Capstone Final Report

“Environmental and Social Impact Assessment of Youssoufia Wastewater Treatment Plant”

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Made by:

Lamssali Mehdi

Supervised by:

Dr. AlBachir Seydou Niandou
Environmental Impact Assessment of Youssoufia’s Wastewater Treatment Plant
EGR 4402
Lamssali Mehdi

Abstract

Water Treatment and Green energy are part of the strategy of Morocco to become a leading country in sustainability and energy independency. This capstone project enables to establish an environmental and Social Impact Assessment for the implementation of a Waste Water Treatment plant nearby the City of Youssoufia. In order to achieve this objective, this study will allow to specifically detect the major negative as well as positive environmental and socio-economic for this given activity during both the construction and operational phase of the project. In addition to that, this study will predict the various environmental mitigation measures that should be implemented in order to reduce the risks and enhance the positive impacts. On the other hand, this study will also allow to design and simulate specific WWTP processes using multiple operational parameters that will enable a proper implementation of the WWTP as a sustainable project. Finally, this study has a critical impact on both the environmental and societal aspect in a way that it enhances the willingness of Morocco to respect its choice as a sustainable development country but is also part of the National Policy for Environmental Management.

Keywords: Environmental Impact Assessment, Mitigation measures, Sustainability, Wastewater Treatment

Approved by the Supervisor

Dr. AlBachir Seydou Niandou
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1 Introduction

The continuous degradation and appalling of the environment has now raised the international awareness who is now looking to the issue of development that will satisfy the needs of future generations without compromising the interests of the current population.

The sustainable development is an important choice that Morocco has subscribed to as for the international community. It is a choice at the national level that will enable a more sustainable country by not only the rationalization of resource management but also for the continuous enhancement of the life quality of the population in Morocco.

Furthermore, the problems related to the environment are multiple and are constantly evolving at the national level. For instance: Air in the cities is more and more polluted, water is becoming a scarce resource requiring a more advanced management, multiple forests are destroyed and species disappear, ecological catastrophes are growing in amplitude. All these examples require from Morocco to implement new sustainable projects that will protect the country in the future in terms of energy and environment protect.

It is in this context that the following capstone project aims in assessing the environmental and social impacts for the project of the implementation of the Youssoufia Wastewater treatment plant.

2 STEEPLE ANALYSIS

2.1 Technological

The implementation of the Youssoufia wastewater treatment plant will require new technologies for wastewater treatment, reuse of treated water, sludge distribution as fertilizer, production of electricity through biogas generation. Furthermore, the filtered water using an advanced sludge system will enable the agricultural plains nearby the study zone to be irrigated and thus positively contribute to the sustainability enhancement of the region.

2.2 Economic

During the last years, Morocco has set itself to become one of the leaders of green and sustainable energy at the North African scale. This project will allow to significantly reduce the electricity expenses
for the Youssoufia’s WWTP and thus help the country move toward its objective of energy independence. Technically speaking, this will allow in reduction of fossil importations and an economic improvement of the city of Youssoufia by offering more job opportunities to the population.

2.3 Ethical

Ethically speaking, the wastewater treatment plant implementation will allow a more sustainable city and positively contribute to the environment, contrary to other projects that increase the pollution and harm the environment.

2.4 Social

The implementation of a wastewater treatment plant nearby the city of Youssoufia will allow enhance the social character of the region by enabling the population to acquire new job opportunities as well as it will contribute improving the sanitary situation within the region.

2.5 Legal and Political

This project is within the legal and institutional framework of the environmental impact assessment laws. It is indeed, framed by multiple acts which dictate the obligations and procedure to be met during the construction and operational phase of the Youssoufia Wastewater treatment plant.

2.6 Environmental

The main purpose of this project is to reduce the sanitation problems in the region of Youssoufia while at the same time positively contributing to the protection of the environment. By establishing a sludge treatment process and irrigating new clean water, the WWTP will significantly reduce the environmental pollution that is present in the region and thus enable the administrative region to be a more sustainable and environmental friendly country.
3 Methodology of Approach

3.1 Concept of Impact

The proposed Methodology for identifying and assessing the impacts, identification of mitigation measures and residual impacts is based on the Environmental Assessment Method used by the National Office of Electricity and Potable Water (NOEP) for power projects in water and sanitation.

An environmental impact can be defined as the effect of human activity on an environmental component (physical, biological and human environments) on a defined space and for a given time.

The concept of impact has two principal dimensions: the extent and the importance

- The extent of the impact: The impact can be punctual (At the level of the site), local (at the level of the receiving environment) or regional if the impacts are felt at distances to the limit of the study zone.
- The importance of the impact: It is obtained with the help of different indicators such as sensitivity, intensity and extent. The relative importance is obtained by combining the importance of the impact with its duration

We can also distinguish the potential impacts in regards to the real impacts:

- Real Impact : Impact on the environment validated in the framework of the environmental follow-up
- Potential Impact: Impact estimated based on the nature and the scope of the project based on the knowledge and the value assigned to a specific component within the project

The assessment of environmental impacts allows to identify the early changes in the environment due to the planned realization of the project. The impacts are related to the implementation and operation of the equipment (pre-construction, construction, exploitation and maintenance.)

3.2 Identification and Impact Assessment

The identification of sources of impact must be made to project from the design phase to the operational phase also including the construction phase.

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1 National Environmental Policy Act : Council on Environment Quality (CEQ) Regulations
Different methods can be used to carry out environmental impact assessments. These methods are based on an objective multidisciplinary scientific approach. The method used in this study is that of matrices that can cross-link different elements of the environment with the different sources of impact and thus determine their cause to effect links.

The impacts are positive or negative, direct or indirect, temporary or permanent. There is also the inevitable or irreversible impacts.

Moreover, the matrix method allows a synthetic reading of impacts. The impact assessment is based on multiple criteria such as the sensitivity, intensity scope as well as the duration of the impacts.  

3.2.1 Intensity

The intensity refers to the extent of an impact. It matches any negative effects that could affect the integrity, performance, or use of an element. There are three levels of intensity: Strong, medium or Poor.

- Strong Intensity: The impact destroys the element, calls into question his integrity, reduces its quality and significantly restricts its use;
- Medium Intensity: The impact modifies the element without the element without calling into question its integrity. However, the impact reduces the quality of the element and thus restricts its use.
- Poor Intensity: The impact slightly modifies the element and not change its quality.

The intensity may in some cases be assessed depending on the implementation mode used on the area occupied by the element.

3.2.2 Sensitivity

The ranking of the elements of the natural and human environments as well as the landscape aims to determine the sensitivity of the environment to the implementation of the proposed facilities. The sensitivity of an element thus expresses the opposition that presents the implementation of the WTP in the study zone.

\[\text{References}\]

2 National Environmental Policy Act: Council on Environment Quality (CEQ) Regulations
3 National Environmental Policy Act: Council on Environment Quality (CEQ) Regulations
This analysis allows to bring out, on one hand, the areas that are preferably to be avoided and on 
the other hand, to determine the areas that are more appropriate to the installation of equipment.

The sensitivity attributed to an element is based on two criteria: the level of the apprehended impact 
which the project is exposed and also the value of the element. The apprehended impact is the characteristic 
of an element to be disrupted or be the source of technical difficulties at the time of its implementation. The 
impact is evaluated based of the information related to the characteristic of this element. We can distinguish 
three impact levels: Strong, Medium and Poor.

The value of an element depends on its intrinsic value, its scarcity, its importance and its location in 
the environment. It also takes account the legal framework. We can distinguish four essential levels:

- Legal Value: The element is protected by a law which prohibits or strictly controls the 
implementation of the works or when it’s extremely difficult to obtain governmental authorizations 
to perform this implementation;
- Strong Value: The element presents outstanding characteristics and features that are conserved or 
protected by a consensus;
- Medium Value: The element has properties whose preservation or protection are a major concern 
without being a general consensus;
- Poor Value: The conservation or protection of an element is subject to poor preoccupation.

3.2.3 The Scope

The scope of the impact corresponds to the spacial radiation the impact has on the study area. It is 
assessed according to the proportion of the population exposed to undergo this impact. We can distinguish 
four levels of impacts:

- National Scope: The impact is felt all over the national territory by both the population and the 
various other environmental factors;
- Regional Scope: The impact will be noticeable by the people of an entire region;
- Local Scope: The impact will be felt by the population of a locality or a portion of this population;
- Point Scope: The impact will not be felt only sporadically and affects only a small group of 
individuals.

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4 National Environmental Policy Act : Council on Environment Quality (CEQ) Regulations
5 National Environmental Policy Act : Council on Environment Quality (CEQ) Regulations
3.2.4 *The Importance of the Impact*

The matrix presented in the study allows to determine the importance of the impact. This factor is an essential criteria which allows to assess a partial judgement impact, which means before the duration would be taken into account. We can distinguish four categories\(^6\):

- **Unacceptable Importance**: The impact causes the apprehended repercussions to not be accepted due to absolute sensitivity
- **Major Importance**: The impact engenders strong repercussions on the environment
- **Medium Importance**: The impact engenders acceptable repercussion on the environment
- **Poor Importance**: The impact engenders reduces repercussions on the environment.

3.3 **Assessment of the relative importance of the impact**

The relative importance of an environmental impact is based on the relation between the importance of the impact and its duration.

3.3.1 *The duration*

The importance of the impact is determined by integrating the duration which is the period in which the impact is felt.

It is important to make a distinction between the duration of the impact and the source of the impact. For example, construction works of few months can cause effects that will be felt over many years. Consequently, a major impact of long duration will be more important for the project rather than an impact of slow duration. We can distinguish three durations\(^7\):

**Long duration**: The impact is felt in a continuous way during the whole project time.

**Medium duration**: The impact is felt in a continuous fashion for a duration inferior to the duration of the project time

**Short Duration**: The impact is felt in a moment and for a short duration.

\(^6\) National Environmental Policy Act : Council on Environment Quality (CEQ) Regulations
\(^7\) National Environmental Policy Act : Council on Environment Quality (CEQ) Regulations
3.3.2 The relative importance of the impact

The matrix presented in this study allows to determine the relative importance of the impact. Indeed, this matrix allows to assess a global judgment on the impacts by comparing them with each other based on their duration.

4 Legal and Institutional Framework:

4.1 Introduction:

It is absolutely necessary to present an overview of the legal and institutional framework of the project that covers the different aspects and domains of the environment susceptible to be concerned with the project for the implementation of the Youssoufia Wastewater treatment plant. This chapter analyses in a detailed manner the main dispositions, orientations and base rules of the national policy that is concerned with the field of protection and enhancement of the environment.

The legal Moroccan framework is characterized by an important number of acts that were established since 1914. Indeed, these acts are mainly focused in general on the protection of the private properties as well as the state of the environment. These acts must be analyzed in order to set the study within a legal framework that will enable the reduction or even the elimination of the negative impact on the project. Consequently, this chapter will present the different acts, laws and decrees the will enable the regulation of the project.

Thus, this chapter’s main objective is to present and define the legal and institutional support compliant with the environmental protection and sustainable development requirements. This synergy will ensure the coherence of the environmental acts and their adaptation to the national policy.

4.2 The legal Framework:

4.2.1 Act 11-03 on the protection and the enhancement of the environment:

The ACT No. 11-03 on the protection and enhancement of the environment, promulgated by Dahir No. 1-03-59 of 10 Rabii I 1424 (12 May 2003), defines the principles and guidelines of the environmental legal strategy for Morocco. This act addresses the need for a comprehensive and integrated approach to ensure the best possible balance between the need to preserve the environment and the needs of economic
and social development of the country. It aims to make all legislation affecting the environment legally coherent. In addition, this text is intended to provide a framework laying down the basic principles on which future texts on the protection of the environment should be developed.

4.2.2 Act 12-03 related to environmental impact studies and its decrees:

Act No. 12-03 related to environmental impact studies, promulgated by Dahir No. 1-03-60 of 10 Rabii I 1424 (12 May 2003), establishes the list of projects subject to an environmental impact study, implementation procedure and the consistency of the deliverables facing the committee reviewing the study. This act also establishes the creation of a committee for the investigation of environmental impact studies chaired by the Minister for the Environment to decide on their environmental acceptability.

The text of the 12-03 act also has a number of definitions related to the environment such as "impact study", "the petitioner" and "the environmental acceptability of a project submitted for consideration impact on the environment." Furthermore, It also evaluates in a methodical and preliminary manner, the potential impact of activities, works, facilities and structures on the environment in order to eliminate, mitigate or compensate for adverse impacts, while also aiming to develop and improve their positive impacts on the environment, especially in order to inform the population concerned about the negative impacts of the project on the environment.

Moreover, The rubrics that must include within the environmental impact study should focus on a detailed description of the project activities, works, facilities and structures, also an analysis of the initial state of the site and its environment an assessment of the foreseeable consequences, direct and indirect activities, works, facilities and structures on the environment and the measures envisaged by the petitioner to eliminate, mitigate or compensate for adverse impacts on the environment. An environmental and social management plan which describes the measures that must be undertaken in term of formation, communication and management in order to ensure the proper execution and exploitation of the project or study with respect to the technical and environmental requirements adopted by the study must be carried out.

On the other hand, two decrees implementing this law were published in the official bulletin namely:

Decree No. 2-04-563 of 5 Kaada 1429 (4 November 2008) on the powers and functioning of the committees:

- The national committee is responsible for deciding on projects of international scope or have a higher investment cost 200 Mdhs or when the project geographically overlaps between two economic regions;
Regional committees in turn are responsible for deciding on projects with investment cost is less than or equal to 200 Mdhs.

Decree No. 2-04-564 of 5 Kaada 1429 (4 November 2008) laying down the modalities of organization and conduct of the public inquiry into the project subject to the environmental impact studies.

4.2.3 Act 10-95 of water and its application texts:

Act No. 10-95 on water as amended and supplemented by Law No. 19-98, provide for legal provisions for rationalizing the use of water, water resources and protection of the environment, widespread access to water, the definition of public water resources, inter-regional solidarity, reducing disparities between city and countryside in order to ensure the water security across the country.

On the other hand, one aspect of the law is the water resource management in the context of a unit geographic, hydraulic basin to design and implement a decentralized water management.

Among the dispositions in relation to sanitation and wastewater treatment:

- Public ownership of water resources, including treated wastewater
- The regulation of the use of treated wastewater

This Act introduces many measures to protect water resources from pollution from solid waste from domestic or industrial origin. It prohibits the deposit or burying of solid waste in the constituent parts of the public water.

Any use of treated waste water is subject to the authorization of the basin agency.

4.2.4 Order No. 1607-06 setting the specific limits of domestic waste

The specific discharge limits specified in Article 12 of Decree No. 2-04-553 of 13 hija 1425 (24 January 2005) relating to spills, runoff, discharges, direct or indirect deposits in surface water or groundwater, applicable discharges of wastewater from urban areas, are presented in the following table:

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Specific Limit Values for Domestic Release</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOD5 mg O2/L (Biochemical oxygen demand for five (5) days)</td>
<td>120</td>
</tr>
<tr>
<td>COD mg O2/L (Chemical Oxygen Demand)</td>
<td>250</td>
</tr>
<tr>
<td>Suspended matter</td>
<td>150</td>
</tr>
</tbody>
</table>

Table 1: Limit Values for Domestic Release
4.2.5 Decree No. 2-04-553 of 13 Hijja 1425 (24 January 2005) concerning with the spill of sewage and its joint orders.

This decree is about spills, discharges and direct or indirect discharges deposits in surface water or groundwater.

This decree opens the way for the effective implementation of existing procedures for reporting releases and subsequent payment of the fee. The fees are collected by the basin agency with the Manager of the sanitation service or the author of the direct release into the natural environment.

The implementation of the Decree induces the need to:

- Request a discharge permit to the Basin Agency
- Respect the domestic discharge limits fixed by the order NO. 1607-06

4.2.6 Act No. 13-03 on the fight against air pollution

This law, enacted by Dahir No. 1-03-61 of 10 Rabii I 1424 (12 May 2003), aims to prevent, reduce and limit emissions of air pollutants that could harm the health of humans in particular and the environment in general. It defines the means to fight against air pollution, the sanctions procedures in case of damage or serious pollution and incentives for investment in the air pollution prevention projects.

Chapter II of the Act, Article 2 states that the law applies to any person or entity, public or private, that owns or possesses or uses or exploits buildings of mining, industrial, commercial, agricultural or artisanal type.

On the other hand, Chapter III of the Act, Article 4 states that "it is forbidden to release, to issue or refuse to allow the release, emission or discharge into the air of pollutants such as gas toxic or corrosive fumes, vapors, heat, dust, odors beyond the quality or concentration permitted by the standards established by the regulation."

This article also provides that "in the absence of standards laid down by regulation, operators of the installations provided for in Article 2 are required to apply the most advanced techniques available to prevent or reduce emissions."
4.2.7 Act No. 78-00 on the communal charter

The communal charter, published in the Official Bulletin No. 5058 dated 21/11/2002, enables local authorities the solid and liquid sanitation management. The 78-00 act on the communal charter is about allowing the Town council to aim for the preservation of the hygiene, safety and environmental protection in which the following points must be respected:

- The protection of the coast, beaches, shores of rivers, forests and natural areas;
- The preservation of water quality including : Drinking and Bathing water;
- The fight against communicable disease vectors
- The fight against all forms of pollution and degradation of the environment and the natural balance
- The evacuation and treatment of wastewater and rainwater.

Furthermore, The Town Council decides in accordance with the laws and regulations in force, the achievement or participation in the implementation of Hydraulic facilities and structures to control the storm water and protect against flooding.

4.2.8 Act and Decree of 27 July 1969 on protection and restoration of soil

This act and decree of 27 July 1969 contains rules on the authorization and prohibition in terms of exploitation of natural resources. Indeed, this act regulates the authorizations of works established in study zones and aims to the restoration of soil. Furthermore, this act allows the implementation of pollutant establishment as well as it imposes a significant number of prohibitions including the most important areas of natural heritage.

4.2.9 Dahir No. 1-72-103 on the establishment of the National Office of Electricity and Potable Water (NOEP) as amended by the Law 40-09

The functions of NOEP branch water are:

- The planning of Potable Water Supply for the Country
- The Service management of drinking water and sewerage services in public, when the management of these services is entrusted by communal council concerned, approved by the competent authority.
- The Control, in conjunction with the competent authorities, of the pollution of water that could be used for food supply.
In 2000, the Royal Decree was amended to assign the NOEP the possibility to manage the sewerage service common by deliberation of the municipal council and approval by the competent authority.

The Act 40-09 concerning the consolidation of the National Office of Electricity (NOE) and the National Office of Drinking Water (NODW), governed respectively by Dahir No. 1-63-226 of 5 August 1963 and the Dahir No. 1-72-103 of April 3, 1972. Indeed, the NOE and NODW have come together within a public institution with legal personality and financial autonomy denoted the National Office of Electricity and Potable Water (NOEP).

4.2.10 Dahir 1-03-194 enacting the Act No. 65-99 on the Labour Code

The features of the Act No. 65-99 related to the labor code, are aimed in improving the working conditions, the environment as well as ensuring the health and safety at the workplace. Particularly the devices of the Title IV on the health and safety of employees that are summarized as follows:

- Ensure proper conditions of cleanliness, hygiene and sanitation in the local work (lighting, heating, ventilation, soundproofing, ventilation, potable water, cesspools, the waste water disposal and washing, dust and vapors, changing rooms, toilet and the sleeping conditions of employees, etc.);
- Ensure normal water supply on construction sites, healthy housing and hygienic conditions for employees;
- Ensure the protection of machines, equipment, tools and machinery in order to present no hazard to employees;
- Ensure the equipment of the employees to work in wells, gas pipes, smoke channels, cesspools, tanks or any devices that may contain noxious gases by safety devices (belts, masks, etc.);
- Inform the employees of the hazards resulting from the use of machines and the precautions to be taken;
- Do not expose workers to danger (to use the machines without guards, carrying loads whose weight is likely to jeopardize his health or safety;
- Do not allow employees to use products or substances, devices or machines that are recognized by the competent authority as being likely to harm their health or compromise their safety.

The establishment of a working medical service within companies that are assigned a workforce of 50 employees or at least those whose work involves exposure of employees to the risk of occupational diseases,
this service will be chaired by a work doctor who will be responsible for the application of the following measures:

- Monitoring of the General hygiene;
- The protection of employees against accidents and against all nuisances that threaten their health;
- Monitoring the adaptation of the workstation to the employee's health;
- Improving of the working conditions, adapting the working techniques to the physical fitness of the employees, elimination of hazardous materials and the study of the work patterns.

The establishment of a safety and health committee, in companies with a workforce of 50 employees at least. The role of this committee is to:

- Detect occupational hazards faced by employees of the company
- Ensure the implementation of laws and regulations concerning safety and hygiene;
- Ensure proper maintenance and proper use of protective devices of employees against occupational hazards;
- Ensure the protection of the environment in and around the enterprise;
- Enable all initiatives, including the methods and work processes, choice of materials, the equipment and tools necessary and suitable for the work;
- Rate the operation of the occupational health service;
- Develop a sense of prevention of occupational hazards and safety within the company.

4.2.11 *Dahir 1-10-123 of 16 July 2010 on the promulgation of the act No. 22-07 related to the protected areas*

The 22-07 act aims to preserve and safeguard the protected areas as part of the commitment of our country to lead a sustainable development policy which enhance the possibility to save the biodiversity and protect endangered species with the help of the growing support from international organizations. A protected area is classified by the competent authority, according to its characteristics, its purpose and its socio-economic scale, in the following categories:

- Natural Park;
- Biological Reserve
- Natural Reserve
- Natural Site
4.3 Institutional Framework

In addition to NOEP, an institution that represents the project's mastery of work but also a key player in the protection and preservation of the environment, it is also necessary to mention the Department of the Environment, within the Ministry of Energy, Mines, Water and Environment, which is responsible for the coordination of environmental management activities. In addition to this department, some other ministries and offices now have services or environmental specialized cells. These Ministries are presented as follow:

- Ministry of Health
- Ministry of Equipment and Transport
- Ministry of the Interior
- Ministry of Housing and Urban Development
- Ministry of Agriculture and Maritime Fishing

4.4 International conventions

Regarding Morocco's contribution to the protection of the environment at the international level, we must emphasize that it displays a strong political will for cooperation in order to protect and manage the environment and also actively participates in the work for the codification of International environmental laws. Thus, the International conventions governing different areas of the environment likely to be affected by this project are described as follow:

- African Convention on the Conservation of Nature and Natural Resources;
- Ramsar Convention on Wetlands of International Importance especially for Waterfowl;
- Convention concerning the Protection of World Culture and Natural Heritage
- Bern Convention on the Conservation of Migratory Species belonging to Wild Animals;
- Rio convention related to the biological diversity

Note also that Morocco has been involved in the work of the three World Conferences on the Environment in Stockholm in 1971, Rio 1992 and Rio + 20 (2012), and participated in 2002 in the work of the World Summit on Sustainable Development in Johannesburg in South Africa.

4.5 Requirements of the World Bank

The World Bank was early concerned about the health of the environment. In 1970 already, it established a counselor for the environment and an office on health and the environment. It also published
in 1973 a directive which predicted the evaluation of projects. In 1984, the World Bank established significant policies which aim into recommending the analysis of the environment within project studies. The projects that it financed and who were susceptible to environmental studies had to be subject to protection measures, such as pollution controls, reforestations, etc. Nevertheless, by lack of competence and workforce, these possibilities were still quite limited. It could not meet the need for protection that required the environment in developed countries.

It was in 1987 that changes took place that included restrictive policies and specific procedures. A Department of Environment and dependent divisions were created, and we increased the personnel assigned to this task.

The goal was to develop strategies for systematically integrating environmental concerns into the "Bank Landings", to ensure that the projects due to loans to developing countries have harmful consequences for the environment. In October 1989, the World Bank provides effective EIA procedure in the form of guidelines. Operational Directive 4.00 was altered and improved by the 4.01 Directive 1991 (OP 4.01) which establishes a new classification system based on the nature and extent of the impact on the environment.

The World Bank has not only made the EIA system. The OP 4.01 states that EIA is an environmental protection instrument among other, such as a regional or sectorial environmental assessment, environmental audit, the study of project-related hazards and risks related to the environmental management plan. These different instruments are used depending on the circumstances and the nature of the project. EIA should be done early in the project cycle. This is that the paid borrower must make reality of EIA assisted by the competent services of the World Bank. It gives recommendations on the content of the UAE and then examines if its demands were met and meet the conditions of a loan. The planned activities are divided into four and the nature and extent of potential impacts.

Category A includes projects likely to create adverse effects, multiple and irreversible. Clearings, for example can be included. In this case, there must be an establishment of positive or negative potential impacts on the environment, compare to that of a replacement project and provide all the measures to prevent, reduce or mitigate them. The borrowing country must engage independent experts not affiliated with the project.

In general, for this kind of highly risky project, the borrowing countries should also apply to an independent advisory panel recognized internationally which has trained specialists to help it with all the essential aspects related to the project. It role depend mainly on the quality of environmental evolution, at
the moment when the bank considers the project. It is also mentioned in general, that the EIA is the principal instrument applicable to the projects of the A category.

Category B includes projects where the potential harmful impacts on the environment are less important. As in the category A, it is to examine the positive and negative impacts of a project and to take appropriate action to reduce their effect. The Operational policy 4.01 does not determine the type of analysis and the precise method to be employed.

A project falls within the scope of application of category C if it has minimal and not harmful impacts. In this case, no assessment is required.

Finally, a project falls into the category FI if it includes banking fund investments through financial intermediaries. In this case, each intermediary has to study the sub-projects and ensure that an evaluation is conducted for each sub-project. Furthermore, Sub-projects must also comply with the requirements of national and local environmental authorities and those in different operational policies of the World Bank.

4.5.1 *International Finance Corporation (World Bank):*

In order for the implementation, investment and operation of a project to take place and to be possible, the client must respect a set of Standards established by the International Finance Corporation which can be classified into eight performance standards described as follow⁸:

- PS 1: Assessment and Management of the Environment, Impacts and Social Risks.
- PS 2: Labor and Working Conditions
- PS 3: Pollution Prevention and Resource efficiency
- PS 4: Community Health, Safety and Security
- PS 5: Involuntary Resettlement and Land Acquisition
- PS 6: Sustainable Management of Living Natural Resources and Biodiversity Conservation
- PS 7: Indigenous People
- PS 8: Cultural Heritage

---

⁸ International Finance Corporation : IFC.org
5 Wastewater Treatment Plant Presentation and Description

5.1 Wastewater Treatment Plant Components

The Wastewater Treatment plant presented in this study is principally financed by the World Bank Backer and the National Office of Potable Water.

The main elements of the Youssoufia Wastewater Treatment Plant are presented as follow:

External Installations:

1. Drainage Pipes
2. Access Roads
3. Gates and Fencing
4. Service Building

Internal Installations:

1. Screen and Grit Removal Equipment
2. Aerated Grit and Removal Tank
3. Primary Sedimentation Tanks
4. Aeration Tanks
5. Secondary Sedimentation Tanks
6. UV Disinfection Unit
7. Sludge Thickener
8. Anaerobic sludge digester
9. Sludge Dewatering System
10. Biogas Storage Tanks
11. Electrical Generation System
5.2 WWTP Process Flow Chart

The treatment of the Wastewater within the WWTP of Youssoufia can be divided into three essential stages: Preliminary, Secondary and Tertiary Treatment.

5.2.1 The Preliminary Treatment Stage:

During this stage, the water is first collected by drainage pipes and direct to the wastewater inlet. The objective of this stage is to remove as much as possible all the large solid material that will inhibit the flow process. This is done first by a screening bar with a diameter of 5 mm that does not allow large solids to pass. The wastewater moves into an aerated grit and removal tank that allow the inert matter that did not decompose to be divided into particles. We will use this process in the Youssoufia’s WWTP to increase the life Cycle of the material since they will not be subject to abrasive corrosion of any equipment or drainage pipes.
5.2.2 The Primary Treatment Stage:

After the preliminary stage treatment and to make sure that no solid material has been left, the wastewater is directed into primary sedimentation tanks that allow the organic solids to settle at the bottom of the tanks and that by considerably reduce the wastewater effluent velocity. The following model generated by the water care organization described the typical sedimentation tank that will be used in this WWTP.
It also important to note, the sludge also known as the organic material is continuously treatment by sludge scraper which rotate the wastewater at a continuous velocity and also reject the wastewater in the system at a constant flow rate.

5.2.3 The Secondary Treatment Stage

5.2.3.1 Presentation of the Activated Sludge System

Also known as activated sludge system or the biological wastewater is a process in which bacteria available within the aeration tanks that decompose the small invisible particulate matter that is present in the wastewater. This system allow to considerably reduce the biological oxygen demand for 5 days, which is a measure of the degree of pollution of the wastewater. While decomposing the organic matter, the bacteria generate multiple biogas components mostly composed of Nitrogen. For our WWTP, the biogas will be used as an essential fuel to generate electricity through gas and heat engines. The electricity will then be used to WWTP consumption as well as distributed to the city. In order for the activated sludge system to be efficient, multiple factors must be taken into consideration.
For the Youssoufia WWTP, we will perform a comparison that will allow us to choose between two different conventional activated sludge treatment techniques: The Plug Flow and the completely mixed Techniques.

The following table presents the typical and conventional multiple values and factors that are used for a Domestic Wastewater Treatment Plant

<table>
<thead>
<tr>
<th>Process</th>
<th>Food Microorganisms Ratio Kg BOD/day/m^3</th>
<th>Sludge Retention Time in days</th>
<th>Mixed Liquor Suspended Solids g/m^3</th>
<th>BOD Removal Efficiency</th>
<th>Volume Loading lb ft^3/day</th>
<th>Hydraulic Retention Time in hours</th>
<th>% Volatile Suspended Solids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completely mixed (Conventional)</td>
<td>0.2 – 0.5</td>
<td>3 - 15</td>
<td>1500-6000</td>
<td>85-95</td>
<td>20 - 40</td>
<td>3 - 6</td>
<td>75 %</td>
</tr>
<tr>
<td>Plug Flow (Conventional)</td>
<td>0.2 – 0.4</td>
<td>3 - 15</td>
<td>1000 -3000</td>
<td>70 - 80</td>
<td>60 -75</td>
<td>4 - 8</td>
<td>60 %</td>
</tr>
</tbody>
</table>

Table 2: Factor values for Activated Sludge System

5.2.3.3 Design and Operation Calculations

For the activated sludge treatment process, we will be interested in designing the aeration tank volume before the construction of the WWTP since it’s an essential step in the process and would likely generate the biogas needed for electricity generation.

Secondly, we will need to assess the sludge flow rate, the flow rate of wastewater and the food to microorganisms ratio that should be constantly maintained during the operational phase of the activated Sludge treatment to generate a continuous and steady biogas production.

5.2.3.3.1 Pre calculations:

Before starting to design the wastewater treatment plant of Youssoufia, we should first calculate the multiple factors that will be used, these factors are presented as follow:
Environmental Impact Assessment of Youssoufia’s Wastewater Treatment Plant
EGR 4402
Lamssali Mehdi

<table>
<thead>
<tr>
<th>Factors</th>
<th>Calculation</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Effluent Flow Rate</td>
<td>0.07 m³/day * 67628 persons</td>
<td>4733.96 m³/day</td>
</tr>
<tr>
<td>The Average BOD5 load</td>
<td>67628 persons * 30 g/person/day</td>
<td>5410240 BOD5/day</td>
</tr>
<tr>
<td>The Effluent BOD5 Concentration</td>
<td>5410240 BOD5/day / 4733.96</td>
<td>114.33</td>
</tr>
<tr>
<td>Average Settled Sludge (ss)</td>
<td>67628 * 90 g ss/person/day</td>
<td>6086520 ss/day</td>
</tr>
<tr>
<td>Sludge SS Concentration</td>
<td>(6086520 ss /day) / 4733.96</td>
<td>1285.71</td>
</tr>
<tr>
<td>Mixed Liquor Suspended Solid</td>
<td>(6000-15000) / 2</td>
<td>2250 g/m³</td>
</tr>
<tr>
<td>Design Volume Loading</td>
<td>Max Value of 0.5 to enhance the capacity</td>
<td>0.15 Kg BOD/day / m³</td>
</tr>
<tr>
<td>% Volatile Mixed Liquor Suspended Solid</td>
<td>Value used in the completely in the Completely mixed</td>
<td>75 %</td>
</tr>
</tbody>
</table>

Table 3: Calculation of Wastewater Treatment Factors

5.2.3.3.1.1 For the Design Phase

For this design, we will consider that there is no frictional effects occurs within our aeration system and that the flow is incompressible so that the volume flow rate is conserved at the entrance and exit of the system.

The results were generated through the use of excel calculation and presented as follow:

Youssoufia Wastewater Treatment Plant (Activated Sludge Treatment Calculations)

Aeration Tank Design

Calculations

\[ V = \frac{(S_o, Q_o)}{X} \]
\[ F:M = \frac{(S_o, Q_o) \times \%Vol \times VL}{V} \]
\[ HRT = \frac{24 \times VL \times Q_o}{V} \]

Equations used for Calculations:

\[ V = \frac{(S_o, Q_o)}{X} \]
\[ F:M = \frac{(S_o, Q_o) \times \%Vol \times VL}{V} \]
\[ HRT = \frac{24 \times VL \times Q_o}{V} \]

Figure 4: Activated Sludge treatment Calculations (Tank Design)
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**Input Parameters (Obtained in the Pre calculations):**

\[
Q_0 = 4734 \text{ m}^3/\text{d}
\]

\[
S_0 = 114.33 \text{ g/m}^3
\]

\[
MLSS = X = 2250 \text{ g/m}^3
\]

\[
V_L = 0.5 \frac{\text{BOD}}{\text{day}}/\text{m}^3
\]

\[
\%\text{Vol} = 75\%
\]

**Output Parameters:**

**Tank Volume:**

\[
V = \frac{(S_0 \cdot Q_0)}{V_L \cdot 1000} = \frac{114.33 \cdot 4734}{0.5 \cdot 1000} = 1082 \text{ m}^3
\]

**Hydraulic Retention Time:**

\[
HRT = \frac{24 + V}{4734} = \frac{24 + 1000}{4734} = 5.5 \text{ hr}
\]

**Food to Microorganism Ratio:**

\[
\frac{S_0 \cdot Q_0}{\%\text{Vol} \cdot X \cdot V} = \frac{114.33 \cdot 4734}{1082 \cdot 2250 \cdot 0.5} = 0.30 \frac{\text{BOD}}{\text{day}}/\text{kg}
\]

The calculations obtained are in conformity with the demand of the population. Indeed, we obtained that the aeration tank would have a volume of 1082 m3 and knowing that the aeration tank would be functioning at a maximum of 12 Hours/day to respect the conformity of the environmental impacts about lighting and odor disturbance at night. Consequently there would be a treatment of 1082000 L * 12 hrs = 12984000 L/day which largely compensate the need of the youssoufia population of 4734000. Thus, if the Youssoufia WWTP is implemented with the following design, there would be a percentage gain of 91.6%.
5.2.3.3.1.2 For the Operation Phase:

We will be mainly interested in generating a calculation of the activated sludge flow rate since it is a completely mixed technique that require the treated wastewater to be recycle and returned back to the aeration tank. In addition, there will be some waste from the biological bacteria that die after their operation and must be evacuated to not affect the wastewater.

**Youssoufia Wastewater Treatment Plant (Activated Sludge Treatment Calculations)**

**Aeration Tank Operation Calculations (Sludge Flow Rate, Waste Activated Sludge)**

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Calculations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prim. Eff. Flow Rate, ( Q_0 ) = 4734 ( m^3/d )</td>
<td>( Q_r ) (Recycle Activated Sludge) = 2.043 ( m^3/d )</td>
</tr>
<tr>
<td>Prim. Eff. COD, ( S_0 ) = 114.33 ( g/m^3 )</td>
<td>Waste Activated Sludge Flow Rate, ( Q_w ) = 29 ( m^3/d )</td>
</tr>
<tr>
<td>Prim. Eff. TSS, ( X_0 ) = 200 ( g/m^3 )</td>
<td>Aeration tank F to M = ( 0.30 ) (kg BOD/day/kg MLVSS)</td>
</tr>
<tr>
<td>Waste/Recycle activated sludge SS conc., ( X_w ) = 7000 ( g/m^3 )</td>
<td>Equation Used for the Calculations</td>
</tr>
<tr>
<td>Aeration tank vol., ( V ) = 1002 ( m^3 )</td>
<td>( Q_r = Q_s(X - X_0)(X_w - X) )</td>
</tr>
<tr>
<td>Aeration tank MLSS, ( X ) = 2250 ( g/m^3 )</td>
<td>( Q_w = (V/X)(SRT/X_w) )</td>
</tr>
<tr>
<td>% waste MLSS, % Vol</td>
<td>( F:M = (S_0/Q_0)(%Vol/X/V_{BOD}) )</td>
</tr>
<tr>
<td>Sludge ret. time, SRT = 12 days</td>
<td></td>
</tr>
</tbody>
</table>

**Input Parameters: (obtained in the pre calculations)**

\[ Q_0 = 4734 \ m^3/d \]
\[ S_0 = 114.33 \ g/m^3 \]
\[ MLSS = X = 2250 \ g/m^3 \]
\[ V_L = 0.5 \ \frac{\text{BOD}}{\text{day}}/m^3 \]
\[ V = 1082 \ m^3 \]
\[ \%Vol = 75 \% \]
\[ X_0 = 200 \ g/m^3 \]
Sludge Retention Time = SRT = 12 Days

Sludge Suspended Solid Concentration = $X_W = 7000 \, g/m^3$

Output Parameters:

Returned Activated Sludge Flow Rate (RAS): $Q_r = \frac{Q_0 \times (X - X_a)}{X_W - X} = \frac{4734 \times (2250 - 200)}{7000 - 2250} = 2043 \, m^3/d$

Waste Activated Sludge Flow Rate (WAS): $Q_W = \frac{V \times X}{SRT \times X_W} = \frac{1082 \times 2250}{12 \times 7000} = 29 \, m^3/d$

From the results obtained, we can note that the flow rate of the waste activated sludge has an extremely small value of 29 m$^3$/d compared to recycled sludge flow rate which demonstrate the validity for the operation of the activated sludge system.

5.2.4 The Tertiary Treatment Stage:

There exist multiple final cleaning techniques to treat wastewater in order to remove any excess of impurities or nitrates components before rejection into the river. The typical technique used is the chemical treatment by chlorine. Nevertheless, this chemical treatment technique has multiple drawbacks that include the significant reduction in water taste in case of rejection into the drainage system, a risk of potential allergic contaminations .... Consequently, in the Youssoufia wastewater treatment plant, we will be using UV disinfection which is more ecological friendly technique that considerably reduces the impurities up to 99 %, according to the Environmental Protection Agency by the use of high frequency lights that kill any remaining chemical or biological excess material.

Furthermore, there exist many other advantages of using UV disinfection. For instance, in terms of environmental impact, there will be no need of transportation of chemical compounds that would lead to risks of spills, rather the process is completely physical and self-centered within the WWTP. In addition to that, and according to the EPA, the UV disinfection is faster and precise in elimination excess impurities which allows the destruction of most viruses in an efficient manner. Finally, the UV disinfection system does not require a lot of space and would be easily implemented within the Youssoufia WWTP.

For the case of our project, we will be using horizontal lamp system which are parallel to the flow of water and allow better treatment in comparison with the horizontal ones. The following figures represents the model that has been developed:
It is also important to note that we used an activated sludge treating system in secondary treatment process to obtain a high quality of wastewater of a maximum degree of 70 % impurity free, and that since the UV disinfection system is largely efficient.

5.2.5 Biogas Production and Heat/Electricity Generation

As a result of biodegradation of the Wastewater treatment during the secondary treatment process, which is primarily constituted of Methane and carbon dioxide. Indeed, the main source of this gas is the degradation of the organic dry matter which involves a direct relationship and correlation between the two factors. Furthermore, the rate of biogas production is also closely related to how much of the dry matter has been degraded within the sludge as well as the quality and age of this product. Lastly, an important factor that should be considered is the hydraulic retention time which represents the time spent by the sludge in the storage tank. For the case of our typical WWTP plant, the biogas production is presented in the table below according to a study performed by Baushman on Advantages and limitations of the fermentation of easily degradable industry products, represents average value for the production of Grosse gas that can be applied to our WWTP.

<table>
<thead>
<tr>
<th>Gross Gas Production</th>
<th>450 to 500 L / KG of ODM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degradation of Organic Dry Matter</td>
<td>45 to 45 %</td>
</tr>
<tr>
<td>Typical Range of CH4 (Methane)</td>
<td>63 to 67 %</td>
</tr>
</tbody>
</table>

*Table 4: Typical Biogas Production Values of the WWTP*
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On the other hand, the Youssoufia WWTP will be using the biogas used from sludge treatment to produce electricity along with heat. This process affirms the position of the WWTP as being an eco-friendly and renewable energy facility. Indeed, the generated heat/electricity will be used to aliment the WWTP in terms of energy and the remaining production will be distributed to the Youssoufia City.

The model used within the WWTP is a combined heat and Power cogeneration system is presented in the following graph:

![Graph of Combined Heat and Power System](Image)

**Table 5: Combined Heat and Power System**

For the Youssoufia WWTP, we will be mostly interested in the electrical efficiency of the plant rather than the heat generation potential since most typical WWTP’s have sufficient heat abundance. For the case of CHP use, the energy efficiency estimated is presented as follow:

<table>
<thead>
<tr>
<th>Electrical Efficiency</th>
<th>&lt; 100 Kw</th>
<th>25 % - 35 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 – 500 Kw</td>
<td>5 - 40 %</td>
<td></td>
</tr>
<tr>
<td>&gt; 500 Kw</td>
<td>38 % - 45 %</td>
<td></td>
</tr>
</tbody>
</table>

**Table 6: Typical Electrical Efficiency Values of the WWTP**

Since the gross biogas production will be between 450 to 500 L/kg, we can estimate the generation potential would be an average of 500 KW and thus a high efficiency would occur.
5.2.6 **WWTP Process Simulation**

In order to have a specific idea of what would be the multiple variable values that define the WWTP, we have simulated using the software Hydromantis GPS-X, the functioning of the WWTP assuming ideal conditions of steady flow as well as ignoring frictional energy losses of the fluid present.

**5.2.6.1 Influent vs Effluent**

First of all, we will look at a 24 Hour simulation of the WWTP and the results are described as follow:
The following graph represents the Influent rate of wastewater coming from irrigation drainage pipes of the city as well as the effluent of total suspended solids that describe and assess the quality of our wastewater since they are large enough to be extensively trapped by a filter. As demonstrated in the graph, the TSS stays at a constant values all along the day even if the effluent rate of wastewater coming up is varying from low values to high values during peak hours.

5.2.6.2 Total Suspended Solids

In order to have a better idea on the Suspended Solids within the treated wastewater, we also simulated the suspended solids distribution profile within a period of 10 days and 20 days. The following results are presented as follow:
For a 10 day Period:

Figure 9: Suspended Solid Profile (10 Day)
For a 20 day Period:

If we perform a critical comparative analysis of the diagrams obtained, we can clearly see that before during a 10 days period simulation, there is an accumulation of suspended solids at the end of the cycle. Nevertheless, for the 20 days period, we can notice a significant buildup of suspended solids within the aeration treatment step that will be significantly reduced by the use of UV disinfection units, consequently keeping the effluent TSS at a constant rate as described in the section before. The profile for suspended solids within our WWTP diagram is presented as follow:

*Figure 10: Suspended Solid profile (20 Days)*
As expected, the flow rate of suspended solids is high when there is untreated wastewater coming from the drainage pipes directly to the screen and grit process, and then decreases slowly as we move on to UV disinfection units that will significantly reduce the total suspended solids and impurities to a lower value.

5.3 Geographical Location

Youssoufia City is located 60 km west of the city of Benguerir the intersection of the Regional Road R201. The WWTP is located at the north of the city of Youssoufia and is surrounded by the douars of bhahra and awlad. The coordinates of the city are described as follow:

In the North Direction: 32°20’04.30

In the West Direction: 8°32’34 80

Elevation: 795 ft
5.4 Administrative Framework

The study zone is part of the municipality of Youssoufia and is surrounded by the rural communes of Labkhati in the North and the commune of El Gountour at the Est.

6 Justification of the Project

The WWTP project for the treatment of sewage water of the city of Youssoufia is part of the National Sanitation Program of Liquid Water and Treatment of Wastewater that has been created by the Ministry of Energy and Environment to solve water needs issues. Indeed, the shortcomings of collection and treatment of wastewater today penalize the economic and social development of the Country. According to an environmental, sanitary and economic study performed by the World Bank in 2003, the annual cost of
sanitation likely exceeds 4.3 Millard of Dirhams which represents approximatively 1.2 % of National Gross Domestic Product. Thus, the national plan comes as an immediate and urgent solution to this issue\textsuperscript{9}.

The Youssoufia WWTP is an integral part of the objectives that has been set by the National Plan of Sanitation which are presented in the following graph:

\begin{itemize}
\item Reach a Volume of Treated Wastewater From 50 % in 2016 to 60 % in 2020 and 100 % in 2030.
\item Implement a Tertiary Treatment of Wastewater and use 100% of it in 2030.
\item Reach a Global level of connection to the network of urban sanitation by 75 % in 2016, 80 % in 2020 and 100 % in 2030.
\end{itemize}

\textit{Table 7: National Plan of sanitation of water and treatment of wastewater}

A this stage, the actual sanitation situation of liquid sanitation has known a considerable advancement in treated wastewater and that is the considerable enhancement of the rate of treated wastewater that has reached 20 % in comparison to 8 % in 2005. Indeed, the number of wastewater treatment plants realized has reached 49 in comparison to 21 in 2005. Consequently, the WWTP of Youssoufia comes as an essential part to reach the 100 % of treated wastewater in 2030 and has all the potential characteristics if properly implemented\textsuperscript{10}.

The WWTP project presented in this paper is a solution to enhance the quality of life of the residents of the city and reduce the risk of increased health problems related to untreated wastewater. Indeed, various factors can be cited in this section in order to justify the project of installation of the WWTP. The main reasons are described as follow:

\textsuperscript{9} Ministry of Energy and the Environment
\textsuperscript{10} Ministry of Energy and the Environment
• The obsolescence of the existing sewerage network which is old and defective
• The ongoing evolution and rapid demographic development of the Youssoufia City with generation of new neighborhood that will not have access to wastewater treatment facilities
• Problems related to hydric health problems
• The ongoing expansion of social accommodations and new buildings
• Irrigation of local field areas due to common dry seasons
• Enhance the potential of agricultural sector by providing biological fertilizer.

The absence of the WWTP (OP 4.07)

In addition to the national sanitation plan for water and treated wastewater, as well as the numerous benefits that would the WWTP generated on the local population, we must also not the absence or the none construction of the project would negatively affect the environmental state of the region. Indeed, the absence of the WWTP within the region of interest would lead to increasing hydric related diseases due to the untreated wastewater as well as a gradual increase of environmental pollution that the region is already suffering from. Thus, the WWTP comes as a necessity to remedy to these issues that would be enhanced in severity if the WWTP is not properly implemented. This justification is part of the OP 4.07 regulation of the World Bank that explicitly cites the necessity of a proper justification in case the projected is not constructed with the study zone.\(^{11}\)

7 Project Activities Timeline

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\(^{11}\) World Bank, *OP 4.07 and its annexes related to the implementation of a project*
The timeline above describes the project activities necessary for the implementation and operation of the WWTP that it will take a duration of 3 years.

The project activities timeline is organized by chronological order and are presented as follow:

- Feasibility Study : 3 Months
- Land Acquisition : 2 Months
- Technical Studies : 10 Months
- In-Site Operations : 6 Months
- Off-Site Operations : 4 Months
- Exploitation Tests : 1 Month

8 Analysis of the initial Environmental State

8.1 Physical Environment

8.1.1 Climate

The climate in the region is a semi-arid climate with hot and dry summer and a humid and temperate winter. However this climate is mitigated by the presence of the Atlas mountain range to the east and the Atlantic Ocean to the west.
The climate is marked by warm currents from the Saharan Zone. Thus, the vegetation remains very intense in some areas, which gives it a barren appearance particularly in the dry season. According to the database of climate-data website, the following diagrams represent the temperature and precipitation variation all along the year.

The following table presents the general trend, variations and changes in temperature for the region of Youssoufia:

<table>
<thead>
<tr>
<th>month</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>mm</td>
<td>40</td>
<td>38</td>
<td>39</td>
<td>31</td>
<td>17</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>31</td>
<td>45</td>
<td>49</td>
</tr>
<tr>
<td>°C</td>
<td>11.5</td>
<td>12.7</td>
<td>14.7</td>
<td>16.8</td>
<td>19.8</td>
<td>23.0</td>
<td>25.9</td>
<td>26.6</td>
<td>23.7</td>
<td>20.2</td>
<td>15.8</td>
<td>12.5</td>
</tr>
<tr>
<td>°C (min)</td>
<td>6.3</td>
<td>7.3</td>
<td>9.2</td>
<td>11.2</td>
<td>14.1</td>
<td>17.3</td>
<td>19.4</td>
<td>20.2</td>
<td>17.8</td>
<td>14.7</td>
<td>10.6</td>
<td>7.4</td>
</tr>
<tr>
<td>°C (max)</td>
<td>16.7</td>
<td>18.2</td>
<td>20.3</td>
<td>22.4</td>
<td>25.6</td>
<td>28.8</td>
<td>32.4</td>
<td>33.0</td>
<td>29.7</td>
<td>25.8</td>
<td>21.0</td>
<td>17.7</td>
</tr>
</tbody>
</table>

Table 8: Table of Temperatures in Youssoufia

---

12 Climate-Data.org
8.1.2 Winds

According to the Wind finder statistical reports, the wind distribution during the whole year is mainly directed in the west direction with an extremely high percentage of 13.2%. In addition to that, the average wind speeds are between 6 to 7 kts. The following graph presents the statistical data obtained:

![Wind Direction of Youssoufia Region](image)

**Figure 16: Wind Direction of Youssoufia Region**

<table>
<thead>
<tr>
<th>Month of year</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dominant wind direction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Year</td>
</tr>
<tr>
<td>Wind probability &gt; 4 Beaufort (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Year</td>
</tr>
<tr>
<td>Average Wind speed (kts)</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>7</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>6</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

**Figure 17: Wind Probability and Speed in the Region of Youssoufia**

8.1.3 Geomorphology

In general, the geomorphology of the zone of study is characterized by an absence of slopes and high altitude geological properties.
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The following figure demonstrated the geomorphological pattern that exists on-site where the Wastewater treatment plant would be implemented and which has a regular, flat pattern defined by an average slope of 1.6 % as shown in the following figure developed using google earth.

![Geomorphological Map of the Study Zone](image)

**Figure 18: Geomorphological Map of the Study Zone**

### 8.1.4 Hydrology

The water resources in the region are extremely insufficient. Indeed, we can notice that only the North and North-Est agricultural plains of the region are irrigated by the Oum Rbia river using mainly three dams: Sidi Machou, Douart and lmfout.

In general, the region of the city of Youssoufia lacks water resources for two main reasons: First the poor situation for the peak area between the hydraulic basin of Oum Rebia and Tensift, and second due to the irregular convergence of the numerous small oueds located in the Collins of Rehamna and Youssoufia directly to the Lac Zima near the city of Chemaia.
The current hydrological situation of the city of Youssoufia is that the main superficial contributions result come essentially from the streaming of the rainwaters which are forwarded to multiple small and also drained by the channel Massouda which was formerly forwarded by the Oued Kouchkat.

Nevertheless, for our study zone there is a presence of a nearby river that will constitute a potential negative impact during the construction of the WWTP as well as a source of wastewater dumping.

8.1.5 Hydrogeology

The drainage system in the region is limited to water processes that move from the Rhamnas sources and which contribute to the enhancement of the natural reservoirs. In this context, the study zone does not have a water table, nevertheless, the closest water table to the study zone is the Bahira Water Table. It is considered as a source of water for the city of Youssoufia and is used in the cleaning of the phosphates.

The Water Table of Bahira fits between the mountains of the Jbilet and the trays Rehamna and Gantour north and extends over an area of approximately 5,000 km². We can distinguish two important aquifers:

- A water table developed in the alluvial formations of the oriental area characterized by silt, sandy loams and sandy limestones of the Quaternary.
- A cretaceous Water table that has taken place all along the limestone plains. This water Table is free in zones where there is a poor depth. Nevertheless, it is very active in zones where there is an important Quaternary formation. In addition to that, direct infiltration of rainwater and infiltration of runoff from Jbilet are the main component of the natural recharge of the aquifer system of Bahira. The general flow is towards the Oued Tessaout.

According the hydraulic basin agency of Tensift, the transmission rate of the both the water tables are good with values between 10.4 m²/s and 10.5 m²/s. Moreover, the storage coefficient varies from 3 to 5 %. The quality of water in these aquifers is medium with the presence of a high degree of salinity with a value of 30g/l.

Nevertheless, for the study zone of the WWTP, there is no presence of direct aquifer and thus will no represent an issue for environmental impacts.

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13 Ressources in Water of Morrocco (Tome 2): Plains and Bassins of Morocco.
14 Ressources in Water of Morrocco (Tome 2) : Plains and Bassins of Morocco
8.1.6 Natural Risks

8.1.6.1 Seismic Risks

According to the earthquake regulations of Morocco of 2000, the region of Youssoufia is located in the zone 3 which has a moderate seismicity. The following map represents the maximal horizontal accelerations of the ground for a probability appearance of 10 % in 50 years as well as the principal earthquakes that the country has experienced before.

Furthermore, according to the global seismic hazard Assessment program, the region of High Atlas maybe the siege of earthquake of which the maximal magnitude does not exceed the M=5 on the Richter Scale.
During the last century, it has been registered in a radius of 400 Km of the region of study about 20 earthquakes with maximum magnitudes of 4 on the Richter scale. The following table summarizes the principal earthquakes:

<table>
<thead>
<tr>
<th>Date</th>
<th>Hour</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Magnitude</th>
<th>Depth (Km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>27/01/1994</td>
<td>23:17</td>
<td>31.748</td>
<td>-10.009</td>
<td>4.0</td>
<td>30</td>
</tr>
<tr>
<td>15/01/2004</td>
<td>07:32</td>
<td>30.953</td>
<td>-8.688</td>
<td>4.1</td>
<td>20</td>
</tr>
<tr>
<td>24/11/2005</td>
<td>03:57</td>
<td>31.009</td>
<td>-8.566</td>
<td>4.2</td>
<td>10</td>
</tr>
</tbody>
</table>

Table 9: Chronological Order of Principal Earthquakes in the region

The phenomenon of the Tsunami does not concern the region of Youssoufia given its estrangement of the coast (rib) and its height with regard to the level of the sea.

In general, the study of the earthquakes performed by the United States Geological Survey with the kingdom of Morocco, for the period going from 1900 to 2009 demonstrates the country’s earthquakes activity is mainly localized in two principal zones:

- The seismic line of Acores within Gibraltar
- The domain of the Rifain Oval and the sea of Alboran,
8.1.7 Soil

According to the soil map established by the Moroccan Association of Soil Sciences (MASS), the pedology of the region of Youssoufia where the study zone is classified as having isohumic soils. These soils have a red to brown color and are characterized by the accumulation of a high degree of organic materials which allows them to have a poor cation exchange capacity, are poorly desaturated and finally do not have the property for a strong water reserve\textsuperscript{15}.

The following map presents the soil information discussed before:

\textsuperscript{15} Moroccan Association of Soil Sciences
8.1.8 Geology

The Study zone is located in part of the Moroccan Mesata and especially within the quaternary of Doukala region. For the study zone that we are interested in, we can find a specific geological formation described as follow:

Figure 20: Soil Map of the Study Region
The above figure describes the whole geological configuration of the region of Youssoufia and can be described as follow:

**Inferior Cretaceous:** Geological configuration of the study zone composed of limestone, clay as well as sandstone formations.

**Maastrichtian:** which is mainly formed of a series of phosphates constituted of siliceous marl, overlain by layers of phosphate sands

**Paleocene:** formed of with Montien structures containing the two most rich horizons of phosphates

**Eocene:** which is constituted first by omnipresent clay topped by a level of silica sand and phosphate as well as a series of marl and siliceous marl. Furthermore, it also constituted of limestones with flint nodules which represent the mineralization of the phosphates.
Finally, the Pliocene-Quaternary which are formations of complex marl, marl limestones, conglomerates, sands and gravel.

8.2 Natural Environment

8.2.1 Ecological Habitats

The principal ecoregion found on the study zone is the Macronesian zones which are a type of vegetation that covered mostly the Mediterranean basin when the climate was more humid.
8.2.2 Forests

If we compare the province of Youssoufia with other provinces of Morocco, we can notice that there is a considerable lack of forest and tree plant within this region. For this Project, the study zone of the WWTP does not involve any presence of forest within or nearby the site of interest. Nevertheless, it is important to note that multiple reforestation activities are being held by the Moroccan Government to remedy to this issue.

8.2.3 Protected Areas

The evaluation of protected areas within the country is based on first the evolution of the sites and then the degree of severity of the sites. Consequently, a network of protected areas has been created under the National Directory Plan for Protected Areas.

For the study zone of the WWTP, there is no presence of Protected Areas within the site. However, we can notice the presence of a sensitive protected zone at a considerable distance of the WWTP. This area is not only a protected area, but is also classified as Ramsar Site as well as protected by the Bird Life International Program.

**Sebkha Zima:** Salty wetland that represents a system of continental endogenic type. Even though the protected area has undergo profound changes, knowing that it is subject to a salt production operation based on excessive drainage, The site has still has great ornithological value, both for winter sessions and reproduction. Indeed, the protected area is considered as important source to recharge the water tables. Furthermore, this protected area constitute one of the most important continental ecosystems for halophytic vegetation with the notable presence of two Moroccan-Algerian endemic species. In addition to that, six species of birds that are considered threatened or vulnerable are present on the protected area.

The following interactive map describes the Sebkha Zima Protected Area:
8.3 Human Environment

8.3.1 Population

According to the last four censuses of 1974, 1982, 1994 and 2004, the population of the city of Youssoufia evolved in the following way:

- The population has tripled within 33 years, in a way that it moved from 22435 habitants in 1974 to 64518 habitants in 2004.
- In general, the population has increased exponentially by a value of 20000 habitant every 10 years.

Nevertheless, the current population density is of the order of 0.7 %, which is considered very weak compared to the rates of national increase, and that for the following reasons:
- The perpetual immigration of retired people from the city to other regions of Morocco that offer socio-cultural and economic activities and equipment such as universities and institutions.
- The movement of work force depending the changes in the mining sector
- The regression of the mining activity in the city, which has gradually transformed the city from an extraction point to a city of treatment and processing of the phosphate\(^{16}\)

The following table summarizes the population development during the presented years:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>22435</td>
<td>42195</td>
<td>60451</td>
<td>64518</td>
<td>67628</td>
</tr>
</tbody>
</table>

Table 10: Evolution of Youssoufia’s Population (GCP)

The Rate of Annual Increase is estimated to be of the order of 0.65%. Furthermore, it always projects that population will continue to increase in the future years:

<table>
<thead>
<tr>
<th>Horizon</th>
<th>2014</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>67628</td>
<td>75936</td>
<td>79254</td>
<td>83466</td>
</tr>
<tr>
<td>Rate of Annual Increase</td>
<td>1.0%</td>
<td>1.0%</td>
<td>1.0%</td>
<td>1.0%</td>
</tr>
</tbody>
</table>

Table 11: Expected evolution of the Youssoufia Population (GCP)

Also, according to the General census of 2004, the active population of the region of Youssoufia is the of the order of 31% which demonstrates a quite high unemployment rate in compare to that of the Country.

The following table summarize the results obtained:

<table>
<thead>
<tr>
<th>Sex</th>
<th>Active Population</th>
<th>Inactive Population</th>
<th>General Rates (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>15146</td>
<td>16936</td>
<td>48.5</td>
</tr>
<tr>
<td>Female</td>
<td>4980</td>
<td>28630</td>
<td>15</td>
</tr>
<tr>
<td>Total</td>
<td>20126</td>
<td>45566</td>
<td>31.3</td>
</tr>
</tbody>
</table>

Table 12: Youssoufia’s Population Distribution

8.3.2 Economic Activities

The City of Youssoufia is characterized by an industrial economic activity of the industrial type based essentially on the mining sector and the agricultural production.

\(^{16}\) General Census of Human Population in Morocco
8.3.2.1 Agricultural Sector

The agriculture is the main economic activity of the study region. Indeed, the region of Doukalla-Abda is characterized by strong potential agricultural activities and that shows up in the fact that during the year 1994, it occupied 56.6 % of the regional population’s activity. Furthermore, the useful agricultural surface covers 1 808 600 ha among which approximately 60 % are occupied by cereal.

The culture of the sugar beet represents 38 % of the National total production. The average yield is 600 quintals to the hectare is a record registered at the National Level.

In general, the commerce of the region is mainly based on food business with a value of 45 %.

8.3.2.2 Mining sector

In terms of phosphate, the region has very important stock of phosphate estimated to be two billion m3. The reserves are mainly localized in the region of Safi and precisely nearby the zone of Gantour.

In the region of Youssoufia, the mining potential is very important. The exploitation of Phosphate is realized in two zones: clear phosphate and black phosphate. In addition to that, The mining activity is estimated at approximately 8.6 billions of m3. The production of phosphate is estimated to be 3 million tons a year.

9 Identification and evaluation of the impacts

9.1 Introduction

An impact on the environment is produced in a large scale when a localized activities in a defined space engenders a variation in the balance of the potential, sensitivity and resources of the natural and human components of an initial state fixed at a specified time. In other words, the intensity of the impact remains in the importance of the modification engendered on site between the initial and the final state.

The judgment of the importance of a given impact on an environmental component, is based upon the following evaluation criteria:17

- Permanence of the anticipated effect and cumulative potential.

17 National Environmental Policy Act : Council on Environment Quality (CEQ) Regulations
In addition to the importance of the impact and its nature related to a project, an impact can be qualified according to the following evaluation criteria:

- Nature of the impact (Negative or Positive)
- Impact signification (Major, intermediate, Minor)
- Intensity of the impact (High, Medium, poor)
- Frequency of the impact (Continuous, discontinuous, less frequent)
- Reversibility of the impact (Permanent, partially reversible, totally reversible)
- Duration of the impact (short, medium, long)
- Probability of the occurrence of an impact (Certain, Not Certain)
- Scale of the impact (Regional, local, Punctual)

In this section, we will describe the impact of the implementation of the Youssoufia wastewater treatment plant on the components of the site during the three phases of the project.

### 9.2 Key environmental issues and sources of impact

The environmental assessment of the current project is a transversal study that requires the analysis and processing of diverse data related to the characterization of the activities of the project on the natural medium such as fauna, flora, soil, metrological conditions, of the infrastructures, as well as the human medium such as the infrastructures, the population and the socio-economic activities.

This analysis aims to examine the consequences both positive and negative that the project would have on the environment in order to propose the adequate mitigation measures that should be implemented or even in special cases delete certain negative impacts.

Based on the available knowledge on the physical, biological and human environment as well as for the description of the project, the main points that will be discussed during the construction and operational phase are described as follow:
Air Quality: Mainly for fugitive dust, release of carbon oxides, sulfur oxides and volatile organic components.

Landscape: Land use, due to the existence of construction works and all the infrastructure that will be implemented, will involve alterations in the landscape of the study area.

The Fauna and Flora: During all the construction period of the project, the movement and displacement of work machines risk to disturb the fauna accustomed to live in the region while also risking in overwriting some woody vegetation located around the site.

The Nuisances: The main nuisances during construction phase can be summarized in the disturbance of the landscape and the noise generated by the work and construction machinery.

By-products of the treatment plant including sludge

Health: The implementation of the wastewater treatment plant nearby the city of Youssoufia will contribute in fighting against the waterborne diseases due to the fact the project will allow to enhance the quality of the wastewater released in the natural medium.

The local, regional and national economy: The implementation of this new wastewater treatment plant will have considerable impacts on the national, regional as well as local economy.

9.3 Sensitivity of the medium

We can distinguish three types of attributed environmental sensitivity parameters of the components of the study area:

1. Strong: A component of the environment is said to have a strong sensitivity in the environment if it satisfies the following two criteria:

   - The component is protected by an act or different acts that assess its viability.
   - The protection or the preservation of the component is subject to a consensus among specialists and managers

2. Medium: A component of the environment is said to have a medium sensitivity in the environment if it satisfies the following criteria:

---

18 National Environmental Policy Act : Council on Environment Quality (CEQ) Regulations
• The preservation and the protection of the integrity of the component constitute a subject of poor preoccupation for specialists and managers

• The component is subject of interest but does not get into a consensus by the specialists and managers.

3. **Poor:** The component of the study area has a poor environmental interest and its preservation, protection and integration into the system is not subject of interest.

The environmental values or sensitivity of each component of the study area is presented in the following table as follow:

<table>
<thead>
<tr>
<th>Recipient Medium</th>
<th>Value</th>
<th>Justification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td>Poor to Medium</td>
<td>Plateau region, windy throughout the year, allowing a good dispersion of the pollution. Nevertheless, particulates from the activities of the construction phase work may have important impacts.</td>
</tr>
<tr>
<td>Soil</td>
<td>Medium to Strong</td>
<td>The region is characterized by a little depth and not evolved that allows cereal agriculture.</td>
</tr>
<tr>
<td>Biological (Fauna)</td>
<td>Poor</td>
<td>According to studies on the region of Youssoufia, we can encounter mostly in the study zone the specie of Common hard and some foxes. These are not protected species and thus do not present a great disturbance for the implementation of the wastewater treatment plant.</td>
</tr>
<tr>
<td>Biological (Flora)</td>
<td>Poor</td>
<td>The Flora and vegetables presented in the study zone are few and do not present a possible problem for the construction and operation phase.</td>
</tr>
<tr>
<td>Surface Water</td>
<td>Strong</td>
<td>Agricultural use, Cattle water supply, meanwhile the rejected treated water is of high quality.</td>
</tr>
<tr>
<td>Landscape</td>
<td>Poor</td>
<td>The landscape of the region is flat and do not present and thus can be assessed as having a poor sensitivity.</td>
</tr>
<tr>
<td>Human</td>
<td>Medium to Strong</td>
<td>Prescience of multiple Douars and agricultural activities in the study area.</td>
</tr>
</tbody>
</table>

*Table 13: Environmental Values of the Recipient Medium*
9.4 Identification and Evaluation of the Impacts

This section of the study will deal with describing the positive or negative impacts, direct or indirect impacts of the components of the project that risk to be generated by different phases of the realization of the project.

9.4.1 Phases that may produce impacts on the environment

The project of Youssoufia Wastewater Treatment Plant is subject to two different phases that would engender multiple impacts either direct or indirect, as well as alterations on the environment. The phases are presented as follow:

The Construction Phase: It included multiple activities which would be the installation of work site with proper gear and equipment, the rehabilitation and extension of the existing network, the works for the realization punctual works, the works for the realization of the WTP and its annex buildings.

The Operational Phase:
For the presence, operation and maintenance of sanitation works. The project is constituted in general of three main components:

- The drainage pipes and storm water relief works which after the end of construction, will become buried in the ground and present no harm to the environment.

- All the necessary components for the operation of the wastewater treatment plant : pretreatment facilities, treatment tanks, pipelines …

9.5 Positive impacts of the Project

9.5.1 Enhancement of the Environmental Conditions

The realization of the wastewater treatment plant will significantly enhance the quality of life of population as well as reduced the nuisances engendered by the direct release of wastewater in the environment which create pollution, foul odors and are considered as potential vector of diseases

Consequently, the implementation of a wastewater treatment plant nearby the city of youssoufia will put an end to various nuisances and will allow the enhancement of:
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- The quality of the air by eliminating the odors related to wastewater discharges
- The quality of water and the protection of water resources due to the treatment of wastewater before the release in the recipient environment.
- The quality of Life of the population by improving the living environment, the sanitary conditions and the neighborhood water quality.
- The overall state of the environment, thus contributing to the sustainable development of the region.

We can estimate the quality of the wastewater treated using primary, secondary as well as tertiary treatments as being:

<table>
<thead>
<tr>
<th>Pollutant Charge</th>
<th>Units</th>
<th>Values Fixed by the Act</th>
<th>Concentration in the Treated Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOD5</td>
<td>mg/l</td>
<td>120 (mg O2 / L)</td>
<td>91</td>
</tr>
<tr>
<td>COD</td>
<td>mg/l</td>
<td>150 (mg )</td>
<td>116</td>
</tr>
<tr>
<td>Suspended Matter</td>
<td>mg/l</td>
<td>250 (mg O2 / L)</td>
<td>230</td>
</tr>
</tbody>
</table>

*Table 14: Comparison between Limit Values of Act 1607-06 and the Values in the Treated Wastewater.*

9.5.2 *Positive Socio-economic Impacts:*

The implementation of the Wastewater treatment plant will have a positive Socio-economic impact at both the local and regional level and that by generating multiple work opportunities and jobs during the construction and operational phase of the project.

Indeed, during the construction phase, the local workforce will come from the area close to the site. Due to the fact that an important part of the works is generally realized by local and regional companies, the realization of the project will allow the creation of temporary jobs during the construction and planning phase. Furthermore, new permanent jobs will be crated during the operational phase of the wastewater treatment plant.

9.5.3 *Positive Human Impact*

The treated wastewater will be directly reject into the agricultural land nearby the WWTP and will serve as drainage means to enhance the agricultural production of the region. In case of excess of water, there will be a rejection of high quality water to the nearby river. In addition to that, that wastewater will
be used to generate electricity using a turbine within the WWTP system that will be distributed to the city of Youssoufia.

9.5.4 Energy Reduction Impact

By generating electricity as well as heat using the combined heat and power system, the WWTP will be able to reduce the concentration of CO2 emissions within the atmosphere by consuming its own produced electricity. Indeed, a generated electricity of about 500 KW would satisfy part of the energy consumption of the WWTP and is thus considered as a long-term sustainable project with a renewable energy source. On the other hand, heat will also be generated by the CHP system and will largely contribute to the thermal energy needs of the WWTP.

9.6 Negative Impacts of the Project

9.6.1 Negative impacts on the environment during the pre-construction phase.

The pre-construction phase consists in the realization of technical studies, topographic works, geotechnical surveys as well as the installation work sites. In general, the activities are limited to site recognition and topographic surveys which present insignificant environmental impacts on the study zone.

9.6.2 Negative Impacts of the Project during Construction Phase

9.6.2.1 Impacts on the Physical Environment

9.6.2.1.1 Noise and Vibrations

The sound environment in the study area is generally composed of a set of distinct noises with regular pitches. These principal sources of noise within the environment generally include:

- The Agricultural activities during cultivation and harvesting periods
- The circulation of engines and vehicles on the road tracks of the city of Youssoufia.

In general, the noise generated by road infrastructure in the receiving environment project and along the sewer network during the day and night, are usually included in the maximum permitted levels set internationally in the guidelines of Community noise and are presented as follow:
<table>
<thead>
<tr>
<th>Area Concerned</th>
<th>Day (07:00 AM – 11:00 PM)</th>
<th>Night (11:00 PM – 07:00 AM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential,</td>
<td>55 (dBA)</td>
<td>45 (dBA)</td>
</tr>
<tr>
<td>Institutional,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Educative</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrial,</td>
<td>70 (dBA)</td>
<td>70 (dBA)</td>
</tr>
<tr>
<td>Commercial</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Table 15: World Health Organization Noise Guidelines*

During the construction Phase, the noises and vibrations come essentially from the machines of the workplace and the vehicles responsible for transporting the material. These noises will be temporary.

The zones most sensitive to the noise in the study zone during the realization phase of the project are those at the level of the habitations which are in proximity to the predicted sites of the installation of the project (Sewerage, Pipelines, Pumping Stations and WTP). The engines that will be used must be in excellent conditions and respect the legal noise limits.

### 9.6.2.1.2 Soil

The storage of certain material construction, such as hydrocarbons and cement used in construction and functioning of equipment can be a source of pollution for the study zone and the soil. Stored in unmanaged areas (without shelter against the storm and the runoff or non-sealed soils), these products can contaminate the quality of the soil as well as the rivers near the construction site. Such environmental accidents are mainly caused by the non-compliance to the products storage rules and the mismanagement of the site and its facilities. Among the operations that can cause the pollution of soil, we can cite:

- The supply of fuel in vehicles in conditions not to avoid or contain leaks and spills of these hydrocarbons.
- Uncontrolled discharge of Fuel on the site

On the other hand, and in order to accommodate the pipelines for the wastewater treatment plant, multiple works must be implemented such as the excavation and earthworks for the realization of the trenches, the movement of construction equipment and materials transport trucks or also the burying of pipes. All these works will cause nuisances that will directly disturb disrupt and change the quality of the surface soil. Nevertheless, mitigation measures will be proposed later to resolve this issue.
9.6.2.1.3 Soil Erosion

During construction phase, there is a risk of soil erosion due to operations such as vegetation removal, works to excavate the soil or also due to access roads establishment. Due to the long-term in-site construction operations, there is a risk of soil erosion and degradation in periods of heavy rainfalls, which would possibly negatively affect the nearby river.

9.6.3 The transportation of Construction Materials

The different materials required for the WWTP development will be delivered from various sources and then deployed within the site. These materials are generally carried out in ordinary overloaded and revealed trucks without covers. Consequently this would highly affect the frictional effect on the unpaved and off roads. Furthermore, there would be certainly a transport of soil minerals such as sand and silt which are very light materials that would easily debases nearby air quality. In addition, we should also take into consideration the possibility of material spillages intensify driving conditions and expand the danger of road collisions. These risk of transportation of these material is considered as a direct, short-term impact that should be taken into account during construction phase.

9.6.4 The Storage of Construction Materials

Due to amid substantial precipitation the would occur during winter precipitation, The development site could prompt the light materials to being sequentially lost and transported to the nearby river which would consequently contribute to the degradation of water quality as well as a heavy sedimentation of the particles within the river.

On the other hand, due to the storage of lubricant and fuel that will be used as means to support and refuel the substantial vehicles present on the construction site, there is a risk of accidental spill of chemical components such as hydrocarbons that would negatively affect the soil and would be a risk factor of pollution for the nearby river.
9.6.5 Impact on the biological Environment

9.6.5.1 Impact on the fauna

Generally speaking, the site works will generate impacts on wildlife which consist mainly of the modification of the behavior of present species which flight to the nearby zones.

According the ecological study performed by the Scientific Information Management System of Morocco, the zone of study does not have any endangered or threatened endemic animal species. Under these conditions, the impact of the project construction phase on wildlife is considerably low.

9.6.5.2 Impact on the flora

The study zone where the wastewater treatment plant will be realized does not show any protected plant species. For these reasons, the construction phase does not represent a significant on the local vegetable species.

9.6.6 Impact on the Human Environment

9.6.6.1 Road infrastructure

The construction phase of the sewerage system and the WTP will result in a slight increase in road traffic on the primarily road and networks that are sought. This increase in the traffic rate could retard the construction works which would negatively affect the urgent needs of the population.

9.6.7 Impact of the Waste

In case the project is implemented, there will be an important number of environmental problems and one of the most critical issues is the waste management issue and that whether it would be solid or liquid waste.

Nevertheless, the household waste that will be generated from human activity on the site should not pose major problem, in case they are put in specific labeled boxes which will be then collected and treated by municipal waste collection agents of the city. In case these measures are not respected, the direct discharge of waste into the environment present a high risk of bad odor and degradation of public hygiene. Furthermore, the abandonment of construction waste on site at the end of the work will constitute a major
problem for the environment since they contain dangerous persistent products such as oil, lubricants, cement and others.

9.6.8 *Impact on the Landscape*

It is indisputable that any project infringes the landscape of its environment, but with these vary widely depending on the project implementation area. For our case, the construction of the Wastewater treatment plant will certainly change the landscape of the study zone. Indeed, the presence of heavy equipment for construction, of stored materials and fences sheet around the work area will certainly have a significant impact on the landscape. Nevertheless, the presence of these construction equipment will be temporary and thus the impact on the landscape is considered as poor.

9.6.9 *Human Security*

A poorly organized construction site where security measures are not respected constitutes a threat to public safety and the safety of workers. Compliance with rules limiting public access to the site as well as the wearing of Protective Equipment such as safety shoes, helmets and gloves on the study zone by the workers will certainly reduce the risk of accident and thus maximize the human security. In case these measures are not taken into account, these human security impact would be considerable.

9.7 *Impact during operational phase*

9.7.1 *Impact on the Drainage Pipes:*

The drainage pipes and shedding structures of rainwater, which are realized before the construction, have no negative impact on the environment in the case of proper realization, since they are isolated from the study zone.

9.7.2 *Impact on the Wastewater treatment plant.*

9.7.2.1 *Impact on the Human Environment*

It is certain that the disposal of sludge from the WWTP will be an omnipresent activity in the operation of the treatment plant. The use of vehicles will therefore be at a relatively high frequency. Consequently, the operational phase of the phase of the wastewater treatment causes a slight increase in
road traffic primarily on the most traversed and sought traffic route which is the R201 that links the city of Youssoufia to the study zone.

9.7.2.2 Impact on the Physical Environment

9.7.2.2.1 Soundscape

The WWTP is designed in order to ensure optimal limitation of noise from installations during the operational phase. All arrangements will be made to limit the intensity of the noise inside and outside the station. This is particularly useful in a way that the:

- Constructive disposition which fixed the limiting noise and vibrations
- Consolidation of particularly noisy equipment in soundproofed locals
- Selection of building materials with excellent insulating acoustic characteristics

9.7.2.2.2 Impact related to the odors

Generally speaking, the purification of waste water is often the cause of bad odors: the sewage is charged with organic materials, nitrogen and phosphorus compounds which induce, directly or indirectly, the formation of malodorous compounds in the treatment process. Indeed, the presence of the Road R201 and Douars as well as some housing residences generate a risk of odor nuisance. For these reason, it is recommended to set up an odor control system at the preprocessing to reduce the odors especially the WWTP has an activated sludge system process with tertiary treatment.

9.7.2.3 Management of by-products of the Wastewater Treatment Plant

Poor management of by-products at the different stages of the purification process can constitute a serious health risk. To avoid contamination, the stabilized and limed sludge will be stored in bins ensuring autonomy before their regular evacuations to appropriate discharge.

9.7.2.4 Impact on the nearby River

As we all know, any thermodynamic system cannot reach a 100% efficiency, thus some of the treated wastewater will be directly rejected in the river close to the WWTP. Nevertheless, this operation could malfunction or thus generating pollution of the river by untreated sewage. Consequently, it is crucial to take into account all the necessary measures to ensure a good exploitation of the WWTP.
9.7.2.5  Impact Related to Soil Occupation

The change of landscape will be significant for the project's operating phase due to the presence of the WWTP. Indeed, in order to give the future Wastewater Treatment Plant and ecological function in connection with its local environment, the future works must be implemented in respect of the charges in terms of roads and access networks. Furthermore, in order to create a landscape and a pleasant visual field, a green screen surrounding the WWTP is likely to mitigate any potential harm to visual perceptions. Moreover, it is also recommended that the study zone would be improved by planting local tree, shrubby and herbaceous species which would fit perfectly into the landscape around the various facilities of the WWTP.

10 Matrix of Impacts

To perform a synthetic reading of all potential impacts of the project, an impact matrix is established which demonstrate the interactions between sources of impacts and environmental components in order to highlight the links of cause and effect.

The following table presents the matrix of Impacts for the Youssoufia Wastewater Treatment Plant:

<table>
<thead>
<tr>
<th>Impact</th>
<th>Phase</th>
<th>Positive (+)</th>
<th>Permanent (P)</th>
<th>Direct (D)</th>
<th>Major (MJ)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Construction</td>
<td></td>
<td></td>
<td>Indirect (I)</td>
<td>Minor (M)</td>
</tr>
<tr>
<td>Environmental Conditions</td>
<td>Operation</td>
<td>●</td>
<td>+</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Socio-Economic                | ●              | ●            | ●             |            |            |

| Noise and Vibrations          | ●              | ●            | -             | T          | I          |

| Soil                          | ●              | -            | T             | D          | M          |

| Transportation of Materials   | ●              | -            | T             | D          | MJ         |
### 11 Mitigation Measures

#### 11.1 Introduction

In this chapter we will try to define in detail the measures and operationally the must be must be taken into consideration in order to prevent, mitigate, repair or offset the negative consequences of the project on the natural and human environment.
Generally speaking, we can classify the mitigation measures into two distinct categories: General Mitigation measures and mitigation measures during construction and operation phases.

11.2 General Mitigation Measures:

Mitigation measures are intended to optimize the resources allocated to the project and to ensure the smooth running of the works. In other words, mitigation of impacts are intended to optimize the resources allocated to the project and ensure its smooth progress. The key points that apply to any project and also the wastewater treatment plant of interest are the following:

- Clearly signal the existence of the site in the most sensitive places by billboards
- Plan the work schedule favoring dry periods of the year
- Promote the reuse of materials and dismantled equipment
- Use adequate road signs and strictly regulate the flow of heavy machinery
- Water regularly and cover stocks of powder materials
- Observe a work schedule that will avoid disrupting the lifestyle of the population
- Establish an emergency plan against accidental spills of pollutants
- Ensure the safety of personnel (Collective Protection Equipment and Individual Protection Equipment) and Health of the site (cleanliness, waste management)
- Provide the redevelopment of roads and disturbed soil after the construction
- Clean and keep clean the entire site and facilities present on the site by establishing a Waste Management Plan
- Reduce noise by the use of engines and machinery that meet the International standards in terms of noise by using for example
- Arrange storage areas suitable for construction materials out of the harsh weather conditions
- Proceed to the redevelopment of the study area at the end of the construction work.

11.3 Mitigation Measures during the construction phase

The accidents on the construction site may be limited or even deleted if the elementary norms are followed. In general, and according to the environmental protection agency, the inclusion of the environmental factor during the construction phase of a project, by some measures of good practice relating to the conduct and scheduling of the work, can significantly reduce the nuisance. Consequently, we will
focus in this section on presenting the various mitigation measures that should be implemented within the construction work of the WWTP.

11.3.1 Quality of the Air

To avoid air emissions formed by the exhaust gas caused by vehicles involved in the construction as well as dust particles, the proposed following mitigation measures can be implemented:

- Practicing regular watering of the areas which may generate dust
- Limit dust emissions from traffic equipment, the machinery and trucks using for example tarpaulins or fresh water as a dust suppressant
- The Construction vehicles must meet the emission standards for discharges of air pollutants
- The systematic control of all vehicles of diesel type engine.
- Maintain equipment and machinery in good working conditions

11.3.2 Soundscape

The company responsible for the work must respect the specifications as well as regulatory requirements related to the noise and vibrations. To minimize the noise nuisance, some steps must be taken:

- Define traffic routes for trucks and noisy gear
- Use a machinery that meets the standards and regulations, and maintain transport vehicles and machinery in good working order to minimize noise emissions.
- Define traffic routes for trucks and noisy gear
- Avoid doing construction work at night
- Equip the site personnel by Ear Muffs
- Provide the building structure (noise barriers) so that the Acoustic pressure do not exceed the appropriate levels
- The Impact of noise should not exceed the level 55 dBA during the day and 45 dBA at night.

11.3.3 Socio-economic Activities

In order to maximize the economic positive impacts on the region and study zone, the following measures can be undertaken:

- Encourage the hiring of local labor
11.3.4 Utility and road safety Infrastructures

The construction phase may require some service interruptions including road traffic at the level of the road R201 for a limited period. In order to mitigate the negative impacts of condensed road traffic and accidents, the following mitigation measures should be applied:

- Adapt signage instructions at the site to ensure the safety of staff and users
- Establish markup and temporary signage site before starting construction work
- Ensure that the nature and position of the panels change according to the risk and project progress
- Avoid the concentration of traffic signs and do not place them too close to the ground
- Ensure that the panels support the effects of weather conditions and traffic

11.3.5 Quality of life and Health

- Avoid accumulation of any type of waste in non-affected areas and evacuate them to the disposal sites intended for this purpose
- Establish a communication program to inform the public of the construction work (time, location, duration) by warning signs

11.4 Mitigation Measures for Operational Phase

11.4.1 Drainage Pipelines

- Take all the protection and surveillance measures needed to prevent illegal tapping by farmers, raw sewage for irrigation
- Proceed regularly to maintenance and cleaning to prevent any garbage dump or clogging of pipes

11.4.2 Wastewater Treatment Plant

For this WWTP project, the activated sludge system will be used in order to achieve the objectives the meet the regulatory requirements set by the International Standards.
Table 16: Fixed Values for Pollutant Charge Rejection

<table>
<thead>
<tr>
<th>Pollutant Charge</th>
<th>Units</th>
<th>Values Fixed by the Act</th>
<th>Concentration in the Treated Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOD5</td>
<td>mg/l</td>
<td>120 (mg O2 / L)</td>
<td>91</td>
</tr>
<tr>
<td>COD</td>
<td>mg/l</td>
<td>150 (mg )</td>
<td>116</td>
</tr>
<tr>
<td>Suspended Matter</td>
<td>mg/l</td>
<td>250 (mg O2 / L)</td>
<td>230</td>
</tr>
</tbody>
</table>

The following mitigation measures must be implemented to reduce the impact on the wastewater treatment plant:

- Discharge the sludge at the discharge of the city of Youssoufia
- The daily maintenance of vegetation, fence and plant screen
- The qualification of all personnel for the operation of the wastewater treatment plant of the city of Youssoufia
- The maintenance of the electromechanical equipment
- Compliance with the Labor Code and the law on hygiene and safety, along with the provision of personal protective equipment (PPE) such as clothes, headphones, earphones, glasses, shoes … as well as collective equipment such as office furniture or workshop equipment.
- Ensure control processing performance of the STEP by measuring the physical and chemical parameters of wastewater at the inlet and outlet of the WWTP
- Conduct campaigns of insect and rodent control in the fight against the proliferation of sickness vectors with the help of the competent authorities
- Ensure proper management of the sludge by performing stabilization techniques, and drying up before transportation to the discharge
- Maintain the efficiency and effectiveness of the treatment of the WWTP
- Provide a regular maintenance of the aeration tank as well as the clarifier considered as the principal components of the WWTP

11.4.3 Valorization of Treated Wastewater

The region of Youssoufia hosting the study zone is experiencing a surge aridity. However, farmers continue somehow to plow their land and mostly depend on metrological conditions. The valuation of treated wastewater would be to use the treated wastewater in order to develop an irrigated culture that would
be of a great help to households and would ensure a decent income while avoiding the exodus to the city. On the other hand, this valorization will also create a "buffer zone" around the WWTP that will allow an enhancement of irrigation perimeter with the time increase.

On the other hand, the Treated Wastewater would be used as a source of energy for the production unit of electric within the WWTP.

12 Environmental Assessment Summary

The project for the implementation of the WWTP in the study zone aims into enhancing the life conditions as well as reducing health related issues of the population for the city of Youssoufia. Nevertheless, the implementation of such a project would necessarily involve the presence of negative impacts which were previously discussed in this ESIA project and that would considerable reduce the productivity of the WWTP as well as its integration within the environment. However mitigation measures have been developed to remedy to this impacts.

On the other hand, if we take into account the environmental and social management plan of the project that will be discussed in the next section of this paper, and that allow to considerably reduce the negative impacts, as well as if we compare the positive and the negative impacts of the project, we can already assess that the implementation of the WWTP nearby the city of Youssoufia is feasible and acceptable.

The environmental assessment summary displayed in the tables below, present in abbreviated and summarized manner, the potential negative and positive impact related to both the construction and operational phase as well as their respective mitigation measures with a special emphasize on the duration and extent of the Impact.

It is also necessary to note that certain identified negative impacts at the moment of the construction and operation of the WWTP. These negative impacts are classified by order of importance and described as follow:

- The risks of accidental pollution by hydrocarbons during the construction phase
- The occupation of roads and road traffic disruption during the construction phase
- Nuisance related to the presence of mosquitoes
- Odor nuisance during operational phase of the project or unfavorable weather conditions
<table>
<thead>
<tr>
<th>Environment Medium</th>
<th>Component</th>
<th>Description of the Impact</th>
<th>Mitigation Measures</th>
<th>Evaluation of the Impact</th>
</tr>
</thead>
</table>
| Physical Environment | Soundscape | The construction site is a source of noise: Works as well as operation and movement of machines and vehicles | -Reduce noise by using silent vehicles (Compressors, generators, hammers, Biting, etc.)  
-Turn off the engines of personal vehicles and machines when not needed for works  
-Adjust the sound level of the warning vehicles in the construction site  
-Regulate the duration of each construction operation within the site | Short and Poor Impact |
| Quality of Air | -Gaseous Discharges of the exhausts  
-Dust and Particulate matter airborne | -Regularly check the correct operation and working of all gear and vehicles on site  
-Tarp trucks which are carrying powdery materials  
-Regular watering of the tracks and roads  
-Watering or covering of powder materials stocks | |
| Infrastructures | -Increased road traffic around the construction zone of the WWTP | -Establish markup and temporary signage site before starting construction work  
-Respect the carrying capacity of roads and repair the damages caused to the roads after completion | |
| Security | -Hygiene and sanitary conditions that are not applied  
-Road Occupancy | -Securing the enclosure of the construction site  
-Ensure that all security rules are respected | |
| Geological Environment | Quality of the Soil | -Risk of accidental pollution of the soils due to the work | -Organize the construction site as to ensure a proper maintenance perspective of the machinery, materials management and safety.  
-Dispose the spoil excess in public landfills  
-Promote the reuse of materials using during the construction of the WWTP  
-Ensure proper inventory management of reusable materials in order to avoid the contamination with other materials.  
-In general, all the reasonable precautions that aim to prevent leaks and spills of pollutants | Strong and Short Impact |
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Lamssali Mehdi

| Biological Environment | Fauna and Flora | Disturbance of the local Fauna | - Reduce the construction materials as much as possible
- Localize the fauna present within the study zone and ensure proper precautions. | Short and Poor Impact |
|------------------------|----------------|-------------------------------|---------------------------------------------------------------|----------------------|
| Landscape and Visual Comfort | - Perturbation due to the presence of the construction site | - Ensure a proper survey to the local’s population opinion by the use of registry complaints with effective monitoring and implementation of corrective actions
- Systematic marking of the construction site and ensure its long-term stability by performing pre-calculation before construction begins. | Poor and Long Impact |
| Health and Quality of life of the Population | - Disturbance of the neighborhood of the study zone in the construction phase.
- Earthworks, transportation and Circulation activities
- Presence of waste within the construction site | - The access roads to the construction site as well as installations networks must be watered regularly.
- Avoid the accumulation of any type of waste in the unaffected areas for this purpose
- Establish a communication program to inform the local population of the construction works which include the time, duration and localization and respect work schedule
- Closing of the construction site and Refurbishment of premises | Short and Poor Impact |
| Economic Activities | - Generation of direct and indirect jobs
- Extensive development of the economic activity | - Favor the Recruitment of the local labor force
- Planning of the construction site
- Adequate signalization of the construction site
- Minimize the extent of the construction site | Strong and Long Impact |
| Local Population | Accessibility of the trails and local terrains that are connected to the WWTP and which are frequently used by the local population | - Restoration of all existing connections and networks after the construction phase is finished.
- Creation of new networks and access road to the WWTP | Strong and Long Impact |
## Summary of the impacts and Mitigation Measures during Operational Phase

<table>
<thead>
<tr>
<th>Environment Medium</th>
<th>Components</th>
<th>Description of the Impact</th>
<th>Mitigation Measures</th>
<th>Evaluation of the Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physical Environment</strong></td>
<td>Soundscape</td>
<td>Noise emission during operation of amenities</td>
<td>Good management of structures and equipment</td>
<td>Poor and Strong Impact</td>
</tr>
<tr>
<td></td>
<td>Landscape and Visual Comfort</td>
<td>-Good landscape integration through the creation of bodies of water and by the plantation of trees on the perimeter of the WWTP</td>
<td>Integration of facilities in the landscape : Management of planted green spaces</td>
<td>Poor and Long Impact</td>
</tr>
<tr>
<td></td>
<td>Quality of Air</td>
<td>Dissipation of nuisance odors nearby the study zone</td>
<td>Integration of odor control systems within the WWTP</td>
<td>Strong and Long Impact</td>
</tr>
<tr>
<td><strong>Human Environment</strong></td>
<td>Health and Quality of Life</td>
<td>-Problem of invasion by mosquitoes at the level of the treatment ponds</td>
<td>-Establishment and implementation in collaboration with Public Health services of a program for the fight against sickness vectors such as rodents and mosquitoes</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Sludge Production by the WWTP</td>
<td>-Perform regular disinfestation</td>
<td>Strong and Long Impact</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Problem of invasion by mosquitoes at the level of the treatment ponds</td>
<td>-Vaccination of the staff and workers within the construction site in order to avoid waterborne diseases and viral infections from the WWTP.</td>
<td>Strong and Long Impact</td>
</tr>
<tr>
<td><strong>Quality of Air</strong></td>
<td></td>
<td>-Odors (refusal to pretreatment, anaerobic ponds, waste extraction, sands and fat from the works preprocessing)</td>
<td>-Drainage of water discharged by overflow -Implementation of odor reduction measures, particularly at the pretreatment stage -Stabilization of sludge at the bottom of the lagoons -Avoid prolonged stagnation of the wastewater and sludge that promotes formation of harmful gases that are the origin of Odors</td>
<td>Strong and Long Impact</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Increased exhaust gas related to vehicle traffic</td>
<td>-Equip the WWTP with an odor control system -Shorten the time of transfer of the sludge produced by the WWTP</td>
<td>Strong and Long Impact</td>
</tr>
<tr>
<td>Planting of a double row of trees / shrubs</td>
<td>Quick drying of treatment ponds</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
13 Environmental and Social Management Plan

The last segment of the Environmental and Social Impact study concerns the observing of the distinctive periods of the Wastewater Treatment Plant and the development of the earth keeping in mind the end goal to guarantee the accompanying criteria:

- The impacts that are described in the Environment Impact Assessment Study are in constituency with the real situation of the Site
- The mitigation measures produced the expected results when applied to compensate the negative impacts
- Maintenance of an adequate operation of the Wastewater treatment plant

Indeed, the main environmental objectives and consideration the company responsible for the construction and operation of the WWTP must take into consideration are described as follow:

Construction Phase

- Build up and realize controls for the temporary workers to guarantee that the proposed alleviation measures are actualized in a convenient and compelling way. This incorporates procurements for laborer safety, waste and materials administration.
- Build up an administration framework in view of a reasonable cleanliness and Security Program and additionally the assurance of a proper Environment Management.
- Minimize the effect on the environment by aiming for an objective of zero impact occurrence.
- Ensure the proper implementation of the Environmental and Social Operational Phase

- Ensure proper management of the aesthetic appearance of the WWTP with a special focus on the nearby ecosystems
- Conduct maintenance procedures according to the procedures of the WWTP
- Identify the environmental performance of all the targets of the WWTP by assessing procedural environmental management plan
- Train the staff and workers on the safety procedures that should be taken into account while operating and maintaining the WWTP.

14 Environmental Monitoring Program

The monitoring program is designed to ensure the progress of construction work is properly controlled under the conditions and consideration of the measures cited above in this EIA both in terms of site construction, organization and operational phase. The environmental monitoring must include the inspection, control and intervention for construction phases and operational phases of the WWTP. In other words, the measures that will described in this section will allow the company to monitor if the WWTP respects the environmental standards for the study zone.

14.1 Lists of applicable measures for environmental protection

14.1.1 Identification of the influence of the study zone

The site must be installed near the structures to be built, and near an existing access road for the supply of material. The site should be located so as to bring the least possible harm to nearby residents. The possible measures that should be taken before the construction of the WWTP include:

- The installation of the construction site with storage areas
- The provisions for hygiene, health and safety
- The selection of hoses and accessories
- The characteristics of fill mate
14.2 Installation of the work site

Beside the WWTP components, the site facilities must include all the appropriate buildings and machinery necessary to the execution of the works and are described as follow:

- An office for the foreman
- An office for the technical staff
- Changing rooms and toilets
- Access Roads
- Fences and signs
- An infirmary for emergency care
- The facilities and Storing areas
- The dispositions for hygiene, health and safety of workers
- The dispositions for waste management and soil Compaction

14.3 Soil Compaction

Before the start of the construction works, it is necessary to establish a Plan for the management of Soil Compaction that delimits and specifies the quantities of materials to be used as well as the temporary disposal sites that will not cause a disturbance for the soil, indeed the construction materials could possibly cause a soil compaction. Generally speaking, Soil compaction represents the relation to how much force is applied on the soil area and the severity or degree of seriousness of this phenomenon is increased if there is a presence if construction equipment. The following graph describes this degree:
To prevent this phenomenon, and before the start of the construction work, it is necessary to minimize as much as possible the necessary construction equipment as well as analyze the most possible areas in the study zone that are sensible to the soil compaction.

14.4 Circulation of Vehicles

Given the importance and the high frequency of transport foreseen in this WWTP Project, it is necessary to keep a close regulation on the conditions of security for the construction of the WWTP. The company responsible for the construction works must ensure that the speed of circulation of the vehicles and heavy engines is limited and that the signalization is respected to enhance the security on site.

14.5 Waste Management

The objective of this section is to describe the dispositions related to the prevention of waste accumulation on the construction site as well as the reduction of the quantity of this waste. Furthermore, this section will also demonstrate the environmental monitoring measures that should be taken into consideration when for the temporary ecological storage, distribution and transportation of this waste.

The company responsible for the construction works must ensure a proper waste management by following the described measures:

- Ensure a good waste management by the recruitment and formation of workers and technicians on site. This formation must include the good practices and procedures that would minimize as much as possible the accumulation of waste.
- The company must also ensure the monitoring and implementation of waste directives by performing the following tasks:
- Ensure the cleanliness of the construction site
- Perform periodic inspections of waste storage areas
- Ensure the development and implementation of contingency plans and emergency in case of spill
- Ensure proper communication with the companies responsible for the collection and disposal of waste
- The disposal of domestic waste must be regularly maintained.
14.6 Nuisance management

The management of nuisances include the management of dust, particulate matter, noise of construction equipment and vibrations. To reduce the impact of these nuisances, the construction company take into consideration the following procedures:

14.6.1 Dust and Particulate matter

Dust and particulate matter will be released during certain operations such as transportation of powdered materials and their storage. The following the measure that must be taken into account:

- Require that trucks carrying equipment that can emit dust and particulate matter are covered with a tarp and washed before and after leaving the site if necessary.
- Avoid storing or discharge of raw materials outside temporary storage areas.

14.6.2 Noise and Vibrations

Mitigation and Prevention measures must be applied to minimize the noise of the construction site in order to avoid that the level of sound emissions disturb the zones and areas with population such as habitations. According to the international sound disturbance programs, the sound levels in the study zone should be maintained below 70 dBa.

To ensure that the noise issue is resolved, the mitigation measures that the company should apply must resolve the root of the problem and are described as follow:

- Use of equipment which generate noise levels at their lowest value.
- Installing appropriate noise suppression equipment on the exhaust of engines and compressors
- Ensure that all gear and equipment used on the site are in good condition and are equipped with silencers that are in good condition
- The construction and operation schedules of the site must be fixed while avoiding the work at night.

14.6.3 Lighting

The lighting of the WWTP is necessary for the security of the site, nevertheless it can be a source of nuisance for the population nearby, this limited lightning is advised within the operational and
construction phase of the WWTP. Also, the construction company is responsible for informing the local population of these works.

14.6.4 Working time and information for the local population

Given the nature of the construction and operational works, working hours must be modeled as to limit any disturbances to the local population. In case the specific construction works are done during the night, these works must be limited in noise and vibrations.

14.7 Sludge Use

The construction company must make sure of the proper management for sludge within the WWTP. As stated before, the sludge will be used in an anaerobic sludge system to be transformed into biogas and storage into tanks. The biogas will be then to generate electricity and distributed to the electrical network. Furthermore, the sludge will represent an added value to the agricultural lands with the use as a fertilizer.

15 Conclusion

All in all, the environmental impact assessment of the Youssoufia WWTP has allowed to assess that multiple factors and impacts that would be generated in case of the implementation of the project within the study zone. Through a sequential analysis, this paper has also demonstrated the multiple mitigation measures that would applied in order to reduce the negative impacts at both the environmental and socio-economic level.

On the other hand, through a consistent calculation and projection of typical values for the WWTP, the research paper has also demonstrated some of the most important design consideration and dimensioning thresholds that should be taking account during the implementation of the WWTP especially during activated sludge treatment process which would generate significant biogas production.

Finally, the Youssoufia WWTP is considered as being both an eco-friendly and renewable energy project, since it will allow to first generate biogas through an activated sludge treatment process, then this biogas will to generate both electricity and heat through the combined combined heat and power process. The electricity and heat will be used to remedy to the energy consumption of the WWTP. Moreover, the WWTP will also be able to generate consistent fertilizer through sludge dewatering which will enhance the production of the agricultural potential of the region. Lastly, the WWTP will be able to produce high quality treated wastewater that will freely distributed to the agricultural field for irrigation.
16 References


Watercare organization


**Software Used:**

Hydromantis GPS-X Software

ArcGIS

Wind Finder

Google Earth

SolidWorks