Arab Republic of Egypt

Holding Company for Water and Wastewater (HCWW), Egypt

Improved Water and Wastewater Services Programme

IWSP 2 - Egypt

Consulting Services for the Programme Management Consultant (PMC)

PROJECT ID:

BMZ no. 2010 70 010

Strategic Environmental and Social Assessment Report

February 2019

CES
Consulting Engineers
Salzgitter GmbH

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EMPLOYER:

HOLDING COMPANY FOR WATER AND WASTEWATER (HCWW)
CAIRO, EGYPT

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Salzgitter GmbH

DOCUMENT TITLE: **STRATEGIC ENVIRONMENTAL AND SOCIAL ASSESSMENT REPORT**

VERSION 02

RECORDS OF REVISION

VERSION NO.	DATED:	DESCRIPTION / PURPOSE OF ISSUE:	PREPARED BY:	EDITED BY:	APPROVED BY:
01	**13/01/2019**	**STRATEGIC ENVIRONMENTAL AND SOCIAL ASSESSMENT REPORT**	**PÖR/SEA**	**GAC**	**ESE**
02	**18/02/2019**	**STRATEGIC ENVIRONMENTAL AND SOCIAL ASSESSMENT REPORT**	**PÖR/SEA**	**GAC**	**ESE**

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LIST OF ABBREVIATIONS

AC	Affiliated Company
AfD	Agence Française de Développement
AS	Activated Sludge
BAT	Best Available Techniques
BOD	Biochemical Oxygen Demand
BST	Best Suitable Techniques
°C	Degrees Centigrade
BOD_5	5-days BOD (standard measurement)
CAPMAS	Central Agency from Public Mobilization and Statistics
CAPWO	Cairo and Alexandria Potable Water and Wastewater Organization
CC	Climate Change
CCIA	Climate Change Impact Assessment
CDM	Clean Development Mechanism
CH_4	Methane
CO	Carbon Monoxide
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
COD	Chemical Oxygen Demand
CoRI	Coastal Research Institute
CHP	Combined Heat and Power
CSI	Climate Smart Investment(s)
DNA-CDM	Designed National Authority for Clean Development Mechanism
DO	Dissolved Oxygen
ds	dry solids
EC	European Commission
ECP	Egyptian Code of Practice
EEAA	Egyptian Environmental Affairs Agency
EIA	Environmental Impact Assessment
EIB	European Investment Bank
EDP	European Development Partners
EMP	Environmental Management Plan
ESIAF	Environmental and Social Impact Assessment Framework
EU	European Union
EWRA	Egyptian Water Regulatory Agency
FAO	Food and Agriculture Organisation of the United Nations
fd	Feddan (1 fd = 4200.883 m^2)
Fe	Iron
FEI	Federation of the Egyptian Industry
GDP	Gross Domestic Product

GEAP	Governorate Environmental Action Plan
GEF	Global Environmental Facility
GHG	Greenhouse Gases
GIS	Geographic Information System
HAA	Haloacetic Acids
HFC	Hydrofluorocarbons
HCWW	Holding Company for Water and Wastewater
IFC	International Finance Corporation
IFI	International Funding Institution
IIIMP	Integrated Irrigation Improvement and Management Project
ILO	International Labour Organisation
INC	Initial National Communication (on Climate Change)
IPCC	Intergovernmental Panel on Climate Change
ISSIP	Integrated Sanitation and Sewerage Infrastructure Project
IWRM	Integrated Water Resource Management
IWSP	Improved Water and Wastewater Services Program
KfW	Kreditanstalt für Wiederaufbau
kWh	Kilowatt Hour
l/c/d	litre per capita per day
MALR	Ministry of Agriculture and Land Reclamation
MHUUC	Ministry of Housing, Utilities and Urban Communities
MJ	Mega Joules
Mm^3	Million cubic meters
Mn	Manganese
Mt	Metric tons
MOP	Manual of Procedures
MOHP	Ministry of Health and Population
MOHUUD	Ministry of Housing, Utilities and Urban Development
MSEA	Ministry of State for Environmental Affairs
MWRI	Ministry of Water Resources and Irrigation
N	Nitrogen
NEAP	National Environmental Action Plan
NGO	Non-governmental Organization
NH_3	Ammonia
N_2O	Nitrous Oxide
NOPWASD	National Organization for Potable Water and Sanitary Drainage
NOx	Nitrogen Oxides
NIMBY	Not in my backyard
NRW	Non-revenue water
NWRC	National Water Resources Center
NWRP	National Water Resources Plan

O&G	Oil & Grease
QC	Quality Control
O&M	Operation and maintenance
P	Phosphorous
PCBs	Poly-Chlorinated Biphenyl
PFC	Perfluorocarbons
PIR	Project Identification Report
PIU	Programme Implementation Unit
PLCs	Programmable logic controller
PMU	Project Management Unit
PM_{10}	Particulate Matter of 10 microns size
PMC	Programme Management Consultant
PPE	Personal Protective Equipment
PPS	Planning Policy Statement
PS	Pumping Station
R&M	Repair and Maintenance
SAR	Sodium Absorption Ratio
SEA	Strategic Environmental Assessment
SESIA	Strategic Environmental and Social Impact Assessment
SECO	Swiss State Secretariat for Economic Affairs
SF	Sulfur Fluoride
SNAP	Support for National Action Plan
SOP	Standard Operating Procedure
SSC	Sanitation Service Cluster
TA	Technical Assistance
TDS	total dissolved solids
TF	Trickling Filters
THM	Trihalomethane
ToR	Terms of Reference
TSE	Treated sewage effluent
TSP	Total Suspended Particles
TSS	total suspended solids
UN	United Nations
USAID	United States Agency for International Development
USD	United States Dollars
WTP	Water Treatment Plant
WUA	Water User Association
WW	Wastewater
WWTP	Wastewater Treatment Plant
Zn	Zinc

EXECUTIVE SUMMARY

Improved Water and Wastewater Services Programme 2 (IWSP 2) is an investment programme which aims to implement infrastructure improvement projects in the water and wastewater sector of four governorates (Qena, Sohag, Assiut and Minya) in Upper Egypt. The HCWW, the programme executing agency, is supported by the Programme Management Consultant (PMC) whose services include project management activities and the preparation of the lists of investment projects for each of the four Governorates. The latter task was concluded prior to the submission of the present report and the projects which will be implemented within the programme will be selected according to the list prepared by the PMC.

In accordance with the requirements of the Terms of Reference, the PMC hereby submits this report entitled Strategic Environmental and Social Impact Assessment (SESIA) Report. SESIA is an important instrument for sustainable development in public planning and policy making and the particular form of SESIA being introduced by the European Union requires the undertaking of Strategic Environmental Assessment on the projects recommended for implementation. EIAs (whether ESIAs are required is to be decided by HCWW and EDPs) will be prepared for singular projects during later planning stages (Detailed Design stage). As a SESIA describes plans and programmes on a higher planning level, impacts are discussed in a more general way in this report. Thus, detailed information on the size and capacities of the singular projects of the project list are not required. The main purpose of the report is to assess whether any of the selected projects is under risk of not being implemented or being delayed or not fulfilling the criteria of sustainability due to environmental and/or social aspects, providing the implementing Institution and the different Financiers sufficient information in this regard.

During the before mentioned selection of the investment projects a pre-screening of projects especially in regard to social aspects has already taken place. In this context, projects for which the executing agency could not provide the proof of land availability were excluded from further considerations, This led to the fact that many social conflicts and risks that could have been faced during the implementation such as resettlement, compensation for private properties agricultural use of proposed land etc. could be avoided prior to the Strategic Environmental and Social Impact Assessment. In addition, the target area consists of quite homogenous social structures without significant conflicts between ethnic or religious groups so that the expected overall social risks for the programme can be classified as low. Due to established eligibility and exclusion criteria within the project identification phase social impacts are already significantly reduced. For this reason the presented report attaches more weight to risks, effects and impacts related to environmental aspects and follows more the structure of a SEA rather than SESIA.

Neverthless expected social impacts are still dicussed in the report. Although the programme is not under a significant risk from a social point of view, the projects will have effects on the society not only after their completion but especially during implementation. However, most of the impacts and risks can be managed by project specific Environmental and Social Management Plans which will be prepared during the detailed design of the projects (within EIAs at project level). The most significant

social impact expected during implementation is related to public safety which shall not be affected by the construction sites which will be located in densely populated residential areas in various cases (mainly the construction of sewer networks). Therfore this topic is highlighted in this report and lessons learned from IWSP 1 which has a very similar setup and extent are presented together with recommendations for improvement in IWSP 2.

The presented SESIA contains the required information about identified impacts and risks as well as associated mitigation measures and recommendations for management which all together serve as guidelines for the development of sub-project/site-specific Environmental Management Plans (ESMPs) and Environmental Impact Assessments (EIAs). The expected risks for each individual project have been evaluated and addressed in the report. The projects have been classified into categories which are decisive for the required forms and efforts in related EIAs.

IWSP 2 Background and Objectives

IWSP 2 includes the following components:

- Rehabilitation / reconstruction of existing WWTPs;
- Construction of new wastewater treatment plants (WWTPs) and regional sewer networks (sanitation service clusters, SSC);
- Extension of existing sewer networks increasing the capacity utilisation ratio of the existing WWTPs;
- Reconstruction of existing and non-operational/life expired water treatment plants (WTPs);
- Rehabilitation of the primary and distribution water networks, including metering and house connections;
- Consulting services for capital investment, programme management, preliminary and detailed design and construction supervision.

Significant negative social impacts (such as resettlements) within IWSP 2 projects are already avoided through introduction of eligibility criteria and exclusion criteria during the project identification process. For instance, land availability had to be ensured by the AC‘s. Thus, if no land was available for the proposed measure the related project has been excluded from the project list. The availability of land was either confirmed by the presentation of a land decree or by a written statement of the AC confirming that land transfer is agreed by the governor. New construction of WTP’s is not foreseen within the programme. The only new WWTP that is foreseen will be built outside residential areas. No potential conflicts between any society groups were identified.

References are done in this report to a Strategical Environmental Assessment whenever environmental aspects are discussed. However, social aspects have been also considered and assessed.

The report describes the stages of the strategical assessement process including the roles and responsibilities of involved stakeholders. Social and Environmental Impacts are identified in the

preparation of the report and mitigation and monitoring activities along with implementing arrangements are defined.

The strategic environmental and social assessment for IWSP 2 follows the same approach as for IWSP 1 in which all proposed projects received approval from EEAA in line with prepared EIAs. The projects are being successfully implemented so far without any risks concerning environmental or social aspects.

PURPOSE OF THE STRATEGIC ASSESSMENT

The strategic assessment is a systematic process for evaluating the environmental and social consequences of proposed policies, plans or programme initiatives in order to ensure that they are fully included and appropriately addressed at the earliest stage of decision-making on par with economic and social considerations.

This strengthens and streamlines the subsequent EIA (or ESIA) process by early identification of potential impacts and cumulative effects, addresses strategic issues related to justification and location of proposals, and reduces the time and effort necessary to assess individual projects.

A key requirement for IWSP 2 is the preparation of a SESIA with the objectives of:

- Assessing the likely effects of IWSP 2 on the environment;
- Assessing the likely social effects of IWSP 2
- Recommending measures to reduce, prevent or offset any identified significant adverse effects during planning, implementation, and/or operation;
- Indicating which specific Environmental Impact Assessments (EIAs) would have to be undertaken; this will be particularly important when new facilities are planned whereas rehabilitation measures undertaken are unlikely to have adverse environmental or social effects.

The presented report summarises the relevant aspects of strategic environmental, social and climate change assessment. The recommendations include not only measures for the programme or the integrated projects but also strategic recommendations for the organisational strengthening of HCWW and the ACs in the target governorates. This should also include the operational and management requirements to meet the environmental objectives of IWSP 2.

A more detailed assessment of specific environmental effects of individual projects is only possible with detailed local data and the defined spatial frame of impact. This is part of the detailed project planning, licensing procedure and project-specific EIA (where this is determined to be necessary). The latter requires the preparation of an Environmental and Social Management Plan (ESMP) to describe the measures for prevention, mitigation or improvement of environmental and social impacts. The report identifies those IWSP 2 projects that will require an EIA and gives recommendations for the EIA process in accordance with EEAA guidelines and the regulatory framework for EIAs in Egypt.

Monitoring allows the actual significant environmental effects of implementing IWSP 2 to be tested against those that are predicted by the SEA. It helps to ensure that any problems which arise during implementation can be responded to, in appropriate manner, whether that is through amendments to IWSP 2 or through the provision of further mitigating measures at the project level (i.e. through the

EMPs of individual projects). Monitoring of the effects of IWSP 2 would be carried out by the HCWW alongside the other effects of their operation and those of the ACs.

SCOPE OF THE PROGRAMME

The key issues and project measures identified in relation to infrastructure requirements for water treatment and supply within the four Governorates include:

- Strategic urban water treatment facilities are worn-out with high risk of essential and critical supply shortages in the near future. Proposed measures: major rehabilitation and/or reconstruction of treatment facilities;
- Extremely high NRW levels due to major distribution network deficiencies, inadequate house connection standards and inappropriate metering. Proposed measures: distribution network improvement works, loss reduction programs; and
- Standard treatment processes of urban water treatment facilities cannot ensure potable water quality in compliance with defined norms and standards due to continuously deteriorating raw water quality. Proposed measures: options of enhanced water treatment technology need to be investigated and applied.

For wastewater collection and treatment, the key issues and infrastructure improvement requirements were identified as:

- Existing wastewater treatment facilities are malfunctioning and under-utilized. The rehabilitation and upgrading of those facilities including the systematic expansion of the sewer networks would have a positive impact with regard to environmental, economic and service coverage aspects;
- Construction of completely new sewerage schemes in semi urban / rural areas which are characterized as follows: (i) The total population of mother and satellite villages >50,000 inhabitants; (ii) design capacity of WWTP >10,000 m^3/d; (iii) high groundwater table allows no proper on-site sanitation and customers are used to high monthly expenditures for the evacuation of their septic tanks; (iv) upstream improvements have a considerable impact on downstream raw water quality for drinking water supply and (v) high level of surface water contamination exists and health risks and epidemics have been reported; and
- The rehabilitation and further expansion of sewer systems and wastewater treatment facilities in special tourist areas is needed but can be only considered and financed under this program if the full cost recovery through adequate tariffs for this clientele is ensured

The complete list of projects currently selected for the programme is provided in this SEA report (Table 29). It is also possible that there may be changes to the projects as IWSP 2 is a long-term dynamic programme.

ASSESSMENT OF PROGRAMME IMPACTS

Predicted Positive Impacts of IWSP 2

The aim of IWSP 2 is to achieve environmental improvements in the four governorates by improving water supply and sanitation services, and to improve the capacity of HCWW and the ACs in the effective management of these services. The following are the main social and environmental benefits expected from the IWSP:

- Progressive reduction in the disparity between population coverage of water supply and wastewater services.
- Increasing volumes of wastewater that are treated to the required standard for discharge to the environment, with concomitant reductions in contamination of water resources and the associated risks of disease transmission.
- Reduction in wastewater pollution levels in drains resulting in improved quality of irrigation water where drainage water is mixed in canal water for unrestricted crop irrigation, and decreasing incidence of water-borne diseases, particularly where drain water is used (illegally) for direct crop irrigation.
- Increasing water quality in drains, canals and finally the River Nile -all drains in Upper Egypt is connected to the River Nile- in the target governorates will lead to an enhancement of habitat quality for aquatic life and water related downstream habitats.
- Reducing pressure on the abilities of the WTPs to produce water that meets potable water standards due to the progressive improvement of the quality of surface and groundwater resources.
- Improving reliability of water supply (quantity and quality) by investment in new and upgraded water treatment and distribution infrastructure and thus reducing impacts on living conditions from intermittent water supply.
- Improving O&M of WTPs and WWTPs through improved management and training, coupled with technical improvements to facilities, will result in more effective treatment, compliance with quality standards and reduced impacts on the environment.
- Reducing number of complaints by the public of poor service provision.
- Improving financial performance of the HCWW and the ACs through improved accounting and management procedures.

Potentially Negative Impacts during Construction

The potentially negative impacts during construction period can be divided into

- Unavoidable environmental effects of construction; and
- Additional risks.

For the unavoidable effects, mitigation and compensation measures have to be developed, applied and monitored regularly.

Additional risks can usually be avoided within the planning process, i.e. to exclude and protect sensitive habitats from occupation (also temporarily) or disturbance. Good practice and working performance according to existing guidelines for construction also will avoid unnecessary nuisance or destruction.

In an assessment matrix, the potential effects of construction on the environment have been evaluated and classified into appropriate categories.

Potentially Negative Impacts during Operation

The potentially negative impacts during operation of existing, refurbished and new facilities can be divided into

- Unavoidable environmental effects of operating the facilities; and
- Additional environmental effects and health risks due to poor operation and maintenance practices, and incorrect handling and control of hazardous substances and chemicals.

For those unavoidable effects, mitigation and compensation measures have to be developed, applied and regularly monitored.

In contrast to the unavoidable effects, all additional risks can usually be avoided within the operational and management processes. Good practice and operational performance according to existing guidelines (e.g. the Egyptian Engineering Codes of Practice) and compliance with the environmental standards set by the Law, will avoid unnecessary nuisance or even more severe environmental or health effects.

The potential effects of operation on the environment have been evaluated in an assessment matrix and classified into appropriate categories.

Within the matrix, the operational processes are differentiated into the following groups of facilities:

- Gravity systems and rising mains;
- Pumping stations;
- Water treatment plants; and
- Wastewater treatment plants.

Overall Environmental Assessment

As summarized in an overall assessment matrix, in some cases significant environmental effects are identified. There are certain risks and threats for the environment mainly related to failure, accident, inappropriate process control and poor maintenance.

During construction phase any project can cause serious damage to the environment and all potential impacts must be subjected to detailed evaluation and measures on the specific location. Therefore the projects EIAs have a crucial role to screen and assess potential negative effects on any environmental sector as early as possible in the project cycle. Based on this assessment, project and site-specific avoidance, mitigation and monitoring measures can be developed.

Under the condition that all intended programme projects / measures will be realised in an adequate timeframe, in a sustainable manner and regarding the measures and recommendations of the SESIA,

the overall assessment anticipates that there will be minimal environmental risks and impacts as a result of appropriate project implementation and operation. As designed to, the Programme will bring enhancement compared to the present situation especially in the water-related environmental sectors. Significant and persistent impacts can only be identified for the soil according to the demand on additional land and soil sealing due to construction. The assessment also describes many risks during construction and operation phases and most of these risks can be controlled by following existing guidelines for construction works and operating the facilities. There is a serious risk remaining caused by the current inadequate situation of solid waste management. All wastes produced at existing facilities are not disposed of in an environmentally appropriate manner and this situation may become worse as new facilities are provided under IWSP 2 unless there are also continued improvements to the solid waste sector.

Overall Social Assessment

During the selection of the investment projects a pre-screening of projects, particularly with regard to social aspects, took place. In this context, projects for which social issues such as land access and availability, whereby the executing agency could not provide the proof of land availability, were excluded from further consideration. This selection criteria has therefore already filtered out projects which may have presented significantly complex social issues and risks such as land acquisition, resettlement, and compensation for private properties and agricultural land where necessary. The selection of investment projects from a social aspect has therefore greatly minimised social impacts likely to occur during the planning phase and therefore this SESIA focuses on further relevant social aspects (positive and negative) that are mostly anticipated during the construction and operation phases.

The most significant social impact anticipated from the project is the improved water supply situation, characterised by increased quality and quantity of potable water available to the residents living in the service areas of the WTPs. Here the quantity of available potable water will thus have a positive impact on meeting the current demand and in view of the project horizon, as well as paving the way for potential future infrastructure development made possible through increased water supply in the area, considering the expected population growth in the respective project areas.

The upgrade of ground water units with iron and manganese removal units and the replacement of asbestos networks will have significant health benefits as it will reduce contamination of water resources and significantly decrease potential health hazards which currently prevail. Improved water quality resulting in the improved health of residents in the area, also reduces the burden on health care services occupied with issues such as water-borne diseases, and families can redirect their financial resources towards improving livelihood conditions aside from health care.

Additionally, the improved sanitation system will not only improve the health situation of the concerned population in Upper Egypt, but it will also have a positive socio-economic impact. The improvement of the quality of the treated wastewater which is mixed in irrigation canals lowers the risks on agricultural production and food exporting industry. The project will also provide permanent jobs during operation

and short-term jobs during construction for residents in neighboring villages which will have a positive effect on the standard of living and workers' income.

An additional socio-economic benefit will be that the current monthly expenditure spent on emptying septic tanks, will be reduced. However, private consumers who previously did not pay for water or wastewater will have to pay higher tarrifs to be connected to the new sanitary systems and pay wastewater fees. The water however will be safer to drink, cleaner, and more reliable in terms of quality and quantity.

The target area consists of quite homogenous social structures without significant conflicts between ethnic or religious groups so that the expected overall social risks for the programme can be classified as low. With increased water supply and therefore reduced pressure and competition for resources, which may have previously caused tensions, amicable relations between community members are likely to prevail.

As mentioned above, there is no resettlement expected within IWSP 2 due to the introduction of the eligibility criteria and exclusion criteria during the project identification process. The exclusion criteria include for example the availability of land as a pre-requisite for the project to be implemented. Therefore, if the availability of land is not proved for the proposed measure, the project is not implemented under IWSP 2 reducing social impacts related to land acquisition, compensation and resettlement.

With regards to the construction phase, works on the water and wastewater networks that will be constructed in urban areas will lead to traffic disturbances (during preparatory works, earthworks, and pipe laying works). The construction works may have therefore a temporary negative impact on nearby businesses and residents. The management of such disturbances need to be considered in the project specific Environmental and Social Management Plans within the EIAs.

The construction of the new WWTP will take place at a distance of about 4 km to the east of the closest village. Thus, significant socio-economic negative impacts are not expected.

Noise disturbances from machinery will have a rather low impact in rural areas where very few settlements are located, however a greater temporary impact in urban areas. Temporary direct and indirect employment, for skilled and unskilled workers, is expected on a localised extent during the construction phase.

In general, the programme will bring significant enhancement to livelihoods on a social level compared to the present situation, especially with regard to public health and reducing the overall disparity in the area in relation to the population currently supplied and not supplied by water and wastewater services.

ENVIRONMENTAL AND TECHNICAL MEASURES

An important task of SEA is to define the approach to achieve overall environmental compliance and sustainability by means of:

- Prevention of avoidable impacts
- Reduction and mitigation of unavoidable and significant effects
- Measures to offset inevitable impacts
- Improvement and project adaptation measures

As IWSP 2 itself is regarded to be in compliance with existing environmental objectives of other related programmes, a number of measures are recommended focussing on developing proposals for potential improvements to prevent avoidable impacts relative to the new projects.

Measures to Prevent Avoidable Impacts

- Keeping the demand on land for new projects or extensions in general as limited as possible, particularly the demand for valuable agricultural land
- Sealing of soil only as much as is really needed
- Proper rehabilitation of land and soil after construction works are finished
- Avoiding any known or potential valuable natural habitat from any occupation, even temporarily
- Avoiding any known or potential cultural / historic value from any occupation, even temporarily
- Avoiding any known or potential cultural / historic value from damage during construction works
- Taking utmost care during any construction works with regard to groundwater and surface water bodies
- Discharging water from dewatering of construction sites only to suitable water bodies
- Preventing the discharge of water treatment sludge to drains; either discharge to the sewerage system where appropriate for further treatment, or dry on site and transport to authorized landfill
- No discharge of wastewater sludge to drains
- Taking utmost care while handling and storage of raw sludge
- Storing air-dried sludge for at least 6 month before being released for use by farmers
- Taking utmost care while handling, storage and application of chemicals and potential hazardous substances
- Avoiding unnecessary truck movements and machinery operation through well-managed construction supervision
- Discharge (bypass) of untreated wastewater to drains only in cases of emergency
- Control of all O & M according to Standard Operating Procedures and manuals

Reduction and Mitigation of Unavoidable and / or Significant Effects

- Implementation of mitigation measures according to the project EIAs
- Proper handling, sampling, reuse and dumping of any solid waste
- Development of solid waste management programmes at the Governorate level
- Optimizing freshwater use (reduced leakage, use of treated effluent for irrigation where appropriate, etc.)
- Reducing energy and fuel consumption as much as possible by selecting energy efficient processes and operating processes efficiently

Measures to Offset Inevitable Impacts

- Implementation of compensation measures according to the project EIAs
- Rehabilitate the landscape and the surrounding of projects sites as far as possible to provide natural habitats

Improvement and Project Adaptation Measures

- Installation of solar power units for temporary facilities on construction sites
- Installation of sludge anaerobic digesters together with CHP plant wherever practicable
- Replacing or supplementing the use chlorine gas with other means of disinfection of effluent, including dechlorination and sand filtration to remove parasite eggs
- Effective and efficient control of aeration of the activated sludge process in order to optimize energy consumption
- Ensuring that the sludge treatment processes can achieve the required reduction in pathogen content of the sludge before selling it to farmers
- Developing and implementing summer / winter regimes for O&M with regard to demographic information, when applicable
- Carrying out a full and thorough WTP / WWTP analysis as a basis for all rehabilitation and upgrading design
- Taking account of the significant increase of population in target governorates as part of the design process.

CLIMATE CHANGE IMPACT ASSESSMENT

Greenhouse gases (GHG) resulting from human activities are the most significant driver of climate change (CC), which is one of the key challenges facing the world and could have potentially severe impacts on Egypt. Expected climate change impacts in Egypt include:

- Changes in annual/seasonal average temperatures, such as warmer, drier summers, springs and autumns and milder, wetter winters, seasonal shift
- Change in rainfall spatial pattern and change in rainfall intensity
- Change in the maximum and minimum temperatures
- Increased frequency of extreme conditions:
  - More very hot days,
  - More intense downpours of rain,
  - More frequent high water levels at the coast.

For Egypt, the following aspects of CC are particularly relevant:

- River Nile water flocculation.
- Rising sea level - more frequent high water levels at the coast
- Warmer and drier summers, springs and autumns.

SEA can help to ensure that plans and programmes take full account of climate change issues and reduce GHG emissions. The SEA can also ensure the feasibility as well as the safety of the invested funds by programme interventions fighting the potential adverse effects of climate change.

There are two necessary and interrelated responses to climate change: mitigation measures represent actions to reduce human impacts on the climate system by reducing our emissions of greenhouse gases; adaptation measures are actions in response to actual or expected climate changes, which moderate harm or exploit the opportunities of their impacts. With respect to the IWSP, the following measures are proposed:

Table 1: Mitigation and adaption measures in regard to Climate Change

	Objectives
Mitigation measures	**Minimizing negative impacts on climate, for example by**: • Reducing energy needs and consumption in all IWSP 2 projects • Improving energy efficiency in all IWSP 2 projects • Utilizing renewable energy in IWSP 2 projects as much as possible • Improving waste and land use practices to reduce emissions • Protecting and enhancing natural carbon sinks • Reducing carbon losses in organic soils
Adaptation measures	**Reducing vulnerability of the new infrastructure to the impacts of climate change ('climate resilience'), for example by:** • Providing sustainable and adjustable drainage systems • Providing sustainable and adjustable sewage systems • Providing sustainable and adjustable water supply systems • Providing sustainable and adjustable WW treatment facilities

There has been an overall increase of 157% in GHG emissions in Egypt since year 2000 and emissions attributable to the wastewater sector in Egypt represent only about 3% of the total national emissions. However, WWTPs usually are among the larger power consumers for a municipality and, as WWTPs are centralised, they are easier to optimise than diffuse sources. A case study (Ras el Bar WWTP in Damietta governorate) is described in the report to demonstrate the possibilities to reduce GHG emissions and power consumption with smart investments in wastewater treatment.

MONITORING AND CONTROL

An effective and quality system of monitoring and evaluation of the environmental impacts of IWSP 2 implementation not only contributes to preventing the programme's possible negative environmental impacts but it also helps to enhance its positive effects in terms of the environment and delivering a higher quality of the project. Accordingly, a number of indicators are proposed for monitoring the environmental effects of the programme.

For an effective quality system to monitor the environmental effects of the operations resulting from IWSP 2, several aspects are of key importance. These include focussed review and possible modification of relevant environmental objectives of the projects selected based on the evaluation of

the related environmental indicators proposed by the SEA for the different areas of intervention in the four target governorates in the context of the individual projects.

CONCLUSIONS

The overall results of the present SESIA on IWSP 2 can be summarized as follows:

- For the water sector, there are overall positive effects in all governorates due to rehabilitation, upgrading and construction of new facilities and networks for water supply and waste water treatment.
- For the public health sector, there will be overall positive effects due to the improvement of water quality. Risks remain due to:
    - The lack of appropriate solid waste management
    - Sewage sludge used in agriculture that is not treated to the high standard of pathogen removal required to protect the health of workers
    - Other sources of contamination of water resources, mostly resulting from illegal discharges
- Land availability was confirmed by the AC's. Therefore no resettlements are being expected in IWSP 2 projects.
- Soil and groundwater quality are currently adversely affected by a number of factors, and IWSP 2 will have minor negative impacts due to changed use of land and operation of new projects and extension in the governorates. In the longer-term, impacts of IWSP 2 will be positive as groundwater contamination will reduce as a result of programme measures but other impacts such as increasing salinity of soils and groundwater, and overexploitation of soils cannot be influenced by means of programme. The use of sludge has beneficial impact on soils provided that its use is control to prevent negative long-term impact resulting from the accumulation of heavy metals.
- There is no significant or known impact on any cultural heritage or tourist attraction. Within the preliminary design, the specific conditions of the project's site and surroundings have to be evaluated and assessed by the respective EIAs.
- The strategy and the guidelines for sludge treatment set in this SEA have significant positive effects for the reduction of GHG emissions.
- In relation to the present situation and the projections for climate change in the target region, some of the projects and measures might be subject to adaptation, relocation or change capacities.
- After full rehabilitation of site and surroundings after construction, no negative effects for the landscape will remain.
- There will be no significant negative effects on flora, fauna and biodiversity in the short-term. Long-term effects will all be positive due to the improvement of water quality and also water habitats. However, the existing threats for natural life (species and habitats) which are currently under pressure will remain; the threats include increasing:
    - Population growth

- Loss of land to urban development and effects of soil sealing
- Water consumption relative to sustainable resources
- Use of fertilizers and pesticides
- Climate change effects, particularly sea level rise.

RECOMMENDATIONS

Policies and Strategies related to the Environment

It is inevitable that the natural environment and its resources are fundamental to the core business of HCWW and the ACs and that the companies also have the potential to impact upon the environment in many ways.

The HCWW is strongly encouraged to commit itself to environmental responsibility and environmental management performance. Therefore an environmental policy and environmental guidelines for the Holding Company, which are also binding on the affiliated companies, must be developed.

Programme and Projects

Notwithstanding the overall useful projects of IWSP 2 and their intended positive effects, the programme should be regularly reviewed to ensure that the measures will not only be the most cost-effective but also the best for the environment as a whole. For instance, this could include focus on rehabilitation or upgrading of existing facilities rather than building new facilities on green field sites, wherever feasible.

All projects should use “Best Suitable Techniques” (BST) instead of Best Available Techniques (BAT) focussing on ease of operation and maintenance to ensure that the expected performance of the facilities can be sustained within the budgets and expertise of the ACs. Expensive high technology facilities have a much greater risk of not being (properly) operated.

Further Studies

With reference to the conclusions of the Climate Change Impact Assessment (CCIA) for IWSP 2 (Annex 3, SEA report), a further and specific CCIA for the target governorates and the Delta region should be carried out. This study should cover the specific climate issues with a proven scientific background. Such CCIA would have to use the latest data, projections and forecasts and give particular attention to the water sector and the IWSP 2 including its envisaged projects. With this additional information about climate change effects and their predicted range in the target governorates, a revised or adapted programme can react on this and adjust the respective measures.

Project EIAs

According to Law 4/1994 for the protection of the environment, as amended by Law 9/2009, an EIA should be undertaken for new establishments and projects and for expansions and renovations of existing establishments before construction. The Law considers the EIA as a main condition for licensing and thus a project that does not prepare an EIA or does not abide by the EIA conditions could have its license revoked.

The present report provides a preliminary screening of all IWSP 2 projects according to the Law but it is the responsibility of the ACs and their Consultants (TADECs) to verify with EEAA which projects will require an EIA and to conduct the EIAs accordingly.

1 INTRODUCTION

1.1 IWSP 2 BACKGROUND AND OBJECTIVES

1.2 GENERAL BACKGROUND

The Holding Company for Water and Wastewater (HCWW) is the Project Execution Agency (PEA) for the "Improved Water and Wastewater Services Programme 2" (IWSP 2), a programme which aims to implement projects in the water and wastewater sector in four governorates (Qena, Sohag, Assiut and Minya) in Upper Egypt (Figure 1). The programme is co-financed by the Government of Egypt (approximately 28%) and the five European Development Partners (EDPs):

- German Development Bank KfW (Lead Financing Institution);
- European Union (EU);
- Agence Française de Développement (AFD);
- European Investment Bank (EIB); and
- Swiss State Secretariat for Economic Affairs SECO

who together provide the remaining 72% of the funds.

The companies who carry out the water and wastewater operations in each governorate in Egypt are "affiliated" to the HCWW. The Affiliated Companies (ACs) of the four IWSP 2 Governorates (Qena, Sohag, Assiut and Minya) are the final beneficiaries and also the "Employers" for the implementation and supervision service contracts.

IWSP 2 consists of an Investment Component and a Technical Assistance (“TA”) Component. The TA Component foresees consultancy services to provide support to the Affiliated Companies (“ACs”) as well as the PMU of the Holding Company for Water and Wastewater (“HCWW”). As part of the TA component, the HCWW will be supported by a Programme Management Consultant (“PMC”) while the ACs will be benefitting from two TA and Design Consultants (“TADECs”), who will take over the role of the independent international Engineering Consultants (“Engineering Consultants”) as well as one Operation & Maintenance Consultant (“O&M Consultant”).

The contract for the Consultancy Services of the Programme Management Consultant (PMC) with duration of 42 months was awarded to the German Consultant “CES Consulting Engineers Salzgitter GmbH”. The Contract was signed on 06/06/18. The Commencement Date of the Contract implementation was 04/06/18.

The services of the PMC are divided in two work packages. The services in Work Package 1 include project management activities whereas the activities under Work Package 2 are focused on the collection of data and the updating and finalisation of the projects lists for each of the four Governorates.

In accordance with the requirements of the ToR, the PMC hereby submits this SESIA Report. Usually; an ESIA is being prepared for singular projects during later planning stages (Feasibility Study and/or detailed design stage). As a SESIA describing plans and programmes on a higher planning level,

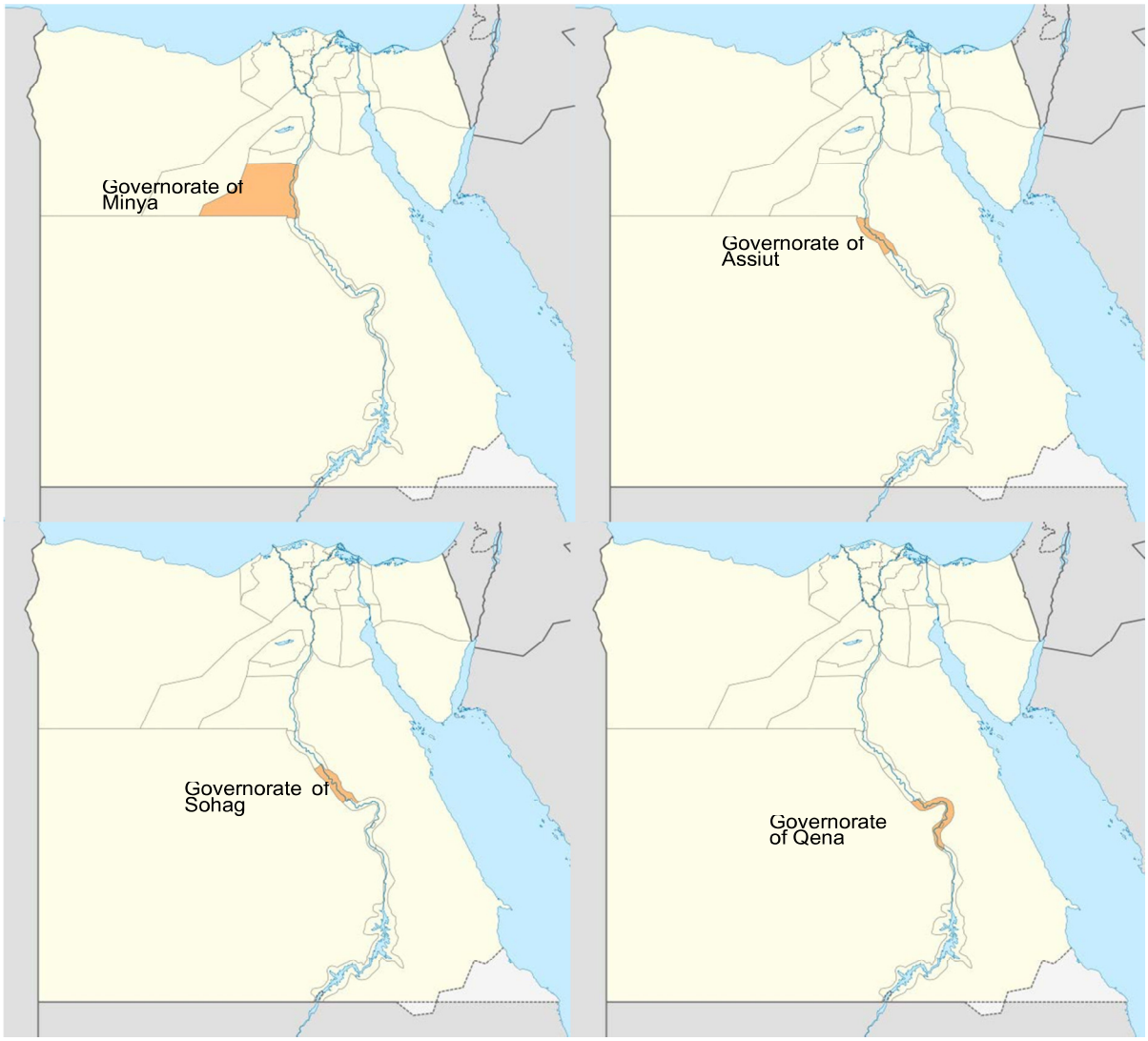
impacts will be discussed in a more general way thus not requiring detailed information on the size and capacities of the singular projects of the project list.

It should be noted that major negative social impacts (such as resettlements) within IWSP 2 are avoided through introduction of eligibility criteria and exclusion criteria during the project identification process. One of the exlusion criteria comprises for example the non-availability of land. Thus, if no land is available for the proposed measure the project cannot be implemented under IWSP 2. The availability of land has to be confirmed either by presentation of a land decree or by a written statement of the AC confirming that land transfer is agreed by the governor.

This report also refers to the SEA (Strategical Environmental Assessment) whenever environmental aspects are discussed. However, social aspects have been also considered and assessed.

The SESIA report describes the stages of the SEA process including the roles and responsibilities of involved stakeholders. During the screening phase it is decided if a project falls or not under the SEA regulatory frame. The SESIA report includes the identification of Social and Environmental Impacts and comprises mitigation and monitoring activities along with implementing arrangements.

Figure 1: Location of the Target Governorates of IWSP 2



1.2.1 Scope of IWSP 2 Investment Component

The IWSP 2 will include the following components:

- Rehabilitation / reconstruction of existing WWTPs;
- Construction of new wastewater treatment plants (WWTPs) and regional sewer networks (sanitation service clusters, SSC);
- Extension of existing sewer networks increasing the capacity utilisation ratio of the existing WWTPs;
- Reconstruction of existing and non-operational/life expired water treatment plants (WTPs);
- Rehabilitation of the primary and distribution water networks, including metering and house connections;
- Consulting services for capital investment, programme management, preliminary and detailed design and construction supervision.

1.2.2 Objectives of IWSP 2

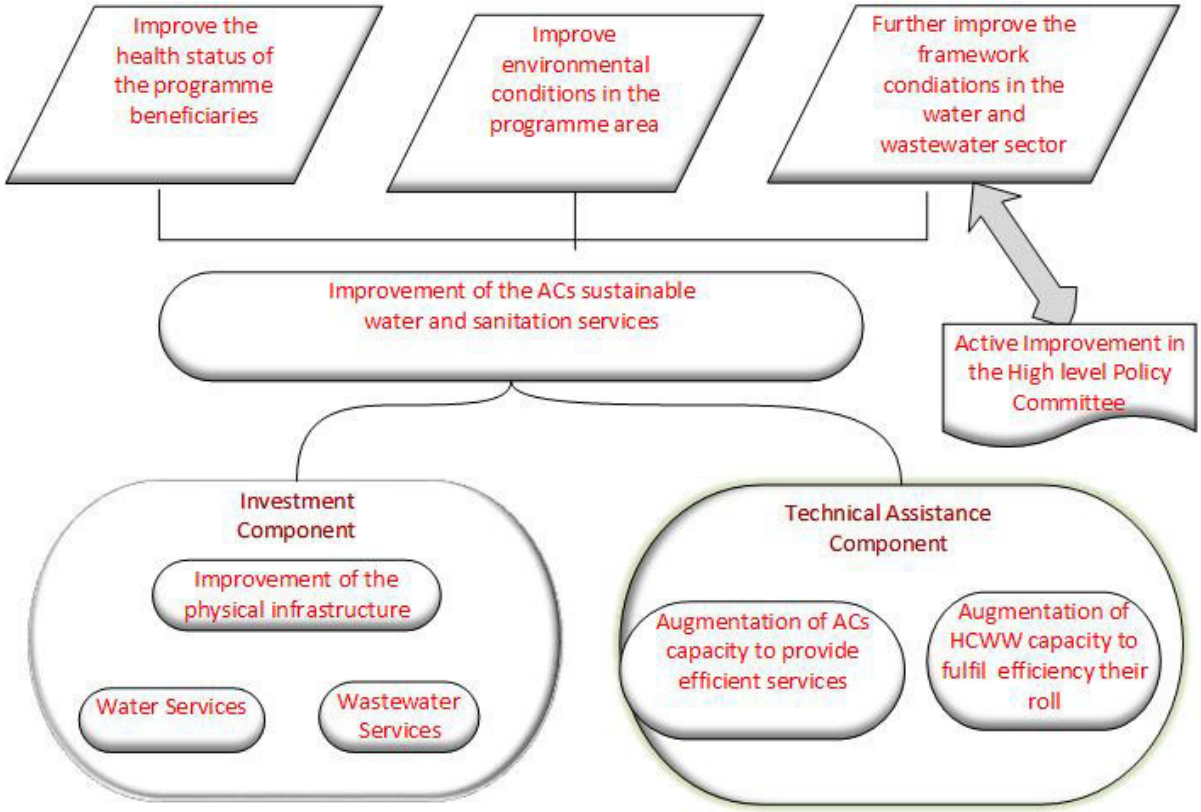
The overall objectives of IWSP 2 are to:

- Improve the health status of the programme beneficiaries;
- Improve environmental conditions in the influence area of the programme; and
- Further improve the framework conditions in the water and wastewater sector.

1.2.3 Overall framework of IWSP2

The overall framework of objectives of the IWSP 2 is shown in Figure 2. The IWSP 2 will provide support towards meeting these objectives through an Investment Component improving the physical infrastructure of the four ACs and by a TA Component which will further develop the capacity of the ACs and the HCWW to enable improved performance of tasks.

Figure 2: IWSP 2 Framework of Objectives



Source: IWSP 2 Manual of Procedures 2018

A key requirement for the PMC under Work Package 2 is to undertake a Strategic Environmental Assessment (SEA) with the objectives of:

- Assessing the likely effects of the IWSP 2 on the environment,
- Recommending measures to reduce, prevent or offset any identified significant adverse effects, and

- Indicating which specific Environmental Impact Assessments (EIAs) would have to be undertaken for the respective individual projects.

1.3 PURPOSE OF THE REPORT

The EC Directive 2001/42/EC[1] (the so-called SEA Directive) states that its objective is "*to provide for a high level of protection of the environment and to contribute to the integration of environmental considerations into the preparation and adoption of plans and programmes with a view to promoting sustainable development*".

SEA is a systematic process for evaluating the environmental consequences of proposed policies, plan or programme initiatives in order to ensure that they are fully included and appropriately addressed at the earliest stage of decision-making on par with economic and social considerations.

This strengthens and streamlines the subsequent EIA process by early identification of potential impacts and cumulative effects, addresses strategic issues related to the justification and location of proposals, and reduces the time and effort necessary to assess individual projects.

The key output is the preparation of an environmental report in which the likely significant effects on the environment of implementing the plan or programme, and reasonable alternatives taking into account the objectives and geographical scope of the plan or programme, are identified, described and evaluated.

SEA also supports and justifies the programme according to the requirements of the EDP. With a SEA and the consideration of their measures for mitigation or even offset potential adverse impacts of the programme, the IFIs can be assured that their decisions and actions will support sustainable development with an improvement of the situation within the target region regarding the people and their standard of living, public health, socio-economics and the environment.

[1] Directive 2001/42/EC on the Assessment of the Effects of Certain Plans and Programmes on the Environment

2 METHODOLOGY AND SCOPE OF THE SEA

2.1 ASSESSMENT OF COMPATIBILITY WITH ENVIRONMENTAL OBJECTIVES

The first step of SEA is to check the compatibility of IWSP 2 programme objectives with other existing environmental objectives at the national and regional (governorate) level. If any contradictions are found, either immediate solutions at a high level have to be determined or the IWSP 2 programme objectives have to be modified in order to achieve compliance on how to improve the environmental situation in the Nile delta and the four target governorates.

2.2 ASSESSMENT OF PROGRAMME EFFECTS

The basis for the assessment of potential impacts and effects of the IWSP 2 are the infrastructure projects and other measures planned to be implemented under the programme which will give rise to improved water supply and wastewater services in comparison to the current state of the environment in the four target governorates. The expected effects of IWSP 2 in terms of environmental impacts in each sector are assessed as follows:

++/+	(very) positive environmental effects
o	neutral or no significant effects
-/- -	negative (and very negative) effects
?	uncertain effects
n.a.	not applicable

The scope of assessment covers only implementation-oriented projects or measures and not general and conceptual statements. This is because the latter cannot directly address specific environmental effects.

Some of the measures may only have long-term effects or the effects are cumulative over the entire life cycle of a project. In such case, only the final effects after project completion are assessed.

The overall assessment also includes the ‘no-programme’ option; i.e. the expected development of environment conditions in the four target governorates without any programme-related measures or projects.

Within the sector-wise environmental assessment of the SEA, special attention is given to the potential impacts of climate change. The projections in this respect are inevitably uncertain but draw on several studies that focus on the potentially negative effects for the Nile Delta, such as reduction of freshwater resources, increase of soil salinity and sea level rise.

In this regard, this SEA tries to assess hydrological risks related to climate change and the long-term investments in water and wastewater infrastructure, and make recommendations for the second phase of IWSP, including adaptation and mitigation measures for projects. In addition this SEA also integrates examples for potential “climate smart investments” (energy recovery, integrated measures to reduce GHG emissions).

2.3 MITIGATION MEASURES

For any negative effects identified, measures are developed to achieve overall environmental compliance and sustainability, as follows:

- Measures of prevention;
- Measures of reduction and mitigation;
- Measures to offset inevitable impacts;
- Improvement and project adaptation measures.

2.4 SEA OUTPUT AND RECOMMENDATIONS

The SEA summarises the relevant strategic aspects of environmental and climate change assessment. The recommendations include not only measures for the programme or the integrated projects but also strategic recommendations for the organisational strengthening of HCWW and the ACs in the target governorates. Recommendations for operation and management are also provided to meet the environmental objectives of IWSP 2.

The more detailed assessment of specific environmental effects of individual projects is only possible with detailed local data and the defined spatial frame of impact. This is part of the detailed project planning, licensing procedure and project-specific EIA (where this is determined to be necessary). The latter requires the preparation of an Environmental Monitoring Plan to describe the measures for prevention, mitigation or improvement of environmental impacts. The SEA identifies those IWSP 2 projects that will require an EIA and gives recommendations for the EIA process in accordance with EEAA guidelines and the regulatory framework for EIAs in Egypt.

Environmental monitoring allows the actual significant environmental effects of implementing the IWSP 2 to be tested against those that are predicted by the SEA. It helps to ensure that any problems which arise during implementation can be responded to in appropriate manner, whether that is through amendments to the IWSP 2 or through the provision of further mitigating measures at the project level (i.e. through the EMPs of individual projects). Monitoring of the effects of the IWSP 2 would be carried out by the HCWW alongside the other effects of their operation and those of the ACs.

3 NATIONAL ENVIRONMENTAL LEGISLATION & OBJECTIVES, APPLICABLE INTERNATIONAL STANDARDS

3.1 RELEVANT ENVIRONMENTAL LEGISLATION

3.1.1 Presidential Decree 135/2004

The Decree established the HCWW and gave it the authority to collect, treat and safely dispose of water and wastewaters. The operational budget, properties and assets of water and wastewater utilities were transferred from local authorities to HCWW and the ACs.

3.1.2 Law 93/1962 for Discharge of Wastewaters

Law 93/1962 regulates the disposal of wastewater to sewerage networks. The law specifies the procedures to be followed for establishing sewerage networks, house connections, licensing procedures for connecting different establishments to the sewerage system and designates the responsibilities for sampling and analysis. Ministerial Decree 171/2005 (replacing the Executive Regulations 44/2000 of Law 93/1962) and the associated Egyptian Code of Practice (ECP) 501/2005 set the standards for the reuse of treated effluent and sludge standards in agriculture. The following summarises the relevant articles:

- Sewers are to be installed in public roads or private roads which are open for general traffic.
- Buildings located along a road in which there is a public sewer should be connected to the sewer.
- Establishments that discharge wastewaters with high contents of solids (such as bakeries, mills, etc.), shall install settlement chambers prior to discharging wastewater to the sewer. Establishments that discharge high loads of oils and fats in their wastewaters (e.g. car parks, services stations, etc.) shall install oil separators prior discharging the wastewater to the sewers. It is prohibited to dilute wastewaters.
- Wastewaters should comply with the standards indicated in the table below, before it may be discharged to public sewers.

Table 2: Environmental standards for wastewater

Parameter	Allowable limit	Parameter	Allowable limit
pH	6-9.5	Settleable solids (cm^3/l) after 30 minutes	15
Temperature (^oC)	43	Total heavy metals (mg/l)	5
BOD_5 (mg/l)	600	Chromium^{6+} (mg/l)	0.5
COD (mg/l)	1,100	Cadmium (mg/l)	0.2
TSS (mg/l)	800	Lead (mg/l)	I

Parameter	Allowable limit	Parameter	Allowable limit
Oil and Grease (O&G) (mg/l)	100	Mercury (mg/l)	0.2
Sulphate (mg/l)	10	Silver (mg/l)	0.5
Total Nitrogen (mg/l)	100	Copper (mg/l)	1.5
Total Phosphorous (mg/l)	25	Nickel (mg/l)	I
Cyanides (mg/l)	0.2	Arsenic (mg/l)	2
Phenols (mg/l)	0.05	Tin (mg/l)	2
Setteable solids (cm^3/l) after 10 minutes	8	Boron (mg/l)	1

Source: Article 14 of Decree 44/2000

- It is prohibited to reuse treated sewage for irrigation except after:
  a) Obtaining the approval of the Ministry of Health and competent authorities determined by the Minister of Housing.
  b) Preparing an environmental impact assessment in accordance with the requirements of the Egyptian Environmental Affairs Agency (EEAA).
- In all cases the treated sewage complies with the standards indicated in the table below for primary, secondary and tertiary treatment.

Table 3: Environmental standards for the treated sewage

Parameter	Primary treatment	Secondary treatment	Tertiary treatment
BOD (mg/l)	300	40	20
COD (mg/l)	600	80	40
TSS (mg/l)	350	40	20
O&G (mg/l)	-	10	5
Nematodes (no. of cells or eggs/l)	5	1	1
Faecal coliform (MPN/l00ml)	-	1,000	100
TDS (ppm)	2,500	2,000	2,000
Sodium Absorption Ratio (SAR)	25	20	20
Chlorides (mg/l)	350	300	300
Boron (mg/l)	5	3	3

Parameter	Primary treatment	Secondary treatment	Tertiary treatment
Cadmium (mg/l)	0.05	0.01	0.01
Lead (mg/l)	10	5	5
Copper (mg/l)	-	0.2	0.2
Nickel (mg/l)	0.5	0.2	0.2
Zinc (mg/l)	-	2	2
Arsenic (mg/l)	-	-	0.1
Chromium (mg/l)	-	-	0.1
Molybdenum (green fodder) (mg/l)	-	0.01	0.01
Manganese (mg/l)	0.2	0.2	0.2
Iron (mg/l)	-	5	5
Cobalt (mg/l)	-	0.05	0.05

Law 93/1962, ECP 501/2005, Art. 15 of Decree 44/2000

- The use of treated effluent for irrigating food crops is effectively prohibited. ECP 501/2005 identifies certain precautions to be observed concerning types of crops, types of soils and methods of irrigation for effluent treated to primary, secondary or tertiary levels, summarised in the following table.

Table 4: Permitted crops and level of treatment

Grade / level of treatment	Permitted crops	Soil type
A. Tertiary	Plants and trees grown for greenery for touristic villages, hotels and residential areas of new cities	All types
B. Secondary	Fodder crops if not fed to dairy animals Fruit crops for human consumption of which the peel is not eaten and grown exclusively for canning Green belts and nurseries Cut flowers and fibre crops Mulberry for the production of silk	Light – medium texture
C. Primary	Industrial oil crops Wood trees	Light texture

Source: Law 93/1962, ECP 501/2005, Art. 15 of Decree 44/2000

- It is prohibited to use sludge as organic fertilisers outside the WWTP except after obtaining the approval of:
  a) the competent administrative authority within the Ministry of Housing;
  b) the Ministry of Health; and
  c) EEAA after preparing an EIA for the production, distribution, utilization and disposal process, if necessary.
- The sludge should be appropriately stabilized using aerobic, anaerobic, chemical, thermal or solar methods.
- The treated sludge should comply with the standards indicated in the following table.

Table 5: Environmental standards for treated sewage sludge

Parameter	Allowable limit	Parameter	Allowable limit
Zinc (mg/kg)	2,800	Molybdenum (mg/kg)	18
Copper (mg/kg)	1,500	Selenium (mg/kg)	36
Nickel (mg/kg)	420	Arsenic (mg/kg)	41
Cadmium (mg/kg)	39	Faecal coliforms (cells/g ds)	1,000
Lead (mg/kg)	300	*Salmonella* (cells/100 ml at 4% ds)	3
Mercury (mg/kg)	17	*Ascaris* eggs (live eggs/l00 ml at 5% ds)	1
Chromium (mg/kg)	1,200	*Ascaris* (no. of species)	3

Source: Law 93/1962, ECP 501/2005

- Appropriate health precautions and buffer zones between lands to which treated sludge is applied and certain developments should be respected.
- The application of sewage sludge should be within the following rates according to soil type:
  8 - 14 m^3/fd per year for clay soil;
  10 - 16 m^3/fd per year for medium textured soil;
  12 - 20 m^3/fd per year for light soil.

3.1.3 Law 48/1982 for Protection of River Nile and Watercourses

Law No. 48/1982 and its Executive Regulation regulate and set standards for the discharge of treated sewage to watercourses and groundwater. A license should be obtained from the Ministry of Irrigation and Water Resources prior to discharging treated sewage to any watercourse or groundwater.
It is prohibited to discharge treated effluents of WWTPs to any freshwater canals. The discharge to drains is only permitted provided that the effluent complies with the standards indicated in the table below.

Table 6: Discharge limits to surface water streams

Parameter	Unit	Allowable discharge limit to drains	Allowable discharge limit to River Nile
pH		6-9	6-9
Temperature	(^{o}C)	35	≤3 ^{0}C difference
BOD	(mg/l)	60	30
COD	(mg/l)	80	40
DO	(mg/l)	>4	>4
O&G	(mg/l)	10	5
TDS	(mg/l)	2,000	1,200
TSS	(mg/l)	50	30
Colour		nil	nil
Sulphates	(mg/l)	1	1
Cyanides	(mg/l)	-	-
Phosphates	(mg/l)	-	-
Nitrates	(mg/l)	50	15
Fluorides	(mg/l)	-	-
Phenols	(mg/l)	-	-
Total heavy metals	(mg/l)	1	1
Pesticides		nil	nil
Total coliforms	MPN/100 ml	5,000	1,000

Source: Law 48/1982

The Executive Regulation specifies certain standards for ambient water quality in freshwater canals and in drains. The MWRI is responsible for meeting such water quality objectives by controlling discharge permits and mixing drain water with freshwater bodies.

In order to better control pollution of River Nile and to increase the safe use of treated wastewater the MWRI released Decree 208/2018 which provides that "In *case of treated wastewater is to be discharged to a non-fresh water body but this body reaches a fresh one, a case by case study shall be carried out in order to justify the characteristics of effluents which must at least be equal to the values in Law 48".*

3.1.4 Environmental Law No. 4/1994 as Amended by Law No. 9/2009

Environmental Law No. 4/1994 as amended by Law No. 9/2009 and its Executive Regulation are the main legislation governing environmental protection in Egypt. The Environmental Law stipulates that an environmental impact assessment (EIA) should be undertaken for development projects as a precondition for obtaining a license. Detailed analysis of the impacts during construction and operation phases in normal operation and emergency situations has to be carried out in an EIA.

The EEAA is required to furnish the competent administrative authority or the licensing authority with its opinion on the EIA within 30 days from receiving the assessment otherwise the assessment shall be deemed accepted by the EEAA. In the event a project has been accepted, the Environmental Law obliges the project proponent to keep an environmental record to document the environmental performance of the project.

The EIA system classifies the projects into three categories (A, B or C) based on different levels of EIA requirements according to the significance of possible environmental impacts and location of the establishment and its proximity to residential settlements, as follows[2]:

- Category A – Projects with minimum environmental impacts;
- Category B – Projects with potential adverse environmental impacts yet less adverse than Category C;
- Category C – Projects which have highly adverse impacts.

EEAA Guidelines for EIAs of Wastewater Treatment Works (2005) identified three categories of WWTPs corresponding to different levels of details in the EIA required. However, in 2009 revised EIA Guidelines were issued by EEAA[3] indicating that compact WTPs (and probably rehabilitation works) should be considered as Category B projects while WWTPs including sanitation systems and public/central construction of water treatment as Category C projects.

It is worth noting that the 2009 EIA Guidelines include requirements for undertaking consultations with the public and concerned entities of the projects under Category C. The Guidelines define the following concerned parties to be involved in public consultations, as a minimum:

- EEAA and Regional Branch Offices;
- Competent administrative authorities, according to the type of project and location;
- The Governorate;
- The Local People Council;
- Representatives from neighbouring sites and affected communities;
- Local NGOs;
- Local universities.

[2] Note that the Project classification provided in the Egyptian EIA legislation is in reverse order as compared to international approaches where Category A projects represent the highest level in terms of environmental assessment needs

[3] Egyptian Environmental Affairs Agency, Guidelines of Principles and Procedures for Environmental Impact Assessment, 2nd Edition, January 2009. Available at: http://www.eeaa.gov.eg/portals/0/eeaaReports/N-EIA/English_EIA_guidelines.pdf

The Guidelines indicate that at least two public consultation sessions should be carried out, one during the scoping phase and the other after the preparation of the draft EIA. Further to this the Guidelines provide details of the procedures that should be followed for advertising, discussion points, documentation and disclosure.

According to the Amendment Law No. 9/2009 *Any leakage, effusion, emission, draining or disposal of any kind of pollutants into the waters of the Nile river, the waterways, the territorial sea, the exclusive economic zone, the sea, taking into consideration the levels determined for certain substances in the executive regulations. These shall be determined by a decision issued by the EEAA in agreement with the competent administrative authority'.*

The Environmental Law regulates the handling of hazardous substances and wastes which may only be performed after obtaining a license from the competent administrative authority. Chlorine, which is used in WTPs and WWTPs for disinfection of drinking water and treated effluent, is a toxic material and will require a license. Other potentially hazardous materials used on WTPs and WWTPs may include fuels, lubricating oils and laboratory chemicals.

The Executive Regulation of the Environmental Law provides limits for noise levels in the working environment, which will apply to excavation / construction activities and operation of pumping stations and WTP/WWTPs. The following table presents allowable noise intensity, correspondent exposure periods, and correspondent numbers of noise impacts.

Table 7: Noise limits according to Law 4/1994

Noise intensity and maximum exposure periods in working environment					
Noise intensity level (LAeq) - decibel	95	100	105	110	115
Period of exposure (hours)	4	2	1	1/2	1/4
Noise intensity and maximum number of intermittent* impacts from heavy hammers					
Noise intensity level (LAeq) - decibel	135	130	125	120	115
Number of permissible impacts - per day	300	1,000	3,000	10,000	30,000

* Impact is considered intermittent if the interval between impacts is ≥1 second

The Environmental Law sets standards for ambient air quality and gas emissions from point sources for specific gases and particulate matter. All fuel combustion machines, such as generators in pumping stations, WTPs and WWTPs should comply with emission standards indicated below.

Table 8: Emission standards according to law 4/1994

Parameter	Allowable limit (mg/m^3)	Parameter	Allowable limit (mg/m^3)
Aldehydes (measured as formaldehyde)	20	Hydrogen chloride	100
Antimony	20	Hydrogen fluoride	15

Parameter	Allowable limit (mg/m^3)	Parameter	Allowable limit (mg/m^3)
Carbon monoxide	250	Lead	2
Sulphur dioxide	4000	Mercury	3
Sulphur trioxide in addition to sulphuric acid	150	Arsenic	20
Nitric acid from nitric acid industry	2000	Heavy elements (total)	25
Hydrochloric acid (HCl)	100		

According to the Amendment Law No. 9/2009, it is prohibited to use machines, engines or vehicles which release intensive smoke or exhaust emissions or annoying noise that exceed the limits set by the Executive Regulations of the Environmental Law.

The Environmental Law also includes articles that control exploration works and corresponding exploration/construction waste disposal. Developers carrying out exploration, drilling, construction or demolition works should take the necessary precautions of storage and transportation of wastes, summarized as follows:

- The storage of excavation and construction waste should not cause obstruction to pedestrian and traffic movements. Wastes that are able to be dispersed in the air shall be covered to avoid air pollution;
- The transportation of the wastes should be by licensed and appropriately equipped vehicles with (i) a suitable cargo box or alternatively an airtight cover to prevent loose particles of waste and debris from dispersing into the air or dropping on the road, (ii) loading and unloading equipment and (iii) the vehicles be in a good condition;
- The disposal of wastes and dusts should be in licensed locations determined by the local authorities. These locations should be at least 1.5 km away from residential areas, at a low contour level, and levelled after being filled in with waste.

3.1.5 Law 38/1967 for General Cleanliness

This law regulates cleanliness of cities with respect to garbage collection and disposal, in addition to sewage cesspits evacuation and disposal. It is prohibited for inhabitants, institutional entities and owners of businesses to dispose of waste in locations other than those identified by the local authority.

The Executive Regulations (Ministerial Decree No. 134/1968) detail the procedures for the collection and disposal of garbage, technical specifications of waste containers, requirements of the disposal or composting area, specifications of cesspits or septic tanks and evacuation procedures.

The law also regulates the wastes from construction and stipulates that vehicles holding wastes resulting from construction shall have a tight cover to prevent emissions or spillage.

3.1.6 Law 117/1983 for Protection of Antiquities

Law 117/1983 defines movable or immovable antiquities produced by different civilizations, including human corpses from ancient times. Antiquities shall be registered by virtue of a Ministerial Decree issued by the Minister of Culture, in which registration implies certain standards and precautions for the protection of antiquities. Requirement and conditions of the law that may apply during construction works include.

- It is not allowed to demolish all or parts of antiquity structures, renovate or change the structures' features;
- The Minister of Culture identifies beatification zones surrounding antiquity sites. These beatification zones are considered part of the site, and it is not allowed to construct or excavate or plant trees inside these zones;
- If a movable antiquity or part of an antiquity structure is discovered, it should not be disturbed and the nearest administrative authority should be notified within 24 hours. The antiquity becomes the property of the State.

3.1.7 Occupational Health and Safety

Law No. 12 (2003), Book V: Occupational Safety and Health (OSH) and Assurance of the Adequacy of the Working Environment.

The objective of Law 12/ 2003 is to organize employment relations, clarify the duties and rights of the parties to the employment agreement, and to ensure safety and health at the workplace. It devotes a specific section (Book V) to OHS and to the assurance of adequacy of the working environment. The Law is supplemented by Ministerial decrees which elaborate more specific technical provisions, In addition to Law 12 / 2003, protection of workers against hazardous processes, machinery and equipment, hazardous chemical, physical and biological agents are regulated by 3 major decrees, No. 126, No. 211 and No. 134:

- **Decree No. 126/2003** (replacing MD 75/1993) defines procedures and forms for notification of accidents and diseases at work. It also specifies the type of statistics on major injuries and accidents that should be collected and notified.
- **Decree No. 211/2003** (replacing MD 55/1983) specifies the necessary conditions required for a safe working environment with respect to physical, mechanical, electrical, chemical, biological and other hazards. Special chapters provide “Maximum Allowable Concentrations” for more than 600 chemical agents in the working environment, safe levels of physical parameters (heat and cold stress, noise, vibration, illumination, radiation, static electrical fields, classification of jobs according to physical workload, etc.), and a list of suspected chemical carcinogens (86 agents). Specifications are equally provided for construction works (ladders, scaffolds, etc).
- **Decree No. 134/2003** (replacing MD 116/1991) defines the type of industrial and non-industrial enterprises which should have an OSH department and a joint OSH Committee.

It also regulates training in occupational safety and health for workers/managers involved with OSH in the enterprise.

Several other laws and decrees tackle occupational health and safety (OHS) provisions at the work place, in addition to Articles 43 – 45 of Law 4/1994, which address air quality, noise, heat stress, and the provision of protective measures to workers. These laws and decrees apply to the work crew that will be involved in construction activities.

3.1.8 Egyptian Engineering Codes of Practice

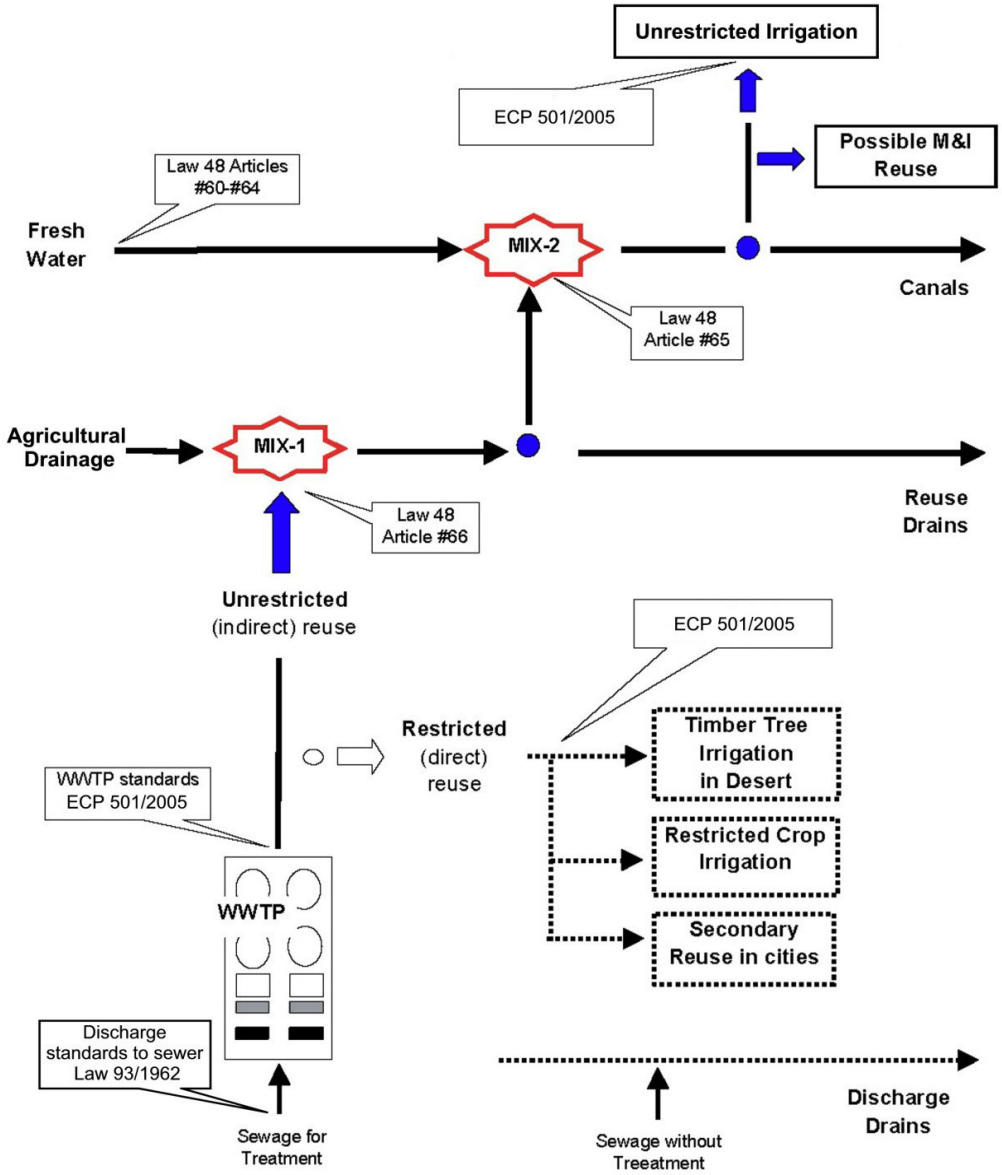
The engineering design and construction specifications for water and wastewater facilities are regulated by several engineering codes of practice issued by the Minister of Housing. These include a series of environmental conditions and specifications for different engineering works. The relevant Codes of Practice are:

- **Ministerial Decree No. 135/1999 - Egyptian Code for Design and Execution of Sanitary Appliances in Buildings**. The Code, in its second part, describes sanitation works for small communities and isolated buildings and necessary wastewater treatment stages.
- **Ministerial Decree No. 286/1990 - Egyptian Code for Design and Execution of Water Supply and Wastewater Piping Networks**. The Code describes basic design consideration for estimating wastewater flow rates, hydraulic design, pipes foundation design, design of accessories such valves, manholes, oil traps ...etc.
- **Ministerial Decree No. 168/1997 - Egyptian Code for Wastewater Pumping Stations**. The Code gives guidelines for selecting locations of PS, hydraulic design, electromechanical design, construction design and execution aspects. The Code also identifies protection and control measures against hydraulic and electromechanical risks of the PS.
- **Ministerial Decree No. 169/1997 - Egyptian Code of Practice for Wastewater Treatment Works**. The Code details the hydraulic, construction and electromechanical design considerations. It also provides guidance for selecting WWTP locations and for its protection against hydraulic and electromechanical risks.
- **Ministerial Decree No. 139/2001 - Egyptian Code of Practice for Soil Mechanics and Foundations Part 9 Earth Works and Dewatering**. The relevant aspects are the precautions identified for excavation works and dewatering to prevent possible effects on the neighbouring constructions.
- **Ministerial Decree No. 334/2002 - Egyptian Code of Practice for Sanitary Ware in Buildings**. The Code provides the specifications of sanitary works and wastewater disposal in isolated areas. There are specifications for septic tanks, cesspits and oil/grease traps. The Code also provides guidelines for locating septic tanks and cesspits in isolated areas.

- **Ministerial Decree No. 171/2005 and ECP 501/2005 - Egyptian Code of Practice for Reuse of Treated Wastewater in Agriculture**. The Code provides specifications for use of treated effluent and sludge use in agriculture (as described above), precautions and conditions for types of crops, irrigation methods, personal protection from direct contact with effluent and sludge, self-monitoring and corrective actions to be taken. The Code has two annexes, the first provides guidelines for suitable treatment methods, irrigation and soil considerations while the second describes the methods of analysis for soil, plants and water.

The following diagram illustrates the discharge and possible means of reuse of wastewater in relation to the laws and standards.

Figure 3: Discharge and reuse of wastewater in relation to the laws and standards



3.2 RELEVANT STRATEGIC ENVIRONMENTAL OBJECTIVES

3.2.1 Environmental Objectives on the National and Local Levels and Related Strategies

The Ministry of State for Environmental Affairs (MSEA) has issued the National Environmental Action Plan (NEAP) for Egypt for the years 2002/2017. The NEAP is the official document representing Egypt's agenda for environmental actions for the 15-year duration of the Plan. The NEAP has identified the following main issues in which a certain agenda of actions and strategies have been developed:

- **Water resources:** The scarcity of fresh water resources and protecting them from pollution and wasteful uses were identified as an environmental issue that concerns all Egyptians and threatens the sustainability and development of Egypt. The Ministry of Water Resources and Irrigation (MWRI) has developed the National Water Resources Plan (NWRP) which focuses on protecting water resources in Egypt with a time horizon also ending in 2017. In 2010, a national strategy for the development and management of water resources until 2050 has been formulated. The strategy has 6 pillars: (1) Development of conventional and nonconventional water resources; (2) Increase water use efficiency; (3) Continue upgrading water resources infrastructure including hydraulic structures; (4) Combat water resources pollution; (5) Address climate change impacts and formulate adaptation strategies; and (6) Enhance integrated water resources planning and management. (Another EU funded project is on-going now for the Preparation of the National Water Resources Plan for Egypt 2017-2037 (NWRP 2017-2037)).
- **Ambient air quality** is a significant environmental issue affecting major urban settlements, which suffer from air emissions from industry, solid waste dumpsites and traffic. The Plan indicates that air quality problems are also extended to some rural areas. EEAA has begun the development of a National Strategy for Air Quality Management including relocation of some industries outside human settlements; adoption of cleaner technologies and energy conservation measures. A National Network for Monitoring Air Pollutants was established in 1998 with 90 air monitoring stations all over the country.
- **Land:** There are concerns that limited cultivated land cannot meet the needs of the country's growing population. Also, desertification and spread of informal urban development are among the environmental priority issues. Plans have been adopted by MALR and MHUUC to maintain sustainable land use and the development of new cities, and secondary cities with desert frontiers and industrial cities to direct urban development. The NEAP includes three regional action plans for managing the desertification issue, one is for the North Coastal Belts, the second is for Nile Valley and reclaimed desert areas that share infrastructure with the Nile valley, and the third is for the Oasis and Southern remote desert areas. The Building Law commissioned the task of preparing a National Strategic Plan for Urban Development 2052 in the end of 2008 to the general organization of public planning, in coordination with all concerned ministries and bodies. The Plan aims to develop a future vision that has a societal consensus and aims to achieve the balance in the spatial, economic and social development, according to an environmental system that

preserves heritage and resources. The Plan was presented and approved by the Supreme Council for Planning and urban Development in December 2013.

- **Marine Environment**: Pollution and erosion of coastal ecosystems are among the environmental priorities. The NEAP includes a program for managing national marine coastal zones, which is aimed at achieving a sustainable use of marine and coastal resources. The responsibility for conserving the marine life lies with EEAA while the protection of coastal areas and shores is the responsibility of MWRI.
- **Waste:** This includes municipal solid waste, agricultural waste, residues from dredging waterways, industrial waste, construction and demolition waste and hazardous waste including hospital wastes. MSEA and EEAA are currently implementing a policy for proper waste management at the national level.
- **Biodiversity:** The threats to biological diversity are caused by different social and economic factors, where low awareness about the importance of this aspect is a major factor. EEAA is currently developing programs and measures for supporting Egypt's declared natural protectorates and conserving biodiversity including specific projects for conserving wetlands near the Northern Coast and the protectorates of the Gulf of Aqaba.
- **Biosafety and Biotechnology:** These are regarded by the NEAP among emerging environmental issues in the world. The NEAP includes a program for regulating the handling of unintentional release of biological materials. It also includes a program for regulating intentional release of Genetically Modified Organisms in the environment.

At the regional and local level, each of the governorates, including those targeted by IWSP 2, prepared an Environmental Profile during 2004/2007 that includes descriptions of the respective main environmental systems and the priority environmental aspects. Following the Environmental Profiles, each governorate has prepared a Governorate Environmental Action Plan (GEAP) that includes sector specific plans at the governorate level, to manage priority environmental issues. More details about this are discussed in Chapter 3 of this report.

3.2.2 Strategic Objectives for Water Supply and Sanitation

Specific plans for water supply and sanitation are prepared by the MHUUC through NOPWASD. These plans are being achieved through allocating the budget for the implementation of water supply and sanitation projects. According to the National Plan for Egypt (2002-2037), the general objectives that are adopted in the Water Supply and Sanitation sector include:

- Complete coverage of cities and villages with water supply services;
- Provision of water supply services to deprived main villages and affiliated villages and set a medium term plan to provide sanitation services to all villages;
- Extend water supply services to desert areas adjacent to existing cities and in areas outside the Nile Valley in order to help extending urban areas;
- Minimize loss in water networks and reduce the load on sewerage systems;

- Upgrade the economics of operation and maintenance of Water Supply and Sanitation Projects in order to gradually reach cost coverage without increasing burdens on citizens;
- Conserve water consumption in houses through making water tariffs against actual consumption and improved water meters, improved awareness through education and media, improved regular maintenance of internal networks and prevention of contamination of water supplies through QC by provision of laboratories in different regions and governorates.

In each of the present target governorates, the ACs have developed detailed master plans for water supply and sanitation services for the time horizon until 2037.

The MHCWW developed the National Rural Sanitation Strategy 2017 to face the problem of very low sanitation coverage in rural area across the country (according to CAPMAS report 2017 the average percentage of sanitation coverage in rural areas in Egypt is 28.50%). Table 9 below summarizes the strategic objectives for national rural sanitation and the type of projects needed to achieve the objectives of the Strategy.

Table 9: National strategic objectives for rural sanitation and required projects types

Strategic objectives	Type of projects needed to achieve strategic objectives
Enable an Institutional environment that enhances performance by building governance capacity of the rural sanitation sub sector and ensuing effective participation of the private sector and local communities	• Preparation of Institutional Development Plan for the rural sanitation sub sector within the overall Sector Institutional Development Framework that aims to develop policy, laws, and institutions including sector entities, the private sector and local communities. • Implementation of an ID Programme with four main components: 1. Developing Policies and Laws 2. Enhancing the capacity of sector entities and concerned parties (consulting firms and contractors). 3. Developing and applying technological packages and systems 4. Enabling the efficient integration of all NRSS core strategies in programme planning and implementation.
Ensure access to sanitation services to populations living in settlements that can be served by sewer networks, and provide alternative viable sanitation options to people living in settlements that cannot be served by traditional sewer networks	• Construction of sewer networks in villages (single projects that aim at ensuring access to sewer networks in the village-built up area • Upgrading Sector Assets including all sewerage projects that have been implemented in the last three decades • Implementing projects to extend alternative options in areas that cannot be served by sewer networks
Enhance human health	• Construction of sewer networks in villages • Provision of alternative sanitation options in areas not served by

Strategic objectives	Type of projects needed to achieve strategic objectives
and wellbeing and environmental sustainability in all rural settlements (villages, Ezab, Naga) located within identified sanitation service cluster.	sewer networks • Establish an efficient system for domestic solid waste management (including transfer stations, sorting, and transport of the organic fraction to Integrated Treatment Facilities (ITF). • Implement public and environmental health awareness programs to strengthen community engagement • Functional and spatial integration achieved at the SSC level as per NRSS 2008
Realize major improvements in water quality in agricultural drains within the watershed of main drains allowing for sustainable reuse.	• Construction of sewer networks in villages • Provision of alternative sanitation options in areas not served by sewer networks • Establish an efficient system for solid waste management (including transfer stations, sorting, and transport of the organic fraction to Integrated Treatment Facilities (ITF). • Implement public and environmental health awareness programs to strengthen community engagement • Industrial pollution abatement projects to ensure compliance of industries located within the water shed of main drains with environmental laws and regulations to protect water resources from industrial pollution

Source: National Rural Sanitation Strategy 2017

Based on this strategic objectives and required projects types the sanitation services levels had been divided also into four levels:

- **First Sanitation Level SSL 1**: Extension of sewer networks, pumping stations and WWTP at the village level.
- **Second Sanitation Level SSL 2:** Provision of sanitation services to areas un-served by sewer networks.
- **Third Sanitation Level SSL 3**: Extension of integrated wastewater and solid waste management at the Cluster Level.
- **Fourth Sanitation Level SSL 4**: Extension of integrated wastewater and solid waste and industrial pollution management in all clusters located within the water shed of main drains.

It is worth mentioning that IWSP1 and IWSP 2 projects were listed under NRSS 2017 with other projects such as ISSIP1&2, Kafr El-Sheikh Wastewater project and Egyptian Utilities Management Agreement (EUM).

3.3 RELEVANT INTERNATIONAL ENVIRONMENTAL GUIDELINES AND STANDARDS

The involvement of EDP in the Programme requires the consideration of selected international guidelines and standards in line with the environmental and social policies of these institutions.

The German Development Bank KfW is the lead institution among the EDPs supporting IWSP 2. According to KfW policies the Project design and implementation arrangements shall be compliant with both, the relevant national legislation, procedures and standards for environmental and social management and with the environmental and social safeguards standards provided in KfW's

'Sustainability Guideline' (2016). In case of discrepancies between these the stricter standards or procedures apply. Besides any national requirements for the EIA process, EU requirements for environmental and social assessment and management shall be considered.

When assessing the environmental, social and climate impact of projects, KfW Development Bank must adhere to the policies and principles laid down in KfW Group's Sustainability Guideline (2016) laid and the specific developmental concepts and guidelines of the German federal government for development cooperation.

The foundation of the assessment of environmental, social and climate impacts of a project or programme is its compliance with the national legal requirements and standards and with the assessment requirements of KfW Development Bank. Mandatory international standards are those of the World Bank Group and the Core Labour Standards of the International Labour Organization (ILO):

- **World Bank Environmental and Social Safeguards**

  http://www.worldbank.org/en/programs/environmental-and-social-policies-for-projects/brief/environmental-and-social-safeguards-policies

  (as of October 2018, the new WB ESS apply and thus the ESIAs undertaken for each project will need to comply with the new ESS)

- **EHS Guidelines from the World Bank Group (general and project scope specific):**

  http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/our+approach/risk+management/ehsguidelines

- **Guidelines from the World Health Organisation (WHO)**

  http://www.who.int/phe/health_topics/outdoorair/outdoorair_aqg/en/
  http://www.who.int/water_sanitation_health/publications/gdwq4-1st-addendum/en/
  http://www.who.int/water_sanitation_health/sanitation-waste/wastewater/wastewater-guidelines/en/

- **The Core Labour Standards from the International Labour Organisation (ILO):**

  1. Freedom of Association & Protection of the Right to Organise Convention, 1948 (No. 87);
  2. Right to Organise and Collective Bargaining Convention, 1949 (No. 98);
  3. Forced Labour Convention, 1930 (No. 29);
  4. Abolition of Forced Labour Convention, 1957 (No. 105);
  5. Minimum Age Convention, 1973 (No. 138);
  6. Worst Forms of Child Labour Convention, 1999 (No. 182);
  7. Equal Remuneration Convention, 1951 (No. 100);
  8. Discrimination (Employment and Occupation) Convention, 1958 (No. 111).

- **KfW Sustainability Guideline (2016)**

  https://www.kfw.de/Download-Center/Konzernthemen/Nachhaltigkeit/englisch/Umwelt-u-Sozialleitsaetze_E.pdf

KfW's Sustainability Guideline requires that all of the above international standards are met in implementing a Project or Programme funded by the Bank. The future environmental management arrangements and mitigation measures provided in the respective Environmental and Social Management Plans (ESMP) shall therefore be aligned with these standards.

- **PMU and ACs will be responsible during the Construction and Operation phases for:**

1. Approval of these ESMPs and associated documents and their implementation prior to Construction Phase;
2. Providing resources to ensure that the implementation of the Projects is done in accordance with Project ESMPs;
3. Obtaining permits for project development;
4. Including environmental compliance requirements in all contracts documents;
5. Ensuring all Contractors as well as the Engineer are issued with the ESMP and associated documents as part of their contract documents.

4 DESCRIPTION OF THE PROJECT AREA

4.1 SOCIO-ECONOMIC CHARACTERISTICS

4.1.1 Demographic Situation and Population Forecast

Regarding all available demographic data and forecasts, the steady increase of the population is a very important factor to be considered when discussing environmental problems.

As per the results of the 2017 Population Census the average population growth rate in Egypt increased from 2.04 % for period from 1996 to 2006 to 2.58 % for period from 2006 to 2016. On average, the growth rate of the four governorates under this Project is 2.29% which means that there population may reach almost 25 M by 2030. Such increase in growth rate in Upper Egypt governorates compared to other governorates is related to the cultural inheritance encouraging early marriage and to low economic standards of the families (this also encourages families to have more children as a source of income).

It is worth mentioning that the government of Egypt is seeking to decrease the population growth rate to reach 1.50% by the year 2030. This goal shall be achieved by implementing a series of sustainable development strategies developed under Egypt's sustainable development strategy 'Visions 2030''[4]

Table 10: Population growth trend and rates in target governorates

Population / Growth Rate	Qena	Sohag	Assiut	Minya	Total
Population in 2006 (millions)	3.0	3.75	3.44	4.18	14.37
Population in 2017 (millions)	3.66	4.97	4.38	5.49	18.50
Annual growth rate	1.84%	2.59%	2.22%	2.51%	2.29%
Urban population (2017)	18.8%	21.22%	25.9%	18.0%	24.6%
Population in 2025 (millions)	4.24	6.10	5.22	6.69	22.25
Population in 2030 (millions)	4.64	6.93	5.83	7.58	24.98

Source: CAPMAS report 2018

The main effects of the high population growth trends in respect of the environment are identified as follows:

- Increasing demand on potable water supplies;
- Increasing demand of wastewater to be treated;

[4] Source: Sustainable development strategy, Egypt's vision 2030

- A steady and significant decrease of groundwater levels;
- Increasing demand on valuable agricultural land for housing, infrastructure, etc.;
- Increasing demand on food and crops, but decrease in agricultural land availability;
- Steady decrease of soil value in many areas;
- Increasing demand on efficient waste handling and management;
- Increasing air pollution and CO2 emissions;
- Increasing demand for energy;
- Increasing demand for protecting water courses and drains from pollution;
- Loss of natural habitats, loss of species (plants and animals);
- Additional challenges of climate change (increasing salinity of soils, increase of rainfall, sea level rise).

4.1.2 Gender Aspects

The sex structure of the four governorates is quite keenly balanced with approximately 48.3 – 48.8% of the population being female. There are small variations between governorates, Markazes and between urban and rural areas. The data for age structure in the target governorates of the IWSP 2 shows that most half the population 51 - 55% are in the 15-60 age (work age), as a result the percentage of those being supported (youngsters + elderly) reaches 45 - 49%, such high percentage increases the burden on the producing category.

4.1.3 Education

Regarding education level the percentage of Illiterate population was 37.2, 34.6, 33.6 and 29.1% for Minya, Assiut, Sohag, and Qena respectively Minya was the highest percentage all over the country and the four project governorates ranked in the top 8. The average number of heads per household in the four Governorates is almost 4.4, while the average number of persons per room reaches 1.34. These figures are higher than the national average by 9 and 13% respectively. The following table shows the percentage of utilities coverage in the target governorates, obvious the four governorates facing a severe problem in sanitation sector especially in rural areas.

Table 11: Percentage of utilities coverage in the target governorates

Utilities		Qena	Sohag	Assiut	Minya
Water supply	Urban	99.5%	99.6%	99.6%	99.7%
	Rural	95.9%	97.4%	98.5%	96.2%
Electricity network	Urban	99.9%	99.8%	99.8%	99.8%
	Rural	99.5%	99.4%	99.5%	99.5%
Sanitation	Urban	63.1%	74.5%	55.5%	78.9%
	Rural	3.8%	7.1%	7.1%	6.6%

Source: CAPMAS 2018

4.1.4 Poverty

As compared to the current average national poverty rate of 27.8% the socio-economic conditions in the four target governorates of the Project represent a huge problem. According to data provided in the National Strategic Plan 2052 the poverty rates in these areas are the highest in the country with almost 66%, 65.8%, 57.8% and 56.7% for Assiut, Sohag, Qena and Minya governorates respectively. Poverty is not only related to income, but also determined by such factors as health, security, education, and basic nutrition services. Water supply and illiteracy may be used as further indicators for poverty.

4.2 PUBLIC HEALTH

Public health is generally poor in the Project's target governorates due to the level of poverty. Although access to health care is improving, malnutrition, cost of medical treatment and traditions serve to compound the effects of inadequate levels of service provision. The relatively low quality of surface water is a major cause of a number of important diseases. The Environmental Action Plans (GEAPs) for different governorates acknowledge this fact and indicate that water-borne diseases are mainly caused by inadequate sanitation, especially in rural communities, and low water quality of canals and drains that are being used by many rural inhabitants for bathing and cleansing purposes.
Exposure to polluted water, whether through oral exposure or skin contact, can cause many diseases such as diarrhoea, bilharzia, hepatitis A, polio, typhoid and malaria. Areas of stagnant water are the breeding grounds for mosquitoes that can transmit a number of diseases.
The following table presents some statistical information regarding known diseases in the four Governorates within the IWSP 2 Programme.

Table 12: Known diseases in Qena, Sohag, Assiut and Minya governorates (2005)[5]

Governorate	Qena	Sohag	Assiut	Minya
Bilharzias	Data unavailable	Data unavailable	26,728	1,500/ 1,442,385
Hepatitis	245	Data unavailable	Data unavailable	Data unavailable
Polio	Data unavailable	Data unavailable	Data unavailable	Data unavailable
Typhoid	130	Data unavailable	6.96/100,000	617
Malaria	Data unavailable	Data unavailable	Data unavailable	Data unavailable

* for each 100,000 capita

It is worth noting that although the above statistics are given in the Environmental Profiles for the Governorates prepared in 2006/2007, it is not expected that more recent statistics will give any different indication as no major improvements were made to water quality and level of sanitation in most of the project area.

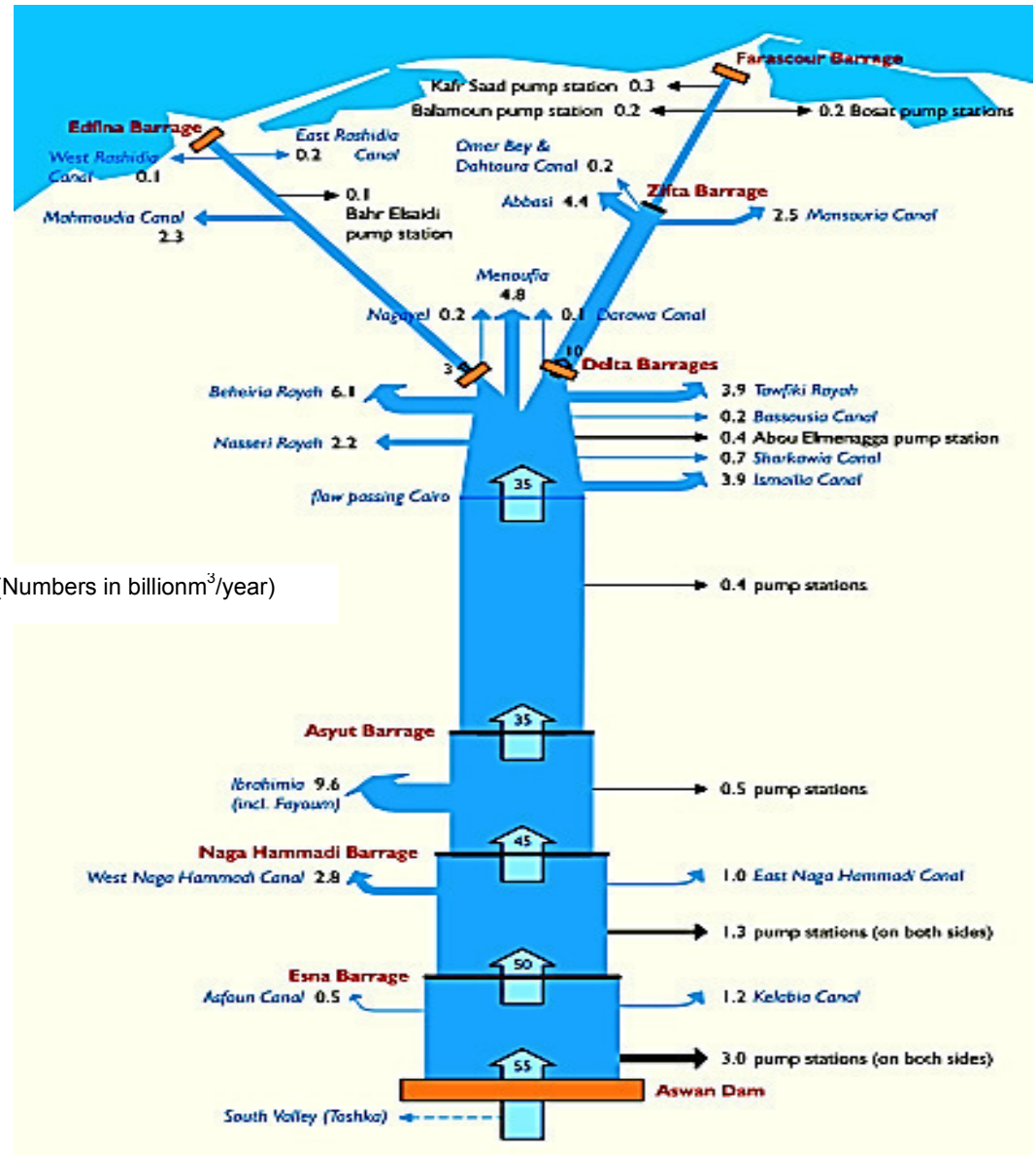
[5] Source: Environmental Profiles of the respective Governorates

4.3 SURFACE WATER RESOURCES

4.3.1 Nile Branches and Irrigation Network

Egypt receives about 98% of its freshwater resources from outside its international borders and the River Nile satisfies more than 95% of the various water requirements. The River Nile is the second longest river in the world and is over 6,800 km in length with a basin area of about 3 million square kilometres. The river travels through ten African countries being fed by the two main tributaries: the Blue Nile originating from the Ethiopian Plateau and the White Nile originating from the Equatorial Plateau.

Figure 4: River Nile Water Balance (Numbers in billion.m^3/year)



(Numbers in billionm^3/year)

National Water Resources Plan (2012-2017)

Qena Governorate

Qena Governorate covers a large area of the Nile Valley and extends more than 350 km along the Nile River from Isna to Naga-Hammady. The MWRI divides the area into 3 main irrigation

inspectorates, namely Isna, Qena and Naga-Hammadi, in order to optimise the management of water resources and demands.

There are two main canals in Qena that take water directly from the Nile upstream of Isna barrage,: the Asfoun Canal and the Kalabaya Canal. These two canals are used to irrigate the agricultural land between Isna and Naga-Hammadi barrages together with 9 pumping stations directly on the main channel of the River Nile.

The Asfoun Canal is located on the western side of the River Nile to irrigate approximately 68,879 fd of agricultural land west of the river Nile. The Kalabaya Canal runs in parallel to the eastern bank of the Nile for a length of 163 km and irrigates approximately 174,515 fd of agricultural land in the east of the river.

Sohag Governorate

Sohag receives its irrigation water from the River and the main irrigation canals, namely Nag-Hammadi-West and Nag-Hammadi-West canals. The total length of these two canals is about 130 km and 150 km, respectively. These canals take water from the River Nile at the upstream side of Nag-Hammadi Barrage.

There are other large irrigation canals to the west of the Nile and they take water from the upstream portion of the regulators constructed on the Nag-Hammadi-West canal. These canals are the El Baliana, El-Kasra, El-Girgawia and El-Tahtawia canals. The total lengths of these canals are 60, 50, 45, and 60 km respectively. In addition, there are a large number of small irrigation canals, mesaks and drains distributed all over the agricultural lands. The main irrigation canals and drains in Sohag Governorate occupy an area of about 8.5 km^2 (about 2023 fd), and have a direct effect on the hydrological conditions of the aquifer. The volume of surface water entering the Sohag Governorate for irrigation purposes into the main canals amounts to 1,950,000m^3/year. The amounts vary on a monthly basis, with the greatest flows being released during June, July and August at about 250,000m^3/day. There is no flow in the canal during January. During the remaining months the average flow is about 150,000m^3/day. The Nile water level fluctuates by about 2m due to the amount of water released by the High Dam.

Assiut Governorate

Assiut Governorate mainly depends on the Nile water for both irrigation and potable water supply. The estimated amount of discharged water to Assuit governorate is about 1599 million m^3/year. The main canals at the governorate are: Ibrahimeya canal which serves to irrigate about 79,407 fd, Nag-Hammadi-West canal, which supplies about 141,000 fd and Nag-Hammadi-East canal, irrigating about 88,000 fd.

Minya Governorate

As the three previous governorates, Minya Governorate mainly depends on the Nile water for irrigation and water supply. The most important canals crossing Minya are Ibrahimeya canal, crossing the governorate from South to North in the middle of the precipitate plain in the center of Minya (out of this canal branches the sub canals that are spread over Minya) and Bahr Youssef, the main canal of the governorate, which runs from South to North and lies on the western edge of the populated areas.

4.3.2 Surface water quality

The Project governorates are provided with water of acceptable quality from the Nile and the main canals branching off from the river. However, most of the agricultural drains discharging into the Nile are highly polluted, containing all types of agricultural, industrial and human drain water. Oils and wastes from the boats are further important water pollutants. Such impacts are most pronounced within and downstream of populated urban and industrial areas.

The results of water quality measurements provided in the Environment Statistics Report of Egypt (2017) show that the values measured in the four governorates generally meet the standards of Law 48/1982. This is mainly due to dilution effects as the total volume of available fresh water is much higher than the polluted sources. As for the water quality of the main canals, there are no data available. These waters, as well, are subject to contamination especially as some of these canals pass along or through population blocks where they are misused by people dumping domestic waste or even dead animals.

The ISSIP 2 project team conducted a water analysis from drains and canals of Assiut and Sohag and found no major differences between the values for the River Nile (Table 13) and the selected samples (Table 14).

Table 13: Water Quality Measurements for River Nile (mg/l)

Parameter	Qena	Sohag	Assiut	Minya
DO	6.2	7.4	7.5	7.2
BOD	6.6	3.6	4.6	6.0
COD	20.1	10.2	6.8	23.3
TDS	245	236	246	220

Source: Environmental Statistics (2017)

Table 14: Water sample results from ISSIP II project (mg/l)

Parameter	Assiut		Sohag					
	Sample 1	Sample 2	Al Samta	Ghunaimyiah	Al Halafi	Um Duma	Al Mahameed	Al Mazalwa
TSS	273	43	ND	22.5	ND	ND	ND	ND
pH	7.32	7.22	7.6	7.7	7.8	7.8	7.5	7.7
BOD	4	6	7	4	4.5	8.5	3	12
COD	18	12	12.5	6	7	13	5	18
TN	1.51	1.89	ND	ND	ND	ND	ND	ND
T.coliform*	1330	1500	Nill	Nill	Nill	Nill	Nill	Nill

* Measured in 100 cells / cm^3

4.3.3 Drainage System

In Upper Egypt, the majority of the drainage water is returned to the main river channel whereas in the Delta region drainage water is pumped in to the Mediterranean Sea and the northern lakes. The main drains in the target governorates of the IWSP 2 are:

- **Qena Governorate:** The River Nile reach between Isna and Naga-Hammadi was estimated to be recharged with drain water of about 0.72 B.m3/year through 16 main drainage channels, from an area of approximately 285,000 fd;
- **Sohag Governorate**: the main drain in Sohag city and the main drain in Tahta, Akhmiem drain, el Balina drain and other small drains. The drain network passes from north to south and in parallel to the main irrigation channels;
- **Assiut Governorate**: The drains in the governorate are Assiouty, Zawya, El Siel, Ababnoub, El Bahary, Bani Mohamed, El Badara main drain, Abou Tieg, Beni Samie el Qebly, El Asaya and El Kom El Ahmar;
- **Minya Governorate**: Minya is divided; drain wise, into two main parts: a part that lies east of the Nile and a part that lies west of the Nile between the latter and Ebrahemya canal. The local topography in both locations helps drainage into the Nile. The land that falls between Ebrahemya canal and Bahr Youssef is characterised by a dense network of surface drains. The volume of water draining from the agricultural lands into the Mohit (the main drain in the governorate) is considered as relatively high with about 1.5 million m3/day beingredirected back to the Nile through Atsa drain opening. Mohit serves an area of 105,000 fd equipped with a network of covered drains. Excess agricultural water is drained to Mohit and then to River Nile without any processing at Etsa village, Samallout.

A survey undertaken by the National Water Research Center in 2006 found that 67 agricultural drains discharge waste water into the Nile between Aswan and El-Kanater. Water from 43 of these drains were tested, and it was found that only few of these samples were compatible with the standards established by the Law 48 of 1982 and the provisions of Article 65 that regulates the type of drain waters which may be mixed with freshwater resources. The worst results were found in following drains:

- Khor Elseil in Aswan;
- Kom Ombo;
- El Barba; and
- Etsa (El-Mohit).

Etsa drain is the main drain in Minya. It was found that this drain discharges the highest load of organic substances (57 tons of COD/day – 51.7 tons of BOD / day). In February 2006 EEAA's Regional Branch Office in Assiut undertook a survey to examine the water quality of El-Mohit drain in the governorate. The sample was not in compliance with the applicable water quality standards due to a lack of dissolved oxygen, and increased concentrations of BOD, COD, TSS, oils and fats, total alkalinity, Fe and cyanide. These results clearly indicate the level of pollution in these drains and the significance of the impact of mixing such polluted water with the Nile.

Table 15: El-Mohit drain - Results of water quality measurements

Parameter	Unit	Result
Temperature	^{0}C	23
pH	unit	7.3
Electrical conductivity	MS-CM	0.925
Turbidity	unit	68
COD	(mg/l)	200
TDS	(mg/l)	615
TSS	(mg/l)	620
Fats and Oil	(mg/l)	0
Sulphides	(mg/l)	15.4
Nitrates	(mg/l)	8.6
TN	(mg/l)	12.1
TOC	(mg/l)	430

Source: Minya Governorate environmental profile (2007)

In general, the water quality of such drains is not in compliance with the quality standards for surface wasters provided in the applicable national legislation. In many cases, these drains represent health hazards for the population and in fact most of the health care problems are related to the sewage. The most common diseases among the population are those resulting from water contamination such as malaria and typhoid.

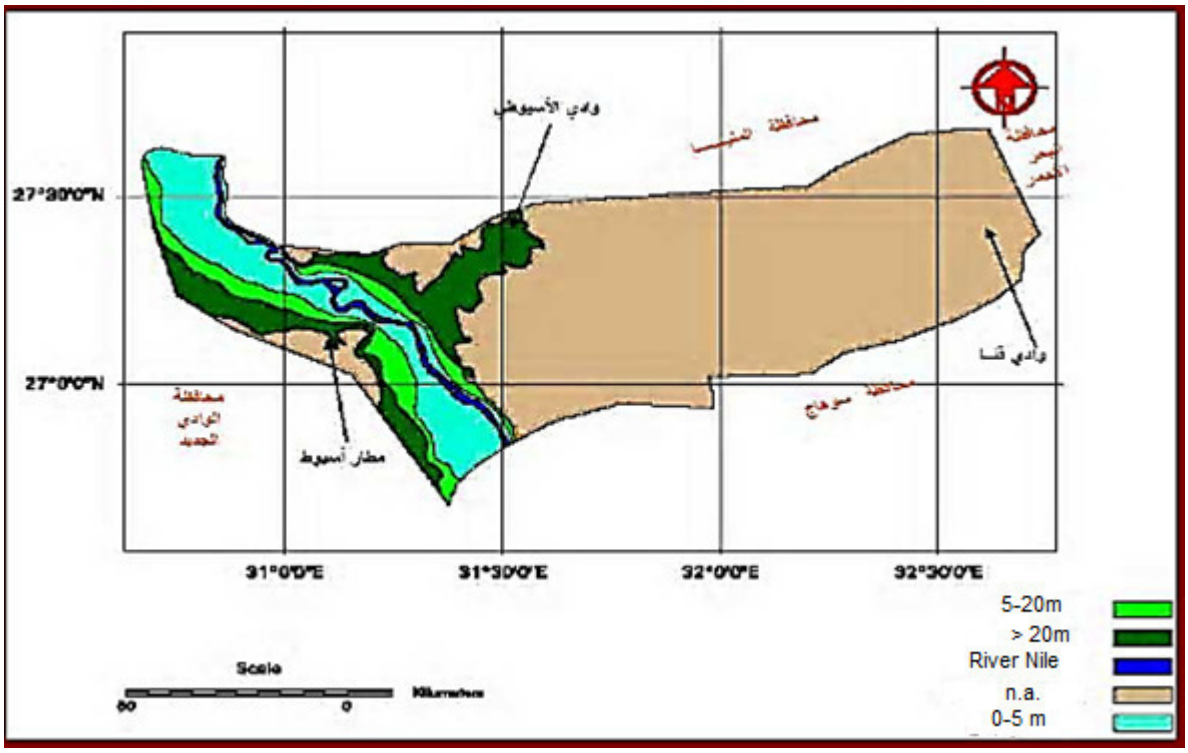
As all Upper Egypt drains are connected to River Nile tertiary treatment (filtration) will have to be foreseen for all WWTPs in line with the requirements of Decree 208/2018 (refer to section 3.1.3 of this report).

4.4 HYDROGEOLOGY AND GROUNDWATER RESOURCES

As shown in Annex 2 ground water is the second main source of potable water in the IWSP 2 governorates through wells stations that are supplied with diving pumps for groundwater extraction. The groundwater table is relatively high especially near the Nile River and irrigation canals. The depth and the salinity of ground water increases based on the distance from these sources, mainly due to the hydraulic connection between both surface water in the river and the main irrigation canals, and groundwater in the aquifer. Generally, the river acts as a discharging body for the aquifer and the irrigation canals act as recipients for these water resources.

The Nile Valley aquifer system is composed of Quaternary and Late Tertiary sand and gravel beds intercalated with clay lenses. The aquifer thickness decreases from 300 m at Sohag to a few meters near Cairo (north) and near Idfu (south). Pliocene clays, generally considered as the impervious base of the aquifer, underlie the aquifer. The inner reservoir of the Nile valley in Project area is supplied from the leakage of the excess irrigation water from the canals and the agricultural lands. The volume of such water varies according to the type of the soil and the method of irrigation. In the sand soils, at the sides of the Nile valley, the rate of vertical drain ranges from 1 to 2.5 mm/day, whereas it reaches 1 m in the agricultural soils covered with mud. This water could be drained at a rate of 80-280 m^3/hr.

Figure 5: Ground water depth for Assiut Governorate



Source: Assiut governorate environmental profile

Groundwater of the Nile Valley aquifer is of good quality and generally suitable for both irrigation and domestic uses. The values for total dissolved salt range between 260 and 1280 ppm. The salinity increases in the unconfined part of the aquifer, mainly due to the leaching of the lithological formation by water flow from the semi-confined aquifer to the unconfined one.

Groundwater in the valley fringes is unsuitable for drinking purposes. The groundwater in the old lands (Nile valley) is characterised as moderately hard water and as very hard at the valley fringes. Some areas have high iron and manganese concentrations. Bacteriological contamination of groundwater resources mainly depends on the source and location of groundwater extraction. According to project governorates environmental profiles the water extracted from the aquifer is free from pathogenic bacteria as long as proper extraction procedures are used (e.g. well depth, well development and maintenance).

4.5 AMBIENT AIR QUALITY

In the urban areas of the IWSP 2 target governorates ambient air quality is generally affected by the combined effects of emissions from traffic and industrial sources. Accordingly air quality in large cities and industrial areas is usually lower than that in rural areas due to high concentrations of PM, often in excess of the standards for ambient air quality provided by Law 4/1994. An exception to the above usually occurs between the months of October and November when large amounts of agricultural waste (especially rice and cotton wastes) are openly burnt in agricultural fields. During this period the air quality in those affected rural areas is highly contaminated, especially during the night when air mixing is at its minimum.

In 2010 the EEAA installed 87 monitoring stations for air quality, which are located in urban, industrial or residential areas. The Table below presents selected ambient air quality data for 2016 as provided for the four Governorates in the Environmental Statistics which are regularly published by CAPMAS

Table 16: Ambient air quality data 2016

Parameter / µg / m³	National limit	WHO Guideline 24h exposure	Qena	Sohag	Assiut	Minya
PM_{10}	70	50	157	299	304	329
Smoke			12.16	53.99	24.58	21.86
TSP	90		---	565	397	667
PB	1		---	0.19	---	0.16
SO_2	60	20	---	---	14.40	24.80

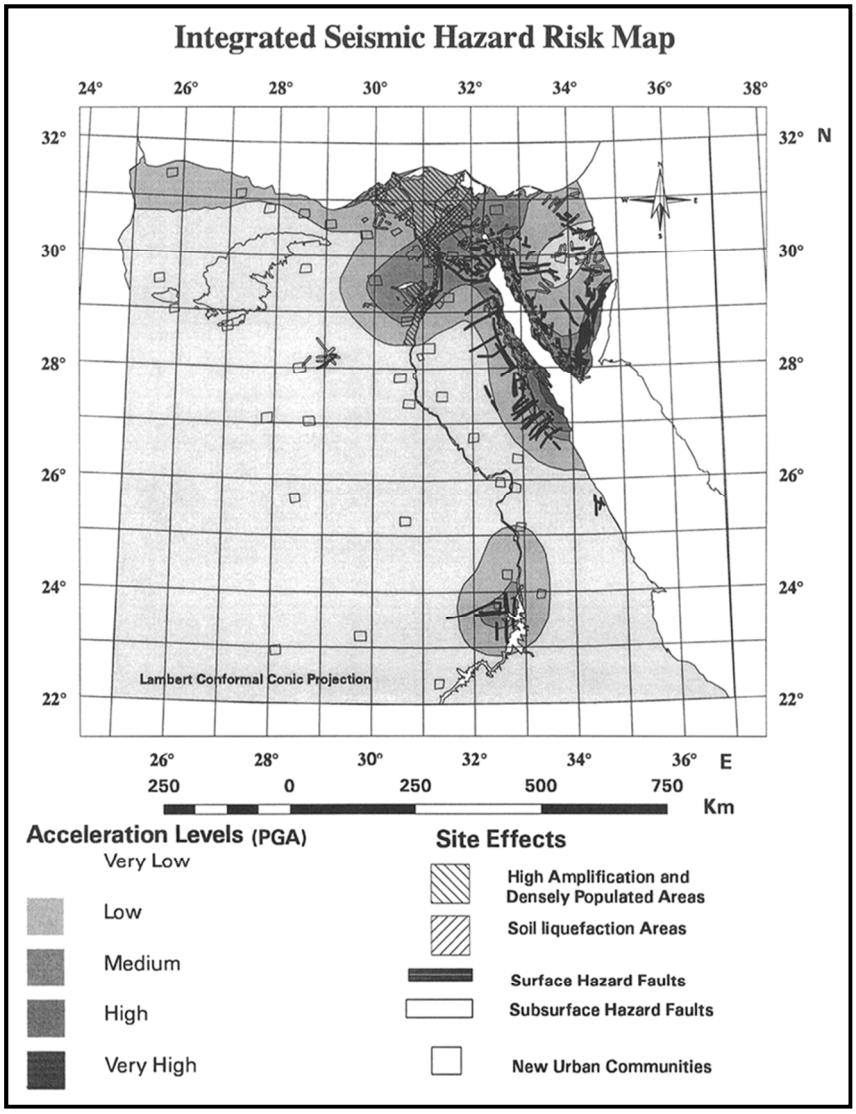
As can be seen from the above, air pollution levels are well in excess of the applicable standards, both nationally and internationally.

4.6 PHYSICAL DATA

4.6.1 Seismicity

The seismicity of the region will be taken into consideration in further planning stages. The project area in Upper Egypt is considered as low risk region.

Figure 6: Seismic Hazard Map



4.6.2 Climate/Climate Change

The climate in the project areas is characterized by hot arid summers and little rain during the winter. The temperatures are especially high in the dry season with a range between 12°C and 41°C with an average temperature of about 29°C.

The climate in Upper Egypt is characterized by scarce rainfall with an annual average rainfall of about 5 mm (in Minya) and 9 mm (in Sohag), which usually occurs during the winter month. Relative humidity varies throughout the year, ranging from 15 to 52 %.

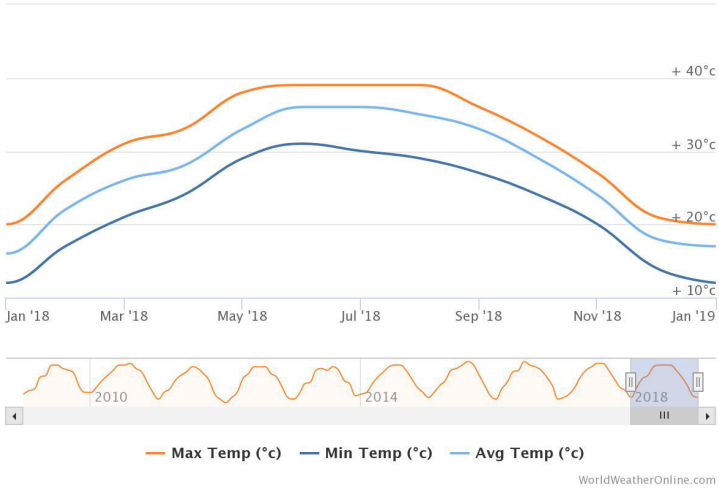


Figure 7 Indicative temperature distribution in Upper Egypt (Minya)

As provided in the ToR for this study a separate "Climate Change Impact Assessment" has been prepared and is attached to this report in Annex 3.

4.7 FLORA, FAUNA, HABITATS, PROTECTED AREAS AND BIODIVERSITY

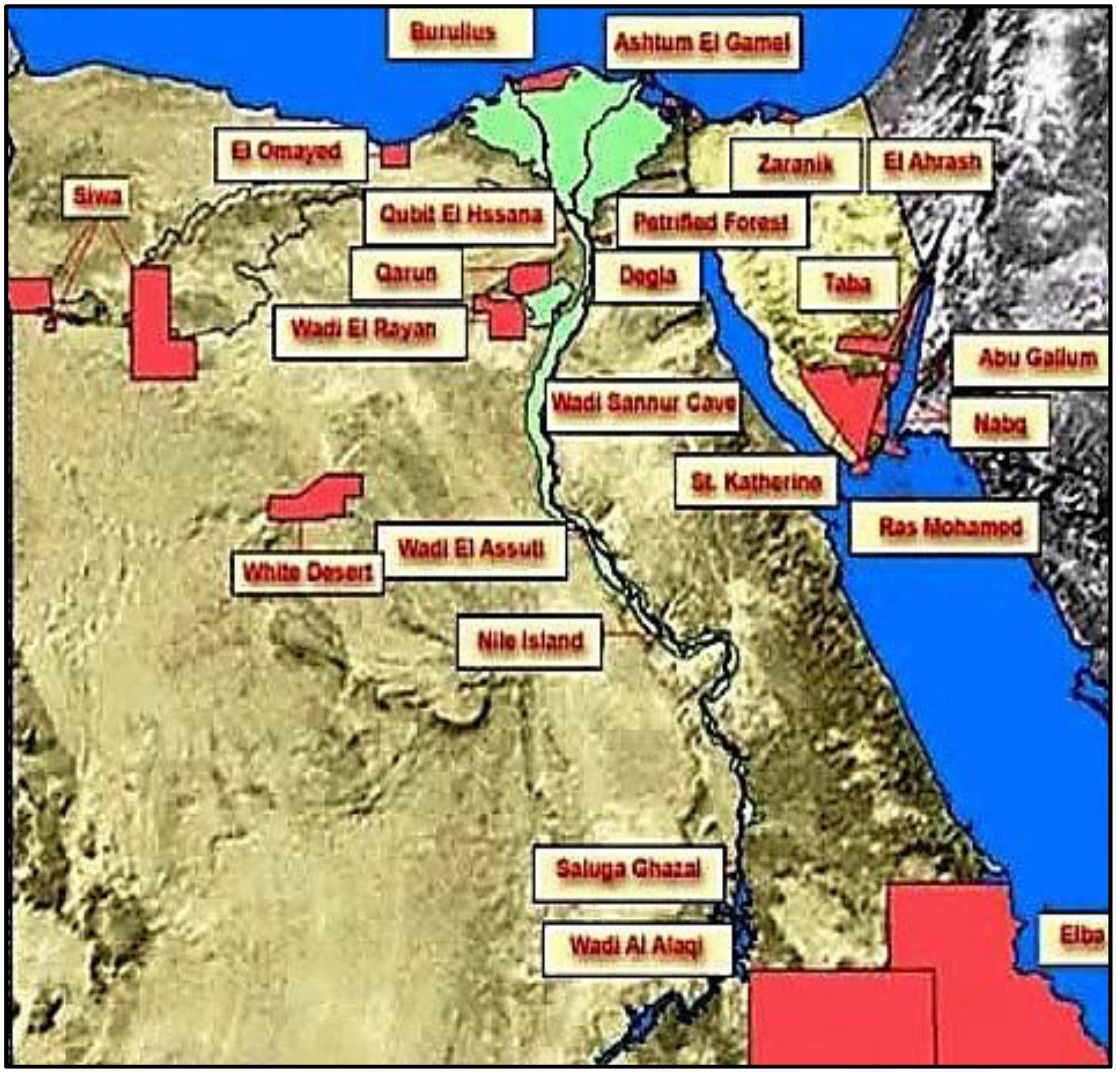
There are 29 declared Protected Areas in Egypt according to Law 102/1983, one item of these 29 areas include all islands located within the River Nile and its branches which sum up to 144 islands. EEAA also identified 34 locations as Important Birds Areas (IBA), 15 of them are within protected areas. The criteria for classifying a certain area as IBA is because these include globally threatened species, species with very small global ranges, concentrations of large numbers of birds and groups of species confined to particular habitat types. The recommended measures by EEAA in these IBAs include protection of birds from illegal hunting and harmful pollution and as well as birds' assessment as part of the EIA process for developmental projects carried out in these areas.

The only protected area in the four governorates is Wadi Al-Assiuty in Assiut Governorate it was declared as protected area on 1989, its area is 35 Km^2 and it is divided into two major sections:

Captive breeding of wild animals: There are possibilities of captive breeding of Egyptian deer, mountain goats, bighorn, ostrich, zebra and some reptiles.

Captive and plant genes: Since there is a need to collect plant genes threatened with extinction, especially palm trees, some types of trees, bushes, plantations, cactus, juicy plants and medical and aromatic plants that are genes of important economic crops, several types were planted in protected areas where the wild genes are collected from the vicinity for reproduction.

Figure 8: Map of protected areas in Egypt



The four target governorates include clay agriculture lands with cultivations of the typical cash crops grown in the Egyptian agricultural areas. Sugar cane, cotton, maize, wheat, and beans are the common crops grown at different seasons in the agricultural land.

The flora of the Nile River in this region is dominated by *Phragmites* and *Typha* reed swamps on its banks, along canals and on islands. Small clusters of Water Hyacinth *Eichhornia crassipes* are found on the river, in isolated, sheltered inlets where the current is weak. *Ceratophyllum demersum* was the only species of aquatic flora found. River and canal banks are normally covered with Halfa grass (*Desmostacia bipinnata*).

In the desert extend of the governorates five common plant species were recorded in the sand flat formation habitat at the area of investigation which covers the surroundings of the Project areas. These species were *Chenopodium album*, the salt-tolerant xerophyte, *Anabasis articulate* and *Tamarix nilotica.*

The Nile Valley and Delta have been converted to a man-made ecosystem due to intensive human action. Animals now inhabiting the region are those that are able to tolerate human activities or those

that can avoid contact with the human. The intensive cultivation and widespread use of agrochemicals have contaminated the region, adversely affecting many of the native animals.

- **Mammals:** Wild mammals are rarely observed largely due to the fact that most are nocturnal, shy and probably relatively scarce. Bats and rodents are the best represented (in terms of number of species) and are the most numerous mammals in project governorates with twelve species each. A small number of large mammals occur in the Governorates, of which at least two species, Barbary Sheep (*Ammotragus lervia ornata*) and Nubian Wild Ass (*Equus asinus africanus*), are thought to have been extirpated during the last two hundred years. Given the few surveys of mammals, it is likely that there are additional species still to be reported.
- **Birds:** The characteristic birds in governorate include *Egretta alba alba* (common), *Egretta ibis ibis* (rare), *Corvus corone saradoniux* (common), *Streptopelia senegalenis aegyptiaca* (common) and *Fringilla montifringilla* (common).
- **Reptiles:** 34 species of reptiles were recorded in the Nile Valley and Delta (Anon, 1993). Common reptiles at the project area include the agama *Trapelus mutabilis*, the gecko *Tarentola annularis annularis*, the small-spotted lizard *Mesalina guttulata*, *Canthodactylus boskianu Hemidactylus turcicus, Chalcides ocelltus*, the snake species *Coluber florulentus*, *Natrix tessellata, Psammophis sibilans, Telescopus dhara* and the Egyptian cobra *Naja haje*, the Nile monitor *Varanus niloticus*, and the skink *Mabya quinquetaeniata*. These reptiles live at both vegetation and desert environments within the Governorate areas.
- **Fishes:** According to the relevant Environmental Profiles for the target areas of this study common freshwater species are Bolti , catfish, grouper, electric eel, labis, shal and snake fish

It is worth noting that according to the Environmental Profile of Egypt 2010, there are 211 species of plants and animals in Egypt that are classified as alien and invasive species. Of these, 21 are among the worst invasive species according to global classification. The water hyacinth is one of these 21 species, invading surface water bodies in IWSP 2 governorates, and generally in Egypt, as result of eutrophic conditions in these waters.

Habitats found within the target area of IWSP 2 are common and widely spread across Egypt. The recorded plant and animal species are common in both the Nile Valley and Delta. Much of the habitats in the study area have been degraded by human activities and according to information in the relevant Environmental Profiles no rare or endangered plants and animals occur.

4.8 LANDSCAPE, LAND USE AND AGRICULTURE

Three of the four target Governorates - except Minya - are narrow strips of land along both banks of the River Nile, with a length of almost 450 km. The cultivated width ranges between 10 and 25 km, but the governorates' boundaries extend according to the recent classification of boundaries to the west and east.

The Upper Egypt region is generally characterized by a gentle-moderate slope from south to north where the slopes descend from approximately 75 meters above sea level in the south of Qena

Governorate to 35 meters above sea level in the north of Minya Governorate. There are some exceptions to this; especially in locations east and west of River Nile (outside the cultivated area).

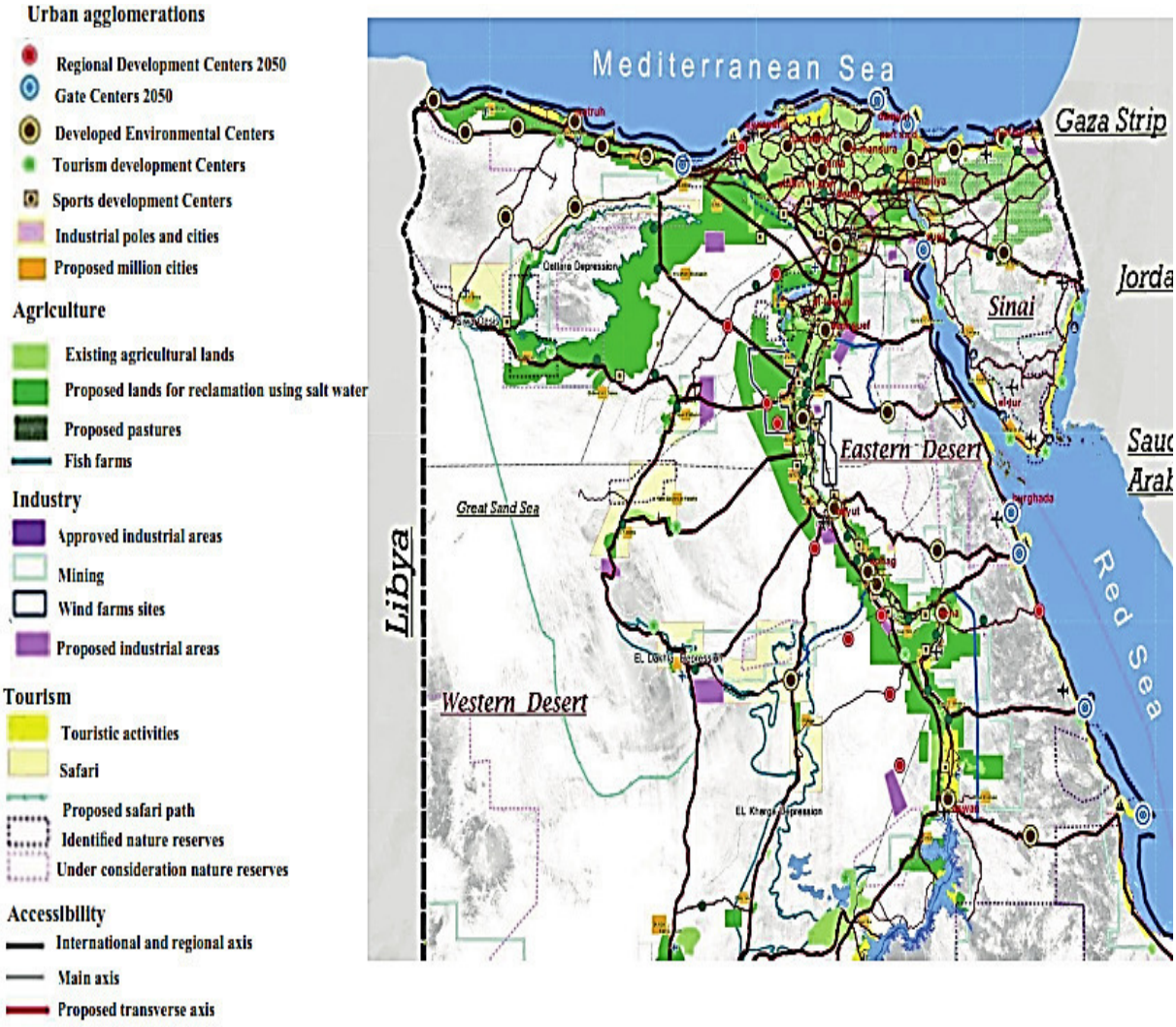
Areas of the target governorates are 10,798km^2, 11,022km^2, 25,926km^2 and 32,279km^2 for Qena, Sohag, Assiut and Minya respectively. According to statistics given in the respective Environmental Profiles[6] about 85 to 95% of governorates' land is classed as uninhabited desert land while most of the cultivated and inhabited land within the four target governorates is used for agriculture purposes (about 85%).

The Ministry of Housing, Utilities and Urban Communities through the General Organization of Physical Planning developed the National Strategic Urban Plan to guide urban development for the entire country up to 2052[7]. This Plan aims to develop a future vision that has a societal consensus and aims to achieve the balance in the spatial, economic and social development, according to an environmental system that preserves heritage and resources. The Plan also includes the establishment of two new cities in the IWSP 2 project governorates named West Qena and West Assiut.

The Upper Egypt region which includes the Governorates of Beni-Suef, Minya, Assiut, Sohag, Qena, Luxor and Aswan makes a significant contribution to agricultural production in Egypt. The agricultural area of Upper Egypt amounting to about 2.90 million fd represents about 32.8% of the total agricultural area, while the crop area, of about 4.7 million fd, represent about 31% of the total cropped area in Egypt. In addition, the region is characterized by favourable climatic conditions for the cultivation of export crops competitive in European markets.

[6] Available at "http://www.eeaa.gov.eg/en-us/mediacenter/reports/govenvprofile.aspx"

Figure 9: National Strategic Plan for Urban Development (2052)



Source: National Strategic Urban Plan 2052

Agriculture areas in the four project governorates equal to 1,649,251 fd which represents 57% of the agriculture area of upper Egypt region and 18.6% of the total agricultural area of the country. These agricultural areas are distributed to be 306,046 fd, 443,777 fd, 407,632 fd and 491,796 fd for Qena, Sohag, Assiut and Minya respectively.

Cropped areas in the four project governorates equal to 2,528,225 fd, which represents 16% of the total cropped area of the country. These crop areas are distributed to be 357,403 fd, 620,758 fd, 669,792 fd and 880,272 fd for Qena, Sohag, Assiut and Minya respectively. It is worth saying that the four governorates crop area percentage is a misleading figure as they contribute to more than 50% of the sugar cane crop area and almost 23% of wheat crop area.

Table 17: Agriculture areas and production of main crops in the IWSP2 governorates

Crop		Qena	Sohag	Assiut	Minya
Wheat	Area (fd)	107,498	191,443	224,925	262,943
	Production (t)	273,152	534,413	628,552	762,009
Cotton	Area (fd)	---	669	2,140	190
	Production (t)	--	448	1,427	129
Sugar cane	Area (fd)	118,089	14,151	1,241	36,096
	Production (t)	5,690,000	658,338	36,812	1,643,356

Source: CAPMAS Agricultural Statistics (2018)

4.9 SOLID WASTE

Solid waste management has been one of the environmental priorities generally in Egypt due to the high urbanization and lack of adequate solid waste handling facilities. In the target governorates of IWSP 2 solid waste collection services are usually available only in some parts of major cities. The coverage of these services is much less in rural areas and small settlements where solid waste collection services do not exist. The estimated quantities and composition of solid waste in the four target governorates are given in the table below.

Table 18: Quantities and Composition of Solid Waste in Target Governorates 2015

Governorate	Estimated generation rate (t/d)	Estimated composition					
		Organic	Plastics	Paper	Metals	Dust	Other
Qena	1300	65	10	3	7	10	5
Sohag	900	35	5	5	5	40	10
Assiut	700	60/33**	12/7.4	10/7.8	2/2.5	5/9.3	11/40
Minya	1300	79	0.3	14.8	0.4	2.1	3.40

Source: EEAA, Annual Environmental Report 2015 ** city/village

For the time being, solid wastes are being collected from inhabited areas (cities only) by cleaners, tractors and vehicles of the local units of Marakez.

Trucks then transfer the solid waste to the public dump site outside the inhabited areas on a daily basis. This system, although existing, is actually inefficient. Containers are mostly unsuitable both in terms of size and type. Most of the time, containers are not available and thus collection is not undertaken regularly. This situation results in health risks due to the accumulation of garbage. As for the rural areas, the official role of these local service units decreases, or even disappears in most of the villages.

Usually each of the districts has an official dumpsite that receives collected solid waste either by City Councils or by private collectors. These dumpsites are usually not lined or controlled in terms of access for waste scavengers. In areas not covered by collection services there are usually unofficial solid waste collection areas in vacant lands and besides roads; these locations accumulate lesser amounts of waste but are numerous and scattered across the area. Appreciable quantities of solid waste are also dumped in and around the banks of irrigation canals and drains passing though towns and villages, which is believed to be an important factor in lowering water quality in these surface water bodies. Burning of waste is also common and represents another significant source of air pollution in rural areas.

A number of recycling factories and composting plants have been constructed in different parts of Egypt, including the IWSP 2 governorates, to recover the organic portion of solid waste. However, these plants were not very successful in many cases due to their low profitability

Hazardous medical waste is usually collected separately from large and governmental hospitals and is usually sent for incineration in incinerators that exist in large hospitals but considerable amounts of healthcare wastes are often observed mixed with domestic wastes in dumpsites.

Solid waste management in Upper Egypt can generally be described as insufficient. The problems are complex both at technical and operational levels. Fact is that the project area is lacking of sustainable disposal paths not only for solid waste but also for sewage sludge. KfW and GIZ are currently financing the National Solid Waste Management Program which is being implemented in Qena and Assiut. New landfills are proposed within the programme and in the preliminary design phase. Simultaneously intensive capacity building measures are being implemented in these two Governorates. The only WWTPs in IWSP 2 are proposed in Qena in which the above mentioned program is being implemented. It is expected that the capacity and infrastructure for waste management will increase especially in this Governorate in the short-term due to ongoing efforts in this sector. PMC will advise together with PMU the designer of the WWTPs in IWSP 2 (TADECs) to develop sustainable sludge treatment and reuse/disposal concepts during design works in close collaboration with the AC taking into consideration newly established waste management facilities and disposal paths. Sludge reuse concepts should be preferred rather than disposal options aiming the establishment of self-sufficient operation without relying on the availability of sustainable disposal facilities.

4.10 CULTURAL HERITAGE

Generally, Upper Egypt region is rich with antiquity sites that belong to different civilizations that existed in Egypt. There are considerable numbers of sites recorded as antiquity sites according the Law on the Protection of Antiquities (117/1983). Also there are a number of historic hills which are regarded either as antiquity sites or potential antiquity sites pending further archaeological studies.

According to the Environmental Profiles of the respective target governorates important cultural heritage sites are as follows:

- **Qena governorate:** There are two major tourist sites in Qena Governorate that attract international and local tourists, namely Isna Temple in Isna Markaz and Dendara Temple in Qena Markaz.

Isna temple comprises components from Pharaonic, Roman, Coptic and Islamic times. Isna was in important town in Pharaonic times and a centre for the worship of the Lates fish (Nile perch). The earliest records dated from the 18th Dynasty (1,450 BC). In the early centuries AD, Isna Temple was one of the main centres of Christianity in Egypt. In the Middle Ages the town regained its importance as a caravan station for routes from the south and Sudan.

Dendara Temple comprises components from Pharaonic, Greco-Roman and Coptic times. The necropolis contains tombs from the Early Dynastic period to the First Intermediate Period (3,100 – 2,050 BC), as well as burials of birds, dogs and cows associated with the goddess Hathor, whose temple is the most important monument at the site. The surviving buildings in the temple enclosure date from the 30 Dynasty (380 – 343 BC) to the Roman Period (30 BC – AD 395), and include the main temple to Hathor, sanatorium, two shrines known as "birth" temples and a Christian basilica, all of which are preserved inside a mud brick enclosure wall. East of the Temple was the town, where there are ruins of a Roman Period temple.

- **Sohag Governorate:** The archaeological locations in the Governorate can be divided into the following categories: Ancient Egyptian monuments; Roman and Greek monuments; Coptic and Islamic monuments. An overview is given in Figure 6.
- **Assiut Governorate**: I includes historical sites from all eras: Pharaonic, Coptic and Islamic. Examples of these sites are are Ezbet Youssef Tombs and Hemameya monuments.
- **Minya Governorate**: enjoys special monumental sites holding and featuring the Egyptian pharaonic history (old state – middle state – modern state), the Greek age, Roman age, Christian and Islamic ages. The following are examples of these sites.

  Deir Mowas Markaz is located 60 km South of Menya city. The monumental Tal El Amarna region located 15 km north east of Deir Mowas, was Egypt's capital during the modern pharaonic state. It is worth mentioning that Akanaton allowed the arts men to freely express themselves and their surrounding establishing the first school of realistic art internationally known as "Amarna Art". The most important monuments of this region are North Tombs, Southern tomb in Haj Kandeel and Akanaton royal tomb.

  Mallawi Markaz lies 48 km south of Minya city and holds the following monumental regions: Ashmonein region, Tona el Gabal Region, Betozoris tomb, Sheikh Ebada region, Deir El-Barsha, Deir Abo Hans and Islamic monuments.

  Abo Korkas Markaz lies 22 km south of Menya city and holds some of the most beautiful monuments in the governorate: Beni Hasan Region, Sultan Beni Hasan Zawya and Antar Stable.

  Islamic monuments: Omarawi mosque, Lamati mosque and Fouli mosque.

  Christian monuments: Father Abahora church.

Maps of archaeological sites are available in the Environmental Profile reports of the respective Governorate.

4.11 SUMMARY OF THE CURRENT MAJOR ENVIRONMENTAL PROBLEMS IN THE IWSP 2 GOVERNORATES

The lack of adequate sanitation and low quality of surface water resources are identified among the priority environmental concerns in the four target governorates of the IWSP 2 that need intervention for improvement. These issues are also addressed in the respective Environmental Profiles of the four governorates and as mentioned earlier in this report Governorate Environmental Action Plans have been set up to tackle these problems. The environmental priority issues identified in the respective governorates are summarized in the table below. The lack of sanitation is categorized as the first priority in all four governorates and generally, environmental issues related to sanitation, water supply and surface water pollution are ranking among the top five priorities together with solid waste management problems. Overall, the four governorates are struggling with the same environmental issues.

Satellite images of currently non-functioning WWTPs Baylana (Sohag) and Al Badhari (Assiut) are shown in the following figures. The extent of uncontrolled wastewater flowing around the facilities is clearly visible.

Figure 10: Non-functioning WWTPs in Sohaq and Assiut

In the following table the highlighted fields indicate the actual environmental problems addressed by interventions proposed under IWSP 2. According to the main objectives of the programme, the water supply and sanitation sectors will be primarily affected in a positive way (blue colour). As a side effect, the generally low level of environmental awareness in all target governorates is expected to improve as a result of project implementation and the effects positive environmental activities (orange colour). All other environmental problems, like air pollution, inadequate solid waste management cannot be addressed by IWSP 2 measures at all.

Table 19: Summary of Current Major Environmental Problems in Target Governorates by Order of Priority

Environmental Issues addressed in GEAPs of IWSP 2 Governorates	Qena	Sohag	Assiut	Minya
Sanitation	The majority of Villages lack a sewage network, municipal evacuation systems are overstretched, evacuation fees and other services are too expensive, vacuum vehicles are poorly equipped and too large for narrow streets, contaminated water spills onto streets/ canals and fields, the number of dumpsites are inadequate and sanitation problems in some Markazes are further worsened by rising ground water.			
Solid and hazardous waste management	No system for the solid waste management in most of the villages-insufficient number of trucks, containers and manpower. Most of the solid waste was disposed by burning in the open air. The insects, rodents and diseases increase rapidly due to lack of environmental awareness			
Water Supply and Water Quality	Low water pressure, poorly maintained and unclean pipes, polluted ground water, seepage into water pipes from poorly maintained sanitation systems, water leakages.			

Water resources	The different resources of contaminated water include canals, drains and high rate of misuse of water, and clogging of canal by weed growth.			
Environmental awareness	Lack of environmental awareness among government staff and the general public, inadequate coordination among government departments responsible for service delivery, Insufficient funding, poor provision of basic services, unhygienic behavioural practices.			
Industrial pollution	Inadequate enforcement of pollution controls, spread of respiratory and liquid pollutant related disease.			
Other issues	Not identified in GEAP	Pesticide use/misuse and poor crop quality.	Not identified in GEAP	The numbers of poor areas increase in entire governorate- shortage of the social and health service

5 PROPOSED PROJECTS AND MEASURES

5.1 IMPROVED WATER AND WASTEWATER SERVICES PROGRAMME

In developing the IWSP 2, the PMC proposed selection criteria for identifying specific project components while recognising that the planned programme should complement and not duplicate activities of other ongoing and/or planned programs (e.g. ISSIP, Rural Sanitation Program, other bilateral co-financed projects, etc.).

The key issues and project measures identified by PMC in relation to infrastructure requirements for water treatment and supply with the four target Governorates included:

- Strategic urban water treatment facilities are worn-out or have become too small due to high population growth with high risk of essential and critical supply shortages in the near future. Proposed measures: rehabilitation (including reconstruction/replacement) and/or extension of treatment facilities;
- Asbestos distribution networks present a risk to proposed measures: replacement of asbestos pipes;

For wastewater collection and treatment, the key issues and infrastructure improvement requirements were identified as:

- Existing wastewater treatment facilities are malfunctioning and are under-utilised. The rehabilitation and upgrading of those facilities including the systematic expansion of the sewer networks would have a positive impact with regard to environmental, economic and service coverage aspects;
- Construction of completely new sewerage schemes in semi urban / rural areas which are characterised as follows: (i) The total population of mother and satellite villages >50,000 inhabitants; (ii) design capacity of WWTP >10,000 m3/d; (iii) high groundwater table allows no proper on-site sanitation and customers are used to high monthly expenditures for the evacuation of their septic tanks; (iv) upstream improvements have a considerable impact on downstream raw water quality for drinking water supply and (v) high level of surface water contamination exists and health risks and epidemics have been reported;
- The rehabilitation and further expansion of sewer systems and wastewater treatment facilities in special tourist areas is needed but can only be considered and financed under this program if full cost recovery through adequate tariffs for this clientele is ensured.

Based on the PMC recommendations and updated by the master plans of the ACs, a detailed project list for IWSP 2 was developed and presented for approval to the Holding Company and the EDP in early December 2018. The following chapter summarises the projects currently selected for each phase for the water and wastewater sectors, respectively. As the IWSP 2 is a long-term dynamic programme and partly dependent on the performance of the ACs, it is possible that there may be changes to the projects selected.

5.1.1 Water Treatment and Supply Systems

The proposed lists for water supply rehabilitation and/or extension projects are summarised in the following table.

Table 20: Project lists water treatment and water supply systems (Projects are ranked according to their priority)

Governorate	Project	Description of works	Investment type
Qena	Extension of El Nejdma and El Hamran WTP	Extension of El Nedjma and El Hamran WTP (600 l/s - 1,200 l/s)	EXT
	Extension of Qos WTP	Extension of Qos WTP (300 l/s - 600 l/s)	EXT
	Extension of Nagaa Hammadi WTP	Extension of Nagaa Hammadi WTP (800 l/s - 1000 l/s)	EXT
	Rehabilitation of Deshna Water Networks	Rehabilitation of water networks, 120 km: Abu Diab, Abu Mannaa, Fau, Desha, Al Samta	REH
	Rehabilitation of Qos Water Networks	Rehabilitation of water networks in Markaz Qos, 155 km	REH
Sohag	Rehabilitation of Needa Surface WTP	Rehabilitation of the intake pipes and civil works for the old ground tank of Needa Surface WTP (Conventional Surface Water Treatment)	REH
	Extension of New Gerga WTP	Extension of New Gerga WTP from 400 l/s to 800 l/s (Conventional Surface Water Treatment)	EXT
	Iron & Manganese Removal Units	Construction of 2 installations for Iron & Manganese removal at ground water units in Naga Al Hardan and Awlad Ali in Awlad Hamza	REH
	Rehabilitation and extension of New Al Abaadia WTP	Rehabilitation of existing Abaadia WTP (100 l/s; Compact Surface WTP) with an extension of the WTP (Direct Filtration) to reach a total capacity of 180 l/s	REH & EXT
	Rehabilitation and extension of Akhmeem WTP	Rehabilitation of existing Akhmeem WTP (Compact Surface Water Treatment, 50 l/s) with an extension of the WTP (Direct Filtration) to reach a total capacity of 180 l/s	REH & EXT
	Rehabilitation and extension of Gerga WTP (English Unit)	Replacement / Complete renewal of existing Gerga WTP (Conventional Surface Water Treatment - "English Type"; 60 l/s) with a WTP for 100 l/s (Direct Filtration), Rehabilitation of the intake	REH & EXT

Governorate	Project	Description of works	Investment type
	Extension of Al Balyana WTP	Extension of Balyana WTP from 800 l/s to 1200 l/s (Conventional Surface Water Treatment)	EXT
	Supply of new equipment for the Central Potable Water Laboratory	Supply of new equipment for the central laboratory for drinking water	SUP
	Supply of new equipment for Local Potable Water Laboratories	Supply of new equipment for the 11 local laboratories for drinking water - Supply of new equipment	SUP
	Rehabilitation of Akhmeem Surface WTP	Rehabilitation of Akhmeem Surface WTP (Conventional Surface Water Treatment), especially replacement of the mechanical equipment of the "English Unit" (70 l/s)	REH
	Rehabilitation of Sohag District Distribution Networks	Rehabilitation of Sohag District distribution network (90 km)	REH
	Rehabilitation of Tima District Distribution Networks	Rehabilitation of Tima District distribution network (100 km)	REH
	Rehabilitation of Tahta District Distribution Networks	Rehabilitation of Tahta District distribution network (90 km)	REH
	Rehabilitation of Akheem District Distribution Networks	Rehabilitation of Akhmeem District distribution network (120 km)	REH
	Rehabilitation of Gerga District Distribution Networks	Rehabilitation of Gerga District distribution network (90 km)	REH
	Rehabilitation of Old Tahta WTP	Rehabilitation of the first stage of the Tahta WTP (200 l/s; Conventional Surface Water Treatment)	REH
	Rehabilitation of New Sohag WTP (English Unit)	Replacement / Complete renewal of New Sohag WTP (English Unit) WTP (50 l/s) with its intake, whereas an extension to 100 l/s should be considered	REH
Assiut	Rehabilitation of El Qoseer WTP	Replacement of artesian well treatment El Qosser by two new wells (capacity of 60 l/s)	REH
	Upgrade of groundwater units with Iron & Manganes Removal - Package 1	Upgrade 6 ground water units with Fe/Mn removal units in Dayrout (5) - Al Ghanayem (1)	REH

Governorate	Project	Description of works	Investment type
	Rehabilitation of Manfalout District Distribution Networks	Rehabilitation and renovation of 27 km asbestos networks in Manfalout District	REH
	Rehabilitation of Abnoub District Distribution Networks	Rehabilitation and renovation of 25 km asbestos networks in Abnoub District	REH
	Rehabilitation of Dairut District Distribution Networks	Rehabilitation and renovation of 20 km asbestos networks in Dariout District	REH
	Upgrade of groundwater units with Iron & Manganes Removal - Package 2	Upgrade 6 ground water units with Fe/Mn removal units in El Qoseer (3) - Abnoub (1) - Sahel Sleem (1) - Sadfa (1)	REH
	Rehabilitation of Abo Teeg District Distribution Networks	Rehabilitation and renovation of 34 km asbestos networks in Abu Teeg District	REH
	Rehabilitation of Assiut District Distribution Networks	Rehabilitation and renovation of 16 km asbestos networks in Assiut District	REH
	Rehabilitation of Al Hota WTP	Rehabilitation of WTP Al Hota (28 l/s, Compact Surface Water Treatment)	REH
	Upgrade of groundwater units with Iron & Manganese Removal - Package 4	Upgrade 6 ground water units with Fe/Mn removal units in El Qoseer (1) - Manfalout (1)- Sahel Sleem (1) - Abu Teeg (2) - Abnoub (1) - Al Ghanayem (1)	REH
	Upgrade of groundwater units with Iron & Manganese Removal - Package 3	Upgrade 6 ground water units with Fe/Mn removal units in Al Fath (1) - El Qoseer (1) - Sahel Sleem (1) - Abu Teeg (1) - Sadfa (2)	REH
Minya	Rehabilitation and extension of Old Maghagha WTP	Rehabilitation and extension of Old Maghagha WTP (capacity extension: 60 l/s → 260 l/s)	REH & EXT
	Rehabilitation and extension of Gazerat Sharouna WTP	Extension of Gazerat Sharouna WTP (capacity extension: 30 l/s → 60 l/s)	REH & EXT
	Rehabilitation of Samalout District distribution networks	Rehabilitation (Replacement) of 241 km asbestos networks in Samalout District (DN 100 - 1400)	REH
	Rehabilitation of Maghagha District distribution networks	Rehabilitation (Replacement) of 178 km asbestos networks in Maghaga District (DN 100 - 800)	REH

Governorate	Project	Description of works	Investment type
	Rehabilitation of Minya District distribution networks	Rehabilitation (Replacement) of 245 km asbestos networks in Minya District (DN 100 - 800)	REH
	Rehabilitation of Mallawi District distribution networks	Rehabilitation (Replacement) of 199 km asbestos networks in Mallawi District (DN 100 - 1400)	REH
	Rehabilitation of Matay District distribution networks	Rehabilitation (Replacement) of 74 km asbestos networks in Matay District (DN100 - 1000)	REH
	Rehabilitation of Deer Mawas District distribution networks	Rehabilitation (Replacement) of 119 km asbestos networks in Deer Mawas District (DN 100 - 600)	REH
	Rehabilitation of Abou Qerqas District distribution networks	Rehabilitation (Replacement) of 81 km asbestos networks in Abou Qerqas District DN100 - 500)	REH
	Rehabilitation of Bani Mazar District distribution networks	Rehabilitation (Replacement) of 39 km asbestos networks in Bani Mazar District (DN100 - 400)	REH

5.1.2 Sewerage Systems and Wastewater Treatment Facilities

The proposed lists for waste water projects (new, rehabilitation, extension) are summarised below.

Table 21: Project lists sewerage systems and wastewater treatment facilities (Projects are ranked according to their priority)

Governorate	Project	Description of works	Investment type
Qena	Karm Omran Cluster Sewer Networks	Construction of sewer networks (Gravity networks + Pumping Stations) for Karm Omran ; Al Ashraf Al Qeblia; Al Ashraf Al Gharbia; Al Ashraf Al Asalia; Al Ashraf Al Sharqia; Abnoud; El Kalaheen; Beer Anbar and connection to the new Karm Omran WWTP	NEW
	Karm Omran WWTP	New waste water treatment plant Karm Omran	NEW
	Samhoud Cluster Sewer Networks	Construction of sewer networks (Gravity networks + Pumping Stations) for Samhoud; Al Awamer & Bani Barza; Al Awsat Samhoud; Abu Shosha; Al Rawateb; Al Khawaled; Al Bahri Samhoud; Koum Gaber; Belad Al Mal Al Bahri; Al Amra	NEW

Governorate	Project	Description of works	Investment type
	Samhoud WWTP	New waste water treatment plant Samhoud	NEW
Sohag	Extension of Tima WWTP	Upgrade of Tima WWTP with tertiary treatment for 60,000 m³/d, rehabilitation of preliminary treatment	EXT
	Tima Cluster sewer networks	Construction of sewer networks (Gravity networks + Pumping Stations) for the villages Al Atamna - Meshta, Koum Al Arab, Al Sheikh Ammar, Koum Ghareeb and connection to Tima WWTP	NEW
	Rehabilitation of Sohag West 1 WWTP	Rehabilitation of Sohag West 1 WWTP (22,000 m³/day)	REH
	Gerga Cluster sewer networks	Construction of sewer networks (Gravity networks + Pumping Stations) for the villages Al Zanqour, Kom Ashkelo, Al Raqaqna and Al Gawaheen and connection to Gerga WWTP	NEW
	Al Balyana Cluster sewer networks	Construction of sewer networks (Gravity networks + Pumping Stations) for the villages Al Okalia, Al Esslah and Barkheel and connection to Al Balyana WWTP	NEW
	Maragha Cluster sewer networks	Construction of sewer networks (Gravity networks + Pumping Stations) for the villages Shandaweel, Basouna, Aamer, Naga Taea and Al Sheikh Yousef and connection to Maragha WWTP	NEW
	Sohag Cluster sewer networks	Construction of sewer networks (Gravity networks + Pumping Station) for Awlad Azaz and connection to Sohag west WWTP	NEW
	Rehabilitation of Sohag Sewer Network	Rehabilitation and renovation of Sohag sewer network (10 km)	NEW
	Rehabilitation of the Central Waste Water Laboratory	Rehabilitation of the central laboratory for waste water - Supply of new equipment	REH
	Rehabilitation of Local Waste Water Laboratories 1	Rehabilitation of the 5 local laboratories for waste water - Supply of new equipment	REH
	Rehabilitation of Local Waste Water Laboratories 2	Rehabilitation of the 5 local laboratories for waste water - Civil works	REH
Assiut	Rehabilitation and Extension of Al Zarabi WWTP	Rehabilitation & Extension of the WWTP Al Zarabi to a capacity up to 24,000 m³/d	REH & EXT

Governorate	Project	Description of works	Investment type
	Sidfa / Al Ghanayem Cluster sewer networks	Construction of sewer networks (Gravity networks + Pumping Stations) for the villages Koum Asfaht, Deer Al Ganadela, Al Mashayaa and Al Azayza and connection to Sidfa and Al Ghanayem WWTP	NEW
	Rehabilitation and extension of Al Birka 1 Pumping Station and surrounding network	Rehabilitation and extension of the Al Barka 1 pump station ($Q_{max2040}$=1,000 l/s) including new force main DN 1000, 8 km	REH & EXT
	Al Wadi Al Assiuti cluster sewer networks	Construction of sewer networks (Gravity networks + Pumping Stations) for the villages Bani Aleeg, Al Atawlaa, Arab Mateer and connection to Al Wadi Al Assiuti WWTP	NEW
	Dairut cluster sewer networks	Construction of sewer networks (Gravity networks + Pumping Stations) for the villages Al Hota Al Gharbia, Nazlat Abdallah, Nazlet Al Awamer, Garf Sarhan and Al Mattawa and connection to Dairut WWTP	NEW
	Rehabilitation of Al Maraghy Pumping Station	Rehabilitation of the Al Maraghy pump station ($Q_{max2040}$ =600 l/s)	REH & EXT
	Rehabilitation of Al Waledia Pumping Station	Rehabilitation and extension of the Al Waledia pump station ($Q_{max2040}$ = 600 l/s)	REH & EXT
	Al Zarabi Cluster sewer networks	Construction of sewer networks (Gravity networks + Pumping Stations) for the villages Al Masoudi and Hagr Dakran and connection to Al Zarabi WWTP	NEW
	Shuttub Cluster Sewer Networks	Construction of sewer networks (Gravity networks + Pumping Stations) for the villages Durunkah Al Gedida, Deer Durunkah and Al Ezzba Al Bahria and connection to Shuttub WWTP	NEW

Governorate	Project	Description of works	Investment type
	Rehabilitation of four force mains and network Assiut City	Renew force mains of pump stations Al Sadat (DN 500; 1.8 km), Feryal (DN 500; 1.4 km) and Al Moderia (DN 500; 1.7 km) and rehabilitation of gravity sewers and force main of Al Sentral (DN 500; 1.4 km, 1.5 km surrounding gravity network)	REH
	Al Badari Cluster sewer networks	Construction of sewer networks (Gravity networks + Pumping Stations) for the villages Koum Monshaat Hamam, Al Marawna and Monshaat Al Badari and connection to Al Badari WWTP	NEW
	Rehabilitation and extension of gravity sewers in Abu Teeg, Al Aqadma, Bani Sameea, Al Zeera	Rehabilitation and extension of gravity sewers in Abu Teeg, Al Aqadma, Bani Sameea, Al Zeera (2.2 km rehabilitation, 22 km extension)	REH & EXT
	Rehabilitation and extension of sewer networks Bani Edrees and Al Qusiyya	Rehabilitation and extension of gravity sewer network of Bani Edrees (0,25 km rehabilitation; 1,5 km extension) and rehabilitation of gravity sewers (2 km) in Al Qusiyya	REH
	Rehabilitation of sewer networks Assiut West and Assiut East and Extension of sewer networks Manqabad and Durunkah	Rehabilitation of sewer networks Assiut West and Assiut East (8 km) and Extension of sewer networks Manqabad and Durunkah (6.2 km)	REH & EXT
Minya	Rehabilitation and Extension of Abu Qerqas WWTP	Rehabilitation of Abu Qerqas WWTP (Activated sludge, 40,000 m³/d) and extension of the sludge treatment facilities	REH & EXT
	Abu Qerqas Cluster Sewer Networks	Construction of sewer networks (Gravity networks + Pumping Stations) for the villages Al Nahal, Kafr Al Fela, Saneem, Grees, Nazlet Grees, Mantut, Abu Al Safa, Al Hassania, Al Karam, Manhary, Monshaat Al Nasr, Al Birba and Abu Qerqas Al Balad 2 and connection to Abu Qerqas WWTP	NEW
	Rehabilitation and Extension of Abu Qerqas Pump station No. 1	Extension, rehabilitation, increasing the capacity of Abu Querqas PS N°1 (Q2040: 700 l/s) including new force main 2 km, DN1000	REH & EXT
	Rehabilitation and Extension of Abu Qerqas Pump station No. 4	Extension, rehabilitation, increasing the capacity of Abu Querqas PS N°4 (Q2040: 500 l/s) including new force main 0.7 km, DN750	REH & EXT

Governorate	Project	Description of works	Investment type
	Maghaga Cluster Sewer Networks	Construction of sewer networks (Gravity networks + Pumping Stations) for the villages of Balhasa, Mayanet Al Waqf, Bani Khaled and Bani Khalaf and connection to Maghaga WWTP	NEW
	Delga Cluster Sewer Networks and WWTP rehabilitation	Extension of sewer network (Phase 2) for Delga village (gravity sewer network & pump station) and connection to Delga WWTP; Rehabilitation of Delga Phase 1 Pump station and Rehabilitation and completion of Delga WWTP (12,800 m³/d)	REH & EXT
	Tanouf Cluster Sewer Networks	Construction of sewer networks (Gravity networks + Pumping Stations) for the villages Monshaat Khozam, Nazlet Al Hassaeba and Al Rahmania and connection to Tanouf WWTP	NEW
	Tala Cluster Sewer Networks	Construction of sewer networks (Gravity networks + Pumping Stations) for Rida and Al Hawaslia villages and connection to Tala WWTP	NEW
	Rehabilitation of Maghaga WWTP	Rehabilitation of Maghaga WWTP (Trickling filters, 20,000 m³/d)	REH
	Mallawi Cluster Sewer Networks	Construction of sewer network (Gravity networks + Pumping Stations) for Al Rayramoun village and connection to Mallawi WWTP	NEW
	Rehabilitation and Extension of Shahin Pump station	Extension, rehabilitation, increasing the capacity of Shaheen PS (Q2040: 1,000 l/s) and of the force main (approx. 5,5 km DN 1000 - 1200)	REH & EXT

5.2 INTERFACES WITH OTHER PROJECTS / PROGRAMMES

NOPWASD / GoE

There are multiple interfaces with project implemented by the National Organisation for Potable Water and Sanitary Drainage (NOPWASD). The organisation is implementing waste water infrastructures in nearly all sewerage clusters (except the Shuttub Cluster in Assiut as well as the two clusters proposed by Qena AC) for which the ACs are also proposing projects to be implemented under IWSP 2. The interfaces include:

- Sewer networks which shall be connected to the same wastewater treatment plant as project to be implemented under IWSP 2;
- Not completed and/or transferred waste water treatment plants to which sewer networks implemented under IWSP 2 shall be connected to (in accordance to the Master Plan);

- Not completed and/or transferred pump stations / sewer networks to which sewer networks implemented under IWSP 2 shall be connected to (in accordance to the Master Plan); and
- Sewer networks to be designed by NOPWASD which shall be connected to pump stations to be implemented under IWSP 2.

According to information of the ACs, many of the above mentioned projects implemented by NOPWASD are making very low progress, constructions partly having started over 20 years ago. It was decided therefore to avoid these interfaces as best as possible. The AC had the opportunity to object in case that there are projects which shall be exempted from this approach.

Other donor programmes

There are some interfaces with other donor funded programmes:

- Integrated Sanitation and Sewerage Infrastructure Project II (ISSIP II) – World Bank (Sohag, Assiut);
- Projects financed by USAID (Sohag);
- Project designed under the "Feasibility Study for Integrated Sanitation Technologies in Some Rural Areas in Upper Egypt" financed by the African Development Bank (Minya, Assiut); and
- Local Development Programme in Upper Egypt – World Bank implemented by the Governorates (in Sohag, Assiut).

The last mentioned programme apparently stopped for reasons not communicated by the AC.

Integrated Sanitation and Sewerage Infrastructure Project (IWSP)

A parallel but separate project to IWSP 2 is the second part of the Integrated Sanitation and Sewerage Infrastructure Project (ISSIP), which focuses on rural sanitation and covers part of the IWSP 2 project area in Assiut and Sohag. According to the findings of Work Package 2 of the PMC there are the following interfaces of ISSIP 2 project with IWSP 2 projects:

Table 22: ISSIP Projects in Assiut and Sohag

Governorate Cluster	IWSP 2		ISSIP 2		WWTP	
	N° of locati-ons	Population 2040 [cap.]	N° of locati-ons	Population 2040 [cap.]	Name Status Current usage [%]	Capacity[m³/d] Population Equivalents
Assiut Shuttub	3	18,024	4	220,688	Shuttub WWTP implemented by ISSIP II and under construction 0%	29,000 m³/d 232,000 cap.
Sohag Tima	5	134,910	2	29,695	Tima WWTP in service approx. 10 – 20 %	60,000 m³/d 300,000 cap.

Sohag **Sohag**	1	22,235	3	49,361	Sohag WWTP in service	50,000 m³/d 300,000 cap.
Sohag **Gerga**	4	36,640	3	100,247	Gerga WWTP in service but only 50 % of aeration equipment installed approximately 30%	65,000 m³/d 390,000 cap.
Sohag **Balyana**	3	102,958	3	99,789	Balyana WWTP Under construction 0%	35,000 m³/d 210,000 cap.

Projects financed by USAID

One interface with an USAID financed project was identified in Sohag Governorate:

- Tima cluster sewer networks for five villages for a total population of 121.823 cap.

Projects financed by African Development Bank (only feasibility study and designs)

The flowing interfaces with these activities have been identified:

- Abu Qerqas sewerage cluster: six out of thirteen networks were designed in the frame of the project (acc. to the AC: feasibility study, detailed design and tender dossiers);
- Abu Qerqas WWTP: rehabilitation of the WWTP was designed in the frame of the AfDB funded project (acc. to the AC: feasibility study, detailed design and tender dossiers);
- Five villages in the Al Sidfa/ Al Ghanayem Cluster which will be connected to the same WWTP as the four networks which shall be implemented under IWSP 2 in the same cluster;

The approach of the consultant EGEC for the WWTP Abu Querqas differs substantially from the recommended approach of the PMC which was agreed by Minya AC. The consultant proposes the extension of the existing plant with SBR technology whereas the PMC considers mainly the rehabilitation of the existing plant and the extension of the sludge treatment which seems to be too small.

6 ASSESSMENT OF EFFECTS AND IMPACTS

6.1 ASSESSMENT OF PROGRAMME EFFECTS OF PROJECT TYPES

6.1.1 Construction of Facilities

This section broadly describes the types of construction activities likely to take place in the context of the proposed projects and the effects that are typically associated with such activities. A further description of the impacts on social and environmental sectors is described and summarized under section 6.3.

General

If the construction of a project component is completed prior to another component, it should not be operated until the construction of the entire project is completed. This will reduce the environmental problems that may arise if, for example, the house connections and wastewater collection systems are completed and operated prior to the completion of pumping stations and the WWTP.

For the same reasons new works, particularly for wastewater, the construction of facilities and their commissioning should follow a logical sequence:

- WWTP constructed before or in parallel with pumping stations;
- Force mains constructed with pumping stations;
- Pumping stations constructed before or in parallel with wastewater collectors; and
- Wastewater collection system constructed before house connections.

Construction/extension of Water Distribution and Wastewater Collection Systems

Water distribution systems and wastewater collectors are commonly constructed in trenches and normally located within the right of way of roads, although pressure pipelines may also be installed above ground where appropriate. Construction includes trench excavation, levelling of the trench bed, fixing the pipe foundation, laying pipes, connecting/welding pipe stretches, testing the line and backfilling of the trench. Construction works will also include installation of manholes and other associated facilities (flushing points, valves, etc.).

The excavation works will be mainly undertaken using mechanical excavators but manual excavation will be necessary in narrow streets where access for such equipment is restricted. Measures to suppress dust and noise are required when construction takes place in populated areas to minimise nuisance. Asphalt removed from paved roads may be recycled or, if this is not possible, will require disposal to landfill and the road way properly reinstated.

The groundwater table is relatively high in much of the target areas of the IWSP 2, therefore dewatering of trenches may be necessary. Dewatering of trenches may be done manually if amount of water is relatively small but in most cases this will be supported by pumps. The pumped water should be discharged to a suitable drainage channel with appropriate approvals.

Crossing works for water and wastewater pipelines should possibly be avoided. However, given the nature of the project area and the number of watercourses and linear infrastructure present (e.g. minor and major roads, railway lines present) such crossings will inevitably occur

Watercourses are usually crossed using piles that are driven into the channel bed. This approach is used for channels without navigation, which applies to the majority of channels in the project areas.

For navigational canals, the crossing is undertaken either by attachment to an existing bridge or by tunnelling a culvert under the canal.

Crossing of roads is normally undertaken through cross-excavation of the road, laying the pipeline, in a culvert where necessary, back-filling and repaving the road. This will cause temporary disturbance and delays for traffic. For major roads and railway lines where (partial) closure is not feasible, tunnelling may be required to pass a pipe culvert.

In addition there will be short-term movements of heavy trucks for delivery and removal of plant, delivery of pipes, fitting and construction materials, and removal of construction waste.

Construction/extension of Wastewater Pumping Stations

Pumping stations for wastewater generally consist of a receiving inlet chamber, a receiving sump including the pumps, outlet force main and flow meter, and for larger installations may include wastewater screens, control room, administration building, transformer room, generator room and fuel tanks. Existing pumping stations proposed for rehabilitation or extension under the Programme as well as newly proposed facilities are usually situated at low lying points within built-up areas to enable gravity flow of the sewage to the site.

The construction of new pumping stations typically includes site preparation and temporary storage of materials, site levelling, removal of bulk materials, excavation works for the sumps, civil works for buildings, transportation and fixation of heavy equipment (generators, transformers, pumps, tanks) and testing for water proofing and of electromechanical equipment.

Measures for the suppression of dust and noise are required particularly when construction takes place in populated areas to minimise nuisance. In most cases the local groundwater table will be high, thus the construction of sumps will require dewatering works and the water will need to be discharged to an appropriate drain with approvals. Sump construction will require driving of the sump frame deep into the ground to reach the desired level which may require hammering causing soil vibration that may be a short-term nuisance in populated areas. Large scale excavations are unlikely in the context of pump station construction as space is limited.

There may be a need to establish temporary units in the construction sites, such as engineer's offices, workshops and accommodation units for workers and site guard – e.g. in case . Such cases will inevitably involve waste generation that should be properly managed and disposed of as appropriate in compliance with the applicable regulations.

Construction activities will inevitably generate a short-term increase of local traffic and the movement of heavy trucks for the delivery of construction materials, plant and equipment, and removal of wastes.

Construction/extension of Treatment Plants for Water and Wastewater

According to the list of projects proposed for implementation under the IWSP 2 construction will mainly involve the rehabilitation and extension of existing facilities (both WTPs and WWTPs). Proposed new construction only includes a single WWTP in Qena governorate. Although the existing WTPs and WWTPs are relatively large facilities they are not usually located inside or in the immediate vicinity of residential areas. Given this the construction and subsequent operation of such plants will have limited impact on the local population.

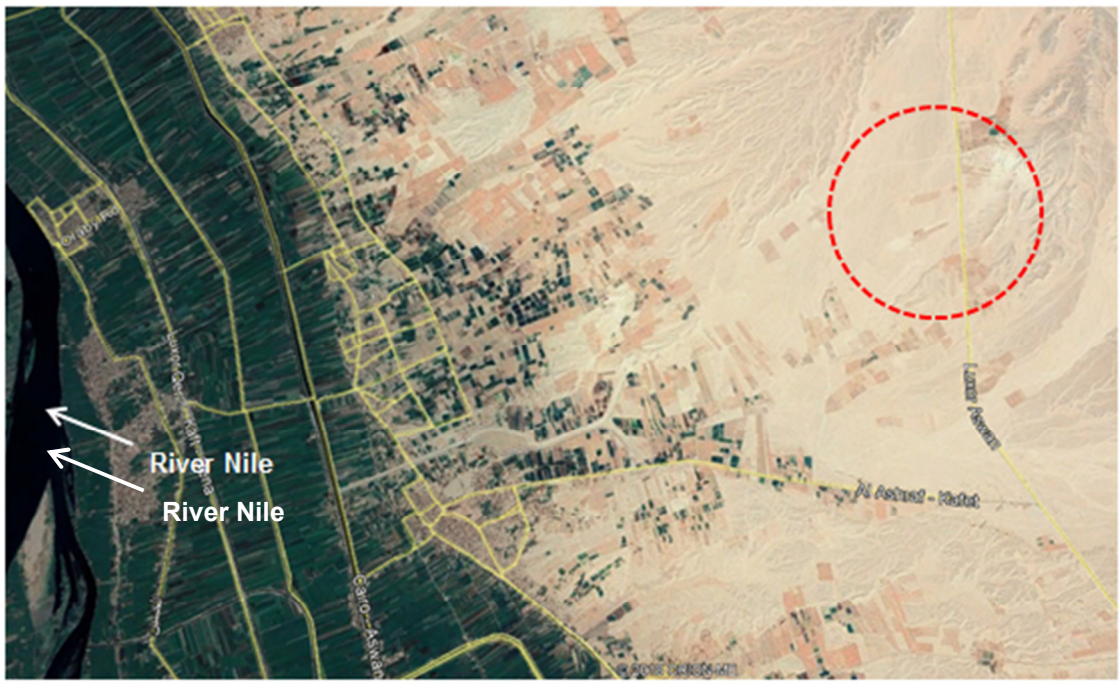
Construction activities include preparation and levelling of the site, excavation works for the sumps and tanks, civil works for buildings, transportation and fixing of heavy equipment (generators, transformers, pumps, steel bridges over reactors and tanks), and testing for water proofing and of electromechanical equipment.

A large amount of soil may be produced by the excavation and levelling works, particularly for the construction of inlet works, tanks and sumps. The soil may be used for landscaping the site to avoid/minimise off-site disposal.

Where a new WWTP is built there may be a risk to adversely affect the local flora, fauna and their habitats through the reclamation of previously undisturbed natural areas, through the temporary presence of workers and the presence and operation of heavy construction machinery and equipment.

As can be seen in the satellite image below the area proposed for the new WWTP in Karm Omran is located in a desert environment and at a distance of about 4 km to the east of the closest village. In this area significant negative effects on natural habitats of flora and fauna are not expected. Also no rettlement will be necessary.

Figure 11: Approximate location of the proposed new WWTP Karm Omran, Qena Governorate



In areas of high groundwater table, dewatering will be required and may generate significant volumes of water requiring safe disposal to a drainage channel with approvals. The construction of sumps and tanks below ground level may require sheet and pile driving in the ground which may cause temporary noise and vibrations.

Temporary offices, workshops and housing units for construction labours will be required, which, along with the general construction activities, will generate solid wastes and liquid wastes. The solid waste will require disposal to an appropriate landfill and the liquid wastes should be transported to a WWTP for treatment.

Construction will inevitably involve a temporary movements of heavy construction vehicles e.g. to transport workers, to deliver construction materials, plant and equipment for installation at the

WTP/WWTP sites, and to remove wastes. These activities and the potentially resulting nuisance for the local population may continue over many months, depending on the size of the respective facilities.

Occupational Health and Safety

Construction is generally known to be critical in terms of occupational health and safety (OHS) for workers. While comprehensive legislation and guidelines exist, the current practice of construction preparation and construction site organisation often does not reflect these requirements or internationally accepted OHS norms and standards. This specifically applies to rural areas, smaller construction sites and cases where numerous sub-contractors are involved. Typical shortcomings at such construction sites include but are not limited to the lack of adequate PPE, lack of adequate form work in excavation sites, lack of safety barriers and signage, inadequate waste management, lack of first aid facilities, lack of systematic training of workers and hence lack of awareness etc.

The implementation of projects proposed under the present IWSP 2 will involve a wide range of standard construction activities with their specific risks for the health and safety of the workers involved. Therefore an appropriate framework for effective preventive health and safety arrangements will need to be put in place in line with the applicable national and international norms and standards.

6.1.2 Operation of Facilities

Operation of Gravity Systems and Rising Mains

Wastewater collected in the public sewers from house connections flows by gravity either directly to the WWTP or to pumping station and then by forced main to the WWTP. It is important that oil and grit traps are installed and maintained at the outlets from particular commercial and industrial premises to minimise oils and inert solids being transferred into the sewerage system. The management of these traps and the safe disposal of waste is the responsibility of the enterprise concerned but there proper functioning should be checked by the ACs.

Regular maintenance of gravity sewers, particularly where shallow, is required for the removal of sand, grit and other materials to prevent blockage. Maintenance should adopt measures to prevent clogging by regular inspection, flushing and cleaning of individual oil traps and interceptors. The wastes generated will require safe disposal to an approved landfill as they may pose environmental and health risks.

If there is failure of a water or wastewater pipeline or is damaged due to accidents during excavations for other underground utilities, etc., that results on leakage or localised flooding, repairs should be made promptly and in the case of wastewater spillage, the area cleaned to minimise negative environmental and health impacts.

Operation of Wastewater Pumping Stations

Collected wastewater is discharged through the gravity systems either directly to the WWTP or to sumps at intermediate pumping stations in the sewerage network; these are equipped with level controls to operate the pumps when wastewater level in the sump reach certain levels. Pumping stations may be equipped with screens to separate impurities and large solids in order to prevent pumps becoming clogged; these screens should be cleaned frequently to maintain efficiency and the waste disposed on safely in an authorised landfill as this poses a potential health risk.

The operation of pumping stations requires ancillary facilities which may include transformers and emergency power generators in case of power failure, fuel tanks, etc. Modern transformers are dry, cooled through air whereas older transformers cooled oil usually containing polychlorinated biphenyl (PCB) which is a hazardous substance. Both types of transformers are referred to in the Egyptian Engineering Code for Pumping Stations (Code 101/1997). When refurbishing existing pumping stations, the existence of wet transformers should be ascertained and preferably replaced with the old transformed treated as hazardous waste.

Operation of Water Treatment Plants

The method of water treatment depends on the source of water and its quality. Water from wells usually contains small quantities of solids but may require removal of dissolved iron and/or manganese to improve the potable quality of the water. This requires the addition of chemicals to aid precipitation and this will result in a small quantity of sludge which is removed by sedimentation and filtration. Iron and manganese removal is not often practiced in Egypt although water quality would generally benefit if it was more widely adopted.

Water from the Nile has a greater load of suspended solids load than groundwater comprising largely of mineral fines, micro-organisms and organic material. Chemicals may be added to aid flocculation and the solids are removed by sedimentation or flotation and gravity sand filtration. As a consequence, the quantities of sludge generated by sedimentation and backwash of sand filters are considerably greater than from the treatment of groundwater.

The sludge contains colloidal and dissolved organic matter, mineral particles, microorganisms, colloidal aluminium and iron hydroxides and manganese oxides, and other precipitation products. It is common practice in Egypt to discharge the sludge to water courses although this is not permitted under Law 48/1982. The chemical composition of the sludge and the high solids load on water courses causes accumulation of sediment and impacts on wildlife, and may adversely affect the quality of water for subsequent use. Good practice is to dewater the sludge for disposal to landfill or, where appropriate with good flushing conditions, discharge liquid sludge to sewerage system for co-settlement at the WWTP. There are limited options to use the sludge beneficially; the sludge has minimal agronomic value although the fine texture of the sludge may be beneficial in reclaiming coarse desert soils (subject to testing under local conditions), and it can be used in the raw feed in cement factories.

Chlorine gas is used commonly to disinfect the water before pumping into the water distribution system. Chlorine gas is toxic and is stored in tanks under pressure. Consequently, this presentsa potential hazard and the facilities and methods for storage and handling of chlorine gas must meet the designated standards for safety of the workers.

Other chemicals commonly used in water treatment include simple and polymeric salts of aluminium and iron (aluminium sulphate is commonly used in Egypt). Chemicals should be stored safely to prevent spillage and contamination of the local environment, and the dosage rate to raw water should be done accurately, following standard procedures.

There will be regular additional traffic movement, mostly associated with workers, but also trucks delivery chemicals, including chlorine gas, and trucks removing WTP sludge (assuming proper disposal practices).

Operation of Wastewater Treatment Plants

Wastewater is received by gravity or rising mains at the inlet works and passes through coarse and fine screens to remove litter (plastics, rags, etc.) and grit and grease removal chambers to settle out solid particles and floating oils and grease. The wastes removed in these stages should be washed to remove faecal material, pressed and discharged to skips for transport off-site and disposal in an authorised landfill as such wastes create odour, attract flies and vermin and are a health hazard.

The types of wastewater treatment processes installed on the WWTP depend on the capacity of the respective WWTP and the land area available for its construction. In the Delta where land is limited, 'intensive' treatment processes will be preferentially selected as these have a smaller footprint compared with the 'extensive' methods that are more suitable where land area is not restricted.

All WWTPs should be constructed in areas remote from habitations in order to minimise nuisance from odour and flies. Odour is generally the most common cause of complaint by the public of wastewater treatment. The operation of WWTPs mainly consists of two treatment lines: i) Wastewater Treatment and ii) Sludge Treatment as explained in the following:

i) Wastewater Treatment and Discharge

Wastewater is treated by a combination of mechanical and biological processes in order to produce effluent of sufficient quality for compliance with standards for discharge to drain or for direct reuse by irrigation.

For medium to large WWTPs, conventional wastewater treatment comprises primary sedimentation (mechanical) followed by the activated sludge process or by trickling filters (aerobic biological treatment processes). Alternatively, wastewater may be treated in a single stage in an aeration basin that may be configured as oxidation ditch or extended aeration.

With the exception of trickling filters, the aerobic stage has high energy consumption in order to introduce oxygen into the wastewater; this is commonly by simple surface aerators but air injection may also be used if there is sufficient O&M expertise. Aeration should be controlled by oxygen probes to ensure adequate oxygenation without excessive use of energy.

In the IWSP 2 target Governorates, activated sludge is the most common treatment process adopted for larger WWTPs, extended aeration for medium size WWTPs, and oxidation ponds and aerated lagoons for small WWTPs. There are only a few WWTPs with trickling filters (TF) in the target Governorates (and operational performance in Egypt has so far been poor despite their simplicity of operation compared to activated sludge). However, the performance of TFs is not readily enhanced should, for instance, nutrient removal be required in the future.

Extensive treatment by pond systems while simple to operate is not appropriate in the Delta to the large area required and the loss of productive agricultural land which is already under high pressure for urban development.

Nutrient (N and P) removal from wastewater is not currently practiced in Egypt as the effluent discharge standards do not necessitate this. Nitrogen can only be removed from wastewater

biologically by designing and operating the aeration basin to provide a sequence of aerobic, anoxic and anaerobic zones that allow nitrification and denitrification. Phosphorous removal may be done simply by chemical dosing of the primary sedimentation tank or by biological removal in the aeration tank.

For small WWTPs (not included in IWSP 2), a range of technical solutions are available, which can be as prefabricated units or package plants, but the principles of wastewater treatment are essentially the same as those of large WWTPs and can achieve the equivalent quality of effluent.

After final clarification, the effluent must be chlorinated for disinfection and may only be discharged to a drain in accordance with Decree 8/1983. As described above for disinfection of potable water, chlorine gas raises important health and safety concerns. Alternatively, sodium hypochlorite, calcium hypochlorite or lime chlorite solutions could be used which are less hazardous.

A potential concern is that the addition of chlorine to the final effluent will most likely result in the formation of trihalomethanes (THM) and haloacetic acids (HAA) due to the free chlorine reacting with the organic matter content of the water in the receiving drain. While the quantities of THM and HAA produced may be greater than by the chlorination of potable water supplies, the risks are significantly less in terms of oral exposure of people. On the other hand, THMs and HAASs may have effects on aquatic life but the toxicity data and transport routes through the food chain are equivocal.

All WWTPs should have a wastewater bypass available to a drain to provide hydraulic protection of the WWTP or if there is treatment or technical failure of the plant; this is a requirement in the Engineering Code of Practice in Decree 169/1997. If the bypass is operated, this will have periodic significant environmental consequences for the quality of drainage water which may be acute if the drainage water is used for irrigation (illegally) or mixed with canal water. Storm water flows will be infrequent, although realistic in the northern Delta, which may necessitate short-term bypassing of the plant and the greater risk is from inadequate O&M of WWTPs that may lead to plant failure and continuous bypassing of wastewater.

ii) Sludge Production and Disposal

Although some of the organic pollution in wastewater is destroyed by biological treatment (lost as CO_2), most of the pollution load is transferred to sludge comprising a complex mixture of organic solids and colloidal material, nutrients, biomass (microorganisms, including pathogens) and pollutants such as heavy metals and organic micro-pollutants that arise from domestic, commercial and industrial discharges to the sewerage system.

In conventional WWTPs, primary sludge is produced by sedimentation and biological sludge comprising surplus microbial biomass is generated by the activated sludge process and from final clarification of effluent. Biological sludge from activated sludge or trickling filters is usually mixed with sludge from primary sedimentation for further treatment. Extended aeration and oxidation ditch plants generally do not have primary sedimentation as treatment is provided in a single process. If nutrient removal is practiced, this increases the overall quantity of sludge produced.

Sludge is produced in liquid form (low total solid concentration) and is usually thickened prior to subsequent treatment or disposal. Most WWTPs in Egypt discharge the sludge to drying beds to significantly reduce most of the moisture content (common practice in the target Governorates) before

removal from the WWTP. Air drying is appropriate for the climatic conditions prevailing in Egypt but requires a large area and can be a source of odour and fly nuisance. For large WWTPs, where sufficient land area is not available, mechanical dewatering may be considered but this increases investment and operating costs; requires the use of chemicals (polymers to aid dewatering); and the sludge still has a relatively high moisture content (75-80%) which may restrict the use or disposal of the sludge without further treatment or drying.

With the exception of sludge produced by extended aeration plants or stabilization bonds, the sludge produced by the WWTPs in the target Governorates is not stabilised. This means that the sludge has the potential for offensive smell and to attract flies, although these issues are minimised by drying. Importantly, the pathogen content of the sludge poses a risk of infection for WWTP labourers (if not adequately equipped and trained); for farm workers manually handling sludge when applying to land (advice on safe handling should be given); and potentially for consumers of crops grown on sludge-treated soil (ECP 501/2005 prohibits the use of sludge for certain high risk crops, i.e. those eaten uncooked or root vegetables).

Conventional sludge stabilisation processes to reduce the fermentable portion of the organic matter (volatile solids) are anaerobic digestion, aerobic digestion (by aeration of liquid sludge in tanks or by composting of dewatered sludge), or lime addition to pH 12 to inhibit fermentation. The benefits of stabilisation are reductions in:

- Mass of sludge for disposal (except lime addition) by the destruction of volatile solids;
- Odour potential, although odour is not totally eliminated but is normally not offensive;
- Pathogen content. Liquid sludge digestion can achieve only limited reduction in pathogen content although air drying of the sludge and long-term storage (>6 months) can achieve compliance with the pathogen standards set by ECP 501/2005. Only composting and lime addition can reliably reduce pathogen content to comply with ECP 501/2005. There are a number of advanced treatment technologies that can effectively disinfect sludge but these are costly to construct and operate and are considered unsuitable for conditions in Egypt.

Internationally, anaerobic digestion is the most commonly adopted stabilisation process but it has high investment cost and requires technical capability to operate. The important benefit is that the process generates biogas (methane) which may be burnt as a fuel in a gas engine to produce heat (to maintain digestion temperature) and power to reduce reliance on imported electricity and hence operating costs. In Egypt, only Gabal El Asfar is equipped with anaerobic digestion and combined heat and power (CHP).

Aerobic digestion may be an appropriate option where the WWTP is not equipped with primary sedimentation and the sludge age in the activated sludge processes is insufficient to stabilise the sludge. However, the process requires power for aeration and so has high operating cost.

Lime addition can be effective in improving sludge quality for disposal to landfill but the quality of the sludge is inappropriate for use in agriculture in Egypt. Soils are generally calcareous and the addition of lime will exacerbate the trace element deficiencies in crops that are common in many parts of Egypt.

Composting of organic wastes is microbial aerobic fermentation which generates metabolic heat (up to 70^{o}C) that is controlled to optimise stabilisation, pasteurisation and drying (evaporative cooling). For sludge to compost, a bulking agent is added to create an open texture to facilitate oxygenation that is enhanced by either forced aeration or by mechanical turning of compost windrows. The bulking agent can comprise separated municipal waste, crop residues (particularly rice straw in Egypt), sawdust or matured compost. Composting of sludge on a large scale is successfully carried out in Alexandria (Site 9N) and results in a high quality and marketable product. Sludge composting with rice straw (the disposal of which is difficult for farmers in the Delta since its burning was prohibited) has also been successfully developed. In addition, there are a number of municipal waste composting plants in Egypt that could be adapted to co-compost sludge, and more waste composting plants may be established in the future to tackle solid waste disposal problems in the Delta. However, composting requires a large area of land as the processing and maturation time is about 2 months, and can be a source of odour and dust, including fungal spores (*Aspergillus*) that may cause respiratory problems.

The final sludge product is stored temporarily on the WWTP prior to use or disposal; as a dry product in a dry climate, this presents limited environmental impact. The use of sludge on agricultural land is widely established in Egypt as there is a high latent demand for organic fertiliser to maintain soil fertility and reduce purchase of expensive fertiliser. Demand is seasonal according to cropping patterns but with two, and possibly three, crops grown on the same land per year (winter, summer and Nili), the peaks of demand are generally easily managed. As a result, there will be regular traffic movement associated with the transportation of sludge from the WWTPs.

The common practice of the ACs is to either:

- Sell the sludge in bulk to a local haulage contractor who transports the sludge off-site and sells to farmers; or
- Allow farmers to collect the sludge (with or without payment)

ECP 501/2005 requires records to be kept of the owner of the land to which the sludge is applied, the area of land and the quantity supplied and sludge quality. In current practice, however, these recommendations are not being followed, i.e.no records are maintained. Consequently, it is not possible to check that the sludge is used in accordance with the Code and, in effect, the use of sludge in Egypt is uncontrolled. Chemical and microbiological analysis of the sludge is not undertaken routinely thus compliance with the sludge quality requirements of the Code cannot be verified. While it is considered highly unlikely that the heavy metal content of sludge is a constraint (and only a long-term environmental risk), the microbial quality may be assumed to be highly questionable given that there is no sludge treatment as yet on any of the WWTPs in the target Governorates except for air-drying and this is an uncontrolled health risk for workers and the general public.

6.2 ASSESSMENT OF PROGRAMME ALTERNATIVES

The implementation of IWSP 2 is predicted to provide wide and cumulative benefits for the environment and public health and for the coverage and efficiency of service provision by the ACs, supported by the HCWW. There are important synergies between the IWSP 2 and other donor-funded interventions in the target Governorates, in particular with regard to Integrated Water Resource Management, the Integrated Sanitation and Sewerage Infrastructure Project and the Integrated

Irrigation Improvement and Management Project which have focussed and coordinated efforts in the Governorates.

Nevertheless, these projects do not, and are not intended to provide complete geographical coverage but focus on where investment will yield the best returns in improving environmental and living conditions and in enhancing water and wastewater service provision by the ACs.

The IWSP 2 was developed by the ACs, HCWW and the EDPs, primarily based on the recommendations of the respective Master Plans for each Governorate. Criteria for the selection or exclusion of project proposals within the objectives of IWSP 2 are provided in MOP3, relating to health, environmental and institutional objectives established by the ToR.

The appropriate technical options for individual projects developed under the IWSP 2 will be determined by the engineering consultants engaged by the ACs, and where required, these will be subjected to EIAs to assess project alternatives, determine specific project impacts and mitigation measures, and prepare specific environmental monitoring programmes.

Compliance with environmental legislation is a mandatory requirement and this will inevitably be a driver in developing the specific engineering solutions and operational concepts for individual projects. This is particularly important for wastewater treatment where secondary treatment will be necessary to meet the standards required for discharge to drain under Law 48/1982.

6.2.1 The No-Programme Option

The IWSP 2 is expected to result in significant environmental improvements in the target governorates and there mainly in the project areas. The existing situation, in which target areas are deprived from sanitation services, leads to major environmental and health problems for the population. Even though there are some impacts associated with IWSP 2 construction and operation as previously indicated, the overall environmental impacts are expected to be positive.

If IWSP 2 is not implemented, the status quo would be maintained with progressive further degradation of the environment and impacts on human health. The likely and important effects of the no-programme scenario are summarised as follows:

- The disparity between population coverage of water supply and wastewater services would continue and widen as the population in the Delta increases;
- Significant and increasing volumes of wastewater would remain untreated and discharged to the environment, further degrading surface and groundwater quality and increasing impacts on human health;
- Increasing pollution levels in drains would result in increased incidence of water-borne diseases where drain water is used (illegally) for direct crop irrigation with exposure risks to farm workers and crop consumers;
- The reduced quality of irrigation water where drainage water is mixed in irrigation canals (21 mixing stations are currently in operation in the Delta) could have impacts over large areas within the Delta (although some mixing stations have been closed due to concerns over drain water quality). In addition, the As-Salem Canal and Umoum projects rely on mixing Nile and drainage water to irrigate new land of more than 1 million fd either side of

the Suez Canal and in the Nubaria area for growing a wide range of food crops, including for export but enteric helminth ova are prevalent in the water;

- The reduced quality of irrigation water also implicates a high risk for the agricultural production and food exporting industry (remember EHEC virus and import bans in Europe in 2011). This sector generates a significant part of the Egyptian GNP;
- Continuing degradation of surface and groundwater resources for potable supply would increasingly challenge the abilities of the WTPs to produce water that meets potable water standards;
- Without investments in new and upgraded water treatment and distribution infrastructure the reliability of water supply would further degrade both in terms of quantity and quality which may have impacts on public health;
- The quality of O&M on WTPs and WWTPs may degrade further, resulting in increasingly poor levels of treatment and, in the case of wastewater, bypassing to drains, exacerbating the consequential downstream impacts on the environment and human health;
- The number of complaints of poor service provision by the ACs would increase;
- The poor financial performance of the ACs may degrade further, putting increasing pressure on their ability to provide adequate water and wastewater services without additional Governmental subsidy.

6.2.2 Programme Alternatives

The objective of analysing programme alternatives is to evaluate options from a strategic environmental perspective on issues that have not yet been decided upon at the project level of IWSP 2. The following alternatives are proposed at a programme level for technical consideration in the design and implementation of projects under IWSP 2 where these would provide additional environmental and health benefits. These issues also have a more general application throughout Egypt.

Disposal of Water Treatment Sludge

The presently common practice of discharging water treatment sludge to surface waters in Egypt is in contravention of Law 48/1982. This practice can have a number of adverse impacts due to the increased sediment load and pollutants that can affect wildlife, increase dredging requirements and reduce water quality for irrigation and water treatment.

As a matter of policy, water treatment plants should be provided with facilities to consolidate the sludge (air-drying on small WTPs or mechanical dewatering on large WTPs) so that the sludge can be disposed of safely to an authorised landfill.

Disinfection of Treated Wastewater

Most drains in the Nile Delta are widely contaminated by inadequately treated wastewater and illegal dumping of septic tank sludge and solid wastes. As a result, drainage water contains high loads of organic solids and large numbers of enteric pathogens. The discharge of disinfected treated

wastewater will provide limited dilution and reduction in the potential health impacts of the drain downstream.

Legislation requires that the final effluent discharged from wastewater treatments is chlorinated as a hygiene precaution. This is sensible where the effluent is used directly for irrigation (generally only possible in the New Lands). Under the current legislation, however, the only option available in the Delta for effluent is discharge to drains and this may have potentially adverse environmental impacts.

The residual chlorine concentration in the effluent will be quickly rendered ineffective by the quality of the drain water and will result in the formation of THMs and HAAs. These compounds accumulate in drain sediment, the environmental consequences of which are not well quantified but are considered as potentially hazardous.

Alternative disinfection methods adopted internationally include the use of ozone or ultra-violet light but both are expensive and require a higher level of O&M than chlorination and the effluent must have low suspended solids for these processes to be effective.

Consequently, the advantages of chlorination may outweigh the disadvantages due to its direct benefits for many people using the drains. The potential risks associated with the formation of THMs/HAAs could be reduced by de-chlorinating the effluent after sufficient chlorine contact time. Dechlorination with sulphur dioxide or sodium thiosulphate will slightly reduce dissolved oxygen and raise the oxygen demand (in terms of BOD and COD) in the effluent which may need to be balanced in the design of the WWTPs by providing more effective biological treatment.

Critically, chlorination by itself cannot achieve compliance with the effluent standards stipulated by ECP 501/2005 as helminth ova are not killed by chlorination. Consequently, it is recommended that additional treatment by sand filtration of the final effluent is considered in the future design and upgrading of WWTPs in order to achieve compliance with reuse standards. The importance of this is indicated by the high prevalence of helminth ova reported in irrigation water after mixing with drainage water, such as in the Salem Canal.

The table on the following page summarizes different processes and their advantages / disadvantages for the disinfection of the effluent.

Table 23: Comparison for effluent disinfection options

Process	Advantages	Disadvantages
Chlorine gas	• Low capital and moderate operating costs. • Most commonly adopted technique. • Proven reliability.	• Potentially hazardous to store. • Strict health and safety requirements. • Does not kill parasite eggs. • Residual chlorine may react in receiving water to create THMs. • May require dechlorination.
On-site hypochlorite generation	• Simple process, requires no hazardous materials (salt). • Simple to operate. • Batch production according to consumption. • Hypochlorite solution does not degrade in storage. • Simple metering pump. • Most suitable for small WWTPs.	• Requires water softening. • Higher operating cost than chlorine gas. • Does not kill parasite eggs. • Residual chlorine may react in receiving water to create THMs. • May require dechlorination.
Commercial sodium hypochlorite	• Simple operation - storage tank and metering pump. • Low maintenance • Minimal power requirements • Most suitable for small WWTPs.	• High concentration of hypochlorite – degrades in storage. • Potentially hazardous to handle. • Limited amount can be stored on site. • Requires reliable contract supply. • Higher operating cost than chlorine gas. • Does not kill parasite eggs. • Residual chlorine may react in receiving water to create THMs. • May require dechlorination.
Ultraviolet radiation	• No handling of potentially hazardous chemicals. • Highly effective in high quality effluent. • Better kill of parasite eggs than chlorination. • No residual toxic effects.	• High investment costs. • Requires effluent with low turbidity/suspended solids. • Requires regular lamp cleaning to maintain efficiency. • UV lamps require regular replacement. • No residual disinfection so bacterial regrowth may occur.
Ozone	• Highly effective • Removes trace organics (including THM precursors).	• Not widely adopted for effluent disinfection. • Potentially hazardous. • High cost. • Potentially hazardous.
Other methods (chlorine dioxide, peracetic acid, etc.)	• No significant advantages over chlorination.	• Not yet used for large-scale effluent disinfection. • Same disadvantages as chlorination. • High cost.

Reuse of Treated Wastewater

Current legislation only permits the direct reuse of wastewater for the irrigation of non-food crops. The Government's strategy is to maximise the reuse of treated effluent in man-made forests and for industrial crops, with a target of 2.4 billion m^3/y irrigating 84,000 hectares[8] whereas the target for overall effluent reuse is 4.5 billion m^3/y by 2017[9] (which presumably included indirect reuse of drainage water).

The lands of existing and planned forests are transferred to the HCWW who will be responsible for their management. It is planned that future forests will be operated by private investors who will pay to lease the land and for receiving treated effluent, and grow crops according to the effluent reuse code, although the financial viability of this has yet to be established. All of the land designated for effluent irrigation is in desert areas and this programme does not apply to the old lands of the Delta.

The existing system in the Delta where wastewater is discharged in agricultural drainage channels, does not allow controlled reuse of wastewater for agricultural irrigation since the mixture will lead to water of unknown quality. However, the quality of mixed waters (effluent discharge to drain, and drain water with canal water) should comply with Law 48/1982 and is monitored by the MWRI.

Treating wastewater to a high standard and for the quality to be degraded by discharge to drains does not appear to make best use of the investment in WWTPs or maximising the benefit of this water resource. Under current conditions, at best the treated effluent will provide a small dilution of pollution emanating from other sources.

For these reasons it may be appropriate to review whether the current precautionary approach to the reuse of treated effluent can be better adapted to the conditions of the Delta. This could include, for instance, the designation of land in the vicinity of WWTPs that can be supplied directly with treated effluent, under the management of a water users association, where restricted but economically viable crops may be grown under controlled conditions.

Improved Sludge Treatment

Currently, very few WWTPs in Egypt can produce sludge that complies with the microbial quality standards of ECP 501/2005, yet sludge is commonly used in agriculture in contravention of these standards. With few exceptions, the sludge is not stabilised.

Using sludge in agriculture is the most sustainable and lowest cost sludge management option in Egypt. Consequently, if sludge quality standards are to be respected and farm workers in particular are to be protected from high exposure risk to disease, the sludge should be treated to the required level as a matter of policy and practice.

The potential scale of this issue is significant. By 2020, it is estimated that sludge production nationally will reach about 2 million t ds/y. Assuming an average annual application rate of 10 m^3/fd (and dry sludge density of 0.65 t/m^3), approximately 300,000 fd will be required annually to reuse all of the sludge produced. As a result, several hundred thousand farm workers would be directly exposed to sludge.

[8] Ministry of State for Environmental Affairs (2006), Annual Report.
[9] Government of Egypt (2001), The National Environmental Action Plan 2002/2017.

As a matter of policy, WWTPs should be equipped with appropriate sludge treatment facilities to ensure that the hygienic quality of sludge complies with the applicable standards. This will incur additional investment and increased operational costs, and require enhanced technical competence of operators.

The selection of the appropriate approach will depend on the size of the respective WWTP and the land area available. Air-drying and long-term storage can achieve the quality standards but the reliably of such approach depends on good management. Composting proved to reliably achieve the quality standards under Egyptian conditions. Both of these processes require large areas of land but this option may be viable for WWTPs in Upper Egypt

Anaerobic digestion may be appropriate for large WWTPs as the biogas produced can be used to reduce the energy cost and carbon footprint of wastewater treatment. The quantity of sludge produced is reduced but the quality may not be compliant without additional treatment.

Consideration should be given to establishing centralised sludge treatment at one or more locations within each AC whereby sludge from small WWTPs is transported to a large WWTP for treatment. The increased scale of operations makes investment in sludge treatment more cost-effective. Although this would incur additional transport costs, the unit cost of treatment would be lower than if done at each plant individually. Such approach would centralise the necessary technical expertise, simplify monitoring and control of sludge, and reduce the number of sludge products offered to farmers. However, the WWTP hosting centralised treatment may require additional wastewater treatment capacity for any liquors produced during sludge treatment, particularly if the sludge is mechanically dewatered.

Because of the poor solid waste management and the insufficient number of disposal paths in the project area, the Designer of the plants has to strictly follow the principle "avoid before reuse/recyle before disposal". The proposed treatment plants shall ensure the lowest possible amount and the highest achievable quality of sludge.

The tables on the following two pages summarise the different sludge treatment options and their respective advantages / disadvantages.

Table 24: Comparison of sludge management options

Treatment	Location		Relative area required	Potential impacts	Relative cost [1] Capex/Opex	Sludge quality		Facilities and equipment required	Suitable outlet [2]
	On-site	Central				Physical	Microbiological		
Liquid sludge									
Aerobic digestion	Yes	Yes	Small	Odour	Capex: moderate Opex: high	Liquid sludge requiring further treatment	Poor	Tanks, aeration system	None without dewatering / drying
Anaerobic digestion	Yes	Yes	Small	Odour, visual	Capex: high Opex: moderate	Liquid sludge requiring further treatment	Poor	Tanks, biogas holder, heat/power recovery	None without dewatering / drying
Air-drying	Yes	No	Large	Odour, run-off	Capex: moderate Opex: low	Good to poor. Depends on climate and storage period	Moderate to poor. Depends on climate and storage period	Hard area, drainage and treatment, loader	Any
Sludge reed beds	Yes	No	Moderate	Minimal	Capex: moderate Opex: low	Good	Good	Lined and under-drained basins.	Any
Mechanically dewatered sludge									
Storage	Yes	No	Moderate	Odour, dust	Capex: low Opex: low	Good to poor. Depends on climate and storage period	Moderate to poor. Depends on climate and storage period	Hard area, drainage and treatment, loader	Any
Solar drying	Yes	Yes	Moderate	Visual (large glass structure)	Capex: high Opex: low	Good. Less susceptible to climate. Depends on retention time.	Moderate	Hard area, glass house, loader, turning equipment	Any

Treatment	Location		Relative area required	Potential impacts	Relative cost [1] Capex/Opex	Sludge quality		Facilities and equipment required	Suitable outlet [2]
	On-site	Central				Physical	Microbiological		
Lime treatment	Yes	Yes	Small	Visual (lime silo)	Capex: low Opex: moderate	Moderate, depends on quantity of lime added	Good if CaO used, otherwise moderate	Silo, mixer, lime supply	Landfill only
Composting	Yes	Yes	Large	Visual (if covered), odour, dust	Capex: high Opex: high	Variable if done outside. Good if done under cover. Bulking agent must be good quality.	Good if time and temperature conditions achieved	Hard area, building, drainage and treatment, loader turning equipment, supply of bulking material	Any
Thermal drying	Yes for large WWTPs	Yes	Small	Visual (stack)	Capex: high Opex: very high	Excellent	Excellent	Thermal drying unit, fuel tank, storage silo, (bagging plant)	Any
Incineration	No	Yes	Small	Emissions, visual	Capex: very high Opex: very high	Bag filter ash and clinker	Not present	Incineration plant	Landfill or use in construction

Note: [1] The cost of land is not considered but if land acquisition is necessary, this would substantially increase investment costs for air-drying, solar drying and composting

[2] Acceptance in agriculture depends on complying with microbiological standard which cannot be reliably achieved by all processes.

6.3 ASSESSMENT OF PROGRAMME IMPACTS

6.3.1 Predicted Positive Impacts of IWSP 2

By improving water supply and sanitation services in four target governorates IWSP 2 will achieve regional environmental improvements, enhance public health conditions and improve the capacity of HCWW and the ACs in effectively managing these services. The following are the main environmental benefits expected from the Programme:

- Progressive reduction in the disparity between population coverage of water supply and wastewater services.
- Increasing volumes of wastewater that are treated to the required standard for discharge to the environment, with concomitant reductions in contamination of water resources and the associated risks of disease transmission.
- Reduced wastewater pollution levels in drains will result in improved quality of irrigation water where drainage water is mixed in canal water for unrestricted crop irrigation, and decreasing incidence of water-borne diseases, particularly where drain water is used (illegally) for direct crop irrigation.
- Improved water quality in drains, canals and finally the River Nile in the target governorates will lead to an enhancement of habitat quality for aquatic life and water related downstream habitats.
- Reducing pressure on the abilities of the WTPs to produce water that meets potable water standards due to the progressive improvement of the quality of surface and groundwater resources.
- Improving reliability of water supply (quantity and quality) by investment in new and upgraded water treatment and distribution infrastructure and thus reducing impacts on living conditions from intermittent water supply.
- Improving O&M of WTPs and WWTPs through improved management and training, coupled with technical improvements to facilities, will result in more effective treatment, compliance with quality standards and reduced impacts on the environment.
- Reducing number of complaints by the public of poor service provision.
- Improving financial performance of the HCWW and the ACs through improved accounting and management procedures.
- Positive socio-economic effects through jobs created by the construction activities. A significant amount of local labour is expected to be required.

6.3.2 Potential Negative Impacts during Construction

The potentially negative impacts during construction can be divided into

- Unavoidable environmental impacts of construction; and
- Additional direct and indirect risks

For the unavoidable effects, mitigation and compensation measures have to be developed, applied and monitored regularly.

Additional risks can usually be avoided within the planning process, i.e. by excluding and protecting sensitive habitats from occupation (also temporarily) or disturbance. Good practice and working performance according to existing standards and guidelines for construction will also avoid unnecessary nuisance or destruction (see Chapter 3.1.8, Egyptian Engineering Codes of Practice).

As shown in the following assessment matrix the potential effects of construction on the environment have been evaluated and classified into appropriate categories (refer to Chapter 1.3.2). For the relevant environmental sectors, only the significant effects are described in more detail.

Occupational Health & Safety

In construction work the causes of accidents are well known and often repeated. Too often hazards are just seen as an inevitable part of the job, so no action is taken to control the risks they create. Consequently, the rate of accidents and ill health remains high. In order to minimize these risks contractors should create and maintain as reasonably practicable a safe and healthy work environment, execute the works in a manner that complies with all the requirements of health and safety regulations, and in so doing, minimize the risk of incidents occurring.

Public Health & Safety

There are no effects of construction works on public health, regarding diseases, mortality rates and such like.

The construction activities and effects are therefore not applicable with regard to public health but there will inevitably be short-term nuisance resulting from additional construction traffic, noise and dust.

Surface Water and Groundwater Resources

Construction works under the IWSP 2 will generally take place close to either surface water resources or in areas with high groundwater tables, thus resulting in generally increased risks for the contamination of water resources, e.g. through accidental spills of hazardous substances such as oil or chemicals, or operational failure. Testing the integrity of sewerage systems can lead to contamination if leakage or damage occurs. Dewatering works may lead to groundwater being brought to the surface which may present another risk of contamination.

Such impacts are not avoidable but all significant risks can be minimised by taking care and applying good practice according to existing guidelines for construction.

Soil

Obviously, natural soil or soils of high value for agriculture are the most affected environmental goods. All installations and facilities (temporary or permanent) will lead to sealing of soils and loss of land. All ecological functions are destroyed under paved and sealed soil and are therefore lost to other types of use. Soil compressing and hammering leads to destruction of soil structure around / beyond the location of direct impact.

The impact on soil is in principle not avoidable but effects can be minimised by applying good practice according to existing guidelines for construction.

Air Quality

Only minor and temporary effects of air emission / local air pollution due to building machinery and truck movements can be identified. Local negative effects on ambient air quality are in principle not avoidable because the use of (heavy) construction machinery is necessary. Minimisation measures are possible.

Climate / Climate Change

Temporary effects of air emissions during the construction period will have no effects on the climate or affect climate change.

Flora, Fauna, Habitats

Construction works generally do affect wildlife and habitats depending on the demand on land and impacts of construction activities (emissions, noise, vibrations, movements of machinery, etc.). Special attention is required in case of new construction of WWTPs and other facilities in remote areas. Disturbance in protected areas can cause negative effects on wildlife breeding success or even on whole populations. However, in the IWSP 2 governorates there are only a few natural habitats as most of the land is heavily influenced by human activities.

Because of their temporary status and the present situation, the effects are considered to be of minor significance. The impact on habitats and species is in principle not avoidable, but effects can be minimised by applying good practice according to existing guidelines for construction.

Landscape

In almost all natural areas, the construction of technical facilities and further human impact is considered to be negative. However in the IWSP 2 areas, the landscape is already significantly modified by human activities (agriculture, urban areas, etc.) and consequently, in general the effects on landscape are considered as minor.

Agriculture

On the SEA level the assessment of effects on agriculture contains a level of uncertainty. The significance of effects may be dependent upon the value and amount of agricultural land additionally demanded for the construction of new facilities.

The construction phase will also need additional space for temporary storage and construction of roads. If there is no proper rehabilitation or reconstruction of temporarily used areas, this will cause negative impact on agricultural values.

In this sector, the assessment is very much dependent upon the respective location and loss of valuable soil and this must be considered by the individual project EIAs. Generally, impacts on agriculture may be unavoidable in the Delta where there are limited areas of non-agricultural land suitable for the construction of the IWSP 2 facilities.

Solid waste

Excavation works and site preparation will generate solid waste. Most of this will be soil from excavations that may be used on site for backfilling and landscaping. There will also be wastes from construction, equipment maintenance and workers; these should be collected and removed from the

site for disposal in an authorised landfill. If there is a proper handling of all solid wastes and reconstruction of temporarily used areas, no significant effects will remain.

Nuisance, socio-economic effects

Generally speaking, construction activities will cause temporary nuisance in neighbouring areas. Noise, emissions, vibrations and heavy truck traffic are the reasons for temporary negative effects on human living space.

Socio-economic effects can be identified if it is necessary to make temporary blocking or detours of roads and access to certain areas which may cause traffic congestion and delays in private and business life. As these effects are temporary, they are considered to be of minor significance. Nuisance effects in principle are unavoidable but can be minimised by good planning, good organisation and applying good practice according to existing guidelines for construction.

Cultural heritage

For known and unknown cultural sites and values, the assessment of effects contains a level of uncertainty. There are some risks if known sites and buildings are not protected during the construction period or if the chance finds of unknown cultural goods are not recognized and protected in time (prior to starting site levelling or excavation works). For known cultural goods, there are risks from improper management of the construction site (no care of prevention of illegal or unnecessary destruction caused by construction works, for example deep excavation or hammering). All of these risks are avoidable by good practice and adequate care being taken during construction works.

The significance of effects can only be evaluated by individual project EIAs when the precise location and the land requirements for construction purposes have been identified. If it transpires that there is a potential risk of damage to undiscovered historical artefacts then the relevant authorities have to be informed.

Table 25: Screening of impacts - construction period

Major environmental and social effects		Public Health & Safety	Surface Water & Groundwater Resource	Soil	Air Quality	Climate / Climate Change	Flora, Fauna, Habitats	Landscape	Agriculture	Solid waste	Nuisance, socio-economic effects	Cultural heritage
General Construction	Emissions (Noise, dust, odor), nuisance, distribution of habitats, risk of devastation and contaminator for soil ground water and watercourses	O	O	-	O	n.a.	O	O	O	O	O	O
Water distribution and wastewater collection systems												
Excavation works	Loss of natural soil, loss of natural habitats, loss of agriculture useful land, noise, dust	n.a.	O	-	n.a.	n.a.	O	O	O	-	-	O
Levelling of trenches, fixing pipe foundation, laying pipes, connecting/welding pipe stretches	Compressing soil	n.a.	O	-	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	O	O
Testing pipe lines and backfilling	Risks of spill into soil and groundwater	n.a.	-	-	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	O	O
Installation of manholes/valve chambers and other facilities	Soil sealing, loss of land	n.a.	O	-	n.a.	n.a.	O	O	n.a.	n.a.	O	O

Major environmental and social effects		Public Health & Safety	Surface Water & Groundwater Resource	Soil	Air Quality	Climate / Climate Change	Flora, Fauna, Habitats	Landscape	Agriculture	Solid waste	Nuisance, socio-economic effects	Cultural heritage
Pumping stations, water and wastewater treatment plants												
Site preparation and site levelling	Loss of natural soil, loss of natural habitats, loss of agriculture useful land, noise, dust	n.a.	n.a.	-	n.a.	n.a.	O	-	O	-	-	O
Excavation works	Noise, dust and air pollution	n.a.	n.a.	O	O	n.a.	O	O	O	O	-	O
Dewatering work, temporary discharge of ground water	Impact on water resources, risk of intake of hazardous substances	n.a.	-	-	n.a.	n.a.	O	n.a.	O	n.a.	O	O
Hammering	Vibration	n.a.	n.a.	O	n.a.	n.a.	-	n.a.	n.a.	n.a.	-	O
Establishment of temporary units	Temporary use of land, destruction of vegetation	n.a.	n.a.	-	n.a.	n.a.	O	n.a.	O	n.a.	O	O
Short or mid-term increase of heavy truck movement	Noise, dust and air pollution	n.a.	n.a.	n.a.	O	n.a.	O	n.a.	n.a.	n.a.	O	O

6.3.3 Potential Negative Impacts during Operation

The potentially negative impacts during operation of existing, refurbished and new facilities can be divided into

- Unavoidable environmental impacts of operating the facilities,
- Additional environmental impacts and health risks due to poor operation and maintenance practices, and incorrect handling and control of hazardous substances and chemicals.

For those unavoidable effects, mitigation and compensation measures have to be developed, applied and regularly monitored.

In contrast to the unavoidable effects, all additional risks can usually be avoided within the operational and management processes. Good practice and operational performance according to existing national standards (for example in the Egyptian Engineering Codes of Practice), international standards and guidelines (e.g. IFC General EHS Guidelines and Sector Guidelines) and compliance with the environmental & H&S standards set by the national legislation(see Chapter 3.1), will avoid unnecessary nuisance or even more severe environmental or health effects.

As presented in the following assessment matrix, the potential effects of operation on the different environmental sectors have been evaluated and classified into categories (see Chapter 3.2.1). Only the significant effects are described in detail.

Within the matrix, the operational processes are differentiated into the following groups of facilities:

- Gravity systems and rising mains;
- Pumping stations;
- Water treatment plants; and
- Wastewater treatment plants.

Occupational Health & Safety

Workers in this sector are exposed to a variety of hazardous chemical and biological materials contained within the effluents and the reagents used in the water/wastewater processing or generated during the water treatment. Chemical agents may cause acute poisoning, chemical accidents (e.g., skin burns, injury to the eyes, etc.) damage to the respiratory system, allergies, dermatitis, chronic diseases, etc. Biological agents include pathogens such as bacteria, protozoa, viruses, helminths and fungi. There may be injuries by slips, trips and falls on wet floors; by falls into treatment ponds, pits, clarifiers or vats and by splashes of hazardous liquids; they may suffer cuts and pricks from sharp tools, contusions, etc.

Pre-planning, careful attention to personal hygiene and proper use of personal protective equipment can greatly reduce the associated risks of exposure to sewage. It is essential that information be provided to the worker on reducing the risks of exposure and injury.

Public Health

In general if treatment plants/facilities are being operated and maintained according to good practice and that quality standards are being achieved, then the risk to public health will be minimised. In fact, positive health benefits are to be expected within the wider environment due to the reduction in discharge of untreated wastewater and exposure risk from contaminated water.

However, there are clearly some risks that could affect public health. These are mainly due to the handling, storage and usage of chemicals and other hazardous substances during water and wastewater treatment. Malfunctioning equipment or failure of biological processes at certain operational stages could likely endanger public health within the service areas through inadequate water or wastewater treatment.

The addition of chlorine gas either in the water treatment process or to the final wastewater effluent may cause serious health problems for the workers due to malfunction of storage or dosage equipment due to poor maintenance or accident. Regarding public health, the effects of chlorine in the food chain and finally to the consumers are not totally clear. However, the likely formation of THM and HAA when treated effluent is discharged to drains is of concern as these substances are suspected to be carcinogenic.

The handling, storage and disposal of raw and untreated sludge are subject to various risks due to the pathogen content . The primary concern is of disease transmission to WWTP workers and farmers who are directly exposed to sludge when handling sludge at the WWTP and when spreading sludge on land. If sludge is composted, the process can be a potential hazard to the respiratory health of workers (aspergillosis) due to the release of fungal spores.

Another source of risk and potential health impacts is the illegal or involuntary discharge of wastewater or raw sludge to water bodies due to malfunctioning or overloading of WWTPs. If the water is subsequently used for irrigation, a wide range of food crops could be contaminated that may result in disease transmission to the general public.

Sewage sludge also contains heavy metals and, when sludge is applied to agricultural land, heavy metals will slowly accumulate in soil. This can result in increased absorption of heavy metals into food crops and in the long-term could present a risk to public health if sludge is applied regularly to land without any control or monitoring.

Summarizing the assessment of impacts and risks for public health, they have to be described as numerous and highly significant.

Surface Water

While treatment of wastewater will generally reduce the pollution of water bodies, there is a risk to water quality due to illegal or involuntary discharge of untreated wastewater or raw sludge due to malfunction or over-loading of the WWTP. The short-term discharge of untreated wastewater (bypassing the treatment) will cause shock-loads on drains and accordingly may have a serious impact on water quality and aquatic life. The impact will also affect a certain downstream area until the dilution effect and natural self-treatment has occurred in order to bring the water quality back to an acceptable standard.

All WWTPs must have an emergency bypass in the case of accident, plant malfunction or high wastewater (storm) flow but good design with sufficient capacity and good maintenance should minimise the use of the bypass.

Groundwater

Risks mainly arise due to leakage from the sewerage network and from poorly maintained oil and grease traps. In areas with a high groundwater table there is a high risk and special attention should be given to good operation and maintenance practice.

All storage and handling of hazardous substances like fuel, oil and chemicals is a risk because of possible accident or failure in operation, and if spillage is not contained, this can cause serious groundwater contamination

Potential environmental impacts are minimised as far as practicable by proper design of buildings and facilities to contain spillages, and adoption of appropriate containment and clean-up procedures in the case of spillage.

The use of treated effluent and sludge on agricultural or green land will result in the addition of nutrients, which is important for crop production. However, if the addition of nutrients is not controlled, a surplus of nitrogen above that which can be utilised by crops may occur, and this will be at risk of leaching as nitrate under irrigated agriculture. This may adversely impact groundwater quality but the potential risks are minimised by provision of suitable advice to farmers on reducing fertiliser use where sludge is applied to the land.

Soils

The risks concerning groundwater contamination from spillage of polluting oils and chemicals are also valid for soils, although the potential impacts are likely to be limited to within the facility and so would have limited significance.

There is a risk of soil contamination by flooding of wastewater in the case of failure of pumping station or breakage of sewer pipeline. This may result in contamination of crops if agricultural land is flooded and so may pose a limited risk to public health.

The quality of soil will be impacted by the use of sewage sludge by farmers on agricultural land. Most of the impacts are very beneficial to soil quality and crop production due to the addition of organic matter, nutrients and trace elements. However, regular application of sludge will result in slow accumulation of heavy metals in the soil, and if not controlled and monitored, this could result in soil concentrations that may be injurious to crops or humans or animal eating the crops. However, the risks are considered to be low and long-term.

Air Quality

There will be minor and temporary effects of air emission / local air pollution due to vehicle movements associated with the operation of the facilities; these will be greatest at WWTPs due to the number of truck movements required to transport sludge from the plant.

WWTPs are a source of odour and should be constructed at an appropriate distance from habitation to minimise nuisance. The main sources of odour are the inlet works, primary sludge tanks and sludge drying beds. Wastewater that is septic has a strong offensive odour the impact of which may be reduced by enclosing the inlet works and providing air treatment.

Certain gases are emitted by pumping stations and WWTPs at low concentrations, in particular hydrogen sulphide (toxic at low concentrations), methane, ammonia and NOx (GHGs). In general, these are unavoidable due to the nature of wastewater and the types of treatment processes. The primary concern is for the health and safety of workers, and safe working practices in enclosed spaces should be adopted.

Composting of sludge and handling dried sludge can result in odour emissions and dust which can have health (respiratory) implications. Consequently, workers should be provided with protection and handling of compost and sludge should not be carried out under windy conditions.
Overall, the environmental effects are generally avoidable by proper operational and process management, and are not significant for the local or regional air quality.

Climate / Climate Change

The above mentioned effects on air quality will have certain GHG emissions but they will not affect the climate itself or climate change.
On the other hand, water and wastewater facilities have high energy demands, particularly wastewater treatment, and there are various possibilities to reduce the carbon footprint of these facilities by means of:

- Increasing energy efficiency of each process step where electrical energy is used: pumps, generators, heat exchangers, motors, etc. By rehabilitation or upgrading the equipment,
- Regular and good maintenance of various processes including cleaning mechanical installations, filters and pipes,
- General regular process control, improving process efficiency,
- Installing anaerobic sludge digesters in combination with heat and power generation (fed with biogas),
- Further climate smart investments (CSI) based on feasibility studies for different plants (see Annex 3).

According to the numerous options available and the recommendations made regarding sludge treatment coupled with CSI to enhance the performance in water and more in the case of wastewater treatment, the overall assessment in this sector is positive.

Flora, Fauna, Habitats

Regular operation of the facilities within fenced borders may have some effects on animals and wildlife like noise, vibrations, movements of machinery, etc. Also an additional demand on land and potential habitats is valid when extension works are going on. This has to be assessed in the respective project EIAs.
In case of failure, accident or designed bypass operation (as described above) the discharge of untreated wastewater will cause a negative impact on aquatic wildlife and habitats. This risk is unavoidable but also no mitigation measures are applicable.
In general, however, the effects in this environmental sector are considered as of minor significance.

Landscape

The operation of facilities has no further effect on the landscape but attention has to be given to additional land demand and extension projects. This has to be dealt with by the project-specific EIAs. In general, the effects on landscape are considered as minor or not applicable.

Agriculture

Most of the sludge produced by the operation of WWTPs is likely to be used by farmers as an organic fertiliser. While this has positive benefits for crop production and farm profitability (by replacing expensive chemical fertilisers and animal manure), all recommended measures, legal requirements and improvements related to sludge treatment and control of pollutants in sludge and its use on land should be observed so as to improve the quality and safety of sludge used in agriculture and of the crops produced.

WWTPs must be designed and operated to ensure that effluent and sludge are treated to the required levels to minimise potentially adverse impacts, particularly in relation to reducing the pathogen contents of effluent and sludge and the consequential risks of disease transmission particularly to those handling the sludge. Sludge should stabilised, preferably by composting or anaerobic digestion, where this is practicable. Air-dried sludge should be stored for sufficient time before usage so that the pathogen load is significantly reduced.

Due to the various positive effects of IWSP 2 and further recommendations in the SEA, the overall assessment in the agricultural sector is positive.

Solid waste

Maintenance upgrading of pumping stations and treatment plants may lead to replacing old wet transformers which will require special care for disposal as hazardous waste.

Routine operation and maintenance works on water and wastewater treatment plants will produce a range of different types of solid waste that will require removal from the site for safe disposal in an authorised landfill. The main types of waste are sludge from WTPs, and screenings, grit and grease from WWTPs. In addition, sludge from WWTPs may require disposal to landfill if there is insufficient demand from farmers to use all of the sludge produced.

At present there are few contained solid waste disposal facilities in the Delta as most of the existing sites are not designed or managed in a manner that properly controls environmental impacts. Consequently, the disposal of wastes from WTPs and WWTPs may potentially generate adverse impacts (which will increase with expansion of wastewater treatment provision) until adequate sanitary disposal facilities will be operational in the Delta.

The overall assessment in this sector is therefore stated as significant with serious additional risks for public health, water bodies, soil and habitats.

Public nuisance

Generally speaking, different stages of operation may cause nuisance on human living space. WWTPs can be significant cause of nuisance due to noise, odour and flies resulting from poor design, inadequate process control and poor maintenance.

All negative effects in this regard can be avoided or at least minimised by observance of adequate separation distance of the facilities from habitations, and appropriate design and operation of the facilities to minimise sources of nuisance.

Socio-economic effects

Socio-economic effects cannot be identified for the operational stage, although WTPs and WWTPs will provide long-term employment opportunities.

In this respect the environmental effects are considered as of minor significance.

Cultural heritage

After the evaluation of potential effects in the project EIAs, no further negative effects are to be expected in the operation stage.

Table 26: Screening of impacts - operational phase

Major environmental and social effects		Public Health & Safety	Water Resource	Soil	Air Quality	Climate / Climate Change	Flora, Fauna, Habitats	Landscape	Agriculture	Solid waste	Nuisance, socio-economic effects	Cultural heritage
General Operation	Nuisance, environmental and h&s risks due to usage/handling of hazardous substances, chances of energy reuse and reduction of carbon foot print	-	+	O	O	+	O	O	+	-	O	O
Gravity systems, rising mains and pumping stations												
Installation and maintenance of oil and gas traps	Risks of spill into soil and groundwater	n.a	-	-	n.a	n.a	n.a	n.a	n.a	n.a	O	O
maintenance of gravity sewers	Sand, grit, waste, operational risk	n.a	O	-	n.a	n.a	n.a	n.a	n.a	O	n.a	O
Waste removal and disposal	Operational and disposal risks	n.a	O	O	n.a	O	n.a	n.a	n.a	--	n.a	O
Rehabilitation/replacements of old wet transformers	Hazardous waste (PCB)	-	n.a	n.a	n.a	n.a	O	n.a	n.a	-	n.a	O

Major environmental and social effects		Public Health & Safety	Water Resource	Soil	Air Quality	Climate / Climate Change	Flora, Fauna, Habitats	Landscape	Agriculture	Solid waste	Nuisance, socio-economic effects	Cultural heritage
Water and wastewater treatment plants												
Addition of chemicals for flocculation	Hazardous waste (PCB)	-	n.a	n.a	n.a	n.a	O	n.a	n.a	-	n.a	O
Backwashing of sand filters	Illegal discharge of water bodies, impact on wild life, impact on water quality	n.a	-	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	O
Addition of chlorine gas	Hazardous substance, air pollution, health and safety risks for workers.	-	n.a	n.a	-	n.a	n.a	n.a	n.a	n.a	n.a	O
WTP sludge storage and disposal	Illegal discharge of water bodies, impact on wild life, impact on water quality	O	-	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	O
Storage and usage of chemicals	Spillage, contamination of soil and water, h&s of workers	-	n.a	n.a	-	n.a	n.a	n.a	n.a	n.a	n.a	O
Traffic and truck movements	Noise dust and air pollution	O	n.a	n.a	-	O	O	O	n.a	n.a	_	O
Aerobic treatment	Some processes high energy demand	n.a	n.a	n.a	O	O	n.a	n.a	n.a	n.a	n.a	O

Major environmental and social effects		Public Health & Safety	Water Resource	Soil	Air Quality	Climate / Climate Change	Flora, Fauna, Habitats	Landscape	Agriculture	Solid waste	Nuisance, socio-economic effects	Cultural heritage
Wastewater by bass in operation	Short term discharge to water bodies, impact on wild life, impact on water quality	O	--	n.a	n.a	n.a	-	n.a	-	n.a	n.a	O
WWTP sludge storage and disposal in drying beds	Odour and fly nuisances, health risks for workers/farmers	-	O	O	n.a	O	n.a	n.a	+	n.a	-	O
WWTP sludge anaerobic digestion and combined heat and power	Generate Methane, alternative energy source, reduction of GHG.	n.a	n.a	n.a	+	++	n.a	n.a	+	n.a	n.a	O
WWTP sludge composting	Metabolic heat generation, high demand on land, Odour and fly nuisances, health risks for workers/farmers	-	O	n.a	O	O	n.a	-	+	n.a	-	O

6.3.4 Overall Environmental Impact Assessment

As summarized in the overall impact assessment matrix (Table 27), significant environmental impacts are identified in some cases. There are certain risks and threats for the environment mainly related to potential accidents, inappropriate process controls and poor maintenance.

During construction any project can cause serious damage to the environment and all potential impacts must be subjected to detailed evaluation and measures at the specific location. Therefore on the project level EIAs have a crucial role to screen and assess potential negative effects on any environmental receptor as early as possible in the project cycle. Based on this assessment, project and site-specific avoidance, mitigation and monitoring measures can be developed.

Under condition that all intended programme projects / measures will be implemented in an adequate timeframe, in a sustainable manner and duly considering the measures and recommendations of this report (see following chapters), the overall assessment is definitely positive. As intended, the programme will bring significant enhancement compared to the present situation especially in the water-related environmental sectors and particularly for public health.

New demand for land and soil sealing will be the main significant impact on soil. The assessment also describes many risks during construction and operation phases and most of these risks can be controlled by following existing guidelines for construction works and operating the facilities. A serious risk remains due to the currently inadequate situation of solid waste management. Operational waste produced at existing facilities is not currently disposed of in an environmentally appropriate manner. This situation may worsen as new facilities are provided under IWSP 2 and hence more waste generated unless there are also continued improvements to the solid waste sector in the region. However, as indicated in 6.2.2 the impacts of the projects will also significantly depend on the chosen programme alternatives.

6.3.5 Overall Socio-economic Impact Assessment

During the selection of the investment projects a pre-screening of projects, particularly with regard to social aspects, took place. In this context, projects for which social issues such as land access and availability, whereby the executing agency could not provide the proof of land availability, were excluded from further consideration. This selection criteria has therefore already filtered out projects which may have presented significantly complex social issues and risks such as land acquisition, resettlement, and compensation for private properties and agricultural land where necessary. The selection of investment projects from a social aspect has therefore greatly minimised social impacts likely to occur during the planning phase and therefore this SESIA focuses on further relevant social aspects (positive and negative) that are mostly anticipated during the construction and operation phases.

The most significant social impact anticipated from the project is the improved water supply situation, characterised by increased quality and quantity of potable water available to the residents living in the service areas of the WTPs. Here the quantity of available potable water will thus have a positive impact on meeting the current demand and in view of the project horizon, as well as paving the way

for potential future infrastructure development made possible through increased water supply in the area, considering the expected population growth in the respective project areas.

The upgrade of ground water units with iron and manganese removal units and the replacement of asbestos networks will have significant health benefits as it will reduce contamination of water resources and significantly decrease potential health hazards which currently prevail. Improved water quality resulting in the improved health of residents in the area, also reduces the burden on health care services occupied with issues such as water-borne diseases, and families can redirect their financial resources towards improving livelihood conditions aside from health care.

Additionally, the improved sanitation system will not only improve the health situation of the concerned population in Upper Egypt, but it will also have a positive socio-economic impact. The improvement of the quality of the treated wastewater which is mixed in irrigation canals lowers the risks on agricultural production and food exporting industry. The project will also provide permanent jobs during operation and short-term jobs during construction for residents in neighboring villages which will have a positive effect on the standard of living and workers' income.

An additional socio-economic benefit will be that the current monthly expenditure spent on emptying septic tanks, will be reduced. However, private consumers who previously did not pay for water or wastewater will have to pay higher tarrifs to be connected to the new sanitary systems and pay wastewater fees. The water however will be safer to drink, cleaner, and more reliable in terms of quality and quantity.

The target area consists of quite homogenous social structures without significant conflicts between ethnic or religious groups so that the expected overall social risks for the programme can be classified as low. With increased water supply and therefore reduced pressure and competition for resources, which may have previously caused tensions, amicable relations between community members are likely to prevail.

As mentioned above, there is no resettlement expected within IWSP 2 due to the introduction of the eligibility criteria and exclusion criteria during the project identification process. The exclusion criteria include for example the availability of land as a pre-requisite for the project to be implemented. Therefore, if the availability of land is not proved for the proposed measure, the project is not implemented under IWSP 2 reducing social impacts related to land acquisition, compensation and resettlement.

With regards to the construction phase, works on the water and wastewater networks that will be constructed in urban areas will lead to traffic disturbances (during preparatory works, earthworks, and pipe laying works). The construction works may have therefore a temporary negative impact on nearby businesses and residents. The management of such disturbances need to be considered in the project specific Environmental and Social Management Plans within the EIAs.

The construction of the new WWTP will take place at a distance of about 4 km to the east of the closest village. Thus, significant socio-economic negative impacts are not expected.

Noise disturbances from machinery will have a rather low impact in rural areas where very few settlements are located, however a greater temporary impact in urban areas. Temporary direct and indirect employment, for skilled and unskilled workers, is expected on a localised extent during the construction phase.

In general, the programme will bring significant enhancement to livelihoods on a social level compared to the present situation, especially with regard to public health and reducing the overall disparity in the area in relation to the population currently supplied and not supplied by water and wastewater services. The socio-economic impact assessment is summarized in the overall impact assessment matrix in Table 27.

6.3.6 Summary of Impacts

The described aspects in 6.3 are summarized in the following Table 27. The table shows an overall impact assessment matrix considering both, environmental and socio-economic impacts on a strategical level for IWSP 2.

Table 27: Overall impact assessment

Major environmental and social effects		Public Health & Safety	Water Resources	Soil	Air Quality	Climate / Climate Change	Flora, Fauna, Habitats	Landscape	Agriculture	Solid waste	Nuisance, socio-economic effects	Cultural heritage
General Construction	Emissions , nuisance, distribution of habitats, risk of devastation and contamination	O	O	O	-	O	O	-	O	-	-	O
Water treatment and supply system												
Rehabilitation of existing networks	Provision of high quality drinking water	++	++	O	O	O	O	O	O	O	O	O
Rehabilitation of existing facilities	Provision of high quality drinking water	++	++	O	O	O	O	O	O	O	O	O
Upgrading of existing facilities	Provision of high quality drinking water	++	++	O	O	O	O	O	O	O	O	O
Extension of existing facilities	Provision of high quality drinking water	++	++	-	O	O	O	O	O	-	O	O
Construction of new facilities	Provision of high quality drinking water	++	++	-	O	O	O	O	O	-	O	O
Process optimization of existing facilities	Improvement of handling, management and maintenance of facilities	++	++	O	O	+	O	O	O	O	+	O
Decommissioning of existing facilities	Risk of uncontrolled decommission	O	+	O	O	O	O	O	O	-	O	O

Major environmental and social effects		Public Health & Safety	Water Resources	Soil	Air Quality	Climate / Climate Change	Flora, Fauna, Habitats	Landscape	Agriculture	Solid waste	Nuisance, socio-economic effects	Cultural heritage
Pumping stations, water and wastewater treatment plants												
Rehabilitation of existing networks	Adequate collection and handling of waste water	++	++	O	O	O	+	O	+	O	O	O
Rehabilitation of existing facilities	Adequate waste water treatment	++	++	O	O	O	+	O	+	O	O	O
Upgrading of existing facilities	Advanced waste water treatment	++	++	O	O	O	+	O	+	+	+	O
Extension of existing facilities	Advanced waste water treatment	++	++	-	O	O	+	O	+	-	O	O
Construction of new facilities	Advanced waste water treatment	++	++	-	O	O	+	-	O	-	O	O
Process optimization of existing facilities	Advanced waste water treatment	++	++	O	O	+	+	O	+	+	+	O
Anaerobic digestion of sludge and CHP	Sludge stabilization, biogas, reduction GHG	++	O	O	+	++	O	O	++	++	+	O
Decommissioning of existing facilities	Risk of uncontrolled decommission	O	+	-	O	O	O	O	O	O	+	O

7 MITIGATION MEASURES

As mentioned in Chapter 1 of this report, it is important to define the appropriate approaches to achieve overall environmental and socio-economic compliance and sustainability by means of:

- Preventing of avoidable impacts;
- Reducing and mitigating unavoidable and significant effects;
- Offsetting inevitable impacts; and
- Adopting measures for project improvement and project adaptation.

As IWSP 2 itself is in compliance with existing national environmental policies objectives of other related programmes, the following measures focus on developing proposals for potential improvements to prevent avoidable impacts relative to the new projects.

7.1 MEASURES TO PREVENT AVOIDABLE IMPACTS

- Keeping the demand on land for new projects or extensions in general as limited as possible, particularly the demand for valuable agricultural land;
- Sealing of soil only as much as is really needed;
- Proper rehabilitation of land and soil after construction works are finished;
- Avoiding any known or potential valuable natural habitat from any occupation, even temporarily;
- Avoiding any known or potential cultural / historic value from any occupation, even temporarily;
- Avoiding any known or potential cultural / historic value from damage during construction works;
- Taking utmost care during any construction works with regard to the effective protection of groundwater and surface water bodies;
- Discharging water from dewatering of construction sites only to suitable water bodies;
- Preventing the discharge of water treatment sludge to drains; either discharge to the sewerage system where appropriate for further treatment, or dry on site and transport to authorised landfill;
- No discharge of wastewater sludge to drains;
- Taking utmost care while handling and storage of raw sludge;
- Storing air-dried sludge for at least 6 month before being released for use by farmers;
- Taking utmost care while handling, storage and application of chemicals and potential hazardous substances;
- Avoiding unnecessary truck movements and machinery operation through well-managed construction supervision;
- Discharge (bypass) of untreated wastewater to drains only in cases of emergency;

- Control of all O & M according to Standard Operating Procedures and manuals.
- Implementation of Special HSE tools and checklists for the use of SVCs
- Holding workshops and trainings on HSE for raising the awarenes

7.2 REDUCTION AND MITIGATION OF UNAVOIDABLE AND / OR SIGNIFICANT EFFECTS

- Works may also be subject to specific schedules to avoid or at last minimize disturbance during the most sensitive periods.
- Implementation of mitigation measures according to the provisions of project EIAs;
- Proper handling, sampling, reuse and dumping of any solid waste;
- Regulation on reinstatement during construction required in the tender documents for the Contractor
- Development of solid waste management programmes at the Governorate level;
- Optimisation of freshwater use (reduced leakage, use of treated effluent for irrigation where appropriate, etc.);
- Reduction of energy and fuel consumption as much as possible by selecting energy efficient processes and operating processes efficiently.

7.3 MEASURES TO OFFSET INEVITABLE IMPACTS

- Implementation of compensation measures according to the results of the individual project EIAs;
- Landscape rehabilitation around the projects sites to properly integrate the new facilities into their surroundings

7.4 IMPROVEMENT AND PROJECT ADAPTATION MEASURES

- Installation of solar power units for temporary facilities on construction sites;
- Installation of sludge anaerobic digesters together with CHP plant wherever practicable;
- Replacing or supplementing the use of chlorine gas with other means of disinfection of effluent, including dechlorination and sand filtration to remove parasite eggs;
- Installation of biological filters where applicable as an energy efficient alternative to the activated sludge process, unless nutrient removal from effluent is a future requirement of WWTPs;
- Effective and efficient control of aeration of the activated sludge process in order to optimise energy consumption;
- Ensuring that the sludge treatment processes can achieve the required reduction in pathogen content of the sludge prior to selling it to farmers;
- Developing and implementing summer / winter regimes for O&M with regard to demographic information, when applicable;

- Carrying out a full and thorough WTP / WWTP analysis as a basis for all rehabilitation and upgrading design;
- Taking account of the significant increase of population in target governorates as part of the design process.

8 MONITORING AND CONTROL

An effective system of monitoring and evaluating of environmental impacts of the IWSP 2 implementation will contribute not only to preventing the programme's possible negative environmental impacts but it will also help to enhance its positive effects in terms of the environment and delivering a higher quality of project.

The following indicators are proposed for monitoring the environmental effects of the programme:

Table 28: IWSP 2 Monitoring and Control Indicators

Objective of IWSP 2	Indicator	Description
Water supply sector		
Distribution network rehabilitation and extension	Supply network completed (km per governorate per year)	GIS data of the ACs
Leak detection and corrective repair and maintenance measures	Amount of non-revenue water (m3 and % per governorate per year)	GIS data of the ACs
Reconstruction / rehabilitation of strategically important worn-out water treatment plants	Progress of performance according to project schedule (% per governorate per year)	Data from project implementation
Increase of services to rural population	Served rural population (% per governorate per year)	GIS data of the ACs
Volume of water produced	m3/d per governorate	GIS data of the ACs
Wastewater sector		
Rehabilitation / upgrading / extension of important WWTPs	Progress of performance in % according to project schedule (per governorate and year)	Data from project implementation
Sewerage network rehabilitation and extension	Sewerage network completed (km per governorate per year)	GIS data of the ACs
Construction of new sewerage schemes	New sewerage pipes completed (km per governorate per year)	GIS data of the ACs
Construction of new WWTPs	Progress of performance in % according to project schedule (per governorate per year)	Data from project implementation
Increase of services to urban population	Served urban population (% per governorate per year)	GIS data of the ACs
Increase of services to rural population	Served rural population (% per governorate per year)	GIS data of the ACs
Volume of wastewater treated	m3/d per governorate	Data from project implementation

Objective of IWSP 2	Indicator	Description
Public health		
Improve public health by reduction of water-borne diseases	Statistics for cases of waterborne diseases (per governorate per year)	Public statistics from the ministry of health
Climate Change		
Reduce GHG emissions of all programme related facilities	Amount of CO2 equivalents per governorate and year	GIS data of the ACs
Improve energy efficiency	Increase in energy efficiency in all facilities (%)	Data from project implementation
Facilitate energy generation from renewable resources and reuse	Number of projects enabling renewable energies and reuse systems	Data from project implementation
Flora / Fauna / Biodiversity		
Protect natural habitats and protected areas	Measures implemented or conflicts reported	Data from project EIA
Cultural Heritage / Tourism		
Protect cultural good and sensitive areas from destruction or nuisance	Measures implemented or conflicts reported	Data from project EIA

In order to ensure appropriate monitoring, it will be necessary to:

- Incorporate the environmental indicators proposed into the overall system of monitoring the impacts of IWSP 2 implementation
- Connect the monitoring system to the system of evaluating and selecting the projects i.e. use the same environmental objectives/indicators for project evaluation and selection and also for further project monitoring;
- Link monitoring of the IWSP 2 to monitoring of the single projects at the EIA level i.e. summarize results of the monitoring from the project level in order to estimate overall effects of the IWSP 2 to the relevant environmental objectives.
- Regularly publish the results of monitoring.
- Ensure sufficient personnel and professional capacities for environmental subjects within the IWSP 2 monitoring programme;
- Involve the key departments of the HCWW and the ACs in discussing and agreeing upon the overall system of monitoring and especially the way of incorporating environmental issues into the overall system before it is launched;

- Ensure that the applicants are informed sufficiently about environmental issues and about possible links of the draft projects to the environment;
- Include environmental NGOs (where applicable) on the monitoring committees to be established.

The monitoring system includes the following activities:

- Monitoring of environmental indicators (especially on the basis of aggregation of data from the project level EMPs);
- Compilation and examination of the monitoring results with respect to changes in environmental indicators;
- Initiation of the appropriate steps in case of negative environmental impacts are found;
- Publishing of the results of monitoring;
- Selection and modifications of environmental indicators with respect to the character of the projects submitted;
- Communication with EEAA and the Governorate environmental protection authorities;
- Providing environmental consulting to staff working in the implementation of IWSP, i.e. particularly Lot B consultants and AC officials;
- Providing information on environmental issues related to the IWSP 2 to all interested parties.

For an effective quality system to monitor the environmental effects resulting from IWSP 2 operations, several aspects are of key importance. These include focussed review and possible modification of relevant environmental objectives of the projects selected based on the evaluation of the related environmental indicators proposed by the SEA for the different areas of intervention in the four target governorates in the context of the individual projects.

9 CONCLUSION, RECOMMENDATIONS AND GUIDANCE FOR EIAS

9.1 LESSONS LEARNT FROM IWSP 1 IN REGARD TO HSE

Based on the experiences gained during the implementation of IWSP 1, it is recommended to use some important lessons learned from this programme in regard to Health and Safety during the construction works in IWSP 2. During the implementation of IWSP 1 it was observed that HSE awareness by Consultants and Contractors is in general at a low level. Neither Supervision Consultants (SvC's) nor Contractors were fully applying the required HSE measures. The most typical problems which were observed in IWSP 1 are summarized in the following:

1. Construction of Sewage Networks Projects:

    - Use of Personal Protective Equipment (PPE): for visibility vests: ~ 90%; for hard hats: ~ 50%; for safety shoes & boots: ~ 20-30% (workers often wear sandals, sneakers or work barefoot). Use of safety gloves, eye or respiratory protection was not recorded.
    - Trench supports: support & bracing of trenches deeper than 1.2 m is oftenly done by narrow wooden planks which are usually insufficient. Use of cring systems, steel trench boxes are not common (or not available) in Egypt which affects not only HSE but work progress and speed. SvCs and Contractors are poorly performing visual inspection of soil on trenches with depth less than 1.2 m for the determination of the suitability of the soil for excavation without bracing. Workers are frequently engaged inside trenches withpout protection by bracing and support of trench sides. Life lines and ropes are usually not used by workers in the trench.

Figure 12: Collapse of trench in one IWSP 1 project

- Trench public protection: Protective physical barriers around the trenches, manhole's work pits and excavation locations mainly consist of warning tapes and rarely by wooden barriers; tapes are placed at 1-1.5 m height.
- Warning signs: Rarely used (both for pedestrians and/or car traffic), night signs and reflectors are usually not used.
- Pedestrian crossings over excavated trenches are oftenly not provided, in cases where they are provided, usually side guardrails or physical barriers are missing so pedestrians cannot safely cross the trench.
- Regulations for securing generators, transformers and cables are not strictly followed. Power supply is frequently taken from local sources, without any verification of safety prior to connecting power tools.
- Excavation of narrow streets (~3 m width): Protective steel piles for protection & securing of the existing building's foundations are not used.
- First Aid kits are usually not available at a sufficient level on sites.
- Neither Contractors nor SvC's have developed proper procedures for HSE inspection, accidents or other recorded problems. HSE monthly reports were not being produced, checklists were not used. Supervision Consultants had problems with engaging full time HSE Engineers due to part time involvement (6 man months out of 12 months project duration). This was corrected for the amendment of SvCs' contracts where full presence of HSE was requested from SvC's.

2. Construction of water/wastewater treatment plants and pump stations:

- Use of PPE: slightly better than in Sewage Networks projects, problems with safety shoes remains.
- Site cleanliness: in many projects incomplete, wooden formworks with exposed nails are frequent, disposal of construction debris is improper.
- Protective barriers: usually only warning tapes, rarely physical barriers.
- Warning signs: if existing only in English although none of the workers speak English.
- Material storages: not properly inspected by HSE Engineers, the most common problem: Oxygen, Acetylene cylinders are not stored in shade or in "valve-up" position but shattered all over the project site usually in horizontal position. Fire extinguishers are often in insufficient number and their location is not strategically chosen.

Figure 13: Acetylene cylinders shattered all over the project site

- Scaffolding (wooden), platforms (wooden): Guardrails rarely exist. Workers oftenly execute works direct from the ladders without protective cages, insufficient life-line and safety rope.

Figure 14: Workers with no safety precautions

- Reinforcement starter bars (vertical, horizontal): Usually without mushroom caps, not bent for preventing injuries. Most of the SvCs are not aware of the existence of such protective products or the requirement for securing reinforcement ends.
- Electrical power sources: insufficiently protected, local sources are oftenly used; safety inspection is usually not conducted prior to connecting power tools to power sources.
- First Aid kits are in insufficient number.
- Training of workers is not properly done by Contractors or SvC's.
- HSE Plan which is a contractual obligation (and therefore submitted by Contractors and approved by SvC's) is not applied properly.

Above explained problems and practices were mainly observed at the beginning of construction works in IWSP 1. The Implementation Consultant (IC) has made intensive efforts, especially in Phase 2 of the programme, to improve the HSE situation on the sites and considerable improvement could be recorded during the implementation of the projects. Besides other measures (such as workshops for raising the awareness, training, providing templates for proper HSE reporting etc.) special HSE tools and checklists were prepared for the use of SVCs. The documents were based on Western Standards and existing documents used in EU and USA but simplified and adapted to particular need in IWSP 1 projects:

- Checklists for trench works and construction works
- Safety Violation Report
- Safety Improvement Notice
- Immediate Incident Report
- HSE Monthly Report

As a conclusion for lessons learned from IWSP 1 it is strongly recommended that above listed documents, prepared for IWSP 1 projetcs, become a part of the tender documents in IWSP 2 and clear penalties are defined and included in the related SVCs' contracts for non-compliance with HSE requirements. Furthermore the topic "HSE" should also be clearly stipulated in the Manual of Procedures. Both MOP of the Programme and the Tender Dossiers of single projects should be amended accordingly and include clear regulations and instructions. The PMC is providing with this report the templates and checklists developed and uitlized in IWSP 1 for monitoring and reporting on HSE measures. It is strongly recommended that the provided tools and documents are transferred to the TADECs of the Programme for their perusal.

9.2 CONCLUSION

The overall results of this report can be summarized as follows:

- For the **water sector**, there are overall positive effects in all governorates due to rehabilitation, upgrading and construction of new facilities and networks for water supply and waste water treatment.
- For the **public health sector**, there will be overall positive effects due to the improvement of water quality. Risks remain due to:
  - The **lack of appropriate solid waste management**;
  - **Sewage sludge** used in agriculture that is not treated to the high standard of pathogen removal required to protect the health of workers;
  - Other **sources of contamination of water resources**, mostly resulting from illegal discharges.
- **Soil and groundwater quality** are currently adversely affected by a number of factors, and IWSP 2 will have minor negative impacts due to changed use of land and operation of new projects and extension in the governorates. In the longer-term, impacts of IWSP 2 will

be positive as groundwater contamination will reduce as a result of programme measures but other impacts such as increasing salinity of soils and groundwater, and overexploitation of soils cannot be influenced by means of programme. The use of sludge has beneficial impact on soils provided that its use is control to prevent negative long-term impact resulting from the accumulation of heavy metals.

- There is no significant or known impact on any **cultural heritage** or tourist attraction. Within the preliminary design, the specific conditions of the project's site and surroundings have to be evaluated and assessed by the respective EIAs.
- The strategy and the guidelines for **sludge treatment** set in this SEA have significant positive effects for the reduction of GHG emissions.
- In relation to the present situation and the projections for **climate change** in the target region, some of the projects and measures might be subject to adaptation, relocation or change capacities.
- After full rehabilitation of site and surroundings after construction, no negative effects for the **landscape** will remain.
- No significant effects on **flora, fauna and biodiversity** are expected in the short-term. Long-term effects are all positive due to the improvement of water quality and also water habitats. However, the existing threats for natural life (species and habitats) which are currently under pressure will remain; the threats include increasing:
  - Population growth
  - Loss of land to urban development and effects of soil sealing
  - Water consumption relative to sustainable resources
  - Use of fertilisers and pesticides
  - Climate change effects, particularly sea level rise.

9.3 RECOMMENDATIONS

9.3.1 Policies & Strategies of HCWW related to Environment Management

The HCWW is strongly encouraged to commit itself to environmental responsibility and environmental managing performance. Therefore an environmental policy and environmental guidelines for the Holding Company, which are also binding on the affiliated companies, have to be developed.

It has to be accepted that the natural resources and the natural environment are fundamental to the core business of HCWW and the ACs and that the companies also have the potential to impact upon the environment in many ways.

An environmental policy recognises the responsibility and sets out the approach as part of a wider commitment to sustainability and good corporate citizenship.

The environmental principles should incorporate, inter alia, the following:

- Protecting and enhancing the natural and built environments, whether they are directly or indirectly impacted by the companies' activities.

- Making effective and efficient use of natural resources, including water, land and raw materials.
- Minimising the impact on climate change through energy avoidance and efficiency, usage of renewables, emissions reduction and good carbon management, while ensuring that the inevitable impacts of climate change on the assets and operations are continually adapted.
- Minimising the generation of waste and making effective and efficient use of unavoidable waste.

These principles will help the HCWW to plan and operate in a sustainable way, and when implementing these environmental responsibilities and IWSP 2, in particular, this will lead to:

- Complying with all relevant environmental laws, regulations and standards.
- Identifying the significant environmental impacts and taking action to manage these throughout the investment programme and wider operations.
- Incorporate environmental considerations into the business decision-making and investment appraisal processes.
- Protect and, where possible, enhance biodiversity, and conserve the country's cultural heritage both on the land holdings and where their activities may have an impact.
- Prevent pollution through effective management of all activities and those of the suppliers, contractors, partners and industrial customers.
- Balance demand management activities with responsible water resource development, ensuring the application of sustainable integrated water resource management practices to all planning processes.
- Reduce the volume of waste and maximise avoidance, reuse and recycling of waste through proactive waste management.
- Ensure the beneficial reuse of treated effluent and sewage sludge, wherever feasible.
- Cooperation with all suppliers, contractors and partners to improve the environmental performance of the whole supply chain.

Each business unit within the Holding Company is required to identify and manage its environmental impacts in a systematic way through implementation of an environmental management system based on the principles of the International Environmental Management Standard ISO 14001 and, where appropriate, to seek certification.

A Health, Safety and Environment Committee should be established in HCWW to review any matters of significance affecting the health, safety, environmental and corporate responsibility performance of the group (HCWW and ACs).

The environmental performance should be monitored and reported regularly internally, leading to an external report each year.

The environmental policy, once set, is not of permanently fixed but should be regularly updated to ensure it reflects always the key environmental impacts and responsibilities, the regulatory duties and wider sustainability aspirations of the HCWW and ACs.

It is worth saying, that all of the above recommendations were already made in the context of the SEA undertaken for IWSP 1 in 2012. Until now, however, all of these remain pending.

Grievance mechanism and complaints monitoring:

HCWW and ACs through the Directorate of Customer Services are committed to putting its grievance mechanism in operation to resolve complaints as quickly and efficiently as possible, currently many ways for submitting complaints are available such as an internet link, mobile app and standard forms..

If a complaint can be resolved with an explanation, clarification, or delivery of information, then these cases are readily closed and documented.

ACs should document all grievances and to process statistical analysis of the information, in order to produce a daily report on grievances, causes and challenges, how the problem was solved, and what challenges needs to be addressed in the future. This report supported with statistical analysis should be sent directly to HCWW to help in decision making, planning, and protestation of interventions.

9.3.2 Recommendations for the Programme and Projects

Notwithstanding the overall useful ness of projects under IWSP 2 and their intended positive effects, the programme should be regularly reviewed to ensure that the measures are not only possibly cost-effective but also represent the possibly best solutions for the environment as a whole. For instance, this could include focus on rehabilitating or upgrading of existing facilities rather than building new facilities on green field sites, wherever feasible.

All projects should use “Best Suitable Techniques (BST)” instead of Best Available Techniques (BAT) focussing on ease of operation and maintenance to ensure that the expected performance of the facilities can be sustained. Expensive High Technology facilities with the high risk of not being (properly) operated are not the preferred option.

Depending on the results of a specific Climate Change Impact Assessment (CCIA), all projects have to be reviewed according to their potential capacity for adjustment and also for their location.

All new sites and facilities should be designed to allow for future extension due to expected population growth and completion of networks and connection of increasing numbers of villages and households. This applies to water supply, sewerage systems and wastewater treatment.

9.3.3 Recommendations for Further Studies

With reference to the Climate Change Assessment for IWSP 2 undertaken as part of the SEA (see Annex 3), a further and specific CCIA for the target governorates should be carried out. This study should cover the specific climate issues with a proven scientific background. Such assessments would need to use the latest data, projections and forecasts and giving particular attention to the water sector and the IWSP 2 including its envisaged projects. With this additional information about climate change effects and their predicted range in the target governorates, a revised or adapted programme can react on this and adjust the measures. It is recommended to appoint a national or regional institute with proven expertise and capacities, for example the NWRC, to undertake such assessments.

As a demonstration site or project for Climate Smart Investments for project IWSP 1 it was proposed Ras el Bar WWTP at Damietta be used for testing and monitoring of energy saving and carbon reduction measures (see Annex 3, chapter 9).

9.3.4 Recommendations for Project-Level EIAs

According to Law 4/1994 for the protection of the environment and as amended by Law 9/2009, an EIA should be undertaken for new establishments and projects and for expansions and renovations of existing establishments before construction. The law considers the EIA as a main condition for licensing and thus a project that does not prepare an EIA or does not abide by the EIA conditions could have its license revoked (Articles 10, 12 and 19 of the executive regulations of Law 4/1994, modified by the Decree 1741/2005).

Categorization of Projects

The executive regulations of Law 4/1994 identify projects which should be subjected to an EIA based upon the following main principles:

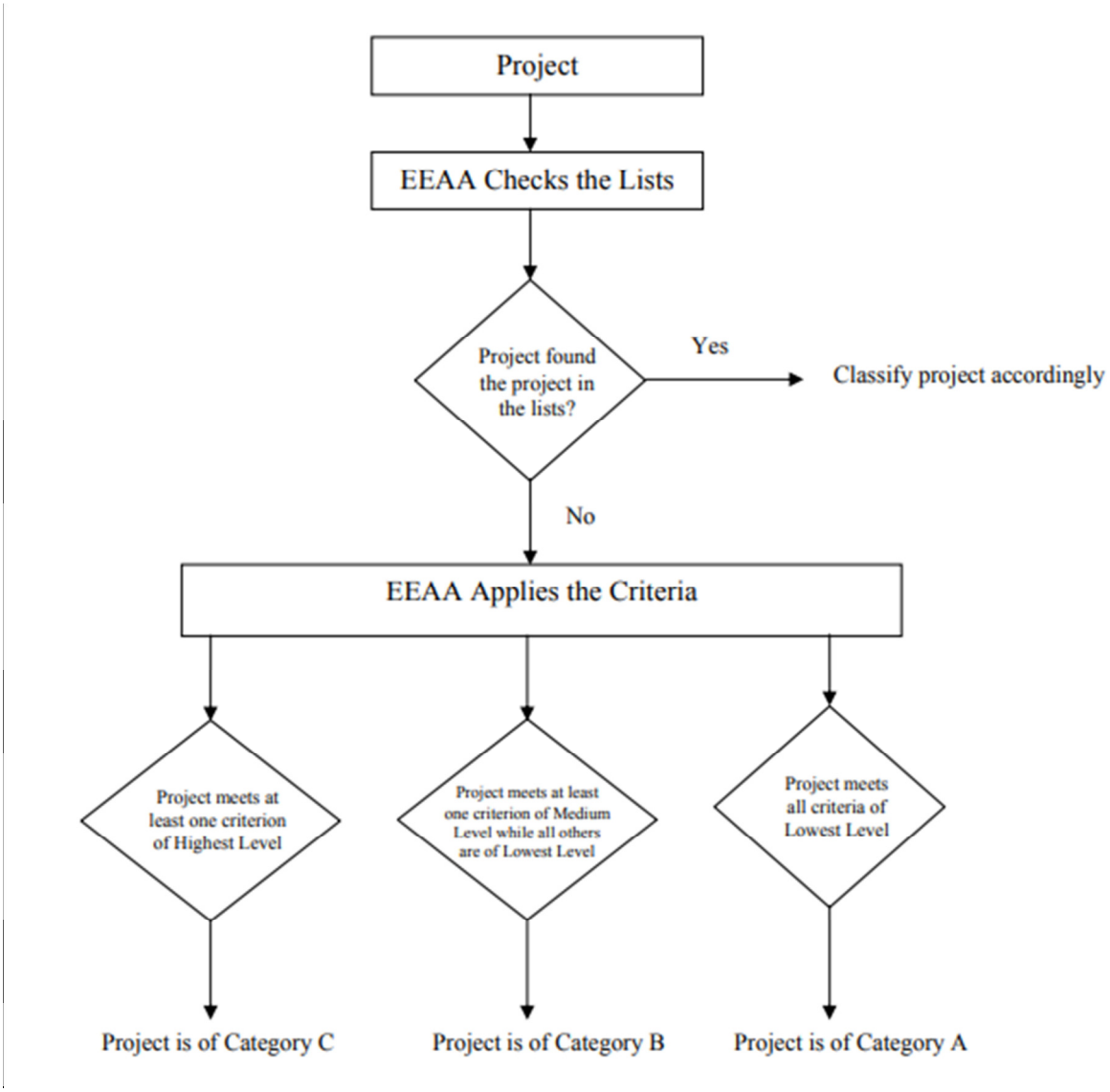
1. Type of activity undertaken by the establishment;
2. Extent of natural resources exploitation;
3. Location of the establishment; and
4. Type of energy used to operate the establishment

The Egyptian EIA system classifies projects into three categories based on different levels of EIA requirements according to severity of possible environmental impacts and location of the establishment and its proximity to residential settlements:

- Category (A): projects with minimum environmental impacts. These are required to complete an environmental impact assessment Form A.
- Category (B): projects with potential adverse environmental impacts yet less adverse than Category C. These are required to complete an environmental impact assessment Form B.
- Category (C): projects which have highly adverse impacts. These are required to prepare a full EIA study.

The classification of projects is based on criteria indicated in “Guidelines of Principles and Procedures for Environmental Impact Assessment, 2nd Edition” (January 2009). Based on these criteria, illustrative lists of projects for the three categories have been prepared to guide the project proponents. The screening procedure is illustrated below:

Figure 15: Project classification process for EIA according to the guidelines



The 2009 Guidelines contain a categorization of water and wastewater projects. According to Annex 6 of these Guidelines, the Category C EIA List includes under section 4-2 'Infrastructure':

- 55 - 'Wastewater treatment plants including sanitation systems for capacity more than 150,000 (m^3/d)';
- 56 - 'Public / central construction of water treatment or desalination plants with capacity more than 20,000 (m^3/d)'.

Without any regard to the classification criteria of the Guidelines, including:

- Consumption of resources;
- Nature of the project and the change it may cause on the environment and resources;
- Nature of inputs and nature and severity of aspects and pollution generated;
- Geographical extent of the project and its effects;

Based on the above mentioned criteria if the new/extended capacity of WTP or WWTPs exceeds 20,000(m^3/d) and 150,000(m^3/d) respectively, the project will be subject to a full EIA (Category C projects). No environmental license is required for rehabilitation work -if the project does not include extension - based on the fact that the original project already had an environmental license.

New construction and extensions of water supply networks are subject to EIA project classification system according to the 2009 Guidelines, which means screening of each project is required according to the above classification criteria.

Requirements for an EIA Study for Category C Projects

The following requirements indicate the different elements required to complete the environmental impact assessment. For Category C projects, a detailed full EIA study is required to fulfil the requirements included in this section according to the following table of contents:

- Executive summary;
- Policy, legal and administrative framework;
- Description of the project;
- Description of the environment;
- Identification and analysis of impacts;
- Analysis of alternatives;
- Public consultation;
- Environmental management plan;
- List of references;
- Annexes include (yet not limited to):
  - List of consultants participating in the study and their role
  - Lists of attendees in public consultation meetings.
  - Agenda of public consultation meetings.

Environmental Management Plan (EMP)

An Environmental Management Plan (EMP) is an integral part of each EIA report. It provides an essential link between the identified impacts and mitigation measures, and implementation and operational activities. The EMP should be formulated in such a way that it is clear and as concise as possible. The EMP should provide reference to identify linkages to other relevant plans relating to the project, such as the emergency plan, which will be prepared later on.

According to the provisions of the 2009 Guideline the following aspects should be addressed within the EMP:

- Summary of Significant Environmental Aspects and Impacts;
- Description of Mitigation Measures;
- Description of Self-Monitoring Program;
- Institutional Arrangements.

9.3.5 Screening of IWSP 2 Projects

This SEA report provides a preliminary screening of all IWSP 2 projects according the above mentioned criteria. However, it will be the responsibility of the ACs and their consultants to confirm with EEAA which projects will ultimately require an EIA and to undertake the EIAs accordingly.

The following tables shows the screening results according to the regulations of EEAA 2009 for the priority projects of IWSP 2, based on the currently available data.

Table 29: Preliminary EIA classification of IWSP 2 water supply and water treatment projects (Projects are ranked according to their priority)

Project	Description of works	EIA classification	Project categories
Qena			
Extension of El Nejdma and El Hamran WTP	Extension of El Nedjma and El Hamran WTP (600 l/s - 1,200 l/s)	Full EIA	C
Extension of Qos WTP	Extension of Qos WTP (300 l/s - 600 l/s)	Form B	B
Extension of Nagaa Hammadi WTP	Extension of Nagaa Hammadi WTP (800 l/s - 1000 l/s)	Form B	B
Rehabilitation of Deshna Water Networks	Rehabilitation of water networks, 120 km: Abu Diab, Abu Mannaa, Fau, Desha, Al Samta	No forms required	B
Rehabilitation of Qos Water Networks	Rehabilitation of water networks in Markaz Qos, 155 km	No forms required	B
Sohag			
Rehabilitation of Needa Surface WTP	Rehabilitation of the intake pipes and civil works for the old ground tank of Needa Surface WTP (Conventional Surface Water Treatment)	No forms required	B
Extension of New Gerga WTP	Extension of New Gerga WTP from 400 l/s to 800 l/s (Conventional Surface Water Treatment)	Full EIA	C
Iron & Manganese Removal Units	Construction of 2 installations for Iron & Manganese removal at ground water units in Naga Al Hardan and Awlad Ali in Awlad Hamza	Form B	B
Rehabilitation and extension of New Al Abaadia WTP	Rehabilitation of existing Abaadia WTP (100 l/s; Compact Surface WTP) with an extension of the WTP (Direct Filtration) to reach a total capacity of 180 l/s	Form B	B
Rehabilitation and extension of Akhmeem WTP	Rehabilitation of existing Akhmeem WTP (Compact Surface Water Treatment, 50 l/s) with an extension of the WTP (Direct Filtration) to reach a total capacity of 180 l/s	Form B	B

Project	Description of works	EIA classification	Project categories
Rehabilitation and extension of Gerga WTP (English Unit)	Replacement / Complete renewal of existing Gerga WTP (Conventional Surface Water Treatment - "English Type"; 60 l/s) with a WTP for 100 l/s (Direct Filtration), Rehabilitation of the intake	Form B	B
Extension of Al Balyana WTP	Extension of Balyana WTP from 800 l/s to 1200 l/s (Conventional Surface Water Treatment)	Full EIA	C
Supply of new equipment for the Central Potable Water Laboratory	Supply of new equipment for the central laboratory for drinking water	No forms required	A
Supply of new equipment for Local Potable Water Laboratories	Supply of new equipment for the 11 local laboratories for drinking water - Supply of new equipment	No forms required	A
Rehabilitation of Akhmeem Surface WTP	Rehabilitation of Akhmeem Surface WTP (Conventional Surface Water Treatment), especially replacement of the mechanical equipment of the "English Unit" (70 l/s)	No forms required	B
Rehabilitation of Sohag District Distribution Networks	Rehabilitation of Sohag District distribution network (90 km)	No forms required	B
Rehabilitation of Tima District Distribution Networks	Rehabilitation of Tima District distribution network (100 km)	No forms required	B
Rehabilitation of Tahta District Distribution Networks	Rehabilitation of Tahta District distribution network (90 km)	No forms required	B
Rehabilitation of Akheem District Distribution Networks	Rehabilitation of Akhmeem District distribution network (120 km)	No forms required	B
Rehabilitation of Gerga District Distribution Networks	Rehabilitation of Gerga District distribution network (90 km)	No forms required	B
Rehabilitation of Old Tahta WTP	Rehabilitation of the first stage of the Tahta WTP (200 l/s; Conventional Surface Water Treatment)	No forms required	B
Rehabilitation of New Sohag WTP (English Unit)	Replacement / Complete renewal of New Sohag WTP (English Unit) WTP (50 l/s) with its intake, whereas an extension to 100 l/s should be considered	Form B	B

Project	Description of works	EIA classification	Project categories
Assiut			
Rehabilitation of El Qoseer WTP	Replacement of artesian well treatment El Qosser by two new wells (capacity of 60 l/s)	Form B	B
Upgrade of groundwater units with Iron & Manganes Removal - Package 1	Upgrade 6 ground water units with Fe/Mn removal units in Dayrout (5) - Al Ghanayem (1)	Form B	B
Rehabilitation of Manfalout District Distribution Networks	Rehabilitation and renovation of 27 km asbestos networks in Manfalout District	No forms required	B
Rehabilitation of Abnoub District Distribution Networks	Rehabilitation and renovation of 25 km asbestos networks in Abnoub District	No forms required	B
Rehabilitation of Dairut District Distribution Networks	Rehabilitation and renovation of 20 km asbestos networks in Dariout District	No forms required	B
Upgrade of groundwater units with Iron & Manganes Removal - Package 2	Upgrade 6 ground water units with Fe/Mn removal units in El Qoseer (3) - Abnoub (1) - Sahel Sleem (1) - Sadfa (1)	Form B	B
Rehabilitation of Abo Teeg District Distribution Networks	Rehabilitation and renovation of 34 km asbestos networks in Abu Teeg District	No forms required	B
Rehabilitation of Assiut District Distribution Networks	Rehabilitation and renovation of 16 km asbestos networks in Assiut District	No forms required	B
Rehabilitation of Al Hota WTP	Rehabilitation of WTP Al Hota (28 l/s, Compact Surface Water Treatment)	No forms required	B
Upgrade of groundwater units with Iron & Manganese Removal - Package 4	Upgrade 6 ground water units with Fe/Mn removal units in El Qoseer (1) - Manfalout (1)- Sahel Sleem (1) - Abu Teeg (2) - Abnoub (1) - Al Ghanayem (1)	Form B	B
Upgrade of groundwater units with Iron & Manganese Removal - Package 3	Upgrade 6 ground water units with Fe/Mn removal units in Al Fath (1) - El Qoseer (1) - Sahel Sleem (1) - Abu Teeg (1) - Sadfa (2)	Form B	B

Project	Description of works	EIA classification	Project categories
Minya			
Rehabilitation and extension of Old Maghagha WTP	Rehabilitation and extension of Old Maghagha WTP (capacity extension: 60 l/s → 260 l/s)	Form B	B
Rehabilitation and extension of Gazerat Sharouna WTP	Extension of Gazerat Sharouna WTP (capacity extension: 30 l/s → 60 l/s)	Form B	B
Rehabilitation of Samalout District distribution networks	Rehabilitation (Replacement) of 241 km asbestos networks in Samalout District (DN 100 - 1400)	No forms required	B
Rehabilitation of Maghagha District distribution networks	Rehabilitation (Replacement) of 178 km asbestos networks in Maghaga District (DN 100 - 800)	No forms required	B
Rehabilitation of Minya District distribution networks	Rehabilitation (Replacement) of 245 km asbestos networks in Minya District (DN 100 - 800)	No forms required	B
Rehabilitation of Mallawi District distribution networks	Rehabilitation (Replacement) of 199 km asbestos networks in Mallawi District (DN 100 - 1400)	No forms required	B
Rehabilitation of Matay District distribution networks	Rehabilitation (Replacement) of 74 km asbestos networks in Matay District (DN100 - 1000)	No forms required	B
Rehabilitation of Deer Mawas District distribution networks	Rehabilitation (Replacement) of 119 km asbestos networks in Deer Mawas District (DN 100 - 600)	No forms required	B
Rehabilitation of Abou Qerqas District distribution networks	Rehabilitation (Replacement) of 81 km asbestos networks in Abou Qerqas District DN100 - 500)	No forms required	B
Rehabilitation of Bani Mazar District distribution networks	Rehabilitation (Replacement) of 39 km asbestos networks in Bani Mazar District (DN100 - 400)	No forms required	B

Table 30: Preliminary EIA classification of IWSP 2 sewerage systems and wastewater treatment facilities (Projects are ranked according to their priority)

Project	Description of works	EIA classification	Project catogory
Qena			
Karm Omran Cluster Sewer Networks	Construction of sewer networks (Gravity networks + Pumping Stations) for Karm Omran ; Al Ashraf Al Qeblia; Al Ashraf Al Gharbia; Al Ashraf Al Asalia; Al Ashraf Al Sharqia; Abnoud; El Kalaheen; Beer Anbar and connection to the new Karm Omran WWTP	Form B	B
Karm Omran WWTP	New waste water treatment plant Karm Omran	Form B	B
Samhoud Cluster Sewer Networks	Construction of sewer networks (Gravity networks + Pumping Stations) for Samhoud; Al Awamer & Bani Barza; Al Awsat Samhoud; Abu Shosha; Al Rawateb; Al Khawaled; Al Bahri Samhoud; Koum Gaber; Belad Al Mal Al Bahri; Al Amra	Form B	B
Samhoud WWTP	New waste water treatment plant Samhoud	Form B	B
Sohag			
Extension of Tima WWTP	Upgrade of Tima WWTP with tertiary treatment for 60,000 m³/d, rehabilitation of preliminary treatment	Form B	B
Tima Cluster sewer networks	Construction of sewer networks (Gravity networks + Pumping Stations) for the villages Al Atamna - Meshta, Koum Al Arab, Al Sheikh Ammar, Koum Ghareeb and connection to Tima WWTP	Form B	B
Rehabilitation of Sohag West 1 WWTP	Rehabilitation of Sohag West 1 WWTP (22,000 m³/day)	No forms required	B
Gerga Cluster sewer networks	Construction of sewer networks (Gravity networks + Pumping Stations) for the villages Al Zanqour, Kom Ashkelo, Al Raqaqna and Al Gawaheen and connection to Gerga WWTP	Form B	B
Al Balyana Cluster sewer networks	Construction of sewer networks (Gravity networks + Pumping Stations) for the villages Al Okalia, Al Esslah and Barkheel and connection to Al Balyana WWTP	Form B	B

Project	Description of works	EIA classification	Project catogory
Maragha Cluster sewer networks	Construction of sewer networks (Gravity networks + Pumping Stations) for the villages Shandaweel, Basouna, Aamer, Naga Taea and Al Sheikh Yousef and connection to Maragha WWTP	Form B	B
Sohag Cluster sewer networks	Construction of sewer networks (Gravity networks + Pumping Station) for Awlad Azaz and connection to Sohag west WWTP	Form B	B
Rehabilitation of Sohag Sewer Network	Rehabilitation and renovation of Sohag sewer network (10 km)	No forms required	B
Rehabilitation of the Central Waste Water Laboratory	Rehabilitation of the central laboratory for waste water - Supply of new equipment	No forms required	B
Rehabilitation of Local Waste Water Laboratories 1	Rehabilitation of the 5 local laboratories for waste water - Supply of new equipment	No forms required	A
Rehabilitation of Local Waste Water Laboratories 2	Rehabilitation of the 5 local laboratories for waste water - Civil works	No forms required	A
Assiut			
Rehabilitation and Extension of Al Zarabi WWTP	Rehabilitation & Extension of the WWTP Al Zarabi to a capacity up to 24,000 m³/d	Form B	B
Sidfa / Al Ghanayem Cluster sewer networks	Construction of sewer networks (Gravity networks + Pumping Stations) for the villages Koum Asfaht, Deer Al Ganadela, Al Mashayaa and Al Azayza and connection to Sidfa and Al Ghanayem WWTP	Form B	B
Rehabilitation and extension of Al Birka 1 Pumping Station and surrounding network	Rehabilitation and extension of the Al Barka 1 pump station (Qmax2040=1,000 l/s) including new force main DN 1000, 8 km	Form B	B
Al Wadi Al Assiuti cluster sewer networks	Construction of sewer networks (Gravity networks + Pumping Stations) for the villages Bani Aleeg, Al Atawlaa, Arab Mateer and connection to Al Wadi Al Assiuti WWTP	Form B	B

Project	Description of works	EIA classification	Project catogory
Dairut cluster sewer networks	Construction of sewer networks (Gravity networks + Pumping Stations) for the villages Al Hota Al Gharbia, Nazlat Abdallah, Nazlet Al Awamer, Garf Sarhan and Al Mattawa and connection to Dairut WWTP	Form B	B
Rehabilitation of Al Maraghy Pumping Station	Rehabilitation of the Al Maraghy pump station (Qmax2040 =600 l/s)	No forms required	B
Rehabilitation of Al Waledia Pumping Station	Rehabilitation and extension of the Al Waledia pump station (Qmax2040 = 600 l/s)	Form B	B
Al Zarabi Cluster sewer networks	Construction of sewer networks (Gravity networks + Pumping Stations) for the villages Al Masoudi and Hagr Dakran and connection to Al Zarabi WWTP	Form B	B
Shuttub Cluster Sewer Networks	Construction of sewer networks (Gravity networks + Pumping Stations) for the villages Durunkah Al Gedida, Deer Durunkah and Al Ezzba Al Bahria and connection to Shuttub WWTP	Form B	B
Rehabilitation of four force mains and network Assiut City	Renew force mains of pump stations Al Sadat (DN 500; 1.8 km), Feryal (DN 500; 1.4 km) and Al Moderia (DN 500; 1.7 km) and rehabilitation of gravity sewers and force main of Al Sentral (DN 500; 1.4 km, 1.5 km surrounding gravity network)	No forms required	B
Al Badari Cluster sewer networks	Construction of sewer networks (Gravity networks + Pumping Stations) for the villages Koum Monshaat Hamam, Al Marawna and Monshaat Al Badari and connection to Al Badari WWTP	Form B	B
Rehabilitation and extension of gravity sewers in Abu Teeg, Al Aqadma, Bani Sameea, Al Zeera	Rehabilitation and extension of gravity sewers in Abu Teeg, Al Aqadma, Bani Sameea, Al Zeera (2.2 km rehabilitation, 22 km extension)	Form B	B
Rehabilitation and extension of sewer networks Bani Edrees and Al Qusiyya	Rehabilitation and extension of gravity sewer network of Bani Edrees (0,25 km rehabilitation; 1,5 km extension) and rehabilitation of gravity sewers (2 km) in Al Qusiyya	Form B	B

Project	Description of works	EIA classification	Project catogory
Rehabilitation of sewer networks Assiut West and Assiut East and Extension of sewer networks Manqabad and Durunkah	Rehabilitation of sewer networks Assiut West and Assiut East (8 km) and Extension of sewer networks Manqabad and Durunkah (6.2 km)	Form B	B
Minya			
Rehabilitation and Extension of Abu Qerqas WWTP	Rehabilitation of Abu Qerqas WWTP (Activated sludge, 40,000 m³/d) and extension of the sludge treatment facilities	Form B	B
Abu Qerqas Cluster Sewer Networks	Construction of sewer networks (Gravity networks + Pumping Stations) for the villages Al Nahal, Kafr Al Fela, Saneem, Grees, Nazlet Grees, Mantut, Abu Al Safa, Al Hassania, Al Karam, Manhary, Monshaat Al Nasr, Al Birba and Abu Qerqas Al Balad 2 and connection to Abu Qerqas WWTP	Form B	B
Rehabilitation and Extension of Abu Qerqas Pump station No. 1	Extension, rehabilitation, increasing the capacity of Abu Querqas PS N°1 (Q2040: 700 l/s) including new force main 2 km, DN1000	Form B	B
Rehabilitation and Extension of Abu Qerqas Pump station No. 4	Extension, rehabilitation, increasing the capacity of Abu Querqas PS N°4 (Q2040: 500 l/s) including new force main 0.7 km, DN750	Form B	B
Maghaga Cluster Sewer Networks	Construction of sewer networks (Gravity networks + Pumping Stations) for the villages of Balhasa, Mayanet Al Waqf, Bani Khaled and Bani Khalaf and connection to Maghaga WWTP	Form B	B
Delga Cluster Sewer Networks and WWTP rehabilitation	Extension of sewer network (Phase 2) for Delga village (gravity sewer network & pump station) and connection to Delga WWTP; Rehabilitation of Delga Phase 1 Pump station and Rehabilitation and completion of Delga WWTP (12,800 m³/d)	Form B	B
Tanouf Cluster Sewer Networks	Construction of sewer networks (Gravity networks + Pumping Stations) for the villages Monshaat Khozam, Nazlet Al Hassaeba and Al Rahmania and connection to Tanouf WWTP	Form B	B

Project	Description of works	EIA classification	Project catogory
Tala Cluster Sewer Networks	Construction of sewer networks (Gravity networks + Pumping Stations) for Rida and Al Hawaslia villages and connection to Tala WWTP	Form B	B
Rehabilitation of Maghaga WWTP	Rehabilitation of Maghaga WWTP (Trickling filters, 20,000 m³/d)	No forms required	B
Mallawi Cluster Sewer Networks	Construction of sewer network (Gravity networks + Pumping Stations) for Al Rayramoun village and connection to Mallawi WWTP	Form B	B
Rehabilitation and Extension of Shahin Pump station	Extension, rehabilitation, increasing the capacity of Shaheen PS (Q2040: 1,000 l/s) and of the force main (approx. 5,5 km DN 1000 - 1200)	Form B	B

ANNEX 1

TERMINOLOGY AND EXPLANATIONS

ANNEX 1 TERMINOLOGY AND EXPLANATIONS

Environmental Assessment

A method or procedure for predicting the effects on the environment of a proposal either for an individual project or a higher-level "strategy" with the aim of taking account of these effects in decision-making.

EIA – Environmental Impact Assessment

The term "Environmental Impact Assessment" (EIA) is used, as in European Directive 337/85/ EEC, for assessments of projects. In the SEA Directive, an environmental assessment means "the preparation of an environmental report, the carrying out of consultations, the taking into account of the environmental report and the results of the consultations in decision-making and the provision of information on the decision", in accordance with the Directive's requirements.

An environmental impact assessment at project level in Egypt has to follow national EIA legislation and further guidance of EEAA in the “Guidelines of Principles and Procedures for Environmental Impact Assessment, 2nd edition 2009” and “EIA Guidelines for municipal wastewater treatment works, 2005”.

Environmental Monitoring

Environmental monitoring is the systematic observation of the state of the environment and of the factors influencing it. Its main purposes are to forecast changes to the state of the environment and to provide initial data for planning documents, programmes and projects.

Environmental Standards

Environmental standards are documents setting rules, guidelines and numeric values defined by the involved parties, and regulating activities or results of activities which either have or are likely to have impact on the state of the environment.

SEA Report

Document required by the SEA Directive 2001/42/EEC on the assessment of the effects of certain plans and programmes on the environment as part of an environmental assessment, which identifies, describes and evaluates the likely significant effects on the environment of implementing a PPS and its reasonable alternatives.

Impact Assessment

Impact assessment is the process of identifying the future consequences of a current or proposed action. It is used to ensure that projects, programmes and policies are economically viable, socially equitable and environmentally sustainable.

Indicator

A measure of variables over time often used to measure achievement of objectives.

Significant Effects Indicator: An indicator that measures the significant effects of the PPS.

Mitigation

It refers to measures to prevent, reduce or offset, as fully as possible, adverse effects on the environment. Mitigation in SEA also includes enhancement and compensating measures.

Objective

A statement of what is intended, specifying the desired direction and outcome.

PPS

Abbreviation used in this glossary for any plan, programme or strategy which is subject to SEA.

Plan or Programme

The term "plan or programme" covers any plans or programmes on national, regional or local level, including strategies with potential significant effects on the environment. It does not matter, if a private or public entity is responsible for the plan or programme. This includes master plans, investment programmes and environmental programmes.

Scoping

The process of deciding the scope and level of detail to be included in an Environmental Report together with requirements regarding consultation periods.

Screening

The process of determining the likely significance of effects on the environment of a PPS. Specific criteria for determining the likely significant effects on the environment have to be set out.

Strategic Environmental Assessment (SEA)

Term used to describe environmental assessment as applied to PPS.

SEA Directive

European Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment.

Significant Environmental Effects

A degree of professional judgement is required in assessing significance of environmental effects but to ensure that determinations are consistent and appropriate, specific criteria for determining the likely significance of effects on the environment of a PPS have to be used, for example:

- How sensitive is the receiving environment?
- Which communities are affected?
- Would the impact establish a precedent?
- Are environmental limit values or targets being threatened?
- Are designated/protected areas or species adversely affected?
- Is an appropriate assessment under the Habitats Directive required?
- Can the impact be mitigated? What is the potential cost of mitigation?
- What is the magnitude of impact? (i.e. scale, duration, reversibility)

ANNEX 2

EXISTING WATER AND WASTEWATER INFRASTRUCTURE

ANNEX 2 EXISTING WATER AND WASTEWATER INFRASTRUCTURE

The existing water treatment and supply facilities in the four Governorates are summarised in the following table, reflecting the latest available data from the ACs, and data from the Central Agency for Public Mobilization and Statistics Report (March 2018).

Existing water treatment and supply facilities in target governorates

Facility	Unit	Qena	Sohag	Assiut	Minya
WTPs	No.	98	50	40	80
Wells	No.	90	213	236	119
Water supply networks	km	8,778	4,952	2,309	9,875
Water treatment capacity	$10^{\wedge 3}$ .m^3/d	950	1,441	1,765	1,189
Actual flow	$10^{\wedge 3}$ .m^3/d	555	742	616	788
Population	M. Capita	3.66	4.97	4.38	5.49
Served urban population	%	99.5	99.6	99.6	99.7
Served rural population	%	95.9	97.4	98.5	97.3
Served total population	%	96.6	97.9	98.8	97.8
Per capita water production	l/c/d	181.62	152.59	142.25	146.61
Volume of consumed / billed water	$10^{\wedge 3}$ .m^3/d	388	570	508	512
Reported water losses	$10^{\wedge 3}$ .m^3/d	167	172	108	276
Reported / estimated water losses	%	30%	23%	17.6%	35%

Existing Wastewater Infrastructure

The existing wastewater collection and treatment facilities in the four Governorates are summarised in the following table. Further details are given in Annex 2.1. The figures are reflecting the latest available data from the ACs, and data from central agency for public mobilization and statistics report March 2018.

Existing wastewater collection and treatment facilities in target governorates

Facility	Unit	Qena	Sohag	Assiut	Minya
Gravity sewers	km	365	694	297	717
Pressure mains	km	118	206	157	124
WWTPs	No.	8	7	6	12
Wastewater treatment capacity	$10^{\wedge 3}$ .m^3/d	189	310	210	237
Actual flow	$10^{\wedge 3}$ .m^3/d	116	110	122	132

Facility	Unit	Qena	Sohag	Assiut	Minya
Population	M. Capita	**3.33**	**4.97**	**4.38**	**5.49**
Coverage of existing WWTPs	%	12	32	31	28
Served urban population	%	63.1	74.5	55.5	78.9
Served rural population	%	3.8	7.1	7.1	6.6
Served total population	%	15.0	21.4	19.6	19.6

ANNEX 3

CLIMATE CHANGE IMPACT ASSESSMENT

ANNEX 3 CLIMATE CHANGE IMPACT ASSESSMENT

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1 INTRODUCTION

Climate change is one of the key challenges facing the world and also Egypt today, it makes development more expensive, complicated, and uncertain than was thought. People and governments will spend resources defending themselves against risks that include more extreme weather, greater risks to agriculture, coastal inundation, spread of disease vectors, and ecosystem disruption. This annex describes the main issues related to climate changes in Egypt such as current situation, improvements in the wastewater sector and the potential reduction of GHG emissions related to IWSP2 Projects.

Recent UN Climate Change Publications[1] [2], numerous scientific studies[3] and National Reports[4] have highlighted the issues and the urgency of the response needed, but also addressed the achievements of the last decade for Egypt.

Strategic environmental assessment (SEA) can help to ensure that plans and programmes take full account of climate change issues. Also the SEA can ensure the feasibility as well as the safety of the investments by programme interventions combatting potential adverse effects of climate change.

As already mentioned in the main SEA report, this SEA refers to the *European Directive 2001/42/EC On the assessment of the effects of certain plans and programmes on the environment (the "SEA Directive").* This Directive requires the initiators of a plan or programme to identify and assess the potential impacts of their plans or programmes on a number of environmental issues, including climatic factors; and, where appropriate, to put measures in place to minimise and respond to significant impacts identified.

2 WHAT IS CLIMATE CHANGE?

The emission of greenhouse gases (GHG) – primarily carbon dioxide (CO_2) but also methane, nitrous oxides, hydroflourocarbons, sulphur hexafluoride and perfluorocarbons – contributes significantly to climate change. Sunlight passes through the atmosphere and warms the earth; heat (or infra-red radiation) from the earth's surface is re–emitted and is partly absorbed by the atmosphere, trapping the heat. This is known as the greenhouse effect. Higher atmospheric concentrations of GHG cause the atmosphere to absorb more heat from the earth's surface, and lead to increased levels of warming, or climate change.

In 2016 GHG emissions in Egypt were about 304 million tonnes carbon equivalent in 2016[5]. Currently these emissions are primarily due to the energy sector (~ 49%), agricultural sector (19%), industrial sector (15%), transport including air travel (12%) and the waste sector (5%) (by source, in million tonnes carbon equivalent). By 2020, the proportion of emissions from the energy sector is expected to

[1] UNEP 2011, Official Website
[2] UNEP 2005: Facing the Facts: Assessing the Vulnerability of Africa's Water Resources to Environmental Change.
[3] Stimson Center 2010: Impacts and Implications of Climate Change for the Coastal Zones of Egypt.
[4] EEAA 2016: Egypt's Third National Communication under the United Nations Framework Convention on Climate Change (UNFCCC).
[5] EEAA 2016: Official Website.

have decreased, but emissions from the transport sector will have increased significantly, in part due to a rise in air travel[6].

Some climate change will occur in the future regardless of what we do now. Northern Africa has already warmed by 0.6–0.7°C since 1950. Because of the inertia of the climate system, average global temperatures are expected to rise by about another 0.5°C, simply as a result of emissions to date. On current trends, global average temperatures will rise by 2–3°C within the next 50 years[7].

For Egypt the expected climate changes include:[8,9,10]

- Increase in mean annual temperatures of between 2°C to 3°C by 2050, with highest increases in the summer months of July-September and more rapid increases in the interior regions;
- Projections for sea level rise in the Nile delta suggest an increase of between 3 cm and 61 cm by 2085 with increases of between 20 cm and 82 cm in Alexandria;
- While the projected extent of precipitation changes remains highly uncertain, there is a general tendency towards slightly drier conditions in most months by 2050. Projected drying is strongest in the dry months of June-October;
- Increases in heavy rains and potential increases in drought, particularly due to increased temperatures by 2050;
- Increased intensity and frequency of dust storms and sand storms;
- Significantly increased duration of long-lasting heat waves, with likely increased duration of between 9 to 77 days by 2085;
- Decreaseing duration of long-lasting cold spells, with likely decrease in duration of 3 to 6 days by2085.

There are two necessary responses to climate change:

Mitigation measures represent actions to reduce human impacts on the climate system by reducing our emissions of GHG — for instance, reducing travel by car in favour of lower emission options (e.g. public transport, cycling); improving energy efficiency (e.g. improving building insulation); and using energy generated from renewable sources. Mitigation measures may also include the removal of GHG from the atmosphere by sequestration in natural carbon sinks (e.g. encouraging uptake by vegetation).

Adaptation measures are actions in response to actual or expected climate changes, which moderate harms or exploit the opportunities of their impacts.

Mitigation and adaptation measures may be interrelated. For instance, increased temperatures will require a response in building design, but this needs to be done in a way that minimises the need for air conditioning, or it will itself add to GHG emissions. Our response to climate change needs to include both adaptation and mitigation: we should aim to manage the unavoidable and avoid the unmanageable.

6 EEAA 2006: Estimated GHG Inventory In Egypt.
7 IPCC 2007: Climate Change 2007, Impacts, Adaptation and Vulnerability, Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.
8 GERICS 2016: Climate Fact Sheet Egypt.
9 USAID 2015: Climate Change Information, Fact Sheet Egypt.
10 USAID 2018: Climate Risk Profile, Fact Sheet Egypt

3 CLIMATE CHANGE IN SEA

The EU SEA Directive requires Responsible Authorities (plan-makers) to assess the likely impacts of their plans and programmes on "the environment, including on… climatic factors". These assessments should also include secondary and cumulative effects (SEA Directive, Annex 1). Climate change is a cumulative effect: it is caused by the build-up of many actions, each of which only has a limited contribution, but which together cause serious effects. Adaptation measures are unusual in that they require consideration of how climate changes are likely to impact on plans and programmes.

4 CLIMATE PROFILE OF EGYPT

Throughout Egypt, days are commonly warm or hot, and nights are cool. Egypt has only two seasons: a mild winter from November to April and a hot summer from May to October. The only differences between the seasons are variations in daytime temperatures and changes in prevailing winds. In the coastal regions, temperatures range between an average minimum of 14°C in winter and an average maximum of 30°C in summer.

Temperatures vary widely in the inland desert areas, especially in summer, when they may range from 7°C at night to 43°C during the day. During winter, temperatures in the desert fluctuate less dramatically, but they can be as low as 0°C at night and as high as 18°C during the day.

Figure 1: Average Annual Mean of Daily Temperature (°C)

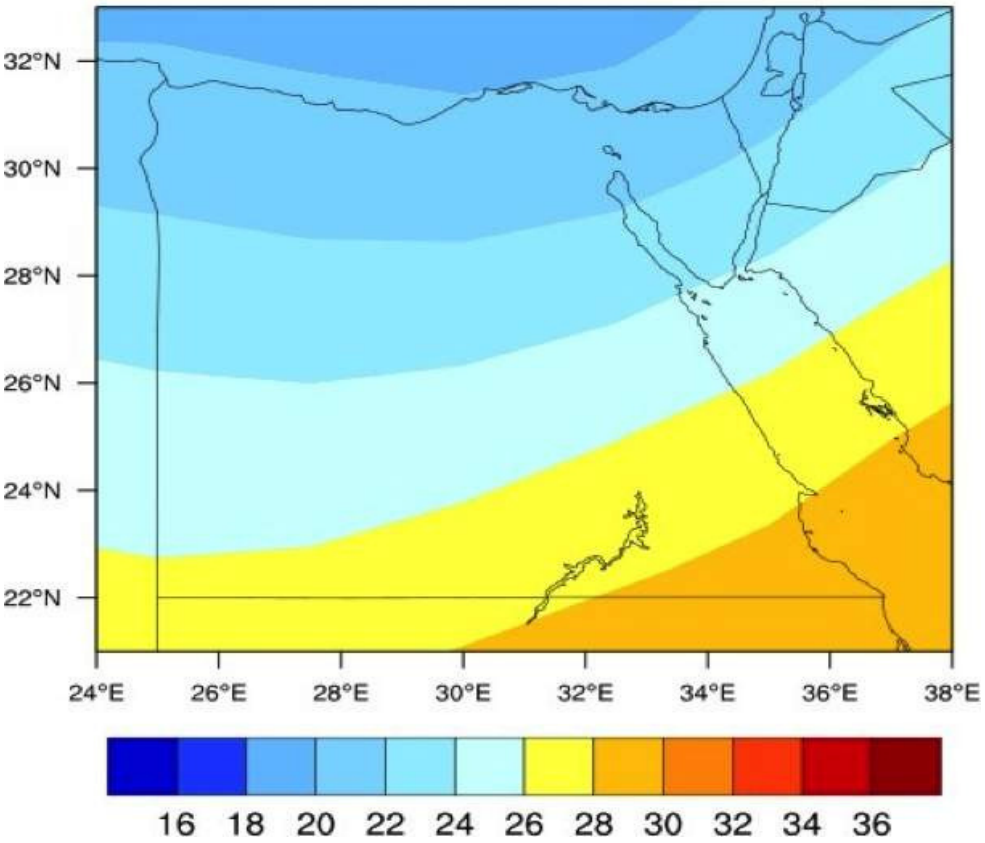


Figure 2: Average Annual Mean of Daily Relative Humidity (%)

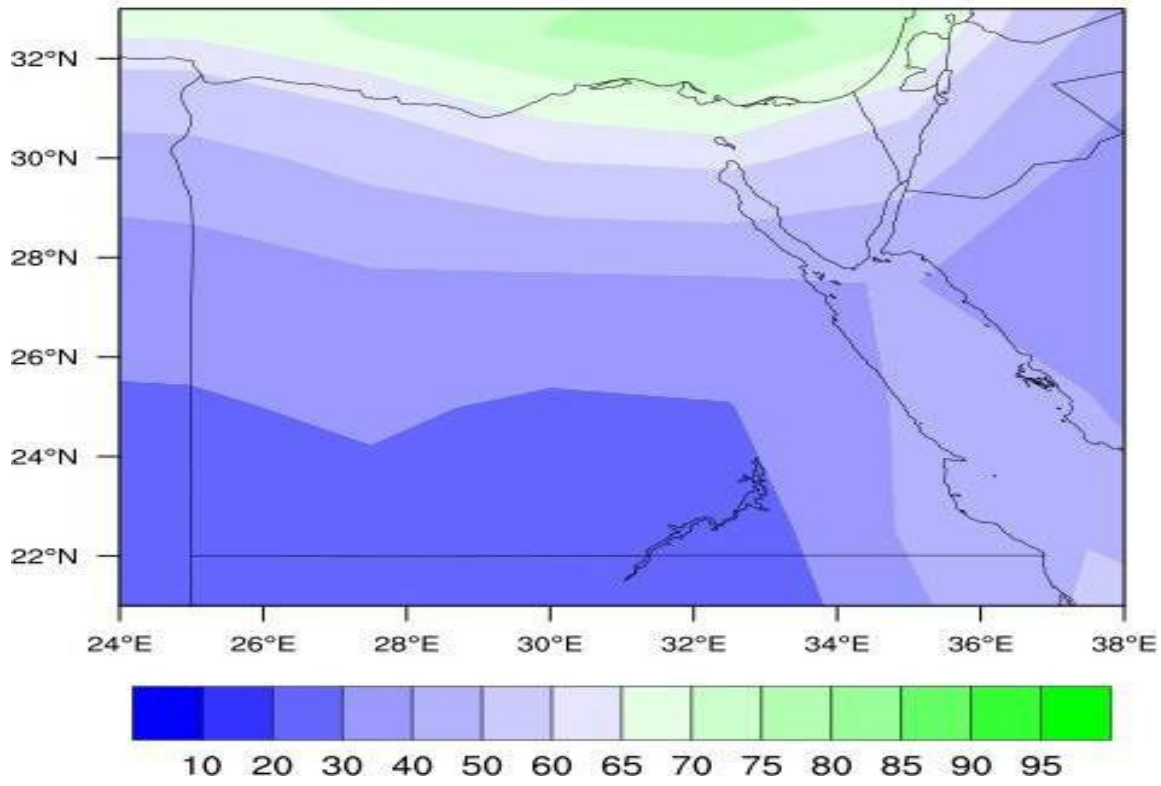
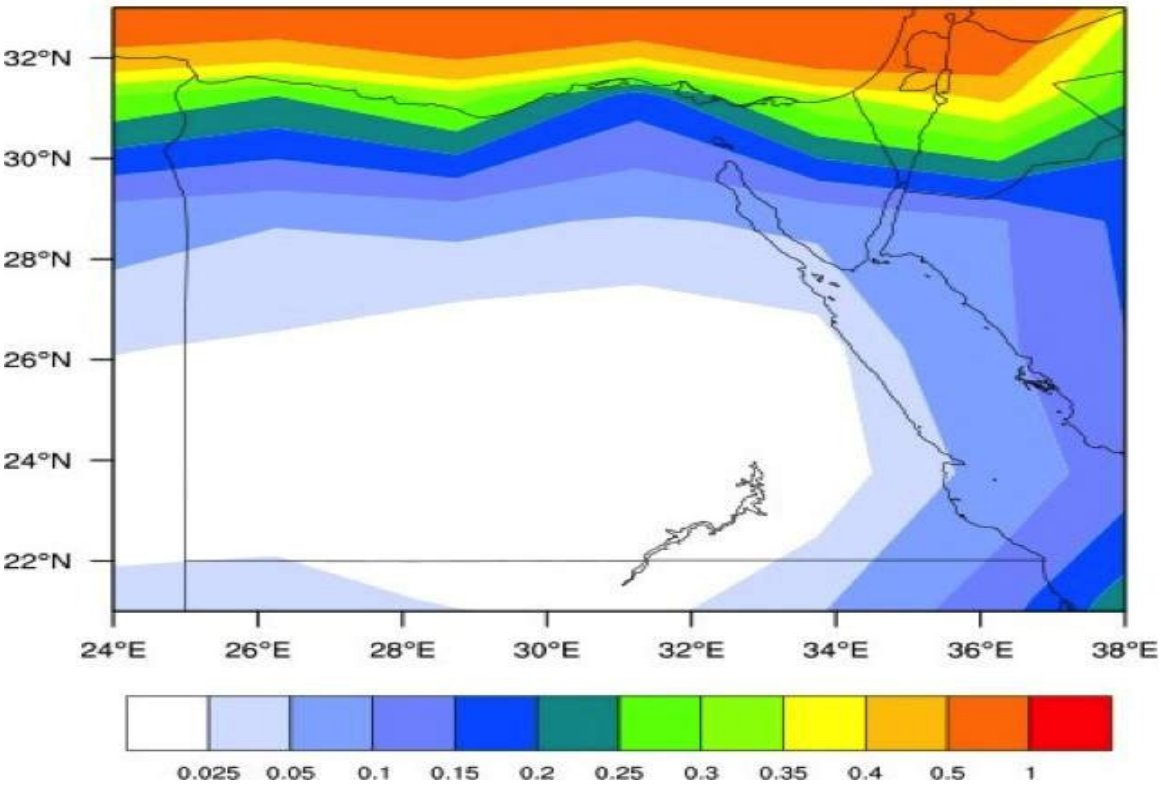


Figure 3: Average Annual Precipitation (mm)



In recent decades, changes of climate parameters have been observed and the analysed data show the following[11]:

- An average decrease in total annual precipitation of 6 percent in 30 years respectively during the period 1901-2013, with a significantly higher decrease of 22 percent in the total annual precipitation from 1983-2013;
- Decreases in precipitation are strongest in the winter and early spring months;
- Evidence of increased frequency and severity of flash floods in recent years;
- Increases of 0.1°C per decade in average annual temperatures from 1901-2013, increasing to 0.5°C per decade in average annual temperatures from 1983-2013.
- Greater warming has been observed during summer than during winters (0.31°C and 0.07°C per decade increase in average temperatures since 1960, respectively)
- Daily minimum temperatures have increased throughout Egypt, with fewer cool nights and more warm nights since 1960.

Observed changes in climate parameters have a number of consequences. The increase in atmospheric pressure implies increases in the number of hazy days, the number of misty days and the turbidity of the atmosphere. Recently, Egypt has been suffering from an increased severity and frequency of sand storms, dense haze and flooding. These extreme events have had negative socio-economic impacts on almost all sectors such as health, agriculture, livestock, environment, and tourism.

The variability of frequency and severity of extreme weather events in Egypt during the last three decades (1973-2002) has been monitored based on the meteorological data of 32 stations distributed all over Egypt. The events of increasing sand storms, haze, thunder storms and flash floods are taken as an indicator of climatic changes. In this respect, statistical analysis of available data revealed that the mean annual number of rising sand storms, having amounted to 29 days in the first decade, increased to 38 days in the second decade, and decreased to 33 days in the third decade. With regards to sand storm days, these amounted to 29 days, 17 days and 13 days in the first, second and third decade respectively. The continuous decrease of the mean number of sand storm days could be interpreted as a reflection in an increased atmospheric stability. Consistent with these findings are the records for mean annual number of hazy days over Egypt, which increased from 20 days in the first decade to 61 days in the second decade, and 67 days in the third decade. The occurrence of hazy days in the third decade exceeded 200 days in the Greater Cairo area as well as in Tanta city and Luxor city.

The prevalence of air pollution episodes in these cities could also be an indicator for growing atmospheric stability, in addition to increased emissions from industries, traffic and other human activities.

The number of days of maximum temperature equalling to or exceeding 45°C have increased in Upper Egypt from 50 days in the first decade to 52 days in the second decade, reaching 69 days in the third decade since 1973. In addition, the extremely hot days in the Western Desert amounted to 37 days in

[11] El Shennawy, I. 2008: Coastal Vulnerability to Climate Changes and Adaptation Assessment for Coastal Zones of Egypt, Coastal Research Institute, Egypt.

the third decade, compared to 22 days in each of the earlier decades. The rest of Egypt did not experience increased number of days with peak temperatures of 45 °C or more.

The Mediterranean coast of Egypt experienced successive increases in the amount of annual rainfall during the last three decades. The mean trend over the area is + 0.76 mm per annum.

5 PRESENT SITUATION IN EGYPT

Egypt's natural resources can be classified as air, land, water and coastal areas. Their uses as well as issues relevant to climate change are presented in this section.

5.1 Natural Resources

5.1.1 Land

The population density in Egypt is among the highest in the world. About 97% of the population lives on an estimated 4% (40,080 km^2) of the total area of Egypt. This yields an average population density of 1,850 persons per km^2. This national average, however, conceals wide variations among governorates, and between urban and rural areas within a single governorate.

Egypt's Initial National Communication on Climate Change specified that four comprehensive 5-year development plans have been developed by the Government. The plans were launched for implementation in 1996 to continue until 2017. These plans inter alia include the construction of new cities in desert areas for resettling millions of Egyptians beyond the narrow Nile Valley, so that the populated areas will cover 25% of Egypt's land area, rather than only 4%.

The Mediterranean coastal zone and the coast of the Red Sea have undergone restructuring and new extension. Some of these cities have been developed as centers for serving agro-businesses, such as Al-Mahala Al-Koubra and El-Mansoura, while others were developed as centers for transportation services and ports, such as Suez and Port Said. A third group was developed for recreational purposes and tourism facilities, such as Sharm El-Sheikh, Hurghada and Luxor. In addition, extensions of old cities in the Nile Valley have been developed and constructed in desert areas just outside the Nile Valley, whenever possible, in order to attract populations to these new cities, which have their own facilities and industrial zones, and which are designed for low population densities.

This is particularly noticeable in Upper Egypt starting from Beni Sueif to Aswan. These new cities are expected to decrease the loss of agricultural land to urbanization. Construction carried out in these new cities generally follows the green building criteria of minimum air conditioning, maximum natural lighting and local building materials. In this respect, these new cities can be considered as part of Egypt's adaptation activities to climate change. In parallel to the construction of new cities, a large network of roads has been developed. This network covers and connects all urban areas in Egypt, and as a result of its size, it is expected to present a burden for maintenance against the expected excessive heat resulting from climate change.

However, experience with these new cities appears to be an inappropriate way of development, as 98.2 % of the population still live in the Nile valley and delta. The new system is acquiring simultaneous regional giant development projects like Suez Canal, West Coast, and Tushka, planning to accommodate the projected population increase of 60 million over the coming 40 years, with a sustainable development mode to preserve the natural resources for the future generations.

5.1.2 Water Resources

Egypt's water resources are limited to the natural flow of River Nile which presents about 95% of the country's water budget. The remaining 5% are groundwater resources and rainfall. The country's quota of Nile water is fixed at 55.5 billion m^3 per year according to an agreement signed in 1959 (Developments in Sudan, Ethiopia or other riparian countries could/may reduce water availability to Egypt). Inflowing Nile water is stored in Lake Nasser shared between Egypt and Sudan, a lake which can store more than 160 billion m^3 of water at its full storage capacity[12]. There are two non-renewable aquifers of groundwater namely the Nubian Sandstone aquifer and the Limestone aquifer. Together they cover more than 50% of the area of the country.

Rainfall on the Mediterranean coastal line with maximum intensity occurs during the winter season. The rainfall does not exceed 130-170 mm on the coast and decreases towards the inland. In light of the above, Egypt's total water budget is estimated at about 58 billion m^3, with the shares of water resources being 95% for River Nile, 1.5% for water aquifers and 3.5% for rainfall. In addition to the 55.5 billion m^3/ y of Nile water, safe abstraction from deep aquifers may reach 1.0 billion m^3 annually. The maximum possible use of water from both deep and shallow aquifers may reach 6.0 billion m^3 annually. Rainfall does not exceed 1.2 billion m^3 per annum but effective rain is much less than this amount. The main water-consuming sector in Egypt is agriculture, followed by municipal and industrial uses. In the year 2000 withdrawal was estimated at 68.3 billion m^3 and on 2010 it was estimated to be 69.25 billion m^3.

Currently, recycling of some used waters is carried out with the objective of covering the deficit between Egypt's water supply and demand. Most agricultural drainage waters of the upper part of Egypt returns back to the main course of the Nile. This amount is estimated at 4.0 billion m^3 per year. Another 8.20 billion m^3 per annum of agricultural drainage water are reused in the Nile Delta in two different ways: the 1st way is the *official reuse* through public pumping stations which pump water from drains to irrigation canals. This accounts for about 4.5 billion m^3/y in the Delta and 0.9 billion m^3/y in Upper Egypt and Faiyoum. The 2nd way is the *unofficial reuse* by farmers themselves when they are short of canal water. In the Delta alone this was estimated to amount to about 2.8 billion m/y. The current annual rate of abstraction from the shallow aquifer is about 4.0 billion m^3/y, totalling the recycled water volume to an estimated 16.20 billion m^3 annually. Also, 2.19 billion m^3/y will be recycled

[12] El Quosy, D. 2007: Vulnerability and Adaptation of Water Resources to Climate Change in Egypt, Second National Communication Project, UNDP-EEAA.

by the end of 2020 after finishing the construction of El-Mahsama and Bahr El-Baqar wastewater treatment plants (these two plants used to treat drain water).

Treated sewage and industrial effluent form part of the water budget in Egypt. The order of magnitude of treated wastewater is expected to reach 3 to 4 billion m^3/y in the near future. Most of summer and winter resorts on the Red Sea, in the Sinai Peninsula, and on the North West coast are provided with water from desalination plants of small and moderate sizes. The total amount of desalinated water in Egypt in 2012 was estimated at 60 Million m^3 per annum and these figures are expected to triple by 2020 based on the current construction activity of El Almain and El Galalah Sea water desalination plants with a cumulative capacity of 110 Million m^3 per annum.

Regarding water demand, agriculture is the main consumer of water in Egypt. This sector uses about 59.55 billion m^3 of water per annum, representing about 86% of the country's water budget. Drinking water, covering more than 96.8% of the Egyptian population, uses almost 5.30 billion m/y, representing about 8% of the country's total water budget.

Industrial water consumption amounts to about 4.0 billion m^3 annually, representing 6.0% of the country's water budget. Thus, currently, Egypt's total water demands are critically covered by recycling agriculture drainage water and the use of treated municipal sewage water. Demand-side management requires expensive development of agriculture irrigation methods, and any expansions in the water budget would require the development of expensive water treatment methods.

5.1.3 Coastal Zones

The coastal zones of Egypt extend for over 3,500 km in length along the Mediterranean and Red Sea coasts (1000 km is primary wave-affected Mediterranean coast, 1500 km is primary Red Sea coast -including Gulf of Suez and Gulf of Aqaba-, 550 km is secondary Mediterranean coast -shorelines of coastal lagoons-, and 450 km is Suez Canal area 'coast', including the adjacent lakes' shorelines). The Mediterranean shoreline is most vulnerable to sea level rise due to its relative low elevation in Egypt compared to the surrounding land.

The wetlands of the Nile delta constitute about 25% of the total area of wetlands in the Mediterranean region, and produce over 60% of the fish catch of Egypt. The northern coastal zone of Egypt is about 1200 km long. The Mediterranean coast is developed for recreational tourism, with the six cities of El-Arish, Port Said, Damietta, Rosetta, Alexandria and Mersa Matrouh. Alexandria, Port Said and Damietta are also industrial towns. The Red Sea and South Sinai coasts are international tourism zones, with diving being the main activity. In addition to increased tourism activities, a tremendous move towards building new industrial complexes is in progress in the northern and the eastern coasts. An international road connecting the most eastern and western towns in Egypt, Rafah and El-Salloum, respectively, was constructed in parallel to the northern coast. The road specifications and level are not designed for protecting the land from sea level rise caused by global warming.

The use of the coastal land is under an extreme pressure from various stakeholders including agriculture, aquaculture, ports and an increased number of national and international recreational users. This pressure poses a devastating threat to the ecosystem of all Egyptian shores. Until recently, the overall planning for the coastal areas has been undertaken by the line ministries and the Governorates. The lack of coordination resulted in unsustainable development, i.e. a massive development of beach resorts, vacation houses and apartment blocks. This, in combination with severe coastal erosion led to the environment being compromised and ecosystems being put at high risk.

Based on the above we could conclude that the coastal zones of Egypt suffer from a number of serious problems including unplanned development, land subsidence, excessive erosion rates, water logging, salt water intrusion, soil salinization and ecosystem degradation. Given Egypt's fast growing population, its limited fertile land, and the concentration of a sizable part of its economic activities in the coastal zones, the potential social and economic impacts of climate change would be serious on the country's future. The key problems in the coastal zones of the country can be summarized as follows:

- Physical alteration of the shoreline;
- Infrastructure for shoreline protection work;
- Development that does not respect the dynamic characteristics of the coastal zone;
- Environmental pollution;
- Habitat destruction which may lead to loss of biodiversity, destruction of spawning and nursery grounds for fish and depletion of fish resources due to overfishing;
- Constrains and threats to the Coastal Zone Management under the threat of the sea level rise (SLR);
- Insufficient data and lack of mechanisms for information exchange;
- Inadequacy and conflict of laws/regulations/mandates as well as inadequate coordination among coastal resources managers;
- Shoreline erosion especially due to infrastructure and shoreline protection projects leading to loss of properties;
- Habitat destruction as a result from development that exceed the carrying capacity of a region, loss of biodiversity and deterioration of fish stocks.

5.2 Key Environmental and Land Use Sectors

5.2.1 Agriculture

An estimated 55% of the labour force in Egypt is engaged in agricultural activities, a sector which consumes about 80% of the fresh water resources and contributes about 13.50 % to the GDP, in 2012/2013.

Egyptian agricultural land can be classified into:

- "Old-land", comprising the lands of the Nile Valley and the Nile Delta which have been irrigated and intensively cultivated since ancient times, representing about 80% of the cultivated area; and

- "New-land", entailing lands that have been reclaimed relatively recently or that are in the process of being now reclaimed (International Fund for Agricultural Development, 2005), representing about 20% of the cultivated area.

The cultivated land base of Egypt is about 3.5 million hectares, with a total annual cropping area of about 6.2 million hectares, representing 176% of the total cultivated land area[13].

Cultivation and modern irrigation in the new lands can be classified as medium to high level. Due to the different conditions of soil, availability, quality of water and climatic conditions, there are two main cropping seasons a year, namely, winter and summer cultivation seasons. In some cases, farmers tend to cultivate a third crop during the period between summer and winter, termed "Nili" season, which may extend for about two months. At the same time, fruit trees are the most important perennial crops. Field crops cultivated in Egypt include maize, rice, cotton and sugarcane as main summer crops, while alfalfa, wheat, barley, green bean, clover, and sugar beet are the main winter field crops. Field crops in Egypt have a superior productivity, which has been improved through the last two decades as a result of switching to new cultivars, applying modern technologies and improving management programs (SADS, 2010).

Livestock production occupies a prominent stage in agricultural activities. Meat production is much greater than milk production under Egyptian conditions. The main animal types are cows, buffaloes, sheep, goats and camels.

5.2.2 Solid Waste and Wastewater

The total annual amount of solid waste produced in Egypt is about 88 million tonnes (Mt) according to the year 2015 estimates including:

- Municipal solid waste - 20 million tons;
- Agricultural waste - 30 million tons;
- Industrial waste - 6 million tons;
- Health care and Hazardous medical waste - 530,000 tons;
- Construction and demolition waste - 4 million tons;
- Waterway cleansing waste - 25 million tons; and
- Sludge - 2.2 million tons.

Final destinations of municipal solid waste entail about 12% of the waste being composted/recycled, 7% landfilled, and 81% dumped in uncontrolled open dumps. In this respect, 16 landfills exist in Egypt: 7 in the Greater Cairo Region, 5 in the Delta governorates and 4 in Upper Egypt. Their capacities range between 0.5 and 12 Mt per day. These landfills are usually operated by private entities. Recently, 53 sites have been identified for new landfills, and the construction of 56 composting plants throughout the country is underway.

[13] Ministry of Agriculture and Land Reclamation, 2005

Industrial waste is estimated to about 6.0 Mt annually (about 17,000 t/d). Estimates show that between 80,000 to 300,000 t of the industrial waste produced is classified as hazardous. Most of the industrial solid waste is produced by 13 industrial cities recently established and 65 industrial zones distributed between the different governorates.

Egypt produces around 30 Mt of agricultural waste annually (around 82,000 t/d). Some of this waste is used in the production of organic fertilizers, animal fodder, food production, energy production, or other useful purposes.

Healthcare waste is estimated to about 500,000 t annually, of which about 30,000 t is hazardous waste. New treatment and disposal units for healthcare waste have been installed in the largest hospitals. They amount to 31 units, handling 2.5-5% of the total amount of healthcare waste generated.

The cost of environmental degradation resulting from solid wastes was estimated as 0.25% of Egypt's GDP for 2001[14], representing a major economic and environmental challenge.

As for wastewater, the National Holding Company of Water and Wastewater manages 147 wastewater treatment plants in the largest towns in Egypt. Their total installed capacity is 10.718 million m^3 per day. The total municipal wastewater discharge is estimated to be 13.882 million m^3 per day, with the difference of more than 3 million m^3 per day remaining untreated. Other wastewater treatment plants (70 plants) are operated under the supervision of the National Authority for Water and Wastewater, treating 1.745 million m^3 of wastewater per day[15]. The remaining 55% of the total domestic wastewater generated in Egypt, is treated through on-site facilities such as septic tanks. By the end of 2009, the Holding Company of Water and Wastewater estimates that 100% of the population in Egyptian cities and 11% of the rural population will be served by sanitary networks. Unfortunately, however, the last 2017 census shows that only 90% of the population in Egyptian cities and 27.5% of rural population is served by sanitary networks.

For the year 2001 the cost of environmental degradation resulting from wastewater was estimated as 1% of Egypt's GDP[14].

5.2.3 Industry

Industry added value (% of GDP) in Egypt was last calculated at 39.22 % in 2012, according to the World Bank. Industry corresponds to ISIC divisions 10-45 and includes manufacturing (International Standard Industrial Classification (ISIC) divisions 15-37). It comprises value added[16] in mining,

[14] Mediterranean Environmental Technical Assistance Program, 2005.
[15] Osama, A. 2007: National Circumstances Waste Sector, Second National Communication Project, UNDP-EEAA.
[16] Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources. The origin of value added is determined by the ISIC revision 3.

manufacturing (also reported as a separate subgroup), construction, electricity, water, and gas. Industrial Production in Egypt increased by 20.69% in November of 2014 over the same month in the previous year. Industrial production in Egypt averaged 4.45% from 2004 until 2014, reaching an all-time high of 34.77% in February of 2012 and a record low of -24.89% in February of 2011. Industrial production in Egypt is reported by the Ministry of Planning, Egypt.

The **cement Industry** has been growing rapidly in developing countries, accounting for 25% of the energy consumed by the manufacturing sector worldwide. Cement production is one of Egypt's most important industries, and by far the largest. This energy-intensive process is a significant source of GHG emissions, responsible for 65% of all emissions in the industrial sector. The industry's size and importance in Egypt mean that it has tremendous potential for reducing GHG emissions, which could be achieved by improving efficiency and shifting to alternative fuels. Equally importantly, an analysis of the industry's profitability, liquidity and debt ratios shows that it is a most attractive sector for undertaking mitigation actions without impacting upon competitiveness due to its very high profitability, good liquidity and relatively low debt ratio.

In the **fertilizer industry**, the production of fertilizer for agriculture consumes 1.2% of total worldwide energy. In Egypt specifically, although it is the smallest contributor of GHGs of the three industrial sectors analyzed, the fertilizer industry is by far the greatest energy consumer. Of the total energy consumed in the sector, approximately 90% is used for producing ammonia. (see the chart on energy types.) Therefore, the sub-sector of ammonia production has the highest potential for reducing energy consumption within the fertilizer sector. Although energy consumption in ammonia plants is down to half of what is was in 1960, further efficiency can be gained by using more efficient, modern equipment and new technology.

The **iron and steel industry** has seen steady growth worldwide since the 1970s, due particularly to its rapid expansion in China. The bulk of this growth has involved the use of inefficient processes and outdated technology - only viable when energy costs are low. Fortunately, more efficient practices continue to emerge, including the use of less wasteful input materials, as well as the use of blast furnaces and coke for power, rather than gas. In Egypt, the most important steps identified for further GHG reductions in this sector include switching to these best-available technologies used worldwide, such as cleaner input materials, upgraded production facilities, implementation of CO2 capture and storage and improved materials management. However, the iron and steel sector was found to be the least financially sound sector of the three in Egypt, due to low profitability, low liquidity and very high debt ratio).

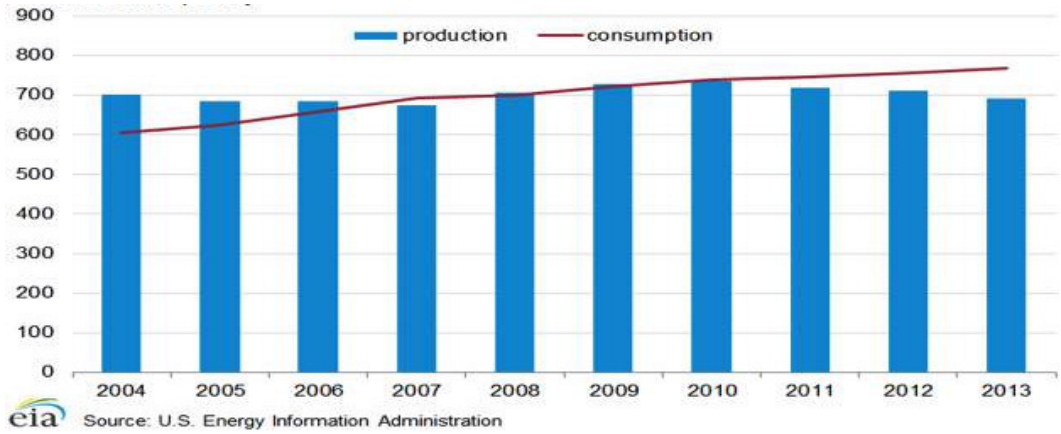
5.2.4 Energy

Oil and Gas

According to the Oil & Gas Journal's (OGJ) January 1, 2013 estimates, Egypt's proven crude oil reserves are 4.4 billion barrels, an increase from the 2010 reserve estimate of 3.7 billion barrels, with

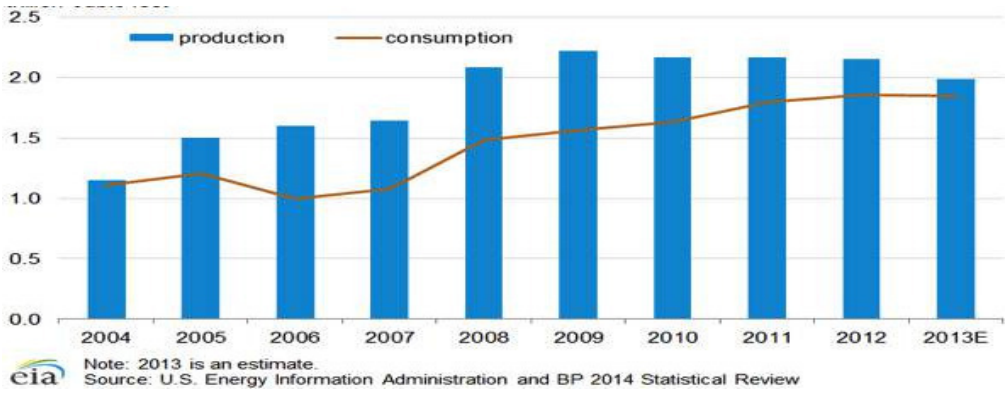
new oil discoveries boosting oil reserves in recent years. According to the Arab Oil and Gas Journal, several new oil discoveries have been made every year since 2008, with 16 in 2011, 16 in 2010, 11 in 2009, and 17 in 2008. Many of these oil discoveries were the result of exploration conducted by the U.S.-based Apache in Egypt's Western Desert. Egypt's oil production comes from the Gulf of Suez, Nile Delta, Western Desert, Eastern Desert, Sinai, and the Mediterranean Sea. Most of Egypt's production is derived from relatively small fields that are connected to larger regional production systems. Overall production is in decline, particularly from the older fields in the Gulf of Suez and Nile Delta. However, declines have been partially offset by small new finds, particularly in the Western Desert and offshore area. In addition, the use of enhanced oil recovery (EOR) techniques at mature fields has eased production declines.

Figure 4: Petroleum and other liquids production and consumption (in thousand barrels /day)



According to OGJ estimates as of January 1, 2013, Egypt's proven natural gas reserves registered at around 77 trillion cubic feet (tcf), an increase from the 2010 estimate of 58.5 tcf and the third highest in Africa, after Nigeria and Algeria. New discoveries in the deep water Mediterranean Sea and Nile Delta, along with some finds in the Western Desert, have led to the increase in proven reserves. There were 16 natural gas discoveries in 2009, 10 in 2010, and 7 in 2011, according to the Arab Oil and Gas Journal. The majority of Egypt's natural gas reserves and production is located in the Mediterranean Sea and Nile Delta.

Figure 5: Natural gas production and consumption (in trillion cubic feet)



As a result of Egypt's growing domestic energy demand, the government plans to increase the amount of power generated from renewable sources, particularly wind and solar energy, and is fostering nuclear power development. The Egyptian household electrification rate in 2009 was approximately 99.7 %, according to the latest estimates from the International Energy Agency (IEA). Although the country has one of the highest electrification rates in Africa, approximately 286,000 people still lack access to electricity, mainly in rural areas.

Hydropower

The total existing hydropower capacity is about 2.81 GW, producing about 24% of the national electricity demand. This capacity is gradually growing. Water has not been released from the High Aswan Dam exclusively for the generation of hydropower since 1990. The production of hydropower can be considered to be a by-product of the releases for irrigation, municipal, and industrial water uses. There is no water loss in the hydropower generation, contrary to the thermal power stations, where large amounts of cooling water are lost by evaporation.

5.3 Egypt's Institutional Framework for Climate Change

Non-governmental organizations (NGOs) in Egypt play a key role in formulating and implementing environmental protection efforts. The Government of Egypt facilitates the growth of the private sector through increasing the scope of incentives aimed at responding to investors' needs for being fully integrated into the Egyptian economy. The Egyptian Environmental Affairs Agency (EEAA) also encourages the use of cleaner technologies through environmentally-friendly industrial zones and processes aiming at increasing the efficiency of the use of resources, including reuse, recovery and recycling in order to reduce the amounts of waste generated from production activities. However, investment offices in the governorates are still needed to facilitate private sector participation. EEAA signed a protocol with the Federation of the Egyptian Industry (FEI) to promote cooperation for environmental protection in Egypt.

Labour unions and political parties are vital in facilitating better environmental management due, in part, to their experience in addressing industrial change, in protecting the workplace and related natural environment, and in promoting socially responsible economic development.
A number of challenges face environmental management and protection in Egypt. One such challenge has been the need for the revision of Law 4/1994 following gained experiences in enforcement and compliance. For example, limit values stated in the executive regulations were found to be vague, therefore needing to be revised in order to improve enforcement and compliance. In this respect, EEAA introduced amendments, including them in the environmental Law 9/2009.

The most significant constraint to effective environmental policy making and implementation in Egypt is the lack of reliable and timely information indicating how various sectors of society impact the environment and whether development is becoming more sustainable or not. Various constraints related to the processes of environmental information collection, production and dissemination are evident in Egypt. These include

- Uncoordinated institutional set-ups for monitoring activities;
- The absence of a common information system for monitoring organizations to feed data and findings into;
- The absence of comprehensive systematic methodologies for monitoring;
- The absence of valuation, and/or the undervaluation, of many natural resources; and
- The lack of financial resources for maintaining monitoring processes.

The coordination required to reach comprehensive and integrated environmental activities is significant because of the cross-sectoral nature of environmental issues. Although EEAA has the primary responsibility for coordination, numerous other entities are partners in environmental policies, playing roles in implementation and/or monitoring. EEAA has the responsibility of implementing national environmental policies and of setting up environmental standards for cases of conflicting interests. In this respect, the Agency established inter-ministerial committees on each of the major relevant crosscutting environmental issues, such as water, energy, and climate change. These are chaired by the Minister of State for Environmental Affairs, and coordinated between multiple competent authorities for the different specific environmental processes of concern.

The Prime Minister renewed the “National Committee for Climate Change” that was established in 1997 by his Decree No. 272 in 2007. The Minister of Environment heads the Inter-Ministerial National Committee for Climate Change. The members represent a wide range of governmental, experts and non-governmental stakeholders. Recently, Ministry of State for Environmental Affairs scaled up the “Climate Change Unit” to strengthen climate change institutional framework on the national level, to be a Central Department in Egyptian Environmental Affairs Agency in 2009. Meanwhile, on the sectoral level attempts to strengthen the institutional framework led to establishing two committees in Ministry of Agriculture and Land Reclamation and Ministry of Water Resources and Irrigation, in addition to establishing a climate change information centre for Agriculture Sector, and conducting an adaptation program in Agriculture Sustainable Development Strategy up to 2030.

On the other hand, Egypt ratified Kyoto protocol on 12/1/2005 followed by establishing the Egyptian Designated National Authority for Clean Development Mechanism "DNA-CDM". Investment costs of initially approved 55 projects in 2009 were USD 1243 million. These projects will reduce GHG by almost 8.3 Million ton CO_2 equivalent; they include reduction of nitrous oxide emission from fertilizer industry, renewable energy, fuel switching, methane capture and flaring from waste and energy efficiency improvement.

5.3.1 Egypt's Greenhouse Gas Inventory

Table 1 and Figure 6 present Egypt's total GHG emissions by gas type and translated into CO_2-Equivalents for the years 2000, 2005, 2010 and 2016, taken from the latest updated version published by the Climate Change Central Department of the EEAA and CAPMAS Environmental report. Table 2 and Figure 7 present Egypt's total GHG emissions by sector showing the latest available data for the year 2016. As can be seen from these data there is a steady and significant increase of all relevant GHGs in Egypt (except N_2O).

Table 1: Egypt's GHG emissions by gas type for the years 2000, 2005, 2010 and 2016

Gas type	Unit	2000	2005	2010	2016
N_2O	Thousand Tons	78.7	90.61	133.4	64.51
	Million Tons Eq. CO2	24.4	28.09	41.36	20.00
CH_4	Thousand Tons	1876.1	2058.09	3030.47	2332.4
	Million Tons Eq. CO2	39.4	43.22	63.64	59.00
HFCs	Thousand Tons				
	Million Tons Eq. CO_2	0.05	0.065	0.095	
PFCs	Thousand Tons				
	Million Tons Eq. CO2	1.1	2.16	3.182	5.00
SF_6	Tons	4.184	5.439	7.949	
	Million Tons Eq. CO2	0.1	0.13	0.19	
CO_2	Million Tons	128.2	142.6	210.0	210.0

The calculation is done like an interest and compound interest calculation from year 2000 on with an average annual growth rate of 2.90%. For all gases and all sectors there is an equal increase in GHG emissions of 157% relative to the emissions in year 2000. The total GHG emissions remain almost the same for the last 6 years this reduced the annual growth rate from 5.1% for the years from 2000 to 2010 to 2.90 and reduced the total increased from 165% to 157%.

Figure 6: Egypt's GHG emissions by gas type between 2000 and 2016

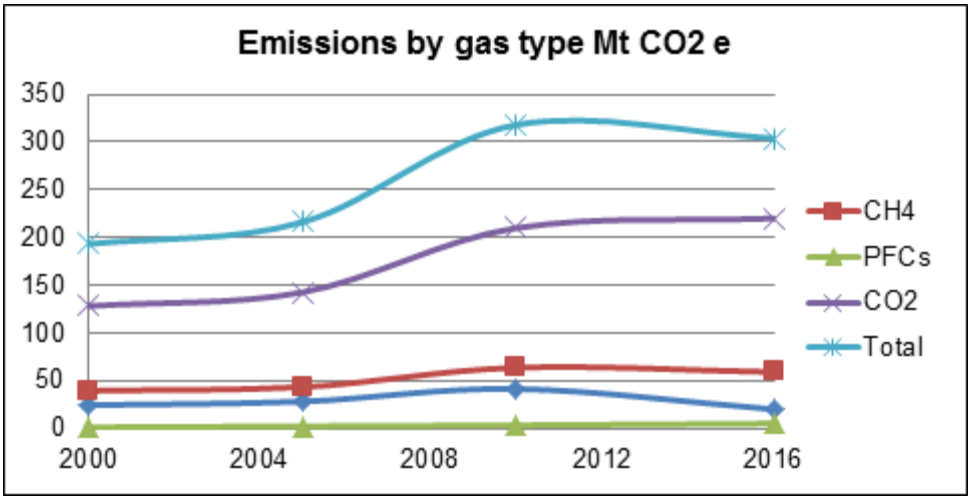
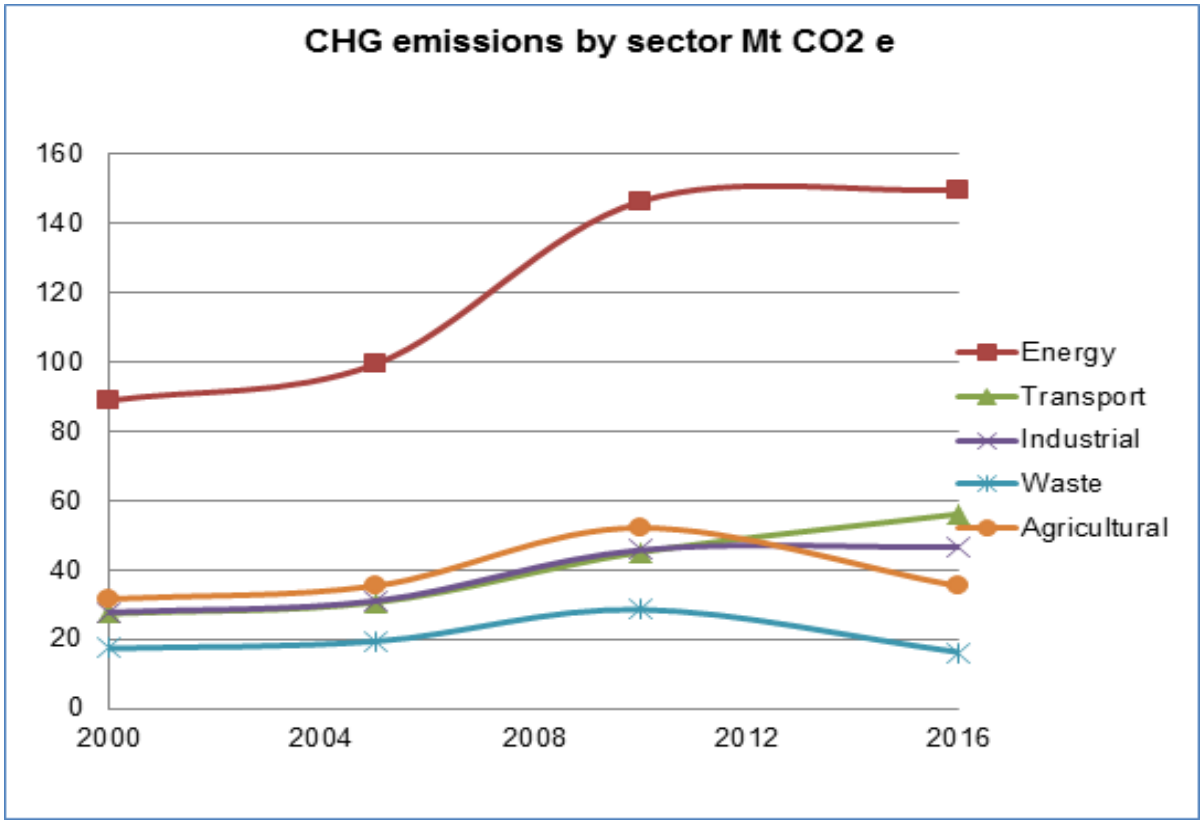


Table 2: Egypt's GHG emissions by Sector for the years 2000, 2005, 2010 and 2016

Indicators	Unit	2000	2005	2010	2016
Total GHG Emission	Million Tons Eq. CO_2	193.3	216.1	318.2	304
GHG Emission / Energy Sector	Million Tons Eq. CO2	88.91	99.4	146.37	149.63
GHG Emission / Transport Sector	Million Tons Eq. CO_2	27.44	30.68	45.18	56.21
GHG Emission / Industrial Sector	Million Tons Eq. CO_2	27.83	31.11	45.82	46.63
GHG Emission / Waste Sector	Million Tons Eq. CO_2	17.39	19.44	28.63	16.27
GHG Emission / Agricultural Sector	Million Tons Eq. CO_2	31.7	35.44	52.18	35.26

Figure 7: Egypt's GHG emissions by sector between 2000 and 2016.



Figures 8 and 9 show the change of sectors' contribution to Egypt's total CO_2 - inventory. As compared to the year 2000 the total GHG emissions of Egypt increased in 2016 to 157% (as is the same compared to 1990).

During this period Egypt's population increased by 147% with an increase in the GDP of 290%. The ratio of GDP, at the 1981/82 fixed prices for the year 2000 to that for 1990 is 151%, denoting that the increase in GHG emissions seems to be correlated to the GDP increase rather than the population growth (it should be noted that these values is in Egyptian pounds while if the calculation is on US$ the increase in GDP will be equal to 235%)

Figure 8: Contributions of different sectors to the GHG inventory in 2000

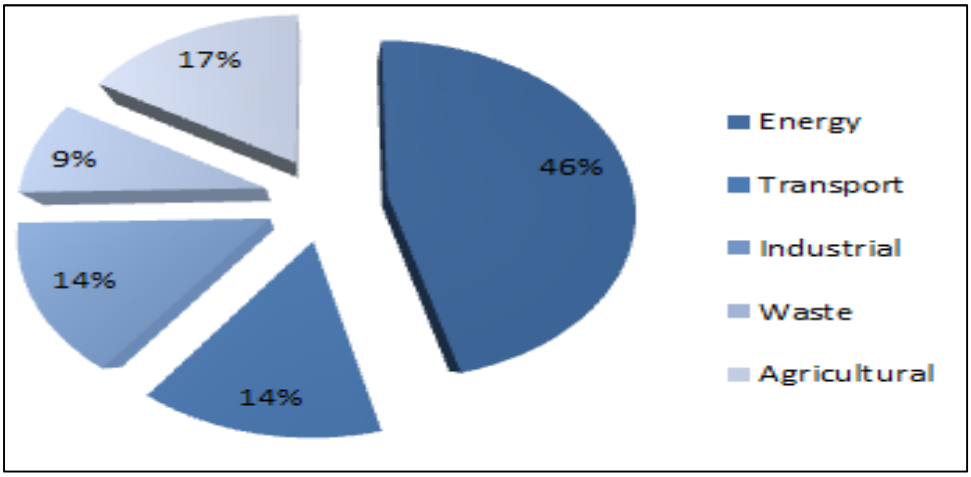
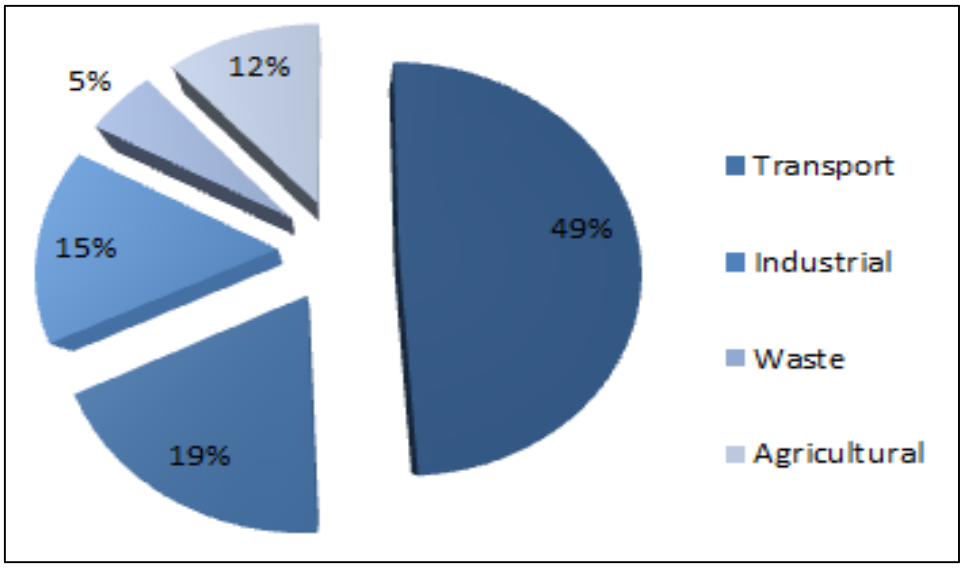


Figure 9: Contributions to the GHG inventory of different sectors in 2016



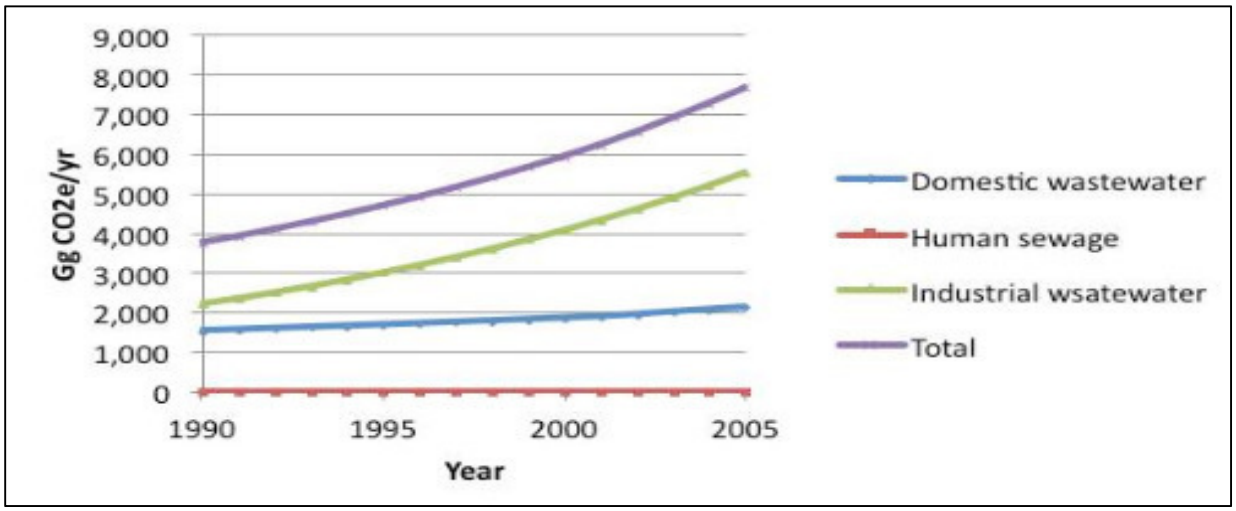
5.3.2 GHG Inventory by Wastewater Sector

Data on domestic WWTPs were obtained from the HCWW, the General Authority for Water and Wastewater and CAPMAS report for 2016. Data for industrial wastewater were very limited and therefore, estimates of the quantities of industrial wastewater provided in the INC were used and extrapolation carried out for values beyond 1990. Default IPCC emission factors were used and assumptions of treated versus untreated wastewater were modified to reflect actual conditions in Egypt. Population statistics of the Central Agency from Public Mobilization and Statistics (CAPMAS), 1999 to 2016 were used for estimating the total organic load. Tier 1 method from IPCC Good Practice Guidance was used for estimating CH_4 emissions from domestic and industrial wastewater. IPCC default value for degradable organic component was used to estimate the total organic load. For industrial wastewater, data on wastewater quantities were only available for food and beverages, textiles, pulp and paper industries. Default IPCC values for CH_4 conversion factors and degradable

organic component for those industries were used. Emissions of N_2O from human sewage were calculated according to the 1996 IPCC guidelines, with the annual per capita protein intake (kg/person/year) for Egypt obtained from FAO official website. Wastewater treatment emissions almost represent 40% of the total emissions from waste sector and 2% of the total emissions of the country.

The total emissions from wastewater handling for 2000 were equivalent to 5.788 Mt CO_2e. The time series of emission estimates for the period 1990 and 2000 is presented in figure below.

Figure 10: Total CO_2 equivalent emissions (G.g. CO_2e/year) from wastewater



5.4 Scenarios on Climate Change for Nile Delta and River Nile

The Nile Delta is one of the oldest intensely cultivated areas on earth. It is very heavily populated, with population densities up to 1600 inhabitants per square kilometre. The low lying, fertile floodplains are surrounded by deserts. Only 2.5% of Egypt's land area, the Nile delta and the Nile valley, is suitable for intensive agriculture. Most of a 50 km wide land strip along the coast is less than 2m above sea-level and is protected from flooding by a 1 to 10 km wide coastal sand belt only, shaped by discharge of the Rosetta and Damietta branches of the Nile. Erosion of the protective sand belt is a serious problem and has accelerated since the construction of the Aswan dam.

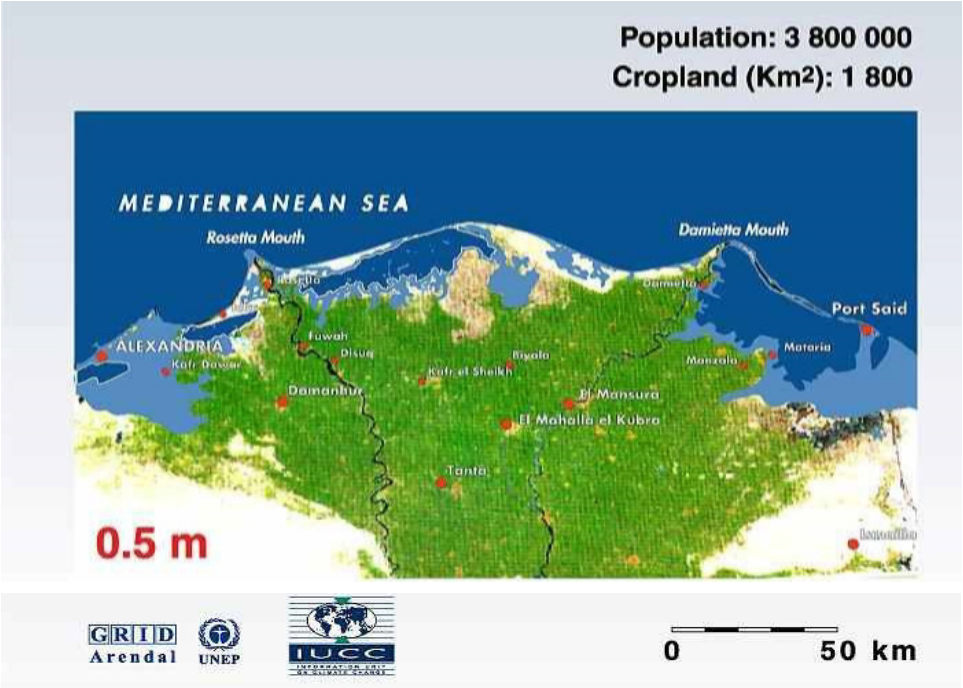
Rising sea level would destroy weak parts of the sand belt, which is essential for the protection of lagoons and the low-lying reclaimed lands. The impacts would be very serious: 60% of Egypt's fish catches are made in the wetlands of the Nile Delta, most of them in the large coastal lagoons. Sea level rise would change the water quality and affect most fresh water fish. Valuable agricultural land would be inundated. Vital, low-lying installations in the cities and harbours would be threatened. Recreational tourism beach facilities would be endangered and essential groundwater would be

salinated. Dykes and protective measurements would probably prevent the worst flooding up to a 50 cm sea level rise. However, it would cause serious groundwater salination and the impact of increasing wave action would be serious (UNEP 2011).

Figure 11: Present situation of sea level in Nile Delta

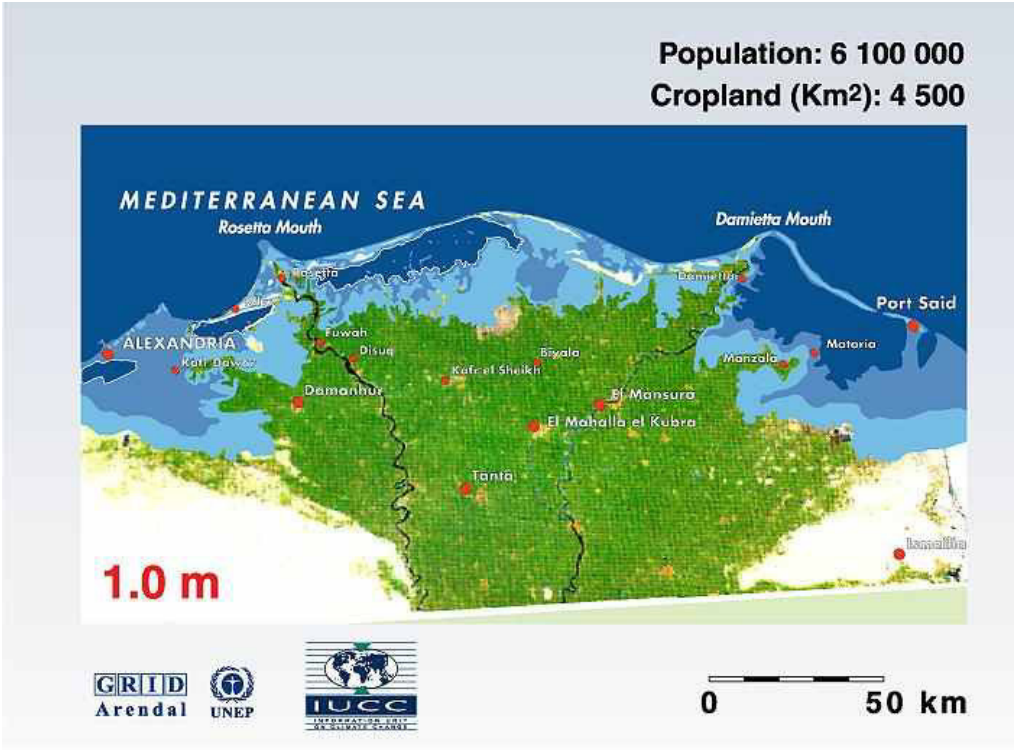
Source: UNEP/Grid Arendal Graphics, 2011

Figure 12: Potential impact of sea level rise in Nile Delta, scenario 0.5 m



Source: UNEP/Grid Arendal Graphics, 2011

Figure 13: Potential impact of sea level rise in Nile Delta, scenario 1.0 m



Source: UNEP/Grid Arendal Graphics, 2011

Nile water originates from three different sources namely the Equatorial Lakes Plateau, Bahr El Ghazal sub basin and the Ethiopian High Lands. The three sub basins are climatically independent and, therefore, the effect of climate change has to be investigated on each sub basin separately.

A conference held in Cairo, 24-25 February 2013 on "Climate Change Impact on the Nile Basin, Exchange of Experiences within the Basin". In this conference, a number of country reports were presented; most of them are not informative. The only country report that can be taken into consideration is that of Egypt which gave the results of a statistically down-scaled model from the UK MO Regional Circulation Model. The conclusion of the report was that changes in rainfall, temperature and potential evapotranspiration were all smaller than previous studies. Following are the ranges of change in flow:

- Blue Nile (Diem): (-19%) to (+29%)
- White Nile (Malakal): (-8%) to (+10%)
- Main Nile (Dongola): (-13%) to (+36%)

In its Assessment Reports 2007 & 2014, IPCC identified Africa as one of the most vulnerable regions to climate change specifically with respect to water resources. The report indicated that most of north and southern Africa will be subject to water stress while east, central and West Africa is projected to receive heavy rain resulting in increased flooding. These strong statements of IPCC reflect the importance of having timely and adequate action to adapt to the anticipated risks of climate change.

UNDP and UNESCO in cooperation with the Egyptian Ministry of Water Resources and Irrigation launched a project on "Climate Change Risk Management". The project was divided into four components: i) Energy efficiency policy, ii) Clean development mechanisms, iii) Flood forecast and IWRM; and iv) Adaptation of agriculture. The four components were implemented by the Ministries of Electricity, Environment, Irrigation and Agriculture respectively.

At the present time Egypt is water scarce (678 m^3 per capita in 2010), Sudan and Ethiopia are water stressed (1,436 and 1,493 m^3/per capita, respectively), Uganda have relatively water sufficiency at 1,953 m^3 per capita. By 2030 Ethiopia and Sudan will be water scarce and water scarcity in Egypt will be even worse than what it presently is. The level sof development among Nile Basin countries vary considerably.

6 CLIMATE CHANGE BASELINE AND INDICATORS

SEA and assessment on climate change should provide at least information of regional and, where ever possible, local-level impacts of climate change and propose mitigation and adaptation measures. Therefore baseline information and indicators on the causes of climate change and impacts regarding the River Nile are needed. The indicators shown in the table below are to identify and to monitor the situation regarding several aspects of climate change in the target region.

If there are significant differences in the target governorates of Qena, Sohag, Assiut and Minya compared to the situation in River Nile region or significant differences among the governorates to emphasise, this should be reflected in a detailed climate change impact assessment (further study needed).

Table 3: Indicators of climate change in River Nile Region and target governorates

Aspects of climate change	**Potential indicators in target governorates**
Causes	• Carbon emissions per person • Greenhouse gas emissions: per region, per capita
Climate/ weather changes	• Precipitation • Temperature • Flood levels in rivers • Extreme events recorded • Sea level rise (scenarios)-minor effect due to migration from north governorates
Local impacts of climate/ weather changes	• River flows and water quality Average annual flood incidence/ damage drought orders • Ranges and movements of species • No. heat and/or cold related deaths • No. cases of subsidence/insurance claims for subsidence
Mitigation measures	• Total electricity and gas use • Vehicle – km travelled per person per year

	• Electricity generated from renewable energy sources and CHP located in the area • Embodied energy in new buildings • Average energy efficiency of new buildings • % of new homes conforming to recognised codes for sustainable buildings
Adaptation measures	• % developments with sustainable drainage systems • No. or % homes in floodplain • No. or % roads/railway lines in floodplain • No. planning permissions granted on grounds of flood risk • Household water use • Enhancement of ecological networks through habitat creation/restoration schemes

7 ISSUES AND CONSTRAINTS CAUSED BY CLIMATE CHANGE

The higher temperatures, wetter winters, drier summers, higher sea levels and increase in extreme events caused by climate change are likely to have a range of impacts, such as those listed below. The 'impact assessment' within the SEA study will need to identify how the programme could be affected by these impacts.

- **Water resources** – Demand for water is likely to increase in the summer due to higher temperatures, at the same time as water availability decreases due to lower summer rainfall. Low-lying lands and estuaries of northern delta will become particularly prone to flooding.
- **Water quality** – Lower flows in summer of Damietta branch and channels will reduce sewage dilution capacity, impacting water quality.
- **Health** – Potential heat waves in warmer summers can cause heat stress. For instance, the European heat wave of the summer of 2003 contributed to the death of about 35,000 people. Such heat waves are expected to be common by 2050. Warmer weather also encourages the spread of disease and pests. Flooding and other extreme events can make access to health services more difficult.
- **Biodiversity** – The vast majority of the landscape in River Nile and Nile delta is fragmented and intensely cultivated since hundreds of years. As a result, many of the important species are effectively constrained to relatively small, isolated wildlife areas, with sharp boundaries between them and adjacent land sites of unsuitable habitat. This renders species unable to move in response to a more rapidly changing climate and makes them increasingly vulnerable to extinction. Climate change impacts on the marine environment are less well studied but could include changes in species composition, and loss of some species altogether. Due to sea level rise there might be significant effects on coastal and estuary fish habitats and also for the commercial fishery.
- **Soils** – The loss of organic matter from soils could accelerate due to increased air erosion and increasing soil salinity. This trend could result in increased emissions of CO_2 and other greenhouse gases.
- **Buildings and infrastructure** – More extreme events such as flooding are likely to increase damage to buildings and infrastructure through flood damage and subsidence. Services such as transport and access to medical facilities may be disrupted. Increased temperatures will need changes in building to maintain internal comfort.
- **Economy** – Generally, the global costs of climate change could be assumed as 20% of the national GDP. The cost of extreme weather alone is expected to be 0.5–1% of the world's GDP by about 2050 (Stern, 2006). The insurance industry is likely to be exposed to an increased volume of claims which will mean higher premiums; some properties may become uninsurable. There could be equally negative impacts on yield, especially due to reduced water availability.

7.1 Climate Change Mitigation and Adaptation Measures

Climate change is a cumulative impact that can only be dealt with through multiple actions. Both mitigation and adaptation measures should be considered "to prevent, reduce and as fully as possible offset any significant adverse effects on [climatic factors] of implementing the plan (or programme)" (EU-SEA Directive, Annex Ig).

Adaptation measures are needed because a degree of climate change is unavoidable regardless of efforts to reduce future emissions. Mitigation measures are needed as a contribution to reducing global greenhouse gas emissions, in order to lessen the risk of worse impacts in the future.

Table 4: SEA objectives regarding climate change issues in target governorates

	SEA objectives
Mitigation measures	**Minimise future climate change, for example by :** • Reducing energy needs and consumption in all IWSP projects • Improving energy efficiency in all IWSP projects • Utilising renewable energy in IWSP projects as much as possible • Improving waste and land use practices to reduce emissions • Protecting and enhancing natural carbon sinks • Reducing carbon losses in organic soils
Adaptation measures	**Reduce vulnerability to the impacts of climate change, for example by:** • Providing sustainable and adjustable drainage systems • Providing sustainable and adjustable sewage systems • Providing sustainable and adjustable water supply systems • Providing sustainable and adjustable WW treatment facilities • Taking a precautionary and risk-based approach to developing in • Allowing no planning permissions in areas of high flood risk • Ensuring adequate sea defence structures

General principles for appropriate mitigation and adaptation measures that are also valid for the IWSP programme are:

- Keeping options open and rehabilitation measures flexible – so that further measures or strategies can be put in place to meet needs identified in the future;
- Avoiding decisions that will make it more difficult to manage climate risks in the future. One example is inappropriate development in a flood risk area;
- Implementing 'no-regret' options that deliver net benefits whatever the extent of climate change, where these exist. If weather-related problems are already being experienced, cost-effective actions to deal with them should be 'no-regret' options;
- Finding win-win options that contribute to climate change mitigation, adaptation and to wider plan objectives, e.g. business opportunities from energy efficiency measures.

7.1.1 Mitigation Measures

The mitigation measures discussed in this section are based on those described in national plans and country studies documents. Implementation of these national plans needs financial and technical support from the international donors. The objective of national plans is to create a national GHG mitigation portfolio to support the process of sustainable development in Egypt. They stress Egypt's need for technology transfer, donor funding, capacity building and financing from the Clean Development Mechanism (CDM).

In the waste sector, a distinction was made between options suitable for solid waste and those suitable for liquid waste. For the former, implemented measures have entailed the establishment of a specialized administrative mechanism for solid waste management in each governorate and city; the recruitment of specialized experts for the choice of locations and the design of sanitary landfills; and the provision of financial and technical assistance to private sector companies interested in waste collection and waste recycling.

For liquid waste, implemented measures have included the maintenance of newly developed primary and pre-treatment systems; clarification of lines of command and communications between different pertinent entities; and the development of institutional and enforcement capabilities of the local authorities of new industrial cities.

Additional mitigation measures include the increase of the country's CO_2 absorptive capacity through afforestation, entailing planting and maintaining suitable types of trees along the sides and the middle-island of inter-city roads, irrigation and drainage canals, in addition to developing man-made forest-wood trees using treated sewage water for irrigation. The implementation of the Support for National Action Plan (SNAP) as well as the GEF building capacity and GHGs emission reduction projects, led to increased concerns about climate change within different institutions and ministries. This has been reflected in having more than twenty projects concerned with GHG mitigation actions over the past decade.

Mitigation Measures for the Waste and Wastewater Sector

Six main criteria have been selected for prioritization of mitigation measures in the waste sector. These entail investment costs; payback periods; GHGs emission reductions potentials; duration of implementation; priority in national strategies and programs; and contribution to sustainable development. Mitigation options, concluded from a multi-criteria analysis, were combined for each sub-sector in order to generate a number of scenarios for solid waste and wastewater. The lowest GHG emitting scenario was selected for implementation during the period 2009 to 2025. Mitigation measures under one or more of appropriate treatment categories, the associated emission reduction potential, and investment costs calculated for a 25 years lifetime in simple linear amortization cost, are summarized in Table 5 for wastewater.

Table 5: Summary of identified mitigation measures for wastewater

Mitigation Measure	Emission reduction potential (kg CO_2 e / m³ WW)	Cost of Mitigation (US$ / m³ WW)
Untreated domestic wastewater in current practice		
Aerobic treatment of WW and aerobic treatment of sludge through composting	0.29	Shallow ponds: 0.015 Aerobic WWTP: 0.050
Aerobic treatment of WW and combustion of sludge in cement kiln	2.25	Shallow ponds: 0.014 Aerobic WWTP: 0.050
Aerobic treatment of WW & treatment of sludge in anaerobic system with biogas flaring	2.55	Shallow ponds: 0.134 Aerobic WWTP: 0.170
Aerobic treatment of WW and treatment of sludge in anaerobic system with electricity generation	2.79	Shallow ponds: 0.154 Aerobic WWTP: 0.190
Anaerobically treated domestic wastewater without biogas recovery in current practice		
Aerobic treatment of WW and aerobic treatment of sludge through composting	1.72	Shallow ponds: 0.015 Aerobic WWTP: 0.050
Aerobic treatment of WW & combustion of sludge in cement kiln	3.68	Shallow ponds: 0.014 Aerobic WWTP: 0.050
Aerobic treatment of WW & treatment of sludge in anaerobic system with biogas flaring	1.84	Shallow ponds: 0.134 Aerobic WWTP: 0.170
Aerobic treatment of WW and treatment of sludge in anaerobic system with electricity generation	4.22	Shallow ponds: 0.154 Aerobic WWTP: 0.190
Untreated industrial wastewater in current practice		
Aerobic treatment of WW & combustion of sludge in cement kiln	4.09	Shallow ponds: 0.014 Aerobic WWTP: 0.050
Aerobic treatment of WW and treatment of sludge in anaerobic system with biogas flaring	2.46	Shallow ponds: 0.134 Aerobic WWTP: 0.170
Aerobic treatment of WW and treatment of sludge in anaerobic system with electricity generation	2.70	Shallow ponds: 0.154 Aerobic WWTP: 0.190
Anaerobic treatment of WW and treatment of sludge in anaerobic system with biogas flaring	0.82	0.120

Mitigation Measure	Emission reduction potential (kg CO_2 e / m^3 WW)	Cost of Mitigation (US$ / m^3 WW)
Anaerobic treatment of WW and treatment of sludge in anaerobic system with electricity generation	4.38	0.140

The relevant Egyptian ministries, in close collaboration with the Governorates concerned, developed several plans and programs over the past ten years to improve the process of dealing with waste reduction, reuse, recycling and/or proper disposal. These plans and programs lead to the reduction in emissions from the waste sector. Yet there are several barriers to achieving the goals of these programs. These comprise the following:

- Although financial support for mitigation of GHG emissions from the waste sector in Egypt has increased significantly over the last years, it still represents a clear constraint in the implementation of the intended programs;
- Investment in this sector requires large funds and is not cost effective for the private sector, so there is significant dependence on external financial support, as grants and concessionary loans, which complicates the planning process, and slows down implementation;
- Technology transfer represents another barrier mainly in anaerobic digestion technologies as it needs high capital investment and skills to operate correctly. Some technologies are designed on site-specific bases, which are not optimal for other regions. Highly local skilled experts and extensive studies are needed for proving the suitability and applicability of the technology according to different varying local conditions in Egypt;
- All parties in the waste sector are relatively of limited environmental management experience and the mechanisms for coordination with EEAA are not well established. Furthermore, privatization of the waste sector lacks clear modalities for partnership, particularly with regards to private-public partnership.

7.1.2 Adaptation Measures

Vulnerability

Egypt is one of the most vulnerable countries to the potential impacts and risks of climate change, even though it produces less than 1% of the world total emissions of GHG, with a vulnerability of all sectors of development and a low resilience of the majority of stakeholders. The sectors of water resources, agricultural resources and food security, coastal resources, tourism, and health are all highly vulnerable with serious socioeconomic implications. This section outlines and updates the main vulnerabilities associated with water resources, coastal zones and wastewater sectors of development in Egypt. Detailed analysis of adaptation policy and measures has been carried out. Vulnerabilities, socioeconomic implications and suggested adaptation policies and measures for each sector are outlined.

Water Resources

This section addresses the sensitivity of the Nile river waters to climate change. The sensitivity of different Nile basins to uniform changes in rainfall have been studied (Sayed, 2004). It is clear that the Eastern Nile (Atbara and the Blue Nile) is extremely sensitive to the change in rainfall both positive and negative, where an increase of 10% in rainfall results in a 36% increase in water flow at Khartoum, and a decrease of 10% in rainfall results in flow reduction of 31%. On the other hand, Equatorial Nile (Lake Victoria at Jinja) flow has low sensitivity to the change in rainfall, with a 6% increase of flow for a 10% increase in rainfall and a decrease of 4% of flow reduce flow for a 10% decrease in rainfall. Bahr El Ghazal Basin (White Nile at Malakal) has moderate sensitivity, where an increase of 10% in rainfall increases water flow by 19% and a decrease of 10% in rainfall reduces water flow by 11%.

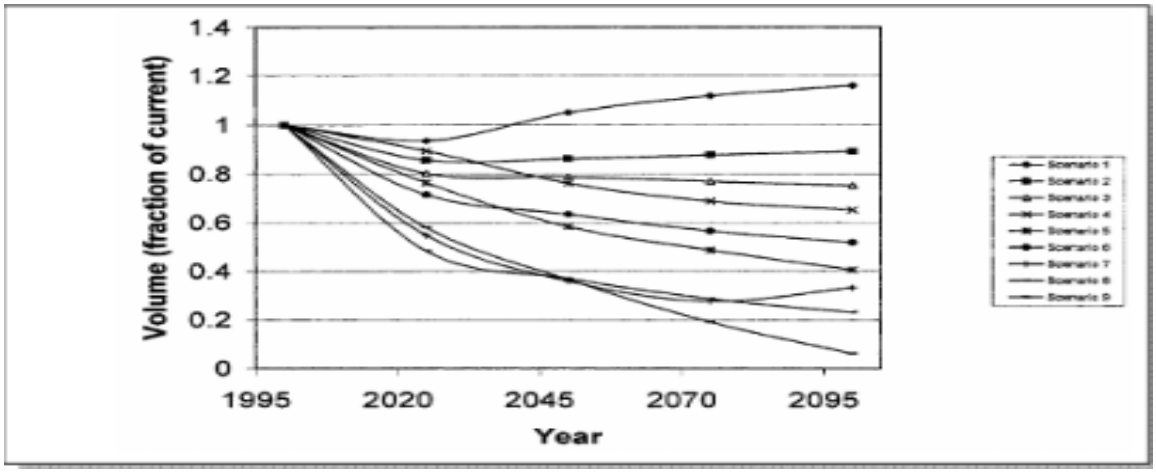
The sensitivity of Nile water flows is also affected by the change in temperature, which causes corresponding changes in evaporation and evapotranspiration (Hulme et al., 1995). An increase of 4% in evapotranspiration would result in a reduction of Blue Nile and Lake Victoria flows by 8% and 11% respectively. A similar study was carried out (Strezpek et al., 1996) where the sensitivity was related to change in precipitation together with change in temperature as a basin wide average. Its results are presented in Table 6.

Table 6: Nile flows under sensitivity analysis (Strezpek et al., 2001).

Precipitation	**-20%**	**-20%**	**-20%**	**0.0%**	**0.0%**	**+20%**	**+20%**	**+20%**
Temperature	0	2	4	2	4	0	2	4
Flow (BCM)	32	10	2	39	8	147	87	27
% of base (100)	37	12	2	46	10	171	101	32

The above results indicate that the Nile flows are extremely sensitive to any change in climate. With 4°C warming and 20% reduction in precipitation Nile flows may decrease by 98%, and with a 20% reduction in precipitation and 2°C warming the decrease may be 88%; if no change in temperature took place the decrease may reach 63% for a 20% reduction in precipitation. For an increase of 20% in rainfall and increase of 4°C, 2°C and 0°C the flow may be reduced by 68% or increased by 1% and 71% respectively. The response of flows to precipitation change is not linear, but it is more or less symmetrical on both sides of increased or decreased precipitation.

Figure 14: Scenarios of Nile River water flow under sensitivity analysis



Source: Strzepek et al., 2001

Coastal Zones

Egyptian coasts extend for about 3,500 km along the Mediterranean and the Red Sea. In addition, Egypt hosts a large number of inland lakes, the largest being the fresh water Lake Nasser and the saline Lake Qarun in Fayoum. The coastal zones of Egypt host a major part of the industrial activities including petroleum, chemicals and tourism distributed among a large number of highly populated economic centers such as the cities of Alexandria, Rosetta, Damietta, Port Said, Suez and Hurghada. Trading and transportation centers are also distributed among a large number of harbors which are considered highly attractive to employment from all over the country. The coastal zones are also considered an important source for fisheries and income generation. Egypt's overall production of fish, according to the 2004 statistics (FAO, 2004), is about 876,000 t, of which 116,600 t (13.3% of the overall production) are from coasts. The coastal zones of Egypt are perceived as vulnerable to the impacts of climate change, not only because of the direct impact of sea level rise, but also because of the potential impacts of climate changes on their water resources, agricultural resources, tourism and human settlements. In particular, the low lying Nile Delta region, which constitutes the main agricultural land of Egypt and hosts over one-third of the national population and nearly half of all crops (World Resources Institute, 2007), industrial activities and commercial centers, is highly vulnerable to various impacts of climate change.

Mediterranean Sea Coastal Zone

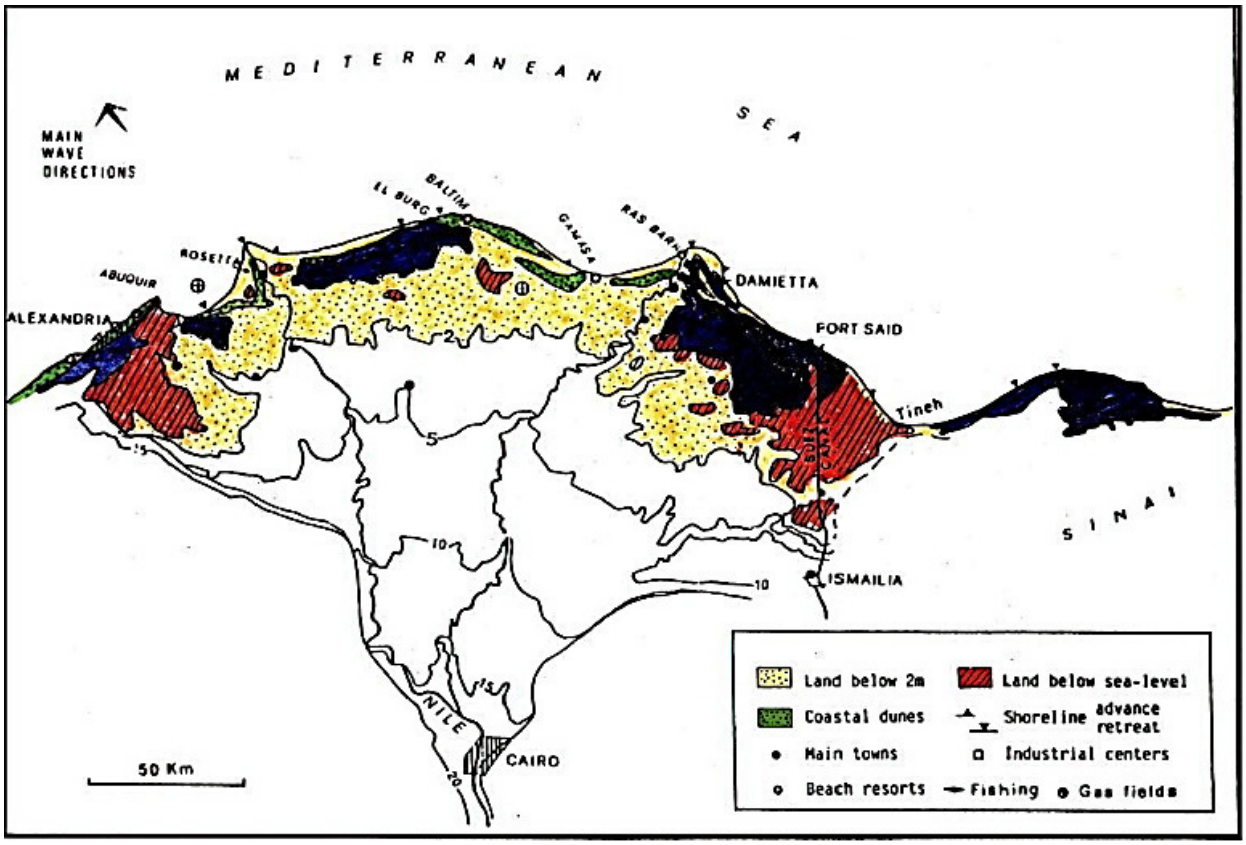
The Mediterranean coastal shoreline includes five large lakes which constitute about 25% of the total area of wetlands in the Mediterranean region. The Mediterranean coastal zone hosts a large number of economic and industrial centers as well as important beaches and tourist resorts. The precipitation along the coastal zone in winter varies between 130 and 170 mm/year and decreases gradually to the south. The tidal range is about 30-40 cm. The Mediterranean coastal zone of Egypt suffers from a number of problems, including a high rate of population growth, unplanned urbanization, land subsidence, excessive erosion rates, salt water intrusion, soil salinization, land use interference,

ecosystem pollution and degradation and lack of appropriate institutional management systems. This zone hosts Alexandria city, which is the main harbor on the western side of the Delta located at a partly low elevation land. The city hosts about 40% of the country's industrial capacity, in addition to being an important summer resort. Other vulnerable large cities include the cities of Rosetta, Damietta, and Port Said.

Coastal Zone of the Nile Delta Region

The Nile Delta region is the most fertile land of the country and hosts most of the agricultural productivity and the largest part of the population of the country. Its shoreline has relatively low elevation areas. In addition the Delta suffers from land subsidence that increases from west to east. Hence it is highly vulnerable to potential impacts of climate change.

Figure 15: General topography of the Nile Delta indicating areas below mean sea level (El Raey, 2009).



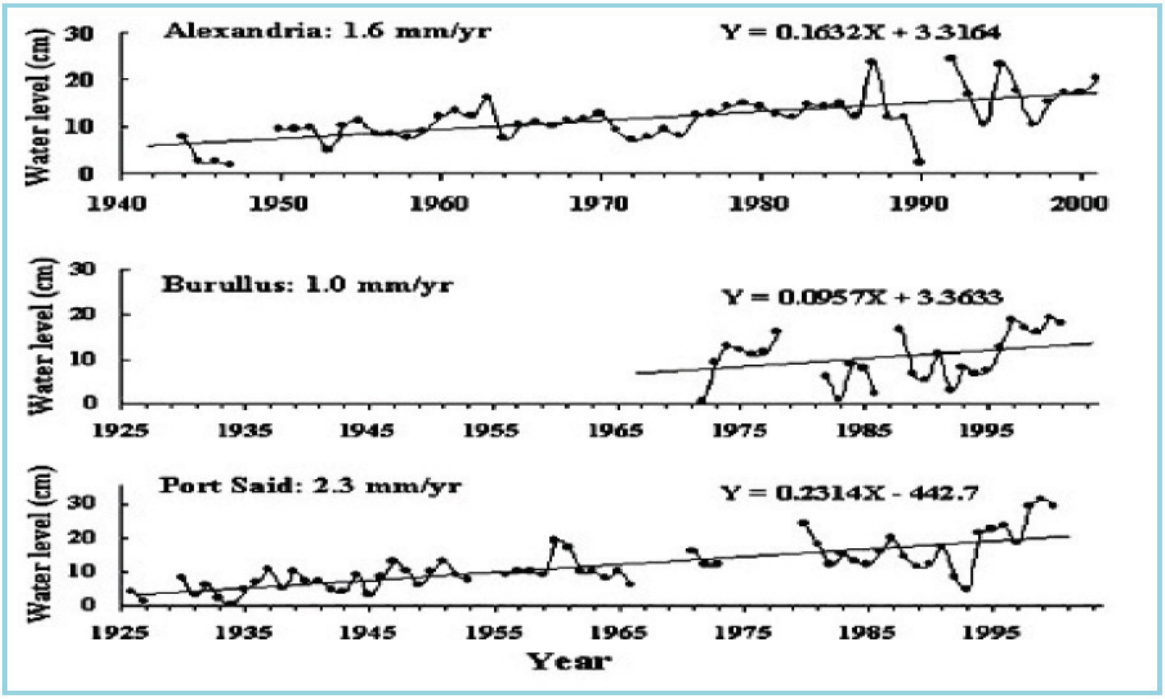
The Nile Delta shoreline extends from Alexandria to the west to Port-Said to the east with total length of about 240 km and is typically a smooth wide coast. This zone consists of sandy and silty coasts of greatly varying lateral configurations, depending on where the various old branches of the Nile have had their outlets. The coastline has two promontories, Rosetta and Damietta. There are three brackish lakes connected to the sea: Edku, Burullus, and Manzala. In addition, there are several harbors located on the coast including: Alexandria, Edku fishing harbor, Burullus fishing harbor, Damietta commercial harbor, El Gamil fishing harbor and Port Said commercial harbor. Two main drainage canals, Kitchener and Gamasa, discharge their water directly to the sea within this zone. The figure

above highlights the vulnerable lands below sea level in the Nile Delta, however some of these lands are protected from inundation by natural systems such as sand dunes or man-made structures such as the banks of El-Salam Canal or the International Roadway. The main threats for the coastal areas are due to erosion and accretion, subsidence and sea level rise (climate change). Agrawala et al., 2004 surveyed specific large economic centers of Alexandria, Rosetta and Port Said and obtained quantitative estimates of vulnerable areas and expected loss of employment in case of no action. They concluded that the Nile Delta coastal zone is highly vulnerable to the impacts of sea level rise through direct inundation and salt water intrusion. Low elevation coastal zones constitute high risk areas due to potential damage of sea protection from earthquakes or human activities.

The Coastal Research Institute (CoRI) has developed accurate coastal elevation maps based on aerial photos and hydrographic profiles. Tide gauges data revealed an increase in the relative sea to land level of about 1.6 mm/year at Alexandria, 1.0 mm/ year at Al-Burullus, and 2.3 mm/year at Port Said, as presented in the figure below[17] .

Despite the project governorates will not be directly affected by sea water rises but internal migration, loss of agriculture land and available resources will be a direct impact on IWSP2 governorates.

Figure 16: Long term Sea-Level rise based on mean annual sea levels measured by tide gauges located at Alexandria, Burullus and Port Said (Frihy, 2003).



[17] Frihy, O. 2003: The Nile Delta-Alexandria Coast: Vulnerability To Sea-Level Rise, Consequences and Adaptation, Mitigation and Adaptation Strategies for Global Change 8: 115–138.

8 PROPOSAL FOR CLIMATE SMART INVESTMENTS IN THE WASTEWATER SECTOR

The wastewater sector generally contributes to only a few per cent of the total GHG emissions of a country. However, WWTPs are usually among the larger power consumers for a municipality as compared to schools or public lighting. WWTPs are centralised and therefore easier to optimise than diffuse power consumers. The purpose of this chapter is to demonstrate the possibilities to reduce the GHG emissions and the power consumption with smart investments, using an example in the field of wastewater treatment.

WWTPs contribute to the emissions of GHGs because of the use electrical energy (indirect emissions) and because the gases that are emitted in the process of mechanical and biological treatment gases - such as CH_4 (methane), N_2O (nitrous oxide) and ammoniac (NH_3) - are several times more effective for global warming than CO_2 (direct emissions). The potential of CH_4 is approx. 25 times higher than for CO_2, the potential for N_2O is approx. 300 times higher than for CO_2 (based on a 100 year scale). The global warming potential (GWP) of a GHG depends on both the efficiency of the molecule as a GHG and its atmospheric lifetime. GWP is measured relative to the same mass of CO_2 and evaluated for a specific timescale. Thus, if a gas has a high radiative forcing but also a short lifetime, it will have a large GWP on a 20 year scale but a small one on a 100 year scale. Conversely, if a molecule has a longer atmospheric lifetime than CO_2 its GWP will increase with the timescale considered. Carbon dioxide is defined to have a GWP of 1 over all time periods.

Methane has an atmospheric lifetime of 12 ± 3 years and a GWP of 72 over 20 years, 25 over 100 years and 7.6 over a 500 years' period. The decrease in GWP at longer times is because methane is degraded to water and CO2 through chemical reactions in the atmosphere.

During the degradation of organic matter at a WWTP, CO_2 is produced. However, it is generally considered that the CO_2 emitted in a WWTP corresponds to the CO_2 which was bounded to plants, fruits or vegetables from the atmosphere during their growth phase and it will not be considered further. But emissions related to transport activities are not to be neglected[18].

The first step is the analysis of emissions occurring at a plant. In a second step alternatives will be given on how to minimize the emissions and which smart investments are required to achieve this goal.

8.1 Indirect emissions

In order to estimate the indirect emissions at a WWTP, it is necessary to know how much power is consumed - in kWh - for the proper operation of the processes at this plant.

[18] Climate relevant emissions at the operation of wastewater treatment systems, Ruediger Mess at al. Korrespondenz Abwasser n° 7, 2011

It is also necessary to know the rate of CO_2 emitted for each kWh produced in Egypt. A first estimate gives a rate of about 1500 g CO_2/kWh for power produced (year 2008). At this stage it must be said that the portion of power produced out of regenerative energy is quite low in Egypt (around 10%) but will be increasing in the next years because new projects in the wind and solar energy are planned or already under construction. Therefore this value will definitely be reduced in a near future, thus decreasing the impact of indirect emissions.

Using the values for power consumption and rate of CO_2 emission per kWh in Egypt, it is straightforward to derive the indirect emissions at an Egyptian WWTP.

8.2 Direct emissions

The analysis of direct emissions from a WWTP is difficult as no measurement is carried out on the gases emitted in the different treatment processes. Nevertheless literature values enable some assumptions. The biological processes contribute to the emissions of N_2O gases, especially if incomplete denitrification takes place[19]. Furthermore, all the sludge units such as thickeners which are usually not covered can be important sources of CH_4 emissions. Actual values found in the literature seem to show that even if the sludge is stabilised in anaerobic digestors and CH_4 used for power generation, CH_4 will be emitted in large quantities in the units located downstream of power generation[20]. Large quantities of CH_4 will also be produced in temporary storage lagoons (wet sludge) or in the landfill, if sludge is to be discharged there. The wetter the sludge is, the more anaerobic degradation will take place and the more CH_4 will be produced[21]. Aerobic conditions (such as created in most composting plants) will prevent the uncontrolled production of CH_4[22]. CH_4 emissions of sludge reused in agriculture also tend to be low.

A detailed knowledge of which processes occur at a WWTP and how the sludge is discharged is necessary in order to estimate the direct emissions from a WWTP.

8.3 Case study (from IWSP1)

The Ras el Bar WWTP in the Damietta governorate was chosen for a case study within this report. The design flow of the WWTP is 50.000 m^3/d.

An analysis of the Ras el Bar WWTP has been conducted including following points:

- Process description: screens, grit chamber, activated sludge etc.;
- Is nitrification and denitrification achieved?
- Effluent standards / Influent value / Effluent value (last months / last years);
- BOD load (kg/d);

[19] Climate change and water management, Johannes Pinnekamp et al, 2008
[20] Energy and CO_2 balance of a water utility, Dieter Thoele et al. Korrespondenz Abwasser n°6, 2011
[21] CH_4 and N_2O emissions from wastewater handling, John Robson, 1999
[22] Measurement of greenhouse gas emissions from constructed wetlands for sludge treatment, E. Uggetti, I. Ferrer, J. Garcia, 2010-2011

- Estimate of population equivalent at the present time;
- Population equivalent of design;
- Flow (dry weather flow / wet weather flow);
- Power consumption in kW/year;
- Sludge transport: how much and how many kilometers?
- Are there large pumping stations in the sewage network that pump the wastewater to the WWTP? If yes, what is the additional power consumption in kW/year?

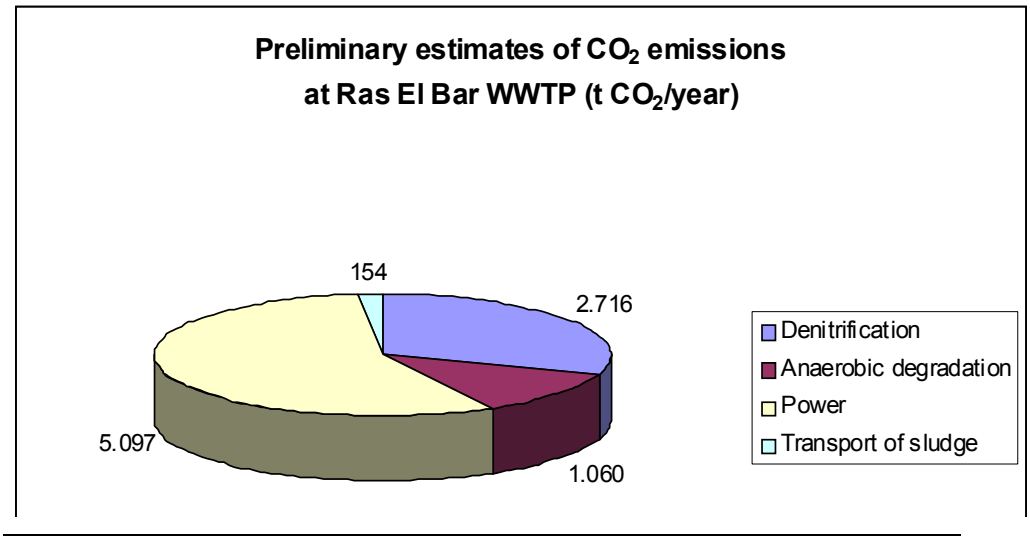
Visits at Ras el Bar WWTP showed that most electro-mechanical equipment is in poor condition so that a major part of the proposed investments will very probably be spent on removing the old equipment and replacing it with modern equivalents. This has the advantage that 18 years old components will be replaced by more effective ones which usually consume less power for the same capacity. Further to this it will be possible to choose equipment which is adapted to the real flow patterns and actual loads of the plant as they may differ from the original design.

Figure 17: Aerators at Ras el Bar WWTP highly contribute to indirect CO_2 emissions and most probably to direct N_2O emissions

8.3.1 Preliminary estimates of CO_2 emissions at Ras el Bar WWTP

A first estimate of the CO_2 emissions from the plant at Ras el Bar was conducted with first values obtained from the staff of the WWTP. The plant is considered to have an average population equivalent of 500,000 PE and a flow varying between 35,000 m^3/d (winter time) and 49,000 m^3/d (summer time). The average power consumption is 3,398.1 kWh/year. The process to be achieved is extended aeration with nitrification and denitrification.

Figure 18: Sources of CO_2 emissions at Ras El Bar WWTP



In total approximately **9,027 t CO_2/year** are emitted at Ras el Bar WWTP or 18 kg CO_2 per PE and year. Especially the specific value per capita is considered to be low, in comparison to values found in literature which are in the range of 30 kg CO_2 per PE (German example for a WWTP without own power generation). This can be explained by the fact that the assumed PE of 500,000 is too high. Furthermore, it is not clear if the given power consumption includes the requirements at the different pumping stations in the sewage network or not.

The figure above shows that the greatest part of the CO_2 emissions is related to the indirect emissions caused by the power consumption of the plant. The second and third relevant source of emissions are due to direct emissions of N_2O gases in the nitrification/denitrification process and direct emissions of CH_4 gases in the sludge treatment units. Emissions related to the transport of sludge are very low, but not negligible.

8.3.2 Climate smart investments

Based on the first estimate of CO_2 volumes emitted at Ras El Bar WWTP, the Consultant now proposes tangible options for minimising CO_2 emissions from this plant. This can be achieved either by minimising the indirect emissions (power consumption) or the direct emissions. Another option is to consider power generation at the plant.

The following investments might be taken into consideration:

- New surface aerators with higher O_2 efficiency
- Programmable logic controller (PLCs) for surface aerators
- New pumps, frequency converters and/or PLCs so as to be able to operate the pumps at their highest efficiency points
- Solar sludge drying beds
- Covers for thickeners + biofilter
- Covers for aerated tanks + Biofilter
- Anaerobic digesters with power generation

- Small units for the generation of renewable energy such as micro wind turbine or photovoltaic panels.

The following table shows a first analysis of the smart climate investments that could be made at the Ras el Bar WWTP and first recommendations are given on the efficiency of those measures. Further, rough price estimates for investment, operation & maintenance are given.

In conclusion, the presented case study clearly shows that the rehabilitation of a WWTP can clearly be used to decrease the impact of a plant on climate change.

Table 7: Overview and first analysis of CSI for Ras el Bar WWTP

Proposed smart climate investment for Ras el Bar WWTP	Estimated efficiency to reduce greenhouse gas emissions	Simplicity of implementation	Required staff for operation	Estimation of cost for implementation	Estimation of cost for operation	Comment & recommendation
New surface aerators with higher O_2 efficiency	High. Relatively high power savings and minimisation of greenhouse gases are expected up to 20%	Adaptation measures (civil works) will have to be carried out. Bridges supporting the aerators will have to be reconstructed (new static requirements)	No additional staff is required	Middle (x 100,000 €)	No additional staff is required	This measure has the advantage to both minimise power consumption and indirectly GHG emissions
Programmable logic controller (PLCs) for surface aerators	High. Thanks to PLCs the power consumption can be reduced by up to 20%	Electronic engineer is required to observe the existing system and implement an optimised monitoring and control system	Once implementation is finalised and stable, no additional staff required	Low (x 10,000 €)	Low (x 1,000 / year)	This measure has the advantage to both minimise power consumption and indirectly GHG emissions
New pumps for recirculation of sludge	High. Relatively high power savings and minimisation of greenhouse gases are expected up to 20%. New pumps shall be adapted to the real flow requirements	For the replacement of the existing Archimedean screw pumps, major adaptation measures (civil and mechanical works) are to be expected.	No additional staff is required	Middle (x 100,000 €)	No additional staff is required	This measure has the advantage to both minimise power consumption and indirectly GHG emissions

Proposed smart climate investment for Ras el Bar WWTP	**Estimated efficiency to reduce greenhouse gas emissions**	**Simplicity of implementation**	**Required staff for operation**	**Estimation of cost for implementation**	**Estimation of cost for operation**	**Comment & recommendation**
Frequency convertors (FCs) for pumps	High. FCs contribute to reduced power consumption of pumps.	Electronic engineer is required	Once implementation is finalised, no additional staff required	Low (x 10,000 €)	Low (x 1,000 € / year)	This measure has the advantage to both minimise power consumption and indirectly GHG emissions
Solar sludge drying beds	Solar sludge drying beds surely contribute to minimise the emissions of CH_4 in comparison to normal drying beds as the sludge is aerated. No information available on emission savings in literature	Civil works are required	No additional staff is required	Middle to high (x 100,000 €)	Low (x 1,000 € / year)	This measure is not to be further considered as not enough information available on efficiency of measure and the investment cost are middle to high
Covers for thickeners and CH_4 biofilters	High. High emissions of CH_4 are expected to be emitted at thickeners and sludge storage tanks. Covering of those units will prevent emissions up to 30 % of the total emissions at the WWTP	Adaptation measures (civil works) are expected to be low	No additional staff is required. Filters must be controlled here and then.	Low (x 10,000 €)	Low (x 1,000 € / year)	This measure probably contributes to high minimisations of CH_4 emissions

Proposed smart climate investment for Ras el Bar WWTP	Estimated efficiency to reduce greenhouse gas emissions	Simplicity of implementation	Required staff for operation	Estimation of cost for implementation	Estimation of cost for operation	Comment & recommendation
Covers activated sludge tanks and N_2O biofilters	High. High emissions of N_2O can be expected at aerated tanks. Covering of those units will prevent emissions up to 30 % of the total emissions at the WWTP	Adaptation measures (civil works) are expected to be low	No additional staff is required. Filters must be controlled here and then.	Middle (x 100,000 €)	Low (x 1,000 € /year)	This measure probably contributes to high minimisations of N_20 emissions
Anaerobic digestors	High. 30% of total power consumption at the plant is expected to be produced at the new anaerobic digestors	New anaerobic digestors are to be constructed which have high quality requirements for civil, electrical and mechanical works	Highly qualified staff is required for the proper operation of the anaerobic digestors	High (x 1,000,000 €)	High (x 10,000 € /year)	This measure would contribute not only to minimise the power consumption and greenhouse gas emissions but it is not recommended at this stage of the project because of the high complexity of operation
Small units for the generation of power (photovoltaic panels, microturbines, microwind power plants)	Low. Up to 5-10% of total power consumption at the plant can be produced with those units	Adaptation measures (civil works) are expected to be low	No additional staff is required	Middle (x 100,000 €)	Low (x 1,000 € /year)	Can be envisaged

9 POTENTIAL REDUCTION OF GHG EMISSIONS DERIVED FROM IWSP 2

The major part of GHG emissions at a WWTP are indirect emissions associated to energy (and fuel) consumption for its operation. The proposed smart investments to decrease the energy consumption as well as an incentive to increase the use of renewable energy will contribute for GHG emissions reduction. However, these indirect emissions are included in the National GHG Inventory in the energy sector and they are not considered for the waste sector, which includes the wastewater handling sector.

The GHG emissions derived from wastewater treatment and discharge are addressed in Volume 5: Waste, Chapter 6 of the IPCC Guidelines[23] and include methane (CH_4) and nitrous oxide (N_2O). Carbon dioxide (CO_2) emissions from wastewater are not considered because these are of biogenic origin and should not be included in national total emissions.

The amount of GHG emissions from wastewater handling strongly depends on the country/area-specific wastewater characteristics and the particular collection, treatment and disposal systems used. Therefore, it is necessary to have a relatively detailed knowledge of the global wastewater system in order to identify the sources of potential CH_4 and N_2O generation and to be able to estimate the emissions.

It is only after having identified the sources of GHG emissions that an assessment can be made of how much GHG emissions will be avoided by the measures of the IWSP.

9.1 Emissions of CH_4

Wastewater as well as its sludge components can produce CH_4 if it degrades anaerobically. The extent of CH_4 production depends primarily on the quantity of degradable organic material in the wastewater, the temperature, and the type of treatment system. With increases in temperature, the rate of CH_4 production also increases. This is especially important in uncontrolled systems and in warm climates, like in Egypt. Below temperatures of 15°C, significant CH_4 production is unlikely because methanogens are not active and the lagoon will serve principally as a sedimentation tank. However, when the temperature rises above 15°C, CH_4 production is likely to resume. This situation is most probably to occur in the Programme Area, considering the average annual mean of daily temperature shown in Figure 1. (Annex 3)

The principal factor in determining the CH_4 generation potential of wastewater is the amount of degradable organic material in the wastewater, measured as BOD and COD.

[23] 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Available on Internet at www.ipcc-nggip.iges.or.jp/public/2006gl/

9.2 Emissions of N_2O

Nitrous oxide (N_2O) is associated with the degradation of nitrogen components in the wastewater, e.g., urea, nitrate and protein. Domestic wastewater includes human sewage mixed with other domestic wastewater, which can include effluent from shower drains, sink drains, washing machines, etc. Centralized wastewater treatment systems may of a variety of processes, ranging from lagooning to advanced tertiary treatment technologies for the removal nitrogen compounds. After being processed, the treated effluent is typically discharged to a receiving water environment (e.g., river, lake, estuary, etc.). Direct emissions of N_2O may be generated during both nitrification and denitrification of the nitrogen present. Both processes can occur in the plant and in the water body that is receiving the effluent. Nitrification is an aerobic process converting ammonia and other nitrogen compounds into nitrate (NO_3^-), while denitrification occurs under anoxic conditions (without free oxygen), and involves the biological conversion of nitrate into dinitrogen gas (N_2). Nitrous oxide can be an intermediate product of both processes, but is more often associated with denitrification

9.3 Treatment and Discharge Systems and CH_4 and N_2O Generation Potential

Treatment systems or discharge pathways that provide anaerobic environments will generally produce CH_4 whereas systems that provide aerobic environments will normally produce little or no CH_4.

Table 8 presents the main wastewater treatment and discharge systems and their potentials to emit CH_4 and N_2O. Wastewater originates from a variety of domestic, commercial and industrial sources and may be treated on site (uncollected), sewered to a centralized plant (collected) or disposed untreated nearby or via an outfall. Treatment and discharge systems can differ for rural and urban users, and for urban high income and low income users.

Wastewater in closed and underground sewers is not a significant source of CH_4. The situation is different for wastewater in open sewers, because it is subject to heating from the sun and the sewers may be stagnant allowing for anaerobic conditions to emit CH_4.

The methods and degree of wastewater treatment can be very variable. In some cases industrial wastewater is discharged directly into water bodies, while major industrial facilities may have comprehensive in-plant treatment. To avoid high discharge fees or to meet regulatory standards, many large industrial facilities can pre-treat their wastewater before releasing it into the sewage system. Domestic wastewater is treated in centralized plants, pit latrines, septic systems or disposed of in unmanaged lagoons or waterways, via open or closed sewers. In some coastal cities domestic wastewater is discharged directly into the ocean. Pit latrines are lined or unlined holes of up to several meters deep, which may be fitted with a toilet for convenience. On-site septic systems may treat wastewater from one or several households. They consist of an anaerobic underground tank and a drainage field for the treatment of effluent from the tank.

There are GHG emissions associated to the treatment and disposal of the sludge produced at the different centralized wastewater treatment systems. N_2O emissions from sludge and wastewater spread on agricultural land, as well as CO_2 emissions derived from urea application are included in the Agriculture, Forestry, and Other Land Use (AFOLU) Sector (Volume 4. of the in IPCC Guidelines). Therefore, it is important to know the amount of sludge produced, its treatment and disposal, in order to correctly estimate and address these emissions in the national GHG Inventory.

Table 8: CH_4 and N_2O emission potentials for wastewater and sludge treatment and discharge systems

Types of treatment and disposal				**CH_4 and N_2O emission potentials**
Collected	Untreated	River discharge		Stagnant, oxygen-deficient rivers and lakes may allow for anaerobic decomposition to produce CH_4 Rivers, lakes and estuaries are likely sources of N_2O
		Sewers (closed and underground)		Not a source of CH_4/N_2O.
		Sewers (open)		Stagnant, overloaded open collection sewers or ditches/canals are likely significant sources of CH_4
	Treated	Aerobic treatment	Centralized aerobic wastewater treatment plants	May produce limited CH_4 from anaerobic pockets Poorly designed or managed aerobic treatment systems produce CH_4 Advanced plants with nutrient removal (nitrification and denitrification) are small but distinct sources of N_2O.
			Sludge anaerobic treatment in centralized aerobic wastewater treatment plant	Sludge may be a significant source of CH_4 if emitted CH_4 is not recovered and flared.
			Aerobic shallow ponds	Unlikely source of CH_4/N_2O. Poorly designed or managed aerobic systems produce CH_4
		Anaerobic treatment	Anaerobic lagoons	Likely source of CH_4 Not a source of N_2O
			Anaerobic reactors	May be a significant source of CH_4 if emitted CH_4 is not recovered and flared
Uncollected	Septic tanks			Frequent solids removal reduces CH_4 production
	Open pits/Latrines			Pits/latrines are likely to produce CH_4 when temperature and retention time are favourable
	River discharge			See above

9.4 Methane emissions from wastewater

Table 10 resumes the steps to estimate the CH_4 emissions from domestic wastewater and the information/data which is needed for the calculation, as suggested by IPCC Guidelines. The

wastewater characterisation will determine the fraction of wastewater treated or disposed of by a particular system, as well as the related emission factors.

If sludge separation is practised and appropriate statistics are available, then this category should be separated out as a subcategory. If default factors are being used, emissions from wastewater and sludge should be estimated together. Regardless of how sludge is treated, it is important that CH_4 emissions from sludge sent to landfills, incinerated or used in agriculture are not included in the wastewater treatment and discharge category.

If sludge removal data are available, the data should be consistent across the sectors, and categories, amount disposed at SWDS, applied to agricultural land, incinerated or used elsewhere should be equal to the amount organic component removed as sludge when estimating CH_4 emissions. Wastewater and sludge that is applied on agricultural land should be considered in Volume 4 for AFOLU Sector.

Table 9: Steps need to the estimation of CH4 emissions from domestic wastewater and the data needed for the calculation

Step	**Unit**
Step 1: estimate **total organically degradable carbon** in wastewater Data needed:	**kg BOD/yr**
• Total population in inventory year	person
• Country-specific per capita BOD in inventory year *estimated value for Egypt = 34 (range 27-41) g BOD/person/day*	g BOD/person/day
• Correction factor for additional industrial BOD discharged into sewers *for collected the default is 1.25, for uncollected the default is 1.00*	
Step 2: Select the pathway and systems (See Table 9) according to the activity data in the area of interest. Estimate the emission factor for each domestic wastewater treatment/discharge pathway or system, ***EF***: **Data needed:**	**kg CH_4 / kg BOD**
• Each treatment/discharge pathway or system	
• Maximum CH_4 production capacity, B_o *default value for B_o = 0.6 kg CH_4/kg BOD or 0,25 kg CH_4/kg COD*	kg CH_4/kg BOD
• Methane correction factor, MCF, dependent on the type of wastewater treatment and disposal *default MCF values for domestic wastewater in **table 3***	fraction
Step 3: Estimate the ***CH_4 emissions***, adjust for possible sludge removal and/or CH_4 recovery and sum the results for each pathway/system **Data needed:**	**kg CH_4/yr**
• Income group, (rural, urban-high and urban-low income)	
• Representation of income group	fraction
• Degree of utilisation of treatment/discharge pathway or system, for each income group fraction in inventory year	fraction
• Organic component removed as sludge in inventory year	kg BOD/yr
• Amount of CH_4 recovered in inventory year	kg CH_4/yr

Wastewater treatment system/pathway usage often differs for rural and urban residents. Also, in developing countries, there are likely to be differences between urban high-income and urban low-income residents. Hence, a factor U is introduced to express each income group fraction. It is *good practice* to treat the three categories: rural population, urban high income population, and urban low income population separately. ICPP suggested values for urbanization and degree of utilization of treatment, discharge pathway or method for selected countries, including Egypt. However, countries are encouraged to use their own data or best judgement.

Table 10: Default MCF values for domestic wastewater

Type of treatment and discharge pathway or system	Comments	MCF	Range
Untreated system			
Sea, River and lake discharge	Rivers with high organics loadings can turn anaerobic	0,1	0 - 0,2
Stagnant sewer	Open and warm	0,5	0,4 - 0,8
Flowing sewer (open or closed)	Fast moving, clean (insignificant amounts of CH_4 for pump stations, etc.)	0,0	0
Treated system			
Centralized aerobic TP	Must be well managed. Some CH_4 can be emitted from settling basins and other pockets	0,0	0 - 0,1
Centralized aerobic TP, not well managed	(overloaded)	0,3	0,2 - 0,4
Anaerobic digester for sludge	CH_4 recovery not considered	0,8	0,8 - 1,0
Anaerobic reactor	CH_4 recovery not considered	0,8	0,8 - 1,0
Anaerobic shallow lagoon	Depth < 2 m	0,2	0,2 - 0,3
Anaerobic deep lagoon	Depth > 2 m	0,8	0,8 - 1,0
Septic system	Half of BOD settles in anaerobic tank	0,5	0,5
Latrine	Dry climate, ground water table lower than latrine, small family (3-5 persons)	0,1	0,05 - 0,15
Latrine	Dry climate, ground water table lower than latrine, communal (many users)	0,5	0,4 - 0,6
Latrine	Wet climate/flush water use, ground water table higher than latrine	0,7	0,7 - 1,0
Latrine	Regular sediment removal for fertilizer	0,1	0,1

9.5 Nitrous oxide emissions from wastewater

Nitrous oxide (N_2O) emissions can occur as direct emissions from treatment plants or from indirect emissions from wastewater after disposal of effluent into waterways, lakes or the sea. Direct emissions from nitrification and denitrification at wastewater treatment plants may be considered as a

minor source. Typically, these emissions are much smaller than those from effluent and may only be of interest to countries that predominantly have advanced centralized wastewater treatment plants with nitrification and denitrification steps. Consequently, direct emissions need to be estimated only for countries that have predominantly advanced centralized wastewater treatment plants with nitrification and denitrification steps.

The activity data that are needed for estimating N_2O emissions are nitrogen content in the wastewater effluent (see estimation-steps on Table 12), country population and average annual per capita protein generation (kg/person/yr). Per capita protein generation consists of intake (consumption) which is available from the Food and Agriculture Organization (FAO, 2004)[24], multiplied by factors to account for additional 'non-consumed' protein and for industrial protein discharged into the sewer system. Food (waste) that is not consumed may be washed down the drain (e.g., as result of the use of garbage disposals in some developed countries) and also, bath and laundry water can be expected to contribute to nitrogen loadings. For developed countries using garbage disposals, the default for non-consumed protein discharged to wastewater pathways is 1.4, while for developing countries this fraction is 1.1. Wastewater from industrial or commercial sources that is discharged into the sewer may contain protein (e.g., from grocery stores and butchers). The default for this fraction is 1.25.

Table 11: Steps need to the estimation of N_2O emissions from wastewater effluent and the activity data needed for the calculation

Step 1: estimate **nitrogen** in the effluent Data needed:	**Kg N/yr**
• Population	person
• Annual per capita protein consumption	Kg/person.yr
• Fraction of nitrogen in protein (default =0.16)	Kg N/kg protein
• Factor for non-consumed protein added to wastewater	
• Factor for industrial and commercial co-discharged protein into the sewer system	
• Nitrogen removed with sludge (default = zero)	Kg N/yr
Step 2: Estimate the ***N_2O emissions***, from wastewater effluent Data needed:	**kg N_2O/yr**
• Emission factor for N2O emissions from discharged wastewater (default value is 0.005)	kg N_2O-N/kg N

[24] FAO (2004). FAOSTAT Statistical Database, United Nations Food and Agriculture Organization. http://faostat.fao.org/ (for Egypt: http://www.fao.org/countries/55528/en/egy/)

The default IPCC emission factor for N_2O emissions from domestic wastewater nitrogen effluent is 0.005 (0.0005 - 0.25) kg N_2O-N/kg N. This emission factor is based on limited field data and on specific assumptions regarding the occurrence of nitrification and denitrification in rivers and in estuaries. The first assumption is that all nitrogen is discharged with the effluent. The second assumption is that N_2O production in rivers and estuaries is directly related to nitrification and denitrification and, thus, to the nitrogen that is discharged into the river.

9.6 GHG emissions associated to wastewater handling in the IWSP2 area

Considering the method suggested in the IPCC Guidelines (as schematized in the tables 10 and 12, respectively) it is obvious that important activity data that are necessary for a rough estimate are still not available:

To estimate the CH_4 emissions it is essential to have:

1) Information on the fraction of wastewater treated or disposed of by a particular system or the degree of utilization of treatment/discharge pathway or system: the emission factor for each system is related to the associated MCF (see Table 11), which determines the extent of CH_4 production in each particular wastewater treatment/discharge pathway.
2) Information about the volume and treatment/disposal of sludge derived from the biological wastewater treatment process.

To estimate the N_2O emissions it is necessary

1) To know the fraction of wastewater discharged into aquatic environments;
2) To know the quantity of nitrogen removed with the sludge; and
3) To evaluate the appropriateness of the proposed emission factors for the country.

The lack of the necessary area-specific information implies the use of many default factors and assumptions to calculate the GHG emissions associated to the wastewater handling. The resulting uncertainty of such estimates would be very high and somehow meaningless.

The CO_2 equivalent emission reductions potentials associated to the planned mitigation measures for the wastewater sector summarized in table 6, involve the fraction of wastewater that would be collected and sewerage to centralized treatment plants. This is actually a small fraction of the whole population in the 4 governorates, particularly for the rural population, where on-site sanitation (septic tanks and latrines) predominates.

Additional GHG emissions reduction potential is associated to IWSP measures to improve the on-site sanitation and to reduce the uncontrolled wastewater discharges into aquatic environments. A qualitative assessment of this potential reduction of GHG emissions can be made, taking into account the sources which are likely to produce CH_4 and/or N_2O and the associated CH_4 production potential (Tables 9 and 11), namely

- Correct operation of the existing aerobic treatment will reduce the CH_4 emissions to nearly null;

- Avoiding open and stagnant sewers which can turn anaerobic;
- Improve the operation of septic tanks and latrines to reduce CH_4 emissions; and
- Encourage appropriate on-site sanitation rather than uncontrolled discharge or also expensive transport of sewerage to centralized treatment plants.

10 CONCLUSIONS

Climate change could have significant adverse economic impacts in Egypt. The country is heavily dependent on the Nile River, which may decrease in flow. Egypt has a large amount of low-lying coastal lands that are highly populated and agriculturally productive. These lands are highly vulnerable to climate change-induced SLR. Agriculture is highly vulnerable since it is highly dependent on Nile water and is also susceptible to temperature increases.

A further and specific CCIA for the project target governorates should be carried out. This study should cover the specific climate issues with a proven scientific background. Such assessments would need to use the latest data, projections and forecasts and giving particular attention to the water sector and the IWSP 2 including its envisaged projects. With this additional information about climate change effects and their predicted range in the target governorates, a revised or adapted programme can react on this and adjust the measures. It is recommended to appoint a national or regional institute with proven expertise and capacities, for example the NWRC, to undertake such assessments.

ANNEX 4

HSE Documents

Project Name:_____
Contract ref.#:_____

CHECKLIST SAFETY

(for regular use by the SvC during the construction works)

Monitoring Period From /: _____ To /: _____
Location:

_____

Section (precise place e.g. between intersections, house number other landmarks):

_____

Contractor's full contact details:

_____

Safety Measures /	Check result				إجراءات السلامة
	Y	N	NN	DK	
1 - SITE ACCESS					**1- الوصول إلى الموقع**
Clean, level ground	☐	☐	☐	☐	الأرض نظيفة ومستوية
Adequate ramps	☐	☐	☐	☐	ممرات كافية
Adequate stairs	☐	☐	☐	☐	درج كافي
Adequate ladders	☐	☐	☐	☐	سلالم كافية
2 - PERSONAL PROTECTIVE EQUIPMENT (Needed at this worksite?)	☐	☐	☐	☐	**2- أجهزة الوقاية الشخصية (مطلوبة بالموقع؟)**
Hard hats worn	☐	☐	☐	☐	إرتداء الخوذة
Foot protection worn (safety boots / rubber boots)	☐	☐	☐	☐	حماية القدم (حذاء الأمان / حذاء المطاط)
Skin protection worn	☐	☐	☐	☐	حماية الجلد
Eyes & face protection worn	☐	☐	☐	☐	حماية الوجه والعينين
Hearing protection worn	☐	☐	☐	☐	حماية الأذنين
Respiratory protection worn	☐	☐	☐	☐	حماية الجهاز التنفسي
3 – GUARDRAILS, BARRICADES	☐	☐	☐	☐	**3- الحواجز الواقية**
Located where required	☐	☐	☐	☐	موجودة بالأماكن التي تتطلب ذلك
Properly constructed & secured	☐	☐	☐	☐	الانشاء بشكل صحيح آمنة
4 – LADDERS (Are present for this worksite?)	☐	☐	☐	☐	**4- السلالم (هل توجد سلالم بالموقع)**
Proper size & type	☐	☐	☐	☐	نوع وحجم مناسب
Safe, firm foundation for ladder feet	☐	☐	☐	☐	آمن ومثبت جيداً
Workers stand below two top steps	☐	☐	☐	☐	لا يقف العمال على آخر سلمتين
Extend more that 90cm over the support	☐	☐	☐	☐	تطويل أكثر من 90 سم بعد التدعيم
Proper handrail & landings	☐	☐	☐	☐	وجود درابزين والنزول آمن
Non-slip basis	☐	☐	☐	☐	اسطح مانعة للانزلاق
5 – SCAFFOLDS: (Are present at this worksite?)	☐	☐	☐	☐	**5- السقالة (هل توجد بالموقع؟)**
Fall protection used if over 2.5m height	☐	☐	☐	☐	الحماية من السقوط إذا زاد الارتفاع عن 2.5 م
Properly secured & planked	☐	☐	☐	☐	مؤمنة بصورة صحيحة مثبته بشكل صحيح
Proper guardrails	☐	☐	☐	☐	حواجز حماية
Proper access to platforms	☐	☐	☐	☐	الوصول الآمن للرصيف
6 – FALL PROTECTION: (Needed at this worksite?)					6- **الحماية من السقوط (هل مطلوبة بالموقع؟)**
Fall protection provided for heights 1.8m or more	☐	☐	☐	☐	توفر الحماية من السقوط لارتفاع 1.8 متر أو أكثر
Safety harness is worn properly and attached to secure anchor	☐	☐	☐	☐	ارتداء حزام الأمان وتثبيته بشكل صحيح
Slide guards are installed across full width and all sides	☐	☐	☐	☐	تثبيت جوانب الحماية بالعرض وبكافة الجوانب
Uprotected openings and edges	☐	☐	☐	☐	الفتحات والجوانب الغير محمية
Working from: Ladders	☐	☐	☐	☐	العمل من: السلالم

Safety Measures /	Check result				إجراءات السلامة
	Y	N	NN	DK	
Scafolds	☐	☐	☐	☐	السقالات
Swingstages	☐	☐	☐	☐	السلالم المتحركة
7 – MACHINE HAZZARDS: (Are power tools and machines used on this site?)	☐	☐	☐	☐	**7- مخاطر الآلات (هل تستخدم الآلات والمعدات بالموقع؟)**
Workers are trained on the use of power tools	☐	☐	☐	☐	العمال مدربين على استخدام الأدوات الكهربائية
Workers have appropriate PPE	☐	☐	☐	☐	لدى العمال مهام الوقاية الشخصية
Workers are trained prior to use of nail guns	☐	☐	☐	☐	العمال مدربين على استخدام مسدس المسامير
8 – HEAT STREESS: (Is it a major problem on this site?)	☐	☐	☐	☐	**8- الاجهاد الحراري: (هل يمثل مشكلة كبيرة بالموقع؟)**
Have workers been trained on preventing & recognizing heat-related illness?	☐	☐	☐	☐	هل العمال مدربين على منع والتعرف على الأمراض المرتبطة بالحرارة؟
Are workers provided with enough water & appropriate rest breaks?	☐	☐	☐	☐	هل يوجد مع العمال الماء الكافي ويحصلون على استراحات كافية
9 – ELECTRICAL HAZZARD: Are present on worksite?	☐	☐	☐	☐	**9- المخاطر الكهربائية: (هل توجد بالموقع)**
Work on electrical circuits or energized equipment is begun only after all power sources have been identified, de-energized and locked out	☐	☐	☐	☐	لا يبدأ العمل في الدوائر الكهربائية أو المعدات التي التي تعمل إلا بعد تحديد جميع مصادر الطاقة وتفريغ الشحنة وإغلاقها
Overhead & underground electrical power lines are located, identified & avoided	☐	☐	☐	☐	توقيع وتحديد وتجنب خطوط الكهرباء فوق الأرض وتحتها
Ladders, scafolds, eqipment & materials more that 3m from any electrical power lines	☐	☐	☐	☐	وضع السلالم والسقالات والمعدات والخامات على بعد 3 م من خطوط الكهرباء
10 – EXCAVATIONS: Are present of this worksite?	☐	☐	☐	☐	**10- الحفر: (هل توجد حفر بالموقع)**
Soil & conditions are inspected on daily basis	☐	☐	☐	☐	فحص حالة التربة بشكل يومي
Safe exits (ladders) for excavations > than 1.2m	☐	☐	☐	☐	مخرج آمن (سلالم) للحفر على عمق اكثر من 1.2 م
Shoring, shielding & inclination assessed for excavations deeper that 1.5m	☐	☐	☐	☐	سند جوانب الحفر للاعماق التي تتعدى 1.5 م
11 – WELDING:	☐	☐	☐	☐	**11- اللحام**
Rods & cylinders properly labeled	☐	☐	☐	☐	وضع العلامات على القضبان والاسطوانات بشكل صحيح
Properly secured ground cables	☐	☐	☐	☐	حماية الكابلات الأرضية
Proper eye protection worn	☐	☐	☐	☐	ارتداء الأقنعة الواقية للعيون
Gas cylinders upright (valve-up) and secured	☐	☐	☐	☐	وضع أسطوانات الغاز مستقيمة (المحبس لأعلى) وآمنة
Fire extinguisher readily available	☐	☐	☐	☐	وجود طفايات الحريق
12 – TEMPORARY POWER SUPPLY:	☐	☐	☐	☐	**12- إمدادات الطاقة المؤقته:**
Properly identified	☐	☐	☐	☐	تحدد بصورة واضحة
Overhead lines flagged & secured	☐	☐	☐	☐	يوجد علامة على الخطو العلوية وآمنه
Surface cables burried or protected	☐	☐	☐	☐	دفن الكابلات السطحية أو حمايتها
13 – WORKER EDUCATION:	☐	☐	☐	☐	**13- مستوى تعليم العاملين**
WHIMS training	☐	☐	☐	☐	تدريب WHIMS
Company safety policy & program	☐	☐	☐	☐	سياسة وبرنامج السلامة بالشركة
Injury reporting	☐	☐	☐	☐	تقارير الحوادث
Hazzard reporting	☐	☐	☐	☐	تقارير المخاطر
OH&S Act & Regulations	☐	☐	☐	☐	قانون ولوائح السلامة والصحة المهنية
Personal H&S responsibilities	☐	☐	☐	☐	مسئوليات السلامة والصحة المهنية الشخصية
14 – FIRST AID REQUIREMENTS:	☐	☐	☐	☐	**14- متطلبات الإسعافات الأولية:**
Adequate qualified first aid workers on site	☐	☐	☐	☐	وجود عدد كاف من المسعفين بالموقع
First aid kits: Addequate number	☐	☐	☐	☐	شنط الإسعافات الأولية عدد كاف
Adequate contents	☐	☐	☐	☐	محتويات كافية

Safety Measures /	Check result				إجراءات السلامة
	Y	N	NN	DK	
15 – SIGNS & WARNING MATERIAL:	☐	☐	☐	☐	**15- العلامات ومواد التحذير:**
Warning signs	☐	☐	☐	☐	العلامات التحذيرية
Emergency phone list	☐	☐	☐	☐	قائمة تليفونات الطوارئ
Report forms	☐	☐	☐	☐	نماذج التقارير
16 – MATERIALS STORAGE:	☐	☐	☐	☐	**16- تخزين الخامات**
Properly located	☐	☐	☐	☐	مخزنة بشكل صحيح
Safely piled,stacked, bundled	☐	☐	☐	☐	مجمعة بشكل آمن
Properly moved or lifted	☐	☐	☐	☐	تنقل أو تحرك بشكل صحيح
17 – CONFINED SPACES:	☐	☐	☐	☐	**17- الأماكن الضيقة:**
Proper access	☐	☐	☐	☐	الوصول بصورة آمنة
Air testing before entry	☐	☐	☐	☐	اختبار الهواء قبل الدخول
Rescue equipment readily available	☐	☐	☐	☐	توفر أجهزة الانقاذ
Safety harness, lifeline properly anchored	☐	☐	☐	☐	حزام الأمان مثبت بشكل آمن
Second person for rescue	☐	☐	☐	☐	شخص آخر للانقاذ
Other /	☐	☐	☐	☐	أخرى

NOTE: Y = YES, Observed & in compliance / NN = NOT NEEDED, Not present on jobsite /
N = NO, Observed & not in compliance / DK = DON'T KNOW /

Conclusion:	YES	NO
HSE situation on Site satisfies safe work condition requirements;	☐	☐
Actions taken:		
Safety Improvement Notice (SIN), issued to the Contractor for improvement of performance to comply with relevant Project's HSE requirements (Works can continue);	☐	☐
Safety Violation Report (SVR), issued to the Contractor for immediate corrective actions prior of continuation of Works	☐	☐

Remedial actions taken in previous Checklist:	Open	Closed
Safety Improvement Notice (SIN) (ref.# ; dated:	☐	☐
Safety Violation Report (SVR) (ref.# ; dated:	☐	☐

Attachments:
- Issued associated SIN, SVR with supporting photo-documentation

Date: _____ Contractor's HSE Engineer's name + signature: _____

The Contractor confirms with his signature that the above check results are correct.

Date: _____ SvC's HSE Engineer's name + signature: _____

Project Name:_____

Contract ref.#:_____

IMMEDIATE INCIDENT REPORT #_____
(for the regular use during construction works)

Issued on / date: _____

Responsible Contractor: _____

SVR Issued by Supervision Consultant:: _____

Concerned Location: _____

IMMEDIATE INCIDENT NOTIFICATION					
1. Incident Details					
Project Company		**Date of incident**			
		Time of Incident			
Location of incident		**Type of Incident**	**Environmental**	☐	
			Injury	*Workforce*	☐
				Public/Local community	☐
			Social incident (e.g. violent labor unrest)	☐	

2. WHAT HAPPENED
Brief description of incident

3. INJURED WORKERS						
Employee / Contractor	**Sex**	**Age**	**Job Title / Description**	**Time with company**	**Cause**	**Injury Type (Major / Fatal)**

4. INJURED MEMBERS OF PUBLIC						
Name	**Sex**	**Age**	**Community**	**Place of Residence**	**Cause**	**Injury Type (Major / Fatal)**

5. ENVIRONMENTAL INCIDENT			
Type (Spill / Gas Release)	**Total Loss (Litres /KGs)**	**Cause**	**Damage**

6. WITNESSES TO INCIDENT			
Name	**Sex**	**Place of Residence**	**Description of incident**

7. OTHER RELEVANT INFORMATION						
Have the authorities been informed?	**Yes**	☐	**No**	☐	**What has been done about the incident?**	
Please provide further information here						
Media attention?	**Yes**	☐	**No**	☐		
Please provide further information here						
Any effects off-site?	**Yes**	☐	**No**	☐		
Please provide further information here						
Photographs taken? (please include them in this report)	**Yes**	☐	**No**	☐		
Name of person completing form						
Position						
Contact details	**Phone**				**Email**	

- *Supporting photographs attached to Immediate Incident Report*

Location	**Description**	**Location**	**Description**

Location	**Description**	**Location**	**Description**

Location	**Description**	**Location**	**Description**

Project Name: اسم المشروع:
Contract ref.#: رقم العقد:

SAFETY IMPROVEMENT NOTICE (SIN)#
(for the regular use during construction works)

إخطار تحسين إجراءات الأمان
(للاستخدام الدوري أثناء أعمال الإنشاء)

Issued on: **تاريخ الإصدار:**

Responsible Contractor: المقاول المسئول

SIN Issued by Supervision Consultant: إخطار تحسين إجراءات الأمان الصادر عن استشاري الاشراف على التنفيذ

Concerned Location: الموقع :

Recorded Status:	تسجيل الموقف الحالي
Improvements Required:	التحسينات المطلوبة

Agreed Completion Date:	تاريخ نهو الأعمال المتفق عليه	_____.____.____ (day) (month) (year)

Agreed Parties' Signatures:	توقيع الأطراف

Contractor's HSE Officer: مسئول السلامة والصحة المهنية للمقاول	Supervision Consultant's HSE Engineer: مهندس السلامة والصحة المهنية للاستشاري
Contractor's Team Leader: قائد فريق عمل المقاول:	Supervision Consultant's Team Leader: قائد فريق عمل استشاري الاشراف على التنفيذ:

Acceptability of Remedial Actions: قبول الاجراء التصحيحي:

SAFETY IMPROVEMENTS REQUIRED UNDER THIS SAFETY IMPROVEMENT NOTICE HAVE BEEN EXECUTED AND ACCEPTABLE!

قبول إجراءات السلامة التصحيحية المنفذه الواردة بالاخطار

Signatures of responsible parties: توقيع الأطراف المسئولة

Responsible Contractor's Team Leader: قائد فريق عمل المقاول المسئول:	Responsible Supervision Consultant's Team Leader: قائد فريق عمل استشاري الاشراف على التنفيذ المسئول
Date: التاريخ	Date: التاريخ

- *Supporting photographs attached to Safety Improvement Notice*

Location:	Description	Location	Description

Location	Description	Location	Description

Location	Description	Location	Description

Project Name: **اسم المشروع:**
Contract ref.#: **رقم العقد:**

SAFETY VIOLATION REPORT (SVR)#
(for the regular use during construction works)

إخطار عدم تطبيق إجراءات الأمان
(للاستخدام الدوري أثناء أعمال الإنشاء)

Issued on: **تاريخ الإصدار:**

Responsible Contractor: **المقاول المسئول:**

SVR Issued by Supervision Consultant: **تقرير عدم الالتزام بمعايير السلامة الصادر عن استشاري الاشراف على التنفيذ:**

Concerned Location: **الموقع:**

Description of Safety Violation Observed:	وصف الاعمال الغير مطابقة التي تم ملاحظتها

Response due Date:	**التاريخ المحدد للرد:**	_____.____.____ (day) (month) (year)

Originator:		**Approved by:**	
Supervision Consultant's HSE Engineer: مهندس السلامة والصحة المهنية للاستشاري		Supervision Consultant's Team Leader: قائد فريق عمل استشاري الاشراف على التنفيذ	
Discussed & acknowledged by the Contractor:		تم إخطار ومناقشة الامر مع المقاول	
Name: الاسم	Position: الوظيفة	Signature: التوقيع	Date: التاريخ

Corrective Actions Taken: الإجراءات التصحيحية المتخذه

Approval of the Contractor's HSE Officer: اعتماد مسئول السلامة والصحة المهنية طرف المقاول	**Expected Completion Date:** تاريخ نهو الأعمال المتوقع
_____ **(signature)**	_____.____.____

Evaluation of Corrective Actions taken: تقييم الاجراء التصحيحي الذي تم اتخاذه	**Accepted** مقبول	**Rejected** مرفوض
	☐	☐

Reason for rejection (if applicable): أسباب الرفض إذا كان مطبقاً

Evaluation by / date: _____.____.____

Verification that stated Safety Violation has been satisfactorily resolved:
التأكد من حل مخالفة إجراءات السلامة بشكل صحيح

Responsible Contractor's Team Leader: قائد فريق عمل المقاول المسئول:	**Supervision Consultant's Team leader:** قائد فريق عمل استشاري الاشراف على التنفيذ:
_____ *(signature)* _____.____.____	_____ *(signature)* _____.____.____

- *Supporting photographs attached to Safety Improvement Notice*

Location	**Description**	**Location**	**Description**

Location	Description	Location	Description

Location	Description	Location	Description

Project Name:_____
Contract ref.#:_____

CHECKLIST SAFETY

(for the regular use during construction works)

Monitoring Period From /: _____ To /: _____

Location (e.g. street name): _____

Section (precise place e.g. between intersections, house number other landmarks): _____

Safety Measures /	Check result				إجراءات السلامة
	1	2	3	4	
Provision of safety and emergency regulations for fire, gas and electric shock /	☐	☐	☐	☐	توفير أنظمة السلامة والطوارئ للحريق والغازات والصدمات الكهربائية
Street warning signs for construction works placed	☐	☐	☐	☐	وضع علامات تحذيرية بالشارع لأعمال الانشاء
Working area protection placed (barriers, fences, warning tapes)	☐	☐	☐	☐	تأمين منطقة العمل (الحواجز- الأسوار- أشرطة التحذير)
Safety helmets, vests and safety shoes for all staff in the site /	☐	☐	☐	☐	وجود خوذ السلامة والسترات الواقية وأحذية السلامة لجميع العاملين في الموقع
Protection of existing buildings (foundations) against excavation damage	☐	☐	☐	☐	حماية المباني القائمة (الأساسات) ضد أضرار الحفر
Trench exacavation protective measures applied	☐	☐	☐	☐	تطبيق إجراءات تأمين حفر الخنادق
Fencing and barriers at open excavation	☐	☐	☐	☐	وضع الحواجز والاسوار على الحفر المفتوح
Excavated trench sides supported from collapsing	☐	☐	☐	☐	دعم جوانب الحفر من الانهيار
Temporary pedestrian bridges over trenches	☐	☐	☐	☐	جسور مؤقته للمشاه أعلى الخنادق المحفورة
Prevention of workers to enter unsupported trench	☐	☐	☐	☐	منع العاملين من النزول داخل الخنادق الغير مدعومة الجوانب
Provision and maintenance of sufficient lighting equipment	☐	☐	☐	☐	وجود الإضاءة الكافية وصيانتها
Provision and maintenance of safe, sound ropes, slings, pulleys and other lifting equipment	☐	☐	☐	☐	توفير وصيانة حبال الأمان، الرافعات والبكرات وغيرها من معدات الرفع
Provision and maintenance of safe, sound mechanical frames, hoists, and vehicles /	☐	☐	☐	☐	توفير وصيانة إطارات ميكانيكية آمنة وسليمة ورافعات وسيارات/
Safe access to the Works /	☐	☐	☐	☐	الدخول الآمن لمنطقة العمل
Noise and vibration protection /	☐	☐	☐	☐	الحماية من الضوضاء
Reinstated street after backfilling presents no danger for public	☐	☐	☐	☐	إعادة الشرارع لوضعه الأصلي بعد انتهاء الحفر حتى لا يتعرض الجمهور للخطر
First aid kit present on site /	☐	☐	☐	☐	وجود مهمات الإسعافات الأولية بالموقع
Provision of transport facility at any time for serious cases (accidents) to hospital /	☐	☐	☐	☐	توفير وسيلة مواصلات في أي وقت لنقل للحالات الحرجة (الحوادث) الى المستشفى
Cleanliness of the site /	☐	☐	☐	☐	نظافة الموقع
Provision of drinking water /	☐	☐	☐	☐	توفير مياه الشرب
Other /	☐	☐	☐	☐	أخرى

NOTE: **1 = not implemented** / **2 = partially implemented** /
3 = adequately implemented / **4 = well implemented** /

Conclusion:	YES	NO
HSE situation on Site satisfies safe work condition requirements;	☐	☐
Actions taken:		
Safety Improvement Notice (SIN), issued to the Contractor for improvement of performance to comply with relevant Project's HSE requirements (Works can continue);	☐	☐
Safety Violation Report (SVR), issued to the Contractor for immediate corrective actions prior of continuation of Works	☐	☐

Remedial actions taken in previous Checklist:	Open	Closed
Safety Improvement Notice (SIN) (ref.# ; dated:	☐	☐
Safety Violation Report (SVR) (ref.# ; dated:	☐	☐

Attachments:

- Issued associated SIN, SVR with supporting photo-documentation

Date: _____ Contractor's HSE Engineer's name + signature: _____

The Contractor confirms with his signature that the above check results are correct.

Date: _____ SvC's HSE Engineer's name + signature: _____