TCE Consulting Engineers Limited

A TATA Enterprise

Comprehensive Environmental Impact Assessment Study Report

for

4000 MW IMPORTED COAL FIRED
MUNDRA ULTRA MEGA POWER PROJECT

COASTAL GUJARAT POWER LIMITED , NEW DELHI

(A wholly owned subsidiary of Tata Power Company)

**Jeevan Bharthi, Tower 1, 10th Floor, Cannaught Circus,
New Delhi-110 001**

August - 2007

ABBREVIATIONS

ACGIH	–	AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS
AEC	–	AHMADABAD ELECTRIC CORPORATION
APHA	–	AMERICAN PUBLIC HEALTH ASSOCIATION
BDL	–	BELOW DETECTABLE LIMIT
BOD	–	BIOLOGICAL OXYGEN DEMAND
BOO	–	BUILD, OWN, OPERATE
CEA	–	CENTRAL ELECTRICITY AUTHORITY
CEIA	–	COMPREHENSIVE ENVIRONMENTAL IMPACT ASSESSMENT
CGPL	–	COASTAL GUJARAT POWER LIMITED
CO	–	CARBON MONOXIDE
CO_2	–	CARBON DIOXIDE
CPCB	–	CENTRAL POLLUTION CONTROL BOARD
CPR	–	CARDIOPULMONARY RESUSCITATION
CRZ	–	COASTAL REGULATORY ZONE
CW	–	COOLING WATER
CWPRS	–	CENTRAL WATER AND POWER RESEARCH STATION
DMP	–	DISASTER MANAGEMENT PLAN
EMD	–	ENVIRONMENTAL MANAGEMENT DIVISION
EMP	–	ENVIRONMENTAL MANAGEMENT PLAN
EPA	–	ENVIRONMENTAL PROTECTION AGENCY
ESP	–	ELECTROSTATIC PRECIPITATOR
FAM	–	FLY ASH MISSION
FCC	–	FALSE COMPOSITE COLOR
FGD	–	FLUE GAS DESULPHURIZATION
GCP	–	GROUND CONTROL POINTS
GCV	–	GROSS CALORIFIC VALUE
GLC	–	GROUND LEVEL CONCENTRATION
GOI	–	GOVERNMENT OF INDIA
GPCB	–	GUJARAT POLLUTION CONTROL BOARD
GPS	–	GLOBAL POSITIONING SYSTEM
HMIS	–	HAZARDOUS MATERIALS IDENTIFICATION SYSTEM

ABBREVIATIONS

HTL	–	HIGH TIDE LINE
IMD	–	INDIAN METEOROLOGICAL DEPARTMENT
IS	–	INDIAN STANDARD
ISCST	–	INDUSTRIAL SOURCE COMPLEX SHORT TERM
LTL	–	LOW TIDE LINE
MCR	–	MAXIMUM CONTINUOUS RATING
MGR	–	MERRY GO ROUND
MoEF	–	MINISTRY OF ENVIRONMENT AND FORESTS
MSDS	–	MATERIAL SAFETY DATA SHEET
MSL	–	MEAN SEA LEVEL
NAAQS	–	NATIONAL AMBIENT AIR QUALITY STANDARD
NFPA	–	NATIONAL FIRE PROTECTION ASSOCIATION
NIO	–	NATIONAL INSTITUTE OF OCEANOGRAPHY
NOx	–	OXIDES OF NITROGEN
NRSA	–	NATIONAL REMOTE SENSING AGENCY
PFC	–	POWER FINANCE CORPORATION
PHAST	–	PROCESS HAZARDS ANALYSIS SOFTWARE TOOLS
PLF	–	PLANT LOAD FACTOR
PM10	–	PARTICULATE MATTER UP TO 10 MICROMETERS
PVC	–	POLYVINYL CHLORIDE
R &R	–	REHABILITATION AND RESETTLEMENT
RA	–	RISK ANALYSIS
RO	–	REVERSE OSMOSIS
RPM	–	RESPIRABLE PARTICULATE MATTER
SC	–	SCHEDULED CASTE
SCBA	–	SELF CONTAINED BREATHING APPARATUS
SEZ	–	SPECIAL ECONOMIC ZONE
SG	–	STEAM GENERATOR
SH	–	STATE HIGHWAY
SO_2	–	SULPHUR DIOXIDE
SPCB	–	STATE POLLUTION CONTROL BOARD
SPM	–	SUSPENDED PARTICULATE MATTER
SPV	–	SPECIAL PURPOSE VEHICLE
ST	–	SCHEDULED TRIBES

ABBREVIATIONS

STEL	–	SHORT TERM EXPOSURE LIMIT
STG	–	STEAM TURBINE GENERATOR
TLV	–	THRESHOLD LIMIT VALUE
TPH	–	TONES PER HOUR
TWA	–	TIME WEIGHTED AVERAGE
UDM	–	UNIFIED DISPERSION MODEL
UMPP	–	ULTRA MEGA POWER PLANT
WHMIS	–	WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM

WEIGHTS AND MEASURES

dB(A)	–	TIME WEIGHTED AVG. IN DECIBELS ON SCALE A
ha	–	HECTARE
km	–	KILOMETER
kW	–	KILOWATT
Leq	–	EQUIVALENT SOUND PRESSURE LEVEL
m	–	METER
mg/l	–	MILLIGRAM PER LITER
MW	–	MEGAWATT
µg/m3	–	MICROGRAMS PER CUBIC METER
pH	–	POTENTIAL OF HYDROGEN
t	–	METRIC TON

CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

REVISION STATUS SHEET

REVISION NO.	MONTH AND YEAR OF ISSUE	DETAILS OF REVISION
R1	JUNE 2007	Draft report
R2	AUGUST 2007	Final report

CHAPTER - I

EXECUTIVE SUMMARY

CHAPTER – I

EXECUTIVE SUMMARY

1. The Government of India has envisaged capacity addition of 100, 000 MW by the year 2012 to meet its Mission of Power to All. Achievement of this target also requires the development of large capacity projects at the national level to meet the requirements of a number of States.

2. Section-63 of the Electricity Act, 2003 provides that the Regulatory Commissions shall adopt the tariff, if it is determined through transparent process of bidding in accordance with the guidelines issued by the Central Government. This aims at moving away from cost-plus support for tariff determination. It is expected to further encourage private sector investment. Guidelines for competitive bidding for determination of tariff for procurement of power by distribution licensees were issued on 19th January 2005. The policy stipulates that all future requirement of power needs to be procured competitively by distribution licensees except in cases of expansion of existing projects and where regulators will need to resort to tariff determination based on norms.

3. Recognizing the fact that economies of scale leading to cheaper power can be secured through development of large size power projects, Ministry of Power, Central Electricity Authority (CEA), and Power Finance Corporation are working together for development of ultra mega power projects under tariff based competitive bidding route. These projects will be awarded to developers on Build, Own and Operate (BOO) basis. The ultra mega power projects, each with a capacity of 4000MW (Nominal), would also have scope for further expansion. The size of these projects being large, they will meet the power needs of a number of states through transmission of power on regional and national basis.

ROLE OF MINISTRY OF POWER

4. Ministry of Power is playing an important role as facilitator to coordinate with concerned Ministries/ agencies and State Govt. for ensuring:

   a) Coal block allotment/ coal linkages
   b) Environmental clearances
   c) Required support from State Government and its agencies
   d) Financial closure by financial institutions
   e) To facilitate PPA and proper security payment mechanism with State Govt./ State utilities
   f) Monitoring the progress of Shell Companies w.r.t predetermined time lines

g) These ultra mega power projects will add 20, 000 MW at five locations within a span of 7-8 years and help in achievements of the targets of capacity addition.

5. In order to enhance investor's confidence, reduce risk perception and get good response to competitive bidding, Shell Companies have been set up as wholly owned subsidiaries of Power Finance Corporation Ltd. (a Govt of India Undertaking) to facilitate tie-up of inputs, linkages and clearances for these projects. These companies will undertake preliminary studies and obtain necessary clearances and tie-ups including water, land and power selling arrangements etc, prior to award of these projects to successful bidders by way of selection of developers through a tariff based ICB. The Shell Companies shall also facilitate the process of obtaining environmental clearance.

6. In the first phase, two projects at coal pit heads (based on domestic coal)and four projects at coastal locations based on imported coal have been identified for development.

7. Wholly owned subsidiaries have been established by Power Finance Corporation Ltd, for taking up developmental work related to ultra mega power projects.

COASTAL GUJARAT POWER LIMITED

8. Coastal Gujarat Power Limited (CGPL), a wholly owned subsidiary of Power Finance Corporation Ltd., was incorporated on 10th Feb 2006 under the Companies Act 1956 with Registration No. U- 40102 DL2006 GOI 146110 (certificate copy of incorporation enclosed).

ROLE OF CGPL

The role of CGPL is outlined below.

a) Appointment of Consultant to undertake preparation of bankable project report
b) Initiative land acquisition proceedings
c) Allocation of water by State Government
d) Appointment of Consultant for International Competitive Bidding (ICB) document preparation and evaluation
e) Obtain various approvals and statutory clearances
f) Tie-ups for off-take/ sale of power
g) Initiate action for development of the power evacuation system and grid tolerance considering the addition of capacity by these projects
h) Green field rating of project

PAYMENT SECURITY

9. The payment mechanism has been stipulated by Ministry of Power for off-take of power from these projects in the following manner:

a) Revolving letter of credit (LC) by distribution licensees

b) Escrow account establishing irrevocable claims on receivables of utilities
c) In case of default, direct supply to HT consumer as per provision of Electricity act, 2003

ROAD MAP FOR BIDDING PROCESS

The bidding process with respect to Mundra UMPP is furnished below.

Activities	Tentative Schedule
a) Notice for Expression of Interest	31.01.2006
b) Bidders Conference for Mundra	21.02.2006
c) Submission of Expression of Interest	28.02.2006
d) Issue of RFQ Documents	31.03.2006
e) Submission of Bids (RFQ)	31.05.2006
f) Issue of RFP Documents	05.08.2006
g) Submission of RFP documents	22.09.2006
h) Selection of Developer/ Transfer of SPV	22.04.2007

10. On selection of successful bidder, the shell company ownership will be transferred from PFC to successful bidder.

11. The deficit in peak power demand in Gujarat would be 1785 MW in the year 2007-08 and 3656 MW by the year 2011-12. The peak power demand for the western region (Gujarat, Maharashtra, Haryana, Punjab, Rajasthan and Uttar Pradesh) would be 56,928 MW by the year 2006-07 and 78,849 MW by the year 2011-12. Even considering installation of new plants, there would be a shortfall of 22,829 MW by the year 2011-12 in the western region.

12. In terms of energy for Gujarat, there would be a deficit of 5237 Million kWh during the year 2006-2007. For western region, the deficit of energy by 2011-12 is estimated to be about 120,759 Million kWh, which is substantial.

13. Power Finance Corporation Ltd. (PFC) has been appointed as nodal agency with the task of establishment of ultra mega power project (UMPP) of 4000 MW (Nominal) capacity at Tundawand village of Mundra taluka in Kutch district of Gujarat. Coastal Gujarat Power Limited (CGPL) as special purpose vehicle (SPV) was incorporated by PFC to carry out various preparatory activities at site. These activities include initial and detailed survey, site selection, fuel tie up, expediting various clearances, preparation of the project report along with plant layout and detailed investigations. CGPL is entrusted to bring the proposed UMPP to a stage of readiness for handing over to developers, who would be selected through a process of competitive bidding. CGPL was transferred to Tata Power Company as a wholly owned subsidiary on 22.04.07.

14. It is proposed that the power generated from Mundra UMPP be allocated to states of Gujarat (1900 MW), Maharashtra (800 MW), Punjab (500 MW), Haryana (400 MW) and Rajasthan (400 MW). Electrical power flow transmission system studies have been assigned to M/s Power Grid Corporation Ltd. (PGCL) to augment the existing 400 kV/other transmission network in Gujarat and other states of western and northern regions.

15. The core team comprising engineers of CEA has carried out initial work on site selection, water availability, for the proposed Mundra UMPP. Some of the activities such as topographical survey, geo-technical investigation, hydrographic, seismic and oceanographical studies, area drainage, fuel transportation study, environmental studies, socio-economic studies, power evacuation and load flow studies, grid tolerance / system stability study, preparation of feasibility / project report for the ultra mega project are being outsourced. The consultants having adequate experience / exposure in respective fields have been appointed for respective activities. CGPL in turn have retained the services of TCE Consulting Engineers Limited to carry out the Environmental Impact Assessment study (Coastal) for the proposed 4000 MW (Nominal) UMPP.

DESCRIPTION OF THE PROJECT

16. The proposed power plant would be located at a site near south of Tundawand village in Mundra taluka of Kutch district in Gujarat coastal area. Proposed site is located at 22^0 49’ 48” N latitude and 69^0 30’ 58” E longitude. The site is well connected with State Highways No. SH-50 (Via Anjar) and No. SH-6 (Via Gandhidham) and would be nearer to the proposed NH-8A (Delhi-Kandala). The nearest railway station is Adipur, which is 57 km away from the proposed site. Adipur railway station is well connected to multi terminal Mundra port through broad gauge railway system privately owned by M/s. Adani Group.

17. The proposed 4000MW(Nominal) power plant would have 1242 Ha of land which includes 241 Ha of land for disposal of ash generated in 9 years. Approximately 182 Ha of land for colony has been identified within 3 km radius from the power plant. A total of 1242 Ha of area has been identified for project facilities. The site is plain/barren and sandy land. UMPP land under ownership of Govt. of Gujarat, MSEZ and private, is under process of acquisition. The proposed site has no inhabitation and is free of trees, vegetation and wild fauna life.

18. The proposed power plant with illustrative configuration of 5 x 800 MW (Nominal) units requires about 14.26Mm^3/day (594,200 m^3/hr) of water. The only source of water, required for the proposed thermal power plant is nearby sea (Gulf of Kutch), which is located at a distance of 2.5 km from the power project site. Sea water will be taken to plant boundary through open channel for condenser cooling and other fresh water requirement. Fresh water requirement would be fulfilled by installation of thermal desalination plant. Inorder to meet the cooling water requirements, once through cooling water system will be incorporated since the same found to be a least cost tariff option.

19. Overall length of intake channel (approx. width=100m) is about 6.5 km, which will be routed through Kotdi Creek. Length of outfall channel (width=60m) is nearly 4.9 km which will be routed through Mudhwa Creek. A precooling

channel will be provided, if necessary, to ensure that the temperature of hot water at the location of discharge meets the environmental stipulations.

20. Detailed studies including model studies will be carried out for finalizing the alignment and design of intake and outfall structures.

21. Coal for the project would be imported, sourced from countries like Indonesia Australia and south Africa through cargo vessels of capacity of 125,000 MT to the nearest Mundra port. The existing facilities at Mundra port for storage and handling of coal would not be adequate, hence, facilities at the port are to be augmented to meet UMPP requirement. MGR rail link has been indicated to the developer for transportation of coal from Mundra port to proposed power project site.

22. The steam generator (SG) would be designed for firing 100% imported coal. The SG would be of two pass design, radiant, single reheat, balanced draft and semi-outdoor type. Steam turbine would be a four cylinder reheat, extraction condensing turbine. It would be complete with all necessary accessories. Power evacuation and its transmission network would be developed. 400 kV system is proposed for cold start up power requirements of the plant and evacuation of power from the plant.. For the purpose of evacuation of the generated power it is currently proposed to have six nos.400KV transmission lines from the power plant connecting to the 400KV substations at Limbdi (chorania), Jetpur and Ranchodpura (Vadavi).

23. The imported coal will have maximum ash content of 15 % and a maximum of 1% sulphur .The annual coal consumption for the proposed 5 X 800 MW (Nominal) power plant is estimated to be 11 –13 million tonnes considering designed gross calorific value (GCV) of 5700 kcal/kg and worst coal having GCV of 4900 kcal/kg and considering an annual plant load factor of 85 %. The daily requirement would be about 35,000 tonnes based on design coal (GCV 5700 kcal/kg). .

EXISTING ENVIRONMENT

24. Baseline environmental condition for ambient air quality was monitored for three seasons of the year 2006 -07. The average background concentration of the study area for SPM, RPM, SO_2, NO_X and CO was recorded. Average ambient concentrations of SPM, RPM, SO_2, NO_X and CO were observed to be 110.5, 67.9,11.5,16.7 and 1560.9 $\mu g/m^3$, respectively considering all the Ambient Air Quality Monitoring Stations (AAQMS). The observed background ambient air quality values are well within the stipulated National Ambient Air Quality Standards (NAAQS) set by MOEF.

25. Meteorological data has been collected for wind speed, wind direction, relative humidity, temperature, rainfall, cloud cover and solar radiation for the year starting from March’06 to February’07. Yearly wind rose pattern during the study period indicated that predominant wind direction is from NNW and WSW sector with 5.4% calm condition.

26. Surface and ground water samples were collected during all season of the year, which were analyzed for their quality based on the parameters of Indian Standard IS 10500. The measured parameters are within the stipulations of the standard.

27. Noise levels were also monitored at all AAQMS. The monitored noise levels in the study area were also found to be within the specified limits of NAAQS with respect to noise.

ENVIRONMENTAL IMPACTS

MARINE ENVIRONMENTAL IMPACT ANALYSIS

29. Separate marine EIA study had been carried out by NIO Mumbai. Rapid marine EIA report includes baseline on marine environment and impacts of proposed UMPP on sea water quality. This report had been separately submitted to CRZ committee of MOEF. MOEF has accorded CRZ clearance based on submitted Rapid marine EIA report.

CONSTRUCTION PHASE

30. Construction phase is going to last for nearly 4.5 to 5 years. Dust emission, noise and water pollution from the construction sites were assessed to be the major environmental impacts during the construction period. Dust pollution can be minimized by water spraying and proper maintenance of road. The compulsion of using pollution certification for properly maintained vehicles and proper maintenance of heavy machinery used during construction period will help in reducing the noise levels. Adopting good construction and engineering practices will help in mitigating the water pollution. Arrangements will be made for septic tank/pit to provide proper sanitary conditions at construction site. The impacts during construction are expected to be temporary in nature that will subside once construction period is over.

31. Temporary beneficial socio-economic impact in terms of increased jobs and availability of money to the workers and villagers settled nearby is expected during the construction period. Migration of workers population is expected to be minimum, as local workers from the nearby area will be preferred for temporary employment.

OPERATION PHASE

Air Pollution

32. The air pollutants from a power plant are:

a) Dust particulates from coal and ash handling systems, fly ash from stack flues, fly ash dust particles from ash silos and ash disposal area

b) Sulphur dioxide (SO_2) and nitrogen oxides (NO_x) from flue gas

33. The applicable standard of 150 mg/Nm^3 for particulate emission will be followed. The electrostatic precipitators (ESP) proposed to be installed in the project will be designed to limit the emission level of the particulate matter.

34. Single-flue for each 800 MW (Nominal) unit is proposed to be constructed for effective dispersal of SO_2. Two multiflue stacks (one with 3 flues and the second one with 2 flues, each flue of 7.5 m inside diameter) of 275 m height will be provided. This would meet the requirement of Indian Emission Regulation. Space provision is also made for future installation of flue gas desulphurization (FGD) unit.

35. To reduce NO_x emissions, steam generators would be fitted with advanced low NO_x burners. Further, over-fire air system equipment with air ports would be installed for the furnace. The NO_x emissions would be checked for ground level concentrations (GLC) as per the above-indicated Indian Emission Regulations.

36. Coal dust would be generated generally at the conveyor transfer points, coal unloading area and coal stockpile area. Hence, track hopper, coal transfer points and coal stockyard would be provided with dust suppression facilities.

37. Dust collection system would also be provided in coalbunkers to evacuate dust and hazardous gases like Methane from the coalbunkers. Collected dust would be returned to either the associated belt conveyor or to the coalbunker. The dust collector outlet emission would be restricted to 100 mg / Nm^3.

38. Fly ash evacuated from the ESP collecting hoppers would be transported in closed pipelines by pneumatic means. At the time of unloading fly ash in to the silos, some ash-laden air would get vented out. In order to restrict the fly ash dust particles to the limits of 100mg / Nm^3., a vent filter would be installed on top of each of the fly ash silos at the vents.

39. The following pollution control measures would be installed for ash disposal :

a) To reduce the dust nuisance while loading the ash into the trucks from fly ash silos, the fly ash would be conditioned with water spray. It is proposed to cover the ash in the open trucks with tarpaulin to prevent flying of fine ash during transportation.

b) The ash disposal area would be lined with impervious lining to prevent seepage of water in the slurry or rain water from the disposal area in to the ground which will prevent contamination of ground water.

c) Arrangements would be made with private entrepreneurs for utilizing fly ash for commercial purposes.

40. US-Environmental Protection Agency's (US-EPA) Industrial Source Complex Short Term (ISCST3) is used for the air quality dispersion analysis. Impact on ambient air quality of the study area is predicted. The fuel is coal having particulates and sulfur. Therefore, emissions have been considered for SPM, NO_x and SO_2. Accordingly, air pollution dispersion modeling has been carried out for these pollutants. Since a stringent standard norm for particulate emission of 100mg / Nm^3. will be followed, particulate emission from stack will be negligible. Meteorological data collected for all three seasons of the year were used for air quality dispersion modeling.

41. The incremental GLCs were predicted for SO_2, NO_x and SPM at all AAQMSs and within the study area of 25 Km. radius. The same were superimposed over maximum monitored background concentrations at all AAQMSs. The resultant back ground concentrations were found to be within the stipulated limits of NAAQS set by MOEF.

42. The maximum worst case incremental GLCs among all the ambient air quality monitoring stations of the study area were computed to be *42.7 µg/m^3 for SO_2, 14.3* µg/m^3 for NO_x and *2.1* µg/m^3 for SPM. These maximum concentrations were reported to be at Desalpar village. The incremental GLCs were superimposed on monitored maximum back ground pollutant concentrations at Desalpar. The predicted maximum worst case background

concentrations are therefore found to be *61.1* µg/m^3 for SO_2, *39.1* µg/m^3 for NO_x and *144.1* µg/m^3 for SPM within 25 km study area. The results are furnished in the following Table I.1:

Table I.1
Overall Worst Case Predicted GLCs at all AAQMS

24 Hourly Concentrations	SO_2	NO_X	SPM
Baseline Maximum Monitored Concentration (µg/m3)	18.4	24.8	142.0
Predicted Maximum Incremental GLC (µg/m3)	42.7	14.3	2.1
Overall GLCs during Worst Case Scenario (µg/m3)	61.1	39.1	144.1
NAAQS Limit (Rural & Residential) (µg/m3)	80	80	200

43. The maximum worst case incremental GLCs of the study area for SO_2, NO_2, and SPM during winter were calculated to be 63.1, 21.0 and 3.1 µg/m3, respectively. The same were superimposed over the maximum monitored background concentration observed during winter season. The result indicated that predicted GLCs are within the stipulated MOEF standards.

44. The results shown in above table indicate that predicted maximum worst case GLCs within the study area are found to be within the limit of air quality standard set by MOEF. However, space provision will be made for installation of flue gas desulphurization (FGD) unit in future, if required at any stage.

Coastal Fumigation Study

45. At coastal sites, sea breeze conditions exist for some period depending on the thermal differential between land and sea. Therefore, impact of coastal fumigation was also studied to assess the situation. This study indicates that effective plume height (H+ΔH) for effluent releases is greater than 1000 m. The majority of the plume will attain the height above the Internal Boundary Layer and as such the increase of GLC due to fumigation condition will not occur at this site.

Water Pollution

46. The sources of effluents from the proposed power plant are the following:

a) Water treatment plant
b) Effluent from bottom ash handling system
c) Coal pile area run off
d) Air pre-heater wash water effluent
e) Plant wash down water
f) Floor and equipment drainage effluent

h) Sewage from various buildings in the plant.

47. Various water pollution controls measures would be undertaken depending on the type of effluent generated. Acidic/ alkali effluent would be drained into an underground neutralization pit. The treated effluent would be neutralized and led to guard pond. The ash slurry would be led to ash pond where ash would be settled and recovered clear water from ash pond would be led to sea The effluent generated by washing of equipment and plant areas would be suitably led to settling basins / guard pond.

Thermal Pollution

48. As once through cooling system is proposed for the project, the cooling water return will be led to outfall structure leading to sea. An arrangement of pre-cooling channel would be provided if required, which will dissipate cooling water temperature to surrounding atmosphere. The resultant discharge water temperature shall meet MOEF norms.

49. The predicted temperature of the flue gas at exit of the boiler would be 134.5 ^{0}C. The heat flux of discharged flue gas from the height of 275 m stacks will not be significant and it will not have any impact at structures on ground, vegetation and human beings. Hence, proposed UMPP would not have significant impact on heat flux of the surrounding environment.

Noise Pollution

50. The source of noise in a power plant are :

a) Steam turbine generator
b) Other rotating equipment
c) Combustion induced noises
d) Flow induced noises
e) Steam safety valves

51. The steam turbine generators would be housed in closed buildings, which would considerably reduce the transmission of noise from the steam turbine generators to the outside environment. The maintenance and plant operating personnel working within the steam turbine generator building would be provided with adequate personal protection against noise.

52. Provision of 100 m wide green belt will attenuate considerable portion of generated noise apart from the natural attenuation achieved due to moist air through the noise traveling up to plant boundary.

Socio-Economic

53. Proposed UMPP site has neither villages, inhabitation nor permanent structures. Hence, rehabilitation and resettlement (R & R) issues are not involved that could alter the existing socio-economic pattern.

54. Most of the people around the site have an income directly or indirectly from agriculture and other service related work. Proposed green field project will employ local people both during construction and operation phase of the project. Infrastructure facilities and amenities developed for the project could be also used by local villagers. The project will improve the infrastructure

facilities and amenities of the study area. Therefore, socio-economic impact of proposed plant is expected to be positive.

55. Since power is the wheel for any of the development, the surrounding villages and region would get maximum benefits out of generated electricity. The benefits may be realized either as up coming of industries and its allied ancillary units. Other benefits would be generation of either direct or indirect employment to the locals. The ensured and reliable supply of power to upcoming industries and surrounding region would be a boon for development of the region. The locals of the project area are expected to get more benefits from the proposed power project.

56. The overall impact of the project is expected to be positive.

ECOLOGICAL

57. Both terrestrial and marine ecology of the surrounding areas including MGR system were studied. Natural vegetation of the surrounding area was dominated with *Prosopis juliflora* as an open scrub forest. Mangrove vegetation were not recorded in close vicinity of the proposed project site.

58. Since the proposed project is consisting of barren sandy area with minimum cultivation and patches of thin vegetation, the setting up of project will not require tree felling , rehabilitation and resettlement. Hence no adverse impact is expected on ecology and land use of the surrounding study area.

59. The site is remotely situated from metropolitan city or eco-sensitive spots including national parks, wildlife sanctuaries, historical, religious and cultural sites, defense installation, tropical forests, biosphere reserves, important lakes, etc. Therefore, impacts are not envisaged for the mentioned sensitive locations.

60. The predicted incremental GLCs of SO_2, NO_x and SPM are not sufficient enough to have any adverse impact on the open scrub forest of the surrounding study area. Addition of 33% of the project land for greenbelt area would improve the aesthetic look and surrounding environment and ecology. Hence, impact of the proposed UMPP is expected to be positive on surrounding environment.

SOLID WASTE MANAGEMENT

61. Generated coal dust will be suppressed using dust suppression /dust extraction facilities. Total area identified for ash disposal is about 241 Ha, which will be adequate for storage fly ash generated for the about 9 years and bottom ash storage for operational period of the plant. Ash disposal would be followed by stabilization of the area using plantation and other suitable technical measures till the ash pond is full. This practice would minimize fugitive dust emission.

62. MOEF notification on utilization of fly ash would be implemented for utilization of 100% fly ash within 9 years after the commissioning of the proposed project.

63. The required consent for handling and disposal of solid waste would be taken before commissioning of the proposed project. Therefore, proper disposal and management of generated solid waste would not pose any pollution problem to the surrounding environment.

POLLUTION MONITORING AND SURVEILLANCE SYSTEM

64. A well-defined environmental monitoring programme would be emphasized with trained and qualified staff that would monitor the ambient air as well as stack gas quality to ensure that the pollutants level is always maintained within the permissible levels.

65. The emission and gas monitoring systems installed in this project would consist of the following :

a) Flue Gas O2 and CO Monitoring: These would be measured at the economiser outlet. In addition, O2 would be monitored at the air pre heater outlet.

b) Stack Emissions: Flue gas letting into the atmosphere would be monitored for CO_2, NOx, SO_2 , SPM and opacity. Stack emission readings would be sent to the DCS for monitoring.

c) Ambient Air Quality Monitoring: Ambient air quality monitoring stations would be set up to monitor the air quality in the neighbouring villages. The parameters to be monitored are suspended particulate matter (SPM), respirable particulate matter (RPM), sulphur di-oxide (SO2), and nitrogen oxide (NOx).

d) Water Quality Monitoring: Effluents generated from various sources will be monitored. The ash pond effluent would be analyzed weekly for pH and suspended solids. Sampling and monitoring area will cover locations around intake and outfall structures. This will be implemented through qualified persons who will be in-charge of monitoring.

e) Marine Environment: Post project periodical marine environmental monitoring shall be carried out for shoreline and sea floor changes, quality of water, sediment, mangroves, seaweeds and fishery resources. Intake and out fall channels will be monitored regularly for instant ambient temperature and alkalinity.

f) Meteorological Data: Meteorological station will be set up to monitor wind velocity / direction, temperature, rain fall, relative humidity, cloud cover, solar radiation and barometric pressure.

RISK ANALYSIS

66. Electro chlorination or chlorine dioxide is proposed for CW system chlorination. Therefore there is no risk of chlorine gas leakage.

67. All equipment vulnerable to explosion or fire would be designed to relevant IS codes & statutory regulations. Suitable fire protection system comprising hydrants and spray systems would be provided for fire protection.

SUMMARY AND CONCLUSIONS

68. Emissions from the proposed project will not degrade the ambient air quality of the surrounding areas. The impact on water, noise level, soil and land use is expected to be negligible. Impact on ecology, socio-economics, amenities and infrastructure of the study area is expected to be positive. All necessary pollution control measures would be installed for minimizing any impact foreseen due to proposed power project.

69. Power is the wheel for any development. The surrounding villages, neighboring states and particularly Gujarat State would get maximum benefits out of generated electricity. The benefits may be realized either as up coming of industries or allied ancillary units. Other benefits would be generation of either direct or indirect employment to the locals. The assured and reliable supply of power to upcoming industries and surrounding region would be a boon for development.

70. The setting up of the proposed power plant will not degrade the quality of surrounding environment. It would contribute towards the improvement of the socio-economic status of the surrounding areas.

CHAPTER - II

INTRODUCTION

CHAPTER – II

INTRODUCTION

1. The Government of India has envisaged capacity addition of 100,000 MW by 2012 to meet its Mission of Power to All. Achievement of this target also requires the development of large capacity projects at the national level to meet the requirements of a number of States.

2. Recognizing the fact that economies of scale leading to cheaper power can be secured through development of large size power projects, Ministry of Power, Central Electricity Authority (CEA), and Power Finance Corporation Ltd.(PFC) are working together for development of ultra mega power projects under tariff based competitive bidding route. These projects will be awarded to developers on Build, Own and Operate (BOO) basis. The ultra mega power projects each with a capacity of 4000MW (Nominal), would also have scope for further expansion. The size of these projects being large, they will meet the power needs of a number of states through transmission of power on regional and national basis.

3. PFC has been appointed as nodal agency with the task of establishment of ultra mega power project (UMPP) of 4000 MW (Nominal) capacity at Mundra taluka in Kutch district, Gujarat. Coastal Gujarat Power Limited (CGPL) as special purpose vehicle (SPV) has been incorporated by PFC to carryout various preparatory activities at site. Such activities include initial and detailed survey, site selection, fuel tie up, expediting various clearances, preparation of the project report along with plant layout and detailed investigations. These activities would be initiated and completed to bring the project to a stage of readiness for handing over to developers who would be selected through a process of competitive bidding.

THE PROJECT

4. The proposed power plant will be located near Tundawand village at Mundra taluka, Kutch district of Gujarat Coastal area. The site is well connected with state Highway no. SH-50 (via Anjar) and SH-6 (via Gandhidham) and would be near to proposed NH-8A (Delhi-Khandla). The latitude and longitude of the project site is 22^0 49’ 48” N and 69^0 30’ 58” E. The proposed 4,000 MW(Nominal) power plant would have a total 1242Ha of land that includes 617Ha for main plant and 241 Ha of land for disposal of ash generated in 9 years. Approximately 182 Ha of land required for colony has been identified within 3 km distance from the power plant. Sufficient land is kept for green belt development and rainwater harvesting.

5. Coal for the project would be imported from countries like Indonesia, Australia and South Africa. The annual coal consumption for the proposed power plant is estimated to be 11-13 million tonnes considering design coal having gross calorific value (GCV) of 5700 kcal / kg and worst coal having GCV of 5350 kcal/kg with annual plant load factor (PLF) of about 85%. However, the existing facilities at Mundra port for storage and handling of coal would not be adequate. Hence, the facilities at the port will be augmented and a captive rail link will be established from the port to proposed power project site.

6. The vicinity map of the proposed power project site is shown in Figure II.1.

JUSTIFICATION OF THE PROJECT

DEMAND FOR ELECTRICAL POWER

7. The deficit in peak power demand in Gujarat would be 1785 MW in the year 2007-08 and 3656 MW by the year 2011-12. The peak power demand for the western region (Gujarat, Maharashtra, Haryana, Punjab, Rajasthan and Uttar Pradesh) would be 56,928 MW by the year 2006-07 and 78,849 MW by the year 2011-12. Even considering installation of new plants, there would be a shortfall of 22,829 MW by the year 2011-12 in the western region.

8. The peak power demand and the energy requirement of Gujarat from the year 2007-2008 to the year 2011-2012 as projected in 16th Electric Power Survey Report is presented in Table II.1.

Table II.1
Projected Peak Power Demand & Energy Requirement of Gujarat

Sl no.	Year	Projected Peak Power demand (MW)	Projected Energy requirement (MkWh)
1	2007-2008	11215	65236
2	2008-2009	11861	68993
3	2009-2010	12545	72967
4	2010-2011	13267	77170
5	2011-2012	14031	81615

AVAILABILITY OF POWER

9. The Power Survey of India recognized that while computing the available peak power from the installed capacity, the following factors need to be considered:

a) Planned outage due to maintenance

b) Forced outage

c) Spinning reserve

d) Auxiliary power consumption

e) Other factors relevant to the aspect of peak power availability.

Table II.2
Deficit in Installed Capacity for the State of Gujarat

Sl No	Details	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012
1	Peak Power Availability (**MW**) - note 1	9430	9873	10251	10375	10375
2	Peak Power Demand (**MW**)	11215	11861	12545	13267	14031
3	Power Deficit (**MW**)	**-1785**	**-1988**	**-2294**	**-2892**	**-3656**

Note 1: Peak power and energy availability are calculated based on their availability factors, considering auxiliary power consumption, transformation losses and benefits from projects under construction.

AVAILABILITY OF ENERGY

10. Energy availability from thermal plants depends on the plant load factor of individual plants. In case of hydroelectric plants, the availability of water for power generation based on hydrology and head considering the dependability of the plant, determines the availability of energy. The energy requirement projected considering the growth of various sectors and the energy availability along with the deficit are shown in Table II.3., for the state of Gujarat.

Table II.3
Deficit in Energy Demand for the State of Gujarat

Sl No	Details	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012
1	Energy Available (**MU**) – note-1	65395	71278	75081	76695	76812
2	Energy Requirement (**MU**)	65236	68993	72967	77170	81615
3	Energy Deficit (**MU**)	**159**	**2285**	**2114**	**-475**	**-4803**

Note 1: Peak power and energy availability are calculated based on their availability factors, considering auxiliary power consumption, transformation losses and benefits from projects under construction.

NEED FOR AUGMENTATION OF POWER

11. It can be noticed from Table II.2 that deficit in peak power demand is 1785 MW in the year 2007-2008. Considering the load growth and the installation of the new power plants, the additional-generating capacity to meet this deficit would be 2231 MW with plant load factor of 0.80.

12. In terms of energy, it may be noted from Table II.3 that the surplus would be around 159 Million units during the year 2007-208. Any delay in the implementation of power projects, due to any reasons such as lack of clearances, financial constraints, etc., would result in much larger deficit in subsequent years.

13. There is no power plant located near the project area. The nearest power plants are Sikka located at 250km and Akrimota at 150km from Bhuj.

14. Considering the above scenario, there is immediate necessity of addition of power generation capacity in the state of Gujarat, and the installation of the proposed project is justified to meet part of peak demand as well as energy demand for Gujarat state and the balance demands of other neighboring states.

JUSTIFICATION OF THE PROJECT FROM ENVIRONMENTAL ANGLE

15. There are no eco-sensitive spots such as reserved forest areas or protected monuments as per MOEF guidelines in the site or in the vicinity of the site proposed. The site is situated in generally barren area with minimum cultivation, habitation and with minimum patches of lean forests.

16. Main plant area is located outside the coastal regulation zone more than 500 m away from the hightide line. The location is suitable for intake and outfall channels which comes under permitted activity of water front project as per CRZ notification.

17. Adequate land is available for coal handling and storage, ash handling and colony for the personnel to be employed for the project.

18. The proposed power project area has no permanent strcutures or habitation. Therfore, rehabilitation and resettlemnt (R&R) issue are not primarly involved. Felling or cutting of trees will not be required for setting of the UMPP project.

19. Huge amount of water required for once through cooling system will be available from sea through open channel. The vicinity of sea with the project site is an added advantage for intake and out fall structure.

20. Initiatives and support of Government of Gujarat, mega power status and over and above sound economic and favorable environmental conditions also justify the location of proposed 4000 MW (Nominal) Ultra Mega Power Plant (UMPP).

OBJECTIVES OF THE REPORT

21. The objectives of the report are as follows:

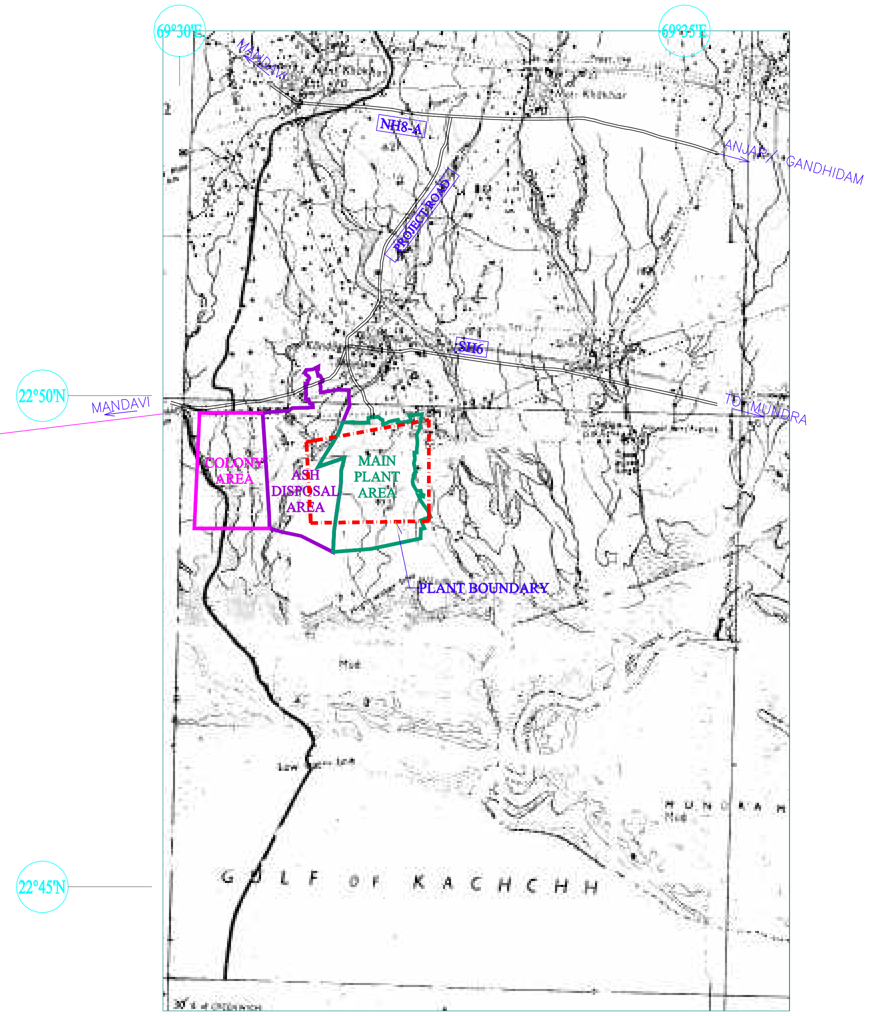
a) Identify and evaluate the environmental impact due to the construction and operation of the proposed plant

b) Delineate the mitigation measures for the impacts

c) Outline the Environmental Management Plan and post project monitoring requirements

d) Risk and Consequence Analysis and Disaster Management Plan

NORTH



LEGEND

1	22°49'48"N69°30'58"E
2	22°49'43"N69°32'24"E
3	22°48'48"N69°32'33"E
4	22°48'38"N69°31'03"E

DO NOT SCALE | Figure II.1

POWER FINANCE CORPORATION LTD.(PFCL)

COASTAL GUJRAT (MUNDRA) ULTRA MEGA TPP 4000MW

VICINITY PLAN

TCE CONSULTING ENGINEERS LTD, MUMBAI

SCALE	DWG. NO:	DATE
NONE	TCE.4861A-ME-SK-0001	APRIL 2006

CHAPTER - III

PROJECT DESCRIPTION

CHAPTER - III

PROJECT DESCRIPTION

LOCATION AND ACCESS

1. The proposed site is located near Tundawand village in Mundra taluka of Kutch district of Gujarat. Coastal area (Gulf of Kutch) is located about 1.5 km away from the project site. The site is well connected with state Highway no. SH – 50 (via Anjar) and SH-6 (via Gandhidham) and would be near to proposed NH-8A (Delhi-Kandla). The nearest railway station is Adipur, which is 57 km away from the site. The railway station is well connected to multi-terminal Mundra port through broad gauge railway system owned by M/s. MSEZ Group. The nearest airport is Bhuj, which is about 60 km from site. The proposed project site is located at 25 kms from Mundra port.

BASIC REQUIREMENTS

Availability of Land

2. Land available for 4,000 MW (Nominal) coal based power plant is about 1242 Ha, which includes main plant, balance of plant, ash disposal area, green belt, roads, MGR and drains etc. This site is situated in coastal area at Tundawand village. Around 182 Ha of land is required for the power plant staff colony. General layout of the proposed power project is shown in Figure III.1. The main plant area comes in Tundawand village. Coal stockyard and ash pond area, which is about 341 Ha., will be located adjacent to western side of main power plant in Tunda and Kandagara village. The residential colony will be constructed near Nana Bhadia village.

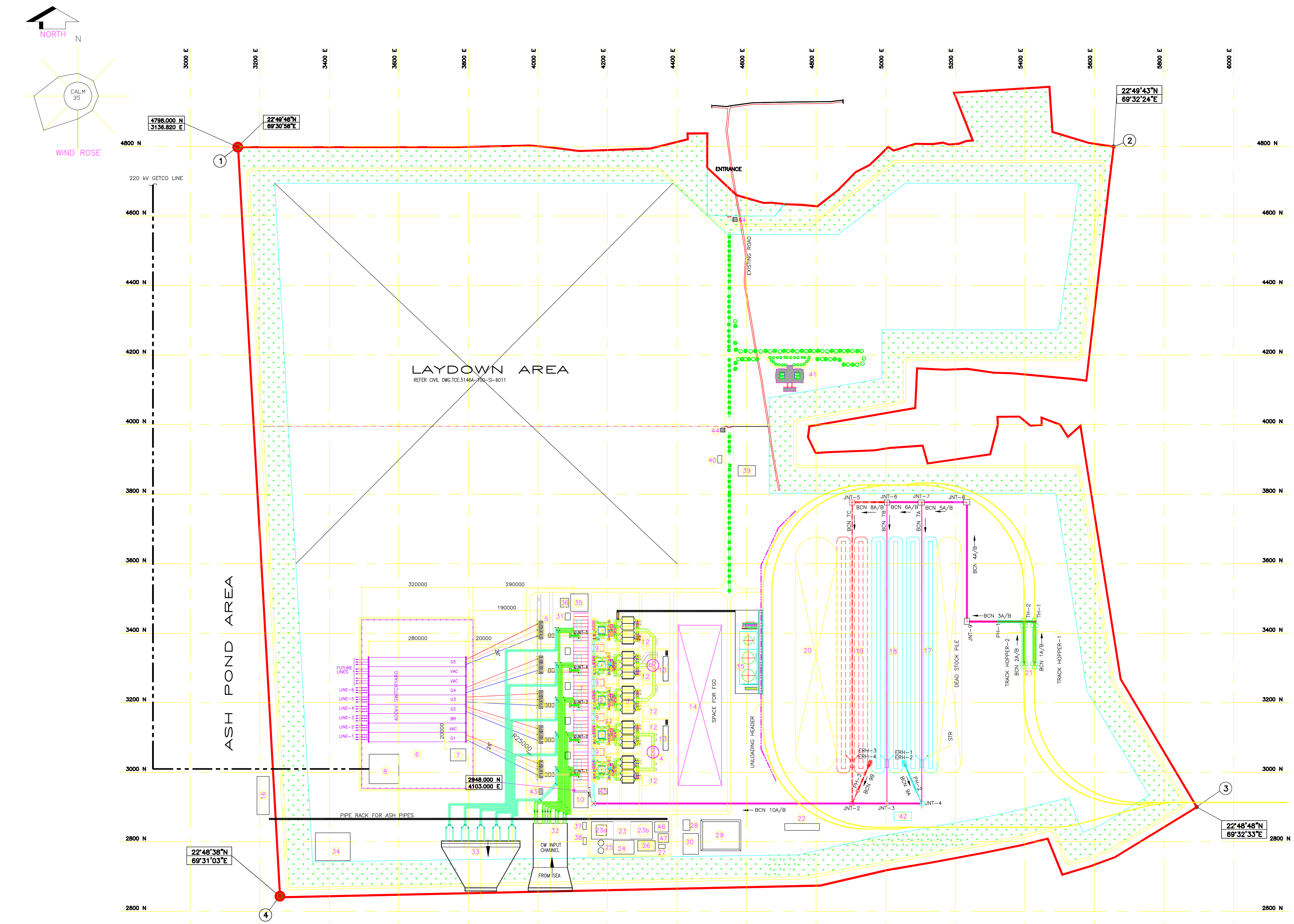
3. The site is barren and generally plain with very little forest cultivation and no habitation. The site for the proposed project is fairly level with minimum undulation and would require nominal filling and grading to an extent of about 1 to 2 metre to grade the plant to the proposed level of 5 m w.r. to MSL. The plant is located more than 500m away from HTL meeting the stipulation of CRZ regulations. Location of intake and outfall channels is shown in Figure III.Ia. Typical process flow diagram for power generation from pulverized coal is shown in Figure III.2.

Project Cost

4. The total indicative cost of the project including cost of pollution control is estimated to be Rs. 18000 Crores (Rupees eighteen thousand crores only). This also includes the cost of once through condenser cooling water system and cost of rail network from Mundra to project site.

Requirement and Availability of Water

5. There is no source of water other than nearby sea. Seawater would be directly used for condenser cooling and the fresh water requirements would be met by installation of a thermal desalination plant . The daily sea water requirement of the proposed 4000 MW (Nominal) coal fired thermal power plant including fresh water requirement is estimated to be 14.26Mm^3/day. The above quantity of seawater would be drawn from nearby sea (Gulf of Kutch), located at a distance of about 2.5 km from the site. Location of intake and outfall channels w.r.t CRZ line is shown in Figure III.1a.



LEGEND

(solid red line)	PLANT BOUNDARY
(yellow hatched line)	RAIL TRACK
(dashed red line)	FUTURE
BCN	BELT CONVEYOR
JNT	JUNCTION TOWER
ERH	EMERGENCY RECLAIM HOPPER
SCR	STACKER CUM RECLAIMER

SL. No.	DESCRIPTION OF FACILITY	SIZE
1.	TG BUILDING	
2.	STEAM GENERATOR	
3.	ELECTROSTATIC PRECIPITATOR	
4.	CHIMNEY	
5.	TRANSFORMER YARD	
6.	SWITCH YARD	
7.	SWITCH YARD (400KV) CONTROL BUILDING	45.0Mx35.0M
8.	220 KV SUB STATION	85.0Mx85.0M
9.	SWITCH GEAR BUILDING	36.0Mx20.0M (4Nos.)
10.	SWITCH GEAR BUILDING INCLUDING CONTROL ROOM	41.0Mx45.0M
11.	EMERGENCY POWER GENERATING SET	12.0Mx3.0M (4Nos.)
12.	ESP/ASH CONTROL CENTER	20.0Mx30.0M (5Nos.)
13.	ASH SLURRY PUMP STATION	15.0Mx70.0M (2Nos.)
14.	FLUE GAS DESULPHURISATION	
15.	FUEL UNLOADING AND STORAGE AREA	
16.	FLY ASH SILO	35.0Mx110.0M
17.	CRUSHED COAL STOCK PILE -1 &2	
18.	CRUSHED COAL STOCK PILE -3 &4	
19.	CRUSHED COAL STOCK PILE -5 &6 (FUTURE)	
20.	DEAD STOCK PILE	
21.	TRACK HOPPER	
22.	CHS SWITCHGEAR CUM CONTROL ROOM AREA	100.0Mx20.0M
23.	MED-THERMO COMPRESSION DISTILLATION	50.0Mx50.0M
23a	DM/CPU/ERF PLANT	30.0Mx30.0M
23b.	CONSTRUCTION WATER DISTILLATION PLANT	30.0Mx30.0M
24.	DESALINATED WATER STORAGE TANK	60.0Mx40.0M
25.	DEMINERALISED WATER STORAGE TANK	ø17.0m (2Nos.)
26.	CONSTRUCTIONAL WATER / DM PLANT DESALINATED WATER STORAGE TANK	50.0Mx30.0M
27.	FIRE FIGHTING EQUIPMENT BUILDING	20.0Mx12.0M
28.	SEWERAGE TREATMENT PLANT	20.0Mx30.0M
29.	STORM WATER POND	115.0Mx89.0M
30.	GUARD WATER POND	45.0Mx60.0M
31.	AIR WASHER ROOM	14.0Mx23.0M (5Nos.)
32.	CW PUMP HOUSE	
33.	SEAL WELL	
34.	AREA FOR HYDROGEN GENERATION PLANT	100.0Mx80.0M
35.	SERVICE BUILDING, TECHNICAL OFFICE & WORKSHOP INCLUDING FIRST AID CENTER	50.0Mx50.0M
36.	CANTEEN	25.0Mx25.0M
37.	AC PLANT ROOM	10.0Mx21.0M
38.	ACID/ALKALI STORAGE AND BULK AMMONIA STORAGE	9.0Mx20.0M
39.	WAREHOUSE AND CHEMICAL HAZARDOUS PLANT	50.0Mx30.0M
40.	FIRE STATION	12.0Mx22.0M
41.	ADMIN BUILDING	
42.	COAL RUNOFF PIT	50.0Mx25.0M
43.	SPARE GT	11.0Mx17.0M
44.	GATE AND SECURITY COMPLEX	13.0Mx12.0M (2Nos.)
45.	COMPRESSOR BUILDING	25.0Mx15.0M
46.	AUXILIARY BOILER	40.0Mx30.0M
47.	PACKAGE WATER TREATMENT PLANT	25.0Mx30.0M

NOTES:

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.

FIGURE III.1

ISSUE	REVISIONS	DRN	DATE
P0	ALTERNATIVE-16 OF PLOT PLAN STUDY	RENU	-
P1	MAIN PLANT SHIFTED UP BY 10.0M. CW, WATER SYSTEM, FUEL UNLOADING AREA DOOSAN BOILER, DETAILS ADDED	RENU	30-04-07
P2	WATER SYSTEM, CW PIPES REVISED, ENTRANCE ROADS AND ADMIN BLDG. DETAILS ADDED.	RENU	22-05-07
P3	WATER SYSTEM,TG DECK, BUS DUCT LOCATION, 220 KV SUBSTATION LOCATION, ENTRANCE, ADMIN BLDG. REVISED, PLANT IS MOVED UP BY 15.0M, LAYDOWN AREA MARKED.	RENU	14-06-07

FILE NAME: F040R3.DWG

DO NOT SCALE

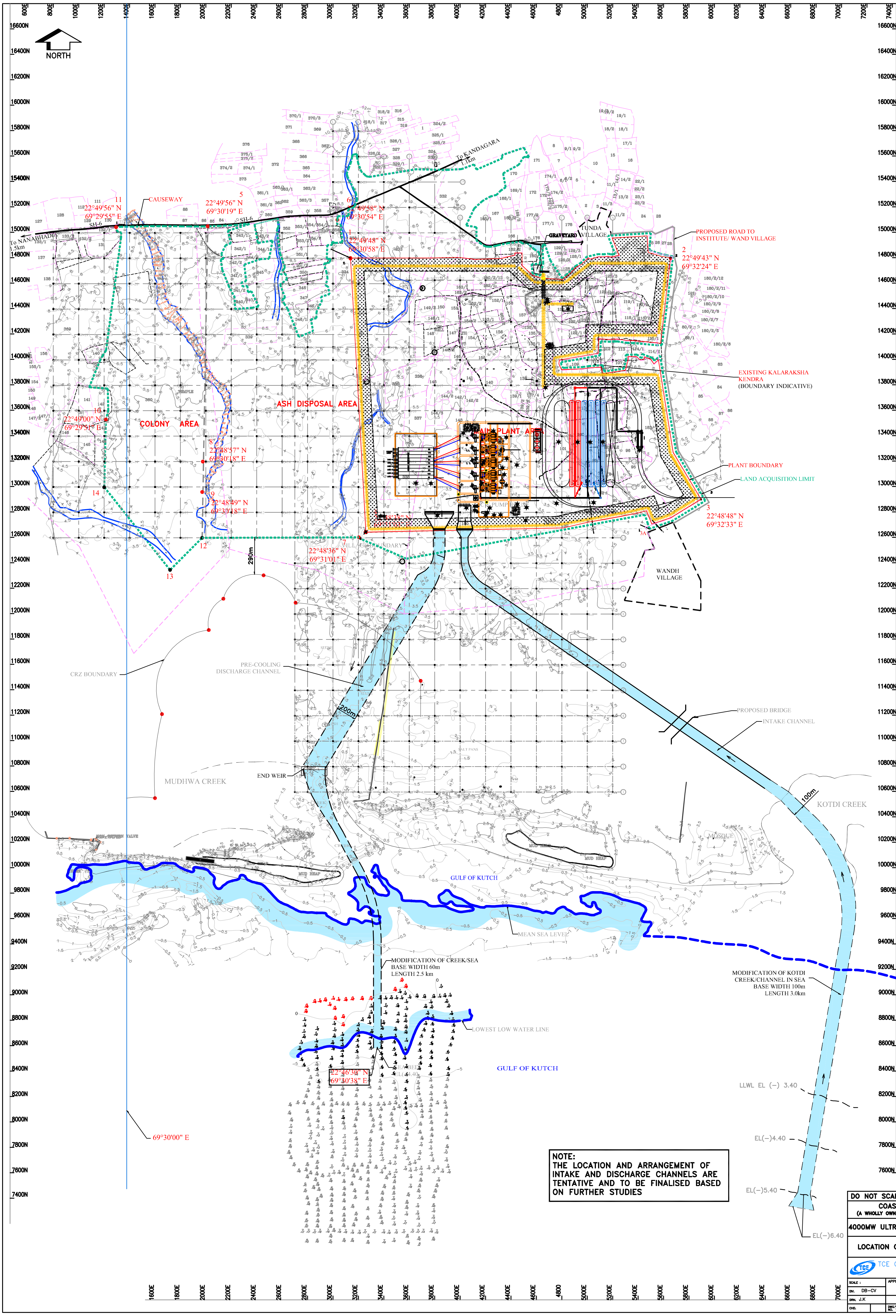
COASTAL GUJARAT POWER LIMITED
(A WHOLLY OWNED SUBSIDIARY OF THE TATA POWER COMPANY LIMITED)

4000 MW ULTRA MEGA POWER PROJECT AT MUNDRA

PLOT PLAN

TCE Consulting Engineers Limited
MUMBAI

SCALE: 1:4000
OFFICE-DISC: DB-ME
DRN: RENU
CHD:
APPROVED
CHIEF MECHANICAL ENGINEER
DATE (R0 ISSUE)
DATE (CURRENT ISSUE)
DWG NO TCE.5146A-100-GA-1051
ISSUE P3
SIZE-A0
TCE FORM NO. 040 R3



LEGEND

PERIMETER BOUNDARY
POWER LINE,
BITUMINOUS ROAD, MUD ROAD
FIELD BUND, SURVEY BOUNDARY, SURVEY NO 153/1
BUILDING: RCC, ACS, TILED
MUD HEAP, WELL, BOREWELL, WATER TANK
GRID PILLAR A-1
HEIGHTS: TRAVERSE POINT, SPOT LEVEL, CONTOUR 3.495
LAND ACQUISITION LIMIT
MAIN PLANT AREA
VILLAGE BOUNDARY
ROAD INSIDE PLANT

NOTES

1. ALL CO-ORDINATES AND ELEVATIONS ARE IN METRES.
2. GTS VALUE (11.0158m) IS CARRIED OUT FROM THE NAVINAL VILLAGE ENGRAVED ON STONE AT SOUTHWEST CORNER OF NORTH PLATFORM OF ENTRANCE TO DARMASHALA ON SOUTH SIDE OF THE VILLAGE & AT 300mts EAST OF VILLAGE TANK
3. SURVEY DETAILS ARE AS ON AUGUST 2006
4. THE COORDINATES INDICATED FOR THE PLANT, INTAKE AND OUTFALL ARE TENTATIVE
5. REVENUE BOUNDARIES INDICATED ARE APPROX AND ARE TAKEN FROM REVENUE MAPS OF KANDAGARA AND TUNDA MOUSAS.
6. (–)1.717 IS THE LOW TIDE LEVEL AS OBSERVED ON 08-04-2006
7. GRID No. A-1 5000E, 595.78N IS TAKEN AS REFERENCE GRID BASE LINE
8. CRZ BOUNDARY IS BASED ON THE MAP NO. 41F09SW, SATTELITE DATA –MARCH 2006 PREPARED BY SPACE APPLICATION CENTRE (ISRO) AHMEDABAD

TIDEL LEVELS AT MUNDRA PORT (CHART 2068)

DESCRIPTION	LEVELS w.r.t. GTS BM
MEAN SEA LEVEL (MSL)	0m
MEAN HIGHER HIGH WATER LEVEL (MHHW)	2.1m
MEAN LOWER HIGH WATER LEVEL (MLHW)	1.6m
HIGHEST TIDE LEVEL	3.0m
MEAN HIGHER LOW WATER LEVEL (MHLW)	(–)1.4m
MEAN LOWER LOW WATER LEVEL (MLLW)	(–)2.2m
LOWEST LOW WATER LEVEL (LLW)	(–)3.4m

NOTE:
THE LOCATION AND ARRANGEMENT OF INTAKE AND DISCHARGE CHANNELS ARE TENTATIVE AND TO BE FINALISED BASED ON FURTHER STUDIES

DO NOT SCALE	FIGURE–III.1a

COASTAL GUJARAT POWER LIMITED
(A WHOLLY OWNED SUBSIDIARY OF THE TATA POWER COMPANY LTD.)

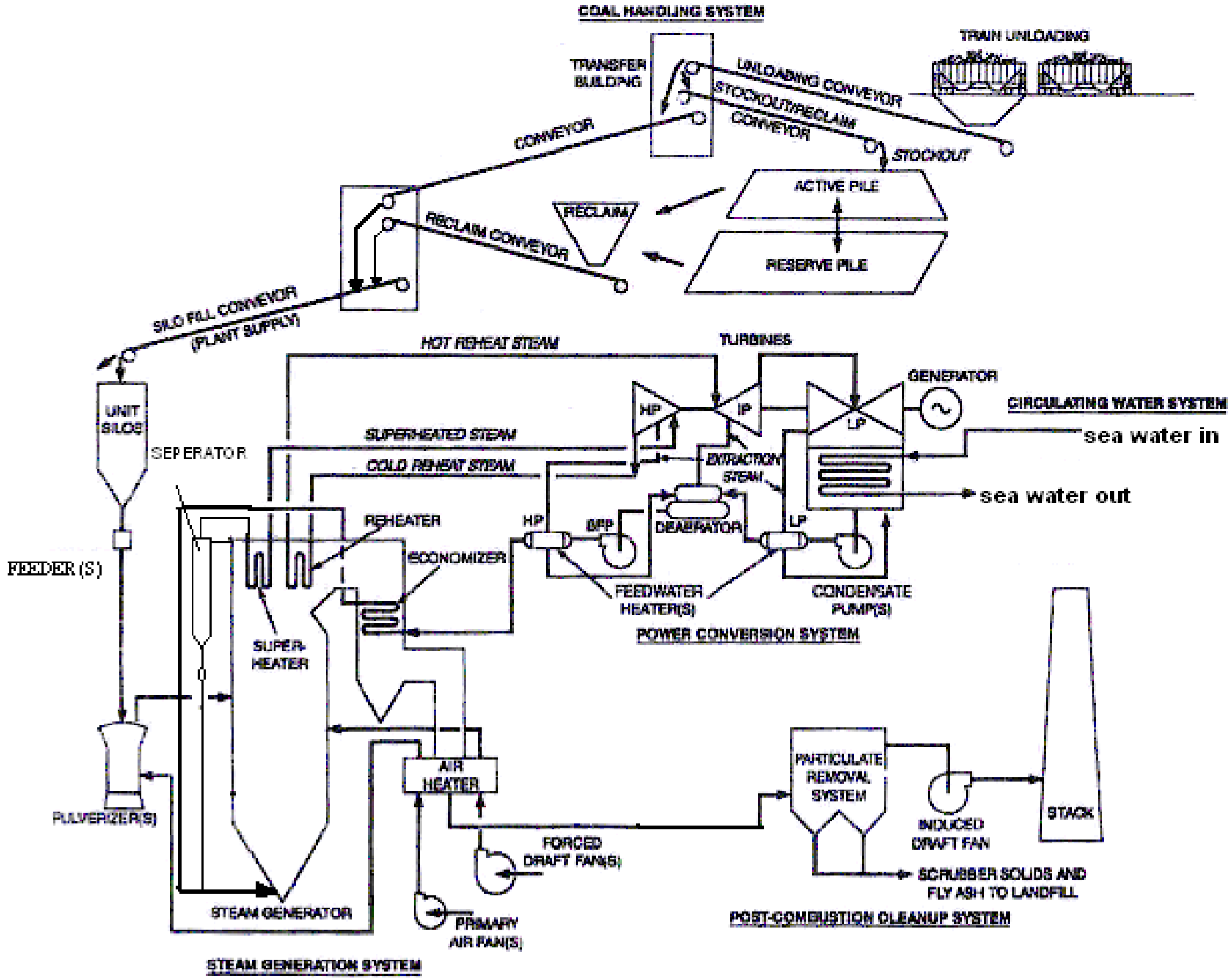
4000MW ULTRA MEGA POWER PROJECT AT MUNDRA

LOCATION OF INTAKE & DISCHARGE CHANNELS

TCE CONSULTING ENGINEERS LIMITED
MUMBAI

SCALE :	APPROVED	DATE (RO ISSUE)
DIV. DB–CV	CHIEF CIVIL ENGINEER	DATE (CURRENT ISSUE) 01-06-2007
DRN. J.K		
CHD.	DWG. NO. TCE–4861A–100–SI–5702	ISSUE P0

FIGURE-III.2
Process Flow Diagram for Power Generation from Pulverized Coal



6. The seawater would be drawn to the plant boundary through an open channel excavated to a depth of about 3 m below lowest tide water level. The width of channel required would be about 100 m to draw an estimated cooling water flow of about 594,200 m^3/hr. channel will be designed for 620,000 m^3/hr. The intake channel would be routed through Kotdi Creek. An on shore pump house located within the plant boundary will house the cooling water pumps. Water balance scheme for once through cooling system is shown in Figure III.2a.

7. Once through or cooling tower system is indicated for the proposed UMPP to determine economics of power unit. However, developer has the freedom to choose the type of cooling water system based on least cost tariff.

PLANT WATER SYSTEM

8. Plant water requirement of 14.26Mm^3/day will be met from nearby sea (Gulf of Kutch). Seawater is used directly for condenser cooling and fresh water is generated from sea water through a desalination plant. Fresh water is used for other services such as Demineralization (DM) plant (for SG make-up), coal handling / ash handling system, potable water for plant / colony, air conditioning system makeup and plant service water. Seawater analysis of sample collected from Gulf of Kutch is furnished in Appendix-1.

9. For condenser cooling, a once through cooling system is proposed which would be economical as the site is located in coastal area close to sea. Seawater drawn from the sea is conveyed to the fore bay/sump in the plant area through a skimmer wall and open intake channel arrangement. Water from sump is pumped to the condenser by 2x50% capacity concrete volute pump for each unit. Hot water from condenser is led back to the sea through a seal well discharge channel arrangement.

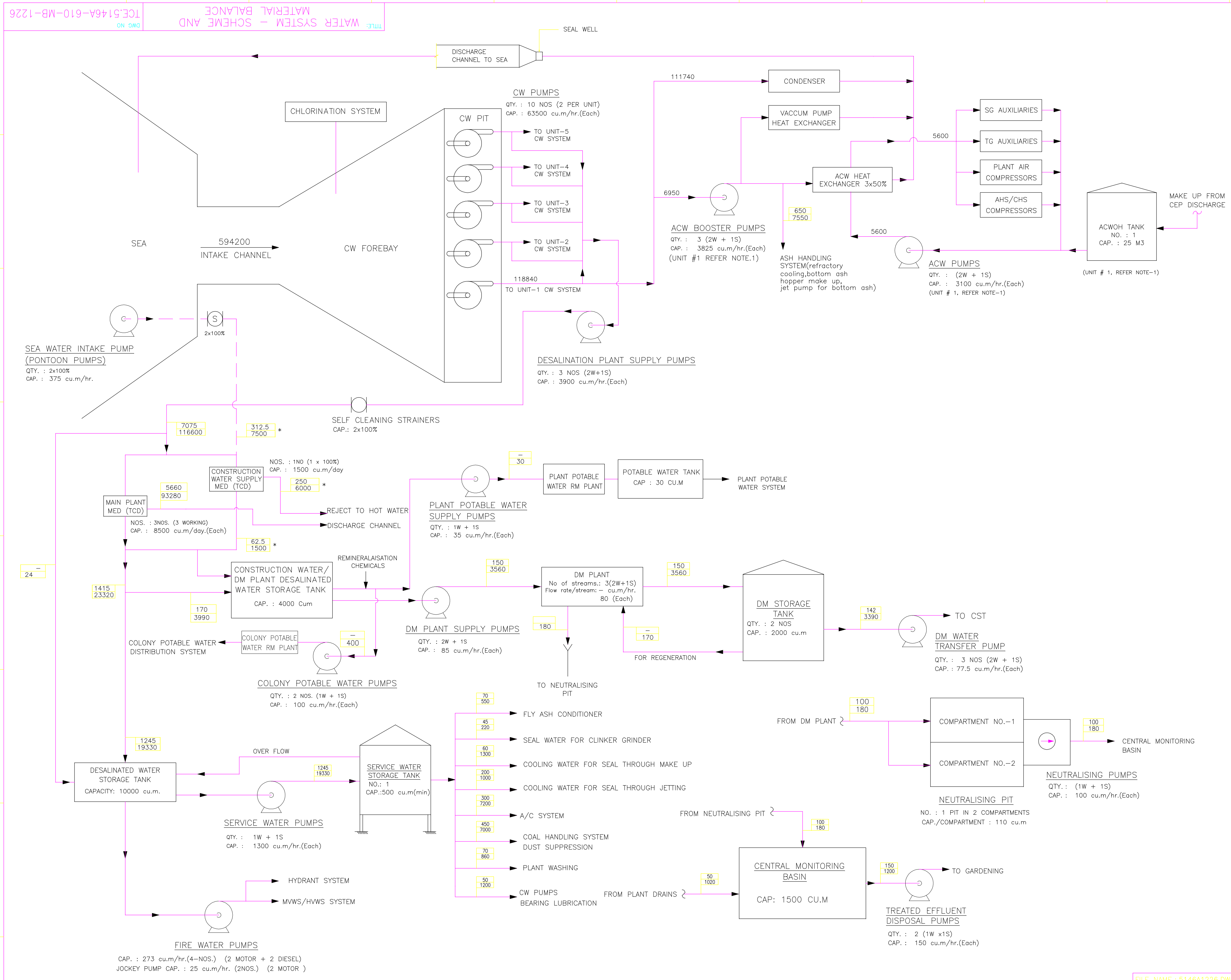
10. Adequate measures would be provided to limit the hot water temperature as per MoEF requirement. Suitable travelling water screens and stop logs at CW sump, Debris filter with on load tube cleaning system for condenser, and chlorination system (through chlorine dioxide system) for dosing chlorine at CW sump for marine growth control are proposed.

11. For cooling of TG / SG auxiliaries and other plant auxiliaries, passivated DM water is used. Hot DM water from the auxiliaries is cooled in plate type heat exchangers (3 x 50% for each unit) by seawater tapped of from condenser cooling water system and recirculated to the auxiliaries. 3 x 50% capacity pumps for each unit are proposed for both primary (DM water) and secondary [seawater] circuit.

12. Sea water pumped by separate set of pumps from CW sump is passed through a thermal desalination plant (MED).The desalination water (Fresh water) is led to a desalinated water storage tank from where water is distribute to various services.

13. Demineralised water required for steam generator make up and auxiliary cooling water system makeup is generated from desalinated water through ion exchange type DM plant (33.33% capacity streams – Cation – Anion – Mixed bed unit or Mixed bed unit only depending up on quality of desalination water).

14. For potable water to plant and colony, water from desalination water storage tank, after suitable treatment is pumped to an overhead tank from where it is distributed to various consumer points.



LEGEND

	CIRCULATING FLOW RATE cu.m/hr.
CEP	CONDENSATE EXTRACTION PUMPS
HVWS	HIGH VELOCITY WATER SPRAY
MVWS	MEDIUM VELOCITY WATER SPRAY
ACW	AUXILIARY COOLING WATER
CW	CIRCULATING WATER
CAP	CAPACITY
CST	CONDENSATE STORAGE TANK
SG	STEAM GENERATOR
TG	TURBINE GENERATOR
A/C	AIR CONDITIONING
DM	DE-MINERALISED
AHS	ASH HANDLING SYSTEM
TCD	THERMO COMPRESSION DISTILLATION
MVC	MECHANICAL VAPOUR COMPRESSION
RM	REMINERALISATION PLANT
	CONSUMPTION IN cu.m/hr. CONSUMPTION IN cu.m/day

NOTES

1. THE ACW SYSTEM IS SHOWN FOR ONE UNIT ONLY. HOWEVER PLANT AIR COMPRESSOR & AHS COMPRESSORS ARE SIZED CONSIDERING COOLING WATER REQIREMENTS FOR ALL THE FIVE UNITS TOGETHER. FOR ACW PUMPS SIZING THE TOTAL COOLING WATER REQUIREMENTS OF PLANT AIR COMPRESSORS & AHS COMPRESSORS IS DISTRIBUTED SO THAT THE SAME CAN BE CATERED BY ANY OF THREE UNITS IN OPERATION
2. CAPICITY OF DESALINATION PLANT SHALL BE AS FOLLOWS.
   a) MAIN PLANT MED(TCD) : 25500 m3/day (3 x 8500Cum/hr)
   b) CONSTRUCTION WATER SUPPLY MED(TCD) : 1500m3/day (1 x 1500 Cum/hr)
3. DURING CONSTRUCTION STAGE, CONSTRUCTION WATER SHALL BE SUPPLIED FROM CONSTRUCTION WATER MED UNIT.THIS UNIT SHALL BE INTEGRATED WITH MAIN PLANT MED LATER
4. ITEMS MARKED THUS * ARE ONLY DURING CONSTRUCTION PERIOD.

Figure–III.2a

DO NOT SCALE

COASTAL GUJARAT POWER LIMITED
(A WHOLLY OWNED SUBSIDIARY OF THE TATA POWER COMPANY LIMITED)

4000 MW ULTRA MEGA POWER PROJECT AT MUNDRA

WATER SYSTEM – SCHEME AND MATERIAL BALANCE

TCE Consulting Engineers Limited
MUMBAI

SCALE: N.T.S. | APPROVED | CHIEF MECHANICAL ENGINEER | 21-06-2007

DWG NO: TCE.5146A-610-MB-1226 | ISSUE: P1

FILE NAME: F041R3.DWG | TCE FORM NO. 041 R3

15. Fresh water for other miscellaneous services in the plant is pumped from the desalinated water storage tank to service water overhead tank from where water is distributed to various services.

Fire Protection System

16. For controlling / extinguishing fire in the plant, portable fire extinguishers / hydrant system covering all areas of plant, high velocity water spray system covering transformers, turbine lube oil system and boiler burner front and medium velocity water spray water covering cable galleries and coal conveyors would be provided. Water for fire fighting purposes would be supplied from the desalination water storage tank through suitable pumping system.

Effluent Disposal

17. All plant process drains and plant surface drains (except rain water) after suitable treatment for oil removal will be led to a guard pond from where the effluent would be utilized for horticulture and coal / ash dust suppression.

18. The desalination plant reject water would be discharged to sea, through the CW discharge channel.

COAL HANDLING SYSTEM

General

19. This system covers proposed facilities for transport of coal from the exporting country to power plant by the sea cum rail route, unloading and conveying coal up to the bunkers of the steam generators (SGs) or to the stockyard.

Design Criteria and Assumptions

20. The design criteria is based on the following functional requirements and assumptions:

a) Coal for each 800 MW (Nominal) unit of the ultra mega power plant at maximum continuous rating (MCR) condition based on imported coal having an average gross calorific value (GCV) of 5700 kcal / kg would be about 295 t/hr. The coal consumption with worst coal having GCV of 5350 kcal/kg would be about 318.4 t/hr. The annual coal requirement would be 11-13 million tonnes that would be imported from countries like Indonesia, Australia and South Africa.

b) A coal stockyard for stacking of coal required for a minimum period 30 days has been considered to take care of any adverse eventualities.

c) Coal would be received by ships at Mundra Port and would be transported to plant site by rail by merry go round system with BOBR wagons.

d) Coal handling system would be designed for the proposed 5x800 MW (Nominal) Units.

e) Two streams of conveyors (2 x 50%) are proposed throughout the power plant except for the emergency reclaim conveyor.

System Capacity

21. Based on coal firing rate of 315 TPH and 16 hours of operation, the system capacity works out to 3500 TPH. Two stream of 2000 TPH each will be provided.

System Description

22. The system description is furnished in the following paras. Process flow diagram for power generation is shown in Figure III. 2.

Coal Conveying to SG Bunkers

23. Coal received by rail through BOBR wagons would be unloaded at the track hopper to be installed by the power project developer. The coal unloaded in to the track hopper would be conveyed either to the power plant bunkers or to the power plant stock yard by the in plant coal crushing, stacking, reclaiming, conveying and bunker feeding system of required capacity to be installed by the power developer.

Coal Storage

24. For the proposed units, space provision has been made in the coal stockyard to store about 30 days requirement of coal for all the five 800 MW (Nominal) Units. As the coal would also be stocked in Mundra port by Adani group it is proposed to provide storage for 30 days in the power plant area to take care of any adverse eventualities. The necessary stacking and reclaiming system of required capacity would be provided by the power plant developer. The management of the stockpiles meant for the power plant in side the Mundra port would be by the power plant developer.

ASH HANDLING SYSTEM

General

25. The following data have been considered for design of ash handling system:

(a) Hourly coal firing rate at MCR condition per unit for imported coal : 342 TPH

(b) Ash content in coal considered for design of ash handling system : 15 %

(c) Distribution of total ash produced as

- Bottom ash : 20 %
- Fly ash : 80%

(However for design, fly ash content would be considered as 90%)

(d) Volume occupied by one tonne of ash in Storage area : 1 cu.m

(e) The system adopted for bottom ash removal would be jet pump system and for fly ash removal, dry type pneumatic system

(f) Fly ash disposal would be either in dry form or wet slurry form

Capacity and Time Cycle

26. The expected bottom ash handling system is 60 TPH per unit and that of fly ash handling system would be 50 TPH per unit (indicative) during continuous operation and 100 TPH based on evacuation of fly ash collected in eight (8) hours in four (4) hours time during emergency. However, these would be reviewed and finalized by power plant developer.

System Description

Bottom ash handling system:

27. Bottom ash collected in the bottom ash hopper below the boiler furnaces would be conveyed by jet pump up to the ash slurry sump for further disposal in wet form.

Fly ash (FA) handling system

28. The fly ash collected at various hoppers would be conveyed pneumatically to FA storage silos. The air would be vented out to atmosphere after passing the same through bag filters to mitigate the environmental pollution. The dry fly ash collected in fly ash silos would be either disposed off in dry or in wet form.

Power Evacuation

29. The following lines are proposed for power evacuation and additional four lines will be identified in due course.
    a) Mundra- Limbdi 400 kV double circuit line
    b) Mundra- Ranchodpur 400 kV double circuit line
    c) Mundra-Jetpur 400KV double circuit line.

Site Topography and Grade Level

30. Site and its vicinity is characterized by presence of sand dunes on the south side close to the sea and practically small streams and small creeks. The land, identified for the project is fairly graded with minimum undulation and would require only nominal filling to grade the plant to the proposed level of about 5 m above MSL.

Soil Characteristics

31. As per the preliminary geotechnical investigations carried out, the soil is predominantly clayey sand in nature.

Foundations

32. Preliminary geo-tech investigation is carried out in the proposed power plant site to ascertain the soil profile and decide on the safe bearing capacity to be considered for the foundation design of major buildings/structures, major equipment. Based on the investigation carried out, pile foundation is envisaged for all the major structures.

Machine Foundations

33. The turbine-generator pedestal would be of reinforced concrete frame structure and would be isolated from the building foundations and super-structure.

PLANT LAYOUT

Station Building: General Arrangement (Illustrative)

34. The main plant along with all the auxiliary systems has been shown in Plot Plan Figure III.1. The station building would be a non-basement structure. The steam turbine generators and auxiliary equipment, feed cycle equipment and electrical equipment would be located in the building.

35. The turbine - generator bay would have three floors - ground floor at 0.00 M level, mezzanine floor at 9.5 M level and operating floor at 17.00 M level. The exact levels of these floors would be finalized during the detailed project report. Localised O&M platforms at required levels would be provided. The deaerator would be located at appropriate floor elevation over the boiler feed pump bay. Road access would be provided to the unloading and maintenance bays for unloading TG components and auxiliary equipment.

36. The superstructure will be of structural steel framing with RCC floor slabs. Brick work side cladding up to 3.0 m above operating floor level and metal sheet cladding above this level has been considered. The roof of the TG bay would be insulated metal sheet. Building will have crane girder at a suitable elevation to support the E.O.T cranes. Intermediate floors are supported with internal columns around TG foundation.

37. The turbine-generator pedestal would be of reinforced concrete frame structure and would be isolated from the building foundations and super-structure.

Steam-Generator Area and Mill Bay 5 X 800 MW (Nominal)

38. The mill bay would be located in between the TG building and the steam generators. The mill bay would be about 15m width and would have floors above the mills for the feeders and the trippers. Concrete paving would be provided in the steam generator and ESP area with necessary drains and trenches. Pipes and cables in this area would, in general, be routed on overhead pipe / cable racks.

Stack

39. Two multiflue stacks (one with 3 flues and the second one with 2 flues, each flue of 7.5 m inside diameter) of 275 m height will be provided for 5 x 800 MW (Nominal) steam generator units. This will meet the requirement of Indian Emission Regulations

Control Room

40. A common control room with unitized electronic cabinet rooms would be envisaged as required.

Sea Water Intake

41. The Mundra UMPP is located in the vicinity of Gulf of Kutch. The area experiences scanty rainfall and arid conditions persist in the region. Considering non-availability of fresh water and availability of sea water in abundance, it is proposed to use sea water for condenser cooling system. Sea water of about 620,000 m^3/hr would be drawn from the Gulf of Kutch through the Kotdi creek.. To draw the required flow, it would be necessary to have a channel with a base width of about 100m. In order to improve hydraulic conditions of the creek for drawing the flow, it is proposed to modify the creek, by widening and deepening suitably. The intake channel will

commence from a depth of 3m below Chart Datum or Lowest Tide Level. The length of the channel till the plant boundary would be about 6.5 km. The alignment of channels through creek (Ref. Fig. III.1a) is on tentative basis and will need to be finalized based on detailed bathymetric survey. On shore pump house located within the plant boundary will house the cooling water pumps (15 nos.). Analysis of sea water is given in Appendix-1.

Sea Water Outfall

42. The hot water will be discharged back to the sea through a discharge channel through the Mudhwa creek. The base width of the discharge channel within plant area will be about 60m . For a length of about 1.9 km outside the plant boundary upto the Mudhwa Creek, the channel is proposed to be designed as a pre-cooling channel, to ensure that at the creek location the temperature of the hot water is not more than 7°C above the ambient water temperature. A base width of about 200m is expected for the pre cooling channel based on the first order design. An end weir will be provided at the creek to ensure proper mixing of hot water with receiving water body. A channel will be provided beyond the creek upto an elevation of 1m below the lowest low tide level. The tentative location of discharge channel is indicated in Fig. III.1a.

43. The intake and discharge channels would be planned and designed based on the thermal dispersion study and hydraulic model study to be carried out by reputed agencies like the Central Water and Power Research Station (CWPRS).

Rain Water Collection

44. It is planned to provide a properly designed rainwater harvesting scheme. In order to conserve the rain water and use the available rainwater, a rainwater pond is planned in the plant layout. The collected water would be treated and used in the plant mainly for spraying for coal stockyard and gardening.

Ash Bund

45. The ash bund would be constructed in the land area of 241 Ha with homogeneous earth fill consisting of impervious core in the middle and semi impervious core for the balance area of bund. Side slope of 2.5 horizontal to 1 vertical would be provided on outer side of the bund and side slope of 2 horizontal to 1 vertical would be provided on inside of the bund. The ash bund would be lined suitably to avoid seepage of ash water into the ground. The minimum height of the ash bund would be about 5 m and this would be raised gradually at 3 m per raise. The raising of ash bund would be done using pond ash and impervious core as hearting with earth cover on outer surfaces.

Miscellaneous Buildings

46. Table- III.I indicates list of major buildings / structures planned in the power plant.

Table – III.I
Buildings / Structures 5 x 800 MW Units (Illustrative)

Sl. no	Buildings / Structures	Type of Construction
1.	Cooling water pump house (CW Pump House)	RC sump with steel superstructure with sheet cladding with EOT crane
2.	CW pumps MCC room	Single storeyed RC framing with brick cladding
3	Desalinated water storage tank and filtered water storage tank	RC construction
4.	Filtered water pump house and desalinated water pump house with MCC rooms	Single storeyed RC framing with brick cladding with EOT crane
5.	Pre-treatment – clarification plant	RC construction
6.	Filtration plant with chemical house & MCC room	RC framing with brick cladding with EOT crane
7	Desalination plant with associated demineralizer plant and MCC room	Single storeyed RC framing with brick cladding
8.	ESP control room	Two storeyed steel / RC framing with brick cladding
9	Fuel oil dyke	Open area
10.	Fuel oil pump house	Single storeyed, steel / RC framing with brick cladding
11.	Coal handling switch gear & control room	Single storeyed, steel / RC framing with brick cladding
12.	Administration building	RC framing with brick cladding
13.	Canteen	Single storeyed, RC framing with brick cladding
14.	Ware houses	Structural steel framing, metal cladding & roofing
15.	Gate/security house	Single storeyed, RC framing with brick cladding
16.	Ash slurry pumps, compr. +MCC+ control room	Single storeyed, steel / RC framing with brick cladding, with monorail

Sl. no	Buildings / Structures	Type of Construction
17.	Hydrogen plant	Single storeyed, RC framing with brick cladding, monorail with 5 T lifting capacity
18.	Diesel Generator house	Single storeyed, RC framing with brick cladding, monorail with 5 T lifting capacity
19.	Air washer block	Single / two storeyed, steel framed building with brick cladding
20.	Service building	Two storeyed, steel framing with brick cladding
21.	Workshop	Single storeyed, steel framing with metal cladding with EOT Crane.
22.	Fire station	Single storeyed, RC framing with brick cladding
23.	Switchyard control room	Single storeyed, RC framing with brick cladding
24.	Electro chlorination plant	Single storeyed, RC framing with brick cladding

Roads And Fences / Compound Wall

47. The roads would initially be of wet mud macadam type with shoulders on either side of carriage width. After major construction activities are completed, these would be surfaced with bituminous carpet. The width of the double lane road would be 7.5 m excluding shoulders and the single lane road would be 4 m. Extra width would be provided on either side, for road side tree plantation, for all internal roads in the plant site. Storm water drains would be provided on either side of the roads. It is also considered to provide RCC roads around boilers and transformers. The proposed compound wall would be of concrete block masonry construction with barbed wire fixed to MS angles on the top.

Drainage

48. Suitable storm water drainage system would be provided to dispose off storm water efficiently from the plant site. The surface water run-off from the main plant area would be discharged into a nalla located on the eastern side of the plant boundary. The surface water run-off from the coal handling plant would be led to a sump for settling and the over flow would be discharged to guard pond located suitably within the plant boundary for treatment and recycling.

Sewage Disposal

49. Sewage from various group of buildings would be led to sewage treatment plant, by means of CI/SW/RCC pipes laid underground.

Landscaping

50. The various services / utility areas within the plant would be suitably graded to different elevations. Natural features of the plant site would be retained as far as possible to integrate with the buildings to form a harmonious / pleasant environment. Areas in front of various buildings and the entrance of power plant would be landscaped with ground cover, plants, trees based on factors like climate, adaptability, etc. The green belt would consist of native perennial green and fast growing trees. Trees would also be planted around the coal stockpile area and ash disposal area to minimize the dust pollution.

Staff Housing

51. The staff housing colony will be located at a distance of within 5 to 10 km from the proposed power plant. Power plant staff are proposed to be accommodated in the colony.

SALIENT FEATURES OF MAIN PLANT EQUIPMENT

Steam Generator

52. The steam generator (SG) would be once through type.

53 The steam generators (SG) would be designed for firing 100% imported coal. The SG would be of two pass design, radiant, single reheat, balanced draft and semi outdoor type.

54 The SGs would be dry bottom type. The water walls would be either of spiral wound plain tubes with vertical tubes over the spiral water walls or vertical with riffled tubes type.

55 The SGs would be of corner fired. The furnace would be appropriately sized to avoid slagging in the pedant / platen super heaters and reheaters and in the heat transfer surfaces in convection pass.

56 The coal burners would be of proven advanced design to reduce NO_x production and the furnace would be provided with over fire air ports to further reduce the NO_x production.

57. The SGs would be provided with circulation system, comprising steam separators and circulation pumps to remove the water moisture from the evaporator outlet and recirculate into economizer inlet, for use during start up and shut down.

58. The steam generator would consist of water cooled furnace, radiant and convection super-heaters, re-heaters, economizer, regenerative air heaters, steam coil pre-heaters, etc. Smart soot blower system would be provided with soot blowers located at strategic locations.

59. The steam generator would be provided with five or six vertical spindle medium speed coal mills, which would be located in the boiler front, behind the turbine

generator building. The milling system would be so designed that one (1) mill will be spare with unit operating at MCR capacity firing design coal. All the six (6) mills will be operated with worst coal. The coal mills would be provided with dynamic classifiers to control the fineness of ground coal thereby to control the unburnt carbon losses.

60. Sampling arrangement at mill outlet would be provided for the purpose of establishing the average gross calorific value of coal as well as coal fineness. The coal mills would be provided with steam blanketing system for the purpose of fire protection. The SG would be designed to handle and burn HFO as secondary fuel upto about 25 % MCR (maximum continuous rating) capacity of SG, for start-up and for flame stabilization during low-load operation or during mill change overs. For unit light up and warm up purposes, LDO would be used with air atomization. Alternatively, a suitably sized LDO fired auxiliary package boiler would be provided to supply the unit auxiliary steam including steam for heating up of HFO, in which case the main SGs will not be provided with LDO firing facilities. The fuel oil pressurizing units and fuel oil heating equipment would be appropriately provided along with High-energy electric arc igniters to ignite the fuel oil guns.

61. In order to increase the turbine cycle efficiency and to reduce the boiler feed pump power consumption, the SGs and steam turbine generators be capable of operating on sliding pressure mode. The load range for the sliding pressure operation would be from about 40% steam turbine generator maximum continuous rating (TGMCR) to 100% TGMCR.

62. The draft plant would comprise primary air fans, forced draft fans, and induced draft fans. The draft fans would be provided with features to reduce power consumption during operation of the power plant. Electrostatic precipitator (ESP) and fly ash hoppers would be provided for the collection of fly ash. The ESP would be provided with micro-processor control system to optimize and minimize the electric power consumption. The ESP would be designed for worst coal firing with outlet dust concentration of 100 mg / Nm^3 (Max.) as stipulated by state/central pollution control board to be achieved.

<u>Steam Turbine Generator And Accessories</u>

63. The steam turbine generators (STG) would be rated for 800 MW (Nominal) maximum continuous output at the generator terminals, with throttle steam conditions of 247.05 ata at 565^0C / 593^0C reheat , 0.082 ata condenser back pressure and 0% make up(Heat balance as per Figure-III.2b). The STG output, at valve wide-open (VWO) condition would be about 854.9 MW.

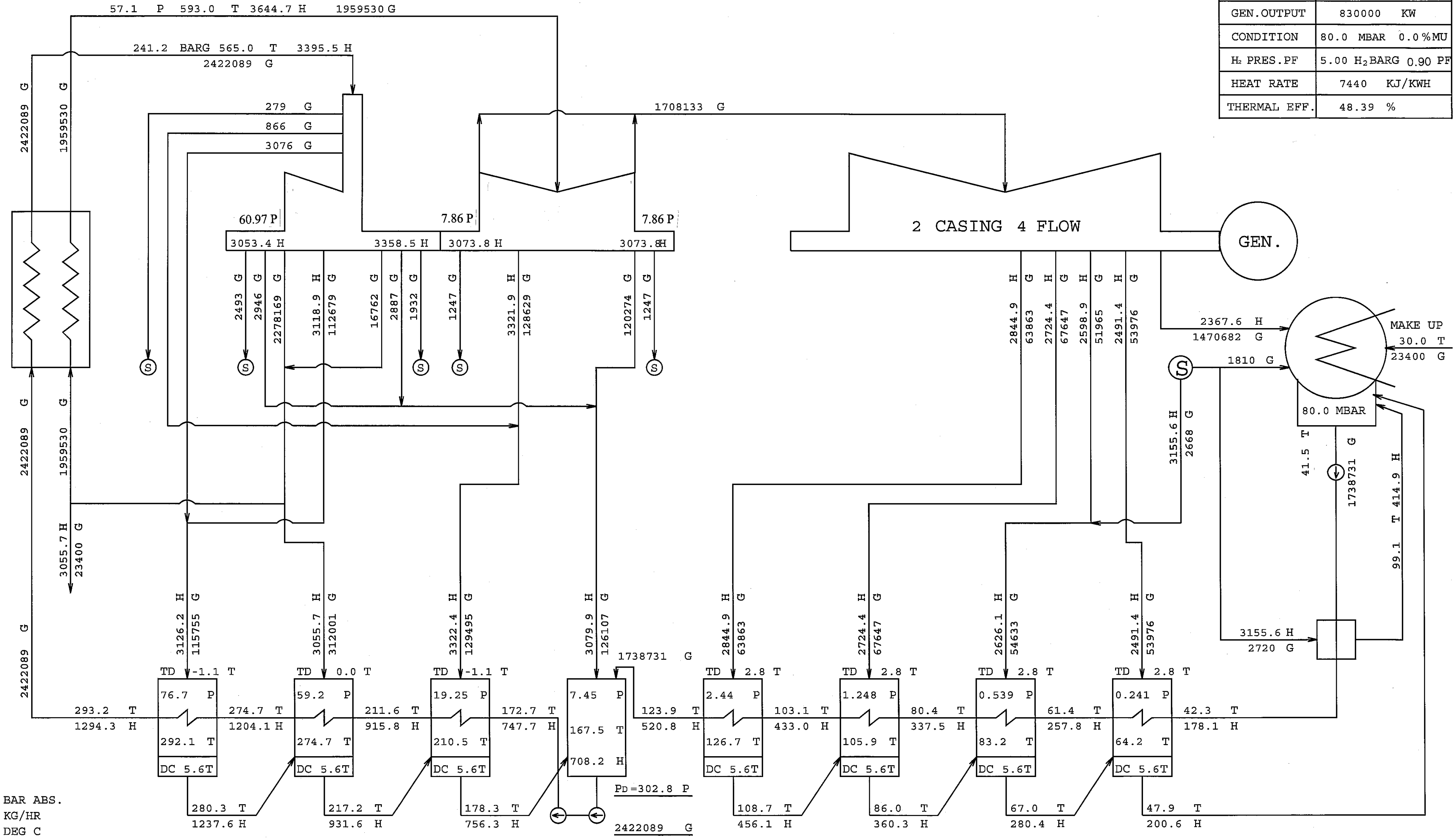
64. The steam turbine would be a four cylinder reheat, extraction and condensing turbine.

65. The turbine generator would be complete with all accessories such as protection system, lube and control oil systems, seal oil system, jacking oil system, seal steam system, turbine drain system, 60% TGMCR HP /LP bypass system, electro-hydraulic control system, automatic turbine run-up system, on-line automatic turbine test system and turbine supervisory instrumentation.

66. The turbine generator would also have all necessary indicating and control devices to permit the unit to be placed on turning gear, rolled, accelerated and synchronized automatically from the control room. Other accessories of the turbine generator would include an oil purification unit with transfer pumps, and clean and dirty oil storage tanks of adequate capacity.

Attachment G01

L O A D	100 % LOAD
GEN.OUTPUT	830000 KW
CONDITION	80.0 MBAR 0.0 %MU
H_2 PRES.PF	5.00 H_2BARG 0.90 PF
HEAT RATE	7440 KJ/KWH
THERMAL EFF.	48.39 %



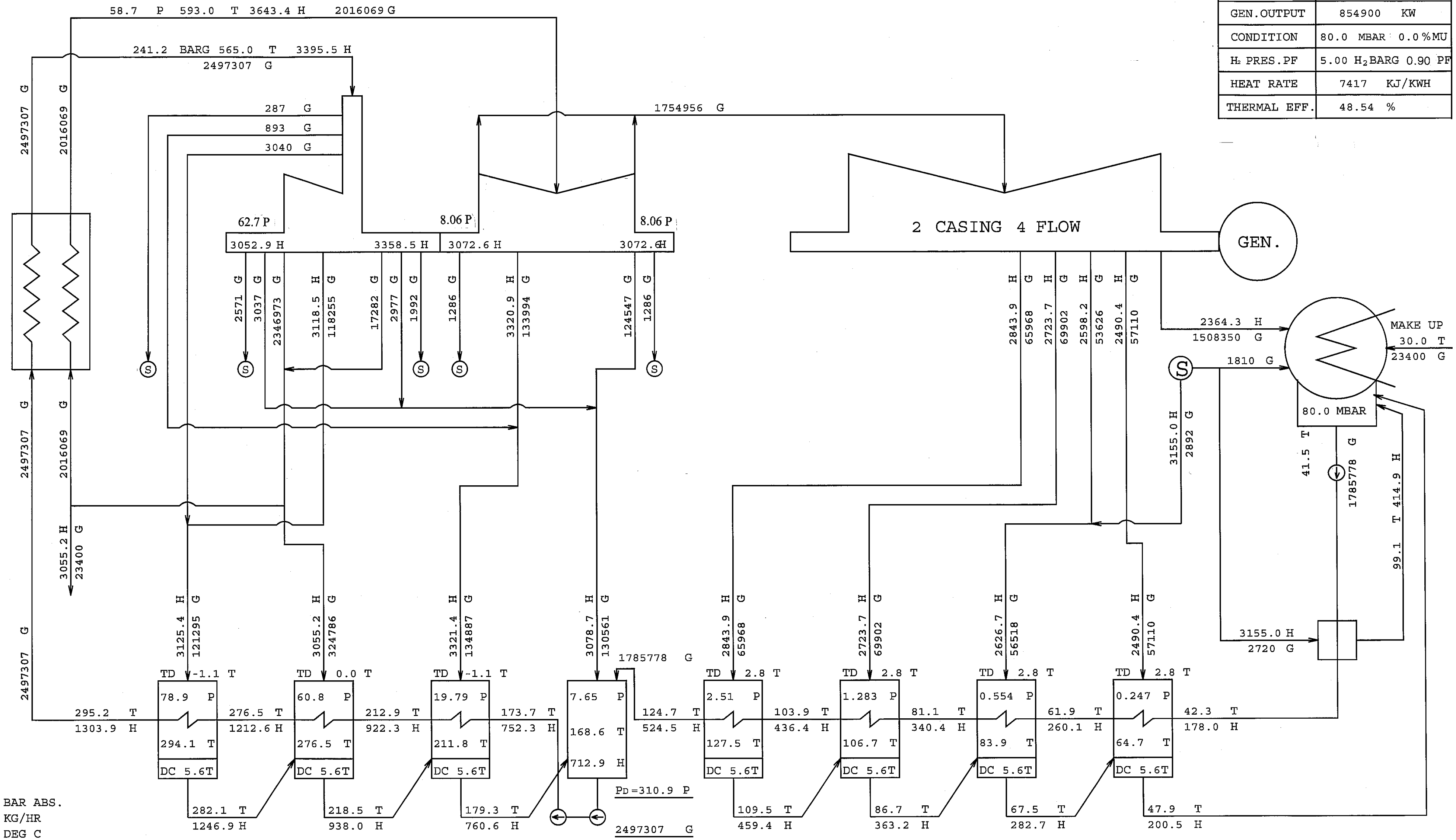
P : BAR ABS.
G : KG/HR
T : DEG C
H : KJ/KG

(2422089 ×3395.5 + 1959530 ×3644.7 + 23400 ×125.6)
— (2422089 ×1294.3 + 1959530 ×3055.7 + 23400 ×3055.7)
- -
6174892237 / 830000 = 7440

APPROVED BY	K. Suzuki 07/4/05	MESSRS. THE TATA POWER COMPANY LIMITED Mundra	830000 KW REHEAT TURBINE
CHECKED BY	K. Suzuki 07/4/05		HEAT BALANCE DIAGRAM
DESIGNED BY	H. Iijima 07/4/05	TOSHIBA CORPORATION	3GMG02231 Rev.1

Attachment G01

LOAD	VWO
GEN.OUTPUT	854900 KW
CONDITION	80.0 MBAR 0.0 %MU
H_2 PRES.PF	5.00 H_2BARG 0.90 PF
HEAT RATE	7417 KJ/KWH
THERMAL EFF.	48.54 %



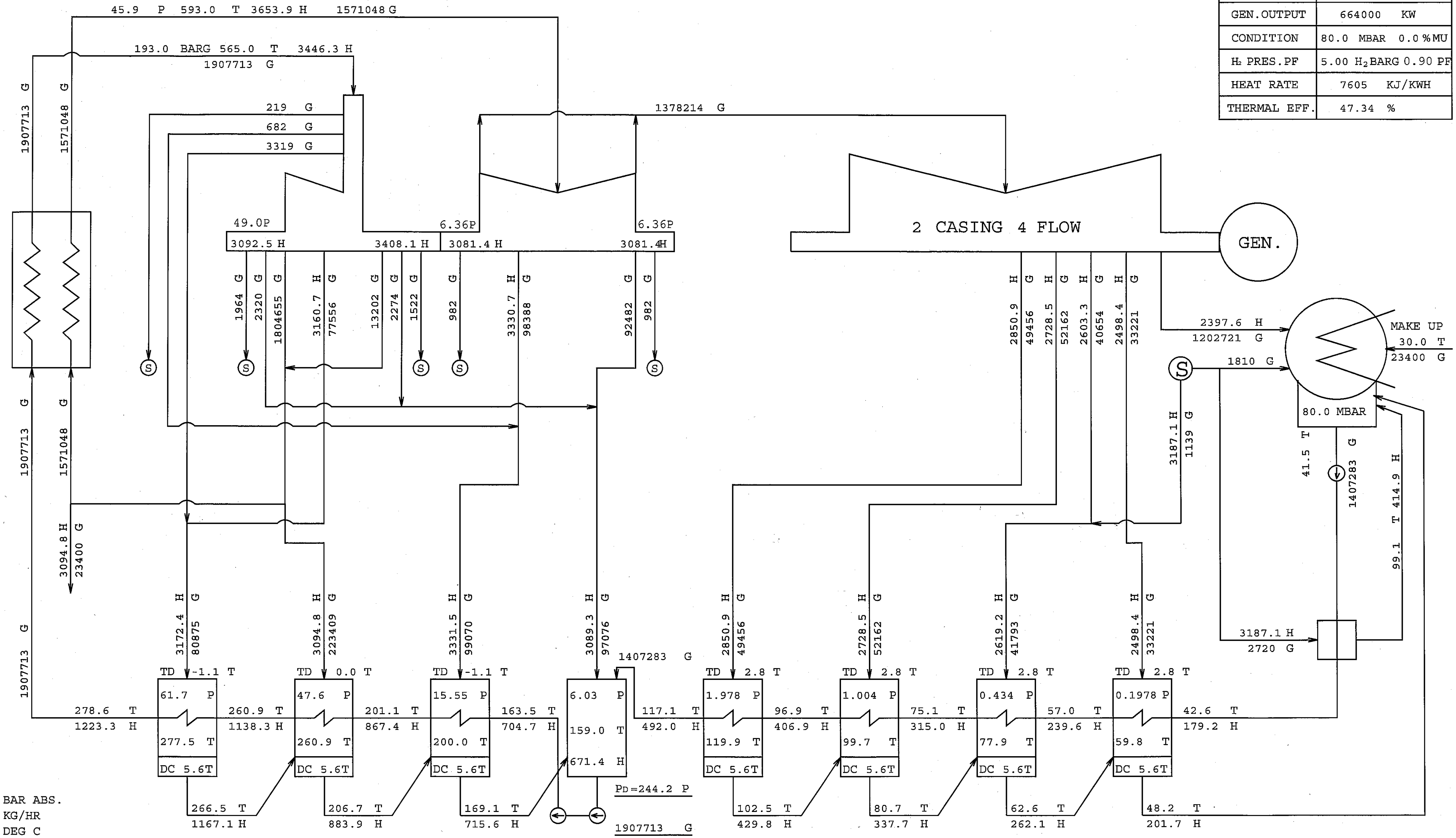
P : BAR ABS.
G : KG/HR
T : DEG C
H : KJ/KG

(2497307 ×3395.5 + 2016069 ×3643.4 + 23400 ×125.6)
— (2497307 ×1303.9 + 2016069 ×3055.2 + 23400 ×3055.2)
6340666467 / 854900 = 7417

APPROVED BY	K. Suzuki 07/4/25	MESSRS. THE TATA POWER COMPANY LIMITED Mundra	830000 KW REHEAT TURBINE
CHECKED BY	K. Suzuki 07/4/25		HEAT BALANCE DIAGRAM
DESIGNED BY	H. Ojima 07/4/25	TOSHIBA CORPORATION	3GMG02232 Rev.1

Attachment G01

L O A D	80 % LOAD
GEN.OUTPUT	664000 KW
CONDITION	80.0 MBAR 0.0 %MU
H_2 PRES.PF	5.00 H_2 BARG 0.90 PF
HEAT RATE	7605 KJ/KWH
THERMAL EFF.	47.34 %



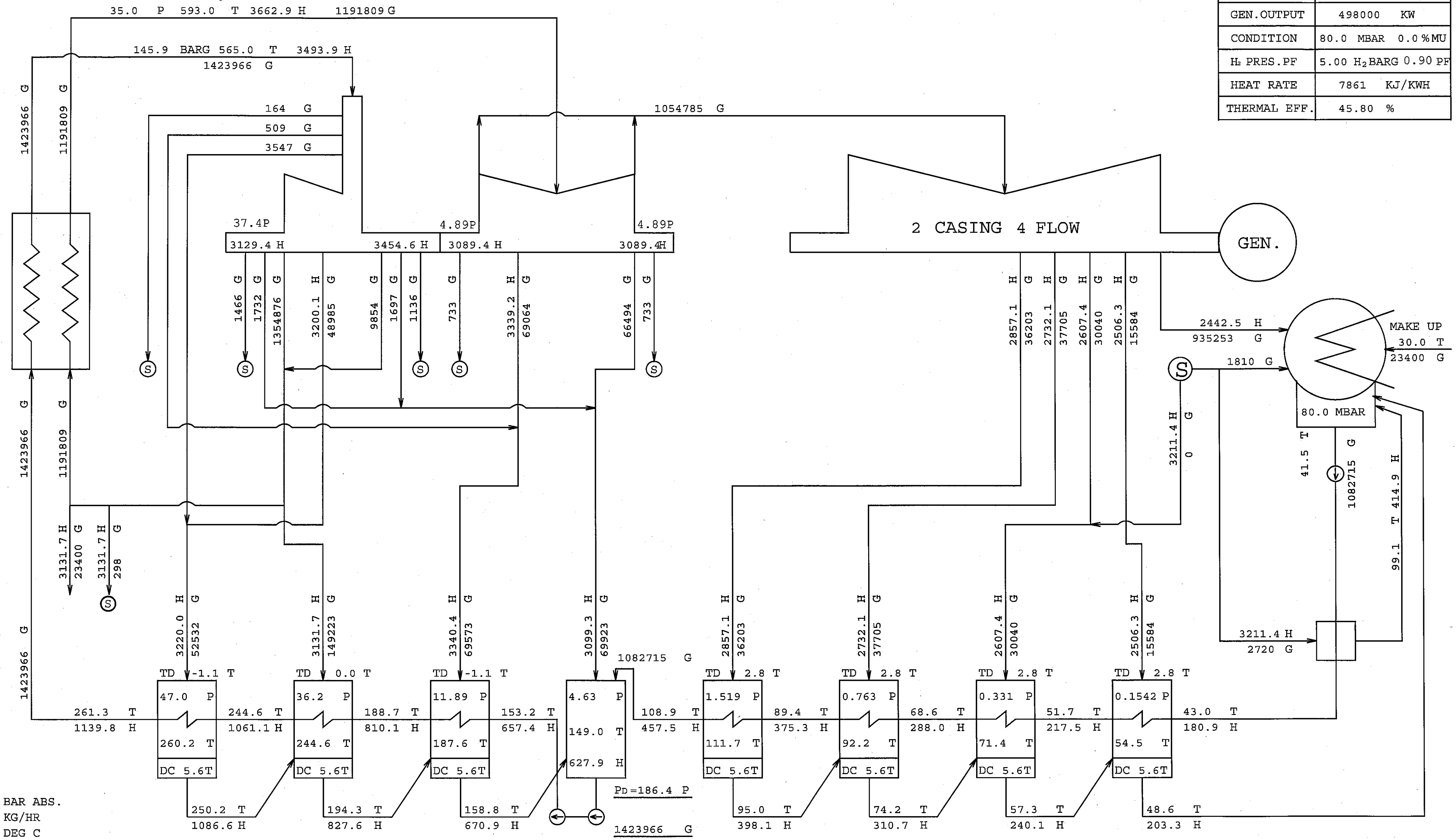
P : BAR ABS.
G : KG/HR
T : DEG C
H : KJ/KG

(1907713 ×3446.3 + 1571048 ×3653.9 + 23400 ×125.6)
— (1907713 ×1223.3 + 1571048 ×3094.8 + 23400 ×3094.8)
- -
5049739656 / 664000 = 7605

APPROVED BY	K. Suzuki '07/5/10	MESSRS. THE TATA POWER COMPANY LIMITED Mundra	830000 KW REHEAT TURBINE
CHECKED BY	K. Suzuki '07/5/10		HEAT BALANCE DIAGRAM
DESIGNED BY	H. [illegible] '07/5/10	TOSHIBA CORPORATION . .	3GMG02265

Attachment G01

L O A D	60 % LOAD
GEN.OUTPUT	498000 KW
CONDITION	80.0 MBAR 0.0 %MU
H_2 PRES.PF	5.00 H_2BARG 0.90 PF
HEAT RATE	7861 KJ/KWH
THERMAL EFF.	45.80 %



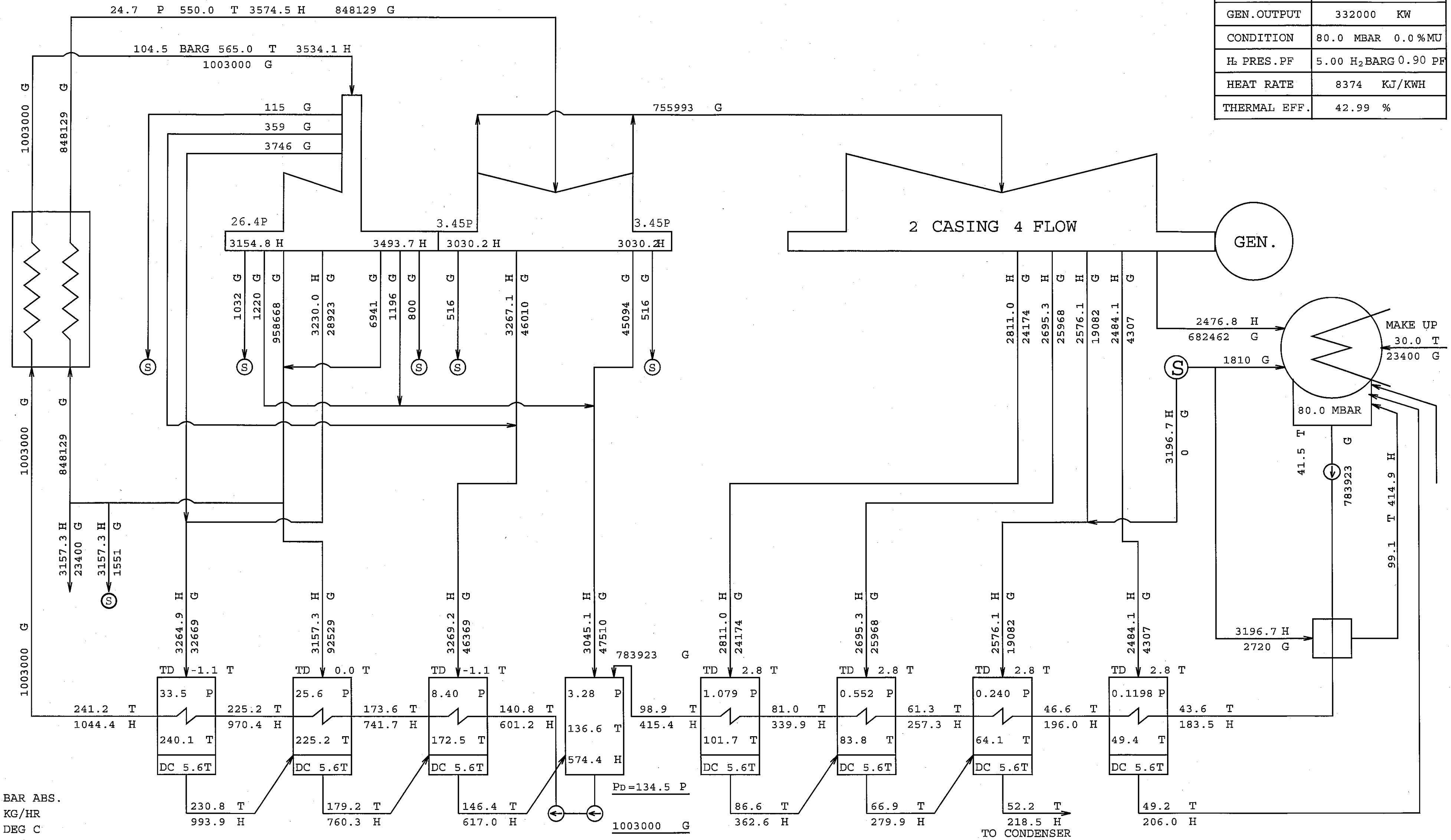
P : BAR ABS.
G : KG/HR
T : DEG C
H : KJ/KG

(1423966 ×3493.9 + 1191809 ×3662.9 + 23400 ×125.6)
— (1423966 ×1139.8 + 1191809 ×3131.7 + 23400 ×3131.7)
- -
3914904561 / 498000 = 7861

APPROV-ED BY	K. Suzuki '07/5/10	MESSRS. THE TATA POWER COMPANY LIMITED Mundra	830000 KW REHEAT TURBINE
CHECK-ED BY	K. Suzuki '07/5/10		HEAT BALANCE DIAGRAM
DESIGN-ED BY	H. Iijima '07/5/10	TOSHIBA CORPORATION	3GMG02266

Attachment G01

L O A D	40 % LOAD
GEN.OUTPUT	332000 KW
CONDITION	80.0 MBAR 0.0 %MU
H_2 PRES.PF	5.00 H_2BARG 0.90 PF
HEAT RATE	8374 KJ/KWH
THERMAL EFF.	42.99 %



P : BAR ABS.
G : KG/HR
T : DEG C
H : KJ/KG

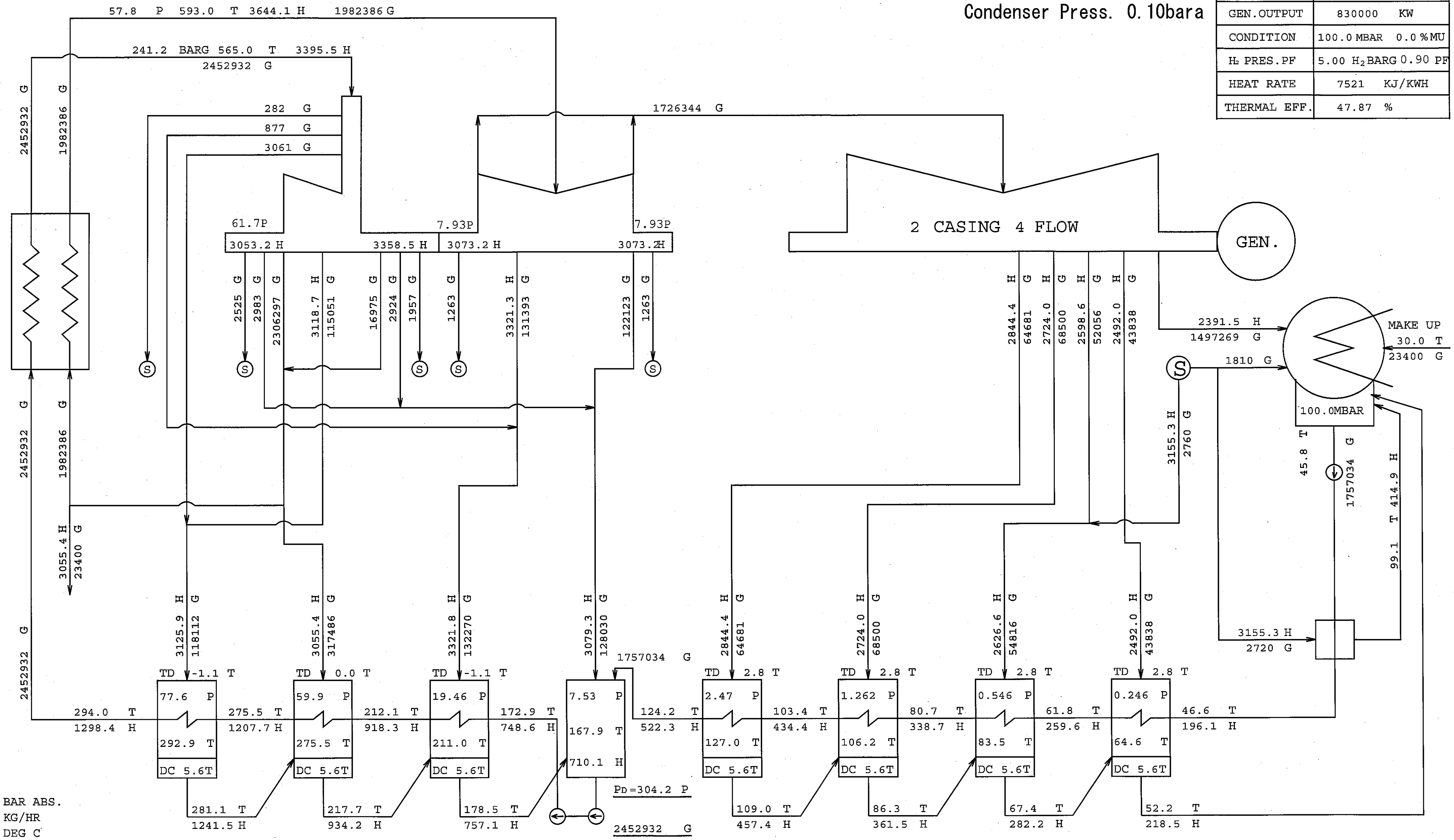
$$\frac{(1003000 \times 3534.1 + 848129 \times 3574.5 + 23400 \times 125.6) - (1003000 \times 1044.4 + 848129 \times 3157.3 + 23400 \times 3157.3)}{} = 2780066739 \ / \ 332000 = 8374$$

APPROVED BY	K. Suzuki '07/5/10	MESSRS. THE TATA POWER COMPANY LIMITED Mundra	830000 KW REHEAT TURBINE
CHECKED BY	K. Suzuki '07/5/10		HEAT BALANCE DIAGRAM
DESIGNED BY	H. [illegible] '07/5/10	TOSHIBA CORPORATION	3GMG02267

Attachment G01

Condenser Press. 0.10bara

L O A D	100 % LOAD
GEN.OUTPUT	830000 KW
CONDITION	100.0 MBAR 0.0 %MU
H_2 PRES.PF	5.00 H_2BARG 0.90 PF
HEAT RATE	7521 KJ/KWH
THERMAL EFF.	47.87 %



P : BAR ABS.
G : KG/HR
T : DEG C
H : KJ/KG

$$\frac{(2452932 \times 3395.5 + 1982386 \times 3644.1 + 23400 \times 125.6) - (2452932 \times 1298.4 + 1982386 \times 3055.4 + 23400 \times 3055.4)}{} $$

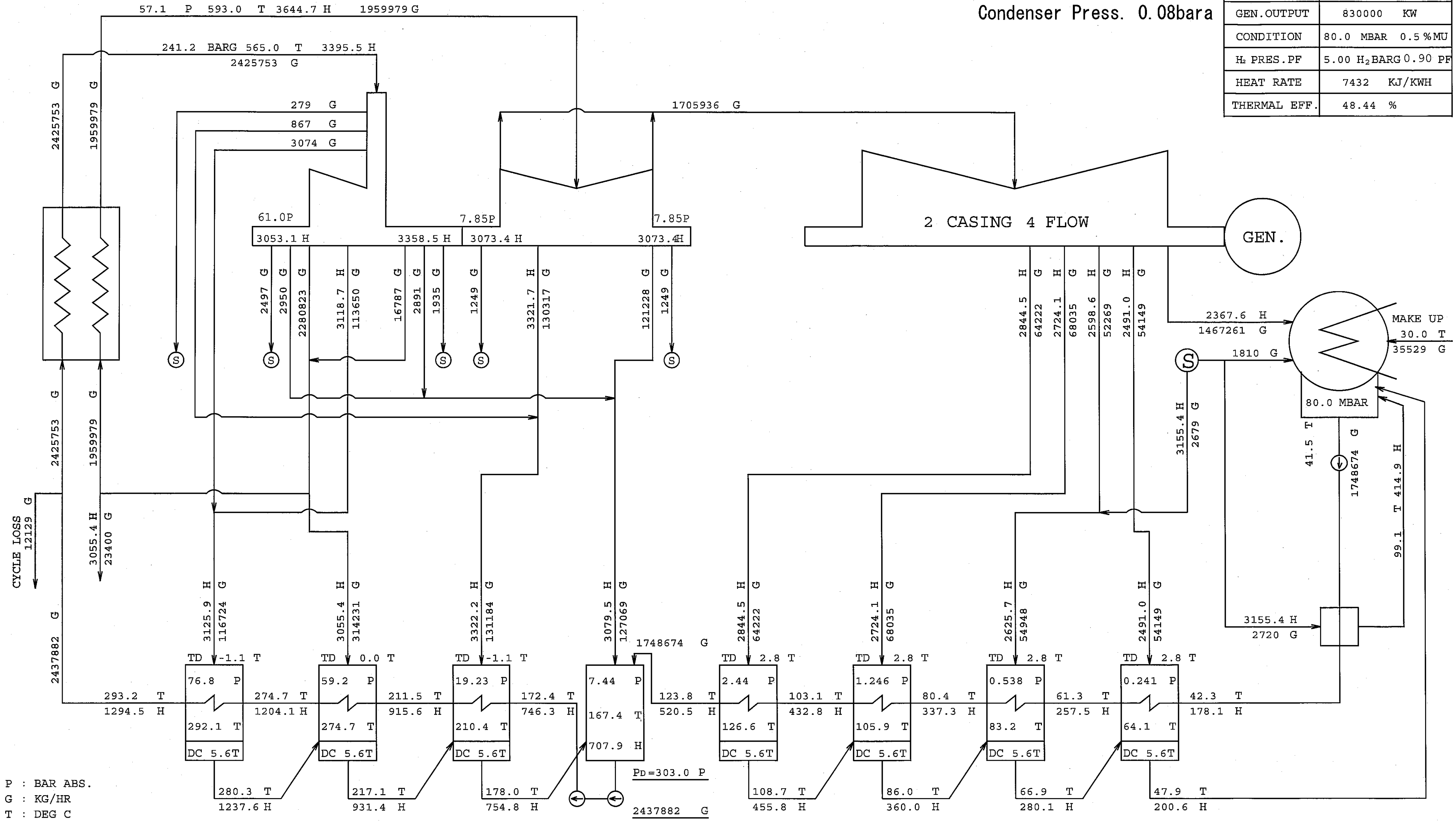
6242517015 / 830000 = 7521

APPROVED BY	K. Suzuki 07/5/10	MESSRS. THE TATA POWER COMPANY LIMITED Mundra	830000 KW REHEAT TURBINE
CHECKED BY	K. Suzuki 07/5/10		HEAT BALANCE DIAGRAM
DESIGNED BY	H. Iijima 07/5/10	TOSHIBA CORPORATION	3GMG02268

Attachment G01

Make Up 0.5%
Condenser Press. 0.08bara

L O A D	100 % LOAD
GEN.OUTPUT	830000 KW
CONDITION	80.0 MBAR 0.5 %MU
H_2 PRES.PF	5.00 H_2BARG 0.90 PF
HEAT RATE	7432 KJ/KWH
THERMAL EFF.	48.44 %



P : BAR ABS.
G : KG/HR
T : DEG C
H : KJ/KG

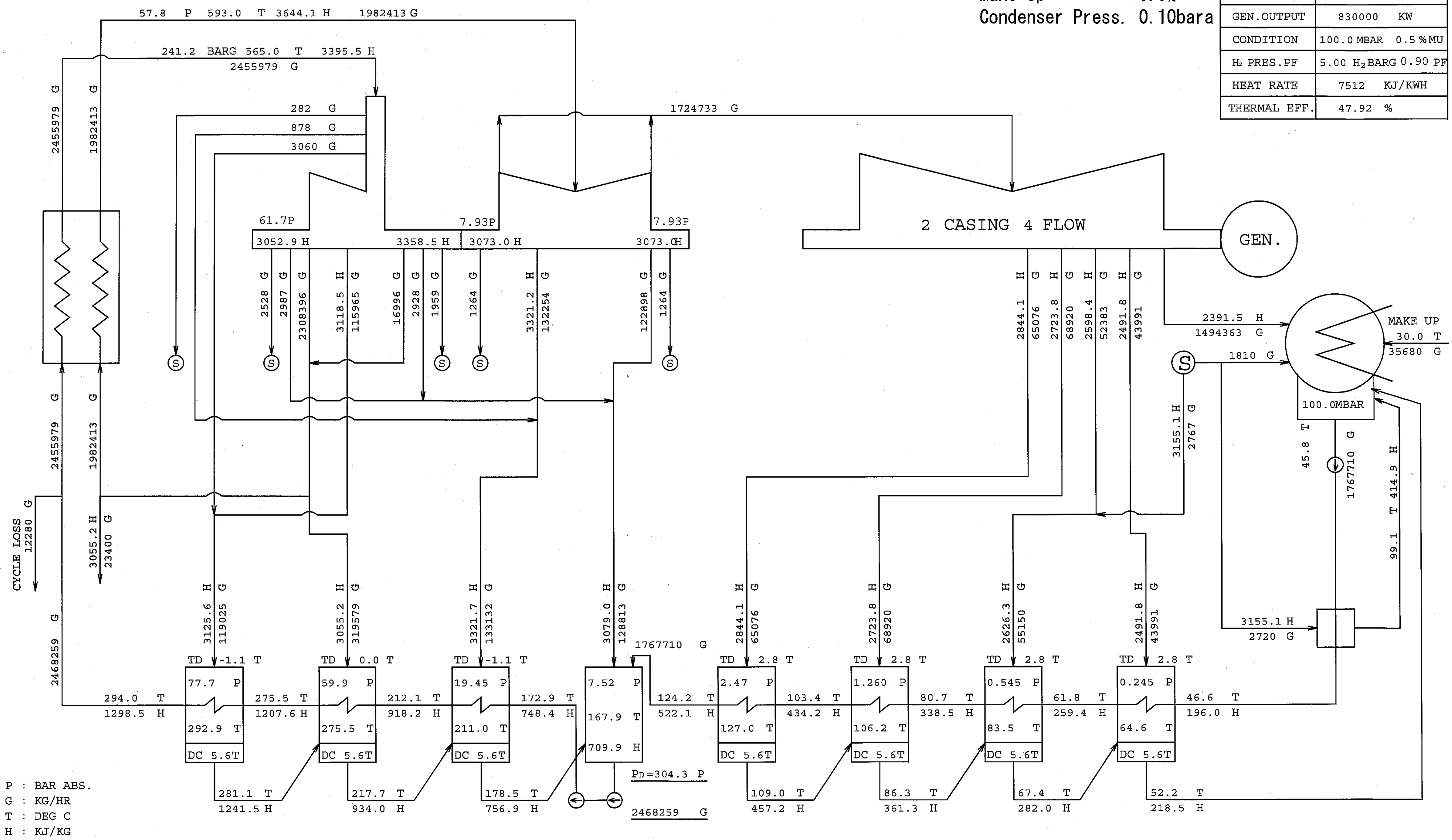
(2425753 ×3395.5 + 1959979 ×3644.7 + 35529 ×125.6)
— (2437882 ×1294.5 + 1959979 ×3055.4 + 23400 ×3055.4)
- -
6168787770 / 830000 = 7432

APPROV-ED BY	K. Suzuki '07/5/10	MESSRS. THE TATA POWER COMPANY LIMITED Mundra	830000 KW REHEAT TURBINE
CHECK-ED BY	K. Suzuki '07/5/10		HEAT BALANCE DIAGRAM
DESIGN-ED BY	H. Fujima '07/5/10	TOSHIBA CORPORATION	3GMG02269

Attachment G01

Make Up 0.5%
Condenser Press. 0.10bara

L O A D	100 % LOAD
GEN.OUTPUT	830000 KW
CONDITION	100.0 MBAR 0.5 %MU
H_2 PRES.PF	5.00 H_2BARG 0.90 PF
HEAT RATE	7512 KJ/KWH
THERMAL EFF.	47.92 %



P : BAR ABS.
G : KG/HR
T : DEG C
H : KJ/KG

(2455979 ×3395.5 + 1982413 ×3644.1 + 35680 ×125.6)
— (2468259 ×1298.5 + 1982413 ×3055.2 + 23400 ×3055.2)

6234675127 / 830000 = 7512

APPROV-ED BY	10/5/10	MESSRS. THE TATA POWER COMPANY LIMITED Mundra	830000 KW REHEAT TURBINE
CHECK-ED BY	10/5/10		HEAT BALANCE DIAGRAM
DESIGN-ED BY	10/5/10	TOSHIBA CORPORATION	3GMG02270

Plant Cycle

67. The condensing plant would comprise two condensers, one each for the two LP turbines. Each condenser would be of two pass design of single shell construction. The condenser would be suitable for use of sea water for condenser cooling. The condenser would have titanium tubes rolled into titanium clad carbon steel sheets. 2 x 100% capacity vacuum pumps would be provided to create vacuum in the condenser during start-up and to remove the non-condensable gases liberated during normal operation.

68. The regenerative cycle would consists of four low-pressure heaters, a variable pressure deaerator, two streams of three high pressure heaters and one gland steam condenser.

69. Under normal operating conditions, drains from the high-pressure heater would be cascaded to the next lower pressure heater and finally to the deaerator. Drains from low pressure heaters would be cascaded successively to the next lower pressure heater and finally to the condenser hot well. The exact routing of the drains in low pressure heater system i.e, ultimate draining to condenser or to pumped forward to condensate line would be decided during the optimization of number of heaters. Heaters would be provided with drain level controls to maintain the drain level automatically throughout the range of operation of the heaters. The system would consist of split-range control valves to take the drain to a lower pressure heater or to the condenser through a flash box.

70. The TG unit would be provided with a TGMCR HP-LP bypass system:

(a) To prevent a steam-generator trip in the event of a full export load throw-off and to maintain the unit in operation at house load.

(b) To prevent a steam-generator trip following a turbine trip and enable quick restart of the turbine generator set.

(c) To minimize warm restart duration of the unit after a trip.

(d) To conserve condensate during start-up.

(e) To facilitate quick load changes in both directions without affecting the steam generator operation during start-ups.

Feed Cycle Equipment

Condensate Pumps

71. The condensate from the condensate hot well would be pumped by 2 x 100% capacity condensate pumps, one working and one standby to the de-aerator, through the gland steam condenser, drain cooler and low pressure heaters. The pumps would be vertical, cannister type, and multistage centrifugal pumps driven by AC motors.

Boiler Feed Pumps

72. Feed water would be pumped from the deaerator to the steam generator through the high pressure heaters by means of 2 x 50% capacity motor driven boiler feed pumps provided with variable speed hydraulic coupling. The boiler feed pumps would be horizontal, multistage, centrifugal pumps of barrel type.

Low Pressure Heaters

73. The low pressure heaters would be of shell and tube type with U-shaped stainless steel tubes, with their ends rolled in carbon steel tube sheets.

Deaerator

74. The deaerating feed water heater would be a direct contact, variable pressure type heater with spray-tray type or spray type of deaeration arrangement. The feed water storage tank would have a storage capacity adequate to feed the steam generator for 6 minutes when operating at MCR conditions.

High Pressure Heaters

75. The high pressure heaters would be of shell and tube type with stainless steel U-tubes welded into carbon steel tube sheets. The HP heaters would be provided with a de-superheating zone and a drain cooling zone in addition to the condensing zone.

Gland Steam Condenser

76. A surface type gland steam condenser would be used to condense the gland steam exhausted from the turbine glands. The gland steam condenser would be of single-pass type with the main condensate flowing through the tubes to condense the steam. Exhausters would be provided to evacuate the air from the shell side and maintain the shell at the required negative pressure.

Turbine Lube Oil and Control Fluid System

77. A complete lubricating oil system would be provided for the steam turbine generator unit. The control fluid system may be fully separated from the lubricating oil system or integrated with the lube oil system as per the turbine manufacturer's standard. The lube oil system would comprise lube oil pumps, main oil tank, lube oil coolers, lube oil filters, piping, valves, fittings etc. The control fluid system would have its own pumps, motors, coolers, strainers, piping, valves and fittings.

Turbine Lube Oil Purification System

78. The quality control of lubricating oil is important for maintenance management of a turbine,.Hence removal and separation of the solid and water which are mixed into the oil are necessary. For the lube oil purification purpose it is proposed to provide filter type (coalescer) oil purifier.

Condensate Polishing Unit

79. In order to maintain high purity of the feed water condensate polishing unit is envisaged in the condensate system.

Fuel Oil System

80. The steam generators would be designed for the use of heavy fuel oil (HFO) for start up and flame stabilization purposes.

81. The steam generators would be provided with a light oil (LDO) system for initial light up and warming up of the steam generators. In addition, one common auxiliary package boiler with LDO as the fuel is also being tentatively planned. The steam from this boiler

would cater to the auxiliary steam during start-up and also would heat up the HFO, which in turn would be used for steam generator light up and warming up purpose.

82. Necessary facilities for fuel oil receipt, storage and forwarding to steam generators would be provided in the premises of power plant.

Chemical Dosing System

83. Ammonia dosing system would be provided to ensure chemical conditioning of the condensate / feed water for controlling the alkanity. The ammonia solution would be injected into the condensate at the condensate extraction pumps discharge.

84. The low-pressure ammonia dosing system would comprise solution preparation-cum-metering tanks with motorised agitators, two positive displacement type dosing pumps, piping, valves, instruments and local control panel. Each dosing pump would be sized to cater to the 100% dosing requirements of each of the 800 MW (Nominal) units. Oxygen dosing will also be provided.

CHAPTER - IV

BASELINE ENVIRONMENTAL CONDITION

CHAPTER – IV

BASELINE ENVIRONMENTAL CONDITION

1. In order to predict anticipated impacts due to any project, it is necessary to obtain baseline information of the environment, as it exists, which would serve as a datum. The interaction of baseline environment and the anticipated impacts are the basis for the environmental management plan for the activities of the proposed power plant.

2. Major activity for the proposed ultra mega power plant includes construction of foundations for steam turbines, storage areas, switchyards and other auxiliary structures for the establishment of proposed power project. This chapter includes existing scenario for various environmental components of the study area.

BASELINE DATA

3. The baseline status of environmental quality in the vicinity of project expansion site serves as a basis for identification and prediction of impact. The baseline environmental quality status is assessed through field studies within the study area for various components of environment, viz, air, noise, water, land, biological and socio-economic. The baseline environmental quality of the study area of 10 km radius from the proposed project has been identified through network method. Also 25 km radius around the project site has been covered for general area of study. The cause -condition - effects are devised for the individual environmental components as well as overall impact.

4. Baseline data collection for each of the environmental components is based on the location of proposed project and anticipated distance of the significant impact. The study area is defined for each of the environmental components independently taking into consideration the vulnerability of the environmental component with respect to the activity of proposed expansion.

METHODOLOGY

5. A general reconnaissance survey of the study area was done before the selection of sites for environmental monitoring. The area covered took into consideration was the accessibility to the sampling sites, topography of the area, major habitation and location of sensitive areas. Some of the recently generated data from secondary sources were also collected and used as baseline information.

PROJECT SITE

6. PFC has identified a potential site for development of proposed coastal power project of 4,000 MW (Nominal) located at Mundra taluka, Kutch district, in Gujarat state. Alternative sites near Kandla Port was also selected but not considered because of a) Non-availability of the sufficient draft for handling 12 MT/annum of coal, b) inadequate coal handling facility and c) unsuitable land consists of salt pans and owned by private people.

7. CGPL intend to install a 4000 MW (Nominal) coal fired thermal power station at site in coastal area at Tundawand village to take advantage of available

habitated land, sea water, proximity to Mundra port (approximately 22 km) and other infrastructure required for the same. The layout map of the proposed power plant is presented in Figure III.1 in Chapter-III.

8. The site is located near Tundawand village at Mundra taluka, Kutch district of Gujarat Coastal area. The proposed project site is located at 22 km from Mundra port. The site is well connected with state Highway no. SH-50 (via Anjar) and SH-6 (via Gandhidham) and would be near to NH-8A (Delhi-Kandla).

9. The nearest railway station is Adipur and is 57 km away from the site. The railway station is well connected to multi-terminal Mundra port through broad gauge railway system owned by M/s. Adani Group. The nearest airport is Bhuj which is about 60 km from site. The site is about 2.5 km from the sea (Gulf of Kutch). The latitude and longitude of north-west corners are 22^0 49’ 48” N and 69^0 30’ 58” E respectively. The location of proposed site is shown in Figure II.1 in Chapter-II.

10. The seawater from Gulf of Kutch is the major source of water for the proposed power plant as there are no sources of sweet water. The location for intake water is identified at about 6.5 km from the plant site.

11. The 4000MW (Nominal) power plant is proposed to be located in a site near Tundawand village. The plant would be located considering CRZ regulations. The boundary of the main power plant is more than 500 m away from the High Tide Line (HTL). A satellite map indicating HTL and LTL is attached as Appendix-2. The land required for the power plant including ash disposal area is estimated to be 1242 Ha, and for housing colony about 182 Ha. The details of the land is given as under

S.No	Plant Facility	Village	Area (Ha)	Ownership
1.	Main Plant Area	Tunda/ Kandagara Sub-Total	88 12 218 169 130 617	Govt. Waste Land, Govt. (Gaucher) MSEZ *(to be notified & allocated to UMPP) Private land Forest land to be allocated
2.	Ash Disposal (Ash corridor, ash dyke, dry ash collection system)	Kandagara	241	Govt. Waste land
3.	Colony	Nana Bhadiya	182	Govt. Waste Land
4.	MGR System	6. From Mundra Port to UMPP Site	100	Govt. Forest and MSEZ and Private Land
5.	Intake Outfall Channel		102	Govt. Land
		Total	1242 Ha	

12. Category wise (ownership) land breakup is shown as below:

S. No	Ownership	Area (Ha)
1.	Government Land	653
2.	MSEZ Land	218
3.	Private Land	169
	Total	**1040**

The land acquisition process is underway.

13. The site for the proposed unit is fairly graded with minimum undulation and would require nominal filling and grading of the plant to the proposed level of about 5 m MSL.

14. The power plant site is located in seismic Zone -V as per IS 1893 classification and therefore seismic factor of 1.5 will be considered for all designs.

15. The proposed site is remotely situated from major town or eco-sensitive spots including national park, wildlife sanctuary, biosphere reserve, historical and cultural sites and defence installation, places of historical, religious and cultural importance.

16. Provision of green belt has been kept within the premise of proposed power plant. For raising plantation adequate saplings would be planted covering about 33% of the total acquired area in side the power plant. The green belt would consist of native perennial green and fast growing trees. Trees would also be planted around the coal stockpile area and ash disposal area to minimise the dust pollution. Sanghi cement plant located at 145km from project site at Sanghipuram and cement plant proposed by M/s Adani and other industries has been considered as potential user of the ash generated from the power plant.

17. Separate housing colony for power plant staff is proposed near power plant within 5 km to accommodate 1200 persons. The area of the colony will be about 182 Ha.

<u>PHYSIOGRAPHY AND DRAINAGE</u>

18. Due to gentle gradient towards the sea (Gulf of Kutch) most of the water flows in the sea within short span of time. The area is drained by several rivers and small tributaries, which are of dendritic pattern which remains dry in almost all the season. The seasonal rivers (rain fed) flowing through Mundra Taluka are River Nagmati, Bhukhi, Khari nadi and Phot, all in turn terminates to Gulf of Kutch. Alll rivers are dry most of time except for monsoon season. Khari nadi flows from North to South near Kandagara village, passes through Tundawand and terminates into the sea.

19. River Nagmati enters from NE and flows towards South and meets Gulf of Kutch near Jarpara village. River Bhukhi flows from North to South while Phot River flows from Village Bocha at North of Taluka and merge in the Gulf of Kutch, South of Taluka near Mundra. In Mandvi Taluka the seasonal rivers are Rukmavati, Kharod and Vantharadi. Mundra lies close to the Narmada Main Canal. The Narmada drinking water pipeline is passing close to the port and water is being tapped from Jarpara area.

20. The main source of water for the proposed power plant will be seawater. The seawater from Gulf of Kutch located at about 2.5 km from the site, will be utilized for the project, as there are no source of sweet water. Seawater would

be directly used for condenser cooling and the fresh water requirement would be met by installation of a desalination plant.

21. The surrounding area of the proposed project is studied for assessing the baseline environmental conditions. Site features and vicinity within 30 km radius from the study area is indicated in Figure IV.1.

22. The surrounding study-areas mainly consisting of rural conglomerates with very sparse population. Agricultural fields are covered with herbs and shrubby vegetation Soil at project location is silty sand. Vegetation of the study area can be categorized as Northern tropical Forest sub type C-I Desert Thorn Forest.

23. The study area within 10 km radius includes the villages from both Mundra and Mandvi Taluka.

24. There is no national park, biosphere reserve, sanctuary, and habitat for migratory birds, archaeological site, or airports within 10 km radius of the study area. However, few historical places are located within 25 km radius at Mandvi and Beraja. Naliya Grassland/ India Bustard Sanctuary (23°30'N, 68° 45'E) is located nearly 100 kms from the project location.

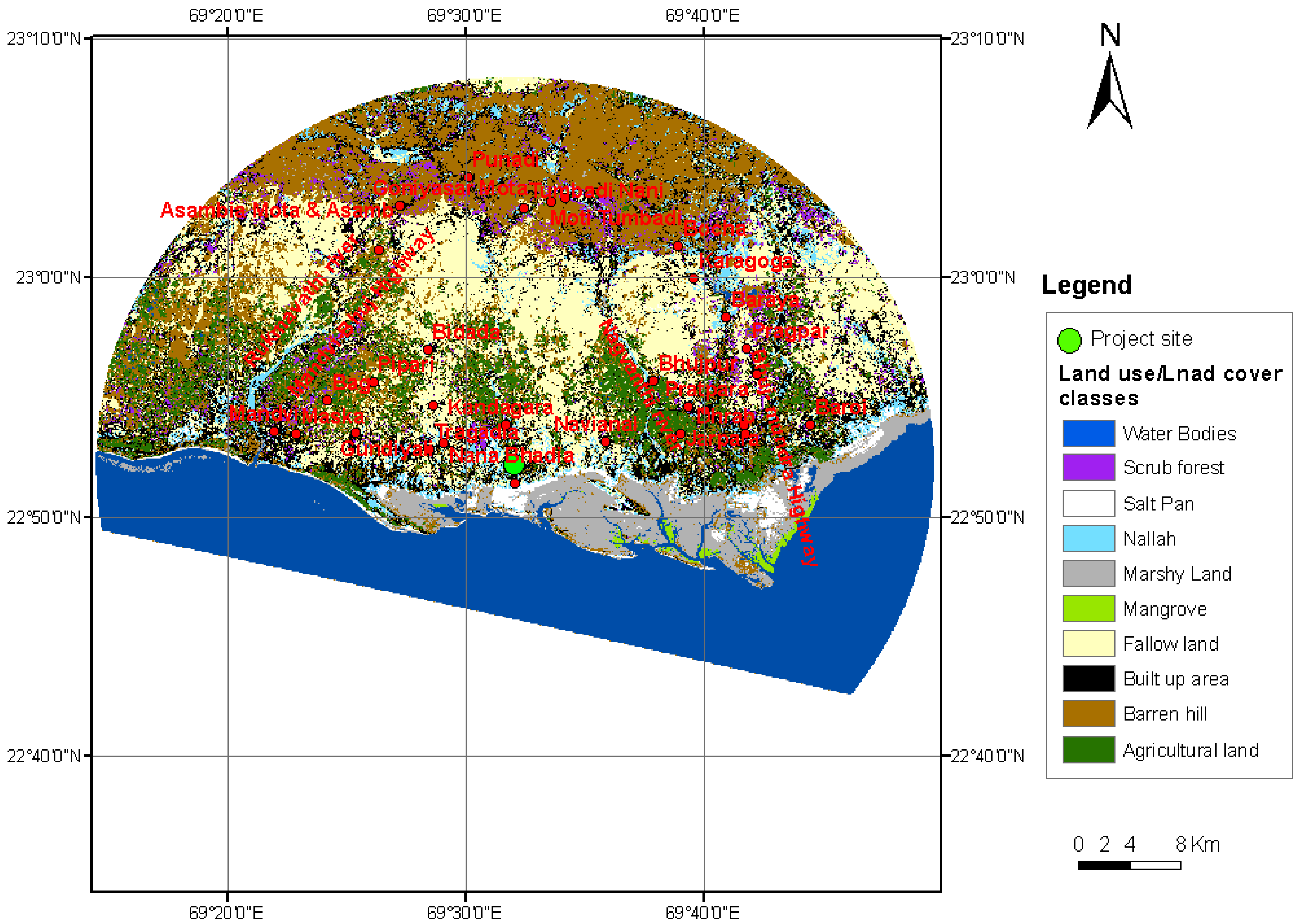
CLIMATE

25. The climate of the study region in general is categorized by frequent draught and extreme temperature. The year may be divided into three seasons – summer (March to May), monsoon (June to September), post-monsoon (October to November) and winter (December to February). The region gets the rainfall from South West Monsoon. It is very erratic both in the extent and in duration. The weak monsoon rains and high rate of evaporation not only make the land area arid but also influence the seawater salinity to increase. Consequently, the region is relatively deficient on water resources.

26. The nearest meteorological station of Indian Meteorological Department (IMD) is at Bhuj located at 50 km. from the site. Data is also available from IMD Bhuj for last 30 years (Figure IV.2a, IV.2b and IV.2c). The meteorological data are also measured at Mundra Port (Figure IV.2 d, e and f). Mundra Port data shows that the mid November to February is the winter season of the year, December being the coldest month having an average minimum temperature of 9°C. Available mixing height data has been collected for Ahemdabad (23 04N Longitude: 72 38E Latitude), which is approximately 310 km (aerial distance) from the site.

27. Summer starts from March and continuous till May end. The air temperature varies from 5°C to 41°C. The relative humidity ranges from 80 to 90% during monsoon season. The sky is clear or lightly clouded except during monsoon period. Visibility is good throughout the period. However, average visibility of less than 1 km can be expected for a few days in winter month. The mean annual rainfall of Mundra and Mandvi talukas are 429 mm and 319 mm (from 1982-2002) respectively. The average number of rainy days in a year is only 14.

Figure IV.1
Panoramic view of the study Area within 30 km radius



Classified image around 30 Km of the project site

Figure IV.2a

Monthly Temperature Variation at IMD Bhuj

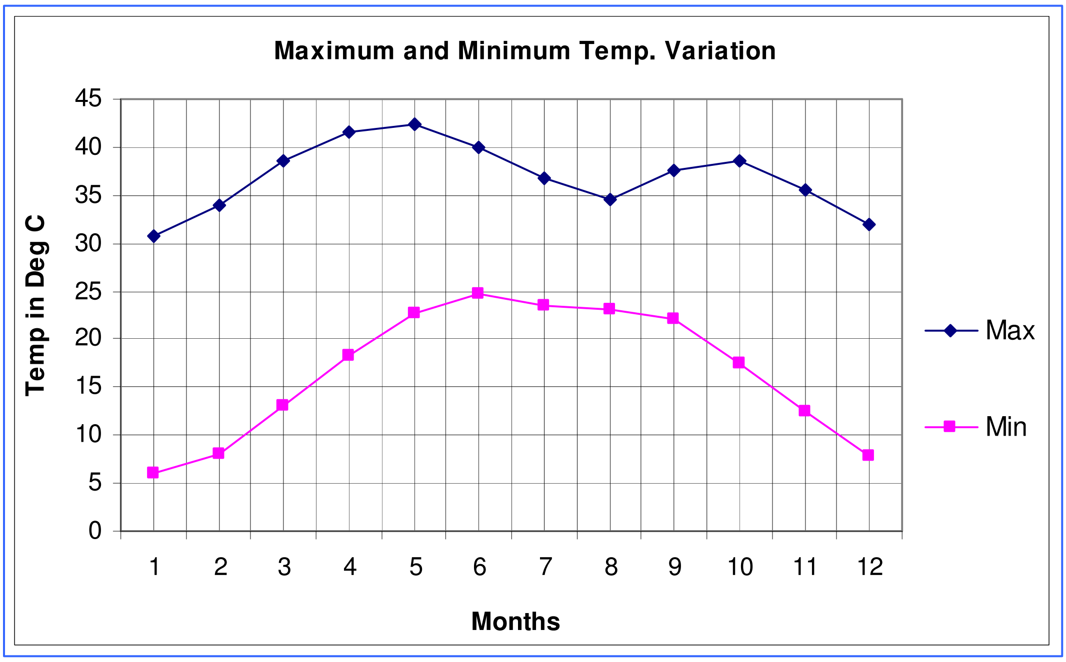


Figure IV.2b

Maximum and Minimum Rh Variation at IMD Bhuj

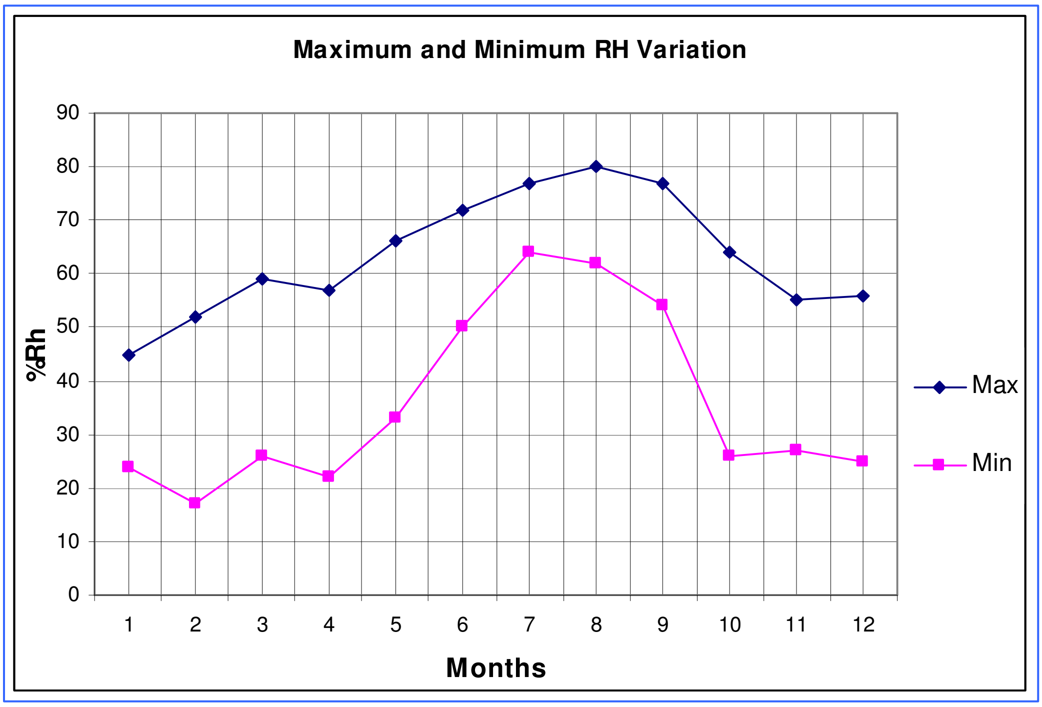


Figure IV.2c
Monthly Rainfall Variation at IMD Bhuj

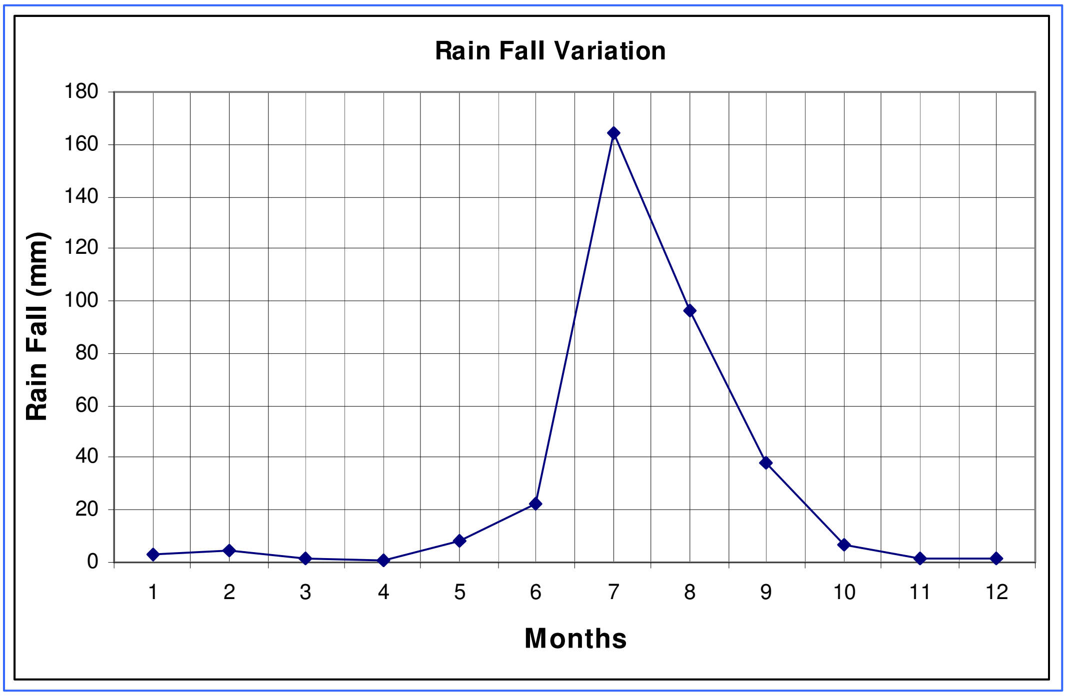
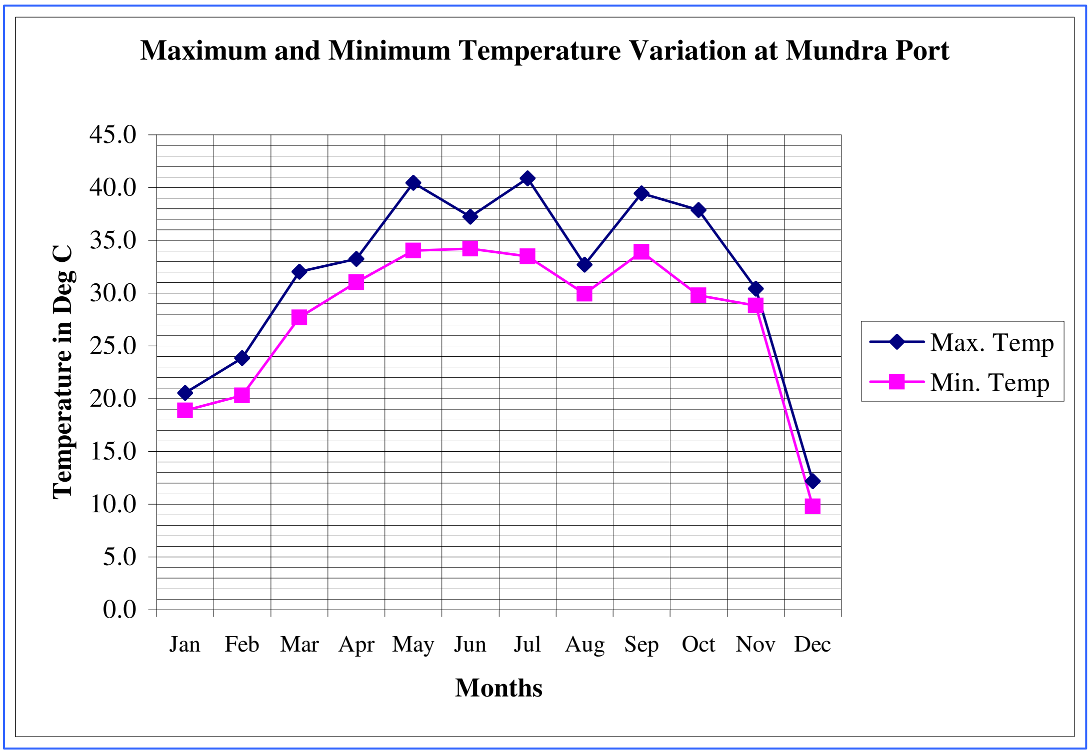
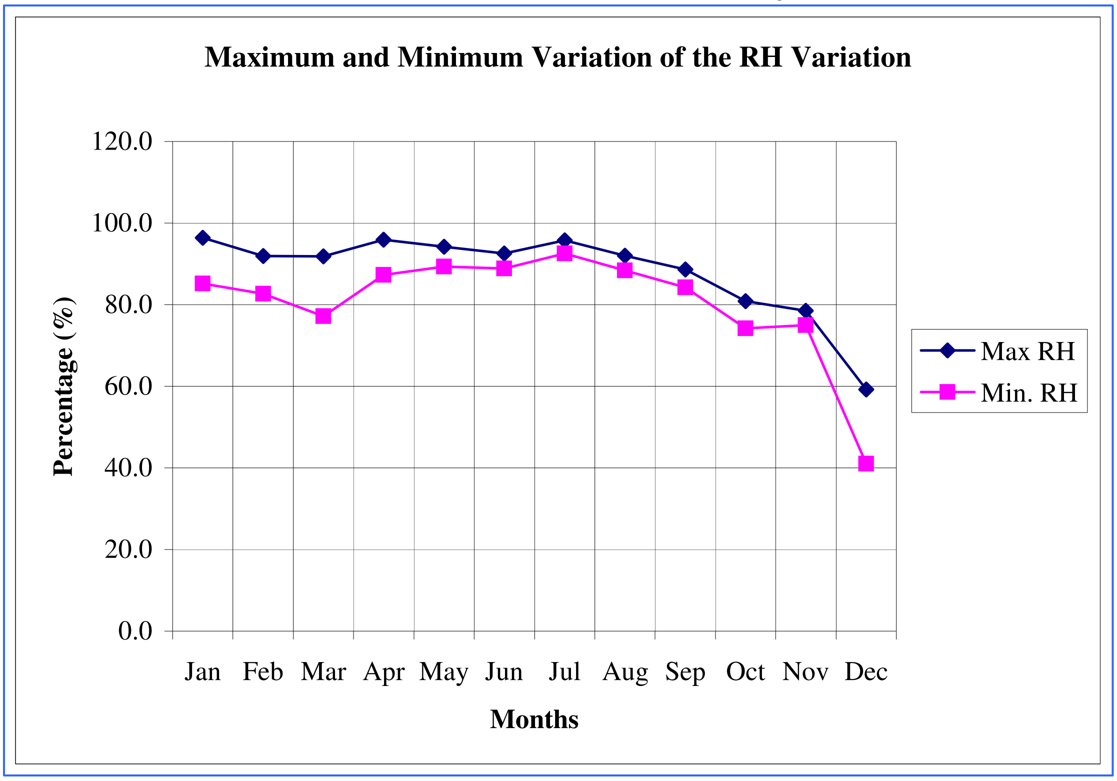


Figure IV.2d
Maximum and Minimum Temperature Variation at Mundra Port



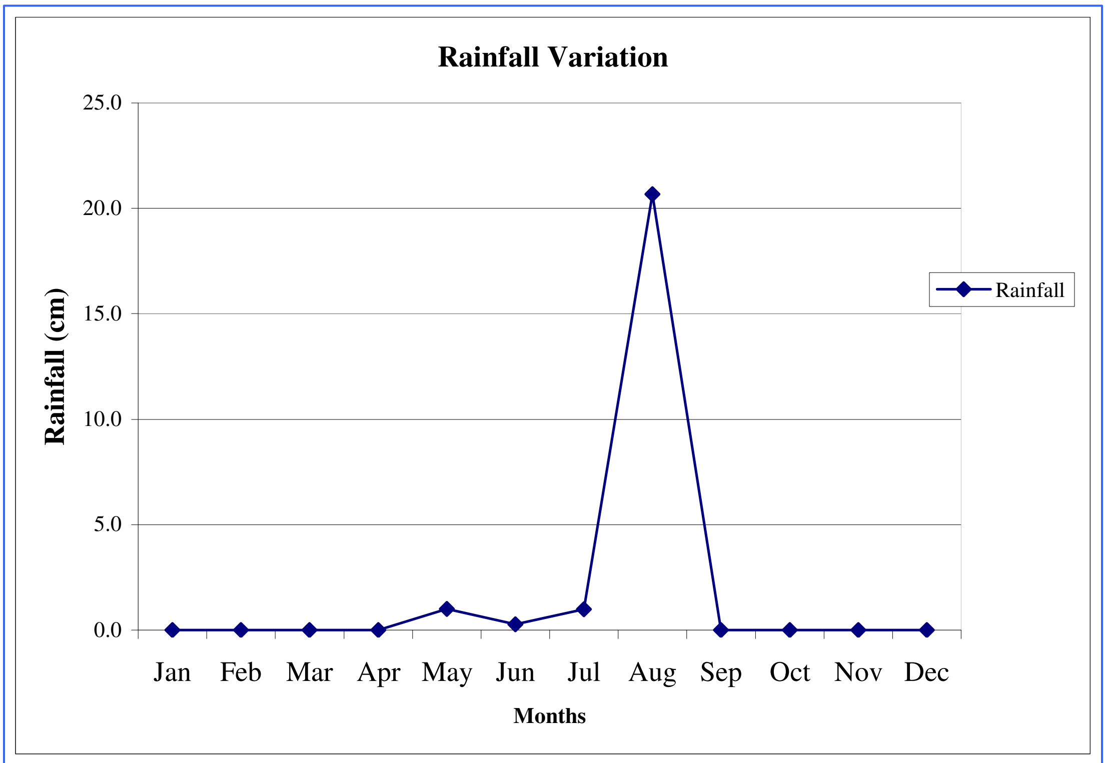
Source: Mundra SEZ

Figure IV.2e
Maximum and Minimum Variation of Relative Humidity at Mundra Port



Source: Mundra SEZ

Figure IV.2f
Monthly Rainfall Variation at Mundra Port



Source: Mundra SEZ

METEOROLOGY

28. Meteorological station was established at one of the centrally located site (Tundawand village) during the air-quality-monitoring period for three months in summer season. Photograph of the met station is shown in Appendix-3. The meteorological station was hindrance free and opens from all directions. Site-specific meteorological data were collected for wind speed, wind direction, ambient temperature, relative humidity (RH), and rainfall. The collected meteorological data for four seasons were analyzed on hourly basis.

29. The collected data on the wind speed and direction were analyzed and wind rose was drawn with the help of in-house developed software. The wind rose diagrams for each season are shown in Figure IV.3a, IV.3b, IV.3c and IV.3d, respectively. Wind rose diagram drawn for total study period is shown in Figure. IV.3e. The prevailing wind direction at site is from NW and NNW during summer season. For monsoon, the prevailing wind direction at site is from WSW and NNW. The prevailing wind direction at site is from W and WSW during post-monsoon season. The prevailing wind direction at site is from NNE during winter season. The prevailing wind direction at site is from WSW to NNW sector during the total study period.

30. The hourly variation of ambient temperature for each season is shown in Figure IV.4a-d. For summer, the mean daily maximum temperature goes up to 33.0℃ and the highest temperature recorded was 40.2℃. Month of May is nearly as hot as April, and in these two months, the heat is oppressive. With the onset of monsoon in June, the weather becomes slightly cooler and continued to be so through out the monsoon period.

31. The annual maximum rainfall at Bhuj is recorded as 348.7mm whereas the maximum monthly rainfall was recorded to be 164mm during month of July. The heaviest 24 hour intensity of rainfall was recorded to be 467.9 mm during the rainy season.

Figure - IV.3a
Wind-rose Diagram for summer (March to May) – 2006

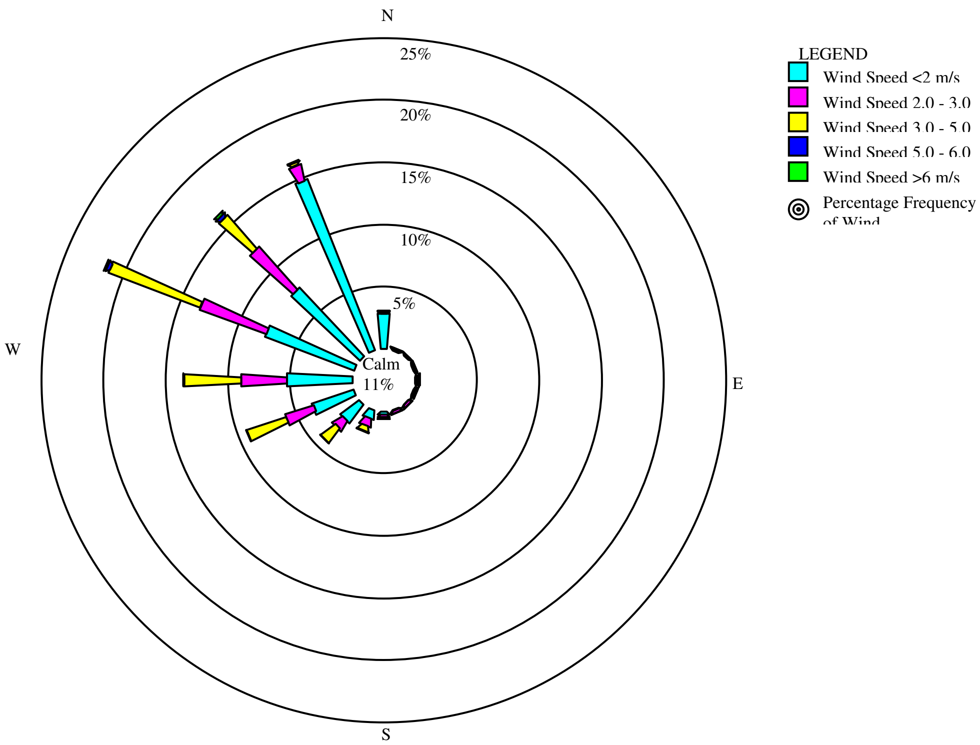


Figure - IV.3b
Wind-rose Diagram for Monsoon (June to September) – 2006

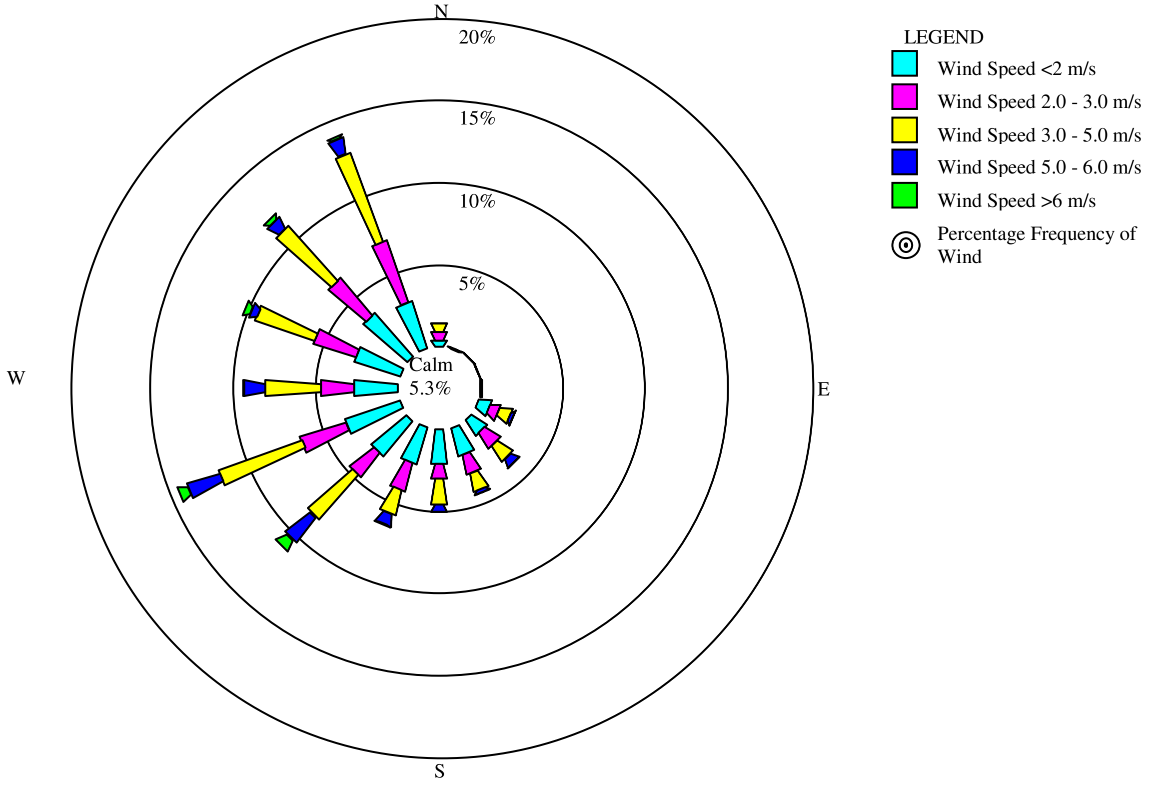


Figure - IV.3c
Wind-rose Diagram for Post-monsoon (October to November) – 2006

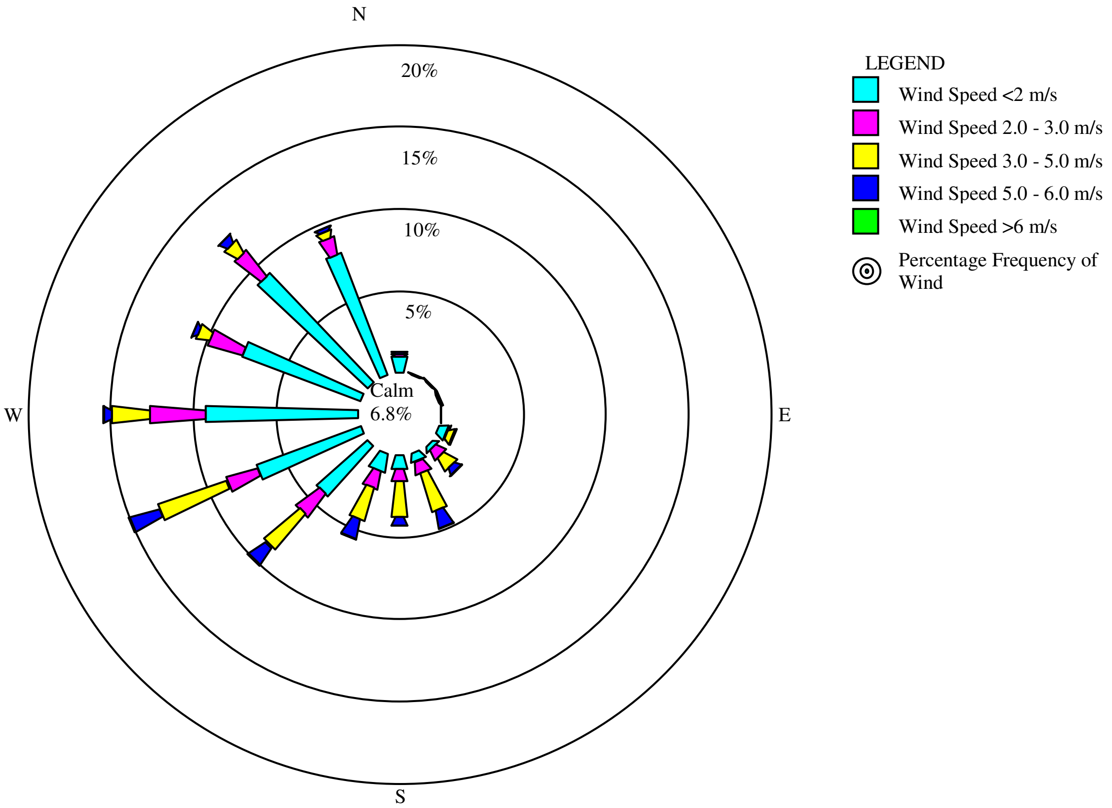


Figure - IV.3d
Wind-rose Diagram for winter (December 2006 to February 2007)

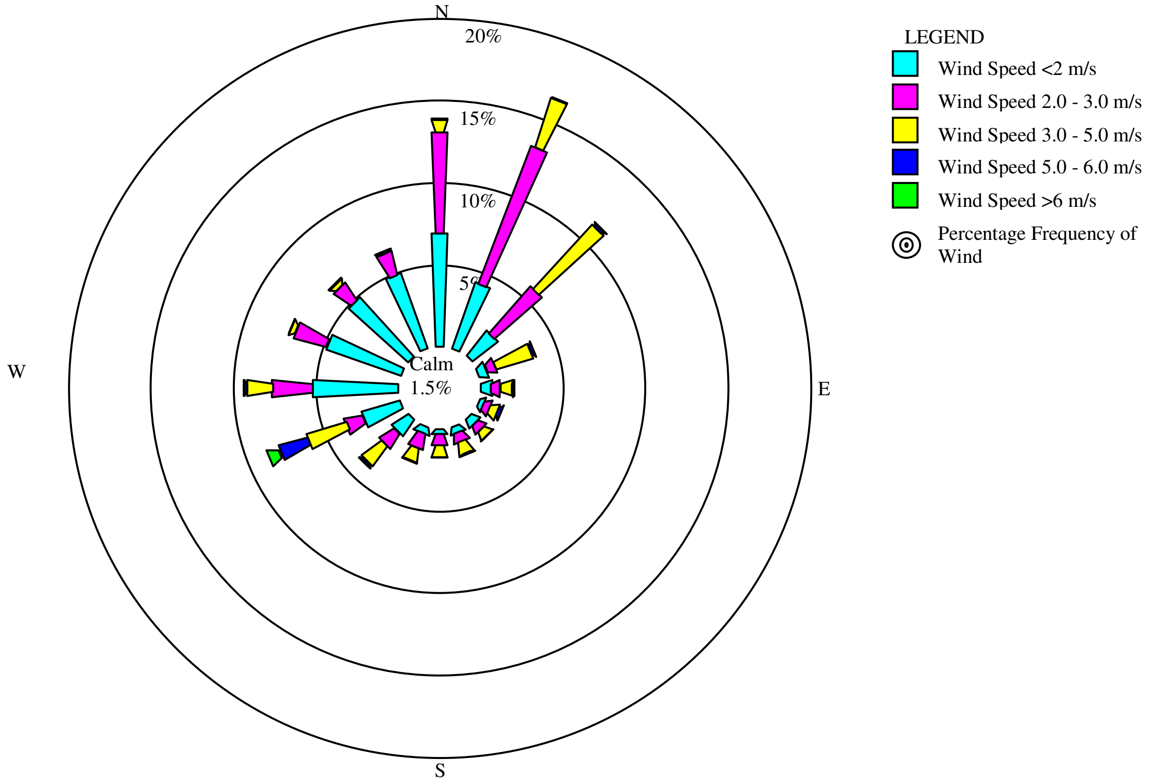


Figure - IV.3e
Annual Wind-rose Diagram (Period March'06 to February 07)

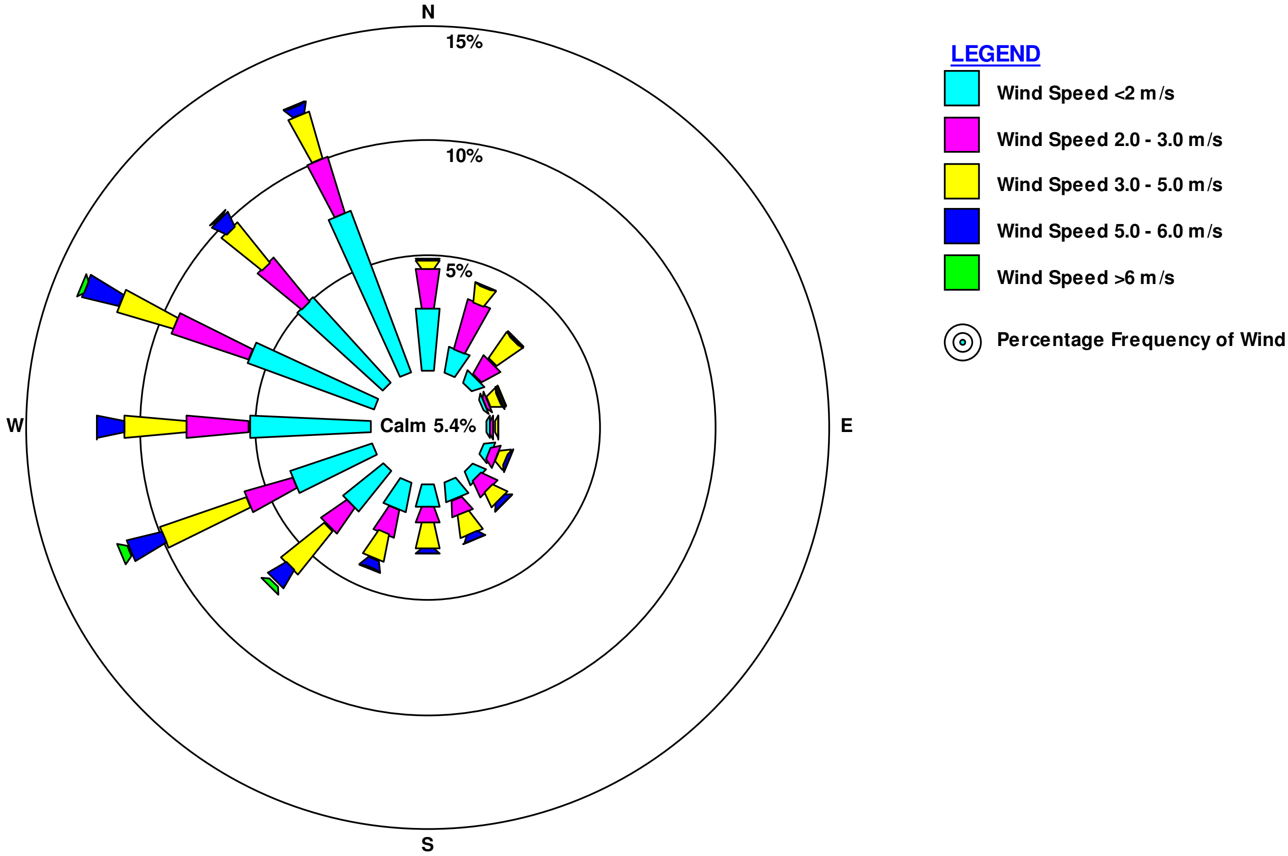


Figure IV.4a
Hourly Variation of Temperature at Tundawand Village for Summer – 2006

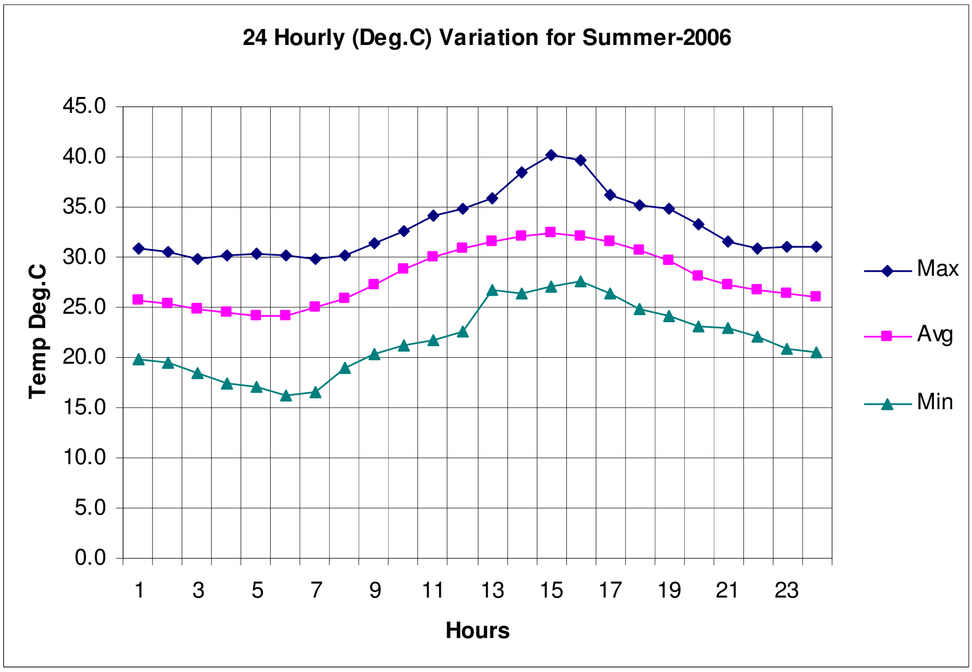


Figure IV.4b
Hourly Variation of Temperature for Monsoon 2006 at Tundawand Village

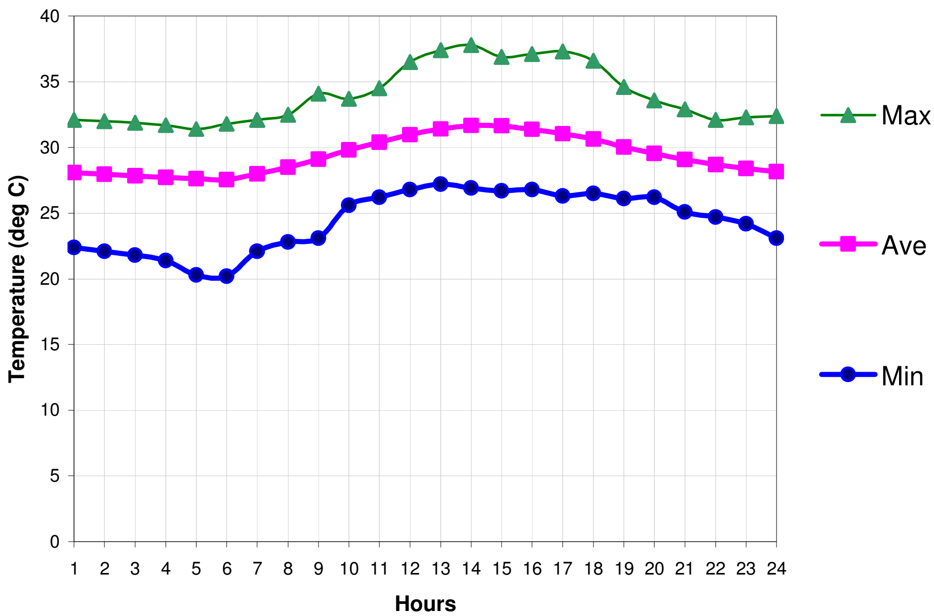


Figure IV.4c
Hourly Variation of Temperature for Post-monsoon – 2006 at Tundawand Village

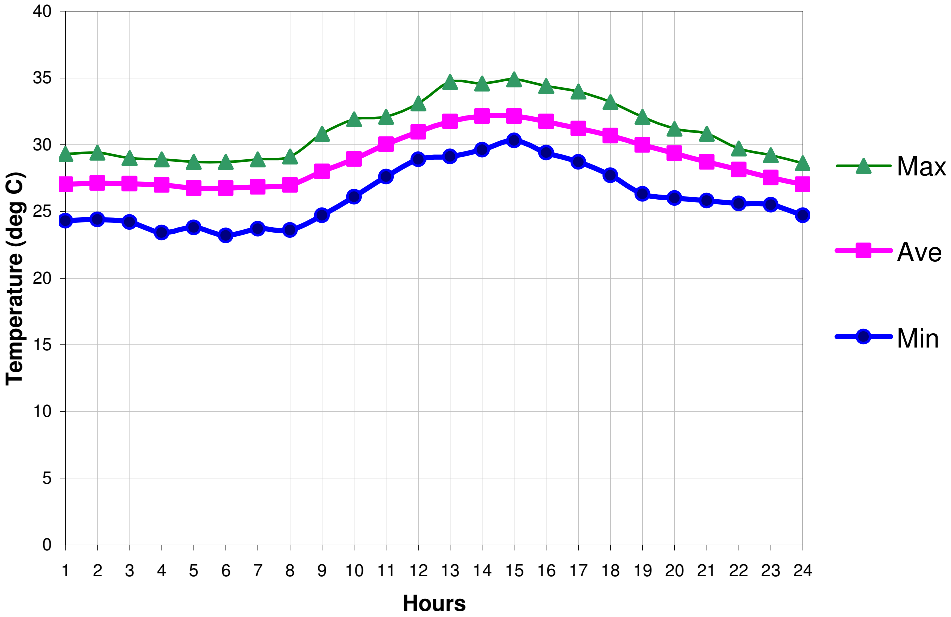
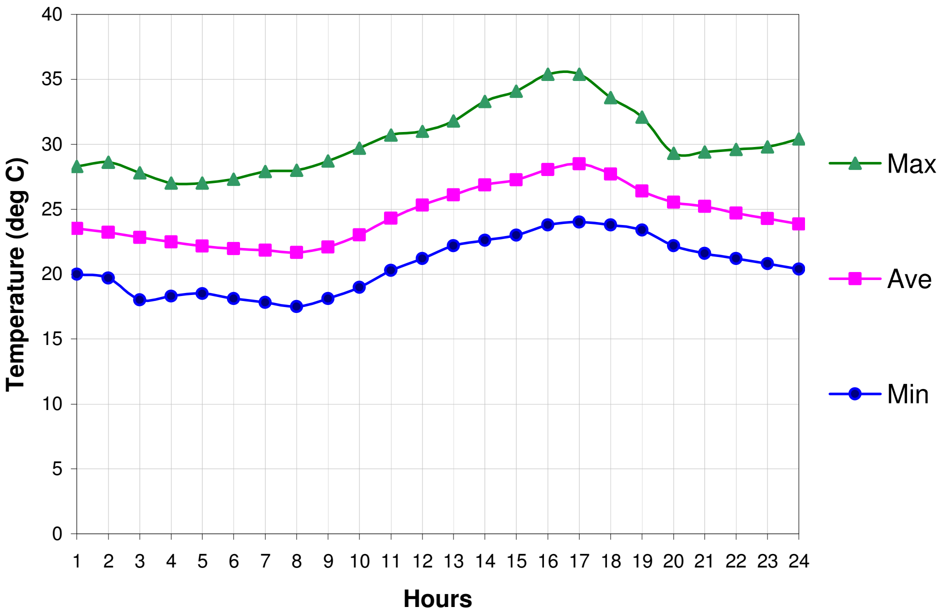


Figure IV.4d
Hourly Variation of Temperature for Winter 2007 at Tundawand Village



32. Summary of some important micro-meteorological parameter recorded at site is shown in Table IV.1.

Table IV.1
Summarised Meteorological Data at Tundawand Village

Sl.No.	*Parameter*	*Max. Value*	*Avg. Value*	*Min. Value*
		Summer - 2006		
1	Wind speed, m/s	9.0	2.2	0.0
2	Temperature, °C	40.2	28	16.2
		Post-monsoon - 2006		
1	Wind speed, m/s	6.1	2.2	0
2	Temperature, °C	34.9	29.0	2
		Winter - 2007		
1	Wind speed, m/s	6.9	2.4	0
2	Temperature, °C	35.4	24.6	17.5

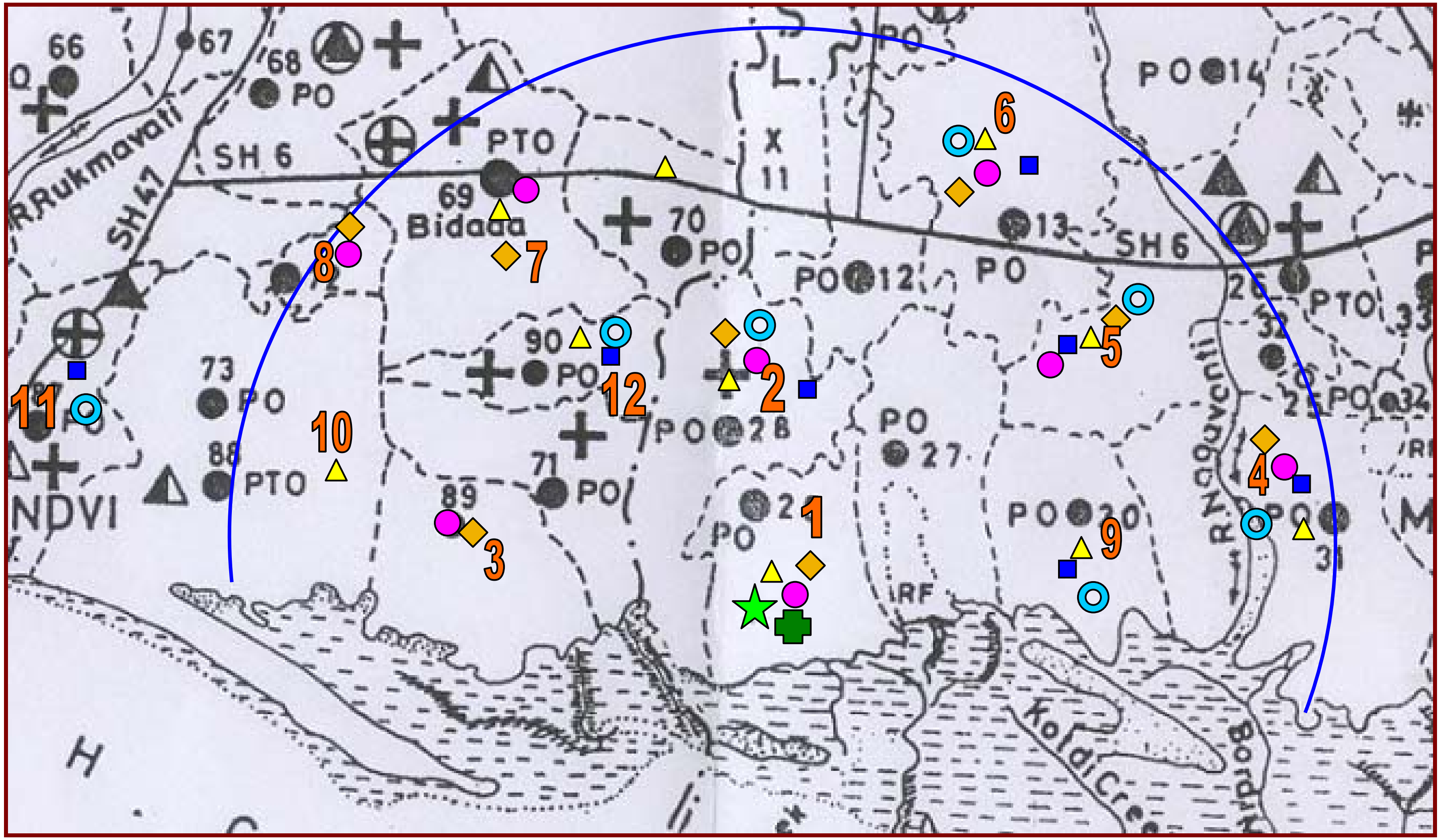
AMBIENT AIR ENVIRONMENT

33. Reconnaissance survey of the study area covering 10 km radius was carried out before selection of sampling site for field environmental monitoring and secondary data collection. Sampling sites were finalized after the visit of study area for ambient air, noise, and soil and water quality monitoring stations.

34. Ambient Air Quality Monitoring Stations (AAQMS) were located considering MoEF guidelines pertaining up wind and down wind direction, quadrants, topography of the area, sensitive locations and major habitation, if there was any. Based up on the criteria mentioned in former line, eight AAQMS were selected for air quality monitoring.

35. The ambient air quality was monitored during all the seasons at all AAQMS. These monitoring locations are shown in Figure IV.5.

Figure IV.5
Location for Ambient Air Quality, Noise, Water (Surface & Ground) and Soil Sampling Stations



Legend – Met Station – Project Site – Air – Surface Water – Ground water – Soil – Noise

1 - Tundawand 2 - Kandagara, 3 -Tragadia, 4 - Jarpara, 5 - Bhujpur Mota, 6 -Desalpar, 7- Bidada, 8 -Pipari, 9 - Navinal, 10 - Gundiyali, 11- Maska 12- Nana Bhadia

The details of AAQMS with direction and distance from the proposed source are given in Table IV.2.

Table - IV.2
Details of AAQMS

Sl. No.	*Location*	*Distance From The Plant (km)*	*Direction W.R.T. Project Site*
1	Tunda village	0	Central
2	Jarpara	9	E
3	Desalpar	7	NNE
4	Mota Bhojapur	6	NE
5	Tragadi	6	W
6	Pipari	10	NW
7	Bidada	7	NNW
8	Kandagara	3	N

METHODOLOGY

36. Samples were collected twice a week over a 52 week from March 2006 to February 2007. 24 hourly samples were collected for monitoring of SPM, RPM, SO_2 and NO_X. One hourly sample was collected on each monitoring day for CO and HC. CEIA study is based on the ambient air quality data generated for the one year data.

37. Each sample was collected based on 24 hourly continuous sampling basis. The monitoring program was scheduled to cover all the days to get the representative concentration of the area. The analysis and methodology used for the monitoring was based on the procedure mentioned in the National Ambient Air Quality Standards (NAAQS) given by the Ministry of Environment and Forests (MoEF). Ambient air quality monitoring result for complete monitoring period is depicted in Appendix–4a-c. Locations for air quality monitoring stations are shown in Figure IV.5.

38. Analysis and measurement methods used for ambient air quality monitoring are shown in following Table IV. 3.

Table IV.3
Analytical / Measurement Methods

POLLUTANTS	METHODS	BIS CODES
Suspended Particulate Matter (SPM)	High Volume Air Sampler	5182 (Part - IV) - 1973
Respirable particulate Matter (RPM)	HVS with Cyclone Separator	5182 (Part - IV) - 1973
Sulphur Dioxide (SO_2)	West & Gaeke Method	5182 (Part - II) - 1973
Nitrogen Oxides (as NO2)	Jacob and Hochheiser Method	5182 (Part - VI) - 1975
Carbon Monoxide (CO)	Flame Ionization Detector	IS: 5182 (Part X)
Hydrocarbon (HC)	Gas Chromatograph	IS: 5182(Part XVII)

39. The maximum, minimum, daily average and 98 percentile season wise monitored values at each location are shown in Table IV.4a-c. Overall summery of monitored ambient air quality data is given in Table IV.4d. The monitored ambient air quality at all AAQMS was compared with National Ambient Air Quality Standards (NAAQS) for residential and rural area. The National Ambient Air Quality Standards is given in Appendix – 5.

Table - IV.4a
Ambient Air Quality in the Study Area for Summer 2006

Location		SPM ($\mu g/m^3$)	RPM ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NOX ($\mu g/m^3$)	CO ($\mu g/m^3$)
Tunda village	Min	78	38	8.0	11.8	980
	Average	106.8	65	11.2	16.3	1543
	Max	138	96	16.2	23.4	2050
	98 Perc.	135	95	16.0	22.3	2015
Jalpara	Min	82	38	7.0	10.9	1000
	Average	110.6	65.5	10.9	16.6	1576.8
	Max	138	94	15.4	22.4	2000
	98 Perc.	138	93	15.1	22	1975
Desalpar	Min	84	42	8.4	13.5	900
	Average	113.11	71.4	11.2	18.4	1563.4
	Max	138	98	15.4	22.8	2010
	98 Perc.	138	96	14.9	22.6	2005
Mota Bhojapur	Min	84	38	7.6	11.2	1000
	Average	112.9	68.8	11.2	16.7	1576.2
	Max	136	98	18.4	23.8	2000

Location		SPM (µg/m³)	RPM (µg/m³)	SO_2 (µg/m³)	NOX (µg/m³)	CO (µg/m³)
	98 Perc.	136	95.8	16.7	23.3	1946.0
Tragadi	Min	78	38.0	8.1	12.6	1000
	Average	108	66.3	10.6	17.0	1523.8
	Max	134	92	14.2	23.5	1900
	98 Perc.	132.6	89.6	13.8	23.3	1900
Pipari	Min	78	38	7.8	12.4	900
	Average	105.1	66.6	10.0	15.6	1348.5
	Max	134	96.0	13.0	22.0	2000
	98 Perc.	131.1	93.1	12.7	21.1	1980.8
Bidada	Min	82	34.0	8.9	14.9	1260.0
	Average	115.1	65.7	11.3	18.7	1700.8
	Max	142.0	98	15.9	22.8	1980.0
	98 Perc.	141.0	95.6	15.2	22.7	1958.4
Kandagra	Min	84	38	7.6	14.2	900
	Average	109.4	66.8	10.6	18.3	1425.7
	Max	134	96	16.4	22.8	1980.0
	98 Perc.	134	95	15.5	22.8	1941.6

Table - IV.4b
Ambient Air Quality In The Study Area For Post-Monsoon 2006

Place		Ground Level Concentration				
		SPM	RPM	SO_2	NO_X	CO
		µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
Tunda village	Maximum	130.0	92.0	14.4	21.6	1845.0
	Minimum	82.0	42.0	8.4	11.5	1010.0
	Average	103.1	64.0	11.0	15.8	1451.8
	98 Perc.	127.4	90.2	14.1	21.2	1808.1
Jalpara	Maximum	138.0	92.0	16.8	22.8	1864.0
	Minimum	86.0	52.0	7.8	12.8	1298.0
	Average	111.1	70.9	11.9	17.2	1591.6
	98 Perc.	135.2	90.2	16.5	22.3	1826.7
Desalpar	Maximum	138.0	92.0	14.6	22.6	1945.0
	Minimum	88.0	48.0	9.0	12.2	1250.0
	Average	115.3	73.4	11.7	15.9	1594.1
	98 Perc.	135.2	90.2	14.3	22.1	1906.1
Mota Bhojapur	Maximum	142.0	98.0	16.4	24.8	1942.0
	Minimum	82.0	42.0	9.2	14.6	1245.0

Place		Ground Level Concentration				
		SPM	RPM	SO_2	NO_X	CO
		$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$
	Average	111.0	73.3	12.9	18.1	1640.7
	98 Perc.	139.2	96.0	16.1	24.3	1903.2
Tragadi	Maximum	124.0	84.0	14.6	20.4	1847.0
	Minimum	82.0	52.0	10.2	14.3	1289.0
	Average	107.3	63.5	12.1	16.8	1544.4
	98 Perc.	121.5	82.3	14.3	20.0	1810.1
Pipari	Maximum	116.0	88.0	16.2	21.2	1845.0
	Minimum	86.0	48.0	8.6	12.2	1463.0
	Average	100.8	69.5	11.5	15.8	1596.6
	98 Perc.	113.7	86.2	15.9	20.8	1808.1
Bidada	Maximum	142.0	94.0	16.8	22.1	1842.0
	Minimum	86.0	52.0	11.9	14.8	1489.0
	Average	113.3	71.0	14.0	18.8	1642.9
	98 Perc.	139.2	92.1	16.5	21.7	1805.2
Kandagra	Maximum	128.0	92.0	14.6	21.6	1946.0
	Minimum	86.0	46.0	8.4	13.5	1368.0
	Average	108.3	71.0	11.2	16.5	1572.8
	98 Perc.	125.4	90.2	14.3	21.2	1907.1

Table - IV.4c
Ambient Air Quality in the Study Area for Winter 2007

Place		Ground Level Concentration				
		SPM	RPM	SO_2	NO_X	CO
		$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$
Tunda village	Maximum	129.0	85.0	14.3	20.1	1798.0
	Minimum	88.0	48.0	9.2	12.2	1124.0
	Average	106.7	63.6	10.9	15.2	1490.0
	98 Perc.	126.4	83.3	14.0	19.7	1762.0
Jalpara	Maximum	138.0	88.0	15.8	21.3	1872.0
	Minimum	87.0	52.0	9.2	14.2	1298.0
	Average	112.0	69.2	12.3	16.9	6195.3
	98 Perc.	135.2	86.2	15.5	20.9	1834.6
Desalpar	Maximum	139.0	93.0	15.2	21.1	1859.0
	Minimum	92.0	58.0	9.6	12.6	1356.0
	Average	117.7	74.3	12.4	16.2	1585.0

Place		Ground Level Concentration				
		SPM	RPM	SO_2	NO_X	CO
		µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
	98 Perc.	136.2	91.1	14.9	20.7	1821.8
Mota Bhojapur	Maximum	137.0	94.0	16.8	21.2	1867.0
	Minimum	88.0	48.0	9.5	14.9	1277.0
	Average	113.3	67.7	12.7	17.2	1598.7
	98 Perc.	134.3	92.1	16.5	20.8	1829.7
Tragadi	Maximum	124.0	72.0	12.6	16.4	1795.0
	Minimum	92.0	52.0	8.9	12.2	1362.0
	Average	107.6	63.5	10.5	13.9	1564.3
	98 Perc.	121.5	70.6	12.3	16.1	1759.1
Pipari	Maximum	123.0	78.0	14.8	17.9	1843.0
	Minimum	92.0	52.0	8.9	11.8	1472.0
	Average	109.8	62.7	10.6	14.7	1607.0
	98 Perc.	120.5	76.4	14.5	17.5	1806.1
Bidada	Maximum	136.0	82.0	15.8	20.8	1836.0
	Minimum	89.0	61.0	12.1	13.3	1476.0
	Average	113.3	68.3	13.2	17.0	1617.0
	98 Perc.	133.3	80.4	15.5	20.4	1799.3
Kandagra	Maximum	128.0	78.0	12.8	17.6	1893.0
	Minimum	89.0	52.0	9.6	12.5	1352.0
	Average	111.0	65.3	11.0	15.1	1572.7
	98 Perc.	125.4	76.4	12.5	17.2	1855.1

Table - IV.4d
Overall Summery Of Ambient Air Quality Data
(Period March'06 to February 07)

	SPM	RPM	SO_2	NO_X	CO
	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
Maximum	142.0	98.0	18.4	24.8	2050.0
Average	110.5	67.9	11.5	16.7	1560.9
Minimum	78.0	34.0	7.0	10.9	900.0
98 Percentile	138.0	94.0	15.9	22.8	1980.0

40. Monitored background concentrations of SPM , RPM, SO2, NOX and CO were compared for all the three seasons. The same has been compared which are shown in the following Figures. IV. 6a to IV.6e.

Figure IV.6a
Variation Of SPM Concentration In The Study Area

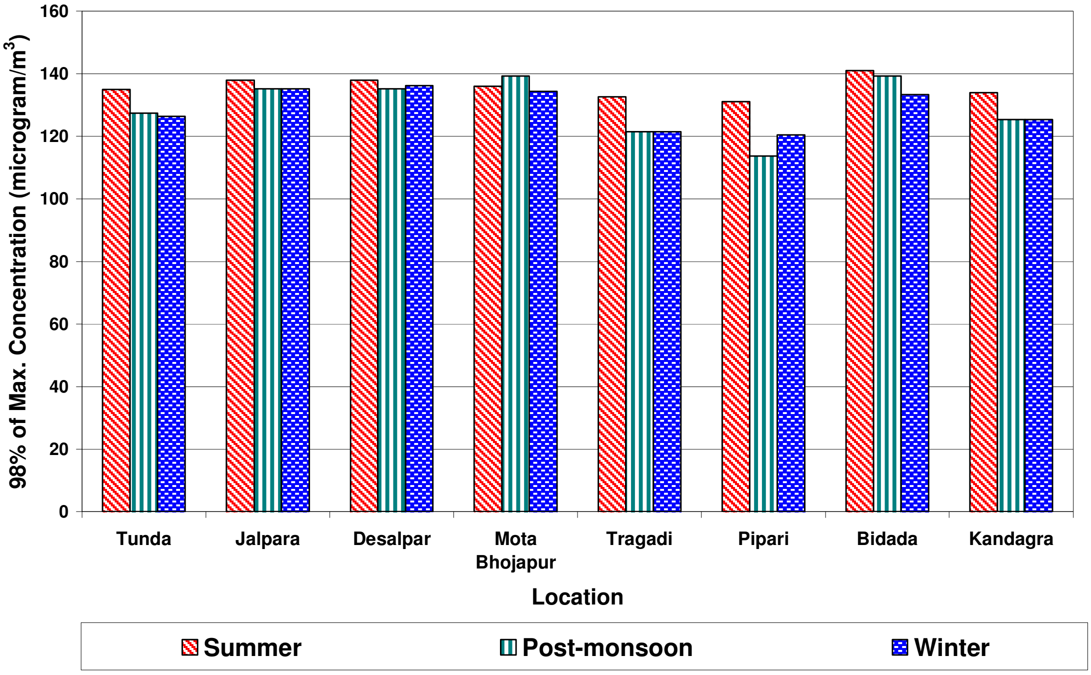


Figure IV.6b
Variation of RPM Concentration in the Study Area

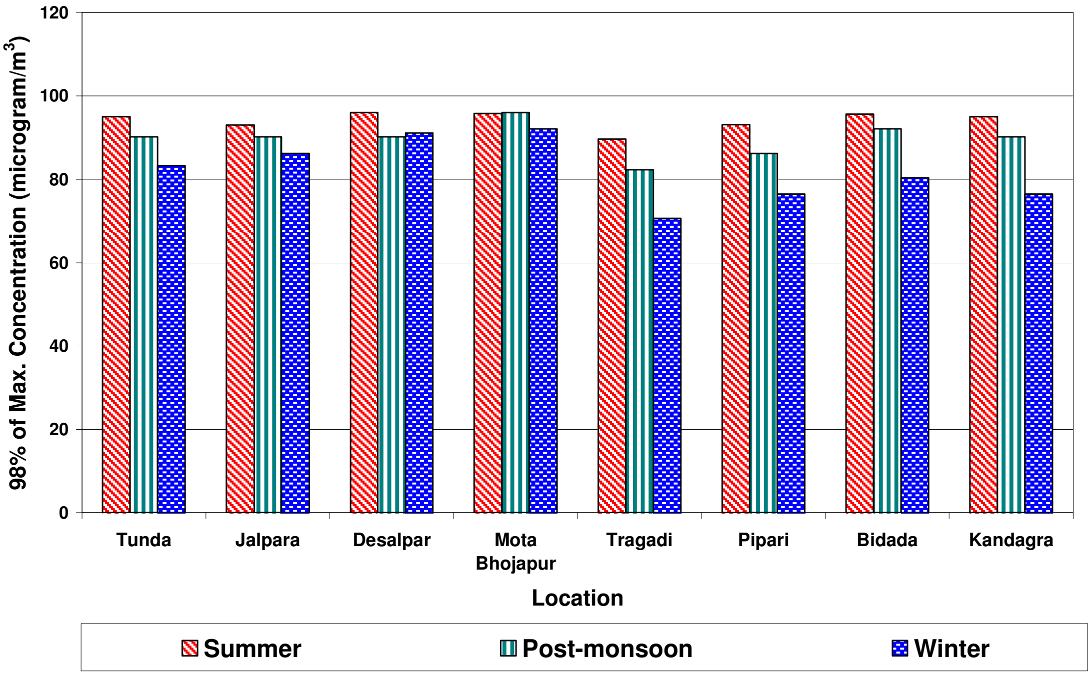


Figure IV.6c

Variation Of SO_2 Concentration In The Study Area

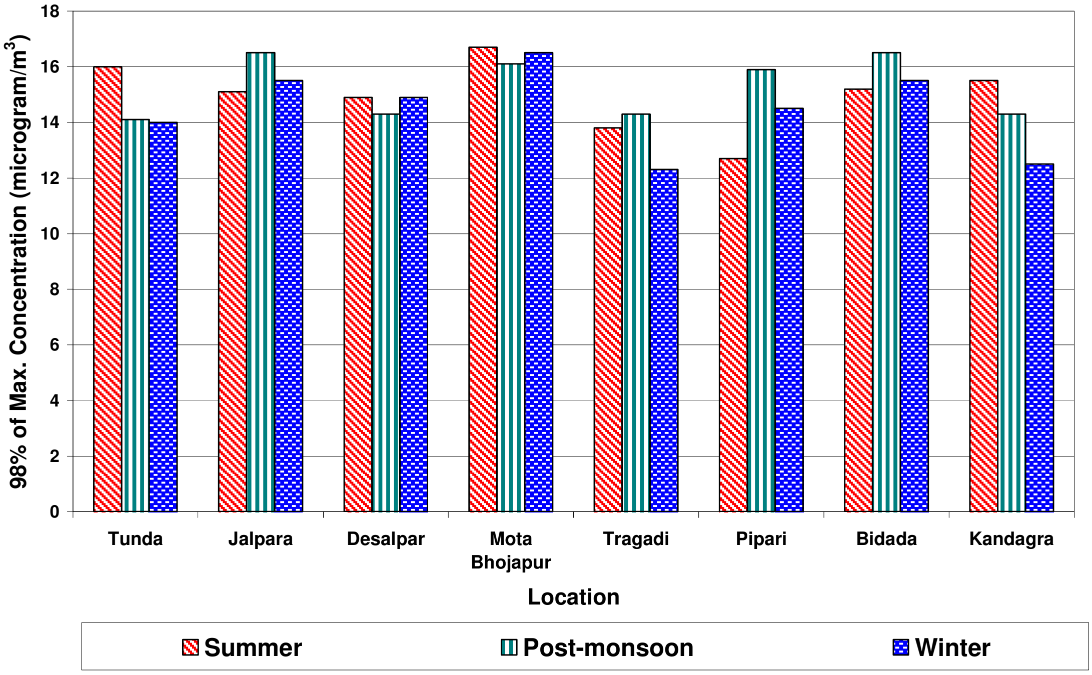


Figure IV.6d

Variation Of No_x Concentration In The Study Area

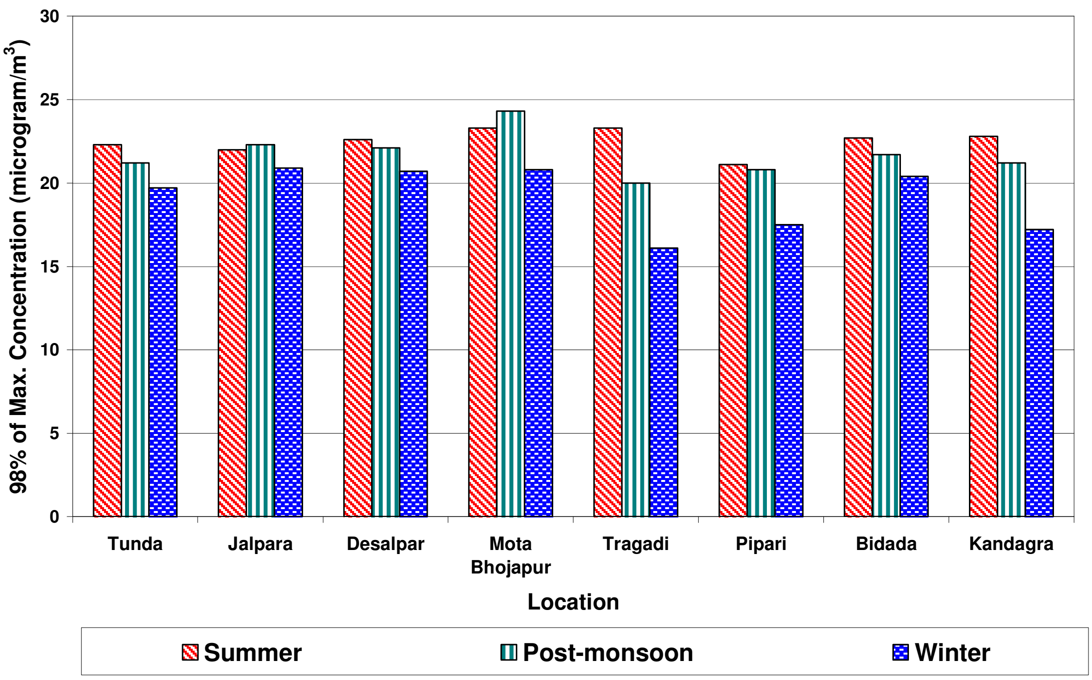
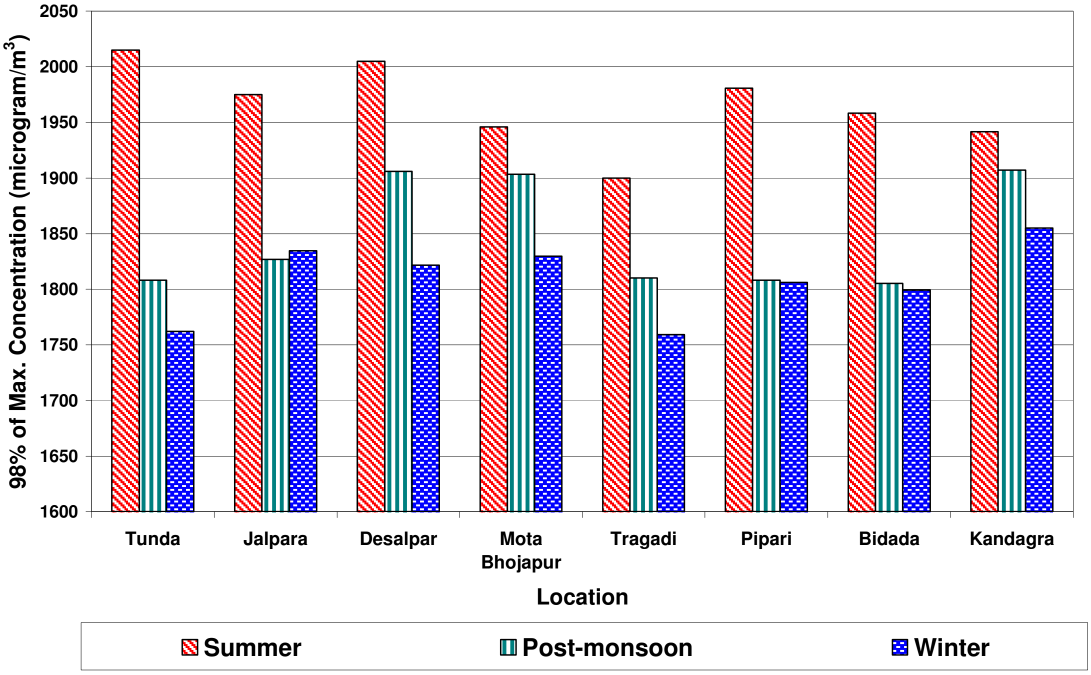


Figure IV.6e

Variation Of CO Concentration In The Study Area



41. The analysis results of monitored air quality indicate that SPM, RPM, SO_2, and NOx, values are well within the stipulated NAAQ standards for residential and rural areas. CO concentration remained well below the standard of 2000 $\mu g/m^3$ for all collected samples.

NOISE ENVIRONMENT

42. The monitoring of noise was carried out at eight locations. Noise monitoring was carried out using precision noise level meter (make-Bruel & Kjar, model-2221, Made in Denmark, Digital type) on hourly basis for 24 hours. The locations of noise monitoring station (N1 to N8) are shown in Figure IV.5. The details of noise monitoring locations are shown in Table IV.5.

Table - IV.5
Details of Noise Monitoring Stations

Sr. No.	*Location*	*Distance (km)*	*Direction w.r.t. Plant Site*
N1	Tunda village	0	Central
N2	Jarpara	9	E
N3	Desalpar	7	NNE
N4	Mota Bhojapur	6	NE
N5	Tragadi	6	W
N6	Pipari	10	NW
N7	Bidada	7	NNW
N8	Kandagara	3	N

43. Noise monitoring was carried out once during the summer season at all noise monitoring locations. Sound levels had been recorded for 24 hours continuously for the duration of fifteen (15) minutes at hourly intervals.

44. Noise monitoring data has been analyzed for each location. The equivalent noise levels for the period from March 2006 to February 2007 are shown in Table IV.6a-d. The results have been compared with the standard specified in Schedule III, Rule 3 of Environmental Protection Rules. The National Ambient Air Quality Standards (NAAQS) with respect to noise is given in Appendix – 6.

Table - IV.6a
Equivalent Noise Levels of the Study Area for Summer 2006

Sr. No.	*Location*	*Equivalent Noise Level (dB(A))*		
		Day-Night (06.00 AM –5.00 AM)	*Day (06.00 AM –10.00PM)*	*Night (10.00 PM – 6.00 AM)*
1	Tunda village	50.8	50.9	50.6
2	Jarpara	59.2	61.2	45.7
3	Desalpar	54.8	53.5	55.9
4	Mota Bhojapur	54.7	54.8	54.5
5	Tragadi	54.6	53.8	55.9
6	Pipari	52.1	51.8	52.7
7	Bidada	53.7	53.1	54.4
8	Kandagara	54.2	52.1	56.4

Table - IV.6b
Equivalent Noise Levels of the Study Area for Monsoon 2006

Sr. No.	*Location*	*Equivalent Noise Level (dB(A))*		
		Day-Night (06.00 AM –5.00 AM)	*Day (06.00 AM –10.00PM)*	*Night (10.00 PM – 6.00 AM)*
1	Tunda village	49.7	51.6	39.8
2	Jarpara	52.2	54.2	37.2
3	Desalpar	53.1	54.5	48.5
4	Mota Bhojapur	52.6	53.6	50.1
5	Tragadi	51.0	52.2	48.0
6	Pipari	50.5	52.0	45.6
7	Bidada	58.2	59.5	54.4
8	Kandagara	47.6	49.0	43.1

Table - IV.6c
Equivalent Noise Levels of the Study Area for Post-monsoon 2006

Sr. No.	*Location*	*Equivalent Noise Level (dB(A))*		
		Day-Night (06.00 AM –5.00 AM)	*Day (06.00 AM –10.00PM)*	*Night (10.00 PM – 6.00 AM)*
1	Tunda village	49.9	51.7	40.6
2	Jarpara	52.3	54.2	41.6
3	Desalpar	55.0	56.7	48.6
4	Mota Bhojapur	57.5	59.3	49.2
5	Tragadi	50.5	52.2	44.4
6	Pipari	50.3	52.0	42.7
7	Bidada	58.2	59.5	54.4
8	Kandagara	49.7	51.3	44.2

Table - IV.6d
Equivalent Noise Levels of the Study Area for Winter 2006

Sr. No.	*Location*	*Equivalent Noise Level (dB(A))*		
		Day-Night (06.00 AM –5.00 AM)	*Day (06.00 AM –10.00PM)*	*Night (10.00 PM – 6.00 AM)*
1	Tunda village	46.7	48.5	38.3
2	Jarpara	51.6	53.5	41.2
3	Desalpar	54.6	56.2	48.4
4	Mota Bhojapur	56.9	58.7	48.8
5	Tragadi	50.1	51.7	44.3
6	Pipari	49.4	51.1	41.7
7	Bidada	56.9	58.3	52.8
8	Kandagara	49.0	50.6	43.5

45. The monitored noise levels at all the locations coming under rural and residential areas are within the prescribed limit of National Ambient Air Quality Standards with respect to noise.

WATER ENVIRONMENT

46. The surface water source for the proposed project is seawater from Gulf of Kutch located at about 2.5 km from project site. The seawater would be drawn to the plant boundary through an open channel excavated to a depth of about 3 m below lowest tide water level. The width of channel required would be about 100 m to draw an estimated cooling water flow of 5,94,200 m^3/hr. The channel would be aligned southwards from the southwest corner of the plant site. An on shore pump house located within the plant boundary will house the cooling water pumps.

47. Sea water requirement is 594,175m³/hr as per following break up:

S. No.	Item	Estimated Quantity Once Through Cooling	
		m^3/hr	m^3/day
1	Sea water for condenser cooling	588850	14132400
2	Sea water for desalination plant	5325	127800
	Total	594175	14260200
3	Fresh water	1072	25710

WATER QUALITY

48. Ground water sample collection is shown in Appendix – 7. The locations of water quality sampling stations are shown in Figure IV.5. The groundwater samples were collected from locations Kandagara, Navinal, Bhujpur Mota, Gundiyali, Jarpara, Desalpar and Nana Bhadiya. These ground water samples were analyzed for various parameters and month-wise results are given in Appendix – 7a-k. Summary of the water quality results are given below:

Summary of water quality during Summer -2006:

pH Value	:	7.3	-	7.84
Conductivity mho	:	566	-	4901
Dissolved Solids, mg/l	:	335	-	3917
Total Hardness (as CaCO3), mg/l	:	30.8	-	1304
Alkalinity , mg/l	:	37.9	-	116.8
Chloride (as Cl), mg/	:	69.3	-	2391
Calcium(as Ca), mg/l	:	5.6	-	236.3
Magnesium (as Mg), mg/l	:	4.1	-	173.4
Fluoride (as F), mg/l	:	0.086	-	1.087

Summary of water quality during Monsoon -2006:

pH Value	:	7.2	-	7.6
Conductivity mho	:	644	-	4867
Dissolved Solids, mg/l	:	356	-	3018
Total Hardness (as CaCO3), mg/l	:	36.9	-	1284
Alkalinity , mg/l	:	49.3	-	215.3
Chloride (as Cl), mg/	:	75.6	-	1148
Calcium(as Ca), mg/l	:	6.9	-	214
Magnesium (as Mg), mg/l	:	4.8	-	179
Fluoride (as F), mg/l	:	0.102	-	1.128

Summary of water quality during Post Monsoon -2006:

pH Value	:	7.3	-	7.5
Conductivity mho	:	1352	-	5498
Dissolved Solids, mg/l	:	796.1	-	3342
Total Hardness (as CaCO3), mg/l	:	62.2	-	1465
Alkalinity , mg/l	:	86	-	695
Chloride (as Cl), mg/	:	183.3	-	2230

Calcium(as Ca), mg/l	:	9.4	-	245.6
Magnesium (as Mg), mg/l	:	9.2	-	209.5
Fluoride (as F), mg/l	:	0.532	-	1.487

Summary of water quality during Winter -2006:

pH Value	:	7.2	-	7.6
Conductivity mho	:	1032	-	5238
Dissolved Solids, mg/l	:	634	-	3016
Total Hardness (as CaCO3), mg/l	:	61.4	-	1566
Alkalinity , mg/l	:	256	-	698
Chloride (as Cl), mg/	:	23.5	-	1869
Calcium(as Ca), mg/l	:	10.8	-	274
Magnesium (as Mg), mg/l	:	8.3	-	214.1
Fluoride (as F), mg/l	:	0.426	-	1.5

49. The water quality is assessed based up on the parameters specified for Indian standard IS 10500 (drinking water standards). The characteristics of water quality of ground water samples were agreeable with the permissible levels of the drinking water.

SOIL ENVIRONMENT

50. In order to assess the soil quality in the Plant site and study area, eight soil samples were collected from various locations during Summer, post monsoon and winter season. Details of soil sampling stations are given in Table IV.7.

Table - IV.7
Details of Soil Sampling Locations

Sample N	Location	Type of Land
SI	Nani Khakhar	Agricultural Land
S2	Desalpar	Agricultural land
S3	Nana Bhadiya	Agriculture Land
S 4	Bidada	Agricultural Land
S5	Kandagra	Agricultural Land
S6	Wand	Agricultural Land
S7	Jarpara	Agricultural Land
S8	Bhojpur	Agricultural Land
S9	Gundiyali	Agricultural Land
S10	Navinal	Agricultural Land

51. The soil of the area varies from dark brown to light brown in color. Soil pH plays an important role in the availability of nutrients for microbial activities and growth of plants.. Electrical conductivity (EC) is a measure of the soluble salts and ionic activity in the soil. The collected soil samples have normal conductivity.

52. Soil Samples are analyzed for various chemical parameters. In the tested soil samples, available N, P & K values varies from low to high. Soil samples collected from agriculture land have medium organic carbon content while soil sample of proposed site indicated low content of organic carbon.

53. Micronutrients play a vital role in the growth and development of plants. Most micronutrients, like Zn, Fe, Mn and Cu are constituents of many enzymes and they play key role in metabolic activities such as chlorophyll synthesis, photosynthesis, respiration, protein synthesis, nitrogen fixation, assimilation of nitrates and sulphate, etc. Soil micronutrient can be employed as a tool for predicting the deficiency of a nutrient and the profitability of its application. The critical limit of micronutrient in a soil is the content of nutrient at which plantation produce a significant response to its application.

54. The detailed soil investigation was carried out for study area. Soil samples were collected from eight locations once in a season during the complete study period. The locations of soil sampling stations are shown in Figure IV.5. Physico-chemical analysis of soil samples was carried out to assess the quality of soil. Their results are shown in Appendix–8a-c**.** summery of soil sampling results during summer'06,post monsoon'06 and winter06 are given in Table 7a-c below:

Table IV.7a
Summary Of Soil Quality During Summer 2006

pH (1 :10 suspension)	6.9 – 7.9
Electric conductivity ms/cm	0.084 – 2.320
Sand, %	14.6 - 33.3
Silt,%	27.6 - 58.6
Clay,%	26.8 – 40.5
Organic Matter%	0.179 – 1.030
Nitrogen, mg/gm	0.019 – 0.038
Phosphorus mg/gm	0.29 – 0.60
Potassuim %	0.2593 – 0.9240
Sodium Adsorption Ratio	0.00792 – 0.289

Table IV.7b
Summary of Soil Quality During Post Monsoon 2006

pH (1 :10 suspension)	7.0 – 7.5
Electric conductivity ms/cm	0.169 – 1.961
Sand, %	16.9 – 30.4
Silt,%	29.3 – 51.6
Clay,%	29.6 – 42.1
Organic Matter%	0.583– 1.213
Nitrogen, mg/gm	0.041 – 0.216
Phosphorus mg/gm	0.319 – 0.55
Potassium %	0.2163 – 0.7631
Sodium Adsorption Ratio	0.0059 – 0.71

Table IV.7c
Summary of Soil Quality During winter 2006

pH (1 :10 suspension)	7.1 – 7.4
Electric conductivity ms/cm	0.176 – 1.813
Sand, %	19.3 – 30.1
Silt,%	28.8 – 50.4
Clay,%	30.3 – 44.7
Organic Matter%	0.626– 1.191
Nitrogen, mg/gm	0.045 – 0.198
Phosphorus mg/gm	0.326 – 0.513
Potassium %	0.224 – 0.7819
Sodium Adsorption Ratio	0.050 – 0.635

TRAFFIC AND TRANSPORT

55. The Plant site is linked with a good network of rail and roadways.. The project site is located at 22 km from Mundra port. The site is well connected with state Highway no. SH-50 (via Anjar) and SH-6 (via Gandhidham) and would be near to NH-8A (Delhi-Kandla).

56. The nearest railway station is Adipur (57 km), which is 57 km away from the site. The railway station is well connected to multi-terminal Mundra port through broad gauge railway system owned by M/s. Adani Group. The nearest airport is Bhuj which is about 60 km from site. The site is about 2.5 km from the sea (Gulf of Kutch).

57. Heavy weight carrying vehicles (HCVs), Light weight carrying vehicles (LCVs), two wheelers and three wheelers are plying frequently on adjoining high way. Traffic pattern at Bhojpur, Bidada, Kandagra, Desalpur Highways for four types of vehicles were recorded during the Summer, post-monsoon and winter 2006. The traffic patterns of the adjoining highways are shown in following Figures IV.7a-h.

Figure IV.7a
Traffic Trend In Bhojpur Highway During Post-Monsoon 2006

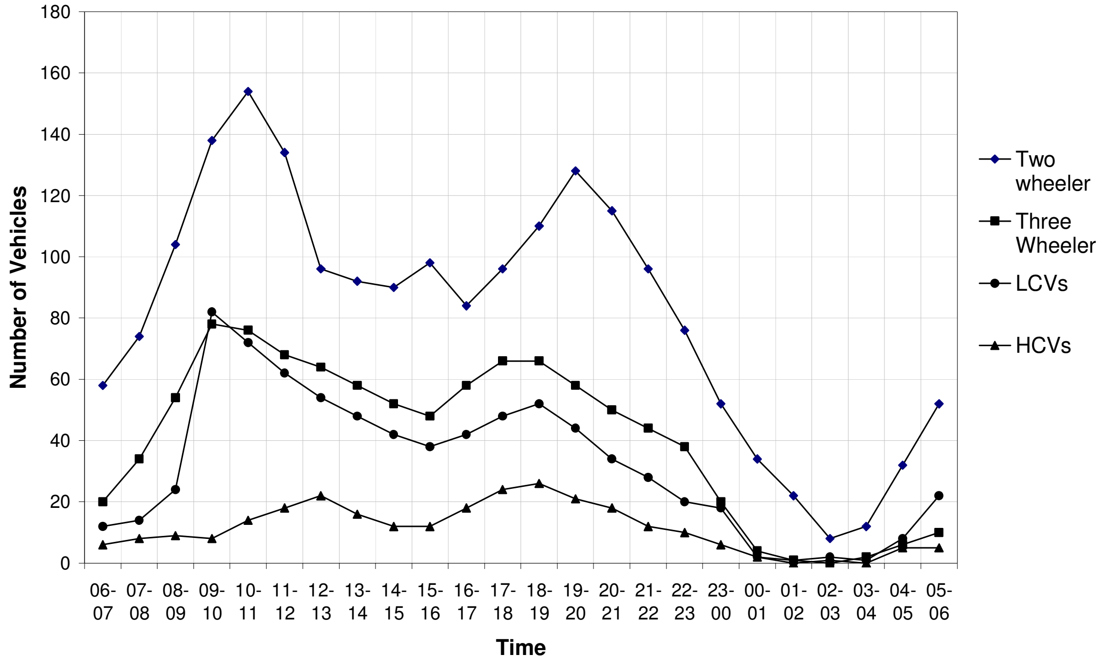


Figure IV.7b

Traffic trend in Bidada Highway during Post-monsoon 2006

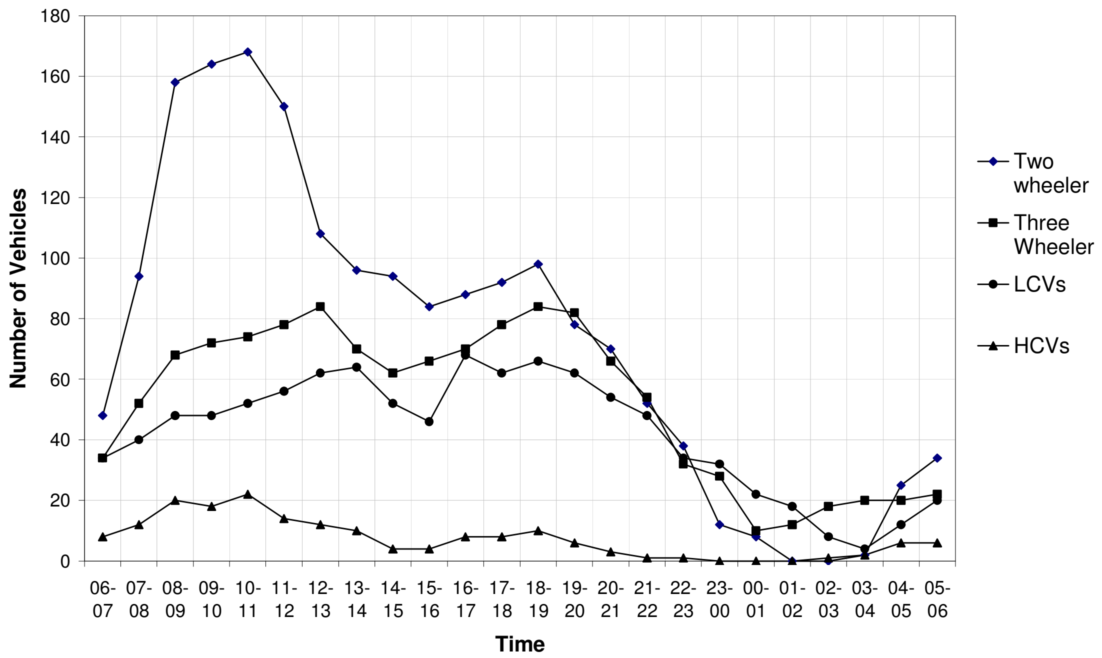


Figure IV.7c

Traffic Trend In Kandagra Highway During Post-Monsoon 2006

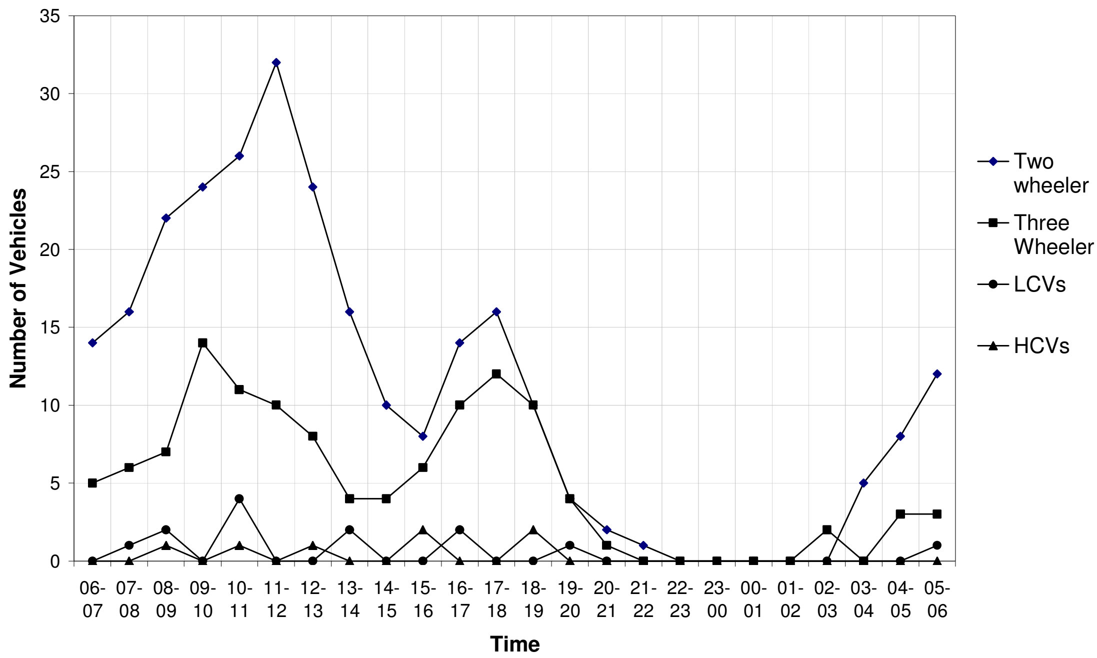


Figure IV.7d

Traffic Trend In Desalpur Highway During Post-Monsoon 2006

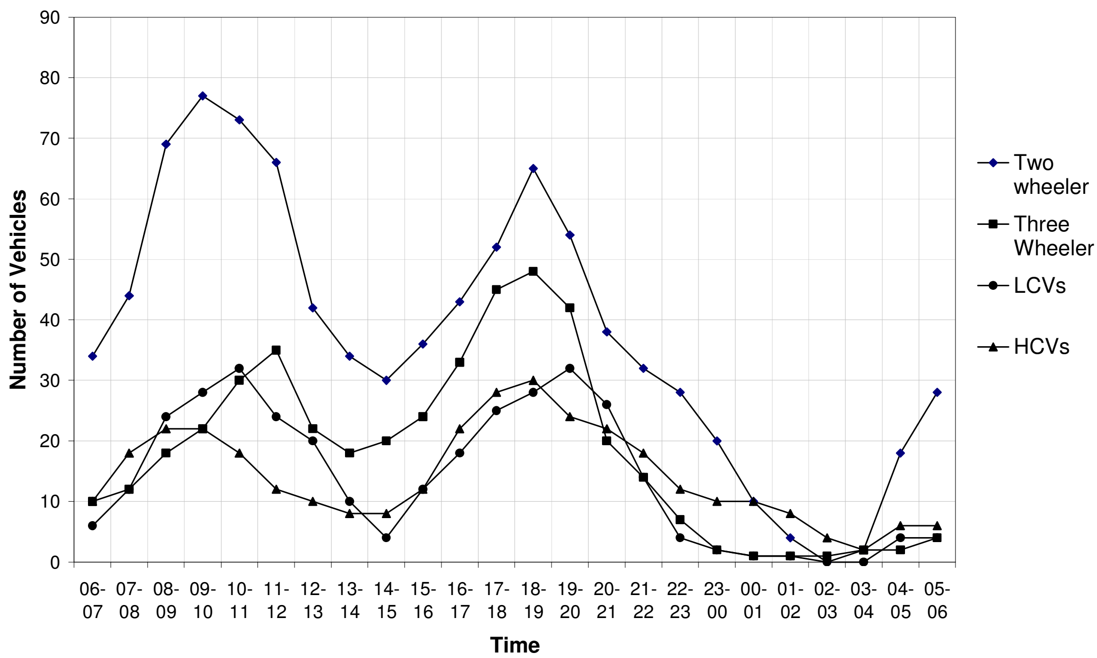


Figure IV.7e

Traffic Trend In Bhojpur Highway During Winter 2006

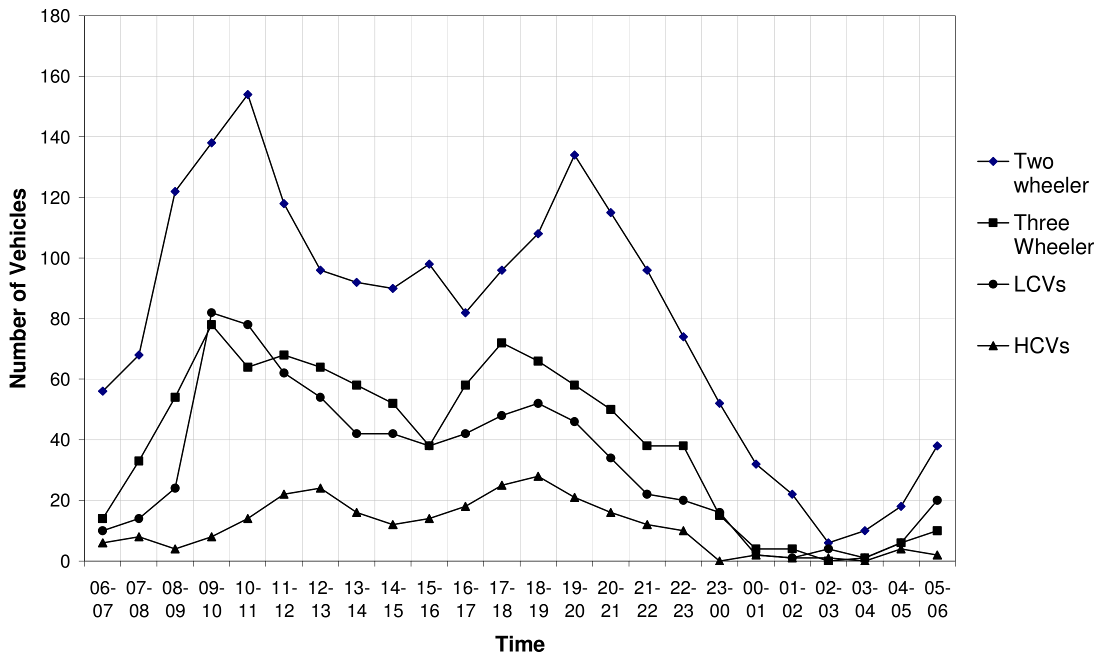


Figure IV.7f

Traffic Trend In Bidada Highway During Winter 2006

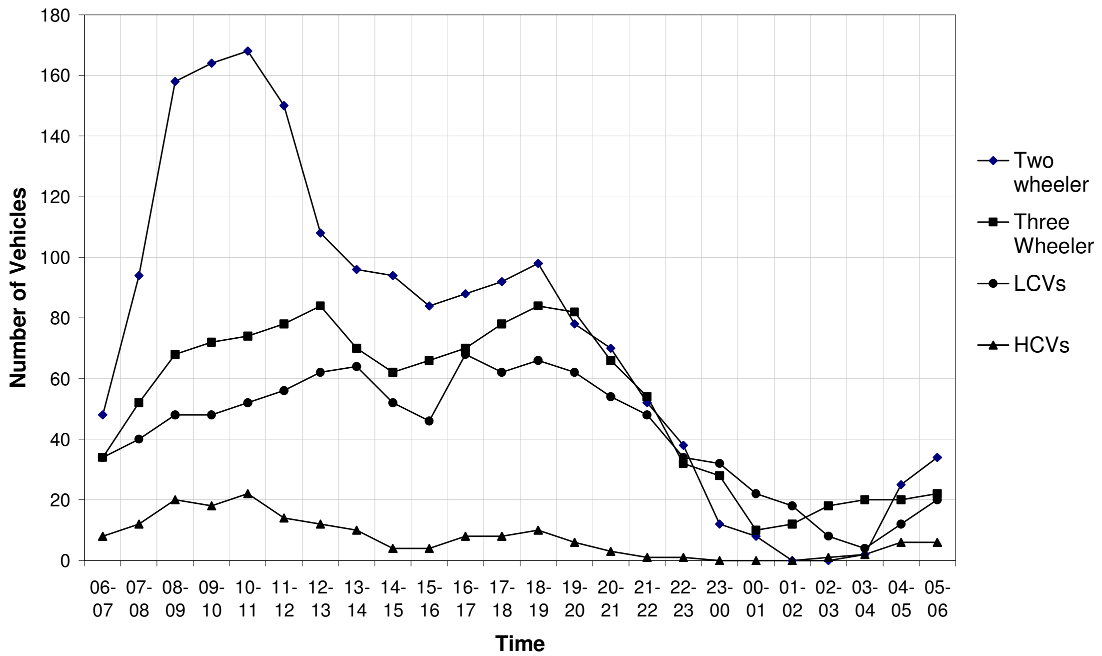


Figure IV.7g

Traffic Trend in Kandagra Highway During Winter 2006

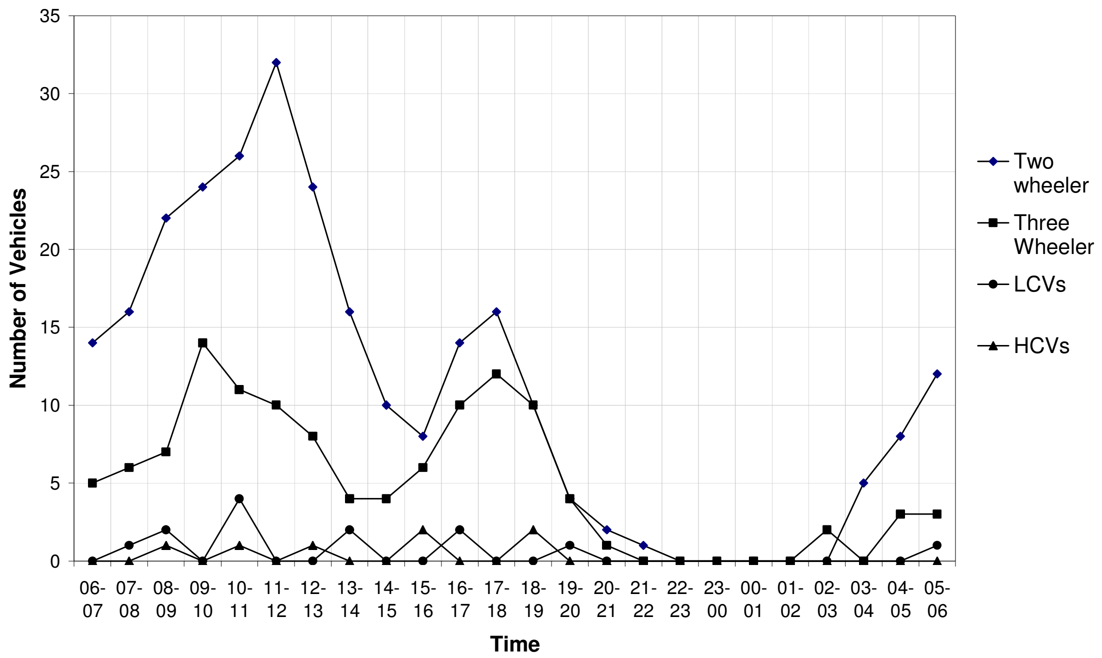
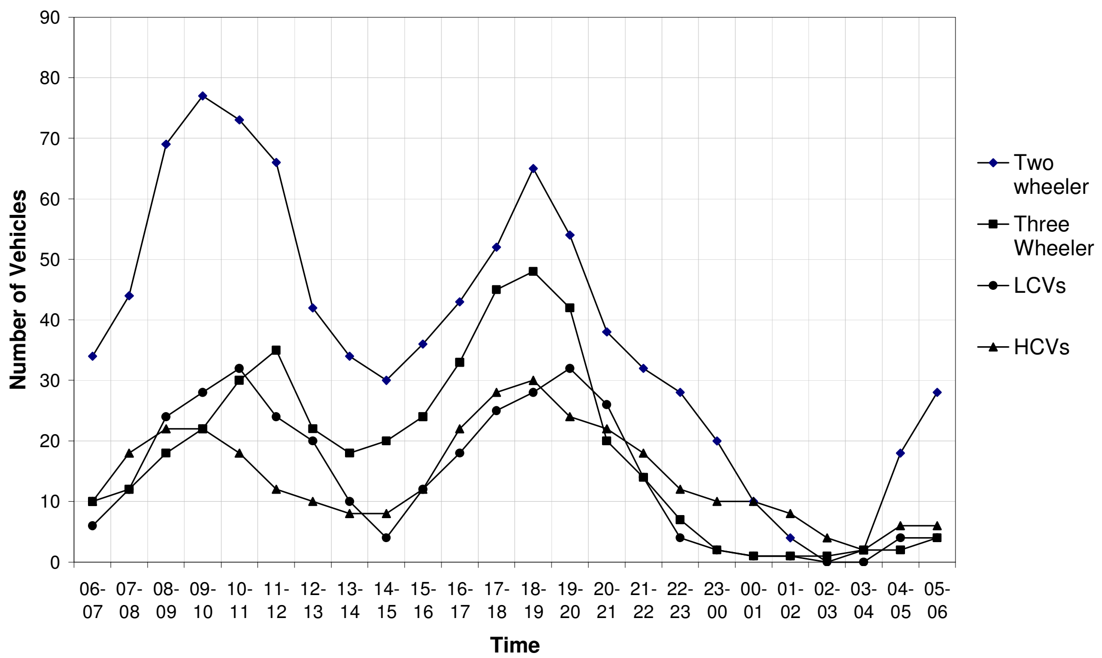


Figure IV.7h

Traffic Trend in Desalpur Highway During Winter 2006



58. From Figures IV.7a-h indicated that maximum traffic was observed during daytime. Frequency of two wheelers and three wheelers was maximum followed by, LCV's and HCV's. Minimum traffic was observed in night time during the period from 11.00 PM to 4.00 AM. Bidada Highway is exposed to more number of vehicles especially two wheelers. Kandagra Highway is having very less number of vehicles. Moreover, there is no significant difference in number of vehicles between post-monsoon period and winter during 2006.

INDUSTRIES

59. There is no major industry within 10km radius of the project area.

SOCIO ECONOMIC ENVIRONMENT

60. Socio-economic study of the area is a part of environmental impact assessment study for the proposed power project. Socio-economics, a component of environment includes description of demography, available basic amenities like housing, health care services, transportation, education and cultural activities. Information on the above said parameters has been collected to define the socio-economic profile of the study area (10-km radius).

61. A reconnaissance survey of the study area was conducted during the study period considering the socio-economic condition of the study area. Socio-economic assessment of the study area was carried out by survey team.List of survey nos. in the main plant area is enclosed in Appendix-9. Visits were made to Taluka office and district head offices for collection of data on population and land use pattern. Census data for the year 2001 was collected in CD form from the available source. Census handbook for the year 1991 was also referred for analysis of socio-economic data. The information on socio-economic aspects collected from various secondary sources including government offices has been analyzed and compiled. Information was also collected from local villagers. A detailed socio-economic study of the surrounding area with impacts and conclusion is enclosed as Enclosure – 1.

62. A list of villages falling within the study area with details of population characteristics and land use pattern is shown in Appendix – 10,11,12,13. The summary of population characteristics, literacy and occupational pattern for the year 2001 of the study area is provided in Table IV.8:

Table IV.8
Summary of Demographic Details within 10 Km Radius of the Study Area

Demographic Parameters	1991	2001
No. of Households	7811	10161
Total Study Area, Ha	36489	36489
Total Population	43272	53452
Total Male	21429	26897
Total Female	21843	26555
Population Density (No./Ha)	1.19	1.46

Demographic Parameters	1991	2001
Female per 1000 Male	1019	987
Family size	5.5	5.3
Percentage of Population below 6 Years	18.0	16.2
Total Schedule Caste	5816	7269
Total Schedule Tribe	1249	2025
No. of Literates	18658	28946
No. of Illiterates	24614	24506
Female literacy	7310	12073
Total Workers Population	16424	20938
Total Male workers	11025	14232
Total Female Workers	5399	6706
Main Workers	14860	15924
Marginal Workers	1744	5014
Non-Workers	26134	32514
Main Cultivator Population	5885	4496
Main Female Cultivator Population	1451	737

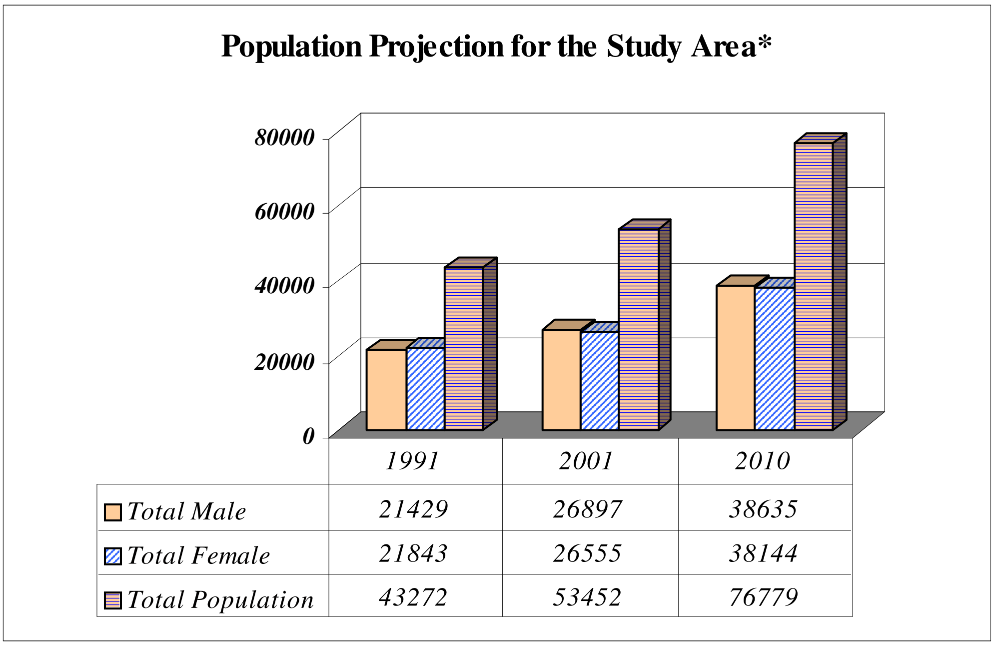
$Source: District Census Handbook 1991, Census 2001

63. Legends used for demographic profiles are as follows:

M:	Male	ST:	Scheduled Tribes
F:	Female	HH:	House Hold
Tot_M:	Total Male	CL:	Cultivator
Tot_F:	Total Female	OT:	Other Workers
P_06:	Population within 6 years	Work:	Workers
P:	Population	Marg:	Marginal
SC:	Scheduled Caste	Lit:	Literates
AL	Agricultural Labourer	ILL:	Illiterates

64. According to the results of Population Census 2001, the population of the study area is reported as 43272. The study area falls under SEZ, therefore, the region will have fast growing population. The population growth rate in 1991-2001 was 43%. The projected population in 2010 would be 76779 as per geometric progression method [Figure IV.8a].

Figure IV.8a
Population Projection for Year 2010

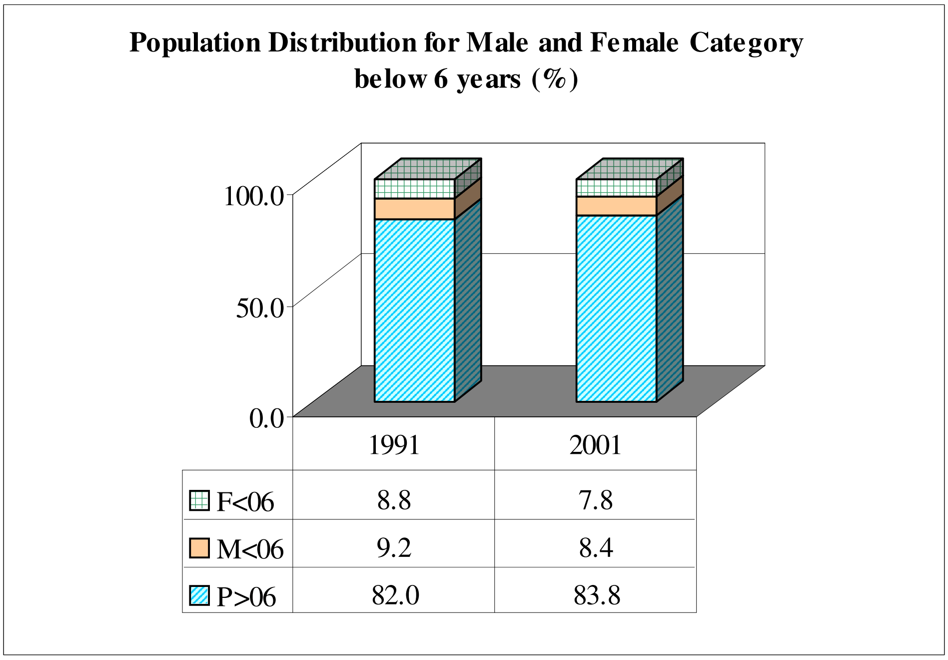


	1991	2001	2010
Total Male	21429	26897	38635
Total Female	21843	26555	38144
Total Population	43272	53452	76779

**Population projection by Geometric Progression Method (within 10 km radius)*
Source: District Census Handbook 1991 and Census 2001

65. The contribution of 0-6 year children to over all population has reduced significantly from 18% (1991) to 16.2 % (2001) as shown in Figure IV.8b. Figure IV.8c indicates that the contribution of scheduled caste and scheduled tribes populations to overall population are 13.6% and 3.8%, respectively in 2001. The analysis result indicated that percentage of schedule tribe population was less as compared to scheduled caste population.

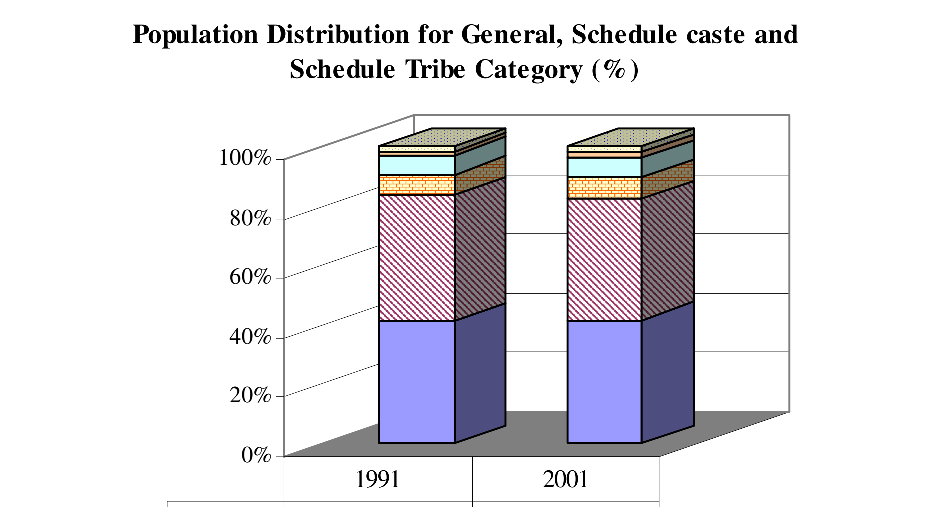
Figure IV.8b
Population Distribution for 0-6 Year Age Group



	1991	2001
F<06	8.8	7.8
M<06	9.2	8.4
P>06	82.0	83.8

Source: District Census Handbook 1991 and Census 2001

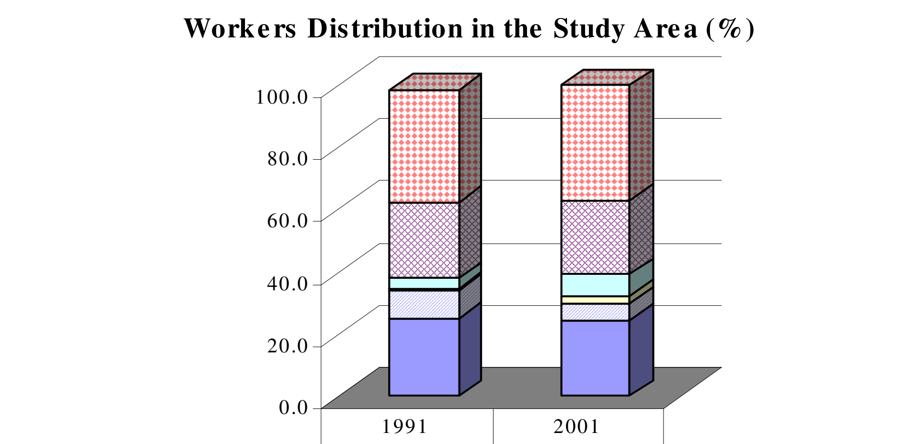
Figure IV.8c
Population Distribution for SC and ST



	1991	2001
F_ST	1.4	1.9
M_ST	1.4	1.9
F_SC	6.5	6.6
M_SC	6.9	7.0
F_Gen	42.5	41.2
M_Gen	41.1	41.4

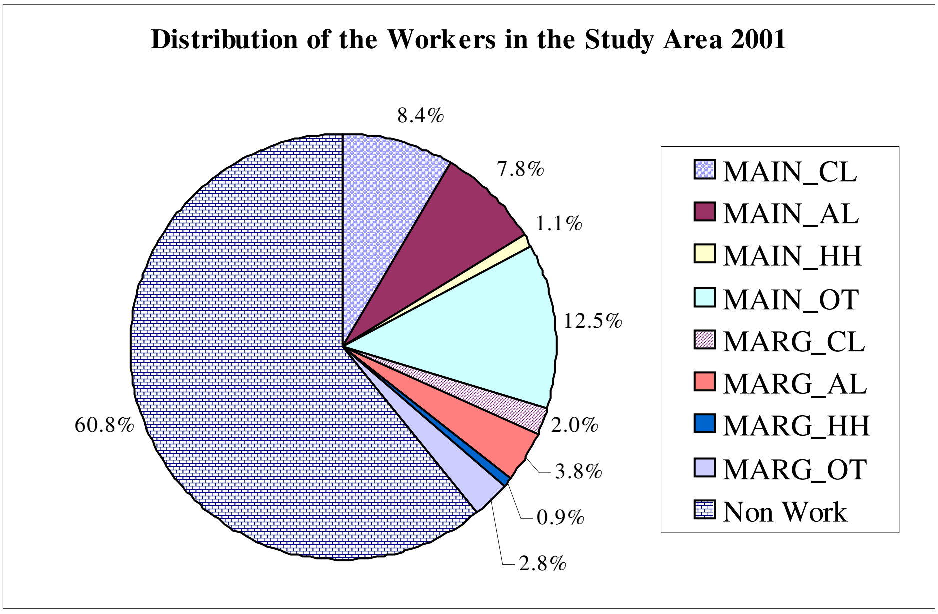
66. Considerable portion about 39.2% of the total population falls under workers categories. Distribution of various categories of workers is shown in Figure IV.9 a & b.

Figure IV.9a
Workers Distribution Pattern



	1991	2001
NON-WORK-F	36.0	37.1
NON-WORK-M	24.4	23.7
MARGWORK-F	3.5	7.1
MARGWORK-M	0.5	2.3
MAINWORK-F	9.0	5.4
MAINWORK-M	25.0	24.3

IV.9b
Distribution of Workers (2001)



67. The summary Table IV.8 indicated that population of non-workers was highest of 60.8% followed by 39.2% of total workers, (34.0 % main workers and 4.0 % marginal workers). Non worker population cover all persons, who are engaged in unpaid home duties and do not know other work or have not done any work at all during the last one year. The main worker is a person, who works for major part of the year. Marginal worker is a person who works for a period of less than 6 months in a year. A detailed village wise workers distribution pattern is shown in Appendix – 11. Population wise distribution of workers is shown in Figure IV.9a & b.

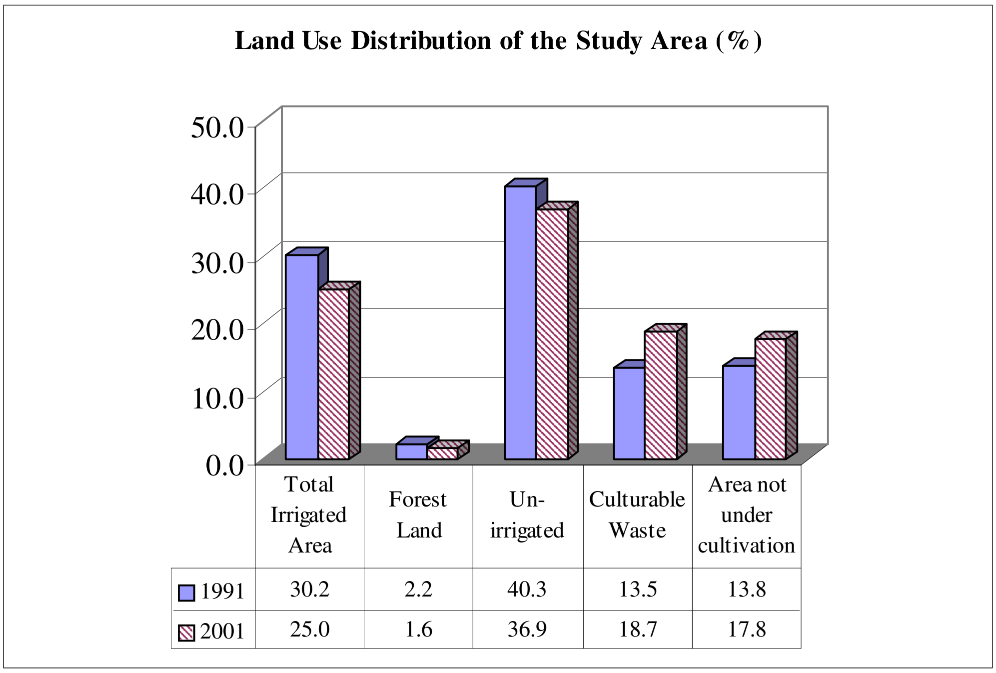
68. Production of Coal from wood is typical activity carried out by specialized population, which is means of income for them. (Appendix-14).

69. The 4000MW (Nominal) power plant is proposed to be located in a site near Tundawand village in Mundra taluka, Kutch district of Gujarat Coastal area. No major displacement of the people is required which may affect their livelihood. However, a separate socio-economic study had been carried out through the questionnaire and field survey. A separate socio-economic study report has been prepared for the consideration of the issues to be dealt for social aspects

LAND USE PATTERN

70. The total study area for this the project is around 36489 Ha. Forest area is 1.6% of the total area of the villages falling within 10 km radius of the study area. There is no forest reserve within the plant boundary. The detail of landuse pattern for the study area is shown in Appendix –12. The following Figure IV.10 shows the agriculture land use pattern in the study area.

Figure IV.10
Land use Pattern



	Total Irrigated Area	Forest Land	Un-irrigated	Culturable Waste	Area not under cultivation
1991	30.2	2.2	40.3	13.5	13.8
2001	25.0	1.6	36.9	18.7	17.8

$Source: Census 2001, Census Handbook 1991

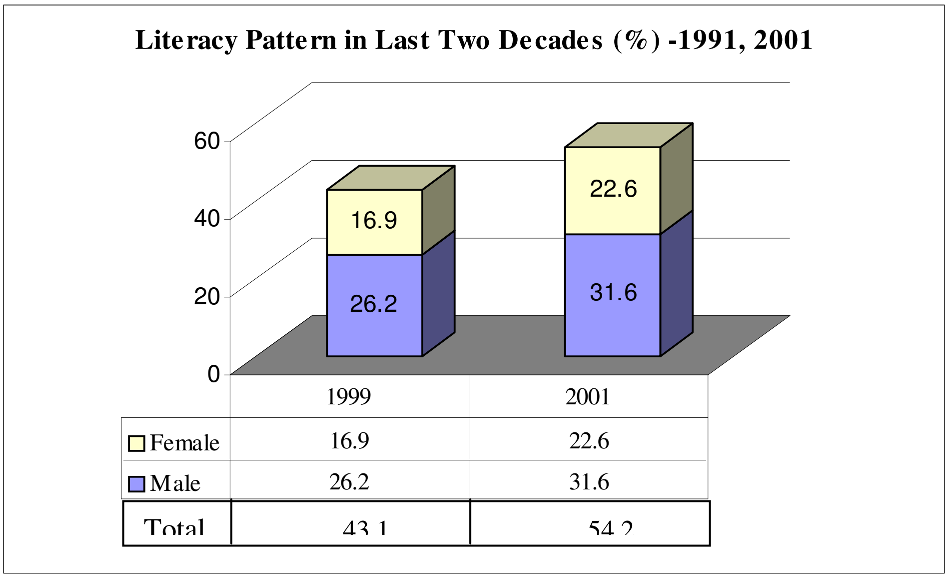
71. The figure indicated that only 25% of land area is coming under irrigation as compared to 36.9% of land area has no irrigation facility. Out of total land area 18.7 % land is culturable waste and 17.8 % of land is not used for any type of cultivation.

72. Major portion of the land area is coming under un-irrigated land category. However, nearly one fourth of land area comes under irrigated land category. This is an indication that surrounding population is depending on source of income other than agriculture also. Agriculture is mainly depending upon monsoon rain.

LITERACY STATUS

73. Educational status of population of the study area is not good as only 54.2% of population is literate. However, female literacy rate is 22.6%, which is comparatively poor. As per 2001 census data 67 % of the population was literate and remaining 33% population comes under illiterate category. A detailed literacy pattern of the study area is included in Appendix -13 Distribution pattern of literacy rate for all category of population is shown in following Figure IV.11.The Education facilities with in 10km radius of the study area is given in Table IV.9.

Figure IV.11
Literacy Pattern In The Study Area



Source: Census Handbook, 1991 and Census 2001.

Table IV.9
Education Facilities within 10 km Radius of the Study Area

Educational Facility	*1991*	*2001*
Primary or Elementary School	27	42
Middle School	1	0
Secondary or Matriculation School	2	4
Higher or Senior Secondary School	0	1
College	0	0
Industrial School	0	0
Training School	1	0
Adult Literacy Class/Centre	26	0
Other Educational Institutions	4	0

Source: Census Handbook, 1991 and Census 2001.

74. The predicted total number of persons required for the proposed project during construction and operation phase is as follows:

Item	Company's	Contractor's	Total
During construction	100	4000	4100
During operation	1850	150	2000

AGRICULTURE AND AMENITIES

75. Economic resources of the area include agriculture, irrigation, livestock and animal husbandry, forest, industries, transport and communication, medical and public health. All villages are electrified and medical facilities are adequate.

76. Amenities of the villages falling within 10km radius of the study area are shown in Appendix –15.

77. The land has been classified according to the different uses of rural areas. The land has been classified into irrigated, un-irrigated, culturable waste, area not available for cultivation and forestland type. The land use pattern of the study area is shown in Figure IV.10.

78. The dominant source of income is agriculture. The percentage of irrigated land is 12% of the total land area. The medical facilities present in study area are given in Table IV.10.

Table IV.10
Medical Facilities within 10km of the Study area

<table>
<tr><th>Medical Facilities</th><th>1991</th><th>2001</th></tr>
<tr><td>Allopathic Hospital</td><td rowspan="4">2</td><td>1</td></tr>
<tr><td>Ayurvedic Hospital</td><td>0</td></tr>
<tr><td>Unani Hospital</td><td>0</td></tr>
<tr><td>Homeopathic Hospital</td><td>1</td></tr>
<tr><td>Allopathic Dispensary</td><td rowspan="4">7</td><td>9</td></tr>
<tr><td>Ayurvedic Dispensary</td><td>2</td></tr>
<tr><td>Unani Dispensary</td><td>0</td></tr>
<tr><td>Homeopathic Dispensary</td><td>0</td></tr>
<tr><td>Maternity and Child Welfare</td><td>1</td><td>2</td></tr>
<tr><td>Maternity Home</td><td>2</td><td>1</td></tr>
<tr><td>Child Welfare Centre</td><td>6</td><td>4</td></tr>
<tr><td>Health Centre</td><td>0</td><td>1</td></tr>
<tr><td>Primary Health Centre</td><td>8</td><td>2</td></tr>
<tr><td>Primary Health Sub Centre</td><td>0</td><td>2</td></tr>
<tr><td>Family Welfare Centre</td><td>4</td><td>3</td></tr>
<tr><td>T.B. Clinic</td><td>1</td><td>1</td></tr>
<tr><td>Nursing Home</td><td>1</td><td>1</td></tr>
<tr><td>Registered Private Medical Practitioners</td><td>14</td><td>9</td></tr>
<tr><td>Subsidized Medical Practitioners</td><td>1</td><td>0</td></tr>
<tr><td>Community Health workers</td><td>18</td><td>18</td></tr>
<tr><td>Other medical facilities</td><td>1</td><td>0</td></tr>
</table>

79. Wheat, pulses, castor seeds, guvar, bajri, groundnut, maize, mug, jowar are the some of major commodities manufactured in the 10km radius area. Apart from these, cotton, kharek (Dates), isabgul and chikko cultivation are also major source of revenue generation. The major commodities manufactured in respective villages within 10 km radius are shown in Appendix –15a.

80. In Mundra the fodder crop dominated the cultivation. In Mandvi, major crops such as cereals and pulses are uniformly distributed. Cotton cultivation is also concentrated in areas of Mundra and Mandvi. Per hectare yield of the selected crops are shown in Table IV.11.

Table IV.11
Average Yield of Crops Per Hectare

Principal Crops	Average yield kg per hectare
Bajri	844
Jowar	447
Wheat	1971
Ground Nut	1010
Cotton	452

Source: Directorate of Agriculture –1990

CONNECTIVITY

81. There are one National highway (NH-8A Extension upto Mandvi through MSEZ) and three state highways (SH-6, SH-47 (Bhuj) and SH-48 (Bhuj)) passing through the study area. The site is accessible by road with State Highway No. SH-50 (via Anjar) and SH-6 (via Gandhidham) and National Highway No. NH-8A (Delhi Kandla). The site is 280 km from Rajkot and 350km from Ahmedabad.

82. The nearest railway station is Adipur (57km). A broad gauge rail network is also operational connecting Mundra with National rail network. The nearest airport is at Bhuj, which is about 60 km from the site. An in-zone airstrip is also being constructed within Mundra-SEZ. There is also Mandvi airstrip about 40km from Mundra port and 15 km from the Western boundary of Mundra SEZ. The proposed site is located at 22 km from Mundra port and 2.5 km away from Gulf of Kutch.

83. The means of transport is by bus, two-wheelers, bullock carts and camel carts. “Chhakada”, a vehicle combination of motorcycle and cart that can carry more than six people at a time, is a basic local transportation. (Appendix-15b)

LIVESTOCK POPULATION

84. Cattle wealth occupies a pivotal place in the rural economy of any of the area. Bullocks & cows, buffalo, sheep, goats, horses, mules, donkeys, camels, pigs and poultry are the livestock reported. Livestock density of the area varies from 50 to 75 per square kilometer. Average density (per square kilometer) for buffalo, cattle, goat, and sheep varies from 10 – 20, 30 – 50, 10 – 20, and below 5, respectively. The cattles (cow and buffaloes) are normally taken to open land for natural manuring of the land. There are various dairy farms (Gau shalas) in the study region that are also important source of earning for village people.

Livestock	***Average Density/sq km***
Buffalo	<10
Cattle	20-30
Goat	20-30
Sheep	20-30

Source: ENVIS website, 2006

WATER BODIES

85. The seasonal rivers flowing through Mundra Taluka are River Nagmati, Bhukhi, Khari nadi and Phot, all in turn terminates to Gulf of Kutch. . In Mandvi Taluka the seasonal rivers are Rukmavati, Kharod and Vantharadi. In Mandvi and Mundra there are medium surface water structures namely Don and Kalaghogha respectively. Taluka wise surface water storage and irrigation potential is summarized in Table IV.12. Table shows that the Mandvi ranks poorer in terms of the storage but demonstrates better irrigation capability.

Table IV.12

Taluka wise Surface water storage and irrigation Potential

Taluka	CCA(Ha)	UIP (Ha)	GS (MCM)
Mundra	7197	4999	37.42
Mandvi	13409	8803	66.44

CCA- Culturable command area; UIP- Ultimate irrigation Potential, GS- Gross Storage

Source: GIDE, 2000.

86. Mundra falls under “dark” category as groundwater development is between 85-100%. Mandvi is categorized as “OE” meaning the ground water is overexploited to the extent of development above 100% (GIDE, 2000).

SATELITE DATA COLLECTION, ANALYSIS AND INTERPRETATION

87. Details of study including methodology adopted for the study is described in the Appendix – 16. Chapter 2.0. Chapter 3.0 describes the field observations and Global Positioning System (GPS) made from ground survey. Chapter 4.0 explains the dominant and representative ground features showing the digital photographs. Chapter 5.0 gives the satellite images, which include classified land use/land cover thematic maps.

88. Satellite image analysis was carried out for the generation of land use/ land cover map of the study region. The study region, is located the district of Kuchhch, Gujarat. The approach for satellite data analysis adopted the well-proven Image processing procedures. The analysis was preceded with a ground survey, which comprised of data collection of ground features along with the respective geographical position in terms of latitudes and longitudes. The interpretation of the satellite data was supplemented by these ground truth studies. The satellite data used has the below specifications:

- Satellite and Sensor: IRS P-6, LIS III (L-3)
- Date on which the image was taken: 26-November-05

89. The said time period of acquisition of the satellite data has been judiciously chosen to depict the vegetation and other ground features at its best, as also avoid the cloud cover over the satellite data.

90. The image processing software used is the professional version of ERDAS IMAGINE 8.4 under Windows NT. A Pentium 1V based computing machine

with high processing speed and graphic facilities under the operating system of Windows NT is used for the image processing and interpretation.

91. The landuse-landcover in the region comprises of various types, referred as classes. The features derived from the satellite image after validation by the ground observations, have been presented as nine classes and are given below. These classifications types are as per the 'level classification' categories followed by National Remote Sensing Agencies (NRSA), -

a) Cultivated Land
b) Fallow Land
c) Built-up Area
d) Water Bodies
e) Barren Area
f) Marshy Land / Low Land
g) waste land
h) Forest Cover
i) Sparse Forest

92. Satellite data from IRS-P6 (November 26, 2005) has been used. The approach used for analysis is given at the Chapter 2.0 of Appendix -16.

93. In order to understand the land use and land features covering the entire study region, both False Composite and classified images have been derived. FCC images depict the land features such as the coastal boundaries, while the classified images show different land use classes listed above. The coverage statistics, the area covered by each land use class, are also derived through satellite data analysis and given below in different Tables-2 included in Appendix – 16.

94. FCC Images for 5, 10, and 30 km from the project site is shown as Figure 1, 2 and 3, respectively. Similarly, classified images for 5, 10 and 30 km from the project site is shown as Figure 4, 5 & 6 in attached Appendix-16.

BIOLOGICAL ENVIRONMENT

95. Environmental Impact Assessment studies needs monitoring of each and every environmental component. Apart from other environmental components, biological environment is an important and integral part of EIA study, as whatever changes due to industrial activities takes place in the surrounding environment, affects both living and non-living component of environment. Assessment of terrestrial ecosystem concentrates on the tree and herbaceous layer vegetation because these are relatively conspicuous and easy to identify.

96. Since the study area belongs to the coastal region and project activities are not limited to land but to marine ecosystem also. Therefore, marine environment is an important component that may be affected due to industrial activity, if proper control measure would not be adopted.

97. Baseline data for flora and fauna has been collected, which includes information on both flora and fauna communities. In present study, information has been collected on existing plant and animal species through survey and field studies. The information on distribution pattern of tree species has been collected to establish the interrelationship between species for prevailing environmental factors for post-development monitoring and management.

98. Plants and its surrounding environment are closely related and interdependent on each other. Plants compete themselves for the need of nutrient and light and adjust by adaptation or by modifying the surrounding environmental conditions. Thus they develop some sort of tolerance / resistance to overcome the adverse conditions. Plant population in a community varies from habitat to habitat that plays a fundamental role in determining the type of community over a period of time. Each constituent species within a community has a large measure of its structural and functional individualism along with more or less different ecological amplitude. Therefore, the dimension, population size and diversity of the species are more significant biological element of an ecosystem.

99. Plant communities are not static but always a dynamic entity. The vegetation cover may reflect the changes, which occurs in its structure, density, and composition. The most important characteristics of a community are its quantitative relationship between abundant and rare species. Characteristics of community in any ecosystem include the composition, structure, species diversity and growth trend of succession and other characteristics of the community, which is applied for the concept and realization of land management. To meet the objective of bio-diversity conservation with temporal & spatial changes, the monitoring of vegetation of an area is a necessary step.

100. A reconnaissance survey of the study area was planned during the study period Summer 2006 to establish the existing baseline ecological condition of the study area. The information about forestland area of the villages was collected from District Census Hand Book Part II – Land use. Prosopis *juliflora* is the dominant species of the terrestrial ecosystem of the study area.

ECOLOGICAL STUDY OF PROPOSED POWER PLANT AT MUNDRA

THE STUDY AREA

101. (Study area: Village Tunda-Wand and the region within 10 km radius from this village; Period of Observation: Pre-monsoon period, Third week of May 2006). Ecological study has also been carried out for MGR system extended from power plant boundary to Adani port at Mundra.

102. Separate study on terrestrial ecology of MGR system and proposed service road has been carried out during first week of December'06. Separate terrestrial ecology report has been submitted to MOEF, New Delhi before second MOEF expert committee meeting held on 09.01.2007. This report includes impacts and finding of ecological study for MGR system. The same is enclosed with this report as Enclosure - 2.

103. Village Tunda-wandh is situated in Mundra taluka of Kuchchh district of Gujarat state. Geographically it is situated on the northern coast of Gulf of Kuchchh. The study area comprises following villages:

a) Coastal villages: Jarpara, Navi Nall, Dhrab, Borana, Siracha, Tunda-Vandh, Gundhiali, Maska
b) Villages away from the coast: Tragdi, Nani Khakar, Mota Khakar, Nana Bhadiya, Mota Bhadiya, Bag, Pipri, Bidada, Desalpar, Bhojpar, Khandagra,
c) Town Mundra and Mandvi fall just out side the study area.

VEGETATION COMPOSITION

104. Vegetation of the study area falls under “VI – B Northern Tropical Forest “ – sub – type C-I Desert Thorn Forest - (VI – Kachchh, Saurashtra, Gujarat). A costal area of the study area has small patches of mangrove forest also in its coastal belt. View of barren project site area without tree and habitation is shown in Appendix - 17. Typical open scrub forest mainly constitutes thorny, stout species of *Prosopis juliflora*, Accasia spp., Ephorbia spp. *Cassia auriculiformis*. A typical scrub vegetation of the study area is shown in Appendix - 18 Sand dunes were also recorded very close to coast area. A typical photograph of sand dune around the species of *Prosopis juliflora* is shown in Appendix-19.

105. The geographical area of Kuchchh is 19,478.96 sq.km and consists 949 villages. The average rainfall of the district is 300-400mm only. The forest cover is 1,83,600 hectares, irrigated land is 71,000 hectares, non-irrigated land is 6,62,600 hectares. Town Mundra and Mandvi fall just out side the study area.

106. The main crops of the District are Bajra, Jowar, Wheat, Coconut, Kharik, Sugarcane and pulses. The geographical area of Mundra taluka is 888.1 sq. m. and consists 60 villages.

107. Marine Impact Assessment is based on the analysis of the baseline data and other available source of information in the study region. The attempt has been made to evaluate the existing environmental condition of the region. If any fragile condition exists it will be identified and addressed. Various parameters inter relationship with each other, possible positive/adverse impacts has been evaluated and enlisted. In case of any negative impacts the possible way of mitigative measures for reducing the impacts, available, alternatives and other suitable mitigation measures will be formulated and presented.

108. Marine Environmental Management Plan is based on the studies, the various marine management plans for the proposed activities during construction and operation phase has been prepared and included in chapter environmental management plan.

BIOLOGICAL CHARACTERISTICS: AND ANALYSIS OF VARIOUS PARAMETERS

109. Phytoplanktons including all drifting or floating aquatic plants. Usually, these plants are single celled and autotrophic. Phytoplankton, as primary producers, contributes appreciably to the total production within the aquatic system.

110. Primary productivity is the rate at which the sun's radiant energy is stored by photosynthetic activity of producer organisms in the form of chemical energy. The primary productivity is thus the basis of whole metabolic cycle in natural aquatic ecosystems; the remainder is consumption and decay. The consumers inhabiting the system utilize the organic matter synthesized by primary producers.

111. All the material synthesized by the producers, however, is not available to consumers (all other forms except producers). The producers themselves utilize part of it in their maintenance (respiration) whereas some part of it is wasted and is use by the decomposers (non-photosynthetic bacteria, fungi, etc.) and the remainder is consumed by the herbivores (organisms using plant material as food). Herbivores transfer some amount of energy to the carnivores (organisms using living animal material as food). The accumulation of biomass in all other organisms except in producers is referred as secondary production. There are four successive steps of production process:

Gross Primary Production (GPP)

112. It is the rate of photosynthesis, and includes the organic matter used up in the respiration during the measurement period.

Net Primary Production (NPP)

113. It is the rate of storage of organic matter in plant tissue in excess of the respiratory utilization by the producers during the period of measurement.

Net Community Production (NCP)

114. It is the rate of organic matter not used by heterotrophs (i.e. NPP - heterotrophic consumption) during the period under observation.

Secondary Productivity (SP)

115. It is the rate of energy storage at consumer level.

116. Primary productivity studies are of paramount interest in understanding the effect of pollution on systems efficiency. High rates of production both in natural and cultural ecosystems occur when physicochemical factors are favourable. Pollution of water in the long run leads to a reduction in primary productivity. Pollution also affects the production (P)/respiration (R) ratio, a proper level of which is very essential for the sustenance of the system. In non-polluted water, the P usually exceeds R but in organically polluted systems R exceeds P and no organic material is left available for the bioactivity of the system leading to system's impairment.

117. Zooplanktons include small animals of weak swimming ability or without swimming ability that are free floating or drifting biota. The Zooplanktons have their importance in the aquatic food web by being an initial consumer of energy fixed by the Phytoplankton, and by them providing a link between primary production and higher trophic levels. Thus, measurements of species richness, species composition and species diversity indices could be used to evaluate the baseline status of the aquatic zone. In the same way the secondary productivity too gives a good idea about the present status of the aquatic environment and also of the impact of a particular development in the sense that if the secondary productivity is more then the physicochemical factors prevailing in the study area are favorable and vice versa.

METHODOLOGY

Sampling

118. Sampling was carried out in the whole study area of 10 km during the month of May 2006. Topographic feature of the area covered for marine ecological study is shown in Appendix -20.

119. The study area is divided into 4 transects. The distribution of transects were done based on the reconnaissance at the beginning of the project as well as the considering the detailed project activity and secondary information on the surrounding areas of water body and the prevalent activity.

120. The samples were collected at inter tidal region and up to a distance of about 3 km, (Radial) into the sea at 4 sampling points.

121. Surface water samples and sediment samples were collected for the selected sampling locations for low tide as well as high tide. Plankton samples were collected using plankton net. Sediment samples were collected using Ekman's grab while the water samples were collected from surface directly. The boats used for sampling is shown as Appendix- 21.

122. The Phytoplankton samples were preserved using Lugol's solution whereas 5% Formalin solution was used for the preservation of Zooplanktons.

Analysis

123. The samples were analyzed within 24 hours from the time of collection using the standard methods of analysis as stated under.

The basic equation of photosynthesis is:

$$6CO_2 + 6H_2O \xrightarrow[\text{Chlorophyll}]{\text{Light}} C_6H_{12}O_6 + 6O_2$$

124. Hence, to measure primary productivity one can measure the carbon uptake as well as the oxygen production, or the formation of the organic compounds or the gain of chemical energy of the system. In aquatic ecosystems, the primary productivity is mainly due to Phytoplankton and aquatic macrophytes. The methodology adopted for determining the primary productivity is the *Chlorophyll method* (**APHA, 1989**).

Chlorophyll Method for Primary Productivity

125. The Phytoplanktons were collected from the by grab sampling method and centrifuged in order to collect the settled mass. These were washed with tap water, then with distilled water and dried with blotting paper. Accurately weighed 1gm. sample was crushed properly with the help of mortar and pestle in 80% acetone medium so as to get a homogenate. A pinch of MgCO3 is added to remove of the unnecessary acids. The contents are finally diluted to 100ml.

126. The absorbance is measured at 630nm, 645nm and 663nm for each sample and the chlorophyll content is calculated by applying the following formula:

Chlorophyll a = (11.64 x O.D at 663nm) - (2.6 x O.D at 645nm) + (0.1 x O. D. at 630nm)

Thus, the primary productivity is determined in terms of chlorophyll content.

Phaeophytin

127. The contents in the cuvette used for the analysis of chlorophyll a are acidified with o.1ml of 0.1 M HCl in order to remove the interference of chlorophyll a. The optical densities are read at 664nm and 665nm respectively.

Phaeophytin is estimated by using the formula:

$$\text{Phaeophytin a} = \frac{26.7\,[1.7\,(665nm) - 884nm] \times V1}{V2}$$

128. **Zooplankton** were analyzed for the species diversity, standing stock and biomass using microscopic examination with the aid of identification keys from the literature available, photoplates, etc.

129. Benthic communities were microscopically examined for identification of species.

OBSERVATIONS AND DISCUSSIONS:

Phytoplankton

130. The phytoplankton pigments were measured at the surface. The results for the same are given in **Table IV.13** and **IV.14**.

Table IV.13

Average of Phytoplankton Pigments at study area (surface)

Sampling Location	Chlorophyll a (mg/m^3)		Phaeophytin (mg/m^3)	
	High Tide	Low Tide	High Tide	Low Tide
S1	2.4	2.7	1.4	1.8
S2	2.3	2.8	1.2	1.6
S3	2.1	3.0	0.8	1.0
S4	1.9	3.1	0.5	1.0

131. The average chlorophyll values of 2.17m^3 and 2.9 mg/m^3 during high tide and low tide suggest moderately high primary production potential. Phaeophytin values are mostly lower than chlorophyll *a* indicating a healthy condition.

132. The productivity values also reveal less primary and secondary consumers as compared to the primary producers. The reason for which is a matter of extensive study.

Table IV.14

Primary Productivity at various sampling locations.

Sampling Location	Gross (MgC/m^3/hr)		Net (MgC/m^3/hr)	
	High Tide	Low Tide	High Tide	Low Tide
S1	1.86	2.55	1.09	1.81
S2	1.95	2.62	1.21	1.91

Sampling Location	Gross (MgC/m^3/hr)		Net (MgC/m^3/hr)	
	High Tide	Low Tide	High Tide	Low Tide
S3	1.91	2.87	1.11	1.57
S4	1.97	2.91	1.17	1.80

133. Phtyplankton in the study area are principally composed of one-celled diatoms, cyanophytes, coccolithophorids, chlorophytes and dinoflgellates (**Table IV.15**). Other Phytoplanktons includes blue-green algae.

Table IV.15

Phytoplankton diversity at various sampling locations (surface)

Sampling Point	Cell count (no x 10^3/l)		Total genera		Composition (Major Groups)
	High*	Low*	High*	Low*	
S1	117	119	4	4	Bacteriastrum, Rhizosolenia, Navicula, Anabaena spiroides
S2	119	121	5	4	Bacteriastrum, Rhizosolenia, Navicula, Thalassiosira, Cosmarium
S3	120	118	4	6	Bacteriastrum, Rhizosolenia, Navicula, Microsystis
S4	112	125	5	6	Coscinodiscus, Navicula, Bacteriastrum, Tribonema

* - Tide

Phytoplankton population is found to be moderately high in almost all the samples. The species diversity found is also fairly good in all the samples.

Zooplankton

134. The predominant groups of Zooplanktons in the study area include copepods, Sagitta, Mysids, Naupilli besides larval forms of gastropods, polychaetes, radiolarians, and others (**Table IV.16**). The standing stock and the biomass found in the samples (sampling points S1 to S4) is moderate with moderate species diversity. However, the trend can be generalized as increasing from S1 to S4. The reasons for the above mentioned trend can be attributed to those similar to that for the Phytoplankton.

Table IV.16
Zooplankton diversity at various sampling locations (surface)

Sampling Point	Biomass (ml/100m^3)		Population Density (no x 10^3/ 100m^3)		Faunal group (no.)	Major group
	High*	Low*	High*	Low*		
S1	6.97	7.07	106	117	13	Copepods (Cyclops), Trichocerca spp, Sagitta
S2	5.48	6.99	83	92	8	Copepods, fish eggs, Mysids, Naupilli
S3	5.67	5.88	119	134	16	Copepods (Cyclops), Moina, Sagitta, Mysids, Cercaria larva
S4	6.92	8.15	132	146	16	Cyclops, fish eggs, Sagitta Mysids, Cercaria larva

* - Tide

Biomass of zooplankton is fairly high. The major group classifications include rotifers, cladocerans and copepods besides some fish eggs and schools of larval fish.

Benthos

135. Intertidal macrobenthic biomass is very high, 134 g/m2. Group diversity was also moderately high with an average of 21 groups. The intertidal organisms include a diverse *Katelysia, Meretrix, Murex, Cyprea, Balanus* etc.

Fishes

136. Fishing is the major source of income in the study area. Lot of fishermen go out in their indigenous boats, some have mechanized trawlers. The area has good fish population. Gujarat, in the northwest coast, is dominated by demersals such as sciaenids, cuttlefishes and non-penaeid prawns. The major commercial varieties of fish that are caught are Jew fish, Bombay duck, Prawn, Lobster, Squid, Cuttle fish, Silver bar, Hilsa, Shark, Catfish, Mullets, Ribbon fish, Shrimps, Sear fish and Croakers. In addition, the Gulf of Kutch has favorable conditions for the growth and sustenance of different types of Oysters, Shellfish and Seaweeds. Trawl catch rate indicates good potential 25 – 35 kg/h with an average species diversity of 34. Gill nettings show average rates of 7.6 kg/h.

Birds

137. The Gulf area, which has many saltpans, Islands and inter-tidal coastal system with mangroves, offer favourable conditions for feeding, breeding and shelter to a variety of birds. A recent study reveals high avifaunal diversity at Mundra region and 140 species have been documented. Some of the birds sighted during the present study are Grey herons, Pond herons, large and small Egrets, Black Ibis etc. Birds seen at Mandvi beach are shown in Appendix-22.

Water quality

138. Hydro chemically, the study area shows properties typical of a shallow semi enclosed sea in an arid region with the little or no freshwater input. The annual variation of water temperature is between 24 and 30℃ though localised higher temperatures upto 35℃ can result in isolated water pools formed in shallow intertidal depressions during low tide.

139. **pH** of the Gulf water is fairly constant (7.8-8.0) and is within the range expected for the coastal tropical seas **(Table IV.17).**

140. **Salinity** is higher than that of the typical seawater. This is particularly because the area experiences low precipitation and high evaporation.

141. **DO** is fairly high (4 -5 ml/l) which indicates good mixing of oxygen thus favourable conditions for organisms. Near homogeneity, absence of stratification and large tidal amplitudes coupled with turbulence render the entire Gulf vertically well-mixed resulting in high dissolved oxygen at or over its saturation point.

Table IV.17
Water Quality of study area

Sampling Location	**Parameters**							
	pH	D.O. ml/L	TSS mg/L	NO_2-N mg/L	NO_3-N mg/L	$PO4^{-3}$ mg/L	B.O.D. ml/L	Salinity (%o)
W1	8.0	4.2	120	0.001	0.098	0.028	0.88	36
W2	7.8	4.8	179	0.001	0.086	0.019	1.2	37
W3	7.8	5.1	83	0.002	0.092	0.010	0.92	38
W4	7.9	4.3	143	0.001	0.122	0.031	0.96	38

142. The concentrations of heavy metals such as chromium, manganese, cobalt, nickel, copper, zinc and lead were studied **Table IV.18**.

Table IV.18
Metal concentrations in water samples from study area

Sampling Location	Metal Concentration µg/g							
	Cd	Cr	Co	Cu	Mn	Ni	Pb	Zn
W1	0.02	BDL	0.07	0.35	0.09	0.86	0.07	0.12
W2	0.01	BDL	0.05	0.24	0.12	0.79	0.04	0.17
W3	BDL	BDL	0.08	0.32	0.12	0.92	0.03	0.13
W4	0.02	BDL	0.06	0.17	0.11	0.88	0.03	0.16

*BDL : Below Detection Level

143. **BOD** is low (0.88-1.2 ml/l) indicating good oxidizing conditions. The organic load in the water column is expected to be effectively oxidized aerobically.

144. **Suspended Solids** (83 – 179 mg/L) vary spatially as well as temporally, and largely result from the dispersion of fine sediment from the bed and the intertidal mudflat, by tidal movements.

145. **PO4^{-3}** concentrations were in a favourable range and more or less uniformly distributed. The network of creeks sustains high natural concentrations of nutrients perhaps due to high regeneration rates.

146. **NO_2-N, NO_3–N** concentrations were also in a favourable range and more or less uniformly distributed with slight variation.

147. **Metal** concentration of the water samples were found to be relatively low, indicating that the water is yet not contaminated to alarming levels.

148. The overall quality of water is excellent. Marginal degradation in water quality in localized areas around industrial and urban centre is possible. But such changes are subsided by semi – diurnal tidal flushings associated with moderate to strong tidal currents.

<u>Sediment quality</u>

149. The near shore sediment, which consists of light grey silt and clay with patches of fine to coarse sand in-between. The major source of this sediment is considered to be the shore material and the load transported by the Indus River. A view of beach located close to project site is shown in Appendix- 23.

150. The concentrations of heavy metals such as chromium, manganese, cobalt, nickel, copper, zinc and lead were studied **Table IV.19**. The metal concentrations indicate natural background levels and there is no evidence of Gross sediment contamination.

Table IV.19
Metal concentration in sediments from the study area

Sampling Location	Metal Concentration µg/g							
	Cd	Cr	Co	Cu	Mn	Ni	Pb	Zn
S1	15.2	10.2	18.3	32.2	23.0	14.0	27.2	46.2
S2	12.8	18.3	20.2	30.9	19.7	17.3	36.1	73.4
S3	8.3	15.8	16.1	27.4	21.2	15.9	24.7	69.7

LAND BASED SURVEY- VEGETATION ANALYSIS

AGRICULTURAL VEGETATION DIVERSITY

151. There happens to be a significant diversity of crops in the study area. Among cereals, Bajra (Pennisetum typhoides) and Jowar (Sorghum bicolor) are mainly cultivated in this region. Proportionately Wheat (Triticum vulgare) is cultivated in lesser quantity. In pulses Mung and Mungphali (Arachis hypogaea) were observed. Kharik Palm (Pheonix dactylifera), Chiku (Achrus sapota), Coconut (Cocus nucifera) Mango (Mangifera indica var. Kesar) were the main cash crops cultivated in orchards. Of these Kharik Palm, Chiku were the predominant in the coastal villages.

152. However in inner villages the Coconut and Mango has reduced their majority significantly. Papita or Papaya (*Carica papaya*) was also observed in few orchards. Erand (*Ricinus communis*) was observed to be cultivated for its oil yielding seeds. In vegetable crops Dudhi, and members of Cucurbitaceae family were observed along with Brinjal. In homestead areas Khatti and Mithi imli (*Tamarindus indicus* and *Pithecolobium dulce*), *Jamun* (*Syzygium cumini)* and *Ber* (*Zizyphus mouritiana*) were very common. Very few numbers of *Artocarpus heterophyllus* were also been observed.

MANGROVE VEGETATION

153. The intertidal region in the study area is though under influence of tide, possesses sandy substratum and hence is devoid of mangrove vegetation. Mangroves show a very dwarf appearance in the creeklets such as “kutri”(local name creek, which is at least 2.5 km. away from the actual project site. Avicennia marina is the dominant species with Suaeda as a majour associate mangrove. Denis indica and Salvadora persica are the other associated species were recorded during the study period. Physical feature of the dominant mangrove species Avicennia marina is shown in Appendix -24.

154. Mangroves, locally famous as “Cheriya” in this region and the mangrove areas are called “Cheriya vistar”. Avicennia marina, Salvadora perciaca, Seuda were very common in this area. According to information available from local forest office, few years back, *Rhizophora mucronata* and *Ceriops tagal* had been introduced in this region. The mangrove vegetation is seen from Mundra port up to Tunda-Vandh coast. However, in Tunda-Vandh, the *Prosopis* and *Acacia* spp. were predominantly observed just above the high tide line.

VEGETATION OF WILD HABITATS

155. This region receives very small amount of rain, in addition the soil texture is also sandy. Hence, the vegetation in this region is typically “scrub” vegetation. The trees and shrubs of *Prosopis* and *Acacia* are predominantly occurs in non-cultivated lands. Also members of Euphorbiaceae namely *E. nivula* and *E. tirucalli* were very commonly observed. *Aloe vera* was also observed at few places. The profusely grown *Ficus benghlensis* were observed near a dry water tank in Navinal village. Among the evergreen species Neem (*Azadiracta indica)* is the only species observed significantly in the study area. In shrubs- *Cassia auriculiformis*, locally called “Avar” is also observed predominantly along with *Calotropis*. In tress species, *Eucalyptus, Casuarina, Delonix, Peltophorum, Nerium, Polyalthia, Thevetia* were observed to be cultivated in homestead areas. A list of flora recorded in the study area is shown in the following Table IV.20

Table IV.20

List of plants recorded from the study region

No.	Name of Plant	Family	*Habit*	Vernacular Name
1.	*Acacia auriculiformis*	Mimosaceae	T	
2.	*Acacia leucociphala*	Mimosaceae	T	Hermo baval
3.	*Acacia nilotica sub-species indica*	Mimosaceae	T	Babhul
4.	*Acacia senagal*	Mimosaceae	T	Gorad
5.	*Acrus sapota*	Sapotaceae	T	Chiku
6.	*Agave ingens*	Agavaceae	H	
7.	*Aloe vera*		H	
8.	*Arachis hypogaea*	Papilionaceae	H	Mungphali
9.	*Artocarpus heterophyllus*	Moraceae	T	
10.	*Avicennia marina*	Avicenniaceae	T	Cheriya
11.	*Azadirachta indica*	Meliaceae	T	Nimda, Limdo, Neem
12.	*Bougainvillea spectabilis*	Nyctaginaceae	C	
13.	*Butea monosperma*	Fabaceae	T	Kesudo
14.	*Calotropis gigentia*	Asclepiadaceae	S	Dholo Akado
15.	*Calotropis procera*	Asclepiadaceae	S	Nano Akado
16.	*Carica papaya*	Carricaceae	T	Papita, Papaya
17.	*Cassia auriculiformis*	Caesalpiniaceae	S	Avar
18.	*Casuarina equisetifolia*	Casuarinaceae	T	Suru
19.	*Cocos nucifera*	Arecaceae	T	Nariyal

No.	Name of Plant	Family	*Habit*	Vernacular Name
20.	*Cordia dichotoma*	Boraginaceae	T	Moto Gundo
21.	*Cordia gharaf*	Boraginaceae	S	Liyar, Gundi,
22.	*Cynodon dactylon.*	Poaceae	HG	
23.	*Cyperous spp.*	Cypereceae	H	
24.	*Delonix regia*	Caesalpiniaceae	T	Gul Mohar
25.	*Derris indica*	Fabaceae	T	
26.	*Eucalyptus Spp.*	Myrtaceae	T	Nilgiri
27.	*Euphorbia nivulia*	Euphorbiaceae	S	Thor
28.	*Euphorbia tirucalli*	Euphorbiaceae	T	Kharsani, Thor
29.	*Ficus benghalensis*	Moraceae	T	
30.	*Ficus recemosa L.*	Moraceae	T	
31.	*Ficus religiosa L.*	Moraceae	T	Pipal
32.	*Ipomea fistulosa*	Convolvulaceae	S	Akari
33.	*Ipomoea sp.*	Convolvulaceae	C	
34.	*Leptadenia pyrotechnica*	Asclepiadaceae	S	Khip
35.	*Leucaena leucocephala*	Mimosaceae	T	
36.	*Mangifera indica L*	Anacardiaceae	T	Aam
37.	*Mimosops hexandra*	Sapotaceae	T	Rayan
38.	*Nerium odoratum*	Apocynaceae	S	Kanher
39.	*Peltophorum pterocarpum*	Caesalpiniaceae	T	
40.	*Pennisetum typhoides*	Poaceae	HG	Bajra
41.	*Phaseolus aureus*	Fabaceae	H	Mung
42.	*Pheonix dactylifera*	Arecaceae	T	Kharik Palm
43.	*Pithecolobium dulce*	Mimosaceae	T	
44.	*Polyalthia longifolia*	Annonaceae	T	
45.	*Portulaca indica*	Portulacaceae	H	
46.	*Prosopis chilensis*	Mimosaceae	S	Gando Baval
47.	*Prosopis chilensis*	Mimosaceae	T	Khijdo
48.	*Prosopis stephaniana*	Mimosaceae	S	Khijdi
49.	*Ricinus communis L.*	Euphorbiaceae	S	Erand
50.	*Samanea saman*	Mimosaceae	T	

No.	Name of Plant	Family	*Habit*	Vernacular Name
51.	*Solanum melanogena*	Solanaceae	H	Baingan
52.	*Sorghum bicolor*	Poaceae	HG	Jowar
53.	*Syzygium cumini*	Myrtaceae	T	Jamun
54.	*Tamarindus indicus L.*	Caesalpiniaceae	T	
55.	*Terminalia catapa*	Combretaceae	T	
56.	*Thevetia peruviana*	Apocynaceae	S	
57.	*Typha angustata*		H	Panj
58.	*Zizyphus mauritiana*	Rhamnaceae	S	Ber

CHAPTER - V

ENVIRONMENTAL IMPACT ASSESSMENT

CHAPTER - V

ENVIRONMENTAL IMPACT ASSESSMENT

1. The impacts on various environmental components are expected due to the construction and operational activities of the proposed coal fired thermal power station. The overall environmental impact is broadly divided into impacts during construction phase and operation phase. Both quantitative and qualitative impacts are assessed for various environmental components. The details of impact identification, prediction and assessment are given in this chapter.

CONSTRUCTION PHASE

2. During construction, activities like drilling, concreting, piling and installation of piping racks will be performed. Temporarily, some of the environmental parameters may get disturbed during the construction phase. The impact of each of these parameters is discussed below:

AIR IMPACT

3. The major source of air pollution during the construction period is from the movement of vehicles for construction activity. The emissions are from the stationary sources like generator sets during emergency service only, and air borne dust emissions from cutting and filling of soil and vehicular movements. The exhaust emission along with the dust emissions resulting from vehicles operating at site will also add to air impact. Dust suppression by spraying of water will reduce these impacts considerably.

4. The emission from vehicles will depend on the type and capacity of the vehicles used. The impact due to additional vehicles plying during the construction period is of temporary nature and their impact on air quality will not be significant.

NOISE IMPACT

5. The major sources of the noise pollution due to construction activity is from the earth moving, levelling and compacting, trucks for transportation of construction materials, concrete mixers, asphalt mixing and laying equipment all add to the general noise level.

6. The noise generated from all construction activities will be restricted to daytime working hours. Generally the noise will be limited very much within the site boundary except noise of piling work for pile foundation, the trucks entering and leaving the site. Geotechnical investigation would be taken into consideration in such a way that may not encounter any solid rock to be blasted. Hence, noise impact from blasting operation is expected to be minimal.

7. Further the noise impact during construction will be temporary in nature. The noise level will drop down to the acceptable level, once construction period will be over.

WATER POLLUTION IMPACT

8. During construction, the runoff from the construction site is a source of water pollution. Such pollution may persist entirely during the initial phase of construction when site grading and excavation for foundation and back filling would be in progress. During this stage the rainwater runoff would carry more soil/silt than normal and this would cause silting problem in the receiving water bodies.

9. Construction management would include the following steps to ensure that such problem are kept to absolute minimum:

   a) Undertake site grading and excavation for foundation and back filling during dry season.
   b) If called for, runoff water from unstabilised fill area, should be channelled and routed to the receiving water body through a settling basin.

10. Prior to construction a peripheral drain and settling pond would be provided to collect the rain runoff. This will prevent the loose soil getting washed away from the site.

11. The other source of water pollution is expected from the sanitary waste coming from the temporary accommodation of the construction workers if envisaged. Approximately 1000 temporary contractor workers are expected to be involved in construction phase. However, most of the construction workers will be made available from the near by villages and no separate migration of workers is envisaged for this project. The facilities presently available with the villages will continue to be used during construction activities and no sanitation problem is expected during construction period. However, on site during working hours additional sanitation will be handled by septic tank/pit if required, the arrangement will be made available during the construction phase of the project.

12. The construction activity for this project is temporary in nature and not likely to have significant impact on the quality of ground water.

ECOLOGICAL IMPACT

13. The proposed mega power project is planned on plain/ barren & muddy land. Land will be acquired for the project. There is no fauna habitat recorded in the proposed project area. The site is neither an ecologically sensitive nor a place of ecological importance. There would be minimum requirement of tree felling for the construction of project. Therefore, significant ecological impact is not envisaged during construction phase of the proposed mega power plant.

14. Construction of intake and outfall structure will be done in such a manner, which will have minimum impact on existing marine and terrestrial ecology. Recommendation of CWPRS/NIO study (This study shall be completed before starting the construction work at site) for design of structure shall be strictly adhered to avoid any ecological disturbance. Mangroves or any other tree species are not reported along the tentative route of intake and outfall structure. Adoption of good construction management practices will minimize the impacts on surrounding ecology to the bare minimal level.

SOCIO-ECONOMIC IMPACT

15. The construction workers will be mainly employed from the adjacent villages as much as possible and necessary amenities will be provided for the construction workers. About 1000 persons will be accommodated in the nearby villages and temporary sheds to be constructed for the skilled workers not available in local villages. This shed will be made within the reach of the proposed project site. Skilled workers to be involved with the project activity may be accommodated in Tundawand and nearby villages, which are situated in nearby area of project site.

16. There will be considerable beneficiary impact on social life of the people around the site. The population in the nearby villages depends mainly on the agricultural work and plantation of some fruit trees. The agricultural work is not only a monsoon dependent seasonal work but tubes well are also used for agriculture. Their income is basically coming from agriculture. The construction of an industrial unit will create a temporary employment for the local people. The construction work does not require any specialized work force, therefore all surrounding population including SC, ST and female population will be able to participate during the construction activities expected to last for five years duration. Most of the construction workers would be made available from the surrounding villages.

17. For construction purpose, female workers can also participate for their earnings. Hence, female employment and status both will improve. This will increase the per capita income and socio-economic status of the population located within the surrounding area.

18. The major construction phase impact can be summarized as temporary impact due to change in air quality, water quality and noise levels due to earth work and construction activity. This impact will subside once the construction period is over.

19. Displacement of the people is not required, as site is free of habitation. Therefore, livelihood of the people will not alter. Hence, rehabilitation & resettlement (R & R) is not required.

20. The details of workers anticipated to be involved during construction and operational phase of the project is shown in following table:

Table - V.1
Number of Persons to be Employed

Period	*Company's Employees*	*Contractor's Employees*	*Total*
During Construction	100	4000	4100
During Operation	1850	150	2000

21. It is envisaged that 1st unit of power plant would be operational in 54 to 60 months. Subsequent units would be synchronised and commercially operated within 3-6 months from the respective commissioning dates of previous units.

OPERATION PHASE

AIR QUALITY

22. The proposed coal based thermal power station will have pollutant emission in form of SO_2, NO_x, and SPM from flue gas of the stacks. The imported coal to be used has upto 1.0% sulphur content that will contribute for SO_2 emission. The particulate emission from stack is 100 mg/ N cu.m of flue gas. Air pollution dispersion modeling has been carried out for SO_2, NO_x and SPM. These emissions will disperse in the atmosphere depending on the atmospheric conditions. The atmospheric conditions that affect the dispersion of pollutants are:

- Wind direction and wind speed.
- Ambient temperature.
- Atmospheric stability: Atmospheric stability depends on the wind speed and solar radiation intensity or cloud cover. During night time the cloud cover, wind speed are considered for the stability calculation. More unstable condition will lead to better dispersion and stable condition will have less dispersion.
- Mixing height: Mixing height is the region between the bottom of the inversion layer and the ground. The inversion layer is a dynamic region, which changes depending on the atmospheric condition. The mixing height can be calculated based on the vertical temperature profile of the atmosphere. Mixing height for Delhi, Bombay and Calcutta and major cities in all state are published by Central Pollution Control Board. Indian Meteorological Department (IMD) is regularly monitoring the vertical temperature profiles at 35 locations. This data can be used for calculating the mixing height at any specific location. However, site-specific mixing height data is not available. Mixing height data available for morning and evening time at nearest observatory at Ahmedabad has been used for present study. The recorded mixing height data for summer, post-monsoon and winter season are shown in Appendix –25a-c.

INPUTS USED FOR DISPERSION MODELLING

Emission Data

23. The important pollutant of the proposed 4000 MW (Nominal) coal based thermal power station is mainly SO_2, oxide of nitrogen (NO_X) as NO_2 , and SPM. Therefore, prediction of GLCs are considered for SO_2, NO_X and SPM emission. The emission from the stack is considered to be constantly distributed throughout the day for the dispersion analysis. Two multiflue stack(one with 3 flues and the second one with 2 flues, each flue of 7.5m inside diameter) .These stacks are located at a inter stack distance of 250m each in a straight line at the project site.

24. The emission rate and stack details for each stack considered for air pollution dispersion analysis is given in Table V.2.

Table - V.2
Emission Rate and Stack Details

Stack	Parameters
No. of Stacks	2(3 flue+2 flue)
SO_2 Emission rate per flue, g/s	1768.9
NO_X Emission Rate per flue, g/s	476.8
SPM Emission Rate per flue, g/s	68.8
Exit Gas Velocity, m/s	25
Volumetric flow rate,m^3/s	1150.6
Exit Gas Temperature, ^oC	134.5
Stack Height, m	275 with future provision of space for FGD
Exit Diameter of each flue, m (considering single-flue)	7.5

Meteorological Parameters

25. Surface meteorological parameters for the site were monitored from March 2006 to February 2007. The air pollutant dispersion modeling was done for individual seasons as well as considering three seasons of the year 2006-07.

MODELING PROCEDURE

26. US-Environmental Protection Agency's (US-EPA) Industrial Source Complex Short Term Model (ISCST3) was used for the air quality dispersion analysis.

Description of Model

27. The Industrial Source Complex Short-Term (ISCST-3) model provides options to model emissions from a wide range of sources that might be present at a typical industrial source complex. The basis of the model is the straight-line, steady state Gaussian plume equation, which is used with some modifications, to model simple point source emissions from stacks.

28. The ISCST-3 model accepts hourly meteorological data records to define the conditions for plume rise, transport, diffusion, and deposition. The model estimates the concentration or deposition value for each source and receptor combination for each hour of input meteorology, and calculates user-selected short-term averages.

29. For a steady-state Gaussian plume, the hourly concentration at downwind distance x (meters) and crosswind distance y (meters) is given by:

$$\chi = \frac{QKVD}{2\pi u_s \sigma_y \sigma_z} \exp\left[-0.5\left(\frac{y}{\sigma_y}\right)^2\right]$$

where,

Q	=	pollutant emission rate (mass per unit time)
K	=	a scaling coefficient to convert calculated concentrations to desired units (default value of 1 x 10^6 for Q in g/s and concentration in $\mu g/m^3$)
V	=	vertical term
D	=	decay term
σ_y, σ_z	=	standard deviation of lateral and vertical concentration distribution (m)
u_s	=	mean wind speed (m/s) at release height.

30. The Vertical Term includes the effects of source elevation, receptor elevation, plume rise, limited mixing in the vertical, and the gravitational settling and dry deposition of particulate (with diameters greater than about 0.1 microns).

31. The ISC model uses either a polar or a Cartesian receptor network as specified by the user. In the Cartesian coordinate system, the X-axis is positive to the east of the user-specified origin and the Y-axis is positive to the north.

32. The wind power law is used to adjust the observed wind speed, u_{ref}, from a reference measurement height, z_{ref}, to the stack or release height, h_s using power law equation.

33. The plume height is used in the calculation of the Vertical Term"V". This is the effective release height of the effluent. This is made up of physical stack height and plume rise due to buoyancy or momentum. In this case the plume rise will be controlled by buoyancy.

34. Appropriate plume rise formulations have been used in this model. The effective plume rise for various weather conditions and wind speed are used.

35. The method of Pasquill (1976) is used to account for the initial dispersion of plumes caused by turbulent motion of the plume and turbulent entrainment of ambient air.

36. The infinite series term in the above Equation accounts for the effects of the restriction on vertical plume growth at the top of the mixing layer. The Equation assumes that the mixing height in rural and urban areas is known for all stability categories. The ISCST models currently assume unlimited vertical mixing under stable conditions, and therefore delete the infinite series term in the Equation for the E and F stability categories.

37. Pollutants traveling down wind will be reflected at the ground. The elevated inversion layer (mixing height) will also reflect the pollutant. At long downwind distances the plume concentration will be fully mixed vertically. This effect has also been built up in the program (model) formulation.

<u>INPUTS TO ISCST3 MODEL</u>

38. Pollution dispersion calculation was done only for NO_X, SO_2 and SPM emission by using ISCST3 model. Emission of fly ash as particulate matter is

controlled due to installation of electro static precipitator (ESP) as pollution control equipment. The fuel is coal, which contains maximum 1.0% sulfur. Therefore, proposed mega power plant will have contribution of SO_2 and NO_X emission. The area has been divided into 500m grid and the ground level concentration of the pollutant at each grid point was calculated. Total area for calculation of incremental GLCs has been considered for 25 km radius from the source.

39. The plume spread parameters σy and σz in a double Gaussian dispersion model depend upon the sampling or averaging time. Consequently, the concentration measured at a given location also depends upon the sampling time. The parameters used here pertain to a sampling time of 10 minutes. We are using 1 hour average data of wind speed and wind direction and use of this will give 1 hour average concentration value.

40. The σ_y value has to be corrected for the averaging time factor. The correction factor is given by:

X 1h, 10min = (10/60) 0.12
= 0.807
= (1/1.24)

That is σ_y from Pasquill graphs/Briggs formulation has to be multiplied by 1.24 or the concentration has to be reduced by a factor of 0.807. (Air Pollution Meteorology by V. V. Shirvaikar and V. J. Daoo – BARC/2002/E/013 – page 91)

MODELLING RESULTS

41. The season wise and yearly incremental and total predicted ground level concentrations (GLC) of SO_2 at all AAQMS have been shown in the following Tables V.3a-d;

Table - V.3a
Total Predictive GLCs of SO_2 for Summer 2006

Sr. No.	*Location*	*X (km)*	*Y (km)*	*24 hourly Max. baseline SO_2 Conc. ($\mu g/m^3$)*	*Incremental SO_2 GLC ($\mu g/m^3$)*	*Total SO_2 Predictive GLC ($\mu g/m^3$)*
1	Tunda village	0	0	16.2	0	16.2
2	Jarpara	9	0	15.4	32.2	47.6
3	Desalpar	6.1	3.4	15.4	41.7	57.1
4	Mota Bhojapur	3.15	5.1	18.4	15.1	33.5
5	Tragadi	-6	0	14.2	18.8	33.0
6	Pipari	-5.3	8.5	13.0	10.7	23.7

Sr. No.	Location	X (km)	Y (km)	24 hourly Max. baseline SO_2 Conc. ($\mu g/m^3$)	Incremental SO_2 GLC ($\mu g/m^3$)	Total SO_2 Predictive GLC ($\mu g/m^3$)
7	Bidada	-6.1	3.4	15.9	1.4	17.3
8	Kandagara	0	3	16.4	11.2	27.6
NAAQS Limit (Rural & Residential) for SO_2 is 80 $\mu g/m^3$						

Table - V.3b
Total Predictive GLCs of SO_2 for Winter 2006

Sr. No.	Location	X (km)	Y (km)	24 hourly Max. baseline SO_2 Conc. ($\mu g/m^3$)	Incremental SO_2 GLC ($\mu g/m^3$)	Total SO_2 Predictive GLC ($\mu g/m^3$)
1	Tunda village	0	0	14.3	0	14.3
2	Jarpara	9	0	15.8	14.8	30.6
3	Desalpar	6.1	3.4	15.2	42.7	57.9
4	Mota Bhojapur	3.15	5.1	16.8	21.6	38.4
5	Tragadi	-6	0	12.6	29.2	41.8
6	Pipari	-5.3	8.5	14.8	16.2	31
7	Bidada	-6.1	3.4	15.8	14.5	30.3
8	Kandagara	0	3	12.8	20.3	33.1
NAAQS Limit (Rural & Residential) for SO_2 is 80 $\mu g/m^3$						

Table - V.3c
Total Predictive GLC of SO_2 for Post-Monsoon 2006

Sr. No.	Location	X (km)	Y (km)	24 hourly Max. baseline SO_2 Conc. ($\mu g/m^3$)	Incremental SO_2 GLC ($\mu g/m^3$)	Total SO_2 Predictive GLC ($\mu g/m^3$)
1	Tunda village	0	0	14.4	0	14.4
2	Jarpara	9	0	16.8	19.0	35.8
3	Desalpar	6.1	3.4	14.6	41.6	56.2
4	Mota	3.15	5.1	16.4	24.9	41.3

Sr. No.	*Location*	*X (km)*	*Y (km)*	*24 hourly Max. baseline SO_2 Conc. (µg/m³)*	*Incremental SO_2 GLC (µg/m³)*	*Total SO_2 Predictive GLC (µg/m³)*
	Bhojapur					
5	Tragadi	-6	0	14.6	4.0	18.6
6	Pipari	-5.3	8.5	16.2	24.6	40.8
7	Bidada	-6.1	3.4	16.8	24.6	41.4
8	Kandagara	0	3	14.6	26.5	41.1
NAAQS Limit (Rural & Residential) for SO_2 is 80 µg/m³						

Table - V.3d
Total Predictive GLC of SO_2 for the Period from March 2006 to February 2007 (Yearly)

Sr. No.	*Location*	*X (km)*	*Y (km)*	*24 hourly Max. baseline SO_2 Conc. (µg/m³)*	*Incremental SO_2 GLC (µg/m³)*	*Total SO_2 Predictive GLC (µg/m³)*
1	Tunda village	0	0	16.2	0	16.2
2	Jarpara	9	0	16.8	32.2	49.0
3	Desalpar	6.1	3.4	15.4	42.7	58.1
4	Mota Bhojapur	3.15	5.1	18.4	24.9	43.3
5	Tragadi	-6	0	14.6	29.2	43.8
6	Pipari	-5.3	8.5	16.2	24.6	40.8
7	Bidada	-6.1	3.4	16.8	24.6	41.4
8	Kandagara	0	3	16.4	26.5	42.9
NAAQS Limit (Rural & Residential) for SO_2 is 80 µg/m³						

42. The incremental SO_2 GLCs were predicted at all AAQMS of the study area. The predicted GLCs were superimposed over maximum monitored background concentrations at all the AAQMS of the study area. Total predicted GLCs at all the AAQMS were found to be within the limit of stipulated standard for SO_2. The maximum predicted GLC of 57.9 µg/m³ was observed at Desalpar during winter season. The yearly maximum predicted

GLC of 58.1 µg/m^3 was observed at Desalpar. These observed values are well below the NAAQS Limit (Rural & Residential).

43. The season wise and yearly isopleths for incremental GLC of SO_2 around 25 km radius are shown in the following Figures V.1a-d;

Figure V.1a
Isopleth of Predicted Incremental GLC of SO_2 for Summer 2006

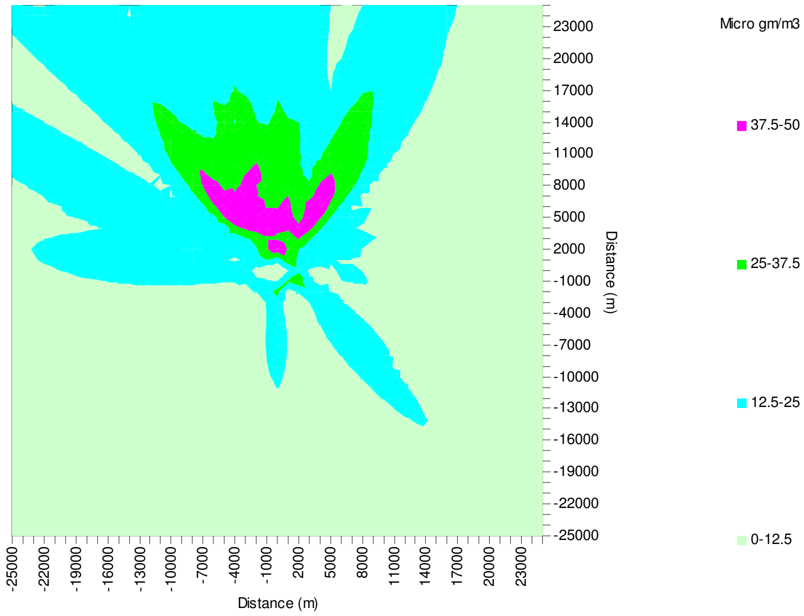


Figure V.1b
Isopleth of Predicted Incremental GLC of SO_2 for Post-monsoon 2006

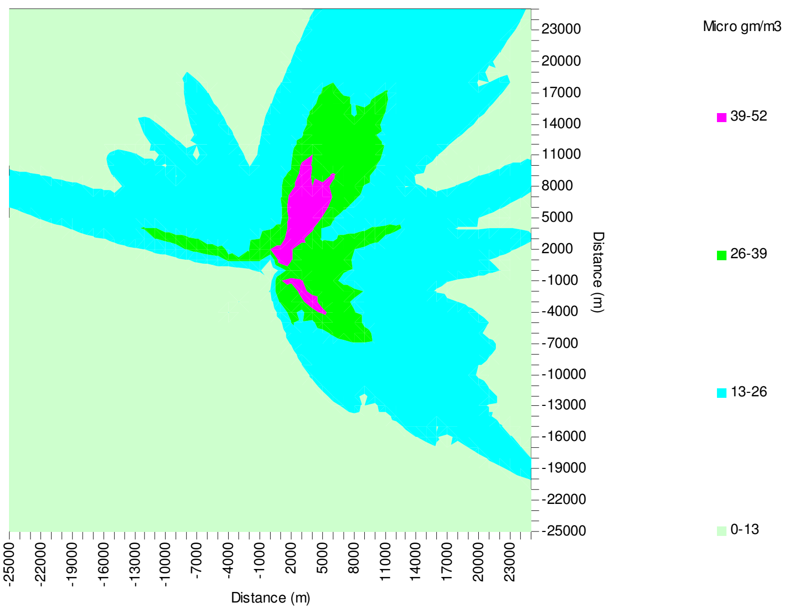


Figure V.1c
Isopleth of Predicted Incremental GLC of SO_2 for Winter 2006

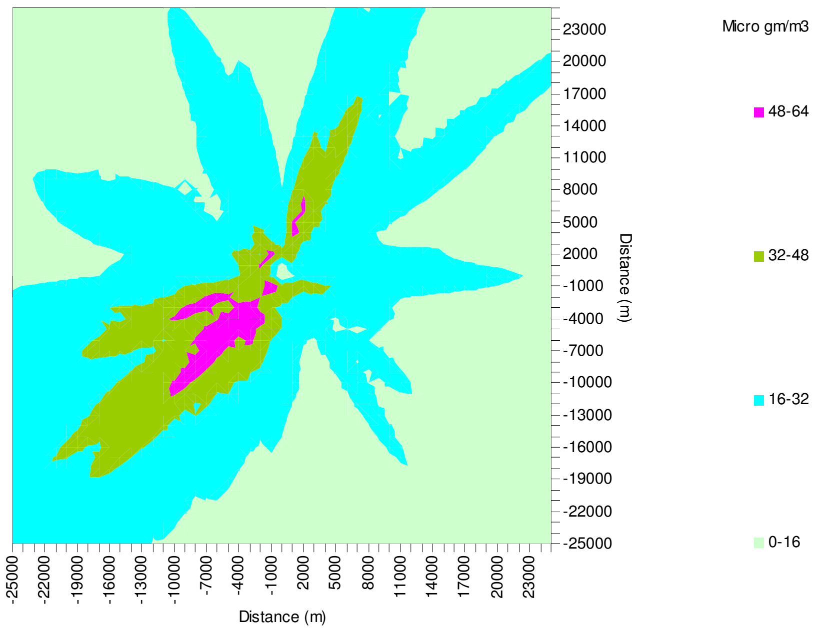
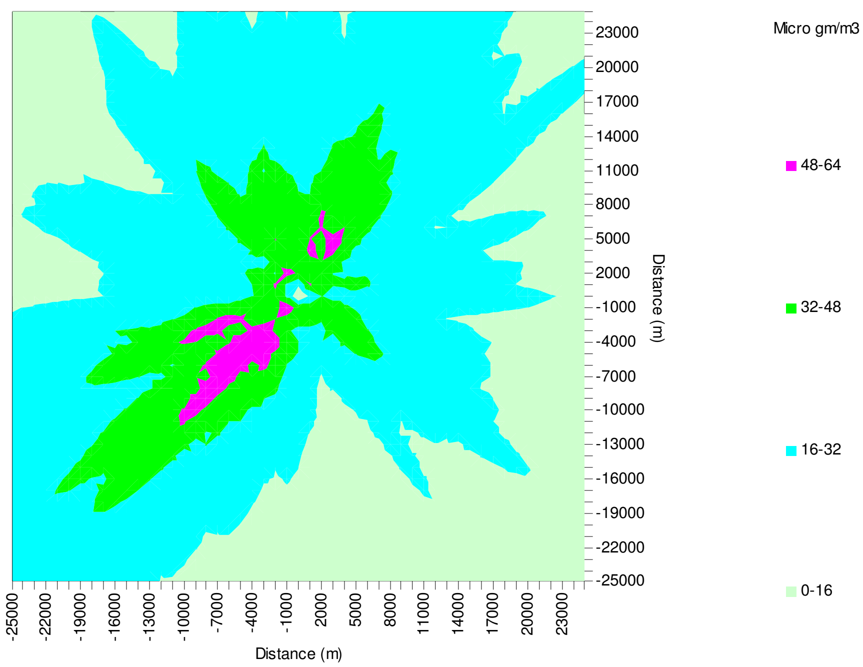


Figure V.1d
Isopleth of Predicted Incremental GLC of SO_2 for the Period from March 2006 to February 2007(Yearly)



44. The maximum worst case incremental SO_2 GLCs were observed to be 48.3, 51.4 and 63.1 µg/m^3 during summer, post monsoon and winter season at a distance of 5.4 km ESE, 5.8 km ENE and 5.7 km SW, respectively.

45. The season wise and yearly incremental and total predicted ground level concentrations (GLC) of NO_2 at all AAQMS have been shown in the following Tables V.4a-d.

Table - V.4a

Total Predictive GLC of NO_2 for Summer 2006

Sr. No.	*Location*	*X (km)*	*Y (km)*	*24 hourly Max. baseline NO_2 Conc. (µg/m^3)*	*Incremental NO_2 GLC (µg/m^3)*	*Total NO_2 Predictive GLC (µg/m^3)*
1	Tunda village	0	0	23.4	0	23.4
2	Jarpara	9	0	22.4	10.8	33.2
3	Desalpar	6.1	3.4	22.8	14.0	36.8
4	Mota Bhojapur	3.15	5.1	23.8	5.1	28.9
5	Tragadi	-6	0	23.5	6.3	29.8
6	Pipari	-5.3	8.5	22.0	3.6	25.6
7	Bidada	-6.1	3.4	22.8	0.5	23.3
8	Kandagara	0	3	22.8	3.7	26.5
NAAQS Limit (Rural & Residential) for NO_2 is 80 µg/m^3						

Table - V.4b

Total Predictive GLC of NO_2 for Winter 2006

Sr. No.	*Location*	*X (km)*	*Y (km)*	*24 hourly Max. baseline NO_2 Conc. (µg/m^3)*	*Incremental NO_2 GLC (µg/m^3)*	*Total NO_2 Predictive GLC (µg/m^3)*
1	Tunda village	0	0	20.1	0	20.1
2	Jarpara	9	0	21.3	4.9	26.2

Sr. No.	*Location*	*X (km)*	*Y (km)*	*24 hourly Max. baseline NO_2 Conc. ($\mu g/m^3$)*	*Incremental NO_2 GLC ($\mu g/m^3$)*	*Total NO_2 Predictive GLC ($\mu g/m^3$)*
3	Desalpar	6.1	3.4	21.1	14.3	35.4
4	Mota Bhojapur	3.15	5.1	21.2	7.2	28.4
5	Tragadi	-6	0	16.4	9.8	26.2
6	Pipari	-5.3	8.5	17.9	5.4	23.3
7	Bidada	-6.1	3.4	20.8	4.9	25.7
8	Kandagara	0	3	17.6	6.8	24.4
NAAQS Limit (Rural & Residential) for NO_2 is 80 $\mu g/m^3$						

Table - V.4c

Total Predictive GLC of NO_2 for Post-Monsoon 2006

Sr. No.	*Location*	*X (km)*	*Y (km)*	*24 hourly Max. baseline NO_2 Conc. ($\mu g/m^3$)*	*Incremental NO_2 GLC ($\mu g/m^3$)*	*Total NO_2 Predictive GLC ($\mu g/m^3$)*
1	Tunda village	0	0	21.6	0	21.6
2	Jarpara	9	0	22.8	6.3	29.1
3	Desalpar	6.1	3.4	22.6	13.9	36.5
4	Mota Bhojapur	3.15	5.1	24.8	8.3	33.1
5	Tragadi	-6	0	20.4	1.3	21.7
6	Pipari	-5.3	8.5	21.2	8.2	29.4
7	Bidada	-6.1	3.4	22.1	8.2	30.3
8	Kandagara	0	3	21.6	8.8	30.4
NAAQS Limit (Rural & Residential) for NO_2 is 80 $\mu g/m^3$						

Table - V.4d
Total Predictive GLC of NO_2 for the Period From March 2006 to February 2007 (Yearly)

Sr. No.	*Location*	*X (km)*	*Y (km)*	*24 hourly Max. baseline NO_2 Conc. ($\mu g/m^3$)*	*Incremental NO_2 GLC ($\mu g/m^3$)*	*Total NO_2 Predictive GLC ($\mu g/m^3$)*
1	Tunda village	0	0	23.4	0	23.4
2	Jarpara	9	0	22.8	10.8	33.6
3	Desalpar	6.1	3.4	22.8	14.3	37.1
4	Mota Bhojapur	3.15	5.1	24.8	8.3	33.1
5	Tragadi	-6	0	23.5	9.8	33.3
6	Pipari	-5.3	8.5	22.0	8.2	30.2
7	Bidada	-6.1	3.4	22.8	8.2	31.0
8	Kandagara	0	3	22.8	8.8	31.6
NAAQS Limit (Rural & Residential) for NO_2 is 80 $\mu g/m^3$						

46. The incremental NO_2 GLCs were predicted at all AAQMS of the study area. The predicted GLCs were superimposed over maximum monitored background concentrations at all the AAQMS of the study area. Total predicted GLCs at all the AAQMS were found to be within the limit of stipulated standard for NO_2. The maximum predicted GLC of 36.8 $\mu g/m^3$ was observed at Desalpar during summer season. The yearly maximum total predicted GLC of 37.1 $\mu g/m^3$ was observed at Desalpar. These observed value are well below the NAAQS Limit (Rural & Residential).

47. The season wise and yearly isopleths of incremental GLC of NO_2 around 25 km are shown in the following Figures V.2a-d.

Figure V.2a
Isopleth of Predicted Incremental GLC of NO_2 for Summer 2006

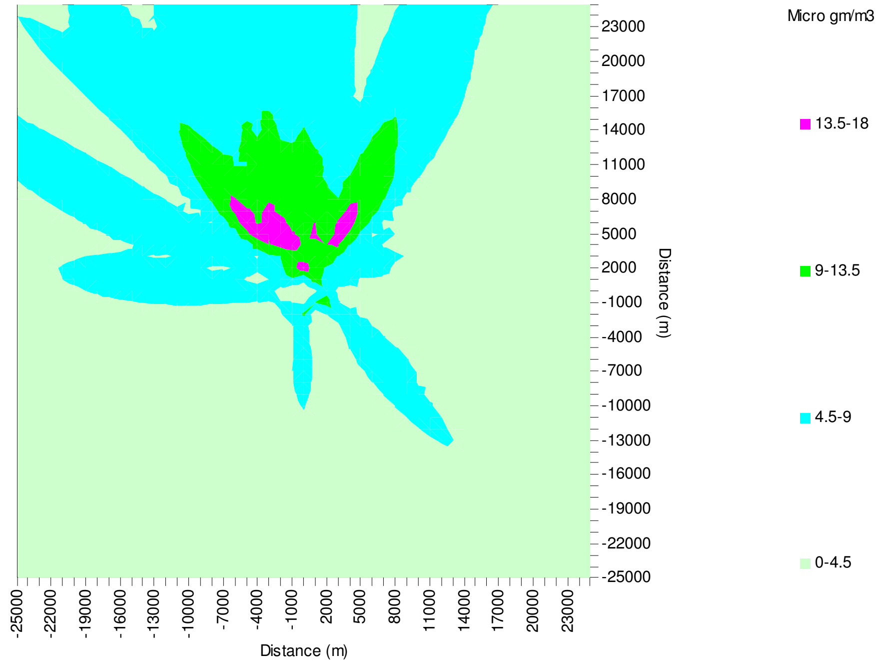


Figure V.2b
Isopleth of Predicted Incremental GLC of NO_2 for Post-monsoon 2006

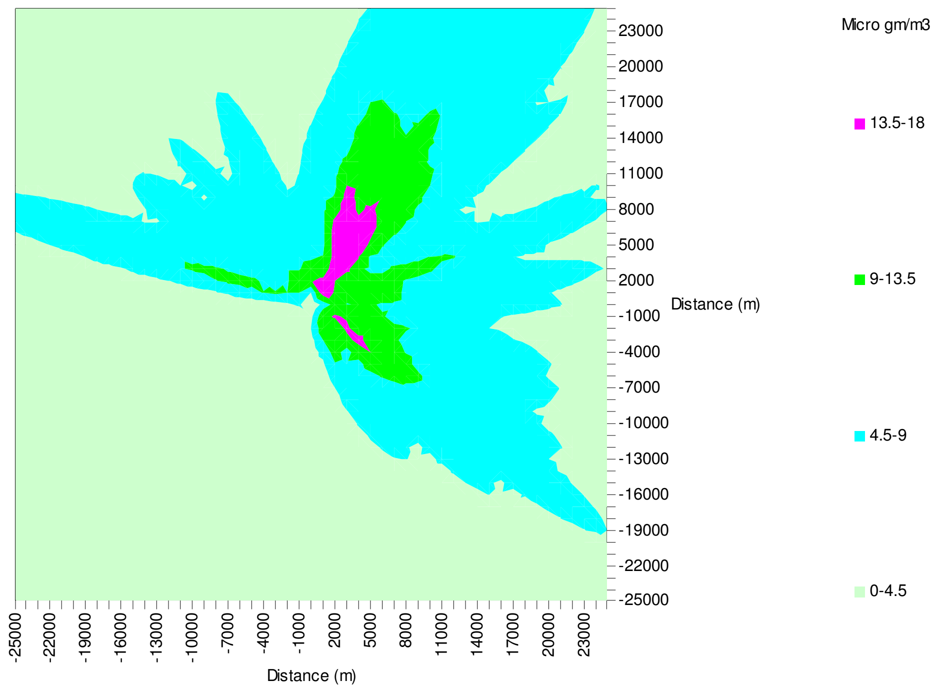


Figure V.2c

Isopleth of Predicted Incremental GLC of NO_2 for Winter 2006

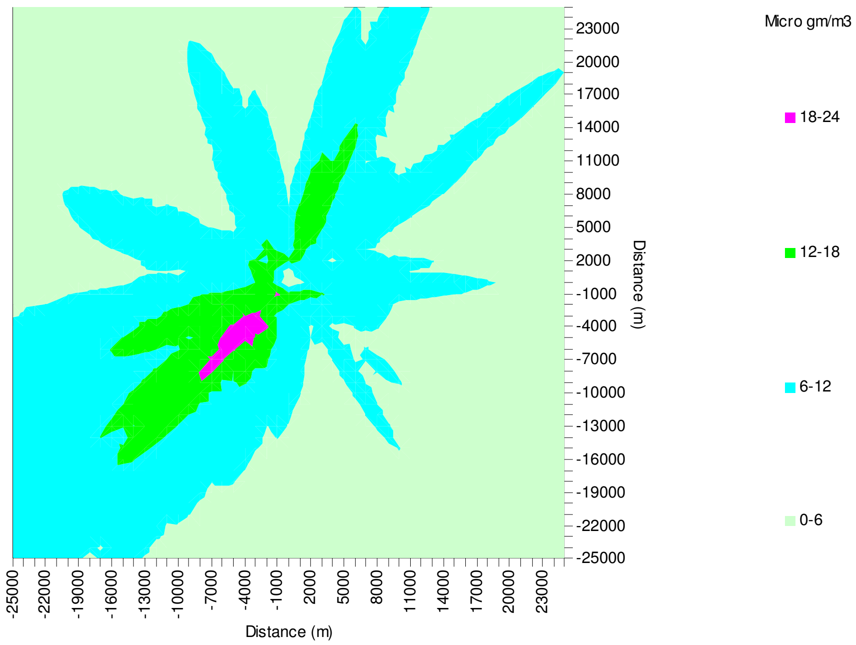
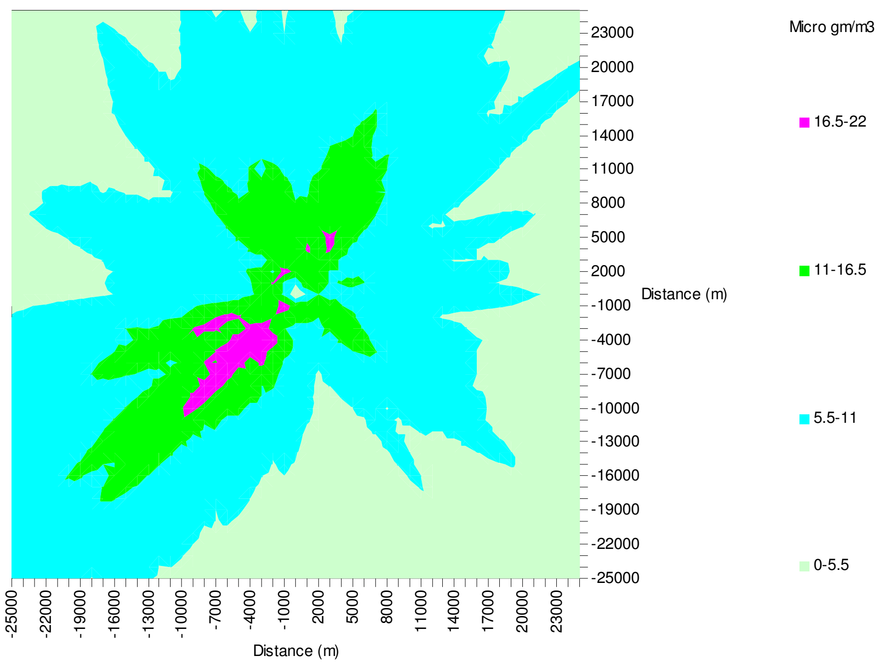


Figure V.2d

Isopleth of Predicted Incremental GLC of NO2 for the period from March 2006 to February 2007 (Yearly)



48. The maximum worst case incremental NO_2 GLCs were observe to be 16.1, 17.2 and 21.0 µg/m^3 during summer, post monsoon and winter season at 5.4 km ESE, 5.8 ENE and 5.7 km SW, respectively.

49. The season wise and yearly incremental and total predicted GLC's of SPM at all AAQMS are shown in the following Tables V.5a-d;

Table - V.5a
Total Predictive GLC of SPM for Summer 2006

Sr. No.	*Location*	*X (km)*	*Y (km)*	*24 hourly Max. baseline SPM Conc. (µg/m^3)*	*Incremental SPM GLC (µg/m^3)*	*Total SPM Predictive GLC (µg/m^3)*
1	Tunda village	0	0	138.0	0	138.0
2	Jarpara	9	0	138.0	1.6	139.6
3	Desalpar	6.1	3.4	138.0	2	140.0
4	Mota Bhojapur	3.15	5.1	136.0	0.7	136.7
5	Tragadi	-6	0	134.0	0.9	134.9
6	Pipari	-5.3	8.5	134.0	0.5	134.5
7	Bidada	-6.1	3.4	142.0	0.1	142.1
8	Kandagara	0	3	134.0	0.5	134.5
NAAQS Limit (Rural & Residential) for SPM is 200 µg/m^3						

Table - V.5b
Total Predictive GLC of SPM for Winter 2006

Sr. No.	*Location*	*X (km)*	*Y (km)*	*24 hourly Max. baseline SPM Conc. (µg/m^3)*	*Incremental SPM GLC (µg/m^3)*	*Total SPM Predictive GLC (µg/m^3)*
1	Tunda village	0	0	129.0	0	129.0
2	Jarpara	9	0	138.0	0.7	138.7
3	Desalpar	6.1	3.4	139.0	2.1	141.1

Sr. No.	Location	X (km)	Y (km)	24 hourly Max. baseline SPM Conc. (µg/m³)	Incremental SPM GLC (µg/m³)	Total SPM Predictive GLC (µg/m³)
4	Mota Bhojapur	3.15	5.1	137.0	1.1	138.1
5	Tragadi	-6	0	124.0	1.5	125.5
6	Pipari	-5.3	8.5	123.0	0.8	123.8
7	Bidada	-6.1	3.4	136.0	0.7	136.7
8	Kandagara	0	3	128.0	1.0	129.0
NAAQS Limit (Rural & Residential) for SPM is 200 µg/m³						

Table - V.5c
Total Predictive GLC of SPM for Post-Monsoon 2006

Sr. No.	Location	X (km)	Y (km)	24 hourly Max. baseline SPM Conc. (µg/m³)	Incremental SPM GLC (µg/m³)	Total SPM Predictive GLC (µg/m³)
1	Tunda village	0	0	130.0	0	130.0
2	Jarpara	9	0	138.0	0.9	138.9
3	Desalpar	6.1	3.4	138.0	2.0	140.0
4	Mota Bhojapur	3.15	5.1	142.0	1.2	143.2
5	Tragadi	-6	0	124.0	0.2	124.2
6	Pipari	-5.3	8.5	116.0	1.2	117.2
7	Bidada	-6.1	3.4	142.0	1.2	143.2
8	Kandagara	0	3	128.0	1.3	129.3
NAAQS Limit (Rural & Residential) for SPM is 200 µg/m³						

Table - V.5d
Total Predictive GLC of SPM for The Period from March 2006 to February 2007 (Yearly)

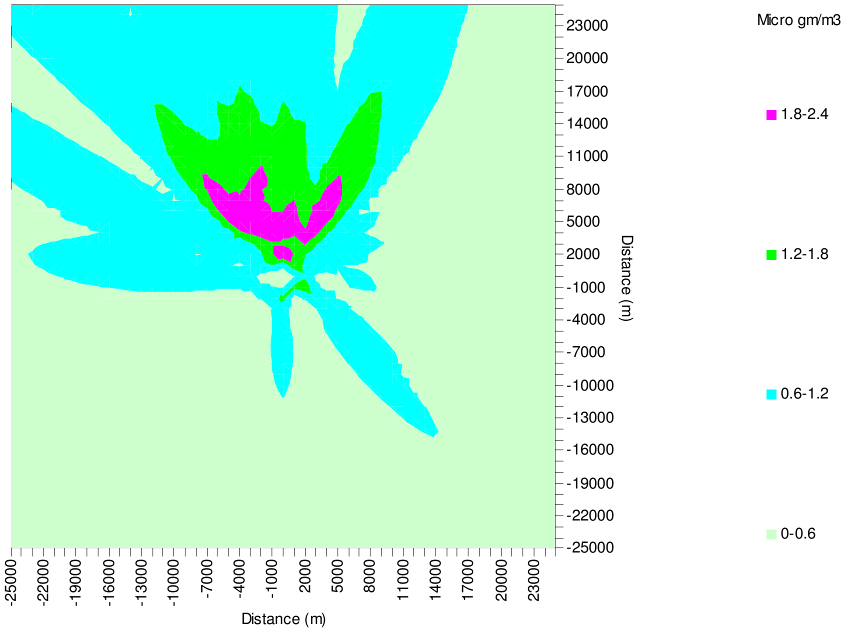
Sr. No.	*Location*	*X (km)*	*Y (km)*	*24 hourly Max. baseline SPM Conc. (µg/m³)*	*Incremental SPM GLC (µg/m³)*	*Total SPM Predictive GLC (µg/m³)*
1	Tunda village	0	0	138.0	0	138.0
2	Jarpara	9	0	138.0	1.6	139.6
3	Desalpar	6.1	3.4	139.0	2.1	141.1
4	Mota Bhojapur	3.15	5.1	142.0	1.2	143.2
5	Tragadi	-6	0	134.0	1.4	135.4
6	Pipari	-5.3	8.5	134.0	1.2	135.2
7	Bidada	-6.1	3.4	142.0	1.2	143.2
8	Kandagara	0	3	134.0	1.3	135.3
NAAQS Limit (Rural & Residential) for SPM is 200 µg/m³						

50. The incremental SPM GLCs were predicted at all AAQMS of the study area. The predicted GLCs were superimposed over maximum monitored background concentrations at all the AAQMS of the study area. Total predicted GLCs at all the AAQMS were found to be within the limit of stipulated standard for SPM. The maximum total predicted GLC of 143.2 µg/m³ was observed at Mota Bhojapur and Bidada during Post-monsoon season. The yearly maximum predicted SPM GLC of 143.2 µg/m³ was observed at Mota Bhojapur and Bidada. These observed values are well below the NAAQS Limit (Rural & Residential).

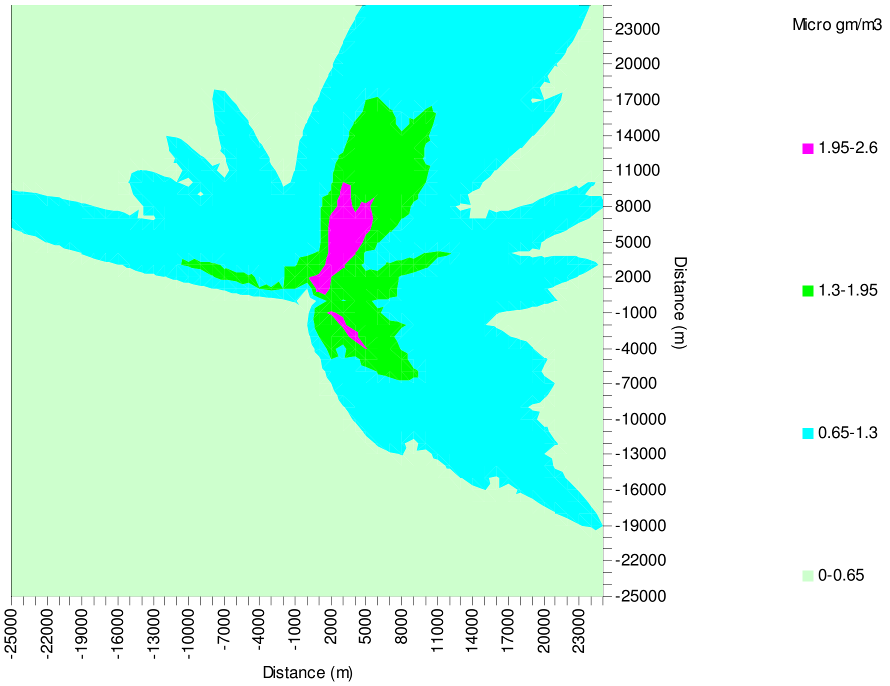
51. The season wise and yearly isopleths of incremental GLC of SPM around 25 km are shown in the following Figures V.3a-d.

52. The maximum worst case incremental SPM GLCs were observe to be 2.3, 2.5 and 3.1 µg/m³ during summer, post monsoon and winter season at 5.4 km ESE, 5.8 km ENE and 5.7 km SW, respectively.

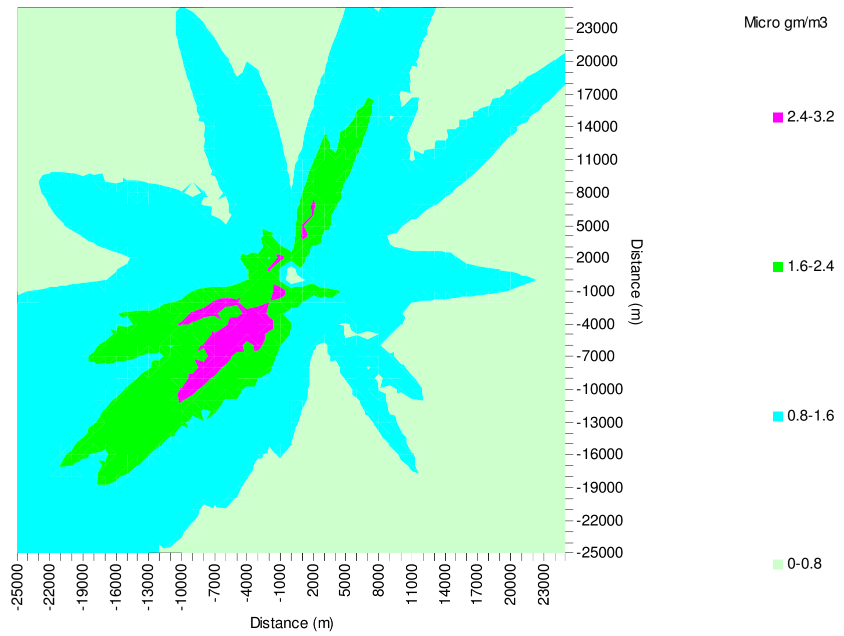
Figure V.3a
Isopleth of Predicted Incremental GLC of SPM for Summer 2006



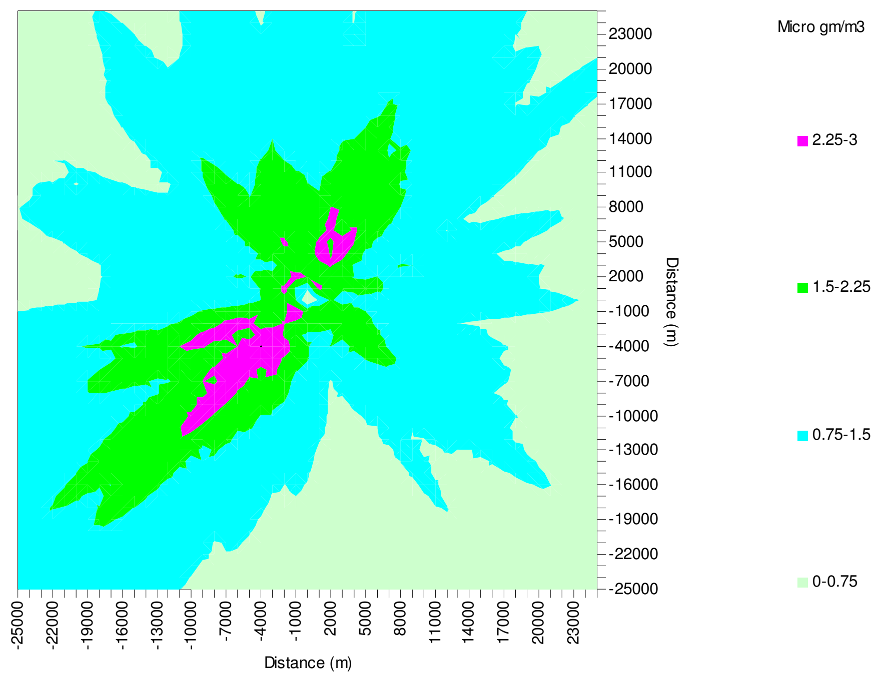
Figures V.3b
Isopleth of Predicted Incremental GLC of SPM for Post-monsoon 2006



Figures V.3c
Isopleth of Predicted Incremental GLC of SPM for Winter 2006



Figures V.3d
Isopleth of Predicted Incremental GLC of SPM for the Period from March 2006 to February 2007 (Yearly)



CONCLUSION

53. Air pollution dispersion modeling was carried out for prediction of incremental GLCs for SO_2, NO_2 and SPM within 25 km radius from the source. The results for pollutant concentrations are predicted at all AAQMS. The results for pollutant concentrations predicted at all AAQMS are shown in Table.V.6. Result indicated that predicted back ground concentrations at all AAQMS for SO_2, NO_2 and SPM are within the stipulated AAQMS set by MOEF. Hence, ambient air quality will not be degraded after the execution of proposed ultra mega power plant.

Table V.6
Overall Worst Case Predicted GLCs at all AAQMS

24 Hourly Concentrations	SO_2	NO_X	SPM
Baseline Maximum Monitored Concentration (µg/m3)	18.4	24.8	142.0
Predicted Maximum Incremental GLC (µg/m3)	42.7	14.3	2.1
Overall GLCs during Worst Case Scenario (µg/m3)	61.1	39.1	144.1
NAAQS Limit (Rural & Residential) (µg/m3)	80	80	200

54. The maximum worst case incremental GLCs of the study area for SO_2, NO_2, and SPM during winter were observed to be 63.1, 21.0 and 3.1 µg/m3, respectively. The same were superimposed over the maximum monitored background concentration during winter season. The result indicated that predicted GLCs are within the stipulated MOEF standards.

55. Required stack and ambient air quality monitoring and management plan will be implemented for emission of SO_2, NO_2 and SPM as required by SPCB and MOEF.

56. The above predicted GLCs are pertaining to all three seasons from March 2006 to February 2007 and conclusion drawn are for this said period. Seasonal as well as yearly dispersion modelling results were superimposed on monitored back grond pollutants concentrations, which indicated that ambient air quality of the surrounding study area will not be degraded after the execution of proposed ultra mega power plant.

COASTAL FUMIGATION STUDY

EFFECT OF COASTAL FUMIGATION

57. The Ultra Mega 4000 MW (Nominal) thermal power project, Mundra is situated along the coast. The stacks which are the sources of gaseous pollution are situated at 1000 m from the coast.

58. At coastal sites sea breeze conditions exists for some period depending on the thermal differential between land and sea. During sea breeze conditions the cold moist air from sea moves over land and starts moving up resulting in the formation of Internal Boundary Layer (IBL). Height of the IBL with respect to Release height / Physical stack height decides whether the pollution will be fully trapped between the ground and the IBL or will partially fumigate below the IBL or does not fumigate at all. In case of first two conditions, the ground level concentration (GLC) predictions arrived at, neglecting fumigation would be erroneous. The GLC under this case will be more. (Refer PROBES/70/1997 – 99 for details guidelines in this regard, Section 4.2, pp 22 plume penetration)

59. Measurement of IBL can be done using an instrument SODAR (SOund Detection And Ranging). However, site specific Meteorological Data collection at the site is carried out using standard Metrological instruments. In the absence of actual measured data on height of IBL, Central Pollution Control Board has recommended formulation to predict the IBL height using standard Met – Data. (Ref. 'Assessment of Impact to Air Environment: Guide lines for conducting Air Quality Modeling' PROBES / 70 / 1997 – 99 page 27 coastal sites).

The height of Internal Boundary Layer (IBL) is given by

$H_{IBL} = 8.8\ (X/U.\Delta\theta\ )^{0.5}$

Where,
X is the distance inland from sea – land interface (m)
U is the sea breeze velocity (m/s), approximately 2 m/s
$\Delta\theta$ is the potential temperature difference between top and bottom of the stable layer i.e. at the shore ~2^{o}K

Stack location inland – 1000 m at 0^{o}

60. Corresponding to this distance H_{IBL} is 139 m. Thus IBL will be below the physical stack height. The thermal plume will have plume rise (exit velocity 25 m/s, Temperature of flue gas 124^{o} C , Air temp 30 ^{o} , dia of stack 7.5 m, Twin flue stacks) of the order of 1000 m.

61. The effect of sea breeze becomes less effective as inland distance increases. The effect is negligible for distance beyond 10 km and for longer distances the effect of IBL formation is not felt. The expected height of IBL at 10 km is 440 m and at 15 km it is 540 m.

62. The effective plume height (H+ΔH) for the effluent releases is greater than 1000 m. The majority of the plume will be above the IBL and as such the increase of GLC due to fumigation condition will not occur at this site.

STACK EMISSION

63. Provision of 275 m tall stacks for the project is complying the Indian emission Norms. Stack emission limits for SO_2 and NO_x are not specified for compliance. Similarly, SPM emission limit of 100 µg/m^3 for the project is meeting the CPCB standards. SO_2 emission has been calculated for 4000 MW (Nominal) coal based UMPP considering maximum S content of 1%.

The value for SO_2 emission is coming to be 764.2 ton per day for proposed project. As per Indian standards, this project is meeting the specified height of 275 m. Emission standards for power plant is shown in Chapter IX and Appendix – 26.

WATER QUALITY

64. Generated wastewater shall be treated to meet the liquid waste discharge limit. The equalization/guard pond would be envisaged for equalization of effluent. The standards of liquid waste discharge are shown in Appendix – 26, 27.

65. All plant process drains and plant surface drains after suitable treatment for oil removal will be led to a Guard Pond. This effluent would be reused and recycled for horticulture and coal / ash dust suppression. Water requirement will be fulfilled from seawater. Thermal desalination plant or RO plant would be installed to meet the process water requirement. The reject water would be discharged to sea, through the CW discharge channel.

66. The sources of plant effluent are mainly:

a) Water Treatment Plant Effluent
b) Effluent From Bottom Ash Handling System
C) Coal Pile Area Run Off
d) Air Pre-Heater Wash Water effluent
e) Plant Wash Down Water
f) Floor And Equipment Drainage System Effluent
g) Rain (Storm) Water Drainage
h) Sewage From Various Buildings In The Plant

67. Hydrochloric acid and caustic soda would be used as regenerate in the water balancing plant. The acid and alkali effluents generated during the regeneration process of the ion exchangers would be drained into an underground neutralization pit. The treated effluent would be neutralized by the addition of either acid or alkali to achieve the required pH of 7. The balanced effluent would be led to guard pond for recycle and reuse within the plant premises.

68. Clear water from ash pond will be let in to CW hot water discharge channel.

69. Clear water from coal pile run off pond will be led in to rainwater reservoir.

70. Sewage from various buildings in the power plant area would be conveyed through separate drains to septic tanks. The effluent from septic tanks would be disposed off in the soil by providing dispersion trenches. There would be no ground pollution because of leaching. Sludge shall have to be removed and disposed off as land fill.

71. The rainwater harvesting is planned to be included to conserve the naturally available water resource. Land for rain water reservoir to store harvested

water has also been considered in the layout. This collected water will be reused and recycled for suitable purposes.

72. The required raw water that will be used for cooling and process water regeneration shall be withdrawn from the intake structure. Rejects of desalination and RO plant would be discharged to suitably design out fall structures.

73. Intake and out fall structure shall be suitably designed. This design will be based upon the study carried out by recognized institution like CWPRS/NIO (This study shall be completed before start of construction at site). The recommendation made in study for controlling the pollutants and any harm to various marine life forms shall be specified for design of marine intake and outfall structures. This study shall be considered before the start of construction for marine outfall and intake channel structure.

74. Intake structure would be envisaged with suitable screens to control the ingress of various marine life forms. Adequate measures would be taken at out fall structure to ensure proper mixing and limit the temperature of the discharged water within stipulations of MOEF. This will ensure that there will not be any harmful impact on the surrounding marine environment.

75. Hence impact on sea water quality is considered to be negligible due to the proposed ultra mega power project.

76. Separate marine EIA study had been carried out by NIO Mumbai. Rapid marine EIA report includes baseline on marine environment and impacts of proposed UMPP on sea water quality. This report had been separately submitted to CRZ committee of MOEF. MOEF has accorded CRZ clearance based on submitted Rapid marine EIA report

NOISE IMPACT

77. The noise impacts are mainly from the following

a) Steam Turbine Generator
b) Other rotating equipment
c) Combustion induced noises
d) Flow induced noises
e) Steam safety valves

78. Workplace noise is also generated. The exact noise level generation from working place will be identified only after commissioning of the plant. The operational noise levels of the plant will be measured once the operation of the plant starts.

79. The steam turbine generators would be housed in closed buildings, which would considerably reduce the transmission of noise from the steam turbine generators to the outside environment. The inlet air and exhaust gas streams would be provided with silencers for noise reduction. Maintenance and operating personnel working within the plant would be provided with adequate personal protection against noise.

80. All the equipment in the power plant are designed / operated to have the noise level not exceeding 85 - 90 dB(A) measured at a distance of 1.5 m from

the equipment. Also, all the measures would be taken to limit the noise levels at the plant boundary within stipulated limits.

NOISE MODELING

81. The noise modeling was done based on the wave divergence formulae. Based on this, the sound pressure level generated by a noise source decreases with increasing distance from the sound source due to wave divergence. The basic formulae for the noise reduction is given below:

L_{p2} = L_{p1} - 20 log (r_2/r_1) Where,

L_{p2} = Sound pressure level in dBA at receptor at r_2 from the source

L_{p1} = Sound pressure level in dBA at a distance of r_1 from the source

82. The noise level at the plant boundary is calculated considering the natural attenuation. This calculation was done based on the divergence formulae. The distance of plant boundary is considered as 250 m from ST Block, the source of noise. The predicted incremental noise calculated to be 22.68 dB(A) at boundary of proposed expansion.

RESULTS OF NOISE MODELING

83. Based on the divergence formula, the additional noise impact to the plant boundary due to the plant operation is about 22.68 dBA over and above the ambient noise level of 51.7 dBA during daytime, 50.6 dBA during nighttime and 50.8 dBA during day night at the plant boundary. The resultant noise level in the ambient air with respect to noise would be 53.0 dBA during daytime, 51.9 dBA during nighttime and 52.1 dBA during day night at the plant boundary (Noise addition is logarithmic addition). Nevertheless, predicted noise level within the mega power project boundary for all three seasons during day time would be within the National Ambient Air Quality Standard in respect of noise for Residential Areas.

84. The noise impact of the proposed mega power plant is negligible and the impact can be considered as insignificant.

IMPACT OF HEAT FLUX

85. The coal fired thermal power station envisages installation of steam generators designed for firing 100% imported coal. The temperature of the flue gas at the exit would be 124 ^{0}C. Installation of Two multiflue stacks (one with 3 flues and the second with 2 flues) having 275m height will have no significant occurrence of thermal radiation at ground level. This radiation level at ground will not be able to cause any impact on the surrounding environment.

86. The heat flux of discharged flue gas from the height of 275 m above the ground will not be significant & it will not have any impact at ground on structures, vegetation and human beings. Hence, proposed mega power plant would not have significant impact on heat flux of the surrounding environment.

SOLID WASTES IMPACT

87. CGPL has proposed to utilize imported coal as fuel. Proposed coal handling system covers facilities for transport of coal from the exporting country to power plant by the sea cum rail route, unloading and conveying coal up to the bunkers of the steam generators (SGs) or to the stockyard. Therefore, proper control system would be installed that should take care of coal dust generated due to handling of coal which may otherwise can pollute the surrounding area.

88. Imported coal is planned to be fired in boilers directly which would be having maximum 15% of ash content. Bottom ash collected in the bottom ash hopper below the boiler furnaces would be conveyed by jet pump for further disposal in wet form. The fly ash collected at various hoppers would be conveyed pneumatically to FA storage silos. The air would be vented out to atmosphere after passing the same through bag filters to mitigate the environmental pollution. The dry fly ash collected in fly ash silos would be disposed off either in dry or in wet form.

89. Various pollution control measures would be installed for ash disposal :

a) To reduce the dust nuisance while loading the ash into the trucks from fly ash silos, the fly ash would be conditioned with water spray.
b) It is proposed to cover the ash in the open trucks with tarpaulin to prevent flying of fine ash during transportation.
c) The ash disposal area would be lined with impervious lining to prevent seepage of rainwater from the disposal area in to the ground and pollute ground water.

90. The area identified for ash disposal is about 241 Ha, which is adequate to store ash generated from the entire 4,000 MW (Nominal) power plant for a period of about 9 years. As per the MOEF notification, the fly ash generated should be utilized fully by the end of 9 years. In order to mitigate and minimise the environmental impact of fly ash disposal, power developer will plan to utilse 100% ash in phased manner in cement, construction industries, back filling, construction of road, agriculture, brick making and any other feasible use. Power developer would look for prospective buyers or users for utilizing the fly ash produced.

91. Proper water cover and earth cover will be maintained to avoid fugitive dust emission from ash pond.

92. During the disposal of ash, the vegetation would be grown on the ash dump. Tree plant nursery and trial planting area would be set up near the ash disposal area for effective growth of vegetation in and around the ash disposal area in order to prevent wind carrying away the exposed ash. The type of vegetation should be tolerant to the fly ash characteristics to achieve growth on ash.

93. Proper disposal of solid waste and its management will not pose any contamination problem to surrounding land environment. The required consent for handling and disposal will be taken before the implementation of the project. Therefore, impacts are not expected due to disposal of solid waste.

SOCIO-ECONOMIC IMPACT

94. Proposed UMPP site has no inhabitation, permanent structure, tree vegetation and wild fauna life. Hence, rehabilitation and resettlement issues are not involved that could alter the existing socio-economic pattern.

95. Most of the people around the site have an income directly or indirectly from agriculture and other service related work. Since, proposed green field project would employ personnel both during construction and operation phase that will help in improving the existing socio-economic status. Therefore, impact of the proposed plant is expected to be positive.

96. Secondary employment will also be generated due to this project, which will enhance the income of surrounding population.

97. The over all impact of the project is expected to be positive as locals of the core areas will be preferred for getting more benefits from the proposed power project.

OTHER IMPACTS

POWER AVAILABILITY

98. Power supply situation of the surrounding area will improve, as proposed power project will add up to 4000 MW (Nominal) electricity to Gujarat State grid and adjacent states. This will drastically improve the power situation of the surrounding area. The industries of Gujarat state will get regular and ensured availability of power for their production. This will improve not only opportunity for primary employment generation but major secondary and associated employment generation also. Other services and industries will also improve their outcome.

ECOLOGY AND SENSITIVE LOCATIONS

99. The predicted background pollutant concentrations are expected to be within NAAQS Limit (Rural & Residential) for SO_2 (i.e) 80 $\mu g/m^3$. Similarly, the resultant predicted concentration is expected to be within the NAAQS Limit (Rural & Residential) for NO_2 and SPM (i.e) 80 $\mu g/m^3$ and 200 $\mu g/m^3$ respectively for all the AAQMS of the study area.

100. Hence, this will not cause any adverse impact on flora and fauna of the surrounding area. Additional plantation will be done in the area earmarked for green belt. This will improve the aesthetic look of the surrounding area. Neither liquid effluents nor air emissions would be sufficient enough to cause any adverse impact on flora and fauna.

101. Ecology along the MGR system and service road has also been studied that indicates that provision of proper management will not affect the surrounding ecology of this route. Hence, there would not be any significant impact on surrounding ecology and sensitive location of the surrounding area.

LAND USE PATTERN

102. The required land is plain and barren land. The land use pattern of the proposed project would be inline with the industrial set up of the area. Additional land for green belt area will improve the aesthetic look of existing

land use pattern. Therefore, land use pattern of the study area would change. However, addition of green belt, plantation, infrastructure facilities and amenities will improve the land use pattern positively. Hence no adverse impact is expected on the surrounding land use pattern.

INFRASTRUCTURE AND AMENITIES

103. Set up of the proposed power plant will add and improve infrastructure facilities and amenities. Therefore, set up of the proposed power project will improve the infrastructure facilities and amenities of the surrounding areas.

SUMMARY OF IMPACTS

104. The environmental impact due to construction and operation of the expansion project are summarized in Table V.7.

Table - V.7
Impact Matrix For Construction And Operation Phase

Activity → / Parameter ↓	CONSTRUCTION PHASE	OPERATION PHASE						
		Water Consumption	Gaseous & Fugitive emission	Effluent Discharge	Heat Radiation	Operation of equipment	Plant Operation	Plantation and Green Belt
Water quality	□	□	□	✹	□	□	✹	□
Air quality	□	□	✹	□	□	□	✹	⊙
Solid Waste	□	□	✹	□	□	□	✹	□
Noise	✹	□	□	□	□	✹	✹	□
Socio-economic	○	□	□	□	□	□	○	○
Ecology	□	□	□	✹	□	□	□	○
Employment	○	□	□	□	□	□	○	○
Land use pattern	✹	□	□	□	□	□	⊙	□
Infrastructure & Amenities	⊙	□	□	□	□	□	○	○

○ - Major Positive,
⊙ - Minor Positive,
✪ - Major Negative,
✹ - Minor Negative
□ - No Impact or Insignificant

CHAPTER - VI

RISK AND CONSEQUENCE ANALYSIS

CHAPTER - VI

RISK AND CONSEQUENCES ANALYSIS

1. The chlorine tonners are the potential chemical risk for power projects. This risk has been avoided by proposing chlorine gas dosing by the installation of electro chlorination system or chlorine dioxide system at CW sump for marine growth control.

CHAPTER - VII

DISASTER MANAGEMENT PLAN

CHAPTER - VII

DISASTER MANAGEMENT PLAN

1. The emergency management plan gives a broad idea of the detailed emergency preparedness in case of an accident. The detailed emergency preparedness plan should be prepared on commissioning of the plant with the help of staffs working at the plant.

2. The Emergency Management Plan (EMP) envisages the need for providing appropriate action so as to minimize loss of life/property and for restoration of normalcy within the minimum time. Adequate manpower, training and infrastructure shall achieve this. An appropriate fire protection system is also developed to meet any emergency.

3. The emergencies are classified as construction hazard, natural hazard and operational hazard. During the construction time good construction practice and safety requirement should be enforced by the contractor at site. The construction manager can be the co-ordinator for the emergency management. Depending on the severity of the injury/ disaster outside medical help can be obtained. Before commencement of the work the hospital facilities should be identified and the address and phone numbers to be available to the contractor as well as the construction manager. During natural hazard the emergency plan to be implemented with the help and guidance from the district collector, who is the co-ordinator for such activity. During operation, the plant manager become the co-ordinator for the emergency activity and the emergency cell will be acting in accordance with the disaster management plan (DMP).

4. During construction phase proper measures should be taken to ensure safety at heights. Fencing/railing should be provided at construction openings to prevent physical injuries and fall of construction workers.

5. The following important elements in the disaster management plan (DMP) are suggested to effectively achieve the objectives of emergency planning:

   a) Reliable and early detection of an emergency and careful planning.
   b) The command, co-ordination, and response organisation structure along with efficient trained personnel.
   c) The availability of resources for handling emergencies.
   d) Appropriate emergency response actions.
   e) Effective notification and communication facilities.
   f) Regular review and updating of the EMP
   g) Proper training of the concerned personnel.

SEQUENCE OF ACTION

6. In order to handle disaster/emergency situations, an organisational chart entrusting responsibility to various plant personnel has been prepared along

with their specific roles during an emergency. The possible composition of the management team is given in Figure VII.1.

INFRASTRUCTURE

7. Following infrastructure & operational systems should be provided to meet emergencies.

a) First aid boxes
b) Gas masks
c) Telephone line with STD facility
d) Loud hailers
e) Emergency lighting system
f) Stretchers
g) Transport facility
h) Fire-fighting machinery
i) Fire-tenders
j) Ambulance

ASSEMBLY POINTS

8. Assembly points are to be set up farthest from the location of likely hazardous events, where pre-designated persons would assemble in case of emergency. The location near to the entrance gate is one of the safest place. This can be the assembly point.

EVACUATION PATH

9. The road straight to the entrance gate is quite wide and no hazardous installation besides the road. This road can be taken as the evacuation path.

COMMUNICATION SYSTEM

10. Different types of alarms to differentiate types of emergencies should be provided. In case of failure of siren, placards of various colours should be used to indicate the situations. If everything fails, a messenger should be used for sending the information and the various placards mentioned would also be used.

11. Alarms should be followed by announcement over Public Address System. In case of failure of alarm system, communication should be by telephone operator who will make announcement in plant through Public Address System, which should be installed. Walkie-talkie and paging systems using predetermined codes of communication are very useful during emergency.

WARNING SYSTEM AND CONTROL

12. The control centers shall be located at an area of minimum risk or vulnerability in premises concerned, taking into account the wind direction, areas which might be affected by fire/explosion, toxic releases etc.

EMERGENCY SERVICES

13. This includes fire-fighting system, first aid center, hospital etc. Alternate sources of power supply for operating fire-pumps, communication with local bodies, fire-brigade etc. should also be clearly identified. Adequate number of external and internal telephone connections should be installed.

FIRE PROTECTION SYSTEM

14. The fire protection system for the proposed plant is to consists of :

a) Hydrant system for all the vulnerable areas of the plant.

b) Portable carbon-dioxide extinguishers for the control room.

c) Portable hand appliances of suitable types/ capacities for extinguishing small fires in selected areas of the plant.

15. The emergency plan will have the key personnel of the organisation and responsibilities assigned to them in case of an emergency and their telephone numbers. These telephone numbers and persons will be finalised after commissioning of the plant.

16. Depend on the severity of the emergency outside agency will be called for the assistance. The following information will included in case outside organizations are involved in assisting on-site emergency:

a) Type of accidents.
b) Responsibility assigned to each of the organisation.
c) Liaison arrangement between the organisations.

17. The safety equipment installed and fire-fighting equipment available will be mentioned in the detailed DMP.

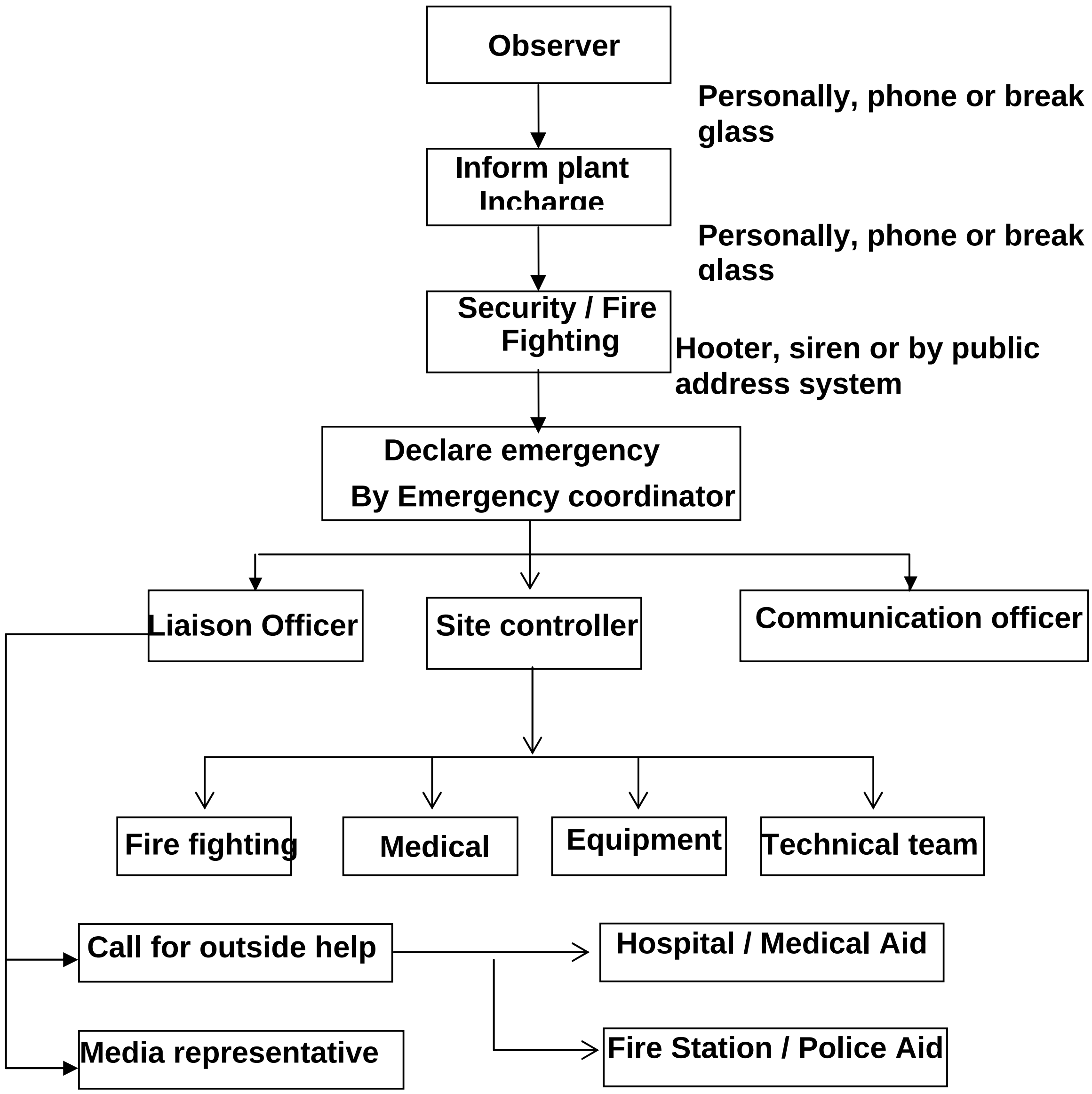
18. Small size maps should be available in control tower, fire station, rescue and fire-fighting and all other supporting vehicles responding to an emergency.

19. The map should contain the site related details such as:

a) Location of dangerous substances.
b) Seat of key personnel.
c) Location of emergency control room.
d) Quantity of the chemicals stored.
e) The parking points of Ambulances and Fire-fighting vehicles must be located such that no hindrance will be posed at any time of the day.

Figure VII.1

Structure of Disaster Management Team



CHAPTER - VIII

ENVIRONMENTAL MANAGEMENT PLAN

CHAPTER -VIII

ENVIRONMENTAL MANAGEMENT PLAN

1. Power is a wheel industrial and agricultural growth of the country. It adds to the economic development and improves the quality of life. Electricity is a clean form of energy at the point of consumption. However its generation in a coal-fired power station has some adverse impact on the environment. A number of safeguards should be built-in during the design phase itself to minimise these adverse impacts. After the plant has become operational, effective planning is required to prevent any adverse impact on the surrounding environment.

2. The chapter deals with the Environmental Management Plan for construction and operational phase of the proposed 4000 MW (Nominal) coal based power plant of Coastal Gujarat Power Ltd. (CGPL). The construction and operation phase environmental management plan has been aimed to achieve the following objectives:

   - To ensure that the environmental control systems installed at the plant and are operating satisfactorily.
   - To ensure that quality of pollutants discharged from the plant is within the stipulated standards.
   - To ensure that pollutants concentration in the surrounding area does not exceed the NAAQS.
   - To monitor impacts on the surrounding environment and the effectiveness of mitigation measures during the construction and operation.

CONSTRUCTION PHASE ENVIRONMENT MANAGEMENT PLAN

3. The following construction engineering practices are recommended to minimise construction phase environment impacts:

   a) Proper disposal of construction wastes.
   b) Adequate erosion control plans to minimise soil erosion.
   c) Minimise noise by using appropriate noise control measures.
   d) Spraying of dust suppressants at regular intervals.
   e) Sedimentation pond and peripheral drains for the runoff water from the construction site.

OPERATION PHASE ENVIRONMENT MANAGEMENT PLAN

4. Important features of the Environment Management Plan are the following:

   a) Environment management cell
   b) Ambient air and noise quality monitoring
   c) Water quality monitoring
   d) Meteorological data collection
   e) Afforestation program
   f) Periodic preventive maintenance & Occupational safety and health

ENVIRONMENTAL MANAGEMENT CELL

5. The major environmental considerations involved in the construction and operation of the thermal power station, will be taken up by a full-fledged multi disciplinary Environmental Management Division (EMD) with key functions of environmental, safety and occupational health for management of the entire plant and surrounding environment.

6. The EMD will comprise a team of environmental engineers, chemists, horticulturists, safety specialists and well-trained staff for operation and maintenance of pollution control equipment. Staff training programmes in the areas of environment, ambient air, water quality monitoring, solid waste management, noise abatement, safety and health aspects would be conducted. The pollution control equipment would be provided with spares and maintenance facilities. Staff would be trained to operate ESP and other pollution control equipment at optimum efficiency. Power plant developer will have to develop Environmental Management Division (EMD) headed by a very senior manager assisted by a team of engineers, chemists, operating staff etc. This EMD will take up additional responsibility of environmental functions related to proposed mega power plant.

ENVIRONMENTAL MONITORING PROGRAMME

7. An environmental monitoring programme is required to provide scientifically defensible information for determining the status of the environmental quality of the surrounding area of the power station and to check whether the levels of critical pollutants are within the environmentally acceptable limits. This will help to obtain an early warning of unacceptable environmental conditions so that control measures can be taken immediately. It also helps to determine in a timely fashion, changes in the local environmental quality.

AIR MONITORING

8. The air quality-monitoring programme consists of ambient air quality monitoring, stack gas emission monitoring, occupational exposure and meteorological investigations. The schedule of monitoring programme is given in Table - VIII.1.

a) Ambient Air Quality Monitoring

An ambient air quality monitoring programme for ground level concentrations of SO_2, NO_x and SPM will be carried out on a regular basis throughout the year at selected monitoring stations.

b) Stack Emission Monitoring

Continuous stationary monitors will be installed to measure opacity, SO_2 , NO_x and SPM concentrations in the flue gas discharged through the stack. Suitable sampling ports will be provided at the stack for in-situ monitoring of these parameters.

c) Occupational Exposure Monitoring

Worker exposure to dust from ash and coal, to toxic gases (e.g. SO_2, and NO_x) leaking from boilers and to excessive noise levels will be monitored around the work place by spot detection instruments.

d) Meteorology

The wind speed, wind direction, solar radiation, relative humidity and rainfall will be monitored continuously using respective meteorological instruments installed at suitable location. The data will be continuously recorded as well as processed for further action.

9. The meteorology, stack emission and ambient air quality monitoring will be conducted considering the mega power plant while optimising the number of monitoring stations and equipment.

Table - VIII.1
Air Quality Monitoring Schedule

Parameters	*Purpose*	*Frequency*	*Equipment*
SPM	Ambient Air quality monitoring	Twice in a week for 24 hours each at each station	Respirable dust Sampler (RDS)
SO_2	Ambient Air quality monitoring	Twice in a week for 24 hours each at each station	Respirable dust Sampler (RDS)
NO_x	Ambient Air quality monitoring	Twice in a week for 24 hours each at each station	Respirable dust Sampler (RDS)
SPM, SO_2, NO_x,	Stack emission	Continuous	In-situ continuous monitors
SPM, SO_2, NO_x	Occupational exposure	Once in a month	Portable spot detectors
Noise level	Noise	Once in a week	Noise level meter
Wind speed & wind direction and solar radiation	Meteorological investigation	Continuous on hourly basis	Anemometer with data logger and printer facility
Relative humidity and temperature	Meteorological investigation	Continuous on hourly basis	Thermohygrograph
Rain fall	Meteorological investigation	Continuous on hourly basis	Rain gauge

WATER QUALITY MONITORING

10. The water quality monitoring programme consists of parameters monitoring prior to discharge, water quality monitoring near sea intake and outfall structure, nearby surface water and ground water will also be covered. The monitoring schedule for treated water generated from various sources and the parameters to be analysed are shown in Table - VIII.2.

Table - VIII.2
Water and Wastewater Monitoring Schedule

Waste Water Sources	**Frequency of Analysis**	**Parameter of Examination**
Boiler blow down	Weekly	Temperature suspended solids, oil & grease, dissolved solids, copper, iron etc.
Water treatment plant effluent	Daily	pH, suspended solids COD, BOD, dissolved solids
Ash pond effluent	Weekly	pH, suspended solids, oil & grease, dissolved solids, heavy metals like chromium, zinc, iron, manganese, aluminium, nickel, phosphate etc.

11. The assessment of sea water, surface and ground water quality (e.g.) drinking and irrigation wells, ponds, tube wells etc.) of surrounding areas will be carried out at different locations, within 5 km radius of the proposed power plant once in a month. The parameters to be monitored will include dissolved solids, oxygen level, bacterial contamination and heavy metals.

POST PROJECT MONITORING OF MARINE ENVIRONMENT

12. Post project monitoring for marine environment should be carried out in order to ensure that the environmental quality is maintained. Specially trained staff should be employed to undertake the monitoring work in a control laboratory of the plant or this work could be assigned to any research Institute having expertise in collection and analysis of sea water and sediment samples in offshore and intertidal region.

13. Any damage to seaweed or nearby mangrove areas should be immediately investigated, eventual damage assessed and remedial measures adopted.

Sampling Site

14. The sampling area should cover the discharge point as well as other locations affected by upcoming marine facilities. The intertidal region should also be periodically sampled to know the beach fauna and beach profile.

Frequency of Monitoring

15. Monitoring program should begin with proper baseline establishment and subsequent periodic observations after the project are commissioned.

1st monitoring	Before operation stage
2nd monitoring	1 month after operation
3rd monitoring	6 months after operation
4th monitoring	12 months after operation
Periodic monitoring	Once or twice every year.

Parameters to be Monitored

Shoreline changes

16. Shoreline configuration and nearshore profiles may be carried out 2 km on either side of the jetty at three seasons continuously.

Seafloor changes along the pipeline route

17. Once in a year, the change in seafloor along the pipeline routes may be monitored by a small echo sounder or by engaging divers.

Water Quality

18. Surface and bottom water samples are to be analysed for temperature, salinity, pH, dissolved oxygen, biochemical oxygen demand, suspended solids, phosphate-phosphorus, nitrite-nitrogen, nitrate-nitrogen, ammonia-nitrogen, phenolic compounds, petroleum hydrocarbons, trace metals, primary productivity, phytoplankton and zooplankton biomass and population and group diversity.

Sediment Quality

19. Sediment samples are to be analysed for trace metals and benthic biomass and population.

Mangrove And Seaweeds

20. Population density *of* mangrove and seaweeds, as well as growth and species diversity should be studied.

Fishery Resources And Bioassay

21. Fishery resources are to be assessed and static bioassay *of* the waste water should be undertaken periodically.

LABORATORY

22. An environmental laboratory for routine analysis of air and water monitoring should be equipped with the following:

a) Respirable dust Sampler (RDS) with RPM assemblies
b) Continuous stack emission monitoring instrument
c) Photo opacity monitor, Wind anemometer, Sound level meter
d) Temperature recorder, Thermo-hydrograph
e) Spectro photometer
f) CO analyser with detector tubes
g) Semi micro balance
h) Incubator, Hot air oven and Flame photometer
i) Chemicals & glass wares

OCCUPATIONAL SAFETY

23. In a power plant, the main safety hazards involve burns, slips and falls. Fire and explosions may occur from flame out. Electrical hazards and electrocution constitute another serious safety problem in power plants due to the high voltage in the electrical lines. Excessive noise from generators can also be a serious problem. Heat and humidity can contribute to heat stress among boiler works. The following safety measures are proposed to prevent and reduce accidents among employees.

a) All elevated platforms, walkways, stairways and ramps will be equipped with handrails, toe-boards and non-slip surfaces.
b) Steam pipes will be provided with thermal insulation.
c) Shield guards and guard railings will be provided where belts, pulleys, shafting, gears or other moving parts are located.
d) Electrical equipment will be grounded and checked for defective insulation.
e) Workers responsible for cleaning boilers will be provided with special footwear, masks and dust-proof clothing. The cleaning of boilers may require the use of corrosive acids such as sulphuric acid and hydrochloric acid as well as caustic chemicals. The workers using these chemicals will wear protective clothing and goggles. Emergency eyewash and showers will be available in the working area.
f) Maintenance workers and cleaners, who enter enclosed areas for cleaning fuel, oil residues or coal ash dust will wear self-contained air respirators.
g) A programme for fire safety will be regularly carried out. This is important to establish a safety programme and in case of fires due to flame out.
h) Good housekeeping practices will include keeping all walkways clear of debris, cleaning up oil spots and excess water as soon as they are noticed, and regular inspecting and maintaining of all machinery.
i) Rigid procedures for de-energizing and checking the electrical equipment will be followed before any maintenance and repair work can begin. Some work may have to be done on energized equipment. A supervisor will be present during the entire period of work and will make sure that all safety measures are taken to prevent any accidents. Revival techniques after electrocution will be part of any first aid course taught to the employees.
j) The temperatures can go as high as 130ºF in boiler rooms and this can result in heat stress. General ventilation and frequent work breaks to the employees will be provided to reduce these problems.
k) The noise level around the generators or other equipment would be kept lower than 90 decibels (dBA). If impossible, those working near the equipment will have an insulated room where the noise level is below 75

dBA. Personnel will be supplied with ear protection to be worn when working around the equipment. Good maintenance of equipment will also help to reduce noise.

TRAINING

24. The education and training of employees in good safety practices will be the responsibility of management. Employees will be instructed in proper use of all equipment operated, safe lifting practices, location and handling of fire extinguishers, and the use of personal protective equipment.

HEALTH

25. The main health hazards due to working in coal handling areas, ash handling areas, acid and alkali using areas, oil storage areas etc. are skin diseases and chemical burns. The workers will be encouraged to wash frequently and good sanitary and washing facilities shall be provided. A separate lunch room will be provided outside the work area. This will help to reduce dermatitis among the employees due to contact with acids, caustic chemicals, solvents, oils, as well as coal ash and fuel oil residues. The work atmosphere will be monitored for SPM, SO_2, NO_x etc. to avoid excessive exposure.

AFFORESTATION PROGRAMME

26. Afforestation is a key element in environment conservation and protection. The establishment of a vegetation covering land in and around the proposed thermal power plant ,ash disposal area and colony will result in many direct and indirect benefits as :

(a) Vegetation can absorb a wide variety of atmospheric pollutants emitted from thermal power plant and attenuates the noise levels.

(b) Vegetation will be able to control the build-up of atmospheric green house gases (e.g. CO_2) that are emitted during power generation and thereby will postpone global warming.

(c) Afforestation will help restore the ecodynamics around the plant. It checks soil erosion and increases soil fertility.

(d) A green belt acts as a buffer zone and increases the aesthetic value of the surrounding area by adding to the greenery and providing a visual filter.

(e) A green belt will also compensate the vegetation loss during the construction phase and will help in reclamation of land used for ash disposal.

(f) Provision of one third land of the project area will help in complying with the statutory requirements.

27. An appropriate afforestation programme is envisaged which will help in establishing the harmony with the environment of the proposed mega power plant and surrounding environment. The green belt covering 33% of the acquired area will be planted inside the plant premises.

28. The above tree plantation program would consider the following:

- Selected plant species would be native of the area. Introduction of monocultures and alien plant species would be avoided to the maximum possible extent.

- Heterogeneous tree species will be selected and planted considering soil and climate adaptability, flowering, growth characteristics, canopy structure and resistance to pollution load.

29. A nursery will be maintained at site or sapling may be taken from local forest nursery to develop good planting stock to meet the plantation requirements. A horticulturist of EMD will supervise this and the entire plantation/afforestation programme.

FLY ASH UTILISATION PLAN

30. The imported coal to be used in power plant which will contain maximum of 1.0 % of sulphur and maximum 15% of ash content. This large volume of fly-ash occupies large area of land and possesses threat to environment. In order to mitigate and minimise the environmental impact of fly ash disposal, power plant developer will plan to utilise 100% ash in Cement and construction industries, back filling, construction of road, agriculture and brick making. Graphical presentation of tentative ash utilisation plan is shown as Figure – A, which is included in Appendix – 29. Total of 241Ha land has been earmarked for ash disposal area, where ash will be stored till 100% ash utilisation is achieved. Fly ash generated from the proposed power plant would be commercially utilised in one or more of the following industries, to the extent possible:

a) Cement Industry
b) Brick Industry
c) Fly ash aggregate making Industry
d) Road making / paving
e) Agriculture, back filling and filling of abandoned mines
f) Any other technical feasible use.

31. Apart from the above fly ash can also be used for construction of ash-pond dyke, reclamation of low lying areas, mine fills and for agricultural applications such as soil conditioner and fertilizer.

32. Department of Science and Technology (TIFAC) has initiated fly ash mission for possible usage of fly ash generated from thermal power plants [Kumar V and Singh G, 2006]. Various uses of fly ash in agriculture and wasteland management as mentioned in the paper are shown in Appendix – 30. For e.g it improves the permeability status of the soil, improves fertility of soil, improves soil texture, reduce bulk density of soil, improves water holding capacity, optimises pH value, improves soil aeration, provides micro-nutrients like Fe, Zn, Cu, Mo, B, Mn, etc, reduces pest incidence. Thus, use of fly ash can save the money for pesticides and fertilisers. Pond ash at a dose of 30-50 tonne/hectare on one time basis along with recommended dose of fertilisers and manure is recommended for its use in agriculture, forestry sector, wasteland management for cultivation of different cereals, pulses, oil seeds and vegetables, etc, the repeat application of which can be made after 4-5 years as it would have significant residual effect on the yield of succeeding crops over a period of 4-5 years. The abandoned ash pond could also be safely reclaimed via suitable amendments for forestry/ floriculture purposes.

33. A survey questionnaire was prepared and circulated among the various cement manufacturing and construction industries (Sanghi Cement, Adani Industries, M/s Adani SEZ) near the vicinity of the project area for the possible utilisation of the fly-ash being generated from the proposed 4000MW (Nominal) power plant (Appendix -31). The questionnaire covered various options of fly-ash utilisation in the existing cement/construction industries. The outcome of the survey result would be implemented. The hunt for further prospective potential users would be continuous programme for maximum utilisation of generated fly ash (The filled in questionnaire received from Adani SEZ is attached for the reference).

CHAPTER - IX

POLICY, INDIAN LEGAL AND ADMINISTRATIVE FRAMEWORK

CHAPTER –IX

POLICY, INDIAN LEGAL AND ADMINISTATIVE FRAMEWORK

ENVIRONMENTAL REGULATORY SYSTEM IN INDIA

1. In 1980, Government of India constituted Department of Environment for coordinating programmes related to environment. Subsequently in 1985, full-fledged Ministry of Environment and Forest (MoEF) was constituted which is the apex administrative body in the country for regulating and ensuring environmental protection. Since 1970s an extensive network of environmental legislation has grown in the country. The MoEF and the pollution control boards (CPCB i.e. Central Pollution Control Board and SPCBs i.e. State Pollution Control Boards) together form the regulatory and administrative core of the sector.

2. A policy framework comprising of Environmental legislation and regulatory systems were established for the purpose of achieving sustainable industrial progress within the country. The Environment Protection Act, 1986; The Water Act, 1974 as amended in 1988; and The Air Act, 1981 as amended in 1987; are the principal environmental legislation in the country which ensure that ecological balance is maintained with industrial progress.

3. This section outlines the regulatory system for prevention and control of environmental pollution and the pollution control standards applicable in India. Organisational structure and responsibilities of the Ministry of Environment and Forests (MoEF), the nodal agency for environmental in the country, is covered in brief and standard relevant to the current project activities are discussed.

ENVIRONMENTAL LEGISTATION

THE WATER (PREVENTION & CONTROL OF POLLUTION) ACT, 1974 (WATER ACT)

4. This Act represented India's first attempts to comprehensively deal with environmental issues. The purpose of this act is to prevent and control water pollution and to maintain or restore the quality of water. This act is applicable to States specified within the act.

5. It directs the Central and State Government to respectively constitute a Central and State Board. Subsequent amendments to this act and passage of the Air (Prevention And Control of Pollution) Act, 1981, entrusts the Central and State Pollution Control Boards the responsibility to prevent and control air pollution. These boards were therefore renamed as the CPCB and SPCB respectively.

6. This Act requires industries, local bodies and agencies engaged in any trade to obtain consent from the SPCB for discharge of effluent into water bodies. The SPCBs have the authority to enforce this Act. The consent to operate regulates the quality and quantity of trade effluent that the industry can discharge into the water body. It prescribes a time bound program for installation of wastewater treatment plants to comply with its provisions.

7. The constitution, powers and functions of the CPCB and SPCB are defined by this Act. An important function of the CPCB is to establish or modify standards for the quality of water bodies. At State level, the SPCBs function under the direction of the CPCB and the state government. Powers of the SPCBs include power to obtain information, collect effluent discharge, grant, refuse or withdraw consent to industries for pollution discharges into water bodies and take emergency measures, if necessary, to restrict water pollution. Gujarat Pollution Control board (GPCB) has stipulated the guidelines for discharge of boiler blow down and ash pond effluent. The new ultra mega power plant at Mundra will need to obtain consent to operate with respect to air and water emission and Hazardous Wastes (Management and Handling) Rules, 1989 from Gujarat State Pollution Control Board.

<u>THE WATER (PREVENTION AND CONTROL OF POLLUTION) RULES, 1975</u>

8. The Water Act requires the Central Government to establish rules in consultation with the CPCB. These rules, known as The Water Rules, direct the CPCB to perform the functions of an SPCB in Union Territories. In this regards the CPCB has powers similar to those of a SPCB. These rules define the procedures that the SPCB and CPCB should follow in performing their duties.

<u>THE WATER (PREVENTION AND CONTROL OF POLLUTION) CESS ACT, 1977</u>

9. The purpose of this act is to augment the resources of the CPCB and SPCBs constituted under Water Act, 1974. The Water Cess Act makes provisions for the levy and collection of a cess on water consumed, by certain categories of industries in the schedule appended to the act. Local authorities may also specify the categories of such industries. There is provision of 25% reduction on cess payable to those industries that consume water within the quantity prescribed for that category of industries and also comply with effluent standards prescribed under Water Act or the EPA.

<u>THE AIR (PREVENTION AND CONTROL OF POLLUTION) ACT, 1981</u>

10. The purpose of this act is to prevent, and control air pollution including noise pollution and preserve air quality. In order to achieve its goals this act empowers the CPCB and SPCB and defines their functions. An important function of the CPCB is to establish standards for the ambient air quality. Important functions of the SPCB include setting standards for the emission of air pollutants into the atmosphere from industrial plants and automobiles. Such standards also consider the ambient air quality standards laid down by the CPCB. For obtaining consent to establish the ultra mega power plant, the investor has to apply to the SPCB in the prescribed form accompanied by the prescribed fees.

11. Ambient Air Quality Standard is the levels of air quality necessary with an adequate margin of safety to protect the public health, vegetation and property (Appendix 4). Whenever and wherever two consecutive values exceed the limit specified above for the respective category it would be considered adequate reason to institute regular/ continuous monitoring and further investigations.

12. Powers of the SPCBs include declaration and inspection of air pollution control areas, inspection of air pollution control equipment, collection of

samples, grant, refuse or withdraw consent or restrict emission discharges into the atmosphere from industries.

13. This Act has gone through several amendments since 1987 for the purpose of incorporating provisions similar to the amendments of The Water Act. The most significant amendment is the inclusion of noise. This act is now covered under The Noise Regulation and (Control) Rules, 2000. Appendix 6 includes the ambient noise standards. This is now applicable to all activities.

14. Separate Noise regulations for DG set of various capacities were introduced in 2002 vide notification of MoEF of 17 May 2002 under the Environmental (Protection) Second Amendment Rules 2002. This required that all DG sets should be provided with exhaust muffler with insertion loss of minimum 25 dB(A). All DG sets manufactured on or after 1 July 2003 have to comply with these regulations.

THE AIR (PREVENTION AND CONTROL OF POLLUTION) RULES, 1982

15. The Air Act of 1981 requires the central government to establish rules in consultation with the CPCB for the prevention and control of air pollution. These rules define administrative procedures that the CPCB and SPCBs should follow. They also require that all industries operating in an air pollution control area obtain consent from the concerned SPCB for discharge of air pollutant emissions into the region. This provision is similar to the one established in the Water Act wherein all industries are required to obtain consent from the SPCB for discharge of effluents. Operation of DG sets at various plant locations will compliance with these Rules for emission discharge and noise control.

INDIAN AND WORLD BANK STACK EMISSION REGULATIONS

16. Emission norms for power plants are set for particular pollutants based on the desired level of control that needs to be achieved from particular sources or activities. Emission standards in many countries are determined by the policy of promotion of best available technology, or state of art technology or best practices apart from ensuring protection of environment and human health. In India, the CPCB has prescribed emission standards for particulate matter and gaseous pollutants emanating from power plants using coal, naphtha and natural gas fuels. The existing emission standards for India and World Bank are shown in following table:

Emission Standards

	Particulate matter ($\mu g/Nm^3$)	*SO_2 ($\mu g/Nm^3$)*	*NO_x ($\mu g/Nm^3$)*
India	150 (210 MW and above)	220m stack height (200 to 500 MW)	50 ppm (Natural gas)
	350 (<210 MW)	275m stack height (500 MW and above)	100 ppm (Naptha) 75 ppm (Natural gas)
World bank	50	2000 or maxm level 0.2 tpd per MW upto 500 MW	750 (365 ppm (coal) 460 (225 ppm) (gas)

17. The WB has prescribed emission standards of 2000 mg/m^3 for SO_2 . It also states that the maximum permissible emission level would be 0.2 tonnes per day (tpd) per MW upto 500 MW and 0.1 tpd per MW for each additional MW over 500 MW but not more than 500 tpd for any plant. Emission standards for SO_2 are prescribed to be 960, 400, 1200-2100 mg/m^3 for USA, EU and China respectively.

THE ENVIRONMENT (PROTECTION) ACT, 1986

18. The Environment (Protection) Act is an umbrella act designed to provide a framework for the cordination of central and state authorities established under Water and Air Act. The Environment (Protection) Act, 1986 is established by the GOI to fulfil its commitment to protect and improve the human environment. It is applicable to the entire country. From time to time the central government issues notifications under the EPA for the protection of ecologically-sensitive areas or issues guidelines for matters under the EPA

19. It empowers the Central Government to take necessary measures for the purpose of protecting and improving environmental quality and preventing, controlling and abating environmental pollution. Important powers of the Central Government includes laying down standards for environmental quality and emission/discharge of environmental pollution from various sources, define procedures and establish safeguards for handling of hazardous substances, and establish rules to regulate environmental pollution.

20. In addition to the above regulations, the MoEF has issued a notification under which all industries requiring consent under the Air or Water Pollution Control Acts or Authorisation under the Hazardous waste (Management and Handling) Rules, 1989 must submit an annual Environment Audit Report to the SPCB. This is to be done for every financial year ending 31st March and must be submitted on or before the 30th of September of the subsequent financial year.

21. The audit report must contain information regarding consumption of raw material and water, pollution generated, hazardous and solid wastes generated along with their disposal practices. The industry is also required to specify in the audit report the impact of pollution control measures on conservation of natural resources, cost of production and additional investment proposed for environmental protection and pollution abatement.

ENVIRONMENT (PROTECTION) RULES, 1986

22. The Environment (Protection) Rules, 1986 establish standards for emission or discharge of environmental pollutants, factors to be considered while prohibiting or restricting the location of industries, and sampling procedures. The MoEF in notifications published from time to time defines requirements and procedures for seeking environmental clearances of projects. These requirements include submission of an application to the MoEF with an Environmental Impact Assessment Report / Environmental Management Plan prepared in accordance with the guidelines issued by the Central Government and MoEF.

23. These rules have been revised to include standards for discharge of pollutants. Schedule VI of these rules contains the following general standards for discharge of environmental pollutants.

Part A: Effluent Discharge Standards (for discharge into an island surface water body, public sewer, land used for irrigation, and marine coastal area)
Part B: Waste water Generation Standards (for industries)
Part C: Load Based Standards (for oil refineries)
Part D: General Emission Standards (for air pollutants from industries)
  a) Concentration Based Standards
  b) Equipment Based Standards
  c) Load/Mass Based Standards

Part E: Noise Standards for specific equipment

24. The CPCB through the MoEF and respective SPCBs is responsible for establishing and enforcing these standards in each state. The SPCBs are empowered to prescribe more stringent limits depending upon the environmental conditions prevailing in a particular area, the technology used and the ultimate point of discharge or emission. The proposed ultra mega thermal power plant requires clearance from both MoEF and State Pollution Control Board.

COASTAL REGULATION ZONE NOTIFICATION (CRZ) (1991)

25. CRZ notification regulates activities along coastal stretches. The objective of the CRZ Notification is to protect the coastal areas from becoming degraded due to unplanned and/or excessive development which results in pollution and the eventual destruction of this highly prized, fragile and irreplaceable natural resource. The Notification is a unique piece of statutory regulation and other countries that seek to also regulate activities in their coastal areas for environmental reasons may benefit from studying India's experiences.

26. As per this notification, dumping ash or any other waste in the CRZ is prohibited. Notification classifies the coastal areas as CRZ I, II, III and IV. The thermal power plants (only foreshore facilities for transport of raw materials, facilities for intake of cooling water and outfall for discharge of treated waste water/cooling water) require clearance from the MoEF. Non-polluting industries in the field of information technology and other service industries in the coastal regulation zone of special economic zones (SEZ) can be allowed. However it is not much clear that which kind of industries are included in service industries. The IT industry is also not non-polluting industry. It accommodates people, use resources and generate waste.

27. As per CRZ-III category, the area upto 200 m from the High tide line is to embarked as " No developkent zone" provided that provided that such area does not fall within any notified port limits or any notified Special Economic Zone" The proposed power plant is located 500m away from CRZ line. However, intake and outfall structures need clearance from state Department of Environment and Forest./ CRZ authority.

28. As per Coastal Regulation Zone Notification, 1991, which regulates developmental activities within 500 mts from the high tide line and the inter tidal region of the country, all 13 Coastal States/Union Territory Governments have prepared Coastal Zone Management Plans demarcating ecologically sensitive areas, built up areas and rural regions.

29. **The Territorial Waters, continental shelf, exclusive economic zone and other maritime zones act, 1976 Section 5(4) (b)** of the Act says: The central government may take measures in contiguous zone with respect to sanitation. According to Section 6 (3) (d), the union has in the continental shelf " Exclusive jurisdiction to preserve and protect the marine environment and to prevent and control marine pollution. The central government may make provisions with respect to the protection of marine environment in the continental shelf and in the exclusive economic zone. In the Exclusive economic zone also the union has exclusive jurisdiction. According to section 15(2)(e), the central executive has power to make rules for preservation and protection of the marine environment and prevention and control of marine pollution.

THE NATIONAL ENVIRONMENT APPELLATE AUTHORITY ACT, 1997

30. This Act provided for the establishment of a National Environment Appellate Authority to hear appeals with respect to restriction of areas in which any industry operation or process or class of industries, operations or processes could not carry out or would be allowed to carry out subject to certain safeguards under the Environment (Protection) Act, 1986.

31. In addition to these, various Acts specific to the coal sector have been enacted. The first attempts in this direction can be traced back to the Mines Act, 1952, which promoted health and safety standards in coal mines. Later the Coal Mines (Conservation and Development) Act (1974) came up for conservation of coal during mining operations.

HAZARDOUS WASTES (MANAGEMENT AND HANDLING) RULES, 1989

32. These rules were notified on 28th July, 1989, under the Environment Protection Act, 1986. They aim at controlling the generation, collection, treatment, transportation, and disposal of hazardous wastes. The principal objective of these regulations is to establish a control mechanism for the management of hazardous wastes. These rules have been amended subsequently in 1998, 2001,2002 and in 2003 to include modalities for disposal of lead acid batteries, bio-medical waste and several other categories of industrial waste including waste oils. Old transformer oil disposal and lead acid batteries replacement in the project will need to be done through authorised recyclers under this regulation.

MANUFACTURE, STORAGE AND IMPORT OF HAZARDOUS CHEMICALS RULES 1989

33. These rules were notified on 27th November, 1989, under the Environment Protection Act, 1986. Their principal objective is to prevent occurrence of major accidents during industrial activities. An important feature of the regulation is that the storage of hazardous/toxic chemicals not associated with a process are treated differently from process used chemicals. New industries are required to prepare the safety report within 5 years of coming into operation. The occupier of the industries handling any of the chemical specified in Schedule 2 and 3 of the Rules is also required to prepare and maintain an up-to-date onsite emergency plan for dealing with major accidents, Material Safety and Data Sheets (MSDS) for all chemicals handled before commencement of the activity. Further, these rules do not override any existing regulations like The Explosives Act, The Petroleum Act, The Factories Act, etc. Chlorine storage will be designed and stored as per Gas Cylinders Rules.

THE PUBLIC LIABILITY INSURANCE ACT, 1991

34. This Act, unique to India, which came into force since 22th January, 1991, provides immediate relief to persons affected by accidents during handling of any hazardous substances. The Act compels the owner to insure third parties against death, injury and damage to property incurred during handling of any hazardous substances. This releif has to be provided on “ on fault basis”. The payment under this act is only for the immediate relief; owners shall have to provide the final compensation , if any, arising out of legal proceedings.

ENVIRONMENTAL IMPACT ASSESSMENT NOTIFICATION, 1994

35. EIA notification issued by Ministry of Environment and Forest in January 1994, makes Environmental Impact Assessment statutory for 32 different identified activities for expansion or modernization of any activity or for setting up new projects listed in schedule I of the notification. This notification includes the details of the procedures for obtaining environemtnal clearance and for public involvement besides setting time schedule for decision taking. As per notification comprehensive EIA is necessary for proposed ultra mega power plant to get environmental clearance.

PUBLIC HEARING NOTIFICATION- S.O. 318 (E) DATED 10TH. APRIL.1997

36. The Environmental (Protection Rules), 1986 imposes certain restrictions and prohibitions on the expansion and modernisation of any activity or undertaking of any project, unless clearance has been granted by the Government. Schedule IV of this Notification deals with the Procedure of Public Hearing which requires Public participation of all persons including bona fide residents, environmental groups and other located at Project site. Under this Notification, State Pollution Control Board has to conduct public hearing before sendingbthe proposal to MoEF for obtaing environemtnal clearance and for site specific projects, it is even before the site clearance applicationsare forwarded to MoEF. SPCB initiate public hearing by publishing the notice in two leading newspapers. As the new project are within the criteria set in terms of its investment and number of persons employed, the need to obtain EIA clearance and of public hearing is required.

ASH CONTENT NOTIFICATION, 1997

37. Ash Content Notification (1997), required the use of beneficiated coal with ash content not exceeding 34% with effect from June 2001, (the date later was extended to June 2002). This applies to all thermal plants located beyond one thousand kilometres from the pithead and any thermal plant located in an urban area or, sensitive area irrespective of the distance from the pithead except any pithead power plant. Proposed UMPP has planned to use imported coal having maximum ash content upto 15%.

DISPOSAL OF FLY ASH NOTIFICATION, 1999

38. The main objective of this notification is to conserve the topsoil, protect the environment and prevent the dumping and disposal of fly ash discharged from lignite-based power plants. The salient feature of this notification is that no person within a radius of 50 km from a coal-or lignite-based power plant shall manufacture clay bricks or tiles without mixing at least 25% of ash with soil on a weight-to-weight basis.

39. For the thermal power plants the utilisation of the flyash is given as a) Every coal-or lignite-based power plant shall make available ash for at least ten years from the date of publication of the above notification without any payment or any other consideration, for the purpose of manufacturing ash-based products such as cement, concrete blocks, bricks, panels or any other material or for construction of roads, embankments, dams, dykes or for any other construction activity, b) Every coal or lignite based thermal power plant commissioned subject to environmental clearance conditions stipulating the submission of an action plan for full utilisation of fly ash shall, within a period

of nine years from the publication of this notification, phase out the dumping and disposal of fly ash on land in accordance with the plan.

FOREST (CONSERVATION) ACT, 1980 AS AMENDED IN 1988

40. This act imposes restriction on the reservation of the Forest or use of forest land for non-forest purpose. There is no forest land in the proposed site.

FOREST CONSERVATION RULES, 2003

41. Every user agency, who wants to use any forest land for non-forest purposes shall make his proposal in the appropriate Form appended to these rules, i.e. Form 'A' for proposals seeking first time approval under the Act and Form 'B' for proposals seeking renewal of leases where approval of the Central Government under the Act had already been obtained earlier, to the concerned nodal officer authorized in this behalf by the State Government, alongwith requisite information and documents, complete in all respects, well in advance of taking up any non-forest activity on the forest land. Indutry seeking forest clearance has to provide map of the forest are required showing the boundary of the adjoining forests, etc. If area is very small, an index map may be submitted showing forest boundaries and a location map on larger scale with a land use of the area required.

ENVIRONMENTAL REGULATORY INSTITUTION -ROLES & FUNCTIONS

42. In the wake of environmental pollution due to industrialisation, a need was felt to establish a national apex body for the protection and conservation of the environment and natural resources of the country. The Environment Protection Act, 1986, also had provisions for the central government to constitute an authority to meet its responsibilities and achieve the goals of the act. In 1985, the Ministry of Environment and Forest (MoEF) was formed and included in the administrative structure of the Government of India (GOI) for the sole purpose of planning, promotion and co-ordination of environment and forest programs.

The key responsibilities of the MoEF are as under:

a) Environmental, Policy planning
b) Ensure effective implementation of legislation
c) Pollution Monitoring and Control
d) Survey and Conservation of Natural Resources
e) Eco development and biosphere reserve programme
f) Management of Forests and Conservation and Wildlife
g) Environment Clearance for Industrial and Development Projects
h) Environmental Education, Awareness and Information
i) Co-ordination with concerned agencies at National and International Levels

43. The MoEF discharges its above responsibilities through various support divisions of its Environment and Forest wings. The Pollution Control and the Impact Assessment (IA) divisions grant environmental clearances to proposed projects.

44. The Central Pollution Control Board (CPCB) is an autonomous agency. It plays an advisory role to the Government and State Pollution Control Boards (SPCB) in matters relating to the implementation and enforcement of the Air, Water and Environmental Acts. In this sense, the CPCB through various SPCBs is responsible for the enforcement and implementation of pollution control legislation, and discharge standards. In addition, the EIA review

committee formed by the IA division consists of a representative from the CPCB.

45. The SPCB is responsible for issuing consent to operate to all proposed industries within the state. This is as per the requirements of the Water Act and Air Rules. This consent identifies the pollutant discharge standards applicable to the proposed industry.

46. The MoEF is responsible for issuing environmental clearances for the proposed project site to certain categories of projects. The procedure for obtaining environmental clearances requires an application to be submitted to the secretary, MoEF, New Delhi. Such an application should be accompanied by a project report, which includes an Environmental Impact Assessment (EIA) Report and Environmental Management Plan (EMP).

STACK HEIGHT CLEARANCE FROM AIRPORT AUTHORITY OF INDIA

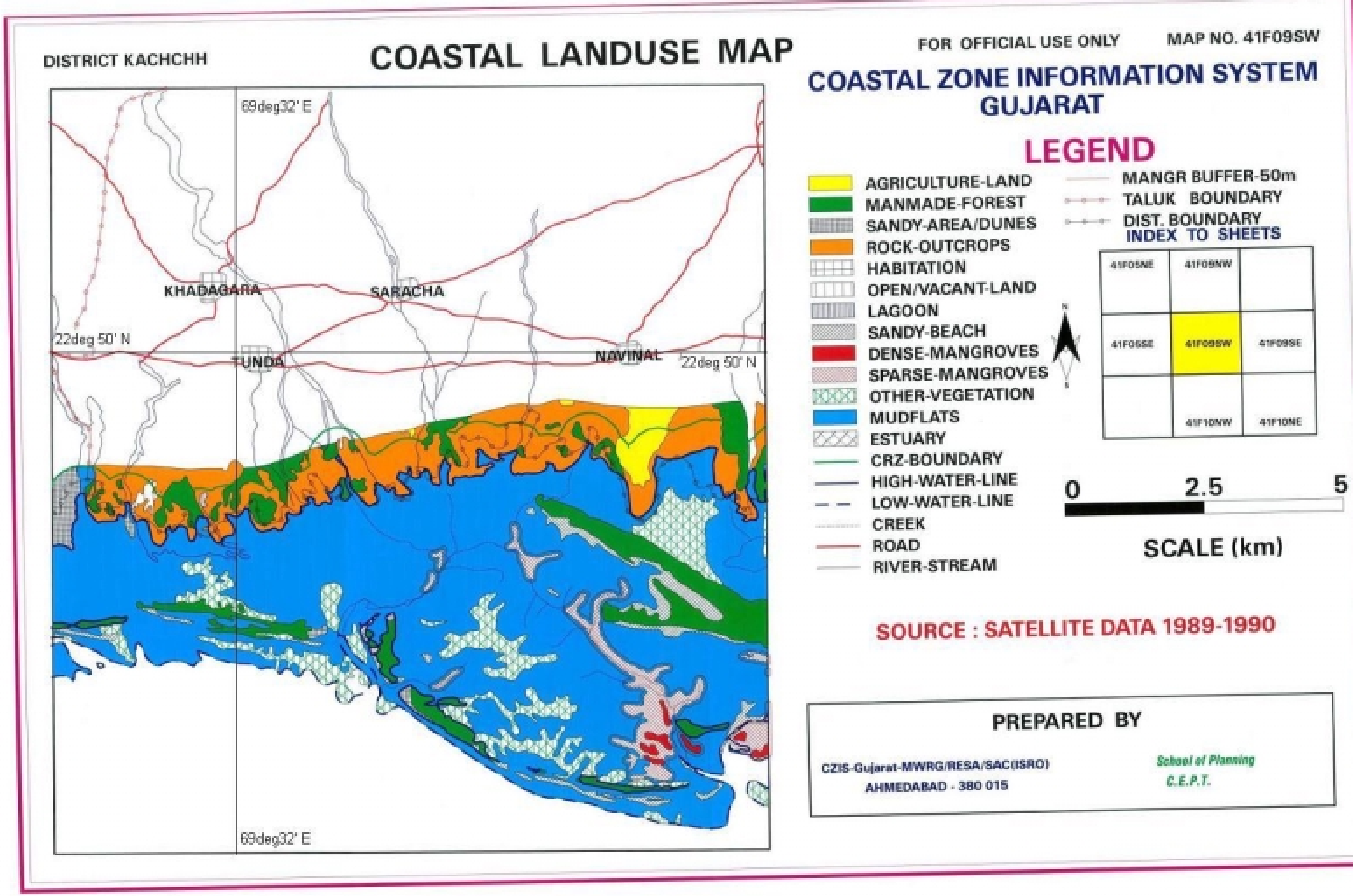
47. Apart from the above rules and regulations, a No Objection Certificate will be required from Airport Authority of India for construction of highrise structures (In this case, stacks) around the vicinty of airports (Bhuj Airport).

APPENDICES

APPENDIX-1

SEA WATER ANALYSIS FROM GULF OF KUTCH

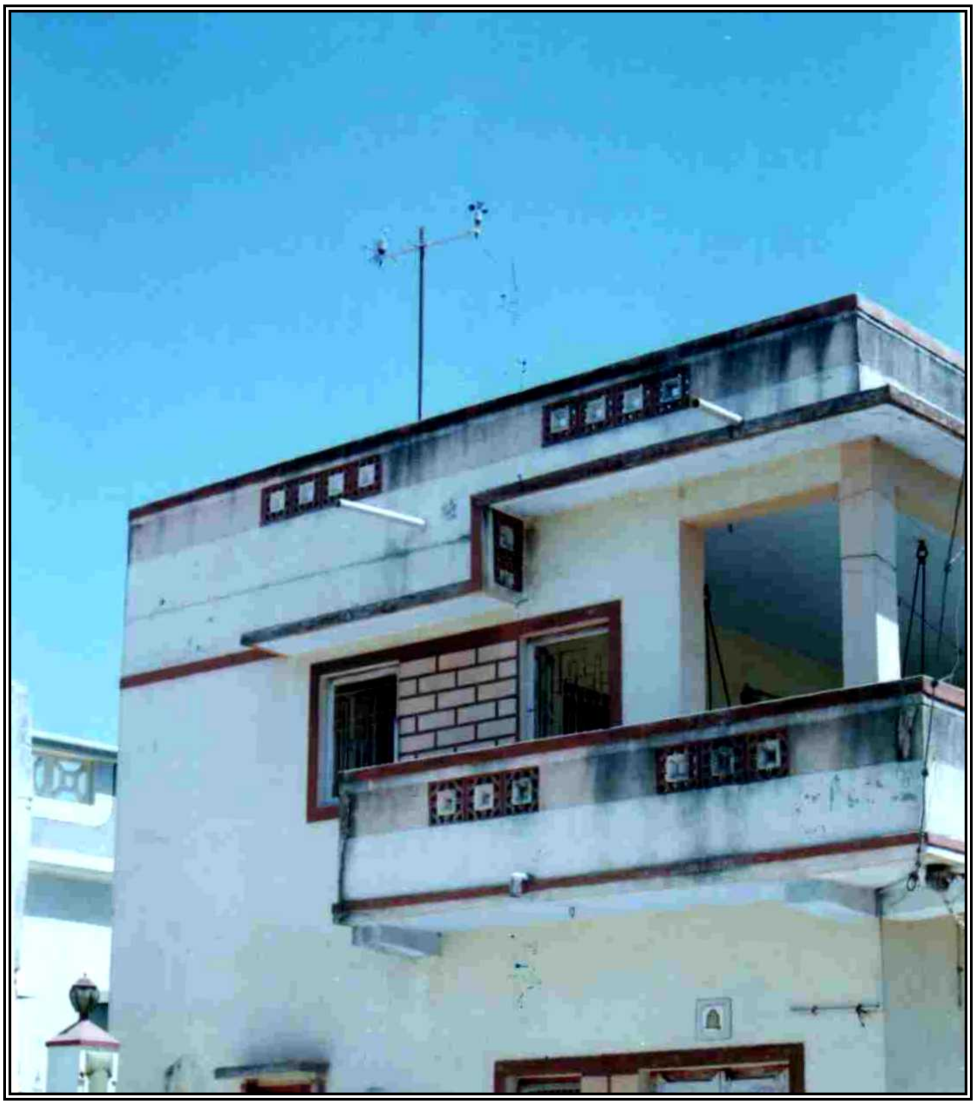
Parameter	Kotdi Creek		Gulf of Kutch off Tundawand	
	Apr 2006	Jan 2006	Apr 2006	Jan 2006
Temp (^{o} C)	28.1	18.3	27.9	21.1
pH	8.0	8.1 - 8.4	7.9	8.1 - 8.4
SS (mg/l)	31	32 - 34	25.0	30 - 139
Salinity (ppt)	37.9	37.5	36.8	37.2
DO (ml/l)	4.5	5.4	4.7	5
BOD (ml/l)	0.6	0.8 – 5.4	1.0-2.1	0.8 – 5.4
PO_4^{3-} -P(μmol/l)	1.8	1.7	0.9	1.6
NO_3^- -N (μmol/l)	1.55	7.1	3.1	7.8
NH_4^+ -N (μmol/l)	0.7	0 – 3	0.6	0 – 23.5
PHc (μ g/l)	16.3	0.3	31.7	0.3 – 21.6



DISTRICT KACHCHH
COASTAL LANDUSE MAP
FOR OFFICIAL USE ONLY
MAP NO. 41F09SW
COASTAL ZONE INFORMATION SYSTEM
GUJARAT
69deg32' E
KHADAGARA
SARACHA
22deg 50' N
TUNDA
NAVINAL
22deg 50' N
69deg32' E
LEGEND
AGRICULTURE-LAND
MANMADE-FOREST
SANDY-AREA/DUNES
ROCK-OUTCROPS
HABITATION
OPEN/VACANT-LAND
LAGOON
SANDY-BEACH
DENSE-MANGROVES
SPARSE-MANGROVES
OTHER-VEGETATION
MUDFLATS
ESTUARY
CRZ-BOUNDARY
HIGH-WATER-LINE
LOW-WATER-LINE
CREEK
ROAD
RIVER-STREAM
MANGR BUFFER-50m
TALUK BOUNDARY
DIST. BOUNDARY
INDEX TO SHEETS
41F05NE
41F09NW
41F05SE
41F09SW
41F09SE
41F10NW
41F10NE
0
2.5
5
SCALE (km)
SOURCE : SATELLITE DATA 1989-1990
PREPARED BY
CZIS-Gujarat-MWRG/RESA/SAC(ISRO)
AHMEDABAD - 380 015
School of Planning
C.E.P.T.

APPENDIX - 3

METROLOGICAL STATION ESTABLISHED IN TUNDAWAND



APPENDIX – 4a

AMBIENT AIR QUALITY MONITORING REPORT FOR SUMMER-2006

Monitoring Location : Tunda Village							
Sr. No.	Date of Monitoring	Week	Ground Level Concentration				
			SPM	RPM	SO2	NOx	CO
			µg/m3	µg/m3	µg/m3	µg/m3	µg/m3
1	01-03-2006	I	128	82	11.4	16.4	1800
2	03-03-2006	I	84	42	9.6	12.6	1400
3	06-03-2006	II	94	48	12.2	18.2	1000
4	08-03-2006	II	86	52	10.7	15.2	980
5	16-03-2006	III	114	96	8.4	13.8	1600
6	18-03-2006	III	108	62	9.8	15.9	1400
7	21-03-2006	IV	98	56	10.2	14.8	1200
8	23-03-2006	IV	84	42	8.0	13.2	1090
9	27-03-2006	V	110	82	11.8	18.5	1890
10	29-03-2006	V	78	38	9.2	16.4	2050
11	03-04-2006	I	132	88	13.8	18.2	1900
12	05-04-2006	I	88	42	10.9	12.6	1765
13	10-04-2006	II	128	82	11.8	15.6	1580
14	12-04-2006	II	110	68	9.2	12.8	1200
15	17-04-2006	III	94	42	10.9	14.4	1600
16	19-04-2006	III	82	88	8.2	15.2	1940
17	24-04-2006	IV	128	78	12.4	16.4	1820
18	26-04-2006	IV	110	48	10.8	11.8	1980
19	01-05-2006	I	128	88	16.2	23.4	1900
20	04-05-2006	I	102	64	12.4	19.4	1860
21	08-05-2006	II	130	94	14.2	21.2	1000
22	11-05-2006	II	98	42	10.4	18.2	1500
23	15-05-2006	III	124	82	15.7	19.8	1020
24	18-05-2006	III	138	70	9.4	16.7	1420
25	23-05-2006	IV	94	48	11.2	17.6	1680
26	27-05-2006	IV	86	38	8.4	18.2	1370
Maximum			138.0	96.0	16.2	23.4	2050
Minimum			78.0	38.0	8.0	11.8	980
Average			106.0	63.9	11.0	16.4	1536.3
98 Percentile			135.0	95.0	16.0	22.3	2015.0

APPENDIX – 4a (Cont'd)

AMBIENT AIR QUALITY MONITORING REPORT FOR SUMMER-2006

Monitoring Location : Jalpara

Sr. No.	Date of Monitoring	Week	Ground Level Concentration				
			SPM	RPM	SO2	NOx	CO
			µg/m3	µg/m3	µg/m3	µg/m3	µg/m3
1	02-03-2006	I	122	82	9.4	14.8	1280
2	04-03-2006	I	98	58	8.2	12.6	1400
3	07-03-2006	II	110	70	10.6	11.5	1180
4	09-03-2006	II	104	66	7.9	10.9	1240
5	13-03-2006	III	88	54	9.0	12.4	1000
6	15-03-2006	III	82	42	8.8	11.2	1200
7	20-03-2006	IV	124	76	10.6	15.5	1380.0
8	22-03-2006	IV	110	68	7.0	12.8	1100.0
9	28-03-2006	V	98	58	10.4	16.9	1890.0
10	30-03-2006	V	86	42	9.2	18.3	1680.0
11	04-04-2004	I	98	42	15.4	21.2	1880
12	06-04-2005	I	84	38	12.8	16.8	1660
13	11-04-2006	II	138	94	10.9	18.6	1940
14	13-04-2006	II	118	86	8.8	13.5	2000
15	18-04-2006	III	128	62	12.8	15.2	1790
16	20-04-2006	III	118	48	14.4	19.2	1680
17	25-04-2006	IV	128	86	10.6	16.5	1808
18	27-04-2006	IV	112	74	9.8	15.8	1680
19	02-05-2006	I	138	92	14.8	22.4	1950
20	05-05-2006	I	110	72	11.6	18.5	1890
21	09-05-2006	II	124	84	13.5	19.4	1650
22	12-05-2006	II	112	68	12.9	21.6	1480
23	16-05-2006	III	108	54	13.4	18.8	1560
24	19-05-2006	III	114	52	10.8	19.2	1700
25	24-05-2006	IV	128	88	8.8	20.2	1400
26	29-05-2006	IV	96	48	10.6	17.2	1580.0
Maximum			138.0	94.0	15.4	22.4	2000.0
Minimum			82.0	38.0	7.0	10.9	1000.0
Average			110.6	65.5	10.9	16.6	1576.8
98 Percentile			138.0	93.0	15.1	22.0	1975.0

APPENDIX – 4a(Cont'd)

AMBIENT AIR QUALITY MONITORING REPORT FOR SUMMER-2006

Monitoring Location : Desalpar							
Sr. No.	Date of Monitoring	Week	Ground Level Concentration				
			SPM µg/m3	RPM µg/m3	SO2 µg/m3	NOx µg/m3	CO µg/m3
1	04-03-2006	I	124	84	8.4	18.5	1480
2	06/03/2006	I	110	78	10.2	20.4	1260
3	16-03-2006	II	98	58	13.2	22.8	1600
4	12-03-2006	II	86	42	11.8	19.7	1300
5	17-03-2006	III	134	86	10.9	16.8	900
6	19-03-2006	III	122	78	8.6	15.7	1400
7	23-03-2006	IV	110	78	12.7	18.4	1300.0
8	25-03-2006	IV	94	62	9.2	13.5	1000.0
9	31-03-2006	V	128	86	10.9	19.9	1680.0
10	02-03-2006	V	84	48	10.2	20.6	1800.0
11	04-04-2004	I	128	82	15.4	21.2	1880
12	09-04-2005	I	86	42	12.8	16.8	1660
13	14-04-2006	II	138	94	10.9	18.6	1940
14	16-04-2006	II	102	68	8.8	13.5	2000
15	21-04-2006	III	124	84	13.8	15.2	1790
16	23-04-2006	III	98	42	14.4	19.2	1680
17	28-04-2006	IV	128	84	10.6	16.5	1808
18	30-04-2006	IV	112	74	8.9	15.8	1680
19	04-05-2004	I	138	98	13.2	21.6	2010
20	06-05-2005	I	122	86	10.4	19.4	1800
21	10-05-2006	II	96	52	11.4	18.4	1680
22	13-05-2006	II	88	42	8.4	16.8	1020
23	17-05-2006	III	134	88	12.6	22.4	1400
24	20-05-2006	III	110	68	9.9	18.7	1380
25	25-05-2006	IV	128	82	12.5	19	1500
26	29-05-2006	IV	118	70	10.8	18.2	1700
Maximum			138.0	98.0	15.4	22.8	2010.0
Minimum			84.0	42.0	8.4	13.5	900.0
Average			113.1	71.4	11.2	18.4	1563.4
98 Percentile			138.0	96.0	14.9	22.6	2005.0

APPENDIX – 4a (Cont'd)

AMBIENT AIR QUALITY MONITORING REPORT FOR SUMMER-2006

Monitoring Location : Mota Bhojapur							
Sr. No.	Date of Monitoring	Week	Ground Level Concentration				
			SPM	RPM	SO2	NOx	CO
			µg/m3	µg/m3	µg/m3	µg/m3	µg/m3
1	04-03-2006	I	136	94	10.4	16.8	1280
2	06-03-2006	I	110	68	9.8	14.2	1400
3	10-03-2006	II	128	72	12.2	19.2	1820
4	12-03-2006	II	96	48	8.2	13.5	1650
5	17-03-2006	III	134	92	9.9	14.4	1200
6	19-03-2006	III	118	84	7.6	12.4	1400
7	23-03-2006	IV	98	52	12.4	13.9	1520.0
8	25-03-2006	IV	86	42	10.6	11.2	1000.0
7	23-03-2006	IV	98	52	12.4	13.9	1520.0
8	25-03-2006	IV	86	42	10.6	11.2	1000.0
9	01-03-2006	V	122	84	8.6	14.2	1800.0
10	02-03-2006	V	110	62	9.4	15.9	1680.0
11	06-04-2004	I	122	86	18.4	22.4	1890
12	08-04-2005	I	98	42	14.6	17.5	1900
13	13-04-2006	II	130	92	10.4	16.3	1580
14	15-04-2006	II	112	62	8.6	14.9	1690
15	20-04-2006	III	132	98	10.4	14.2	2000
16	23-04-2006	III	110	68	13.5	16.8	1794
17	26-04-2006	IV	122	78	13.5	19.4	1850
18	28-04-2006	IV	84	38	9.9	14.2	1590
19	04-05-2004	I	130	94	13.8	19.4	1820
20	06-05-2005	I	116	72	11.6	21.8	1200
21	10-05-2006	II	108	64	10.4	18.4	1600
22	13-05-2006	II	94	42	9.8	16.9	1480
23	17-05-2006	III	136	88	14.5	22.8	1640
24	20-05-2006	III	110	64	9	18.5	1700
25	25-05-2006	IV	124	84	15.2	23.8	1680
26	29-05-2006	IV	110	62	8.2	20.5	1450.0
Maximum			136.0	98.0	18.4	23.8	2000.0
Minimum			84.0	38.0	7.6	11.2	1000.0
Average			112.9	68.8	11.2	16.7	1576.2
98 Percentile			136.0	95.8	16.7	23.3	1946.0

APPENDIX – 4a (Cont'd)

AMBIENT AIR QUALITY MONITORING REPORT FOR SUMMER-2006

Monitoring Location : Tragadi

Sr. No.	Date of Monitoring	Week	Ground Level Concentration				
			SPM µg/m3	RPM µg/m3	SO2 µg/m3	NOx µg/m3	CO µg/m3
1	01-03-2006	I	128	78	8.2	14.4	1000
2	07-03-2006	II	110	64	8.8	12.6	1200
3	13-03-2006	III	102	62	10.2	16.8	1300
4	20-03-2006	IV	86	42	8.1	13.2	1200
5	27-03-2006	V	112	74	12.6	18.4	1890
6	03-04-2006	I	110	76	11.8	15.6	1900
7	10-04-2006	II	86	52	9.6	14.2	1820
8	17-04-2006	III	122	82	12.2	16.4	1900
9	24-04-2006	IV	78	38	10.4	17.2	1780
10	01-05-2006	I	122	78	12.3	22.8	1420
11	08-05-2006	II	86	42	10.4	19.2	1620
12	15-05-2006	III	134	92	8.6	16.5	1520
13	22-05-2006	IV	128	82	14.2	23.5	1260
Maximum			134.0	92.0	14.2	23.5	1900.0
Minimum			78.0	38.0	8.1	12.6	1000.0
Average			108.0	66.3	10.6	17.0	1523.8
98 Percentile			132.6	89.6	13.8	23.3	1900.0

APPENDIX – 4a (Cont'd)

AMBIENT AIR QUALITY MONITORING REPORT FOR SUMMER-2006

Monitoring Location : Pipari							
Sr. No.	**Date of Monitoring**	**Week**	**Ground Level Concentration**				
			SPM	**RPM**	**SO2**	**NOx**	**CO**
			µg/m3	**µg/m3**	**µg/m3**	**µg/m3**	**µg/m3**
1	02-03-2006	I	118	84	8.2	14.8	1200
2	08-03-2005	I	108	74	9.4	12.4	1100
3	14-03-2006	II	98	52	10.6	13.5	900
4	21-03-2006	IV	78	38	10.2	16.2	980
5	28-03-2006	V	110	78	9.8	14.9	1490
6	04-04-2006	I	134	96	11.4	18.2	1680
7	11-04-2007	II	122	84	9.2	16.5	1920
8	18-04-2006	III	112	78	10.8	14.8	2000
9	25-04-2006	IV	98	52	8	12.7	1590
10	02-05-2006	I	110	68	11.8	16.8	1680
11	09-05-2006	II	82	40	7.8	12.4	980
12	16-05-2006	III	100	64	10.4	18	1010
13	23-05-2006	IV	96	58	13	22	1000
Maximum			134.0	96.0	13.0	22.0	2000.0
Minimum			78.0	38.0	7.8	12.4	900.0
Average			105.1	66.6	10.0	15.6	1348.5
98 Percentile			131.1	93.1	12.7	21.1	1980.8

APPENDIX – 4a (Cont'd)

AMBIENT AIR QUALITY MONITORING REPORT FOR SUMMER-2006

Monitoring Location : Bidada							
Sr. No.	**Date of Monitoring**	**Week**	**Ground Level Concentration**				
			SPM	**RPM**	**SO2**	**NOx**	**CO**
			μg/m3	**μg/m3**	**μg/m3**	**μg/m3**	**μg/m3**
1	03-03-2006	I	132	88	12.2	22.2	1580
2	10-03-2006	II	128	68	10.2	16.2	1620
3	15-03-2006	III	110	58	8.9	19.2	1800
4	22-03-2006	IV	96	44	9.2	18.2	1260
5	29-03-2006	V	110	68	12.6	20.4	1690
6	05-4-2006	I	138	86	12.8	19.2	1890
7	12-04-2006	II	124	72	10.2	16.2	1800
8	19-04-2006	III	94	48	11.6	18.2	1650
9	27-04-2006	IV	82	34	9.8	15.2	1800
10	03-5-2006	I	142	98	15.9	21.2	1680
11	10-05-2006	II	128	82	11.6	19.5	1560
12	17-05-2006	III	118	62	12.8	22.8	1980
13	24-05-2006	IV	94	46	9.1	14.9	1800
Maximum			142.0	98.0	15.9	22.8	1980.0
Minimum			82.0	34.0	8.9	14.9	1260.0
Average			115.1	65.7	11.3	18.7	1700.8
98 Percentile			141.0	95.6	15.2	22.7	1958.4

APPENDIX – 4a (Cont'd)

AMBIENT AIR QUALITY MONITORING REPORT FOR SUMMER-2006

Monitoring Location : Kandagra							
Sr. No.	Date of Monitoring	Week	Ground Level Concentration				
			SPM ug/m3	RPM ug/m3	SO2 ug/m3	NOx ug/m3	CO mg/m3
1	05-032006	I	112	78	11.2	16.8	1274
2	11/3/2006	II	98	52	8.2	14.2	1400
3	17-03-2006	III	122	72	10.4	19.4	1000
4	24-03-2006	IV	86	38	7.6	15.2	1200
5	30-03-2006	V	118	82	9.6	19.5	1600
6	08-04-2006	I	134	92	10.4	18.4	1650
7	15-04-2006	I	110	62	9.9	19.2	1980
8	22-04-2006	II	122	82	12.2	22.8	1820
9	29-04-2006	III	84	40	8.8	17.4	1790
10	05-05-2006	I	134	96	12.8	22.8	1480
11	12-05-2006	II	94	54	9.8	17	1260
12	19-05-2006	III	120	82	16.4	19.6	1180
13	26-05-2006	IV	88	38	10.4	15.8	900
Maximum			134.0	96.0	16.4	22.8	1980.0
Minimum			84.0	38.0	7.6	14.2	900.0
Average			109.4	66.8	10.6	18.3	1425.7
98 Percentile			134.0	95.0	15.5	22.8	1941.6

APPENDIX – 4b

AMBIENT AIR QUALITY MONITORING REPORT FOR POST-MONSOON-2006

Monitoring Location : TUNDA VILLAGE							
Sr.	**Date of**	**Week**	**Ground Level Concentration**				
No.	**Monitoring**		**SPM**	**RPM**	**SO_2**	**NO_X**	CO
			$\mu g/m^3$	**$\mu g/m^3$**	**$\mu g/m^3$**	**$\mu g/m^3$**	**$\mu g/m^3$**
1	03/10/2006	I	114	78	12.4	18.8	1782
2	07/10/2006	I	94	68	10.8	13.4	1345
3	10/10/2006	II	96	52	9.6	14.2	1010
4	14/10/2006	II	82	48	11.2	16.4	1210
5	17/10/2006	III	122	84	10.2	12.8	1468
6	21/10/2006	III	110	82	8.6	14.4	1620
7	24/10/2006	IV	88	62	11.9	17.6	1274
8	28/10/2006	IV	82	56	10.6	15.8	1089
1	03/11/2006	I	124	84	14.4	21.6	1845.0
2	06/11/2006	I	110	56	11.2	18.4	1452.0
3	10/11/2006	II	98	52.0	10.6	13.7	1622.0
4	14/11/2006	II	88	48	8.4	12.2	1289.0
5	18/11/2006	III	112	58	12.6	19.2	1564.0
6	22/11/2006	III	82	42	9.8	11.5	1388.0
7	25/11/2006	IV	130	92.0	13.7	20.2	1812.0
8	29/11/2006	IV	118	62	10.4	12.8	1458.0
Maximum			130.0	92.0	14.4	21.6	1845.0
Minimum			82.0	42.0	8.4	11.5	1010.0
Average			103.1	64.0	11.0	15.8	1451.8

APPENDIX – 4b (Cont'd)

AMBIENT AIR QUALITY MONITORING REPORT FOR POST-MONSOON-2006

Monitoring Location : JALPARA							
Sr. No.	Date of Monitoring	Week	Ground Level Concentration				
			SPM	RPM	SO_2	NO_X	CO
			$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$
1	03/10/2006	I	132	88	14.4	21.4	1494
2	07/10/2006	I	124	74	10.8	16.8	1352
3	10/10/2006	II	92	56	9.8	15.2	1846
4	14/10/2006	II	110	64	7.8	13.8	1568
5	17/10/2006	III	122	72	12.6	18.2	1697
6	21/10/2006	III	114	68	10.9	15.8	1578
7	24/10/2006	IV	86	52	11.9	19.4	1722.0
8	28/10/2006	IV	94	70	8.8	14.4	1489.0
1	03/11/2006	I	124	84	12.8	19.2	1682.0
2	06/11/2006	I	118	78	11.9	16.4	1446.0
3	10/11/2006	II	108.0	62.0	16.8	22.8	1842.0
4	14/11/2006	II	94	72	11.2	15.6	1389.0
5	18/11/2006	III	138	92	14.6	18.4	1578.0
6	22/11/2006	III	126	70	10.8	14.2	1620.0
7	25/11/2006	IV	110.0	68.0	15.4	21.5	1864.0
8	29/11/2006	IV	86	64	9.9	12.8	1298.0
Maximum			138.0	92.0	16.8	22.8	1864.0
Minimum			86.0	52.0	7.8	12.8	1298.0
Average			111.1	70.9	11.9	17.2	1591.6

APPENDIX – 4b (Cont'd)

AMBIENT AIR QUALITY MONITORING REPORT FOR POST-MONSOON-2006

Monitoring Location : DESALPAR							
Sr.	**Date of**	**Week**	**Ground Level Concentration**				
No.	**Monitoring**		**SPM**	**RPM**	**SO_2**	**NO_X**	CO
			$\mu g/m^3$	**$\mu g/m^3$**	**$\mu g/m^3$**	**$\mu g/m^3$**	**$\mu g/m^3$**
1	04/10/2006	I	126	78	14.4	22.6	1724.0
2	08/10/2006	I	118	68	11.8	16.4	1562.0
3	11/10/2006	II	110	62	12.4	18.2	1945.0
4	15/10/2006	II	94	58	10.5	14.3	1684.0
5	18/10/2006	III	88	48	9.4	12.8	1250.0
6	22/10/2006	III	108	62	9.2	12.2	1368.0
7	25/10/2006	IV	132	92	13.2	18.8	1645.0
8	29/10/2006	IV	120	72	11.2	17.2	1552.0
1	04/11/2006	I	116	78	14.6	21.6	1645.0
2	07/11/2006	I	94	64	12.4	20.4	1487.0
3	11/11/2006	II	124.0	82.0	11.2	18.2	1842.0
4	15'/11/2006	II	112	70	9.8	12.2	1735.0
5	19/11/2006	III	138	92	14.2	16.5	1522.0
6	23/11/2006	III	122	84	13.5	15.4	1489.0
7	27/11/2006	IV	128.0	92.0	10.4	12.8	1847.0
8	30/11/2006	IV	114	72	9	12.8	1347.0
Maximum			138.0	92.0	14.6	22.6	1945.0
Minimum			88.0	48.0	9.0	12.2	1250.0
Average			115.3	73.4	11.7	16.4	1602.8

APPENDIX – 4b (Cont'd)

AMBIENT AIR QUALITY MONITORING REPORT FOR POST-MONSOON-2006

Monitoring Location : Mota Bhojapur							
Sr. No.	**Date of Monitoring**	**Week**	**Ground Level Concentration**				
			SPM	**RPM**	**SO_2**	**NO_X**	CO
			µg/m³	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**
1	04/10/2006	I	142	98	12.8	19.8	1674
2	08/10/2006	I	110	68	11.6	18.5	1562
3	11/10/2006	II	112	72	10.8	16.4	1927
4	15/10/2006	II	84	52	9.2	15.2	1820
5	18/10/2006	III	132	82	15.2	22.2	1689
6	22/10/2006	III	96	64	11.9	18.2	1522
7	25/10/2006	IV	94	60	13.4	17.6	1745
8	29/10/2006	IV	82	42	12.2	15.2	1469
1	04/11/2006	I	134	94	15.4	21.3	1687.0
2	07/11/2006	I	128	88	10.8	14.6	1845.0
3	11/11/2006	II	118.0	82.0	14.6	18.9	1420.0
4	15/11/2006	II	88	58	12.9	16.7	1320.0
5	19/11/2006	III	120	86	16.4	24.8	1942.0
6	23/11/2006	III	98	66	11.2	15.5	1560.0
7	27/11/2006	IV	124.0	82.0	14.8	19.4	1824.0
8	30/11/2006	IV	114	78	12.9	15.8	1245.0
Maximum			142.0	98.0	16.4	24.8	1942.0
Minimum			82.0	42.0	9.2	14.6	1245.0
Average			111.0	73.3	12.9	18.1	1640.7

APPENDIX – 4b (Cont'd)

AMBIENT AIR QUALITY MONITORING REPORT FOR POST-MONSOON-2006

Monitoring Location : Tragadi							
Sr.	**Date of**	**Week**	**Ground Level Concentration**				
No.	**Monitoring**		**SPM**	**RPM**	**SO_2**	**NO_X**	CO
			$\mu g/m^3$	**$\mu g/m^3$**	**$\mu g/m^3$**	**$\mu g/m^3$**	**$\mu g/m^3$**
1	05/10/2006	I	118	68	12.4	18.2	1620.0
2	12/10/2006	II	98	54	10.2	15.9	1489.0
3	19/10/2006	III	124	72	14.6	20.4	1562.0
4	26/10/2006	IV	110	60	11.4	16.8	1382.0
1	01/11/2006	I	122	84	13.4	18.4	1847
2	08/11/2006	II	94	56	10.8	14.9	1542
3	16/11/2006	III	110	62	12.9	15.8	1624
4	24/11/2006	IV	82	52	11.4	14.3	1289
Maximum			124.0	84.0	14.6	20.4	1847.0
Minimum			82.0	52.0	10.2	14.3	1289.0
Average			107.3	63.5	12.1	16.8	1544.4

APPENDIX – 4b (Cont'd)

AMBIENT AIR QUALITY MONITORING REPORT FOR POST-MONSOON-2006

Monitoring Location : Pipari							
Sr.	Date of	Week	Ground Level Concentration				
No.	Monitoring		SPM	RPM	SO_2	NO_X	CO
			μg/m³	μg/m³	μg/m³	μg/m³	μg/m³
1	05/10/2006	I	112	82	10.8	16.8	1620.0
2	12/10/2006	II	94	64	8.6	12.2	1478.0
3	19/10/2006	III	86	48	11.9	14.8	1569.0
4	26/10/2006	IV	110	78	9.2	13.8	1520.0
1	02/11/2006	I	116	88	14.6	19.4	1654
2	09/11/2006	II	86	54	10.4	15.4	1845
3	17/11/2006	III	110	80	16.2	21.2	1624
4	25/11/2006	IV	92	62	9.9	12.8	1463
Maximum			116.0	88.0	16.2	21.2	1845.0
Minimum			86.0	48.0	8.6	12.2	1463.0
Average			100.8	69.5	11.5	15.8	1596.6

APPENDIX – 4b (Cont'd)

AMBIENT AIR QUALITY MONITORING REPORT FOR POST-MONSOON-2006

Monitoring Location : Bidada							
Sr.	Date of	Week	Ground Level Concentration				
No.	Monitoring		SPM	RPM	SO_2	NO_X	CO
			$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$
1	06/10/2006	I	142	94	15.2	21.6	1842
2	13/10/2006	II	98	58	12.6	15.2	1524
3	20/10/2006	III	122	82	13.8	18.9	1674
4	27/10/2006	IV	86	52	14.4	20.2	1489
1	02/11/2006	I	132.0	88.0	16.8	22.1	1684.0
2	09/11/2006	II	86.0	56.0	12.5	18.2	1520.0
3	17/11/2006	III	126.0	74.0	14.6	19.6	1826.0
4	25/11/2006	IV	114.0	64.0	11.9	14.8	1584.0
Maximum			142.0	94.0	16.8	22.1	1842.0
Minimum			86.0	52.0	11.9	14.8	1489.0
Average			113.3	71.0	14.0	18.8	1642.9

APPENDIX – 4b (Cont'd)

AMBIENT AIR QUALITY MONITORING REPORT FOR POST-MONSOON-2006

Monitoring Location : Kandagra							
Sr.	**Date of**	**Week**	**Ground Level Concentration**				
No.	**Monitoring**		**SPM**	**RPM**	**SO_2**	**NO_X**	CO
			µg/m³	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**
1	06/10/2006	I	124	82	11.8	18.4	1489.0
2	13/10/2006	II	86	46	9.9	15.2	1642.0
3	20/10/2006	III	112	76	12.2	16.2	1542.0
4	27/10/2006	IV	98	54	8.4	13.5	1368.0
1	01/11/2006	I	110	82	12.4	16.9	1754.0
2	08/11/2006	I	128	92	10.6	14.2	1452.0
3	16/11/2006	II	114	84	14.6	21.6	1946.0
4	24/11/2006	III	94	52	9.4	15.8	1389.0
Maximum			128.0	92.0	14.6	21.6	1946.0
Minimum			86.0	46.0	8.4	13.5	1368.0
Average			108.3	71.0	11.2	16.5	1572.8

APPENDIX – 4c

AMBIENT AIR QUALITY MONITORING REPORT FOR WINTER-2006

Monitoring Location : TUNDA VILLAGE							
Sr. No.	Date of Monitoring	Week	Ground Level Concentration				
			SPM	RPM	SO_2	NO_X	CO
			μg/m³	μg/m³	μg/m³	μg/m³	μg/m³
1	1/12/2006	I	112	73	10.8	13.6	1695
2	6/12/2006	I	95	66	9.5	12.8	1423
3	9/12/2006	II	97	60	9.9	14.1	1124
4	14-12-2006	II	92	58	11.2	15.6	1234
5	18-12-2006	III	118	75	10.5	12.4	1462
6	22-12-2006	III	112	77	9.8	14.2	1602
7	25-12-2006	IV	91	60	8.4	17.2	1265
8	29-12-2006	IV	90	57	9.6	15.5	1132
9	1/1/2007	I	126	82	13.2	20.1	1765
10	5/1/2007	I	112	58	10.3	14.2	1467
11	8/1/2007	II	106	55	11.4	16.5	1578
12	12/1/2007	II	92	52	9.2	12.3	1326
13	15-01-2007	III	115	62	12.2	16.7	1574
14	19-01-2007	III	89	48	10.1	12.2	1432
15	22-01-2007	IV	129	85	11.4	15.4	1798
16	26-01-2007	IV	121	66	9.7	13.4	1524
17	1/2/2007	I	124	75	13.8	17.4	1689
18	6/2/2007	I	110	56	12.4	18.5	1452
19	8/2/2007	II	98	54	9.8	15.2	1541
20	13-02-2007	II	90	50	9.2	12.6	1365
21	15-02-2007	III	112	66	13.4	16.4	1481
22	20-02-2007	III	88	52	10.2	12.5	1524
23	22-02-2007	IV	126	74	14.3	18.2	1692
24	27-02-2007	IV	118	63	11.2	13.6	1620
Maximum			129.0	85.0	14.3	20.1	1798.0
Minimum			88.0	48.0	8.4	12.2	1124.0
Average			106.8	63.5	10.9	15.0	1490.2
98% Perc. of Max.			126.4	83.3	14.0	19.7	1762.0

APPENDIX – 4c (Cont'd)

AMBIENT AIR QUALITY MONITORING REPORT FOR WINTER-2006

Monitoring Location : JALPARA							
Sr. No.	Date of Monitoring	Week	Ground Level Concentration				
			SPM	RPM	SO_2	NO_X	CO
			µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
1	2/12/2006	I	123	76	10.1	18.6	1523
2	7/12/2006	I	120	71	11.6	15.7	1365
3	11/12/2006	II	95	60	9.2	14.9	1796
4	15-12-2006	II	114	66	10.4	14.2	1545
5	19-12-2006	III	118	73	12.6	15.3	1687
6	23-12-2006	III	115	70	11.3	16.2	1486
7	26-12-2006	IV	92	58	8.8	17.6	1657
8	30-12-2006	IV	97	69	12.6	14.2	1516
9	2/1/2007	I	125	72	12.9	18.9	1689
10	6/1/2007	I	121	66	12.4	17.5	1512
11	9/1/2007	II	110	70	15.7	20.1	1689
12	13-01-2007	II	96	58	12.4	16.3	1485
13	16-01-2007	III	135	82	15.2.	18.7	1572
14	20-01-2007	III	128	72	11.4	15.6	1592
15	23-01-2007	IV	111	64	14.8	18.6	1786
16	27-01-2007	IV	92	52	10.3	14.5	1319
17	2/2/2007	I	121	76	14.3	17.6	1576
18	7/2/2007	I	117	72	13.6	16.4	1432
19	9/2/2007	II	106	58	15.8	21.3	1642
20	14-02-2007	II	94	64	12.6	15.8	1423
21	16-02-2007	III	138	84	14.5	18.5	1572
22	21-02-2007	III	120	88	12.2	15.2	1534
23	23-02-2007	IV	110	72	13.2	20.1	1872
24	28-02-2007	IV	87	66	10.2	14.2	1298
Maximum			138.0	88.0	15.8	21.3	1872.0
Minimum			87.0	52.0	8.8	14.2	1298.0
Average			111.9	69.1	12.3	16.9	1565.3
98% Perc. of Max.			135.2	86.2	15.5	20.9	1834.6

APPENDIX – 4c (Cont'd)

AMBIENT AIR QUALITY MONITORING REPORT FOR WINTER-2006

Monitoring Location : DESALPAR							
Sr. No.	Date of Monitoring	Week	Ground Level Concentration				
			SPM	RPM	SO_2	NO_X	CO
			μg/m³	μg/m³	μg/m³	μg/m³	μg/m³
1	1/12/2006	I	124	76	13.8	20.3	1685
2	6/12/2006	I	120	66	12.2	15.8	1523
3	9/12/2006	II	112	64	12.5	17.3	1825
4	14-12-2006	II	95	62	11.3	13.8	1672
5	18-12-2006	III	92	58	10.2	14.2	1423
6	22-12-2006	III	110	66	10.5	14.6	1489
7	25-12-2006	IV	128	82	14.2	17.5	1576
8	29-12-2006	IV	124	70	12.6	16.4	1685
9	1/1/2007	I	118	81	15.2	18.7	1653
10	5/1/2007	I	96	66	12.6	19.3	1532
11	8/1/2007	II	126	83	11.5	18.3	1859
12	12/1/2007	II	114	74	10.3	14.5	1765
13	15-01-2007	III	139	93	14.6	15.8	1533
14	19-01-2007	III	128	80	14.3	15.5	1524
15	22-01-2007	IV	132	89	11.3	13.2	1796
16	26-01-2007	IV	116	74	10.2	12.9	1466
17	1/2/2007	I	120	78	14.9	21.1	1542
18	6/2/2007	I	97	65	13.1	19.5	1486
19	08-022007	II	123	76	12.1	18.4	1624
20	13-02-2007	II	115	73	10.5	16.2	1356
21	15-02-2007	III	128	81	13.9	15.5	1475
22	20-02-2007	III	127	78	14.4	14.6	1513
23	22-02-2007	IV	126	75	11.6	13.4	1624
24	27-02-2007	IV	121	73	9.6	12.6	1416
Maximum			139.0	93.0	15.2	21.1	1859.0
Minimum			92.0	58.0	9.6	12.6	1356.0
Average			118.0	74.3	12.4	16.2	1585.1
98% Perc. of Max.			136.2	91.1	14.9	20.7	1821.8

APPENDIX – 4c (Cont'd)

AMBIENT AIR QUALITY MONITORING REPORT FOR WINTER-2006

Monitoring Location : Mota Bhojapur							
Sr. No.	**Date of Monitoring**	**Week**	**Ground Level Concentration**				
			SPM	**RPM**	**SO_2**	**NO_X**	CO
			µg/m³	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**
1	2/12/2006	I	137	94	12.4	17.6	1598
2	7/12/2006	I	114	66	12.2	17.2	1572
3	11/12/2006	II	110	74	10.6	16.6	1789
4	15-12-2006	II	92	56	9.5	15.5	1652
5	19-12-2006	III	134	76	14.8	17.9	1679
6	23-12-2006	III	98	60	12.4	16.4	1545
7	26-12-2006	IV	92	59	13.6	15.8	1648
8	30-12-2006	IV	88	48	12.5	14.9	1476
9	2/1/2007	I	132	84	15.6	20.3	1691
10	6/1/2007	I	112	64	11.2	15.1	1793
11	9/1/2007	II	121	78	14.8	17.8	1521
12	13-01-2007	II	90	58	13.4	16.9	1365
13	16-01-2007	III	118	72	16.8	21.2	1867
14	20-01-2007	III	103	58	11.6	15.9	1587
15	23-01-2007	IV	119	70	15.2	18.6	1820
16	27-01-2007	IV	116	62	13.2	16.2	1345
17	2/2/2007	I	131	81	10.9	18.6	1685
18	7/2/2007	I	126	72	13.5	15.6	1598
19	9/2/2007	II	118	77	12.6	16.8	1483
20	14-02-2007	II	91	55	11.5	17.2	1372
21	16-02-2007	III	114	66	13.2	20.1	1756
22	21-02-2007	III	108	62	12.8	16.2	1564
23	23-02-2007	IV	120	72	11.6	17.7	1682
24	28-02-2007	IV	112	58	10.5	16.7	1277
Maximum			137.0	94.0	16.8	21.2	1867.0
Minimum			88.0	48.0	9.5	14.9	1277.0
Average			112.3	67.6	12.8	17.2	1598.5
98% Perc. of Max.			134.3	92.1	16.5	20.8	1829.7

APPENDIX – 4c (Cont'd)

AMBIENT AIR QUALITY MONITORING REPORT FOR WINTER-2006

Monitoring Location : Tragadi							
Sr. No.	Date of Monitoring	Week	Ground Level Concentration				
			SPM	RPM	SO_2	NO_X	CO
			$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$
1	4/12/2006	I	110	64	9.6	12.2	1598
2	12/12/2006	II	98	58	10.5	14.8	1476
3	20-12-2006	III	118	68	11.2	16.4	1622
4	27-12-2006	IV	92	52	8.9	12.8	1485
5	3/1/2007	I	124	72	10.6	13.9	1795
6	10/1/2007	II	102	58	11.2	15.6	1536
7	17-01-2007	III	112	68	9.5	12.6	1599
8	24-01-2007	IV	93	62	10.8	13.2	1362
9	3/2/2007	I	120	72	9.8	11.9	1697
10	10/2/2007	II	110	62	11.3	14.5	1542
11	17-02-2007	III	117	68	12.6	16.2	1576
12	24-02-2007	IV	98	58	10.2	12.8	1485
Maximum			124.0	72.0	12.6	16.4	1795.0
Minimum			92.0	52.0	8.9	11.9	1362.0
Average			107.8	63.5	10.5	13.9	1564.4
98% Perc. of Max.			121.5	70.6	12.3	16.1	1759.1

APPENDIX – 4c (Cont'd)

AMBIENT AIR QUALITY MONITORING REPORT FOR WINTER-2006

Monitoring Location : Pipari							
Sr. No.	Date of Monitoring	Week	Ground Level Concentration				
			SPM	RPM	SO_2	NO_X	CO
			μg/m³	μg/m³	μg/m³	μg/m³	μg/m³
1	5/12/2006	I	110	68	11.2	16.5	1590
2	13-12-2006	II	92	46	10.1	13.2	1624
3	21-12-2006	III	94	48	11.6	14.2	1546
4	28-12-2006	IV	112	64	9.6	14.8	1475
5	4/1/2007	I	123	76	9.6	12.6	1662
6	11/1/2007	II	110	59	10.4	15.6	1843
7	18-01-2007	III	117	78	11.4	16.3	1596
8	25-01-2007	IV	108	65	8.9	11.8	1472
9	5/2/2007	I	118	68	9.5	17.9	1598
10	12/2/2007	II	111	62	12.3	15.8	1756
11	19-02-2007	III	112	58	10.8	14.5	1598
12	26-02-2007	IV	110	60	11.4	12.6	1523
Maximum			123.0	78.0	12.3	17.9	1843.0
Minimum			92.0	46.0	8.9	11.8	1472.0
Average			109.8	62.7	10.6	14.7	1606.9
98% Perc. of Max.			120.5	76.4	12.1	17.5	1806.1

APPENDIX – 4c(Cont'd)

AMBIENT AIR QUALITY MONITORING REPORT FOR WINTER-2006

Monitoring Location : Bidada							
Sr. No.	Date of Monitoring	Week	Ground Level Concentration				
			SPM	RPM	SO_2	NO_X	CO
			μg/m³	μg/m³	μg/m³	μg/m³	μg/m³
1	5/12/2006	I	136	75	11.6	16.4	1756
2	13-12-2006	II	102	61	13.2	18.5	1534
3	21-12-2006	III	126	73	12.4	15.3	1620
4	28-12-2006	IV	89	64	10.9	13.5	1476
5	4/1/2007	I	126	82	15.8	20.8	1689
6	11/1/2007	II	93	61	13.2	16.5	1524
7	18-01-2007	III	121	70	14.2	18.7	1836
8	25-01-2007	IV	116	68	12.1	15.6	1589
9	5/2/2007	I	124	72	14.9	18.6	1598
10	12/2/2007	II	95	62	13.6	16.9	1575
11	19-02-2007	III	117	68	14.5	17.4	1725
12	26-02-2007	IV	118	66	12.8	16.5	1488
Maximum			136.0	82.0	15.8	20.8	1836.0
Minimum			89.0	61.0	10.9	13.5	1476.0
Average			113.6	68.5	13.3	17.1	1617.5
98% Perc. of Max.			133.3	80.4	15.5	20.4	1799.3

APPENDIX – 4c (Cont'd)

AMBIENT AIR QUALITY MONITORING REPORT FOR WINTER-2006

Monitoring Location : Kandagra							
Sr. No.	Date of Monitoring	Week	Ground Level Concentration				
			SPM	RPM	SO_2	NO_X	CO
			$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$
1	4/12/2006	I	128	78	11.6	16.4	1475
2	12/12/2006	II	89	56	10.2	15.3	1624
3	20-12-2006	III	110	72	12.4	15.8	1573
4	27-12-2006	IV	103	60	9.6	14.2	1352
5	3/1/2007	I	114	64	9.2	12.8	1759
6	10/1/2007	I	123	72	11.4	14.8	1456
7	17-01-2007	II	115	68	12.8	17.6	1893
8	24-01-2007	III	99	52	9.9	15.8	1423
9	3/2/2007	I	112	62	10.5	12.5	1657
10	10/2/2007	I	118	74	11.6	15.7	1485
11	17-02-2007	II	116	70	10.8	13.2	1712
12	24-02-2007	III	106	58	12.3	17.2	1464
Maximum			128.0	78.0	12.8	17.6	1893.0
Minimum			89.0	52.0	9.2	12.5	1352.0
Average			111.1	65.5	11.0	15.1	1572.8
98% Perc. of Max.			125.4	76.4	12.5	17.2	1855.1

APPENDIX –12
LANDUSE PATTERN OF THE STUDY AREA (In Hectare)

Village Name	*Total Irrigated Area*	*Un-Irrigated Area*	*Culturable waste*	*Area not under cultivation*
Mandvi Taluka				
Faradi	1327.5	1756.6	1929.7	856.32
Bidada	1161.9	1005.7	543.25	48.18
Nani Khakhar	545.5	212.1	139.15	85.09
Nana Bhadiya	82.6	1134.3	88.45	547.95
Pipari	62.7	301.9	72.62	19.02
Maska	464.6	357.3	208.94	362.22
Bag	801.0	0.0	0.00	12.96
Gundiyali	1227.6	1122.1	208.00	127.62
Mota Bhadiya	194.1	180.0	41.94	20.77
Tragadi	68.3	414.8	246.41	727.46
Mundra Taluka				
Deshalpar	809	920	379	822
Khakhar Moti	293.40	669.4	202.55	85.43
Kandagara Mota	153.8	1118.6	278.39	534.15
Tunda	30.4	403.20	266.51	614.24
Shiracha	80.9	613.5	301.01	554.50
Moti Bhujpar	127.5	2263.6	394.09	513.15
Pratappar	57.9	122.9	57.77	104.97
Nani Bhujpar	80.94	266.30	57.90	35.84
Navinal	121.41	439.90	176.37	55.40
Jarpara	1416.5	177.40	1238.33	359.12
Sukhpar	NA	NA	NA	NA

APPENDIX - 7

GROUND WATER SAMPLING AT VILLAGE DESALPAR

GROUND WATER SAMPLING AT VILLAGE KANDAGARA

APPENDIX – 7a

Ground Water Quality In The Study Area During March 2006

No.	Parameter	Maska	Desalpar	Nana Bhadiya	Mota-Bhojpur	Navinal	Kandagra	Jalpara
1	pH Value	7.6	7.3	7.45	7.14	7.33	7.41	7.84
2	Temperature OC	25	24	23	24	24	22	23
3	Turbidity, NTU	<5	<5	<5	<5	<5	<5	<5
4	Dissolved Oxygen, mg/l	3.2	3.1	3	3.6	3.7	3.1	3.2
5	Suspended Solids,mg/l	<5	<5	<5	<5	<5	<5	<5
6	Conductivity mho	4760	1410	566	852	969	796	2106
7	Dissolved Solids, mg/l	3036	870	335	535	598	480	1273
8	Total Hardness (as $CaCO_3$), mg/l	1079.1	130.6	32.6	235.6	141.5	35.6	1256.8
9	Alikalinity , mg/l	52.9	65.5	102.3	55.2	58.6	72.4	37.9
10	BOD 5Day @20 ^{0}C	13.6	4.4	3.5	5.4	4.1	3.3	8.0
11	COD mg/l	48.3	14.3	12.4	18.4	14.3	11.6	25.6
12	Nitrate (as NO_3), mg/l	0.813	0.421	0.311	0.311	0.289	0.306	519
13	Total Phosphorous, mg/l	0.3	0.4	0.6	1.5	0.5	0.8	1
14	Chloiride (as Cl), mg/	2340.7	533.5	71.9	293.9	333.2	264.7	518.5
15	Sulphate (as SO_4), mg/l	64	43.5	32	28	31	27	63
16	Sodium,mg/l	255	208	143	82.2	148.8	120.8	260
17	Potassium, mg/l	5.178	4.048	3.195	4.67	3.463	3.767	5.21
18	Calcium(as Ca), mg/l	166.5	20.6	5.9	47.9	27.3	5.9	229.9
19	Magnesium (as Mg), mg/l	161.1	19.2	4.3	28.1	17.7	5.1	165.8
20	Silica , mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
21	Oil &Greasemg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL

No.	Parameter	Maska	Desalpar	Nana Bhadiya	Mota-Bhojpur	Navinal	Kandagra	Jalpara
22	Phenol(as C6H6OH), mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
23	Fluoride (as F), mg/l	0.645	0.514	0.887	1.087	0.135	0.87	ND
24	Salinity, mg/l	14	BDL	BDL	BDL	BDL	BDL	BDL
25	Total Nitrogen, mg/l	1.21	0.483	0.369	0.392	0.299	0.348	0.569
26	Iron (as Fe) mg/l	0.556	0.102	0.273	0.393	0.383	0.265	0.475
27	Cooper (as Cu) mg/l	0.034	0.027	0.018	0.012	0.009	BDL	0.002
28	Zinc (as Zn) mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
29	Lead (as Pb), mg/l	0.02	0.026	0.023	0.01	0.053	0.033	0.041
30	Cadmium (as Cd), mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
31	Total Cr , mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
32	Chromium (as Cr+6) mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
33	Arsenic (as As), mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
34	Mercury (as Hg) mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
35	Selenium (as Se) mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
36	Total Coliforms, Nos. / 100 ml	14	0	0	0	0	0	0
37	Faecal Coliforms, Nos. / 100 ml	0	0	0	0	0	0	0
BDL : Below Detection Limit.								

APPENDIX – 7b

Ground Water Quality In The Study Area During April 2006

No.	Parameter	Maska	Desalpar	Nana Bhadiya	Mota-Bhojpur	Navinal	Kandagra	Jalpara
1	pH Value	7.4	7.2	7.3	7	7.4	7.5	7.6
2	Temperature OC	26	25	25	25	26	25	25
3	Turbidity, NTU	<5	<5	<5	<5	<5	<5	<5
4	Dissolved Oxygen, mg/l	3	2.9	2.9	3.5	3.5	3	3.1
5	Suspended Solids,mg/l	<5	<5	<5	<5	<5	<5	<5
6	Conductivity mho	4857	1460	582	883	977	861	2189
7	Dissolved Solids, mg/l	3917	1067	365	549	706	554	1317
8	Total Hardness (as $CaCO_3$), mg/l	1132	136.6	35.1	246.8	147.2	36.9	1304
9	Alikalinity , mg/l	63.8	72.3	98.6	59.3	62.4	77.5	42.6
10	BOD 5Day @20 ^{0}C	13.8	4.2	3.8	5.6	4.3	3.4	12.3
11	COD mg/l	49.2	14.5	12.6	18.8	14.8	11.9	26.9
12	Nitrate (as NO_3), mg/l	0.829	0.410	0.326	0.320	0.296	0.289	0.818
13	Total Phosphorous, mg/l	0.312	0.418	0.623	1.9	0.61	0.76	1.7
14	Chloiride (as Cl), mg/	2391	561	75.6	281.3	341.3	278	526.3
15	Sulphate (as SO_4), mg/l	69	46.8	36	35	26	35	57.4
16	Sodium,mg/l	273	213	151	87.4	136.3	131.2	271.6
17	Potassium, mg/l	6.112	5.112	3.203	5.1	3.213	3.891	5.43
18	Calcium(as Ca), mg/l	176	22.4	6.5	50.3	28.6	6.3	236.3
19	Magnesium (as Mg), mg/l	168	19.6	4.6	29.4	18.4	5.8	173.4
20	Silica , mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
21	Oil &Greasemg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL

No.	Parameter	Maska	Desalpar	Nana Bhadiya	Mota-Bhojpur	Navinal	Kandagra	Jalpara
22	Phenol(as C6H6OH), mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
23	Fluoride (as F), mg/l	0.612	0.561	0.761	0.913	0.189	0.983	0.126
24	Salinity, mg/l	17	BDL	BDL	BDL	BDL	BDL	BDL
25	Total Nitrogen, mg/l	1.09	0.471	0.381	0.379	0.301	0.358	0.580
26	Iron (as Fe) mg/l	0.313	0.116	0.216	0.318	0.261	0.281	0.022
27	Cooper (as Cu) mg/l	0.039	0.032	0.022	0.029	0.013	BDL	0.011
28	Zinc (as Zn) mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
29	Lead (as Pb), mg/l	0.03	0.038	0.029	BDL	BDL	0.021	0.062
30	Cadmium (as Cd), mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
31	Total Cr , mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
32	Chromium (as Cr+6) mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
33	Arsenic (as As), mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
34	Mercury (as Hg) mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
35	Selenium (as Se) mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
36	Total Coliforms, Nos. / 100 ml	0	0	0	0	0	0	0
37	Faecal Coliforms, Nos. / 100 ml	0	0	0	0	0	0	0

BDL : Below Detection Limit.

APPENDIX – 7c

Ground Water Quality In The Study Area During May 2006

No.	Parameter	Maska	Desalpar	Nana Bhadiya	Mota-Bhojpur	Navinal	Kandagra	Jalpara
1	pH Value	7.5	7.4	7.2	7.2	7.5	7.3	7.7
2	Temperature OC	27	26	24	26	24	25	26
3	Turbidity, NTU	<5	<5	<5	<5	<5	<5	<5
4	Dissolved Oxygen, mg/l	2.9	3	3.2	3.3	3.6	3.2	3
5	Suspended Solids,mg/l	<5	<5	<5	<5	<5	<5	<5
6	Conductivity mho	4901	1435	594	826	976	812	2009
7	Dissolved Solids, mg/l	3091	894	349	561	642	527	1298
8	Total Hardness (as CaCO3), mg/l	859	150	30.8	269.3	163.5	42.75	1289.6
9	Alikalinity , mg/l	58.6	78.4	116.8	66.3	66.9	83.4	48.4
10	BOD 5Day @20 ^{0}C	13.4	4.5	3.7	5.8	4.2	3.6	12.9
11	COD mg/l	48.8	14.4	12.7	18.7	14.6	12	27.4
12	Nitrate (as NO3), mg/l	0.838	0.429	0.339	0.331	0.273	0.296	0.714
13	Total Phosphorous, mg/l	0.341	0.426	0.609	2.1	0.58	0.84	1.4
14	Chloiride (as Cl), mg/	2378	549	69.3	286.4	350.6	284	542.4
15	Sulphate (as SO4), mg/l	76	55.4	43	42	35	25	69
16	Sodium,mg/l	266	236	141	81.6	152.6	142	284
17	Potassium, mg/l	5.813	4.569	3.216	4.8	3.316	3.798	6.9
18	Calcium(as Ca), mg/l	138	25.6	5.6	57.4	30.2	6.9	215.6
19	Magnesium (as Mg), mg/l	125	20.8	4.1	30.6	21.4	6.2	150
20	Silica , mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
21	Oil &Greasemg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL

No.	Parameter	Maska	Desalpar	Nana Bhadiya	Mota-Bhojpur	Navinal	Kandagra	Jalpara
22	Phenol(as C6H6OH), mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
23	Fluoride (as F), mg/l	0.638	0.543	0.396	0.987	0.163	1.054	0.086
24	Salinity, mg/l	15	BDL	BDL	BDL	BDL	BDL	BDL
25	Total Nitrogen, mg/l	1.17	0.498	0.806	0.386	0.286	0.371	0.591
26	Iron (as Fe) mg/l	0.349	0.130	0.031	0.362	0.376	0.772	0.671
27	Cooper (as Cu) mg/l	0.045	0.036	0.013	0.021	0.019	0.028	0.017
28	Zinc (as Zn) mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
29	Lead (as Pb), mg/l	BDL	0.061	0.022	BDL	BDL	BDL	0.051
30	Cadmium (as Cd), mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
31	Total Cr , mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
32	Chromium (as Cr+6) mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
33	Arsenic (as As), mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
34	Mercury (as Hg) mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
35	Selenium (as Se) mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
36	Total Coliforms, Nos. / 100 ml	0	0	0	0	0	0	0
37	Faecal Coliforms, Nos. / 100 ml	0	0	0	0	0	0	0
BDL : Below Detection Limit.								

APPENDIX – 7d

Ground Water Quality In The Study Area During June 2006

Sl. No.	Parameters	Units	Location						
			Maska	Desalpar	Nana Bhadiya	Mota-Bhojpur	Navinal	Kandagra	Jalpara
1	pH Value		7.3	7.6	7.4	7.4	7.2	7.4	7.5
2	Temperature	^0C	25	24	24	24	23	24	25
3	Turbidity	NTU	< 5	< 5	< 5	< 5	< 5	< 5	< 5
4	Dissolved Oxygen	mg/l	2.6	2.5	2.8	3.1	3.4	3.0	2.9
5	Suspended Solids	mg/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5
6	Conductivity	mho	4867.0	1489	644.0	990.0	1040.0	935.0	2098
7	Dissolved Solids	mg/l	3018	908	356	586	670	556	1295.0
8	Total Hardness (as $CaCO_3$)	mg/l	713.0	161.7	36.9	279.0	186.9	47.4	1031
9	Alkalinity	mg/l	51.6	71.3	123.8	75.6	60.8	89.6	53.6
10	BOD_5 @20 ^0C	mg/l	12.8	4.8	2.8	6.0	4.4	3.7	13.0
11	COD	mg/l	45.3	15.6	13.4	19.6	15.1	12.8	28.9
12	Nitrate (as NO_3)	mg/l	0.545	0.235	0.245	0.203	0.149	0.195	0.212
13	Total Phosphorous	mg/l	0.365	0.411	0.563	1.96	0.65	0.76	1.21
14	Chloride (as Cl)	mg/l	1148	516	75.6	298.2	361.3	295	553
15	Sulphate (as SO_4)	mg/l	68	58.3	38	53	39	32	75
16	Sodium (Na)	mg/l	278	189	152	89.9	165.3	151	295
17	Potassium (K)	mg/l	5.906	4.611	3.332	5.6	3.523	3.916	7.4
18	Calcium(as Ca)	mg/l	116	27.5	6.9	65.1	35.6	8.1	189
19	Magnesium (as mg)	mg/l	103	22.6	4.8	28.3	23.8	6.6	136
20	Silica	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL

Sl. No.	Parameters	Units	Location						
			Maska	Desalpar	Nana Bhadiya	Mota-Bhojpur	Navinal	Kandagra	Jalpara
21	Oil &Grease	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
22	Phenol(as C_6H_6OH)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
23	Fluoride (as F)	mg/l	0.576	0.516	0.369	0.816	0.181	0.966	0.102
24	Total Nitrogen	mg/l	1.09	0.465	0.486	0.394	0.292	0.382	0.416
25	Iron (as Fe)	mg/l	0.316	0.141	0.042	0.183	0.385	0.168	0.684
26	Copper (as Cu)	mg/l	0.052	0.042	0.021	0.031	0.026	0.011	0.028
27	Zinc (as Zn)	mg/l	0.018	0.021	0.016	0.018	0.021	0.024	0.011
28	Lead (as Pb)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
29	Cadmium (as Cd)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
30	Total Cr	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
31	Arsenic (as As)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
32	Mercury (as Hg)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
33	Selenium (as Se)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
34	Total Coliforms	Nos. / 100 ml	0	0	0	0	0	0	0

Note: BDL : Below Detectable Limit

APPENDIX – 7e

Ground Water Quality In The Study Area During July 2006

Sl. No.	Parameters	Units	Location						
			Maska	Desalpar	Nana Bhadiya	Mota-Bhojpur	Navinal	Kandagra	Jalpara
1	pH Value		7.4	7.5	7.2	7.3	7.5	7.2	7.4
2	Temperature	^0C	24	22	23	23	22	23	24
3	Turbidity	NTU	< 5	< 5	< 5	< 5	< 5	< 5	< 5
4	Dissolved Oxygen	mg/l	2.4	2.2	2.9	2.9	3.1	2.9	2.7
5	Suspended Solids	mg/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5
6	Conductivity	mho	4645	1312	685	830	1070	900	1930
7	Dissolved Solids	mg/l	2893	892	382	550	650	530	1190
8	Total Hardness (as $CaCO_3$)	mg/l	778.2	157.9	47.5	246.0	164.2	52.1	929.5
9	Alkalinity	mg/l	56.3	65.1	109.8	68.6	71.3	85.3	49.3
10	BOD_5 @20 ^0C	mg/l	12.4	4.2	2.6	5.8	4.6	3.5	12.7
11	COD	mg/l	42.3	14.3	13	18.2	15.5	12.7	26.5
12	Nitrate (as NO_3)	mg/l	0.462	0.228	0.228	0.189	0.161	0.187	0.218
13	Total Phosphorous	mg/l	0.352	0.396	0.516	1.79	0.49	0.616	1.09
14	Chloride (as Cl)	mg/l	1062	578	86.3	281.3	348.6	279	519
15	Sulphate (as SO_4)	mg/l	59	51.6	45	49	46	39	64
16	Sodium (Na)	mg/l	259	165	163	74.3	150.6	136	268
17	Potassium (K)	mg/l	5.116	4.589	3.362	5.1	3.486	3.811	7.1
18	Calcium(as Ca)	mg/l	122	29.6	10.1	58.3	31.8	10.5	176
19	Magnesium (as mg)	mg/l	115	20.4	5.4	24.4	20.6	6.3	119
20	Silica	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL

Sl. No.	Parameters	Units	Location						
			Maska	Desalpar	Nana Bhadiya	Mota-Bhojpur	Navinal	Kandagra	Jalpara
21	Oil &Grease	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
22	Phenol(as C_6H_6OH)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
23	Fluoride (as F)	mg/l	0.589	0.498	0.351	0.785	0.196	0.881	0.135
24	Total Nitrogen	mg/l	0.916	0.45	0.451	0.376	0.316	0.369	0.433
25	Iron (as Fe)	mg/l	0.308	0.156	0.049	0.169	0.391	0.216	0.661
26	Copper (as Cu)	mg/l	0.059	0.05	0.028	0.025	0.032	0.019	0.035
27	Zinc (as Zn)	mg/l	0.024	0.019	0.021	0.011	0.016	0.01	0.019
28	Lead (as Pb)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
29	Cadmium (as Cd)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
30	Total Cr	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
31	Arsenic (as As)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
32	Mercury (as Hg)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
33	Selenium (as Se)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
34	Total Coliforms	Nos. / 100 ml	9	0	0	0	0	0	0

Note: BDL : Below Detectable Limit

APPENDIX – 7f

Ground Water Quality In The Study Area During August 2006

Sl. No.	Parameters	Units	Location						
			Maska	Desalpar	Nana Bhadiya	Mota-Bhojpur	Navinal	Kandagra	Jalpara
1	pH Value		7.3	7.4	7.2	7.4	7.4	7.3	7.2
2	Temperature	^0C	24	23	24	23	23	23	23
3	Turbidity	NTU	< 5	< 5	< 5	< 5	< 5	< 5	< 5
4	Dissolved Oxygen	mg/l	2.9	2.8	2.9	3	3.2	3.2	3.1
5	Suspended Solids	mg/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5
6	Conductivity	mho	3239	2418	1132	1225	1234	1253	2045
7	Dissolved Solids	mg/l	1963	1499	723	701	715.2	731.2	1232
8	Total Hardness (as $CaCO_3$)	mg/l	1284	152	59.5	263.4	148.6	89.4	751.3
9	Alkalinity	mg/l	192	89	215.3	160.3	136.7	131.4	126
10	BOD_5 @20 ^0C	mg/l	12.1	3.8	2.8	5.4	4.4	3.4	10.1
11	COD	mg/l	41.6	13.4	12.6	17.8	15.1	13.1	25.6
12	Nitrate (as NO_3)	mg/l	0.168	0.187	0.126	0.118	0.181	0.226	0.283
13	Total Phosphorous	mg/l	2.71	0.938	0.879	1.94	0.781	0.862	1.42
14	Chloride (as Cl)	mg/l	1085	543	130.2	296.5	301	316	489
15	Sulphate (as SO_4)	mg/l	128	62	46	45	37	40.2	73
16	Sodium (Na)	mg/l	218	760	288	165.7	236	256	334
17	Potassium (K)	mg/l	5.387	4.824	3.465	4.39	3.492	3.512	5.085
18	Calcium(as Ca)	mg/l	214	28.1	10.3	55.8	29	17.6	151.8
19	Magnesium (as mg)	mg/l	179	18.9	7.8	29.9	18.1	10.4	94.6
20	Silica	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL

Sl. No.	Parameters	Units	Location						
			Maska	Desalpar	Nana Bhadiya	Mota-Bhojpur	Navinal	Kandagra	Jalpara
21	Oil &Grease	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
22	Phenol(as C_6H_6OH)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
23	Fluoride (as F)	mg/l	0.72	0.878	0.829	0.982	0.865	1.128	0.462
24	Total Nitrogen	mg/l	0.931	0.416	0.351	0.361	0.313	0.337	0.428
25	Iron (as Fe)	mg/l	0.786	0.811	0.481	0.418	0.721	0.578	0.758
26	Copper (as Cu)	mg/l	0.039	0.012	0.026	0.023	0.027	BDL	0.027
27	Zinc (as Zn)	mg/l	0.045	0.067	0.028	0.0113	0.012	0.065	0.038
28	Lead (as Pb)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
29	Cadmium (as Cd)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
30	Total Cr	mg/l	0.062	0.073	0.038	0.031	0.019	0.032	0.021
31	Arsenic (as As)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
32	Mercury (as Hg)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
33	Selenium (as Se)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
34	Total Coliforms	Nos. / 100 ml	3	2	2	2	3	2	1

Note: BDL : Below Detectable Limit

APPENDIX – 7g

Ground Water Quality In The Study Area During September 2006

Sl. No.	Parameters	Units	Location						
			Maska	Desalpar	Nana Bhadiya	Mota-Bhojpur	Navinal	Kandagra	Jalpara
1	pH Value		7.3	7.4	7.3	7.5	7.5	7.5	7.3
2	Temperature	^0C	24	23	25	24	25	24	25
3	Turbidity	NTU	< 5	< 5	< 5	< 5	< 5	< 5	< 5
4	Dissolved Oxygen	mg/l	2.7	2.4	3	2.9	2.8	3	3.0
5	Suspended Solids	mg/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5
6	Conductivity	mho	5012	2898.1	1463.5	1562	1382.3	2012	2216.4
7	Dissolved Solids	mg/l	2981	1905.5	822.3	822.5	793.1	1104.8	1267.6
8	Total Hardness (as $CaCO_3$)	mg/l	1291.8	142	67.6	248.8	131.4	123.8	432.1
9	Alkalinity	mg/l	276	86	234.2	283.1	184.3	348.7	213.4
10	BOD_5 @20 ^0C	mg/l	11.7	3.8	2.8	4.9	4.3	3.2	8.7
11	COD	mg/l	40.2	15.2	12.2	17.1	14.8	13.4	24.1
12	Nitrate (as NO_3)	mg/l	0.646	0.158	0.108	0.196	0.165	0.241	0.264
13	Total Phosphorous	mg/l	1.32	1.806	2.14	2.54	2.06	2.01	2.216
14	Chloride (as Cl)	mg/l	1124	527	183.3	342.1	288	411.8	437
15	Sulphate (as SO_4)	mg/l	159	74	48	39	31	43.7	82
16	Sodium (Na)	mg/l	1109	1081	419	213.4	307.2	391.6	451
17	Potassium (K)	mg/l	5.671	5.109	3.731	3.208	3.503	3.094	3.784
18	Calcium(as Ca)	mg/l	221	26.43	10.4	48.2	25.1	23.1	84.6
19	Magnesium (as mg)	mg/l	193	16.2	9.2	31.3	15.4	13.3	50.1
20	Silica	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL

Sl. No.	Parameters	Units	Location						
			Maska	Desalpar	Nana Bhadiya	Mota-Bhojpur	Navinal	Kandagra	Jalpara
21	Oil &Grease	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
22	Phenol(as C_6H_6OH)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
23	Fluoride (as F)	mg/l	1.181	1.067	1.094	1.087	1.139	1.248	0.873
24	Total Nitrogen	mg/l	0.943	0.393	0.339	0.338	0.311	0.305	0.421
25	Iron (as Fe)	mg/l	1.548	1.183	0.921	0.631	1.163	0.928	0.839
26	Copper (as Cu)	mg/l	0.039	0.01	0.026	0.024	BDL	BDL	BDL
27	Zinc (as Zn)	mg/l	0.045	0.087	0.098	0.0114	BDL	BDL	BDL
28	Lead (as Pb)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
29	Cadmium (as Cd)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
30	Total Cr	mg/l	0.06	0.093	0.036	0.032	0.017	0.023	BDL
31	Arsenic (as As)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
32	Mercury (as Hg)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
33	Selenium (as Se)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
34	Total Coliforms	Nos. / 100 ml	2	2	2	1	3	1	0

Note: BDL : Below Detectable Limit

APPENDIX – 7h

Ground Water Quality In The Study Area During November 2006

Sl. No.	Parameters	Units	Location						
			Maska	Desalpar	Nana Bhadiya	Mota-Bhojpur	Navinal	Kandagra	Jalpara
1	pH Value		7.3	7.5	7.4	7.3	7.5	7.5	7.4
2	Temperature	^0C	24	23	24	24	23	23	24
3	Turbidity	NTU	< 5	< 5	< 5	< 5	< 5	< 5	< 5
4	Dissolved Oxygen	mg/l	3.1	3.0	3.1	3.0	2.9	3.3	2.9
5	Suspended Solids	mg/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5
6	Conductivity	mho	5498	3751.3	2268	1352.7	1871	2902	1742
7	Dissolved Solids	mg/l	3342	2190.1	1253	836.5	1055	1560	1001.2
8	Total Hardness (as $CaCO_3$)	mg/l	1465	118	62.2	272.3	138	142.8	249.1
9	Alkalinity	mg/l	388.9	503	415.8	434	298	695	241
10	BOD_5 @20 ^0C	mg/l	12.0	3.4	3.2	4.8	4.1	3.3	7.0
11	COD	mg/l	42.8	15.9	12.5	17.2	14.4	12.8	25.1
12	Nitrate (as NO_3)	mg/l	0.554	0.205	0.168	0.177	0.148	0.161	0.227
13	Total Phosphorous	mg/l	3.5	2.0	2.9	2.9	0.32	2.8	2.9
14	Chloride (as Cl)	mg/l	2230	535	281	384	279	468	381
15	Sulphate (as SO_4)	mg/l	206	79	55	48	36	65	75
16	Sodium (Na)	mg/l	202	1230	636	281	507	548	296
17	Potassium (K)	mg/l	6.6	3.26	3.5	2.388	3.316	3.083	3.026
18	Calcium(as Ca)	mg/l	245.6	24.8	9.4	48.2	28.4	29.3	63.9
19	Magnesium (as mg)	mg/l	209.5	13.6	9.4	36.9	16.3	16.9	21.7
20	Silica	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL

Sl. No.	Parameters	Units	Location						
			Maska	Desalpar	Nana Bhadiya	Mota-Bhojpur	Navinal	Kandagra	Jalpara
21	Oil &Grease	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
22	Phenol(as C_6H_6OH)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
23	Fluoride (as F)	mg/l	0.614	0.532	1.438	1.263	1.436	1.487	1.089
24	Total Nitrogen	mg/l	1.106	0.409	0.338	0.348	0.295	0.32	0.453
25	Iron (as Fe)	mg/l	2.450	1.390	1.410	0.916	1.35	1.38	0.861
26	Copper (as Cu)	mg/l	0.025	0.015	0.021	0.036	BDL	BDL	0.019
27	Zinc (as Zn)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
28	Lead (as Pb)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
29	Cadmium (as Cd)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
30	Total Cr	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
31	Arsenic (as As)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
32	Mercury (as Hg)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
33	Selenium (as Se)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
34	Total Coliforms	Nos. / 100 ml	3	2	3	3	3	2	2

Note: BDL : Below Detectable Limit

APPENDIX – 7i

Ground Water Quality In The Study Area During December 2006

Sl. No.	Parameters	Units	Location						
			Maska	Desalpar	Nana Bhadiya	Mota-Bhojpur	Navinal	Kandagra	Jalpara
1	pH Value		7.4	7.4	7.3	7.2	7.4	7.3	7.5
2	Temperature	^0C	25	24	25	25	24	25	25
3	Turbidity	NTU	< 5	< 5	< 5	< 5	< 5	< 5	< 5
4	Dissolved Oxygen	mg/l	2.9	2.8	2.9	2.8	2.8	3.2	3.0
5	Suspended Solids	mg/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5
6	Conductivity	mho	4715	2538	1208	1860	1830	2840	1900
7	Dissolved Solids	mg/l	3012	1680	744	1045	1038	1520	1100
8	Total Hardness (as $CaCO_3$)	mg/l	1489	135	70.3	286.4	142	153	243.4
9	Alkalinity	mg/l	396	492	408.6	449	286	682	256
10	BOD_5 @20 ^0C	mg/l	12.3	3.5	3.1	4.7	4.3	3.2	6.9
11	COD	mg/l	43.1	16.2	12.3	17.4	14.8	13.4	24.6
12	Nitrate (as NO_3)	mg/l	0.523	0.375	0.174	0.183	0.156	0.21	0.303
13	Total Phosphorous	mg/l	3.3	1.9	3.3	3.2	3.4	3.0	3.4
14	Chloride (as Cl)	mg/l	1869	542	276.8	379.8	286	456	390
15	Sulphate (as SO_4)	mg/l	193	88	61	39	33	53	81
16	Sodium (Na)	mg/l	1022	1242	650	260	492	536	380
17	Potassium (K)	mg/l	322	4.35	3.6	2.354	3.46	2.993	3.162
18	Calcium(as Ca)	mg/l	261	25.4	13.8	49.8	29.3	28.6	62.4
19	Magnesium (as mg)	mg/l	203.3	17.3	8.7	39.3	16.7	19.8	21.2
20	Silica	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL

Sl. No.	Parameters	Units	Location						
			Maska	Desalpar	Nana Bhadiya	Mota-Bhojpur	Navinal	Kandagra	Jalpara
21	Oil &Grease	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
22	Phenol(as C_6H_6OH)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
23	Fluoride (as F)	mg/l	0..816	0..816	0.426	1.236	1.243	1.216	1.023
24	Total Nitrogen	mg/l	0.998	0.446	0.361	0.321	0.286	0.301	0.433
25	Iron (as Fe)	mg/l	0.624	0.168	1.315	0.863	0.328	0.452	0.448
26	Copper (as Cu)	mg/l	0.032	0.015	0.018	0.029	BDL	BDL	0.022
27	Zinc (as Zn)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
28	Lead (as Pb)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
29	Cadmium (as Cd)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
30	Total Cr	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
31	Arsenic (as As)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
32	Mercury (as Hg)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
33	Selenium (as Se)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
34	Total Coliforms	Nos. / 100 ml	2	3	2	3	2	3	2

Note: BDL : Below Detectable Limit

APPENDIX – 7j

Ground Water Quality In The Study Area During January 2007

Sl. No.	Parameters	Units	Location						
			Maska	Desalpar	Nana Bhadiya	Mota-Bhojpur	Navinal	Kandagra	Jalpara
1	pH Value		7.3	7.5	7.4	7.5	7.5	7.4	7.4
2	Temperature	^0C	24	25	25	25	25	26	26
3	Turbidity	NTU	< 5	< 5	< 5	< 5	< 5	< 5	< 5
4	Dissolved Oxygen	mg/l	3.0	2.9	3.1	2.9	2.8	3.0	2.9
5	Suspended Solids	mg/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5
6	Conductivity	mho	5238	2438	1109	1990	1857	2890	1960
7	Dissolved Solids	mg/l	2896	1498	634	1080	1050	1560	1130
8	Total Hardness (as $CaCO_3$)	mg/l	1503	129	74.9	264.6	156	139	236.8
9	Alkalinity	mg/l	410	485	419	455	299	698	269
10	BOD_5 @20 ^0C	mg/l	12.5	3.6	3.0	4.5	4.4	3.3	6.9
11	COD	mg/l	43.9	16.7	12.6	17.3	14.9	13.3	24.4
12	Nitrate (as NO_3)	mg/l	0.499	0.389	0.183	0.174	0.168	0.236	0.321
13	Total Phosphorous	mg/l	3.1	2.3	3.4	3.5	3.7	3.2	3.5
14	Chloride (as Cl)	mg/l	1108	538	284.6	393	269	469	410
15	Sulphate (as SO_4)	mg/l	388	95	56	42	30	54	86
16	Sodium (Na)	mg/l	1953	1219	673	275	510	553	375
17	Potassium (K)	mg/l	6.0	4.62	3.75	2.361	3.49	2.893	3.011
18	Calcium(as Ca)	mg/l	268	25.8	14.3	47.4	30.3	28.9	66.8
19	Magnesium (as mg)	mg/l	202.5	15.6	9.5	35.8	19.5	16.2	17.0
20	Silica	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL

Sl. No.	Parameters	Units	Location						
			Maska	Desalpar	Nana Bhadiya	Mota-Bhojpur	Navinal	Kandagra	Jalpara
21	Oil &Grease	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
22	Phenol(as C_6H_6OH)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
23	Fluoride (as F)	mg/l	1.069	0.968	1.413	1.246	1.193	1.285	1.039
24	Total Nitrogen	mg/l	1.101	0.430	0.339	0.341	0.299	0.33	0.456
25	Iron (as Fe)	mg/l	0.724	0.162	0.348	0.426	0.373	0.421	0.326
26	Copper (as Cu)	mg/l	0.031	0.025	0.024	0.024	BDL	BDL	BDL
27	Zinc (as Zn)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
28	Lead (as Pb)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
29	Cadmium (as Cd)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
30	Total Cr	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
31	Arsenic (as As)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
32	Mercury (as Hg)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
33	Selenium (as Se)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
34	Total Coliforms	Nos. / 100 ml	2	2	3	3	2	3	2

Note: BDL : Below Detectable Limit

APPENDIX – 7k

Ground Water Quality In The Study Area During February 2007

Sl. No.	Parameters	Units	Location						
			Maska	Desalpar	Nana Bhadiya	Mota-Bhojpur	Navinal	Kandagra	Jalpara
1	pH Value		7.5	7.4	7.5	7.4	7.6	7.5	7.5
2	Temperature	^0C	26	26	25	25	25	25	26
3	Turbidity	NTU	< 5	< 5	< 5	< 5	< 5	< 5	< 5
4	Dissolved Oxygen	mg/l	2.7	2.3	2.8	2.4	2.6	2.8	2.6
5	Suspended Solids	mg/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5
6	Conductivity	mho	4574	2234	1032	1730	2065	2610	2110
7	Dissolved Solids	mg/l	3016	1348	651	990	1160	1430	1220
8	Total Hardness (as $CaCO_3$)	mg/l	1566	99.9	61.4	254.9	149.8	146.8	249
9	Alkalinity	mg/l	440.2	494.5	480	437	343.3	533.2	296
10	BOD_5 @20 ^0C	mg/l	12.8	3.8	3.8	4.8	4.8	4.1	7.0
11	COD	mg/l	44.4	16.9	13.7	17.6	16.3	15.6	24.8
12	Nitrate (as NO_3)	mg/l	0.398	0.22	0.23	0.28	0.213	0.3	0.278
13	Total Phosphorous	mg/l	2.6	2.2	3.2	3.2	3.1	3.1	3.3
14	Chloride (as Cl)	mg/l	1139	23.5	242.6	355.4	281.5	430	440
15	Sulphate (as SO_4)	mg/l	193	70	50	40	35	45	99
16	Sodium (Na)	mg/l	258	350	650	340	580	580	390
17	Potassium (K)	mg/l	10.5	5.9	3.377	5.9	3.296	3.5	4.5
18	Calcium(as Ca)	mg/l	274	21.4	10.8	42.8	28.4	29.5	65.3
19	Magnesium (as mg)	mg/l	214.1	11.3	8.3	35.9	19.1	17.2	20.8
20	Silica	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL

Sl. No.	Parameters	Units	Location						
			Maska	Desalpar	Nana Bhadiya	Mota-Bhojpur	Navinal	Kandagra	Jalpara
21	Oil &Grease	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
22	Phenol(as C_6H_6OH)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
23	Fluoride (as F)	mg/l	0.97	0.88	1.5	1.183	1.33	1.266	0.886
24	Total Nitrogen	mg/l	1.121	0.392	0.29	0.37	0.27	0.39	0.369
25	Iron (as Fe)	mg/l	2.366	1.325	0.523	0.578	0.416	0.324	0.526
26	Copper (as Cu)	mg/l	0.025	0.032	0.032	0.023	0.030	BDL	0.025
27	Zinc (as Zn)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
28	Lead (as Pb)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
29	Cadmium (as Cd)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
30	Total Cr	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
31	Arsenic (as As)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
32	Mercury (as Hg)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
33	Selenium (as Se)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL
34	Total Coliforms	Nos. / 100 ml	3	3	2	2	2	2	3

Note: BDL : Below Detectable Limit

APPENDIX –8a

Soil Quality In The Study Area During Summer 2006

Sr.No.	Sampling Location :	Nani Khakhar	Desalper	Nana Bhadiya	Bidada	Kandagra	Wand	Jalpara	Bhojpur	Gundiyali	Navinal
	Date of Sampling :	19/03/2006	19/03/2006	19/03/2006	19/03/2006	19/03/2006	19/03/2006	19/03/2006	19/03/2006	19/03/2006	19/03/2006
	Parameters ,units										
1	Apperance	Dark Brown	Dark Brown	Light Brown	Light Brown	Light Brown	Light Brown	Dark Brown	Dark Brown	Light Brown	Dark Brown
2	Texture	Clay Loam	Clay Loam	Silty Clay	Silty Clay	Silty Clay Loam	Clay Loam	Silt Clay	Silty Caly	Silty caly loam	Silty caly loam
3	Sand, %	33.3	31.9	20.1	14.6	23.2	26.9	20.1	22.2	25.4	23.5
4	Silt,%	28.5	27.6	40.3	58.6	36.3	33.3	40.1	42.6	46.3	48.9
5	Clay,%	38.2	40.5	39.6	26.8	40.5	39.8	39.8	35.2	28.3	27.6
6	Organic Matter%	0.853	0.624	0.583	0.439	0.716	0.771	1.03	0.722	0.487	0.179
7	Electric conductivity,ms/cm	0.087	0.233	0.221	0.086	0.134	2.32	0.226	0.101	0.084	0.138
8	Bulk Density .gm/cc	1.298	1.210	1.284	1.351	1.506	0.958	1.236	1.335	1.256	1.276
9	Moisture Content .%	1.4	0.195	1.785	0.0307	0.224	1.065	0.285	0.33	0.039	0.417
10	Porosity%	37.1	45.8	34.3	52.1	86.1	96.5	23.7	43.5	34.1	14.8
11	Nitrogen,mg/gm	0.038	0.031	0.03	0.022	0.029	0.031	0.035	0.028	0.021	0.019
12	Phosphorus mg/gm	0.5	0.48	0.45	0.43	0.56	0.51	0.6	0.35	0.31	0.29
13	Potassuim %	0.6056	0.924	0.3502	0.318	0.408	0.915	0.621	0.44	0.2593	0.4154
14	Sodium Adsorption Ratio	0.037	0.197	0.048	0.00792	0.0514	0.289	0.024	0.0423	0.079	0.024
15	PH(1:10Suspension)	6.96	7.2	7.9	7	7.5	6.8	7.2	7	6.9	7.1
16	Water Holding Capacity,(%)	28.7	18.9	24.4	8.6	16.8	23.4	23.3	27.3	20.9	29.4
17	Permeablity,cm/sec.	0.041	0.05	0.053	0.058	0.056	0.051	0.053	0.05	0.051	0.053
18	Sodium (as Na),ppm	95.81	1065	341.7	62.99	389.8	1677	187.4	162.6	61.49	165.3
19	Chloride (as cl) mg/gm	0.091	0.275	0.242	0.048	0.073	4.612	0.218	0.058	0.0613	0.129

Sr.No.	Sampling Location :	Nani Khakhar	Desalper	Nana Bhadiya	Bidada	Kandagra	Wand	Jalpara	Bhojpur	Gundiyali	Navinal
	Date of Sampling :	19/03/2006	19/03/2006	19/03/2006	19/03/2006	19/03/2006	19/03/2006	19/03/2006	19/03/2006	19/03/2006	19/03/2006
	Parameters ,units										
20	Total Alkalinity mg/gm	0.081	0.3	0.374	0.143	0.233	0.133	0.141	0.112	0.087	0.169
21	Iron (as Fe),mg/gm	0.4528	0.0166	0.3735	0.178	1.9072	2.2136	1.6392	0.4889	0.5153	1.0017
22	Cadmium(as Cd)mg/gm	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
23	Zinc (as Zn),mg/gm	0.5799	0.5963	0.3578	0.004874	0.005107	0.007336	0.008758	0.4785	0.5562	0.4553
24	Copper (as Cu),mg/gm	0.01285	0.01409	0.8671	0.008832	0.01402	0.01627	0.00651	0.01088	0.01186	0.01097
25	Lead (asPb)mg/gm	0.001541	0.001661	0.00111	0.001463	0.000802	0.000976	0.001153	0.001018	0.00085	0.000967
26	Chromium (as Cr+6) mg/gm	0.029	0.03554	0.03697	0.03134	0.04266	0.03723	0.002232	0.01866	0.03187	0.02926

APPENDIX –8b

Soil Quality In The Study Area During Post-Monsoon 2006

Sampling Location :			Nani Khakhar	Desalpur	Nana Bhudiya	Bidada	Kandagra	Wand	Jalpara	Bhojpur	Gundiyali	Navinal
Date of Sampling :			16/11/2006	16/11/2006	16/11/2006	16/11/2006	16/11/2006	16/11/2006	16/11/2006	16/11/2006	16/11/2006	16/11/2006
Sr. No.	Parameters	Units	S - 1	S - 2	S - 3	S - 4	S - 5	S - 6	S - 7	S - 8	S - 9	S - 10
1	Appearance		Light brown	Dark Brown	Dark Brown	Light brown	Dark Brown	Light brown	Dark Brown	Dark Brown	Light brown	Dark Brown
2	Texture		Clay Loam	Clay Loam	Silt Clay	Silty Clay	Clay Loam	Clay Loam	Silt Clay	Silt Clay	Silty Clay Loam	Silty Clay Loam
3	Sand	%	30.4	29.8	25.3	16.9	20.4	23.4	22.8	19.6	23.8	21.9
4	Silt	%	29.3	30.6	45.1	51.6	37.5	34.8	42.9	44.9	45.8	46.9
5	Clay	%	40.3	39.6	29.6	31.5	42.1	41.8	34.3	35.5	30.4	31.2
6	Organic Matter	%	1.213	0.913	0.691	0.762	0.823	0.963	0.916	0.864	0.691	0.583
7	Electrical conductivity	ms/cm	0.169	0.196	0.246	0.186	0.183	1.961	0.388	0.216	0.201	0.219
8	Bulk Density	gm/cm^3	0.916	0.929	0.986	1.1032	1.236	1.116	1.316	1.226	1.168	1.184
9	Moisture	%	0.893	0.361	1.126	0.316	0.306	0.983	0.384	0.416	0.145	0.386
10	Porosity	%	39.8	42.3	30.3	56.3	72.3	81.6	36.8	45.6	37.4	25.1
11	Nitrogen	mg/gm	0.123	0.085	0.041	0.123	0.091	0.216	0.163	0.131	0.143	0.093
12	Phosphorus	mg/gm	0.433	0.365	0.319	0.366	0.481	0.431	0.55	0.48	0.46	0.35
13	Potassium	mg/gm	0.5561	0.7631	0.3110	0.388	0.3961	0.616	0.583	0.3610	0.2163	0.3762
14	Sodium Absorption Ratio		0.212	0.168	0.085	0.71	0.059	0.414	0.163	0.109	0.164	0.093
15	pH (1:10 suspension)		7.10	7.3	7.4	7	7.2	7.0	7.3	7.4	7.1	7.5
16	Water Holding Capacity	%	31.6	28.7	25.3	19.8	25.9	31.9	29.6	33.5	24.6	36.3
17	Permeability	cm/sec	0.056	0.064	0.069	0.068	0.059	0.064	0.066	0.059	0.062	0.06

Sampling Location :			Nani Khakhar	Desalpur	Nana Bhudiya	Bidada	Kandagra	Wand	Jalpara	Bhojpur	Gundiyali	Navinal
18	Sodium as (Na)	mg/gm	0.138	0.983	0.506	0.123	0.326	1.260	0.216	0.209	0.109	0.138
19	Chlorides as (Cl)	mg/gm	0.186	0.199	0.296	0.134	0.116	6.113	0.363	0.184	0.129	216.3
20	Total Alkalinity	mg/gm	0.123	0.289	0.326	0.266	0.268	0.219	0.225	0.316	0.143	0.316
21	Iron as (Fe)	mg/gm	0.24	0.18	0.22	1.47	0.19	1.80	1.42	0.37	0.49	0.82
22	Cadmium as (Cd)	mg/gm	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
23	Zinc as (Zn)	mg/gm	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
24	Copper as (Cu)	mg/gm	0.016	0.026	0.061	0.010	0.022	0.018	0.021	0.013	0.016	0.012
25	Lead as (Pb)	mg/gm	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
26	Chromium as (Cr)	mg/gm	0.035	0.030	0.041	0.038	0.037	0.03	0.025	0.0.20	0.028	0.022

APPENDIX –8c

Soil Quality In The Study Area During Winter 2006

Sampling Location :			Nani Khakhar	Desalpur	Nana Bhudiya	Bidada	Kandagra	Wand	Jalpara	Bhojpur	Gundiyali	Navinal
Date of Sampling :			16/11/2006	16/11/2006	16/11/2006	16/11/2006	16/11/2006	16/11/2006	16/11/2006	16/11/2006	16/11/2006	16/11/2006
Sr. No.	Parameters	Units	S - 1	S - 2	S - 3	S - 4	S - 5	S - 6	S - 7	S - 8	S - 9	S - 10
1	Appearance		Light brown	Dark Brown	Dark Brown	Light brown	Dark Brown	Light brown	Dark Brown	Dark Brown	Light brown	Dark Brown
2	Texture		Clay Loam	Clay Loam	Silt Clay	Silty Clay	Clay Loam	Clay Loam	Silt Clay	Silt Clay	Silty Clay Loam	Silty Clay Loam
3	Sand	%	29.2	30.1	26.4	19.3	22.6	21.6	20.9	20.8	21.6	20.6
4	Silt	%	28.8	29.7	42.1	50.4	36.8	33.7	41.3	42.3	44.3	45.8
5	Clay	%	42.0	40.2	31.5	30.3	40.6	44.7	37.8	36.9	34.1	33.6
6	Organic Matter	%	1.191	0.968	0.716	0.784	0.839	0.978	0.941	0.886	0.764	0.626
7	Electrical conductivity	ms/cm	0.176	0.208	0.252	0.198	0.199	1.813	0.416	0.243	0.239	0.240
8	Bulk Density	gm/cm^3	0.923	0.941	0.994	1.094	1.196	1.023	1.224	1.196	1.149	1.196
9	Moisture	%	0.911	0.373	1.109	0.328	0.292	0.926	0.416	0.398	0.168	0.374
10	Porosity	%	40.3	43.4	34.6	51.4	65.4	73.4	39.4	41.8	38.6	26.8
11	Nitrogen	mg/gm	0.129	0.093	0.045	0.135	0.116	0.198	0.184	0.146	0.154	0.109
12	Phosphorus	mg/gm	0.396	0.372	0.326	0.353	0.424	0.409	0.513	0.493	0.478	0.376
13	Potassium	mg/gm	0.5433	0.7819	0.326	0.396	0.378	0.594	0.536	0.376	0.224	0.381
14	Sodium Absorption Ratio		0.209	0.179	0.093	0.635	0.050	0.399	0.175	0.163	0.181	0.116
15	pH (1:10 suspension)		7.2	7.4	7.3	7.1	7.3	7.1	7.2	7.2	7.3	7.4
16	Water Holding Capacity	%	32.4	30.4	26.9	21.6	28.7	34.3	30.4	31.8	26.8	35.6
17	Permeability	cm/sec	0.04	0.039	0.041	0.054	0.048	0.053	0.049	0.048	0.049	0.051

Sampling Location :			Nani Khakhar	Desalpur	Nana Bhudiya	Bidada	Kandagra	Wand	Jalpara	Bhojpur	Gundiyali	Navinal
18	Sodium as (Na)	mg/gm	0.129	0.995	0.513	0.136	0.334	1.199	0.242	0.219	0.116	0.143
19	Chlorides as (Cl)	mg/gm	0.194	0.215	0.314	0.146	0.131	0.124	0.349	0.196	0.136	0.209
20	Total Alkalinity	mg/gm	0.134	0.296	0.319	0.281	0.276	0.230	0.241	0.299	0.156	0.303
21	Iron as (Fe)	mg/gm	0.26	0.21	0.25	0.093	0.203	1.35	1.28	0.43	0.53	0.75
22	Cadmium as (Cd)	mg/gm	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
23	Zinc as (Zn)	mg/gm	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
24	Copper as (Cu)	mg/gm	0.018	0.022	0.072	0.019	0.026	0.023	0.019	0.020	0.022	0.019
25	Lead as (Pb)	mg/gm	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
26	Chromium as (Cr)	mg/gm	0.029	0.026	0.038	0.031	0.029	0.02	0.019	0.016	0.023	0.026

APPENDIX-9

List Of Survey No. In The Main Plant Area

List of Survey Nos. of proposed land to be acquired under land Acqusition Act for Mundra UMP

Village: Tunda, Tal: Mundra, Dist: Kachchh

SR. NO	SURVEY NO		AREA HEC	AREA ARE	AREA PARE	TYPE OF LAND	CLASS OF LAND
1	89		3	61	18	NT	
2	90		3	89	28	NT	
3	91		2	24	60	OT	
4	92		2	24	60	OT	
5	93		3	29	82	OT	
6	94		2	29	66	OT	
7	95		2	60	1	NT	
8	96		3	45	0	OT	
9	97		2	30	67	OT	
10	98		2	27	84	OT	
11	99		5	64	54	OT	
12	100		8	46	48	OT	
13	101		3	51	7	OT	
14	102	/1	1	25	45		
15	102	/2	1	61	88		
16	103		1	73	6	OT	
17	104		1	98	30	OT	
18	105	/1	1	85	14	OT	
19	105	/2	1	44	68	OT	
20	106		2	12	46	OT	
21	107	/1	1	14	32	OT	
22	107	/2	0	84	98	OT	
23	108	/1	1	36	58		
24	109		1	71	99	OT	
25	110		1	61	88	OT	
26	111		4	95	74	OT	
27	112		1	97	17	OT	
28	113	/1	1	33	57		
29	113	/2	0	80	94		
30	114	/1	1	64	91	OT	
31	114	/2	1	60	66	OT	
32	115	/1	1	28	49	OT	
33	115	/2	0	40	47	OT	
34	115	/3	0	37	43	OT	
35	116		2	5	38		
36	117	/1	1	2	18		
37	117	/2	0	80	94		
38	118	/1	0	84	98	OT	
39	118	/2	0	89	3	OT	
40	118	/3	0	98	14		
41	119	/1	1	11	29	OT	
42	119	/2	2	16	51	OT	
43	121		2	7	40	OT	
44	122	/1	1	86	16	OT	
45	122	/2	1	26	47	OT	
46	124		0	47	55		
47	125	/1	0	52	61		
48	125	/2	1	74	2		
49	125	/3	1	55	81		
50	126	/1	0	94	9		
51	126	/2	0	92	7		
52	126	/4	0	72	84		
53	126	/5	0	55	64		
54	127		0	27	32		
55	128	/4	1	32	54		
56	130		1	23	43		
57	131		1	37	59		
58	132		1	63	90		
59	133		2	38	73		
60	134		0	86	0		
61	135	/1	1	8	25	NT	
62	135	/2	1	98	70	NT	
63	135	/3	1	70	82	NT	
64	135	/4					
65	136	/1	1	61	87	NT	
66	136	/2	0	5	6	NT	
67	136	/3	0	69	81		
68	137	/1	0	60	70	OT	
69	137	/2	1	21	41	OT	
70	137	/3	0	30	2	NT	

APPENDIX- 10

Population Distribution within the Study Area (within 10 kms)- 2001

Village Name	Tot HH	Tot-P	Tot-M	Tot-F	P_06	M_06	F_06	P_SC	M_SC	F_SC	P_ST	M_ST	F_ST
Mandvi Taluka													
Bag	476	2528	1288	1240	387	204	183	0	0	0	32	15	17
Bidada	1491	7595	3842	3753	1034	549	485	1374	709	665	321	159	162
Faradi	386	1933	974	959	311	151	160	404	207	197	9	5	4
Gundiyali	891	5353	2705	2648	957	500	457	444	217	227	164	73	91
Maska	932	5055	2546	2509	699	350	349	211	109	102	117	65	52
Mota Bhadiya	511	2822	1417	1405	547	289	258	380	193	187	15	8	7
Nana Bhadiya	179	799	394	405	110	56	54	330	160	170	43	26	17
Nani Khakhar	645	3374	1676	1698	505	253	252	534	278	256	248	121	127
Pipari	283	1485	751	734	263	148	115	58	28	30	6	4	2
Tragadi	143	824	402	422	150	75	75	0	0	0	0	0	0
Mundra Taluka													
Deshalpar	424	2013	1045	968	285	161	124	366	188	178	125	62	63
Jarpara	1019	5762	2893	2869	1067	564	503	649	343	306	86	43	43
Kandagara Mota	454	2306	1150	1156	353	174	179	317	171	146	144	70	74
Khakhar Moti	324	1596	810	786	265	143	122	335	177	158	60	36	24
Moti Bhujpar	1188	5952	2942	3010	983	492	491	895	466	429	498	253	245
Nani Bhujpar	126	717	370	347	101	60	41	252	129	123	0	0	0
Navinal	241	1146	598	548	238	131	107	189	99	90	98	57	41
Pratappar	20	62	31	31	7	2	5	0	0	0	0	0	0
Shiracha	187	923	456	467	154	69	85	463	222	241	59	30	29
Tunda	241	1207	607	600	237	119	118	68	37	31	0	0	0
Sukhpar*	0	0	0	0	0	0	0	0	0	0	0	0	0
Sub Total	**10161**	**53452**	**26897**	**26555**	**8653**	**4490**	**4163**	**7269**	**3733**	**3536**	**2025**	**1027**	**998**

* Un-habitated

Source: Census 2001

HH	House Holds	**F**	Female	**Tot_F**	Total Female Population
Tot_P	Total Population	**SC**	Scheduled Caste	**P_06**	Population 0-6 years age group
Tot_M	Total Male Population	**ST**	Scheduled Tribes	**M**	Male

APPENDIX- 11
WORKERS DISTRIBUTION PATTERN IN THE STUDY AREA

Vill_Name	TOT_P	TOT_ WORK_P	MAIN WORK_P	MAIN_ CL_P	MAIN_ AL_P	MAIN _ HH _ P	MAIN _ OT _ P	MAR_ WORK_P	MAR _ CL _ P	MAR _ AL _ P	MAR_ HH _ P	MAR_ OT _ P	NON_ WORK_P
Mandvi Taluka													
Faradi	1933	526	188	20	8	8	152	338	33	110	11	184	1407
Bidada	7595	2961	2236	505	866	77	788	725	194	292	35	204	4634
Nani Khakhar	3374	1370	1051	284	393	40	334	319	16	206	57	40	2004
Nana Bhadiya	799	288	272	0	48	16	208	16	0	3	0	13	511
Pipari	1485	661	454	146	136	8	164	207	126	75	3	3	824
Maska	5055	1789	1523	293	149	62	1019	266	32	46	25	163	3266
Bag	2528	1078	684	312	103	4	265	394	214	62	3	115	1450
Gundiyali	5353	2148	1537	319	395	131	692	611	47	223	188	153	3205
Mota Bhadiya	2822	1167	981	423	294	12	252	186	43	65	6	72	1655
Tragadi	824	440	359	46	67	91	155	81	0	60	16	5	384
Mundra Taluka													
Deshalpar	2013	822	440	162	75	1	202	382	20	222	3	137	1191
Khakhar Moti	1596	567	517	118	222	1	176	50	4	29	1	16	1029
Kandagara Mota	2306	700	600	154	90	9	347	100	0	18	2	80	1606
Tunda	1207	605	482	46	66	23	347	123	25	44	1	53	602
Shiracha	923	353	281	78	82	43	78	72	0	14	44	14	570
Moti Bhujpar	5952	2286	1810	460	493	74	783	476	46	182	83	165	3666
Pratappar	62	14	14	2	5	0	7	0	0	0	0	0	48
Nani Bhujpar	717	355	191	87	71	1	32	164	93	62	2	7	362
Navinal	1146	337	302	85	69	1	147	35	0	8	0	27	809
Jarpara	5762	2471	2002	956	525	2	519	469	152	296	1	20	3291
Sukhpar*	0	0	0	0	0	0	0	0	0	0	0	0	0
Sub Total	**53452**	**20938**	**15924**	**4496**	**4157**	**604**	**6667**	**5014**	**1045**	**2017**	**481**	**1471**	**32514**

*Un-habitated

Source: Census 2001

APPENDIX –12
LANDUSE PATTERN OF THE STUDY AREA (In Hectare)

Village Name	*Total Irrigated Area*	*Un-Irrigated Area*	*Culturable waste*	*Area not under cultivation*
Mandvi Taluka				
Faradi	1327.5	1756.6	1929.7	856.32
Bidada	1161.9	1005.7	543.25	48.18
Nani Khakhar	545.5	212.1	139.15	85.09
Nana Bhadiya	82.6	1134.3	88.45	547.95
Pipari	62.7	301.9	72.62	19.02
Maska	464.6	357.3	208.94	362.22
Bag	801.0	0.0	0.00	12.96
Gundiyali	1227.6	1122.1	208.00	127.62
Mota Bhadiya	194.1	180.0	41.94	20.77
Tragadi	68.3	414.8	246.41	727.46
Mundra Taluka				
Deshalpar	809	920	379	822
Khakhar Moti	293.40	669.4	202.55	85.43
Kandagara Mota	153.8	1118.6	278.39	534.15
Tunda	30.4	403.20	266.51	614.24
Shiracha	80.9	613.5	301.01	554.50
Moti Bhujpar	127.5	2263.6	394.09	513.15
Pratappar	57.9	122.9	57.77	104.97
Nani Bhujpar	80.94	266.30	57.90	35.84
Navinal	121.41	439.90	176.37	55.40
Jarpara	1416.5	177.40	1238.33	359.12
Sukhpar	NA	NA	NA	NA

APPENDIX - 13
LITERACY PATTERN OF THE STUDY AREA

VILL_NAME	TOT_P	P_LIT	M_LIT	F_LIT	P_ILL	M_ILL	F_ILL
Mandvi Taluka							
Faradi	1933	1013	592	421	920	382	538
Bidada	7595	5015	2823	2192	2580	1019	1561
Nani Khakhar	3374	2027	1120	907	1347	556	791
Nana Bhadiya	799	486	276	210	313	118	195
Pipari	1485	721	444	277	764	307	457
Maska	5055	2998	1704	1294	2057	842	1215
Bag	2528	1361	800	561	1167	488	679
Gundiyali	5353	2480	1452	1028	2873	1253	1620
Mota Bhadiya	2822	1344	855	489	1478	562	916
Tragadi	824	281	159	122	543	243	300
Mundra Taluka							
Deshalpar	2013	1158	639	519	855	406	449
Khakhar Moti	1596	861	515	346	735	295	440
Kandagara Mota	2306	1397	800	597	909	350	559
Tunda	1207	558	317	241	649	290	359
Shiracha	923	479	280	199	444	176	268
Moti Bhujpar	5952	3213	1840	1373	2739	1102	1637
Pratappar	62	40	23	17	22	8	14
Nani Bhujpar	717	423	266	157	294	104	190
Navinal	1146	574	352	222	572	246	326
Jarpara	5762	2517	1616	901	3245	1277	1968
Sukhpar	0	0	0	0	0	0	0
Total	53452	28946	16873	12073	24506	10024	14482

TOT_P Total Population
P_LIT Population Literate
F Female Population
P_ILL Population Illiterate
M Male Population

APPENDIX – 14

COAL PRODUCTION BY VILLAGERS FROM WOOD NEAR TRAGADI VILLAGE

APPENDIX-15
AMENITIES IN THE VILLAGES OF THE STUDY AREA

Village Name	*Total Area (Hac)*	*No. of Households & total population*	*Educational Facilities*	*Medical Facilities*	*Drinking Water (potable)*	*Post, Telegraph & Telephone Facilities*	*Communication (Bus stop, railways, navigation)*	*Approach to the Village*	*Nearest Town - Distance in km*	*Power Supply*	*Most Imp. Commodities manufactured.*
Faradi	5870.1	386 (1933)	P	NA	T, W (2), TK(2), TW(2), HP(2), R(2), C(2), L(2), S(2), O(2)	PO(1), P(10)	BS, NW (2)	PR	Mandvi - 22	PALL	Pulses, Guvar, wheat
Bidada	2759.0	1491 (7595)	P(8), S(1), SS(1)	ALL, ALLD (3), AYUD (2), MCWC, FWCC, NH, RMP(4),CHW	T, W(2), TK(2), TW(2), HP(2), R(2), C(2), L(2), S(2), O(2)	PO(1), P(400)	BS, NW (2)	PR	Mandvi- 15	PALL	Bajri, groundnut, wheat
Nani Khakhar	981.9	645 (3374)	P(2)	CHW	T, W (2), TK(2), TW(2), HP(2), R(2), C(2), L(2), S(2), O(2)	PO (1), P(7)	BS, NW (2)	PR	Mandvi- 22	PALL	Cotton, wheat, maize
Nana Bhadiya	1853.3	179 (799)	P	ALLD, RMP, CHW	T, W, TK(2), TW(2), HP(2), R(2), C(2), L(2), S(2), O(2)	PO (1), P	BS, NW (2)	PR	Mandvi- 16	PALL	Bajri, Jowar, Wheat
Pipari	456.3	283 (1485)	P	CHW	T, W, TK(2), TW(2), HP(2), R(2), C(2), L(2), S(2), O(2)	P(2)	BS, NW (2)	PR	Mandvi- 12	PALL	Wheat, Bajri, Mug

APPENDIX-15
AMENITIES IN THE VILLAGES OF THE STUDY AREA

Village Name	*Total Area (Hac)*	*No. of Households & total population*	*Educational Facilities*	*Medical Facilities*	*Drinking Water (potable)*	*Post, Telegraph & Telephone Facilities*	*Communication (Bus stop, railways, navigation)*	*Approach to the Village*	*Nearest Town - Distance in km*	*Power Supply*	*Most Imp. Commodities manufactured.*
Maska	1393.1	932 (5055)	P(2), S(1)	ALLD(4), MCWC, PHC, PHSC, FWC, TBC, RMP, CHW	T, W(2), TK(2), TW(2), HP(2), R(2), C(2), L(2), S(2), O(2)	PO(1), P(10)	BS, NW (2)	PR	Mandvi-3	PALL	Bajri, Groundnut, Jowar
Bag	814.0	476 (2528)	P(3)	RMP, CHW	T, W(2), TK(2), TW(2), HP(2), R(2), C(2), L(2), S(2), O(2)	PO(1), PO(2)	BS, NW (2)	PR	Mandvi-6	PDOM, PAGR	Cotton, Bajri
Gundiyali	2898.5	891 (5353)	P(3)	FWC, RMP, CHW	T, W(2), TK(2), TW(2), HP(2), R(2), C(2), L(2), S(2), O(2)	PO, P(4)	BS, NW (2)	PR	Mandvi-8	PDOM, PAGR	Bajri, Cotton, Jowar
Mota Bhadiya	436.8	511 (2822)	P(3)	HOMH, CHW	T, W(2), TK(2), TW(2), HP(2), R(2), C(2), L(2), S(2), O(2)	PO, P(5)	BS, NW (2)	PR	Mandvi-13	PALL	Bajri, Mug, Groundnut
Tragadi	1456.9	143(824)	P	CHW	T, W, TK(2), TW(2), HP(2), R(2), C(2), L(2), S(2), O(2)	- 3KMS-	BS, NW (2)	PR	MandviI-13	PALL	Bajri, Jowar, Wheat
Deshalpar	2930	424 (2013)	P	CHW	T, W(2), TK(2), TW(2), HP(2), R(2), C(2), L(2), S(2), O(2)	PO, P(20)	BS, NW(2)	PR	Mundra-23	PALL	Cotton, Castor seeds, Isabgul

APPENDIX-15

AMENITIES IN THE VILLAGES OF THE STUDY AREA

Village Name	*Total Area (Hac)*	*No. of Households & total population*	*Educational Facilities*	*Medical Facilities*	*Drinking Water (potable)*	*Post, Telegraph & Telephone Facilities*	*Communication (Bus stop, railways, navigation)*	*Approach to the Village*	*Nearest Town - Distance in km*	*Power Supply*	*Most Imp. Commodities manufactured.*
Khakhar Moti	1250.8	324(1596)	P(3)	NA	T, W(2), TK(2), TW(2), HP(2), R(2), C(2), L(2), S(2), O(2)	PO, P(23)	BS, NW(2)	PR	Mundra-26	PALL	Cotton, wheat, Bajri
Kandagara Mota	2085.0	454(2306)	P, S	HC, PHSC, CHW	T, W(2), TK(2), TW(2), HP(2), R(2), C(2), L(2), S(2), O(2)	PO, P(27)	BS, NW(2)	PR	Mundra-22	PALL	
Tunda	1314.3	241(1207)	P	CHW	T, W(2), TK(2), TW(2), HP(2), R(2), C(2), L(2), S(2), O(2)	PO	BS, NW(2)	PR	Bhuj-58	PALL	Cotton, Guvar, Jowar
Shiracha	1676.6	187(923)	P	CHW	T, W(2), TK(2), TW(2), HP(2), R(2), C(2), L(2), S(2), O(2)	PO, P(11)	BS, NW(2)	PR	Mundra-15	PALL	Wheat, Bajri, Mug
Moti Bhujpar	3298.4	1188 (5952)	P(3), S	MH, CWC(2), PHC, RMP, CHW	T, W(2), TK(2), TW(2), HP(2), R(2), C(2), L(2), S(2), O(2)	PO, P(100)	BS, NW(2)	PR	Mundra-15	PALL	Groundnut, Bajri, Wheat
Pratappar	343.6	20(62)	P	CWC, CHW	T(2), W, TK(2), TW(2), HP(2), R(2), C(2), L(2), S(2), O(2)	P(20)	BS, NW(2)	MR	Mundra-8	PALL	Wheat, Castor Seeds, Guvar

APPENDIX-15
AMENITIES IN THE VILLAGES OF THE STUDY AREA

Village Name	*Total Area (Hac)*	*No. of Households & total population*	*Educational Facilities*	*Medical Facilities*	*Drinking Water (potable)*	*Post, Telegraph & Telephone Facilities*	*Communication (Bus stop, railways, navigation)*	*Approach to the Village*	*Nearest Town - Distance in km*	*Power Supply*	*Most Imp. Commodities manufactured.*
Nani Bhujpar	441.0	126(717)	P	CWC, CHW	T, W(2), TK(2), TW(2), HP(2), R(2), C(2), L(2), S(2), O(2)	PO, P(2)	BS, NW(2)	PR	Mundra-9	PALL	Groundnut, castor seeds, guvar
Navinal	1038.3	241(1146)	P	CHW	T, W(2), TK(2), TW(2), HP(2), R(2), C(2), L(2), S(2), O(2)	PO, P(25)	BS, NW(2)	PR	Mundra-13	PALL	Cotton, wheat, bajri
Jarpara	3191.3	1019 (5762)	P(4)	ALLD, CHW	T, W, TK, TW(2), HP(2), R(1), C(2), L(2), S(2), O(2)	PO, P (50)	BS, NW (2)	PR	Mundra-8	PALL	Kharek, chikoo, coconut
Sukhpar	819.8	0	NA	NA	NA	NA	NA	NA	Mundra	NA	NA

Source: Census 2001

Drinking Water: T- Tap, W - Well, TK- Tank, TW- Tube well, HP- Hand pump, R- River, C- Canal, L- Lake, S- Spring, O- Others
Medical Facilities– ALLH- Allopathic Hospital, AYUH- Ayurvedic Hospital, UN- Unani Hospital, HOM-Homeopathic, ALLD-Allopathic Dispensary, AYUD- Ayurvedic Dispensary, MCWC- Maternity Child and Welfare Center, MH- Maternity Home, CWC- Child Welfare Centre, HC- Health Centre, PHC- Primary Health Centre, FWC-Family Welfare Centre, TB- TB clinic, NH- Nursing Home, RMP- Registered Medical Practitioner, SMP- Subsidized Medical Practitioner, CHW- Community Health workers, O-Others,
Irrigated by Source: CG- Canal Government, CP- Canal Private, WWOEL- Well without electricity, WWEL- Well with Electricity, TWWOEL- Tubewell without electricity, TWWEL- Tubewell with electricity, TK- Tank, R- River, L- Lake
Communication- BS- Bus Stop, RS- Railway Station, NW- Navigational Water
Approach to roads- PR- Paved Roads, MR- Mud roads, FP- Foot path
Power- PALL- Electricity for all purpose, PAGR – Electricity for agricultural purpose, PDOM- Electricity for domestic purpose
NA- Not Available

APPENDIX – 15A

IMPORTANT COMMODITIES MANUFACTURED IN THE STUDY AREA

Name of the Village	Most important Commodity Manufactured-1	Most important Commodity Manufactured-2	Most important Commodity Manufactured-3
Mandvi Taluka			
Faradi	Pulses	Guvar	Wheat
Bidada	Bajri	Groundnut	Wheat
Nani Khakhar	Cotton	Wheat	Maize
Nana Bhadiya	Bajri	Jowar	Wheat
Pipari	Wheat	Bajri	Mug
Maska	Bajri	Groundnut	Jowar
Bag	Cotton	Bajri	
Gundiyali	Bajri	Cotton	Jowar
Mota Bhadiya	Bajri	Mug	Groundnut
Tragadi	Bajri	Jowar	
Mundra Taluka			
Deshalpar	Cotton	Castor Seeds	Isabgul
Khakhar Moti	Cotton	Wheat	Bajri
Kandagara Mota			
Tunda	Cotton	Guvar	Jowar
Shiracha	Wheat	Bajri	Mug
Moti Bhujpar	Groundnut	Bajri	Wheat
Pratappar	Wheat	Castor Seeds	Guvar
Nani Bhujpar	Groundnut	Castor Seeds	Guvar
Navinal	Cotton	Wheat	Bajri
Jarpara	Kharek	Chikoo	Coconut

APPENDIX – 15B

LOCAL TRANSPORTATION SYSTEM (CHAKKADA) FOR GOODS AND VILLAGERS

APPENDIX 16

Satellite Data Analysis and Interpretation –Areas in the neighbourhood of the proposed Mega power Plant, Kutchch District, Gujarat State

Submitted To:
TCE Consulting Engineers Ltd., Mumbai

CARE Sustainability bai

Registered Office
A-29,
DARA ENCLAVE
AWHO, Sector 9,
Nerul - 400706
Navi Mumbai

June 2006

CONTENTS

Tables

EXHIBITS

Chapter 1.0

INTRODUCTION

TCE Consulting Engineers Ltd. has retained CARE Sustainability CARE), Navi Mumbai, to carry out “**Satellite Data Analysis, Interpretation and Ground Observations- for the areas of interest located at Kutchch district**, in the State of Gujarat. The scope of work was to derive land use/land cover from satellite data.

In accordance with the terms of reference CARE professionals have undertaken:

- Procurement of satellite data
- Study of relevant documents
- Field Survey- Ground Truthing
- Generation of landuse- landcover maps using IRS-P6 satellite data

The methodology adopted for the study is detailed in Chapter 2.0. Chapter 3.0 describes the field observations and Global Positioning System (GPS) made from ground survey. Chapter 4.0 explains the dominant and representative ground features showing the digital photographs. Chapter 5.0 gives the satellite images, which include classified land use/land cover thematic maps.

Chapter 2.0

APPROACH and METHODOLOGY

Satellite image analysis was carried out for the generation of land use/ land cover map of the study region. The study region, is located the district of Kutchch, Gujarat. The approach for satellite data analysis adopted the well-proven Image processing procedures. The analysis was preceded with a ground survey, which comprised of data collection of ground features along with the respective geographical position in terms of latitudes and longitudes. The interpretation of the satellite data was supplemented by these ground truth studies. The satellite data used has the below specifications:

- Satellite and Sensor: IRS P-6, LIS III (L-3)
- Date on which the image was taken: 26-November-05

The said time period of acquisition of the satellite data has been judiciously chosen to depict the vegetation and other ground features at its best, as also avoid the cloud cover over the satellite data.

The image processing software used is the professional version of ERDAS IMAGINE 8.4 under Windows NT. A Pentium 1V based computing machine with high processing speed and graphic facilities under the operating system of Windows NT is used for the image processing and interpretation.

The detailed description of methodology followed for the generation of landuse-landcover map is given in the paragraphs below.

IRS P6 data were extracted using the ERDAS Imagine's extract utility. The raw satellite data was subjected to the enhancing steps such as edge enhancement and histogram equalization, the built in functions of the image processing software, so as to obtain the best classification results. The satellite data were georeferenced by adopting the raster to raster geocoding. For georeferencing, the ground control points (GCP) recorded by Global Positioning System (GPS) during ground truthing of the study area were used. The GCPs were taken at locations well spread across the study region, and hence enabled to obtain very high georeferencing accuracy. UTM projection system was applied to the image.

The georeferenced image was viewed under different band combinations in the viewer of ERDAS IMAGINE and different features were demarcated based upon the tone, texture shape, size, association etc. The locational maps of study region and ground truthing data were also used for reference. Field studies proved to be very helpful in correctly demarcating the features. For classification, 'supervised classification' was adopted. The classified features were verified with ground truth data. Land use/ land cover maps depicting the classified ground features for different areas of interest were subsetted from the master classified image. Circular regions with project site as center and radial distances of 50kms, as shown in the subsequent sections, were few of the derived areas of interest. The proportional presence of different land uses in terms of statistical percentages was also derived for the said areas of interest. Appropriate legends were used to represent the various categories of landuse-landcover, and are written on the prepared landuse-landcover maps.

Chapter 3.0

GROUND SURVEY AND GPS READINGS

The region for field survey was chosen around the project site, spreading radially on the land side about thirty kilometers from the project site. The field survey was carried out, during May 15-18, 2006 in order to observe and understand the ground features. The GPS readings and observations of land features were taken at several ground locations spread evenly in the study region. The project site, being close to the gulf of Kutchch waters, the field observations have been made mainly on the land.

The following table enumerates the land features and its corresponding GPS readings of all the ground truthing locations selected for the study.

Table 1. Land use features, GPS readings at locations on the land within the radial distance of 35kms from the proposed project site. The Table 1 also provides the taluka and village of each location

Sr No	GPS reading		Category	Description	Taluka	Village
	Latitude	Longitude				
1	22° 48.179’ N	069°32.078’ E	Sandy Shore	Barren sandy area with no vegetation.	Mundra	Tunda wandh
2	22° 50.602’ N	069°31.682’ E	Built up area	Concrete buildings with roofed top.	Mundra	Kandagara
3	22° 50.124’ N	069°31.271’ E	Scrub forest	The area is with small bushes or in many places exposed sandy soil is seen	Mundra	Kandagara
4	22° 49.849’ N	069°29.323’ E	Agricultu ral land	Plantation of Kharik. Admeasuring an	Mandvi	Nana Bhadia

				area of > 5acres		
5	22° 49.845’ N	069°29.068’ E	Built up area	Human settlement	Mandvi	Nana Bhadia
6	22° 49.569’ N	069°28.502’ E	Artificial Lake	Pond constructed by human effort > 4 acres	Mandvi	Tragadia
7	22° 49.555’ N	069°28.179’ E	Built up area	Building construction Panchayat office	Mandvi	Tragadia
8	22° 49.818’ N	069°26.516’ E	Agricultu ral land	Tilled land ready for sowing.	Mandvi	Gundiyali
9	22° 50.273’ N	069°25.405’ E	Artificial Lake	Naran Sarovar Artificial Lake of > 25acres With no traces of water.	Mandvi	Gundiyali
10	22° 50.176’ N	069°25.198’ E	Built up area	Houses built for human settlement	Mandvi	Gundiyali
11	22° 49.945’ N	069°24.578’ E	Agricultu ral Land	Cultivation of Hinjwa, used for feeding livestock.	Mandvi	Gundiyali
12	22° 50.180’ N	069°23.359’ E	Agricultu ral Land	Coconut Farm	Mandvi	Maska
13	22° 50.211’ N	069°23.330’ E	Agricultu ral Land	Bajra Plantation Standing crop Plot admeasuring 1 to 2acres	Mandvi	Maska
14	22° 50.190’ N	069°22.920’ E	Built up area	A small temple	Mandvi	Maska
15	22° 50.298’ N	069°21.982’ E	Highway	Mandvi-Bhuj Highway octroy point near Reliance petrol pump	Mandvi	Mandvi
16	22° 49.979’ N	069°21.566’ E	River	Rukmavathi river near Mandvi bridge	Mandvi	Mandvi
17	22° 50.164’ N	069°22.740’ E	Built up area	Ek ka Das Mahadev Temple	Mandvi	Maska
18	22° 51.076’ N	069°23.788’ E	Agricultu ral land	Ready for sowing >10acres	Mandvi	Bag
19	22° 51.047’ N	069°24.141’ E	Built up area	Township with good green cover Houses small red tiled roof.	Mandvi	Bag

20	22° 51.675’ N	069°24.225’ E	Water tank	Shallow water tank artificially created having stagnant water > 500 SqM	Mandvi	Bag
21	22° 51.648’ N	069°24.224’ E	Agricultu ral land	Harvested land, used for crop rotation. Crops like wheat ,cotton, jowar, are cultivated in these land	Mandvi	Bag
22	22° 52.202’ N	069°24.685’ E	Agricultu ral land	Jowar crop ready for harvesting	Mandvi	Bag
23	22° 52.383’ N	069°26.137’ E	Built up area	Village settlement small houses with roofed top	Mandvi	Pipari
24	22° 53.874’ N	069°26.949’ E	Agricultu ral land	Chickoo plantation > 2-4 acres	Mandvi	Bidada
25	22° 53.215’ N	069°53.215’ E	Built up area	Temple Manav Mandir	Mandvi	Bidada
26	22° 53.750’ N	069°28.447’ E	Built up area	Human settlement	Mandvi	Bidada
27	22° 51.410’ N	069°28.646’ E	Built up area	Human settlement	Mandvi	Mota Bhadia
28	22° 50.210’ N	069°29.017’ E	Artificial lake	>50 acres No trace of water seen	Mandvi	Nana Bhadia
29	22° 48.179’ N	069°32.078’ E	Sandy Shore	Barren sandy area with no vegetation.	Mundra	Tunda wandh
30	22° 48.447’ N	069°42.518’ E	Built up area	Human settlement Houses are very peculiar dome shaped with mud wall and thatched roof.	Mundra	Tunda wandh
31	22° 48.881’ N	069°32.060’ E	Road	Junction road meeting project site with local road.	Mundra	Tunda wandh
32	22° 50.618’ N	069°44.428’ E	Built up	Houses with	Mundra	Baroi

			area	concrete walls with tiled roof		
33	22° 50.373’ N	069°50.447’ E	Road	Main Bus depo of Mundra city.	Mundra	
34	22° 50.665’ N	069°41.799’ E	Dried water coarses or nallah	Dried river trespassing the village	Mundra	Nana Kapaya
35	22° 50.589’ N	069°41.663’ E	Built up area	Main village	Mundra	Nana Kapaya
36	22° 51.010’ N	069°40.465’ E	Dried water coarses or nallah	Dried river trespassing the village.	Mundra	Borana
37	22° 51.186’ N	069°40.020’ E	Built up area	Main village	Mundra	Borana
38	22° 51.365’ N	069°39.333’ E	Artificial lake	Lake constructed	Mundra	Pratpara
39	22° 51.398’ N	069°38.974’ E	Built up area	Main village	Mundra	Pratpara
40	22° 51.639’ N	069°38.464’ E	Agricultu ral land	Castor plantation >5 acres.	Mundra	Bhujpur
41	22° 51.751’ N	069°38.300’ E	Agricultu ral land	Chickoo plantation inter spaced with kharik	Mundra	Bhujpur
42	22° 52.432’ N	069°37.893’ E	Built up area	Main village	Mundra	Bhujpur
43	22° 53.048’ N	069°37.320’ E	River	Nagvanthi river Completely dried.	Mundra	Bhujpur
44	22° 52.941’ N	069°37.203’ E	Agricultu ral land	Mango plantation Ready for harvesting	Mundra	Bhujpur
45	22° 50.400’ N	069°35.823’ E	Dried water coarses or nallah	Water coarce trespassimg through Village	Mundra	Navianal
46	22° 50.010’ N	069°35.907’ E	Built up area	Human settlement	Mundra	Navianal
47	22° 49.863’ N	069°35.892’ E	Artificial lake	>25acres dried	Mundra	Navianal
48	22° 50.169’ N	069°37.738’ E	River	River crossing the road Dried	Mundra	Navianal

49	22° 50.202’ N	069°39.027’ E	Built up area	Human settlement	Mundra	Jarpara
50	22° 50.060’ N	069°40.811’ E	Built up area	Human settlement, Mosque	Mundra	Dhrab
51	22° 50.239’ N	069°41.741’ E	Highway	Zero point highway Junction leading to adani port	Mundra	Dhrab
52	22° 52.726’ N	069°42.192’ E	Highway	Bhuj- mundra Highway	Mundra	Mota Kapaya
53	22° 53.817’ N	069°41.806’ E	Highway	Highway junction near pangrapol Bhuj –mundra	Mundra	Pragpar
54	22° 55.045’ N	069°41.089’ E	Highway		Mundra	Baraya
55	22° 55.082’ N	069°40.936’ E	Dried river		Mundra	Baraya
56	22° 56.708’ N	069°39.576’ E	Built up area	Village settlement	Mundra	Karagoga
57	22° 57.861’ N	069°38.899’ E	Built up area	Human settlement	Mundra	Bocha
58	22° 58.107’ N	069°38.907’ E	Barren hilly area		Mundra	Bocha
59	22° 58.321’ N	069°38.735’ E	Barren hilly area	Rock cliffs	Mundra	Bocha
60	22° 58.637’ N	069°38.556’ E	Highway	Junction from Bocha village to Bhuj highway	Mundra	Bocha
61	23° 00.084’ N	069°34.197’ E	Built up area	Human settlement	Mundra	Tumbadi Moti
62	22° 59.945’ N	069°33.600’ E	Agricultural land	Fertile land for cultivation	Mundra	Moti Tumbadi
63	22° 59.680’ N	069°32.446’ E	Built up area	Temple	Mundra	Tumbadi Nani
64	22° 59.948’ N	069°32.084’ E	Barren hill		Mundra	Tumbadi Nani
65	22° 59.981’ N	069°32.022’ E	Built up area	Temple	Mundra	Tumbadi Nani
66	23° 00.185’ N	069°31.672’ E	Agricultural land	Fertile land admeasuring >10 acres	Mundra	Tumbadi Nani
67	23° 00.970’ N	069°30.128’ E	Built up area	Village settlement	Mandvi	Punadi
68	23° 01.080’ N	069°28.346’ E	Road	Road from Punadi to Mandvi	Mandvi	Punadi

				bhuj highway		
69	22° 59.743’ N	069°27.273’ E	Road	Junction point at Mota Asambia and Nana Asambia	Mandvi	Asambia Mota & Asambia Nana
70	22° 57.934’ N	069°26.344’ E	Highway	Junction of Mandvi –Bhuj highway leading to Mota Asambia	Mandvi	Asambia Mota
71	22° 58.526’ N	069°26.621’ E	Agricultu ral land	Cultivation of Jowar, ready for harvesting	Mandvi	Goniyasar Mota
72	22° 59.790’ N	069°27.255’ E	Agricultu ral field	>5-10 acres fertile land The area is fully infested with thorny undergrowth. These are considered as nuisance weeds, which makes the agricultural activities difficult	Mandvi	Goniyasar Mota

Chapter 4

SIGNIFICANT LAND USE FEATURES

The proposed power plant site is situated in the **Kuchch** district of Gujarat state. A study of the significant ground features were carried out in and around the site within the periphery of 30kms.radial distance from the project site. The study area falls under two Talukas viz, Mundra and Mandvi. There are more than 57 villages covered during the field visit.

1. General Phytogeography of the State of Gujarat

The state of Gujarat is situated on the west coast of India between 20° and 25° north latitude and 68° and 75° east longitudes. Its boundaries are defined by Arabian sea on the west, the state of Rajasthan on the north-east, Madhya Pradesh on the east and Maharashtra on the south east and south. On the north-western fringe it has a common boarder with Pakistan

The state of Gujarat has a landmass of 1,9602400 hectares that accounts for about 6 per cent area of the country which 23,34,400 hectares are under irrigation. The state has 8,48, 300 hectares under permanent pasture and grazing land. In addition to this 8,62,800 hectares are under fodder crops. The state has 1600Km of coastal area. Rainfall varies from about 340mm in the western arid district of Kachch to about 1800mm in the southern hills of Dangs and Bulsar. The climate varies from arid to dry sub-humid in Kachch and Bulsar districts. Nearly 25% of the geographical area in the western part is arid.

From the point of view of the forest distribution and description of vegetation the whole of the state can be divided into three distinct zones viz, area of the south of the Narmada consisting of deciduous forests with teak as the main economic species, the areas between the river Narmada and the extreme north excluding Saurashtra and Kutch covering dry deciduous forests with or without teak, and the area of Saurashtra and Kutch with poor teak forests in Junagadh, scrublands, mangrove forests and desert areas.

2. The Topography of the area covered under study

The present study area falls in Kutchch peninsula. The topography of the area is such that the central portion forms the table land sloping on all sides. It is practically an undulating rocky area with small hills and with rann of Kutch lying on the northern end, consisting of vast expense of tidal mud flats with salt-encrusted mud. The soil vary a great deal from place to place, along the coastline, there are alluvial soil and in some parts they are saline. There are also areas with sandy soil.

Photo No-1: General Topography of the area

2.1 General pattern of vegetation

The forest type of the area falls under scrub forest as per the classification of Champion and Seth (1968). These forests are typical of arid and semi-arid zones of the earth where the total rainfall ranges from 25-100Cm. The vegetation presents a very open appearance so that the trees and shrubs are widely spaced. The bulk of the vegetation consist of co-dominant, spinous shrubs and trees capable of drought resistance.

The typical species found in these areas are given in the following photographs.

Photo No -2: Dichrostachys cinerea

Photo No:-3 Capparis decidua

Photo No-4: Prosopis *juliflora* (swartz) DC.

2.2 Agricultural crops

The major agricultural crops cultivated in the area are Jowar, wheat, cotton, castor etc. Fruit trees like sapota, mango, are also cultivated in some part of the district. The most dominant species which is found growing in almost all parts of the district is ***Phoenix robusta*** (Bell.) Bell. & Hook. f. locally known as Kharik. It is a commercial crop cultivated for its edible fruits.

Photo No 5: Phoenix robusta (Bell.) Bell. & Hook.f.

3. Land use pattern of the study area

The following are the significant land use features encountered during the ground truthing survey:

3.1. Open scrub forest

Most of the land area of the district is covered by scrub forest, which is either exposed or sparsely covered by vegetation cover.

Photo No-6: Open scrub forest

3. 2. Barren hilly areas

These areas are mostly seen on both side of the Bhuj- Mundra highway. These are open dry land without any vegetation cover. There are no water bodies present in and around these sites.

Photo No-7 : Barren hilly areas

3.3. Agricultural land

These are agricultural lands spread like the huge tract of land admeasuring 10-50 Acres of area, divided into small, medium and large plots. These lands are found under the possession of landlord or individual farmers. Different agricultural crops such are cotton, jowar, bajra, wheat etc. are cultivated in these plots. Such agricultural lands are found in the villages like Nana Bhadia, Gundiyali, Maska, etc. Presently these agricultural fields are tilled and exposed to sun. The sowing is done immediately after the fall of the first shower.

Agricultural land with different crop type, different stage of cultivation such as harvested field, ready for harvesting, standing crop etc. are also covered in the ground truthing survey.

Each of these plot is bordered on four sides with tall perennial species like coconut, Kharik etc.

Photo No-8 : Typical view of agricultural field

3.4. Sandy shore

Are mostly seen in the coastal belt and are subjected to all extremes such as temperature, salinity, turbidity, wave action etc. There are no vegetation seen on these sites, however there are some faunal intertidal molluscan species visits these sites occasionally. The remnants of their shells are most frequently seen.

Photo No-9: Sandy Shore

3.5. Built up area

Are mostly restricted near the village headquarters where the village sarpanch and other infrastructural facilities like schools, hospitals, temple, mosque, market etc are located. Every village has a central point where the human settlement is maximum.

Photo No-10 : Built up areas

3.6. Roads and Highways

There are two major highways passing through the project site viz, Mundra – Bhuj Highway (SH-48) and Mandvi – Bhuj Highway (SH-47). Apart from this another major road (SH-6) connecting the two highways trespasses through the project boundary.

Photo No-11: Highway at zero point

3.7. Rivers

There are two major perennial rivers viz Nagvati and Rukmavathi rivers passes through the project boundary. These rivers are the only water sources for the entire area.

Photo No-12: Rukmavathi River

3.8. Dried water courses or Nallah

There are many small river coarses or nallah passing through each village. They are highly seasonal and the water is available only in the limited period of the year. In summer these rivers are literally dry.

3.9. Artificial lake

With the Governments active participation and the sramadhan from the local people there are many artificial lakes constructed. The main purpose is to store water to make it available throughout the year. These lakes are seen in villages like Gundiyali, Tragadia , etc. Many of them are very huge covering more than an area of 25-30 acres.

Photo No-13: Artificial lake at Gundiyali village

3.10.Water tank

These are structures used for storing water to meet the day to day agricultural and livestock requirement. The water is pumped from the ground water which is 200 - 300meters below and stored on the surface in small artificially made water tanks. Such water bodies are recorded from the village Bag, Gundiyali, etc.

Photo No-14: Water Tank at Bag village

Chapter 5.0

SATELLITE DATA INTERPRETATION - CLASSIFICATION

.

The landuse-landcover in the region comprises of various types, referred as classes. The features derived from the satellite image after validation by the ground observations, have been presented as nine classes and are given below. These classifications types are as per the 'level classification' categories followed by National Remote Sensing Agencies (NRSA), -

1. Cultivated Land
2. Fallow Land
3. Built-up Area
4. Water Bodies
5. Barren Area
6. Marshy Land / Low Land
7. waste land
8. Forest Cover
9. Sparse Forest

Satellite data from IRS-P6 (November 26, 2005) has been used . The approach used for analysis is given at the Chapter 2.0.

Inorder to understand the land use and land features covering the entire study region, both False Composite and classified images have been derived. FCC images depicts the land features such as the coastal boundaries, while the classified images show different land use classes listed above. The coverage statistics, the area covered by each land use class, are also derived through satellite data analysis and given below in different Tables.

FCC and Classified images have been derived for 30kms 20 kms , 10kms and 5kms

The images classified into the above-mentioned nine classes for different regions of interest are given at Exhibits, . Brief description of each type of the class forming landuse-landcover, derived from the satellite data analysis and the ground observations, is depicted in the classified image. Here, it is advised that the photographs given at the Chapter 4.0 are also referred.

The coverage areas of these nine classes of land use existing in the study region have also been derived from the satellite image analysis. The statistical percentage of these various classes, forming the land use/land cover, is also derived for the different regions of interest, 30kms, 20kms., 10kms, and 5kms .

Table 2:
Land Use Types and Its Coverage within 5, 10 and 30 Km. radius (Statistical Percentages)

LAND USE CLASSESS WITHIN 5 KM RADIUS

Classes	Area (Km^2)
Scrub forest	1.326274637
Salt Pan	8.319278704
Mangrove	0.054819352
Built up area	14.78530965
Fallow land	18.88261409
Nallah	7.241459516
Agricultural land	5.15743997
Water Bodies	5.406779602
Barren hill	5.210490956
Marshy Land	12.89581038
Total	**79.28027686**

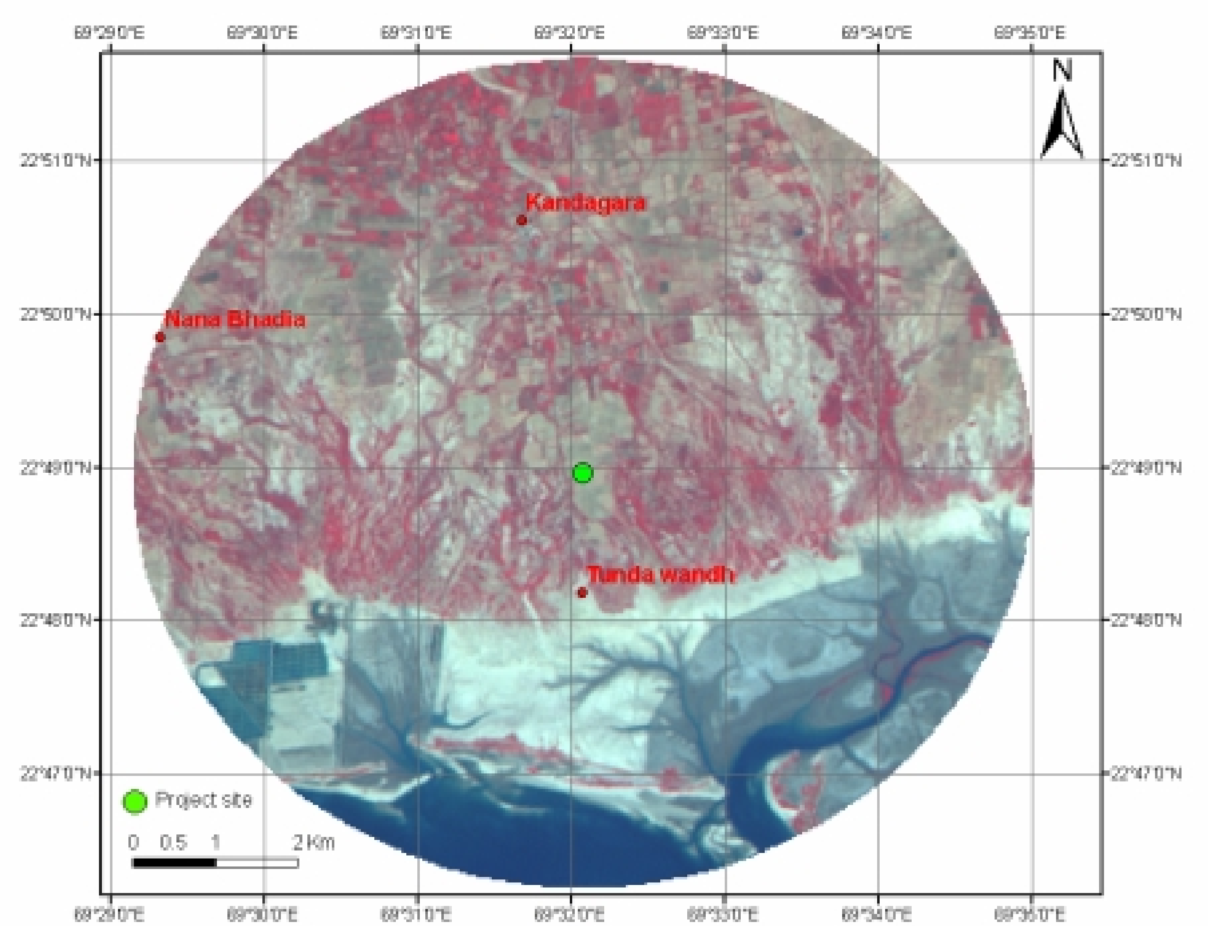
LAND USE CLASSESS WITHIN 10 KM RADIUS

Scrub forest	2.829385891
Salt Pan	13.23445251
Mangrove	0.719725036
Built up area	44.29934123
Fallow land	70.77974062
Nallah	15.3839016
Agricultural land	33.14890827
Water Bodies	63.53651274
Barren hill	25.53697604
Marshy Land	46.71581362
Total	**316.1847575**

LAND USE CLASSESS WITHIN 30 KM RADIUS

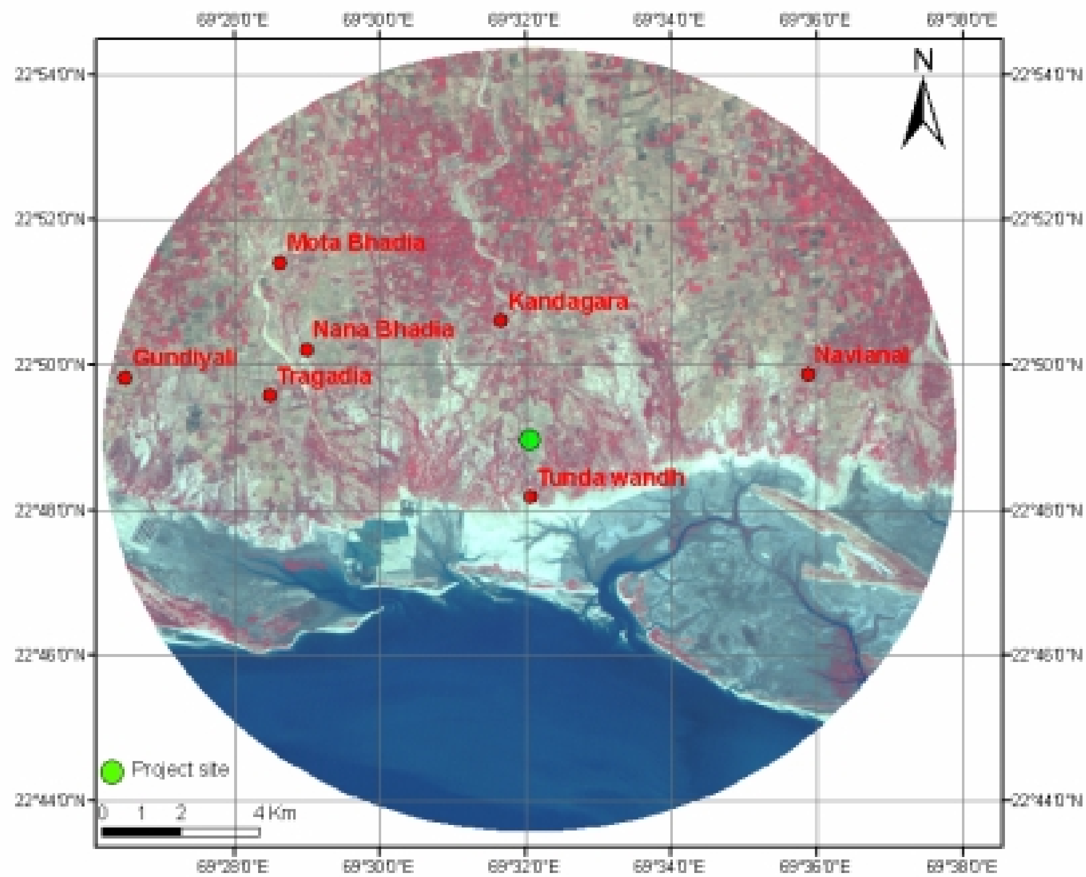
Scrub forest	53.16239253
Salt Pan	32.66260757
Mangrove	6.764000647
Built up area	280.4018678
Fallow land	443.8271969
Nallah	84.7790115
Agricultural land	158.2316376
Water Bodies	515.5998752
Barren hill	414.0859303
Marshy Land	120.9942667
Total	**2110.508787**

Figure 1



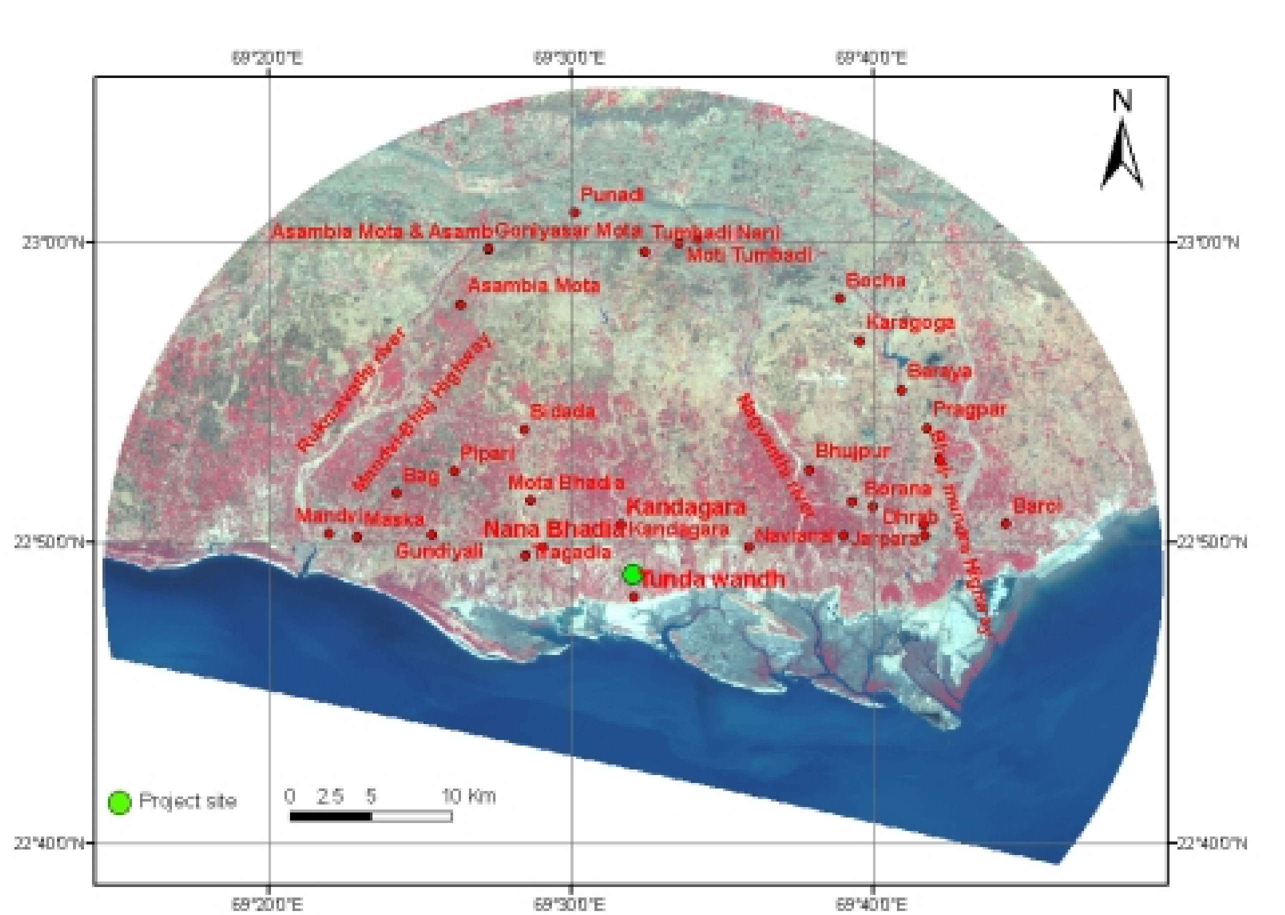
FCC image around 5 Km of the project site

Figure 2



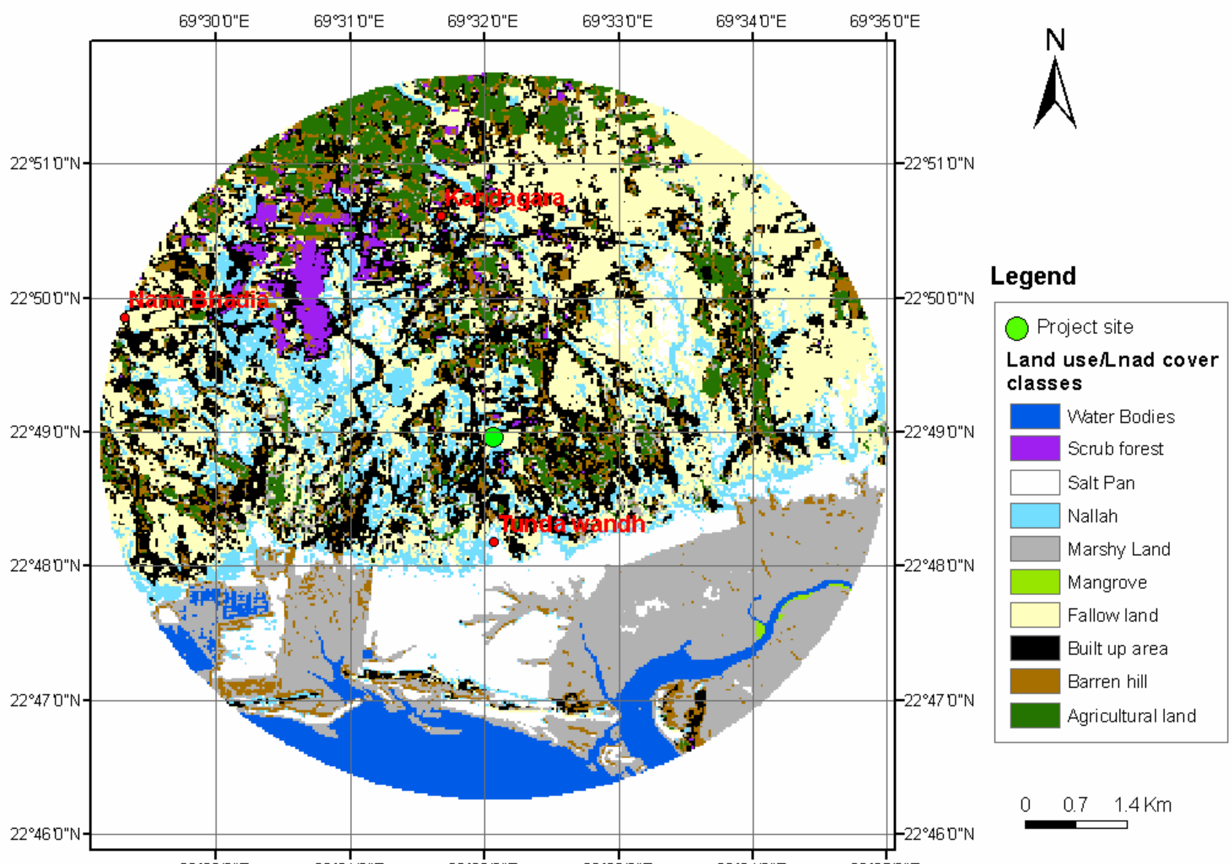
FCC image around 10 Km of the project site

Figure 3



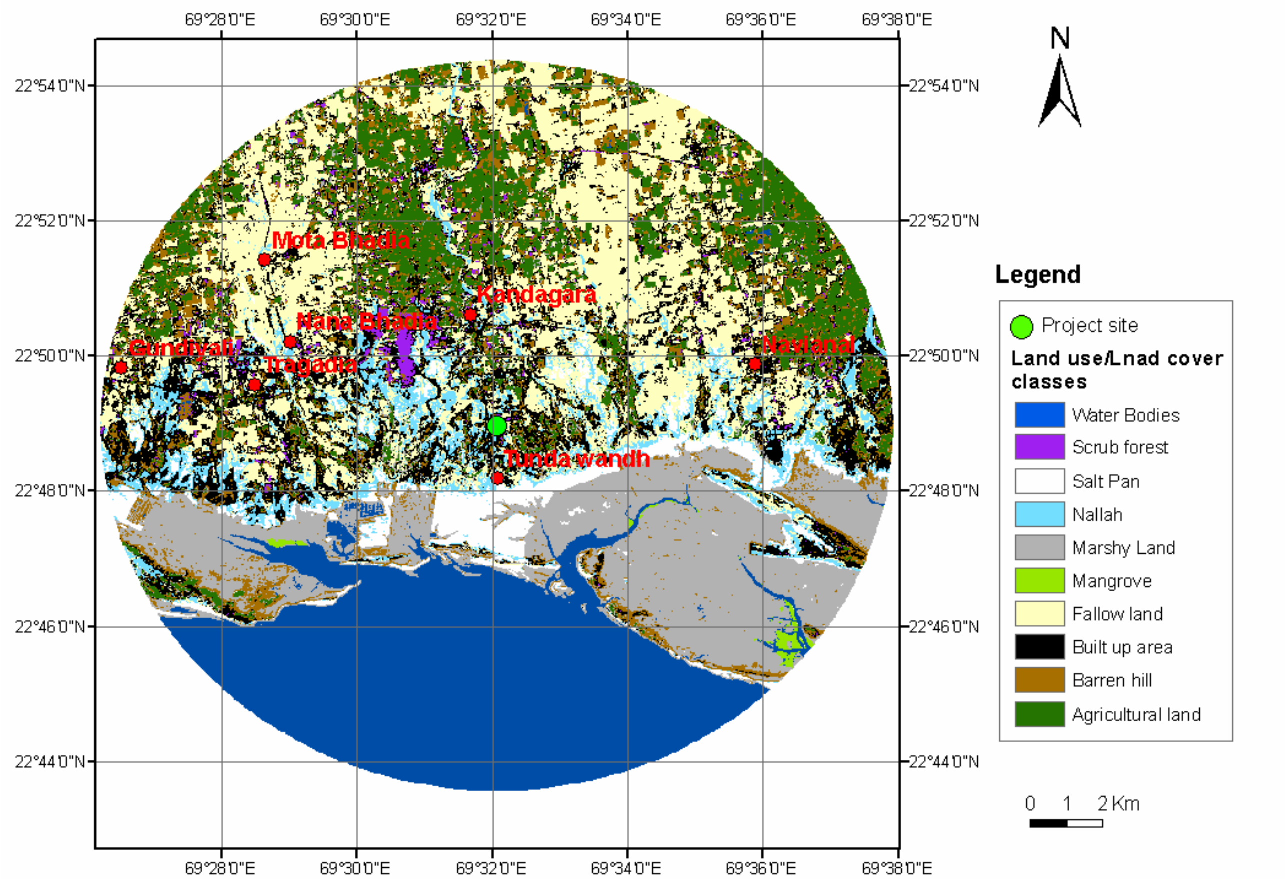
FCC image around 30 Km of the project site

Figure 4



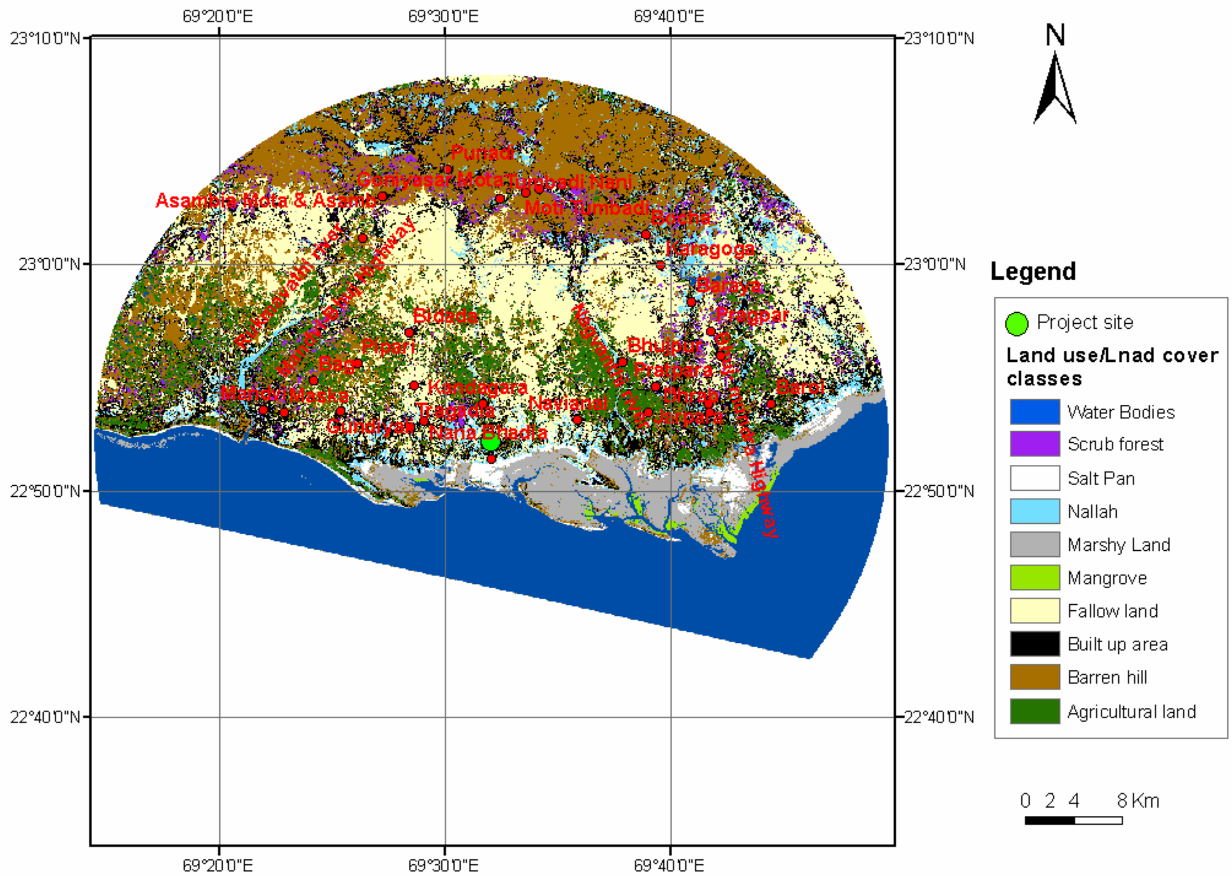
Classified image around 5 Km of the project site

Figure 5



Classified image around 10 Km of the project site

Figure 6



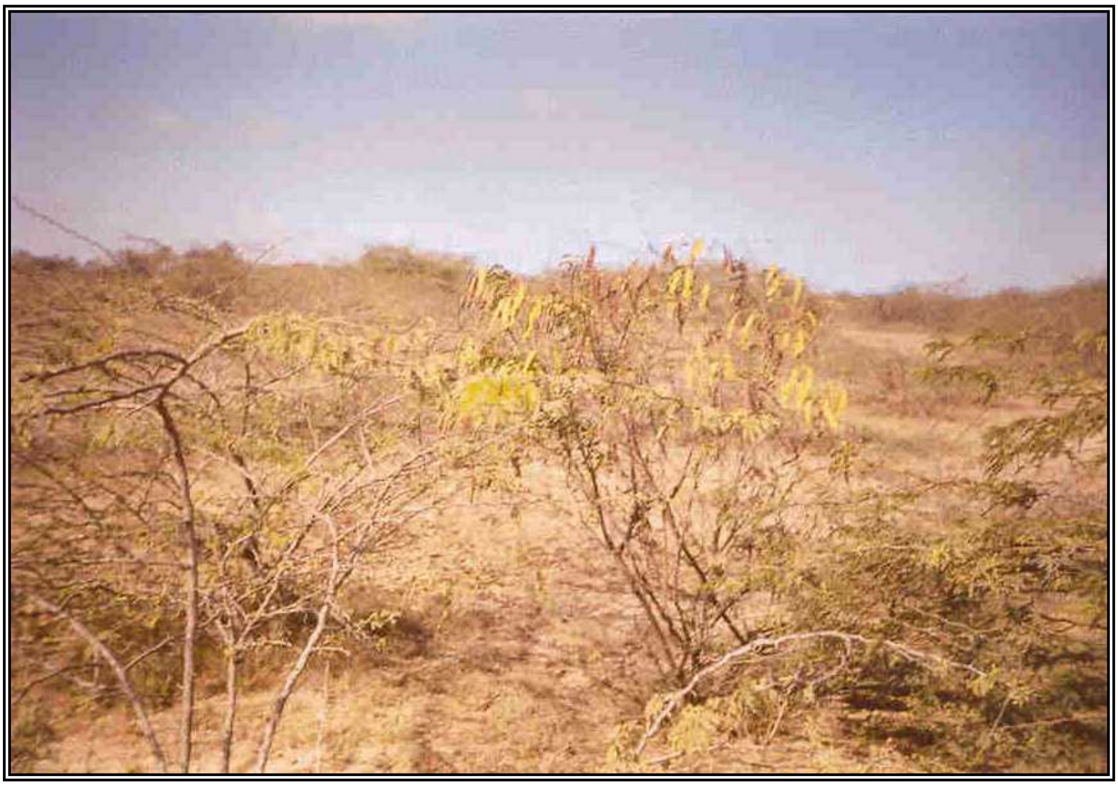
Classified image around 30 Km of the project site

APPENDIX - 17

VIEW OF BARREN PROJECT SITE AREA WITHOUT TREE AND HABITATIION

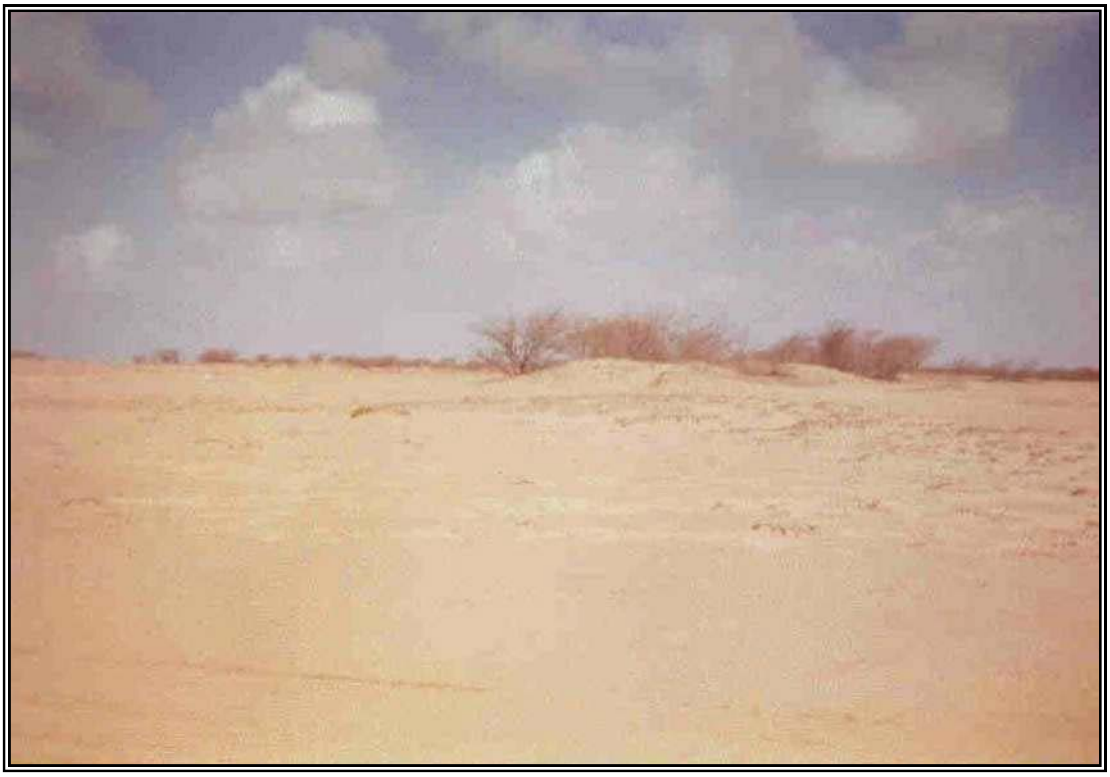
APPENDIX - 18

A TYPICAL OPEN SCRUB VEGETATION OF THE STUDY AREA



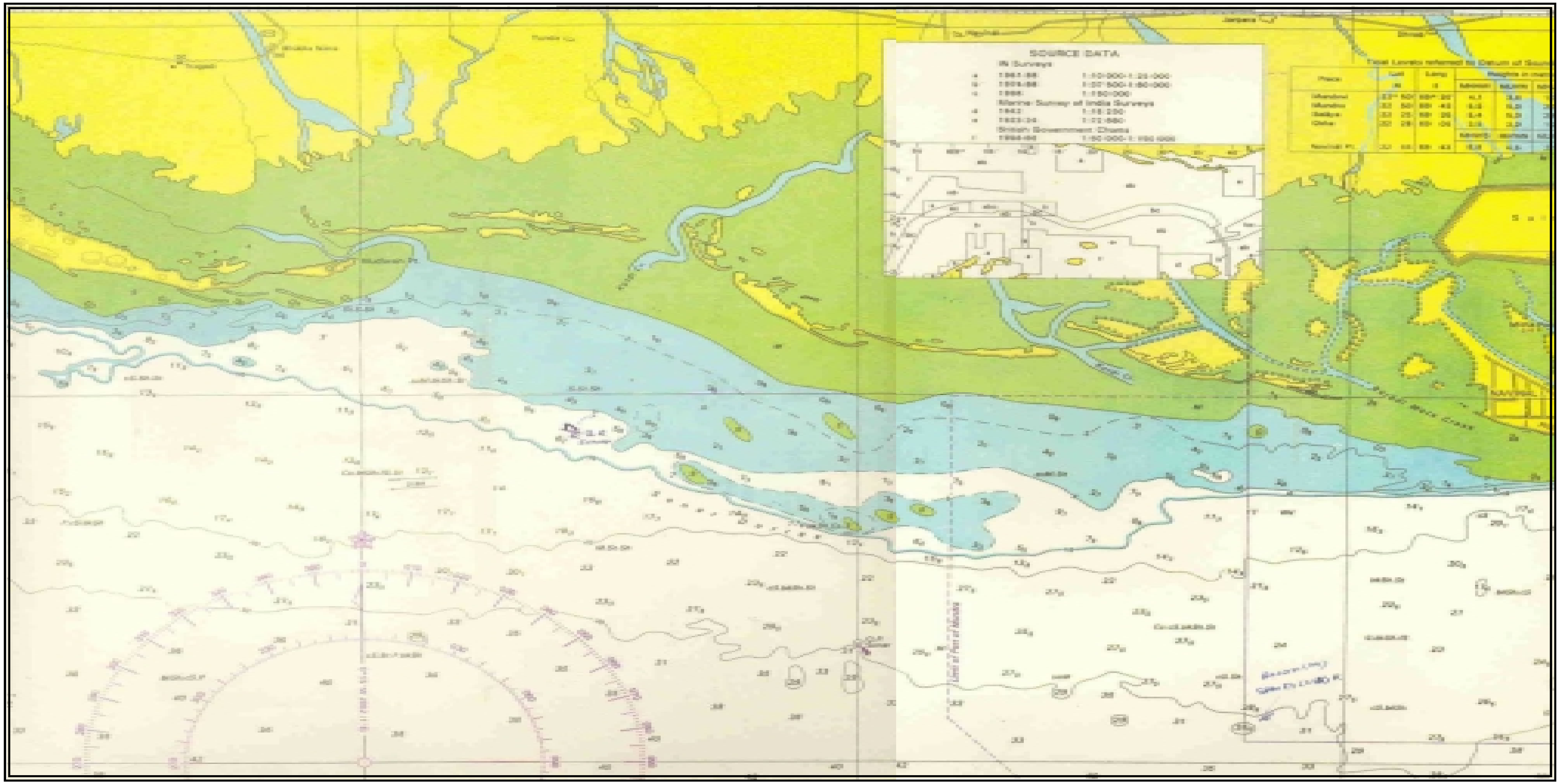
APPENDIX - 19

TYPICAL PHOTOGRAPH OF SAND DUNE AROUND THE SPECIES OF Prospis *juliflora*



APPENDIX - 20

TOPOGRAPHIC FEATURE OF THE AREA COVERED FOR MARINE ECOLOGICAL STUDY



APPENDIX - 21

THE BOATS USED FOR MARINE SAMPLING

APPENDIX - 22

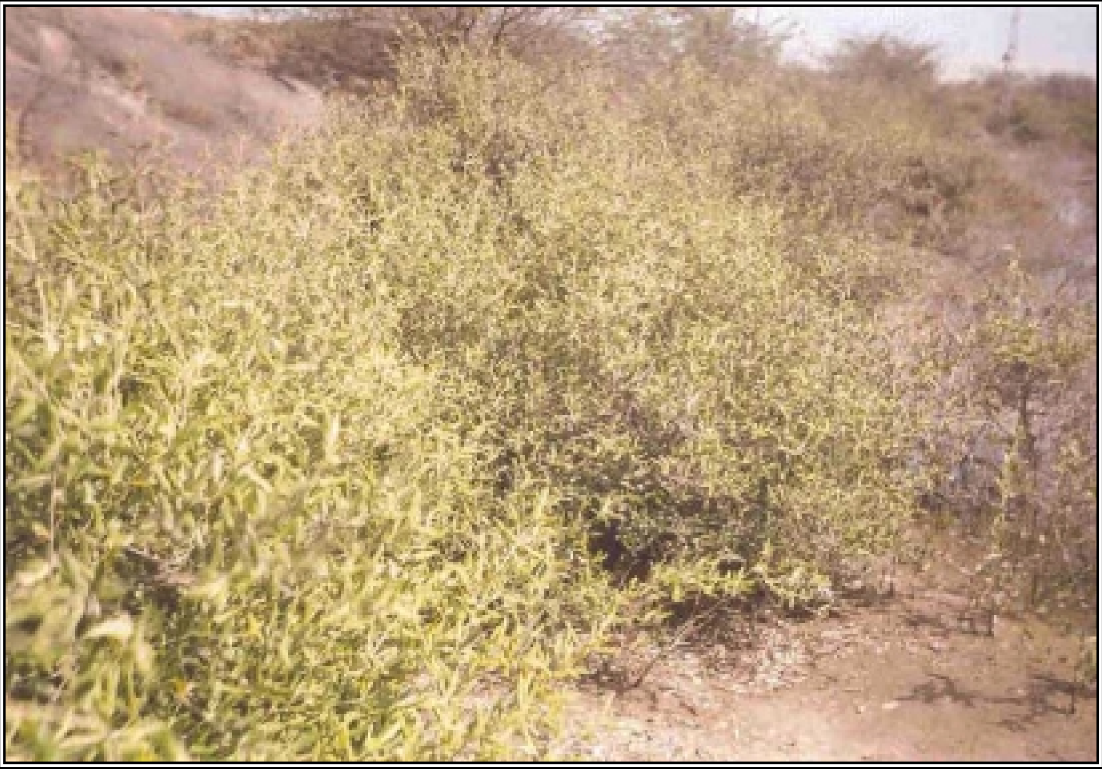
BIRDS SEEN AT MANDVI BEACH

APPENDIX - 23

A VIEW OF THE BEACH LOCATED NEAREST TO THE PROJECT SITE

APPENDIX - 24

DOMINANT MANGROVE Avicennia *marina SPECIES OF THE STUDY AREA*



APPENDIX – 25a

STABILITY CLASS AND MIXING HEIGHT FOR SUMMER 2006

Hours	Stability Class	Mixing Height
1	F	155
2	F	155
3	E	155
4	E	300
5	E	300
F	E	500
7	D	800
8	C	1500
9	C	2500
10	B	3500
11	B	5228
12	A	5228
13	A	5228
14	B	3500
15	B	2000
1F	C	2000
17	C	1500
18	E	1000
19	E	800
20	E	800
21	E	600
22	E	500
23	E	250
24	F	250

APPENDIX – 25b

STABILITY CLASS AND MIXING HEIGHT FOR POST-MONSOON 2006

Hours	Stability Class	Mixing Height
1	F	155
2	F	155
3	E	155
4	E	200
5	E	300
F	E	400
7	D	650
8	C	1100
9	C	1800
10	B	2500
11	B	2700
12	A	3150
13	A	3150
14	B	2700
15	B	2500
1F	C	2200
17	C	1800
18	E	1100
19	E	650
20	E	350
21	E	200
22	E	200
23	E	155
24	F	155

APPENDIX – 25c

STABILITY CLASS AND MIXING HEIGHT FOR WINTER 2006

Hours	Stability Class	Mixing Height
1	F	155
2	F	155
3	E	155
4	E	200
5	E	200
F	E	350
7	D	550
8	C	1000
9	C	1700
10	B	2350
11	B	2500
12	A	2850
13	A	2850
14	B	2500
15	B	2350
1F	C	2100
17	C	1700
18	E	1000
19	E	550
20	E	350
21	E	200
22	E	200
23	E	155
24	F	155

APPENDIX – 26

ENVIRONMENTAL STANDARDS FOR POWER PLANTS

(i) Thermal Power Plant : Emission Standards

Generation Capacity	Pollutant	Emission limit
Generation capacity 210 MW or more	Particulate matter	150 mg/Nm3
Generation capacity less than 210 MW	Particulate matter	300 mg/Nm3

Depending upon the requirement of local situation, such as protected area, the State Pollution Control Boards and other implementing agencies under the Environment (Protection) Act, 1986, may prescribe a limit of 150 mg/Nm3, irrespective of generation capacity of the plant.

(ii) Thermal Power Plants : Stack Height/Limits

Generation Capacity	Stack Height (Metres)
500 MW and above	275
200 MW/210 MW and above to less than 500 MW	220
Less than 200 MW/210 MW	H= 14 $Q^{0.3}$ where Q is emission rate of SO2 in kg/hr, and H is Stack height in meters, subject to a minimum of 30 meters.

Source : EPA Notification
[G.S.R. 742(E), dt. 30th Aug; 1990]

(iii) Liquid waste discharge limit

Parameter	Maximum limit of concentration (mg/l except for pH and temperature)
pH	6.5-8.5
Temperature	As applicable for other thermal power plants
Free available chlorine	0.5
Suspended solids	100.0
Oil and grease	20.0
Copper (total)	1.0
Iron (total)	1.0
Zinc	1.0
Chromium (total)	0.2
Phosphate	5.0

Source: MOEF New Delhi Notification G.S.R.7. dated 22.12.1998

APPENDIX - 27

TEMPERATURE LIMIT FOR DISCHARGE OF CONDENSER COOLING WATER FROM THERMAL POWER PLANT

A: New thermal power plants, which will be using water from rivers/lakes/reservoirs, shall install cooling towers irrespective of location and capacity. Thermal power plants which will use sea water for cooling purposes, the condition below will apply.

B: New projects in coastal areas using sea water.

The thermal power plants using sea water should adopt suitable system to reduce water temperature at the final discharge point so that the resultant rise in the temperature of receiving water does not exceed 7°C over and above the ambient temperature of the receiving water bodies.

C: Existing thermal power plants.

Rise in temperature of condenser cooling water from inlet to the outlet of condenser shall not be more than 10°C.

D: Guidelines for discharge point:

The discharge point shall preferably be located at the bottom of the water body at mid-term for proper dispersion of thermal discharge.

In case of discharge of cooling water into sea, proper marine outfall shall be designed to achieve the prescribed standards. The point of discharge may be selected in consultation with concerned State Authorities/NIO.

No cooling water discharge shall be permitted in estuaries or near ecologically sensitive areas such as mangroves, coral reefs/spawning and breeding grounds of aquatic flora and fauna.

Source: MOEF New Delhi Notification G.S.R.7. dated 22.12.1998

APPENDIX – 29

ASH UTILIZATION PLAN

Ash utilization is the need of time that check the degradation of environment and helps in meeting the stipulated environmental regulations. Ministry of Environment and Forest's notification on Ash Utilization dated 14.09.1999 stipulates that new thermal power plants shall have to utilize ash to the extent of 30% in first 3 years of commissioning and to attain 100% utilization by 9th year. Keeping in view, the above stipulation CGPL/ Power developer would consider the brief study for maximum utilization of fly ash.

The study has revealed, inter alia, there will be an annual production of 14.4 crores bricks considering 10% fly ash in making bricks. If Fal-G bricks, which utilizes pozollanastic properties of fly ash without any requirement of sintering, thus saving valuable energy as well as requirement of sintering, thus saving valuable energy as well as topsoil of this fertile land being used in making conventional clay bricks, can be economically produced and marketed. Market survey will be done at appropriate time for use of manufactured bricks through Fal-G technology.

The average annual generation of ash from the 5 x 800 MW Coastal Gujarat Power Limited Mundra shall be as under:

Coal Consumption (85% PLF)	:	11-13 Tons/annum(averge:12Million Tons/annum
Ash content in coal	:	maximum 15%
Fly Ash generation	:	1.44 Million Tons/annum
Bottom Ash generation	:	0.36 Million Tons/annum

Projected year wise utilisation of ash for proposed UMPP at Mundra is shown in Figure – A. While manufacturing Fal-G products including bricks the fly ash collected in ESP hoppers from 2^{nd} field onwards are to be used in making Fal-G mix, while coarser fly ash from other hoppers can be used as aggregate. The Bottom Ash, which normally contains more un burnt carbon and clinkers, is not suitable for conversion into useful products and, as such, can only be used for land-fill for which there is not much requirement in the area. While designing the power station, separate handling system and silos will be provided for storing bottom ash, fly ash from the hoppers of Economiser, Air heater and the 1^{st} field of ESP, and that from the hoppers of 2^{nd} field of ESP onwards separately.

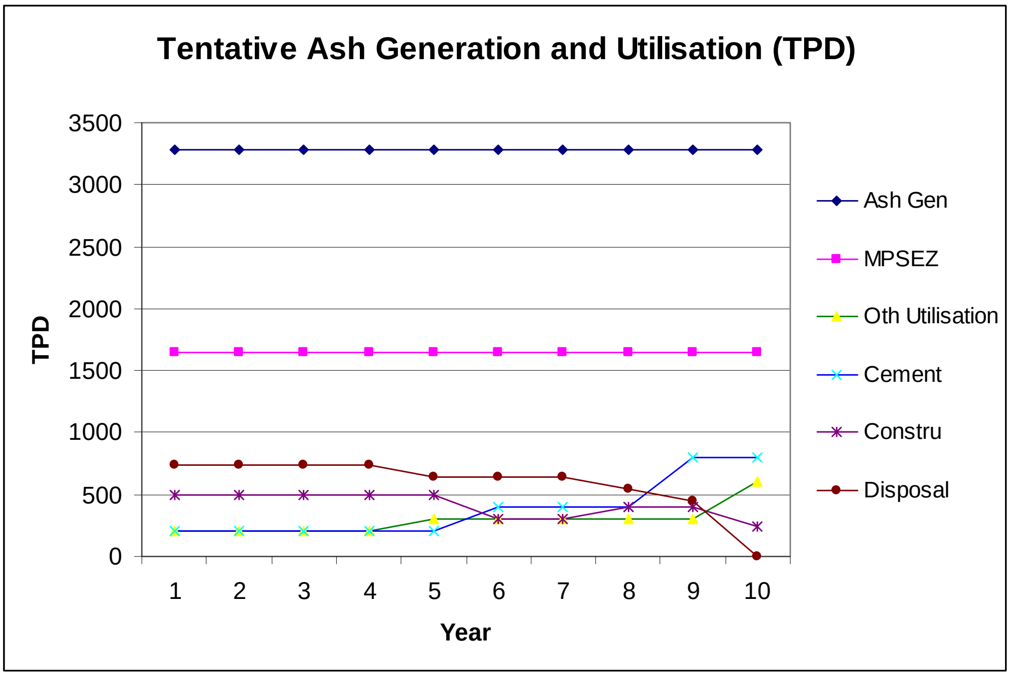
This is expected that existing manufacturers of clay bricks within the target zone may not be adverse to switch over to Fal-G brick making provided the technology is made available to them and the new product is patronized by the Government

Departments as well as certain financial incentives offered to them for the change over. Fal-G brick making process relieves the manufacturers from hassles like scarcity and high cost of coal, ever increasing cost of land and labour, large involvement of working capital, variation of weather, etc.

In fact, workshop organized at country level on Fal-G brick making evoked very positive response from the local brickmakers. If the existing brickmakers and the labour involved in the industry can be converted to Fal-G brick making it would insure against loss of employment to lakhs of labour engaged in this trade while gainfully utilizing the solid waste from the power station with the consequent protection of environment.

The approximate consumption of fly ash, both for making Fal-G mix and for using as aggregate, in manufacture of Fal-G bricks as well as for admixing in cement manufacturing grinding units are shown below. As may be seen from the calculations, 1.0 lakh MT of FA-II (ie. fly ash obtained in ESP hoppers of 2nd field onwards) and 1.67 lakh MT of FA-I (ie. fly ash of coarser variety), ie. 2.67 lakh MT of fly ash can produce 12.91 crores of Fal-G bricks of standard size (230 x 100 x 75 mm) and 3.9 Lakh MT of fly ash can produce 13 Lakh MT of cement. In order to utilize the fly ash generated at the power station as per the guidelines of the Ministry of Environment and Forest, the year-wise production of Fal-G bricks would be 12.91 crores per Lakh MT of fly ash. Tentative flysh utilisation plan is shown in following Figure:

Figure - A
Tentative Ash Utilization Plan For 5X800 UMPP



It may be considered a good prospect of utilizing total fly ash to be generated at the power station in manufacturing Fal-G bricks as well as in manufacturing of cement with its positive impacts on economy and ecology besides saving the degradation of agricultural land. However, certain logistical problems like the process available to the existing brick makers will have to be solved, technology to be made available, a certain amount of market awareness created and government patronage provided to the existing brickmakers for switching over to Fal-G brick making to make it a success.

CGPL/Power developer has to envisaged the following strategies towards achieving the objective:

I. Fly Ash utilisation in manufacturing of bricks:

(i) Fly ash will be supplied free of cost from the plant silos to any brickmaker wishing to commence Fal-G brick making.

(ii) Basic technology as well as initial expert advice for Fal-G brick making will be provided to local brick makers free of cost.

(iii) Seminars and workshops will be organized at CGPL cost to create market awareness in the large urban conglomerates like Bhuj, Mundra, Mandvi, Gandhidham etc.

(iv) The State Government will be approached to offer certain financial incentives, in line with some other States who have already done it, to the Fal-G brickmakers as well as ensuring use of Fal-G bricks in public works to the fullest extent possible. We intend to pursue the matter to bring it to a logical conclusion.

(v) CGPL/power developer intend to use Fal-G bricks in construction of our township as well as the boundary walls, various plant/non-plant buildings of our project to instill confidence in the minds of the local consumers and to provide the initial fillip to Fal-G brickmaking activity in the area from now itself. CGPL/power developer has to establish the contact to local prospective areas, so that fly ash is provided free of cost to the intending brick makers and are in the process of arranging with some of the local brick makers to produce Fal-G bricks with guaranteed that if it materializes, the local brick makers will be induced to switchover to Fal-G brick making once fly ash is available from the Power Station. This practice will enable less consumer resistance towards accepting the new product.

(vi) CGPL/power developer feels that the major constraint in spreading adoption of this technology will be availability of fly ash as well as lime and gypsum to the brick makers who are scattered all over the area. The State Government can provide valuable assistance in this respect by creating depots near large consumption centers under its auspices.

The power stations may be directed to make available the fly ash in dry form to be loaded directly on brick manufacturer trucks. This practice will reduce handling cost of fly ash for brick manufacturer. The impact of this activity on power cost will be nominal only but the activity would certainly boost fly ash utilization.

The Ministry of Environment and Forests and State pollution Control Board can play a vital role in the matter by coordinating with other concerned ministries and the State Government in taking policy level decisions.

II. Fly Ash utilisation in cement grinding units:

Fly ash utilization in cement admixing is gaining momentum and now a days cement manufacturers are setting their grinding / blending plants near thermal power stations to ensure easy procurement of fly ash. Number of such plants may come out in the future. M/s Sanghi Cement and Adani's may be the potential users of fly ash for cement manufacturing.

III. OUTLINES OF FAL-G TECHNOLOGY

Basic Technology

Fal-G is a ground blend of fly ash, lime and calcined gypsum in suitable proportions, which, upon hydration. yields strengths in the range of 200-400 kg/cm^2, rendering a water impervious hard matrix, similar to that in Portland cement.

This mix can find the following use:

(i) As an argillaceous raw material in the manufacture of Portland cement

(ii) As a pozzolona in the manufacture of Portland Pozzolona Cement (PPC);

(iii) In making different types of bricks and other building components;

(iv) As one of the ingredients of concrete mix;

(v) In the manufacture of sintered aggregates for making light-weight concrete, etc.

Fal-G Brick Manufacturing Process

Fly Ash, Lime and calcined gypsum are mixed in a Pan Mixer in the ratio of 60:30:10 approximately. This mix is then moulded into bricks either manually or mechanically kept in the open for 1-2 days for drying and then water is sprinkled intermittently for the next few days. The brick becomes ready for transportation in 6/7 days time. Brick made of pure Fal-G as above may have compression strength in the range of 275-300 kg/cm^2. which may be difficult to work within normal construction activity. Some aggregate, therefore, is usually mixed with the

Fal-G mix to arrive at a strength of around 150 kg/cm^2. These aggregates can be coarse sand, crusher dust, clay or even coarse fly ash (with low carbon content).

The quality of Fal-G mix will depend on the quality of fly ash to be used. It has been found that fine partials of fly ash from modern thermal power plants where abrupt cooling of flue gas takes place in economizer/air heater zone, and collected by dry process is best suited for the mix design. Fly ash collected from economizer/air heater and 1St field of ESP, which is generally coarse, can be used as aggregates in making of Fal-G bricks.

IV. Conversion of Fly Ash into Fal-G Brick

The mix ratio of Fal-G is Fly Ash: Lime: Gypsum: : 60:30:10
Therefore, 1 tonne of Fly Ash will produce 1/0.6=1.67 tonnes of fal-G
Or, 1.00 lakh MT of Fly Ash will make 1.67 lakh MT of Fal-G mix:
Using coarse fly ash as aggregate in proportion of 1: 1, this mix will consume further 1.67 lakh MT of Fly Ash.

The density of this mix considered to be 1.5 gm/cc.
:. The resultant mix of 3.34 lakh MT will produce brick of volume:
$3.34 \times 10^5/1.5 = 2.226$ lakh cu.m.
The volume of each brick of standard size is
:230 x 100 x 75 mm=1725 cc = 0.001725 cu.m.
:. 1 cu.m. of mix will produce 1/0.001725 = 580 nos. bricks.
:. 2.226 lakh cu. m. of mix will produce $2.226 \times 10^5 \times 580$
= 1291 lakh bricks
= 12.91 crore bricks

3288 TPD for 5X800 MW TPP units
CGPL : 3333x360 = 1.2 MTPA
10 % of generated fly ash has been considered for brick manufacturing = 0.12 MTPA
Therefore, total number of bricks production per year = 12.91x0.12 MTPA = 1.55 Crore bricks

APPENDIX – 30

PROSPECTS OF BUIK USE OF FLY ASH IN AGRICULTURE & WASTELAND MANAGEMENT - INITIATIVES OF FLY ASH MISSION

Vimal Kumar
Adviser (Fly Ash) &
Scientist 'G'

Gulab Singh
Sr. Project Officer

FLY ASH UTILISATION PROGRAMME
Technology Information, Forecasting & Assessment Council (TIFAC)
Department of Science & Technology
New Delhi - 110016

ABSTRACT

Approximately 260 million tonne of coal is consumed per annum by 82 utility thermal power plants (TPPs) in India (2003-04). It constitutes nearly 70 per cent of the total power generation which, in turn, produced 108 million tonne of fly ash* per annum. The annual generation of fly ash is projected to exceed 175 million tonne per annum by 2012 (considering the plans to double the power generation over next 10 years). This large volume of fly ash occupies large area of land and possesses threat to environment. As such, there is an urgent and imperative need to adapt technologies for gainful utilisation & safe management of fly ashes on sustainable basis.

Realising the importance of the subject matter, Fly Ash Mission (FAM) was commissioned by the Govt. of India in 1994, with Department of Science & Technology (DST) as the Nodal Agency and Information, Forecasting and Assessment Council (TIFAC), an autonomous body under the aegis of DST as the Implementing Agency in close cooperation with Ministry of Power (MoP) & Ministry of Environment & Forests (MoEF) to undertake Technology Demonstration Projects for creating awareness / confidence building in ash utilisation / safe management technologies inter alia development and up-scaling of relevant technologies of fly ash. Agriculture and related applications have emerged as one of the potential bulk

* Unless otherwise stated "fly ash" represents total ash generated at TPP consisting of (i) hopper ash / dry ash (ii) economizer ash (iii) preheater ash (iv) bottom ash. Un-utilised ashes are generally put in lagoons / ash ponds in the form of slurry and are known as pond ash.

utilisation areas for fly ash. Due to concerted efforts of Fly Ash Mission, the utilisation of pulverised fuel ash that has increased from 1 million tonne per year in 1994 to 32 million tonne in year 2004 has also gathered considerable momentum to reach higher levels with appropriate support & facilitation which is graphically presented below:

Fig 1 Ash generation and utilisation

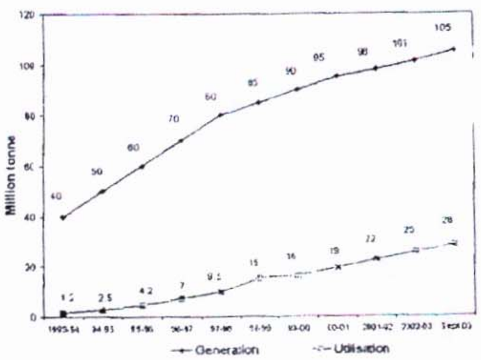
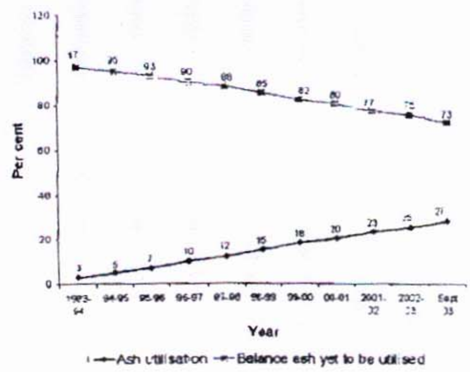
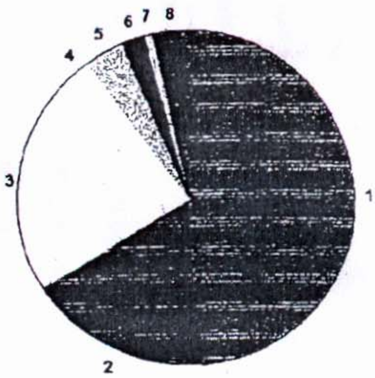


Fig 2 Percent Ash Utilised & Balance ash left for Utilisation



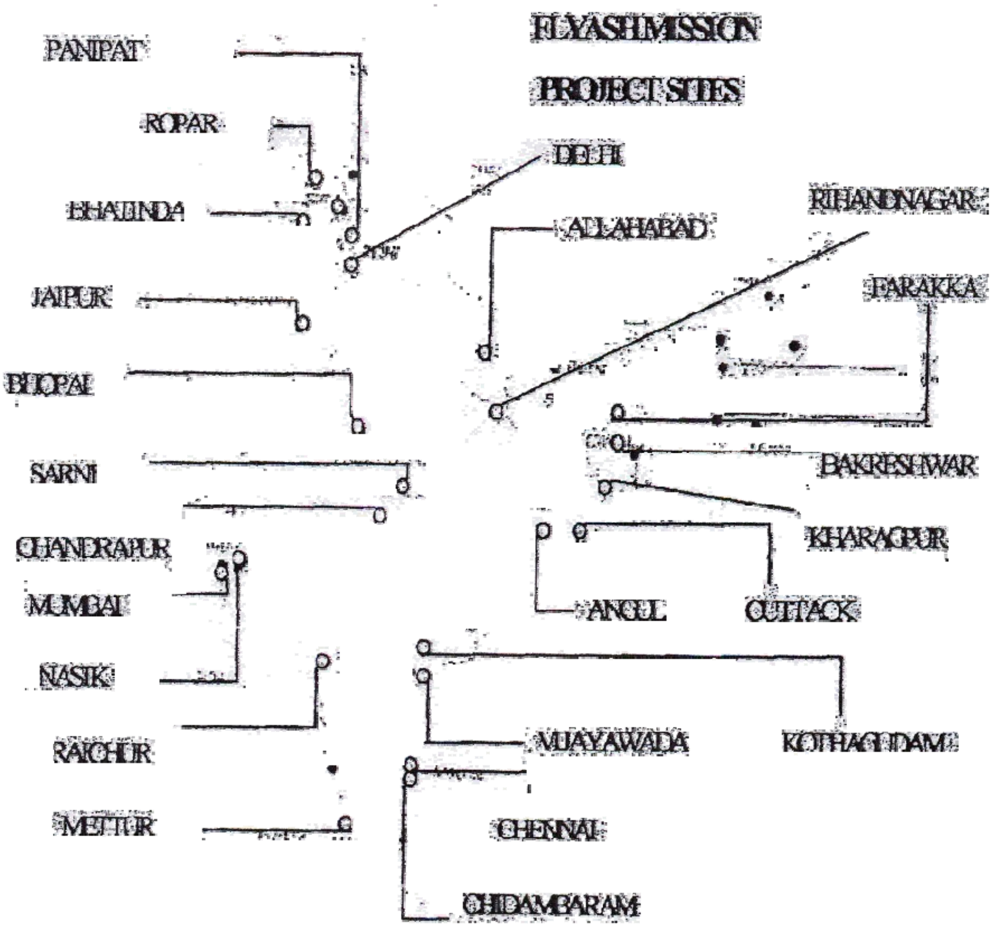
Utilisation Areas – 2004
Total utilisation ~ 32 MnT / year

1	Cement Manufacture / Substitution	- 49%
2	Low Lying Area Fill	- 17%
3	Roads & Embankments	- 22%
4	Brick Manufacturing	- 2%
5	Dyke Raising	- 4%
6	Minefills	- 2%
7	Agriculture	- 1%
8	Others	- 3%



Technology demonstration projects commissioned by Fly Ash Mission on use of fly ash in agriculture

The focus of project was "To develop empirical data on the effect (beneficial as well as possible adverse) of fly ash / pond ash application in terms of crop growth & yield, status of macro & micro-nutrients; heavy metals & toxic elements and radioactivity of soil, plant produce and water". Accordingly, FAM commissioned 15 R & D projects with fly ash at 55 project sites alongwith different R & D Institutes / Universities and farmers as given below in the map.



The technology demonstration projects carried out in (a) agriculture sector, (b) forestry sector for wasteland management, (c) reclamation of saline-alkali soil / eroded land / ash pond & (d) nutritional quality of crop produce obtained from various field demonstration sites are as follows:

(a) Technology Demonstration Projects undertaken at various sites in the area of agriculture sector

Field crops & vegetables grown with fly ash in different soil types at various project sites are as follows:

S.N.	Soil	Fly ash doses range	Crops & No. of Sites	Location	Executed by
1	Alluvial Soil	0-200 t/ha	Rice, wheat (2)	Farakka	CFRI, Dhanbad
2	Alluvial Soil	0-100 t/ha	Mustard, jute (1)	Farakka	CFRI, Dhanbad
3	Laterite Soil	0-200 t/ha	Rice, wheat (4)	Bakreshwar	CFRI, Dhanbad
4	Laterite Soil	0-100 t/ha	Mustard, Potato, Lentil (1)	Bakreshwar	CFRI, Dhanbad
5	Black Soil	0-50 t/ha	Sugarcane	Chidambaram	Annamalai University
6	Laterite Soil	0-150 t/ha	Groundnut	Neyveli	Annamalai University
7	Laterite Soil	0-100 t/ha	Sugarcane	Neyveli	Annamalai University
8	Black Soil	0-150 t/ha	Rice-Green Gram (1)	Sathamangalam	Annamalai University
9	Black Soil	0-120 t/ha	Cotton-Rice (1)	Vellampudugai	Annamalai University
10	Lateritic Soil	0-10 t/ha	Rice-Groundnut (3)	Kharagpur	IIT-Kharagpur
11	Lateritic Soil	0-20 t/ha	Rice, Groundnut-Mustard (1)	Kharagpur	IIT-Kharagpur
12	Lateritic Soil	0-30 t/ha	Mustard-Rice (1)	Kharagpur	IIT-Kharagpur
13	Lateritic Soil	0-10 t/ha	Rice (2) –Mustard, Groundnut, Potato (1)	Balarampur, Gholghoria, Burari	IIT-Kharagpur
14	Lateritic Soil (Red)	0-80 t/ha	Sunflower-Groundnut (2)	Raichur	CAS, Raichur
15	Black Soil	0-80 t/ha	Sunflower-Maize (2)	Raichur	CAS, Raichur
16	Alluvial Soil	0-650 t/ha	Tomato (1), Cabbage (1), Potato (1), wheat (2), Pea (1) – Maize (6), Wheat-Maize (2)	Dhodhar, Nilgiri, Rihand Nagar	RRL, Bhopal
17	Alluvial Soil	0-650 t/ha	Sunflower (1), tomato (1), Potato (1), Wheat (1), Berseem (1), Red Gram (1), Maize (1), Rice (1)	Nilgiri, Rihand Nagar	RRL, Bhopal
18	Alluvial Soil	0-40/0-80 t/ha	Rice-Wheat (1), Cotton-Wheat (1), Sunflower-Maize (1) Wheat-Rice (1)	Ropar, Bhatinda	PAU Ludhaina
19	Alluvial Soil	0-12 t/ha	Wheat	Ropar (Astalpur)	PAU Ludhaina
20	Alluvial Soil	100% ash body with 7.5 cm soil cover	Arhar-Wheat (1)	Bhatinda	PAU Ludhaina
21	Black Soil	0-640 t/ha (Residual Effect)	Wheat-Maize, Soyabean-Maize, Lemon Grass (1)	Sarni	RRL, Bhopal
22	Alluvial Soil	0-640 t/ha	Maize-Onion, Rice-Sunflower (1)	Angul	RRL, Bhopal

(b) Projects undertaken at various sites in the area of forestry sector for wasteland management

Various forestry species grown with fly ash in wasteland at various sites are as follows :-

S.N.	Soil/Land Type	Fly ash doses range	Tree Species & No. of Sites	Location	Executed by
1	Laterite Soil	0-240 t/ha	Eucalyptus (1)	Chaudwar, Cuttak	TCRDC, Patiala
2	Laterite Soil	0-24% of pit volume	Eucalyptus, Acacia auriculiformis, Casurina equisetifolia, Acacia mangium (1)	Durga Prasad, Cuttack	TCRDC, Patiala
3	Alkali-Saline Eroded land (in Arid Zone)	0-20% v/w	Eucalyptus, Zizyphus, Jojoba (1)	Jaipur	TERI, New Delhi
4	Ash Pond	-	Melia azadirach, Delbergia Sisso, Eucalyptus sp., Populus deltoides (1)	Badarpur	TERI, New Delhi
5	Low Fertile Soil	1/3 Pit volume	Ceiba pentandra, Melia azadirach, Cassia siamea, Erythrina indica, Cassia glauca, Bauhinia purpurea, Putranjiva, Pongamia glabra, Thevetia elifera (1)	New Delhi	TERI, New Delhi

(c) Project undertaken at various sites on reclamation of Saline-Alkali Soil / Eroded Land / Ash Pond:

Different crops, forestry / floriculture species grown on saline-alkali soil / eroded land / ash pond at different project sites are as follows :

S.N.	Soil/ Land Type	Fly ash doses range	Crops/Tree Species	Location	No. of Sites	Executed by
1.	Usar	0-5%	Rice-Wheat	Dailapur	1	IFFCO, Phulpur
2.	Usar	0-5%	Rice-Wheat	Tardih	1	IFFCO, Phulpur
3.	Usar	0-5%	Rice-Wheat	Yakubpur	1	IFFCO, Phulpur

Contd.

4.	Usar	0-6%	Rice-Wheat	Purisudi	1	IFFCO, Phulpur
5.	Usar	0-6%	Rice-Wheat	Parasinpur	1	IFFCO, Phulpur
6.	Usar	0-6%	Rice-Wheat	Mobarukpur	1	IFFCO, Phulpur
7.	Alkali Saline Eroded Salt Affected	0-20%	Eucalyptus, Jojoba, Zizyphus	Chaksu	1	TERI, Jaipur
8.	Ash Pond	-	Rajnigandha, Tagetus Carnation, Palmarosa and Sunflower	Badarpur, New Delhi	1	TERI, New Delhi

(d) Project undertaken on nutritional quality of crop produce at National Institute of Nutrition (ICMR) is as follows:

Crop produce namely cereals (rice & wheat), pulses (pea), oilseeds (mustard & groundnut), vegetables (potato, tomato & cabbage) grown on fly ash treated plots and control plots (without fly ash) at various project sites as at (a) above were taken up for the nutritional study with the following scope:

(i) To evaluate the nutritional quality and heavy metal content of the agriculture produce.

(ii) To assess the growth promoting activity between samples of agriculture produce obtained with or without fly ash application.

To achieve (i) & (ii) above, the food crops grown with or without fly ash (control) were analyzed for:

1. Nutritive value : Moisture, protein, fat, energy, ash, carbohydrate, crude fibre, vitamins and trace element content.

2. Heavy metal content : Pb, Cd, As and Cr.

3. Growth promoting activity in weanling rats, after feeding for 6 months at 90% level (food).

4. Hematological and histopathological changes in different tissues collected from animals fed on diets containing food grains grown either on fly ash treated plots or on control plots.

APPENDIX- 31
Questionnaire for Fly Ash Management

Sr.No	Description	Details
1	Name of the Potential User/Firm/ Company	1.) Sanghi Cement, which is 120 Km from Bhuj. 2.) Concrete Block and Pavers block production next to GAPL port gate.
2	Name of the respondent	-------------------------------------
3	Suppliers of existing fly ash	AEC (Ahmedabad Electric Corpoartion), Ahmedabad
4	Willingness for use of fly ash	Depends on future demand.
5	Address/Location	1) Sanhgi Cement, Moti Bher, Abdasa, Taluka Naliya. (120 Km from bhuj) 2) PMC, block manufacturers, GAPL gate. (Part of ADANI GROUP)
6	Distance from the Project Site	35 Kms from project site to GAPL
7	Route for transportation	at present possibly by road SH-6 from site to GAPL
8	Potential form of utilization	Utilized for manufacturing of Concrete Block and Paver Block.
9	Current usage, if any	Currently they are using in proportion of 40% of the total constituents.
10	Possible usage (t/month)	176 t/month
11	Likely mode of transportation	Possibly by road.
12	Possible quantity	--------------------------------------
13	No. of Years for possible utilisation	Depends upon future demand of paver blocks.
14	Mode of transport/ Distance from existing facility	-------------------------------------
15	Storage area available	------------------------------------

APPENDIX-32

ANNEXURE-7

सत्यमेव जयते

प्रारुप एक

Form 1

निगमन का प्रमाण पत्र

Certificate of Incorporation

सं० U40102DL2006GOI146110 192 6 1927

No. U40102DL2006GOI146110 2005 - 2006

कोस्टल गुजरात पॉवर लिमिटेड ।

मैं एतद् द्वारा प्रमाणित करता हूँ कि आज ....

कम्पनी अधिनियम 1956 (1956 का 1) के अधीन निगमित की गई है और यह कम्पनी परिसीमित है।

I hereby certify that Coastal Gujarat Power Limited

is this day Incorporated under the Companies Act, 1956 (No. 1 of 1956) and that the Company is Limited.

मेरे हस्ताक्षर से आज ता० 21 माघ, 1927 को दिया गया।

Given under my hand at NEW DELHI this TENTH

day of FEBRUARY TWO THOUSAND AND SIX

(विष्णु काटकर)

सहायक

Asst.

कम्पनी रजिस्ट्रार

Registrar of Companies

रा. रा. क्षेत्र दिल्ली एवं हरियाणा

N.C.T. OF DELHI & HARYANA

4000 MW IMPORTED COAL FIRED MUNDRA ULTRA MEGA THERMAL POWER PROJECT

COASTAL GUJARAT POWER LIMITED, NEW DELHI

(A wholly owned subsidiary of Power Finance Corporation Limited)

Socio - Economic Assessment Study Report

Submitted by

TCE Consulting Engineers Limited

In Association with

Services for Multi-disciplinary Applied Research & Training

August 2006

CONTENTS

CONTENTS

CONTENTS

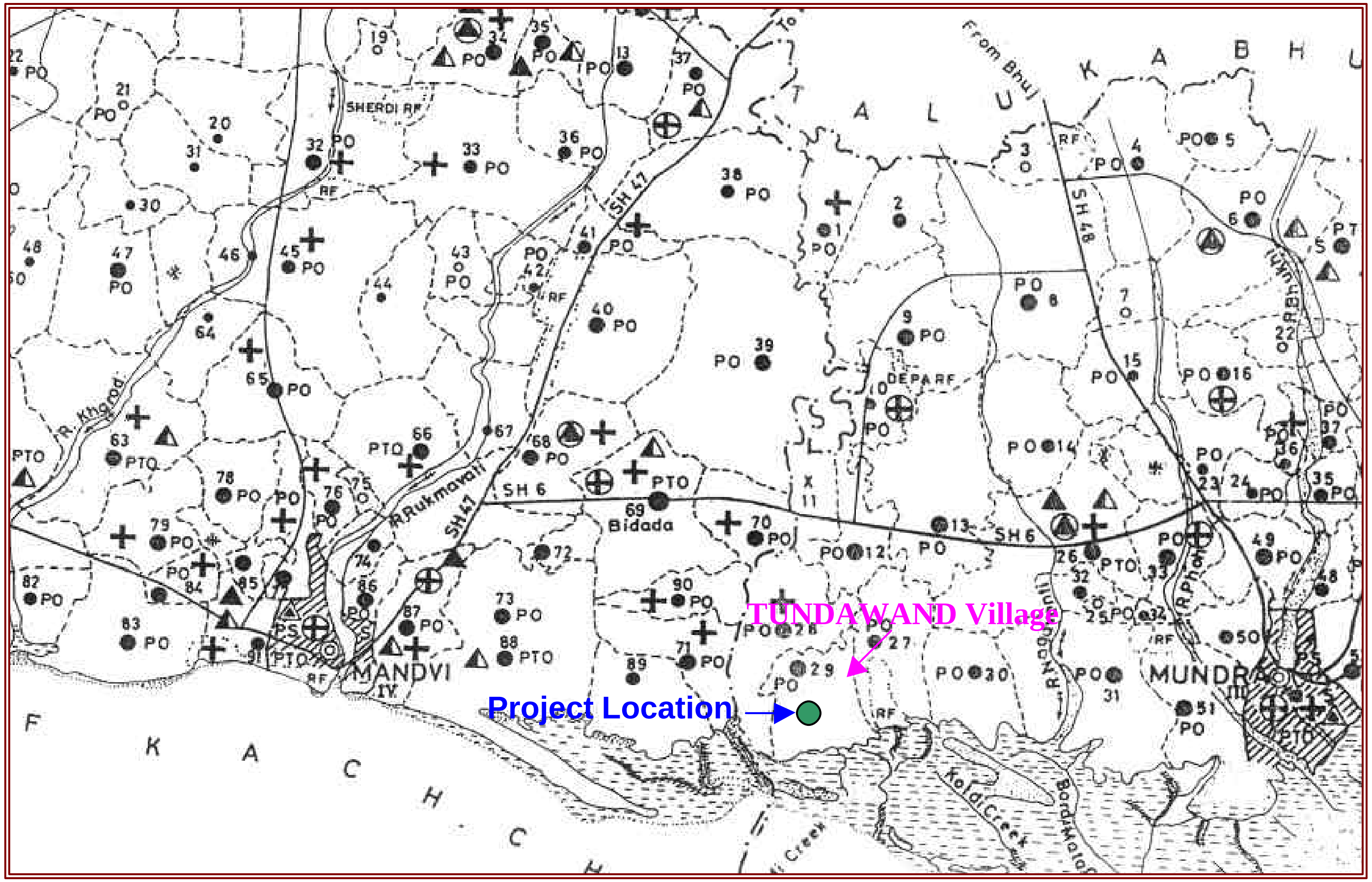
List of Figures **Page No.**

CONTENTS

List of Figures | **Page No.**

CONTENTS

Map No.1
Map showing Villages of Mundra and Mandvi Taluka in the Study Area



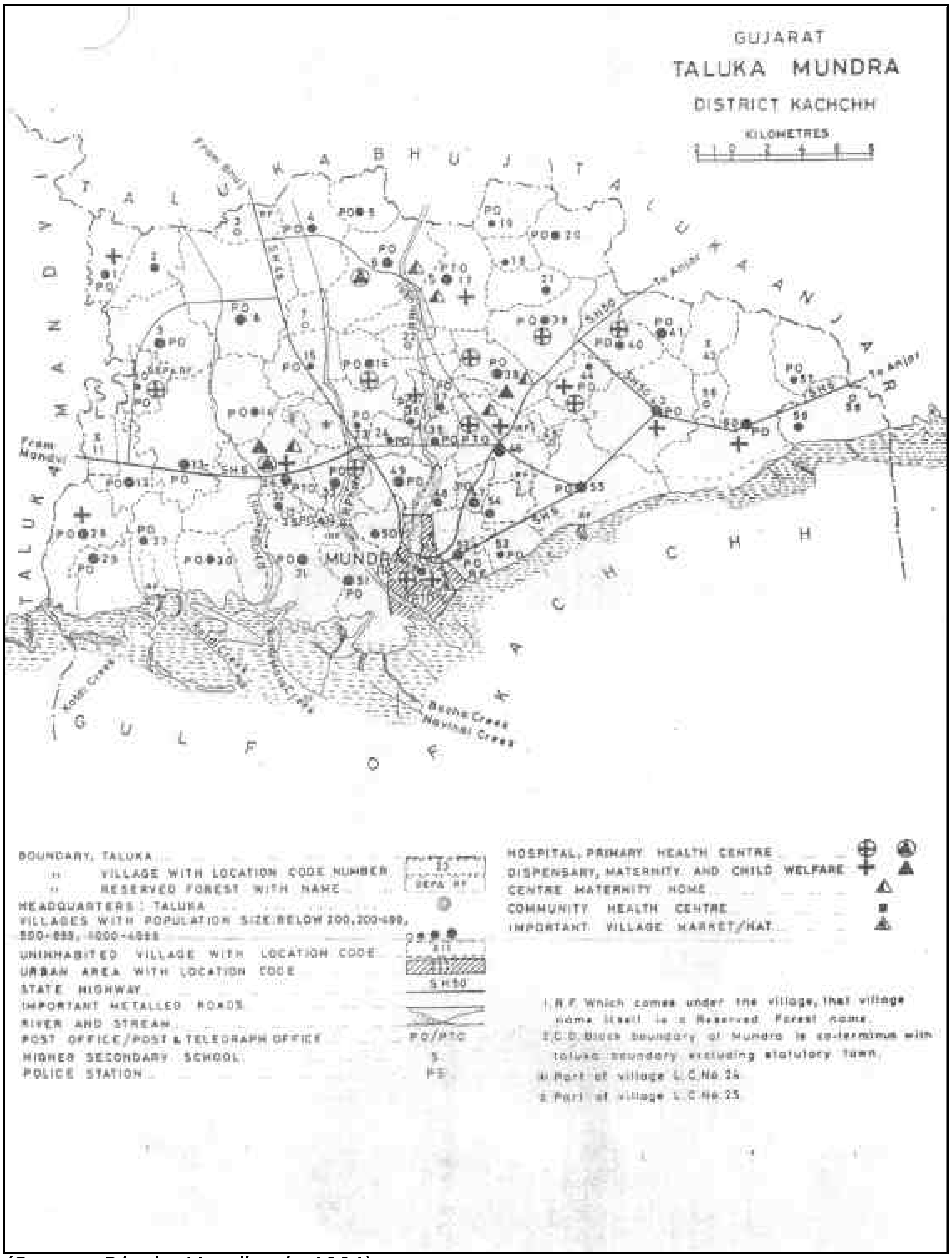
Mandvi Taluka
Bag
Bidada
Faradi
Gundiyali
Maska
Mota Bhadiya
Nana Bhadiya
Nani Khakkar
Pipari
Tragadi

Mundra Taluka
Deshalpur
Jarpara
Kandagara Mota
Khakhar Moti
Moti Bhujpar
Nani Bhujpar
Navinal
Pratappar
Shiracha
Tunda

(Source: District Handbook, 1991)

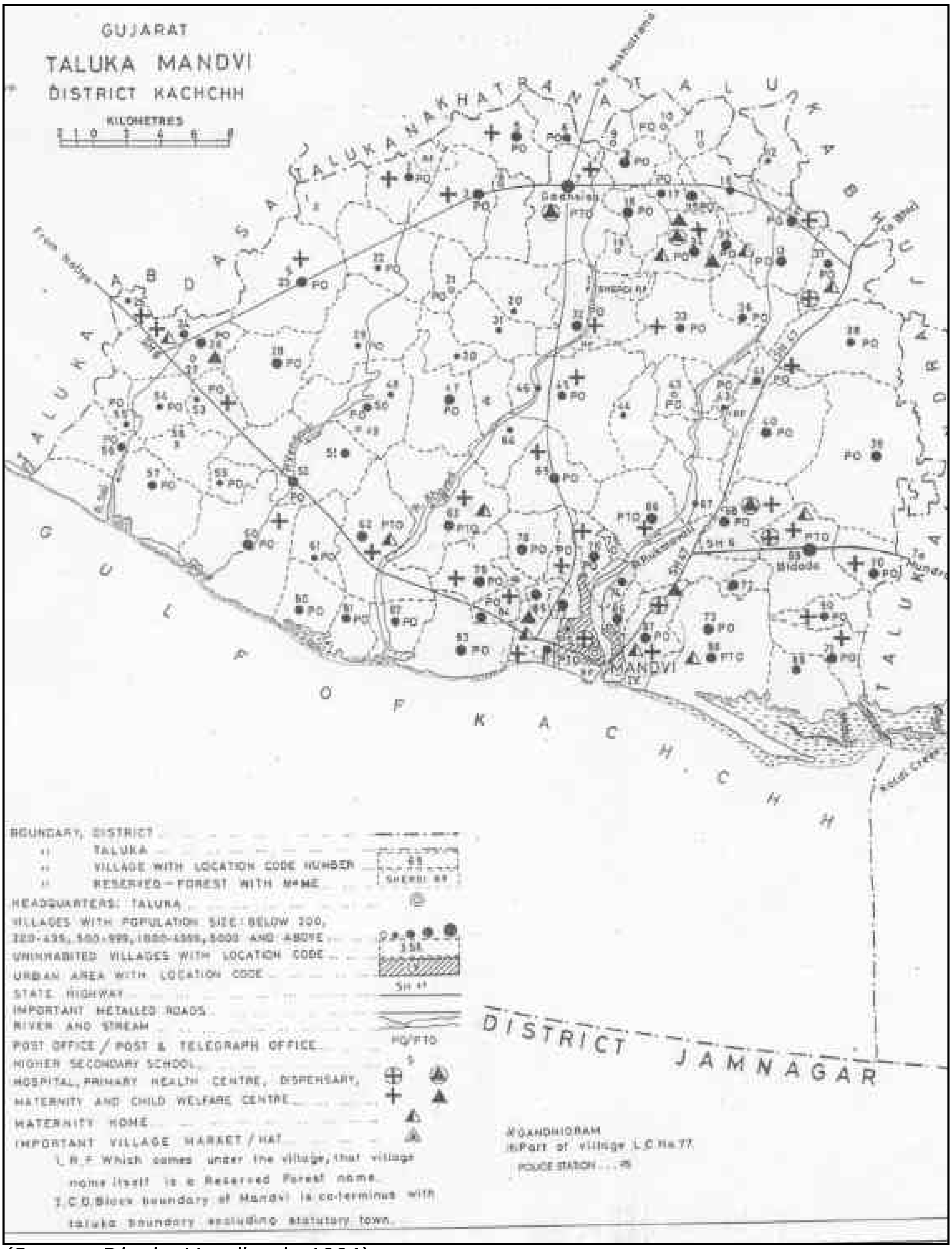
Map No.2
District Kachchh

Map No.3
Taluka Mundra



(Source: District Handbook, 1991)

Map No.4
Taluka Mandvi



(Source: District Handbook, 1991)

COASTAL GUJARAT POWER LIMITED

SOCIO-ECONOMIC ASSESSMENT SURVEY

Introduction

The Coastal Gujarat Power Limited (A wholly owned subsidiary of Power Finance Corporation (PFC)) has entrusted the task of studying the feasibility of a coal based 8X500 MW ultra mega power plant in the Mundra Taluka of Kutch district of Gujarat to TCE Consulting Engineers Ltd, Bangalore. As a part of this feasibility study, it is aimed at studying the socio-economic aspects of the area in which the plant is proposed to be located. It is also envisaged that this study will establish the baseline condition, access the social-economic impacts due to land acquisition and project activities, establish the number of impoverishment risk to find out the most vulnerable section of society if any and suggest the action which could be initiated immediately to cope up these issues. It will point out the likely impact of the Power Plant on the population, life style, agriculture and cattle and will suggest measures for mitigation of the adverse impact, if any. Considering the views mentioned in former line, the study has been carried out.

Figure No.1
Proposed Site for the Ultra Mega Power Plant near Tunda

The information needed for this study has been collected from primary as well as secondary sources. For secondary information, the Census reports of years 1991 and 2001 have been referred. For collecting primary data, a socio-economic survey questionnaire was circulated to the Gram Panchayat officials of the villages in Mundra and Mandvi Taluka. These questionnaires were filled by Gram Panchayat officials/ Sarpanch and their feedback were received by us. A copy of the questionnaire designed for this study is enclosed in the last pages of report as one of the appendix. Apart from the above methodology, a reconnaissance survey to the study area was also made and information was gathered from the villagers, agriculturists, traders, milkmen and Panchayat officials. The information collected was analysed and has been presented in this report. At the end of the report, likely impact of the power plant along with measures for mitigation has been presented for two stages of the plant viz. 'During the Construction Phase' of the plant and 'After the Plant becomes Operational'.

History of Kuchchh

The site of the PFC's coal based thermal power plant is located near two villages Tunda and Wandh in Mundra taluka of Kuchchh district in the state of Gujarat. The district of Kuchchh derives its name from the sea creature Kachhua (Tortoise/Turtle), because of its shape. The Kuchchh region lies between Sindh (now in Pakistan) and Saurashtra. The history of Kuchchh may roughly be divided into two periods, ancient and modern; before and after the Samma of Jadeja conquest about the beginning of 14th century. It was the conquest of Kuchchh by the Sind tribes of Samma Rajputs that marked the emergence of Kuchchh as a separate Kingdom in 14th century. The modern history of Kuchchh dates from the conquest by Sind tribes of Samma Rajputs. According to Sind historians in about 1530, Shah Hussain entered Kuchchh and inflicted on the Rao a severe defeat. At that time, the representatives of the three branches of the Jadeja family were Jam Dadarji, Jam Hamirji and Jam Raval. During the time of Moghul Emperor Jahangir, Bharmal went to Ahmedabad to pay his respects and made 'Nazarana' (presentation). Jahangir was much pleased with him, gave presents in return, and freed Kuchchh from tribute on the condition of giving pilgrims a passage to Mecca. The present district of Kuchchh is formed of the former native state of Kuchchh and 10 enclave villages of the former native state of Morvi. After 1947, it was a part 'C' state administered by the Government of India through the Chief Commissioner. (Reproduced in parts from District Census Handbook: Kachchh District; Census of India 1991)

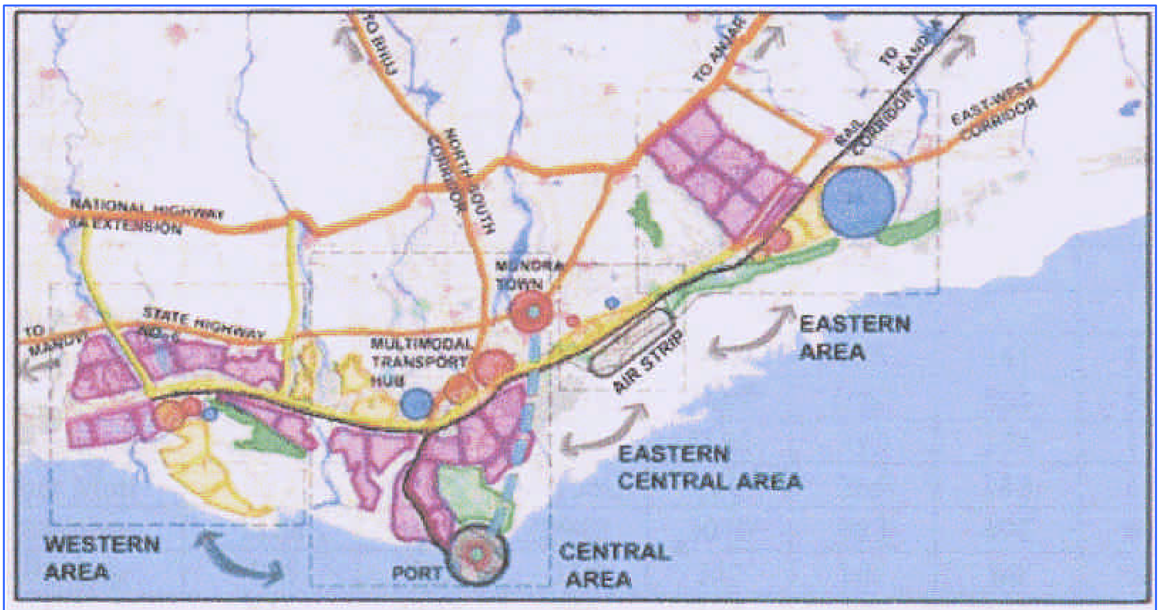
The district of Kuchchh consists of nine talukas (tehsils) viz. Bhuj, Mundra, Mandvi, Abdasa, Lakhpat, Nakhatrana, Rapar, Bhachau and Anjar. The PFC power plant will be located in the Mundra taluka near the villages Tunda and Wandh at a distance of about 25 Kms from the Mundra town. The seat of the Jadeja rulers is located in Bhuj town at a distance of 60 Kms from Mundra. There are five ports in the Kuchchh district viz. Kandla, Mandvi, Mundra, Jakhau and Koteshwar. Of these, Kandla is a major port administered by the Kandla port trust. Mundra is a private port owned by M/s Gujarat Adani Port Ltd (A Joint venture of Gujarat Maritime Board and Adani Group). Fertilizers, sulphur, imported coal, iron scrap and dets, wool and food grains are the main items of import at these ports where as onion, salt and bentonite are the principal items of export through these ports.

Figure No.2
River Nagmati in Mundra Taluka within Study Area

Population Characteristics

The project area within 10 km. radius of the proposed Power Plant consists of 20 villages of which 10 are located in Mundra taluka and 10 in Mandvi Taluka. The site of Power Plant is situated in Mundra Taluka and is located at a distance of 25 Km from Mundra town. The list of villages in Mundra and Mandvi taluka is given below with the number of households, population, number of males and females, etc according to Census 2001.

Figure No.3



Location of Mundra Port

A Ship at Mundra Port

Table No.1
Population Distribution within the Study Area (within 10 kms) (2001)

Name of Village	No. of Households	Total Persons	Total Males	Total Females	Persons age 0-6	Males age 0-6	Females age 0-6
Mandvi Taluka							
Bag	476	2528	1288	1240	387	204	183
Bidada	1491	7595	3842	3753	1034	549	485
Faradi	386	1933	974	959	311	151	160
Gundiyali	891	5353	2705	2648	957	500	457
Maska	932	5055	2546	2509	699	350	349
Mota Bhadiya	511	2822	1417	1405	547	289	258
Nana Bhadiya	179	799	394	405	110	56	54
Nani Khakhar	645	3374	1676	1698	505	253	252
Pipari	283	1485	751	734	263	148	115
Tragadi	143	824	402	422	150	75	75

Name of Village	No. of Households	Total Persons	Total Males	Total Females	Persons age 0-6	Males age 0-6	Females age 0-6
Mundra Taluka							
Deshalpar	424	2013	1045	968	285	161	124
Jarpara	1019	5762	2893	2869	1067	564	503
Kandagara Mota	454	2306	1150	1156	353	174	179
Khakhar Moti	324	1596	810	786	265	143	122
Moti Bhujpar	1188	5952	2942	3010	983	492	491
Nani Bhujpar	126	717	370	347	101	60	41
Navinal	241	1146	598	548	238	131	107
Pratappar	20	62	31	31	7	2	5
Shiracha	187	923	456	467	154	69	85
Tunda	241	1207	607	600	237	119	118
Sub Total	**10161**	**53452**	**26897**	**26555**	**8653**	**4490**	**4163**

Source: Census 2001

The total population of the area within 10 Km radius of the site is 53,452 persons (Table-1). Projected population of the area in 2006 and 2011 by arithmetic progression is 57,730 and 62,007 persons respectively (Table-2). However, by geometric progression method, the projected population of the area in the year 2010 is estimated at 76,779 persons.

Table No.2
Population Projection (for study area within 10 Km of Power Plant)

Taluka	Population (Census 1991)	Population (Census 2001)	Population (2006) Projected*	Population (2011) Projected*
Mandvi	26324	31768	33801	35834
Mundra	16948	21684	23929	26173
Total	**43272**	**53452**	**57730**	**62007**

* Projected with decennial growth rate of 20.7% for 'Mandvi' and 12.8% for 'Mundra'

Figure No.4

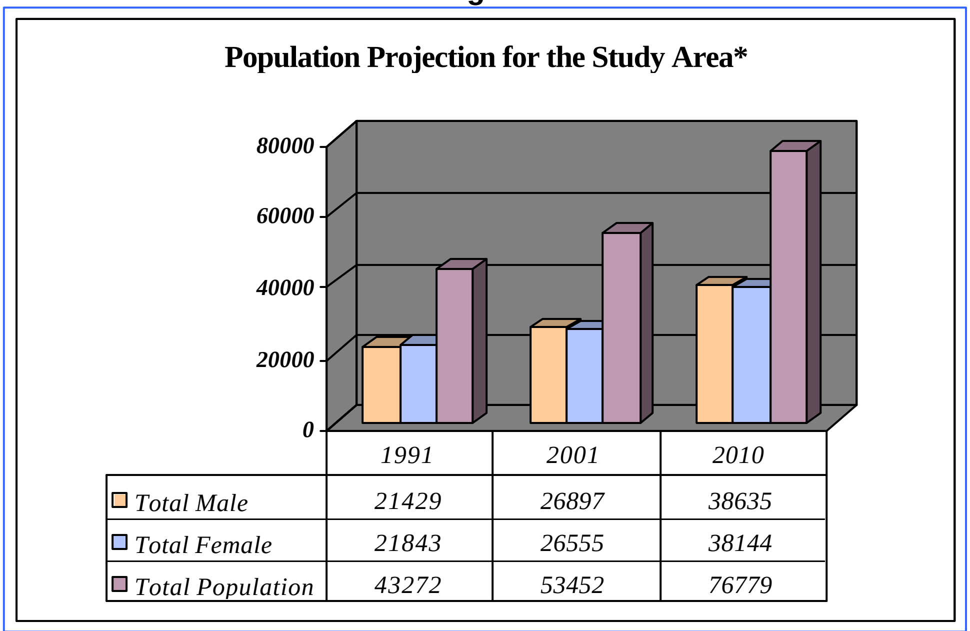
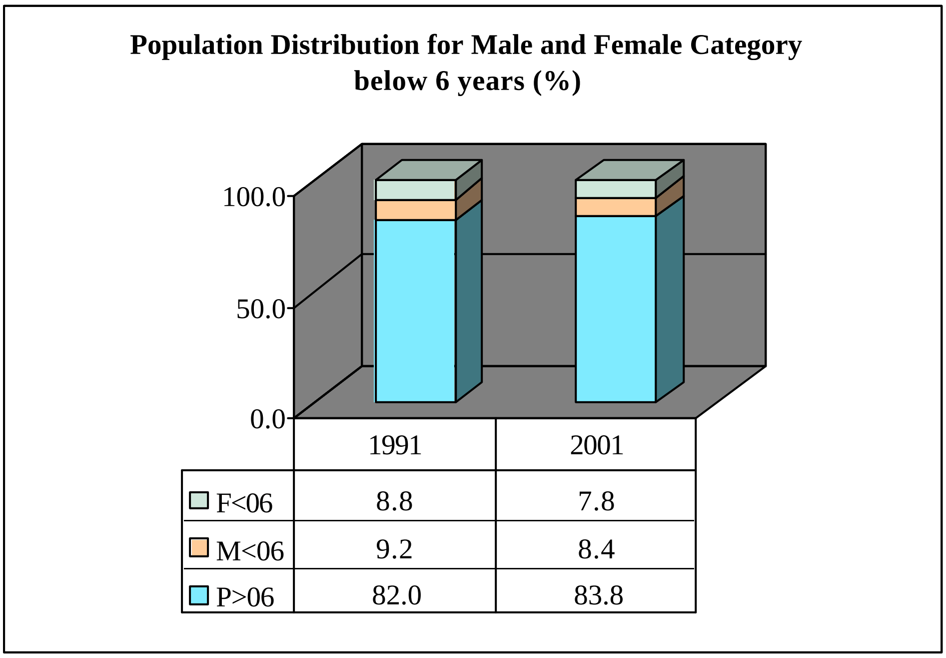


Figure No.5



Source: District Census Handbook 1991 and Census 2001

The contribution of 0-6 year children to over all population has reduced significantly from 18% (1991) to 16.2 % (2001) as shown in above Figure.

Table No.3
Scheduled Castes and Scheduled Tribes population (2001)

Name of Village	Persons (SC)	Males (SC)	Females (SC)	Persons (ST)	Males (ST)	Females (ST)
Mandvi Taluka						
Bag	0	0	0	32	15	17
Bidada	1374	709	665	321	159	162
Faradi	404	207	197	9	5	4
Gundiyali	444	217	227	164	73	91
Maska	211	109	102	117	65	52
Mota Bhadiya	380	193	187	15	8	7
Nana Bhadiya	330	160	170	43	26	17
Nani Khakhar	534	278	256	248	121	127
Pipari	58	28	30	6	4	2
Tragadi	0	0	0	0	0	0
Mundra Taluka						
Deshalpar	366	188	178	125	62	63
Jarpara	649	343	306	86	43	43
Kandagara Mota	317	171	146	144	70	74
Khakhar Moti	335	177	158	60	36	24
Moti Bhujpar	895	466	429	498	253	245
Nani Bhujpar	252	129	123	0	0	0

Navinal	189	99	90	98	57	41
Pratappar	0	0	0	0	0	0
Shiracha	463	222	241	59	30	29
Tunda	68	37	31	0	0	0
Sub Total	**7269**	**3733**	**3536**	**2025**	**1027**	**998**

Source: Census 2001

The study area within 10 Km radius is 36,489 Hectares. Total number of households in the study area is 10,161 as per Census 2001 (Table-4), which works out to a population density of 1.46 persons per Ha. Average family size in the area is 5.3. The percentage of males and females as per 2001 census is almost equal with 50.3% males and 49.7% females. Thus the sex ratio is 987 females per thousand males.

The percentage of scheduled caste and scheduled tribe population is 13.6% and 3.8% respectively. Total working population is about 39%. Among workers, 68% are males and 32% females. The literacy rate in the area is 54.2% as per 2001 Census.

Figure No.6

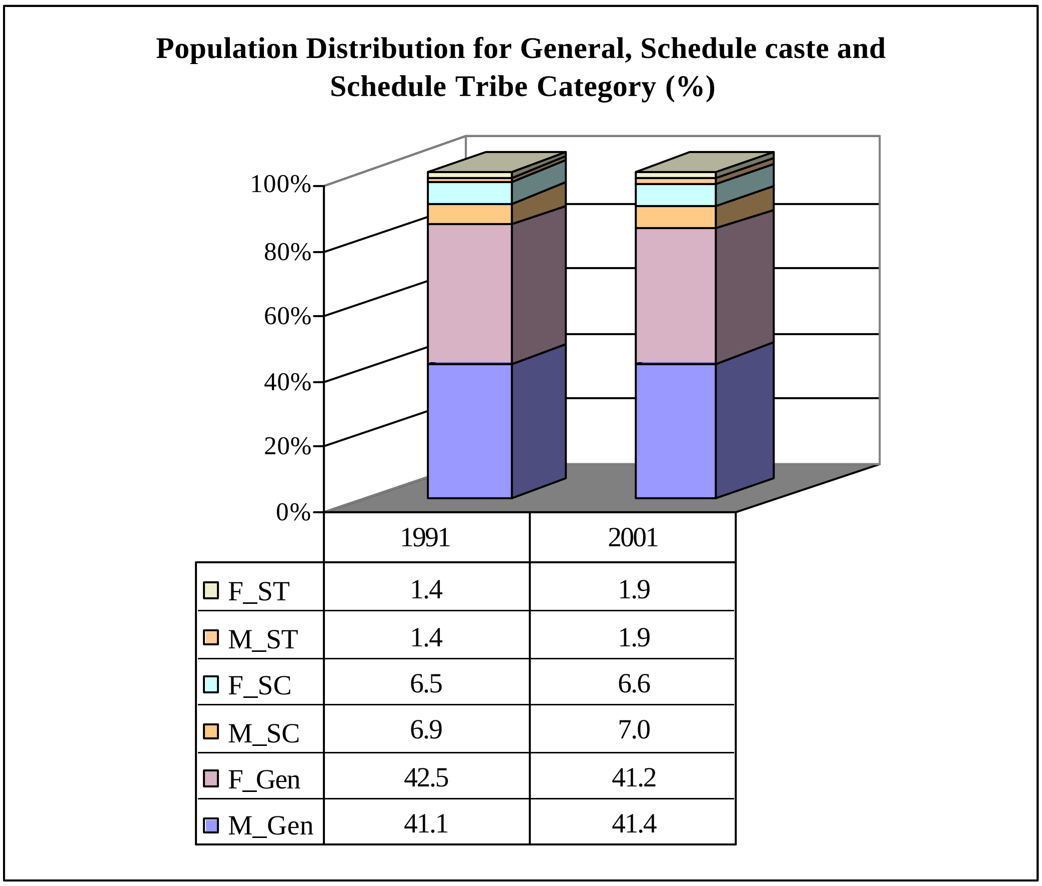
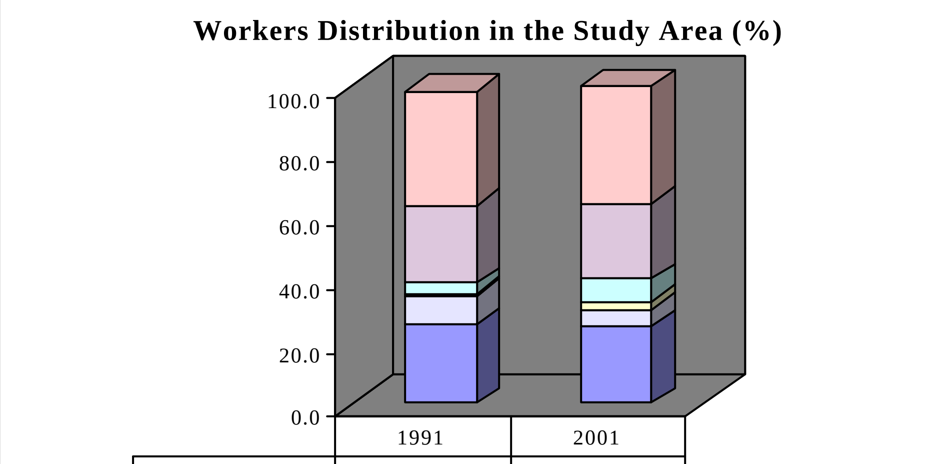
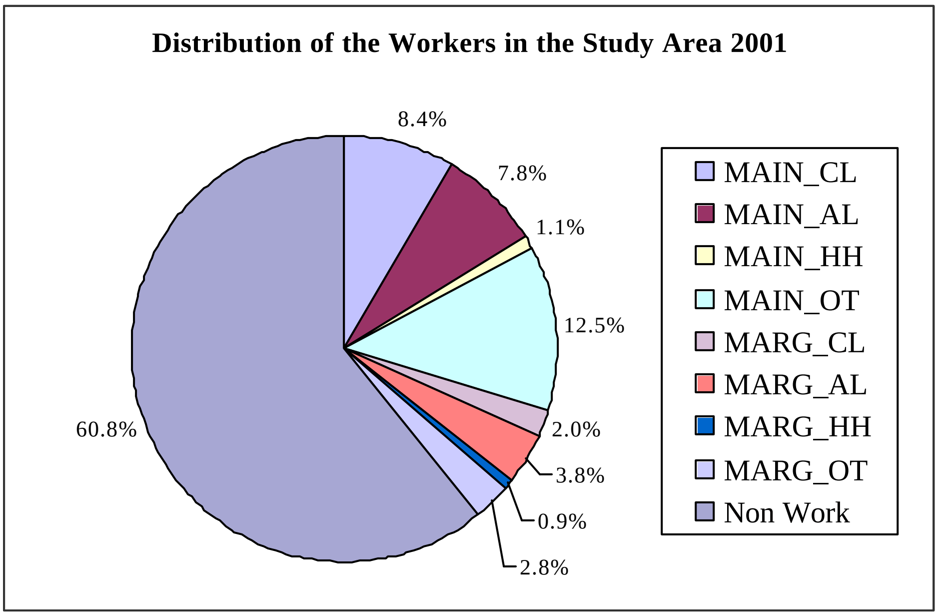


Figure No.7



	1991	2001
NON-WORK-F	36.0	37.1
NON-WORK-M	24.4	23.7
MARGWORK-F	3.5	7.1
MARGWORK-M	0.5	2.3
MAINWORK-F	9.0	5.4
MAINWORK-M	25.0	24.3

Figure No.8



Considerable portion about 39.2% of the total population falls under workers categories that population of non-workers was highest of 60.8% followed by 39.2% of total workers, 34.0 % main workers and 4.0 % marginal workers. Non worker population cover all persons, who are engaged in unpaid home duties and do not know other work or have not done any work at all during the last one year. The main worker is a person, who works for major part of the year. Marginal worker is a person who works for a period of less than 6 months in a year.

Table No.4
Summary of Demographic Details$ (within 10 Km Study Area)

Parameters	Census 1991	Census 2001
No. of Households	7811	10161
Total Study Area in Ha	36489	36489
Total Population	43272	53452
Total Males	21429 (50.5%)	26897 (50.3%)
Total Females	21843 (49.5%)	26555 (49.7%)
Population Density (Persons/Ha)	1.19	1.46
Sex Ratio (Number of Females per 1000 Males)	1019	987
Average Family size	5.5	5.3
Percentage of Population below 6 Years	18.0%	16.2%
Total Schedule Caste population	5816 (13.4%)	7269 (13.6%)
Total Schedule Tribe population	1249 (2.9%)	2025 (3.8%)
No. of Literates (Percent Literacy)	18658 (43.1%)	28946 (54.2%)
No. of Illiterates (Percent Illiteracy)	24614 (56.9%)	24506 (45.8%)
No. of Literate Females(Percent Female Literacy)	7310 (33.5%)	12073 (45.5%)
Total Worker Population (% to total population)	16424 (39.6%)	20938 (39.2%)
Total Male workers	11025	14232 (68.0%)*
Total Female Workers	5399	6706 (32.0%)*
Main Workers	14860 (90.5%)*	15924 (76.1%)*
Marginal Workers	1744 (9.5%)*	5014 (23.9%)*
Non-Workers	26134 (60.4%)	32514 (60.8%)
Main Cultivator Population	5885 (35.8%)*	4496 (21.5%)*
Main Female cultivator Population	1451 (24.7%)@	737 (16.4%)@

$*Source: District Census Handbook 1991 and Census 2001*
** Percentage to Total workers*
@ Percentage to Total Main Cultivators

Education Facilities

All the villages have primary schools within the village. Three villages have Secondary schools (up to X standard) and one village has a technical Institute. Looking at the number of students the enrollment of children in school is high.

Table No.5
Educational Institutions and No. of Students

S. No.	Taluka	Village	No. of Primary schools	No. of Students	Secondary Schools	No. of Students	Technical Institute	No. of Students
1	Mandvi	Faradi	1	300	0	0	0	0
2	Mandvi	Bidada	1	1000	1	400	0	0
3	Mandvi	Nani Khakhar	1	480	0	0	0	0
4	Mandvi	Nana Bhadiva	1	200	1	60	0	0
5	Mandvi	Pipari	1	300	0	0	0	0
6	Mandvi	Maska	1	400	1	400	1	70
7	Mandvi	Bag	1	600	0	0	0	0
8	Mandvi	Gundiyali	1	NR	0	0	0	0
9	Mandvi	Mota Bhadiva	1	500	0	0	0	0
10	Mandvi	Tragadi	1	161	0	0	0	0
11	Mundra	Tunda	1	103	0	0	0	0
12	Mundra	Shiracha	1	140	0	0	0	0
13	Mundra	Moti Bhuipar	1	1100	1	500	0	0
14	Mundra	Pratappar	1	100	0	0	0	0
15	Mundra	Nani Bhuipar	1	200	0	0	0	0
16	Mundra	Navinal	1	350	0	0	0	0

Source: Gram Panchayat Official

Figure No.9
Primary School at Navinal

Figure No.10
Technical Institute at Maska

Religion

The two major religions in the district including in the project area are Hindu and Muslim. Muslims in some villages forms a sizeable proportion of the population, e.g. in Tragadi and Tunda. Unlike other parts of Gujarat, there have been no Hindu-Muslim riots in this area. Each village has number of Temples and Mosques. The rich families contribute to the development of the village by constructing temples, schools, community centres, etc. in their own villages. Many villages have Gau-shalas/ gaucher land (charitable grazing sheds for cows), which are financed by village people.

Patel is a farming community whereas Baniya is a business community. Most of the villages in the project study area have some families of Baniya and Patel communities. As mentioned generally the families belonging to Baniya community stay away from the village in other towns and cities for business and come to village only during summer vacations and holy occasions/festivals.

Table No.6
Percentage Distribution of Population by Religion & Caste

S. No.	Taluka	Village	Hindu (%)	SC (%)	ST (%)	Muslim (%)	Patels (%)	Baniyas (%)	Other (%)
1	Mandvi	Faradi	70	10	1	30		10	
2	Mandvi	Bidada	80	25	2	20	25	25	3
3	Mandvi	Nani	80	15	5	20	5	20	

S. No.	Taluka	Village	Hindu (%)	SC (%)	ST (%)	Muslim (%)	Patels (%)	Baniyas (%)	Other (%)
		Khakhar							
4	Mandvi	Nana Bhadiya	80	60	10	20			
5	Mandvi	Pipari	95	5		5			4
6	Mandvi	Maska	80	30		20	10	10	
7	Mandvi	Bag	65			35			
8	Mandvi	Gundiyali	65			35	1		
9	Mandvi	Mota Bhadiya	95	60		5			
10	Mandvi	Tragadi	50		5	50		10	15
11	Mundra	Tunda	60	5		40		30	
12	Mundra	Shiracha	100	40	10				
13	Mundra	Moti Bhujpar	80	20		20	10	5	
14	Mundra	Pratappar	100						
15	Mundra	Nani Bhujpar	100	40	40		10		10
16	Mundra	Navinal	80	40		20		5	

Source: Gram Panchayat Official

Figure No.11
Statue of Lord Shiva at Faradi

Figure No.12

Mosque at Nana Bhadia

Figure No.13
Jain Temple at Kolapar (Mandvi)

Figure No.14
Mosque on sea beach near site of Power Plant

Agriculture

Agriculture is a major activity in the area but is mostly dependent on rains. The area has scanty rainfall. Land holdings are quite large because of low yield. Only few farmers have wells in their farm through which they can reap two crops. All others without wells can take only one crop i.e. Jowar and Bajra and that too if there are rains.

Table No.7
Important Commodities Grown

Name of the Village	Most important Commodity Grown-1	Most important Commodity Grown-2	Most important Commodity Grown-3
Mandvi Taluka			
Faradi	Pulses	Guvar	Wheat
Bidada	Bajri	Groundnut	Wheat
Nani Khakhar	Cotton	Wheat	Maize
Nana Bhadiya	Bajri	Jowar	Wheat
Pipari	Wheat	Bajri	Mung
Maska	Bajri	Groundnut	Jowar
Bag	Cotton	Bajri	
Gundiyali	Bajri	Cotton	Jowar
Mota Bhadiya	Bajri	Mung	Groundnut
Tragadi	Bajri	Jowar	
Mundra Taluka			

Name of the Village	Most important Commodity Grown-1	Most important Commodity Grown-2	Most important Commodity Grown-3
Deshalpar	Cotton	Castor Seeds	Isabgol
Khakhar Moti	Cotton	Wheat	Bajri
Kandagara Mota			
Tunda	Cotton	Guvar	Jowar
Shiracha	Wheat	Bajri	Mung
Moti Bhujpar	Groundnut	Bajri	Wheat
Pratappar	Wheat	Castor Seeds	Guvar
Nani Bhujpar	Groundnut	Castor Seeds	Guvar
Navinal	Cotton	Wheat	Bajri
Jarpara	Kharek	Chikoo	Coconut

Source: Census 2001

Figure No.15
Castor Crop at Faradi

Major crops in the area are Bajri and Jowar during rainy season. Those who have wells also grow wheat in winter. Other crops are Moong, Castor, Maize, Groundnut, Guvar and Cotton. Among plantations, the major ones are Kharik and Chikoo followed by Coconut. In the villages near Power Plant site i.e. Tunda and Wandh, there are not many plantations.

Figure No.16

Chikoo Plantation at Jarpara

Table No.8
Land Holding

			No. of households with land			
S. No.	**Taluka**	**Village**	**< 1acre**	**1-5 acre**	**> 5 Acre**	**No. of Households**
1	Mandvi	Faradi	50%	20%	30%	
2	Mandvi	Bidada	5%	20%	75%	
3	Mandvi	Nani Khakhar	40%	10%	50%	
4	Mandvi	Nana Bhadiya	10%	40%	50%	
5	Mandvi	Pipari	15%	50%	35%	350
6	Mandvi	Maska	15%	35%	50%	
7	Mandvi	Bag	70%	15%	15%	
8	Mandvi	Gundiyali	60%	20%	20%	
9	Mandvi	Mota Bhadiya	10%	40%	50%	
10	Mandvi	Tragadi	30%	20%	50%	
11	Mundra	Tunda	10%	40%	50%	
12	Mundra	Shiracha	25%	25%	50%	
13	Mundra	Moti Bhujpar	10%	40%	50%	
14	Mundra	Pratappar	0	50%	50%	
15	Mundra	Nani Bhujpar	5%	70%	25%	
16	Mundra	Navinal	10%	90%	0	

Source: Gram Panchayat Official

Figure No.17
Kharik Plantation at Bhojpar

Figure No.18
Coconut Plantation at Maska

Cattle

The area is rich in cattle wealth. Every village has plenty of bullocks, cows, buffalos, goats and sheep. Bullocks are used for farming and driving cart for farm products. The area also has a sizeable number of tractors. This shows the economic condition of farmers.

Figure No.20
Cows at Jarpara

Figure No.19
Buffaloes at Navinal

Table No.9
No. of Cattle by Villages

S. No.	Taluka	Village	Bullocks (No.)	Tractors	Cows	Goats/ sheep	Other cattle	Milk Production per day	Rearing of cattle
1	Mandvi	Faradi	15	8	500	1000 / 200	100	1000	25
2	Mandvi	Bidada	150	10	6000	1500 / 500	200	2000	1000
3	Mandvi	Nani Khakhar	20	11	700	1000 /2000	200	1000	1500
4	Mandvi	Nana Bhadiya	55	1	250	300 / 0	200	500	20
5	Mandvi	Pipari	25	12	300	300 / 70	100	1000	0
6	Mandvi	Maska	50	20	400	800 / 1500	150	1000	70
7	Mandvi	Bag	20	25	700	4000 / 0	150	2000	200
8	Mandvi	Gundiyali	200	20	600	3250 /1000	50	500	200
9	Mandvi	Mota Bhadiya	100	13	300	350 / 100	100	1500	700
10	Mandvi	Tragadi	15	3	200	200 / 0	200	400	50
11	Mundra	Tunda	4	2	50	305 / 7	150	1000	65
12	Mundra	Shiracha	12	15	150	500 / 0	50	300	160
13	Mundra	Moti Bhujpar	20	70	300	1000 /1000	500	2000	1000
14	Mundra	Pratappar	0	15	50	50 / 50	200	1500	20
15	Mundra	Nani Bhujpar	0	10	250	50 / 50	400	3000	100
16	Mundra	Navinal	4	4	1500	2000 / 0	400	800	200

Source: Gram Panchayat Official

Since rainfall in the region is scanty, cattle rearing, wool spinning and milk production is a major occupation after plantation and agriculture. The area produces plenty of milk. The milk is sold to dairies.

Figure No.21
Goats at Navinal

Figure No.22
Sheep at Nani Khakhar

Migration of Families for Livelihood

As seen above major sources of livelihood in the villages are Plantations (Kharik, Chikoo and Coconut), Cattle (milk production), Agriculture (mainly summer crop, if there is rain) and other occupations like trade, transport and services. Many families from these villages also work in towns like Ahmedabad, Vadodara, Surat and Mumbai. These families come to village only during summer vacations or on certain occasions. This is especially true of Jain families, which is a business community. Many streets in some of the villages, especially in the villages inhabited by Jain community, are deserted throughout the year because these families live in other cities for their livelihood. These families construct a descent house in the village and keep on contributing to the development of the village in some form or the other like constructing temple, school, community hall, dharamshala etc. Important elite families of the village also construct an entry gate to the village with their names inscribed on the gate. Such scenes are very common all-over the villages in the project area.

Table No.10
Migration of Families to Other Cities

S. No.	Taluka	Village	No. of families Migrated to Metropolitan cities	No. of Families migrated to Other Towns
1	Mandvi	Faradi	20%	10%
2	Mandvi	Bidada	10%	5%
3	Mandvi	Nani	20%	5%

S. No.	Taluka	Village	No. of families Migrated to Metropolitan cities	No. of Families migrated to Other Towns
		Khakhar		
4	Mandvi	Nana Bhadiya	20%	5%
5	Mandvi	Pipari	2%	1%
6	Mandvi	Maska	15%	5%
7	Mandvi	Bag	5%	2%
8	Mandvi	Gundiyali	20%	5%
9	Mandvi	Mota Bhadiya	1%	0
10	Mandvi	Tragadi	Not Known	Not Known
11	Mundra	Tunda	10%	5%
12	Mundra	Shiracha	10%	5%
13	Mundra	Moti Bhujpar	40%	10%
14	Mundra	Pratappar	75%	0
15	Mundra	Nani Bhujpar	0.5 %	1%
16	Mundra	Navinal	50%	10%

Source: Gram Panchayat Official

Figure No.23
A Deserted Street in Kandagra due to Migration of Families to Cities for Livelihood

Figure No.24
A Gate at Entry of Village in Nani Khakhar

Figure No.25
Fishermen near Tundawandh about 1½ kms from Power Plant

Table below gives sources of income from various activities.

Table No.11
Income from Various Occupations

			Annual Income Per Family (in thousand Rupees) from							
S. No.	**Taluka**	**Village**	**Employment**	**Agriculture**	**Animal husbandry**	**Rearing of cattle**	**Fishing**	**Handicraft**	**Trading**	**Any other**
1	Mandvi	Faradi		40		20			50	
2	Mandvi	Bidada	6	12		10		1.8	36	
3	Mandvi	Nani Khakhar		50						
4	Mandvi	Nana Bhadiya	36	20		30				
5	Mandvi	Pipari		250	360				600	
6	Mandvi	Maska	14	5		36		5	50	
7	Mandvi	Bag	10	50		50			40	
8	Mandvi	Gundiyali	20	40		20	40		35	
9	Mandvi	Mota Bhadiya		50		15			50	
10	Mandvi	Tragadi		20		10	20		50	
11	Mundra	Tunda		40					50	
12	Mundra	Shiracha		50		30		25		
13	Mundra	Moti Bhujpar		8000		2000		1000	1000	2000
14	Mundra	Pratappar		50		50				
15	Mundra	Nani Bhujpar		100		100				
16	Mundra	Navinal								

Source: Gram Panchayat Official

Water and Electricity

Drinking water in all the villages is supplied through bore-wells. Every village has over-head tank in which the water is filled by the Gram Panchayat and then supplied through pipeline to the houses at fixed time slots. Water is available at a depth of 200 feet but it is salty. The depth of the bore-wells for sweet water is more than 400 feet. Water is also stored in small dams (ponds) during rainy season. However, it depends on the rainfall, which is very scanty.

Since rainfall is scanty the villagers are more dependent on wells. The Table below gives the number of wells and the ones with and without pumps. In every village only one well is used for drinking water supply.

Table No.12
No. of Wells for Drinking and Irrigation

S. No.	Taluka	Village	No. of wells in village	No. of Wells for drinking	Wells for Irrigation without pump	Wells for Irrigation with pump
1	Mandvi	Faradi	40	1	25	14
2	Mandvi	Bidada	14	4	6	4
3	Mandvi	Nani Khakhar	252	2	0	250
4	Mandvi	Nana Bhadiya	32	25	0	7
5	Mandvi	Pipari	6	1	0	5
6	Mandvi	Maska	3	0	0	3
7	Mandvi	Bag	120	Narmada Water	0	120
8	Mandvi	Gundiyali	126	1	0	125
9	Mandvi	Mota Bhadiya	104	2	2	100
10	Mandvi	Tragadi	25	0	0	25
11	Mundra	Tunda	52	1	11	40
12	Mundra	Shiracha	100	1	49	50
13	Mundra	Moti Bhujpar	204	4	0	200
14	Mundra	Pratappar	31	1	0	30
15	Mundra	Nani Bhujpar	70	0	0	70
16	Mundra	Navinal	25	1	0	24

Source: Gram Panchayat Official.

All the villages in the area are electrified. There is no load shedding for the residential houses. However, agricultural farms have fixed time for supply of electricity.

Transport and Communication

Nearest airport to the Power Plant area is Bhuj, which is located at a distance of about 60 Kms from Mundra town and about 75 Kms from the site of CGPL. Nearest railway stations are Adipur, Bhuj and Gandhidham at about 57, 45 and 55 Kms respectively from Mundra town in opposite directions. A good motorable road in the area is National Highway NH-8A running from Gandhidham to Mandvi. The other roads a State Highway and other metal roads in the area are narrow and not in good condition. Local people travel by autorikshaws/chakkda, which carry 6-10 passengers. The villages are covered by State road transport buses but the frequency is limited and scanty in the villages. Mundra and Mandvi towns are well connected with other cities and towns of the State by State road transport buses. All the villages are covered by mobile telephone service provider. Most of the villages have Local and STD telephone booths. Newspapers are also available in the villages.

Figure No.26
Gandhidham – Mandvi Highway NH-8A

Figure No.27
Auto-Rickshaw stand at Bhojpar

Table No.13
Availability and Means of Transport

S. No.	Taluka	Village	Trans-port	No. of Bullock carts	No. of Auto Vehicles / Chhakda	Distance of bus stand	Nearest Railway station
1	Mandvi	Faradi	Road	5	12 / 5	In village	Bhuj
2	Mandvi	Bidada	Road	50	1000 /45	1 Km	Bhuj
3	Mandvi	Nani Khakhar	Road	10	30 / 5	In village	Bhuj
4	Mandvi	Nana Bhadiya	Road	0	5 / 2	In village	Bhuj
5	Mandvi	Pipari	Road	10	30 / 6	1 Km	Bhuj
6	Mandvi	Maska	Road	30	400 / 7	In village	Bhuj
7	Mandvi	Bag	Road	10	7 / 3	In village	Bhuj
8	Mandvi	Gundiyali	Road	100	40 / 20	In village	Bhuj
9	Mandvi	Mota Bhadiya	Road	50	25 / 5	In village	Bhuj
10	Mandvi	Tragadi	Road	12	2	In village	Bhuj
11	Mundra	Tunda	Road	3	18 / 4	In village	Bhuj
12	Mundra	Shiracha	Road	3	1 / 3	In village	Bhuj
13	Mundra	Moti Bhujpar	Road	0	400 / 200	In village	Bhuj
14	Mundra	Pratappar	Road	0	3 / 3	In village	Bhuj
15	Mundra	Nani Bhujpar	Road	0	50 / 3	In village	Bhuj
16	Mundra	Navinal	Road	1	15 / 10	In village	Bhuj

Source: Gram Panchayat Official

Availability of number of auto-vehicles in the area shows the economic status of the villagers. All the milk-men use motor bikes for transporting milk from the village to selling point. The farmers also use motor-bikes for transport as for every need they can not depend on public transport.

Health and Sanitation

There are not many hospitals in the area. People have to travel 2 to 10 Kms for hospital services. Many villages do not have Private practitioners. They go to nearby villages for their needs. Though villagers prefer out-side open field for nature's call, many houses especially those migrated to urban towns and having their houses in the village have latrines inside the house as they are used to such facility in cities. Most of the houses in the area are pucca with either pucca roof or tiles. Tiles keep the house cool during summer. Out-migrants who have their business in cities and towns have constructed huge houses in the villages, which are furnished with all facilities inside the house.

Figure No.28
Soakpits at Gundiyali

Table No.14
Availability of Health Facilities and Sanitation

S. No.	Taluka	Village	Hospital	No. of doctors	Pvt practitioners	Health workers	General preventive diseases	Any family Wel. Scheme	Latrine	Soak pits
1	Mandvi	Faradi	7 km	0	0	No		No	200	2
2	Mandvi	Bidada	Yes	1	1	Yes2		No	1000	0
3	Mandvi	Nani Khakhar	6 km	6	0	Yes		No	65	0
4	Mandvi	Nana Bhadiya	8 km	0	Yes	No	Fever	No	500	5
5	Mandvi	Pipari	5 km	1	0	No		No	0	25
6	Mandvi	Maska	Yes	2	0	Yes	TB	No	24	5
7	Mandvi	Bag	6 km	0	Yes	Yes	Acidity	No	400	3
8	Mandvi	Gundiyali	8 km	0	Yes	Yes		Yes	200	1
9	Mandvi	Mota Bhadiya	5 km	0	0	Yes	Fever	No	4	1
10	Mandvi	Tragadi	13km	0	Yes	No		No	0	0
11	Mundra	Tunda	3 km	1	0	Yes	Gastro	No	50	3
12	Mundra	Shiracha	4 km	0	Yes	Yes		No	4	4
13	Mundra	Moti Bhujpar	Yes	1	Yes	Yes		Yes	1500	0
14	Mundra	Pratappar	6 km	0	0	No		No	100	2
15	Mundra	Nani	2 km	0	0	No		No	0	3

S. No.	Taluka	Village	Hospital	No. of doctors	Pvt practitioners	Health workers	General preventive diseases	Any family Wel. Scheme	Latrine	Soak pits
		Bhujpar								
16	Mundra	Navinal	10km	0	Yes	Yes		No	150	1

Source: Gram Panchayat Official

Facilities of Bank, Post Offices and Library

Most of the villages have post office in the village itself but the bank facility is rare and at times as far as 15 Km. away. A bank requires certain threshold of population to be viable for its existence and therefore it is understandable that the villages do not have banks.

Figure No.29
Post Office at Tunda

Table No.15
Availability of Post Office, Band and Library

S. No.	Taluka	Village	Post office	Bank	Library
1	Mandvi	Faradi	Yes	7 km	Yes
2	Mandvi	Bidada	Yes	Yes	Yes
3	Mandvi	Nani Khakhar	Yes	6 km	Yes

S. No.	Taluka	Village	Post office	Bank	Library
4	Mandvi	Nana Bhadiya	7 km	15km	Yes
5	Mandvi	Pipari	5 km	5 km	No
6	Mandvi	Maska	Yes	No	No
7	Mandvi	Bag	Yes	6 km	No
8	Mandvi	Gundiyali	Yes	8 km	8 km
9	Mandvi	Mota Bhadiya	Yes	5 km	No
10	Mandvi	Tragadi	2 km	11 km	No
11	Mundra	Tunda	Yes	3 km	3 km
12	Mundra	Shiracha	Yes	4 km	Yes
13	Mundra	Moti Bhujpar	Yes	Yes	Yes
14	Mundra	Pratappar	Yes	6 km	Yes
15	Mundra	Nani Bhujpar	2 km	2 km	2 km
16	Mundra	Navinal	Yes	5 km	Yes

Source: Gram Panchayat Official

Entertainment Facilities

Television is available to almost all the families in the villages of the project area. There are no cinema halls or sport like cattle race. Only two villages have some sports facility in the form of play-ground.

Table No.16
Availability of Entertainment Facilities

S. No.	Taluka	Village	No. of Radio sets	No. of TVs	Cinema Halls	Cattle Race	Sports
1	Mandvi	Faradi	325	140	None	None	None
2	Mandvi	Bidada	100	200	None	None	None
3	Mandvi	Nani Khakhar	100	350	None	None	None
4	Mandvi	Nana Bhadiya	120	120	None	None	None
5	Mandvi	Pipari	150	262	None	None	None
6	Mandvi	Maska	1050	720	None	None	Yes
7	Mandvi	Bag	55	165	None	None	None
8	Mandvi	Gundiyali	75	750	None	None	None
9	Mandvi	Mota Bhadiya	35	25	None	None	None
10	Mandvi	Tragadi	No	0	None	None	None
11	Mundra	Tunda	25	42	None	None	None
12	Mundra	Shiracha	120	120	None	None	None
13	Mundra	Moti Bhujpar	50	2500	None	None	Yes
14	Mundra	Pratappar	10	5	None	None	None
15	Mundra	Nani Bhujpar	15	40	None	None	None

S. No.	Taluka	Village	No. of Radio sets	No. of TVs	Cinema Halls	Cattle Race	Sports
16	Mundra	Navinal	10	80	None	None	None

Source: Gram Panchayat Official

Speciality of the Villages

The villages have very few specialities. The handicraft, temple and festivals were reported by investigators from the Gram Panchayat Officials. The household activities like spinning of woollen, thread and weaving of blankets by the shepherds were also recorded. Besides, Mundra is famous for its handicrafts especially tie -dye, block prints, Namda work by Mansoori people

Table No.17
Speciality of the Village

S.No.	Taluka	Village	Handicraft	Folk Art	Music	Temple/ Monument	Festival/ Market
1	Mandvi	Faradi	No	No	No	**Yes**	**Yes**
2	Mandvi	Bidada	No	No	No	**Jain Derasar**	
3	Mandvi	Nani Khakhar	No	No	No	No	No
4	Mandvi	Nana Bhadiya	No	No	No	**Rama Peer**	No
5	Mandvi	Pipari	No	No	No	No	No
6	Mandvi	Maska	No	No	No	No	No
7	Mandvi	Bag	No	No	No	No	No
8	Mandvi	Gundiyali	**Yes**	No	No	**Yes**	No
9	Mandvi	Mota Bhadiya	No	No	No	**Baveswar Temple**	
10	Mandvi	Tragadi	No	No	No	No	No
11	Mundra	Tunda	No	No	No	No	No
12	Mundra	Shiracha	No	No	No	**Yes**	No
13	Mundra	Moti Bhujpar	No	No	No	No	No
14	Mundra	Pratappar	No	No	No	No	No
15	Mundra	Nani Bhujpar	No	No	No	No	No
16	Mundra	Navinal	No	No	No	No	No

Source: Gram Panchayat Official

NGOs and Welfare Schemes

No major Non Government Organization (NGO) was found in the area. Some local community groups were functioning for the local needs mainly religious and community functions. The Gram Panchayats were given financial assistance from the State Government for certain activities like housing, drinking water and sanitation.

Table No.18
Availability of NGO and Welfare Schemes

S. No.	Taluka	Village	NGO Name	Welfare schemes	Funded Project
1	Mandvi	Faradi	No	No	No
2	Mandvi	Bidada	No	Sanitation	Indira Awas
3	Mandvi	Nani Khakhar	Kuchchh Jyoti Trust	No	No
4	Mandvi	Nana Bhadiya	No	No	No
5	Mandvi	Pipari	No	No	No
6	Mandvi	Maska	No	No	No
7	Mandvi	Bag	No	No	No
8	Mandvi	Gundiyali	No	No	No
9	Mandvi	Mota Bhadiya	No	No	No
10	Mandvi	Tragadi	No	No	No
11	Mundra	Tunda	No	No	No
12	Mundra	Shiracha	No	No	No
13	Mundra	Moti Bhujpar	VRTI	Yes	No
14	Mundra	Pratappar	No	No	No
15	Mundra	Nani Bhujpar	No	No	No
16	Mundra	Navinal	No	No	No

Source: Gram Panchayat Official

Figure No.30
Gram Panchayat Office, Mota Kandagra

Figure No.3

Gram Panchayat Office, Bhojpar

Difficulties Faced

The Gram Panchayat Officials have reported some common problems faced by the village. These are lack of good cultivable land, health facility in the village, higher level schools say up to X standard, water for drinking as well as irrigation and lack of grazing area for the live stock.

Table No.19
Difficulty Faced by the Villagers

S. No.	Taluka	Village	Lack of land	Health facility	School	Water	Lack of Grazing Area for Live Stock
1	Mandvi	Faradi	Yes	Yes	Yes	Yes	No
2	Mandvi	Bidada	Yes	No	No	Yes	Yes
3	Mandvi	Nani Khakhar	No	Yes	Yes	No	Yes
4	Mandvi	Nana Bhadiya	No	Yes	No	Yes	No
5	Mandvi	Pipari	No	Yes	Yes	Yes	Yes
6	Mandvi	Maska	No	No	No	Yes	No
7	Mandvi	Bag	Yes	Yes	No	No	Yes
8	Mandvi	Gundiyali	Yes	Yes	Yes	Yes	Yes

S. No.	Taluka	Village	Lack of land	Health facility	School	Water	Lack of Grazing Area for Live Stock
9	Mandvi	Mota Bhadiya	Yes	Yes	Yes	Yes	Yes
10	Mandvi	Tragadi	No	No	Yes	No	No
11	Mundra	Tunda	No	Yes	Yes	Yes	No
12	Mundra	Shiracha	No	Yes	No	Yes	Yes
13	Mundra	Moti Bhujpar	Yes	Yes	Yes	Yes	Yes
14	Mundra	Pratappar	Yes	Yes	Yes	Yes	Yes
15	Mundra	Nani Bhujpar	Yes	Yes	Yes	Yes	Yes
16	Mundra	Navinal	No	Yes	No	Yes	Yes

Source: Gram Panchayat Official

Awareness of Public about upcoming Ultra Mega Power Plant

During the visit to villages, some persons from general population, farmers and Gram Panchayat officials were contacted informally to find out their awareness about the power plant and attitude towards the proposed power plant. People in the study area are aware of the coming up of power plant. They are however not aware about its exact nature and capacity. And therefore, they are not able to fully assess its impact on the area. The similar perception was received from Gram Panchayat Officials also who were aware of the project but not about the likely impact on the local people, cattle and agriculture.

Table No.20
Awareness about Project

S. No.	Taluka	Village	Awarness about project	Disadvantages of project
1	Mandvi	Faradi	Aware	Not Aware
2	Mandvi	Bidada	Aware	Not Aware
3	Mandvi	Nani Khakhar	Aware	Not Aware
4	Mandvi	Nana Bhadiya	Aware	Not Aware
5	Mandvi	Pipari	Aware	Not Aware
6	Mandvi	Maska	Aware	Not Aware
7	Mandvi	Bag	Aware	Not Aware
8	Mandvi	Gundiyali	Aware	Not Aware
9	Mandvi	Mota Bhadiya	Aware	Not Aware
10	Mandvi	Tragadi	Aware	Not Aware
11	Mundra	Tunda	Aware	Not Aware
12	Mundra	Shiracha	Aware	Not Aware
13	Mundra	Moti Bhujpar	Aware	Not Aware
14	Mundra	Pratappar	Aware	Not Aware
15	Mundra	Nani Bhujpar	Aware	Not Aware
16	Mundra	Navinal	Aware	Not Aware

Source: Gram Panchayat Official

Kuchchhis are known to be progressive. They are hard working, business minded and believe in self-employment. Generally, all the people contacted welcomed the power plant though some of them feared some harm to plantations, land and agriculture due to ash pollution. They said that progress cannot come without any cost. People are thrilled about Narmada river/dam water coming to Kuchchh and they are aware that it has come at the cost of households whose houses and land got submerged in the dam. They therefore believe that the progress has its own cost for which they should be ready. They also said that in case there is any damage to the land and crop they will shift their livelihood from agricultural to some other activities. The residents in the area have seen rising prices of the land after coming of Mundra port. They had never seen such high price for their residential and agricultural land, which is more or less barren. The price for agricultural land in area is between 2 to 3 lakh per acre. They are therefore happy about the upcoming power plant, as it will fetch yet more money for the land owned by them, which they can use for some investment and alternative livelihood.

Likely Impact on People, Agriculture, Cattle and Plantation during construction

During construction of the plant heavy machinery and construction material will be brought to the plant site. The roads in the region are narrow that will be improved and designed to take care of required load bearing. Since the machinery will be heavy and if it happens to brought by road transport, it may affect the movement of local people, local vehicles and cattle, if proper attention will not be given on existing roads. It may also spoil the roads and produce dust pollution. Public is in favour of power plant, this opinion may be retained by following good management practice during the construction and operational phase of the project. There will be movement of vehicles for construction of plant and housing colony in and around the villages and nearby towns. This will in some way or the other may affect smooth movement of local people, cattle and vehicles, if proper care would not be considered. There is no likelihood of any impact on agriculture and plantations during construction phase. Set up of the project will not affect the ground water table and existing water supply of the villages, as provision of thermal desalination plant/RO by using sea water will full fill complete water requirement of ultra mega power plant. Proper attention on existing infrastructures will not only minimise the impact but also will improve the existing infrastructure facilities.

Likely Impact on People, Agriculture, Cattle and Plantations after plant becomes operational

The plant is coming up on a barren land and therefore does not affect households, plantations, cattle grazing or agriculture. The only impact on the population, agriculture and plantations is likely to be the pollution due to coal ash, which will flow with the wind. Provision of green belt and plantation will help in reducing the fugitive dust emission. The discharge of the coal ash needs to be controlled and disposed off properly to minimise its adverse impact on the residential houses, people, cattle and plantations (Kharak, Chikoo and Coconut).

The disposal of balanced effluent and cooling water through out fall structure into the deep sea will have insignificant impact on marine life. The fish population of the study area will have insignificant impact as out fall structure will be properly designed that will not impact existing local marine life.

According to the proposal, the coal ash is to be stored at some distance away from the power plant, necessitating transporting the ash from plant to collection ground (ash depot). Transportation of ash to disposal area through wet system will not create inconvenience to local population and local traffic.

The power plant will need plenty of water that will be full filled from nearby sea. The area has severe scarcity of water. Therefore, under-ground water has not been proposed for use in power project. Water requirement of residential colony for the employees will have to be made available from their own facility from proposed thermal desalination plant/ RO plant. All the villages in the area have their own water supply through overhead tanks in which water is drawn from bore-wells. Therefore, existing water uses of the study area will have no impact due to set up of mega power plant.

Mitigation during Construction of Plant

The plant machinery and construction material should be brought by rail transport through a convenient port facility so that local people and cattle are not affected. Yet some road movement will be necessary between the plant site and some nearby villages and Mundra / Mandvi towns. It is therefore suggested that roads may be improved for smooth transportation without causing any inconvenience to the locals. Improvement of roads will also generate favourable public opinion during construction and reduce resentment if any due to inconvenience caused. A sizeable amount of water will also be required during construction. Thermal desalination plant should be envisaged to meet the water requirement of plant during the start of construction.

Mitigation after Plant becomes Operational

The greatest impact that requires mitigation is the effect of pollution due to coal dust and ash on the people, cattle, plantations and agriculture land. Serious attention is required towards control of coal ash in the environment and heat generated during power generation. Even transport of coal ash from the plant to the collection depot will affect the local movement of traffic. It is advised to use railways or enclosed system for this purpose. Lifting of coal ash by the buyers from the ash depot will also have to be organized properly so that air pollution during lifting can be minimized and there should be minimum disturbance to local traffic during shipment from ash depot to buyers' warehouses. Disposal of treated effluent from desalination plant and cooling system will not have any impact on local ecology and marine life, if disposed to deep sea through a properly designed out fall structures. Therefore, the livelihood of fishermen will not be affected. It would be advisable to provide loan facilities to the needy fishermen for buying better mechanized boats so that the fishermen can go deeper in the sea for fishing.

SUMMARY OF IMPACT AND MITIGATION MEASURES
DURING CONSTRUCTION

S. No.	Activity	Likely Impact	Mitigation Measures
1.	Transportation of Plant Machinery and construction material to site of power plant	Damage to Roads and dust in atmosphere	Good construction management practices will Improve local roads connecting plant, ash depot and residential colony. Construction of Railway line will help in reducing transportation problems.
2.	Water required during construction of Power Plant, Ash Depot and Residential colony	Reduction of water table in the area	Thermal desalination desalination plant / RO plant envisaged will have no impact on ground water
3.	Drinking water for construction workers	Reduction of water table in the area	Thermal desalination desalination plant / RO plant envisaged, that will have no impact on ground water
4.	Unskilled labor required for construction	May create some some social problems like drinking	Employment of local labor would be less likely to fall prey to such activities
5.	Movement of staff between site, ash depot, residential colony and nearby towns in vehicles	Damage to roads and obstruction to local traffic	Good construction management practices will Improve local roads connecting plant, ash depot and residential colony

SUMMARY OF IMPACT AND MITIGATION MEASURES
AFTER CONSTRUCTION

S. No.	Activity	Likely Impact	Mitigation Measures
1.	Movement of coal from port to power plant	No adverse impact if railway is used	No mitigation required if railway is used
2.	Water required for Power Plant	No adverse impact if sea water is used	No mitigation required if sea water is used
	Dust emission from Coal and ash from power plant	Adverse effect likely on the health of the population, cattle, plantation and agricultural land	Proper dust suppression systen and 100m wide green belt apar from the plantation in ash disposa and within the premises wi minimize the dust emissio problems. Health check-up facilitie for the workers, cattle and villager are the necessary measures t minimize the impacts.
3.	Transportation of coal and ash from power plant to Ash depot	Dust pollution	Use of closed system and water as dust suppression at transfer point will minimize the impacts.
4.	Disposal of ash from ash depot to buyers	Air pollution	Use closed containers, dust suppression system and preferred railways instead of road for transportation
5.	Water for residential colony	Water table in the area will go down	Use of sea water for desalinated water will have no impact on existing ground water table.
6.	Disposal of effluent into sea	Adverse impact on marine life (fish) and loss of livelihood of fishermen	Intake and outfall structures should be properly designed that should minimize the impacts on marine life. If fisherman requires any help, loan should be arranged for betterment of their livelihood.

APPENDIX

SOCIO-ECONOMIC SURVEY
QUESTIONNAIRE FOR GRAM PANCHAYAT/GRAM SARAPANCH

Date: Village:

Name of interviewer: Respondent:

Area of Village: Population: as on

Total No. of House Holds:

1.	Population Breakup	%	SC	ST
	Hindu			
	Muslims		-	-
	Patels			
	Banias			
	Other		-	
2.	Land Breakup	Percentage of Households		
	Less than 1 acre			
	1-5 acre			
	More than 5 acre			
	No. of Households			
3.	School in Village	No. of Institutions / No. of Students		
	Primary	/		
	Secondary	/		
	Technical Institution	/		
	Collage	/		
	University			
	Adult literacy Centre			
	Training Institute			
4.	No. of Wells in village	Number		
	For drinking			
	For Irrigation without pumps			
	For Irrigation with pumps			

5.	Crop yield/acre/year	Yield/acre/year
	Crop 1:	
	Crop 2:	
	Crop 3:	
	Crop 4:	
	Crop.5:	
	Total Crops/acre/year	
	Major wadis (chikoo, dates, any other)	
6.	Agriculture	Number
	No. of bullocks	
	No. of tractors	
	No. of cows	
	No. of Goats/sheeps	
	Other Cattle	
	Milk production per day	
	No. of Rearing cattle	
7.	Source of Income in Rs.	Amount
	Through Employment	
	Agriculture	
	Animal Husbandry	
	Rearing of cattle	
	Fishing	
	Handicrafts	
	Trading	
	Any other	
8.	No. of persons working in factory	Number
	Directly	
	Indirectly	

9.	No. of Employees	Number		
	Govt. Employees			
	Private Employees			
10.	Education			
	Total No. of Educated persons			
		%	Employed	Unemployed
	Upto High School			
	Upto graduation			
11.	No. of Electrified Houses	Number (%)		
	TV			
	Radio			
	Fan			
	Other			
12.	Consumption of fuel per day	Number of Households (%)		
	Wood / Weed			
	Coal			
	Gas			
13.	Medical facilities	If not available / distance from village		
	Hospitals			
	No. of Doctors			
	Private Practitioners			
	Health Workers/Midwives			
	General prevalent diseases			
	Any family welfare schemes			
14.	No. of Latrines			
15.	No. of Soakpits			
16. M	Means of Transport	Road / Navigation - River		
17.	No. of Bullock Carts			
18.	No. of Auto-vehicles/Chhakada			

19.	Distance of bus stand from village	
20.	Distance of nearest railway station from village	
21.	Amenities	If not available/ distance from village
	Post Office/Telegraph Office	
	Bank	
	Library	
22.	No. of drinking water sources	Number
	Wells	
	River Ghats	
	Hand Pump	
	Ponds/Springs	
23.	Any specific problem related to drinking water (scarcity /taste/ odor/long distance from source/ other	
24.	Is there a place of tourist attraction in your village	
25.	Is there any religious place	Names:
26.	Historical/Monuments/Sanctuary	Names:
27.	Is there weekly market in a week	
28.	If no, how far persons going for market	
29.	No. of persons visiting the market	
30.	What are the facilities for entertainment	Number
	Radio	
	TV	
	Cinema	
	Cattle race	
	Sports	
	Other	

31.	Main specialty of the village	
	Handicraft	
	Folk art/Dance	
	Music	
	Temple/Monuments	
	Festival/Market	
32.	Are there any specific revenue earning facilities? (Temple, Mela, etc.)	
33.	Migration of population towards cities	Number (%) migrating
	Metropolitan Cities	
	Other	
34.	Any NGO working in the village.	Name:
	Any welfare scheme	
	Any funded project	
35.	Village levels specific problem.	
	Lack of land	
	Lack of health facilities	
	Lack of schools	
	Accessibility to water	
	No grazing area for live stock	
	Any other (specify)	
36.	Awareness about the project	Aware / Not aware
	Advantages of the project	
	Disadvantages of the project	

TCE Consulting Engineers Limited

A TATA Enterprise

Ecological Study Report
for
MGR System

of

4000 MW Imported COAL Fired
Mundra Ultra Mega Thermal Power Project

Coastal Gujarat Power Limited, New Delhi
(A wholly owned subsidiary of Power Finance Corporation Limited)

Chandralok Building,36, Janpath, New Delhi-110001

December 2006

INTRODUCTION

1. The Government of India has envisaged capacity addition of 100, 000 MW by 2012 to meet its Mission of Power to All. Achievement of this target also requires the development of large capacity projects at the national level to meet the requirements of a number of States.

2. Recognizing the fact that economies of scale leading to cheaper power can be secured through development of large size power projects, Ministry of Power, Central Electricity Authority (CEA), and Power Finance Corporation are working together for development of five ultra mega power projects under tariff based competitive bidding route. These projects will be awarded to developers on Build, Own Operate (BOO) basis. The ultra mega power projects each with a capacity of 4000MW would also have scope for further expansion.

3. CGPL proposed to set up a power plant near South of Tundawand village in Mundra taluka of Kutch district of Gujarat Coastal area with a capacity of 4000 MW. Proposed site is located at 22^0 49’ 48” N latitude and 69^0 30’ 58” E longitudes. The site is well connected with State Highways No. SH-50 (Via Anjar) and No. SH-6 (Via Gandhigram) and would be nearer to the proposed NH-8A (Delhi- Kandala). The nearest railway station is Adipur, which is 57 km away from the proposed site. Adipur railway station is well connected to multi terminal Mundra port through broad gauge railway system privately owned by M/s. Adani Group.

4. Coal for the project would be imported, sourced from countries like China, Indonesia, Australia and South Africa through cargo vessels of capacity of 125,000 MT to the nearest Mundra port.

5. Secondary and start up fuels are HFO and LDO which would be obtained fro Jamnagar/ Vadodara by rail/ road.

6. However, the existing facilities at Mundra port for storage and handling of coal would not be adequate. Hence, the facilities at the port are being proposed to be augmented to meet UMPP requirement. MGR rail link has been indicated to the developer for transportation of coal from the Mundra port to proposed power project site.

7. RITES feasibility study carried out for proposed transportation of coal to Mundra has been considered for present study. Seven to eleven train loads per day (depending upon rake type) is expected to meet the fuel requirement of UMPP.

8. The topography from Mundra port to proposed site is plain and flat terrain. Most of the land is barren. Some to the land is marshy also. The distance from Mundra coal yard area and project site is 21 km. Small *Prosopis juliflora* (Ganda bawal), other shrubby plants and very few of the commercial crops at Navinal, Siracha and Jarpara are the main habitation on the route of proposed MGR line.

9. Following are the objectives of the study:
   a) Reconnaissance survey along the proposed MGR system
   b) To study the proposed activities along 21 Km long MGR (Merry Go Round) railway system.
   c) Survey of flora and fauna falling along 21 km MGR stretch
   d) Determine the impact of the proposed activities on existing ecology
   e) Management plan for restoring the existing ecology

f) To prepare a report on ecological impact

METHODOLOGY

10. The field survey was carried out in the last week of November'2006 to evaluate the ecological condition along MGR (Merry Go Round) system. The stretch of 21 km from the Mundra Port to proposed UMPP plant site was surveyed for existing ecological conditions. Surveyed route is shown in Drawing No. RITES/PFC-Mundra-plan/01 sheet 1 of1 Plan of the proposed MGR route.

11. Literature reviewed for collection of secondary data from Forest Working Plan of Kutch Forest Division and a study report on Sustainable Development Plan for Environmental Protection of Kutch by Gujarat Institute of Desert Ecology.

12. Satellite Imagery data has been used to derive the land use pattern of the study area.

13. Local public were also contacted for the existing flora and fauna and awareness of the proposed development

14. Impact has been assessed qualitatively

GENERAL FEATURE OF THE REGION

15. The great Rann of Kachchh consists of a vast expanse of tidal flats with saline efflorescence. Strata of northern strip of Kachchh belong to the Jurassic with recent alluvium of the low land and the Banni tract.

16. The soil is mostly sandy or sandy loam on the coastal tract where as in the other area of the district it is alluvial, sandy, swampy or black clay or loam.

17. The Rann of Kachchh remain flooded for about four months in rainy season with sea water driven up by the strong south west monsoon and fresh water brought down by the river Rann consists of a vast expense of tidal mudflats with saline efflorescence

TOPOGRAPHY OF THE STUDY AREA

18. The present study area falls in Kutchch peninsula. The topography of the area is such that the central portion forms the table land sloping on all sides. It is practically an undulating rocky area with small hills and with Rann of Kutch lying on the northern end, consisting of vast expense of tidal mud flats with salt-encrusted mud. The soil varies a great deal from place to place, along the coastline, there are alluvial soils and in some parts they are saline. Soil type indicates that area has high erodability. Elevation of the route varies from 10 m to 21m MSL . A typical topographic feature and vegetation of the route is shown in the following Figure – 1:

Figure -1
General Topography and Vegetation

LAND USE PATTERN OF THE STUDY AREA

19. Satellite image analysis was carried out for the generation of land use/ land cover map of the study region. The approach for satellite data analysis adopted the well-proven Image processing procedures. The analysis was preceded with a ground survey, which comprised of data collection of ground features along with the respective geographical position in terms of latitudes and longitudes.

20. The satellite data used has the below specifications:

- Satellite and Sensor: IRS P-6, LIS III (L-3)
- Date on which the image was taken: 26-November-05

21. In order to understand the land use and land features covering the entire study region, both False Composite and classified images have been derived. An FCC image depicts the land features such as the coastal boundaries, while the classified images show different land use classes listed above. The coverage statistics, the area covered by each land use class, are also derived for 5 km ,10km and 30 km through satellite data analysis and shown in following Tables and Figures:

Table - 1

LAND USE CLASSESS WITHIN 5 KM RADIUS

Classes	Area (Km^2)
Scrub forest	1.326274637
Salt Pan	8.319278704
Mangrove	0.054819352
Built up area	14.78530965
Fallow land	18.88261409
Nallah	7.241459516

Agricultural land	5.15743997
Water Bodies	5.406779602
Barren hill	5.210490956
Marshy Land	12.89581038
Total	**79.28027686**

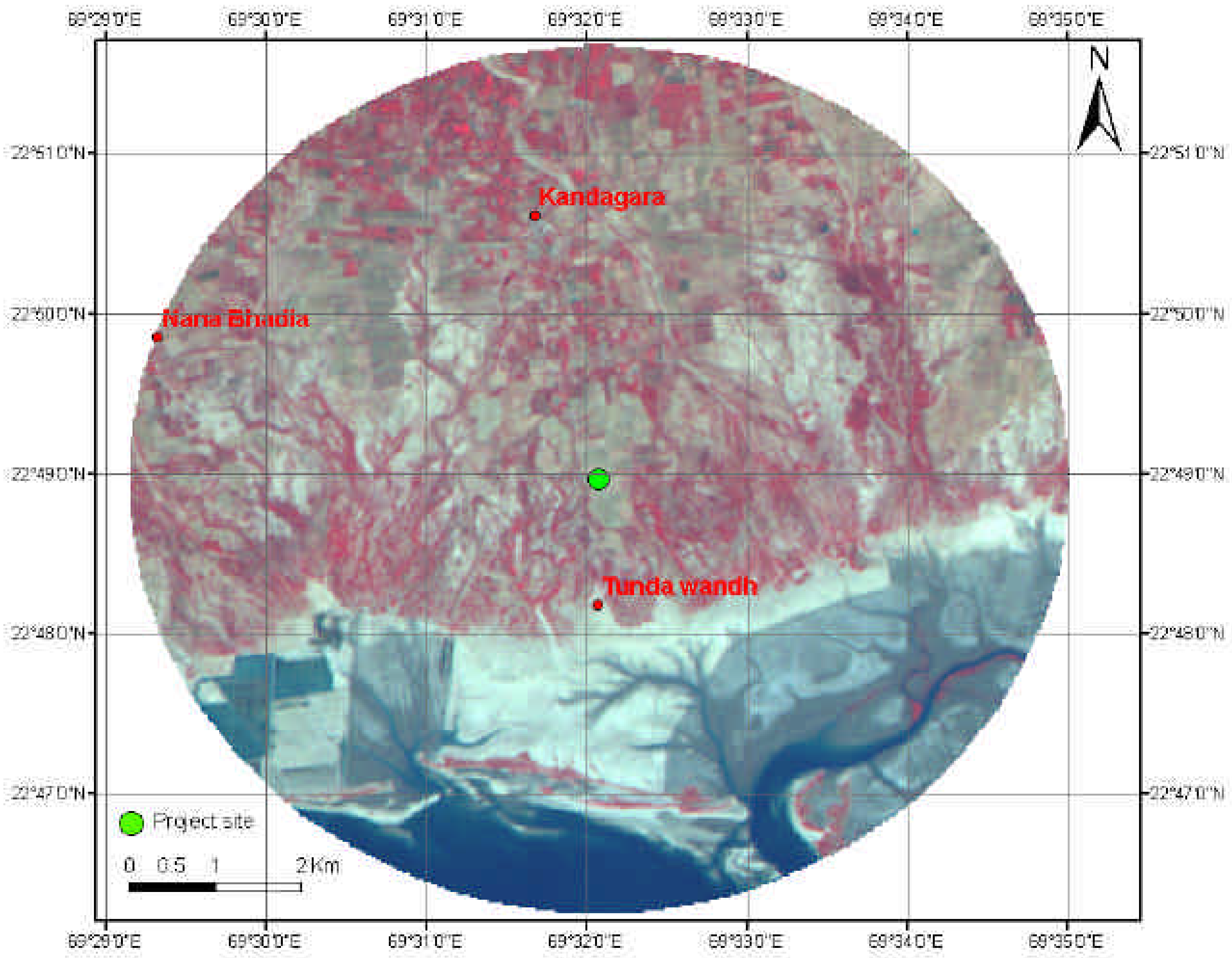
Table -2
LAND USE CLASSESS WITHIN 10 KM RADIUS

Classes	Area (Km^2)
Scrub forest	2.829385891
Salt Pan	13.23445251
Mangrove	0.719725036
Built up area	44.29934123
Fallow land	70.77974062
Nallah	15.3839016
Agricultural land	33.14890827
Water Bodies	63.53651274
Barren hill	25.53697604
Marshy Land	46.71581362
Total	**316.1847575**

Table - 3
LAND USE CLASSESS WITHIN 30 KM RADIUS

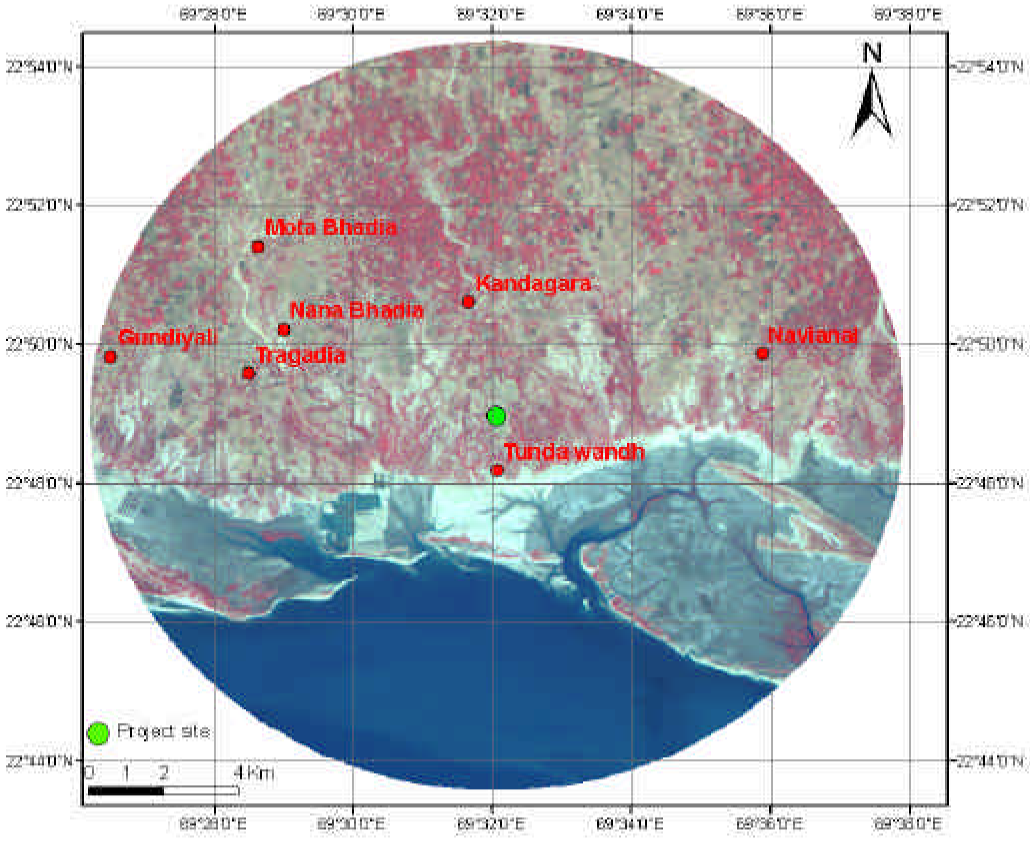
Classes	Area (Km^2)
Scrub forest	53.16239253
Salt Pan	32.66260757
Mangrove	6.764000647
Built up area	280.4018678
Fallow land	443.8271969
Nallah	84.7790115
Agricultural land	158.2316376
Water Bodies	515.5998752
Barren hill	414.0859303
Marshy Land	120.9942667
Total	**2110.508787**

Figure – 2
FCC Image around 5 Km. Radius from the Project site



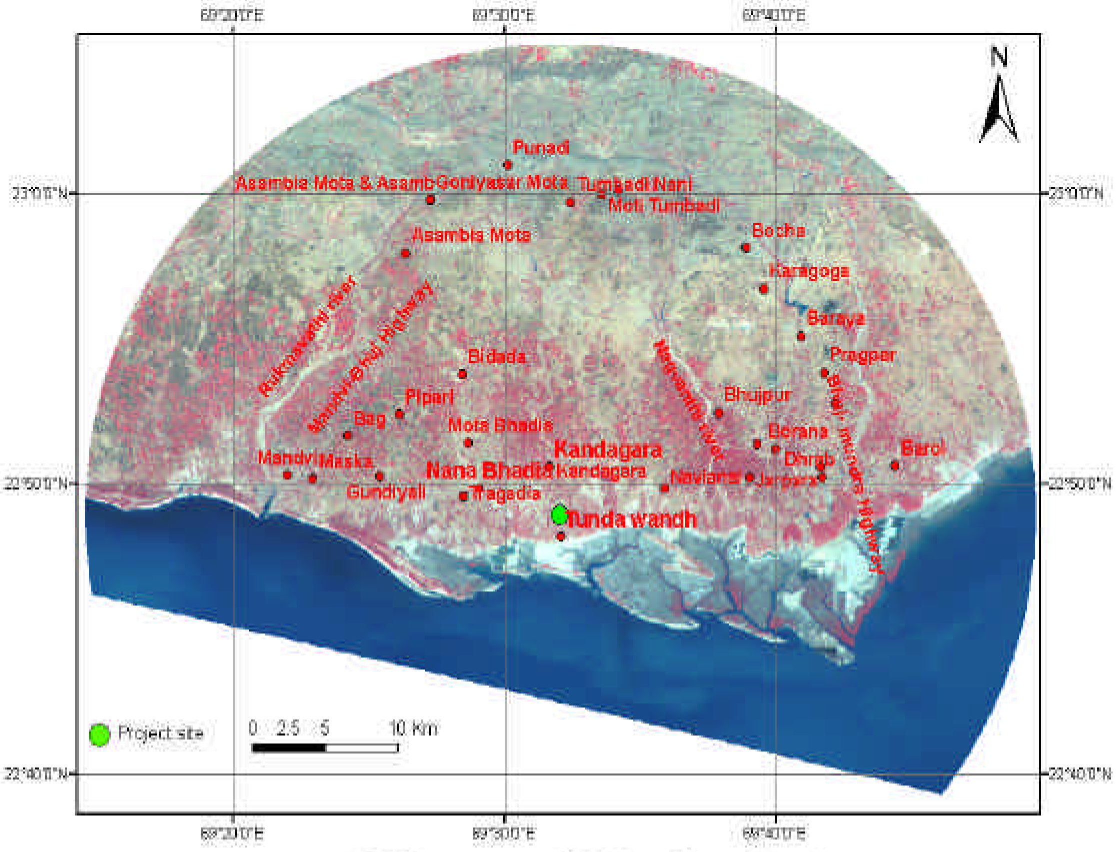
FCC image around 5 Km of the project site

Figure – 3
FCC Image around 10 Km. Radius from the Project site



FCC image around 10 Km of the project site

Figure –4
FCC Image around 30 Km. Radius from the Project site



FCC image around 30 Km of the project site

FLORA OF THE STUDY AREA

22. The forest type of the area falls under scrub forest as per the classification of Champion and Seth (1968). These forests are typical of arid and semi-arid zones of the earth where the total rainfall ranges from 25-100Cm. The vegetation presents a very open appearance so that the trees and shrubs are widely spaced. The bulk of the vegetation consist of co-dominant, spiny shrubs and trees capable of drought resistance.

23. The typical species found in these areas are shown in the following figure:

Figure – 5
Prosopis juliflora - A Dominant Species of the Area

Figure – 6

Dichrostachys cinerea ***Capparis decidua***

24. Detailed information's on ecological condition has been collected, which includes information on both flora and fauna communities. In present study, information has been collected on existing plant and animal species through survey and field studies. The information on distribution pattern of tree species has been collected to establish the interrelationship between species for prevailing environmental factors for post-development monitoring and management.

25. Plant communities are not static but always a dynamic entity. The vegetation cover may reflect the changes, which occurs in its structure, density, and composition. The most important characteristics of a community are its quantitative relationship between abundant and rare species. Characteristics of community in any ecosystem include the composition, structure, species diversity and growth trend of succession and other characteristics of the community, which is applied for the concept and realization of land management. To meet the objective of bio-diversity conservation with temporal & spatial changes, the monitoring of vegetation of an area is a necessary step.

26. A reconnaissance survey of the study area was planned during the study period November 2006 to establish the existing ecological condition of the study area. The information about forestland area of the villages was collected from District Census Hand Book Part II – Land use also. *Prosopis juliflora* is the dominant species of the terrestrial ecosystem of the study area.

27. Vegetation of the study area falls under "VI – B Northern Tropical Forest " – sub – type C-I Desert Thorn Forest - (VI – Kachchh, Saurashtra, Gujarat).

28. The major agricultural crops cultivated in the area are Jowar *(Sorghum bicolor),* Bajara *(Pennisetum typhoides)* wheat, cotton, castor etc. Fruit trees like sapota, mango, are also cultivated in some part of the district. The most dominant species which is found growing in almost all parts of the district is **Phoenix robusta** (Bell.) Bell. & Hook. f. locally known as **Kharik**. It is a commercial crop cultivated for its edible fruits.

29. There happens to be a significant diversity of crops in the study area. Among cereals, Bajra (Pennisetum typhoides) and Jowar (Sorghum bicolor) are mainly cultivated in this region. Proportionately Wheat (Triticum vulgare) is cultivated in lesser quantity. In pulses Mung and Mungphali (Arachis hypogaea) and cotton were observed.

30. The most dominant species which is found growing in almost all parts of the district is ***Phoenix robusta*** (Bell.) Bell. & Hook. f. locally known as **Kharik**. It is a export quality commercial crop cultivated for its edible fruits.Kharik Palm *(Pheonix dactylifera),* Chiku (*Achrus sapota*), Coconut *(Cocus nucifera)* Mango *(Mangifera indica var)*. Kesar were the main cash crops cultivated in orchards. Of these Kharik Palm, Chiku were also reported in the coastal villages.

Figure – 7

Phoenix robusta (Bell.) Bell& Hookf ***Acrus sapota*** plantation

Photo No.:7 Phoenix robusta (Bell.) Bell& Hookf

Photo No.:8 Acrus sapota plantation

31. However in inner villages the Coconut and Mango has reduced their majority significantly. Papita or Papaya (*Carica papaya*) was also observed in few orchards. Erand (*Ricinus*

communis) was observed to be cultivated for its oil yielding seeds. In vegetable crops Dudhi, and members of Cucurbitaceae family were observed along with Brinjal. In homestead areas Khatti and Mithi imli (*Tamarindus indicus* and *Pithecolobium dulce*), *Jamun* (*Syzygium cumini)* and *Ber* (*Zizyphus mouritiana*) were very common. Very few numbers of *Artocarpus heterophyllus* were also been observed.

MANGROVE VEGETATION

32. The intertidal region in the study area is though under influence of tide, possesses sandy substratum and hence is devoid of mangrove vegetation. Mangroves show a very dwarf appearance in the creeklets such as "kutri"(local name creek, which is at least 2.5 Km. away from the actual project site. Avicennia marina is the dominant species with Suaeda as a majour associate mangrove. *Denis indica* and *Salvadora persica* are the other associated species were recorded during the study period.

33. Mangroves, locally famous as "Cheriya" in this region and the mangrove areas are called "Cheriya vistar". Avicennia marina, Salvadora perciaca, Seuda were very common in this area. According to information available from local forest office, few years back, Rhizophora mucronata and Ceriops tagal had been introduced in this region. The mangrove vegetation is seen from Mundra port up to Tunda-Vandh coast. However, in Tunda-Vandh, the Prosopis and Acacia spp. were predominantly observed just above the high tide line.

Figure – 8
Natural Vegetation of the study area

VEGETATION DENSITY:

34. Mangrove plant density varies considerably between creek and island in study area. Density of mangrove trees ranges from minimum of 525/ ha at Jarpara to a maximum of 1666/ha at Navinal Creek -1. *Mangrove species were not reported along the proposed MGR rail route.*

35. Highest mangrove tree density of 1666 per ha was recored at Navinal creek. Details of the vegetation characterstics falling alongthe route are given below.

Station	Tree Density/Ha	Height (m)		GBH (m)	
		Mean	Range	Mean	Range
Adani	500	1.34	1- 4.5	0.32	0.2-0.59
Navinal cr-1	1666	3.28	1-6	0.53	0.1-1.05
Navinal cr-2	860	2.46	1-5.5	0.36	0.15-0.93

Station	Tree Density/Ha	Height (m)		GBH (m)	
		Mean	Range	Mean	Range
Jarpara	525	1.85	1-2.5	0.26	0.2-0.36

Source: Gujarat Institute of Desert Ecology

36. This region receives very small amount of rain, in addition the soil texture is also sandy. Hence, the vegetation in this region is typically "scrub" type vegetation. The trees and shrubs of *Prosopis* and *Acacia* are predominantly reported in non-cultivated lands. Also members of Euphorbiaceae namely *E. nivula* and *E. tirucalli* were very commonly observed. *Aloe vera* was also observed at few places. The profusely grown *Ficus benghlensis* were observed near a dry water tank in Navinal village. Among the evergreen species Neem (*Azadiracta indica)* is the only species observed in significant number in the study area. Among shrubs- *Cassia auriculiformis*, locally called "Avar" is also observed predominantly along with *Calotropis*. In tress species, *Eucalyptus, Casuarina, Delonix, Peltophorum, Nerium, Polyalthia, Thevetia* were observed to be cultivated in homestead areas. A list of flora recorded in the study area is shown in the following Table:

Table - 4

List Of Flora Recorded In The Study Region

No.	Name of Plant	Family	Habit	Vernacular Name
1.	*Acacia auriculiformis*	Mimosaceae	T	
2.	*Acacia leucociphala*	Mimosaceae	T	Hermo baval
3.	*Acacia nilotica sub-species indica*	Mimosaceae	T	Babhul
4.	*Acacia senagal*	Mimosaceae	T	Gorad
5.	*Acrus sapota*	Sapotaceae	T	Chiku
6.	*Agave ingens*	Agavaceae	H	
7.	*Aloe vera*		H	
8.	*Arachis hypogaea*	Papilionaceae	H	Mungphali
9.	*Artocarpus heterophyllus*	Moraceae	T	
10.	*Avicennia marina*	Avicenniaceae	T	Cheriya
11.	*Azadirachta indica*	Meliaceae	T	Nimda, Limdo, Neem
12.	*Bougainvillea spectabilis*	Nyctaginaceae	C	
13.	*Butea monosperma*	Fabaceae	T	Kesudo
14.	*Calotropis gigentia*	Asclepiadaceae	S	Dholo Akado
15.	*Calotropis procera*	Asclepiadaceae	S	Nano Akado
16.	*Carica papaya*	Carricaceae	T	Papita, Papaya
17.	*Cassia auriculiformis*	Caesalpiniaceae	S	Avar
18.	*Casuarina equisetifolia*	Casuarinaceae	T	Suru
19.	*Cocos nucifera*	Arecaceae	T	Nariyal
20.	*Cordia dichotoma*	Boraginaceae	T	Moto Gundo

No.	Name of Plant	Family	Habit	Vernacular Name
21.	*Cordia gharaf*	Boraginaceae	S	Liyar, Gundi,
22.	*Cynodon dactylon.*	Poaceae	HG	
23.	*Cyperous spp.*	Cypereceae	H	
24.	*Delonix regia*	Caesalpiniaceae	T	Gul Mohar
25.	*Derris indica*	Fabaceae	T	
26.	*Eucalyptus Spp.*	Myrtaceae	T	Nilgiri
27.	*Euphorbia nivulia*	Euphorbiaceae	S	Thor
28.	*Euphorbia tirucalli*	Euphorbiaceae	T	Kharsani, Thor
29.	*Ficus benghalensis*	Moraceae	T	vad
30.	*Ficus recemosa L.*	Moraceae	T	
31.	*Ficus religiosa L.*	Moraceae	T	Pipal
32.	*Ipomea fistulosa*	Convolvulaceae	S	Akari
33.	*Ipomoea sp.*	Convolvulaceae	C	
34.	*Leptadenia pyrotechnica*	Asclepiadaceae	S	Khip
35.	*Leucaena leucocephala*	Mimosaceae	T	
36.	*Mangifera indica L*	Anacardiaceae	T	Aam
37.	*Mimosops hexandra*	Sapotaceae	T	Rayan
38.	*Nerium odoratum*	Apocynaceae	S	Kanher
39.	*Peltophorum pterocarpum*	Caesalpiniaceae	T	
40.	*Pennisetum typhoides*	Poaceae	HG	Bajra
41.	*Phaseolus aureus*	Fabaceae	H	Mung
42.	*Pheonix dactylifera*	Arecaceae	T	Kharik Palm
43.	*Pithecolobium dulce*	Mimosaceae	T	
44.	*Polyalthia longifolia*	Annonaceae	T	
45.	*Portulaca indica*	Portulacaceae	H	
46.	*Prosopis chilensis*	Mimosaceae	S	Gando Baval
47.	*Prosopis chilensis*	Mimosaceae	T	Khijdo
48.	*Prosopis stephaniana*	Mimosaceae	S	Khijdi
49.	*Ricinus communis L.*	Euphorbiaceae	S	Erand
50.	*Samanea saman*	Mimosaceae	T	
51.	*Solanum melanogena*	Solanaceae	H	Baingan
52.	*Sorghum bicolor*	Poaceae	HG	Jowar

No.	Name of Plant	Family	Habit	Vernacular Name
53.	*Syzygium cumini*	Myrtaceae	T	Jamun
54.	*Tamarindus indicus L.*	Caesalpiniaceae	T	
55.	*Terminalia catapa*	Combretaceae	T	
56.	*Thevetia peruviana*	Apocynaceae	S	
57.	*Typha angustata*		H	Panj
58.	*Zizyphus mauritiana*	Rhamnaceae	S	Ber

FAUNA OF THE STUDY AREA

37. Old records reveal that at the beginning of the 18th centaury Lion, Tiger and other animals relating to cat family was plentiful in Kachchh, but villages observed that most of these animals are not seen in the area.

38. Some of the common animals found in the study area are Fox, Mangoose,Nilgai (in Mundra forest) Rabbit etc,

39. In reptile's cobra, monitor lizard, rat snake is reported by surrounding villagers at rare occasions.

40. A recent study reveals high avifaunal diversity at Mundra region and 140 species have been documented. Some of the birds sighted during the present study are Grey herons, Pond herons, large and small Egrets, Black Ibis etc. Following figures indicate about the presence of avifauna of the area.

Figure – 9
Avifaun of The Study Area

LIVESTOCK POPULATION

41. Cattle wealth occupies a pivotal place in the rural economy of any of the area. Bullocks & cows, buffalo, sheep, goats, horses, mules, donkeys, camels, pigs and poultry are the livestock reported. Livestock density of the area varies from 50 to 75 per square kilometer. Average density (per square kilometer) for buffalo, cattle, goat, and sheep varies from 10 –

20, 30 – 50, 10 – 20, and below 5, respectively. The cattle's (cow and buffaloes) are normally taken to open land for natural manuring of the land. There are various dairy farms (Gau shalas) in the study region that are also important source of earning for village people. Following Table and Figures shows the livestock population of the study area

Livestock	***Average Density/sq km***
Buffalo	<10
Cattle	20-30
Goat	20-30
Sheep	20-30

Source: ENVIS website, 2006

42. Herds of goat were reported during the study period, which is shown in following figure:

Figure – 10
Livestocks of the Study Area

Figure – 11
Livestocks of the Study Area

MGR RAILWAY SYSTEM AND VEGETATION DESCRIPTION.

43. To describe the MGR railway route, MGR line is divided into four segments viz. A) Unloading bulb B) MGR load alignment Loading C) Loading and D) Loading terminal station @ Adani R & D railway yard. Proposed MGR railway route is shown in Drawing No. RITES/PFC-Mundra-plan/01 sheet 1 of1.

44. For the purpose of description of rail alignment, the starting point proposed at the entrance of unloading bulb is assumed as km 0.00. For in motion of coal rakes for unloading in the track hopper the train will have forward movement. Therefore a bulb type arrangement has been proposed in the unloading terminal. Unloading terminal station is partially on straight and curve and ends at km 5/692.

45. After unloading terminal station at km 5/692 the alignment is straight up to km 8/208. after this the alignment takes a the curve (no.6)with a curve of radius 500k meters up to km 8/477 and then the alignment is straight up to km 11/709, there after the alignment take a left hand curve (no.7) with curve of radius 500 meters up to km 11/798 and then straight up to km 13/641. after this the alignment takes right hand curve (no.8) with a curve of radius 500 meters up to km 13/657 after that the alignment takes is straight unto km 15/434 and takes a right hand curve (No.9) with curve of radius 500 meters up to km 15/685.Thereafter the alignment is straight up to km 18/590 and takes right hand curve (no.10) with a curve of radius of 500 meters up to km 18/634and than straight up to km 21/424. After this the alignment takes right hand curve (no.11) with a curve radius of 500 meters up to km 21/951 and then straight up to km 25/110. After this the alignment takes a left hand curve (no.12) with a curve of radius 500 meters up to km 25/507 where the alignment enters in to the loading bulb.

46. The alignment enters into a loading bulb with a curve (no.12) at km 25/110 with a curve radius of 500 meters up to km 25/507. There after the alignment Is straight up to km 25/784. After this the alignment takes a left hand curve (no.13) with a curve of radius 500 meters up to km 25/874 and than straight up to 26/595. After this the alignment takes a right hand curve (no.14) with a curve of radius 300 meters up to km 27/128 and than alignment straight up to 27/141. After this the alignment takes a right hand curve (no.15) with a curve of radius 300 meters up to km 27/670 and than alignment straight up to 28/372and takes right hand curve (no. 16) with a radius of curve 500 meters up to km 28/489 and than the alignment straight up to 28/993. After this the alignment takes a right hand curve (no.17) with a curve of radius 500 meters up to km 29/164 and meets the MGR bulb.

47. Existing Adani's R & D rail yard has 5 lines for handling port traffic. It is proposed to bring the UMP POL rakes from Adipur station to Adani R & D rail yard for handling. Unloading line No. 1 and 2 shall be used for handling the loading and unloading coal rakes.

48. The proposed railway yard near Adani railway yard doesn't have any vegetation. The Adani railway yard and vacant place for the MGR railway yard is shown in following photographs.

Figure – 12

Adani railway yard | **Place For Proposed Railway Route Near Adani Railway Yard**

49. Ideally in MGR system, the train needs not to be physically stopped as both loading and unloading operations are in motion. The proposed MGR system is envisaged not to disturb village habitations, village roads, and ecology along the MGR line.

50. Photograph showing typical Vegetation near the MGR route near Adani railway yard at Mundra.

Figure – 13

Vegetation Along The MGR Route. Near Adani Railway Yard

51. There are 18 bridges proposed on the MGR route. One of them is planned over Nagavantahi Nadi also. Typical feature and vegetation under the proposed bridges is shown in following figure.

Figure – 14
Proposed Bridge At Nagvanthi Nadi

52. Proposed coal stack yard area was also surveyed during the study. *Prosopis juliflora* is the predominate species at the proposed project site coal stack yard. Existing features of the area is shown in following figure :

Figure – 15
Coal Stacking Yard

IMPACTS AND MANAGEMENT PLAN

53. Mangrove or other forested areas are not falling along the 100 wide route of MGR system. There may be cutting of some vegetation at certain stretches; the exact number can be ascertained after the finalization of the route. However, effort will be done to minimize the minimum shrub/trees felling.

54. Plantation is planned all along the available corridor of railway route. This will help in restoring the existing ecology of the route.

55. The above plantation will attenuate the noise generated due to operation of rail route.

CONCLUSION:

a) Predominent species along the route is reported to be *Prsopis juliflora* (Ganda bawal).

b) Mangrove species were not reported along the proposed MGR route.

c) No National park, wild life sanctuary, Biosphere Reserves, Bird sanctuary are falling along the rail route of proposed MGR system.

d) Ther is no Lakes, Reservoir, Dams coming in the way of MGR line. A small Bridge will be constructed on nagvanthi nadi.

e) Study area does not have Sensitive monuments and, Historical Places.

f) Mostly domestic and pet animals were report during the study. However, wild animals are also noticed by villagers at some of the accasions.

g) No significant wild life habitate disturbance is expected due to proposed MGR route and its activities.

h) During the lay down of MGR line, mainly local shrub plantation and some of the commercial specis of **Phoenix robusta** locally known as **Kharik**. , Chiku (*Achrus sapota*), Coconut *(Cocus nucifera)* Mango *(Mangifera indica var)* will be disturbed. However, proposed plantation along the MGR route will be helpful in compensating the loss of flora.

i) Plantation will be done all along the MGR route in consultation with local forest department.

j) Plant species native of the area shall be introduced. The preferred plant species will be heterogeneous in nature. Monocultures will be discouraged as much possible.