Contract ID : **20EO0109**
Contract Name **: Cluster 15 - Sewerage and Waste Water Facility and Boardwalk**
**15.1 - Construction of Boardwalk and Sewerage Treatment Plant Phase 2 at Sabang Beach**
**15.2 - Construction of Boardwalk and Sewerage Treatment Plant at White Beach**
Location of the Contract**: Puerto Galera, Oriental Mindoro**

## PROJECT FACT SHEET

| | | |
|---|---|---|
| **Name of the Project** | SEWERAGE AND WASTE WATER FACILITY AND BOARDWALK | |
| **Proponent Name** | LOCAL GOVERNMENT UNIT | |
| **Proponent Address** | POBLACION,PUERTO GALERA ORIENTAL MINDORO | |
| **Authorized Representative** | **Name**<br>Mr. ROCKY D.ILAGAN | **Designation**<br>Mayor |
| **Proponent Means of Contact** | **Landline No.**<br>043-287-3045 | **Fax No.**<br>043-287-3045 |

### Project Description

| **Project Type** | **Project Size Parameter** | **Project Size** |
|---|---|---|
| Infrastructure Projects; Waste Management Projects; Domestic wastewater treatment facility (including septage treatment facility); | Based on system capacity | 3000.000000 cubic meter |
| **Other Description Details:**<br>Construction of boardwalk and sewage treatment plant at White Beach,Puerto Galera Oriental Mindoro.Location : Puerto Galera Oriental MindoroProject Classification : General BuildingContractor : MARCBILT CONSTRUCTION INC./EFREN RAMIREZ CONSTRUCTION AND GENERAL SERVICES CORPORATION(JV)IMPLEMENTING OFFICE :DPWH REGION IV-BPROJECT DURATION: 360 CALENDAR DAYS | | |

### 1.1. PROJECT LOCATION AND AREA:

| | | |
|---|---|---|
| Street/Sitio/Barangay:<br>SAN.ISIDRO PUERTO GALERA | Zone/Classification (i.e. industrial, residential):<br>General Tourism Zone | |
| Region:<br>R4B | City/Municipality:<br>Puerto Galera | Province:<br>Mindoro Oriental |
| Total Project Land Area:<br>11444.00 sq. m. | Total Project/Building Footprint Area:<br>600.00 sq. m. | |

### Geographic Coordinates of the Project Area (WGS84):

| Area | Longitude | Latitude |
|---|---|---|
| 1 | 120.905143 | 13.507679 |
| | 120.904684 | 13.507091 |
| | 120.904078 | 13.506355 |

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# PROJECT DESCRIPTION

## I. OVERVIEW

Puerto Galera is a Y-shaped peninsula located on the north shores of Mindoro Island, 130 km south of Manila and 14 nautical miles from Batangas City or 13°23' to 13°32'N; 120°50' to 121°00'E in Geographic Positioning System (GPS). One of its Baranggay, San Isidro, houses the White Beach. Baranggay San Isidro covers a total land area of 853.356 hectares.

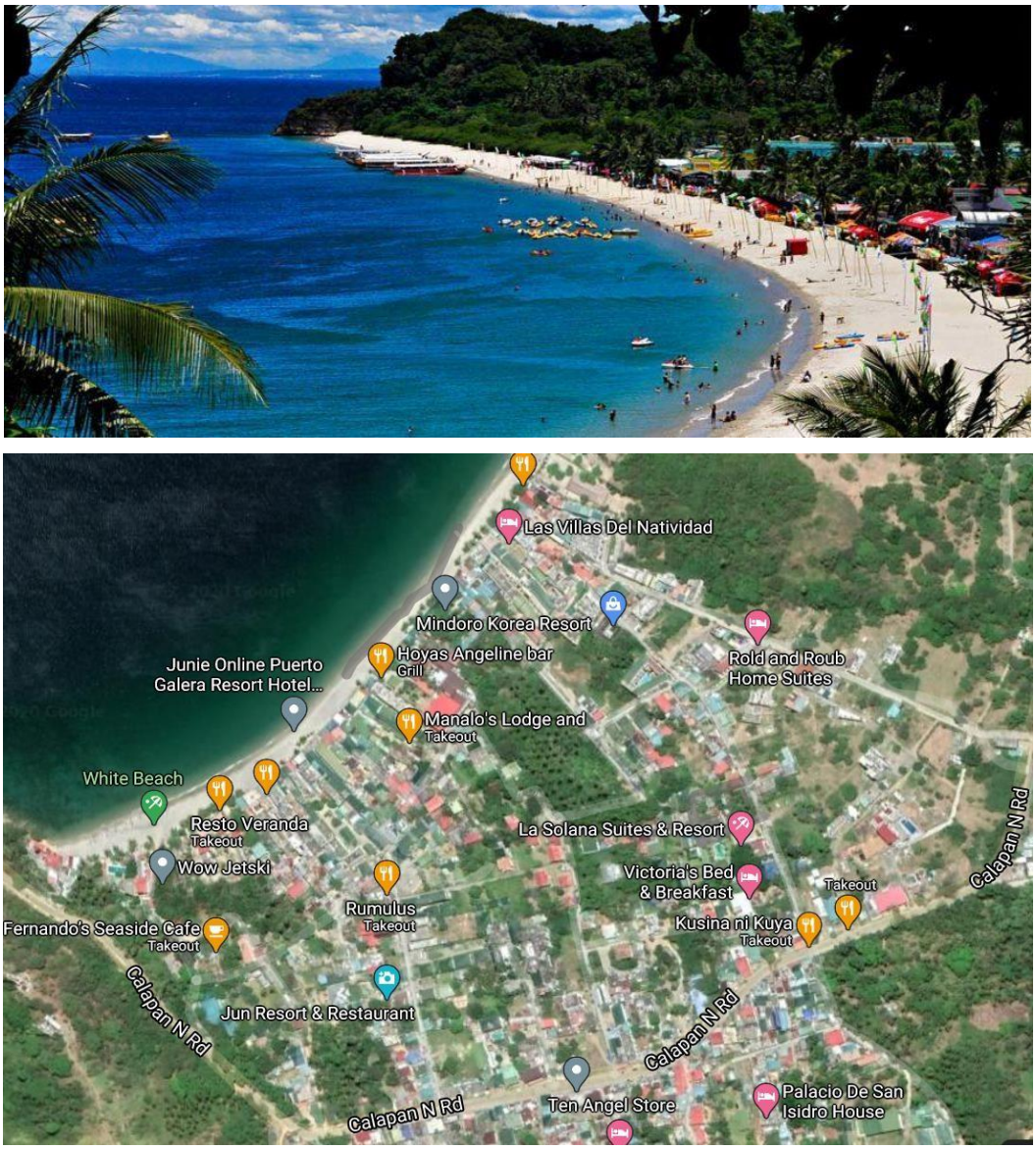


Figure 1. White Beach, San Isidro, Puerto Galera.

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Location of the Contract**: Puerto Galera, Oriental Mindoro**

The project shall consist of Sewerage Main Line and Wastewater Treatment Plant, catering to Domestic and Commercial (i.e. accommodations and restaurants). Its discharge location is a nearby creek, classified as SB waters. The treatment technology to be used is called the Modified Sequencing Batch Reactor with Nutrient Removal with a max capacity of 3000 cubic meters per day.

| Parameter | Details |
|---|---|
| Area | Brgy. San Isidro, White Beach |
| Scope | Sewerage Main Line and Wastewater Treatment Plant |
| Type of Wastewater | Domestic and Commercial (i.e. accommodations and restaurants) |
| Discharge Location | Nearby Creek (Class C Waters) |
| Treatment Technology | Modified Sequencing Batch Reactor with Nutrient Removal |
| Max. Capacity | 3000 $m^3$/d |
| Building Area | 600 sq.m |
| Land Area | 11,444 sq.m |

## II. COVERAGE AREA

The projects shall cover the treatment of wastewater coming from the household and commercial establishments near the White Beach of Brgy. San Isidro, Puerto Galera, Oriental Mindoro.

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*PERSPECTIVE VIEW*

## III. SCOPE OF THE PROJECT

1. The project shall include process design and process engineering of one (1) wastewater treatment plant (WWTP), with an average flow capacity of 1,761 cu.m. per day and maximum design flow capacity of 3,000 cu.m. per day.
2. The project shall include the detailed design of the conveyance system, including Pump Stations and Piping Systems, from household and commercial establishments to the proposed WWTP also the extension of the existing boardwalk.

## IV. WASTE WATER TREATMENT PLANT

1. Treatment System

The project shall include detailed electromechanical engineering designs extending to automation and instrumentation of the treatment plant and conveyance system. The project shall include installation of all equipment listed in Table 1

Table 1. Equipment Requirements

PUMP STATION

Submersible Pump

PRELIMINARY TREATMENT

Manual Bar Screen

Equalization Pump

BIOLOGICAL TREATMENT

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Aeration Blower

Fine Bubble Diffuser System

Waste Activated Sludge Pump

Decant Pump

BIOLOGICAL NUTRIENT REMOVAL

Anoxic Submersible Mixer

Chemical Dosing Pumps

Chemical Storage Tanks

DEWATERING SYSTEM

Volute Press

Chemical Dosing Pump

Chemical Preparation Mixer

DISINFECTION AND EFFLUENT SYSTEM

Chlorine Dosing Pump

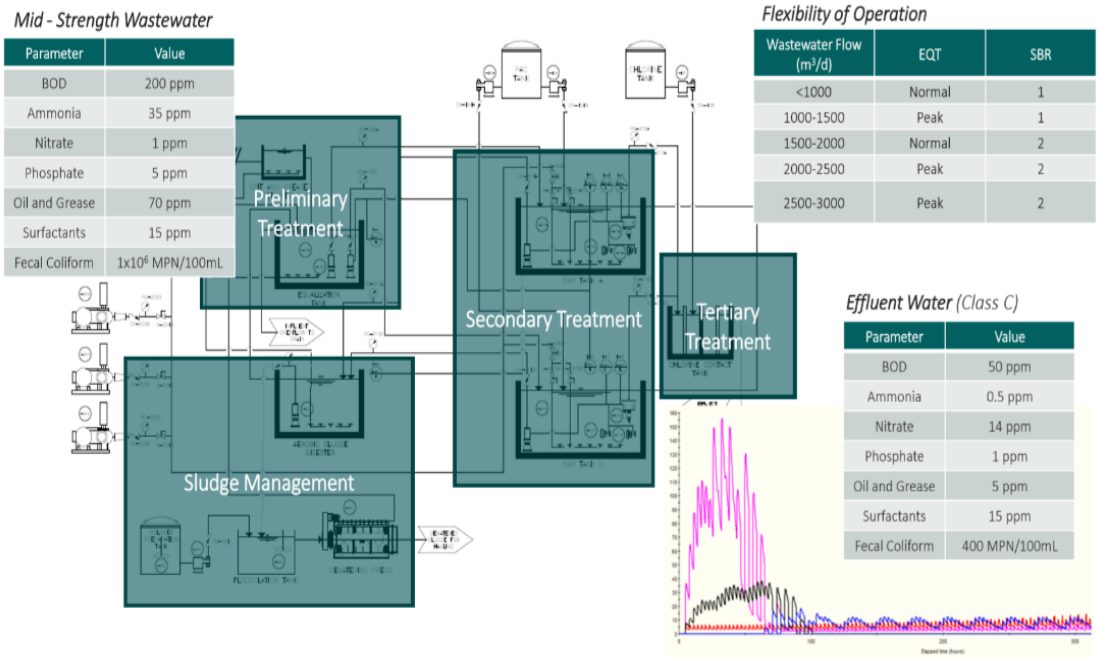
Effluent Pump

The process design is based on the standard Sequencing Batch Reactor (SBR) system. The SBR is an activated sludge process for treating wastewater which follows a four-phase treatment process. The activated sludge produced reduces organic matter and

biodegradables pollutants along with the unwanted nutrients. For compliance to the DAO 2016-08 standards, the modified SBR system will be using anoxic and aerobic processes with minimal chemical dosing.

The four phases of operation in the Sequencing Batch Reactor are as follows:

1. Fill- Mix – Wastewater fills the tank, mixing with biomass that settles during the previous cycle, in this stage, a submersible mixer is used to suspend the sludge and promote an anoxic environment for nitrogen-removal.
2. React – Air is added to the tank to promote biological growth and pollutant degradation
3. Settle – Aeration is discontinued allowing the solids to settle leaving only the treated effluent above the sludge blanket
4. Decant – Withdrawal of treated effluent from below surface of the mixed liquor, chlorine is dosed in the chlorine contact tank while the treated effluent is being discharged.



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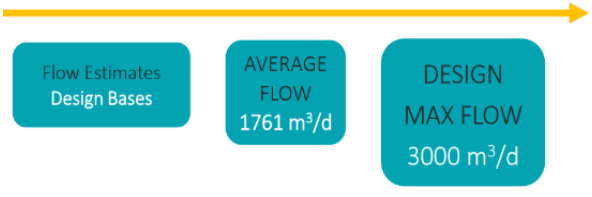
## 2. Design Standards

The treatment facility will have a total estimated floor area of 600 sq.m., capable of reducing the pollutant level for the following parameters: Biochemical Oxygen Demand (BODs), Chemical Oxygen Demand (COD), Total Suspend Solids (TSS), pH, Oil and Grease (O&G), additional nutrients including Ammonia ($NH_3$-N), nitrates ($NO_3$-N) and Phosphates ($PO_4$) as prescribed in the new effluent standards (DAO 2016-08) set by the Department of Environment and Natural Resources (DENR). The treatment technology will be based on the Modified Sequencing Batch Reactor with Nutrient Removal, also known as SBR System. It includes 4 lift stations near the boardwalk with different capacities: LST-1A (3cu.m.), LST-2A (5cu.m.), LST-3A (8cu.m.), and LST-1B (3cu.m.). Each will use gravity flow to collect the wastewater generated from individual households/resorts, wherein these lift stations will centralize the collection of the wastewater for treatment. This project will provide a treatment facility for domestic and residential waste water and ensure safe effluent disposal and discharge which is based on a 20 year design period.




| Design Basis | |
|---|---|
| 2030 Population (at 4% Growth Rate) | 7,181 |
| Commercial to Residential Water use Ratio | 0.75 |
| Wastewater Conversion Ratio | 0.80 |
| Percentage of Infiltration | 15% |

| Year | Population |
|---|---|
| 2010 | 3,702 |
| 2011 | 3,839 |
| 2012 | 3,981 |
| 2013 | 4,128 |
| 2014 | 4,281 |
| 2015 | 4,439 |
| 2020 | 5,237 |

Average Growth Rate: 3.2%

| Year | Water use ratio |
|---|---|
| 2005 | 0.76 |
| 2006 | 0.70 |
| 2007 | 0.70 |
| 2008 | 0.69 |

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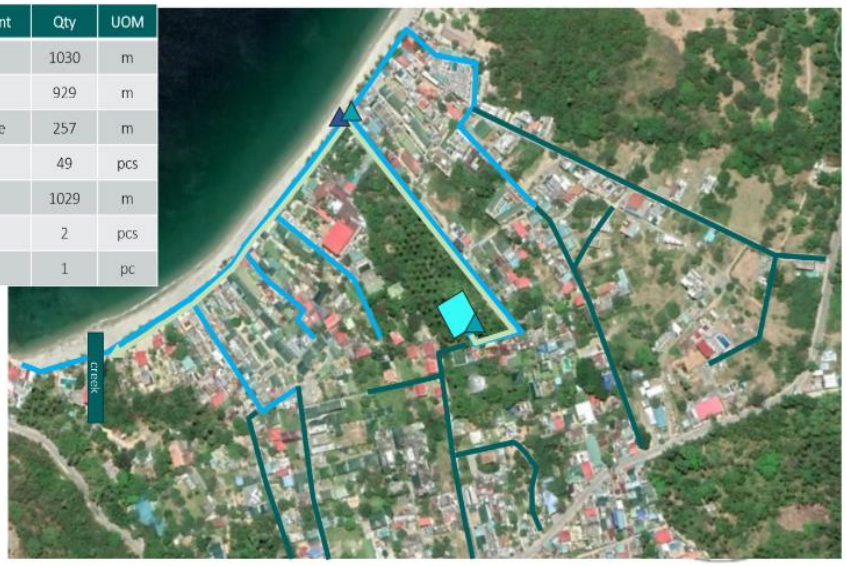
## V. CONVEYANCE SYSTEM

The project shall include the detailed design of the conveyance system, including Pump Stations and Piping Systems, from household and commercial establishments to the proposed WWTP.

The project shall include the supply, cutting and connection of all pipes for the conveyance system.

| Conveyance System Component | Qty | UOM |
|---|---|---|
| 200 mm PVC Gravity Pipe | 1030 | m |
| 250 mm PVC Gravity Pipe | 929 | m |
| 100 mm PVC Pressurized Pipe | 257 | m |
| Sewer Manhole | 49 | pcs |
| 200 mm PVC Gravity Pipe | 1029 | m |
| Lift Station | 2 | pcs |
| Pump Station | 1 | pc |



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# PROJECT CONSTRUCTION PHASE

Scope of the project makes the detailed design on wastewater treatment plant with an average flow capacity of 1,761 cu.m. per day and maximum design flow capacity of 3,000 cu.m. per day. The treatment facility will have a total estimated floor area of 600 sq.m., capable of reducing the pollutant level as prescribed in the new effluent standards (DAO 2016-08) set by the Department of Environment and Natural Resources (DENR). The project shall consist of Sewerage Main Line and Wastewater Treatment Plant, catering to Domestic and Commercial (i.e. accommodations and restaurants). Its discharge location is a nearby creek, classified as SB waters. The treatment technology to be used is called the Modified Sequencing Batch Reactor with Nutrient Removal.

Conveyance system to be used is called a Separate System. Wastewater is conveyed into two separate pipes. Sanitary sewer systems collect sewage from households and directly transport to WWTP.

Figure 3. Figurative representation of a Separate conveyance system.

The components of the conveyance system shall include:

- 200 mm PVC Gravity Pipe
- 250 mm PVC Gravity Pipe
- 100 mm PVC Pressurized Pipe
- Sewer Manholes
- Lift and Pump Stations

While the gravity pipes deliver wastewater by gravity, lift and pump stations are placed to increase the head of the wastewater to deliver it to the WWTP and the creek, respectively. Manholes provide access to operators for ease of maintenance.

## CONSTRUCTION OF WASTE WATER TREATMENT PLANT

### 1. Site Preparation Works

The wastewater treatment plant is located in Brgy. San Isidro, White Beach Puerto Galera. The area about 1,000 sq.m enclosed by temporary fence and earth canals as waterway since the location is a flood prone area.

Upon installation of the tributary lines, the pipes will be embedded approximately 2.0 meters from natural grade line. Proper shoring during excavation is needed to prevent the trench to collapse and it is very important to the safety of the workers that will be moving in the trench.

## 2. Civil Works

Civil works consists of structure works, earth works and temporary works. All structures are designed by reinforced concrete. The following main structures and earthworks were designed as civil;

A. Wastewater Treatment Plant

B. Pumping Stations

C. Engineering Office

D. Sludge Dewatering and Blower Room

E. Pump Area

F. Fuel Tank

G. Hazardous Waste Storage

H. Cistern Tank

I. Service Area

J. Conveyance System

K. Effluent Pipes

L. Sanitary Sewer

M. Sewer Manholes

N. Landscape Works

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# OPERATION PHASE

The operation phase describes the scheme of process, control & operation of the Puerto Galera White Beach Wastewater Treatment Plant which is designed to be automatic with minimal operator interface.

## 1. Control System

i. PLC/HMI based control system shall cater to the related inputs and outputs of the plant process stream.

ii. Local control station shall be provided. It will contain the HMI, alarms and manual/auto and on/off button controls for all drives.

## 2. Operational Modes of Equipment

The equipment can be operated in one of the two operation modes.

1. Automatic Mode

   The equipment are operated under full control of the process control system per pre-defined control system.

2. Manual Mode

The equipment are operated in manual mode through the Local Control Panel (LCP). For all operational modes, the predefined interlocks have to be activated prior to operation to protect the system from potential mis-operation and malfunctioning.

## 3. Interlock Type

Interlocks refer to process control system (PCS) inputs or logic that will be used to control the operation of equipment. Two types of interlocks are provided- Hard Wired and Process Interlocks (Soft) to protect and ensure safe operation of drives in automatic and manual modes.

*Hardwired interlocks*

Hardwired interlocks are required for fundamental safety which means that these interlocks will work irrespective of mode of operation (Auto or Manual). These interlocks shall be wired directly to the circuit of the pump motor starter.

*Process Interlock (Soft)*

A process interlock input or logic shall be required for the normal operation of a device in the process. In manual mode, process interlocks shall be bypassed. In auto mode, all process interlocks shall be activated.

*Permissive*

A permissive is a special type of interlock. It is a predefined criteria which has/have to be satisfied before allowing the system to start. Once the system has been started, the permissive would become inactive. There shall be a possibility to override permissive and/or defeat them for reasons such as operational flexibility, maintenance and other unavoidable reasons.

## 4. General Operation of the Plant

The plant is a Sequencing Batch Reactor (SBR) system wherein wastewater is treated through predefined stages in batches. These stages are:

1. FILL-MIX
2. REACT

3. SETTLE
4. DECANT

One Cycle is defined as a batch going through the four stages. Each stage of the process is operated on a time basis. The timer should be adjustable and contain set default values. Prior to commissioning these values can be set as default:

*Table 1. SBR Operations*

| SBR 1 | | SBR 2 | |
|---|---|---|---|
| Stage | Time (hours) | Stage | Time (hours) |
| Fill-Mix | 1 | Fill-Mix | 1 |
| React | 3 | React | 3 |
| Settle | 1 | Settle | 1 |
| Decant | 1 | Decant | 1 |

These values should be changeable after commissioning.

At each stage, only certain equipment will operate. The rest will stop and return to their "off" state. The stages can be classified as Process Interlocks (soft) for the equipment which will not be operational.

*Table 3. Operational Equipment Summary.*

| | SBR 1 | SBR 2 |
|---|---|---|
| Stage | Operational Equipment | Operational Equipment |
| Fill-Mix | EQT Pump<br>EQT Motorized Valve 1 Anoxic Mixer 1<br>Blower | EQT Pump<br>EQT Motorized Valve 2 Anoxic Mixer 2<br>Blower |
| React | Aeration Blower Motorized Valve 1 PAC Dosing Pump 1 | Aeration Blower Motorized Valve 2 PAC Dosing Pump 2 |

| | | |
|---|---|---|
| Decant | Decant Pump 1 Chlorine Dosing Pump | Decant Pump 2 Chlorine Dosing Pump |

For the operation of the motorized valve for the EQT Pumps and the blowers, appropriate delays should be given such that the valves have already fully-opened prior to the operation of the pumps.

## 5. General Operation of the Plant

### Fill-Mix

During the fill-mix operation, the respective SBR tank will be receiving sewage from Equalization Tank. The sewage will be pumped by the Equalization Tank Pump with the respective EQT Motorized Valve. To give time for the valve to open, there shall be a delay upon opening of the valve prior to activation of the EQT Pump. The Anoxic Mixer inside the tank would be operational as well and would ensure proper de-nitrification while keeping the solids in suspension.

General Operating Conditions/ Permissives of Equalization Tank Pump:

1. EQT High Level Switch is reached (level is high).
2. One of the EQT Motorized Valve is running (fully-open).
3. The respective SBR High-High Level Switch is not reached (level is not high).
4. General Operating Conditions/ Permissives of EQT Motorized Valve:

The respective SBR High-High Level Switch is not reached (level is not high).

### React

During the React operation, the blower would operate and provide air to the SBR tank. In this stage, complete nitrification occurs through the continuous aeration.

To maintain adequate micro-organism level, the DO is maintained around 2 ppm and the suspended solids at 3500-4000 ppm. During this phase, the blower is operational with the respective aeration blower motorized valve.

Dosing of PAC is active with the use of the respective PAC dosing Pump . It will start ten (10) minutes before the end of the aeration time and it will continue until the end of the React Phase.

Settle

In this phase, sludge formed during the biological process is allowed to settle to the bottom of the SBR tank. No equipment is operating at this stage.

Decant

Treated effluent is allowed to flow out of the tank during the decant stage. In the process, disinfection will take place as well via chlorine dosing. During this stage, the appropriate decant pump will operate with the chlorine dosing pump. The chlorine dosing pump will start five (5) minutes before the decant time and continue until the end of the decant phase.

The Decant Pumps would transfer the treated water from the SBR to the chlorine dosing tank. The chlorine from the chemical storage tanks will be applied to the treated water by the chlorine dosing pumps.

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# DECOMMISIONING PHASE

Provision of at least one (1) week of hands-on training to end-user operators. The constructed plant shall run continuously within the desired parameters with no upsets. Contractor will provide sets of As-built Plan with detailed drawings signed by duly licensed engineers.

Activities to fully empty the wastewater system:

1. Sealing of Sewerage Pipes Mainline
2. Desilting of Influent Pump Stations
3. Treatment of Last Batch of Wastewater (including emptying of Equalization Tank)
4. Wasting of Remaining Volume on SBRs
5. Dewatering of Sludge Holding Tank
6. Pumping out of Chlorine Contact Tank
7. Sealing of Effluent Pipelines
8. Desilting of Effluent Pump Stations
9. Hauling of Dewatered Sludge

## OUTPUT

Contractor shall guarantee that the performance of the wastewater treatment plant, when constructed, operated, and maintained according to the drawings, manual and designs,

specifications, will meet the DENR effluent standards (DAO 2016-08) for each period of performance testing within the parameters.

## DESIGN CHARACTERISTICS

| PARAMETERS | UNIT | INFLUENT | EFFLUENT CLASS C |
|---|---|---|---|
| $BOD_5$ | mg/L | 200 | 50 |
| COD | mg/L | 400 | 100 |
| TSS | mg/L | 200 | 100 |
| Ammonia ($NH_3$-N) | mg/L | 35 | 0.5 |
| Nitrates ($NO_3$-N) | mg/L | 10 | 14 |
| Phosphate ($PO_4$-P) | mg/L | 10 | 1 |
| pH | - | 6.5-9.0 | 6.5-9.0 |
| Oil and Grease (O&G) | mg/L | 50 | 5 |
| Fecal Coliform | MPN/100mL | $4.90x10^2$ | 400 |
| Surfactants | mg/L | 15 | 15 |

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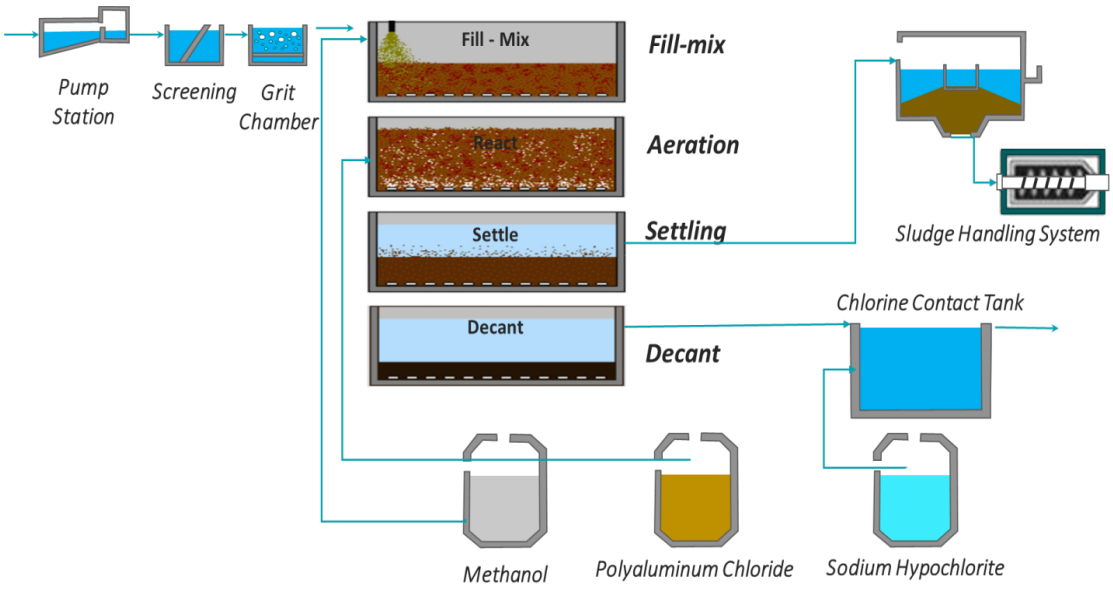
# PROCESS AND TECHNOLOGY OF THE WASTEWATER TREATMENT

The wastewater treatment plant system to be constructed and installed is called a *modified* Sequencing Batch Reactor (SBR). The overview of the system is shown below.




*PROCESS FLOW DIAGRAM*

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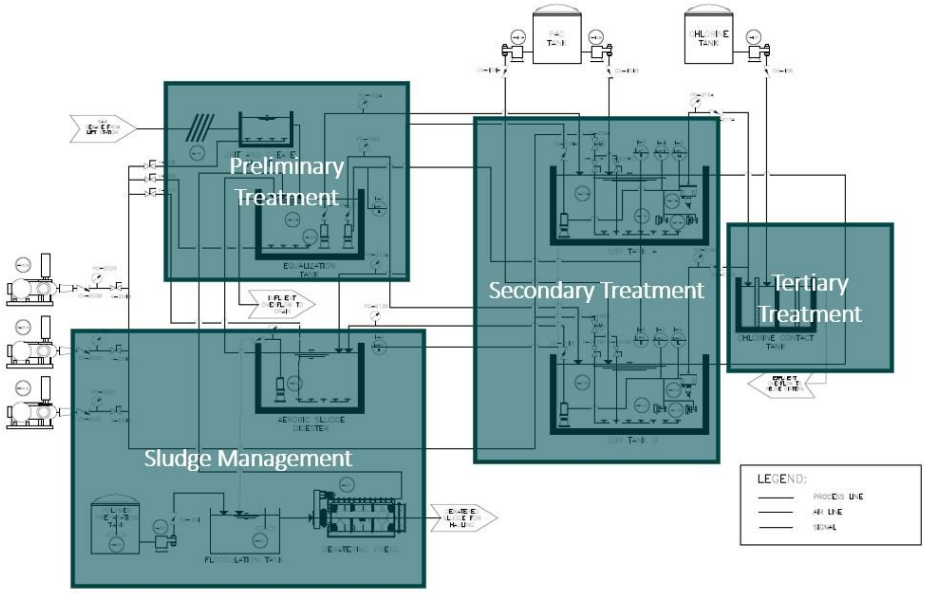


*PROCESS AND INSTRUMENTATION DIAGRAM*

## 1. Preliminary Treatment

The preliminary treatment is designed to treat oil and grease and surfactants through a series of physical processes. It also equalizes wastewater flow through an equalization tank.

## 2. Secondary Treatment

The secondary treatment uses the SBR. The SBR is an activated sludge process for treating wastewater. The activated sludge produced reduces organic matter and biodegrades pollutants along with the unwanted nutrients. For compliance to the DAO 2016-08 standards, the modified SBR system will be using anoxic and aerobic processes with minimal chemical dosing for phosphorus removal.

The different modes of operation in the Sequencing Batch Reactor are as follows:

a. *Fill-Mix* – Wastewater fills the tank, mixing with biomass that settles during the previous cycle, in this stage, a submersible mixer is used to suspend the sludge and promote an anoxic environment for nitrogen removal.

   Dominant chemical reaction is called denitrification through denitrifying bacteria:

$$NO3- + BOD \rightarrow N2\ (g) + CO2\ (g)$$

b. *React* – Air is added to the tank to promote biological growth and pollutant degradation

   Dominant chemical reactions are called oxidation and nitrification through the heterotrophic and nitrifying bacterica, respectively:

$$BOD + O_2 \rightarrow CO_{2(g)}$$

$$NH4+ + O2 \rightarrow NO3-(aq)$$

Phosphorus removal is also done in this phase through coagulation-flocculation.

Dominant reaction is given by:

$$Al3+ + PO43- \rightarrow AlPO4(s)$$

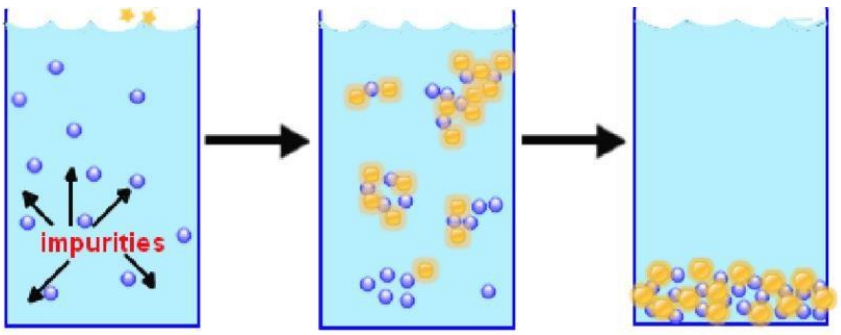


*Figure 9. Coagulation Flocculation Process.*

c. *Settle* – Aeration is discontinued, and the solids are allowed to settle leaving only the treated effluent above the sludge blanket

d. *Decant* – Withdrawal of treated effluent from below the surface of the mixed liquor, chlorine is dosed in the chlorine contact tank while the treated effluent is being discharged.

### 3. Tertiary Treatment

The tertiary treatment uses chlorination to remove the residual coliform through cell oxidation.

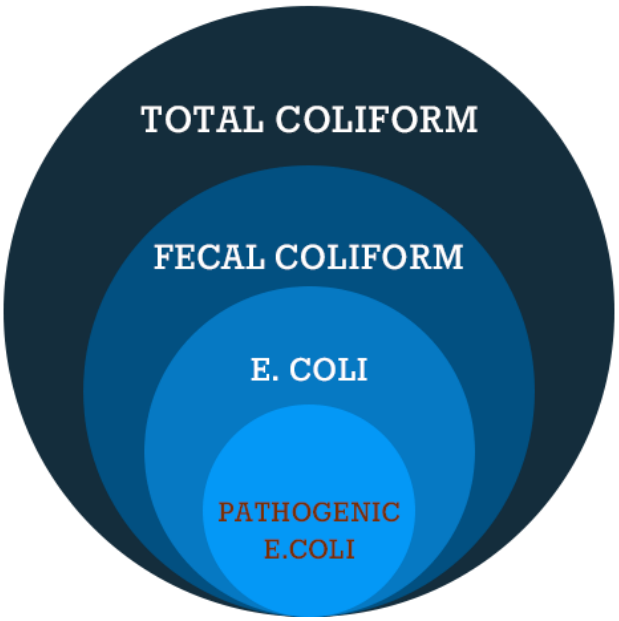


*Figure 10. Coliform hierarchy removed by chlorination.*

### 4. Sludge Management

The excess sludge coming from the SBR are pretreated using the sludge handling system. It is composed of the sludge tank where aerobic digestion takes place and a dewatering system to

remove the concentrated solids into biosolids for disposal. Dominant reaction for the aerobic digestion is given by:

$$\text{Sludge} + O_2 \rightarrow CO_{2(g)}$$

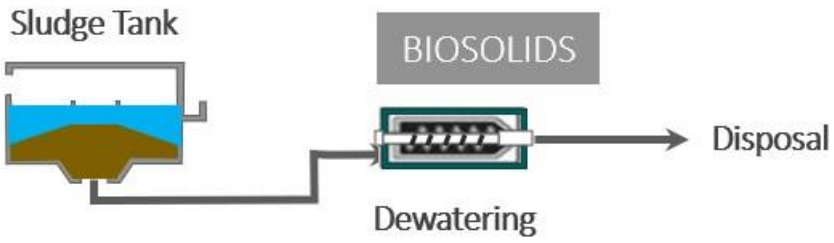


*Figure 11. Sludge Management*

## CLARIFICATION

Upon confirmation with the DPWH Project Engineer, this is to clarify that there is no initial ECC Application made from their office. On the other hand, the application is being processed by the Puerto Galera LGU.

With regards to the Construction Phase, since this project is a new construction and as far as we are aware, there is still no plan for Phase 2. Furthermore, tapping connection from the households and establishments will be discussed thoroughly seeing that it is not included on Phase 1. We are also open for modification and upgrades that will be available in the near future.

Considering that the project includes Sewerage Main Line and Wastewater Treatment Plant from households and commercial establishments, the plant will be turned over to the end-user in full operation.

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# PROPOSED BOARDWALK

## CONSTRUCTION PHASE

The area will be enclosed by temporary fence and install barricades and safety signage before the start of construction. Proper shoring during excavation is needed to prevent the trench to collapse and it is very important for the safety of the workers that will be moving in the trench. Safety precautions are needed to implement to prevent hazard on the workplace.

The existing boardwalk will be extended 1.5 meters width. Concrete posts will be installed and abaca rope as guard rails. Along the boardwalk, pipes will be embedded approximately 2.8 meters in depth and 1 meter away from the existing boardwalk. The following pipes are the gravity pipes for sewer and pressurized pipes for discharge. Concrete manholes will be constructed for the maintenance of the pipelines.

## OPERATION PHASE

Contract ID : **20EO0109**
Contract Name **: Cluster 15 - Sewerage and Waste Water Facility and Boardwalk**
**15.1 - Construction of Boardwalk and Sewerage Treatment Plant Phase 2 at Sabang Beach**
**15.2 - Construction of Boardwalk and Sewerage Treatment Plant at White Beach**
Location of the Contract**: Puerto Galera, Oriental Mindoro**

The extension of boardwalk will serve different purposes. It further improve access along the beachfront. It allows clearance for multi-mode users such as wheelchairs and bikers. It also serves an access for emergency purposes. Aside from this, it adds attraction for the tourists to enjoy the amazing island of Puerto Galera.