This questionnaire has been designed by a work team of the Technological Center CARTIF to obtain information about the wastewater treatment plant in the field of the MEDAWARE project - Development of tools and guidelines for the promotion of the sustainable urban wastewater treatment and reuse in the agricultural production in the Mediterranean countries

1 BASIC DATA OF THE WASTEWATER TREATMENT PLANT

Name: WasteWater treatment Plant of Drarga ONEP- Direction Régionale du Sud- Agadir	Position: Sousse-Massa-Darâa Region *east of Agadir*

1. Where is your local wastewater treatment plant located?

Address: **Tagadirt-Naâbadou / Commune Rurale Drarga / Cercle Agadir Banlieux / Préfecture Agadir Ida Outanane / Région Souss Massa Draâ**

City: Agadir	County: Morocco	State: rural community of **Drarga**	Zip: **BP 845 Poste Principale / Agadir /Préfecture Agadir Ida Outanane / Royaume du Maroc**

Current situation of the WWTP- drarga : In charge of the (ONEP) (Office National de l'Eau Potable)

The National Office of Potable Water (ONEP)	Telephone number:	Fax number:	E-mail address
1- Fanzi Abd hamid (Chef de service assainissement à Drarga)	212 48842176	212 48823400	**Krafik@onep.org.ma**
3- Mahi Mustapha (Chef service recherche et développement à Rabat)	212 37657396	212 37655686	**mustapha_mahi@onep.org.ma**

2. How many stages of treatment does your facility use?

Primary	☐	anaerobic pond
Secondary	☐	Infiltration perccolation (Sand filters)
Tertiary	☐	Reed Beds
Other	☐	Denitrification

3. What is the capacity of the treatment plant?

Liters per day (average)	1200 m^3
Number of People and/or Employees	16000 people
Peak Daily Flow Estimate	2130 m^3

4. How is the sludge disposed of?

Landfill	☐
Other	☐

The dried sludge must be removed with a small loader and disposed of or used for co-composting with municipal solid waste. The on-site municipal solid waste/wastewater sludge co-composting project is currently under design through a separately funded project.

5. Where does the treated wastewater go after it leaves the plant?

River or Stream	☐
Reuse	☐

In 2001, the commune of Drarga started operating the treatment plant and provided treated wastewater to a few farmers to irrigate fields in the irrigated perimeters of 6 Ha around construction site of the plant. Currently, farmers grow forage crops, particularly alfalfa, clover, maize, and others vegetables crops.

The bypass chamber is the first structure in the wastewater treatment plant. Normally, all of the wastewater flow generated by the Municipality will be treated at the plant. However, during heavy rain events, a large quantity of rainwater may enter the collection sewer system through inflow and infiltration.
This rainwater will dilute the strength of the sewage, but it will also increase the quantity of sewage above what the treatment plant is capable of handling. During such periods, the treatment plant will continue to function at full hydraulic capacity, while any additional flow will bypass to the intermediate pump station from where the combined raw sewage and recirculating sand filter effluent will be pumped into the Oued Irhzer El Arba. It is anticipated that this situation will occur very infrequently, and when it does the Oued Irhzer El Arba will be flowing with water which will further dilute the bypassed sewage.

6. In what year was the plant built?

October 2002

7. Have there been any modifications of the plant in recent years?

-The methane from the anaerobic basins is recovered and converted to energy to run pumps at the plant , thereby reducing electricity.

8. Are there any plans for additional improvements to the plant?

-The design nitrate recycle ratio is 2.4 for the year 2010 design and 1.8 for the year 2020 design. There are two anaerobic lagoons in the year 2010 design.

-A third lagoon will be added in the$_3$ future expansion to the year 2020 design flow. Each lagoon has a volume of 918 m^3 and the units combine to provide a 3.0 day hydraulic detention time (HRT) for the year 2010 design flow, and a 2.3 day HRT for the year 2020 design flow.

-There are two denitrification lagoons in the year 2010 design. A third lagoon will be added in the future expansion to the year 2020 design flow.

-There are two flow holding basins in the year 2010 design. A third basin will be added in the future expansion to the year 2020 design flow. Each basin has a volume of 360 m^3 .

- Two RSFs will be dosed at a time for the Year 2010 design, and three at a time for the Year 2020 design. Each RSF has a surface area of 1560 m^2 and at the design dosing rate of 360 m per sand filter, the hydraulic loading will be 230 mm per dose. Each RSF is dosed once every five dosing periods. There are three dosing periods each day. In each dosing periods, the slide gate at the end of both flow holding basins is opened, sending a rush of stored wastewater onto the surface of two of the RSFs.

9. Wastewater analysis information (influent)

Wastewater BOD	625
Wastewater COD	1825
Wastewater Suspended Solids	655

10. Treated water- Local government requirement - If known (effluent)

Wastewater BOD	9.4
Wastewater COD	5.7

Wastewater Suspended Solids	39

2 WASTEWATER TREATMENT INFORMATION

11. Primary Treatment Processes

	Processes	*Size (if know)*	*Main operational problems (if exists)*
☐	Bar or bow screen: to remove large floating and suspend solide		
☐	Grit removal : two parallel grit removal chambers		
☐	Primary sedimentation: anaerobic pond	_918 m^3	__production gas__

12. Secondary Treatment Processes

	Processes	*Size (if know)*	*Main operational problems (if exists)*
☐	Anaerobic filter	Sand filters (360m^3/filters/d)	Production the NO_3^- AND COLMATAGE
☐	Stabilisation ponds	Regulation basins	________________________________

13. Tertiary Treatment Processes

	Processes	*Size (if know)*	*Main operational problems (if exists)*
☐	Infiltration: Reed Bads	2900 m^2x 2	________________________________
☐	Denitrification: anaerobic basins	736 m^3	_____production gas_______

14. Advanced Treatment Processes

	Processes	*Size (if know)*	*Main operational problems (if exists)*
☐	_______________	___________________	________________________________
☐	_______________	___________________	________________________________

Other comments about the WWTP of the Drarga

Bypass Chamber
The bypass chamber is the first structure in the wastewater treatment plant. Normally, all of the wastewater flow generated by the Municipality will be treated at the plant. However, during heavy rain events, a large quantity of rainwater may enter the collection sewer system through inflow and infiltration. This rainwater will dilute the strength of the sewage, but it will also increase the quantity of sewage above what the treatment plant is capable of handling. During such periods, the treatment plant will continue to function at full hydraulic capacity, while any additional flow will bypass to the intermediate pump station from where the combined raw sewage and recirculating sand filter effluent will be pumped into the Oued Irhzer El Arba. It is anticipated that this situation will occur very infrequently, and when it does the Oued Irhzer El Arba will be flowing with water which will further dilute the bypassed sewage.

Screening
The first step of the treatment process is to remove large floating and suspended solids, rags, rocks, debris, and other large objects from the influent wastewater. These objects will be captured in the manually cleaned influent bar screen located immediately downstream of the bypass chamber. Influent screening is important because large solids and rags could potentially clog downstream pumps, pipes, and valves if not removed at this time.

Grit Removal
The next step of the treatment process is grit removal, which occurs in two parallel grit removal chambers. Dense solids such as sand or bone fragments will settle to the bottom of this chamber, from which they must be shoveled out by hand. A proportional weir at the end of each chamber maintains a constant flow velocity through the chamber. This constant velocity ensures that biodegradable organic solids, which are typically less dense than grit, will not settle inadvertently in the grit removal chamber.

Flow Distribution
There are three flow distribution boxes in the plant: Flow Distribution Box No. 1, Flow Distribution Box No. 2, and the Nitrate Recycle Flow Distribution Box. These boxes are used to spilt the wastewater flow evenly between all process tanks on line by flow over equal length sharp-crested weirs set at the same height.
In addition, the Nitrate Recycle Flow Distribution Box allows the RSF effluent pumped from the intermediate pump station to be distributed proportionally between the denitrification lagoons and the reed beds. By using stop plates to cover some of these weirs, the operators can achieve a 3:1, 2.4:1, 1.8:1, 1.2:1, or 0.6:1 ratio of nitrate recycle to plant influent. The design nitrate recycle ratio is 2.4 for the year 2010 design and 1.8 for the year 2020 design. The ratio is lower for the future design condition because the nitrogen concentration in the plant influent is expected to decrease with modernization of the area (see Development of Design Criteria, above).

Anaerobic Lagoons
The purpose of the anaerobic lagoons is to remove COD present in the influent wastewater through anaerobic biological decomposition. At the same time, suspended solids present in the influent wastewater and the bacteria that grow as a result of the anaerobic activity will settle to the bottom of the lagoon. There are two anaerobic lagoons in the year 2010 design. A third lagoon will be added in the future expansion to the year 2020 design flow. Each lagoon has a volume of 918 m and the units combine to provide a 3.0 day hydraulic detention time (HRT) for the year 2010 design flow, and a 2.3 day HRT for the year 2020 design flow. The anaerobic biological decomposition process

generates methane gas and carbon dioxide as a byproduct. Floating covers over the lagoon capture this gas. Collection piping carries the gas to a 16 kW engine generator, which converts the energy in the methane gas into electricity. The electricity can be used to power the operator's house, laboratory, and selected pumps. Submersible sludge pumps in the bottom of the lagoon can be used to pump the sludge out of the lagoon onto the sludge drying beds for dewatering.

Denitrification Lagoons
The purpose of the denitrification lagoons is to remove oxidized nitrogen (nitrate and nitrite) by the biological process of denitrification. This process is carried out by heterotrophic bacteria operating in an anoxic environment. The bacteria require a carbon source to carry out the denitrification process. The carbon source in this application is the COD present in the anaerobic lagoon effluent wastewater.
Additional COD can be supplied by directly bypassing a portion of the influent wastewater from Flow Distribution Box No. 1 around the anaerobic lagoons. The effluent from the anaerobic lagoons contains most of the nitrogen present in the form of TKN. Therefore, a portion of the effluent from the RSFs (in which the nitrification process has converted ammonia into oxidized nitrogen) must be recycled back to the denitrification lagoons. This is accomplished by the Nitrate Recycle Flow Distribution Box. Like the anaerobic lagoons, the denitrification lagoons contain submersible sludge pumps that can be used to pump settled solids out of the lagoons and onto a sludge drying bed for dewatering. There are two denitrification lagoons in the year 2010 design. A third lagoon will be added in the future expansion to the year 2020 design flow. Each lagoon has a volume of 736 m and the units combine to provide a 2.4 day nominal HRT for the year 2010 design flow, and a 1.9 day nominal HRT for the year 2020 design flow.

Flow Holding Basin
The purpose of the flow holding basin is to store the effluent from the denitrification lagoons until it is time to dose the next sand filter. The sand filters are dosed three time per day, so the combined volume of the flow holding basins are equal to one-third of the total volume of influent flow and nitrate recycle flow for one day. At pre-set intervals during the day, the operators will manually open the sluice gate at the end of the flow holding basin, releasing the contents of the basin to the RSFs. There will be relatively few solids present in the flow leaving the denitrification lagoons, but some additional solids may settle out in the flow holding basins and can be removed periodically by draining the foot of the basin into the recycle pump station. There are two flow holding basins in the year 2010 design. A third basin will be added in the future expansion to the year 2020 design flow. Each basin has a volume of 360 m^3.

Recirculating Sand Filters
The primary purpose of the recirculating sand filters (RSFs) is nitrification (the biological process by which ammonia is converted to nitrate by autotrophic bacteria under aerobic conditions). Additional reduction of BOD and some degree of denitrification will also take place in the RSFs. The denitrification is possible in portions of the RSF which do not receive adequate oxygen. The primary source of oxygen in the RSFs is diffusion of oxygen into the upper layers of the sand from the air. This effect is enhanced by frequent “tilling” of the sand on the surface. The tilling process involves turning the top few centimeters of sand to expose the bacteria growing on the sand grains to the surface air. The tilling process also breaks up the hard pan of solids and algae that tends to build up on the RSF surface over time. Some oxygen will also enter the bottom of the RSF through the open underdrains. There are ten RSFs built for the Year 2010 design flow. An addition four RSFs will be constructed for the year 2020 design flow. Two RSFs will be dosed at a time for the Year 2010 design, and three at a time for the Year 2020 design. Each RSF has a surface area of 1560 m^2 and at the design dosing rate of 360 m^3 per sand filter, the hydraulic loading will be 230 mm per dose. Each RSF is dosed once every five dosing periods. There are three dosing periods each day. In each dosing periods, the slide gate at the end of both flow holding basins is opened, sending

a rush of stored wastewater onto the surface of two of the RSFs. The flow of wastewater onto the RSF surface is faster than the liquid can percolate through the sand, so the liquid ponds on top of the sand surface. The ponding results in an even depth of wastewater over the entire RSF surface, which in turn, ensures an even distribution of flow across all parts of the RSF. Over the next several hours, the ponded water percolates through the sand particles, where attached bacteria carry out the nitrification process.
The close packing of the sand grains also filters out solids. In addition, studies at Ben Sergao have indicated that significant pathogen reduction occurs across the sand filters, both from filtration and from natural die-off of bacteria, which is largely a function of time and temperature.

Intermediate Pump Station
The effluent from the RSFs drains into the intermediate pump station. The maximum water level in the intermediate pump station must be kept below the bottom of the RSFs to allow the RSFs to drain completely. Due to the great depth below the ground surface at this point, submersible wastewater pumps are used to lift the wastewater back up to the surface level. These pumps serve a dual purpose, as they also return a portion of the RSF effluent back to the front end of the denitrification lagoons to serve as a source of nitrates for the denitrification process. The intermediate pump station has a large volume so that it can act as a flow equalization point. Even though liquid exits the RSFs at an inconsistent rate (due to the periodic loading method), the RSF effluent flow will be equalized in the intermediate pump station and (when properly adjusted) the pumps will operate at a constant rate throughout the 24-hour period.

Reed Beds
There are two reed beds, each about 2,900 m in area. These membrane lined beds, which are subsurface irrigated with a constant water depth of 1.0 m, will be planted with local varieties of fastgrowing giant reeds (qchqlich and aghanin) in alternating rows. The primary purpose of the reed beds is to grow reeds that will be harvested periodically and sold as a source of income for the plant. The reed beds will also remove some nitrogen and other nutrients from the wastewater by uptake into the plants and by biological nutrient removal. This nitrogen removal, however, will be partially off-set during many parts of the year by the loss of water through the basins due to evapotranspiration. Thus, although the nitrogen load (in kg/d) will decrease across the reed beds, the change of nitrogen concentration across the reed beds is highly dependent on the percentage of water loss across the reed beds. The concentration can increase or decrease.

Effluent Storage Ponds and Pump Station
$_3$There are two effluent storage ponds, each with a volume of 1,014 m^3 . The effluent flow storage ponds store treated effluent from the plant until it is needed by the local farmers. The effluent pump station pumps treated plant effluent from the effluent flow storage ponds to the farmer's fields for use as irrigation water. A flowmeter is used to measure the quantity of irrigation water delivered to the farmers. Irrigation water will be distributed among the eligible farmers through a piping distribution network. Valves will be installed at each farm parcel and controlled under the authority of a "gouadier" (according to the traditional rules of the region). Major crops to be developed include alfalfa, clover, corn, bananas, zucchini, pumpkin, cabbage, potato, and onion. Water may be allocated for cereal crops, such as wheat, during certain crucial growing periods (such as the ripening period). The reuse water will provide a significant source of nutrients (nitrogen, phosphorus, and potassium) to the irrigated crops without excessive contribution of nitrates to the groundwater. Excess water which is not required by the farmers will overflow the storage ponds and into the adjacent Oued Irhzer El Arba.

Sludge Drying Beds
The purpose of the sludge drying beds is to dewater sludge produced in the anaerobic lagoons and the denitrification lagoons. The liquid sludge is pumped from the bottom of the lagoons by submersible pumps and onto the surface of the sludge drying beds. The liquid portion of the sludge will evaporate into the atmosphere or drain through the sand in the drying beds into the underdrain

below. The underdrain is piped back to the anaerobic lagoon effluent channel. The dried sludge must be removed with a small loader and disposed of or used for co-composting with municipal solid waste. The on-site municipal solid waste/wastewater sludge co-composting project is currently under design through a separately funded project.

3 CONTROL AND MONITORING SYSTEMS

15. Which are the most critical process parameters that may affect the efficiency of the wastewater treatment plant? **(Case of the Drarga)**

	Parameter	*Process*	*Current Automatic Control?*
☐	Wetwell levels	On-off pumping	No ☐
☐	Sludge depth	Primary treatment	No ☐
☐	Solids Retention Time (SRT)	Conventional activated sludge	Yes ☐ No ☐
☐	Dissolved oxygen concentration	Conventional activated sludge	Yes ☐ No ☐
☐	Return flowrate from the clarifier	Conventional activated sludge	Yes ☐ No ☐
☐	Internal recycle	Biological nutrient removal	No ☐
☐	Methanol feed rate	Biological nutrient removal	No ☐
☐	Air / solids ratio	Dissolved air flotation thickening	No ☐
☐	Sludge depth	Gravity thickening	No ☐
☐	Belt speed	Gravity belt thickening	Yes ☐ No ☐
☐	Chemical dosage rate	Chemical addition for water-solids separation	No ☐
☐	Chlorine dosage rate	Chlorination	No ☐
☐	____________________	________________________________	Yes ☐ No ☐

All the operations are carried out manually.

16. In your opinion, what are the main problems with the control system of the wastewater treatment plant?

All the operations are carried out manually;

17. In your opinion, what treatment processes / parameters should be monitored / controlled automatically?

-pH of wastewater .
-Flows of wastewater.
-Wetwell levels (On-off pumping)
-Chlorine dosage rate
-All Retention Time (for each operation)
-Sludge depth.
-Dissolved oxygen.
-Volumes of the produced gazs or their pressure for the recovered basins.
-Color of treated water.
-Chemical dosage rate (nitrogenized forms and phosphorus)

If you have any questions about this document, please contact us by e-mail at yolnun@cartif.es

Thank you for you collaboration.

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