MAIA-TAQA

MAIA-TAQA - Mobilizing new Areas of Investments And Together Aiming to increase Quality of life for All

Report on the pilot project definition

WP3 Development of sustainable services in the MED area (pilot cases)

Output 3.1 Detailed design of the pilot project

WP leader: QUIPO

Responsible partner: Industrial Research Institute - IRI

Date	Version	Comment
February 26, 2020	1	-

Content

• Abstract/Summary

The main purpose of this document is to provide the main features of the detail design of the Lebanese pilot project in the framework of WP3- "Development of sustainable services in the MED area" of MAIA TAQA project.

The pilot project will consist of a construction of a Waste Water Treatment Plant for the IRI building, and the reuse of the treated water for irrigation purposes.

The proposed design aims to fulfil the following priorities:

- Efficient system with the best quality for price ratio
- Innovative technology for treatment, monitoring of treated water & valorisation of sludge
- Large potential of application in local context

• Abbreviations

DAF	Dissolved Air Floatation
IRI	Industrial Research Institute
MBBR	Moving Bed Bio-Reactor
RE	Resource Efficiency
RES	Renewable Energy Sources
WWTP	Waste water treatment plant

1. Pilot Project definition

1.1 Pilot Project Site Description

The plant shall be built at the Industrial Research Institute premises located in the Lebanese University Campus in Hadat, 10 km from Beirut.

Established in 1953, the Industrial Research Institute (IRI) is registered as a Lebanese non-profit institution declared of public utility by D/L n° 10059 dated 17 August 1955, linked to the Ministry of Industry by Lawn° 642/1997, with administrative and financial autonomy for studies, industrial research and scientific testing, calibration, inspection and certification (system, product and personnel).

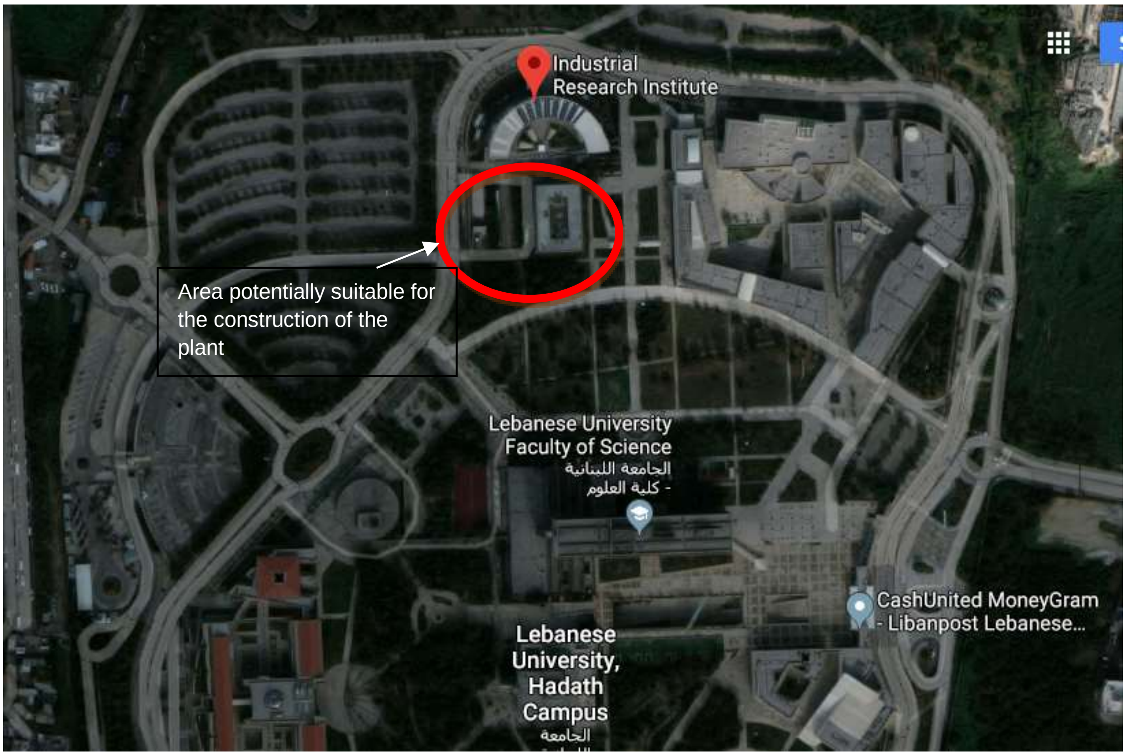


Figure 1: Satellite view of pilot project site (source Google maps)

The location of the building is at the following coordinates:

Longitude: 35° 31' 17"

Latitude: 33° 49' 53"

Altitude: 49m

The building was constructed in 2004. It has a gross area of 8,000 m^2 spread on 4 floors of 2,000 m^2 each. The main use of the building is for offices, labs, and workshops. The number of occupants is around 145.

The construction material used for the building are the following:

Bearing elements: Masonry, concrete, steel

External walls: Masonry, concrete, aluminum

Roof: Concrete, steel

Ground floor slab: Concrete, steel

Windows glass pane: Double, double low-E

Windows frame: Aluminum

Partitions: Concrete, masonry

Figure 2: Photo of the IRI building

1.2 Sources of Electricity

The building has three sources of electricity:

1 – Diesel Generators: Three diesel generators (500 kVA, 500 kVA, and 200 kVA)

2 – Solar PV: A total capacity of 80 kWp solar PV system is installed on the building (Roof, overhangs, and canopy)

3 – EDL network: The building is connected to the national grid of Electricite Du Liban (EDL). However, due to the sensitivity of lab equipment and the instability of the EDL network (variation in Voltage), the diesel generators and PV systems are used most of the time.

The average electricity consumption of the building is 1,300 kWh per operational day.

1.3 Water and Wastewater

Water Supply:

The water is supplied by the Lebanese University (LU) Campus ground water wells. Additional water need is bought by LU and supplied to IRI during the months of water shortage (in Summer).

Water Consumption:

The water consumption is between 30,000 and 35,000 liters per day.

IRI laboratories, watering and hand wash, consume between 15,000 and 20,000 liters per day and the rest is for flushing.

Water Quality:

It is supposed to be fresh and potable water. However, starting the month of April every year the water TDS level increases up to 8,000 in summer and therefore the water is treated by a Reverse Osmosis system.

Storage:

The total storage of water available on IRI premises is 36,000 Liters divided as follows:

4 tanks of 8,000 L each

2 tanks of 1,000 L each

1 tank of 2,000 L

Wastewater:

There is no wastewater treatment plant on site. The wastewater network depth is between 1.5 and 4 m.

Separate wastewater network are available (for labs, for grey water, for storm water…) with different sizes (4", 6" and 8"). However, they are connected to the same 60 cm diameter pipe of the campus.

2. Preliminary Assessment of the Lebanese Pilot Project

The aim of this project is to construct a pilot wastewater treatment plant with a maximum capacity of 20 m^3/day.

For this purpose, a containerized packaged unit including monitored flow controls and quality control devices was selected.

This system has many advantages on the conventional wastewater treatment stations:

A- Quick installation period, minimal disturbance period to the campus during installation.

B- In case the capacity increased, the station is modular and a new container (station) can be added.

C- The additional plant can be installed without interrupting the operation of the existing one.

D- Station can be easily relocated.

The technology or type of treatment adapted is the MBBR type with many innovative ideas, for example:

A- Highly efficient system with low power consumption

B- Solar power for saving electricity;

C- System flexible with flow or capacity fluctuation;

D- Advanced monitoring.

3. Pilot Project Configuration

The proposed solution is based on the following:

- Innovation in value: Best value for price system in terms of initial investment (capex) and running cost (Opex)
- Innovative technology:
  - Highly efficient system with low power consumption
  - Potential for power saving using solar power
  - Flexible system in terms of fluctuation in daily consumption
  - Movable system for re-use in different areas

- Advanced monitoring:
    - Potential for monitoring inlet and outlet water quality via use-friendly application
    - System can be interlocked with alarm system notifying maintenance specialist
- Adaptable system with potential of use in different fields.
- Sludge valorization
- The WWTP plant will be connected to the main wastewater network outflow pipe.

The proposed solution will consist of:

- Settlement tank and screening for solid separation
- Neutralization system
- DAF unit for oil and grease removal
- Advanced MBBR unit for biological treatment
- Tertiary treatment

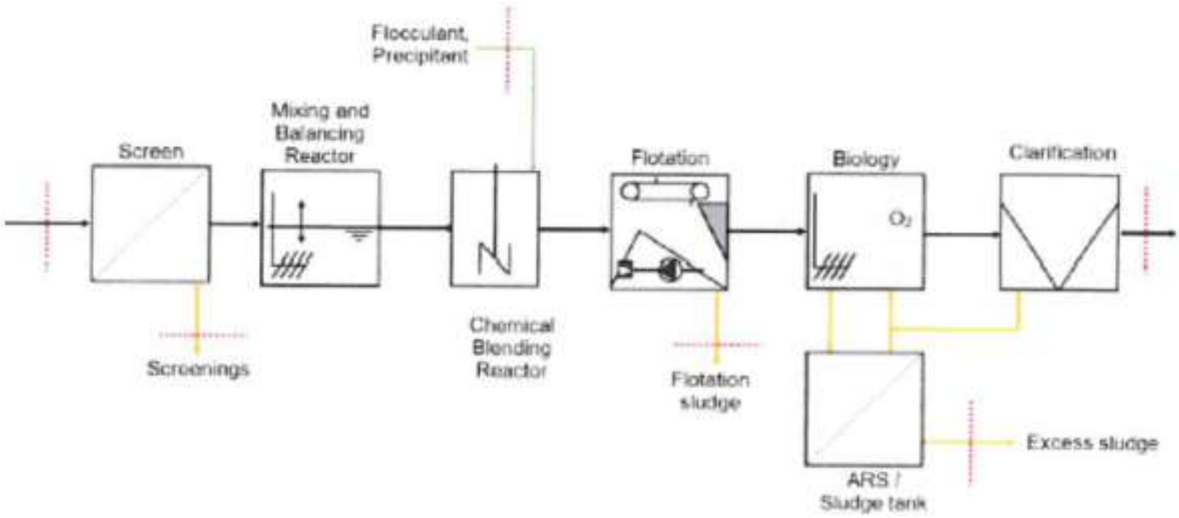


Figure 3 – Pilot schematic view

The wastewater is collected after a manual screening in a settlement tank, allowing heaving solids to settle at its bottom. Firstly, the wastewater will be neutralized by dosing PH regulator reagent, then the wastewater is dosed with a coagulant and a flocculent to conglomerate the particles into bigger clusters. Water is then transferred to the dissolved air floatation (OAF) unit. The OAF clarifies wastewaters by the removal of suspended matter such as oil or solids. The removal is achieved by dissolving air in the water or wastewater under pressure and then releasing the air at atmospheric pressure in a flotation tank basin. The released air forms tiny bubbles which adhere to the suspended matter causing the suspended matter to float to the surface of the water where it may then be removed by a skimming device. Water is then transferred to a Moving Bed Bio-Reactor (MBBR) waste water treatment plant.

The Advanced MBBR process includes a combination of extended aeration and Floating Biological Reactor technology. Water enters through the anoxic compartment, working as a mixing tank for the return sludge and raw sewage. In this compartment, under anoxic conditions a partial denitrification occurs and the flow is forced to the second compartment by gravity.

In the next compartment of the aeration tank the pollutants which give rise to the Biochemical Oxygen Demand (BOD) are removed by the bio mass freely circulating in the compartment. Specially designed free floating Bio Media provides a large biofilm surface area as host for the bacteria and freely flows inside the compartment.

The next compartment is the activated sludge compartment. Organic waste pre-treated by the Free Floating Biomedia in the previous compartment is introduced in to a compartment where an aerobic bacterial culture is maintained in suspension. The content of the compartment is called as MLSS (Mixed Liquor Suspended Solids).

Bacterial culture, in the presence of oxygen, carries out the conversion of organic matter in wastewater in to new bacterial cells, carbon dioxide, ammonia and other end products. Bacteria inside the Activated sludge compartment form a satisfactory floc to achieve an effective separation of the biological solids in the settling compartment. Air requirement of compartment 2 and 3 is supplied by side channel air blowers and high efficiency, fine bubble diffusers.

The mixed liquor is displaced from the aeration tank by the incoming feed and flows by gravity to the settling tank. The function of the settling tank is to allow separation of the suspended solids from the mixed liquor by means of tilted plates. The separated liquid discharged from the tank over the weir for disposal as final effluent.

Activated sludge from the settling tank is returned to the aeration tank via submersible pump. Dead sludge from the settling tank will be periodically discharged into a sludge holding tank via submersible pump. Treated water is pumped through a sand filter for tertiary treatment, making it suitable for non-edible irrigation.

The quality of the treated water is expected to be as follows:

Table 1 – Concentrations of treated wastewater

Parameters	Maximum Concentration
BODs	25 mg/1
COD	125 mg/1
TSS	35 mg/1
TKN	40 mg/1

The effluent quality shall conform with the Lebanese Ministry of Environment Decree No. 52/1- Standards for the minimization of pollution to air, water and soil. Effluent quality shall be suitable for non-edible irrigation, and the energy consumption for the proposed system shall be around 10 kWh per hour.

4. Technical Recommendations and Reservations

The Pilot Project technical recommendations and reservations are as follows:

• Hydraulic load is considered not to fluctuate more than 20%

• DAF unit to reduce oil & grease.

• MBBR station for biological and physical treatment.

• Excess sludge is transferred to a sludge holding tank, where it will be stored, and aerated.

• The station is assumed to have 24-hour power supply, from EDL or a back-up generator. However, an integrated solar system will act as a third power source, reducing the power consumption of the station up to 70% (depending on usage).

• Tertiary treatment for further filtration, to make the effluent water suitable for non-edible irrigation.

• Treated water will be stored in a treated-water tank, before it is pumped to the irrigation water tank.

• An optional odor control unit to minimize emitting disturbing odors to the plant surroundings.

5. Electrical Load and Space Requirements

The total electric load needed for the operation of the proposed WWTP is 17.5 kw (operational electrical load).

As for the space requirement, the MBBR station needs a 40ft container (12.05 m x 2.35 m x 2.39 m) while the DAF unit: a container of (3.5 m x 2.5 m x 2.5 m).

6. Mechanical and Plumbing Requirements

The requirement needed to be available at the station or to be provided by general MEP contract of the campus are as follows:

• Vent

• Main power supply line

• Connection between waste water main line and the sewage treatment station

• Pumping and connections between treated water tank and storage tank

• Fresh water line

7. Pilot replicability in Lebanon

Taking into account of similar wholesale markets in each city, the designed pilot presents a wide possibility of replication. As the core of the proposed system is a OAF and Advanced MBBR system, it will be adaptable to different scenarios ranging from small scale domestic to large scale industrial. Depending on the raw water quality, the chemicals injected in the OAF unit can be adjusted to keep the proposed solution relevant. And depending on the quantity of water to be treated, parallel compact units can be added. Finally, as the station is containerized and movable, the station can be moved to different locations if needed.

8. Pilot development timetable

Table 1 lists the start and end date of the main phases of Lebanese pilot development.

Table 2 – Main tasks for pilot development

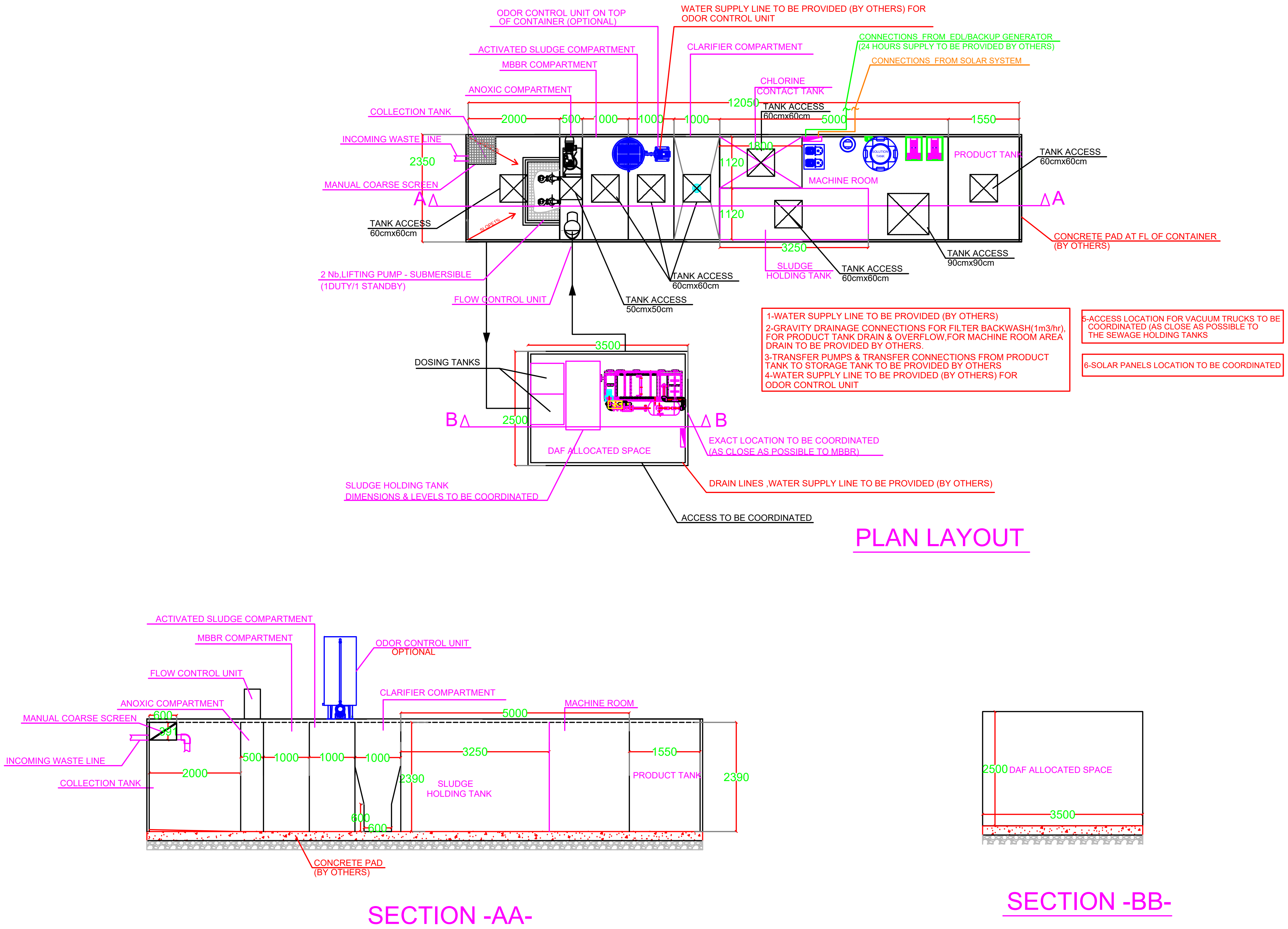
Task	Deadline
Technical Recommendation and reservations Loads and space requirement General MEP requirements, Power, Drain, Make up Water. Budget	2/February/2021
Plant Preliminary design	5/February/2021
Bill Of Quantity	17/February/2021
Detailed Schedule of Equipment Approved vendor list	19/February/2021
Electro Mechanical Specification General conditions	26/February/2021
Final Design Drawings Footprint	12/March/2021

A summary of the different steps with the corresponding date can be found in the table above

The ToR document for the execution phase is expected to be ready by the end of March 2021 (tentative depending on the situation).

Annexes

Annex 1: WWTP Plan Layout and Section
Annex 2: WWTP Flow Diagram



WATERMASTER

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GENERAL NOTES:

1) Responsibility Of CLIENT :

- All civil works, lifting, crane, Loading, unloading, etc...
- The execution of a drainage line to evacuate the backwash/ brine water.
- Any consumables such as, but not limited to, spare parts, water, power, chemicals, lubricants, fuels for erection, commissioning or running the plant except where specifically included herein.
- The main cable feeder shall be supplied by client to the water treatment plant Control panel. The above supplied cable feeder shall be protected by a disconnect switch.
- Sump pit to evacuate backwash water.

Rev #	Last revision dates	Drawn by:	Checked by:	Status
0	05/02/2021	C.L.	D.A.Z.	

Project/Subject
CONSTRUCTION OF A WASTE WATER TREATMENT PLANT FOR THE INDUSTRIAL RESEARCH INSTITUTE

Client

Attention

Phase / Nature
SCHEMATIC DRAWING SDW

Primary Technical Discipline
MECHANICAL

Drawing Number and Title
PLAN LAYOUT & SECTION 1/2

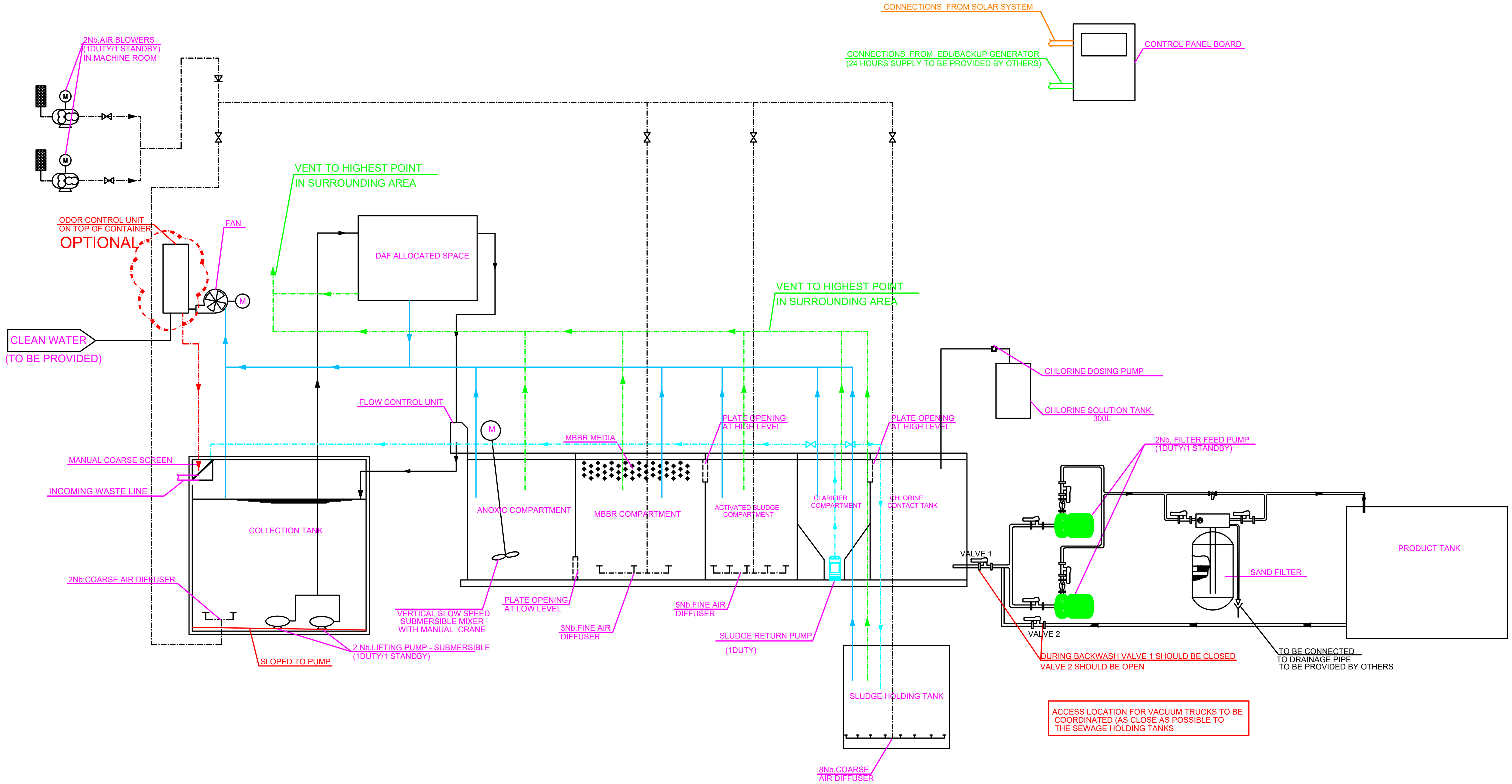
Revision Number

Review Cycle :

Format A3 | Scale 1/100

Revision Issue Date :

Plan Refernece:



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Primary Technical Discipline
MECHANICAL

Drawing Number and Title
FLOW DIAGRAM 2/2

Revision Number

Review Cycle :

Format A3 | Scale 1/100

Revision Issue Date :

Plan Referece: