage on the water and sanitation infrastructure is more or less profound among the assessed LCs. Particularly the LCs Abyan, Aden, Hajjah, Sa'ada, Lahij and Taiz were and are affected by the conflict. In some LCs the offices are destroyed, looted or taken over and employees are not able to attend to work. Further damage occurred on reservoirs, pumping stations, wells, WWTP, water and sewerage networks, which prevents the LCs to provide adequate services. For appropriate support of the LCs it is of utmost importance to restore the water and sanitation system in order to resume and improve the public water supply service and enhance wastewater collection and treatment. Therefore Investment Plans were established with the strong cooperation of the individual LCs to identify the detailed requirements. The investments were grouped in 11 Investment Packages covering the following:

→ Restoration and rehabilitation of damaged water and sanitation networks and facilities;

→ Rehabilitation and new construction of damaged reservoirs, pumping stations, WWTP;

→ Maintenance and operation of networks and electro-mechanical equipment:
- Provision of operation and maintenance materials including spare parts;
- Provision of vehicles, machines and tools;
- Provision of bulk water meters and domestic water meters;
- Supply of valves for improved network control.

TA Package	Conflict – 2018 – 2020	Post-conflict	Total
TA 1: Financial Support	51,024,000 EUR		51,024,000 EUR
TA 2: Training Courses	2,230,000 EUR	1,267,000 EUR	3,497,000 EUR
TA 3: IT & Office Equipment	1,850,000 EUR	1,088,000 EUR	2,938,000 EUR
TA 4: Coaching and Consultancy Services	890,000 EUR	2,865,000 EUR	3,755,000 EUR
TA 5: Operation Management Support		3,839,000 EUR	3,839,000 EUR
TA 6: Gender Supporting WASH Projects	4,189,000 EUR		4,189,000 EUR
TA 7: Public Relation / Awareness	1,013,000 EUR	1,363,000 EUR	2,376,000 EUR
Management Information System		430,000 EUR	430,000 EUR
Total	**61,196,000 EUR**	**10,852,000 EUR**	**72,048,000 EUR**

TABLE 2: ESTIMATED COST FOR PROPOSED TECHNICAL ASSISTANCE PACKAGES

- → Improvement and control of water quality through:
  - Installation of disinfection units;
  - Provision of laboratory equipment and materials;
- → Supply of new generators, tanks and fuel to increase the power supply;
- → Implementation of alternative renewable energy systems:
  - Installation of solar power system at wells, pumping stations, WWTP.

The investment packages were further categorized according to their urgency and feasibility into four priority groups:

- → Priority 1 – **Urgent:** goods to be procured and civil works to commence within six months, proposed in 2018.
- → Priority 2 – **High Priority:** goods to be procured and civil works to commence within twelve months years, proposed in 2018 – 2019.
- → Priority 3 – **Short-term:** goods to be procured and civil works to commence in 2019 – 2021.
- → Priority 4: **Long-term:** goods to be procured and civil works to commence in 2021 – 2025.

The estimated cost for each assessed Local Corporation, Utility and the Branches is presented in the Table 3 below.

LC / AU / Branch	Urgent (EUR)	High priority (EUR)	Short-term (EUR)	Long-term (EUR)	Total (EUR)
Abyan LC	573,000	3,870,000	893,000	270,000	5,606,000
Aden LC	6,017,000	10,492,000	23,981,000	4,265,000	44,755,000
Amran LC	3,014,000	1,269,000	2,959,000	386,000	7,628,000
Dhamar LC	1,709,000	1,210,000	295,000	9,163,000	12,377,000
Mukalla LC	6,372,000	5,601,000	247,000	1,027,000	13,247,000
Al Shehr Utility	3,502,000	455,000	583,000	0	4,540,000
Hajjah LC	1,442,000	1,288,000	929,000	3,490,000	7,149,000
Hajjah Branches	235,000	1,052,000	603,000	1,389,000	3,279,000
Hudaydah LC	5,798,000	8,103,000	13,084,000	974,000	27,959,000
Bait Al-Faqi Utility	2,686,000	653,000	478,000	5,000	3,822,000
Mansouriah Utility	483,000	104,000	0	0	587,000
Zabid Utility	2,123,000	2,587,000	517,000	1,806,000	7,033,000
Bajil Utility	1,830,000	586,000	677,000	270,000	3,363,000
Ibb LC	4,509,000	2,479,000	225,000	34,734,000	41,947,000
Lahij LC	7,582,000	2,590,000	328,000	0	10,500,000
Sa'ada LC	1,382,000	1,952,000	58,000	1,165,000	4,557,000
Sana'a LC	11,540,000	12,936,000	7,975,000	8,755,000	41,206,000
Taiz LC	0	5,229,000	20,188,000	5,450,000	30,867,000
Turbah Branch	60,000	536,000	0	0	596,000
Mukha Utility	316,000	598,000	229,000	0	1,143,000
Total cost	**61,173,000**	**63,590,000**	**74,249,000**	**73,149,000**	**272,161,000**

TABLE 3: ESTIMATED COST FOR PRIORITIZED INVESTMENT MEASURES

Recommendation

In order to re-establish and improve the water and sanitation situation in the LCs, comprehensive technical assistance and investments are needed. The required measures and respective needed budget has been determined for each LC.

The measures defined under "Conflict" for the Technical Assistance and those under "Urgent" and "High Priority" investments shall be implemented within the next two years. For these activities a budget of about **200 million Euros** is needed.

In order to coordinate the recommended activities with the ongoing emergency response measures, it is proposed to hold a conference with the participation of GIZ WSP and active donor organizations to discuss the results of DAS III and identify the intervention and area of responsibility of each organization. The individual parties should agree on the packaging of the measures, the implementation time frame, appropriate implementation methods and monitoring processes.

It is recommended that the implementation of the agreed measures is coordinated and controlled by an active Humanitarian organization. This organization shall agree with the respective LC, BoD (or LAC), MWE and donor institution on final proposed packaging of the institutional measures.

The unpredictable political situation in Yemen prevents any certain forecast on further technical assistance and needed investment support beyond 2020. Therefore, the LCs institutional condition including the status of the infrastructure has to be re-assessed after two years. The progress of implementation and the impact of the implemented measures (Conflict, Urgent and High Priority) shall be evaluated to identify the effects, required adjustments and further support measures. The prepared Technical Assistance measures in Post-conflict as well as the Short-term and Long-term investment of this study could be used as a basis for the re-evaluation.

1 Introduction

1.1 Methodology of Assessment

This report "Part 2: Situation Assessment Report and Development of Technical Assistance and Investment Plans for the Infrastructure Rehabilitation and Restoration of Water Supply and Sanitation Services", presents the assessment results of the investigated twelve Local Corporations (LC) with five affiliated Branch Offices and six Autonomous Utilities (AU)[2]. The produced Assessment Reports are attached as Annexes 1 to 20 to this report. Each Local Corporation, Utility and Branch was evaluated based on:

a) the filled questionnaire forms;
b) site visits to LCs: office, water and wastewater system locations;
c) meetings and discussion with LC managers;
d) provided technical and institutional data;
e) provided investment proposals, Bills of Quantities;
f) local workshops; meetings and discussion with LC and AU Managers;
g) previous studies and reports;
h) visits and discussions with education office, local council, civil society organizations members;
i) visit of selected schools, hospitals and camps.

The above mentioned questionnaire forms were split into two parts containing questions to the situation of the LC within the last three years (2015 to 2017). The forms were distributed to the individual LC managers and focal persons in mid-April 2017. To enhance the data provision, GIZ Yemen nominated a focal person for each LC. These contact persons were responsible for enabling the necessary support for the Consultant from the utilities: allow for site investigation, push the utilities to fill in the forms and make available important reports and documents.

Part A of the questionnaire forms is covering all institutional subjects: management, governance, human resources, customer management, financial management, water and wastewater services, and IT management. The respective assessment results are presented in Chapter 1 to 6 of each Technical Assessment Report. The Part A includes also questions regarding the water supply and sanitation service provision of public institutions, public places and for women, children and marginalized. That section was separately investigated by the Consultants Gender expert. The shortcomings and recommended Technical Assistance measures were summarized in the Chapter 7 of the Technical Assessment Reports.

The second set of forms, Part B, comprised questions regarding the technical condition, availability, parameters and physical status of the LC / AU / Branch infrastructure and the subsequent requirements for rehabilitation and restoration of services. The respective assessment results are outlined in Chapter 8 to 10 (or 11) with the summarized investment measures in Chapter 11 (or 12), Part B of the individual Technical Assessment Reports.

2 LCs include: Abyan, Aden, Amran, Dhamar, Hadramout, Hajjah, Hudaydah, Ibb, Lahij, Sa'ada, Sana'a, and Taiz.
Six utilities include: Al Shehr in Hadramout as well as Zabid, Al-Mansouriah, Bajil and Bait Al-Faqi (Hudaydah LC), Mukha (Taiz LC).
Five branch offices include: Harad, Aba, Kahlan Afar, and Mabian (all a part of Hajjah LC) as well as Al-Turbah (part of Taiz LC).

The following tasks were carried out for each LC:

- Receive and evaluate latest institutional data;
- Identify institutional problems and shortcomings for each department;
- Observe the trend of performance for the last five years and more thoroughly for the last three years;
- Determine institutional measures to enhance performance and strengthen the resilience at conflict and post conflict scenario;
- Assess and prioritize the needs for restoration and maintenance of the infrastructure;
- Consider the suspended and terminated projects to be resumed at post-crisis;
- Consider the water sector strategy and investment program (NWSSIP) and the subsequent updated objectives;

LC managers and key personnel were directly contacted to obtain missing information throughout the assessment. Due to provided incomplete and incorrect data the process of data collection and evaluation extended over a period of eight months, until November 2017. Missing information and clarification on misleading data were obtained through site visits, intermediate workshops and through direct contact with key staff via email and telephone.

Numerous additional files regarding situation reports, proposals for investments and requirement lists were provided by the LCs. All provided data were analysed and respective results incorporated in the respective Technical Assessment Reports.

The analyses of the comprehensive data led to the proposed Technical Assistance Plan and the Investment Plan for each LC, which are attached to the individual Assessment Reports.

The draft reports were provided to the LC followed by presentation and discussion in two separate local workshops in Sana'a. During the first workshop on 10/11th of October 2017 the managers and focal persons of following LCs participated: Abyan, Amran, Dhamar, Ibb, Lahij, Hadramout (Mukalla, Al Shehr).

In the second workshop on 28/29th of November 2017 the managers and focal persons of the LCs Sana'a, Aden, Taiz, Hudaydah, Sa'ada and Hajjah and Al Mukha, Zabid, Al Mansouriah, Bait Al-Faqi, Bajil AUs participated.

Besides the Assistant Deputy Minster from Ministry of Water and Environment (MWE), the WASH Activities Coordinator, GIZ Project Coordinator, Technical Officers as well as the entire local Consultants' team participated actively in both meetings.

The assessment of data and findings were also discussed at three international workshops in February, May and September 2017 with GIZ Project Director, Project Coordinator, Technical Officer, the Deputy Minister of MWE and the Consultant (international and local team) in Amman.

The comments from the LCs, the MWE and GIZ were taken into consideration to compile the final version of all reports and particular the Technical Assistance Plans and Investment Plans. The jointly agreed measures reflect the requirements to restore and improve the LCs water and sanitation infrastructure and to re-establish functional sustainable institutions.

1.2 Key Data of Assessed LCs

The study comprises the assessment of the major twelve Water and Sanitation Local Corporations (LCs) and affiliated six Autonomous Utilities and five Branches in Yemen. Their location is shown in the Figure 1 below. The biggest LCs in terms of served population are Sana'a with 3.2 million followed by Aden with 0.96 million, Hudaydah with 0.62 million and Taiz with 0.66 million inhabitants. In total all the 23 LCs / AUs / Branches are serving 7.4 million people corresponding to 26 % of Yemen population (28.4 million).

These LCs are providing water service only to the urban population. Sanitation service, i.e. wastewater collection is provided only by 12 out of 23 utilities. The remaining LCs / AUs / Branches have either no sanitation system or it is operated by the local council[3]. The rural population of the respective governorates is supplied through the General Authority for Rural Water and Sanitation Project (GARWSP).

The comparison of data for 2014 with 2017, as shown in the Table 1 below, illustrates the increase of population in the different governorates as well as the total population within the catchment area of each assessed LC with some other relevant data. Only n Taiz the population decreased compared to 2014 due to the ongoing crisis.

The total concerned population of the investigated LCs is 6.60 million, which corresponds to 26 % of the total population of Yemen and 85 % of the urban population of Yemen. The number of Internally Displaced People (IDP) is fluctuating from month to month and depends on the conflict situation of the governorate or actually the city itself. The International Organization for Migration (IOM) reported 1.99 million IDPs (7 % of Yemen population) by February 2017[4].

Since the network for water and sewer is not fully developed the public services reaches only part of the urban population. The public water supply service coverage decreased from average 68 % prior to crisis (2014) to 59 %

FIGURE 1: LOCATION MAP WITH ASSESSED LCS, UTILITIES AND BRANCHES

3 See Table 4 below for details

4 Source: Task Force on Population Movement (TFPM), 13th Report, March 2017

in 2017. It shall be noted that the water coverage figures do not reflect the sufficiency of water supply to the connected households. In contrary, due to the power shortage and the damage on the infrastructure the water production decreased significantly with subsequent impact to supplied quantities as shown in Figure 10. The public sanitation service is covering less than half of the urban population. The connection of the urban population to the sewerage system decreased from average 52 % in 2014 to 45 % in 2017.

Beside the water shortage and worsening sanitation services, the cholera outbreaks are of great concern and weaken the suffering population further. The number of cholera suspected cases increased dramatically within the last few months of 2017. According to United Nation Office for the Coordination of Humanitarian Affairs (OCHA) within the period of 27 April 2017 to 3 August 2017 about 315,001 acute watery diarrhea (AWD) / suspected cholera cases were reported in the concerned governorates[5].

GOVERNORATE					
Governorate / LC		Governorate Population[6]		IDP (Feb 2017)[7]	Cholera suspected cases[5]
		2014	2017	2017	27/4 – 03/08/2017
1	Abyan	534,000	568,000	12,990	15,220
2	Aden	855,850	957,171	36,234	13,239
3	Amran	1,013,000	1,052,000	146,724	46,133
4	Dhamar	1,760,000	1,913,000	141,684	35,383
5	Hadramout	1,367,000	1,489,000	10,560	
6	Hajjah	1,960,000	2,129,000	404,130	47,389
7	Hudaydah	2,917,000	3,189,000	103,662	55,409
8	Ibb	2,659,000	2,837,000	134,364	33,562
9	Lahij	917,000	983,000	57,642	8,090
10	Sa'ada	976,000	1,078,000	103,572	1,354
11	Sana'a	2,824,000	3,234,000	139,686	28,000
12	Taiz	2,984,000	1,913,000	271,026	31,222
Total / Average		**20,766,850**	**21,342,171**	**1,562,274**	**315,001**

5 Source: Cholera Outbreak – Daily epidemiology update, 3 August 2017, by WHO, period 27 April 2017 to 3 August 2017

6 Source: Central Statistical Organization

7 Source: Task Force on Population Movement (TFPM), 13th report, March 2017 by IOM /UNHCR

LC / BRANCH / UTILITY											
Served City		Urban Population (nos.)[8]		Water Coverage (nos. / %)[9]				Sewerage Coverage (nos. / %)[9]			
		2014	2017	2014		2017		2014		2017	
1	Ja'ar/Zinjibar, Al-Husn, Al Kood, Al-Makhzan	100,961	108,406	84,807	84 %	86,429	80 %	47,452	47 %	47,699	44 %
2	Aden	855,850	957,171	790,463	92 %	824,640	86 %	674,213	79 %	660,282	69 %
3	Amran	70,144	74,610	34,370	49 %	37,305	50 %	22,446	32 %	26,860	36 %
4	Dhamar	205,486	228,487	156,169	76 %	159,941	70 %	94,524	46 %	95,965	42 %
5	Mukalla	322,353	351,427	300,272	93 %	320,428	91 %	203,082	63 %	217,884	62 %
	Al Shehr	109,178	120,124	97,168	89 %	99,783	83 %	46,947	43 %	48,518	40 %
6	Hajjah	71,017	77,602	70,306	99 %	76,582	99 %	42,610	60 %	42,681	55 %
	Abs	36,700	38,535	no data		no data		no collection			
	Harad	28,600	30,030	16,588	58 %	no data		no collection			
	Kahlan Afar	6,030	7,430	4,824	80 %	5,040	68 %	no collection			
	Mabian	50,000	52,500	23,000	46 %	24,270	46 %	no collection			
7	Hudaydah	564,290	622,019	462,718	82 %	465,827	75 %	276,502	49 %	255,028	41 %
	Al Mansouriah	16,623	18,164	16,457	99 %	17,730	98 %	no collection			
	Bajil	73,937	80,793	54,713	74 %	61,950	77 %	32,532	44 %	33,125	41 %
	Bait Al-Faqi	59,615	65,143	55,442	93 %	57,116	88 %	41,730	70 %	42,777	66 %
	Zabid	37,679	41,173	35,795	95 %	37,837	92 %	30,144	80 %	30,468	74 %
8	Ibb	324,358	349,298	249,756	77 %	280,349	80 %	197,858	61 %	230,300	66 %
9	Al Hawta, Tuban	140,786	163,800	115,445	82 %	115,724	71 %	no collection			
10	Sa'ada	70,001	79,029	24,500	35 %	28,350	36 %	no collection			
11	Sana'a	2,824,000	3,234,000	1,355,520	48 %	1,376,558	43 %	1,270,800	45 %	1,288,340	40 %
12	Taiz	633,075	654,330	506,460	80 %	251,118	38 %	446,261	70 %	248,645	38 %
	Turbah	17,000	20,000	10,880	64 %	12,800	64 %	no collection			
	Mukha	31,700	33,000	31,700	100 %	26,494	80 %	no collection			
Total / Average		**6,649,382**	**7,407,071**	**4,497,354**	**68 %**	**4,366,271**	**59 %**	**3,427,101**	**52 %**	**3,268,571**	**44 %**

TABLE 4: KEY DATA OF ASSESSED LCS

8 Source: Central Statistical Organization

9 According to LC provided data

2 Institutional Assessment Results

2.1 Performance Indicator

The condition and performance of the LCs are detailed in the individual Technical Assessment Reports, as Annex to this report. The performance indicators outlined in the table below shall provide an overview of the impact of crisis on the efficiency and financial capacity of each LC. The following selected and explained indicators give information about service coverage, collection efficiency, financial capacity, staffing situation and water production / supply figures. The figures have been calculated from the provided and assessed data of the years 2016 or 2017, as the case may be.

The most significant indicators to judge the performance of the LC are:

a) Water service coverage in [%]: this figure presents the population served by the LC compared to total population of the service area in %. It does only indicate the percentage of population reached by the LC service, but not the adequacy of water supply.

b) Wastewater service coverage in [%]: this figure presents the population connected to the LCs sanitation system compared to total population of the service area in %. It does not indicate the adequacy of wastewater service, e.g. wastewater collection may be interrupted through damage in the sanitation system.

c) Water availability and consumption in liter per capita and day in [lpcd]: the amount of water produced respectively consumed (billed) per supplied (connected) person.

d) Non-revenue water in [%]: the amount of unbilled water in m^3 compared to total water produced in m^3.

e) Collection efficiency in [%]: share of revenues received or collected compared to the billed amount. It also gives a conclusion about the payment moral or payment ability of the customers.

f) Receivable amount in [YER]: outstanding accumulated debts payable by the customer in March 2017.

g) Average water production cost [YER/m^3]: Operation and maintenance cost for the water and sanitation system, per m^3 of produced water.

h) Average weighted tariff [YER/m^3]: The average weighted tariff is an average theoretical tariff value and is calculated by the quotient of total water billed in YER (the wastewater is included as % of water billed) by total quantity of water billed in m^3.

i) Deficit / profit without depreciation in [YER]: difference of total amount of revenues and total expenses within one fiscal year without considering depreciation.

j) Number of staff (including contractors and day-workers) per 1000 house connections.

In evaluating the LCs efficiency external circumstances out of hand of the LC have to be taken into consideration. These include among others: termination of previous implemented investment programs, customers willingness and ability to pay their fees, increasing power cost, fuel price (which is differs among the LCs), accessibility and availability of water resources as well as wastewater collection and treatment method which affects the water production and treatment cost.

The table below presents these described indicators together with some other important parameters for the assessed LCs.

Performance Indicator	Unit	LC Abyan	LC Aden	LC Amran	LC Dhamar	→
Residents 2017	nos	108,406	957,171	74,610	228,487	
Water service coverage 2017	**%**	**80%**	**86%**	**50%**	**70%**	
Water connections 2017	nos	12,347	128,850	5.085	20,963	
Wastewater service coverage 2017	**%**	**44%**	**69%**	**36%**	**42%**	
Wastewater connections 2017	nos	6,816	103,169	4,436	12,660	
Non-revenue water (2016)	**%**	**37%**	**48%**	**28%**	**21%**	
Water availability 2016	lpcd	224	132	42	52	
Water consumption 2016	**lpcd**	**141**	**70**	**31**	**32**	
Collection efficiency 2016	**%**	**4%**	**28%**	**117%**	**65%**	
Receiveable amount (debts) March 2017	YER	768,167,092	16,786,068,541	204,000,000	1,029,857,569	
Domestic water tariff (0–5 m³) incl. sewer fee 2017	YER/m³	30	52	288	300	
Avg. water production cost (excl. depreciation) 2016	YER/m³	154	123	493	155	
Avg. weightet tariff 2016	YER/m³	164	203	339	250	
Deficit / saving without depreciation 2016	**YER**	**-292,763,072**	**-535,806,046**	**-62,788,041**	**160,621,800**	
Deficit / saving with depreciation 2016	YER	-327,849,902	-1,687,567,697	-197,284,573	-257,707,498	
Total financial liabilities (March 2017)	YER	722,576,577	4,793,074,796	158,581,884	487,409,012	
Electricity and fuel cost in 2016 actual	YER	154,352,664	1,585,557,786	67,227,225	114,79,508	
Salary expenses in 2016 actual	YER	166,235,429	2,803,133,855	113,902,466	304,988,648	
Total staff (incl. contractors and dayworkers) 2017	nos	239	2,020	120	317	
Nos. of staff per 1000 connections 2017	**nos / 1000**	**19**	**16**	**25**	**15**	

TABLE 5: PERFORMANCE INDICATOR OF ASSESSED LCS[10]

10 Excluding Hajjah branches, Bajil and Turbah (insufficient data available)

	LC Mukalla	Utility Al Shehr	LC Hajjah	Branch Harad	Branch Abs	Branch Kahlan Afar
	351,427	120,124	77,602	30,030	38,535	7,430
	91%	**83%**	**99%**	**0%**	**n.a.**	**68%**
	48,403	15,073	8,147	0	n.a.	504
	62%	**40%**	**55%**	**N/A**	**N/A**	**N/A**
	32,714	7,329	4,523	0	n.a.	0
	42%	**40%**	**7%**	**n.a.**	**n.a.**	**n.a.**
	127	111	29			12
	70	**67**	**24**	**0**	**0**	**n.a.**
	78%	**77%**	**44%**	**n.a.**	**n.a.**	**n.a.**
	1,844,182,661	371,390,862	656,331,633	n.a.	n.a.	n.a.
	71	65	224	n.a.	n.a.	n.a.
	115	80	434	163	374	
	178	116	551	140	269	
	-495,486,137	**-50,419,253**	**-58,683,874**	**-18,920,642**	**-59,353,715**	**-52,900,696**
	-1,050,700,137	-143,336,939	-45,316,126	-18,920,642	-59,353,715	-52,900,696
	1,240,247,818	211,747,290	282,596,740	n.a.	n.a.	n.a.
	292,337,000	68,149,682	139,483,664	n.a.	n.a.	n.a.
	1,087,754,000	217,073,610	163,066,502	n.a.	n.a.	n.a.
	774	160	141	22	54	19
	16	**11**	**17**	**13**	**13**	**38**

Performance Indicator	Unit	Branch Mabian	LC Hudaydah	Utility Mansouriah	Utility Bait Al-Faqi	→
Residents 2017	nos	52,500	622,019	18,164	65,143	
Water service coverage 2017	**%**	**46%**	**75%**	**98%**	**88%**	
Water connections 2017	nos	2,427	66,517	2,955	8,787	
Wastewater service coverage 2017	**%**	**n.a.**	**46%**	**n.a.**	**66%**	
Wastewater connections 2017	nos	44	40,462	0	6,581	
Non-revenue water (2016)	**%**	**n.a.**	**43%**	**25%**	**33%**	
Water availability 2016	lpcd	15	87	427	51	
Water consumption 2016	**lpcd**	**n.a.**	**49**	**36**	**34**	
Collection efficiency 2016	**%**	**n.a.**	**60%**	**63%**	**67%**	
Receiveable amount (debts) March 2017	YER	n.a.	3,890,343,068	63,213,939	63,213,939	
Domestic water tariff (0 – 5 m^3) incl. sewer fee 2017	YER / m^3	n.a.	90	160	102	
Avg. water production cost (excl. depreciation) 2016	YER / m^3	848	144	281	214	
Avg. weightet tariff 2016	YER / m^3	655	199	194	137	
Deficit / saving without depreciation 2016	**YER**	**-78,547,682**	**-448,095,310**	**-12,451,773**	**-47,718,959**	
Deficit / saving with depreciation 2016	YER	-78,547,682	-646,488,675	-31,081,369	-132,718,959	
Total financial liabilities (March 2017)	YER	n.a.	2,365,535,946	63,921,708	151,276,811	
Electricity and fuel cost in 2016 actual	YER	n.a.	934,884,519	33,838,100	54,849,497	
Salary expenses in 2016 actual	YER	n.a.	898,655,432	32,607,737	65,939,640	
Total staff (incl. contractors and dayworkers) 2017	nos	56	765	29	76	
Nos. of staff per 1000 connections 2017	**nos / 1000**	**23**	**12**	**10**	**9**	

TABLE 5: PERFORMANCE INDICATOR OF ASSESSED LCS[11]

11 Excluding Hajjah branches, Bajil and Turbah (insufficient data available)

	Utility Zabid	Utility Ibb	LC Lahij	LC Sa'ada	LC Sana'a	LC Taiz	Utility Mukha
	41,173	349,298	163,800	79,029	3,234,000	654,330	33,000
	92%	**80%**	**71%**	**36%**	**43%**	**38%**	**43%**
	5,821	28,607	16,532	4,050	94,935	52,124	2,817
	74%	**66%**	**n.a.**	**0%**	**40%**	**38%**	**0%**
	4,682	23,500	n.a.	0	88,851	23,500	0
	24%	**24%**	**24%**	**28%**	**37%**	**100%**	**n.a.**
	48	52	100	47	10	20	35
	36	**60**	**76**	**35**	**6**		**23**
	73%	**92%**	**0.7%**	**32%**	**57%**	**41%**	**88%**
	118,497,062	584,492,089	3,613,598,400	274,518,983	10,222,590,189	2,903,681,666	76,031,023
	146	168	28	150	130	100	63
	333	178	56	263	537		149
	216	256	64	232	1018		141
	-39,185,747	**109,000,652**	**-87,660,972**	**-44,681,415**	**525,344,764**	**572,379,283**	**-11,330,013**
	-110,185,747	-101,770,408	-87,660,972	-81,786,415	-1,725,934,636	n.a.	-33,060,487
	132,252,449	17,919,100	304,958,000	118,057,432	5,522,209,460	2,377,141,213	63,445,612
	59,553,140	321,755,794	101,260,000	38,384,244	485,058,288		6,395,207
	65,482,450	389,932,963	144,984,000	73,598,187	1,676,617,146	186,432,148.44	36,869,930
	65	263	218	74	1523	837	29
	14	**9**	**13**	**18**	**16**	**16**	**10**

2.2 Performance of the LCs

The assessment on the institutional condition of the LCs revealed the strangling problems all LCs are confronted with to a different extent. The crisis in Yemen created shortcomings and problems in previously functional LCs and caused worsening of already bad performing LCs which resulted in deteriorated water supply and sanitation services.

The identified shortcomings can be summarized as follows:

- → Frequent power cuts accompanied by decreased water production;
- → financial constraints with subsequent inability of LC to pay salary, fuel for generators, O & M materials;
- → lack of IT equipment, software and office materials / furniture resulting in inefficient work performance;
- → weakened governance and management leading to lack of required support for the LCs;
- → insufficient qualified and motivated staff resulting in deteriorated work performance and service;
- → inability or refusal of customers to pay service fees leaving aggravating financial capacity of LCs;
- → termination of water and wastewater projects due to the prolonged crisis.

The problems and shortcomings are explained in the Part 1 Strategy Report, Chapter 5 and 6 and in detail in the individual Technical Assessment Reports in Annex 1 to 20 attached to this report.

The LCs differ significantly in the results with regards to: size of the LC respectively number of customers, water and wastewater service coverage, revenues, financial liabilities, number of staff, water balance and other important parameters.

The findings below summarize the overall institutional condition decisive for the service and performance of the LC by means of analysis of the important performance indicators:

- → In nearly all LCs the **water service coverage** decreased from average 68 % at pre-crisis (2014) condition to 59 % (2017), reflecting possibly the increase in the population at constant connection ratio. The conflict and its negative side effects prevented the LCs to extend the network and increase the number of house connections. However 14 out of 23 LCs / AUs / Branches (8 out of 12 LCs) have service coverage rate of above 70 %. The worst water service coverage rate is in Sana'a, Sa'ada, Taiz and Mabian with below 50 %. Particularly Taiz is suffering from the crisis where the water coverage dropped significantly from 80 % to 38 %. The service coverage is no indicator for the water sufficiency, considering a water supply of less than 40 lpcd in some LCs.

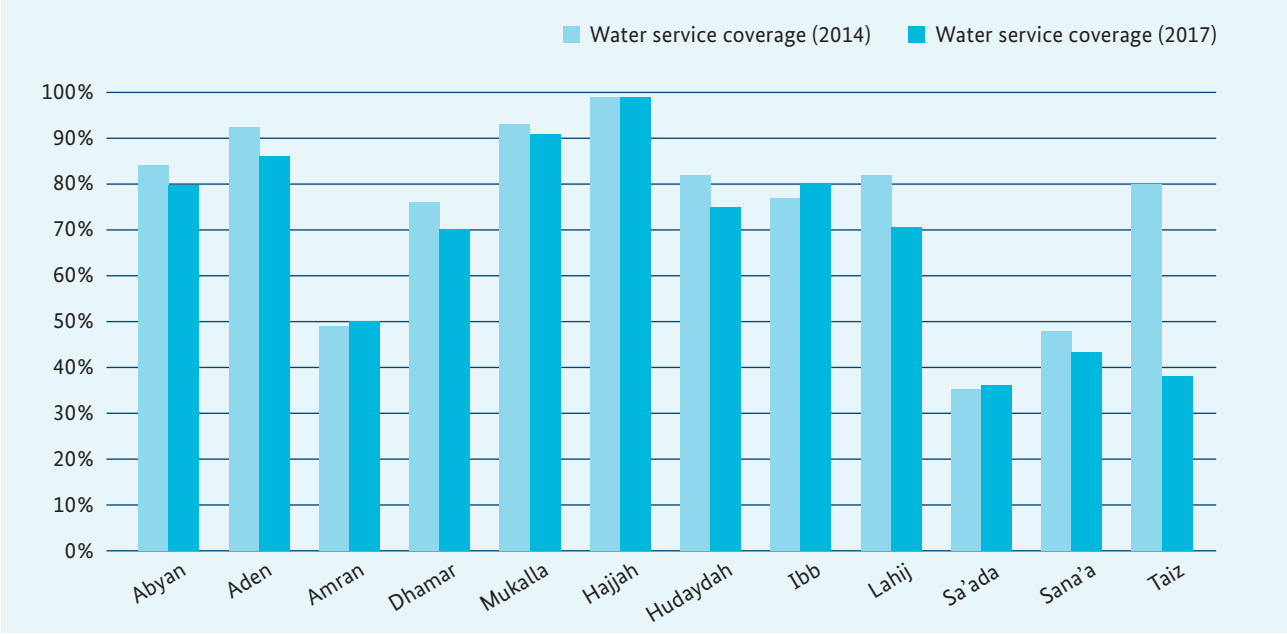


FIGURE 2: WATER SERVICE COVERAGE FOR ALL LCS

→ The **wastewater service coverage** decreased from average 52 % (2014) to about 44 % (2017). The discrepancy among LCs is quite high, between 36 % to 74 % with the lowest coverage in Amran (36 %) and Taiz (38 %). There are several LCs without sewerage system, like the Hajjah branches, Mansouriah, Lahji, Sa'ada and Taiz branches. Abyan has sewerage system, but it is operated by the local council. The sewerage coverage for Taiz dropped significantly from 70 % to 38 %.

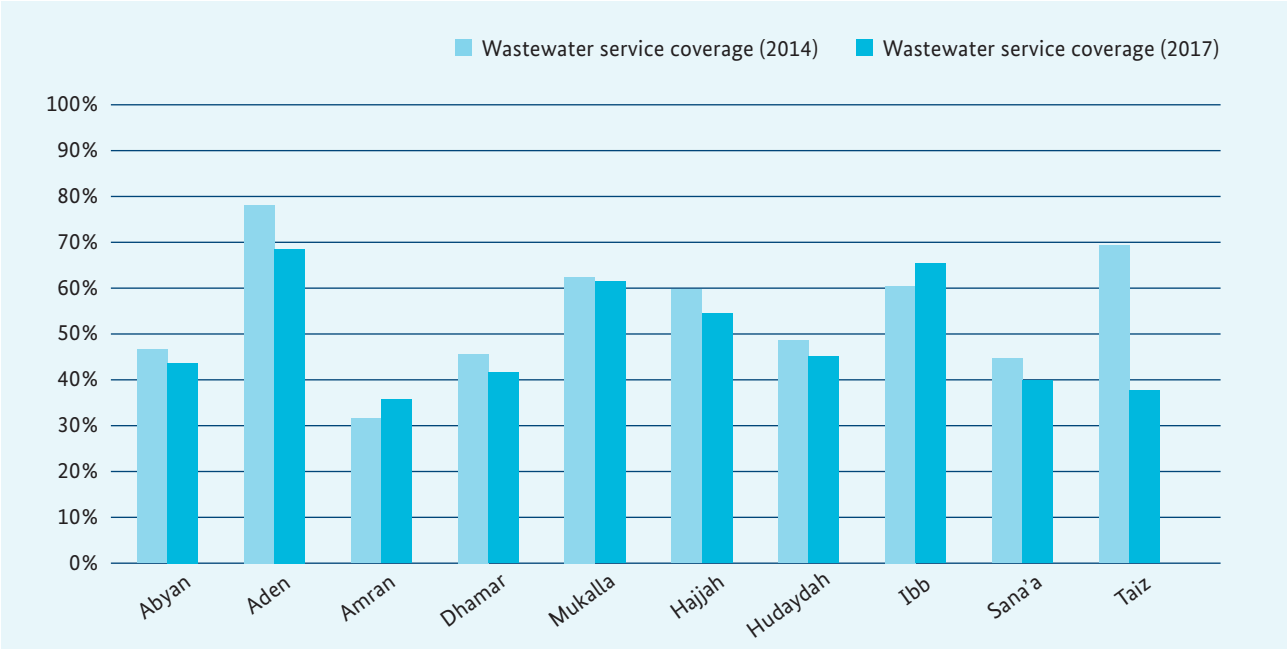


FIGURE 3: WASTEWATER SERVICE COVERAGE FOR LCS WITH SEWER SYSTEMS

→ The **collection efficiency** figures differ considerably from one LC to another. The worst collection efficiencies have been observed in Abyan and Lahji LC, with negligible revenues, followed by Aden (28 %), Sa'ada (32 %), Taiz (41 %) and Hajjah (44 %). The best efficiencies were reached in Amran, Ibb and Mukha in 2016. Amran with 117 % collected also older outstanding payments. Due to the low collection efficiencies in most LCs, the receivable amount, i.e. amount of outstanding debts payable by customers, therefore increased significantly within the last few years. Aden shows the highest receivable amount, of nearly 17 billion YER followed by Sana'a (10 billion), and Hudaydah (3.9 billion).

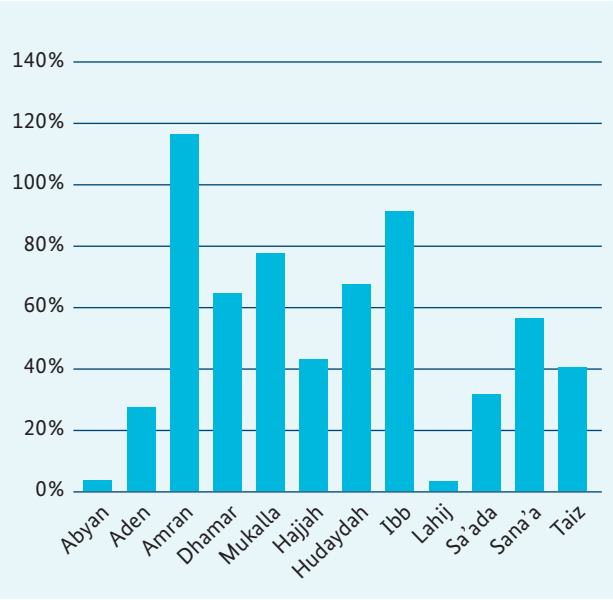


FIGURE 4: COLLECTION EFFICIENCY OF ALL LCS IN 2016

→ For the analyses of appropriate **tariff** structure, the water production and wastewater disposal costs have to be considered as well as the financial ability of customers. The production and wastewater disposal cost varies significantly among the LCs. Particular for LCs where water has to be extracted from deep wells, the water needs treatment or the wastewater collection and treatment consumes high power, the O & M cost is very high. For the cost of production all O & M expenses (with or without depreciation) are considered. The lowest cost without depreciation was identified for Lahij with 56 YER/m³ while the highest was recorded in Sana'a with 537 YER/m³ for 2016. Even though the operation costs increased due to the high electricity cost, most of the LC did not adjust the tariff during the crisis, except Ibb, Amran, Dhamar, and Hudaydah LCs. The figure below illustrates the minimum tariff for water plus sewer fee for all the LCs. The highest tariff is charged in Dhamar and Amran with 300 YER/m³ respectively 288 YER/m³ for both services while the lowest is in Lahji with only 28 YER/m³.

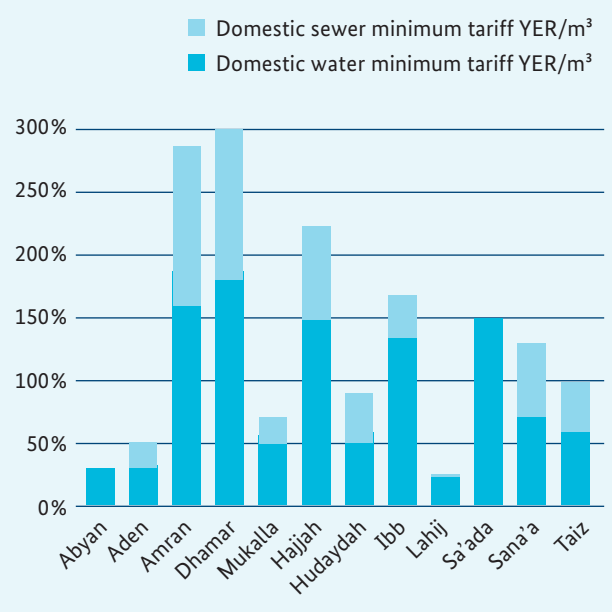


FIGURE 5: MINIMUM TARIFF FOR DOMESTIC CUSTOMERS

For the calculation of appropriate tariff, the average weighted tariff can be used as a first indicator. It varies from 64 YER/m³ for Lahij to 1,018 YER/m³ for Sana'a for the year 2016. When comparing the production cost with the average weighted figures, the difference indicates the gap where adjustment is needed, either on the tariff structure or on the production cost or on both. For complete analyses and adjustment of the tariff structure the Non-revenue water would need to be considered as well as the financial capacity of the population.

→ The revenues, i.e. total billed amount and other sources, of most of the LCs cannot cover the recurrent cost (mostly O & M cost with the highest share on electricity and salary) plus depreciation in 2016. All LCs made financial loss; the worst situation is in Aden, Mukalla and Sana'a with over 1 – 1.7 billion YER deficit in 2016. However, excluding the depreciation, some LCs would be able to cover the recurrent cost through the revenues, like Dhamar, Hajjah, Ibb and Sana'a. Due to the financial constraints, most LCs are not able to cover the recurrent expenses for salary, electricity / fuel, taxes, insurance and other payable amounts. The seriously bad financial situation becomes apparent when considering only the actual collected amount versus the O & M cost. Therefore Aden had a deficit of nearly 3.5 billion YER in 2016 which explains also the figure of receivable amount of 16.8 billion YER in March 2017. The figure below presents the gap between revenues and expenses resulting in **deficit** and in few cases in **savings**.

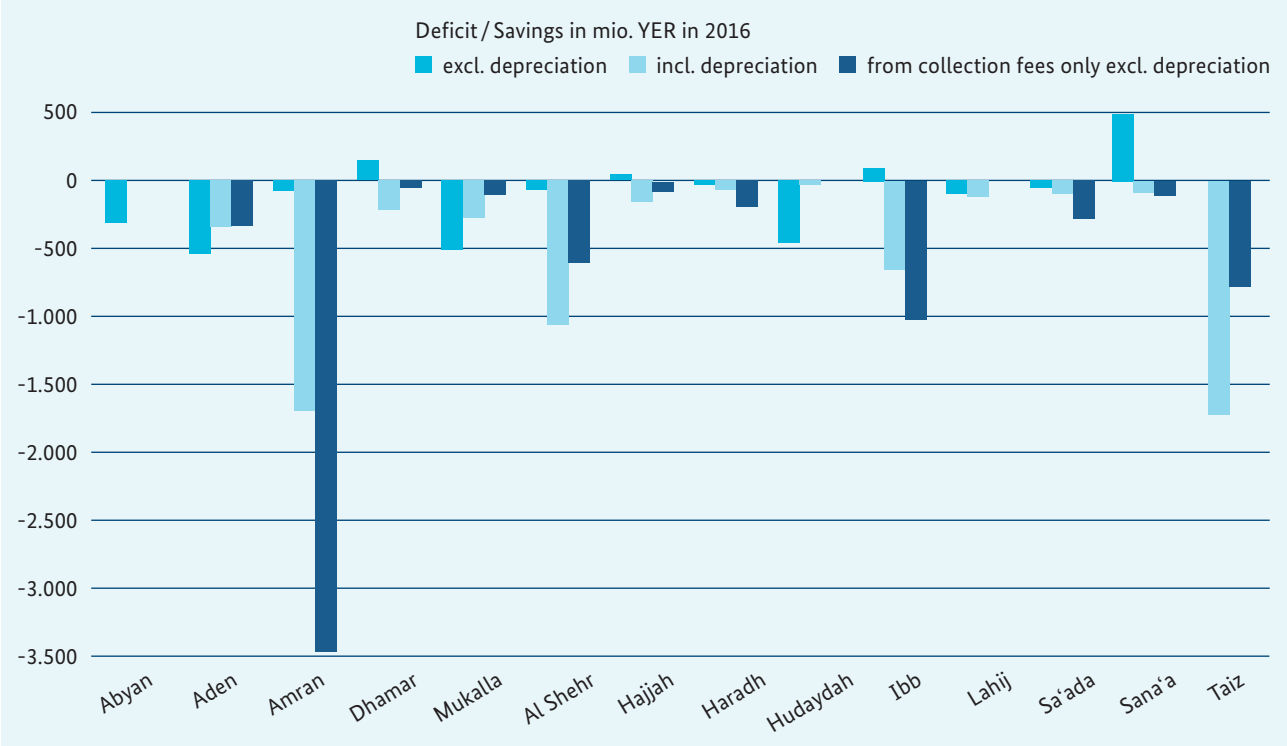


FIGURE 6: DEFICITS AND SAVINGS OF LCS IN 2016[12]

→ Because of the low revenue collection on one hand and the lack of subsidies, the LCs accumulated **financial liabilities** with values from 18 million YER (Ibb) to 5.52 billion YER (Sana'a) in March 2017. The outstanding payments concern salary, electricity / fuel, taxes, insurance and other payable amounts. The highest outstanding payment for salary is in Aden, Sana'a and Taiz.

→ Comparing the receivable amount figures with the financial liabilities, the amount each LC would have to receive from their customers are higher than the financial liabilities, except for Bait Al-Faqi and Zabid. However, for those LCs with high outstanding payments in either direction, it is not feasible that the respective LC would receive the debts or be able to compensate the liabilities. The total receivable amount from 17 utilities (43 billion YER) is more than double the amount than the financial liabilities (18 billion), as illustrated in the figure below.

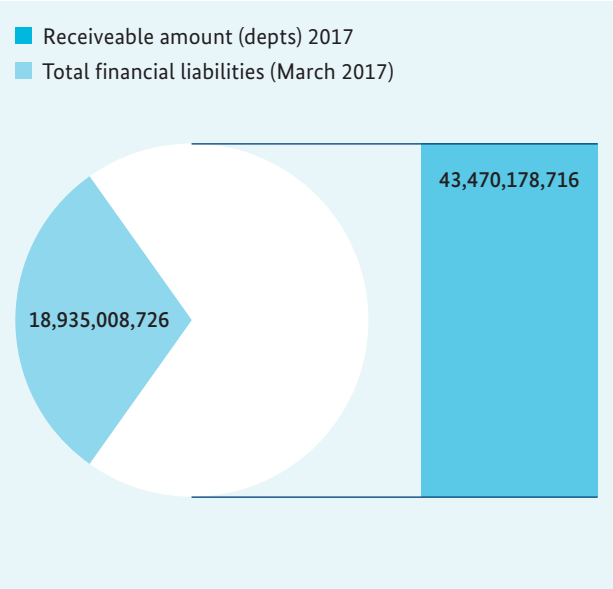


FIGURE 7: RECEIVABLE AMOUNT VERSUS FINANCIAL LIABILITIES[13]

12 Excluding Taiz (Insufficient data available)

13 According to available data from 17 LCs, Utilities, Branches

→ Regarding the staffing, all LCs seem to be overstaffed when applying the indicator of staff per 1000 water connections, in average 15.8 for all assessed utilities. However, during the conflict the employees and LC face huge challenges which disable them to work efficiently. Due to the crisis (destroyed offices and security situation) a high number of staff cannot attend do work, like in Abyan (85 % of employees), Sa'ada (58 %) and Taiz (78 %). Another shortcoming is that only less than 20 % of the employees have an academic degree. Therefore the available human capacity is not appropriately and fully utilized leading to inefficient performance.

Because the expenses on electricity increased during the crisis and due to power cuts, the LCs would have to spend a significant higher budget for purchasing fuel, generators and spares. The subsequent result is that either the spending on energy increased with fewer budgets available for other recurrent cost, like maintenance, network extension or the water production decreased or something in between. The expenses on salary, fuel and electricity take about 75 to 97 % of the total expenses of a utility with fewer funds for O & M as illustrated in below figure.

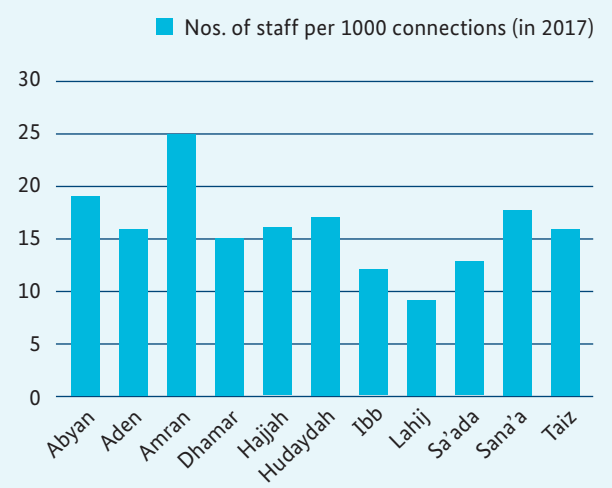


FIGURE 8: RATIO OF STAFF NUMBER PER NUMBER OF WATER CONNECTIONS

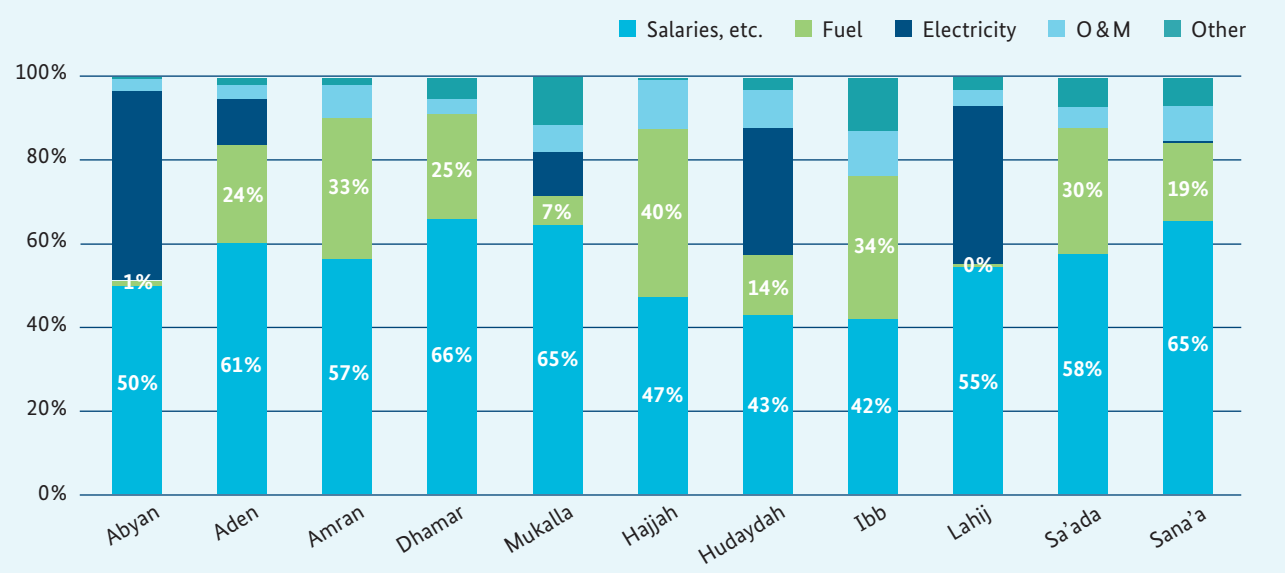


FIGURE 9: SHARE OF EXPENSES OF ALL LCS IN 2016[14]

14 Excluding Taiz (Insufficient data available)

→ The figures for the water balance are in most cases rather estimated amounts than measured figures, considering the absence of functional water meters (bulk meters on production side, house water meters on consumption side), security issues and priority of LC (leading to rather estimated consumption figures then actual readings). Under these circumstances the calculated **Non-revenue water** of the LCs can be used as an indicator for the approximate "lost" water and not with reasonable certainty. The figure below presents the basis for the water balance calculation, with the water availability (production) on one hand and the water consumption (billed amount) on the other hand per customer and day in average in 2016. While the LCs produced in average 61 lpcd the billed amount was only 41 lpcd. The difference is the non-revenue water which is in the range of 24 % to 48 % of the produced water.

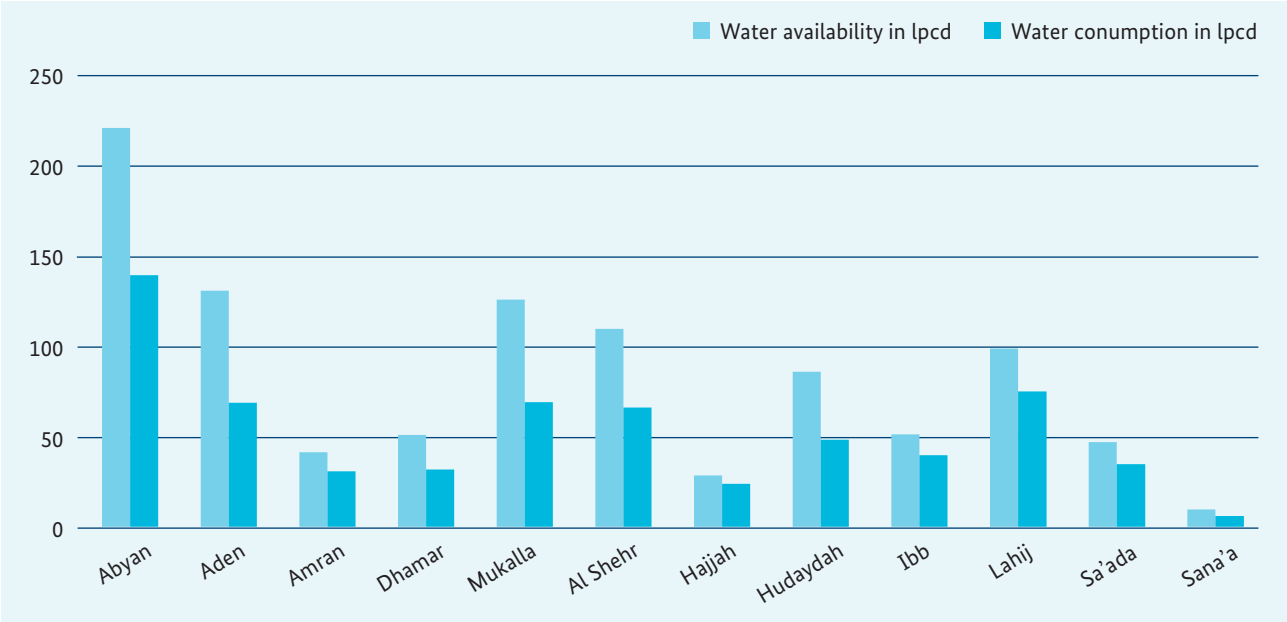


FIGURE 10: WATER AVAILABILITY AND CONSUMPTION PER CAPITA (2016)[15]

15 Excluding Taiz (Insufficient data available)

3 Development of Technical Assistance Plan

3.1 Definition of Conflict and Post-Conflict Measures

The conflict period is defined as the period in which the humanitarian organizations or UN declared a state of emergency. Yet under the current unstable conditions, it is unclear how long this situation will remain in the country. The assessment of the institutional condition of the LCs reveals the individual shortcomings. The recommended measures as drafted in the following chapters are proposed to be implemented as an integrated package and in parallel to strengthen the LC and increase their resilience during the period of conflict. The activities should be implemented within the next 1 – 2 years if the situation does not deteriorate in Yemen.

In case the conflict escalates, the procedures of the emergency plan have to be applied individually for each LC, considering the existing supply and sanitation system and kind of power supply and coordinate the application with the Humanitarian Organisations. Further details are described in Chapter ??!

The post-conflict period is the stage where the conditions of conflict are not met and peace is achieved in Yemen. Yet, it is completely vague when this status will be reached.

3.2 Identification of TA Packages and Cost

The details of condition and problems of each LC have been assessed and are presented in the Technical Assessment Reports in Annex 1 to 20 together with proposals for improving the resilience of the utilities in maintaining water and sanitation services for (i) post conflict scenario and (ii) continued conflict scenario.

For all assessed utilities the appropriate measures were identified to enhance the LCs capacity, performance and improve the customer service. The recommended activities were grouped into seven Technical Assistance (TA) packages and are summarized in one comprehensive Technical Assistance and are attached to each individual report as Appendix.

- → TA Package 1: Financial support
- → TA Package 2: Capacity Building
- → TA Package 3: Office Equipment and IT
- → TA Package 4: Coaching and Consultancy Services;
- → TA Package 5: Operation Management Support / GIS
- → TA Package 6: Gender Supporting WASH Projects
- → TA Package 7: Public Relation and Awareness

Except for the OMS Support (TA 5), all packages should be initiated during the conflict to establish the basis and provide the needed support for increased performance of the LCs and therefore improve the water and sanitation services for the population. However, the prevailing condition of the LC at the anticipated time of implementation has to be evaluated to take decisions on suitable timing of the individual activities.

3.2.1 TA 1: Salary Support and Support of Energy Supply

This package comprises the support for salary, liabilities for insurance pension as one sub-package and another component for energy supply.

1) **Salary support:** It is anticipated that the LCs will be able to pay the staff salary once they obtain fuel (energy source) support. In order to avoid the inappropriate practices by the LCs to rely on the provided support and neglecting revenue collection on one

side, as well as to motivate the LCs in sustainable performance on the other side, it is recommended to pay the outstanding salaries until the end of 2017. The total amount (accumulated by January 2018) and the monthly recurrent salary amount are presented in the TA Package 1.1, in case further support is needed. This has to be decided case by case depending on the developing financial capacity of the LC.

The need to cover the gap of delayed salary payments is not a high priority at the moment. However, the outstanding salary will remain as a strangling problem and will not only negatively affect the performance of LC, but it is expected that this will lead to the interruption of the performance of LC. Especially if other government agencies are treated differently and considering the fact that most LCs receive their own income in form of collection revenues.

For those LCs that are suffering from conflict and insecure conditions, it is recommended providing support for salaries as an incentive for needed employees, in order to ensure continuation of water supply and sanitation services at a sufficient level. Furthermore, it is required to provide subsidy in paying the outstanding insurance pension for which the LC is liable to the national insurance authority. Such would enable the shifting of the applied employees for retirement, reduce the over-staff and enhance the financial capacity of the utilities at the same time. The financial liabilities amounts have been provided by the LC during the assessment and are detailed in Chapter 3.2.2 in the Annexes (Technical Assessment Reports)

2) **Fuel support:** the requirement for fuel has been assessed for each LC on basis of resuming the water production and sanitation service of 2014 (prior to crisis). The respective energy consumption figures for the operation of the Electro-mechanical (EM) equipment has been utilized or calculated. The availability of public power supply or alternative energy sources were taken into consideration under the current circumstances. The factor of the eventual price escalation for fuel remains unknown, wherefore the fuel requirements have been calculated in both, amount in litres / month and amount in EUR (or YER) / month. Since the YER is incumbent on the high fluctuating market price, both, the exchange rate in accordance with Aden Central Bank, Yemen and International exchange rate (Oanda platform)[16] which is 467.51 YER per Euro by 18 April 2018 respectively 309 YER per Euro by 19 April 2018 had been applied. The financial capacity of the LC and provided governmental support was considered in the assessment. The needed subsidy has to be adjusted for areas with high price fluctuation and change of power supply condition during the course of time.

   In general the support for fuel is calculated for twelve successive months during **conflict**, further support depends on financial capacity of LC, availability of public power supply, fuel requirement, market price of the fuel and needs re-assessment. At the same time the figures calculated as starting guideline are subject to change in any time, taking into consideration the special situation of each LC in terms of economic conditions, the change in number of displaced persons, the security situation, access to the site, the extent of the implementation for the recommended packages such as the implementation of alternative energy sources or energy saving equipment and the improvement in the performance of the LCs.

   For **post-conflict** condition it should be considered that the water utilities are governmental organized; therefore any support should be from Yemeni government through the Ministry of Finance. Further support could be given in maintaining and resuming the services or for any LC facing difficulties in covering operation and maintenance cost and in accordance with MoF regulations. The required support has to be re-assessed at the appropriate time.

3) For the LCs like in Abs, Mukha or Taiz where the offices have been destroyed or no access to the offices is possible, new office rooms have to be rented until the LCs have access to its refurbished or secured building The organization of new offices respectively the reconstruction has to be coordinated and organized by the respective LC with external financial support.

   The required budget for fuel, salary and other mentioned support is outlined in the **TA Package 1** of the Technical Assistance Plan.

16 Source: https://www.oanda.com/lang/de/currency/converter

3.2.2 TA 2: Capacity Building / Training Courses

Training or building the capacity of the staff is considered a development activity, such as investment projects. Investment in staff in the context of capacity building measures is expected to provide the necessary knowledge and ability for managers and key staff to enable them to convert the LC to a sustainable efficient institution.

Comprehensive training courses are proposed for members of Board of Director, Local Advisory Committee, for LCs managers and key staff. This group was targeted to transfer the knowledge and gained experience to the other employees of the LC. The training needs were determined based on different factors. The prevailing staffing condition, like number of managers and key staff played an important role in the assessment. The study considered changes in the general situation (conflict and its effects) concerning crisis management and emergency situation. Further, the most important processes of the institution affecting the service performance as well as the human resource deficiencies had been taken into consideration. All of the LCs were requesting certain training courses; the actual needs and urgency had been analysed. Finally the status of already provided training courses for the past three years and eventual existing training plans were incorporated in the assessment. The evaluation of all these factors led to the proposal of recommended training courses.

The cost estimation is based on the obtained prices for courses from the Human Resource Development Centre and Yemen Institute of Directors for the governance courses. It includes the training itself, all needed materials, travel allowance, accommodation and meals for each participant. It is recommended to engage a consultant to organize the courses, monitor implementation and evaluate the outcome. Therefore an additional amount of 20 % had been added to cover such cost and any other related unforeseen expenses. The cost estimation can be considered representative for the other training centres. To reduce cost, but also for safety reasons, training courses shall be grouped and held in several locations of the country. Alternative option or additional activity could be remote web-based training through specialized companies which would have to prepare tailor made courses for the different subjects. Such courses would be either taken by the participants through self-study with support if required, or in a group through remote trainer. Further investigation on this option and respective cost assessment would be needed. The important and urgent training courses which should show immediate impact on the LCs performance are packaged for conflict situation while the remaining identified courses should be held at post-conflict period to further develop and strengthen the capacity of the LCs staff.

The training subjects with respective number of participants from the different departments, duration of training and estimated cost is outlined in the **TA Package 2** of the Technical Assistance Plan, split into conflict and post-conflict training. Details on the training courses, i.e. content of courses are presented in Appendix A.

3.2.3 TA 3: Office equipment and IT

The requirements for the LC office itself have been investigated by the Consultants IT expert working with and for Yemen LCs for many years. Most of the LCs were visited and the availability and condition of the equipment were investigated. Due to the financial constraints the LCs were not able to invest in IT equipment, software or even furniture for the past years. In some LCs the equipment was destroyed or looted during the crisis. In addition the LCs active operation time is also restricted by the available power supply. All these shortcomings result in inefficient work performance. To overcome these deficiencies, new IT hardware and software updates is needed throughout all departments, as well as solar systems and furniture. The estimated cost for the new materials are based on the current local market prices and includes coaching and training of those employees using the new software. The identified needs were categorized into conflict and post conflict measures, and are detailed in the **TA Package 3** of the Technical Assistance Plan.

For the software intervention, the consultant has identified two type of major intervention as following:

→ "National water sector software": it comprises applications for accounting, billing payroll, assets, and inventory. The software is owned by the Yemen Water sector and could either replace the dysfunctional "Yemen Soft" software with the "National water sector software" or update / upgrade the existing version of the "National water sector software" by adding a new application. The estimated cost is only for the IT expert who will develop, update, and install this programme, as the case may be, including the conversion of the data from the old system to the new system. In addition training to the LC staff is foreseen and included in the cost estimates. This component can be implemented during the conflict already and is part of TA Package 3.

→ GIS system, which is incorporated with the OMS support in TA Package 5, explained below.

3.2.4 TA 4: Coaching and Consultancy support

Some assessed utilities require certain support for special studies, updates of previous designs for water and sanitation projects or an external auditor for auditing of accounts and evaluation of assets. Further external assistance has been identified for the development and introduction of improved HR procedures, organizational restructuring, training need assessment plans, etc. to enhance and maintain the staff capacity and improve the performance sustainably. Additional experts are needed for coaching on administrative water losses and its reduction in order to increase the collection revenues. Another support component is the re-structure of the tariff in accordance with the prevailing situation, i.e. O & M cost, financial condition of LC, customer financial ability. To tackle the energy problem studies on other alternative energy sources like wind, geothermal, biogas or restoration of public power supply as well as on the energy saving options are recommended. The cost has been estimated based on the prevailing local consultancy cost. These activities can be either initiated already during conflict or at post-conflict, depending on the situation, capacity of the LC and if external support from international experts is required and feasible. The details with cost estimates are provided in the **TA Package 4** of the Technical Assistance Plan.

3.2.5 TA 5: Operation Management Support

Introduction of a comprehensive GIS system or update for those LCs which use already GIS is required in the long run. The component includes procurement and incorporation of satellite images, installation of Maintenance Management System (MMS) application, comprehensive customer subscriber survey (CSS) and establishing customer service centre. These activities were previously supported through GIZ funded Operation Management Support (OMS) projects. Especially the MMS and CSS tasks are very comprehensive and require 2 – 3 years for proper implementation with external support through different experts. With the establishment of a customer service centre with trained staff, the LC should have the capacity to update and maintain the database and address customer complaints more professionally. The respective detailed requirements and cost are outlined in the **TA Package 5** of the Technical Assistance Plan.

3.2.6 TA 6: Gender Supporting WASH Projects

The procurement of the urgently needed equipment and materials for the public places and institutions is not within the responsibility of the utilities. However, indirectly it releases the LCs from their obligation to provide services to these locations.

The urgent requirements for schools, hospitals and for camps or other public places were identified through the assessment by visiting these places and by obtaining the feedback from these institutions. The assessment incorporates all the result of the provided information from these institutions, education offices, local councils and civil society organizations. The major shortcomings are the lack of water tanks and power supply to lift the water to the roof tanks. Hospitals do not treat the heavy polluted wastewater before discharging it into the public sewer system which causes overload for the wastewater treatment plants.

The needed material comprises: water storage tanks, septic tanks, solar systems with pumps, water distribution points, bathrooms and pre-treatment systems for hospitals. The organization of procurement and installation should be coordinated by the local NGOs, particular the WASH Cluster, with the cooperation of the respective local councils, schools and hospitals. The WASH Cluster is already active in the provision of emergency materials to such institutions and to marginalized groups.

The cost for the equipment has been estimated according to the local market price and is detailed for the concerned beneficiaries in TA Package 6 of the Technical Assistance Plan to be procured during conflict.

3.2.7 TA 7: Public Relation and Awareness

Awareness campaigns comprise manifold set of activities, like: presentations at public places and institutions, lectures at schools, universities and mosques, distribution of leaflets to households, TV and radio announcements. The aim of these measures is primarily to sensitize customers for the importance of the public service and functionality of infrastructure and to provide residents with important information. The public shall be informed about environmental protection and health / hygiene issues and other related subjects. Respective activities with detailed awareness programme, locations, time schedule for each LC shall be organized through a specialized consultant. It is recommended to establish and maintain an awareness campaign committee for a period of two years for each

LC. The committee shall be formed of a selected group of members – their size depending on the population number – and trained through the consultant. The committee shall organize the awareness campaigns in coordination with the LC, local council, women department of the LC and possibly donor organizations.

The topics of public awareness campaigns should include the following:

- The importance and process of providing safe water and sanitation services for the health of customers, their families and their communities as a whole;
- The concept of providing sustainable services depends on the cost recovery approach and therefore importance of paying bills in time through customer;
- The reasons and importance of notification of water leakage, illegal connections and other problems that cause the waste of limited water resources;
- The importance of preventing water pollution and what customers can do in their homes to help in this regard;
- The importance of water saving and the relationship between water use, costs and environment and how customers and communities can support;
- Personal hygiene, food and household hygiene, health issues;
- Education of children (for mothers) with regards to hygiene, water use, sanitation.

The estimated cost for awareness campaigns have been only roughly estimated according to the LCs customer number. Further detailed cost assessment is required in accordance to the particular extent of the activity, once the measure is properly defined. The duration of activities is anticipated over a period of two years during conflict and two years in post-conflict. The proposed requirements with cost estimates are presented in the **TA Package 7** of the Technical Assistance Plan.

3.3 Management Information System (MIS)

The concept of a centralized Management Information System (MIS), to be established in the MWE headquarter, has been prepared already through a specialized consultant in 2010[17]. The MIS would be a computerised tool to support the Monitoring and Evaluation (M & E) activities of MWE. It is one part of the overall M & E system. The intention of the envisioned MIS is not only to gather and manage data for the strategic and policy tasks of the MWE, but also to support the sub-sector agencies, namely General Authority for Rural Water Supply and Sanitation Projects (GARWSP), National Water Resources Authority (NWRA), National Water and Sanitation Authority (NWSA), the Local Corporations and the Irrigation department of Ministry of Agriculture and Irrigation (MAI) in their own management efforts.

The setup of the MIS with the links to the subsectors of the MWE is illustrated in Appendix B together with cost estimate for the experts and equipment. A detailed system concept with hardware requirements and software specifications for the system and ToR had been prepared and is available with the MWE. The following costs have been estimated for the establishment of the MIS:

→ For program design:	140,000 EUR
→ For supply and installation of equipment and software:	290,000 EUR

The anticipated time for implementation would be at post-conflict.

Once the Management Information System (MIS) is established at the ministry the utilities should be linked to the system. The Performance Indicators data entered from each LC will be transferred to the system. The ministry would be in the position to enhance the control on the performance of the utilities and could react faster if deviations to the achievable goals are detected.

17 Monitoring and Evaluation of the NWSSIP Update – Organisational Setup & Management Information System, by denkmodell (2010)

3.4 Cost Estimation for Technical Assistance Support

The costs for the Technical Assistance measures have been grouped into seven categories and in Conflict and Post-conflict measures. The individual TA Plan with the individual TA packages for the LC is attached to each Technical Assessment Report in the Annexes 1 to 20.

The total cost for the Technical Assistance Package for conflict and post conflict is as following:

TA Package	Conflict 2018 – 2020 (EUR)	Post-conflict (EUR)	Total (EUR)
TA1: Financial Support	51,024,000		51,024,000
TA2: Training Courses	2,230,000	1,267,000	3,497,000
TA3: IT & Office Equipment	1,850,000	1,088,000	2,938,000
TA4: Coaching and Consultancy Services	890,000	2,865,000	3,755,000
TA5: Operation Management Support		3,839,000	3,839,000
TA6: Gender Supporting WASH Projects	4,189,000		4,189,000
TA7: Public Relation/ Awareness	1,013,000	1,363,000	2,376,000
Management Information System		430,000	430,000
Total	**61,196,000**	**10,852,000**	**72,048,000**

TABLE 6: TOTAL COST ESTIMATION FOR TECHNICAL ASSISTANCE MEASURES DURING CONFLICT AND POST-CONFLICT

For the implementation of all proposed activities a total amount of 61.2 million EUR during conflict, i.e. the next two years and 10.85 million EUR at Post-conflict would be required.

The following tables outline the totals of cost estimates per LC and Technical Assistance package. More details regarding the measures and cost are presented in the references Annexes.

Reference	TA Measure LC /AU / Branch	TA1: Financial Support Total Conflict (EUR)	TA2: Training Courses Total Conflict (EUR)	 Total Post-conflict (EUR)	TA3: IT & Office Equipment Total Conflict (EUR)	 Total Post-conflict (EUR)	→
Annex 1	Abyan LC	30,000	108,000	57,000	67,000	24,000	
Annex 2	Aden LC	577,000	361,000	165,000	287,000	107,000	
Annex 3	Amran LC	1,015,000	87,000	61,000	82,000	30,000	
Annex 4	Dhamar LC	1,565,000	129,000	71,000	169,000	50,000	
Annex 5	Mukalla LC	0	185,000	95,000	114,000	139,000	
Annex 6	Al Shehr Utility	0	98,000	37,000	79,000	45,000	
Annex 7	Hajjah LC	2,527,000	78,000	49,000	66,000	60,000	
Annex 8	Hajjah Branches	1,722,000	47,000	18,000	52,000	142,000	
Annex 9	Hudaydah LC	5,944,000	169,000	97,000	141,000	105,000	
Annex 10	Bait Al-Faqi Utility	796,000	72,000	15,000	62,000	12,000	
Annex 11	Al Mansouriah Utility	217,000	52,000	16,000	88,000	22,000	
Annex 12	Zabid Utility	647,000	64,000	16,000	59,000	22,000	
Annex 13	Bajil Utility	816,000	63,000	15,000	59,000	8,000	
Annex 14	Ibb LC	3,280,000	129,000	84,000	108,000	45,000	
Annex 15	Lahij LC	181,000	99,000	61,000	79,000	53,000	
Annex 16	Sa'ada LC	684,000	66,000	50,000	67,000	23,000	
Annex 17	Sana'a LC	20,139,000	322,000	140,000	102,000	106,000	
Annex 18	Taiz LC	10,597,000	56,000	204,000	78,000	71,000	
Annex 20	Mukha Utility	287,000	45,000	16,000	91,000	24,000	
Management Information System							
Total Cost		**51,024,000**	**2,230,000**	**1,267,000**	**1,850,000**	**1,088,000**	

TABLE 7: COST ESTIMATION FOR TECHNICAL ASSISTANCE MEASURES FOR ALL LCS

	TA4: Coaching and Consultancy Services		TA5: OMS	TA6: Gender Supporting WASH Projects	TA7: Public Relation / Awareness		Total Cost	
	Total Conflict (EUR)	Total Post-conflict (EUR)	Total Post-conflict (EUR)	Total Conflict (EUR)	Total Conflict (EUR)	Total Post-conflict (EUR)	Total Conflict (EUR)	Total Post-conflict (EUR)
	58,000	349,000	383,000	217,000	37,000	49,000	517,000	862,000
	66,000	158,000	368,000	443,000	173,000	238,000	1,907,000	1,036,000
	74,000	248,000	224,000	190,000	30,000	35,000	1,478,000	598,000
	74,000	295,000	291,000	363,000	41,000	62,000	2,341,000	769,000
	74,000	60,000	566,000	198,000	101,000	148,000	672,000	1,008,000
	50,000	20,000	0	79,000	30,000	44,000	336,000	146,000
	74,000	120,000	186,000	108,000	32,000	40,000	2,885,000	455,000
	0	55,000	0	155,000	0	0	1,976,000	215,000
	82,000	138,000	600,000	182,000	92,000	125,000	6,610,000	1,065,000
	8,000	10,000	0	123,000	26,000	31,000	1,087,000	68,000
	0	160,000	0	57,000	14,000	17,000	428,000	215,000
	0	10,000	0	90,000	25,000	31,000	885,000	79,000
	0	10,000	0	0	25,000	30,000	963,000	63,000
	66,000	180,000	0	329,000	56,000	85,000	3,968,000	394,000
	74,000	118,000	278,000	146,000	43,000	59,000	622,000	569,000
	74,000	233,000	185,000	222,000	26,000	30,000	1,139,000	521,000
	66,000	258,000	288,000	468,000	172,000	220,000	21,269,000	1,012,000
	50,000	283,000	470,000	388,000	76,000	102,000	11,245,000	1,130,000
	0	160,000	0	431,000	14,000	17,000	868,000	217,000
								430,000
	890,000	**2,865,000**	**3,839,000**	**4,189,000**	**1,013,000**	**1,363,000**	**61,196,000**	**10,852,000**

4 Implementation of Technical Assistance Measures

4.1 Technical Assistance at escalating Conflict

Most of the LCs did not prepare an emergency plan which would help them to follow structured and organized procedures to enable:

→ The minimum water supply to the population;
→ Regulated disposal of wastewater to avoid health risks and the pollution of ground water.

The procedures have to be established individually for each LC, considering the existing supply and sanitation system and kind of power supply. Thus the process should describe:

a) **How the population is provided with water during prolonged power cuts.** There are different ways to fulfil this requirement; the possible and applicable options depend on the available water supply system of each LC.

- Switch from pumping supply to gravity supply through establishing overhead tanks or just simple water tanks at various strategic points around the city. The LC should fill these tanks during situations when there is surplus water.
- Installation of transmission lines / connections to storage tanks.
- Consideration of the storage capacity of household tanks (for one week up to a month).
- Identify the wells inside the city and keep them in operation.
- Zoning of the supply network for each well.
- Switch to direct pumping from wells to customers.
- Optional supply through water tankers from outside the critical areas.
- Keep water tankers available and in operational condition. Incorporate Private water suppliers into the emergency plan.
- Identify facilities / wells which can be operated without power or with solar power.
- Installation of manual pumps at wells where possible.

The different options and detailed procedure of application in case of emergency should be described in the LCs customized "Operation procedure for emergency water supply".

b) **How the wastewater is disposed of appropriately**, so it does not pose any health risk and not to pollute the environment. Most of the households, being not connected to the sewer system maintain cess pits or septic tanks. Therefore the LCs have to consider primary their operational sewerage system. Those LCs which operate wastewater pump stations and WWTPs the electricity cuts will cause the major problem. The utilities may have to install additional standby generators and sufficiently sized fuel tanks or if possible solar panels at the WWTP and sewer pump stations.

The different options and detailed procedures of application in case of emergency should be described in the LC customized "Operation procedure for emergency sewage disposal".

c) **How the power supply can be maintained.** Currently most of the utilities are using mainly generators for the power supply. During emergency the utilities will face increased difficulties to buy fuel and spare parts. Therefore the LC should:

- Be equipped with surplus fuel tanks, at least to enable few hours water supply per day.
- Replace or add to the generators solar power systems for pump operation. The LC has to identify the most important wells for water production in combination with the technical feasibility to operate solar power systems.
- Consider the use of manual pumps and identify possible locations for such operation (surface wells).

The different options and detailed procedure of application in case of emergency should be described in the LC customized "Operation procedure for emergency power supply".

The LC has to nominate responsible key staff and empower them to act and delegate tasks according to the respective operation procedure in case of emergency. The key staff and active staff have to be trained for their particular tasks and get familiar with the procedures. At least six staff members (2 for water, 2 for sanitation and 2 for power supply) should be responsible for the service of one supply area. The employees have to receive clear instructions what to do in case of emergency; overlapping of responsibilities need to be avoided. An incentive scheme should be established to compensate selected active staff members at emergency situation.

The LC should prepare an awareness programme for the customers in coordination with relevant government offices, local authority and NGOs announcing:

- The closest public water distribution points;
- information about public sanitation facilities;
- Possibilities to save water or re-use reclaimed wastewater;
- Information how to harvest and store rain.

Some LCs, e.g. Dhamar, Sana'a, Hudaydah have already prepared an emergency plan which could be adapted to the other LCs. The humanitarian organizations are active in the provision of water supply and sanitation facilities during emergency and crisis, as outlined in the Strategy Report, Part 1, Chapter 2.4.2 and 2.4.3. Therefore it is proposed that the LC management prepare emergency plans together with these organizations. The coordination and implementation of the specific requirements to apply the emergency plan has to be jointly with LCs, humanitarian organizations and donor organizations.

4.2 Technical Assistance in Conflict and Post-conflict

The proposed Technical Assistance measures should be implemented individually and in parallel to achieve the optimized output. In order to coordinate the recommended activities with the ongoing emergency response measures, it is proposed to hold a conference with the participation of GIZ WSP and active donor organizations to discuss the results of DAS III and identify the intervention and area of responsibility of each organization. The individual parties should agree on the implementation time frame and appropriate implementation method and monitoring processes.

It is recommended that the implementation of the agreed measures is coordinated and controlled by an existing active Humanitarian organization with the support of an appointed Consultant. This organization shall agree with the respective LC, BoD (or LAC), MWE and donor institution on final proposed packaging of the institutional measures. The prevailing procedures of the organizations as explained in the Strategy Report, Part 1, Chapter 2.4.2 could be applied for the implementation of the measures during the conflict.

1) **TA Package 1 – Financial Support:** The provision of financial support for fuel, salary, insurance pension shall be through the existing Humanitarian organizations. They shall directly coordinate with the LC or Utility to provide the required financial support based on the calculated requirement outlined in the package.

2) **TA Package 2 – Training Courses:** The capacity training has to be organized with the training institutions and all the envisaged participants. The courses should be grouped according to theme. Each LC should appoint a coordinator to organize the administrative matters, i.e. preparation of participant list, scheduling of courses, travel, accommodation, allowance for participants. The participant list shall be approved by the LC management. The needed period for all the conflict categorized training courses is expected to take up to twelve months. Further courses will be required for the non-urgent themes to be implemented at post-crisis.

Regular training need assessment plans shall identify the required training measures in assessing the capacity of the staff at that time.

3) **TA Package 3 – Office Equipment and IT:** The approved IT equipment shall be tendered and procured from the local market. This can be either for the individual LCs separately or jointly with other LCs (packaging). The equipment and software shall be installed through an IT expert from the LC or extern. Training on the new software program must be conducted where required. The procurement and installation of IT equipment and other small materials foreseen during conflict may need at least twelve months for all utilities. To furnish all the LCs completely with needed and proposed equipment may require up to three years.

4) **TA Package 4 – Coaching and Consultancy Services:** The institutional measures concerning re-organization of LC including staffing; amendment of important procedures; introduction of incentive scheme; adjustment of tariff structure shall be implemented either at conflict or post-conflict depending on the individual situation of the LC. Further support through external consultants as detailed in the respective TA package shall be coordinated and organized between LC management, MWE and donor organization. These activities will stretch over few years and the feasibility of implementation, the commencement and needed duration of measures depends also on the capacity of the LC.

5) **TA Package 5 – Operation Management Support / GIS:** The implementation of the OMS / GIS activity is foreseen at post-crisis. The tasks require first the proper establishment of a database with network maps including all attributes, satellite images, and customer data. Therefore the updating of water network and

Ref.	Tasks	Duration Conflict	Tentative date: Duration Post-conflict	→
	Conference and workshop for coordination of activities	2 months		
	Final packaging of TA measures and agreement with project stakeholders	2 months		
	Imlementation of Institutional Measures			
TA1	Financial support for salary and fuel	12 months		
TA2	Capacity Building			
	Training of LC managers and key staff	12 months	12 months	
	Training of BoD members and secretary	1 months	6 months	
TA3	Office equipment and IT			
	• Procurement and installation of IT equipment	12 months	6 months	
	• Installation of updated or new software	3 months	3 months	
	• Procurement of office equipment and furniture	3 months	3 months	
TA4	Coaching and Consultancy support			
	• Revision and adjustment of tariff	3 months	6 months	
	• Revison of institutional procedures and processes		12 months	
	• Re-structuring of utility organization		2–5 years	
	• Studies, planning and design		3 months	
TA5	Operation Management Support / GIS			
	• Installation of GIS and applications		6 months	
	• Establish customer complaint unit		6 months	
	• Customer subscriber survey		2 years	
	• Network updating		2 years	
TA6	Gender Supporting WASH Projects			
	• Procurement and installation of small equipment for public institutions and places	12 months		
TA7	Public Realation and Awareness			
	• Establish and train awareness committee	3 months		
	• Preparation of awareness campaigns	3 months		
	• Public awareness campaigns	2 years	2 years	
	Establish central data bank (MIS)		2 years	

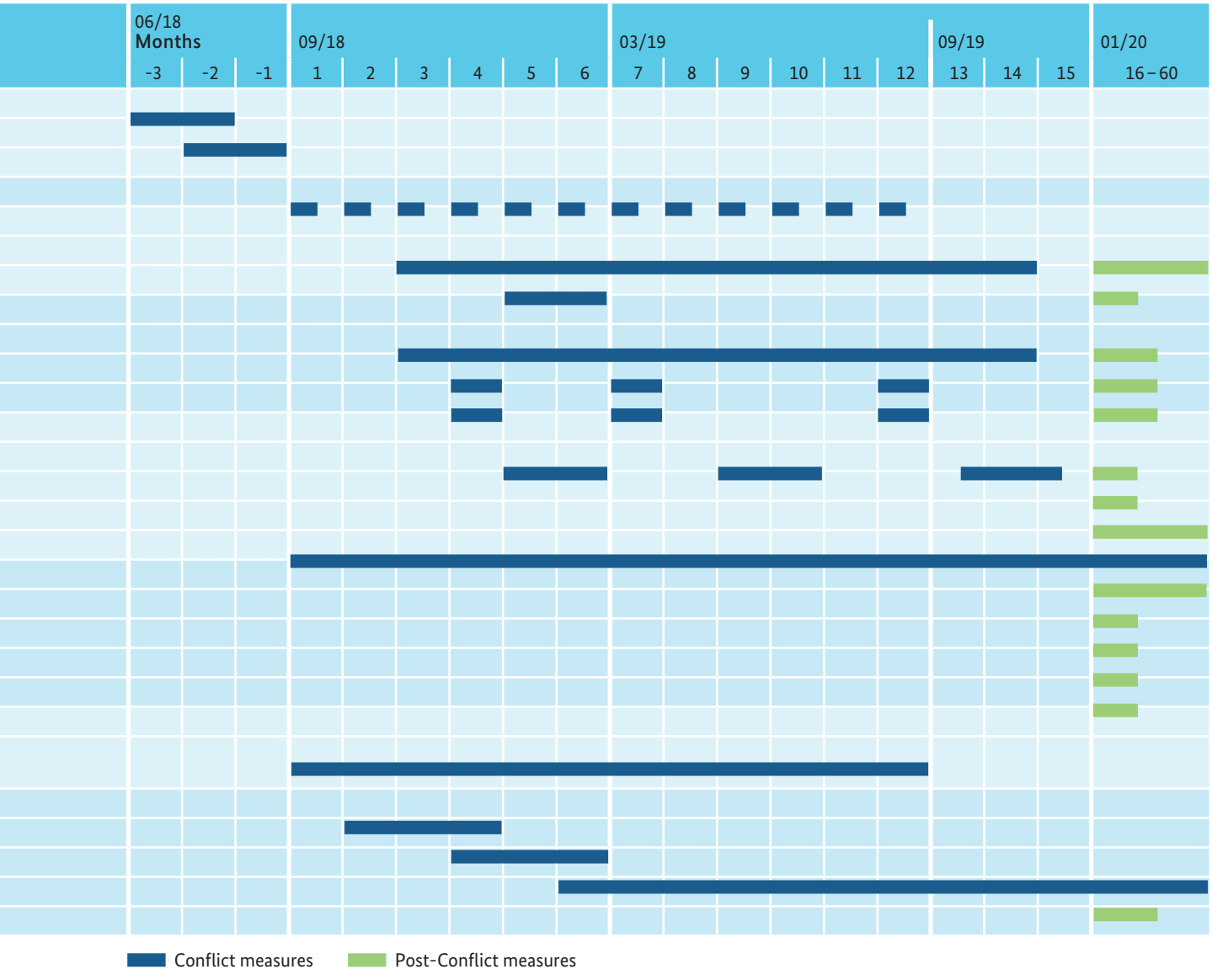
FIGURE 11: TENTATIVE IMPLEMENTATION SCHEDULE FOR TECHNICAL ASSISTANCE MEASURES

customer data in the field is required to be entered then into the GIS. The management has to establish a customer service center and respective responsible staff has to be trained. All the tasks are comprehensive, time consuming and require at least two years for first implementation with the support from external consultant for each LC. The feasibility of implementation shall be discussed with the individual LCs and the funding organizations.

6) **TA Package 6 – Gender Supporting WASH Projects:** The procurement of emergency and urgent small needs materials and equipment shall be coordinated through the humanitarian organizations. They shall organize the tendering and procurement from the local market in cooperation with the beneficiaries. The complete implementation is envisaged within twelve months during the conflict period.

7) **TA Package 7 – Public Relation and Awareness:** This activity requires first the appointment of local consultants, specialized with awareness campaigns. These experts shall initiate the process to set up awareness campaign committees in each LC and provide training to its members. In cooperation with the committee and the LC a Public Awareness Program shall be prepared. The implementation of the different activities would be thought the committee with observation and guidance though the consultant. The anticipated duration for the execution of the campaign is two years during conflict and two years at post-conflict.

The tentative implementation schedule below is illustrating the anticipated commencement and duration of the conflict measures for all LCs. Since the current performance and institutional condition is different from LC to LC the specific requirements and therefore duration for implementation is subsequently varying among the LCs.



5 Damage Assessment Results

The available water and sanitation infrastructure and the physical condition of the infrastructure of each LC were assessed, the detailed results are presented in Chapters 8 to 11 (or 12) of each Technical Assessment Reports in Annex 1 to 20. The assessment comprised the investigation of LC buildings, warehouses, stores, reservoirs, WWTP, pumping stations, wells, water network, and sewer system. In some areas there was no direct damage of the water and wastewater infrastructure. Those areas which were directly affected by the conflict, the infrastructure suffered considerably as in: Abyan, Aden, Hajjah, Sa'ada, Taiz, Sana'a Lahij and Hudaydah. In addition to the damage, in some LCs materials, equipment and vehicles were looted. All these conditions contributed to the deterioration of the water and sanitation system and the overall bad asset situation of the LCs. Due to the lack of operation and maintenance materials, the LCs are not in the position to maintain or rehabilitate their infrastructure sufficiently. This impairs the quality and functionality of networks, pumps, WWTP etc. and shortens the lifetime. The damage on the public electricity grid combined with fuel shortage for the power plants caused frequent and prolonged power cuts.

The results are:

- → Failure of generators, pumps resulting in decreased water production and supply;
- → Increased requirement on generators, fuel tanks and fuel which increased the cost on power production significantly.
- → Failure of wastewater pumps and WWTP operation causing floods, environmental pollution and eventually health risks;
- → Increased number of leakages on the water network leading to high physical water losses;
- → Dysfunctional valves preventing proper control of the water supply system;
- → Increase in power consumption due to inefficient operation;
- → Absence of required water quality checks and tests for control of potable water and treated wastewater.

The direct major damage caused by the conflict on the different facilities and networks of the LC, as well as looted or damaged equipment are summarized and presented in the table below.

LC	Date & Reason	Main Office	Warehouse / Workshop	Reservoirs	Pumping station
Abyan	conflicts in 2012	completely destroyed (Zinjibar) but has been rebuild	store completely destroyed but has been rebuild	Ja'ar Ground Res. (750 m^3), Hisn Shadad tower (150 m^3), Almaraqed tank (50 m^3) all 3 totally damaged. Al Koud (150 m^3)	The Water pump stations of Al-Shak Salem, Al-Maraked, Al-Asla had been totally destroyed. The wastewater pump station of Al-Code had been partially destroyed.
Aden	conflict in 2015	new and old office partially damaged	Sheik Othman building materials looted	Ground iron res. No. 3 completely and No. 4 partially damaged	Main PS Isthmus destroyed & several Wastewater PS at khormaksar and kriter Tawahy was damaged
Amran	no damage	no damage	no damage	no damage	no damage
Dhamar	no damage	no damage	no damage	no damage	no damage
Hadramout – Mukalla	conflict in 2015 Hurricane in 2015	no damage	no damage	2 tanks partially damaged	no damage
Hadramout – Al Shehr	conflict in 2015 Hurricane in 2015	no damage	no damage	2 tanks partially damaged	no damage
Hajjah	no damage through war, but floods in 2016	no damage	no damage	no damage	PSs at Wadi Sharas partly damaged by floods
Hajjah branches	Mabian and Kahlan Afar no damage. Completely destroyed infrastructure in Harad and Abs. Harad is military area and not accessible. Abs started with rehabilitation of infrastructure.				
Hudaydah	conflict in 2015	no damage	no damage	no damage	WW PS No. 5 completely damaged
Hudaydah Utilitiy	No damage in Bait Al-Faqi, Mansouriah, Zabid. Damage in Bajil through air strike in February 2017.	no damage	Bajil Hangar of the warehouse in the city	no damage	no damage
Ibb	no damage	no damage	no damage	no damage	no damage
Lahij	damage through conflict in 2015/2016	LC head office in Al Hawtah completely destroyed	warehouses damaged	no damage	no damage
Sa'ada	conflict since 2004	no damage	no damage	reservoirs completely or partially destroyed	no damage
Sana'a	damage through conflict in 2015, 2016, 2017	Head office partially damaged, Building in 1st, 5th area and main WWTP partially damaged	April 2017: Al Rawadah warehouse completely damaged	Al Nahdain reservoir completely destroyed	Al Nahdain Booster pumps totally destroyed
Taiz	conflict since 2015	Head office partially damaged. Admin. Building in 1st and 2nd area partially destroyed and in 3rd area totally destroyed.	warehouse partially damaged, materials loote	Iron reservoir completely destroyed	External damage on 5 main PS and buildings. Booster pumps totally (3) and partially (9) destroyed. 3 sewer PS destroyed.
Taiz – Mukha Utilitiy	conflict since 2015	Office partially damaged, furniture looted	no damage	no damage	no damage
Taiz – Turbah Branch	no damage	no damage	no damage	no damage	no damage

TABLE 8: DIRECT DAMAGE OF WATER AND SANITATION FACILITIES ON ALL LCS →

LC	Wells	WWTP/ Ponds	Laboratories / Disinfection	Water network	Sewer network	Materials, Equipment, Vehicle
Abyan	no damage	no damage	materials looted	valve chambers destroyed	no damage	Most of house water meters stolen / destroyed, same with bulk meters. O&M vehicles damaged / looted
Aden	Operation building, panel, tank at Bir Nasser and electric wires at Bir Ahme wellfield damaged	WWTP damaged. PS at Khor Maksar, Tawahi, and Crater damaged	Main water laboratories destroyed, materials looted, wastewater lab partially damaged. 3 Water disinfection facilities destroyed. Sanitation lab in Alarish completely destroyed, materials looted.	main pipeline and valve chamber at Aden Gate damaged. valve chamber at several disteract		O&M cars and vehicles damaged / looted
Amran	no damage	no damage	no damage	no damage	no damage	no damage
Dhamar	no damage	no damage	no damage	no damage	no damage	no damage
Hadramout – Mukalla	6 wells partially damaged, 3 totally destroyed	no damage	no damage	some damage, but mostly rehabilitated	some damage, particularly in the western area of the city	no damage
Hadramout – Al Shehr	no damage	N/A	no damage	no damage	no damage	Looted vehicles and materials
Hajjah	no damage	no damage	no damage	no damage	no damage	no damage
Hajjah branches	Mabian and Kahlan Afar no damage. Completely destroyed infrastructure in Harad and Abs. Harad is military area and not accessible. Abs started with rehabilitation of infrastructure.					
Hudaydah	no damage	no damage	no damage	no damage	no damage	no damage
Hudaydah Utilitiy	Office and laboratory at Bajil WWTP completely destroyed	no damage	no damage	no damage	no damage	no damage
Ibb	no damage	no damage	no damage	no damage	no damage	no damage
Lahij	well houses damaged	N/A	Sterilization facility destroyed.	no damage	N/A	water meter chambers damaged. Vehicles, equipment, Water meters stolen or destroyed.
Sa'ada	well heads destroyed	N/A	no damage	networks completely or partially destroyed	N/A	valve chambers and generators completely or partially destroyed.
Sana'a	no damage	no damage	no damage	no damage	no damage	materials of warehouse damaged
Taiz	well heads destroyed incl. electrric equipment and valves	Walls and room of WWTP partially damaged	Laboratory completely destroyed. 5 Water sterilization units partially damaged	parts of network damaged.	Trunkline Siphon at Assifrah damaged	Generators totally (6) and partially (21) damaged
Taiz – Mukha Utilitiy	no damage	N/A	no damage	network partially damaged	N/A	no damage
Taiz – Turbah Branch	no damage	N/A	no damage	no damage	N/A	no damage

TABLE 8: DIRECT DAMAGE OF WATER AND SANITATION FACILITIES ON ALL LCS (CONT.)

6 Development of Investment Plans

6.1 Structure of the Investment Plan

The Investment Plan comprises all materials, equipment and works necessary to rehabilitate, restore and maintain the water and sanitation infrastructure of each assessed LC individually and is attached to each Technical Assessment Report. It includes not only the restoration / rebuilding of damaged structures and networks, but also materials and equipment needed for rehabilitation and extension of networks, maintenance of electro-mechanical equipment, construction of new wells. Solar systems have been also included to replace the costly generator operation.

It can be stated that for all LCs the maintenance of networks and facilities has been heavily neglected, due to: (i) lack of materials (finance), (ii) stopping of investment programmes through the national budget, (iii) security issues and (iv) inability of LC to carry out works. Therefore the needs of the individual LCs is manifold and more or less extensive, naturally depending also on the extent of available infrastructure / number of customers.

The Investment Plan for each assessed LC has been structured into 11 Packages:

1) **Civil works on buildings and structures:** the package comprises all civil works required for office, workshops, stores, operator buildings, laboratories and structural work on WWTP, reservoirs, wells.

2) **Well rehabilitation and new construction:** the package includes submersible pumps, electro-mechanical equipment, and related materials for rehabilitation of existing and for construction of new wells.

3) **Water pumping stations:** the package includes required pumps and auxiliary equipment for pump station rehabilitation or for new constructed pump stations.

4) **Water network rehabilitation and extension:** the package comprises required pipe materials for rehabilitation and extension of water networks as well as complete extension projects.

5) **Wastewater treatment plants and sewage pumps:** the package includes required pumps and auxiliary equipment for WWTP and wastewater pump stations rehabilitation or for new constructed WWTPs and pump stations.

6) **Sewer network rehabilitation and extension:** the package comprises required pipe materials for rehabilitation and extension of sewer networks as well as complete extension projects.

7) **Generators and spares:** the package comprises required new generators and spare parts for maintenance of existing generators.

8) **Operation and Maintenance materials:** the package comprises materials for operation and maintenance of the water supply and sanitation system, in general: pipes, fittings, valves, water meters, safety equipment, manhole covers.

9) **Vehicles, machines and tools:** the package includes vehicles, equipment, machines and tools for O & M of the infrastructure like: backhoe, loader, jet tanker, dump truck, 4WD pick up, crane, electric machines, and hand tools.

10) **Electric materials and Solar systems:** the package comprises electric equipment and materials for pumps, WWTP, e.g. motors, panels, transformers, switches, cables. In addition solar system with all required equipment (pumps, motor, control panel and needed auxiliary equipment) for operation of wells or WWTP or office are included in this package. Some LCs requested wind speed measuring tools for investigation of possible use of wind power station.

11) **Laboratory equipment:** the package includes all required equipment, machines, materials and consumables for water and wastewater laboratory. It includes also the requirements for chlorination stations.

In case items of particular investment packages was not needed it remained empty to keep the structure and for better eventual packaging of more LCs.

For **big investment projects**, e.g. water or sewer network extension the LC may have already first designs and Bills of Quantities available. Some of the studies would need to be updated before proceeding to the next stages of tendering and implementation.

6.2 Prioritization of Investment measures

The proposed measures were prioritized according to urgency in combination with feasibility for each LC assessed. The feasibility considers firstly the security situation of the assessed LC under the current conflict condition and second other possible constraints, like institutional shortcomings or material availability. Nevertheless the prevailing condition at anticipated time of implementation has to be scrutinized prior to start of the implementation process.

1) Feasibility of Implementation of Measures

Safety: The LCs have been analysed according to the prevailing security condition, which is changing from time to time. For example Lahij, Aden, Abyan which were hit by the civil war in 2015, 2016 are now considered safe and stable. The most critical areas are currently (January 2018) Taiz, Harad, Al Mukha, which are basically impossible to access. Nonetheless, provision of small emergency equipment and materials which can be implemented by the LC, should be considered as a high priority irrespective of the security risks.

Rehabilitation or reconstruction projects which require a long lead-time due to planning and tendering procedures could be initiated already during the crisis. This concerns the usual time-consuming design, tendering and prequalification of contractors. For example necessary planning or other preparatory works for the completion or continuation of the WWTP in Sana'a and Ibb or Al Shehr could be initiated.

Institutional: The support of the LC management and key staff is required for successful implementation and utilization of the procured equipment and material. The staff capacity and available construction machines of the utilities have to be considered for implementing and operating new equipment. The Investment plan indicates those measures where external support is needed (= supply & installation)

Material availability: Some of the material required for rehabilitation measures is available on the local market. Also solar panels and electro-mechanical equipment is available. See also Chapter 6.3 below.

2) Urgency of Implementation

The LCs were asked to prioritize the requirements according to urgency from 1 (high priority) to 4 (low priority). The Consultant scrutinized the data provided and made his own brief assessment followed by the respective recommendation. In case the parameter was not provided, the Consultant determined the "Urgency" on the basis of available data and information.

3) Prioritization

According to feasibility and urgency the measures were categorized into four groups to commence and be implemented in different stages.

→ Priority 1 – **Urgent:** goods to be procured and civil works to commence within six months, proposed in 2018. This category includes urgent civil works projects which may require more than six months for completion.

→ Priority 2 – **High Priority:** goods to be procured and civil works to commence within twelve months, proposed in 2018 – 2019. This category includes civil works projects which may require more than one year for completion.

→ Priority 3 – **Short-term:** goods to be procured and civil works to commence in 2020 – 2021. However, feasibility may be compromised and delay investment measures.

→ Priority 4 – **Long-term:** less urgent or not feasible measures under the current conflict condition, goods to be procured and civil works to commence in 2021 – 2025.

The Investment Plan of each LC summarizes the measures for the Packages with respective cost estimate. The work category indicates if the measure or material is completely new ("New") or if it is to be for maintenance purpose or replacement ("Maintenance"). Further if the materials and equipment needs just be procured (= "Supply") or if supply and installation (= "Supply & installation") through a contractor is needed. Some of the rehabilitation or extension measures may need further studies and detailed investigations. Design and engineering efforts would have to be considered. Such activities are noted in the investment package with respective remark and respective costs have been included in the overall cost estimate of the item.

End of 2014 most of the investment projects were suspended or completely terminated. The status of the projects at time of suspension as well as utilized and remaining budget have been summarized according to the information made available from LCs and Urban Water and Sanitation Project (UWSP) unit and are incorporated in the Investment Plan.

6.3 Material Availability and Specifications

For the rehabilitation and improvement of the water and sanitation facilities and networks most of the materials are available on the local market or can be procured from the neighboring countries, if the borders are open. The delivery of materials is feasible within 9 to 15 weeks.

The below list present an overview of the mainly required items and their availability.

Category	Items / Materials	Availability / Supplier
Building material	structural material, windows, doors, tiles	local
Water and wastewater pipes	high-density polyethylene (HDPE) galvanized iron (GI) ductile iron (DI) steel (St) unplasticized polyvinyl chloride (uPVC) glass reinforced plastic (GRP)	local and outside
Fittings and Appurtenances	GI fittings PE fittings DI Valves	local and outside
Water tanks	galvanized iron	local
Sanitation	manhole covers	local and outside
Pumps	submersible pumps booster pumps wastewater pumps	local and outside
WWTP	screens	outside
EM equipment	generator dewatering pumps pump jet sewer vacuum pump mobile sewerage pump compressor	local and outside
Electrical	motors for pumps control panels transformers solar systems cable	local and outside
Machines / Vehicles	water tanker O & M trucks Jetting truck Pick up Excavator	local and outside
Laboratory	for water testing for wastewater testing	local and outside
Other	diesel storage tanks safety equipment tools	local

TABLE 9: AVAILABILITY OF MATERIALS ON LOCAL MARKET

Each investment package contains the itemized materials, equipment and tools with important brief specifications as provided by the LC. Dimensions, pressure class and material type are mostly available for pipes and fittings. Pumps are classified by the operation point and power. For the generators the motor size and fuel requirements are given. The needed laboratory equipment is in general outlined in detail. For most of the items the specifications would be sufficiently described to procure the particular needed goods.

The **solar system** for the individual locations should be designed as complete and compact package: solar panel, pump, control system with electrical inverter. The system should operate automatically in combination with generators to switch to generator or public grid operation at cloudy weather or during the night if required. The use of batteries for energy storage should be avoided due to its extensive cost and short life time. Therefore the pumps must either supply directly to the customers or to water tanks and reservoirs. It is advised to obtain all required parameter for the design of the complete system and verify the efficiency and functionality of the requested components prior to procurement. An example of a complete solar system including submersible pumps and electric devices is presented in Appendix C.

6.4 Cost Estimation for Investment Measures

The cost estimates are based on the local market prices in Euro or US Dollar, either derived from the LCs or through other similar tendered projects. The estimates shall serve as a basis for investment budgeting. A contingency of 10 % has been added on all items to cover unforeseen investment needs. The investment package – works and

Reference	Investment Package LC /AU / Branch	1 Civil Works	2 Well rehabilitation	3 Pumping stations	4 Water networks	5 WWTP	→
Annex 1	Abyan LC	421,000	297,000	111,000	641,000	11,000	
Annex 2	Aden LC	10,947,000	608,000	713,000	1,657,000	1,866,000	
Annex 3	Amran LC	537,000	1,938,000	100,000	728,000	150,000	
Annex 4	Dhamar LC	30,000	96,000	100,000	2,935,000	24,000	
Annex 5	Mukalla LC	478,000	82,000	0	4,675,000	452,000	
Annex 6	Al Shehr Utility	514,000	282,000	0	2,310,000	64,000	
Annex 7	Hajjah LC	680,000	270,000	105,000	1,341,000	30,000	
Annex 8	Hajjah Branches	1,004,000	312,000	140,000	0	0	
Annex 9	Hudaydah LC	1,973,000	1,053,000	785,000	8,648,000	1,040,000	
Annex 10	Bait Al-Faqi Utility	306,000	123,000	0	287,000	0	
Annex 11	Mansouriah Utility	0	54,000	0	0	0	
Annex 12	Zabid Utility	108,000	257,000	0	2,346,000	266,000	
Annex 13	Bajil Utility	203,000	238,000	0	115,000	0	
Annex 14	Ibb LC	33,089,000	604,000	0	3,117,000	201,000	
Annex 15	Lahij LC	175,000	418,000	54,000	5,145,000	0	
Annex 16	Sa'ada LC	725,000	432,000	0	930,000	0	
Annex 17	Sana'a LC	7,482,000	3,046,000	76,000	2,633,000	2,173,000	
Annex 18	Taiz LC	1,249,000	2,584,000	1,882,000	5,889,000	5,722,000	
Annex 19	Turbah Branch	0	106,000	0	81,000	0	
Annex 20	Mukha Utility	50,000	46,000	0	211,000	0	
Total cost		**59,971,000**	**12,846,000**	**4,066,000**	**43,689,000**	**11,999,000**	

TABLE 10: INVESTMENT COST ACCORDING TO INVESTMENT PACKAGES (IN EUR)

materials as well as the prices – would have to be re-evaluated, further detailed and finalized by respective LC and donor organization or Consultant prior to procurement. Such is recommended also under the point of view, that until the procurement process commences, eventually the crisis may have caused further damage or parallel running donor programmes would have covered part of the proposed measures already.

The tables below summarize the investment needs for the 11 Investment Packages for each LC. With the procurement and implementation of the "Urgent" and "High" priority measures the LCs should experience considerable improvement in the water supply situation and sanitation service within one to two years. Pre-condition is the immediate implementation of measures after the procurement, either through the LC or through external contractors followed by operation and finally regular maintenance of the equipment.

	6	7	8	9	10	11	
	Sewer network	Generators	O&M materials	Vehicles, machines	Electric materials	Laboratory equipment	Total
	2,425,000	35,000	306,000	811,000	506,000	41,000	5,606,000
	6,562,000	2,294,000	8,696,000	5,825,000	5,148,000	439,000	44,755,000
	1,726,000	182,000	318,000	777,000	986,000	186,000	7,628,000
	6,638,000	173,000	297,000	318,000	1,543,000	223,000	12,377,000
	1,008,000	215,000	1,751,000	2,157,000	1,687,000	743,000	13,247,000
	0	127,000	231,000	179,000	828,000	6,000	4,540,000
	2,400,000	263,000	284,000	705,000	646,000	424,000	7,149,000
	0	479,000	376,000	230,000	739,000	0	3,279,000
	5,431,000	1,556,000	2,171,000	1,807,000	3,354,000	141,000	27,959,000
	1,112,000	252,000	476,000	470,000	593,000	204,000	3,822,000
	0	78,000	213,000	35,000	208,000	0	587,000
	1,292,000	287,000	855,000	360,000	1,059,000	204,000	7,033,000
	92,000	463,000	664,000	623,000	760,000	204,000	3,363,000
	1,080,000	533,000	1,595,000	960,000	656,000	113,000	41,947,000
	0	300,000	741,000	2,267,000	1,321,000	78,000	10,500,000
	0	169,000	312,000	981,000	771,000	236,000	4,557,000
	4,817,000	990,000	4,545,000	5,765,000	5,725,000	3,955,000	41,206,000
	1,281,000	1,488,000	1,575,000	5,825,000	2,818,000	556,000	30,867,000
	0	0	17,000	58,000	309,000	25,000	596,000
	0	70,000	70,000	125,000	342,000	229,000	1,143,000
	35,864,000	**9,954,000**	**25,493,000**	**30,278,000**	**29,999,000**	**8,007,000**	**272,161,000**

The following table summarizes the estimated cost in Euro according to the priority: Urgent, High Priority, Short-term, Long-term for each LC. It also presents the total cost per person within the service area, per customer and per house connection.

LC / AU / Branch	Urgent	High priority	Short-term	Long-term	Total	→
Abyan LC	573,000	3,870,000	893,000	270,000	5,606,000	
Aden LC	6,017,000	10,492,000	23,981,000	4,265,000	44,755,000	
Amran LC	3,014,000	1,269,000	2,959,000	386,000	7,628,000	
Dhamar LC	1,709,000	1,210,000	295,000	9,163,000	12,377,000	
Mukalla LC	6,372,000	5,601,000	247,000	1,027,000	13,247,000	
Al Shehr Utility	3,502,000	455,000	583,000	0	4,540,000	
Hajjah LC	1,442,000	1,288,000	929,000	3,490,000	7,149,000	
Hajjah Branches	235,000	1,052,000	603,000	1.389,000	3,279,000	
Hudaydah LC	5,798,000	8,103,000	13,084,000	974,000	27,959,000	
Bait Al-Faqi Utility	2,686,000	653,000	478,000	5,000	3,822,000	
Mansouriah Utility	483,000	104,000	0	0	587,000	
Zabid Utility	2,123,000	2,587,000	517,000	1,806,000	7,033,000	
Bajil Utility	1,830,000	586,000	677,000	270,000	3,363,000	
Ibb LC	4,511,000	2,479,000	225,000	34,734,000	41,949,000	
Lahij LC	7,582,000	2,590,000	328,000	0	10,500,000	
Sa'ada LC	1,382,000	1,952,000	58,000	1,165,000	4,557,000	
Sana'a LC	11,542,000	12,936,000	7,975,000	8,755,000	41,208,000	
Taiz LC	0	5,229,000	20,188,000	5,450,000	30,867,000	
Turbah Branch	60,000	536,000	0	0	596,000	
Mukha Utility	316,000	598,000	229,000	0	1,143,000	
Total cost	**61,177,000**	**63,590,000**	**74,249,000**	**73,149,000**	**272,165,000**	

TABLE 11: TOTAL PRIORITIZED COST ESTIMATION FOR INVESTMENT MEASURES

	Total Population	Seviced population (customers)	House connections	EUR / person	EUR / customs	EUR / HC
	108,406	86,429	12,347	52	65	454
	957,171	824,640	128,850	47	54	347
	74,610	37,305	5,085	102	204	1,500
	228,487	159,941	20,963	54	77	590
	351,427	320,428	48,403	38	41	274
	120,124	99,783	15,073	38	45	301
	77,602	76,582	8,147	92	93	878
	128,495			26		
	622,019	465,827	66,517	45	60	420
	65,143	57,116	8,787	59	67	435
	18,164	17,730	2,955	32	33	199
	41,173	37,837	5,821	171	186	1,208
	80,793	61,950	8,850	42	54	380
	349,298	280,349	28,607	120	150	1,466
	163,800	115,724	16,532	64	91	635
	79,029	28,350	4,050	58	161	1,125
	3,234,000	1,376,558	94,935	13	30	434
	654,330	251,118	52,124	47	123	592
	20,000	12,800	1,600	30	47	373
	33,000	26,494	2,817	35	43	406
	7,407,071	**4,336,961**	**532,463**	**37**	**63**	**511**

The total calculated investment amount for the improvement of the water and sanitation infrastructure of all LCs has been estimated to:

- → **Urgent measures:** **61.2 million EUR**
- → **High priority measures:** **3.6 million EUR**
- → **Short-term measures:** **74.2 million EUR**
- → **Long-term measures:** **73.1 million EUR**
- → **Total amount:** **272.2 million EUR**

The average investment cost per person would be 37 EUR, per connected person 63 EUR and per house connection 511 EUR. The lowest expenses per person is expected in Sana'a (13 EUR / person), having the highest population number. The highest expenses per person are expected in Zabid (171 EUR / person).

7 Implementation of Investment Measures

7.1 Considerations for Implementation

The proposed Investment Measures can be implemented individually and in parallel. In order to coordinate the emergency response measures, it is proposed to hold a conference with the participation of GIZ WSP and active donor organizations to discuss the results of DAS III and identify the intervention of each organization, agree on the implementation time frame and on proper implementation method and monitoring processes.

Prior to the procurement the below outlined aspects should be considered for each LC individually to guarantee a successful implementation.

Capacity of the LC: depending on the O & M capacity and the extent of work the LC may be able to implement small rehabilitation and restoration works themselves. Their attendance at training courses would enhance the skills and performance of the maintenance unit. Apart from the big investment projects, e.g. construction of reservoirs, network extensions, which are to be implemented by contractors, additional required support has to be identified and communicated by the LC. Skilled contractors or external experts for specialized itemized works may be needed, such as for:

- Installation of solar system;
- Well construction / rehabilitation;
- Installation of laboratory and chlorination equipment;
- Electro-mechanical repair and rehabilitation of equipment.

Ref.	Tasks	Tentative date: Duration	→
0.1	Conference and workshop for coordination of activities	2 months	
0.2	Agree on prioritized measures with LC / BoD	2 months	
1.1	Packaging and tendering of **urgent measures**	2 months	
1.2	Supply (direct procurement) and installation of materials and equipment	6 months	
1.3	Implementation of civil works contracts	6 – 12 months	
2.1	Packaging and tendering of **high-priority measures**	3 months	
2.2	Supply (direct procurement) and installation of materials and equipment / implementation of small restoration works	12 months	
2.3	Implementation of civil works contracts	1 – 2 years	
3.1	Packaging and tendering of **short-term measures**	3 months	
3.2	Supply (direct procurement) and installation of materials and equipment	1 – 3 years	
3.3	Implementation of civil works contracts	1 – 3 years	
4.1	Packaging and tendering of **long-term measures**	3 months	
4.2	Supply (direct procurement) and installation of materials and equipment	12 months	
4.3	Implementation of civil works contracts	3 – 5 years	

FIGURE 12: TENTATIVE IMPLEMENTATION SCHEDULE FOR INVESTMENT MEASURES

Supply, delivery and storage: for pure procurement contracts the supplier should deliver the materials and equipment to the respective LCs warehouse. Alternative locations must be provided by the respective LC in case of destroyed or badly damaged storage building. The amount of materials provided for rehabilitation of the water and sanitation system should not exceed the envisaged six month implementation period to avoid looting or damage of the new goods prior to installation. Before the delivery of goods the LC must carry out an inventory of the available materials and record all items in their inventory or stock management system.

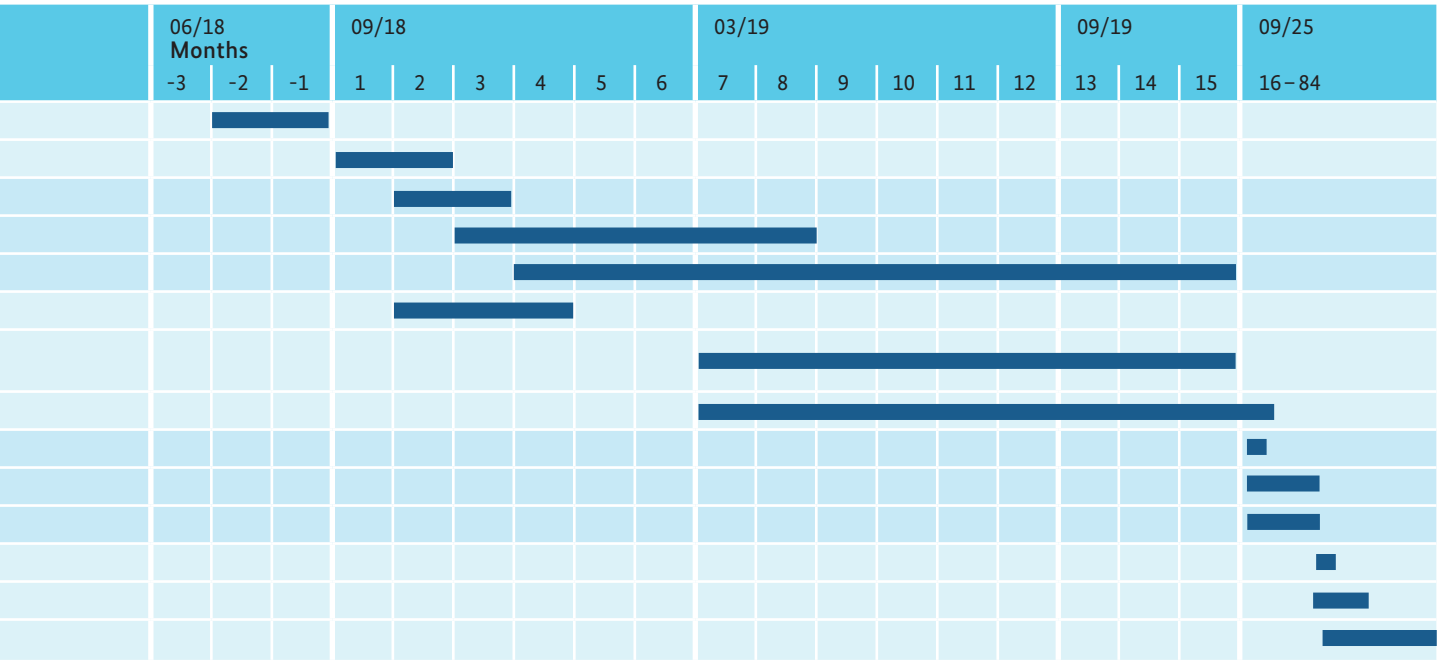
Procurement procedure: The procurement of materials and works are to be through Yemen procurement law. However, the procurement guidelines of the international funding organizations in addition to the Yemeni procurement law should be maintained where feasible. The tendering would be carried out in stages for the individual investment packages in accordance with its priority. During the conflict and if the standard procedures cannot be applied the procedures of the humanitarian organizations as outlined in the Strategy Report, Part 1, Chapter 2.4.2 may be adopted.

Security of works and equipment: Previous experience on implementation projects indicates that the security of the contractor, materials, equipment and works is required. This considers not only the critical current civil war situation but also the protection from the residents demanding support in the form of jobs or money.

The LC or contractor has to secure in particular the newly procured vehicles and machines. The warehouse with all equipment must be properly guarded. Therefore fencing of the respective site may be required besides the placement of security guards.

7.2 Tentative Implementation Schedule

The proposed 11 investment packages for each LC shall be implemented in parallel and in accordance with the priority. The anticipated duration for the implementation of the procurement and civil work contracts is presented in the tentative implementation schedule below would have to be adjusted for each LC individually according to the prevailing condition of the particular LC.



Appendix A: Content of Training Courses

Training course	General Objective	Main Topics
BOARD OF DIRECTORS		
Certified Board Member Program	Present a deep view of the main duties and functions of the members of Boards of Directors and the legal responsibilities and the role of the BOD in general, as well as the concept of corporate governance.	• Basics of Board of Directors – Introduction to Board of Directors and Corporate Governance. • Practical tools for strategic orientation and management control. • Role of BOD in disclosure and transparency. • Role of Board of Directors in safeguarding shareholder rights.
Corporate Governance Principles Program	Provide practical information to LAC members and stakeholders on the most important principles and concepts of corporate governance, increase the effectiveness of the role of the LAC in the control and effective strategic direction of the Utility.	• The importance of governance. • Forming an effective Board of Directors – roles and responsibilities. • Board members – composition and structure. • Disclosure of information and transparency. • Risk management and control environment. • Utility governance.
Board of Directors Secretary Program	• Practical exercise on the tools of developing the governance of the institutions and the role of secretaries. • Definition of governance and its establishment and principles. • Definition of the Board of Directors: categories, tasks and its committees composition. • Defining the role of the secretary, the daily tasks and those preceding and successing the meetings.	• Professional governance. • The basics of the secretary tasks and responsibilities. • Composition of the Board of Directors and succession planning. • Monitoring and evaluation of the Board of Directors performance. • Effective and dynamic board meetings. • Resposibilities and tasks of Board members. • Assessment and development strategy. • Continuous business risk planning. • Building ethical cultures. • Good corporate citizenship. • Integrated reporting. • Leadership change and its effects. • Institutional finance.
MANAGEMENT & HR		
Leadership skills	Developing the leadership skills and deepening the administrative and behavioral concepts of the participants to increase the capacity in taking and performing of their tasks and responsibilities.	Management and Leadership. • Leadership styles and management network. • Leadership and overall quality. • Creative thinking, problem-solving skills, support and decision-making methods. • Communication skills and negotiation and conflict management. • Change Management and Creative Leadership. • Build and manage the team works.

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Training course	General Objective	Main Topics
Strategic planning	Developing the capacity and skills of the participants in the field of strategic planning and follow-up implementation of the plans in order to formulate effective strategies to achieve the objectives of the organizations.	Strategic planning basics. • Analyzing the external environment of the organization and identifying opportunities and threats. • Analyzing the organization's own capabilities and identfying the strengths and weaknesses points. • Define the overall orientation strategy of the organization (Quadratic analysis, Network objectives and stakeholder expectations). • A guide to transform ideas into action plans. • How to analyze and evaluate the business portfolio of organization using SWAT ans PERT analisis. • Recovery map as a tool for project planning and follow-up. • Methodology of monitoring and evaluation of the programs.
Crisis management and emergency planning	Provide knowledge and skills needed to develop and implement crisis management systems and limitation of losses if they occur. Build crisis management teams, deal with a variety of crisis and disasters, and provide the participants with all planning strategies to prevent, manage and control crises and disasters.	Introduction and definition of risk management, its importance and the most important types of risks. • Risk management strategy, risk management process mechanisms, the overall framework of the risk management programs. • The concept , the classification and types of crisis. • Assess the reaction of the sudden and stagnant crisis. • People reactions to crises. • Preventive strategies. • The pre-crisis phase, the life cycle of a crisis, the stages of crisis management. • How to detect early warning signs of a crisis. • Assessing the attitude towards early detection of the crisis. • Crisis Communications Plans and communication tools. • How to establsh a Crisis management team and a management center. • Leadership skills for managers in case of crisis. • Design and implementation of emergency and crisis management plan.
Water supply, sanitation and hygiene according to Sphere standards	Introduce Sphere manual and guidelines releated to the minimum standards for humanitarian response to water supply, sanitation and hygiene to improve the capacity of LCs in dealing with humanitarian organizations in the crisis.	What is Sphere project? • Identify the Sphere Handbook as a disaster response tool and its contents. • The Humanitarian Charter. • Core Standards. • Protection Principles. • Minimum standards in water supply, sanitation and hygiene provisions (Hygiene, Water supply, Excreta disposal, Vector control, Solid waste management and Wastewater effluent management).
Stress management	Improve the knowledge of managers regarding the methods of dealing with the work stress and how to encounter the difficult problems and situations.	Managing and dealing with others as one of the reasons for working stress. • Work pressures: concept, sources and causes, effects on performance effectiveness. • Symptoms of stress, and integrated diagnosis. • Stress reflection on psychological and physical health. • Stress management skills as it causes a negative impact on performance. • Methods of coping with work pressures and managing difficult situations (authorization, empowerment, time management, innovation and creativity). • Diplomatical solutions in facing the non-stereotyped stress and disputes. • Priorities management. • Predicament and brainstorming skills in management.

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Training course	General Objective	Main Topics
Modern basis in the preparation of organizational structures and job descriptions	Provide a modern fundamental knowledge in preparation of effective organization structure and job description and specification.	Fundamentals of job design and identification of tasks and functional activities. • Fundamentals of organizational structure design. • Categories of management organization. • Scope and limits of delegation. • Determine the scope of supervision for organizational levels. • Centralization and decentralization of management organization. • Determine performance rates. • Fundamentals and justifications of structure reform. • The main principles of effective administrative organization. • Indicators of measuring the efficiency of management organization. • Job analysis and characterization. • Prepare job description. • Job evaluation.
Financial Management for non-financial managers	Provide a comprehensive understanding of the basic elements of financial management and applying relevant financial instruments in the water and sanitation sector.	Importance and objectives of finance management. • Importance of finance as management tool to provide information on planning and decision making processes. • Financial performance and financial data reports. • Cash controlling using information from financial data. • Calculating comprehensive set of finance ratios and its use to evaluate financial status of water utilities. • Use of equilibrium point analysis (profit threshold) and understanding deficiency of ratio analysis.
Training needs assessment and design and implement training plans	Develop the knowledge of training managers and human resource manager in the field of training and human resource development with the principles and standards specialized in applying the concepts of integrated training processes and following the quality standards and the accuracy of the objectives and the mechanism of implementing the training programs efficiently.	Internationally recognized methods for identifying training needs. • Methods of analysis and classification of data obtained from TNA. • Writing educational objectives (ILOs) that comply with the results of training needs analysis. • Assess the effectiveness of training for different levels using appropriate data collection methods and tools for each level of assessment. • Calculate the return on investment (ROI) of training programs by identifying costs and financial returns. • Methods of evaluating the training packages qutations and supported training services. • Conditions for evaluation and acceptance of scientific materials in training programs. • Identify weaknesses and strengths in the administrative process and ways of addressing them in the field of training. • Constrains to training and development within organizations and how to overcome them. • Prepare the training programs including the required training budgets and designing of training programs.

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Training course	General Objective	Main Topics
Institutional loyalty	Provide knowledge and skills to understand the concept of organizational loyalty and work ethic and its contribution to the success of the administrative process of the institution with different working conditions	The concept of institutional loyalty. • The concept of the institution and the rapid changes. • Characteristics of Government Services. • Principles of loyalty to work and work ethics. • Results of compliance with work ethic. • Performance monitoring and evaluation techniques. • Nature, exclusion, values and ethics of job provision. • Job satisfaction. • Indicators for maintaining organizational loyalty among employees. • Factors contributing to the development of organizational loyalty (policies, clear objectives, team work, improve the work environment inside the organization).
Business planning	Provide fundamendal knowledge in the preparation of business plans.	• Elements, objectives, and purposes of business planning. • Method and source of data and the required. • Measurements to establish infrastructure (wells, pumps, distribution networks, customer connections etc.). • Analysis of financial reports. • Forecasting future demand. • Analysis of bottlenecks to define required projects in order to improve or expand the service. • Finance tools and approaches (like net current value, break-even point, analyze possible projects).
Personnel administration & management of salaries & wages	Provide fundamental understanding of all aspects of administering and managing employees (personnel) including salaries, wages, compensations, and others.	Information sources of the Civil Services legislations and systems. • Employment system and staff categories. • Basic aspects of hiring, appointing, transferring, and terminating of personnel per categories. • Administrative discipline and handling cases of indiscipline. • Job records and its purposes. Organization of professional syndicates' procedures. • Procedures and review of salaries calculation process and implementing these procedures based on used formats.
Human Resources management	Provide a fundamental understanding of theories and basic concepts of human resources management and development.	Importance of human resource management as a vital management function. • Different activities of human resource management and development. • Defining basic elements of managing human resources. • How to connect human resource development and management with the strategy of the organization. • Steps of selection, appointing, and training of employees either from inside or outside the organization
Reports writing skills	Provide theoretical understanding and practical skills for report writing.	• Concepts of reports. • Specification of a good report. • Types of reports. • Structure a report professionally. • The stages of preparing the report. • Skill of reports presentation.

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Training course	General Objective	Main Topics
Training of trainers	Provide practical knowledge and skills to create the competency for carrying out training activities in order to facilitate the transfer of accumulated knowledge and work experience.	• Comprehend the principles of adult education and effective communication. • Command effective presentation skills. • Facing the audience. • Effective use of the training/teaching aids. • Avoiding common errors in training. • Effective communication, convincing and persuading the audience by utilizing all principles of adult education. • Visualization techniques to achieve the target.
TECHNICAL		
Water production (Basic Course)	Provide theoretical understanding and relevant practical skills in water production (wells, pumps, and motors).	• Clarify the components of the drinking water pump station (pumps, electro motors, and spare diesel generator). • Basic principles of operating the internal combustion engines, especially diesel motors. • Operating and controlling the water production system (either by electrical centrifugal pumps, or submersible pumps, and the network of pipes and valves), according to operation and maintenance procedures. • Observation of all meters/gauges and realizing the abnormal appearances in the system (water level, pressure, water flow, motor voltages, electrical current, lubrication level etc.). • Distinction between indicators for differential fall for tanks base and recognizing of differential indicators for tanks base fall. • Proper steps to maintain water supply with good quality. • Basic principles and special applications of installing house network.
Water production (Advanced)	Provide advanced understanding and practical skills related to the operation and maintenance of water production components.	• Pumps and pumping stations. • Technical standards of pumps including well pumps. • Choosing suitable types of pumps, and electro-mechanical systems of pumps. • Maintenance of pumps and ancillaries. • Operating and maintenance of electrical panels. • Operating and maintenance of transmission pipes. • Water reservoirs. • Water treatment and chlorination.
Water distribution networks (Basic)	Provide fundamental understanding of water distribution networks and their main components.	• Main components of distribution networks. • Valves and their maintenance. • Meters and their maintenance. • Networks, pipes and their maintenance. • Water losses and their causes. • Cleaning the networks.
Water distribution networks (Advanced)	Provide advanced understanding of water distribution networks and of correct and regular handling of main components of water distribution networks.	• Types of pipes and correct installation of house connections. • Water meters, their operation and repair. • Calculating required diameters of pipes. • Repair of different types of pipes. • Mechanical repair of valves. • Proper storage of pipes. • Storing, installing and fitting PVC pipes.

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Training course	General Objective	Main Topics
Wastewater collection systems	Provide proper understanding of wastewater characteristics, operation and maintenance of wastewater networks, pumping stations, and related components.	• Sources and characteristics of wastewater. • Studies required for designing wastewater networks. • Types and shapes of wastewater networks. • Materials of wastewater pipes. • Maintenance of wastewater network by natural gradient. • Cleaning wastewater networks. • General hazards in wastewater networks. • Safe and safety recommendations. • Pumping stations, pumps of networks and wastewater treatment plants.
Wastewater treatment method	Provide proper understanding of different technologies used for treating wastewater, methods and steps of safe sludge treatment and re-use of wastewater and sludge.	• Wastewater treatment. • Pretreatment. • Secondary (biological) treatment. • Sludge treatment. • Odour treatment. • Laboratory tests of wastewater. • Using treated wastewater in agriculture. • Using treated sludge in agriculture.
Maintenance and operation of wells, pumps , water reservoirs	Provide theoretical knowledge and practical skills related to the proper operation and maintenance of wells, pumps, and reservoirs.	• Standards of well design with emphasis on protection against pollution. • Types of water reservoirs. • General standards for drinking water reservoirs. • Short procedures of maintenance and repair of wells. • Technical standards of operating reservoirs. • Operation and maintenance of pumps used in wells. • Primary maintenance of water pumping from the wells.
Management of operation and maintenance of motors and pumps	Providing general theoretical understanding and practical skills related to operating and maintaining motors, pumps, circuits, controlling and protection equipment. duties required to operate, maintain, and repair pumps and motors.	• Basic concepts of electrical energy for pumps and motors used to provide water and used in waste water treatment facilities. • Major components and technical data of pumps and motors, control and protection of equipment. • Developing useful procedures to manage and monitor the operation and maintenance. • Using a guide or a mentor to repair faults and to understand the possible causes of pump failure. • Analysis of log book to identify potential and actual deficiencies.
Maintenance and repairs of water meters	Provide theoretical understanding of and practical skills in maintenance and repairs of water meters.	• The different components of water meters. • Common failures of water meters. • Methods of testing of water meters. • Comparison between electronic and magnetic water meters. • Preparation of technical specifications of water meters. • Maintenance and repair of water meters.

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Training course	General Objective	Main Topics
Operation and maintenance of diesel generators (diesel power stations)	Provide theoretical understanding of and practical, skills in operation and maintenance of diesel generating units.	• Theory of electrical generators (how electrical power is generated). • Basic operation theory and structure of diesel motors. • Occupational safety procedures at normal and emergency operation cases. • Preventative maintenance procedures and fault identification of generators. • Regular lubrication of systems and machines. • Fuel systems of diesel motors and their maintenance, repair, and replacement of defected parts. • Cooling systems and their correct maintenance.
Operation and maintenance of control panels	Provide theoretical understanding of practical skills in operation and maintenance of electrical control units.	• Safety. • System components. • Apparatus for dealing between machine and human. • Data transforming apparatus. • Data processing apparatus. • Power controlling instruments. • Electrical schemes. • Motors controlling circuits.
Safety in labs	Providing theoretical understanding and practical skills in the field of health and safety in laboratories.	• Concept of chemical safety, color codes, and safety signs. • Personal protection requirements in laboratories. • General protection and prevention in laboratories and facilities. • Different risks of fires and related firefighting. • Safe practices in laboratories, and identification of different methods of exposure to chemical materials. • Classification of dangerous chemicals, procedures of transporting, handling, and storing of chemicals. • Emergency procedures for handling the spelling or spreading of dangerous chemical material. • Procedure of safe disposal of dangerous chemicals, and laboratory disposals.
Quality control and quality assurance in chemical labs	Providing theoretical understanding and practical skills of quality control and for quality assurance.	• Understanding principles, fundamentals, and terms of quality. • Objectives, basic rules, components, and system of quality management inside laboratories. • Calculations related to measurements and different statistical concepts. • Quality assurance plan and programme inside the laboratory. • Measurements and tools of quality control and implementing measures of quality control and correction. • Standard operating procedures for analysis inside the laboratory. • Quality manual for laboratory. • Quality of analysis, confirmation of results, and effective analysis methods. • Quality of data, expression of results, and reporting.
Preparation of reagents and standard solutions	Provide theoretical understanding and practical skills in preparing standard reagents and solvents.	• Principles and fundamentals of work in chemical laboratories. • Correct handling of laboratory equipment and tools used in the preparation of solvents. • Chemical calculations related to preparing standard reagents and solvents, and different expressions of concentration. • Classification of materials and solvents and general rules of handling. • Standardization of volumetric glass tools. • Practical exercises for applying knowledge and skills.

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Training course	General Objective	Main Topics
Chlorination	Provide a proper understanding of the purpose of chlorination, factors affecting the chlorination process, dosage and safe handling of chlorine.	• Purpose of chlorination. • Chlorination curve demand and factors affecting the dosage of chlorine. • Field examination of chlorine sample. • Controlling the storage of chlorine powder and chlorine gas. • Control the dosage proportion of the chlorine. • Applying safety regulations and precautions. • Applying the emergency standard procedures of chlorine gas leak, to protect livings and assets.
Water and wastewater analysis	Provide theoretical understanding and practical skills on standard chemical, physical, and germinal testing methods of water and wastewater.	• Standard physical, chemical, and germinal analysis methods of water. • Standard physical, chemical, and germinal analysis methods of wastewater. • Modern equipment used for water and wastewater analysis like ionic chromatography, atomic adsorption, plasma exhortation, and gaseous chromatography. • Maximum limits of concentration of elements in drinking water and resulting hazards when concentrations exceed these limits. • Handling of laboratory equipment. • Most important methods of wastewater treatment. • Practical exercises for applying knowledge and skills.
Water chemistry and quality standards	Provide a general understanding of water chemistry, standards of drinking water quality and introducing analytical quality control in laboratories.	• Properties of water sample and its storage. • Steps of pre-analysis. • Using of equipment to test the drinking water, its composition and properties. • Physical standards. • Chemical standards. • Yemeni standards of drinking water. • Treatment methods.
First aid and fire fighting	Provide knowledge and skills to raise the efficiency of participants to deal with emergencies and fire professionally.	• First aid and concept – priorities of ambulance. • Ambulance objectives – ambulance methods (fractures, trauma, burns, wounds, gums, etc.). • Artificial respiration – Cardiopulmonary resuscitation. • Methods of evacuating the injured (fire chemistry, fire extinguishers, hand extinguishers). • Practical applications on hand extinguishers, hoses, etc.
Management of maintenance and occupational safety	Providing a general understanding of the importance of planned maintenance and of basic concepts of Occupational Safety and Health (OSH) for creating a safe working environment and preventing health hazards.	• Definition of planned maintenance of equipment. • Maintenance leads to cost reduction in operation and maintenance. • Check all factors related to the maintenance tasks, and introducing simple procedures to plan and monitor the maintenance tasks. • Importance of store services to support maintenance duties, and highlighting the major factors in stores management. • Listing the work hazards in the water and sanitation utilities and how to eliminate their impacts. • Legislations of occupational health and safety. • Preparing safety forms. • Using personal protection equipment. • Common OSH deficiencies in water utilities.

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Training course	General Objective	Main Topics
Safety requirements for work in confined areas	Developing the competencies of employees in confined spaces in accordance with the international standards NFPA and OSHA to carry out the work without risks.	• Confined spaces (definition / types). • Risks of confined spaces. • Access permits to confined spaces. • Investigate the environmental condition of the confined area. • Chemical and organic pollution devices measurement. • Ventilation of confined spaces. • The individual protection equipment is required for the work in the confined spaces. • Safety rules and prodecdures for working in confined spaces in accordance with OSH specifications.
Sampling	Providing theoretical knowledge and practical skills for technicians working in chemical and germinal laboratories on standard sampling.	• Standard methods of sampling according to the source of samples (wells, basins, springs, lakes etc.). • Standard methods of sampling according to required tests (chemical, germinal, heavy metals, organic pollutants, radioactive, or isotopic). • Types of suitable containers for sampling, standard methods for preservation of sample, and materials needed to preserve samples according to tests required. • Maximum period of preservation. • Tests to be taken in the field and forms of field testing. • Methods of calibrating field testing equipment and form filling. • Correct transportation of samples from the field to the laboratory. • List of necessary requirements before doing field sampling.
Ground water fundamentals	Provide relevant principles of ground water management with focus on maintenance and rehabilitation of wells.	• Reading constant water level and interpretation. • Identifying production problems and water level decrease, weak production of pumps and finding solutions. • Well monitoring, measuring water level and pumping level and retaining period and well depth and pump production. • Field testing including measurements of well data. • Well rehabilitation to preserve defined production limits.
Drawing and design – AutoCAD D3	AutoCAD Civil 3D software is a civil engineering design and documentation solution that supports Building Information Modeling workflows. Using AutoCAD Civil 3D, you can better understand project performance, maintain more consistent data and processes, and respond faster to change.	Setting up your survey database, field to finish workflow, creating automatic linework, creating TIN surfaces, adding surface labels, working with different data sources, boundary survey in civil 3D, drawing and labeling a boundary and effective tips and tricks.
Sewer network designs, Sewer CAD	Modeling software for design and analysis of sanitary sewers.	• Introduction to sewers network. • SewerCAD overview. • Design sanitary sewers. • Allocate and estimate sanitary loads. • Build and manage hydraulic models. • Simulate gravity and pressure hydraulics.
Water network designs by Water CAD	Use of water distribution hydraulic modelling. Design improvements such as the sizing and location of pipes, pumps, and tanks in order to meet water flow and drinking water requirements.	• WaterCAD overview. • Analyze pipe and valve critically. • Build and manage hydraulic models. • Design water distribution systems. • Develop flushing plans. • Identify water loss. • Manage energy use.

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Training course	General Objective	Main Topics
Design, installation and maintenance of solar electric power	Provide general theoretical understanding and practical skills in the design, installation and operation of solar cell systems and maintenance standards for proper selection of pumps, solar panels and site analysis procedures.	• The basics of solar energy and the principle of its work and the fundamentals of electricity and transformations of energy and the mechanism of turning the light into electricity. • Components of the solar system and their respective characteristics. • Design and installation of solar power systems (systems connected with power grid system components, site analysis, photovoltaic model standards, safety and start-up tests). • Design of solar electric power (systems isolated from power grid and hybrid systems and explain all components). • Problems of poor design, installation and maintenance of the solar system. • Criteria for the proper selection of pumps and solar panels and their number. • Analysis of the location and taking into account the factor of solar radiation and height and quantities of water during the installation of the solar pump. • Differentiation between different regions and the impact of climate change on the performance of the solar system.
Project management and planning using software (Prima Vera)	Understand the theory, tools techniques, and key success factor to succeed the project.	• Identify the prosess of the project. • Initiate /plan/ executes control and close such project. Identify project planning process including checklist, Kick-off meeting, work breakdown structure, network diagram with critical path.
Water leakage control	Provide a general understanding of the main factors of water leakage and leak detection tools.	• Six possible reasons for water leakage. • Core reasons for controlling water leakage. • Controlling technical losses. • Controlling methods of leaks. • Calculating leak ratio of areas as per control method used.
Rainwater harvesting	Present a deep view of The water cycle; advantages of rainwater; water quality consideration; how does a rainwater harvesting system work; how much water is needed; how much water can you collect; cost consideration.	• The water cycle. • Rainwater characteristics. • Measuring of rainwater quantity. • Design of rainwater harvesting system. • Cost estimation calculation.
Water conservation	Develop a water conservation program that provides targeted audience in LC services areas with information.	How to set conservation program and plans. Acquainting with devices and operational procedures to conserve the water consumption. What are the financial and administration measures required to conserve the water supply demand.
Appropriate wastewater treatment for agriculture use	Providing theoretical knowledge and practical skills for technicians and engineers, public health officers, wastewater treatments plants designers.	• Health aspects of wastewater reuse. • Agriculture aspects of wastewater reuse. • Appropriate waste water for agriculture reuse. • Issues in wastewater reuse. • Monitoring effluent for wastewater reuse. • Sludge suitability for agriculture reuse.
Wastewater treatment for small communities	Providing theoretical knowledge and practical skills for Sanitary engineers, public health officers, Wastewater treatments plants designers.	• Introduction to wastewater. • Facility development process. • Viability and assessment. • Regulatory requirements. • The consulting engineer. • Selection of wastewater technology. • Project financing. • Project commitment.

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Training course	General Objective	Main Topics
Low-cost sanitation	Providing theoretical knowledge and practical skills in low-cost sanitation for sanitary engineers, water supply personnel, public health officers.	• Disease infestations related to excreta. • Sanitation status in Yemen and related diseases. • An introduction to Low-cost sanitation. • Pit Latrines: design options, Components and construction. • Septic Tanks and Aqua Privies. • Using excreta and sludge. • Emptying the one-site sanitation unit. • Joint family latrines. • Communal latrines. • Increasing sanitation coverage and upgrading systems. • Social and institutional consideration. • Pre-project and Post- project surveys. • Sanitation selection and sequence.
FINANCE		
Planning and control of budgets	Provide general understanding of the importance of well planned and controlled budgets.	• Principles and procedures of budgeting. • Evaluation of financial performance and activities in Local Corporation / Branch. • Modern approaches of controlling the planned budgets. • Read, understand and analyses financial data and reports. • Cost recovery concept
Unified accounting system	Provide a theoretical understanding of the unified accounting system and its objectives and the general framework of the accounting guide and accounting process for accounts of assets, liabilities, uses and resources and preparation of final accounts.	• The concept of the unified accounting system and the general framework of the accounting guide. • Accounting process for assets and liabilities accounts. • Accounting process for expenses and financial resource. • The documentary cycle of the unfied accounting system. • Prepare the final financial report in accordance with the unified accounting system. • The concept of the governoment and accompanying coding accounts.
Cost accounting	Provide essential knowledge and skills for efficient cost accounting procedures.	• Principles for efficient cost accounting. • Objectives of cost accounting systems. • Relation of cost accounting to overall financial accounting. • Classification of cost components or elements. • Preparing cost lists. • Principles of attributing indirect costs to cost centers. • Accounting and financial cycle for cost accounting system under unified accounting system. • Basic pillars of the internal monitoring system. • Executive procedures needed to achieve audit properties.
Store management and accounting	Provide essential understanding of proper procedures for the management of stores and related accounting.	• Store function and store accounts (important and objectives). • Improving the relation with other departments through quality management. • Store organization. • Store computer application. • Store monitoring. • Store inventory and evaluation.

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Training course	General Objective	Main Topics
Internal Auditing Guidelines Implementation	Provide knowledge and skills in controling and auditing process according to the national and international standards of auditing in order to enable them to perform the audit work efficiently.	• Introduce the concept and importance of auditing and controlling. • The theoretical vision of the auditing science. • International standards for auditing and controlling. • The internal auding and controlling process and procedures including planning and implementation. • Required skills of auditor. • Modern methods of auditing and controlling. • The factors of success auditing process. • Prepare internal auditing and controlling reports. • Implement and monitor the warehouse inventory.
Procurement and store management	Provide good understanding of efficient management of stores and procurement and develop necessary administrative and financial skills.	• Developing administration and financial awareness of purchasing and stores management and stores control. • Developing abilities of administration and finance leaderships related to purchasing and stores management, store auditing, tendering, and contracting under normal or electronic procedures. • Encouraging researches and reports on purchase management and accounting, storing, store auditing, tendering, contracting, guarantee letters and related human and finance factors. • Importance and concepts of efficient purchasing and store management. • Auditing on stores and procurement. • Identification of storing and auditing goals. • Recognizing storing problems, their classification, and finding solutions. • Building balanced relation between purchasing management, stores, and other departments within the Local Corporation. • Preparing and deciding purchase budgets based on estimated budgets and purchasing according to budget lines. • Tender procedures, actual tendering, contracting, according to new Yemeni laws. • Importance of utilizing modern technology in purchasing and stores auditing (electronic commerce). • International and regional electronic commerce legislations.

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Training course	General Objective	Main Topics
CUSTOMER RELATIONS AND SERVICES		
Water meter reading	Provide general understanding of the importance of water meter reading and water consumption and scientific skills for correct and efficient meter reading.	• Purpose and role of customer water meter reading. • Planning of customer meter reading. • Procedures of customer meter reading. • Handling customer complaints. • Smooth and effective cooperation between meter readers and billing section.
Collection the recievable amounts	Provide the participants with the most effective skills to increase their capacity and efficiency to increase revenue collection from those customers are not paying their bills for long time of each categories.	• The basics of collection, the features of the professional debt collector and the most important functions of his job; when and how to follow up with customers; the use of smart questions and purpose to identify the real reasons for non-paying. • Follow-up process and gradual escalation, motivation and provided incentives for non-paying customers. • Collection skills (telephone / field / recovery and acquisition), negotiation and persuasion skills to increase collection; alternative solutions for full collection; how to maintain your customers and improve your relationship with them. • Develop communication skills and overcome the fear of dialogue with the client and respond to their complaines. • The art of dealing with and understanding the personal and behavioral patterns of different types of customers and how they deal with each type of them; how to categorize the customer to sub categories. • The prevailing Laws and regulations related to the collection of governoment debts and customer rights, standards and professional controls for collectors. • How to divide the collection site campaigns and scheduling it to increase effectiveness.
Tariff Structure design	Provide general understanding of the concept of tariff and the factors affecting its evaluation.	Tariff concept: • Factors affecting tariff design. • Problems applying the new tariff. • Legal considerations when designing a tariff. Tariff design steps: • Tariff design stages. • Estimate the costs to be recovered. • Design of tariff alternatives.
Billing system applications	To understand the correct procedures to deal with this software as well as the types of output reports and how to benefit from it.	System operation stages, input and data processing screens, system management screens, input control reports, statistical reports, recommendations and suggestions.
Customer Relations Management	Provide basic theoretical knowledge, practical skills, administrative techniques, and related attitudes necessary for good customer relations.	• Water supply and wastewater collection as customer oriented services. • The basic marketing concepts and the role of customer relations in monopolistic conditions. • Basic Concepts of the customer behavior. • Principles of effective communication (Concepts & Skills). • The customer styles & personality and methods of dealings with them. • Skills of dealing with customer complaints & conflicts. • Customer surveys.

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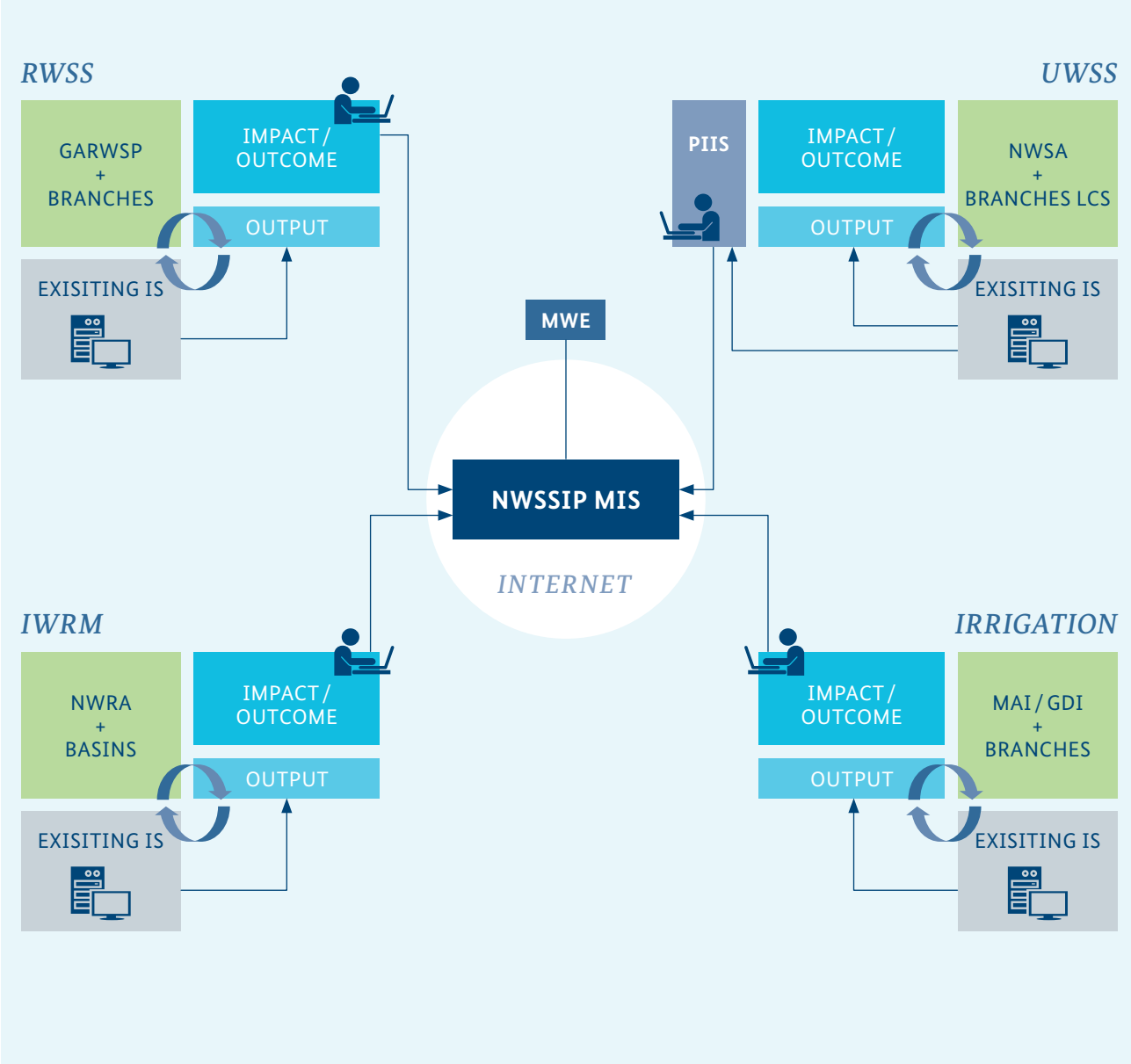
Training course	General Objective	Main Topics
Design of Awareness Plans & Campaigns	Improve present skills in Design of awareness plans & campaigns.	• Identification of tools, types and properties of media. • News preparation, legal aspects, WUA administration. • Program identification and producing. • Media benefits. • Participation community.
IT		
Oracle SQL	Provide basic theoretical knowledge, practical skills on Sequential Query Lanuage (SQL) for simple dealing with database records.	Basic synatx and rolls of Database query lanuage used by most databases (oracle, sqlserver etc.) to select ,update, insert or delete data records and create,modify or droped tables of data.
Oracle PLSQL	Provide basic theoretical knowledge, practical skillsof programming language by using SQL.	Syntax and rolls of designing programs (functions, procedures, backages, triggers) by using SQL.
GIS ArcMap	Provide basic theoretical knowledge, practical skills to using GIS ArcMap.	The concepts of treatment the satellite imagery, refleting and projection the water and santition network using GIS ArcMap and the connection with customers databases.
Training on Performance information indicator system (PIIS)	Allows the possibility of monitoring and evaluating the performance indicators of the LC and improving its conditions.	• Explain indicators (concepts, types, how to calculate them, baseline data, sources). • Explanation of the uses of the basic parts of the indicators program, reportind and import and export the reports to the Ministry.
Windows Server 2012 Setup, Configuration and Server Administration	Provide basic theoretical knowledge, practical skills to setup windows severs which serve the IT network.	Windows 2012 or 2016 server installation steps (setup server, domain, DHCP, Network, Administrations).
ICT Disaster recovery planning	To prepare scientific ICT Disaster recovery plans.	Compare several options and select the most appropriate practical option.
Cloud management and Security: principles and best practice	Understand cloud strengths and misconceptions, and discuss its benefits and weaknesses.	Cloud overview, management, establishing trust in clouds, identity and access management, provenance in clouds.
Training on network maintenance and maintenance of computers	The IT staff is able to maintain network and PCs to achieve the LC save money and time.	PC software maintenance, hardware maintenance, computers network building and maintenance.

Appendix B: Management Information System

SETUP OF THE MIS AT MWE AND THE SUB-SECTORS WITH SPLIT LEVELS[18]



18 Source: Combined Mission Report, Monitoring and Evaluation of the NWSSIP Update – Organizational Setup & Management Information System, by denkmodell (2010), commissioned by GIZ.

Estimated cost for supply and installation of a Management Information System (MIS) at MWE

1. Program design

Expert	Unit	Input	Unit rate	Total amount
Team Leader	mm	2.5	15,000	37,500
International IT programmer Expert	mm	1	15,000	15,000
Local IT programmer Expert	mm	4	5,000	20,000
Local IT network Expert	mm	1	3,500	3,500
International Data analysit Expert	mm	2	8,500	17,000
Web site designer	mm	1	6,500	6,500
Local Water and Sanitation Expert	mm	1	3,000	3,000
Local Hydrugoligst Expert	mm	1	3,000	3,000
Local Irregation Expert	mm	1	3,000	3,000
Data input spcialist	mm	6	2,500	15,000
Other Expenses	mm	6	2,500	15,000
Total				**138,500**

2. Development & Implementation

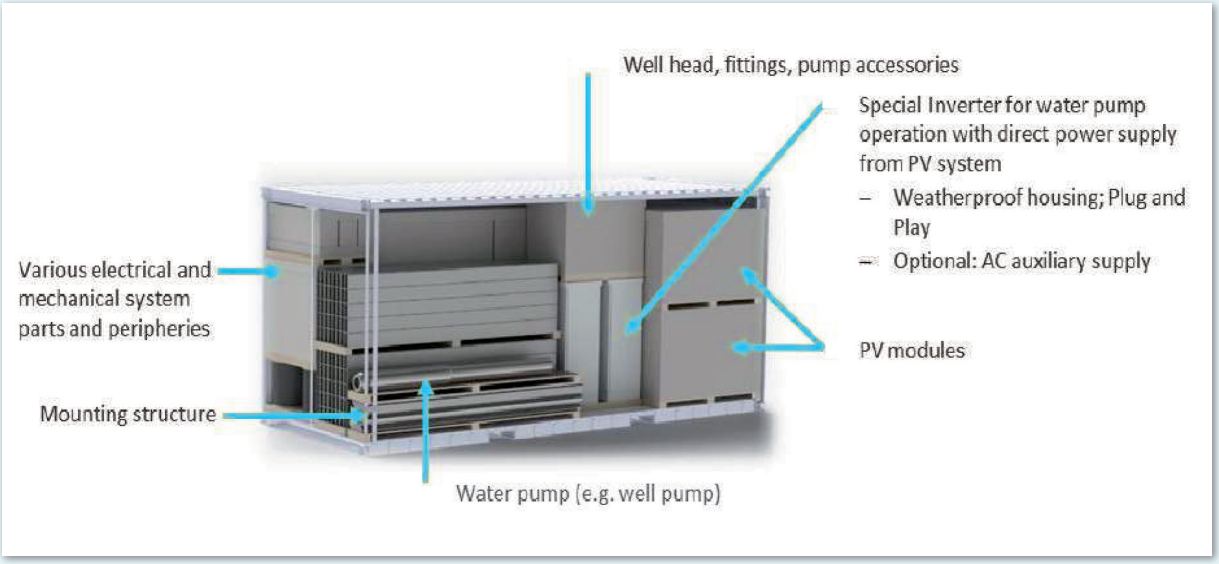
Supply and Install Equipment and software

Description	Unit	Input	Unit rate	Total amount
MIS Software	No	1	75,000	75,000
Other connection application	No	3	12,000	36,000
Core server at MWE	No	1	17,000	17,000
Severs at the Headquarter of Each subsector	No	4	8,000	32,000
Desk Top at the Headquarter of Each subsector	No	15	1,200	18,000
Lap Top at the Headquarter of Each subsector	No	15	2,200	33,000
Printers	No	5	270	1,350
Wire and wireless network Connection	lump sum	1	15,000	15,000
Web site rent	mm	12	1,500	18,000
Connect to Existing PIIS and other MIS system in the four subsector	lump sum	1	12,000	12,000
Office equipment	lump sum	1	15,000	15,000
Training the staff of MWE and subsectors	lump sum	1	15,000	15,000
Total				**287,350**

Appendix C: Layout of Solar System Components

PLUG & PLAY CONTAINER SOLUTION[19]

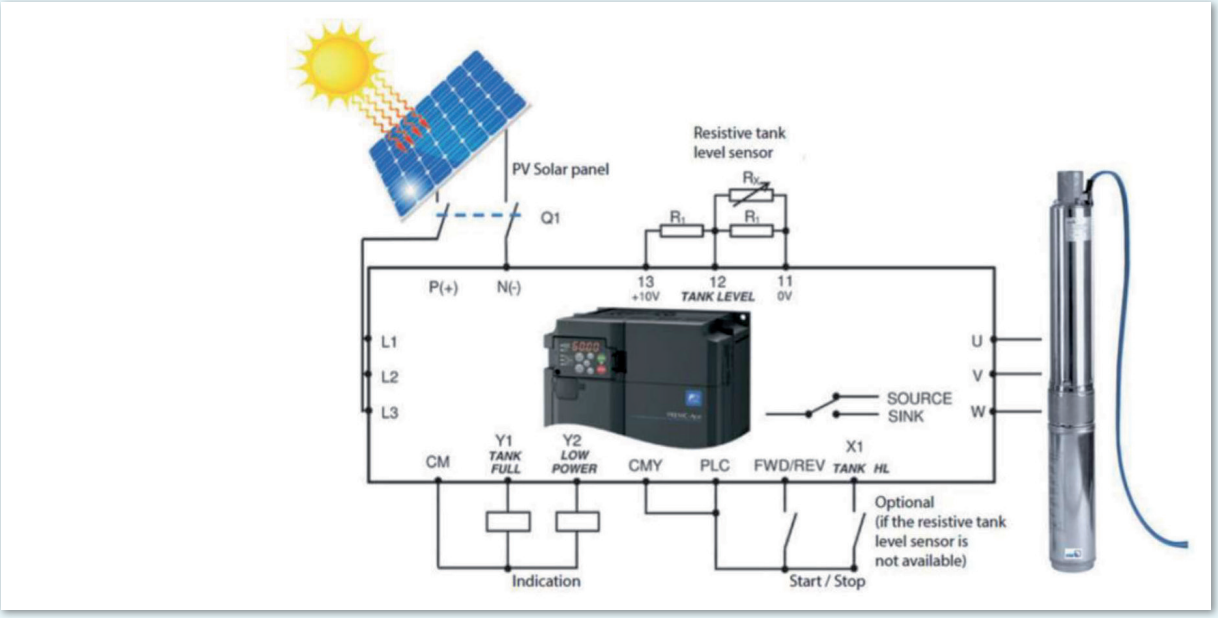
- → DESIGNED TO A LOGISTIC CONCEPT IN STANDARD CONTAINERS.
- → THE CONTAINER IS CUSTOMIZED TO BE INSTALLED AS **CONTROL / STORAGE ROOM** (OPTIONAL).
- → THE SYSTEM IS SCALABLE BY ADDING FURTHER SHIPPING CONTAINERS **(FOR LARGE-SCALE PROJECTS > 60 KWP PV)**.
- → **PLUG & PLAY**



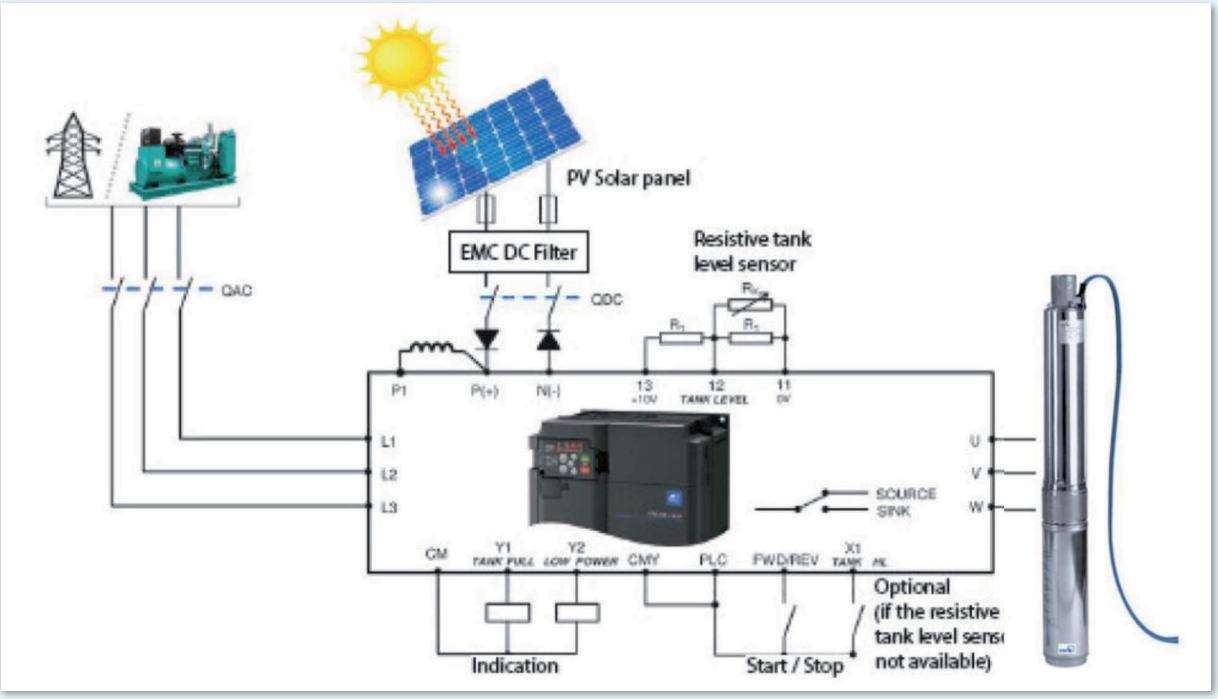
19 Source: VISPIRON GmbH

SYSTEM CONFIGURATIONS – EXAMPLES[20]

→ **OFF GRID SOLAR PUMP SYSTEM** WITH ISOLATED SOLAR PHOTOVOLTAIC POWER PLANT

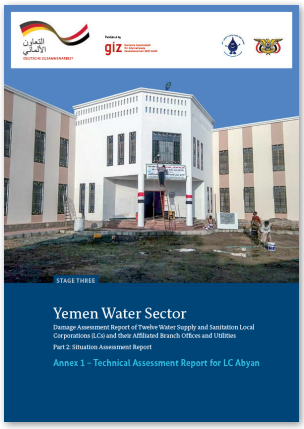


→ **SOLAR PUMP SYSTEM – HYBRID** (GRID OR DIESEL GENERATOR)

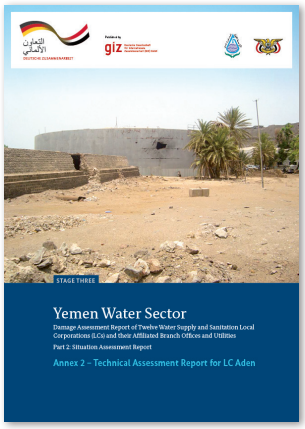


20 Source: VISPIRON GmbH

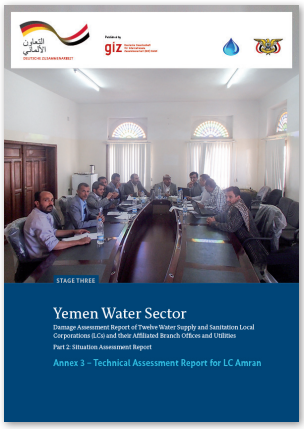
Annexes – separate volumes



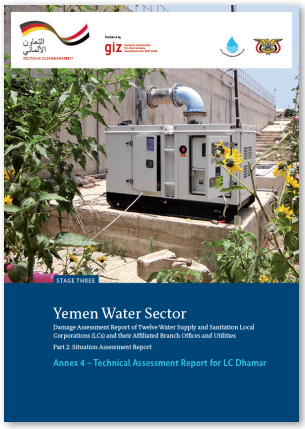
Annex 1: Technical Assessment Report for LC Abyan



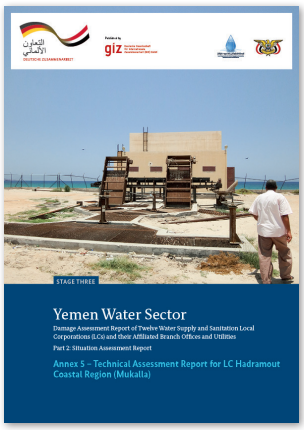
Annex 2: Technical Assessment Report for LC Aden



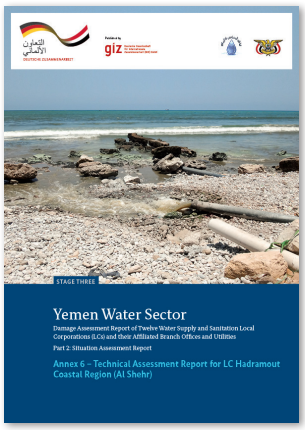
Annex 3: Technical Assessment Report for LC Amran



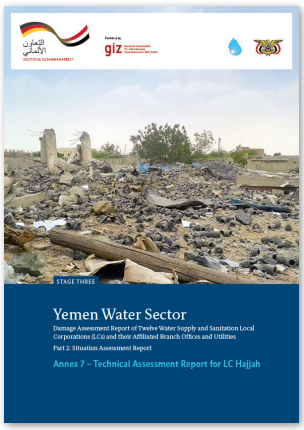
Annex 4: Technical Assessment Report for LC Dhamar



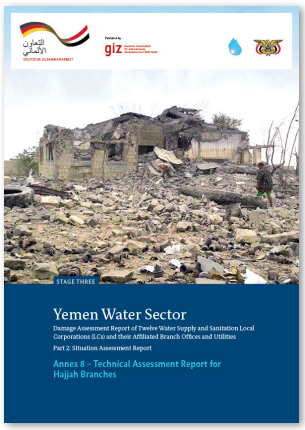
Annex 5: Technical Assessment Report for LC Hadramout – Mukalla



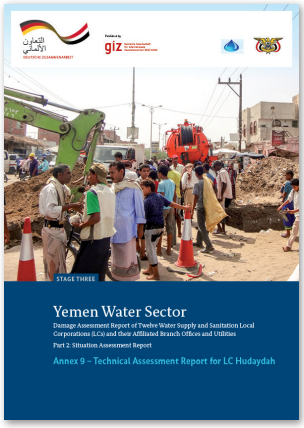
Annex 6: Technical Assessment Report for LC Hadramout – Al Shehr



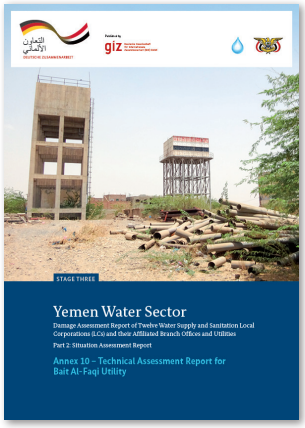
Annex 7: Technical Assessment Report for LC Hajjah



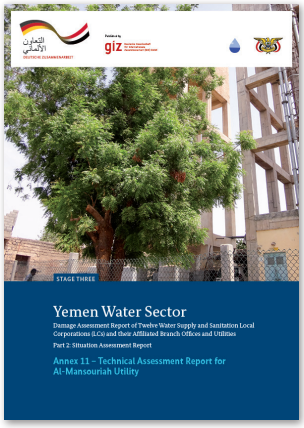
Annex 8: Technical Assessment Report for Hajjah Branches



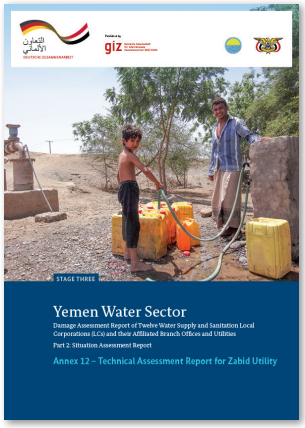
Annex 9: Technical Assessment Report for LC Hudaydah



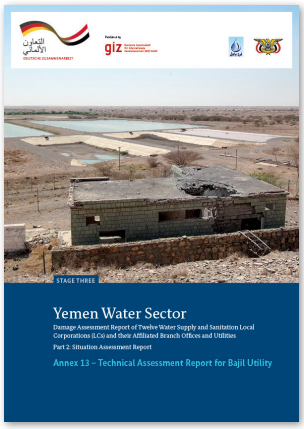
Annex 10: Technical Assessment Report for Bait Al-Faqi Utility



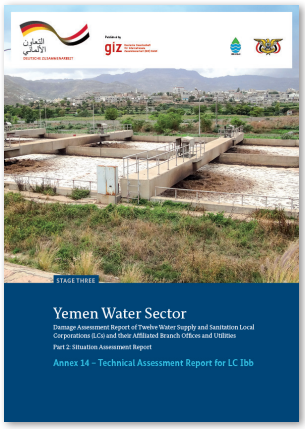
Annex 11: Technical Assessment Report for Al-Mansouriah Utility



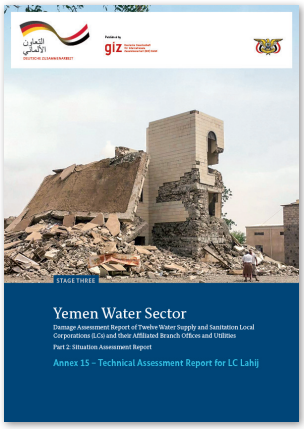
Annex 12: Technical Assessment Report for Zabid Utility



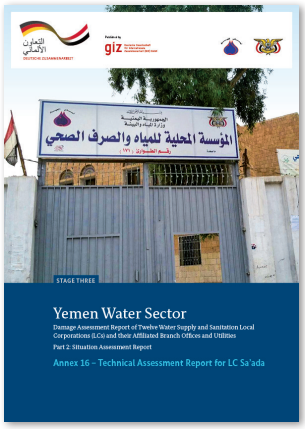
Annex 13: Technical Assessment Report for Bajil Utility



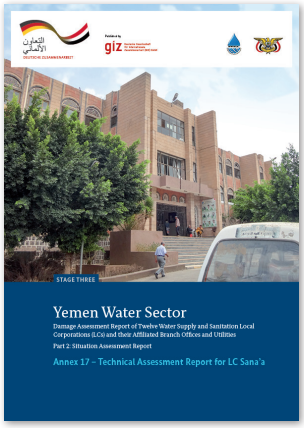
Annex 14: Technical Assessment Report for LC Ibb



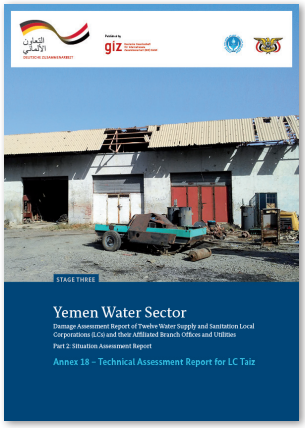
Annex 15: Technical Assessment Report for LC Lahij



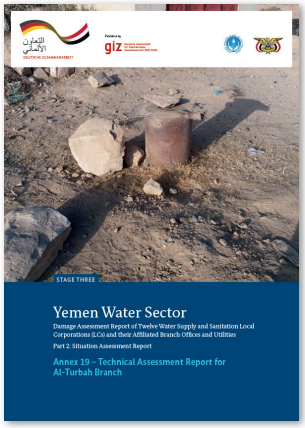
Annex 16: Technical Assessment Report for LC Sa'ada



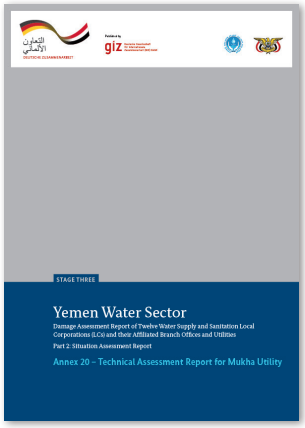
Annex 17: Technical Assessment Report for LC Sana'a



Annex 18: Technical Assessment Report for LC Taiz



Annex 19: Technical Assessment Report for Al-Turbah Branch



Annex 20: Technical Assessment Report for Mukha Utility

Notes

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and Development