RAPID ENVIRONMENTAL IMPACT ASSESMENT REPORT

FOR

PROPOSED "5 STAR RESORT" PROJECT

"VIVANTA BY TAJ AT HAVELOCK"

At

(Plot No: 149/1, 149/3, 150/3/2, 150/3/3, 150/3/4)
Village - Radha Nagar, Gram Panchyat - Govinda Nagar, Havelock Island, Tehsil - Port Blair Dist. Andaman, A&N Islands

Prepared for

TAJ
Hotels Resorts and Palaces

The Indian Hotel Company Limited

Prepared by

GREEN MEMBER GROUP
THE GREEN PEOPLE

GREEN CIRCLE, INC.

Integrated HSEQR Consulting Engineers, Scientists & Trainers
(ISO 9001:2008, 14001: 2004 & OHSAS 18001: 2007 Certified organization & Recognized by Ministry of Environment & Forest, New Delhi under EPA 1986 & GPCB approved Environment Auditor – Schedule II & provisionally accredited by QCI-NABET on 89th AC meeting dated 17.10.2012)

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January, 2013

GREEN CIRCLE, INC.

EIA CERTIFICATE

This is to certify that ***M/s. Green Circle, Inc.****, has conducted the REIA Study for proposed project* ***"Vivanta by Taj at Havelock"****, Andaman at Plot No: 149/1, 149/3, 150/3/2, 150/3/3, 150/3/4 at, Village - Radha Nagar, Gram Panchyat - Govinda Nagar, , Havelock Island, Tehsil - Port Blair Dist. Andaman, A&N Islands and observed that the* ***project does not have major negative impact to the environment.***

For: Green Circle Inc.

(Pradeep Joshi)

CEO & Group President

Corporate & Head office

GREEN CIRCLE, INC.

Integrated HSEQR Consulting Engineers, Scientists & Trainers
(ISO 9001:2008, 14001: 2004 & OHSAS 18001: 2007 Certified organization & Recognized by Ministry of Environment & Forest, New Delhi under EPA 1986 & GPCB approved Environment Auditor – Schedule II & provisionally accredited by QCI-NABET on 89th AC meeting dated 17.10.2012)

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DISCLOSURE

DISCLOSURE AS PER NABET / QCI		
Details as per Schedule of EIA Notification 2006, as amended till date		
Project / Activity No.	CRZ Clearance for 5 Star Resort "Vivanta by Taj" at Havelock, Andaman	
Category	B	
Project or activity as per schedule of MoEF notification dated Sep.14, 2006 and subsequent amendments	8 (a)	
NABET Sector No.	38	
Specialization (FAE, unless mentioned)	**Name**	**Signature**
Land use, Meteorology, Air Quality, Monitoring and Prediction; Air Pollution Control	Dr. Jessica Kariya	
Ecology and Biodiversity	Dr. Sandeep Sohani & Pravin Shinde	
Solid Waste and Hazardous Waste Management; Water Pollution Prevention, Monitoring and Control	Mrs. Ridhdhi Pandya	
Risk Assessment and Hazard Management	Mr. Pradeep Joshi	
Noise and Vibration	Shailendra Singh	
Water Pollution Control	Ranjit Kalita & Kundan Ajudiya	
Air Pollution Control	Ram Raghav Soni	
Project Managers		
Designation	**Name**	**Signature**
EIA Sector Co-ordinator	Mr. Anand Shirsat	
Checked	Mr. Pradeep Joshi	
Released by	Mr. Nachiket Joshi	
Authenticated	Mr. Pradeep Joshi	

ACKNOWLEDGEMENT

Green Circle Inc. highly appreciates the opportunity provided by **M/s. The Indian Hotels Company Limited** for assigning the preparation of Rapid Environmental Impact Assessment study report for the project **"Vivanta by Taj at Havelock", Andaman.**

We express our sincere gratitude to the officials of **M/s. The Indian Hotels Company Limited** for the cooperation and support extended to us during this assignment, devoid of which this report could not have been successfully prepared.

The assistance of large number of persons in government departments and private individuals in secondary data collection is also thankfully acknowledged.

DISCLAIMER

The information contained in this report is based on the scientific analysis of data/information/drawings provided by the sponsor and also collected from other sources / nodal agencies during the time of the study. Conscious efforts have been made to ensure the accuracy of information in the report, however, **Green Circle Inc.** shall not own, in any manner, any legal, financial or consequential responsibility for any event of occurrence of any accident/hazard or direct or indirect damage/loss to any third party or to sponsor due to the use or inability to use the information contained in the report.

The sponsor shall exercise due diligence and make their own decision to implement the contents of this report. The report shall not be constructed as any guarantee or warranty from **Green Circle Inc.**

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The proposed project is designated under Island Coastal Regulation Zone (ICRZ) and falls under **ICRZ-III and requires ICRZ clearance from Andaman & Nicobar Island Coastal Zone Management Authority (ANCZMA)** for approval of the project.

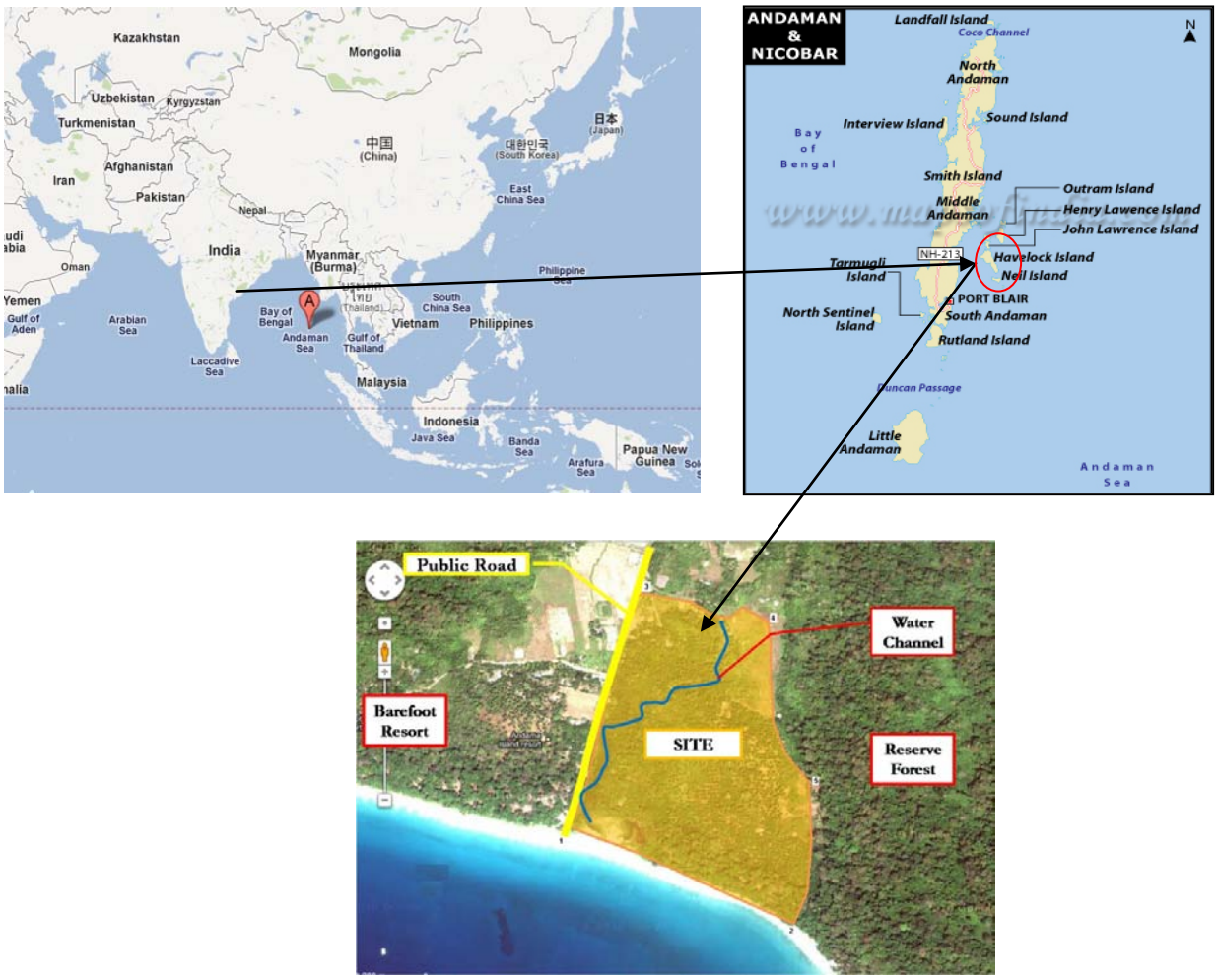


Fig: Location of the project site

Based on the recommendations of A&N CZMA, Environmental clearance and CRZ clearance will be issued by MoEF, New Delhi. The site is a beachfront property which falls under the Coastal Regulation Zone having about 400 meters of beach frontage. It extends inwards in land to a distance of approximately 525 meter encapsulating an area with dense tropical vegetation, a water channel and some plantations. The total cost of the project is estimated to be 80 crores.

1.1 Phases of the project:

The project will be completed in two phase:

1st phase: 50 keys will be constructed over a period of around 2 years (commencement of construction: March 2013 and completion of construction: December, 2015). In addition 10 public buildings and 4 staff accommodation buildings will be constructed.

2ndnd Phase, another 50 keys will be constructed to raise the inventory to 100 keys.

1.2 Accessibility to the Site:

The Havelock Island is easily accessible from Port Blair by sea routes. It is at a distance of around 57 km from port Blair. Government and private ferries are available in the day time. From Jetty Havelock, Radhanagar is at 10 km (road distance). Autos and Bus services are available from Jetty to Radhanagar beach.

1.3 Site connectivity

Major services	Name	Road Distance	Aerial Distance	Direction
Hospital	Primary health centre.	10 Km	6 Km	NEE
Police station	Havelock police station	12 Km	6.7 Km	NE
Fire Station	Havelock fire station	12 Km	6.7 Km	NE
School	Primary School at Radha Nagar	100 m	100 m	E
	Sr. Sec school, main market	10 km	6 Km	NEE
Air port	Vir Savarkar International Air Port	…..	57 Km	SW
Bus stop	Jetty Havelock	12 km	6.7 Km	NE
Bank	SBI & AN Cooperative Bank	10 Km	6 Km	NEE
Post Office	6 No. Krishna Nagar	6 Km	4 Km	NEE
Jetty	Jetty, Havelock	12	6.7	NE
Temple	Temple	12	6.7 Km	NE
Forest office	DFO office	10	6 Km	NEE

2 Project Descriptions

2.1 Major Project Components & Resource Requirement

2.1.1 Land Area statement

Sr. No.	Particulars	Area in Sq mt.
1.	Total Plot Area	1,82,834.741
2	Deduction	69,349.910
3	Net Plot Area	1,13,484.831
4	FSI area	15,796.57
5	Permissible FSI (1.8)	1.5%
6	Non FSI	3175
7	Proposed Built Up area	15796.57
8	Total construction built-up area	18972
9	Land scape	24,000
10	Open space	70513

2.2 Water:

The source of water is rain water harvesting and ground water. Ground water shall be drawl using bore wells.

I	During Construction Phase	
1	For Workers	40 KLD
2	Construction purposes	20 KLD
	Total	**60 KLD**
II	During Operation Phase	
2	Domestic water requirement	250 KLD
3	Flushing water requirement	36 KLD
4	Landscaping requirement	114 KLD
5	Air Condition	40 KLD
6	D.G cooling tower	20 KLD
7	Swimming pool	20 KLD
	Total	**480 KLD**
8	Waste water generation	233 KLD
9	Treated wastewater	210 KLD
10	Waste water to drain/Nalla	Nil

Recycled water (210 KLD) will be used for gardening, flushing, Air conditioning, D.G cooling tower and Zero liquid Discharge shall be achieved.

2.4 Power Requirement

The during operation phase connected load will be around 985 KW / 1230 KVA. Power requirement will be met through DG sets. The details of power requirement are given below.

1	**Construction phase:** Source: DG set Power requirement: 100 KVA approx
2	**Operation phase:** Source: Diesel Generators only Quantity of power requirement: 720 KW / 900 KVA Connected load: 985 KW/1230 KVA Demand load:720KW/900 KVA

2.5 Raw material requirement

The raw material required for construction purpose shall be Cement, RMC, Sand, Aggregates, brick, Steel, stone, timber etc. In short it is rammed earth for walls, rubble masonry for foundation and timber windows and doors. The exact quantities of each shall be furnished at design stage.

2.6 Man-power requirement

During construction phase, about 300 numbers of laborers shall be required to carry out construction activities. Temporary Hutments will be provided for laborers employed during construction phase at the site itself.

2.7 Design Approach

The design approach for this resort should be formed of an amalgamation of traditional and contemporary styles. While the traditional architectural style will draw inspiration from local architecture & materials and modern facilities and luxurious amenities maybe provided through a more contemporary approach to building design.

2.8 Sewage Generation and treatment

There will be no waste water generation from the construction activities. The only source of wastewater during construction phase is from labors use. Generated sewage approximately 36 KLD will be disposed off through septic tank connected to soak pit.

During operation phase, 233 KLD of sewage water will be generated for which it is proposed to construct 1 no. of Sewage Treatment Plant (STP) of capacity 235 KLD. For the Complex.

2.9 Solid waste

Construction activities can lead to solid waste generation including sand, concrete, gravel, stone, bricks, plastic, paper, wood, metal and glass. Approximately2-3 tons of construction debris shall be generated on an average from the project site per day during the construction phase. The entire construction waste, masonry & plastering debris will be used in Batching Plant and lower grade of concrete, excavated soil will be used filling up low lying areas. Glass, wood, aluminium, broken tiles, boxes, cans, etc. will be handed over to authorized vendor for disposal. Excavated earth material (4500m^3) shall be used for refilling.

Approximately 63 kg/day of solid waste will be generated during operation phase, which shall be segregated as biodegradable (38 kg/day) and non-biodegradable (25kg/day) waste. **Organic Waste Processor (OWP)** shall be provided for converting bio-degradable waste to manure and non-biodegradable waste will be sold to prospective buyers. The end product shall be used as manure. Sludge from STP approximately (2.33 KL/day) shall be handed over to authorized vendor for further disposal.

2.10 Rain Water Harvesting Details:

Rain water harvesting will be carried out which in the project area for restricting surface runoff and minimizing utilization of ground water. Around 6425m^3 of rain water will be harvested annually.

2.11 Storm Water & Run off Details

Storm water drainage will be provided to conserve soil erosion and water logging problems.

2.12 Fire Fighting System

Hydrant and Sprinkler with pumping from Diesel pump, electrical pump and jockey pump will be installed as a part of fire fighting system. Portable fire extinguishers are proposed to be placed at strategic locations such as Sprinklers, Dry Chemical Powder etc.

2.13 Hazardous Wastes

Hazardous wastes generated will include waste oil and grease from DG sets during oil changes. The used oil will be handed over to authorized vendor Hazardous waste (management and handling) rules 2008.

3. Baseline Environmental data

The baseline environmental qualities of various environmental components like air, noise, water, land, flora and fauna and socio-economic form an important and integral part of any environmental study. The present report presents the data collected during the sampling period of three months in **summer season during March to May 2012**. Various environmental components were monitored and samples analyzed. Studies were carried out in about 10 km radius area from the proposed site.

3.1 Land Use

3.2 Climate of the Study Area

The island has a tropical climate which is warm, moist and equable. Day time temperature generally varies between 27 ^{o}C to 32.6 ^{o}C and night time temperature varies 23 ^{o}C to 26 ^{o}C. The maximum relative humidity was about 78.5 - 82% almost throughout the year. The average wind speed varies from 1– 47 m/s. Rain occurs throughout the year and varies from 46 mm to 501 mm, the lowest being in January and highest in June. The average rainfall in the Havelock Island is 3176 mm. Best weather sees between January to May wherein the sky remains clear. During the study period, the sky was clear.

3.3 Air Environment

Air monitoring carried out at 9 locations and the analytical result shows PM_{10} to be in the range of 32 - 42 µg/m^3, $PM_{2.5}$ 22 – 26 µg/m^3, SO_2 5.8 – 6.8 µg/m^3, NOx in 8.2 – 9.6µg/m^3. All the parameters are well within the permissible limit of NAAQS as stipulated by CPCB.

3.4 Noise Environment

Noise monitoring was done at 10 locations in silence, residential and commercial zone. No industrial zone is present in the study area. The noise levels varied in the study area during day and night time in the range of 45 – 53.1 dB (A) and 36 - 42 dB (A) respectively. There is no other source of noise except that of vehicular traffic. Day time noise in the study is ranges within the permissible limit, except near Govinda Nagar PHC. Noise level exceeds at Govinda Nagar PHC because it is located in the market area where the noise remains high due to vehicular movement.

3.5 Water Environment

The sources of water in the study area are: Surface water stream (Fresh Water), Ground water and Marine water. A total of 10 water samples were collected, 9 surface water samples of which 3 are marine and one ground water sample and analysis was done at MoEF approved laboratory of Green circle Inc.

Water quality of streams is in the permissible limits in respect of various parameters. BOD in all the samples were in BDL range and *E.Coli* was absent. Salinity of Radhanagar stream passing through the project site was between 0.3 to 0.5 ppt which absolutely reflects fresh water characteristic of the stream. Marine water was saline in nature with high pH and salinity. Overall quality of water has been good. Ground water is slightly brackish in nature. The detail analysis result is given in chapter 3.

3.6 Land Environment

Soil is formed by sedimentary rocks like limestone, sand stone, coral shell etc. which are in general marine deposit. The soil is extremely well drained with rapid permeability, sandy, loamy sand, sandy loam in texture. Overall soil is suitable for agriculture black in nature. The detail analytical result of soil is given in chapter 3.

3.7 Biodiversity

The Andaman group of island is rich in biodiversity. As per Botanical Survey of India (BSI) and Zoological Survey of India (ZSI), there are around 2000 species of flowering plants out of which 221 species are endemic of which 110 are rare and endangered. Over 5100 animals have been described which include 100 fresh water, 2100 terrestrial and 2900 marine animals.

Mangroves: Mangroves species found are are *Rhizophora apiculata, Rhizophora styalosa, R. mucronata, Bruguiera gymnorhiza, avicennia marina, Heritera litardis, xylocarpus granatum soneratia alba* etc. in Havelock. Avicennia marina is dominant on project site present on both sides of the fresh water nalah, but there is no endangered species.

Sea Weeds: Common sea weeds are *Gracillaria crassa, J. agardh, padina, gymnospora knickers, Turbinaria, conoides.*

Fauna: Fauna of the study area include mammals, reptiles, birds etc. Salt water crocodile, sea turtle, sea cucumber, dolphin, octopus, sea snake, shark, etc. are commonly found. In addition, variety of benthic fauna is also found in this region.

Fisheries Potential: Around 1200 species are found, of which 350 species of fishes are commercially important.

Molluscs: Among a huge variety of mollusks, endangered species found in A & island are *Caseis rifa, Trochus Oiloticus, Caesia corn, Cypraea Tigris, Turbo marmeratus, Xencus pyrunud, Nautilus prmiplus.*

Corals: In this island fringing type of corals are found. The dominant corals on this island are porites salida, porites lutea, porites lobata, acropora formosa, acropora moniticulosa, acropora florida, acrophana humilis.

Benthos: Benthos form important component of marine life. 75% of benthic animals live on firm substrates (rocks, corals etc.), 20% occur on sandy/muddy bottoms & only 5% of the total are planktonic.

Planktons: Plankton – phytoplanktons and zooplanktons are found in the study area.

There are no Eco-sensitive areas like NPKs/WLS (except few Mangrove species on both sides of the fresh water stream passing through the proposed plot) within PIA of 10 km radius from the proposed project site.

3.8 Socio-Economic Profile of Study Area

Revenue Villages: There are five revenue villages in the study area namely Radha Nagar, Shyam Nagar, Govinda Nagar, Vijay Nagar, and Krishna Nagar and 5 beaches.

Infrastructure: Infrastructure like health centers, Schools, Jetty is present. Financial Institutions like - State Bank of India, and Andaman and Nicobar Cooperative Bank is present. Metalled road around 20 km and kutcha road 10 km is present. SH-4 of 11 km connects Jettty with Radha Nagar Beach and SH-5 of 9 km is existing. State Transport Services ply on the road from Jetty to Radha Nagar. Autos are available for traveling throughout the villages.

Occupation: The main occupation of the people of Havelock is agriculture. Some people are also engaged in fishing, Govt. jobs and other commercial activities.

Drinking Water Facilities: Almost every house hold is provided with water supply from reservoir at Krishna Nagar and Radha Nagar. Rain water harvesting is also one of the important sources for drinking water. There is one storage tank of stream water located in Krishna nagar, at a distance of 5 to 6 km from Radha nagar beach.

Power: Power supply is made by the electricity department of A & N administration through diesel generating sets. In Havelock power generation station capacity of 0.6 MW is present.

4. Anticipated Environmental Impacts and mitigation Measures

4.1 Impacts on Ambient Air Environment

The potential ambient air quality impacts would occur mainly during construction phase. Suspended particulate matters of various sizes would be the major air pollutant during construction phase. The gaseous emissions such as SO_2, NO_X and CO will be generated from the construction equipments and vehicles. During operation phase, DG sets would be the only point source of emission. Dust will be controlled by spraying water.

4.2 Impacts on Noise Environnent

Construction activities will result in temporary and short duration increases in noise levels but will not exceed 85 dB(A) and will be site specific however at most of the time noise will not exceed 65dB(A). The main sources of noise during construction period include movement of vehicles for loading and unloading of construction materials, fabrication, handling of equipment and materials, operation of power shovels, concrete mixing plants, generators, etc. The areas affected are site specific and close vicinity to the site. No noise pollution is envisaged during operation phase except from DG set.

4.3 Impacts on Water Environment

Impacts on Ground Water: Ground water will be withdrawal during construction and operation phase of the project. However, no significant impact on quality & quantity of ground water is envisaged as the aquifers have good potential.

Impacts on Piped Water Supply / surface water: Water will not be taken from existing village water supply system neither in construction nor in operation stage of the project. Thus there is no impact piped water supply.

4.4 Impacts on Land Environment

Impacts on Soil: No construction will be done in rainy season. The project proponent will adopt good construction practices prevent soil erosion. Development of green belt and other landscape on the proposed site would enhance the visual aesthetics of the area.

4.5 Impact on Marine Environment

Impact on Marine Intertidal area: The proposed project may create impact mostly in construction and little or no impact in operation phase.

Impacts due to Sewage: If untreated sewage disposed off in marine water body, water will be affected. There is little or no possibility of impact as sewage will be disposed off

through septic tank during construction period. During operation phase, sewage will be treated through STP and treated water will be used for flushing and gardening.

Impacts due to Solid Waste generation: Solid wastage like excavated earth and rock will be used for refilling. Other miscellaneous materials like glass, plastic material, etc. will be disposed off in accordance with applicable guidelines. During operation phase, bio-degradable wastage will be treated through OWP and non biodegradable wastage will be delivered to authorized vendors of CPCB. Hence no impact is envisaged.

4.6 Impact on Biodiversity

Flora and fauna present near the site may pose threat due to noise and suspended dust. However it will be mitigated through suitable measures and maintenance. No impact is envisaged during operation phase since this is a resort project. Only DG set will be operational for electricity generation for which air and noise will be monitored periodically. ***No eco-sensitive areas like national parks, WLS etc. are present within 10 km radius from the project site. Hence no major impacts are envisaged on biodiversity of the region.***

4.7 Impacts on Socio – Economic Environment:

There will be positive impact on socio-economic status of the study area. The project will result in direct or indirect income source. The direct and indirect employment to the local population during the operation of the project at both skilled and unskilled levels will benefit the local population. Economic activity will get a boost hence have a positive impact.

5. Environmental management Plan (EMP)

5.1 Management of Air Environment: Any vehicle not meeting the vehicular pollution standards will not be allowed within the construction site and for the construction activity. It will be ensured that all the vehicles deployed for the project possess Pollution under Control (PUC) Certificate. Water will be sprayed by high pressure water hoses during dust generating construction activities e.g. excavation, crushing, concrete mixing, material handling etc. to suppress dust.

5.2 Management of Water Environment

A. Surface water quality (Marine and Fresh water): Domestic sewage should be treated in STP before discharging. Solid waste should be segregated and stored properly so that leaching will not occur due to rain. Hazardous waste should be prevented from spillage and handed over to authorized vendor.

Ground water quality: Precautionary measures should be taken so that ground water is not contaminated during boring and water withdrawal. No hazardous construction wastes should be disposed of on land, as water table is between 2.2 mbgl to 5mbgl. Hazardous waste should be handed over to authorized vendor.

5.3 Management of Noise Environment: Construction equipment generating minimum noise and vibration should be chosen. Ear plugs and/muffs should be provided to workers. Vehicles and construction equipment with internal combustion engines without proper silencer will not be allowed to operate.

5.4 Management of Soil Environment: Rainy season will be avoided for cutting and filling of earthwork. Soil binding and fast growing vegetation and grass should be grown around the construction site before commencement of construction activity to reduce soil erosion. Temporary drainage channels should be provided to minimize soil erosion. Waste water will be treated before discharging from the site. **S**oil erosion control measures should be taken.

5.5 Management of Marine Environment: Hazardous waste (Spent oil, grease etc.) should not be released in inter tidal areas. Excavated earth should backfilled in the trench after foundation work and top soil should be restored for the agricultural purpose. Precautions should be taken to minimize damage to native plants like mangroves on the periphery of construction area. Sewage should be treated before discharging.

5.6 Solid waste management: Normal debris, sand, waste concrete & plaster, excavated soil, stone, broken bricks, plastic will reused. Biodegradable waste should be treated through OWP and non biodegradable waste should be handed over to authorized vendors.

5.7 Ecology: Every precautionary measure shall be taken so that flora and fauna in the study area is not affected. Economically important trees uprooted during site clearing should be replanted. Mangroves should not be cut however if cleared with due permission from regulatory authority, 5 times will be planted in suitable patch of land according CRZ notification 2011. A buffer zone of around 10 – 12 meter (width of the creek) shall be left as NDZ. The green belt should be developed in the project site as well as periphery. This will help in reducing air pollution, noise pollution and develop aesthetic value of the site. More than 33% of the plot area shall be covered with trees planted phase-wise. Local and fast growing species shall be planted.

5.8 Management of Socio-Economic and Cultural Environment: Prior information about the project should be given to locals in study area. Caution should be exercised to avoid disturbance to existing infrastructure. An emergency plan should be prepared in advance, to deal with fire fighting. Local people will be employed for construction work to the maximum extent possible.

5.9 Traffic Control: Traffic congestion and road hazards should be prevented. Deliveries of materials to the project site should be consolidated whenever feasible to minimize the flow of traffic. Existing network of roads should be used for transporting equipment and construction material and no new road should be constructed unless unavoidable. Two gates, one for entry and one for exit, will be provided for the smooth moving of vehicles. Security personnel will manage traffic on shift basis at entry / exit point.

6. Risk Assessment & Disaster Management Plan

The proposed project site may be associated with following risks. The risks may be of the following types:

I) Water and Climate related risk:
II) Geology related risk:
III) Accident related risk:
IV) Epidemic related risk:

6.1 Storage of Hazardous Materials: The proposed project envisages storages of kerosene, diesel & liquefied petroleum gas (LPG). It is to be noted here that above material will not be stored in the bulk quantities. The kerosene may be stored in carboys and the LPG will be obtained in cylinders supplied by the authorized dealer.

6.2 Emergency Preparedness Plan (EPP): The project may face the threat of disaster which could be natural or man-made, technological or political. Disasters could be accidental or intentional. Such disasters could be controllable by effective EPP.

6.3 Disaster Response Team: A Disaster Response Team at site will be organized in the resort during construction and operation phase of the project. During operation phase, it will have the General Manager, Security Manager, Chief engineer, Maintenance Manager, Front Office Manager, Housekeeping Manager, all assistant managers & Supervisors. They will be given specified duties (mentioned below) and meet regularly to review the situation in the Hotel.

6.4 A general chart shall be displayed at each floor for hotel guests:

Once you feel tremors/shaking, don't panic and stay calm

↓

Cover under a nearest sturdy table, desk, bed or Kitchen table, don't run

↓

Brace yourself inside a corner or interior wall away from windows;

↓

Cover head with pillows/hands

↓

Once shaking stops, immediately vacate the building through staircase

↓

Don't forget about aftershocks

6.5 SOP for DMP Team

Once tremors are felt, Shut off the Gas, power, Water supply immediately

↓

Inform Staff to evacuate occupants once the shaking has stopped

↓

Call emergency services, as appropriate, and then give first aid as necessary

↓

Put out small fires quickly if this can be done without endangering personnel

↓

Clean up flammable liquid spills immediately, if any

↓

Inspect and repair the building for damage that may have occurred

CHAPTER 1

Introduction to the Project

1.0 PROJECT GENESIS

The Indian Hotels Company Limited (IHCL) has entered into a long term lease with Andaman & Nicobar Islands Integrated Development Corporation (ANIIDCO) for building a **premium 5 star resort** at Havelock Island. The project will come up on a 45-acre beachfront parcel of land and will be branded **Vivanta by Taj** @ Havelock. The built up area for the project is 18972 sq.m. The land parcel is located at Radha Nagar Beach (also called Beach No.7) which was rated as the 'Best Beach in Asia' by Time Magazine in 2004.

Launched in September 2010, Vivanta by Taj is the youngest among the four brands under which IHCL operates its chain of hotels across the world (the others being Taj Hotels, Resorts & Palaces, Gateway Hotels & Resorts). The brand, Vivanta by Taj is crafted to appeal to the cosmopolitan global traveler who appreciates new experiences and pleasant surprises, rather enjoying a conventional hotel experience. The Vivanta brand is stylish and sophisticated, contemporary, vivid and creative – a 'cool avatar' of luxury. At the same time Vivanta shares a strong connect with the Taj warmth and friendliness, being overtly endorsed by the quintessential Indian Hospitality brand.

Besides this, some of the Vivanta by Taj properties currently under development are located at - Bekal, Kerala; Madikeri, Coorg; Race Course Road, Coimbatore; Dwarka, New Delhi; Gurgaon, NCR; Begumpet, Hyderabad; GS Road, Guwahati and Circular Road, Amritsar**.**

The proposed project is designated under Island Coastal Regulation Zone (ICRZ) and falls under **ICRZ-III** and requires CRZ clearance from Andaman & Nicobar Island Coastal Zone Management Authority (A&N CZMA). Finally Environmental Clearance and CRZ clearance will be required from MoEF, Delhi based on the recommendations of A&N CZMA.

The purpose of this Environmental Impact Assessment (EIA) study is to provide information on the nature and extent of environmental impacts arising from the construction and operation of the proposed project and related activities taking place concurrently and to also define an Environmental Management Plan (EMP) to minimize the adverse environmental impacts, if any.

1.1 BRIEF OF PROJECT SITE:

The project "Vivanta by Taj @ havelock" is proposed at Plot No: 149/1, 149/3, 150/3/2, 150/3/3, 150/3/4 at village - Radha Nagar, Gram Panchyat - Govinda Nagar, Tehsil - Port Blair, Havelock Island, Dist. Andaman, Andaman & Nicobar Islands to be constructed by Indian Hotels Company Limited.

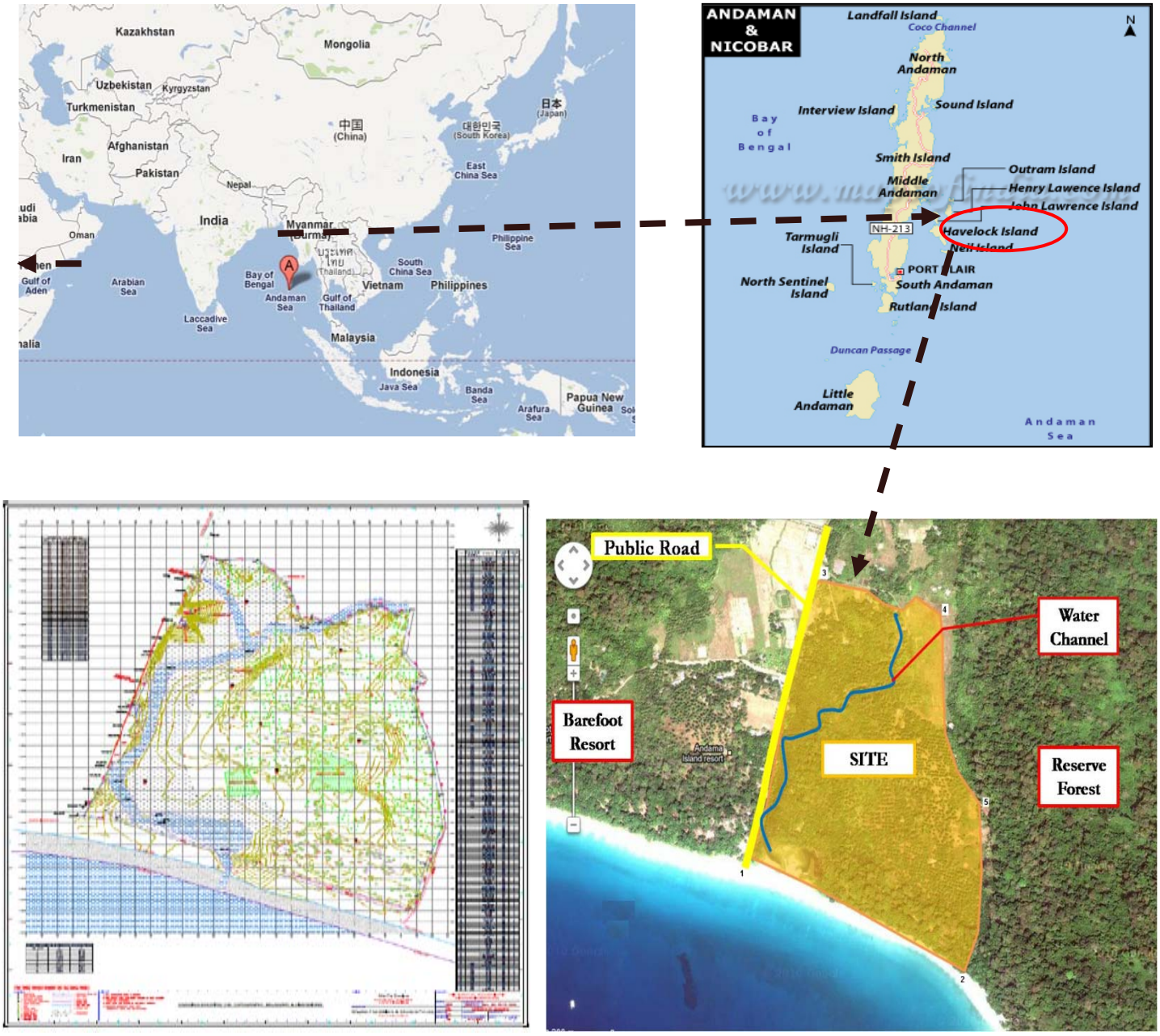


Figure 1.1: Location of Project Site

1.2 PURPOSE OF THE STUDY

This study was carried to comply with the guideline of Ministry of Environment and Forests. The purpose of this study is to:

- To determine at the time of studies, the prevailing situation relating to the environment, human beings and local communities & wildlife in the contact area and in the adjoining / neighboring areas.
- To establish the likely impacts on the environment, human beings and local communities & wildlife in the project site and in the adjoining / neighboring areas as a consequence of the relevant phases of this project and to work out methods and measures for minimizing the environmental damage as well as carrying out site restoration activities.
- To mitigate the environmental impacts by appropriate Environmental Management Plan (EMP).

1.3 FRAMEWORK OF ASSESSMENT

Based on the scope of work, guidelines generally followed for EIA studies, a study area of 10 km around the site has been taken as the spatial frame for the impact assessment. Temporal frame of assessment has been chosen to reflect the impacts in two distinct phases of the project namely:

- Construction phase
- Operation phase

1.4 SCOPE OF THE WORK

The scope of work includes collection of baseline data with respect to major environmental components namely air, noise, water, land, biological and socio-economic components around the study area, impact assessment of proposed activities and finally, preparation of Environmental Management Plan.

Objectives:

The EIA study shall be aimed to cover the following aspects:

- Evaluation of present environmental status through analysis of generated and collected baseline data for **pre monsoon season-2012.**
- Assess the probable impact on the environmental factors due to implementation of the project with respect to the existing scenario.
- Analyze the predicted impact with respect to the regulatory environmental standards.

- Develop an Environmental Management Plan and Disaster Management Plan for the proposed project to mitigate the negative significant impacts if any that would arise from the proposed project.
- Obtain necessary clearance from the regulatory authorities.

1.4.1 Baseline Environmental Data

The baseline data shall be collected by necessary monitoring for environmental components such as air, water, land, noise, flora and fauna and socio-economic aspects in the project impact area i.e. within 10 km of the study area, collection of established data through secondary agencies. The baseline data collection shall include the following components:

Physico-chemical Environment:	Air Quality
	Meteorology
	Noise Environment
	Water (Surface water, Sea Water & Ground water)
	Soil Quality
	Land Use Pattern
Biological Environment:	Density and diversity of aquatic and
	Terrestrial flora & fauna
Socio-Economic Profile:	Demographical and socio-economic details

1.4.2 Anticipated Environmental Impacts and Mitigation Measures

During the study, probable impacts on environmental parameters are assessed in a systematic way and divided into the following phases:

- A systematic assessment of environmental impacts on marine and terrestrial environment (air, noise, water, land, ecological and socio-economic environments) in the study area shall be done by predicting the nature, scale, severity and event of changes that would be associated with the proposed project and their subsequent effects on the environment in comparison to the existing baseline conditions during construction phase and operational phase.
- Prediction of impact on air quality taking into consideration the proposed emissions to project the overall scenario
- The effect of discharge of treated liquid effluent and solid waste, if any, on surface/ground water shall be assessed, as relevant.
- The impact of noise level during construction, and operation phase shall be carried out.
- The impact assessment shall be done for predicting the ecological impact, impact

on land environment, socio-economic and health impact.

- Evaluation of total impacts after superimposing the predicted scenario over the baseline scenario to prepare an Environmental Management Plan.

1.4.3 Environmental Management Plan

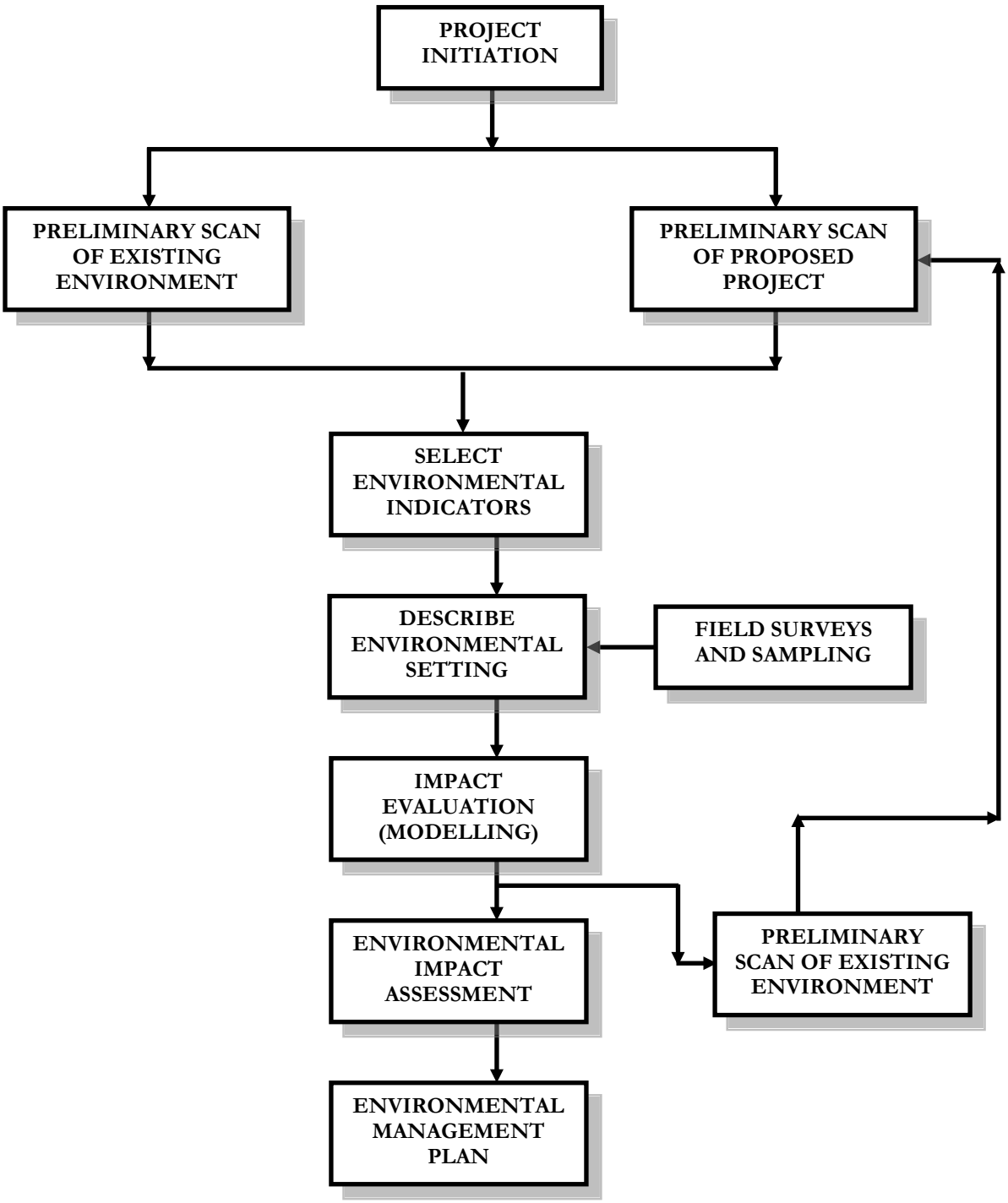
The EIA study shall suggest specific, structured and targeted management plans to mitigate the significant adverse impacts of the proposed project during construction and operation phases.

1.5 METHODOLOGY ADOPTED FOR RAPID ENVIRONMENTAL IMPACT ASSESSMENT

The purpose of this section is to enumerate the methodology for Rapid Environmental Impact Assessment (REIA) which has been followed for this study. Any activity involving construction and operation is expected to cause impacts on surrounding environment. The impacts may be adverse or beneficial, short term or long term, and reversible or irreversible. In order to assess the significance of impacts, various steps that are used in conducting an REIA within core and buffer zone around the proposed project construction site are divided into the following phases:

- Identification of significant environmental parameters and assessing the existing status within the impact zone with respect to air, water, noise, land, biological, and socioeconomic components of environment.

- Study of various activities of the proposed project components to identify the area's leading to impact/change in environmental quality.



Identification of potential impacts on various environmental components due to the activities envisaged during pre-construction, construction, and operational phases of the proposed project.

- Prediction of significant impacts on the major environmental components using qualitative /quantitative techniques.
- Preparation of environmental impact statement based on the identification, prediction and evaluation of impacts.
- Delineation of Environmental Management Plan (EMP) outlining preventive and curative strategies for minimizing adverse impacts during pre-construction, construction and operational phases of the proposed project.
- Formulation of environment quality monitoring programmed for construction and operational phases to be pursued by the project proponent

1.6 ENVIRONMENT MANAGEMENT CELL

Company will ensure to conduct all business operations in compliance with applicable laws, regulations and standards related to occupational Health, Safety and Environment. An Environmental management cell with adequate professional expertise and resources shall be established to discharge responsibilities related to environmental management including statutory compliance, pollution prevention, environmental monitoring, etc. The EMC will be made responsible for all issues related to environmental management of the proposed project facilities.

1.7 REPORT PRESENTATION

This report is based on an extensive reconnaissance survey of the area and field studies conducted during the sampling period **of summer for 2012.** For primary baseline data collection samples for ambient air, water and soil and noise levels in the study area were collected and analyzed, and the secondary data was collected from various sources in public domain and other agencies.

The report has been presented in the following pattern. The environmental parameters are grouped under Physical (Air, Water, Noise, Land), Biological (Flora and Fauna), and Socio-economic Environments. The baseline, impact and mitigate measures are described in accordance with the broad categories as above in the following chapters.

The report is divided in 6 chapters as given below. All supporting data is presented in the Appendices.

Executive Summary

It gives insight of the REIA Report and chapters there in.

Chapter 1: Introduction to the Project

This chapter provides background information on need of project, need of EIA study and brief of the project. It also covers the identification of project & project proponent, brief description of nature, size, location of the project and its importance to the country and the region.

Chapter 2: Project Description

This chapter deals with the project details of the proposed project with type of project, need for the project, location, size & magnitude of operation including associated activities required by and for the project, proposed schedule for approval and implementation.

Chapter 3: Baseline Environment Status

This chapter presents the existing environmental status of the study area around the proposed project including topography, drainage pattern, water environment, geological, climate, transport system, land use, flora & fauna, socio-economic aspects, basic amenities etc. Environmental assessment of the proposed project site in regard to its capability to receive the proposed new development is also discussed in this Chapter.

Chapter 4: Anticipated Environmental Impacts and Mitigation Measures

This chapter describes the overall impacts of the proposed project activities and underscores the areas of concern, which need mitigation measures. It predicts the overall impact of the proposed project on different components of the environment *viz*. Air, Water, Land, Noise, Biological, and Socio-Economic.

Chapter 5: Environment Management Plan

This chapter details the inferences drawn from the environmental impact assessment exercise. It describes the overall impacts of the proposed activities during construction and operation phases and underscores the areas of concern, which need mitigation measures.

Chapter 6: Risk Assessment & Disaster Management Plan

The Disaster Management Plan is to be related to the identification of various hazards addressed qualitatively and gives a broad identification of risks involved in the project operation

1.8 POST PROJECT ENVIRONMENTAL MONITORING

Environmental Monitoring Programmed for implementation during project construction and operation phases has also been delineated in this section. The objective of environmental monitoring programmed is to assess the adequacy of various environmental safeguards and to compare the predicted and actual scenario during construction and operation phases. This enables suggestion of remedial measures not foreseen during the planning stage but arising during these phases.

1.9 APPLICABLE ENVIRONMENTAL LEGAL FRAMEWORK

i) Recommendations on the proposed project for CRZ and Environmental Clearance by A&N CZMA.
ii) Consent to Establish / Consent to Operate /HWA from A&N Pollution Control Committee.
iii) Permission from A & N administration for drawl of ground water through bore wells.
iv) NOC from Chief Fire Officer for fire fighting.
v) CRZ and EC clearance from MoEF, Delhi.

CHAPTER 2

Project Description

2.0 INTRODUCTION

This section of the report describes the features of the proposed project in sufficient detail to allow an assessment of its environmental impact. A complete description is important to understand the potential environmental implications of the initiative and accordingly addressing issues in an appropriate manner. Description of the proposed project components and activities are presented together with the aspects during the construction and operation phase of the project which are also important from the environmental perspective.

2.1 PROJECT DESCRIPTION

The Indian Hotels Company Limited (IHCL) has entered into a long term lease with Andaman & Nicobar Islands Integrated Development Corporation (ANIIDCO) for building a premium 5 star resort in Havelock Island. The project will come up on a 45-acre beachfront parcel of land and will be branded **Vivanta by Taj, Havelock Island**. The land parcel is located on Radha Nagar Beach (also called Beach No.7) which was rated as the 'Best Beach in Asia' by Time Magazine in 2004.

2.1.1 Site Features

The site is a beachfront property which falls under the Coastal Regulation Zone having about 400 meters of beach frontage. It extends inwards in land to a distance of approximately 525 meter encapsulating an area with dense tropical vegetation, a water channel and some plantations. The site overlooks Radha Nagar Beach rated as one of the best in the world by Time Magazine and is anticipated to be the major attraction around which the resort may be built. A public road leading to the beach is present right next to the site. This road is about to 3.5 meters wide.

The water of the beach is a brilliant shade of blue-green. The beach is full of white sand. It stretches for a significant distance; the property is located somewhat centrally along the stretch of land just beyond the beach. Beyond the site is the reserve forest area, where any real estate development is unlikely. However, the beach against the backdrop of this reserve forest can be as close to a private beach as there can be for the proposed resort. The dense vegetation provides the setting of a tropical jungle by the beach.

The design of the layout has taken into consideration for enough open space so as to create a pleasant living environment.

2.1.2 Project Cost

The estimated project cost for proposed project is approximately Rs. 80 Crores.

2.2 PHASES OF THE PROJECT

The project will be completed in two phases:

2.2.1 First phase of the project

It is proposed to begin operations with 50 keys in 1st phase. In addition to these 10 public buildings (Banquets, Restaurant, Bar, Gym, Spa (4), Kids area, dive centre) and 4 staff accommodation buildings will be constructed. The 1st phase of project will be implemented over a span of around 2 years (commencement of construction: March 2013 and completion of construction: December 2015). In addition to 50 keys, staff quarters, bridge over stream, approach road to resort will be constructed. It has also been proposed to construct floating jetty, arrival pavilion and dive centre as an off shore construction. It would encompass 3 F&B outlets for exclusive dining experiences, banqueting & meeting facilities, spa, health club and recreation & sports amenities and other associated amenities. **The detail area program is given in section 2.8.**

2.2.2 Second phase of the project

In 2nd phase, there will be addition of another 50 keys and raise the inventory to approximately 100 keys. Additional F&B facilities will be created. Further expansion of the property at a future date will depend on the performance of the resort as well as receipt of requisite statutory approvals. The master planning to accommodate the possibility of expansion should be amenable to modular expansion of specific areas (such as kitchen) in event the key count expansion comes through in future. No infrastructure by way of pathways, roads etc. shall be created to cater to the expansion.

The main purpose and benefit of the project are as under:

- To develop a 5 star resort in Havelock Island;
- To provide quality stay which is the best in the country at affordable prices;
- To create an environment that could support the culture of good standard of living by co-locating essential facilities required for day-to-day living;
- To meet the growing demand of Resorts in Havelock in an environmentally sustainable manner;
- To enhance the surroundings with greenery, landscaping and recommended aesthetics;
- To emphasize on rainwater harvesting to create a better microclimate in the area.

2.3 PROJECT SITE DETAILS

The site details pertaining to project area are described below:

2.3.1 Site location and description

The project site is located at 11°59'8.76"N and 92°57'19.00"E at Radha Nagar beach (also known as beach no. 7) in Havelock Island, Andaman. It is world class beach and has been given grade 'A' status by the UNDP and WTO (1997). The island has geographical area of 113.93 km^2 and situated east of Great Andaman, and about 57 km northeast of Port Blair. The maximum elevation of the island is 168 meters. It is surrounded by Bay of Bengal from all side. The population of the island is mainly inhabitated in five villages, namely, Govinda Nagar, Bijoy Nagar, Shyam Nagar, Krishna Nagar and Radha Nagar according to 2001 census. Rural life is abloom – though good infrastructure, all-weather roads, a well equipped jetty and inland transport like Jeeps and autos and bus service.

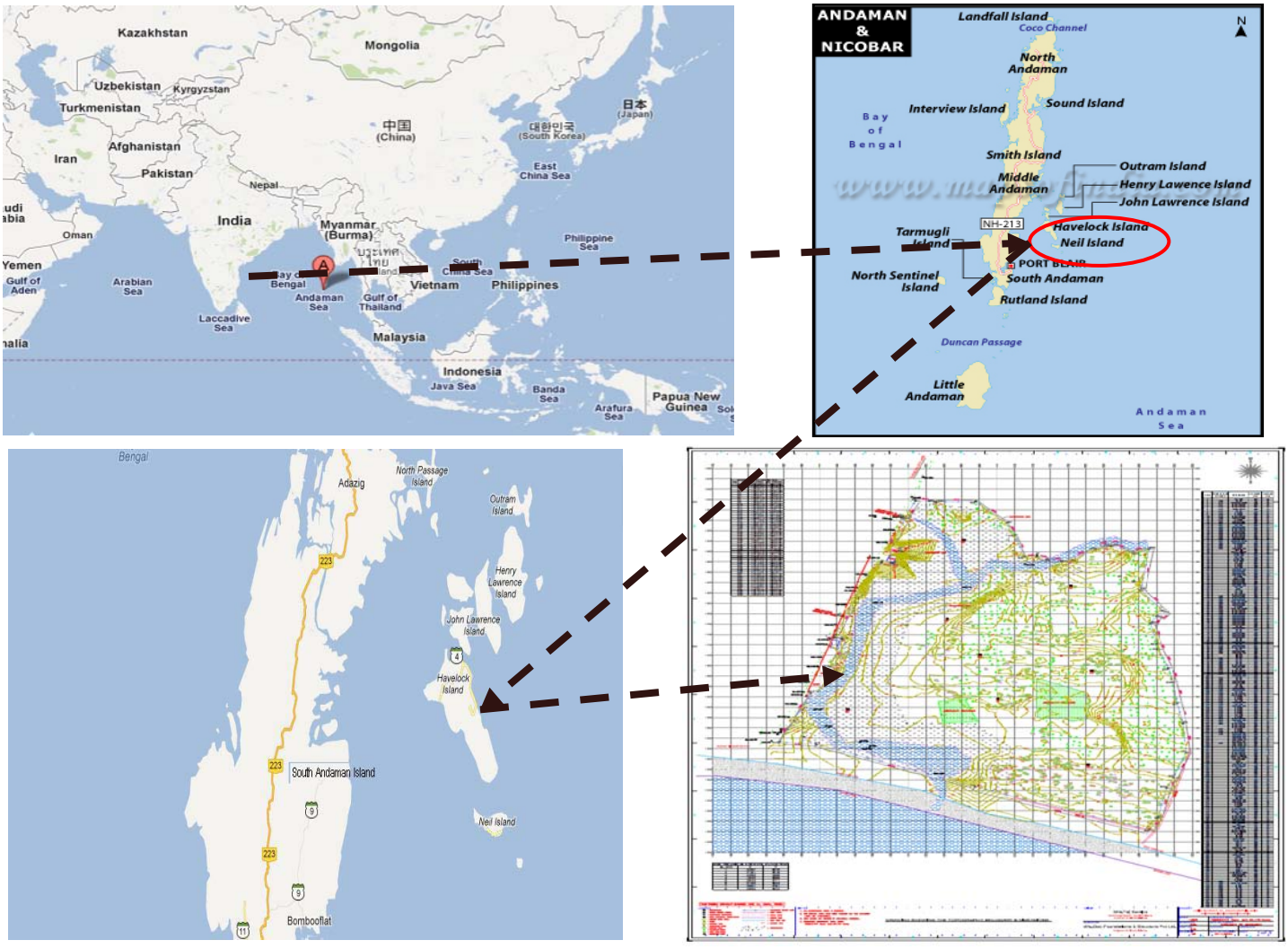


Figure 2.1: Project location

2.3.2 Accessibility

2.3.2.1 Access to the Resort

The resort can be easily accessed from Port Blair by waterways transport. Guests be transported by sea in ferries or by air through sea planes/helicopters if permitted by the statutory bodies. The option of creating a private jetty for departures from Port Blair would also be explored.

2.3.2.2 Travel by Sea

This can be done by an exclusive ferry to Havelock Island operated by the Taj, by the regular Government-operated ferry or private ferry services such as Macruzz which have recently started from Port Blair. To enhance the exclusivity of the experience it is recommended that the sea travel be provided by a Taj-operated vessel.

It is only during season time, i.e. December to March that the sea at Radha Nagar beach is calm and boats can come upto Radha Nagar beach. During these months a pontoon jetty may be installed as a private disembarkation point for guests checking in to Vivanta by Taj. At other times, there should be a swift transport from the existing public jetty to the resort, which is a distance of about 12 km.

2.3.2.3 Travel by Air

The Government has recently introduced a sea plane service from Port Blair to Havelock via a 9 seater aircraft. The 15 minute air ride is a vast improvement over the sea option which takes upto two and a half hours one way. The option of bringing guests through these flights and chartered helicopter rides should also be developed. Additionally, swift transportation will need to be provided from the existing helipad and sea plane landing facility at Havelock Island.

2.3.3 Site setting

The topography of the land is coastal plain. Natural vegetation is surplus as reserve forest is adjacent to the project site. The surrounding areas of the site with prominent features are tabulated below:

Table 2.1: Site connectivity from the project site

Major services	Name	Road Distance	Aerial Distance	Direction
Hospital	Primary health centre.	10 Km	6 Km	NEE
Police station	Havelock police station	12 Km	6.7 Km	NE
Fire Station	Havelock fire station	12 Km	6.7 Km	NE
School	Primary School at Radha Nagar	100 m	100 m	E
	Sr. Sec school, main market	10 km	6 Km	NEE
Air port	Vir Savarkar International Air Port	…..	57 Km	SW
Bus stop	Jetty Havelock	12 km	6.7 Km	NE
Bank	SBI & AN Cooperative Bank	10 Km	6 Km	NEE
Post Office	6 No. Krishna Nagar	6 Km	4 Km	NEE
Jetty	Jetty, Havelock	12	6.7	NE
Temple	Temple	12	6.7 Km	NE
Forest office	DFO office	10	6 Km	NEE

2.3.4. Project Layout and Development Concept

The layout plan of the proposed project has been developed keeping in view of the following major design considerations:

- Meeting the projected spatial requirements for the entire complex, as per the design brief.
- Design to be responsive, to the site parameters and the nature of villas proposed.
- Creating architecturally satisfying villas, this will stand out as a landmark in the vicinity.
- Adherence to the building bye-laws and master plan implications.
- The overriding prime objective of the proposed project is streamlining the functionary efficiency and catering to the needs of various users groups.

2.3.5 Site Development and Grading

The site is regular in shape and contiguous. The terrain of the land is generally plain. It is proposed to carryout site development and grading works within project boundary and the extent of site grading depends on the contour. All earthworks shall be carried out with appropriate technical considerations to avoid erosion or possibility of localized slip failure. Effective storm water drainage system has been proposed within the site

The existing open land will be leveled and graded prior to construction. Site preparation shall involve clearing of mostly areca nut trees but important species of trees will be preserved and or replanted. Every precautionary measure will be taken to preserve the floral components of the plot. During construction phase, some excavation is envisaged in order to provide foundations.

The quantities of earthwork involved are as follows:
Expected Excavation Quantity is 4500 m^3 and the filling quantity shall be for refilling or foundation trenches and for leveling of low lying areas within the plot premises. All the excavated earth material will be reused and thus there shall be no disposal to other site. Top soil of the site will be collected at site and reused for landscaping.

2.3.6 Fencing

All around the plot, wire fence is provided. Only one entry with two separate gates for entrance and exit are planned.

2.3.7 Roads

Adequately wide entry/exit will be proposed in the project along with pedestrian walkways provided for internal movement in order to facilitate smooth movement pattern of traffic.

2.3.8 Parking provision

There will be parking provision for few cars and motor cycles in the project site owned by Taj Hotel during operation phase of the project. There is no requirement of large parking area because guests cannot bring cars from Port Blair. At present, the approach route is by means of ferries operated by govt. & private agency from Port Blair to Havelock Island. However adequate parking spaces as per NBC norms/ Local byelaws are proposed within the premises.

2.3.9 Drainage

Effective storm water drainage and suitable rain and storm water management practices shall be followed to maintain the storm water flow. Rain water harvesting is proposed to further reduce the natural runoff at site.

2.4 MAJOR PROJECT COMPONENTS & RESOURCE REQUIREMENT

The major components that form a part of the project and its resource requirements are described below:

2.4.1 Land requirement

The total area of the plot is around **45 acres (1,82,834.741 sq.m),** covered with herbs, shrubs and mostly areca nut trees. The land allocation proposed for various uses is tabulated below:

Table 2.2: Area Statement & FSI details

Sr. No.	Particulars	Area in Sq.m
1.	Total Plot Area	1,82,834.741
	Deduction (10% Open Space)	69,349.910
2.	Net Plot Area	1,13,484.831
3.	FSI Area	15,796.57
4	Permissible FSI	1.5%
5	Non FSI	3175
6	Proposed Built Up area	15796.57
7	Total construction built-up area	18972
8	Area for Landscape	24,000
9	Open space	70513

2.4.2 Water Requirements and Supply

Water requirement will be met through rain water harvesting and drawl of ground water during construction and operation phases of the project. The requirement with the source of supply is tabulated below:

Table 2.3: Water Requirement

I	**During Construction Phase**	
1	For Workers	40 KLD
2	Construction purposes	20 KLD
	Total	60 KLD
II	**During Operation Phase**	
1	Total water requirement	480 KLD
2	Domestic water requirement	250 KLD
3	Flushing water requirement	36 KLD
4	Landscaping requirement	114 KLD
5	Air Condition	40 KLD
6	D.G cooling tower	20 KLD
7	Swimming pool	20 KLD
8	Waste water generation	233 KLD
9	Treated wastewater	210 KLD
10	Treated Waste water to drain/Nalla	NIL

The quantity of water required during operation phase is around 480 KLD out of which fresh water requirement shall be around 250 KLD, 20 KLD for Swimming Pool and the balance 210 KLD is the recycled treated wastewater. The fresh water shall be extracted through Bore wells and Rain water harvesting. The break-up of water requirement for different utilities of operation phase is shown below:

Table 2.4: Break up of Water Requirement

Sr. No.	Purpose	Fresh water (KLD)	Recycle water (KLD)
1	Flushing	-	36
2	Domestic	250	-
3	Swimming pool	20	-
4	Landscaping	-	114
5	Air condition		40
6	D.G cooling tower		20
	Total Water requirement	**270**	**210**

Water Balance Chart

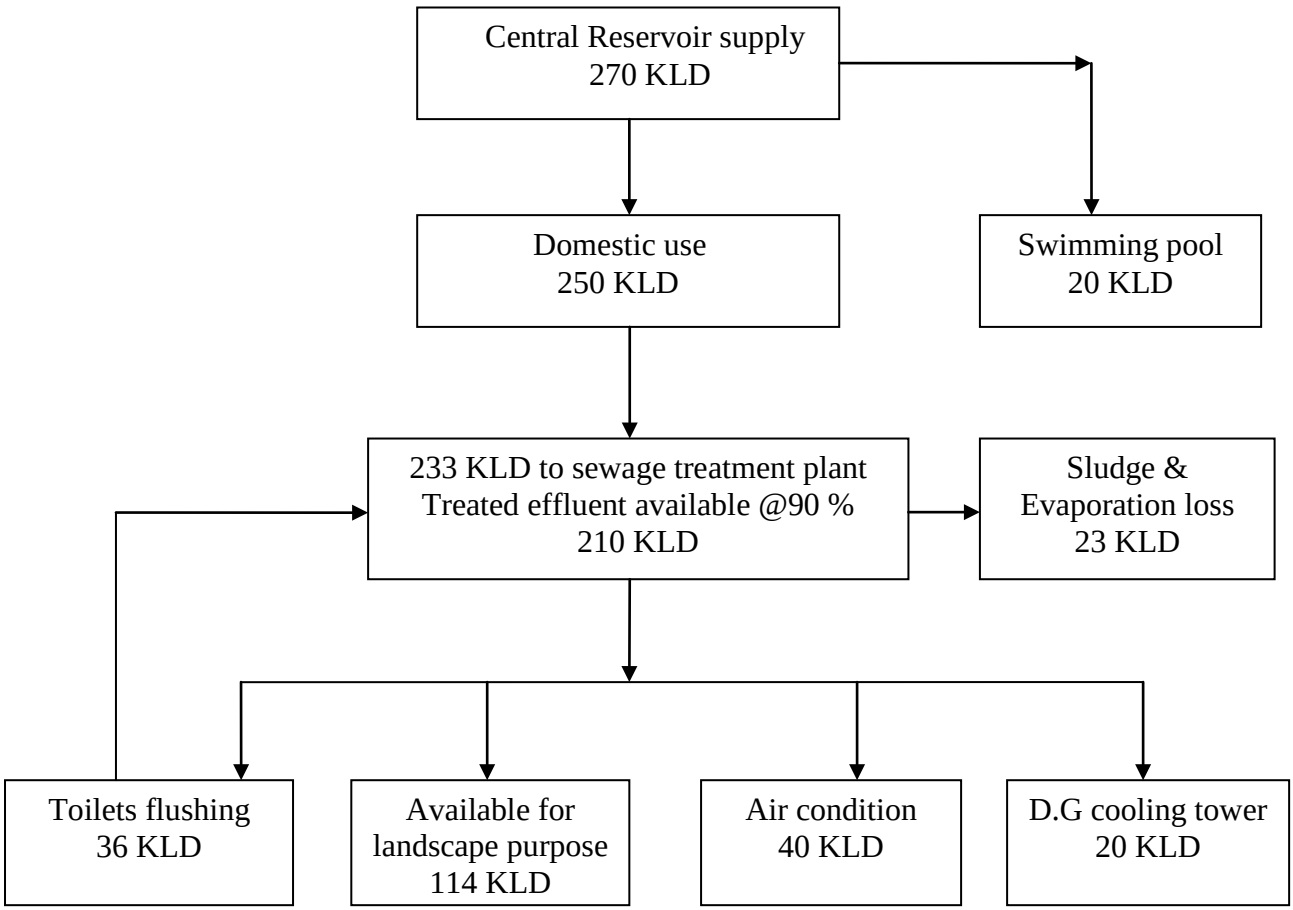


Figure 2.2: Water balance for the operation phase

2.4.3 Water Storage:

Water will be stored in 6 nos. of 100 KL tank each (Both Domestic and Fire tanks are considered). The quality of water supplied will be as per IS 10500:1991.

2.4.4 Sewage Generation and treatment

There will be no waste water generation from the construction activities. The only source of wastewater during construction phase is from temporary labour camp, mainly sewage. Generated sewage (around 36 KLD) during construction phase will be disposed off through septic tank connected to soak pit.

During operation phase, total 233 KLD of wastewater will be generated from the project. It is proposed to construct 1 nos. of Sewage Treatment Plant of capacity 235 KLD for the Complex. The treatment process shall be Time tested and reliable activated sludge process with extended aeration through diffused aeration. The treated water (210 KLD) from the Sewage Treatment Plant shall be used for landscaping, HVAC and Flushing requirement etc. There will be Zero Liquid discharge during operation phase of the project.

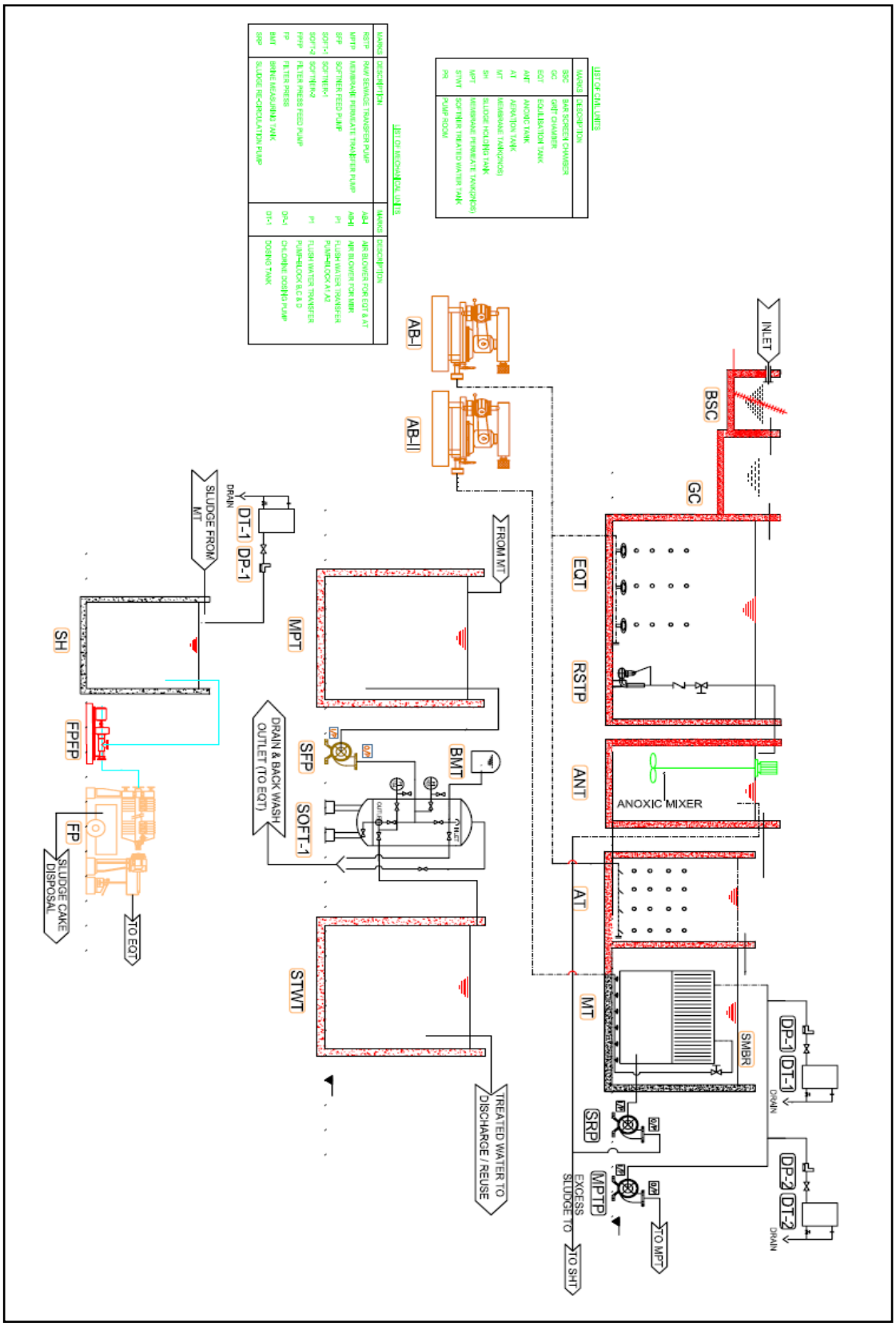


Fig. 2.3: Schematic diagram of STP

2.4.5 Solid waste:

Waste is an unavoidable byproduct of human activity. Economic development, rapid urbanization & improved living standards have led to the increase in quantity & complexity of the waste generated.

Proper disposal of waste is essential for preservation and improvement of public health. Inefficient management of solid waste is an obvious cause for degradation of environment in most of the cities. Municipal solid waste materials generally encountered are garbage, rubbish, street refuse, dead animals, hazardous wastes etc. Description of solid wastes generated from the proposed project site during the operation phases of the project is given in Figure below.

2.4.5.1 Solid waste generation during construction phase

Construction activities can lead to solid waste generation including sand, concrete, gravel, stone, bricks, plastic, paper, wood, metal and glass. Approximately, 2 to 3 tons of waste shall be generated on an average from the project site per day during the construction phase. The entire construction waste, masonry & plastering debris will be used for land filling and lower grade of concrete, excavated soil will be used filling up low lying areas. Glass, wood, aluminium, broken tiles, boxes, cans, etc. will be handed over to authorized vendor for disposal. Total earth excavation quantity during construction phase shall be 4500m^3 which shall be used in refilling.

Domestic Solid waste: Approximately 135 kg/day of domestic solid waste will be generated which shall be collected and stored in collection bins and finally handed over to outside agency for final disposal.

Table 2.5: Debris disposal option

From Masonry & Plastering	Used in Batching Plant for lower grade of concrete
Excavated soil	Used in Filling up low lying areas, back filling
Wastage of glass, wood, aluminium	Vendor to be responsible for disposal of wastage
Broken tiles, boxes, cans, etc.	Vendor to be responsible for disposal of wastage

2.4.5.2 Solid waste generation during operation phase

Approximately 63 kg/day of solid waste will be generated during operation phase, which shall be segregated as biodegradable (38kg /day) and non-biodegradable (25 kg/day) waste. **Organic Waste Processor (OWP)** shall be provided for converting bio-degradable waste to manure and non-biodegradable waste will be sold to prospective buyers. Sludge of 2.33 kg per day will be generated for which filter press shall be provided.

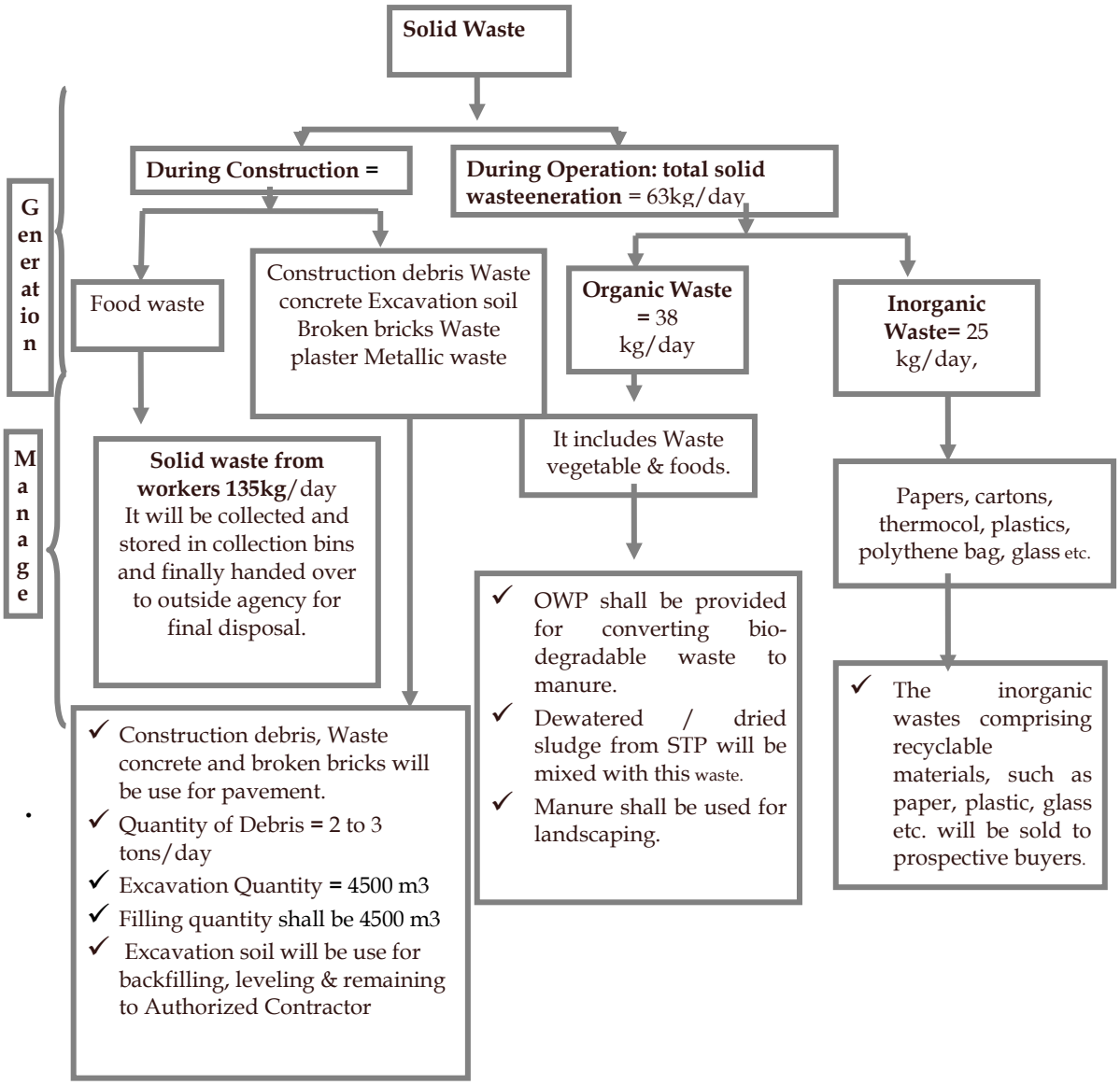


Figure No.2.4: Total Solid waste generation and its quantification

2.4.6 Hazardous Wastes Characteristics

Hazardous wastes generated will include waste oil and grease from DG sets during oil changes. The used oil will be handed over to authorized vendor.

S. No.	HW waste	Categorization as HW rule 2008
1	Spent oil	5.1
2	Hazardous waste container	33.3

2.4.7 Power Requirements and Supply

The during operation phase connected load will be around 985 KW / 1230 KVA. Power requirement will be met through DG sets.

Table 2.6: Power Requirement

1	**Construction phase:** • Source: DG set • Power requirement: 100 KVA approx
2	**Operation phase:** • Source: Diesel Generators only • Quantity of power requirement: 720 KW / 900 KVA • Connected load: 985 KW/1230 KVA • Demand load:720KW/900 KVA

2.4.8 Raw material requirement

The raw material required for construction purpose shall be Cement, RMC, Sand, Aggregates, brick, Steel, stone, timber etc. In short it is rammed earth for walls, rubble masonry for foundation and timber for roof. The exact quantities of each shall be furnished at design stage.

2.4.9 Man-power requirement

During construction phase, about 300 numbers of laborers shall be required to carry out construction activities. Temporary hutments will be provided for laborers employed during construction phase at the site itself.

2.4.10 Rain Water Harvesting Details

Rain water harvesting has been proposed at the project site, the layout of which is shown in fig below.

Table 2.7: Details of Catchment area Rainwater harvesting

Sr. No.	Specification	Area (m2)	Run off Coefficient %	Rain fall intensity (mm)	Run off in m3/hr.
1	Roof top area	13500	0.95	501	6425
2	Paved area	10500	0.95	501	4902
3	Green area	157000	0.4	501	31462

1	Rain Water Harvesting details	
A	Catchment area for RWH	45 Acres
	i) Roof top area	13500 Sq.m
	ii) Paved area	10500 Sq.m
	iii) Green area	157000 Sq.m
B	No. of storage tank / recharge pit	Storage Tank capacities shall be as follows: 100 KL – 2 No's, 250 KL – 2 No's, 300 KL – 1 No.
C	Size of storage tank	100KL Tank size = 10M Length, 5M Breadth & 2M Liquid Depth; 250KL Tank size = 15M Length, 8.5M Breadth & 2M Liquid Depth; 300KL Tank size = 15M Length, 10M Breadth & 2M Liquid Depth

Assuming the intensity of rainfall to be 501mm

= 4278 m^3

= 11.88 m^3/sec

Roof water Collection Sump = 6425 m3

- Rainwater from the Roof is led down through vertical ladders and connected to the Roof Water Collection sump through a separate network of pipelines of 160mm dia.
- Thereby conserving the regular fresh water source. The water from the roof after first rain is let out into the external storm water drain allowing the dirt and Contaminants to get cleansed and roof water from the second rain is let into the Raw Water sump. This water is further treated & stored in the Treated water tank.

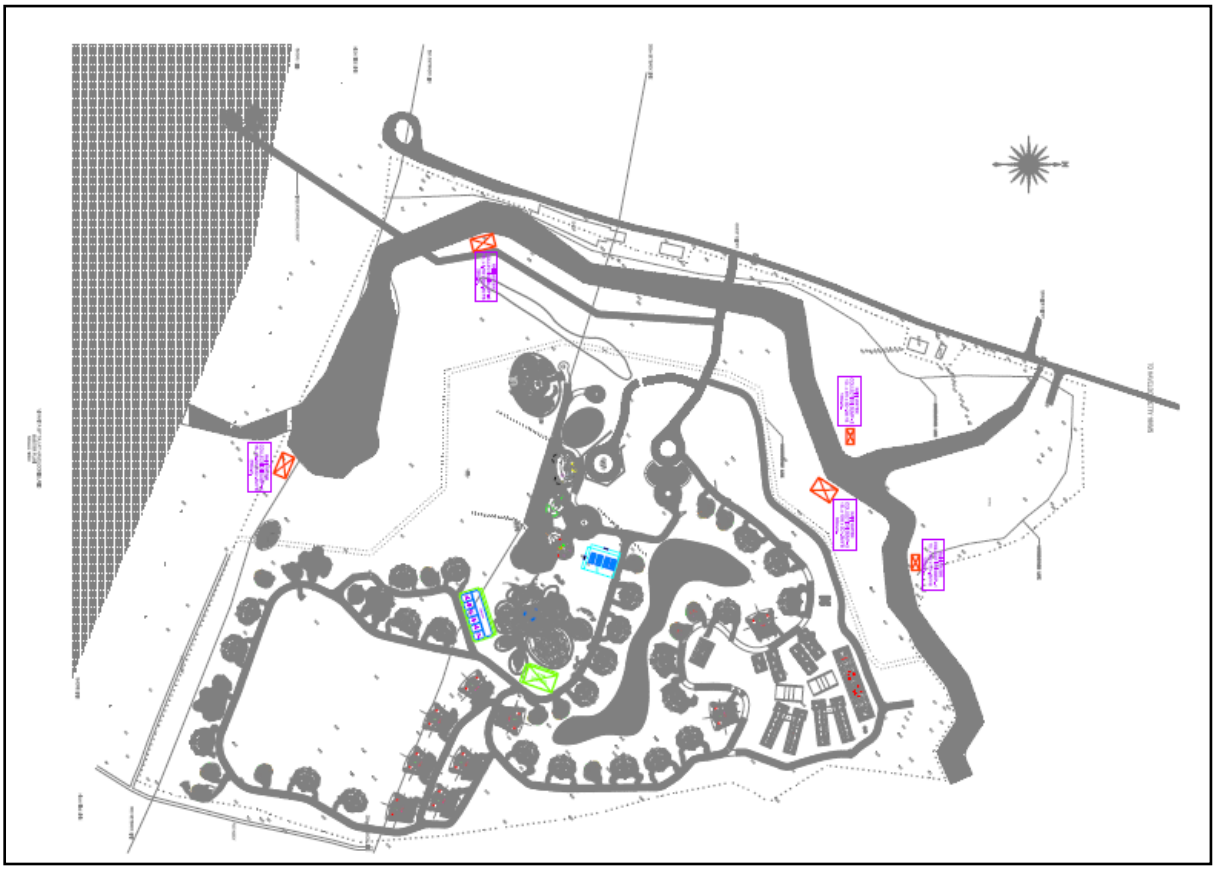


Fig. 2.5: Locations Showing RWH Structures

2.4.11 Storm Water & Run off Details

The storm drainage above ground will essentially cater for the seasonal rains. The major part of discharge will be from roof. Rain water outlets will be provided at the edges from where it will be carried down by down take pipes to discharge into catch basins/chambers. Rain Water Harvesting Tank will receive rain water only from the Terraces and Paved areas.

However, the rain water from paved areas will be collected by open drains, and led to existing storm water disposal system through the recharge system provided on the ground level. The runoff from external areas will be directed into recharged pits. The overflow from recharged pits will separately discharge into external storm drains. The invert level of public drain/ nallah is to be ascertained.

2.4.12 Water Storage

It is necessary to provide bulk storage for water. It is intended to provide Sintex water tank during construction phase & underground storage tank during operation phase.

The storage tank details are shown below:

1. Number & quantity: 6 no's 100 KL each (Both domestic And Fire tanks are considered)

2.4.13 Fire Fighting System

- External yard Hydrants shall be considered in all villas & other commercial building.
- Sprinklers shall be considered in all villas & other commercial building.
- Upright sprinklers shall be considered in all areas.
- Hydrant / sprinkler pumps, Diesel engine pump & Jockey pumps shall be considered for firefighting system.
- 2 no's of fire water tanks are considered of capacity 100 KL each.

2.4.14 Land Scaping & Greenbelt development

The main purpose of green belt designing is to attenuate the adverse impacts, while keeping in view the availability of vacant/open land, preferably wasteland. Because, conventionally the efficacy of green belting in the pollution abatement mainly depends upon the simple principle of the width of the green belt, tree heights to formulate green belt canopy while keeping in view the distance and direction of source of pollution as well as the focal points of noise emitting sources like permanent installations.

An ideal green belt always imparts scenic beauty besides providing roosting/perching place for birds and ground surface for naturally available reptiles, other flora and fauna species, to make the area more natural and hazard free.

The green belt as per the requirements of MoEF/CPCB will be developed. More than 33% of the plot area will be covered under green belt. Local and fast growing species shall be planted and Green Belt.

2.5 MAIN PHASE OF PROJECT

2.5.1 Construction Phase

The civil works for the construction and development of proposed project include bulk earthworks, construction of internal roads, pavements, parking area, underground water storage tanks, foundations for villas and structures, installation of storm water drainage, water supply, and sewage drainage network, services, landscaping and security fencing. Other excavation will be limited to trenching for storm water, water tanks, sewerage, electrical rooms/sub-stations and other facilities.

2.5.2 Operation Phase

The regular operation and maintenance will be required for sewage treatment plant, pumps, and DG sets. These will be equipped with electrical control and mechanical fittings. The maintenance of rainwater harvesting system will be required both on short term and long term basis. The trained operators will be deployed on all these facilities.

2.6 BUILDING DESIGN FEATURES ON SEISMIC LOAD

Various measures taken to make the proposed structure earthquake resistance include:

The vision for the resort should be to create a sense of the following amongst the guests -

- Ecological fragility
- Natural harmony
- Tranquility
- Leisure, Entertainment & Rejuvenation

The resort should minimize the environmental disruption during development and operation while simultaneously creating a suitable guest experience. Appropriate natural building materials should be considered for the resort buildings keeping in mind proximity to the sea.

As per the land lease conditions, captive power generation will need to be arranged for the property and hence all public and guest spaces should be abundant with

natural light and avenues for natural circulation of air as an alternative to even air-conditioning wherever possible to minimize environmental impact.

There is natural water channel at site which could be augmented to create a permanent lagoon which can be a striking feature of the resort on the banks of which guest accommodation and F&B facilities have been organized creatively.

The other guiding design principles for the design of this resort are –

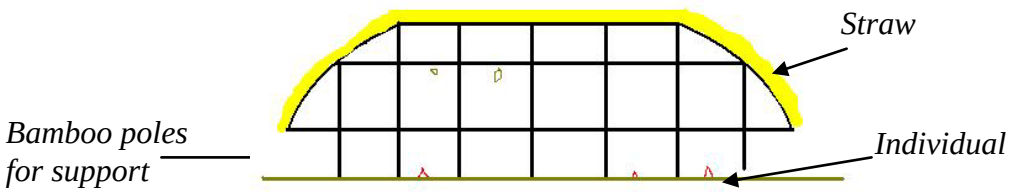
- The architecture should effortlessly blend with the environment.
- The buildings should be visually non-obtrusive with soft lines, inclusive landscaping and usage of local materials.
- Ornate carvings and complicated designs should be avoided.
- The interior design in these resorts should be modern and eclectic, set within a broad framework of native architecture and vegetation.
- Public areas likewise should blend tradition with modernity, adapting to the nature and using local materials and motifs / patterns to the extent possible.
- The Resort should provide guests across age-groups and expectations a range of activities during their stay such as mini-club for kids, gym & health club, outdoor sports and water-sports options.

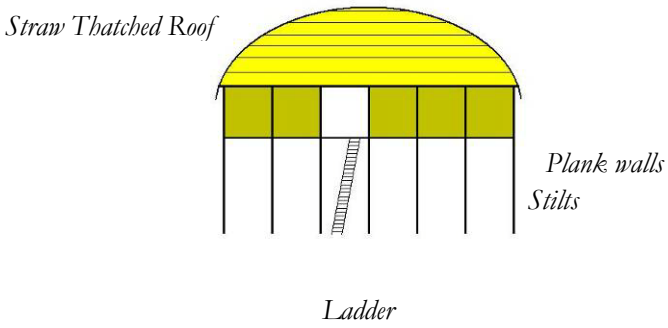
2.6.1 Design Approach

The design approach for this resort should be formed of an amalgamation of traditional and contemporary styles. While the traditional architectural style will draw inspiration from local architecture & materials and modern facilities and luxurious amenities maybe provided through a more contemporary approach to building design.

2.6.2 Traditional Style

Inspiration may be drawn from traditional Andaman & Nicobar architecture.





Traditional architectural style may be show cased through some signature buildings on the property such as arrival pavilion, all-day dining etc. Balancing the three themes of ecological harmony, local cultural settings and comfort is important while adopting this design approach.

2.7 CONSTRUCTION PLAN AND TIME TABLE

The total construction period for 50 keys in 1st phase is by December 2015. This schedule is dependent on receiving timely environmental approvals from the concerned authorities.

2.8 AREA PROGRAM

It is proposed begin to commence operations with 50 keys and raise the inventory to 100 keys in Phase II. This addition would however depend on the market performance as well as statutory approvals coming through at that stage.
The resort is proposed to have the following facilities –

1. Guest Rooms - 50 + 50 (Phase II)
2. F&B Outlets - 3 + 1 (Phase II)
    a. All Day Dining restaurant
    b. Bar
    c. Beach Shack
    d. Specialty (Phase II)
3. Banquets
    a. One partitionable hall of 1800 sqft
    b. Supporting meeting facilities
4. Recreation Zone
    a. Swimming Pool & Children's Pool

b. Kids' Club & Recreation Centre (for < 12 yrs and >12 yrs)
c. Gym
d. Wet Areas as part of pool changing areas

5. Spa and Saloon
6. Back-of-House Areas
   a. Medical Centre
   b. Staff Accommodation for at least 35 people
   c. Housekeeping
   d. Laundry
   e. Water treatment plants
   f. Generator areas
   g. Electric buggy charging station /parking
   h. Parking
   i. Materials receiving, storage etc. areas
   j. Executive office
   k. Kitchen
   l. Stores
   m. Pantries (hskp / butler)

CHAPTER 3

Baseline Environmental Status

3.0 INTRODUCTION

The baseline environmental qualities of various environmental components like air, noise, water, land, flora and fauna and socioeconomic form an important and integral part of any environmental study. The baseline data forms the basis for predicting/assessing the environmental impacts of the proposed project. The baseline environmental quality is assessed through field surveys within the impact zone as well as secondary data for various components of the environment.

The present report presents the data collected during the sampling period of three months during **summer season from March to May 2012.** Various environmental components were monitored and samples analyzed.

The baseline quality of various components of the environment (**marine and terrestrial components**), viz. air, noise, water, land, biology, meteorological and socio-economic has been assessed within the impact zone of 10 km radius around the proposed project site.

3.1 STUDY AREA INCLUDED IN ENVIRONMENTAL SETTING

Field studies were carried out in pre monsoon season in about 10 km radius area from the proposed site with respect to meteorology, flora, fauna, land, geology, hydrogeology and socioeconomics of the area. Further the air quality, water quality, noise level and soil quality sampling and analysis was carried out. The air quality, water quality, noise level and soil quality in the study area is evaluated based on this physical sampling and analysis. The revenue villages that fall under PIA are Radhanagar, Govinda nagar, Bijay nagar, Shyam nagar and Krishna nagar in Havelock island. Analysis was carried out at MoEF approved Environmental Laboratory of Green Circle Inc., Vadodara.

Fig. 3.1: Project Impact Area of 10 km radius from the project site

3.1.1 Land Use

The Land Use of the study area shows forest, water bodies, Mangroves, roads, settlements. It shows the existing land cover in and around the proposed project site. Area under water body is highest (74.67%), and least in settlements (0.03%). The land use map is shown below in fig. 3.1 & the detail land use classification is tabulated below in table 3.1 and land use map is shown below in fig. 3.2.

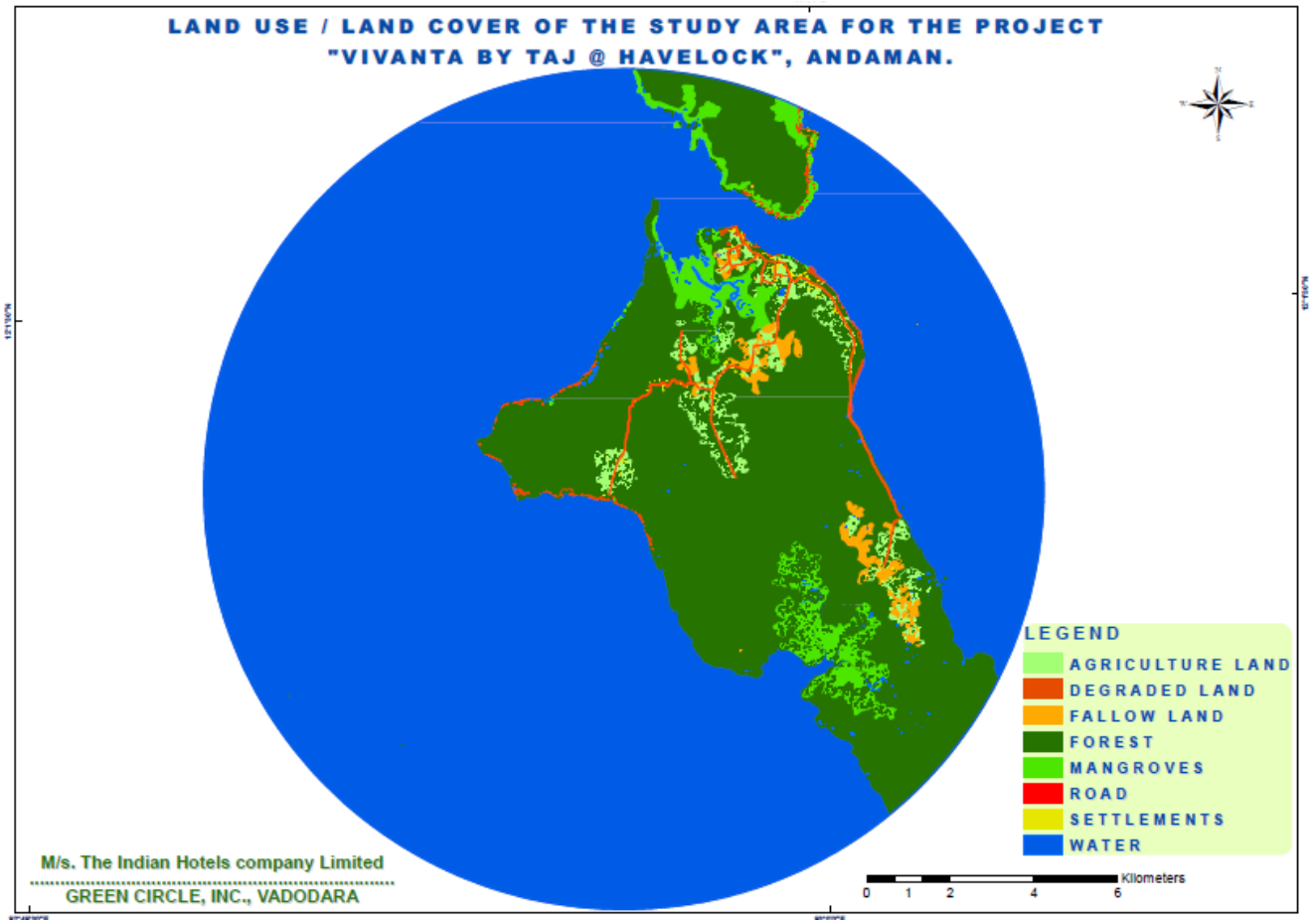


Fig. 3.2: Land Use/Land cover Map of the study area

Table 3.1: Land Use Classes of the Study area

S. No.	Land use Pattern	Area (m^2)	Area (ha)	Area (%)
1	Agriculture land	4114125	411.41	1.33
2	Water	231303867	23130.39	74.67
3	Degraded land	523425	52.34	0.17
4	Forest	68775700	6877.57	22.20
5	Fallow land	1832525	183.25	0.59
6	Settlements	91025	9.10	0.03
7	Roads	261775	26.18	0.08
8	Mangroves	6983880	698.39	2.25
	Area	**309772197**	**30977**	**100**

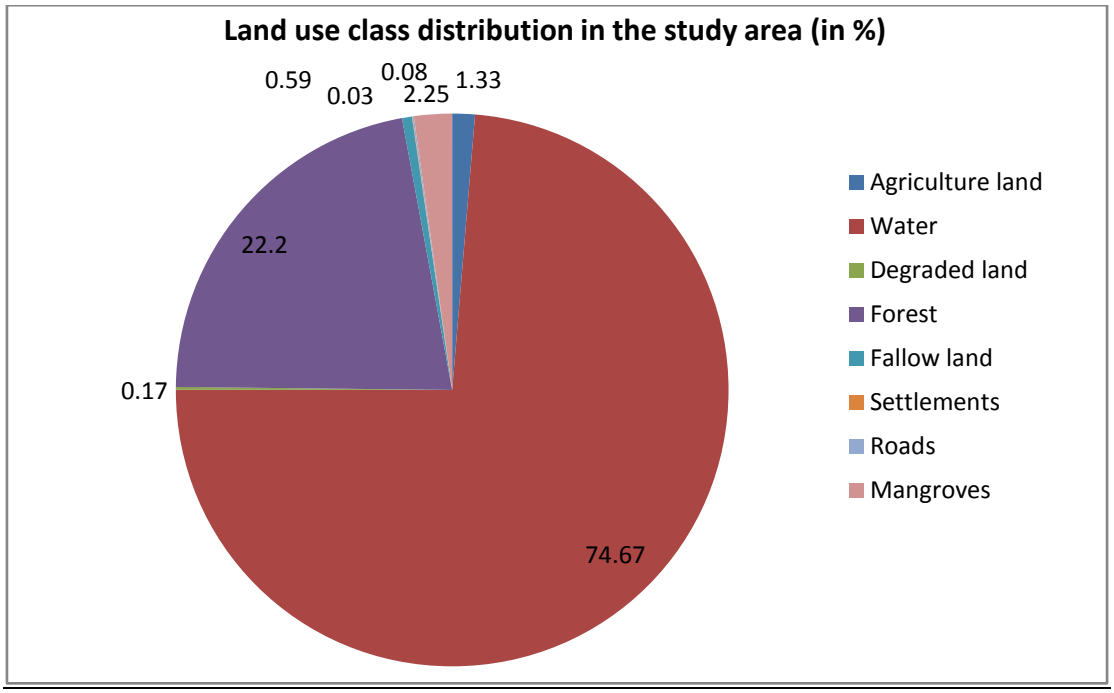


Fig. 3.3: Land Use Class distribution

3.2 METHODOLOGY

The methodology for conducting the baseline environmental survey obtained from the guidelines given in the EIA Manual of the MoEF. Baseline information with respect to air, noise, water and land quality in the study area were collected by conducting primary sampling/field studies during summer season of year 2012.

Table 3.2: Environmental Attributes & Frequency of Monitoring

Sr. No.	Attribute	Parameters	No. of Sampling Locations	Frequency of Monitoring / Data Collection
1	Ambient air quality	PM_{10}, $PM_{2.5}$, SO_2, NO_x,	9	24 hourly samples twice a week
2	Meteorology	Wind speed and direction, temperature, relative humidity and rainfall.	At project site	Data has been collected for IMD, for corroborating the data and planning the monitoring network.
3	Water quality	Physical and chemical, biological parameters	10	Once during the study period.

Sr. No.	Attribute	Parameters	No. of Sampling Locations	Frequency of Monitoring / Data Collection
4	Terrestrial Ecology	Existing flora and fauna.	Study area	Through field visit during the study period and substantiated through secondary sources.
5	Marine Ecology	Aquatic flora and fauna	3 locations	Through field visit during the study period and substantiated through secondary sources.
6	Noise levels	Noise levels in dB(A)	10	Hourly observation once
7	Soil characteristics	Physical and Chemical Parameters.	8	Sub surface composite samples collected once during the study period.
8	Socio-economic Environment	Socio-economic character - ristics, population statistics existing amenities in the study area.	Study area	Based on field surveys and data collected from secondary sources

3.3 IMPORTANT FEATURES WITHIN THE STUDY AREA

Details of the important features along with other sensitive ecological locations in the study area are provided in table 3.3.

Table 3.3: Site Connectivity

Major services	Name	Road Distance	Aerial Distance	Direction
Hospital	Primary health centre.	10 Km	6 Km	NEE
Police station	Havelock police station	12 Km	6.7 Km	NE
Fire Station	Havelock fire station	12 Km	6.7 Km	NE
School	Pri. School at RadhaNagar	100 m	100 m	E

Major services	Name	Road Distance	Aerial Distance	Direction
	Sr.Sec school, main market	10 km	6 Km	NEE
Air port	Vir Savarkar International Air Port	….	57 Km	SW
Bus stop	Jetty Havelock	12 km	6.7 Km	NE
Bank	SBI & AN Cooperative Bank	10 Km	6 Km	NEE
Post Office	6 No. Krishna Nagar	6 Km	4 Km	NEE
Jetty	Jetty, Havelock	12	6.7	NE
Temple	Temple	12	6.7 Km	NE
Forest office	DFO office, Havelock	10	6 Km	NEE

3.4 CLIMATE OF THE STUDY AREA

The island has a tropical climate which is warm, moist and equable.

3.4.1 Temperature

Day time temperature generally varies between 27 ^{o}C to 32.6 ^{o}C throughout the year being highest in April and night time temperature varies 23 ^{o}C to 26 ^{o}C being highest in April & May. During post monsoon, maximum temperature various between 30 ^{o}C to 32.6 ^{o}C & minimum temperature vary between 22.2 ^{o}C to 25.3 ^{o}C. Rainy season temperature max.: 28.7 ^{o}C to 30.4 ^{o}C, min. 23.5 ^{o}C to 24.9 ^{o}C. April is warmest month.

3.4.2 Relative Humidity

The maximum relative humidity was about 78.5 - 82% almost throughout the year.

3.4.3 Wind

The average wind speed varies from 19 - 47 km/hr. The maximum wind speed experienced was 180 km/hr based on historical data. The annual wind pattern shows the prominent wind directions as north- east, north- west, followed by south- west. Wind rose diagram is given in **Figure No. 3.4.**

3.4.4 Rainfall

Rain occurs throughout the year and varies from 46 mm to 501 mm, the lowest being in January and highest in June. However, the average rainfall in the study area is 3176 mm.

3.4.5 Cloud Cover

There used to be cloud cover in Havelock Island during monsoon season which start

late may till the rain is over. Best weather sees between January to May wherein the sky remains clear. During the study period, the sky was clear.

Table 3.4: Climatologically data – Havelock

MONTH	M.MAX TEMP. (^{0}C)	M.MIN TEMP. (^{0}C)	M/R.FALL IN MM
January	30.5	23.4	4.3
February	31.0	23.2	2.8
March	30.8	23.5	14.7
April	32.1	25.0	1.8
May	32.0	24.9	13.2
June	30.1	24.5	19.6
July	29.7	23.9	19.6
August	29.6	24.0	17.3
September	29.3	24.1	21.5
October	31.2	24.9	4.9
November	32.6	25.0	2.4
December	30.5	24.7	7.8

(**Source:** RMC Kolkata)

3.4.6 Site specific meteorological data of the season

Site specific meteorological data shows that average wind speed in the summer season is varies from 1m/s to 40.8 m/s. Wind rose diagram prepared for summer season is shown in fig. Calm wind contributes to about 0.09%. Average temperature recorded for summer season was 27.6^{o}C with maximum temperature of 32 ^{o}C and minimum of 23 ^{o}C which is a characteristic of this study area. The average relative humidity recorded was 85% with maximum relative humidity of 98 % and minimum of 55% The data obtained has been complied to obtain average data.

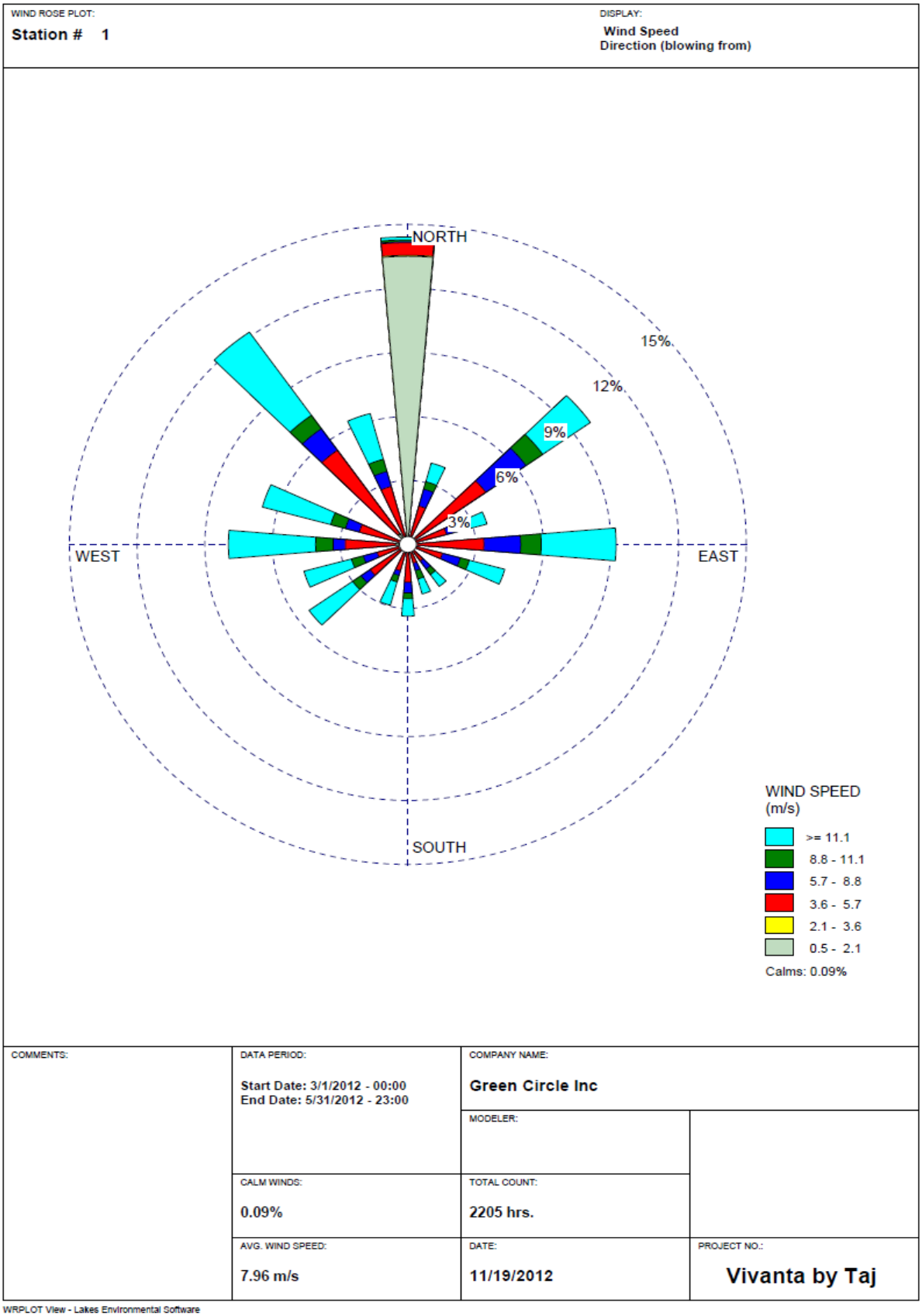


Fig. 3.4: Windrose diagram

3.5 AIR ENVIRONMENT

3.5.1 Reconnaissance

The quality of ambient air depends upon the background concentration of specific contaminants, the emission sources and meteorological conditions. The study on baseline ambient air quality status in the project area is an essential and primary requirement for assessing the impacts on air environment due to any proposed developmental activity.

The baseline studies on air environment include identification of specific air pollution parameters expected to have significant impacts and assessing their existing levels in ambient air within the impact zone. To assess the baseline status of ambient air quality in the study area, monitoring is undertaken to ascertain the baseline pollutant concentrations in ambient air.

3.5.2 Methodology & frequency of Monitoring

Monitoring was carried out on 24 hourly average basis twice in a week over the season as per guidelines of CPCB and NAAQS using calibrated Respirable dust sampler (RDS) and Fine particulate matter sampler. The conventional and project specific parameters such as Particulate Matter – PM_{10} & $PM_{2.5}$, Sulphur Dioxide (SO_2), Oxides of Nitrogen (NO_x) were monitored.

3.5.3 Selection of stations for Sampling

Depending upon the purpose of the study IS: 5184 (part XIV) lays down various criteria for selecting sampling stations. For EIA/ EMP, the purpose is to ascertain the baseline pollutant concentrations in ambient air. Accordingly, the criterion can be selected to ascertain quality of air at important human settlements or environmentally sensitive areas if any located in the 10 km radius of study area.

3.5.4 Monitoring Locations

The locations for AAQM study were selected within the 10 km radius of the proposed site. Ambient air quality was monitored in 9 locations to generate representative ambient air quality data. The sampling locations are shown in Figure 3.5 and listed in Table 3.5.

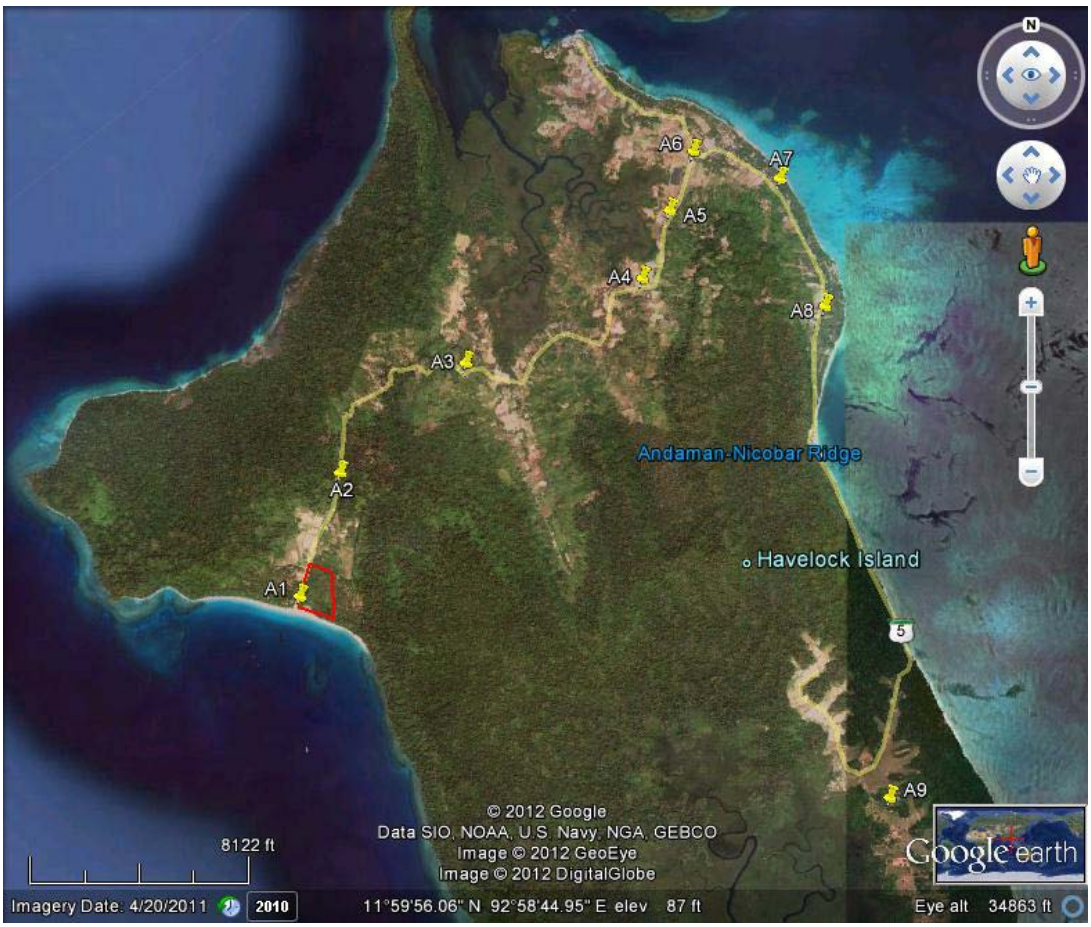


Figure 3.5: Map showing air Monitoring Locations

Table 3.5: Ambient Air Quality Monitoring Locations

Sampling Code	Name of Location	Coordinates		Distance	Direction w.r.t to project Site
		Northing	Easting		
A1	At Site	11°59.072′	92°57.196′	0 Km	-
A2	Water tank, Radha nagar 7 No.	11°59.821	92°57.449	~1.1 Km	NE
A3	NRHM, Subcentre, Krishna Nagar, Havelock	12°00.484	92°58.224	~2.8 Km	NE
A4	Shyam Nagar	12°00.999	92°59.319	~4.8 Km	NE
A5	Shyam Nagar no. 3	12°01.411'	92°59.488'	~5.6	NE
A6	Market Govinda Nagar	12°01.768	92°59.636	~6.2 km	NE
A7	Gold India Resort,	12°01.602	93°00.171	~6.7 km	ENE

Sampling Code	Name of Location	Coordinates		Distance	Direction w.r.t to project Site
		Northing	Easting		
	Govinda Nagar				
A8	Vijay Nagar	12°00.832	93°00.453	~6.3 Km	ENE
A9	Kalapathar	11°57.853	93°00.851	~6.5 km	SE

3.5.5 Status of Ambient Air Quality

The existing ambient air quality with respect to PM_{10}, $PM_{2.5}$, SO_2 and Nox is as observed in the study area are presented in **Table: 3.6**.

Table 3.6: Ambient Air Quality of the study area

S. No.	Location name		PM_{10} (µg/m³)	$PM_{2.5}$ (µg/m³)	SO_2 (µg/m³)	NO_X (µg/m³)
A1	At Site	Max	40.1	28.5	7	10.5
		Min	31.6	20	5.5	6.8
		Avg.	**36**	**24**	**6.3**	**8.7**
A2	Water tank, Radha nagar 7 No.	Max	35	25	7.5	12
		Min	28	18.5	4.2	5
		Avg.	**32**	**22**	**5.8**	**8.2**
A3	NRHM, Subcentre, Krishna Nagar, Havelock	Max	46.5	28	10.2	13
		Min	28	17.2	4	6.2
		Avg.	**38**	**22**	**6.7**	**9.6**
A4	Shyam Nagar	Max	48	32	10.2	13
		Min	32	18.5	4	5
		Avg.	**42**	**26**	**6.1**	**8.9**
A5	Shyam Nagar no. 3	Max	40.1	28.5	7	10.5
		Min	31.5	20	5	6
		Avg.	**36**	**24**	**5.9**	**8.5**
A6	Market, Govinda Nagar	Max	55	30	7.7	12
		Min	40.5	22	5.5	7.5
		Avg.	**48**	**26**	**6.8**	**9.4**
A7	Govinda Nagar (Gold India Resort)	Max	40	25	8.6	12.5
		Min	28	18.5	4.5	6
		Avg.	**34**	**22**	**6.2**	**8.7**
A8	Vijay Nagar	Max	45	30	6	10.5
		Min	33.5	25	4.5	7.5
		Avg.	**38**	**27**	**5.3**	**9**
A9	Kalapathar	Max	45	32	10.2	14
		Min	26	18	4	6.2
		Avg.	**35**	**24**	**6**	**9.4**
Standard			**100**	**60**	**80**	**80**

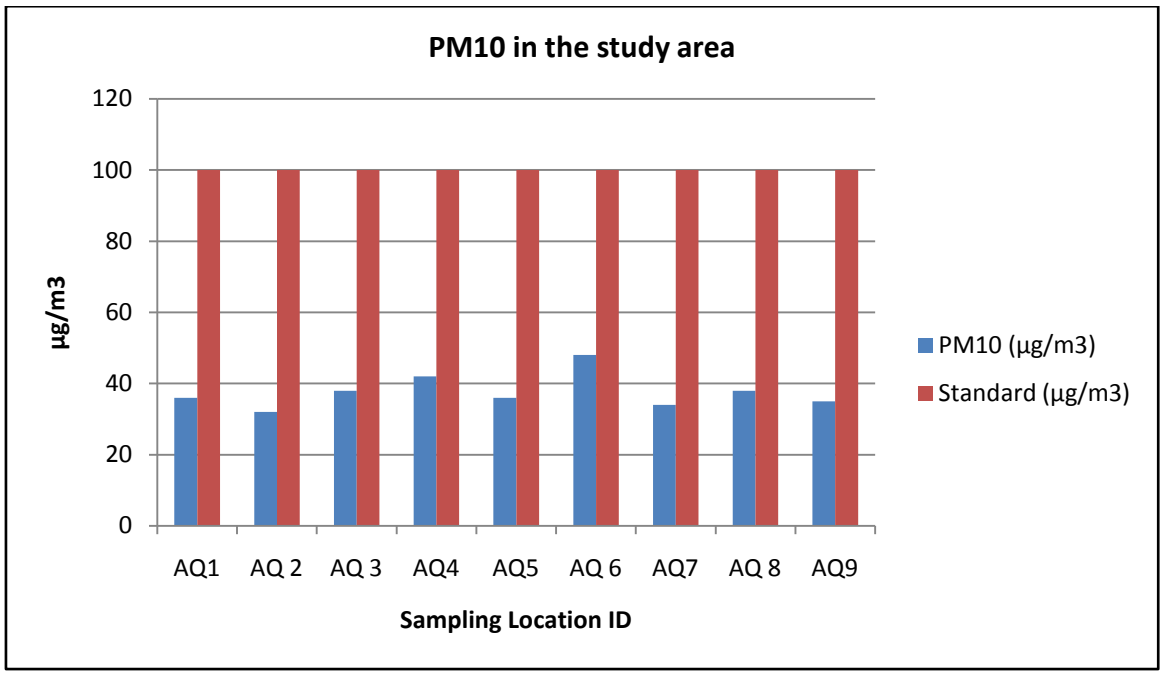


Fig. 3.6: Graphical Representation of PM_{10} in the study area

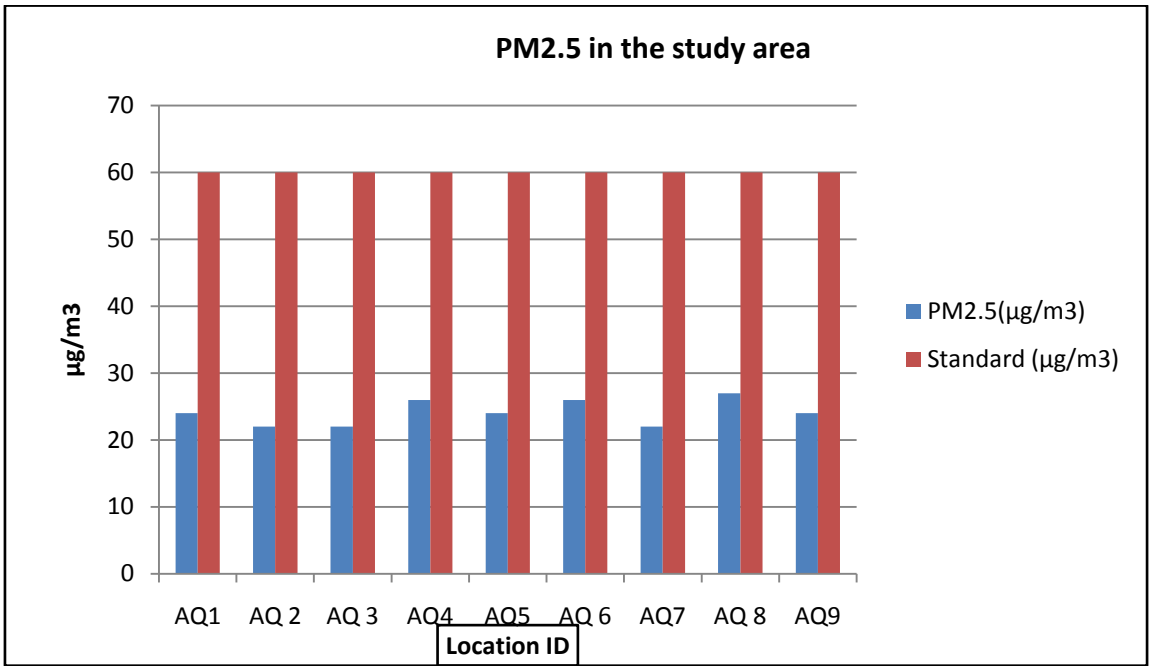


Fig. 3.7 Graphical Representation of PM2.5 in the study area

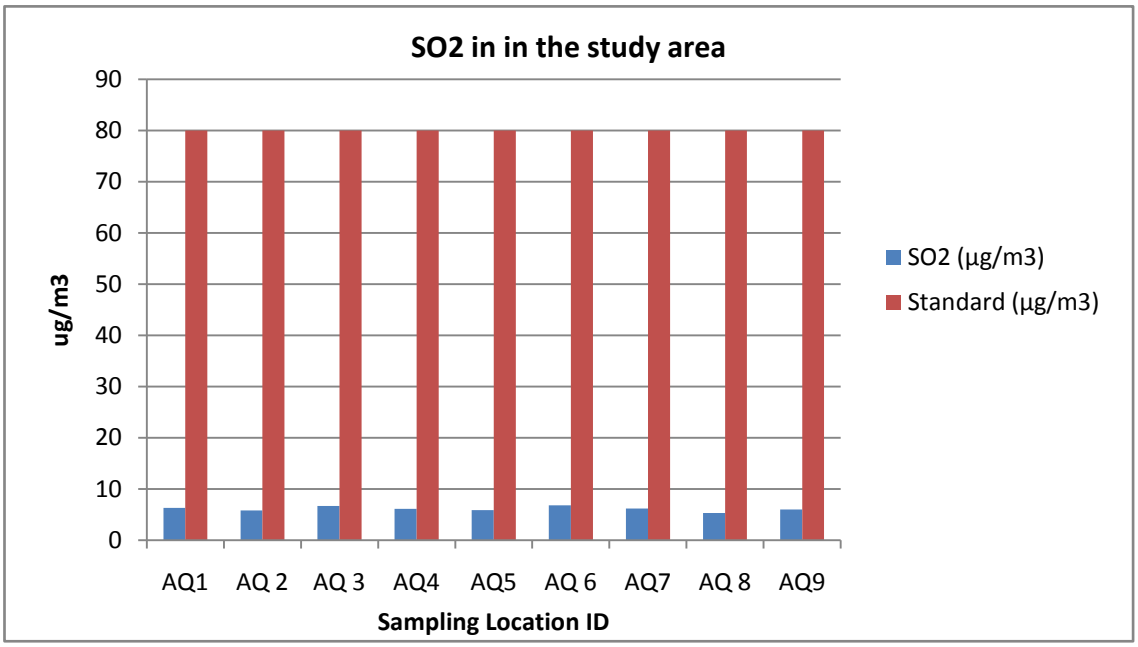


Fig. 3.8: Graphical Representation of SO_2 in the Study area

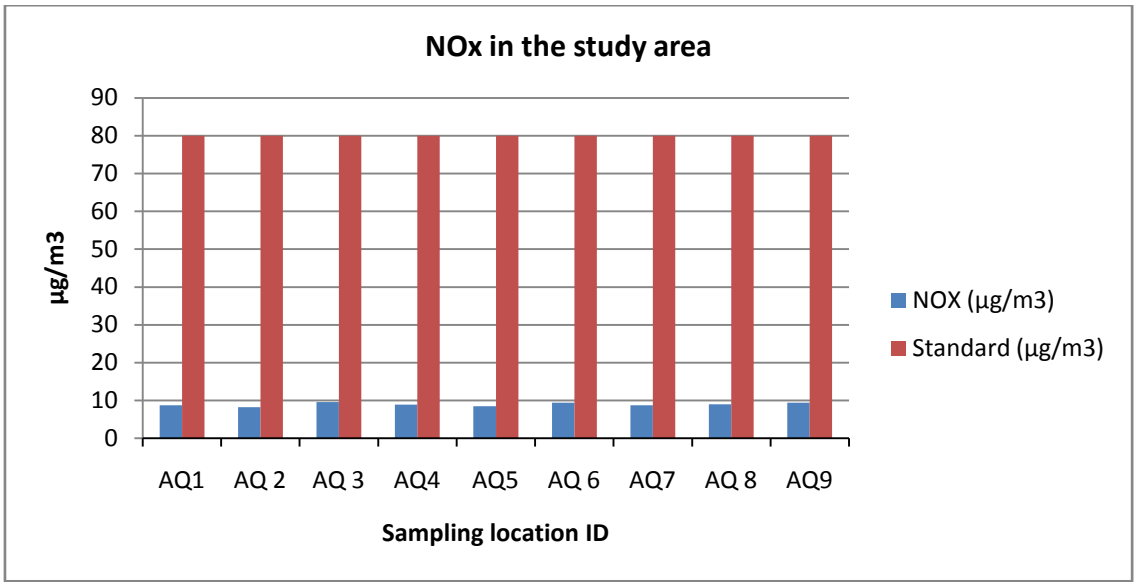


Fig. 3.9: Graphical Representation of NOx in the study area

Table : 3.7 National Ambient Air Quality Standards (NAAQS):

Sr. No.	Pollutants	Time Weighted Average	National Ambient Air Quality Standards		
			Industrial, Residential, Rural and other area	Ecologically Sensitive Area	Methods of measurement
1	SO_2 (µg/m^3)	24 hours	80	80	Improved West and Gaeke method
2	NO_x (µg/m^3)	24 hours	80	80	Modified Jacob & Hochheiser (Na Arsenite)
3	PM_{10} (µg/m^3)	24 hours	100	100	Gravimetric
4	$PM_{2.5}$ (µg/m^3)	24 hours	60	60	Gravimetric

(Source: NAAQS, CPCB notification, 2009)

3.5.6 Observation:

From the above results it can be observed that in the study area the average value of PM_{10} is in the range 32 - 42 µg/m^3, $PM_{2.5}$: 22 – 26 µg/m^3, SO2: 5.8 – 6.8µg/m^3, NOx in 8.2 – 9.6µg/m^3. All the parameters are well within the permissible limit of NAAQS as stipulated by CPCB. The maximum PM10 value was found at Govinda nagar (55µg/m^3) and minimum was found at Kalapathar (26µg/m^3). Maximum va;ue of PMPM 2.5 was recorded at Shyam nagar and kalapathar (32µg/m^3) and minimum at Kalapathar itself (32µg/m^3). SO2 was found maximum at Kalapathar and Krishnanagar (10.2µg/m^3) and minimum at Shyam nagar, kalapathar and Krishna nagar (4µg/m^3) whereas in Nox value was maximum at Kalapathar (14µg/m^3) and minimum at Radha nagar. The data reveals that none of the parameters exceed the permissible limit of CPCB during 3 month air monitoring. All the values are well below the prescribed standard.

3.6 NOISE ENVIRONMENT

Noise can be defined as an unwanted sound. It interferes with speech and hearing. If intense enough, it can damage hearing, or is otherwise annoying. The definition of noise as unwanted sound implies that it has an adverse effect on human beings and their environment. Noise can also disturb natural wildlife and ecological system.

The objective of the noise pollution survey in the study area was to identify existing noise sources and to measure background noise levels. The collection of baseline noise environment data included following steps:

1. Reconnaissance
2. Identification of noise sources and to measure background noise levels
3. Measurement of noise levels due to transportation

3.6.1 Reconnaissance

To measure the existing noise sources and to identify the background noise levels, the noise pollution survey around the proposed site was carried out. The collection of baseline noise environment data included Identification of noise sources and to measure background noise levels and measurement of noise levels due to transportation and other local activity.

3.6.2 Noise Monitoring Methodology

Noise has been monitored using calibrated noise meter for day time and night time in the study area. Noise meter was handled at a height of 1m - 1.5 meter above the ground while monitoring.

3.6.3 Noise Monitoring Locations

Noise was monitored at silence, residential and commercial zone. No industrial zone is present in the study area. The monitoring locations are indicated in the fig. 3.10 and table 3.8.

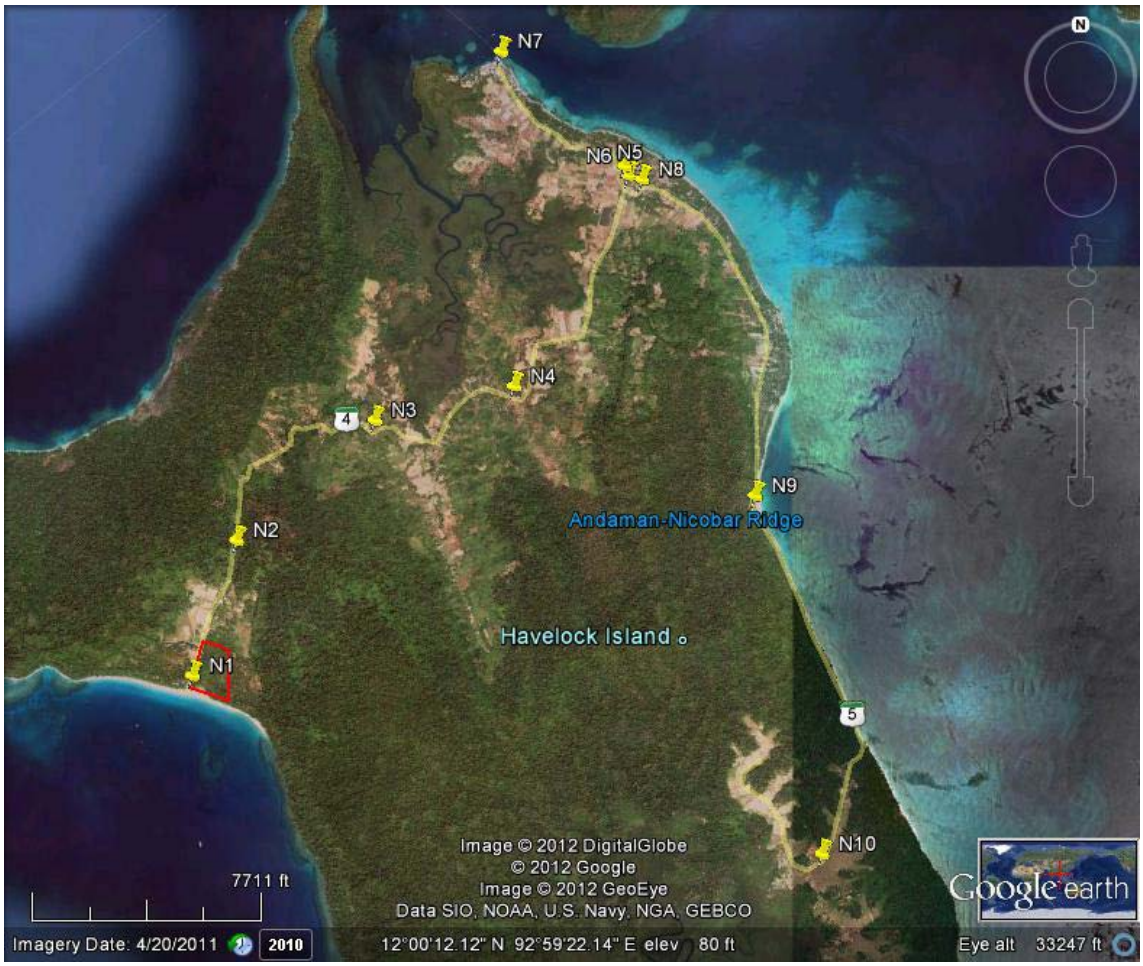


Fig. 3.10: Map showing Noise Monitoring Locations

Table 3.8: Noise Monitoring Location Details

Sl. No.	Name of Location	Coordinates		Direction from Site	Aerial distance	Remarks
		Northing	Easting			
N1	At Site	11°59.051	92°57.239	-	0 km	Residential
N2	Water tank, Radha Nagar	11°59.821	92°57.449	1.1 Km	NE	Silence zone
N3	NRHM Krishna Nagar	12°00.484	92°58.224	2.8 Km	NE	Residential
N4	Shyam Nagar	12°00.673	92°59.009	North east	4 km	Residential zone
N5	PHC, Govinda Nagar	12°01.841	92°59.655	North East	6 km	Silence zone

Sl. No.	Name of Location	Coordinates		Direction from Site	Aerial distance	Remarks
		Northing	Easting			
N6	Govt. Sr. Sec. School, Govinda	12°01.893	92°59.635	North East	6 Km	Silence zone
N7	Jetty	12°02.529	92°58.937	North	6.7 km	Commercial
N8	Nr. Dolphion Resort, Vijay	12°01.818	92°59.733	North East	6.7 Km	Residential
N9	Vijay Nagar	12°00.067	93°00.370	East	6.6 Km	Residential
N10	Kalapather	11°58.084	93°00.748	East	6.4 km	Residential

3.6.4 Baseline Noise Status

Baseline noise level in the study area for silence, residential and commercial areas is given in the table below:

Table 3.9: Status of Noise within the study area

Location mark	Name of Location	Reading in dB (A)			
		Day	Standard	Night	Standard
N1	At Site	52.7	55	40	45
N2	Water tank, Radha Nagar	45	55	36	45
N3	NRHM Krishna Nagar	46	50	36	40
N4	Shyam Nagar	53.1	55	40	45
N5	PHC, Govinda Nagar	51.2	50	37	40
N6	Govt. Sr. Sec. School, Govinda Nagar	53	50	36.5	40
N7	Jetty	53	55	42	45
N8	Nr. Dolphion Resort, Vijay Nagar	51.5	55	41	45
N9	Vijay Nagar	45.5	55	41	45
N10	Kalapather	48.8	55	37	45

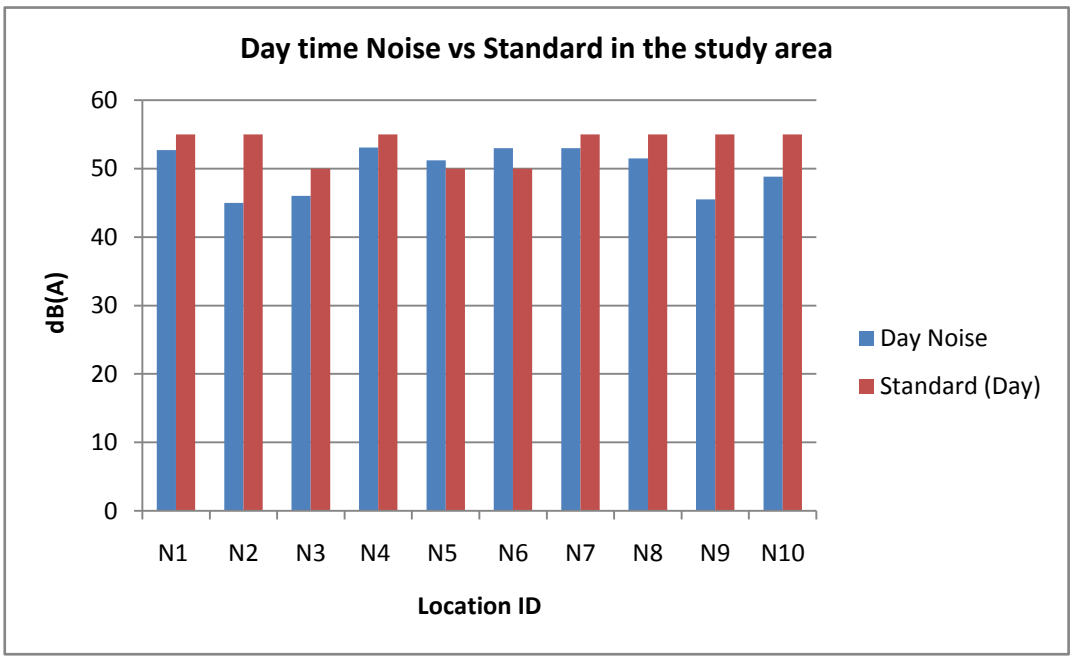


Fig. 3.11: Graphical representaion of day time noise in the study area

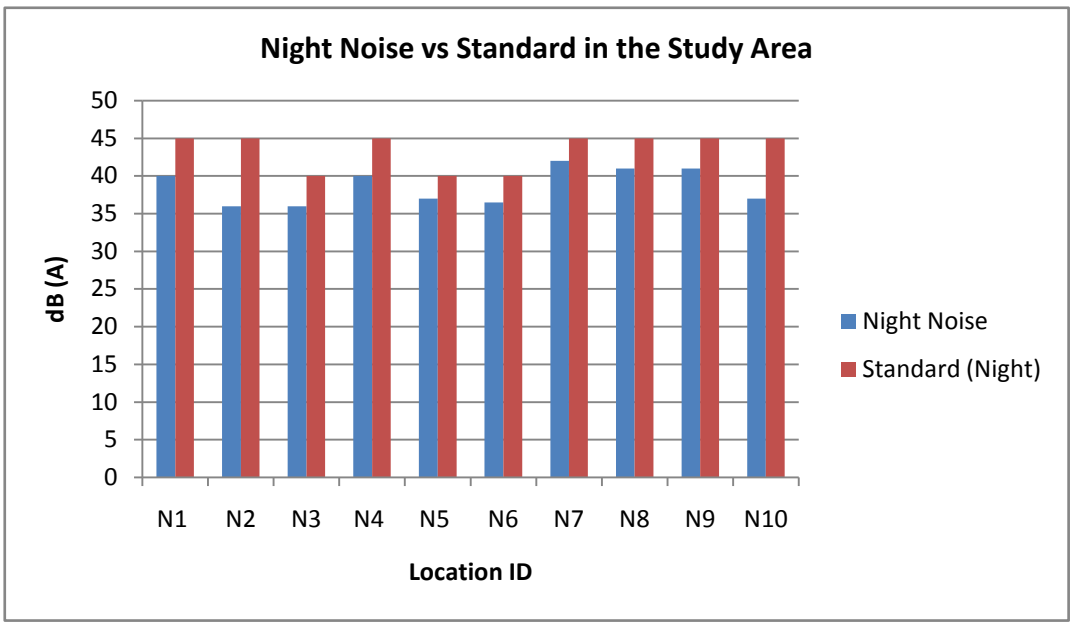


Fig. 3.12 Graphical representaion of night time noise in the study area

3.6.5 Observation:

The noise levels varied in the study area during day and night time in the range of 45 – 53.1 dB (A) and 36 - 42 dB (A) respectively. There is no other source of noise except that of vehicular traffic. Day time noise in the study is ranges within the permissible limit, except near Govinda Nagar PHC. Noise level exceeds at Govinda Nagar PHC because it is located in the market area where the noise remains high due to vehicular movement.

Thus it can be concluded that the noise levels at and around site are within the prescribed noise levels. The noise levels were below the stipulated standards of CPCB for residential areas whereas it is on higher side in case of commercial areas. This is due to the fact that silence zone viz. schools and hospitals are surrounded by commercial centers and human activities and traffic movement. During night time, noise level is below the permissible limits as per CPCB guidelines. Overall noise in the study area is satisfactory within the permissible limit

3.7 WATER ENVIRONMENT

3.7.1 Reconnaissance

The water requirement forms an integral part of any project. The water requirement during construction phase is for drinking and construction purpose. The amount of waste water generated will be less in quantity and shall be reused after treatment for gardening and flushing. Hence there shall be no major impact of these activities on the surface as well as sub-surface water quality.

3.7.2 Sources of water in study area

The sources of water in the study area are:

1. Surface water stream (Fresh Water)
2. Ground water
3. Marine water

3.7.2.1 Surface water:

In the study area streams and pond form the major source fresh water. Perennial streams are present at Radha Nagar, Vijay Nagar and Shyam nagar in the study area. Ponds are present in few households used for fishery and or domestic purpose.

3.7.2.2 Ground water:

According to Central ground water board 2005, below 10 to 12 m depth water quality changes from fresh to brackish. The EC of fresh water vary from 800 to 1300 ms/cm. Tsunami which is generally spared Havelock could not damage the water resources of this island to a great extent. However the contaminated wells at places showed salinity, which got disappeared in many of the wells in post tsunami monsoon precipitation. At places like Radha Nagar, the decline of ground water was also reported.

Table 3.10: Ground water level in Pre monsoon & Post monsoon

No.	Seasons	Water level
1	Pre monsoon	3.39 mbgl to 4.38 mbgl
2	Post monsoon	2.0 mgbl to 2.76 mbgl

3.7.2.3 Marine water:

The study area is surrounded by sea. Sea water has been monitored for understanding marine water quality.

1) **Temperature:** The sea surface temperature in Andaman varies from 26.40°C to 31.20°C. The monthly mean values range from 27°C in February & 30°C in May.

2) **Salinity:** overall salinity in the southern Andaman Sea is reported varied from 32 to 33% at the surface, & on the eastern side of North Andaman, salinity varied from 31.64 to 32% at the surface.

3) **Dissolved oxygen:** In the Andaman water, the surface level saturated DO is ranging from 4.39 to 5.20 mg/l. The DO at 100m depth during different seasons was found to be 1.69 to 2.49 mg/l, & at 200m depth corresponding values were 0.62 to 1.20 mg/l.

4) **Nutrients:** Free nutrient like phosphate & nitrate are low in Andaman water. However as a result of heavy river discharges, large quantities of organic suspended matter are present which in turn supplement the nutritionally inadequate food in these waters.

3.7.3 Surface and Ground Water Monitoring Methodology

Surface and ground water present in the study area has been identified and sampled manually. Representative samples were taken from surface and ground water found in the study area following CPCB guidelines for water quality monitoring.

3.7.4 Water sampling locations:

Monitoring locations were identified based on requirement, availability of sources and accessibility. A total of 10 water samples were collected, 9 surface water samples of which 3 are marine and one ground water sample. The sampling locations are shown in fig. 3.13 and table 3.11.

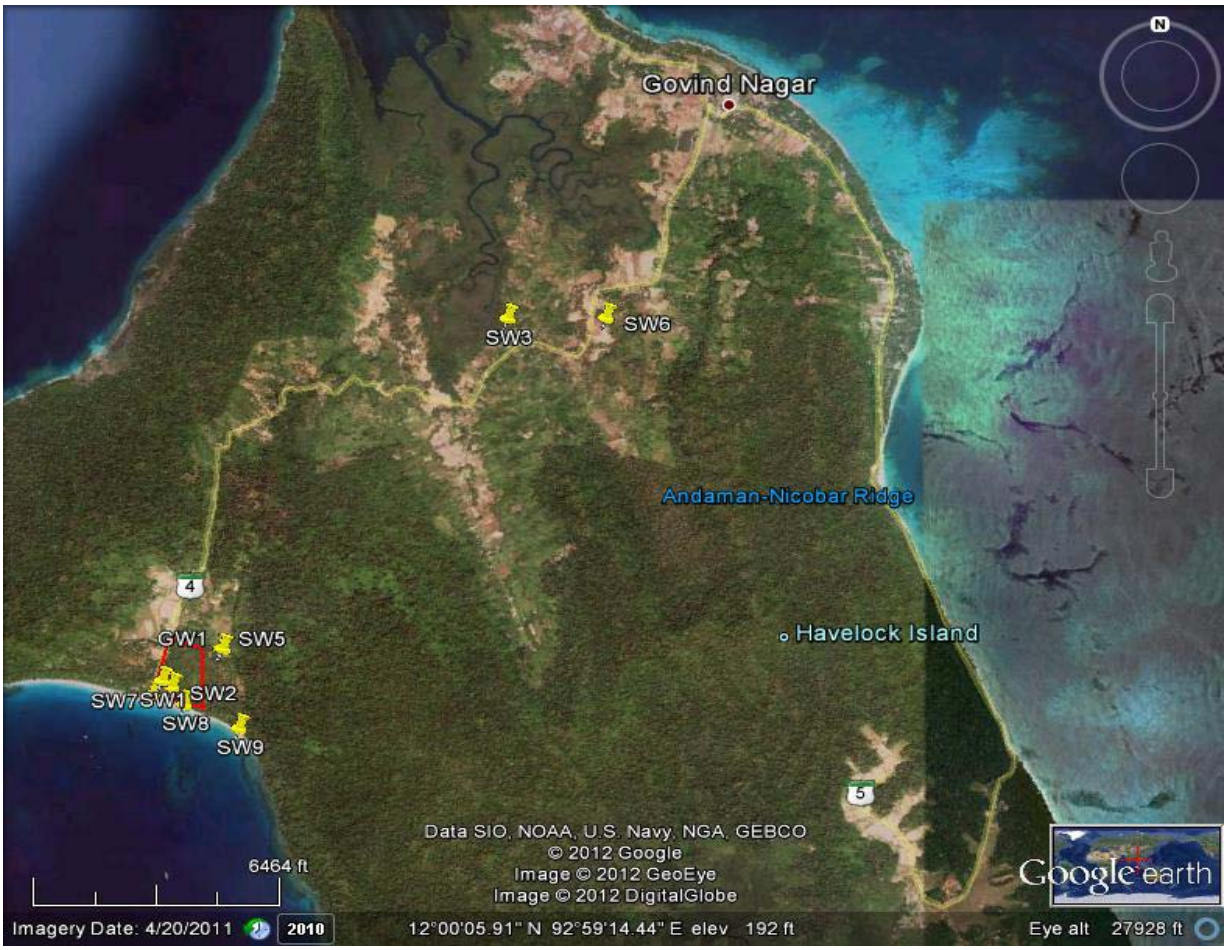


Fig. 3.13: Map showing water sampling locations in the study area

Table 3.11: Water Sampling Locations in the study area

Sr. No	Location ID	Location name	Coordinates		Type of Water Boy	Distance from Project Site	Direction
			Northing	Easting			
1	SW1	Project Site	11°59.071'	92°57.222	Stream water	--	--
2	SW2	Near Project site	11°59.041'	92°57.265	Stream water	5 m	NE
3	SW3	Shyam Nagar 4 nalah	12°00.783'	92°58.745	Stream water	4 km	NE
4	SW4	Vijay Nagar 5 nalah	12°00.067'	93°00.370	Stream water	4 km	NE
5	SW5	Radha Nagar	11°59'13.26"	92°57'28.82"	Supply water	300 m	E
6	SW6	Shyam nagar	12°00.787	92°59.180	Pond water	3 km	E
7	SW7	Radhanagar	11°59.004	92°57.179	Sea Water	500 m	S
8	SW8	Radhanagar	11°58.958	92°57.319	Sea Water	500 m	S
9	SW9	Radhanagar	11°58.845	92°57.560	Sea Water	500 m	S
10	GW1	Radhanagar	11°59'13.36"	92°57'29.33"	Ground water	300 m	E

Table 3.12: Physico-chemical and biological characteristics of surface and ground water of the study area

Sr. No.	Parameter	Unit	Result										Permissible limit as per IS-10500-1992 for Drinking Water	Reference Method
Sample Identification			SW_1	SW_2	SW_3	SW_4	SW_5	SW_6	SW_7	SW_8	SW_9	GW_1		
1	pH	-	8.2	7.7	6.4	8.1	7.9	7.9	8.0	8.0	8.0	7.6	6.5-8.5	APHA 4500-B
2	Temperature	^oC	28.4	27.5	28.2	27.5	28.8	27.3	28.4	28.3	28.7	25.8	-	APHA 2550-B
3	Transparency	m	5	6	4	5.4	5.8	7.0	7.5	7.6	8.0	-		
4	Dissolved Oxygen	mg/l	7.4	7.5	7.2	7.2	7.5	7.1	4.38	4.56	4.66	7.2	NS	APHA 4500 – O – C
5	Biochemical Oxygen Demand	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	NS	APHA 5210
6	Chemical Oxygen Demand	mg/l	2.4	3.8	1.2	2.8	3.5	1.6	2.8	2.5	3.4	2.4	NS	APHA 5220
7	Salinity	mg/l	1500	310	440	840	865	520	31250	32560	33240	240	NS	APHA 2520
8	Conductivity	µS/cm	2185	492	1284	1180	745	540	45280	50140	49350	325	-	APHA 2510-B
9	Total Dissolved Solids	mg/l	1400	280	810	748	425	300	29170	32120	31410	210	2000	APHA 2540-C
10	Silicate	mg/l	2.8	2.7	2.8	1.4	1.9	1.0	4.2	4.5	5.0	0.25	NS	APHA 4500 SiO2 –C
11	Turbidity	NTU	8	8	7	5	6	8	2	2	3	2	10	APHA 2130-B
12	Sulphate	mg/l	120	24.0	32.5	48.5	52	12.25	1020	1150	1180	12.5	400	APHA 4500-$SO4^{2-}$
13	Alkalinity	mg/l	314	230	32	250	264	170	140	140	148	144	600	APHA 2320-B
14	Chloride	mg/l	505	72.8	68	121.4	77.7	29.14	1894	1748	1724	29.14	1000	APHA 4500-B

Sr. No.	Parameter	Unit	Result										Permissible limit as per IS-10500-1992 for Drinking Water	Reference Method
Sample Identification			SW_1	SW_2	SW_3	SW_4	SW_5	SW_6	SW_7	SW_8	SW_9	GW_1		
									1	4	1			
15	Total Hardness	mg/l	430	250	500	270	340	230	6700	7300	7800	150	600	APHA 2340-C
16	Calcium Hardness	mg/l	230	200	132	168	218	156	880	860	870	128	200	APHA 3500-Ca
17	Nitrate	mg/l	0.8	1.2	1.8	1.8	1.2	1.5	2.5	2.7	2.8	4.5	100	APHA4500 NO3- - B
18	Total Nitrogen	mg/l	2.4	2.8	4.5	2.4	1.8	1.7	2.5	2.7	2.8	5.8	NS	APHA 4500–NORG-B
19	Phosphate	mg/l	0.4	0.11	1.2	0.5	0.54	0.48	0.05	0.06	0.07	0.5	NS	APHA 4500 – P
20	Total Phosphorous	mg/l	1.22	0.34	3.67	1.2	1.65	1.47	0.15	0.18	0.21	1.53	NS	APHA 4500 – P
21	Ammonia	mg/l	0.4	1.2	0.8	0.4	0.45	0.2	0.54	0.65	0.62	0.05	NS	APHA 4500 - NH3
22	Copper	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1.5	APHA 3500-Cu
23	Zinc	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	15	APHA 3500-Zn
24	Total Coliform	MPN/ 100 ml	14	18	Absent	45	25	38	> 1.8	> 1.8	> 1.8	Absent	> 10	APHA 9221 B
25	E. Coli	MPN/ 100 ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	APHA 9221 F

3.7.5 Observation

pH of water samples is between 6.4 to 8. The lowest pH is observed in Shyam Nagar 4 Nalah (6.4). All the marine samples are having pH of 8. Water is clear in all the location with transparency of 5 – 8. DO is found to be satisfactory in the range of 4.66 to 7.5 mg/l. BOD found as BDL and COD 1.6 to 2.8 mg/l. Conductivity is lowest for stream water (492 µS/cm) near the project site and highest for marine water samples (45280 µS/cm to 50140 µS/cm). TDS is also lowest for stream water near project site and high for marine samples. Temperature is in the range of 25.8 ^{o}C to 28.7 ^{o}C. Turbidity has been observed between 2NTU to 8NTU. Sulphate is in the range of 12.25 mg/l to 1180 mg/l, highest being in marine water samples (1020 to 1180 mg/l). Alkalinity is in the range of 32mg/l to 314mg/l being lowest for samples of Shyam nagar 4 nalah (SW3). Chloride is between 68mg/l to 505mg/l for fresh water and 17241mg/l to 18941mg/l for marine water. Total hardness for fresh water is between 250mg/l to 500mg/l and 6700mg/ll to 7800mg/l for marine water. Calcium hardness is between 156mg/l to 230 mg/l for fresh water, exceed the limit of 200 mg/l for sample SW1 and SW5 where as for marine sample it is 860 to 880mg/l. Ammonia is found to be 0.05 to 1.2. Copper and zinc is found Below Detection Limit (BDL) and E. coli is absent.

Thus from above water analysis results it can be concluded that the fresh water (surface and ground water) is in permissible limit of IS: 10500 except for calcium hardness of SW1 and SW5 but marine water samples exceed the limit.

3.8 LAND ENVIRONMENT

3.8.1 Geological Features and Seismic Zone

Geological formation is mainly intrusion of basic and ultra basic igneous rock. Havelock is sub divided into two main physiological formations (i) Low lying plain land and coastal plains, (ii) Moderate to high hills ranging in altitude from nearly 20m to 80 m from the mean sea level. These long hilly tracks are flanked by plain lands. Encircling the islands for about a stretch of 150 to 200 m, coastal plains are found although at some places it is around 15m. Havelock Island is underlaying by Miocene limestones which are generally fractured and cavernous. The low lying areas and the coastal tracts are covered by coralline limestone which are highly porous and form potential aquifers in the sub surface. The study area fall in seismic zone V.

(**Source:** *Working Plan for Baratarang Forest Division (for the period 2006 to 2016), Dept. of Env. & Forests, A&N administration National Disaster Management Guidelines, Management of earth quakes, 2007*)

3.8.2 Characteristics of soil

Soil is formed by sedimentary rocks like limestone, sand stone, coral shell etc. which are in general marine deposit. The soil is extremely well drained with rapid permeability, sandy, loamy sand, sandy loam in texture. The soil is highly suitable for any type of plantation and vegetables. Due to coarse soil texture, there is no chance for water logging during rainy season. The general soil characteristics in Havelock are alkaline in nature.

3.8.3 Sampling Locations

Soil samples were collected from various locations within the study area to draw baseline information for certain vital parameters of the soil. The location detail is shown in fig 3.14 and also in table 3.13.

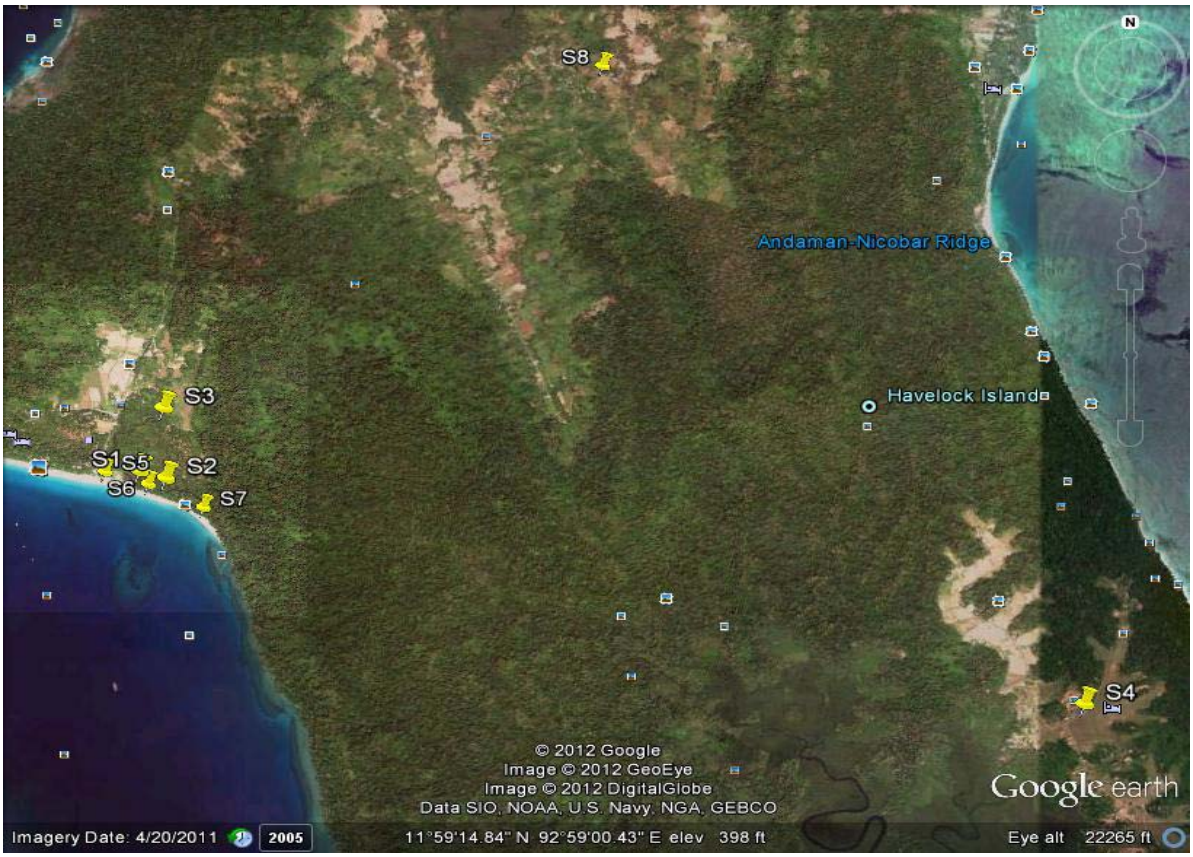


Fig. 3.14: Soil Sampling Location Map

Table 3.13: Details of Soil Sampling Locations

Sr. No.	Name of the sampling locations	Coordinates		Distance from the site	Direction From the site
		Northing	Easting		
S1	At Site (Mid point of plot)	11°59.026'	92°57.329'	At Site	At Site
S2	Near the site	11°58.997'	92°57.424'	5 m	South east
S3	Shyam Nagar	11°59.281'	92°57.418'	10 m	North east
S4	Kalapathar	11°58.084'	93°00.748'	6 Km	ESE
S5	Radha Nagar Beach	11°59'1.97"	92°57'12.51"	200 m	South
S6	Radha Nagar Beach	11°58'58.95"	92°57'21.73"	200 m	South
S7	Radha Nagar Beach	11°58'53.30"	92°57'33.84"	200 m	South
S8	Shyam Nagar	12°00.673	92°59.009	North east	4 km

Table 3.14: Physico-chemical characteristics of soil in the study area

Sr. No.	Parameter	Units	Result								Reference Methods
Sample Identification			S_1	S_2	S_3	S_4	S_5	S_6	S_7	S8	
1	pH	---	8.7	7.6	8.2	8.1	8.3	8.2	7.9	7.7	IS 2720 : Part 26 : 1987
2	Colour	-	Dark	Dark	Dark	Light	White	White	White	Dark	-
3	Moisture Content	%	22.5	18.2	22.7	25.9	18.6	19.5	21.8	20.3	-
4	Electrical	dsm^{-1}	5.95	5.8	6.2	5.2	5.4	5.2	6.1	5.5	IS 14767: 2000
5	Salinity	ppt	4.5	4.8	4.4	4.2	4.8	4.1	4.2	4.5	-
6	Water Holding Capacity	%	4.5	4.8	4.2	4.3	4.1	4.7	4.5	4.6	-
7	Nitrogen	%	1.4	1.8	1.5	1.6	1.8	1.2	1.4	1.5	APHA 4500–NORG-B
8	Organic Carbon	%	2.62	1.42	0.17	4.22	0.86	0.74	0.54	1.1	IS 2720 : Part 22 : 1972
9	Organic Matter	%	4.51	2.44	0.29	7.27	1.48	1.27	0.89	2.23	-
10	Chloride	%	2.15	3.04	2.19	4.71	5.05	4.15	3.19	3.05	-
11	Bicarbonate	mg/kg	158	175	164	162	162	169	158	160	APHA 2320
12	Phosphorous	%	0.65	0.8	0.7	0.84	0.92	0.68	0.74	0.7	APHA 4500 – P
13	Sulphate	%	0.4	0.35	0.3	0.38	0.38	0.32	0.42	0.32	IS 2720 – P – 27
14	Copper	%	0.002	0.004	0.003	0.001	0.009	0.0025	0.013	0.003	-
15	Lead	%	0.0338	BDL	BDL	BDL	0.023	0.003	BDL	BDL	-
16	Nickel	%	0.0016	0.0106	0.003	0.002	0.006	0.002	0.001	0.001	-
17	Texture Class	-	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy loam	-
18	Sand	%	65.4	65.9	67.8	63.7	74.5	72.8	75.8	67.5	-
19	Silt	%	28.5	29.2	27.8	27.4	22.8	24.5	22.2	27.6	-
20	Clay	%	6.1	4.9	4.4	8.9	2.7	2.7	2.0	4.9	-

3.8.4 Observation:

From the above table, it is observed that are soil quality is within the norm as required for growth of plants and vegetation. Colour of soil is dark and for that of marine sand is white. pH of the soil is in the range of 7.6 – 8.7 which is slightly basic in nature. Moisture content is in between 18.2% to 25.9%. Organic carbon is very less in between 0.17% to 2.62%. Organic matter is also very low (0.89 % to 2.44%). Chloride is in the range of 2.15 % to 5.05%. Soil is sandy loam in nature dominated by sand. Copper, Lead and Zinc are at a very low concentration. All the parameters are in the permissible range.

3.9 BIOLOGICAL ENVIRONMENT

The Andaman group of island is rich in biodiversity. As per Botanical Survey of India (BSI) and Zoological Survey of India (ZSI), there are around 2000 species of flowering plants out of which 221 species are endemic of which 110 are rare and endangered. Lower plants are not sufficiently documented however 100 species are reported. Over 5100 animals have been described which include 100 fresh water, 2100 terrestrial and 2900 marine animals. Mammals form 62 species out of which 55 sp. are terrestrial and 7 sp. are marine. Most of the mammals are reported from Baratarang Forest Division. 284 species of bird species and sub species have been reported. Sandy beaches are nesting ground for sea turtles. 88 species of reptiles have been reported out of which 76 are terrestrial, 12 are marine reptiles and of these 24 species are endemic. Salt water crocodile (*Crocodilus palustris*) among the biggest reptiles are found. Thwe islands are also very rich in fish species owing to long coastal stretch. More than 1200 species of fish have been reported in these islands. The land mass covering 10 km radius from the proposed project site is coved with luxuriant, almost impenetrable growth of tropical forest, characteristics of warm, humid and wet tropics, except for the area cleared for revenue settlements. The dense forest consists of tangled mass of climbers, lianas, canes, bamboos, etc. The trees grow in intimate mixtures of different species. The mangrove forest makes the border in low lying banks of creeks and sheltered portions of coastal line subject to tidal action.

The vegetation is composed of five major classes according to nature of soil, elevation, topographical structure and edaphic factors. These are evergreen forest with canopy formed by *Dipterocarpus sp*., Tropical semi evergreen forest include both evergreen and deciduous species, Deciduous forest dominated by Pterocarpus and *Terminalias sp*, Mangrove forest dominated by *Rhizophora sp*. And Littoral forest is dominated by Manilkara littoralis. The below mentioned plant species are found in islands of Andaman, Baratarang Forest Division, thus also present in Havelock island.

(Source: Working Plan for Baratarang Forest Division (for the period 2006 to 2016), Dept. of Env. & Forests, A&N administration)

3.9.1 Description of flora / vegetation in study area

A field survey was undertaken in the study area. The floral enlistment of trees, shrubs and climbers, herbs, agricultural crops, ornamental plants with their scientific names, common names and the family to which they belong is presented below. The geography of study area boasts of having a wide variety of terrestrial and marine species of plant and animal species which are spread throughout its length and breadth. There are three major ecosystems: the forest ecosystem, the mangrove ecosystem, the marine ecosystem.

Havelock Island	Area
Geographical area	11393 ha
Non forest area	1833 ha
Reserved forest area	9560 ha
Total forest area	9560 ha
Tribal reserve area	-
Wildlife sanctuary	-

3.9.2 Types of forest in the study area

3.9.2.1 Tropical evergreen forest: *Dipterocarpus grandiflorus, D. pilosus, Artocarpus chaplasa, , A. gomeziana, , Calophyllum soulattri, Planchonia andamanica, Hopea odorata, Endospermum chinense, Sideroxylon longipetiolatum, Xanthophyllum andamanicum, Myristica andamanica, M. glaucescens, Baccaurea sapida, Croton argyratus, Pterospermum acerifolium, Caryota mitis, Crytocarya sp.,, Memecylon sp., Euphorbia epiphylloides, Pseuduvaria prainii, Actephila excels, Anaxagoria luzonensis, Dinochloa andamanica, Calamus palustris, Gnetum scandens, Ancistrocladus tectorius. Dipterocarpus costatus, Mesua ferrea, Cnarium manii, Harpullia cupanioides, Hopea andamanica, Cratoxylon formosum, Eurphobia trigona, E. epiphylloides, Memecylon caeruleum, Cryptocarya ferrarsi, phoenix sp.*

3.9.2.2 Cane Brakes: *Licuala peltata, Zalacca sp.*

3.9.2.3 Bamboo Brakes: Oxytenanthera nigrocilia, Dipterocarpus sp., Bambusa schizostachyoides,

3.9.2.4 Semi-Evergreen Forest: *Pterygata alata, Pterocymbium finctorium, Sterculia campunalata, Terminalia bialata, Bombax insigne, Arocarpus lakoocha, A. chaplasha, Pterocarpus dalbergioodes, Lagerstroemia hypoleuca, Dillenia pentagyna, Dracontomelum mangiferum, Pometia pinnata, Myristica irya, Pisonia excels, Litsea panamanja, Xanthophyllum andaminicum, Fragraea morindaefolia, Talauma andamanica, Garcinia*

andamanica, Aporosa vilosula, Licuala peltata, Caryota mitis, Areca triandra, Saprosma ternatum, Maesa andamanica, Micromelum pubescens, Clerodendrum viscosum, Leela indica, Clinogyne grandis, Dinochloa andamanica Thunbergia laurifolia, Buettneria andamensis, Combretum extensum, Daemonorops, Calamus.

3.9.2.5 Moist Deciduous Forest: *Pterocarpus dalbergiodies, Terminalia bialata, T. Manii, T. procera, canarium euphyllum, Pterocymbium tinctorium, Tetrameles nudiflora, Chukrasia tabularis, Albizzia lebbek, Lagerstroemia hypoleuca, Baombax insigne, Lannea coromandelica, Adenathera pavonina, Dilenia pentagyna, Diospyros marmorata, Saccopetalum, Sageraea elliptica, Crotoxylon formosum, Semecarpus kurzii, Cinnamomum sp., Pterospermum aceroides, Oxytenanthera nigrociliata, Bambusa schizostachyoides, Plicospermium alatum, Canthium gracilipes, Ixora grandifolia, Murraya paniculata, Atalantia monophylla, Rinorea bengalensis, Mallotus acuminatus, Glycomis pentaphylla, Licula pentata, Blutternia andamensis, ventilago madraspatana, Delima sarmentosa, Acacia pinnata, Entada phaseoloides, Calamus sp.*

3.9.2.6 Littoral Forest: *Manikara littoralis, Pongamia pinnata, Morinda citrifolia, Erythrina variegate, Calophyllum inophyllum, Terminalia catappa, Barringtonia asiatica, cordia subcordata, Thespesia populnea, Hibiscus tiliaceus, Pandanus tectorius, Ipomea pes-caprae, Crinum asiaticum, vigna retusa, Scaevola frutescens, Mucuna gigantean, Columbrina asiatica, Caesalpinia bonduc.*

3.9.2.7 Mangrove Forest: *Rhizophora mucronata, R. candelaria, , Bruigera conjugate, B. parviflora, Avicennia officinalis, ceriops tagal, Kandelia candel, Xylocarpus mollusccensis, Sonneratia caseolaris, Excoecaria agallocha, Scyphiphora hydrophyllacea etc.*

3.9.2.8 Brakish water Mixed Forest: *Heritiera littoralis, Barringtonia racemosa, B. asiatica, Bronlowia lanceolata, Acanthus sp., Phoenis paludosa, Nypa sp.*

(**Source:** Working Plan for Baratarang Forest Division (for the period 2006 to 2016), Dept. of Env. & Forests, A&N administration)

3.9.3 Mangroves in the study area

In Andaman the total area under mangrove conservation working circle is 8658.00ha, & from that Havelock Island is conserve 922 ha. As per available information from various sources 27 tree species, 5 shrubs, 1 climber, 2 palms, & 2 ferns have been reported occurring in the three identified zones, viz. proximal zone (near shore), middle zone (middle portion), & distal zone (toward land).

(Source: Working Plan for Baratarang Forest Division (for the period 1999 to2009), Dept. of Env. & Forests, A&N administration)).

3.9.3.1 Functions and Values

Mangroves are largely responsible for the high productivity of the coastal waters – their roots trap soil and sediment and provide shelter from predators and nursery for fish and small aquatic organisms. Their body protects the shore from the wind and waves, and their detritus are a part of the aquatic food chain, the mangroves serve as the nursery ground for the coastal species of fish & shell fish sustaining natural production of these stocks.

3.9.3.2 Current Status of Mangrove

Due to massive earthquake & Tsunami waves of 26/12/2004 some mangrove are submerge & dried up. However scientific study to find out actual loss of mangrove forest has not been completed. In Havelock island *Rhizophora sp.*, are observed in the near shore area on island mangrove vegetation located 1005.98 ha, which mostly occur interior area of creek. Mangroves are scanty in distribution & were scattered in the vicinity of the jetty & Radhanagar beach. Dominant species of Mangroves in Havelock are are *Rhizophora apiculata, Rhizophora styalosa, R. mucronata, Bruguiera gymnorhiza, avicennia marina, Heritera litardis, xylocarpus granatum soneratia alba* etc. In Radhanagar beach area, *Avicennia marina* is the dominant species found on both sides of the fresh water nalah in small patches.

The mangroves serve as the nursery ground for the coastal species of fish & shell fish sustaining natural production of these stocks.

3.9.4 Sea Weeds Habitation

In the Andaman Sea, sea weeds also create a habitat or temporal shelter for many burrowing and benthic organisms. Many aquatic species migrate either daily or at certain stages of their life cycle. The 2004 tsunami affected 3.5% of sea weeds areas along the Andaman Sea via siltation and sand sedimentation and 1.5% suffered total habitat loss. Common sea weeds are *Gracillaria crassa, J. agardh, padina, gymnospora knickers, Turbinaria, conoides.*

3.9.5 Fauna:

There is wide diversity of faunal species in Andaman Islands. Fauna of the study area include mammals, reptiles, birds etc. On the Havelock island Salt water crocodile, sea turtle, sea cucumber, dolphin, octopus, sea snake, shark, etc. are commonly found. In addition, variety of benthic fauna is also found in this region. Out of a number of species, a few species is mentioned below.

3.9.5.1 Mammals in the study area

Table 3.15: Mammals in the study area:

Sl. No.	Name of the species	Common name	Status
1	*Actinodaphne macroptera*	-	Common
2	*Aglaia fusa*	-	Common
3	*Amomun maximun*	-	Common
4	*Amoora manni*	-	Common
5	*Ardisia andamanica*	-	Common
6	*Sus serofa andamanensis Blyth.*	Andaman Wild - pig	Endangered
7	*Dugong dugong (Mullor)*	Dugong	Endangered
8	*Maeaeaqrus umbross Millor*	Crab eating Maeaque	Endangered
9	*Crocidura hispida*	Andaman Spiny shrew	Common
10	*Muntiacus muntjak*	Barking deer	Common
11	*Balaenoptera muscules*	Blue whale	Common
12	*Physeter catodon*	Sperm whale	Common
13	*Axis axis*	Chital	Common
14	*Delphinus delphis*	Common Dolphin	Common
15	*Dugong dugon*	Dugong (Sea cow)	Common

Sl. No.	Name of the species	Common name	Status
16	*Paguma larvata tytleri*	Palm civet	Common

(Source: Working plan for Baratang forest division Report, A & N Island, 2007)

3.9.5.2 Reptiles in the study area

Table 3.16: Reptiles in the study area:

Sl. No.	Name of the species	Common name	Status
1	*Crocodilus porosus (Schneider)*	Saltwater Crocodile	Endangered
2	*Crocodilus palustris*	Salt water crocodile	Endangered
3	*Cholonia myda*	Green sea Turtle	Endangered
4	*Dermochelys Coriacea*	Lether back Turtle	Endangered
5	*Veranus salvator andamenensis (Lau)*	Water monitor lizard	Endangered
6	*Phelauma andamaneses (Blyth)*	Green Lizard	Endangered
7	*Ophiophamus hannsah (Cantor)*	King Cobra	Endangered
8	*Bungarus andamensis*	Andaman Banded Krait	Endangered
9	*Eretmochelys imbricata*	Hawks Bill Turtle	Endangered
10	*Lepidochelys olivacea*	Olive Ridley Turtle	Endangered
11	*Varanus salvator*	Water Monitor Lizard	Endangered
12	*Carotta ereta*	Brown Loggered Turtle	Endangered
13	*Python reticulatus*	Reticulated Python	Endangered

(Source: Working plan for Baratang forest division Report, A & N Island, 2007)

3.9.5.3 Avifauna in the study area

Table 3.17: Bird species in the study area:

Sl. No.	Name of the species	Common name	Status
1	Anas gibberifrons albogularis	Andaman Teal	Endangered
2	Dendrocitta bayleyi	Andaman Tree Pie	Common
3	Columba palumboides	Andaman Wood Pigeon	Common
4	Nettapus coromandelianus	Cotton Teal	Common

Sl. No.	Name of the species	Common name	Status
5	Spilornis cheela	Crested Serpent Eagle	Common
6	Chalcophaps indica	Emerald Dove	Common
7	Ducula aenea	Green Imperial Pigeon	Common
8	Gracula religiosa	Hill Myana	Common
9	Dendrocygna javanica	Lesser Whistling Teal	Common
10	Collocalia fuciphaga	Swiftles	Endangered
11	Haliaetus leucogaster	White Bellied Sea eagle	Common
12	Coracina nigras (kloss)	Pied Cuckoo shrike	Common
13	Soilornis Elgini (Blyth)	Andaman serpent eagle	Endangered
14	Rhyticerous undulates narcondum	Narcondum Hornbill	Endangered
15	Turdus obserrus	Dark Thrush	Endangered
16	Chlidonis leucopterus	Whitewinged Blacj tern	Endangered
17	Sterns fuscata	Sooty Tern	Endangered
18	Coracina nigra	Pied Cuckoo Shrike	Endangered

(Source: Working plan for Baratang forest division Report, A & N Island, 2007)

3.9.5.4 Fisheries Potential

Fisheries form one of the major natural resources of the island. Over 1200 species of fishes, 580 species of crustaceans, 900 species of mollusks, & 300 species of echinoderms are known to occur in the island water. Out of 1200 fish species, about 350 species are commercially important at present.

Fish Landing Centre at Havelock island is located at Govinda nagar (12° 02' 317" N & 92° 58' 564" E. Fish Market is also located at Govind nagar area (12° 01.812N & 92°59 .736E). Fish varieties in this area are Elasmobranch, silver bellies, perches, pomfret, cat fish, crocker, ribbon fish, penaeid shrimp, lobster, mackerel anchovies, sardine, hilsa, macrqal, mullet, & sear fish. The high value fish like 'gobra' & 'snapper' are sent to port blair for export, & the rest of fish stock is mainly supplied to Chennai & Kolkata.

No.	Items	Andaman water (100 –150 N)	Nicobar water (050 -100 N)
1	Type of fishing	Drift long line using light sticks for sword fishing. Tuna long line for oceanic tuna &	Tuna long line for oceanic tuna & allied resources.

No.	Items	Andaman water (100 –150 N)	Nicobar water (050 -100 N)
		allied resources	
2	Depth range (Mtr.)	854 m – 3130 m	484 m -3700 m
3	Best seasons for Tuna long line	October to April	October to April
4	Type of fish available	Sword fish, yellow fin Tuna, Barracuda, Pelagic thresher shark, thresher shark, Black tip shark & other varieties like black rays etc.	Yellow fin Tuna & pelagic thresher shark etc.
5	Fishing Crafts	Plank built flat bottom dinghies, dugout canoes, mechanized boat & trawlers.	Plank built flat bottom dinghies, dugout canoes, mechanized boat & trawlers
6	Fishing Gear	Drift gill net, shore – seine, hook, line & cast net.	Drift gill net, shore – seine, hook, line & cast net.

(Source: Fishery survey of India Report, Andaman & Nicobar Island)

3.9.5.5 Molluscs in the study area

Table 3.18: Molluscs in the Andaman

Sl. No.	Name of the species	Common name	Status
1	*Caseis rifa*	Lamark	Endangered
2	*Trochus Oiloticus*	Linnaous	Endangered
3	*Caesia corn*	Linnaous	Endangered
4	*Cypraea Tigris*	Linnaous	Endangered
5	*Turbo marmeratus*	Linnaous	Endangered
6	*Xencus pyrunud*	Lamark	Endangered
7	*Nautilus prmiplus*	Linnaous	Endangered
8	*Cypraea Tigris*	Linnaous	Endangered
9	*Connus Litteratus*	Linnaous	Endangered
10	*Connus textile*	Linnaous	Endangered

(Source: Working plan for Baratang forest division Report, A & N Island, 2007)

3.9.5.6 Corals in the study area

On Havelock island fringing type of corals are found & corals are present throughout the island. The dominant corals on this island are porites salida, porites lutea, porites lobata, acropora formosa, acropora moniticulosa, acropora florida, acrophana humilis. Left site of jetty corals are found 20 m away from high water mark & up to 40 m. No live corals are found on proposed project site.

Table 3.19: Corals in Andaman

Sl. No.	Name of the species	Common name	Status
1	*Acroppra foramosa*	Dana	Endangered
2	*Acroppra nobilis*	Dana	Endangered
3	*Acroppa hycinthus*	Ellis and Slender	Endangered
4	*Fevia palliea*	-	Endangered
5	*Corallium spp.*	pallas	Endangered
6	*Funquis echinata*	Linnaous	Endangered
7	*Funquia funquites*	-	Endangered

(Source: Working plane for Baratang forest division Report, A & N Island, 2007)

(Dead Corals near proposed project site)

3.9.5.7 Benthos:

The term benthos is widely used for organisms which are related to aquatic sediment. Benthic organisms are in general sessile & slow moving in nature. 75% of benthic animals live on firm substrates (rocks, corals etc.), 20% occur on sandy/muddy bottoms & only 5% of the total are planktonic. The size of benthos varied from microscopic to several orders of magnitude. Benthos are describe on the basis of their position in

sediment, organism live within the sediment are called as "Infauna" & which is found in burrowing condition in sediment that is known as "Epifauna".

Significance

Benthic organism is best pollution indicator species. Benthos plays a vital role in aquatic food chain. It is use for recycling the essential element like carbon, nitrogen & phosphorus. Benthic ecosystem of coral reef, mangrove, mudflats, as a good feeding, breeding, spawning, & nursery ground for bird, fishes, sea mammals & reptiles.

Materials and Methods

Sampling was done from three different Transect, these transect is decided in front of project site in intertidal zone. While sampling, latitude, longitude & Tidal information were taken which are represented below. Samples were collected in season in the month of March 2012.

Table 3.20: Macro benthos Sampling Station

Transect	Transect location	Lat. & Long.	Zone	Sediment
1	Front of proposed project site (Toward approachable road side)	110 59′ .044 N 920 57′ .199 E	Low water level	Sandy
2	Front of proposed project site (middle)	110 58′ .992 N 920 57′ .331 E	Low water level	Sandy
3	Front of proposed project site (Toward forest side)	110 58′ .881 N 920 57′ .590 E	Low water level.	Sandy

In inter tidal area macro benthos sample was collected with help of metal quadrant. After collection, samples were sieved with help of 500 micron sieve, transfered all that sieved sample in plastic bags & add preservative like Rose bengol and formaldehyde. samples were transported to laboratory in big petry plate. The organisms have been picked using forceps and pipettes. They were also hand-picked, if bigger, after keeping the slurry in white background. For quantitative sampling, each sample was handled separately, avoiding any loss. After sorting, macro invertebrates were identified to the lowest practical identification level (LPIL) which in most cases was to the species level unless the organism was a juvenile, damaged, or otherwise unidentifiable. Macro invertebrates were preserved in 10% formalin. Identification of the organisms was done under Stereo-microscope. Pennak (1978), Tonapi (1980), Ward and Whipple (1992) were used as standard reference for identification of the macro invertebrates.

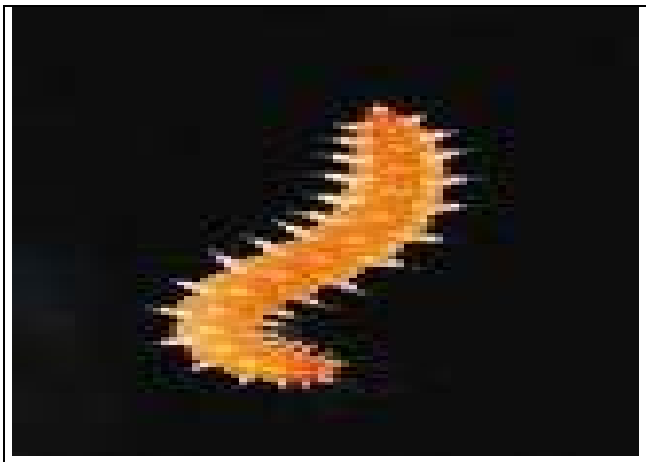
Table 3.21: Benthos group wise density in Project Site

Organism Group	Transect I	Transect II	Transect III	Total
Polychaetes	2	2	3	7
Molluscs	1	3	3	7
Crustaceans	2	3	5	10
Total	5	8	11	24

Table 3.22: Diversity of Benthos on project site

No.	Polychaetes	Mollusc	Crustaceans
1	Nemertine	Pelecypodes	Amphipode
2	-	Gastropoda	Isopode
3	-	-	Macrurance
4	-	-	Brachurance
5	-	-	Hermit crab

Photos



Polychaetes

Gastropods

Anamurance(Her crab)

Brachyurans (Crab)

Crustacean larva

Pelecypodes

Table 3.23: Faunal community in Mangrove area

No.	Faunal community in mangrove habitat.	Species
1	Aquatic	Benthos, Molluscan, Crustaceans, Fishes.
2	Birds	Heron, Egret, Hawk, Sea eagle, Water hen, sandpiper, parakeet, Crow-pheasant, Kingfisher, Woodpecker, Crow, Cuckoo-shrike etc.
3	Reptile	Salt water crocodile, Lizards, Water snake & some Amphibians.
4	Insect	Mosquitoes, Mites, Beetles, Termite, Honeybees, Bugs & Borers

(Source: Working plane for Baratang forest division Report, A & N Island, 2007)

3.9.6 Planktons:

The term plankton was coined by Hansen in 1887. Plankton means organisms of plant & animal origin both. Plankton includes microscopic floating or drifting organism which are at the mercy of the water movement, many of them have independent powers of movement. Plankton is basically divided in 2 broad functional group i.e. Phytoplankton and zooplankton.

Table 3.24: Sampling details for Planktons

Parameter	Sample details	Total Volume of Sample	Sampling Equipment	Preservation Method
Physico-chemical	Surface Water	1 liter	Plastic bucket	Ice Box
Phytoplankton	Surface Water	500 ml	Plastic bucket	Lugol's Iodine

Parameter	Sample details	Total Volume of Sample	Sampling Equipment	Preservation Method
				solution
Zooplankton	Water	500 ml	Heron Trantor Net	Formalin solution
Benthos (Macrobenthos)	Intertidal Sediment	Approximate (1 – 1.5 kg)	Metal Quadrant	Formalin with Rose Bengal

3.9.6.1 Phytoplankton

The plant component of the plankton is called phytoplankton. It is more resemble to plant material compared to animal. Phytoplankton is the first member in aquatic food chain. The majority of Phytoplankton belongs to Chlorophyceae, Cyanophyceae, & Bacillariophyceae. Their unique ability to fix inorganic carbon to build up organic matter through primary production makes them very important in food web. Phyto-planktons generally multiply through the process of cell division. Phytoplankton is microscopic plants that live in the ocean, freshwater and other terrestrial based water systems. There are many species of phytoplankton, each of which has a characteristic shape, size and function.

Significance

Phytoplankton's are the major primary producers of organic matter in the aquatic ecosystem and especially oceans whose 90% productivity is from the planktons. Collectively, they directly or indirectly support the entire animal population. Their unique ability to fix inorganic carbon to build up organic matter through primary production makes them very important in food web.

Materials and Methods

Sampling was done from three different locations. Sample was collected from surface level & around 500 m away from coast line. While sampling, latitude longitude & Tidal information were taken which has been represented below.

Sample water is taken from surface level of sea water by using plastic bucket, and then sample collect in 500 ml plastic bottle & preserve with 2% Formaldehyde and Lugol's Solution, then sample is carryout in laboratory for further analysis.

Drop Count Method and Microscopic Observations

5ml of the sample was taken on Sedwick -Rafter Counting Cells and plankton number was counted. The identification was done using a Stereo-microscope under 45X or 100X magnification. The planktons were then compared with the descriptive and/or

photographic identification keys given by Desikachary, 1959; Prescott, 1959; Sournia, 1974; Boltovskoy, 1981; Santhanam, 1993 etc.

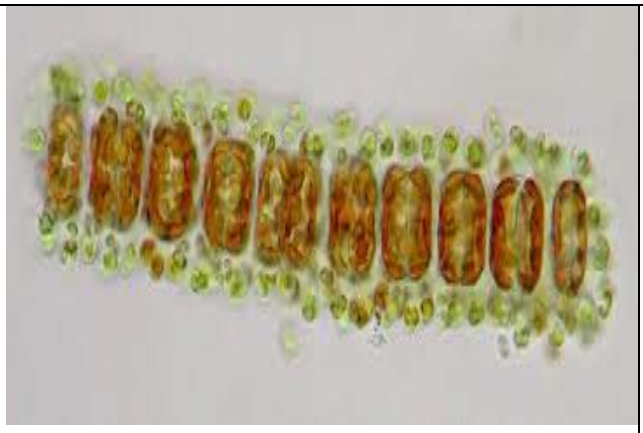
Plankton Diversity

In our selected area total 3 stations are decided, Samples were collected during March to May, 2012. The Diatom group has been found mainly R. stiliformis, R. alata, Thalassiosira decipens, Phaeocystis sp. Thalassionema nitzschiodies & corethron criophilum. Dinoflagellate group is present like peridinium depressum, ceratium candelabrum & gymnodinum spe.

Average primary production in Andaman Sea has been estimated to be 273 mgC/m^3/day. According to previous research, The Phytoplankton population was mostly constituted by *Navicula sp.*, *Peridenium sp.* & *Trichodesmium sp*. & the low level of primary production may be due to high temperature, high salinity & low phosphate values in the region.

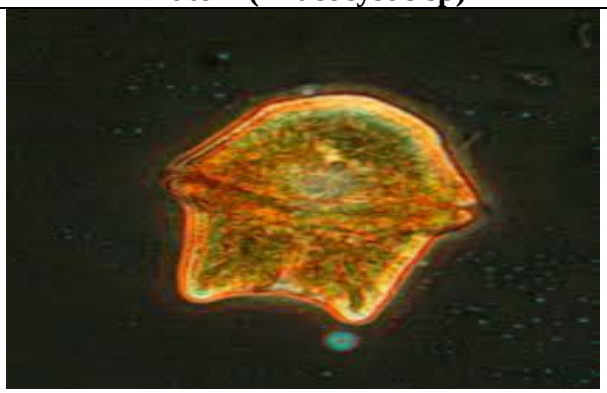
Table 3.25: Phytoplankton Cells (No./L) Density

Sr. No.	Species	Phytoplankton cells No/L
1	R. *stiliformis*	150
2	R. *alata*	132
3	*Thalassiosira decipens*,	094
4	*Phaeocystis sp*	060
5	*Thalassionema nitzschiodies*	048
6	*corethron criophilum*	040
7	*peridinium depressum*	034
8	*ceratium candelabrum*	032
9	*gymnodinum* spe	028



Diatom (Phaeocystis sp)

Dinoflagellate (Ceratium spe.)



Dinoflagellate (Gymnodinum sp.)

Dinoflagellate (Gymnodinum sp)

3.9.6.2 Zooplankton:

The zooplankton samples were collected as horizontal surface tow with a modified Heron-Tranter (HT) net (having 0.25 m^2 mouth area and 300 µm mesh size). All the samples were preserved in 5% neutralized formaldehyde solution. The zooplankton biomass was later estimated by displacement volume method and readings were converted for 100 m^3. Different zooplankton taxa were sorted, identified and enumerated under stereoscopic zoom binocular microscope.

The number were calculated for the whole samples and given for 100m^3 of water. The Zooplankton biomass in Andaman Sea ranged from 1.8 to 14.4ml/100 m^3. Zoo-plankton biomass in Andaman water mainly constituted by copepod, chaetognatha, tunicate, ostracoda, euphasiacea, decapods etc.

Table 3.26: Population of Zooplankton (Units/M^3)

Sr. No.	Species	Population (units/m^3)
1	Isopoda	28
2	Amphipoda,	23
3	Cyclopoid copepod	20
4	Calanoid	20-
5	Radiolarvians,	18

6	Microstella	16
7	Protozoans	15
8	Fish egg.	11

Eco-sensitive areas: No eco-sensitive areas are present within 10 km radius from the proposed project site.

3.10 TRAFFIC SURVEY

Traffic study in Radhanagar road has been studied field investigation. As Havelock is a small island of tourist destination, only motorcycles, few cars and bus has been observed. The SH4 bifurcates at Govinda nagar – one road goes to Radha nagar and other to Kalapathar. The vehicle type, frequency and PCU is given in below.

Sr. No.	Vehicle Type	During Peak Hrs (No. of vehicles/hr)	No. of Vehicles in PCU'S (Peak hrs)	During Lean Hrs (No. of vehicles/hr)	No. of Vehicles in PCU'S (Lean hrs)
1.	Two Wheelers	50	37.5	30	22.5
2.	Three Wheelers	20	40	20	40
3.	Cars/Sumos	30	30	25	25
4.	Buses/Mini Buses	1	2.2	1	2.2
5.	Trucks/Lorries	1	2.2	1	2.2
6.	Other Heavy vehicles	0	0	0	0
7.	Slow moving vehicles (Cycle)	5	2	2	0.8
	TOTAL	**102**	**113.9**	**77**	**92.7**

(Source: Primary data**)**

Off Season:

Sr. No.	Vehicle Type	During Peak Hrs (No. of vehicles/hr)	No. of Vehicles in PCU'S (Peak hrs)	During Lean Hrs (No. of vehicles/hr)	No. of Vehicles in PCU'S (Lean hrs)
1	Two Wheelers	20	15	15	11.25
2.	Three Wheelers	3	6	2	2.4
3.	Cars / Sumos	10	10	7	7
4.	Buses/Mini Buses	1	2.2	1	2.2
5.	Trucks/Lorries	1	2.2	1	2.2
6.	Other Heavy vehicles	0	0	0	0
7.	Slow moving vehicles (Cycle)	1	1.5	1	0.8
	TOTAL	**35**	**36.9**	**26**	**25.85**

(Source: Secondary data**)**

Peak Hrs: Between 7 hrs to 11 hrs & 3 hrs to 6 hrs in the evening.
Lean Hrs: Between 11 hrs & after 3 hrs in the evening (also afternoon hrs 1 to 5 hrs)
Note: PCU's as per IRC-106:1990

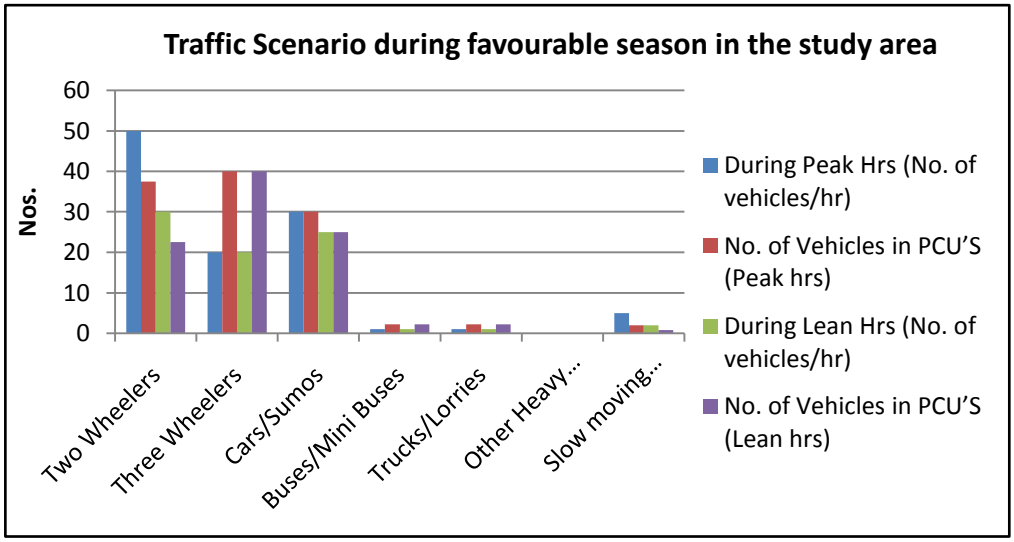


Fig. 3.15: Graphical representation showing traffic scenario in the study area

3.10.1 Existing Traffic Scenario & Level of Services

Capacity of road as per IRC = 2000 PCU's/hr
Total Volume during Peak Hours =102
Existing Volume/Capacity ratio = 0.051
The level of service is "A" that is excellent.

3.10.2 Level of Service

Sr. No.	Existing Volume/Capacity Ratio	Level of Services
1	0.0 to 0.2	"A" (Excellent)
2	0.2 to 0.4	"B"(Very Good)
3	0.4 to 0.6	"C" (Good)
4	0.6 to 0.8	"D" (Fair)
5	0.8 to 1.0	"E" (Poor)

3.11 SOCIO-ECONOMIC PROFILE OF STUDY AREA

Havelock Island, with an area of 113.93 km^2, is the largest of the islands which comprise Ritchie's Archipelago a chain of islands to the east of Great Andaman in the Andaman Islands. Havelock is situated 57 km North East of Capital City Port Blair. The island is named after Henry Havelock, a British general active in India. It is one of the few places that the administration of the Andaman and Nicobar Islands union territory of India has permitted and encouraged development of tourism, with a focus on promoting eco-tourism.

3.11.1 Reconnaissance

The study of socio-economic component of environment incorporating various facets viz. Demographic structure, availability of basic amenities such as housing education, health and medical services, occupation, water supply, sanitation, communication and power supply, prevailing diseases in the region as well as features such as temples, historical monuments, sacred rivers, etc. in the study area is an integral part of EIA process. The study of these parameters helps in identifying, predicting and evaluating the likely impacts due to project activity in that region.

3.11.2 Study area (PIA)

The land area of the PIA falls under Havelock Island under 5 revenue villages and partly Peel Island. The entire area of Peel is under forest cover and is un-habitated.

3.11.2.1 Revenue Villages in Havelock island:

1. Radha nagar
2. Govind nagar it is 11.5 km from project site.
3. Bijay nagar it is 10.5 km from project site.
4. Shyam nagar it is 6 km from project site.
5. Krishna nagar it is 5 km from project site.

***(Note:** Distance given above is road distance)*

3.11.2.2 Total beaches in Havelock Island

1. Radha nagar beach
2. Govind nagar beach
3. Vijay nagar beach
4. Elephant beach
5. Kalapathar beach.

3.11.3 Infrastructures / Amenities

1. Total Health Centres: 3 nos.
2. Total Schools: 9 nos.
3. Government Offices: Police department, PWD, Hospital, Agriculture, Forest, Panchayt, Shipping.
4. Big Hotels: 8 nos. (Bare foot/ Silver sand/ Manju resort/ Shimphoni/ Sea shell/ Orchid resort/Kingdom/ TSG hotel.)
5. Small hotels: 20 to 25 no.

3.11.3.1 Community Health

In the entire Havelock Island there is one Primary Health Centre (PHC) at Govinda Nagar near main market and two sub centers at Vijay Nagar and Govinda Nagar respectively. There is one doctor and around 12 paramedical staffs including nurses are present in the health centers.

3.11.3.2 Financial Institutions

1. State Bank of India, near main market - 1no.
2. Andaman and Nicobar Cooperative Bank - 1no.

3.11.3.3 Transportation

Metalled road around 20 km and kutcha road 10 km. SH-4 of 11 km connects Jettty with Radha Nagar Beach and SH-5 of 9 km. State Transport Services with nos. of buses ply on the road from Jetty to Radha Nagar and make 10 trips a day. Three wheelers (Autos) are available for travelling throughout the villages. It is 57 km from Port blair by ship.

3.11.3.4 Drinking Water Facilities

Almost every house hold is provided with water supply from reservoir at Krishna Nagar and Radha Nagar. Rain water harvesting is also one of the important sources for drinking water. There is one storage tank of stream water located in Krishna nagar, at a distance 5 to 6 km from Radhanagar beach. After collection, all water transfer to tank no. VI tand then tank no. IV for purification at shyam nagar. After this process water will supply for local use. In Govind nagar area also one filter unit for sea water for filtration and purification present, the treated water of which is supplied domestic use. Water is supplied generally during morning hours.

3.11.3.5 Education

There are 4 primary schools with 242 student & 14 teaching staff, a middle school with 174student & 8 teacher, senior secondary school with 958 student & 44 teaching staff. There is no college, college is in Port Blair.

3.11.3.6 Power

Power supply by the electricity department of A & N administration through diesel generating sets. In Havelock power generation station capacity of 0.6 MW. Total connection in village is 1067. In rainy season power is intermittent failure.

3.12 OCCUPATION

The main occupation of the people of Havelock is agriculture. Some people are also engaged in fishing, Govt. jobs and other commercial activities. Permanent pasture & grazing land form 1.25% of total geographical area of Andaman Island the highest i.e. 10.05% being in Neil island & Havelock is (1.71%).

3.13 IMPACT OF TSUNAMI, 2004

Tsunami has not shown any major attack or major losses (economically or life) on Havelock. During tsunami, sea water entered into the villages & that show effect on stored water (salinity increase), but that recovered after post Tsunami monsoon.

Table 3.27: Population Profile of study area

Island	Villages	No. of HH	Total Population	Total Male	Total Female	Population (0-6)	Male (0-6)	Female (0-6)
	Govinda Nagar (RV)	593	2419	1270	1149	385	182	203
	Bejoy Nagar (RV)	209	992	533	459	174	88	86
	Shyam Nagar (RV)	126	593	326	267	81	41	40
	Krishna Nagar (RV)	146	735	388	347	113	63	50
	Radha Nagar (RV)	133	615	343	272	112	55	57
Havelock	**Total**	**1207**	**5354**	**2860**	**2494**	**865**	**429**	**436**

(Source: Census of India, 2001)

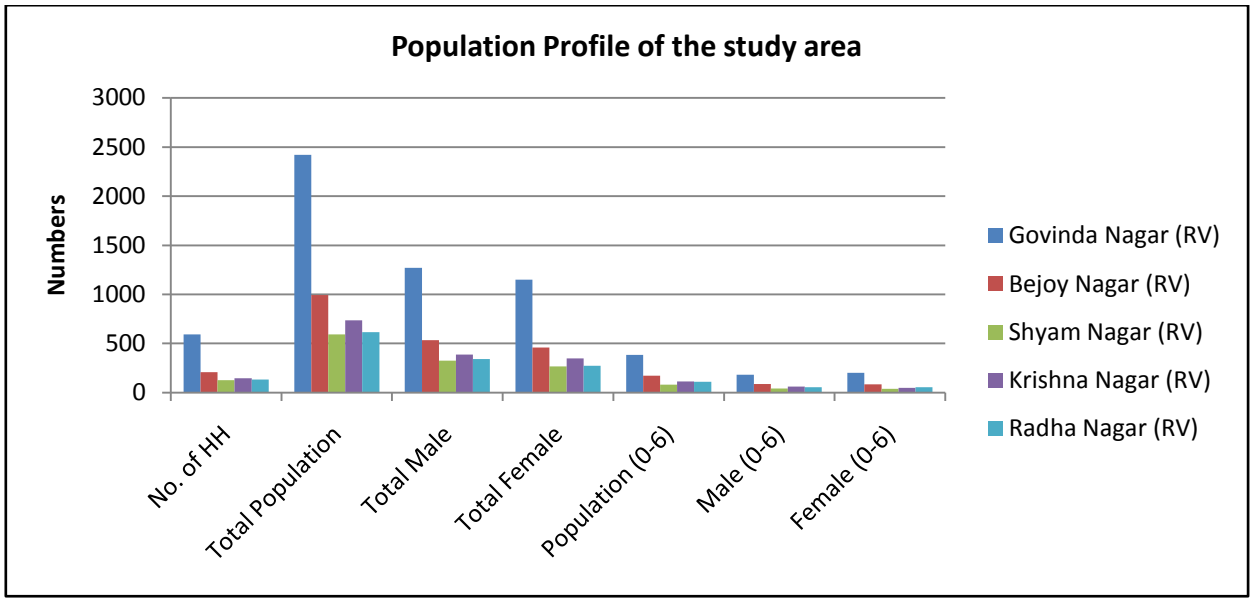


Fig. 3.16: Graphical representation of population profile of the study area

(**Note:** There are no SC and ST population in the study area)

Table 3.28: Population Literacy Profile in Study Area

Island	Villages	Populatn Literacy	Male Literacy	Female Literay	Populatin Illiteracy	Male Illiteray	Female Illiteray
Havelock	Govind Nagar (RV)	1659	944	715	760	326	434
	Bejoy Nagar (RV)	629	369	260	363	164	199
	Shyam Nagar (RV)	424	256	168	169	70	99
	Krishna Nagar (RV)	536	299	237	199	89	110
	Radha Nagar (RV)	392	234	158	223	109	114
	Total	**3640**	**2102**	**1538**	**1714**	**758**	**956**

(**Source**: Census of India, 2001)

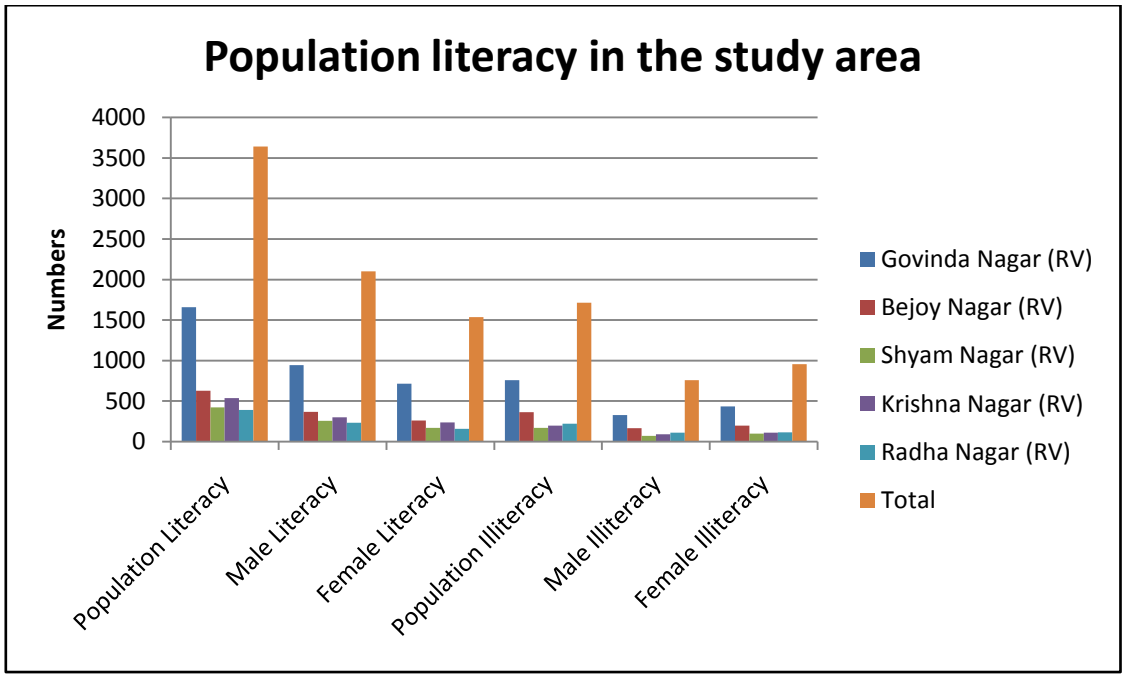


Fig. 3.17: Population Literacy in the study area

Table 3.29: Occupational Pattern in the Study Area

Villages	Total Workers	Main Workers	Main Cultivators	Agricultural labourers	Marginal Workers	Marginal Cultivators	Marginal Agricultural Labourers	Non workers
Govinda Nagar (RV)	837	880	173	34	274	173	19	1265
Bejoy Nagar (RV)	345	455	316	17	76	69	3	461
Shyam Nagar (RV)	232	178	95	1	194	160	6	221
Krishna Nagar (RV)	276	253	153	18	243	207	9	239
Radha Nagar (RV)	212	196	66	0	50	22	0	369
Total	**1902**	**1962**	**803**	**70**	**837**	**631**	**37**	**2555**

(**Source:** Census of India, 2001)

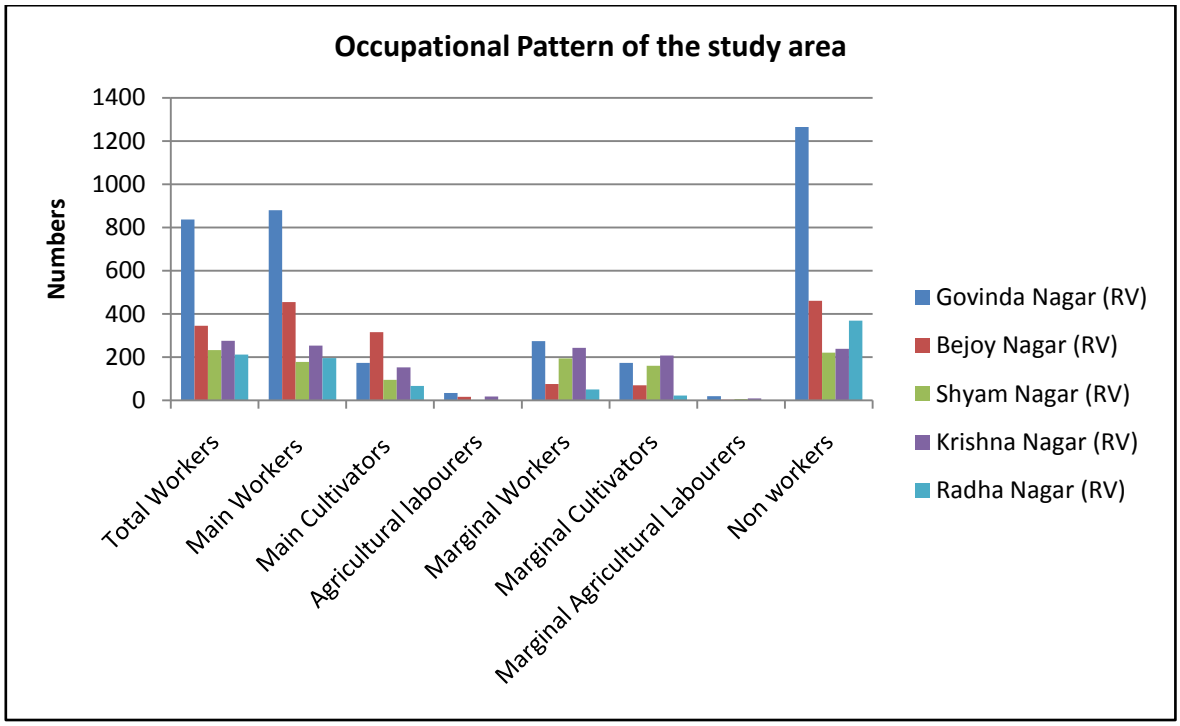


Fig. 3.18: Graphical Representation of Occupational pattern in the study area

Table 3.30: Distribution of Population by Sex Ratio

Sex Ratio (females per 1000 males)	803
Sex Ratio (0-6 Years)	954

(Source: Census of India, 2001)

Plate 8: Field Photographs of Socio-economic Features in the Study Area

Housing pattern

Paddy cultivation

Common fish sp. in Havelock

Office of Gram Pradhan

Fallow land

Paddy Cultivation, Kalapathar

Plate 2: Field Photographs of Air Monitoring

Govinda Nagar (Near Resort)

Radha nagar

Radha nagar

Krishna nagar

Bijay Nagar

Bijay Nagar

Plate 3: Field Photographs of Noise Monitoring

Govinda Nagar

Temple near Jetty, Havelock

Jetty, Havelock

School, Havelock

Near Project site

Night noise Monitoring

Plate 4: Field Photographs of Water Monitoring

Sampling from fresh water nalah near site

Sampling from Bijay nagar nalah

Sampling near Radha nagar nalah

Sampling from pond water

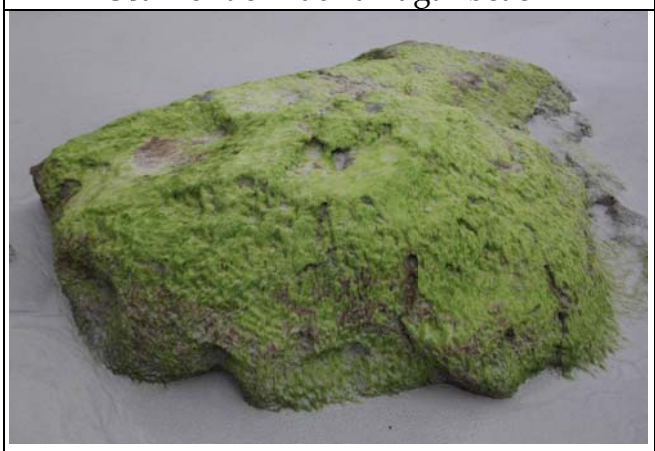
Sampling done from sea

Sampling nalah joining sea

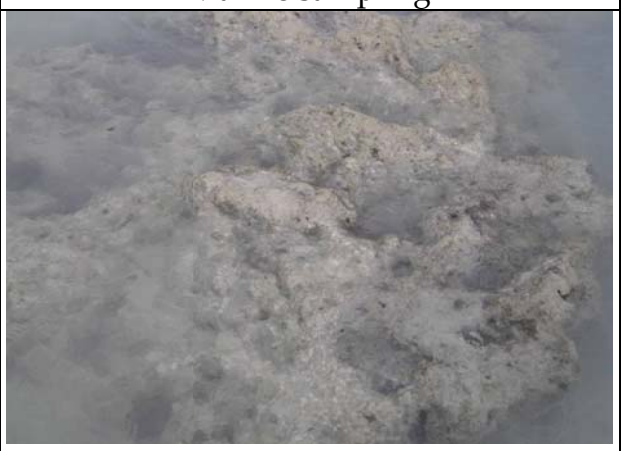
Plate: 5: Field Photographs of Marine Study

Sea front of Radha nagar beach

Marine sampling



Algae formation



Dead Corals

Hermit crab

Fisherman

Plate 6: Field Photographs of Soil Sampling

<table>
<tr><td> 
</td><td>  </td></tr>
<tr><td>Soil sampling at Kalapthar</td><td>Sediment sampling</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Soil sampling near stream</td><td>Sediment sampling</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Soil Sampling</td><td>Soil sampling</td></tr>
</table>

Plate 7: Field Photographs of Vegetation in the Study Area

Vegetation near the project site

Project site

Shrubs

Areca nut trees

Bettle nut trees

Bushes

Plate 8: Field Photographs of Socio-economic Features in the Study Area

Housing pattern

Paddy cultivation

Common fish sp. in Havelock

Office of Gram Pradhan

Fallow land

Paddy Cultivation, Kalapathar

Plate 9: Mangrove Vegetation at Proposed project site

A. marina

A. marina

Mangrove sp. View from the channel side

Project site

CHAPTER 4

Anticipated Environment Impacts and Mitigation Measures

4.0 INTRODUCTION

This section identifies and predicts the potential impacts on different environmental components due to construction and operation of the proposed project. It details all the potential impacts on biophysical and socio-economic components of the local environment due to the proposed activities and sub-activities.

Prediction of impacts is the most important component in the Environmental Impact Assessment studies. Several qualitative and quantitative techniques and methodologies are used to conduct analysis of the potential impacts likely to occur as a result of the proposed development activities on physical, ecological and socio-economic environments. Such predictions are superimposed over the baseline (pre-project) status of the environmental quality to derive at the ultimate (post-project) scenario of environmental conditions. The prediction of impacts helps to minimize the adverse impacts and maximize the beneficial impacts on environmental quality during pre and post project execution. The proposed project would create impacts on the environment in two distinct phases:

- During the construction phase which may be regarded as temporary or short – term.
- The other during the operation stage which would have long – term effects.

The environmental impacts in this section have, as such, been discussed separately for the construction phase and the operation stages of the proposed project. The environmental impact assessment approach used to evaluate the proposed project comprises of three sequential elements. These are impacts identification, prediction and evaluation. The first step of the impact assessment process involves identifying the key issues associated with the construction and operation phases of the project. Issues and concerns of the proposed project are scoped based on the knowledge and experience with respect to environmental setting and project elements. Accordingly, the existing environmental system is described and the components of the project are determined.

This step involves identification of the environmental modification that may be significant, forecasting of the quality and spatial dimension of change in the environment identified and estimation of the probability that the impact will occur. This step involve determination of the incidence of benefit to user groups and population affected by the project, specification and comparison of effects between

various alternatives, and assessment of the likely effect of the project on the environmental, economical and social components indicating the nature of effects.

4.1 IMPACTS ON AMBIENT AIR ENVIRONMENT

The potential ambient air quality impacts arising from the proposed project would occur mainly during project construction phase. Suspended particulate matters and of various sizes would be the major air pollutant during construction phase. The gaseous emissions such as SO_2, NO_X and CO would be generated from the construction equipments and vehicles. During operation phase, DG sets would be the only point source of emission.

The ambient air quality monitoring results show that the PM_{10} and $PM_{2.5}$ concentrations are well within the norms prescribed for the residential areas and commercial areas in all the locations. However, appropriate mitigation measures would still be employed during the construction stage to reduce any incremental rise in pollution level to an acceptable limit.

Monitored values of SO_2, NOx and CO in the ambient air are well within the limits indicating low pollution level as per the CPCB criteria.

4.1.1 Impacts during construction phase

During construction, the project would have two major impacts on ambient air quality due to an increase in gaseous emissions by construction equipments and vehicles, and an increase in dust by construction activities. Earth excavation work, foundation work, , material storage, transportation and handling of construction materials, and wind erosion are the major factors that would produce a temporary, localized increase in SPM and RPM and $PM_{2.5}$ levels.

The increased movement of heavy vehicles carrying construction materials, operation of DG set would generate gaseous emissions. The degree of dust generated would depend on the soil compaction and moisture content of the ground surface during construction. Dust and exhaust particulate emissions from equipment operations would temporarily degrade air quality in the immediate construction zone. The increase in air particulates would be minimized by the performance of the work.

The construction contractor will visually monitor dust levels on the site during construction. Dust suppression will be instituted, using water tankers mounted on tractors, sprinklers and other means as necessary, in the event that high levels of dust are observed, strong winds and dry conditions make dust generation likely, and complaints about dust are received.

Other diffused source of gaseous emissions from the construction site would be if the construction labours use fuel wood for cooking. The construction contractor will ensure that such practice is not adopted by the labours and they are provided with LPG cylinders for cooking in their labour camps.

4.1.2 Impacts during Operation phase

There will be no impact on air quality during their normal operation phase of the project. However, the only point source of emission will be DG sets which will be installed as a source of power supply system. The DG sets will be run on HSD with a maximum sulphur content of 1.0 %. It is proposed to install stacks of adequate height to exhaust the DG emissions. The stacks of adequate height will be provided as per CPCB guidelines.

Since HSD fuel will be used, very small quantity of Particulate matter, SO_2, NOx and CO will be generated during the combustion process.

The impacts on air quality due to vehicular emissions in the complex will be very less as only LMVs will be operational for bringing tourists. It is for these reasons that the ambient air quality predictions using models have not been carried out.

4.2 IMPACTS ON AMBIENT NOISE ENVIRONMENT

4.2.1 Impacts during construction phase

Construction activities normally result in temporary and short duration increases in noise levels. The main sources of noise during construction period include movement of vehicles for loading and unloading of construction materials, fabrication, handling of equipment and materials, operation of power shovels, concrete mixing plants, generators, etc. The areas affected are site specific and close vicinity to the site.

Under the worst case scenario, considered for prediction of noise levels during construction phase, it has been assumed that all these equipments generate noise from a common point at an average noise level of 85 dB (A).

Table 4.1 Locations likely to have Noise impacts

	Name Of Location	Direction To Site	Distance (km)
N1	At Site	-	0 km
N2	Radha Nagar	North of the Site	200 meter

It is a known fact that there is a reduction in noise level as the sound wave passes through a barrier. The transmission loss values for common construction materials are given in **Table 4.2.**

Table 4.2: Transmission loss for common construction materials

Material	Thickness of Construction material (inches)	Decrease in noise Level db(a)
Light concrete	4	38
	6	39
Dense concrete	4	40
Concrete block	4	32
	6	36
Brick	4	33
Granite	4	40

Thus, the walls of the adjoining buildings along with other factors like air absorption, vegetal cover etc. would result in significant attenuation of at least 25 - 30dB (A) at 100 m distance. The resultant noise levels on proposed project site at 50m distance at peak level of construction are anticipated to be about 70 – 75 dB(A), which is well within the limit for commercial area during the day time.

Further to minimize these potential impacts, major construction activities would be scheduled during normal daylight working hours and would be implemented consistent with the applicable standards. The construction contractor will use equipments that are adapted to operate with appropriate noise muffling devices resulting in the least possible noise. Every effort would be taken to minimize the

noise levels including the mandatory use of construction equipment with operable mufflers.

4.2.2 Impacts during operation phase

During operation, the DG set will be the point sources of noise pollution in the complex. The DG set room, compressor and pumps room will be isolated from the outside environment and proper acoustic arrangements will be made to control the noise generated from the rooms. The noise levels outside the room will be maintained within the stipulated norms both during the day and night time.

The effect of high noise levels on the operating personnel in the DG, compressor and pump rooms will also be considered and appropriate mitigation measures would be adopted.

4.3 IMPACTS ON WATER ENVIRONMENT

4.3.1 Impacts during Construction phase

During the construction phase which may be regarded as temporary or short term. The major source of water pollution could be from sewage from labour camps and offices. The generated sewage would pass into a septic tank. Hence there will be little or no impact on sea water. Moreover, no construction waste will be disposed off in the coastal area. So that doesn't show any direct effect on marine environment.

4.3.1.1 Impacts on Ground Water

Ground water will be drawl during construction and operation phase of the project. However, no significant impact on quality & quantity of ground water envisaged as the aquifers have good potential. The coralline limestone formations forms potential aquifer in Havelock etc. and the yield of dugwells (having 5m dia, 6m depth) varies from 15000 to 1 lakh lpd (http://cgwb.gov.in/er/andaman.htm).

As the project is proposing to implement the rain water harvesting and reuse of treated water, drawl of ground water will be little, and thus effect would be minimal in the aquifers.

The waste water generated will be treated and reused within the campus for flushing of toilets, gardening and HVAC purpose. Both these measures along with

implementation of rainwater harvesting and conservation measures would have positive impact on the ground water quality and quantity.

These measures would reduce the fresh intake quantity from the ground water. Groundwater was tested at the project site and was compared to IS: 10500 (1991) for evaluation. Most of the parameters are observed to be within the limits prescribed by this standard. Since no wastewater from the complex will be discharged into the open, no impact on groundwater quality is envisaged.

The water requirement during the construction phase (60 KLD) will be met through rain water harvesting and bore wells.

4.3.1.2 Impacts on Piped Water Supply / Surface Water

Water will not be taken from exiting village water supply system neither in construction nor in operation stage of the project. Thus there will be no impact piped water supply. However may be minimal increase in TDS due to runoff in fresh water nalah.

4.3.1.3 Impact on Marine Water:

In this project, the proposed project site is located around more than 150 m from sea coast line area. At the time of low tide the distance between project site & tidal water level mark is approximately 150 m as well as in high tide time that distance will be nearby 100 m. The proposed project would create impacts on the marine water body in two distinct phases:

4.3.2 Impacts during operation phase

No significant impact on marine environment is envisaged during project operation. According to project plan, whatever sewage generated will be treated and reused for flushing, gardening etc. Water will not be taken from sea neither in operation stage of the project. Thus there will be no impact on marine environment. Zero liquid discharge will be maintained and follow all statutory guidelines of A&N administration. Thus no impact is envisaged on surface water, ground water and intertidal areas in operation phase of the project.

4.3.3 Impacts due to Waste Water Generation

4.3.3.1 During Construction phase:

The major source of water pollution during project construction phase will be sewage from labour camps and make shift office. It is expected that at any given time during the construction phase, the peak manpower strength on construction site comprising of technical staff, clerical/supervisor, skilled and unskilled workers would be about 300 persons. The average domestic water requirements would be about 40 KLD. It is assumed that about 90% of the water required will be generated as sewage. The generated sewage would pass into a septic tank. Hence there will be little or no impact on water and soil.

4.3.3.2 During Operation phase:

No major source of water pollution is envisaged during project operation as sewage generated will be treated and reused for flushing, gardening etc. The expected characteristics of the untreated & treated wastewater are given in *Table 4.3*. There will be saving of fresh water by recycling sewage water for non-potable purpose (flushing) and gardening.

Table 4.3 Expected Characteristics of raw & treated waste water

Sr. No.	Parameter	Unit	Raw sewage characteristics	Treated sewage Characteristics
1.	pH	--	6.0 - 8.0	7 - 7.5
2.	BOD 3 days at 27^0C	mg/l	200 - 350	< 10
3.	COD	mg/l	500 - 700	< 30
4.	Suspended Solids	mg/l	200 - 300	< 10
5	Oil & Grease		15	< 5

4.4 IMPACTS ON LAND ENVIRONMENT

4.4.1 During Construction phase

Impact on construction phase may be regarded as temporary or short term. Possible impacts could be from runoff and discharge of sewage from the project site to inter tidal area. No construction waste will be disposed off in inter tidal areas and so there will be no impact.

4.4.1.1 Impacts on Land Use

The current land-use of the site is non residential and covered with herbs and shrubs. But land use pattern will be changed on completion of the project. However no negative impact is sought due to land use change the construction will be eco- friendly and will have enough free spaces for gardening and vegetation. Development of green belt and other landscape on the proposed site would enhance the visual aesthetics of the area.

4.4.1.2 Impacts on Soil

The site clearing and preparation activities will involve removal of scanty vegetation (areca nut trees) existing on the proposed plant site. The project site is primarily dominated by shrubs and areca nut trees.

Gardening and landscape development will be done in phase manner during construction and operation. As the topography in and around the site is mostly plain with slope, the digging of the site before the start of the construction work would not result any significant effect on soil erosion and silt run off, even during the heavy rains. The project will not require extensive work on the excavation and removal of soil and hence there will be minimal impact on soil.

The project proponent will adopt good construction practices that will ensure the environmental impacts of waste generated on-site during construction will be minimized.

4.4.1.3 Impact on Marine Intertidal area:

In this project, the proposed project site is located around more than 150 m from sea coast line area. At the time of low tide the distance between project site & tidal water level mark is approximately 150 m as well as in high tide time that distance will be nearby 100 m. The proposed project would create impacts on the Intertidal area in two distinct phases:

4.4.2 Operation phase

No significant impacts are envisaged in operation phase of the project as sewage will treated in STP and solid waste will be processed in Organic Waste Processor (OWP).

4.4.3 Solid Wastes

4.4.3.1 Construction Stage:

The generation of waste material is inevitable during the construction phase of the development. Waste is generated at different stages of construction process. Waste during construction activity relates to cement mix or concrete left after work is over, rejection caused due to change in design or wrong workmanship etc.

Excavation of earth and rock generates muck. Other wastes include top soil, clay, sand, and gravel. These are normally re-used as filler at the same site after completion of excavation work. Other miscellaneous materials that arise as waste include glass, plastic material, general refuse, scrap metal, cardboard, plastics, and sewage wastes from the construction workers housing. The refuse will be dispose off in accordance with applicable guidelines. Every precautionary measure will be taken to reduce and reuse the waste materials.

4.4.3.2 Operation Stage:

Solid wastes (bio-degradable and non bio degradable) will be generated from guest rooms, F & B outlets, Banquets, Recreation zone, Spa and Saloon, staff accommodation etc.

Total solid waste from the operation phase is expected to be generated 63.kg/day. The solid wastes will be segregated into bio-degradable and non-biodegradable. The bio-degradable will be 38 kg/day and the non-biodegradable will be 25 kg/day. The Solid Waste will be segregated into Dry Garbage and Wet Garbage and stored in separate container. Wet garbage will be treated in to Organic Waste Processor & dry garbage will be handed over to the authorized recycler for further handling & disposal.

The solid waste i.e. sludge generated from the STP will be dewatered and used for the horticulture purpose within and outside the complex as a manure or handed over to authorized vendor.

4.5 IMPACTS ON SOCIO – ECONOMIC ENVIRONMENT

4.5.1 Hazards to Construction Workers and the Local Population:

During the construction period, the activities may result pondage of water in the dug – out areas of the site. This has the potential for creation of mosquitoes breeding and spreading of vector borne diseases. The most important construction aspects are the impediment of temporary drainage by blocked silt traps or the ponding of water within foundation works. Other mosquito breeding sites maybe created through the use of uncovered water tanks. The project will give careful attention to the design and maintenance of earthworks and drainage systems during construction to avoid the creation of significant habitat areas for mosquito larvae. The use of larvicides may be required to prevent mosquito breeding in silt traps.

4.5.2 Housing and Transportation of Construction Workers

The project will facilitate maximum participation of the fair and equitable local work force for the construction. This will not only benefit local economy and employment, but also reduce the need to build temporary shelter and supply services. However, the project will still require some skilled and unskilled migrant workers. In such case, the project will provide sanitary toilets, washing facilities, potable water supply, and LPG for cooking on site during construction. The sewage will be passes to septic tanks.

The supply of LPG cylinders for cooking will reduce the dependency of the construction workers on the fuel wood and hence chances of any release of smoke and other air pollutants in the environment.

4.5.3 Socio – Cultural Impacts

The project will contribute marginally to the socio-economic development of the area at the local level. The land values around the project site are likely to be increased after the operation of the project. The direct and indirect employment to the local population during the operation of the project at both skilled and unskilled levels will benefit the local population and its specific groups. Economic activity will get a boost hence have a positive impact.

4.5.4 Impacts on Physical Infrastructure

No impacts on physical infrastructure are envisaged as all requirements will be borne by the project proponent. Power requirement will be met by installing DG sets and solar power plant in the site.

4.5.5 Employment Opportunities

The construction of the proposed project is expected to provide temporary employment to a good number of skilled and unskilled workers directly. More over there will be economic boost to that region.

4.6 RESOURCES

No impacts are sought on local resources rather there will be more economic development of the region. The project proponent will ensure that the contractor selected to construct the project will implement best management practices to use renewable resources and conserve conventional resources. These may include, but are not limited to:

- Use of energy-efficient lighting
- Lighting of only critical areas during non-working hours
- Efficient scheduling of construction crews
- Minimizing idling of construction equipment and vehicles
- Generation of power from solar energy.

4.7 IMPACT ON BIODIVERSITY

The Andaman group of islands including Havelock having tropical and humid climate is rich in biodiversity. There are five forest types, namely Tropical Wet Evergreen, Tropical Semi-evergreen, Tropical Moist Deciduous, Littoral and Swamp forests. The island is the habitat of several species of flora (angiosperms, pteridophytes, lichens, mosses etc.) and fauna (mammals, reptiles, birds, and aquatic species).

4.7.1 Construction phase

Minor impacts are likely on floral species as several trees (mostly areca nuts) will be cut during site preparation and grading. Mangrove may be affected if solid and liquid wastes are disposed in mangrove habitat areas. Local avifauna species may also be affected during this stage. Faunal species (crustacean, reptiles, etc) present in

and around the project site are likely to be disturbed during site preparation and construction. Also the proposed project site is located near to reserved forest.

Since construction work will be carried out in day hours and noise be controlled under permissible standard, no significant impacts are likely on biodiversity. Air pollution likely to occur due to suspended dust will also be controlled by spraying water. No wastage will be discharged in the mangrove habitats. Moreover, contractors will be instructed to carry out the work in such a way so that biodiversity around the site is not affected.

4.7.2 Operation phase

No impacts on biodiversity are envisaged during operation phase since this is a resort project. Only DG set, will be the source of pollution for air and noise but it will be maintained as per CPCB standards so that flora and fauna are not affected.

No eco-sensitive areas like national parks, WLS etc. are present within 10 km radius from the project site. Hence no major impacts are envisaged on biodiversity of the region.

4.8 POTENTIAL ENVIRONMENTAL IMPACT MATRIX

This methodology incorporates a list of project activities with a checklist of environmental components that might be affected. Matrix methods incorporate environmental conditions on one axis and proposed actions on the other.

The impact of each action on the various environmental components are filled in a tabular format to estimate the impacts may be either qualitative, insignificant, high, adverse, beneficial or quantitative by assessing a numerical score, but in the end there should be a grand total to signify the magnitude of the impact. The activities discussed above are likely to affect the environment in varying degrees. Relevant components of environment, which are likely to experience some impacts due to the project activities, have been identified.

Environmental parameters are broadly classified under three following groups considering the cause - effect relationship:

- Physical Environment
- Biological Environment
- Non Biophysical Components (NBP)

The parameters selected for impact identification are site activities and project specific. Different parameters considered under the said groups are as follows:

- Ambient Air Quality
- Noise
- Surface and Ground water quality
- Marine water
- Soil stability / erosion
- Soil quality
- Vegetation
- Resource use
- Health
- Socio economic

The interaction between project activities and environmental parameters described above are shown in the impact matrix in the Table 4.4. The matrix points out each activity and its impact on specific environmental parameters. This is a qualitative work and does not indicate quantitative impact. Some of the impacts are temporary and localized and some impacts are short term and long term in the matrix.

Table 4.4 Potentiel Environmental Impact Matrix

Project activities		Physical							Biological		Non Biological Components (NBP)		
	Air Quality	Ground Water	Surface water (Fresh water)	Marine water	Soil Stability/ Erosion	Soil Quantity	Noise	Land use	Flora	Fauna	Resource Use (Water supply and use, visual features)	Health (Individual/ Community , Occupational)	Socio economic (Population, Community Infrastructure, Employment)
Construction Phase													
Site excavation and foundation work	ST, -ve, RE	ST, -ve	ST, -ve	ST, -ve	ST, -ve, RE		ST, -ve	LT,	ST, -ve	ST, -ve			ST, +ve
Material storage, transportation and handling	ST, -ve		ST, -ve	ST, -ve			ST, -ve					ST, -ve	ST, +ve
Movement of vehicles	ST, -ve						ST, -ve						+ve
Construction workers camps	ST, -ve		ST, -ve	ST, -ve								ST, -ve	+ve
Operation of DG set and machineries	ST, -ve						ST, -ve						
Operation Phase													
Running of DG sets,	RE, LT, -ve						RE, -ve, LT,					IR, LT, -ve	
Sewage generation			ST, -ve	ST, -ve							-ve		
Water requirement		LT	LT, IR,										

ST – Short Term
LT – Long Term
RE – Reversible
IR – Irreversible
+ ve - Potential Positive Impacts
-ve - Potential Negative Impacts (require mitigation measures)

CHAPTER 5

Environment Management Plan

5.0 INTRODUCTION

Environmental Management is basically resource management and environmental planning similar to development planning. The conventional resource management and development planning look at the issues from narrow micro-economical point of view while environmental management views the issues from the broader prospective of long term sustainable development option, which ensures that the environment is not desecrated. An Environmental Management Plan is prepared for construction phase, post construction phase (commissioning & operation) and for post project phase. The environmental management plan is prepared to minimize the impact of atmospheric emissions, liquid effluents, solid wastes & noise generation on the surrounding environment.

The baseline settings of different relevant environmental components in the study area are analyzed and potential impacts on those components due to the proposed project are documented. The impacts on environment are found to be minimal during the study; however additional measures are documented for both construction and operation stages for further improvement of Environmental Quality in the form of an Environmental Management Plan (EMP).

5.1 ENVIRONMENTAL MANAGEMENT PLAN

Besides delineating an EMP to address the various environmental impacts identified and assessed, the EMS suggests an overall framework under which the EMP is executed.

The EMP presents the project specific guidelines on

- Environmental management strategies
- Specialized engineering construction procedures in relation to environmental guidelines of the country.
- Spill prevention and control
- Disposal (management) of wastes and hazardous chemicals
- Air, water and soil quality protection
- Noise control
- Soil erosion control and slope stabilization
- Vegetation, wildlife and habitat protection
- Socio-economic and welfare considerations
- Risk and disaster prevention

Due to its complexity and implications, the implementation of the EMP must be executed utilizing a specific EMS framework. Once an EMP has been approved, it should provide the basis for environmental considerations of all the activities carried out on the site by the appointed personnel. With respect to the various environmental impacts identified during the EIA stage, mitigation measures to prevent or minimize the impacts are suggested for all the environmental components.

The environmental management plan for the proposed project aims to mitigate the potentially detrimental impacts on the environment, both during construction and operation phases of the project. It is also necessary that continued compliance with existing environmental regulations is ensured. The construction and associated activities have been planned so as to minimize impacts on the physic-chemical, biological and socio-economic-cultural environments. Even though it is expected that all detrimental impacts can be avoided, it is apparent that most of the impacts will be localized and temporary in nature.

5.2 ENVIRONMENTAL OBJECTIVES

While developing an EMP within the framework of an EMS, it is imperative to have clear environmental objectives and delineate them. The key environmental management objectives for this project are to avoid significant adverse environmental impacts and to ensure that where impacts do occur they are mitigated. The objectives are -

- To adopt construction and operational methods which will limit environmental degradation
- To protect physical environmental components such as air, water and soil
- To conserve terrestrial and aquatic flora and fauna
- To protect historic and cultural sites
- To incorporate the views and perceptions of the local inhabitants in the project.
- To generate employment opportunities wherever possible
- To provide environmental guidelines and stipulations to the construction contractors to minimize the impact of activities around the proposed site.
- To establish a long term program to monitor effects of the project on the environment.

5.3 IMPLEMENTATION

The various players responsible for execution of the EMP and associated monitoring and inspection, and their designated levels of responsibilities are delineated below:-

- The Project Proponent will be responsible for providing all the necessary funding and administrative support to the EMP and be ultimately responsible for carrying out this project with total commitment to environmental matters.
- Coordinator of Environment Management Cell (EMC) will be responsible for coordinating the activities of a technical staff responsible for monitoring and managing compliance of the EMP. The responsibilities include technical, community and administrative matters related to the EMP, including liaison with the general public in the project area, other parties and regulatory bodies on environmental issues related to the project. This person will also keep the local communities informed of the environmental compliance of the project and properly address any issues of their concern.
- The **HSE Representative** with the help of the technical staff, will be responsible for monitoring the compliance of the EMP (for which they will be given adequate training) and must report to Management Representative (MR).
- The **Construction Contractor** will be responsible for ensuring full compliance with environmental matters related to construction activities, as laid down in the EMP. The construction contractor will ensure that all his workers are properly briefed in environmental matters in terms of Dos and Don'ts while they work on the project. The cost towards implementation of EMP is the part of the bidding document so that the related costs are included in the contract.

The proposed project would create impacts on the environment in two distinct phases:

Phase 1: During the construction phase which may be regarded as temporary or short – term

Phase 2: During the operation stage which will have marginal impacts.

5.4 EMP FOR CONSTRUCTION PHASE

Environmental impacts during the construction phase can be attributed to the site preparation, excavation of trenches, erection & mechanical fabrication, construction activities, transportation etc. and provision of civic amenities to the construction workforce. The potential for environmental impact during construction phase on most of the environmental components, is temporary, and the environment returns back to its previous status on completion of the construction. State of the art technology will be adopted for control of pollution during project execution phase, whenever and wherever applicable.

All construction activities generally cause disruptions to the pre project environmental quality. The following environmental protection measures should be incorporated as part of terms and conditions of contract for implementation by the contractor or the authority as appropriate. Recommendations made to minimize impacts during construction phase are delineated below:

5.4.1 Management of Air Environment

The Central Pollution Control Board (CPCB) has set standards with regard to the ambient air quality levels and emission levels. Respirable Particulate Matter (PM_{10}) levels in residential and rural area should not exceed 100 $\mu g/m^3$ and Fine Particulate Matter ($PM_{2.5}$) levels in residential and rural area not to exceed 60 $\mu g/m^3$. The vehicular emissions should meet standards prescribed by CPCB.

One or more of the following measures may be implemented to minimize impacts on air quality during construction and operation of the project.

- Any vehicle not meeting the vehicular pollution standards will not be allowed within the construction site and for the construction activity.
- All vehicles and construction equipment with internal combustion engines in use will be maintained for effective combustion to reduce particles, CO emission.
- It will be ensured that all the vehicles deployed for the project possess Pollution under Control (PUC) Certificate.
- All vehicles will be properly maintained to minimize emissions of contaminants, for this necessary measure will be taken.
- A schedule for the operation of vehicles will be established to minimize to the extent practicable, the time of operation of emission sources.

- Water will be sprayed by high pressure water hoses during dust generating construction activities e.g. excavation, crushing/demolishing, concrete mixing, material handling etc. to suppress dust.
- Wetting (sweeping or sprinkling) will be used, wherever practicable, to minimize dust dispersion.
- Usage of Asbestos will be avoided as far as possible.

5.4.2 Management of Water Environment

A. Surface water quality (Marine and Fresh water)

- Sewage from the temporary camp sites should disposed of through septic tanks. No untreated sewage should dis-charge in water bodies.
- Rainy season will be avoided for cutting and filling of earthwork as this runoff may contaminate sea water.
- Soil binding and fast growing vegetation and grass should be grown around the construction site to reduce soil erosion thereby preventing surface water pollution.

B. Ground water quality

- Ground water should not be contaminated from construction waste water.
- Precautionary measures should be taken so that ground water is not contaminated during boring and water withdrawal.
- No hazardous construction wastes should be disposed of on land, as water table is between 2.2 mbgl to 5mbgl. However, such wastes should be handed over to authorized vendor.

5.4.3 Management of Noise Environment

The Central Pollution Control Board (CPCB) has set standards for ambient noise levels in various activity zones. For commercial areas the daytime noise levels are not to exceed 65 dB(A) and the night time levels 55 dB (A). In case of residential areas, the day and night standards are 55 dB(A) and 45 dB(A) respectively.

The following measures may be adopted to minimize the impact of noise during construction phase of the project:

- Construction should not be carried out in nigh time.
- Construction equipment generating minimum noise and vibration should be chosen.

- Ear plugs and/muffs should be used by the construction workers working near the noise generating activities / machines / equipment.
- Vehicles and construction equipment with internal combustion engines without proper silencer will not be allowed to operate.
- Construction equipment meeting the norms specified by EP Act, 1986 will only be used.
- Noise levels will be reduced by the use of adequate mufflers on all motorized equipment.

5.4.4 Management of Soil Environment

Following measures will be taken for management of soil and inter tidal environment of the study area.

- Rainy season will be avoided for cutting and filling of earthwork.
- Soil binding and fast growing vegetation and grass should be grown around the construction site before commencement of construction activity to reduce soil erosion.
- Temporary drainage channels should be provided to minimize soil erosion.
- Adopting prudent soil erosion control measures.
- Existing top soil which must be removed during construction should be stockpiled temporarily for replacement whenever required.

5.4.5 Management of Marine Environment

- Waste water should be treated before discharging from the site.
- Hazardous waste (Spent oil, grease etc.) will not be released in inter tidal areas, that is handed over to authorised vendor.
- Precautions should be taken to minimize damage to native plants on the periphery of construction area.
- Solid waste should be segregated and disposed as per norms.
- Spillage of any kind of hazardous waste should be prevented as it may cause marine water pollution.
- Runoff should be diverted to storm water drain from the construction site so that intertidal areas and sea water is not contaminated.
- Every precaution should be taken so that terrestrial flora and fauna is not affected in during construction period. Economically important tree species and mangroves present on both sides of the stream passing

through the proposed project site should not be uprooted. However if mangrove clearing is done with due permission from CZMA, 5 times of the mangroves cut should be replanted in suitable patch of land or as directed by A&N CZMA.

- Mangrove habitat should be protected by temporary fencing during construction.

5.4.6 Solid Waste Management:

Construction activities can lead to solid waste generation including Normal debris, sand, waste concrete & plaster, excavated soil, stone, broken bricks, plastic, paper, wood, metal and glass. These wastes shall be generated from the project site during the construction phase. This waste shall be used for leveling and base course preparation of roads within project premises.

Approximately 135 kg /day Domestic solid Waste is generated from labour use. It includes food waste, rubbish & other biodegradable waste.

5.4.7 Management of Socio-Economic and Cultural Environment

To minimise adverse impacts arising out due to the project activity, mitigate measures are suggested in the EMP. Proper implementation of EMP would mitigate adverse impacts in the region.

- Prior information about the project should be given to locals in study area.
- Caution should be exercised to avoid disturbance to existing infrastructure.
- An emergency plan should be prepared in advance, to deal with fire fighting.
- All construction material and equipment should be stored in a neat and orderly manner so that it is not spread out.
- Local people will be employed for construction work to the maximum extent possible.
- Proper facility for domestic water supply, sanitation, domestic fuel and other essential community services will be made available to the construction workers.

5.4.8 Traffic Control

- Traffic congestion and road hazards should be prevented.
- Deliveries of materials to the project site should be consolidated whenever feasible to minimize the flow of traffic.
- Existing network of roads should be used for transporting equipment and construction material and no new road should be constructed unless unavoidable.
- Truck traffic will be staggered all through the day and during non- peak hours, materials will be received during non-peak hours and the water will be sprinkled during transportation.
- Only one entry with two separate gates, one for entry and one for exit, will be planned for the smooth moving of vehicles.
- Security personnel will manage traffic on shift basis at entry / exit point.
- There will be ample space for movements of vehicles and parking.

5.4.9 Safety and Aesthetics

- All construction equipment and material should be stored in a neat and orderly manner.
- Excess excavated material should be removed from the project site as soon as possible after the completion of excavation operations. This material should be used for leveling and landscaping
- Temporary sanitary facilities should be provided for onsite workers. These facilities should be maintained in a clean, odour free condition and care should be taken to avoid soil and groundwater contamination.

5.4.10 Completion of Construction Activity - Restoration

Before the activity is considered as complete by the authority, appropriate measures should be taken to restore the project site and surrounding areas to that of pre-construction condition. Temporary structures, equipment, surplus material and refuse should be removed from the project site at the earliest.

Land will be restored as discussed below:

- To at least as good as pre-construction condition.
- To minimize erosion
- Construction debris and other wastes will be cleared.
- Access roads will be restored to pre-construction conditions or better.

5.5 EMP FOR OPERATIONAL PHASE

Several control measures have been incorporated in the process technology to minimize the generation of wastes and subsequent environmental impacts during the operational phase. Strict adherence to these pollution prevention and control measures shall moderate the environmental impacts to the minimum possible level during operational phase. In general, the environmental management plan during operational phase of the plant shall be directed to the following:

- It shall be ensured that all the pollution control / environment management systems are commissioned before the commencement of operation of the project.
- Regular performance evaluation of the control systems shall be undertaken to ensure their optimum performance.
- Preventive maintenance schedule of the control systems will be matching with that of the respective operational unit.
- Regular monitoring for various components of environment shall be undertaken to ensure effective functioning of pollution control measures as well as to safe guard against any unforeseen changes in environment.
- Efforts shall be made to ensure the maximum utilization of wastes generated.
- A program of vegetation reinstatement should be undertaken to compensate for loss of vegetation cover during construction phase

During the operational phase, there will not be any significant impacts on environmental components.

5.5.1 Management of Air Environment

The proposed project does not impose any major impact on the ambient air quality, during operation phase. D.G Sets (2 Nos x 440 KVA) will be installed & also is provided with acoustic measures and Generator exhaust will be taken as per CPCB norms.

- Regular maintenance of valves, pumps and other equipment to prevent leakage.
- Plantation of trees would act as noise and dust buffers.
- Greenbelt development shall be implemented to mitigate impacts from fugitive emissions.
- The air quality surveillance program may be strengthened properly keeping in view the combined maximum impacts from post-project activities particularly in critical downwind directions

5.5.2 Management of Water Environment

A. Surface water quality

During operation phase no wastewater will be discharged to any surface water body and hence no negative impact is envisaged. Sewage generated will be treated in STP and used for gardening & flushing.

B. Ground water quality

No Waste water or solid/hazardous waste will be discharged to any ground water body. Hence, no impacts are envisaged.

Below figure shows water balance for residential building in the operation phase

Water Balance Chart

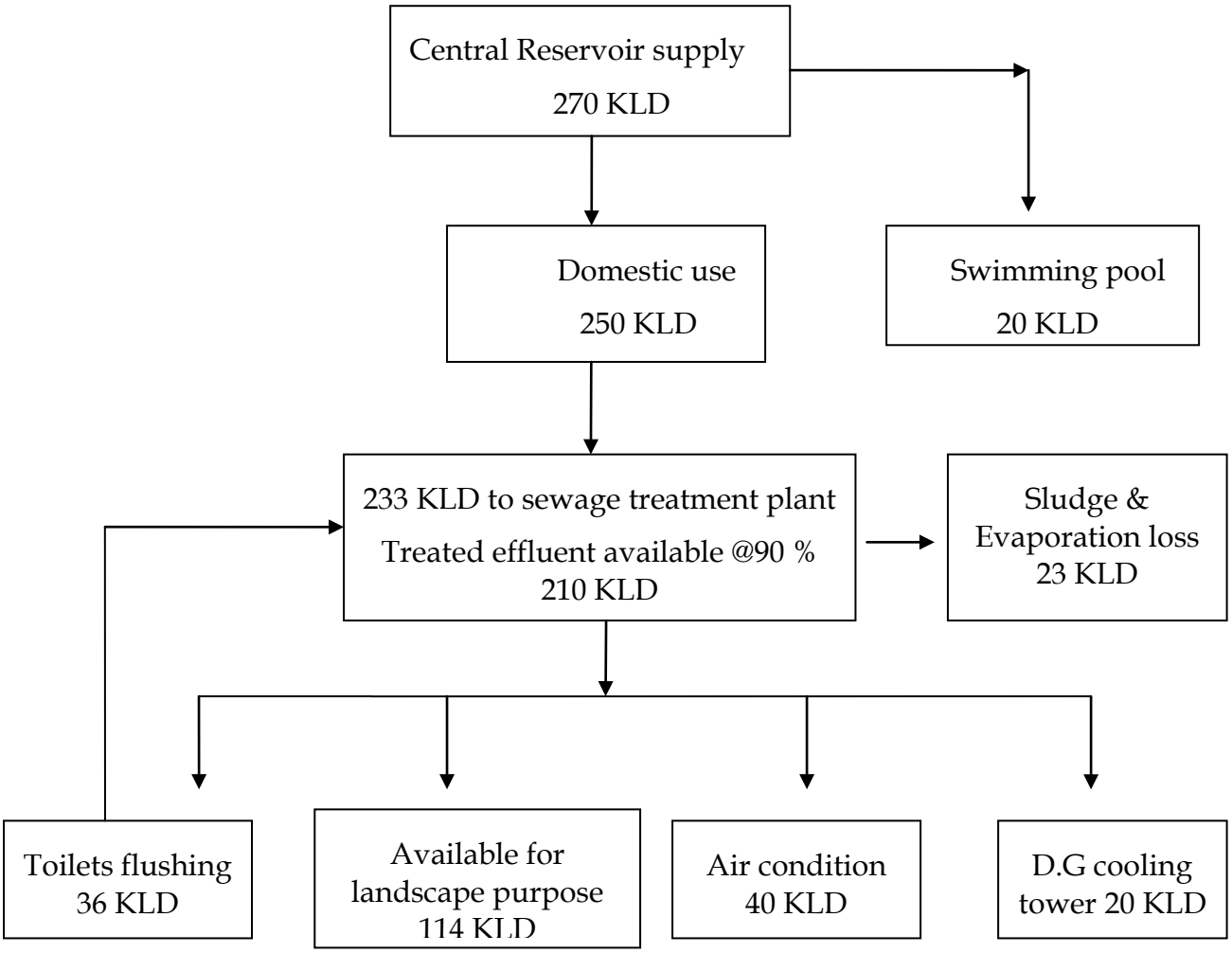


Fig. 5.1: Water balance for the operation phase

All capacities in Kilolitres / Day (KLD)

Central Utility water supply: 270 KLD

Recycled water requirement: 210 KLD

5.5.3 Management of Noise Environment

- The only source of noise during operation phase is from DG set, pumps, & cooling towers. However it will provided with appropriate acoustic barriers so that the noise level within 1 m of these facilities be less than 75 dBA.

To control the noise, following control measures will be implemented.

- Periodic maintenance of DG set.
- Noise suppression measures such as enclosures, buffers will be provided.
- A good quality digital sound pressure level meter is essential for this purpose.
- Implementation of greenbelt development and landscaping are expected to further reduce noise impacts within the project premises.

5.5.4 Management of Land Environment

i) Green belt should be developed around the plot to prevent soil erosion.
ii) Storm water drainage should be provided.
iii) Rain water harvesting should be done

5.5.5 Management of Biological Environment

The Andaman group of islands including Havelock, having tropical and humid climate is rich in biodiversity. There are five forest types, namely Tropical Wet Evergreen, Tropical Semi-evergreen, Tropical Moist Deciduous, Littoral and Swamp forests. The island is the habitat of several species of flora (angiosperms, pteridophytes, lichens, mosses etc.) and fauna (mammals, reptiles, birds, and aquatic species). Economically and aesthetically valuable trees will be preserved within the plot. Habitats will not be disturbed during construction phase. If any valuable plants are to be removed while clearing the site, that will be replanted in selected area. Contractors and field surveyors will be instructed to carry out the civil work without disturbing flora and fauna. Mangrove habitats will not be disturbed and fenced where ever necessary to protect the species. Moreover green belt will be developed as a measure pollution control and aesthetic development.

5.5.5.1 Green belt development

The main purpose of green belt designing is to attenuate the adverse impacts, while keeping in view the availability of vacant/open land, preferably wasteland. Because, conventionally the efficacy of green belting in the pollution abatement mainly depends upon the simple principle of the width of the green belt, tree heights to formulate green belt canopy while keeping in view the distance and direction of source of pollution as well as the focal points of noise emitting source like DG sets.

An ideal green belt always imparts scenic beauty besides providing roosting/perching place for birds and ground surface for naturally available reptiles, other flora and fauna species, to make the area more natural and hazard free. It is proposed to plant local fast growing species for landscaping.

5.5.5.2 Criteria for Selection of Species for Greenbelt

The plant species suitable for green belt development should be selected based on the following characteristics.

- Suitable for climatic conditions
- Require Low Maintenance.
- Improve Microclimatic Condition Within Site.
- Provide Shade and Create Avenue.
- Act As a Buffer & Control Air & Noise Pollution.
- Plant saplings of 2-3 years old will be planted to ensure better survival rate
- Preference will be given for trees with ecological value followed by aesthetic value.
- Local flora of that region will be planted.

5.5.6 Management of Marine Environment:

Sewage should be treated before discharging. Sewage should be treated in STP before discharging. The treated water should preferably be reused in gardening and flushing. Solid waste should be segregated and disposed as per norms. Hazardous waste (Spent oil, grease etc.) should not be released in inter tidal areas and sea water body, rather handed over to authorized vendor. Precautions should be taken to minimize damage to native plants like mangroves on the periphery of construction area. Fence may be provided on both sides of the stream passing through the plot for mangrove habitat conservation.

The name of the species found in the periphery of plot may be displayed on board and instructed not disturb them.

5.5.7 Sewage Collection, Treatment and Disposal System

One STP is designed to cater for discharges from villas. It is proposed to locate the Sewage Treatment Plants on ground.

5.5.7.1 Sewage Generation:

- Sewage will generate mainly from kitchen, washroom and toilets.
- The total quantity of sewage that will be generated is 233 KLD. The sewage shall be treated in separate Sewage treatment Plants with capacities of 235 KLD/day.
- The treated water from the STP will be used for flushing and gardening & dried sludge will be handed over to authorized vendor. The treatment plant shall be based on the MBBR Process.

5.5.7.2 Sewage Treatment:

Primary Treatment - Screening

Secondary Treatment – Biological process

Tertiary Treatment –Activated carbon filters / softeners.

Sewage will be treated in STP of MBR type.

5.5.7.3 Sewerage:

- Drainage system should be based on the most efficient, functional design, minimum maintenance after installation.
- The main drainage is carried through a battery of manholes and finally discharged into Sewage Treatment Plant (STP).
- The sewerage will be channelized through closed drainage net work and will be transferred to STP for Primary/Secondary/Tertiary stage treatment.

5.5.7.4 Details of the Scheme Proposed

Method adopted for the design of STP (Modular STP)

The design is made keeping in mind the total quantity of generation of **233 KLD**. The modular technology is adopted in the design, i.e., when the flow increases drastically, the present units itself can be used with additional units attaching to it in modules, which would be economical and saves on the area required too. The proposed STP is of MBR membrane type. The schematic is shown in fig. 5.2.

5.5.7.5 Sewage Characterization:

The general characteristic of sewage is considered as shown in the table below.

Sr. No.	Parameter	Unit	Raw sewage characteristics	Treated sewage Characteristics
1	pH	--	6.0 - 8.0	7 - 7.5
2	BOD 3 days at 27^0C	mg/l	200 - 350	< 10
3	COD	mg/l	500 - 700	< 30
4	Suspended Solids	mg/l	200 - 300	< 10
5	Oil & Grease	mg/l	15	< 5

5.5.7.6 Mode of Treatment:

It is proposed to setup a treatment plant for treating the domestic waste using the Time tested and reliable MBR- membrane based process with extended aeration through diffused aeration.

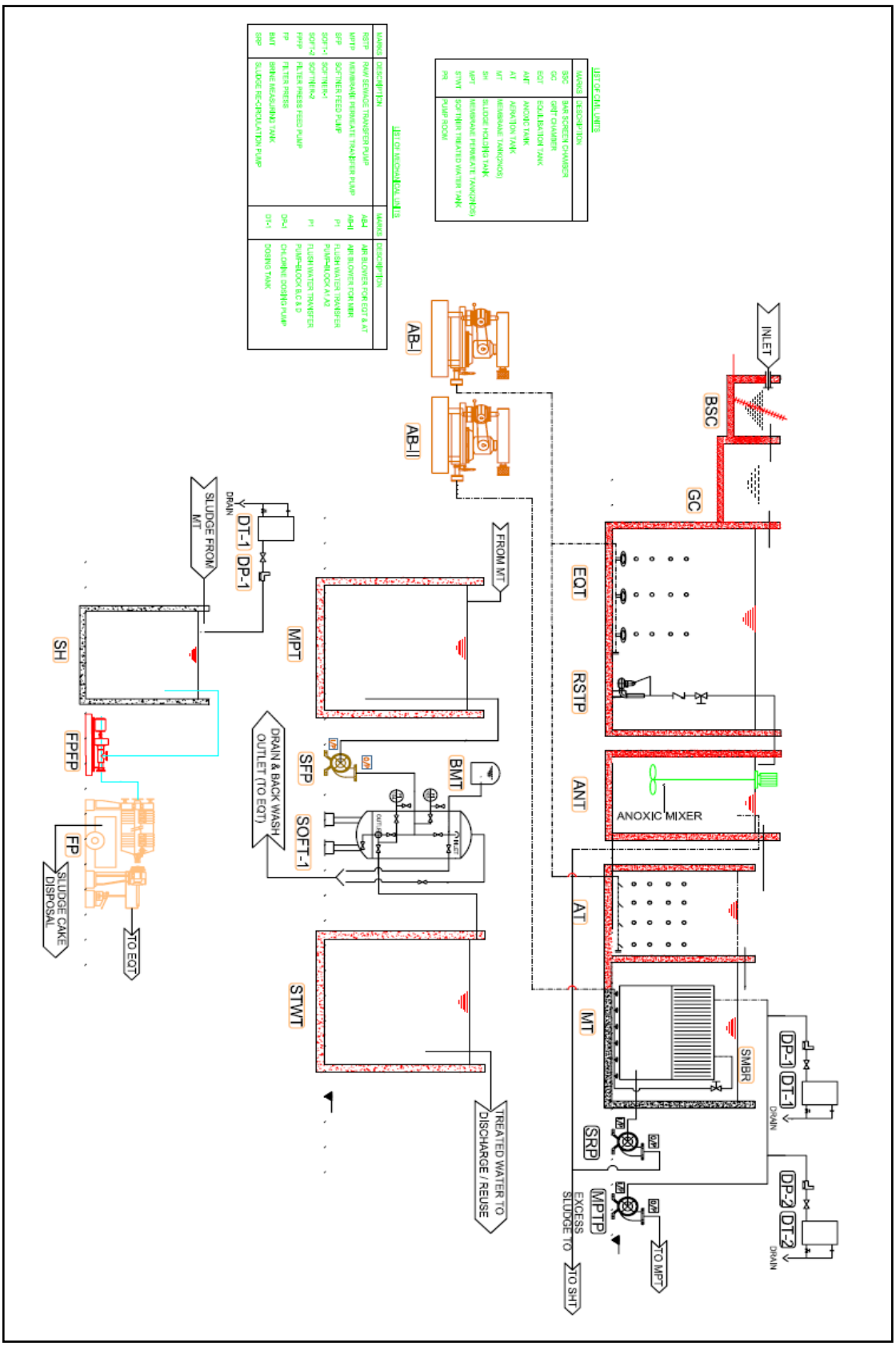
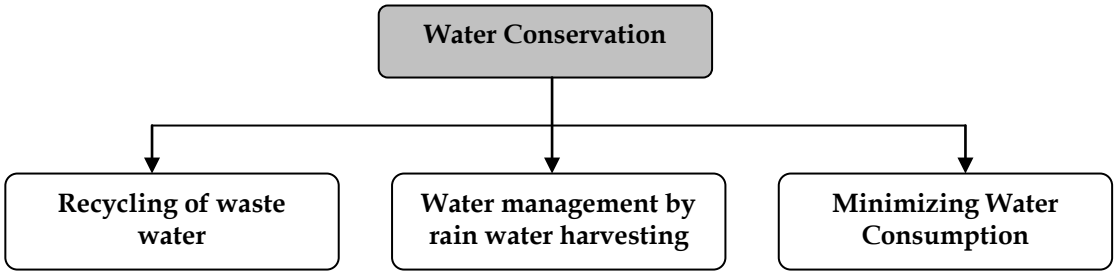


Fig. 5.2 Schematic of STP

5.5.8 Water Conservation and Development:

The water conservation plan will consist of a combination of three major steps depicted below:



Water conservation shall be practiced to the extent possible by use of reclaimed water for all non potable application like gardening, car washing, flushing toilets etc.

A. Recycling of Waste water

The total quantity of sewage that will be generated is 233 KLD and the same shall be treated in Sewage treatment Plants with capacities of 235 KLD The treated water from the STP will be used for flushing and gardening.

B. Minimizing Water Consumption

A combination of water saving appliances and water management measures will be planned in all the villas. Specific measures that will be implemented include the following:

C. Management Measures

- Reduce dependency on ground water by appropriate rainwater harvesting methods.
- Provision of STP.
- Reduce demand for fresh water by using treated water for landscaping & flushing.
- Recycling of swimming pool water.
- Drip irrigation system shall be used for the lawns and other green area (if necessary). Drip irrigation can save between 15-40% of the water use, compared with other watering techniques.
- Plants with similar water requirements shall be grouped on common zones to match precipitation heads and emitters.
- Use of low-volume, low-angle sprinklers for lawn areas.

5.5.9 Solid Waste Management:

Solid waste management is one of the most essential services for maintaining the quality of life in operation phase for ensuring better standards of health and sanitation. The solid waste shall be segregated as bio-degradable and non-biodegradable.

- Organic waste will be processed through Organic Waste Processor (OWP).
- Non biodegradable waste will be handed over to authorized recycler for further handling and disposal.
- Planned system for waste collection, segregation and disposal.

5.5.10 Management of Socio-economic Factors

Local people will be employed as far as possible to avoid migration of people from outside the study area for certain tasks.

5.5.11 Management of Traffic

During Operational Phase:

- The site will be directly connected to existing Radha Nagar road.
- There will be enough space for movements of vehicles and parking.
- Thus the traffic management on the project site will be easily and smoothly monitored without any hindrance to the regular flow of traffic on the main road.
- Only one entry with two separate gates, one for entry and one for exit, will be planned for the smooth moving of vehicles
- Adequate Ramp Feeds will be provided
- Flow of traffic is eased out by providing adequate entries and exits on surface parking areas.
- Entry and exit managed by security personnel who will also regulate traffic.

5.6 ADDITIONAL MITIGATION MEASURES

In addition to the above suggested measures for management of air, water, soil, traffic etc following additional measures shall be provided.

5.6.1 Human Health and Safety Management Plan

The objective is to ensure that the health and safety of on-site personnel is proactively managed during the construction stage of the project. Below are given

the proposed project related human health and safety environmental concerns and its management.

- The project would ensure safe potable water supply to the workers on site.
- Adequate space needs to be provided for construction of temporary sheds for construction workers to avoid unhygienic conditions.
- Construction site will be provided with a readily available first aid kit including an adequate supply of sterilized dressing materials and appliances.
- Suitable transport to take injured or sick person to the nearest hospital will be immediately provided.
- The project will ensure the safe working of all workers. Each construction worker will be provided with safety gadgets and made to wear during the construction work. This will include protective footwear, helmets, and hand gloves to all workers employed for the work on mixing, cement, lime mortars, concrete etc.; the welder's protective eye-shields to workers who are engaged in welding works; earplugs to workers exposed to loud noise; safety belts to the labours working at higher platforms; and masks to avoid dust.
- The project will strictly follow the statutory child labour act.
- The project will also ensure that no paint containing lead or lead products is used except in the form of paste or readymade paint.
- Face masks will be provided for use to the workers when paint is applied in the form of spray. Adequate safety measures will be ensured for workers during handling of materials at site.
- The project will comply with all regulations regarding safe scaffolding, ladders, working platforms, stairwells, excavations, and safe means of entry and exit.
- The project will take adequate precautions to prevent danger from electrical equipments.
- No material will be so stacked or placed as to cause danger or inconvenience to any person or the public.
- All necessary fencing and lights will be provided to protect the public.
- All machines to be used in the construction will conform to the relevant Indian Standard Codes, will be free from patent defect, will be kept in good working order, will be regularly inspected and properly maintained as per IS provision.

- Work spots will be maintained clean, and provided with optimum lighting.

5.6.2 Fire Safety and Protection

The proposed complex will be provided with adequate fire protection arrangements such as underground water storage tank. Main entrance to the complex shall be of adequate width to allow easy access to the fire fighting appliances. The proposed buildings shall be suitably compartmentalized so that fire/smoke remains confined to the area where fire incidents have occurred and does not spread to the remaining part of the building. The services, ESS standby generator, canteen, stores etc. must be segregated from other by erecting fire resisting wall of atleast 4 hrs rating.

Fire hydrant and sprinklers will also be provided. The portable fire extinguishers shall be provided at strategic locations. Automatic fire detection system i.e. smoke / heat detection system shall be provided in the buildings. The system shall be connected to the fire alarm system. An emergency intercommunication system shall be provided for the entire building. The control room / security room with communication system to all floors and facility for receiving messages from different floors shall be provided at entrance on ground floor.

5.6.3 Rain Water Harvesting Details Units Description

Run-off from the proposed project site is calculated using the rational formula.

A – Catchments area in Hectares.

C – Co-Efficient of Run-off.

I – Intensity of Rainfall in mm/hr

Q – Run-off in m^3/hr.

Table 5.1: Details of Catchment area Rainwater Harvesting

Sr. No.	Specification	Area (m2)	Run off Coefficient %	Rain fall intensity (mm)	Run off in m3/hr.
1	Roof top area	13500	0.95	501	6425
2	Paved area	10500	0.95	501	4902

3	Green area	157000	0.4	501	31462

Storage Tank details

1	No. of storage tank / recharge pit	Storage Tank capacities shall be as follows: 100 KL – 2 No's, 250 KL – 2 No's, 300 KL – 1 No.
2	Size of storage tank	100KL Tank size = 10M Length, 5M Breadth & 2M Liquid Depth; 250KL Tank size = 15M Length, 8.5M Breadth & 2M Liquid Depth; 300KL Tank size = 15M Length, 10M Breadth & 2M Liquid Depth

Assuming the intensity of rainfall to be 501mm

= 4278 m^3

= 11.88 m^3/sec

Roof water Collection Sump = 6425 m^3

- Rainwater from the Roof is led down through vertical leaders and connected to the Roof Water Collection sump through a separate network of pipelines of 160mm dia.
- Thereby conserving the regular fresh water source. The water from the roof after first rain is let out into the external storm water drain allowing the dirt and Contaminants to get cleansed and roof water from the second rain is let into the Raw Water sump. This water is further treated & stored in the Treated water tank.

5.6.4 Storm Water Management:

Storm water drainage system shall be provided to collect the surface water generated within the project site. Intensity of rainfall of 501mm shall be considered for design purpose of storm water drains.

Effective storm water drainage system has been proposed within the site. The storm water shall be channelized through storm water drains to storage tanks.

5.6.5 Energy Conservation

Energy conservation measures are often the easiest, quickest and cheapest way to reduce costs and be environmentally pro-active. Energy conservation program will be implemented through measures taken both on energy demand and supply. Energy conservation will be one of the focuses during the complex planning and operation stages. The conservation efforts would consist of the following:

A. Architectural design

- Natural ventilations will be provided.
- Maximize the use of natural lighting through design

B. Energy Saving Practices

Following are the methods proposed for the project achieving the same.

i. Most of the common area lighting is proposed to work on energy efficient lamps (CFL).

ii. Solar lightening has been proposed.

C. Solar Architectural Features

The proposed project will provide enough day light factors in the building to permit maximum day light to interior to minimize overall energy consumption. These features will also minimize the impact of climate both in summer and in winter and as a result, the use of electricity will likely to be reduced.

Other energy saving measures are:

i) LED and energy efficient CFL lamps have been considered in all rooms.

ii) Capacitors are used for PHE and fire fighting loads to reduce power demand of the system.

iii) External lighting, part of it shall be powered from Solar PV Cells

iv) Split units will be used for proposed for Air conditioning.

v) Hydro-pneumatic pumps are proposed for Water Supply System.

vi) Heat recovery from DG for Boilers.

vii) Variable refrigerant flow system for public areas.

viii) Solid waste disposal via vermiculture.

ix) Use of condensate of Laundry for water heating.

D. Energy Conservation Strategies for Air–conditioning & Ventilation System

a. High COP (Low IKW / TR) Water chilling machines & air cooled variable refrigerant flow system.
b. Energy efficient motors (EFF-1) for ventilation fan motors.
c. Selection of highly efficient fans for ventilation system. Fans shall be selected for 75% or more efficiency for higher rating. For smaller rating, fan shall be selected for efficiency around 60% to 70%.
d. Variable speed drive on large ventilation fans above 9000CFM. For smaller rating, DC motors shall be selected.

E. Energy Conservation Strategies for Plumbing system

a. VFD based hydro pneumatic system.
b. Efficient condensate return & recovery system.
c. Pumps & equipment selected on "best" energy efficiency point.
d. Use of low flow fixtures.
e. Use of treated water with BOD less than 10 ppm and COD less than 50 ppm from STP for HVAC cooling tower make up, flushing and irrigation.

5.6.6 Vehicle Parking and Management Plan

The layout plan of the proposed site has developed an internal road network. Entry points to the building have been worked out keeping in view the desired movement of vehicles. Parking facility will be provided in the project site for cars and two wheelers.

5.7 ENVIRONMENTAL MONITORING PLAN

Environmental monitoring of critical parameters is essential to assess the changes in environmental conditions, if any, during construction and operation of the project; to monitor the effective implementation of mitigation measures; and to suggest for any additional mitigation measures in case of significant deterioration of environmental quality.

A summary of the recommended measures or actions proposed with respect to the various envisaged impacts as a part of Environment Management Plan is given below in the table.

Table 5.2: Environmental Monitoring Plan during Construction Phase

Component	Parameters	Location	Frequency	Duration
Ambient Air Quality	PM_{10}, $PM_{2.5}$, SO_2, NOx,	3-4 locations with minimum 1 locations in upwind side	Once in a month	CPCB guidelines
Stack emissions	SPM, SO_2, NOx, CO, HC	DG sets, construction equipments	Once in a month	As per standard protocols of CPCB
Noise level	Noise day time and night time in dB (A)	2 to 4 locations representing different receptors/land use	Once every season	24 hour reading with a frequency of 10 minutes every hour
Water quality	Physico-chemical and biological characteristics	2-3 locations in and around the site	Once every season	One grab samples from each source
Soil Quality	Physico-chemical characteristics	At relevant locations	Once every season	Sample every season
Ecology	Monitoring of flora	At site	Periodically	--
Health	All relevant parameters	Work locations	Regular check ups	Every Month
Solid/ hazardous	Depending on type of	At the construction area	--	--

Component	Parameters	Location	Frequency	Duration
wastes	wastes			
Traffic Volume	Road Traffic volume, characteristics and speed	At the road leading to construction site	1 day hourly counts	One time

Table: 5.3 Environmental Monitoring Plan during Operation Phase

Component	Parameters	Location	Frequency	Duration
Ambient Air Quality	PM_{10}, $PM_{2.5}$, SO_2, NOx,	Minimum 3-4 locations with one on upwind side, two on downwind and one on lateral side.	Half yearly	CPCB guidelines
Stack emissions	SPM, SO2, NOx, CO,	DG stack	Quarterly	As per the recommendations of A&N PCC
Noise level	Day time & Night time noise in dB(A)	In and around the DG set	Quarterly	24 hour reading with a frequency of 10 minutes every hour
Water quality	Physico-chemical & biological parameters	3-4 locations in and around the site	Once in a season	One grab samples from each groundwater source

Component	Parameters	Location	Frequency	Duration
Waste Water quality	Physical-chemical & biological parameters	Inlet and outlet of each STP units	Quarterly	Composite flow-weighted sampling
Soil Quality	Physico-chemical characteristics	At relevant locations	Quarterly	Sample every season
Ecology	Survival rate of plantation	At locations of compensatory plantation and landscaping	Annually	For 3 years after operation starts
Health	All relevant parameters	Nearby area	Regular check ups	Every Month
Solid waste	Depending on type of wastes	Processed in OWP at project site and spent oil from DG set will be handed over to authorized vendor	--	--

Table 5.4: Environmental Management Plan Matrix

Sr. No.	Environmental Component	Potential Impacts	Potential source of Impact	Controls though EMP and Design	Impact Evaluation
1.	Water	Water contamination	**Construction Phase** Domestic waste water from workers	Septic tank will be provided and disposed into municipal sewer	No adverse impact
			Surface runoff from site.	Silt traps and diversion ditches will be constructed to control surface run off.	No adverse impact
			Operation phase Discharge of domestic wastewater.	Generated sewage will be transferred to STP for its treatment. Sewage Treatment Plant of 235 m^3/day capacity will be provided.	No adverse impact
			Surface runoff from site	Rain water harvesting will be done prevent runoff.	Positive impact

Sr. No.	Environmental Component	Potential Impacts	Potential source of Impact	Controls though EMP and Design	Impact Evaluation
2.	Air Quality	Dust Emission	**Construction Phase** Construction activities	• Dust mask will be provided to prevent worker exposure of dust. • Barricading the site periphery by tin sheets. • Sprinkling of water will be done for dust suppression.	Temporary & minor impact
		Particulate & gaseous emissions i.e. PM_{10} & $PM_{2.5}$, SO_2, NO_x	Site clearing, Excavation, Construction equipments and vehicular movement.	• Periodic maintenance of construction equipments will be done. • Heavy vehicle must be checked for PUC certificate.	Temporary & insignificant impact
		Particulate & gaseous emissions of SPM, SO_2, NO_x	**Operation Phase** DG Set	• Applicable height of stack will be maintained. Periodic maintenance of DG set & monitoring will be carried out.	No significant impact

Sr. No.	Environmental Component	Potential Impacts	Potential source of Impact	Controls though EMP and Design	Impact Evaluation
			Emissions from vehicular traffic.	• Adequate wide approach road is proposed for smooth vehicular movement. • Approach road side plantation will further act as sink to gaseous emission.	No significant impact
3.	Noise	Increase in noise level	**Construction Phase** Operation of construction equipments and vehicular movement.	Use of well-maintained equipment fitted with silencers.	No significant impact.
				Providing noise shields near the heavy construction operations.	
				Noisy operations will be limited to day time only.	
				Ear plug and muffs will be provided to workers.	
			Operation Phase	Wide road and ample parking space will be provided to reduce vehicular noise	No significant impact

Sr. No.	Environmental Component	Potential Impacts	Potential source of Impact	Controls though EMP and Design	Impact Evaluation
			Vehicles movement		
			D.G. sets operations	No significant noise pollution.	No impact.
4.	Land	Land contamination by construction debris and solid waste	**Construction Phase** Disposal of construction debris & solid waste.	• Construction debris will be collected and used for leveling the site. • Solid waste from labours use will be collected in collection bins and disposed off to approve municipal landfill site.	No significant impact.
			Excavated soil	Top soil will be used for landscaping	No significant impact.
			Metallic waste	Metallic waste will be sold to vendors for reprocessing	No significant Impact.
			Operation Phase Municipal solid waste like	Efficient solid waste collection and storage facility is proposed.	No significant impact

Sr. No.	Environmental Component	Potential Impacts	Potential source of Impact	Controls though EMP and Design	Impact Evaluation
			rubbish, paper, plastic garbage etc.	Segregation of waste as biodegradable and non biodegradable waste will be done. Biodegradable waste will be treated by vermin composting while non biodegradable waste will be given to approved vendors for disposal.	No significant impact
5.	Biodiversity	Impact on Flora & Fauna	**Construction Phase** • Site Development during construction activities	• Proper slope will be maintained • Phase wise plantation will be done • Boundary will be marked on both side of the stream to protect & conserve mangroves.	Minor impact
			Operational Phase • Increase of green cover	• Suitable green belt will be developed as per landscaping plan at site.	Positive impact

Sr. No.	Environmental Component	Potential Impacts	Potential source of Impact	Controls though EMP and Design	Impact Evaluation
6.	**Traffic Pattern**	Increase of vehicular movements	**Construction Phase** • Heavy Vehicular movement at site	• Heavy Vehicular movement will be restricted to daytime only and adequate parking facility will be provided.	Minor impact
			Operational Phase • Traffic due to commercial once the site is operational	• Vehicular movement will be regulated inside the site with adequate roads and parking.	Insignificant impact
7.	**Socio-Economic**	Increase in Job opportunities	**Construction Phase** • Infrastructure development	--	Positive impact

5.8 COST ESTIMATES

An effective Environmental Monitoring Plan (EMP) is proposed during the construction phase and operational phase of the project to conserve the environment at site. The details of EMP are as under.

Table 5.5: Budgetary Provision for EMP during Construction Phase

SR. NO.	PARAMETER	TOTAL COST (IN LAKHS)
1	Pollution Control Measures (water Spraying using Tankers, Noise shields around periphery of DG set etc)	3
2	Site Sanitation Facility (Soak pit, Vermicomposting)	10
3	Safety Measures (PPE like helmets, ear plugs, safety shoes etc.)	3
4	Environmental Monitoring (Monthly monitoring for air, water, noise)	10
5	Green Belt Development	2
6	Health Check Up	3.5
7	Fire Management	5
8	Solid Waste Management (Vermicomposting)	5
9	EHS Training Programs	1.5
	TOTAL COST	43

Table no. 5.6 Budgetary provision for EMP during Operation Phase

SR. NO.	Parameter	Capital Cost (in lakhs)	Operational & Maintainace Cost (in lakhs per annum)
1	STP cost	35	5
2	Pollution control measures (Muffler in DG set)	2	0.5
3	Environmental monitoring (for air, water, waste water, soil, DG stack, noise etc. by third party)	…..	6.5
4	Gardening	15	2
5	Solid waste management	20	2
6	EHS training	…	2
7	Others	10	2
	Total cost	82	20

The Environmental Management Plan shall be effectively implemented so that optimum benefit could be achieved. The Environmental Management and Monitoring Plan shall be synchronized with the construction schedules.

5.9 FINDINGS

From the foregoing sections it is clear that environmental considerations were foremost during development of the project, at all the following levels:

- Project siting
- Planning and design
- Project construction
- Post project operations

The following findings are to be mentioned:

- The Project will have no significant environmental impacts during construction and operations
- Project risks will be minimized through rigorous enforcement of design and operational standards.
- The environmental and safety aspects of the Project are straight forward and well understood.

The EMP also provides for establishing, and maintaining a system of environmental monitoring to ensure strict compliance of all the measures identified in the EMP, and minimize adverse environmental and social impacts. Suitable provisions related to environmental management will also be made in the construction contract agreement.

5.10 CONCLUSION

The project may cause minor impacts only during construction phase due to the various activities involved during that phase. However, strict adherence to the various mitigate measures as identified under the EMP, strengthened by adequate environmental monitoring using best available technology (BAT) and auditing and good construction practices, including the special construction methods as prescribed, will go a long way in effectively reducing the impacts as to negligible level.

During operation phase of the project, none of the routine activities will cause any noticeable impact on any component of the environment, including the socio-economic component. Provision of green belt and rain water harvesting, storm water management and energy conservation shall further facilitate in overall scenario management of Environment.

Thus, it can be concluded on a positive note that after the implementation of the mitigation measures and Environmental Management Plan, the proposed project shall have negligible impact on environment and will benefit the local people and economy.

CHAPTER 6

Risk Assessment & Disaster Management Plan

6.0 INTRODUCTION

Hazard analysis involves the identification and quantification and various probable hazards (unsafe conditions) that may occur at the proposed project. On the other hand, risk analysis deals with the identification and quantification of risks, the equipment/ facilities and personnel exposed to, due to accidents resulting from the hazards present at the proposed project area. Disaster Management Plan helps to prevent disaster. The purpose of DMP is –

- Minimize the risk occurrence (Prevention).
- Rapidly contain Emergency (Emergency response).
- Effectively rehabilitate damaged areas (Restoration).

The proposed project site may be associated with following risks. The risks may be of the following types:

I) Water and Climate related risk:

II) Geology related risk:

III) Accident related risk:

IV) Epidemic related risk:

I. Water & Climate related Hazard

i) Flood: The proposed project site may be prone to flood as the island is in earth quake zone-V and probability of tsunami is high. Also the area receives vary annual rainfall. So no construction should be carried out in the hazard line.

ii) Cyclone: Effects of Cyclone & tidal Surge may occur at site as it is near to sea. At the onset of monsoon, the islands are affected but usually not seriously by the cyclonic weather I the Bay of Bengal. On an average 2-3 tropical cyclones form every year, of which one or two could be severe. Andaman & Nicobar islands are classified as Moderate Damage Risk Zone A. The basic wind speeds are applicable to 10 meters heights above the mean ground level in an open terrain cyclone seldom parts over the islands, though most of them form in Andaman Sea.

II. Geology related Hazard:

Geological formation is mainly intrusion of basic and ultra basic igneous rock. Havelock is sub divided into two main physiological formations. (i) Low lying plain land and coastal plains, (ii) Moderate to high hills ranging in altitude from nearly 20m to 80 m from the mean sea level. Havelock Island is underlaying by

Miocene limestone which is generally fractured and cavernous. The low lying areas and the coastal tracts are covered by coralline limestone which are highly porous and form potential aquifers in the sub surface.

i) Earth quake- Geologically it is very unstable and falls in earth quake zone -V.
ii) Tsunami: Tsunami may frequently occur as it falls in seismic zone – V.

III. Accident related Hazard:
Accidents may be more prevalent during construction phase only. As suitable precautionary safety measures will be taken as discussed in previous chapter, there will be least accident related risks.

- Fire and / or explosion ;
- Leakage of flammable material and catching fire;

IV. Epidemics: As per the primary data of the study, no epidemic occurred in Havelock island for last 50 years.

V. **Other incidents, which can also result in a disaster, are;**

- Agitation / forced entry by external group of people and;

Emergency prevention through good design, operation maintenance and inspection are essential to reduce the probability of occurrence and Consequential effect of such eventualities. However, it is not possible to totally eliminate such eventualities and random failures of equipment or human errors, omissions and unsafe acts cannot be ruled out. An essential part of major hazard control has therefore, to be concerned with mitigation the effects of such Emergency and restoration to normalcy at the earliest.

The overall **objective** of a disaster management plan is making use of the combined resources at the site and outside services to achieve the following:

- To localize the emergency and if possible eliminate it;
- To minimize the effects of the accidents on people and property;
- Effect the rescue and medical treatment of casualties;
- Safeguard other people;
- Evacuate people to safe areas;
- Informing and collaborating with statutory authorities;

- Provide authoritative information to news media;
- Initially contain ultimately bring the incident under control;
- Preserve relevant records and equipment for the subsequent enquiry in to the cause and circumstances of the emergency and
- Investigating and taking steps to prevent reoccurrence

It is increasingly acknowledged by safety authorities, that the use of curtain walls (versus traditional wall construction) in building structures adds to the risk of fire. Filler material used in curtain walls is often not adequately fire-resistant, allowing the quick spread of fire throughout a structure.

The DMP has therefore to be related to the identification of various hazards is addressed qualitatively , which gives a broad identification of risks involved in the project operation. Based on the risk assessment of various hazards, disaster management plan has been formulated and presented here.

6.1 STORAGE OF HAZARDOUS MATERIALS

The proposed project envisages storages of kerosene, diesel & liquefied petroleum gas (LPG) in kitchens for residential house. It is to be noted here that above material will not be stored in the bulk quantities. The kerosene may be stored in carboys and the LPG will be obtained in cylinders supplied by the local dealer.

6.2 PRELIMINARY HAZARD ANALYSIS (PHA) DURING CONSTRUCTION & OPERATION PHASE

A preliminary hazard analysis is carried out identifying the major hazards associated which the functioning of proposed project. The major aspects are described below in Table 6.1:

Table 6.1: Preliminary Hazard Analysis for the Whole project in General

Equipment / activity	Process	Potential hazard	Provision
Power Transmission from DG sets	-	Fire and explosion	All electrical fittings and cables are provided as per the specified standards. Fire Detection and Protection System are to be provided.

Equipment / activity	Process	Potential hazard	Provision
DG	Converts mechanical energy into electrical energy.	Mechanical hazards and fire Hazards in 1.Lube Oil System 2. Cable Galleries 3. Short Circuits	All electrical fitting and cables are provided as per the specified standards. Fire Detection Alarm System - House it in safe place.
Switch Yard	For substations	Fire	All electrical fittings and cables are provided as per the specified standards. Fire Detection and Protection System are to be provided.
Switch Yard control room	-	Fire in cable galleries and switch	All electrical fittings and cables are provided as per the specified standards. Fire Detection and Protection System are to be provided.
Use of LPG Cylinder	Used in mainly in Kitchen	Fire and explosion due to leakage	LPG Cylinder shall be stored away from any fire hazards

6.3 EMERGENCY PREPAREDNESS PLAN (EPP)

The project faces the threat of disaster from internal and external sources. They could be natural or man-made, technological or political. Disasters could be accidental or intentional. Such disasters could be controllable or those beyond the organizations control. Disasters could strike with or could come with no prior warnings.

Mitigation addresses the positioning of those measures and activities that will lessen the possibilities or the impact of an adverse incident occurring in the organization

6.3.1 Objective

The objective of Emergency Preparedness Plan is to put contingency systems in place to handle emergencies with minimum damage to life, property and environment.

6.3.2 Disaster Response Team

A Disaster Response Team at site will be organized during construction and operation phase of the project.

During construction phase it will have Project manager and as the nodal officer for DMP and will be assisted by Deputy Project Manger. Early warning system will be displayed on the board and aware of calamities / risk & disasters to workers and nearby local people. Standard SOP will be in place to mitigate risks & disasters.

During operation phase, it will have the General Manager, Security Manager, Chief engineer, maintenance Manager, Front Office Manager, Housekeeping Manager, all assistant managers & Supervisors. They will be given specified duties (mentioned below) and meet regularly to review the situation in the Hotel.

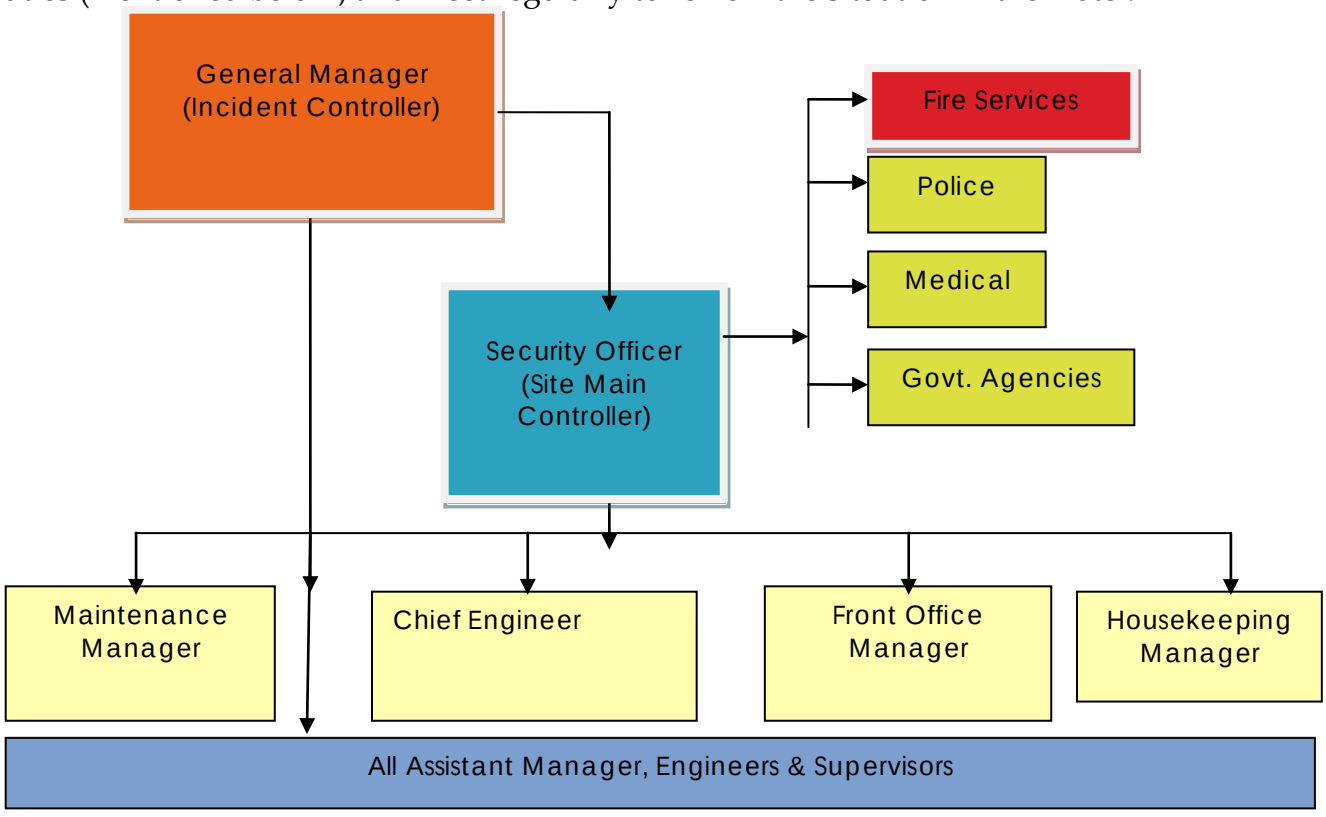


Fig 6.1: Disaster Response Team

6.3.3 Duties of the Disaster Response Team

The duties of the Disaster Response Team are multifarious:

- declaring emergencies and implementing the emergency plan;
- implementing evacuation procedures;
- contacting emergency services (fire, police, ambulance) and other utilities;
- establishing a command post, chain-of-command and reporting procedures;
- accessing and stabilizing the environment;
- assessing and obtaining emergency services, supplies and equipment;
- ensuring the safety of guest, staff and volunteers at all times during an emergency;
- arranging for off-site storage and work facilities;
- arranging the transfer of collections to a safe site;
- recording the movement of collections;
- implementing and supervising salvage procedures for collections;
- contacting, deploying and supervising building staff;
- contacting, training and supervising volunteers;
- preparing post-emergency reports.

6.3.4 Emergency Plan

I. Authority Statement

The General Manager is vested with the authority to declare a state of emergency and to make appropriate use of whatever resources are necessary.

II. Policy Statement

During a disaster, the hotel building declares its priorities to be:

1. Protection of life;
2. Protection, recovery and stabilization of the property & collection.

III. General Instructions

1. Wherever necessary, visible emergency exit signs (Radium) will be posted clearly.
2. On hearing an alarm or information from staff, all persons shall evacuate the building.
3. Copies of the emergency plan should be readily available to the disaster response team.
4. The hotel blueprints (layout plan) with detailed evacuation plan i.e. exit points, Refuge areas and assembly points will be readily displayed at each floor villa for occupants

5. The Disaster Response Team has authority in all practical matters for the duration of the emergency.

Table 6.2: List of Important offices for Emergency

Emergency Services	Name
Fire Service	Fire Station, Jetty Havelock
Police	Police Station, Jetty havelock
Ambulance	Primary Health Centre, Govinda Nagar
Hospital	Primary Health Centre, Govinda Nagar
Public work Department	A&N CPWD

6.3.5 Emergencies

The emergency preparedness for various kinds of disaster is mentioned below:

A. Fire

- ★ Portable fire extinguishers are proposed to be placed at strategic locations such as Sprinklers, Dry Chemical Powder etc.
- ★ Fire Escape Mask shall be provided.
- ★ Fire detection system will be installed.
- ★ Fire fighting tank i.e. underground water storage tank having a capacity of 1KL.
- ★ Fire alarm system and Public address system will be provided for the entire villas.
- ★ Common areas & parking areas shall be protected with automatic sprinkler and smoke detector system.
- ★ Adequate and proper Entry/Exit fluorescent signage (green colour) shall be provided.

Leakage from LPG cylinder without fire:

1. Open all windows to increase ventilation and hence prevent build up of vapor cloud.
2. Avoid getting entrapped in cloud vapor.
3. Water sprays should be used to disperse the vapor cloud.
4. Warn the surrounding areas to put off all naked flames.
5. **SOP for Fire Fighting**

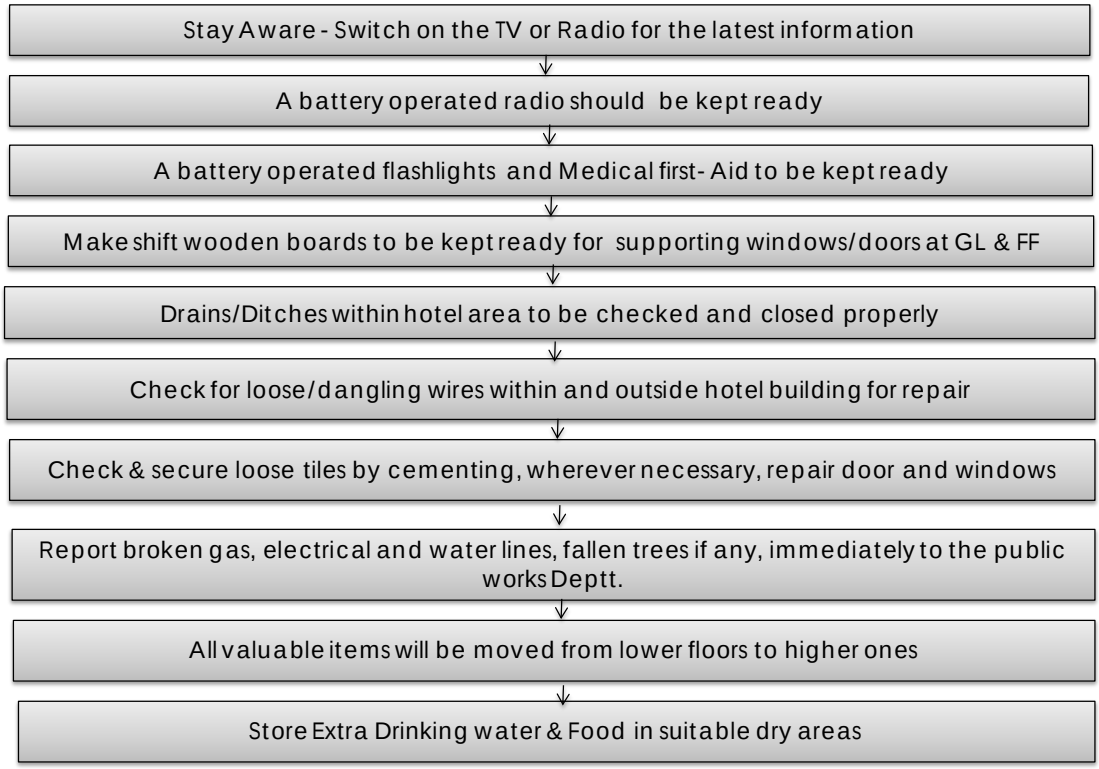
   i) Raise emergency alarm and communicate to DMP team regarding extent of emergency

ii) Trained staff to rush and attempt extinguish source of fire (small fire). Call fire tender vehicles (in case major fire)
iii) Evacuate the guests/other people through emergency exits routes to safe assembly point.
iv) Main power should be shut off.
v) Call for ambulance (victims transported to professional medical help immediately)

B. Floods, cyclones & lightning

1. The site shall be provided with good drainage systems to prevent entry of water into the buildings
2. Storm water drains shall be well designed and are adequate for the anticipated peak capacity
3. Storm water drains and sewage systems shall empty out in areas meant for drainage.
4. The return path for the discharge of a lightning strike is separate from that of power earthing pits. The earthing pits and material used for lightening discharge meet the respecting standards.
5. Suitable lightning discharge tubes shall be installed to prevent damage by lightning to voice communication systems.

DURING A FLOOD WATCH – Instructions To Hotel DMP Team



C. Earthquakes, Building Collapse & Accidents

1. In earthquake prone areas, construction material used in building is as recommended by experts.
2. Buildings are designed such that damage in case of earthquake would be minimal.
3. All construction shall be as per the advice / design of architects and engineers of repute.

Following provisions will be done in the hotel to negate the effects of earthquake:

1. Structural Design of building will be as per Indian Standard Codes of Practice to render the buildings safety and stability

- IS – 1893 – 2002 – Criteria for Earthquake Resistant Design of Structure
- IS – 875 – 1987 – Code of Practice for Design Loads
- IS – 456 – 2000 – Code of Practice for Plain & Reinforced Concrete Structure

2. UPS SYSTEM: During Earthquake there are chances of power supply failure hence centralized UPS equipment shall be planned for common area emergency lighting and some critical loads which shall be capable of providing uninterrupted power during changeover period of city power to DG power. UPS will guide to exit during power failure. The duration will be of 30 minutes

3. EMERGENCY ANNOUNCEMENT SYSTEM:
   All process areas shall be provided with dual tone hooters and strobe lights of 110 Cd rating. All hooters and lights shall be linked to Fire Alarm System. Source equipment shall be microphones for public address. Additionally message / alarm tone generators shall be used for emergency call/ evacuation
4. SIGNAGE: Radium signage for evacuation will be provided at all floors

A general chart shall be displayed at each floor for hotel guests:

Once you feel tremors/shaking, don't panic and stay calm

↓

Cover under a nearest sturdy table, desk, bed or Kitchen table, don't run

↓

Brace yourself inside a corner or interior wall away from windows;

↓

Cover head with pillows/hands

↓

Once shaking stops, immediately vacate the building through staircase

↓

Don't forget about aftershocks

SOP for DMP Team

Once tremors are felt, Shut off the Gas, power, Water supply immediately

10.

Inform Staff to evacuate occupants once the shaking has stopped

11.

Call emergency services, as appropriate, and then give first aid as necessary

12.

Put out small fires quickly if this can be done without endangering personnel

13.

Clean up flammable liquid spills immediately, if any

14.

Inspect and repair the building for damage that may have occurred

DURING A FLOOD WATCH – Instructions To Hotel Guests

Stay aware – tune in to All India Radio or Television

Avoid being misled by rumors

stay away from low lying beaches or areas

If near low lying area/rivers/beach/ streams, immediately move to safer areas

Stay away from drains and ditches

Avoid food/water from outside

Leave sufficiently, before in time to hotel to avoid the risk of being marooned by flooded roads

If unable to reach hotel in time, head to safe public shelter areas , call & wait for help from authorities

If advised to evacuate, do so immediately

DURING A FLOOD – Emergency Declared

Turn off all utilities at the main switch and close the main gas valve

↓

Guide the visitors to assemble at the assembly point at higher floors and the head count will be done

↓

DG room to be closed and power supply to be shut off

↓

To protect and safeguard guests, provide food & drinking water and relief material

↓

To provide first aid , if required

↓

Keep Calm and follow the instructions given by DMP in- charge

Post Flood/ Cyclone Measures

After a cyclone passes, remain inside until informed to move/return home

↓

Inform relatives promptly

↓

Avoid any loose and dangling wire from the lamp poll/ electricity polls

↓

Keep away from disaster area

↓

Clear the debris, if any

↓

The losses should be reported to the appropriate authorities

↓

Antisocial elements if any should be prevented from doing mischief and reported to the police

↓

Buses, Lorries and Carts should be driven carefully

Terrorist Attack – SOP for Hotel DMP Team

Screen the guests/visitors at all the entrance

↓

Screening of the baggages through x – ray machines at all the entrances

↓

CCTV camera to keep images of all Entrances, Exits & Lobbies

↓

In case of breach in security and terrorist attack, guests to be safeguarded and evacuated to safer place, if possible

↓

Keep all helpline numbers such as numbers of hospitals, blood banks, police stations, etc. handy.

↓

Stay Aware - Switch on the TV or Radio for the latest information

provide first aid, CPR, if required

Terrorist Attack – SOP To Hotel Guest

Stay Aware - Switch on the TV or Radio for the latest information

↓

Stay Cool - Avoid being misled by rumors

↓

Keep mobile phone charged and make sure that you will not run out of balance on such tricky situation.

↓

In case, you hear firing inside hotel, stay inside your room, lock the room , sit silent and wait till the way is clear to be evacuated

↓

Inform relatives and friends and ask them to stay back home.

↓

If you see any suspicious stuff, inform hotel staff immediately

6.3.6 Medical

When a disaster strikes timely medical help and assistance would make the difference between life and death to an employee. A disaster preparedness plan in this regards shall be put in place as follows:

- A first aid kit is provided at adequate locations.
- It is possible to call on medical assistance from a nearby hospital.

The following additional steps shall be taken in this area:

- Availability of doctor on call on a 24-hours basis.
- Ambulance on need basis.

6.3.7 Voice Communication

Voice and data communication is highly critical during any emergency. Any disruption in voice or data communication would result in major crises.

- Connectivity is in cyclic loops, which provides for redundancy in networking. Depending on the magnitude of the disaster, this cyclic loop will be helpful in communicating to the external world.
- A highly efficient support from vendors and service providers is ensured.
- Efforts are made to provide 100% uptime for communication.
- The best possible technology is used to provide accessibility for voice communication including voice mail service, auto attendant facility etc.
- All efforts have been made to ensure that the communication network has been installed with every precaution to prevent damage by any disaster including lighting, floods or cyclones, etc.
- The communication lines are protected. The protection is meant to protect against fire and human shock hazard and is enough to protect sensitive electronics.

- Ongoing maintenance / service once the protectors are installed and the system is properly bonded and grounded, all equipment are being protected. This is done periodically.
- Security personnel of the company are networked with separate channels of frequencies on radio network within city. This communication option also offers redundancy in the eventuality off the EPABX system shutting down for any reason, at least for critical functions.

6.3.8 Visitor Handling

The numbers of visitors including security and organizers, who shall visit, are required to comply with rules pertaining to checking.

6.3.9 Evacuation and Exit Plan

- Will have at least 2 evacuation exits from every location inside the resort.
- An exit will be separated by fire resistant materials.
- The speedy & orderly evacuation of the building occupants in event of any five hazard or terrorist attacks etc. are of paramount importance. Speedy & safe evacuation needs to be addressed with utmost care & sensitivity towards able bodied as well as disabled occupants.
- The floor plans & location of assembly areas are proposed on basis of the fire safety regulations & guidelines as prescribed by fire department.

6.3.10 Fire Protection System

A full-fledged Fire Protection System will be installed as per the direction of Fire Officer of Havelock Island. Following provisions will be done in the building:

- Underground fire water storage tank for sprinkling.
- Automatic sprinklers system , Fire pump, booster pump, sprinkler pump & jockey pump , Standby Pump , External Hydrants, Alternate Source of power supply, Portable fire extinguishers, Portable Fire extinguishers of all types, Smoke & fire Detectors, Automatic & manually operated alarms, Automatic Sprinklers, Fire alarm system, Public Address system, Fire escape masks, Escape route from flat to staircase floors.

6.3.11 Post – Emergency Waste Disposal

- All cases of fire occurrence, no matter how small, must be reported promptly to the coordinator for follow up.
- Under no circumstances should fire extinguishing equipment once used be returned to the fixed location before it is recharged or replaced.
- Solid waste generated during an emergency shall be segregated and disposal as per the waste management chart.

6.3.12 Response Sequence for Dangerous Situations

Person noticing the fire should attempt to isolate and extinguish the fire with the available equipment and inform or arrange to inform the security regarding the following:

- Location of the fire
- What is burning
- The Extent of fire
- Callers name and number
- Do not disconnect unless the person on the other side repeats the message or acknowledges it.
- Security on duty or coordinators
- Respond to the scene of the incident
- Extinguish the fire with the available equipment.
- Arrange to send the necessary firefighting equipment to the location of the incident

6.3.13 Assembly points

Assembly points shall be marked & display on the site & ensure that all the persons of the affected area shall de-instruct to go to respective assembly points.

6.3.14 Response Evaluation, Testing & Updating of the Plan

Formulation of a Disaster Management Plan cannot possibly be an end by itself. It needs to be tested by holding of periodical mock emergency simulation and drill. Any shortcomings reveled during such exercise should thereafter be corrected by amending the plan. The plan should be for times to come; hence it must be reviewed at periodic intervals.

The plan should be also reviewed and updated when:

- Major alteration or extension of existing structure is carried out.
- Major change in habitation or land use of the neighborhood takes place.
- Important telephone numbers used are altered.

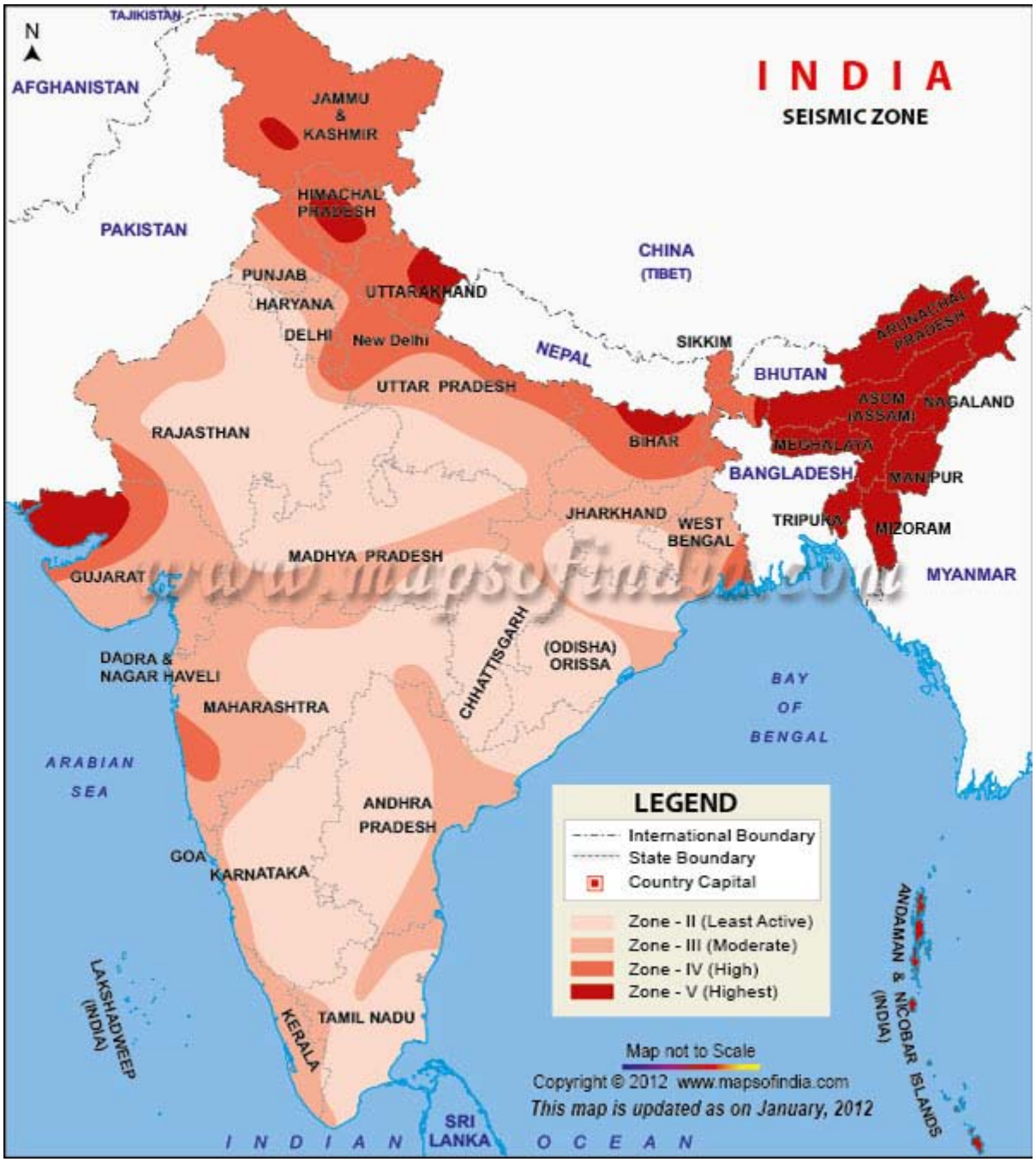


Fig. 6.2: Seismic map of India

CHAPTER – 7

DISCLOSURE OF CONSULTANT

7.0 GENERAL INFORMATION

Name of organization	:	Green Circle Inc.
Address	:	Green Empire (Anupushpam Habitat Centre) Above Axis bank, Near Yash Complex, Gotri Road, Vadodara - 390021 (Gujarat)
Telephone Nos	:	+91-265-2371269 +91-265-2371028 +91-9998036028
Fax	:	+91-265-2371269
Email	:	info@greencircleinc.com , gccipl@rediffmail.com

7.1 VISION

We shall ensure quality, reliability and continuous technology up gradation thereby enhancing the value of stakeholders. We should inspire others to create pollution free world in order to achieve sustainable growth.

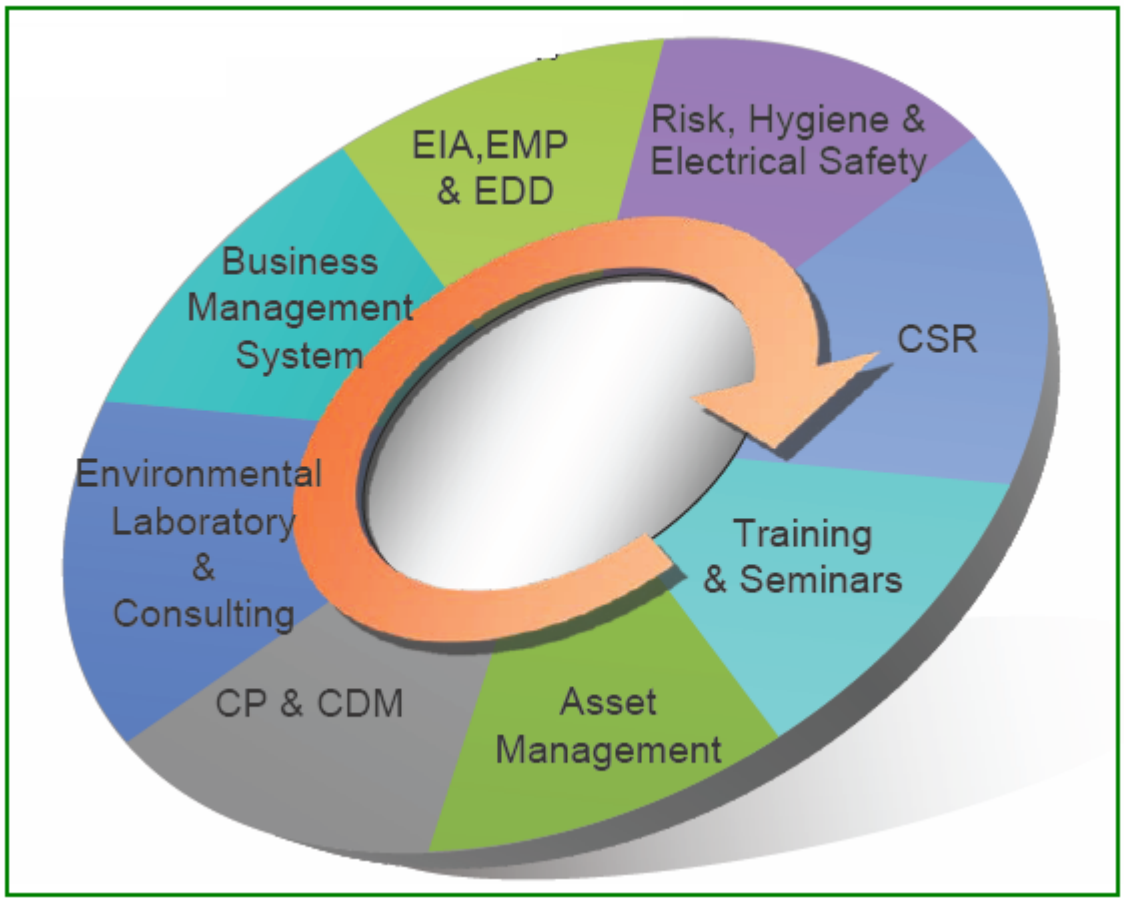
7.2 MISSION

Our mission is to become one stop consultancy for all kind of services in the field of environment, health, Safety and risk by providing optimal solutions and to strengthen our position by adopting and evolving best practices and principles. We strive to give our customer highest level of satisfaction based upon a commitment to serve, an understanding of their needs and goals, and a demonstrated ability to produce results.

7.3 APPROVALS & ACCREDATATIONS

- MoEF (Ministry of Environment & Forest) Recognized & Gazetted Laboratory with Field Monitoring Facility.
- Recognized by Ministry of Environment & Forest, New Delhi under EPA 1986
- GPCB Approved Schedule II Environmental Auditor.
- ISO 9001:2008, 14001: 2004 & OHSAS 18001 Certified organization. Currently NABL, ISO 17025 & BIS system implementation &certification process is in progress.
- Provisionally Accredited by QCI-NABET on 89th AC meeting dated 17.10.2012

7.4 ACTIVITIES



7.5 EIA TEAM

The EIA team engaged in the preparation of EIA report consists of professionals with multidisciplinary skills and experience required for undertaking this project. The EIA involved in various stages of planning to final report preparation is given below in table 7.1.

Table 7.1: EIA TEAM MEMBERS

S/No.	Person Name	Qualification	Key Responsibility Area	Experience (Years)
1	Mr. Pradeep Joshi	M.Sc. (Env. Sc) Industrial Engineer	Team leader	25
2	Mrs. Jassica Caria	M.Sc., PhD (GIS & RS)	Land use preparation	9
3	Mr. Anand Shirsat	BE (Chemical Eng.)	Report finalization	8
4	Dr. Sandeep Sohani	M.Sc. Ph.D (Ecology)	Ecologist	7
5	Mr. Pravin Shinde	M.Sc. (Marine Sc.)	Report preparation	6
6	Mrs. Ridhdhi Pandya	M.Sc. (Env. Sc.)	Laboratory analysis	5
7	Mrs. Kundan Ajudiya	BE (Chemical Eng.)	Report Preparation	5
8	Mr. Raghav Soni	M.Sc. (Env. Sc)	Report Preparation & Monitoring	5
9	Priyanka Pandey	M.Sc. (Biochemistry)	Laboratory analysis	5
10	Mr. Shailendra Singh	M.Sc. M.Phil. (Env. Sc)	Air and Noise Monitoring	5
11	Mr. Ranjit Kalita	M.Sc. M. Phil. (Env. Sc)	Report Preparation	3
12	Ms. Stuti Patel	M.Sc. (Env. Sc & Tech.)	Report Preparation	1.5
13	Mr. Markendaya Tiwari	BE (Biotechnology), ME (Env. Eng.)	Monitoring & Report Preparation	1

ANNEXURE – I

Ambient Air Analysis Result of 3 months study period

S. No.	Date	PM10 (µg/m³)	PM2.5 (µg/m³)	SO2 (µg/m³)	NO2 (µg/m³)
		Project Site			
1	02.03.2012	35	20.5	6.3	8.1
2	05.03.2012	32.5	26.5	6.2	8.6
3	09.03.2012	31.8	28.3	6.5	7.3
4	12.03.2012	36	28.5	6.2	9.5
5	16.03.2012	36.2	24.5	6.1	7.1
6	19.03.2012	35.5	20	6.3	9.5
7	23.03.2012	33.5	20.3	6.5	10.5
8	26.03.2013	40.1	21.3	6.7	9.7
9	30.03.2013	36.5	22	6.5	8.9
10	02.04.2012	38.5	25.5	6.3	10
11	06.04.2012	39.4	24.5	6.8	9.5
12	09.04.2012	35	23.5	6.3	8.5
13	16.04.2012	32.6	23.5	6.5	9.5
14	05.04.2012	31.6	25.5	6.4	7.8
15	20.04.2012	37	26	7	6.8
16	23.04.2012	35.4	24.5	6	7.7
17	27.04.2012	38	24	5.8	7.8
18	30.04.2012	36.8	23	6.8	8.8
19	04.04.2012	36.2	24.6	6	8.5
20	07.04.2012	39	22.5	6.2	8.5
21	11.04.2012	38.5	23.4	6.1	8.4
22	14.04.2012	38	25.2	6.4	9.5
23	18.04.2012	34.5	24.5	5.8	8.8
24	21.04.2012	36.5	24	5.5	9.5
	Mean	**36.0042**	**24.0042**	**6.3**	**8.7**
	Max	40.1	28.5	7	10.5
	Min	31.6	20	5.5	6.8
		Market, Govinda nagar			
1	03.03.2012	48	26.5	6.8	9.4
2	06.03.2012	50	26	6.5	9.5
3	10.03.2012	50.5	27	7	9.3
4	13.03.2012	40.6	24	7.5	9.6
5	17.03.2012	41.2	25.6	6.5	8.5

S. No.	Date	PM10 (µg/m³)	PM2.5 (µg/m³)	SO2 (µg/m³)	NO2 (µg/m³)
6	20.03.2012	52	23.5	6.7	10.5
7	24.03.2012	44.5	27.5	7.2	10
8	27.03.2012	53	27	6.8	9.4
9	31.03.2012	48.6	29.5	6.5	8.6
10	03.04.2012	52.6	30	5.8	9.5
11	07.04.2012	52	25	6.8	8.5
12	10.04.2012	55	24.5	5.5	8.6
13	14.04.2012	48.6	23.4	5.6	9.8
14	17.04.2012	47.5	22.5	6.8	9.5
15	21.04.2012	40.5	27.5	7.5	9.4
16	24.04.2012	43.8	29.4	7.6	9.3
17	28.04.2012	45.6	29	7.7	11
18	03.05.2012	48	28.5	7.5	10.5
19	07.05.2012	45.8	26	6.8	8.2
20	10.05.2012	49	25.5	6.7	7.5
21	14.05.2012	47.8	26.5	6.9	12
22	17.05.2012	48.5	24.5	6.8	7.8
23	21.05.2012	46.2	23.5	6.8	9.4
24	24.05.2012	52.8	22	6.9	9.8
	Mean	**48.0042**	**26.0167**	**6.8**	**9.4**
	Max	55	30	7.7	12
	Min	40.5	22	5.5	7.5
		Bijay nagar			
1	04.03.2012	38	27	5.3	9
2	07.03.2012	35.5	28	5.1	9.5
3	11.03.2012	39	25.6	4.5	10.5
4	14.03.2012	35	28	4.6	10.3
5	18.03.2012	42	27	5.5	8.5
6	21.03.2012	42.5	28	5.6	8.6
7	25.03.2012	35	27	5.4	7.8
8	28.03.2012	40.2	26.5	5.8	9
9	01.04.2012	38	28.7	6	9.2
10	04.04.2012	42	30	5.5	9
11	08.04.2012	43	26	5.3	9.5
12	11.04.2012	36	28.5	5.4	8.5
13	15.04.2012	45	27.5	5.3	9
14	18.04.2012	43.6	25.3	5.2	10.2
15	22.04.2012	36	27	5.1	8.5

S. No.	Date	PM10 (µg/m³)	PM2.5 (µg/m³)	SO2 (µg/m³)	NO2 (µg/m³)
16	25.04.2012	36.2	25	4.8	7.5
17	29.04.2012	35.5	27	4.7	7.6
18	02.05.2012	34.5	26.5	5.8	8
19	06.05.2012	33.5	25	5.3	9.5
20	09.05.2012	36	26	5.2	10
21	13.05.2012	34	27.6	5.3	8.6
22	16.05.2012	35	26.5	5.5	9.5
23	20.05.2012	38.6	25	5.8	8.4
24	23.05.2012	38	29.5	5.2	10
	Mean	38.0042	27.0083	5.3	9.008333
	Max	45	30	6	10.5
	Min	33.5	25	4.5	7.5
Water Tank, Radha nagar					
1	02.03.12	32	22	5.8	8.2
2	06.03.2012	33	21	5.2	7.5
3	10.03.2012	33.5	22	6.5	8.5
4	13.03.2012	28	22.5	5.6	8.5
5	17.03.2012	32	25	5.8	9
6	20.03.2012	32.5	21	4.8	6.2
7	24.03.2012	31.5	22.3	6.5	6.5
8	27.03.2012	32	24.5	6.2	10.5
9	31.03.2012	28	24	7.5	10
10	03.04.2012	34	19	6.3	8.5
11	07.04.2012	29	19.5	5.8	12
12	10.04.2012	33.5	22.1	5.7	8.2
13	14.04.2012	32	25	5.8	8.3
14	17.04.2012	30	24	5.9	8
15	21.04.2012	35	25	6.2	8.6
16	24.04.2012	32	19.5	5.2	7.5
17	28.04.2012	32.5	18.5	5.6	7.6
18	01.05.2012	34	19.5	7.5	8.2
19	05.05.2012	31.2	19.2	6.2	8.2
20	08.05.2012	32	20	5.2	6.3
21	12.05.2012	30	20.5	4.2	6.2
22	15.05.2012	33	24	4.5	8.2
23	19.05.2012	34	23	5.4	5
24	22.05.2012	33.5	25	5.8	11.1
	Mean	32.0083	22.0042	5.8	8.2

S. No.	Date	PM10 (µg/m³)	PM2.5 (µg/m³)	SO2 (µg/m³)	NO2 (µg/m³)
	Max	35	25	7.5	12
	Min	28	18.5	4.2	5
			NRHM Krishna nagar		
1	04.03.2012	38	22	6.7	9.6
2	07.03.2012	45	20	8.5	13
3	11.03.2012	33.5	23	6.5	8.5
4	14.03.2012	28	22.5	5.6	12
5	18.03.2012	44.4	25	8	10
6	21.03.2012	32.5	21	4.8	6.2
7	25.03.2012	36	22.3	6.5	9.6
8	28.03.2012	34.3	24.5	10.2	10.5
9	01.04.2012	44.5	25	7.5	10
10	04.04.2012	34	19	6.3	8.5
11	08.04.2012	38	19.5	8.8	12
12	11.04.2012	42	22.1	5.7	8.2
13	15.04.2012	32	25	5.8	9.6
14	18.04.2012	40.5	26	7.2	8
15	22.04.2012	42.5	25	6.2	8.6
16	25.04.2012	33.5	19.5	5.1	7.5
17	29.04.2012	32.5	18.5	5.6	9
18	02.05.2012	34	19.5	7.5	12
19	06.05.2012	44.5	17.2	6.2	8.2
20	09.05.2012	45	19	9	9.8
21	13.05.2012	44	20.5	3.8	8.5
22	16.05.2012	33	24	5	8.2
23	20.05.2012	34	20	8.5	10.9
24	23.05.2012	46.5	28	5.8	12
	Mean	38.0083	22.0042	6.7	9.6
	Max	46.5	28	10.2	13
	Min	28	17.2	3.8	6.2
			Shyam nagar 3		
1	06.03.2012	36	24	5.9	8.5
2	09.03.2012	31.5	26.5	6.2	8.6
3	13.03.2012	31.8	26	6.5	7.3
4	16.03.2012	36	28.5	6.2	9.5
5	20.03.2012	36.2	24.5	5.5	7.1
6	23.03.2012	35.5	20	5	9.5

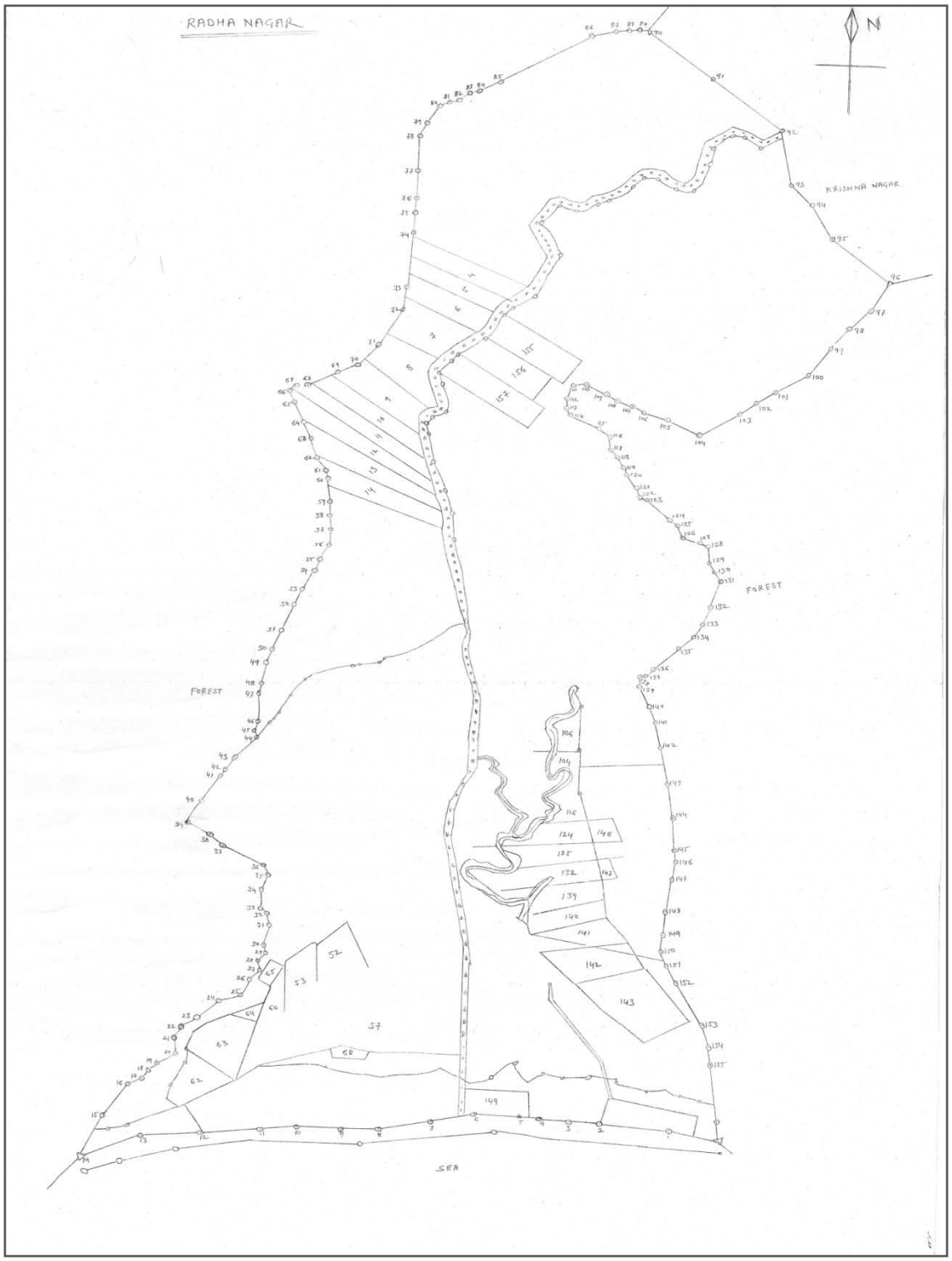
S. No.	Date	PM10 (µg/m³)	PM2.5 (µg/m³)	SO2 (µg/m³)	NO2 (µg/m³)
7	27.03.2012	33.5	20.3	6.5	10.5
8	30.03.2012	40.1	21.3	5	9.7
9	03.04.2012	36.5	22	6.5	8.5
10	06.04.2012	38.5	28	5.5	6
11	10.04.2012	39.4	24.5	6.8	9.5
12	13.04.2012	35	23.5	5.8	8.5
13	17.04.2012	32.6	23.5	6.5	9.5
14	20.04.2012	31.6	25.5	5	7.8
15	24.04.2012	37	26	7	7.2
16	27.04.2012	35.4	24.5	6	7.6
17	01.05.2012	37.8	24	5.8	7.9
18	04.05.2012	36.8	23	5	8.8
19	08.05.2012	36	24.6	6	8.5
20	11.05.2012	40	22.5	6.2	8.5
21	15.05.2012	38.5	24.5	5	7.7
22	18.05.2012	38	25	6.4	9.5
23	22.05.2012	36.5	20	5.8	8.8
24	25.05.2012	34	24	5.5	9
	Mean	**36.0083**	**24.0083**	**5.9**	**8.5**
	Max	40.1	28.5	7	10.5
	Min	31.5	20	5	6
Near Resort, Govinda nagar					
1	05.03.2012	34	22	6.2	8.7
2	08.03.2012	33	22	5.2	7.5
3	12.03.2012	33.5	21	6.5	8.7
4	15.03.2012	28	22.5	5.6	8.5
5	19.03.2012	40	25	5.8	9
6	22.03.2012	32.5	21	4.8	9.5
7	26.03.2012	38	22.3	6.5	6.5
8	29.03.2012	34	23.5	6.2	10.5
9	05.04.2012	34.5	25	7.5	10
10	08.04.2012	34	19	6.3	8.5
11	12.04.2012	36	19.5	7.5	12
12	15.04.2012	40	22.1	6.5	8.2
13	19.04.2012	32	25	6.5	8.3
14	22.04.2012	33	24	5.9	12.5
15	26.04.2012	37.5	25	6.5	8.6

S. No.	Date	PM10 (µg/m³)	PM2.5 (µg/m³)	SO2 (µg/m³)	NO2 (µg/m³)
16	29.04.2012	32	19.5	5.1	7.5
17	05.05.2012	32.5	18.5	6	10
18	08.05.2012	34	19.5	7.5	8.2
19	12.05.2012	31.2	19.2	6.2	7.7
20	15.05.2012	32	20	6.6	6
21	19.05.2012	30	20.5	4.5	6.2
22	22.05.2012	36	24	5	8.2
23	26.05.2012	34	24	8.6	7
24	29.05.2012	34.4	24	5.8	11
	Mean	34.0042	22.0042	6.2	8.7
	Max	40	25	8.6	12.5
	Min	28	18.5	4.5	6
			Shyam nagar		
1	04.03.2012	48	30	6.7	9.6
2	07.03.2012	45	28	4.5	13
3	11.03.2012	33.5	31	6.5	8.5
4	14.03.2012	45	22.5	5.6	12
5	18.03.2012	44	30	4	10
6	21.03.2012	46	21	4.8	6.2
7	25.03.2012	48	30	6.5	9.6
8	28.03.2012	34.3	24.5	10.2	10.3
9	01.04.2012	44.5	25	4	5
10	04.04.2012	48	28	5	8.5
11	08.04.2012	45	19.5	8.8	5
12	11.04.2012	45	30	5.7	8.2
13	15.04.2012	32	25	5.8	9.6
14	18.04.2012	40.5	26	7.2	8
15	22.04.2012	42.5	30	6.2	8.6
16	25.04.2012	33.5	19.5	5.1	7.5
17	29.04.2012	48	18.5	5.6	8
18	02.05.2012	34	32	7.5	12
19	06.05.2012	44.5	30	6.2	8.2
20	09.05.2012	40	30	9	9.8
21	13.05.2012	44	22	4.2	8.5
22	16.05.2012	42	24	5	8.2
23	20.05.2012	34	20	8.1	7.5
24	23.05.2012	47	28	4.2	12
	Avg.	42.0125	26.0208	6.1	8.908333

S. No.	Date	PM10 (µg/m³)	PM2.5 (µg/m³)	SO2 (µg/m³)	NO2 (µg/m³)
	Max	48	32	10.2	13
	Min	32	18.5	4	5
			Kalapathar		
1	04.03.2012	40	20	6.7	9.6
2	07.03.2012	45	19	4.5	9
3	11.03.2012	33.5	31	6.5	8.5
4	14.03.2012	45	22.5	5.6	12
5	18.03.2012	27	30	4	10
6	21.03.2012	44	21	4.8	6.2
7	25.03.2012	28	30	6.5	9.6
8	28.03.2012	34.3	24.5	10.2	10.3
9	01.04.2012	40	25	4	13
10	04.04.2012	45	28	5	8.5
11	08.04.2012	45	19.5	7	14
12	11.04.2012	26	29	5.7	8.2
13	15.04.2012	32	25	5.8	9.6
14	18.04.2012	28	24	7.2	8
15	22.04.2012	42.5	27	6.2	8.6
16	25.04.2012	28	18	5.1	7.5
17	29.04.2012	30	18.5	5.6	8
18	02.05.2012	34	32	7	12
19	06.05.2012	35	30	6.2	8.2
20	09.05.2012	36	18	9	9.8
21	13.05.2012	30	22	4	8.5
22	16.05.2012	28	24	5	7
23	20.05.2012	34	18	8.5	7.5
24	23.05.2012	30	20	4.2	12
	Avg.	35.0125	24	6.0125	9.4
	Max	45	32	10.2	14
	Min	26	18	4	6.2

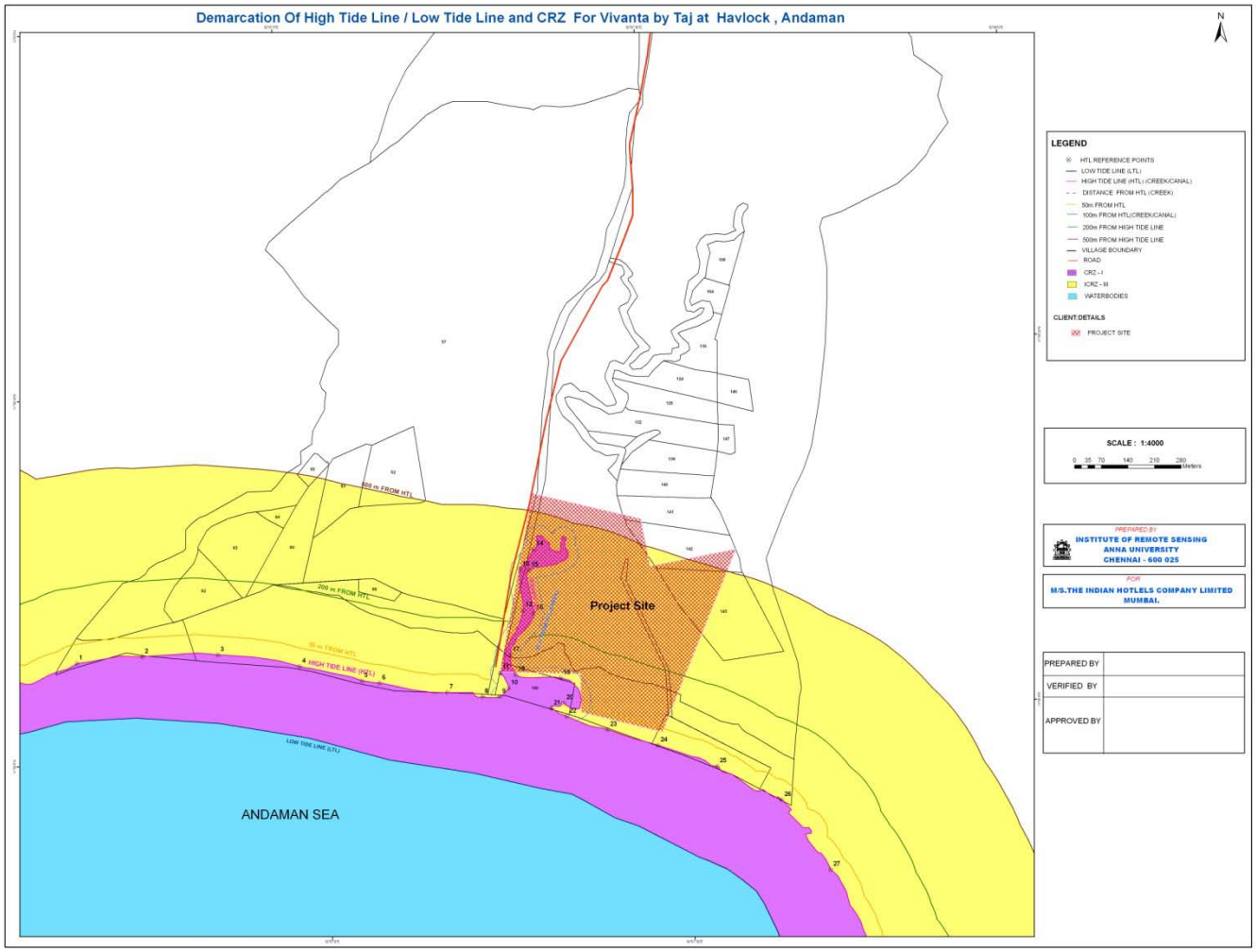
ANNEXURE –II

Village Survey Map of Radha nagar, Havelock



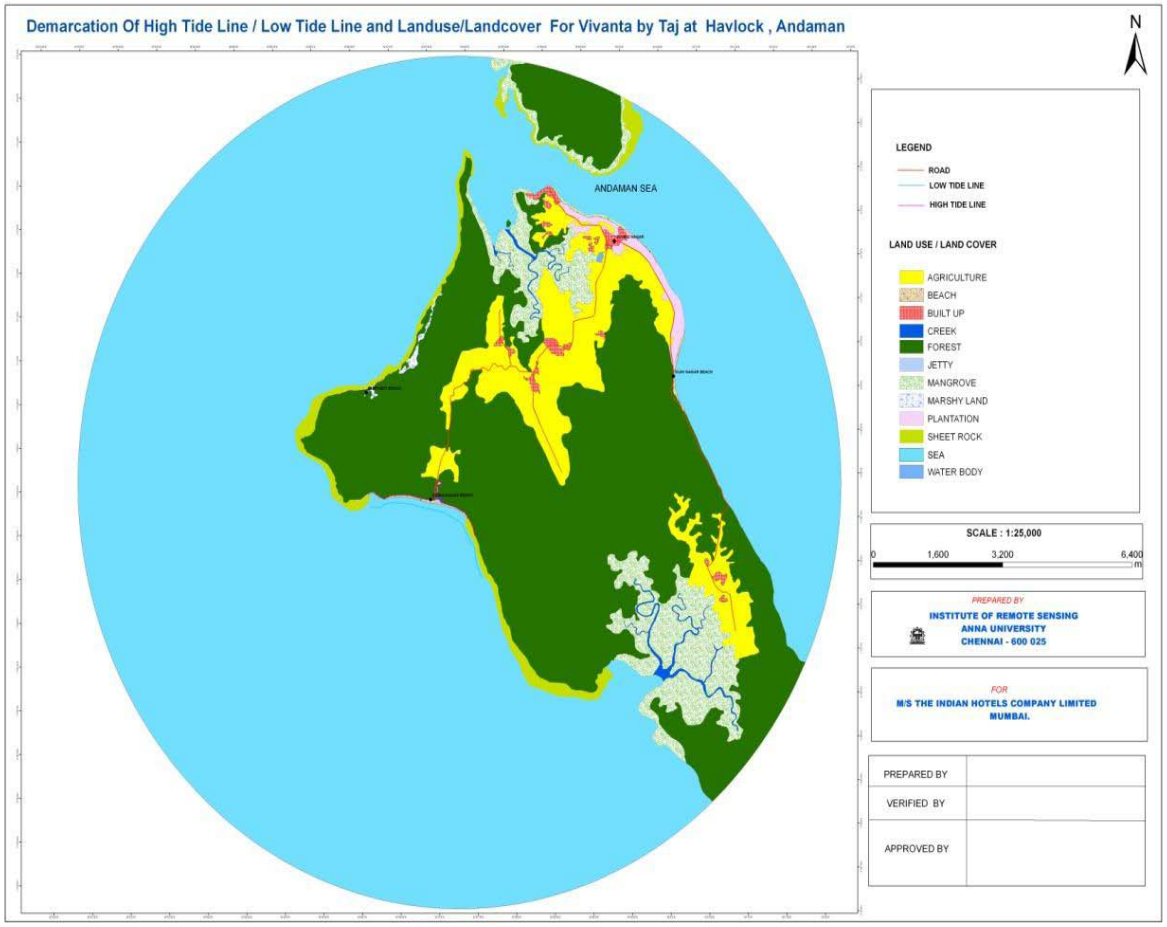
ANNEXURE – III

CRZ MAP of Havelock, Andaman



ANNEXURE – III

Landuse map and statistics of Havelock Island in 7 km radius around project site



Sl No.	Description	Area in HA
1	AGRICULTURE	1211.65
2	BEACH	26.71
3	BUILT UP	76.23
4	CREEK	72.27
5	FOREST	5119.50
6	JETTY	0.48
7	MANGROVE	993.70
8	MARSHY LAND	17.73
9	PLANTATION	105.87
10	SHEET ROCK	234.49
11	WATER BODY	2.94

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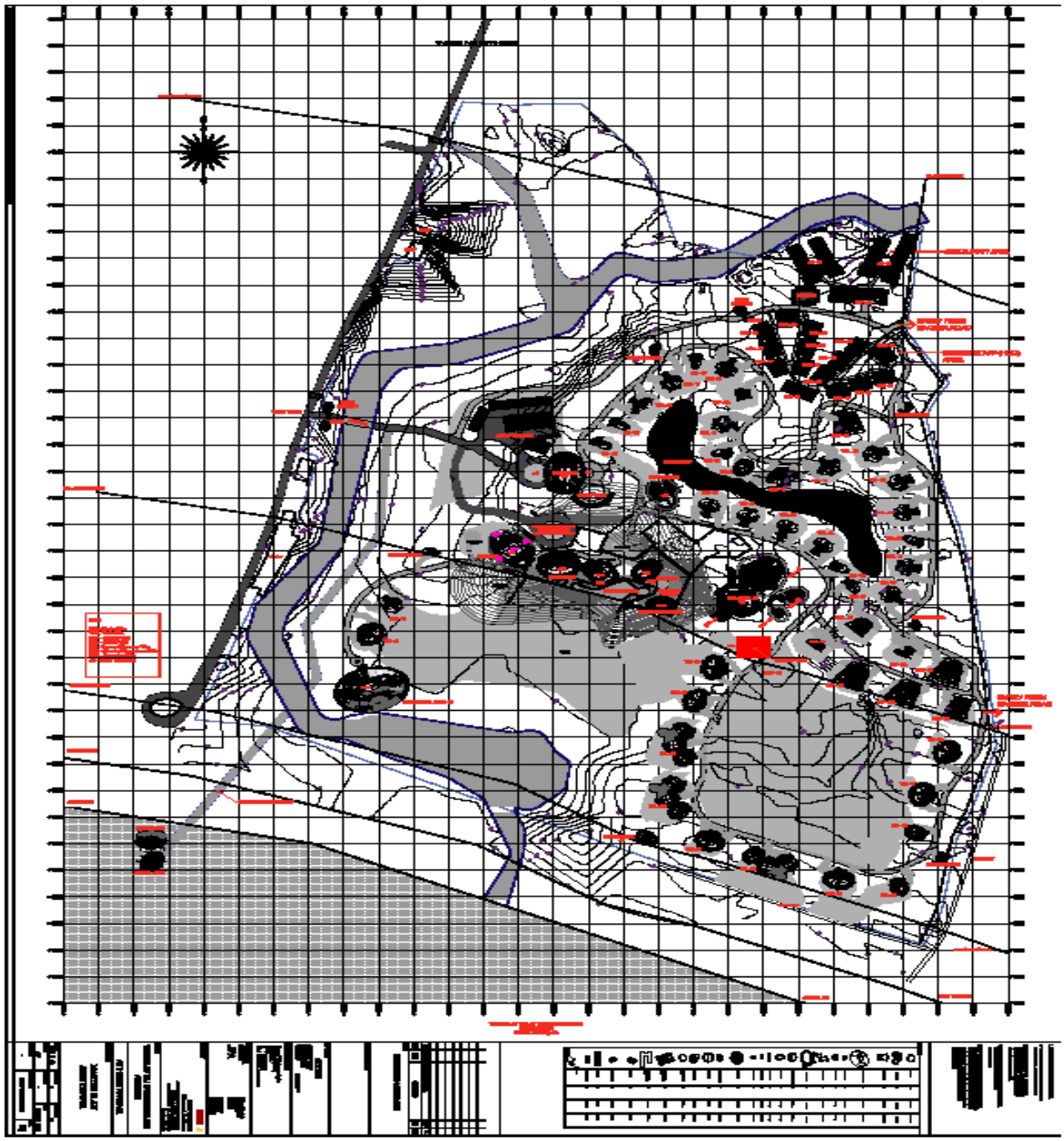
ANNEXURE – IV

Master Layout Plan

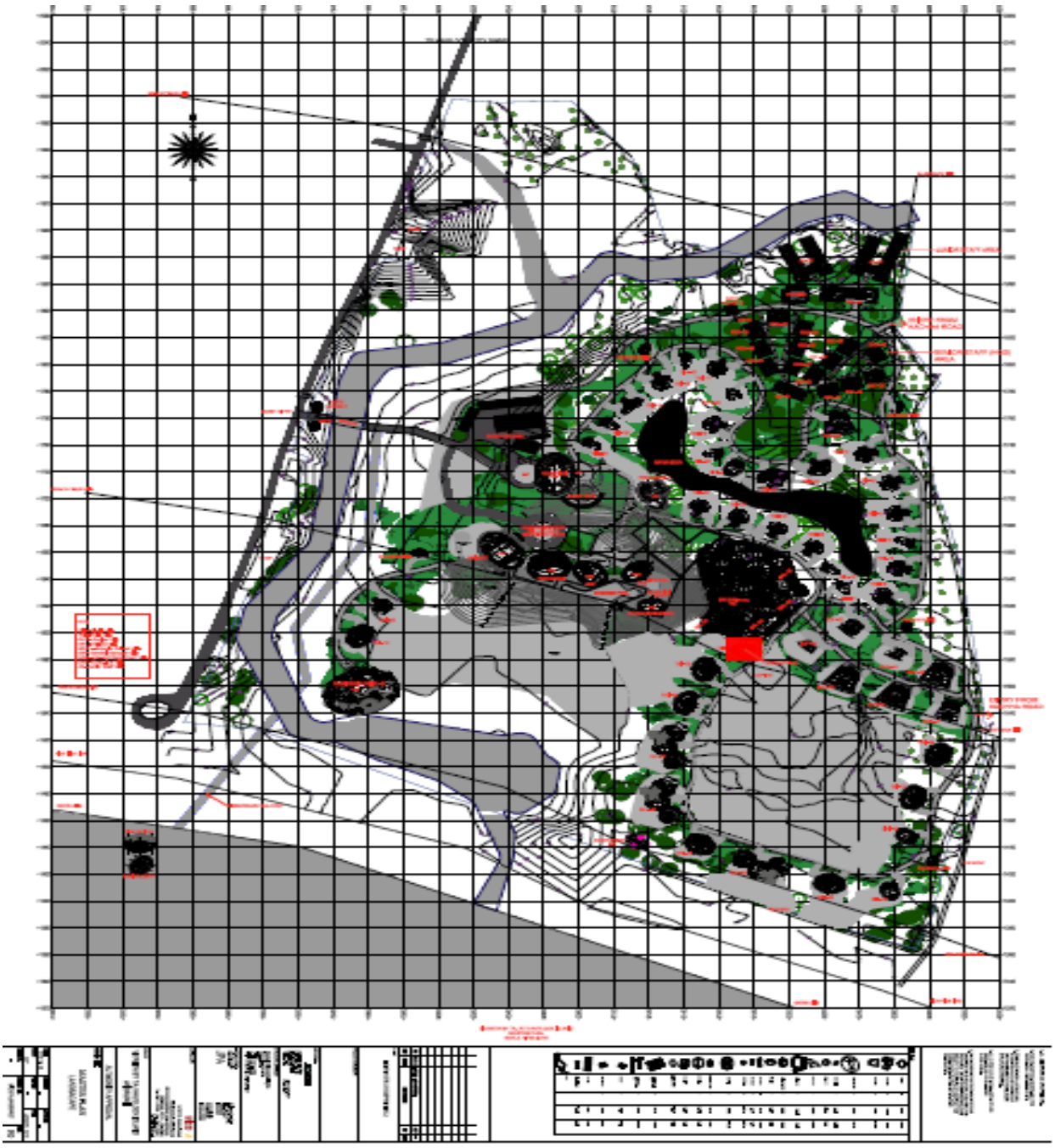


ANNEXURE – V

Master superimposed on Google image

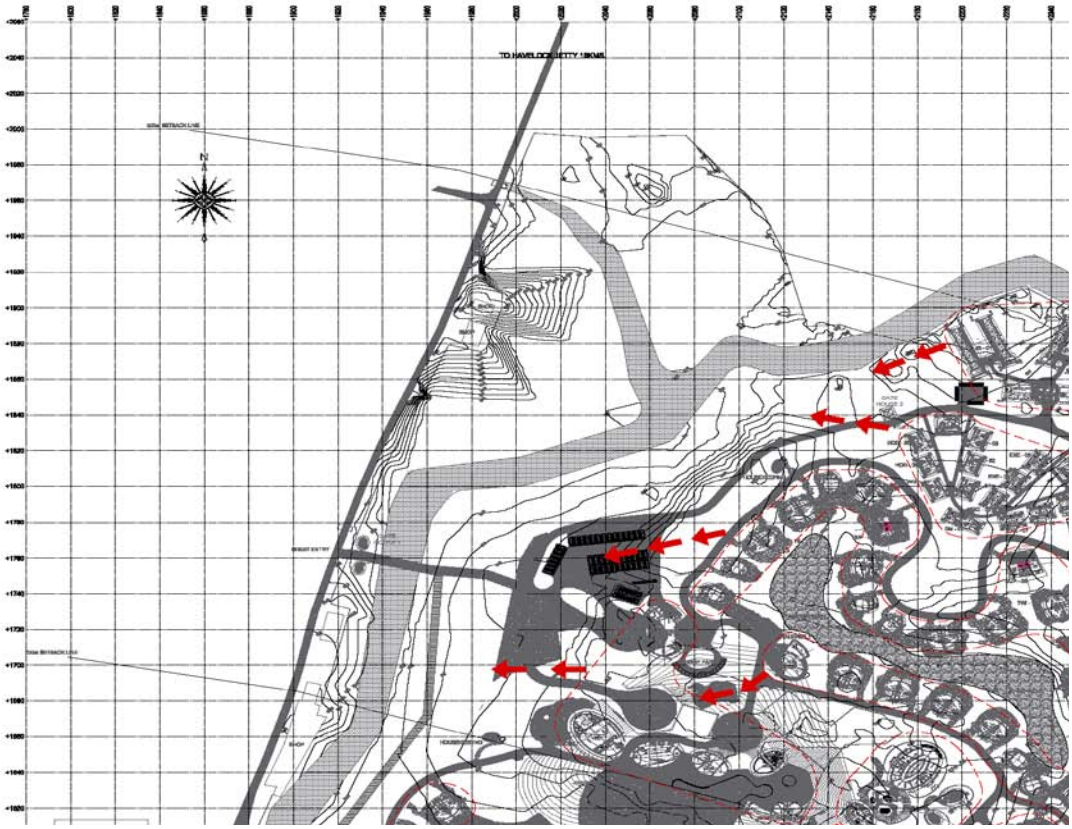
ANNEXURE – VI

Landscape Layout



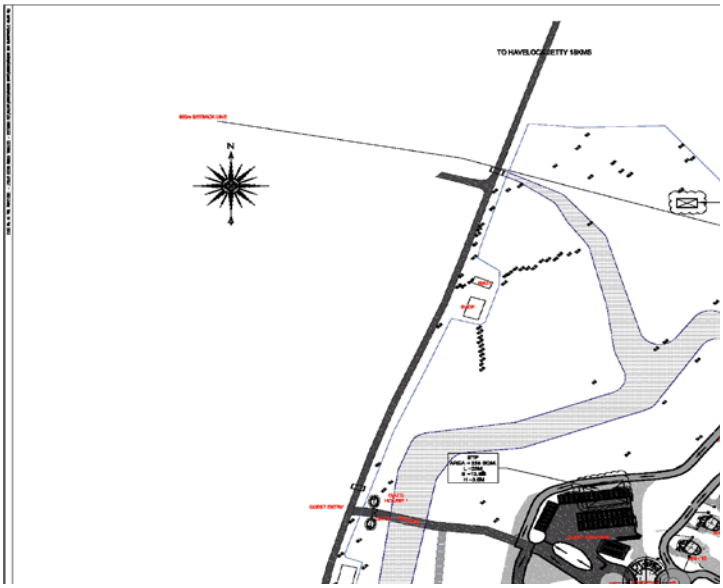
ANNEXURE – VII

Master plan (Fire evacuation)



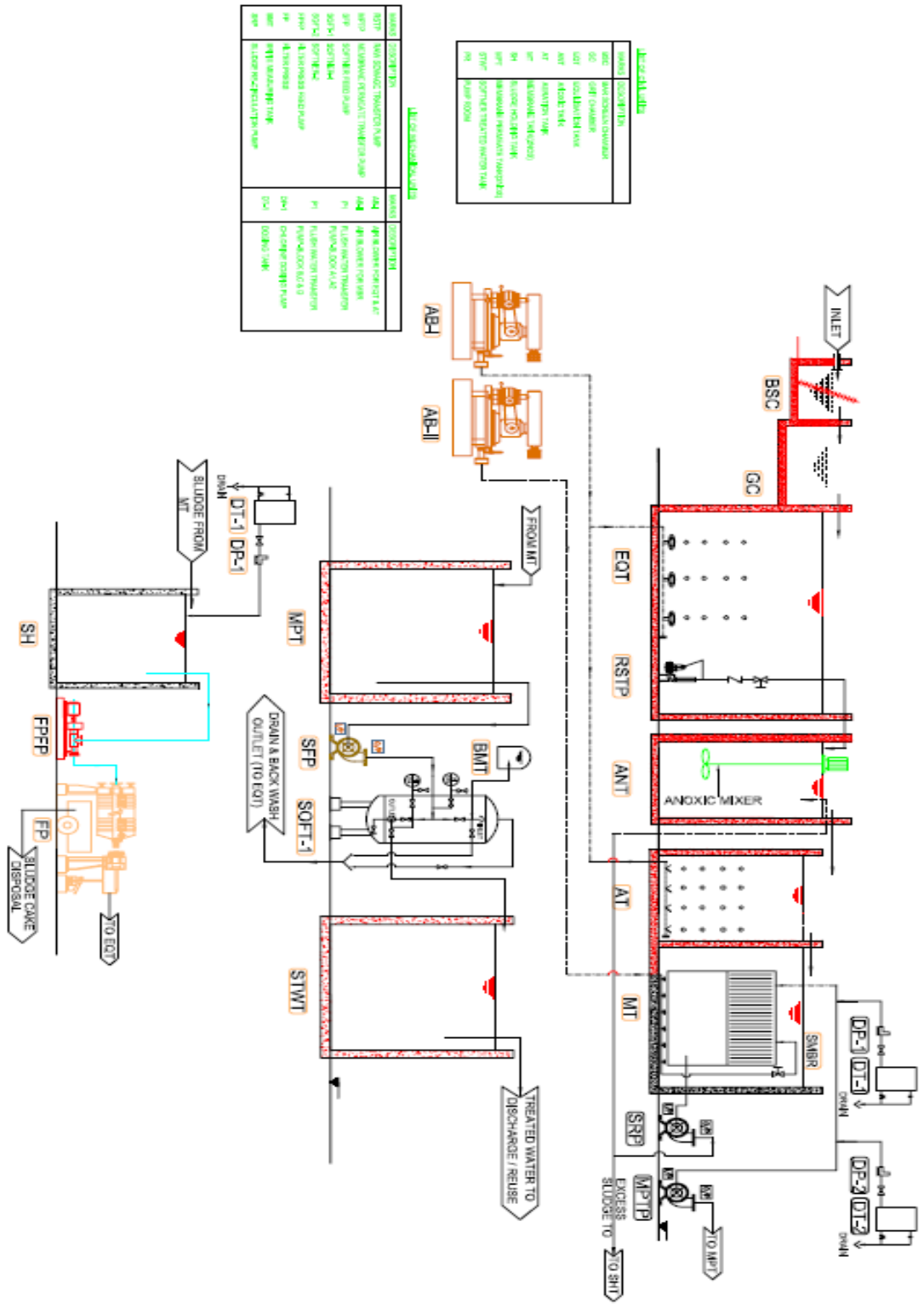
ANNEXURE – VIII

External storm water



ANNEXURE – IX

STP Schematic



ANNEXURE – X

MEP – BOH area

ANNEXURE – XI

Parking Layout