TATA CONSULTING ENGINEERS LIMITED

SURAT SMART CITY DEVELOPMENT LIMITED

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Detailed Project Report for Continuous Ambient Air Quality Monitoring System And Water Quality Monitoring System for the Surat City.

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1 INTRODUCTION

1.1 About Surat

Surat is one of the cleanest cities of India and is also known by several other names like "THE SILK CITY", "THE DIAMOND CITY", "THE GREEN CITY", etc. Surat, the city of diamonds and textile may have earned the distinction of being one of the cleanest cities in the country, but it lags behind when it comes to keeping a check on industrial and Vehicular pollution. Industrial development in Surat district is attributed to the presence of a large number of diamond processing, textiles and chemical & petrochemical industries. There are over 41,300 small and medium industries functioning in the district. Some of the main industries are textiles, chemicals, dying & printing, diamond processing, zari (silver) making, and; engineering and related activities (including manufacturing machines & equipments). Maximum number of (nearly 24,000 units) in small and medium enterprises is related to textile industry in the district followed by repairing & service industry with more than 11,000 units.

In terms of providing the quality of the life to the citizens of Surat, Surat Municipal Corporation has decided to implement the Ambient Air Quality Monitoring System (AAQMS). The main objectives of implementation of AAQMS will be to provide:

- To determine the current status and trends of ambient air quality
- To indicate the levels of air quality necessary with an adequate margin of safety to protect the public health, vegetation and property.
- To assist in establishing priorities for reduction and control of pollutant level;
- To examine if the prescribed ambient air quality standards are maintained or not
- To gain knowledge and an insight required for developing preventive and corrective measures
- To understand the natural cleansing process undergoing in the environment through various processes such as pollution dilution, dispersion, wind based movement, dry deposition, precipitation and chemical transformation of the pollutants released.

Air pollutants are added in the atmosphere from variety of sources that change the composition of atmosphere and affect the biotic environment. The concentration of air pollutants depend not only on the quantities that are emitted

from air pollution sources but also on the ability of the atmosphere to either absorb or disperse these emissions. The air pollution concentration vary spatially and temporarily causing the air pollution pattern to change with different locations and time due to changes in meteorological and topographical condition. The sources of air pollutants include vehicles, industries, domestic sources and natural sources. The problem of air pollution is in major cities where the prominent source of air pollution is vehicles and small/medium scale industries. The below graph represent the main sources of pollution.

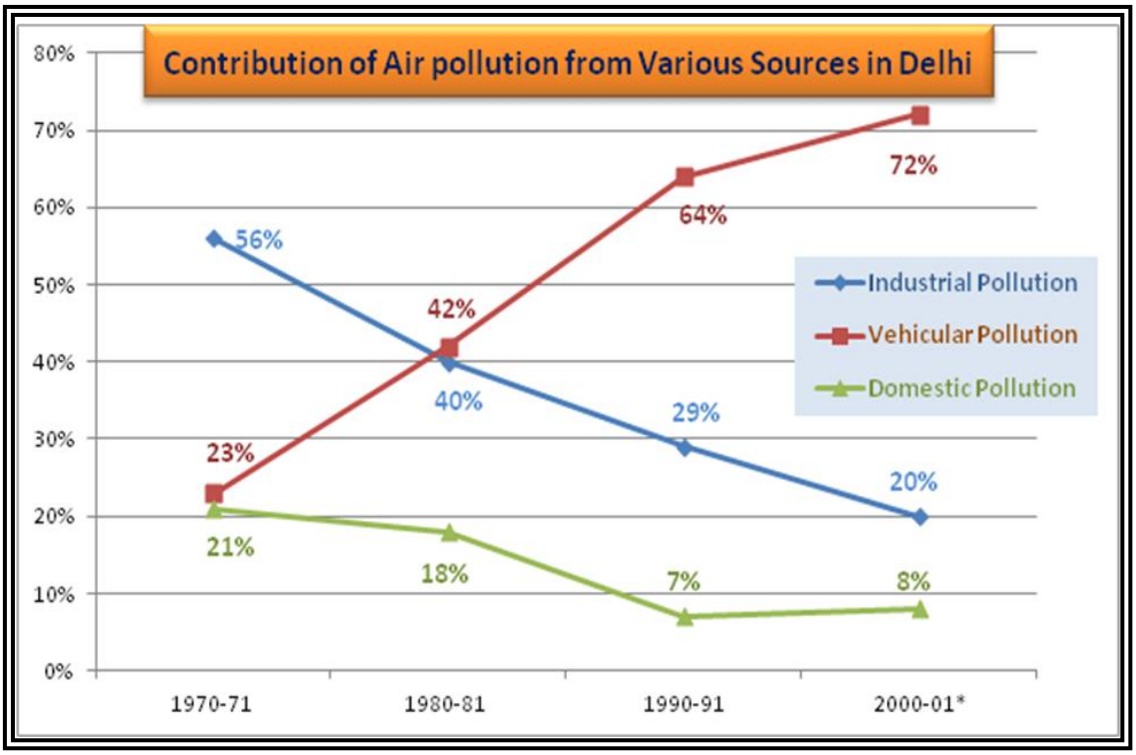

Figure 1: Contribution of Air Pollution from Various sources in Delhi (Source MOEF)

Because of the presence of high amount of air pollutants in the ambient air, the health of the population and property is getting adversely affected. It is necessary to assess the present and anticipated air pollution through continuous air quality survey/monitoring programs. The report presents guidelines for carrying out ambient air quality monitoring for Surat under Smart City initiatives and providing Quality of life to citizen. Ambient air quality monitoring is carried out so as to generate data that meets the objectives of monitoring. Ambient air quality monitoring programs are needed to determine the existing quality of air, evaluation of the effectiveness of control programs and to develop new programs.

The report aims towards developing a more uniform air monitoring network so that data from various stations is comparable.

The report discusses the various aspects of air quality monitoring network such as, which pollutants should be monitored, location where monitoring should be carried out and the various techniques of monitoring. The network design also depends upon the type of pollutants in the atmosphere through various common sources, called common urban air pollutants, such as Suspended Particulate Matter (SPM), Respirable Suspended Particulate Matter (RSPM), Sulphur dioxide (SO2), Oxides of Nitrogen (NOx), and Carbon Monoxide (CO) etc. The areas to be chosen primarily are such areas which represent high traffic density, industrial growth, human population and its distribution, emission source, public complaints if any and the land use pattern etc.

2 Codes and Standards

All Analyzers shall confirm to USEPA automated reference or equivalent method as specified for individual analyzers.

Offered analyzers and the analysis method should be acceptable to Central Pollution Control Board.

2.1 National Ambient Air Quality Standard:

Pollutant	Time Weighted Average	Concentration of Ambient Air		Method of Measurement
		Industrial, Residential, Rural and Other Areas	Ecologically Sensitive Area (notified by central Government)	
Sulpher Dioxide (SO2), µg/Cb. M	Annual*	50	20	Improved West and Gaeke Ultraviolet Fluorescence
	24 Hours**	80	80	
Nitrogen Dioxide (NO2), µg/Cb. M	Annual*	40	30	Modified Jecob & Hochheiser (Na-Arsenite) Chemiluminescence
	24 Hours**	80	80	
Particulate Matter (Size less than 10 mg), PM10, µg/Cb. M	Annual*	60	60	Gravimetric TOEM Beta Attenuation
	24 Hours**	100	100	
Particulate	Annual*	40	40	Gravimetric

Matter (Size less than 2.5 mg), PM2.5, µg/Cb. M	24 Hours**	60	60	TOEM Beta Attenuation
Ozone (O3), µg/Cb. M	Annual*	100	100	UV Photometric Chemiluminescence Chemical Method
	24 Hours**	180	180	
Lead (Pb), µg/Cb. M	Annual*	0.5	0.5	AAS/ICP method after sampling on EPM 2000 or equivalent filter paper ED-XRF using Taflon filter
	24 Hours**	1	1	
Carbon Monoxide (CO), mg/Cu. M	Annual*	2	2	Non Distructive Infra Red (NDIR) spectroscopy
	24 Hours	4	4	
Ammonia (NH3), µg/Cu.M	Annual*	100	100	Chemiluminescence Indophenol Blue Method
	24 Hours	400	400	
Benzene (C6H6), µg/Cu.M	Annual*	1	5	Gas chromatography based continuous analysis. Adsorption and description followed by GC Analysis
Benzo(a)Pyrene (Bap), Particulate phase only, ng/Cu.M	Annual*	1	1	Solvent extraction followed by HPLC/GC Analysis
Arsenic (As), ng/Cu.M	Annual*	6	6	AAS/ICP method after sampling on EPM 2000 or equivalent filter paper ED-XRF using Taflon filter
Nickel (Ni), ng/Cu.M	Annual*	20	20	AAS/ICP method after sampling on EPM 2000 or equivalent filter paper ED-XRF using Taflon filter

- * Annual arithmetic mean of minimum 104 measurements in a year taken twice a week, 24 hourly at uniform interval.
- ** 24 hourly or 8 hourly or 01 hourly values as applicable shall be complied with 98% of the time in a year. 2% of the time they may exceed, but not on 2 consecutive days.
- Note: Whenever and wherever monitoring results on two consecutive days of monitoring exceeds the limits specified above for the respective category, it shall be considered adequate reason to institute regular or continuous monitoring and further investigation.

2.2 Ambient Noise Standards:

Area Code	Category of Area	Limits in dB(A) Leq	
		Day Time*	Night Time
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence zone**	50	40

Noise Standards in the work environment are specified by Occupational Safety and Health Administration (OSHA-USA) which in turn are being enforced by the Government of India through model rule formed under the Factories Act are as per Table below:

Total Time of Exposure (per day in hours) (Continuous or short term Exposure)	Sound Pressure Level in dB(A)
8	90
6	92
4	95
3	97
2	100
3/2	102
1	105
3/4	107

1/2	110
1/4	115
Never	>115

Primary Water Quality Criteria for Designated Best Use Classed

Designated Best Use	Class	Criteria
Drinking Water Source without conventional treatment but after disinfection	A	• Total coliforms Organism (Most probable number (MPN)/100ml) shall be 50 or less • pH Shall be between 6.5 to 8.5 • Dissolved Oxygen Demand (DO) shall be 6mg/l or more • Biological Oxygen Demand (BOD) for 5 days at 20 deg. C shall be 2mg/l or less
Outdoor Bathing (Organised)	B	• Total coliforms Organism (Most probable number (MPN)/100ml) shall be 500 or less • pH Shall be between 6.5 to 8.5 • Dissolved Oxygen Demand (DO) shall be 5mg/l or more • Biological Oxygen Demand (BOD) for 5 days at 20 deg. C shall be 3mg/l or less
Drinking water source after conventional treatment and disinfection	C	• Total Coliforms Organism (Most probable number (MPN)/100ml) shall be 5000 or less • pH Shall be between 6 to 9 • Dissolved Oxygen Demand (DO) shall be 4mg/l or more • Biological Oxygen Demand (BOD) for 5 days at 20 deg. C shall be 3mg/l or less
Propagation of wildlife and fisheries	D	• pH Shall be between 6.5 to 8.5 • Dissolved Oxygen Demand (DO) shall be 4mg/l or more • Free Ammonia (as N) shall be 1.2mg/l or less
Irrigation, Industrial, cooling, controlled waste disposal	E	• pH Shall be between 6.0 to 8.5 • Electric Conductivity at 25 deg. C (Micro Ohom/cm) shall be max. 2250 • Sodium absorption ratio shall be max. 26 Boron shall be max. 2mg/l
	Below-E	• Total coliforms Organism (Most probable number (MPN)/100ml) shall be 50 or less • pH Shall be between 6.5 to 8.5 • Dissolved Oxygen Demand (DO) shall be 6mg/l or more • Biological Oxygen Demand (BOD) for 5 days at 20 deg. C shall be 2mg/l or less

3 System Description for AAQMS

The AAQMS are equipped with analyzers of CO, CO2, SO2, O3, NOx, PM2.5 and PM10. Gas analyzers shall be maintained to strict QA/QC procedures to ensure reliable results. Provision for transferring data to Central Computer shall be there. Monthly brief reports are prepared & sent to the management.

4 Meteorological Monitoring System (MMS) System & Water Quality System

Standard meteorological sensors shall include wind direction sensor, wind speed sensor, ambient temperature sensor, rain gauge, solar radiation, etc.
The meteorological sensor shall be interfaced directly with the data acqisition system.
The Online measurement of the Water quality shall include the following parameters.

- pH
- Conductivity
- Turbidity
- Total Organic Carbon
- Dissolved Oxygen

The sensor shall be interfaced directly with the data acqisition system System Design basis
The offline measurement of the water quality shall include the following parameters.

- Biological Oxygen Demand
- Sodium absorption ratio
- Total Suspended solid
- Total Coliforms

4.1 For AAQMS System

The AAQMS shall include continuous monitoring of the following:

- Sulphur Dioxide(SO2)
- Oxides of Nitrogen (NOX)
- Carbon Monoxide (CO)
- Carbon dioxide(CO2)
- Suspended Particulate Matter (PM10)

- Suspended Particulate Matter (PM 2.5)
- Ozone (O3)

The above listed measurements shall be provided at twenty one (21) locations. Refer Annexure – I for location details. In the first phase seven locations has to be equipped with the Ambient Air quality monitoring which covers all the seven SMC zonal offices and the remaining will be done in the subsequent phases. Therefore, AAQMS system shall include twenty one (21) AAQMS stations and a Centralized AAQMS Data Acquisition System (CMS) (PC based) at command and control center of Smart City, Surat.

Location details for first phase of work:

Zone office	**Location**
West Zone	Vahivati Bhavan, Bala Saheb Devrash Road, New Rander Road, Tadwadi, Surat
Central Zone	Vahivati Bhavan, GordhanCMS Chokhawala Marg, Muglisara, Surat-395003
North Zone	Vahivati Bhavan, Behind Gajera school, B/s Ramjikrupa Raw-House, Katargam, Surat
East Zone	Vahivati Bhavan, Nr. Saifee Society, Opp. Panchwati Wadi, Lambe Hanuman Road, Surat
South Zone	Vahivati Bhavan, Udhana Main Road, Opp. Satya Nagar, Udhan, Surat
South West Zone	Vahivati Bhavan, Municipal Shopping Center, Near Aadarsh Nagar Society, Athwalines, Surat.

South East Zone	Bh. Vatika Township, Bh. Model Township, Dumbhal, Surat

The AAQMS equipment shall be housed in a weather proof air conditioned compartment. AAQMS for each location shall be a fixed type, self contained station. Total twenty one (21) nos. of such stations will be provided. The CMS shall be data logger designed to acquire, transmit, hook data in the format required, process and store data.

All instruments related to a particular AAQMS station shall be connected to a data acquisition unit placed in its individual room. Data transfer between the twenty one (21) AAQMS stations and the central evaluation AAQMS CMS (PC based)-(located in central control room) shall be performed through GSM modems/TCP-IP which shall be appropriately licensed.

The Central AAQMS CMS system shall perform following functions:

- To collect all the data from the individual AAQMS Stations at prescribed time or on request.
- Ability to manage multiple remote AAQMS Stations.
- Monitoring, analyze, report generation and archiving of data.

Measurement of the gases such as NOx, SO2, O3, CO shall be based on the electrochemical principle whereas the measurement of CO2 shall be based on the NDIR technology.

Measurement of Dust particles (PM 2.5 and PM 10) shall be based on the light scattering principle.

4.2 For MMS System

Micro-Meteorological data collection & recording station shall be continuous on-line type. The measurements shall be provided at twenty one (21) locations. Refer Annexure – I for location details. In the first phase seven locations has to be equipped with the MMS system which covers all the seven SMC zonal offices and the remaining will be done in the subsequent phases.

Location details for first phase of work:

Zone office	Location
West Zone	Vahivati Bhavan, Bala Saheb Devrash Road, New Rander Road, Tadwadi, Surat
Central Zone	Vahivati Bhavan, GordhanCMS Chokhawala Marg, Muglisara, Surat-395003
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South Zone	Vahivati Bhavan, Udhana Main Road, Opp. Satya Nagar, Udhan, Surat
South West Zone	Vahivati Bhavan, Municipal Shopping Center, Near Aadarsh Nagar Society, Athwalines, Surat.
South East Zone	Bh. Vatika Township, Bh. Model Township, Dumbhal, Surat

MMS shall allow monitoring, logging of parameter values, archiving and report

generation for environmental monitoring authorities and municipal management personnel. For the data relating to the following meteorological measurements:

a. Wind Speed & Direction
b. Wind Rose
c. Air Pressure & Relative humidity
d. Solar Radiation
e. Rainfall
f. Ambient temperature

- All the data related to Meteorological station shall be connected to central evaluation PC located at Command and Control Center (CCC). Necessary software as required for the MMS shall be loaded into central evaluation PC.

4.3 For Water Quality

The Water Quality measurement for the ABD area of 8 sq.km shall include the measurement of the following parameters:

- Total Coliforms
- pH
- Dissolved Oxygen (DO)
- Biological Oxygen Demand (BOD)
- Chemical Oxygen Demand (COD)
- Conductivity
- Sodium absorption
- Total Suspended Solid (TSS)
- Turbidity

The parameters such as Dissolved Oxygen, pH, Electrical Conductivity, Total Organic Carbon, Turbidity, Colour, Odour shall be measured at the site itself so these parameters are considered as 'Field determinations' parameters and the data can be sent online. The instrument for measuring these parameter shall be installed in a mobile van itself. The Locations of the sample collection for the measurement of various parameters shall be as per the CPCB guidelines and will be decided by the contractor during engineering stage

Parameter to be monitored	Method of Testing	Frequency for Measurement
Colour	Online in Mobile Van	Weekly
odour	Online in Mobile Van	Weekly
pH	Online in Mobile Van	Weekly
Dissolved Oxygen	Online in Mobile Van	Weekly
Total Organic Carbon which gives the probable Chemical Oxygen Demand	Online in Mobile Van	Weekly
Turbidity	Online in Mobile Van	Weekly
Conductivity	Online in Mobile Van	Weekly
Biological Oxygen Demand	In existing Lab	Monthly
Sodium absorption ratio	In existing Lab	Monthly
Total Suspended solid	In existing Lab	Monthly
Total Coliforms	In existing Lab	Monthly

The following parameters shall be measured in the lab of surat Municipal Corporation.

- Biological Oxygen Demand
- Sodium absorption ratio
- Total Suspended solid
- Total Coliforms

Water samples shall be collected from the following locations every month for testing in Lab for BOD, Sodium absorption ratio, TSS & Total coliforms.

However, the **sampling frequency** is governed by the level of variation in water quality of a water body. If variations are large in a short duration of time, a larger frequency is required to cover such variations. On the other hand, if there is no significant variation in water quality, frequent collection of sample is not required. The water quality variations could be of two types i.e. random and

cyclic or seasonal. In case of random variations e.g. due to sudden rainfall in the catchment or sudden release of water from the dam etc., increased frequency may not help much as such variations are highly unpredictable. Thus, within the available resources it is not cost effective to cover such variations. In case of the water bodies having cyclic variations more frequently, sampling on monthly basis is justified. But for all those water bodies having stable water quality round the year, monthly sampling is not justified.

Frequency and Parameters

- On routine basis, a combination of general parameters, nutrients, oxygen consuming substances and major ions should be analyzed at all stations. Depending upon the industrial activities and anticipated at the upstream of the sampling station other parameters like micro-pollutants, pesticides or other site specific variables may be included at lower frequency. Such stations need to be identified.
- A list of parameters to be considered for analysis and frequency of sampling is provided in the "Protocol for Water Quality Monitoring" notified by Govt of India.
- It was also emphasized that biological monitoring should form an important part of our water quality monitoring programme due to its inherent advantages. The SPCBs/PCCs agreed to initiate such exercise initially at limited stations.
- Sediment needs to be analyzed for micro pollutant in some stretches as most of micro pollutants are associated with sediment. This should form part of monitoring programme.

Parameter And Frequency Of Monitoring In Surface water:

Type Of Station	Frequency	parameter
Baseline	Perennial rivers and Lakes : Four times a year Seasonal rivers : 3-4 times (at equal spacing) during flow period. Lake: 4 times a year	(A) Pre-monsoon: Once a year Analyse 25 parameters as listed below : (a) General : Colour, odour, temp, pH, EC, DO, turbidity, TDS (b) Nutrients : NH3-N, NO2 + NO3, Total P

		(c) Organic Matter : BOD, COD (d) Major ions : K, Na, Ca, Mg, CO3, HCO3, Cl,SO4, (e) Other inorganics : F, B and other location specific parameter, if any (f) Microbiological : Total and Faecal Coliforms (B) Rest of the year (after the pre-monsoon sampling) at every three months' interval: Analyse 10 parameters: Colour, Odour, Temp., pH, EC, DO, NO2 + NO3, BOD, Total and Faecal Coliforms.
Trend	Once every month starting April-May (pre-monsoon), i.e. 12 times a year	(A) Pre-monsoon: Analyse 25 parameters as listed for baseline monitoring (B) Other months : Analyse 15 parameters as listed below (a) General : Colour, Odour, Temp, pH, EC, DO and Turbidity (b) Nutrients : NH3-N, NO2 + NO3, Total P

		(c) Organic Matter : BOD, COD (d) Major ions : Cl (e) Microbiological : Total and Faecal coliforms (C) Micro pollutant :Once in a year in monsoon season (i) Pesticides-Alpha BHC, Beta BHC, Gama BHC (Lindane), OP-DDT, PP-DDT, Alpha Endosulphan, Beta Endosulphan, Aldrin, Dieldrin, 2,4-D, Carboryl (Carbamate), Malathian, Methyl Parathian, Anilophos, Chloropyriphos (ii)Toxic Metals-As, Cd, Hg, Zn, Cr, Pb, Ni, Fe (Pesticides & Toxic metals may be analysed once a year)

Online measurement data of the various locations shall be sent to the Central location which shall be performed through GSM modems/TCP-IP which shall be appropriately licensed.

5 System General Requirements

5.1 Control Panel unit for the AAQMS

Electric Power Supply

- 230 V AC Power supply shall be provided to each analyzer panel.

Air conditioning

- Proper cooling arrangement shall be provided to each panel.

Uninterrupted power supply (UPS)

- Single phase UPS (2x100%) with 30 minutes battery backup should be provided for smooth operation of each station of adequate capacity during emergency.

Technology	-	PWM using IGBT/MOSFETS
Crest Factor	-	More than 3:1
Input	-	400 V AC
Voltage Range		+/-10%
Frequency		50 Hz +/- 3%
Output Voltage	-	230 V AC
Voltage Regulation		+/- 1%
Frequency		50 Hz
Frequency Regulation		+/- 0.01Hz
Waveform		Pure sine wave
Battery type	-	VRLA Battery
Distortion	-	Less than 1% on linear load
Power factor	-	0.8 to 1
Indicator	-	LED – Battery charge, over load, battery on, replace battery
Alarm	-	Audible alarm for battery backup, battery fault
Protections	-	Surge suppression meets BIS or International Standard
Overload	-	Fuse and current limited
Short Circuit	-	Fuse & current limited & cut off
Efficiency	-	More than 90%
Environment	-	Operating Temperature: 0 -50 degrees C
Operating Humidity		10% to 95% (non-condensing)
Audible Noise		Less than 45 db (at 1 meter)

Solar power supply

The provision for the solar power supply shall also be provided to all the analyzer panel

5.2 General specifications for Analyzers

Parameters	Measuring range	accuracy
Electro chemical based gas measurement		
Ozone	1-100 µg/Nm3	+/- 2% at constant temperature
Sulphur Dioxide	1-1300 µg/Nm3	
Carbon Monoxide	1-500 µg/Nm3	
Nitrogen dioxide	900 µg/Nm3	
NDIR based gas measurement		
Carbon Dioxide	0-2000 ppm	+/- 2% at constant temperature
Dust measurement- Light Scattering		
PM 10 & PM 2.5	1-10000 µg/Nm3	+/- 2% at constant temperature

6 Meteorological Monitoring system

The meteorological instrumentation should be interfaced directly with the Data Acquisition System after passing through a lightning protection isolation box. A crank- Up telescopic 10 meters tower should be erected for mounting of meteorological sensors. The relative humidity and solar radiation sensors should be mounted on the Tower. All sensors should be NIST (National Institute for Standards and Technology, USA) traceable. The specifications are follows:

(a) WIND SPEED

- Range (Operation) : 0 – 60 m/s or better
- Sustainability: Up-to 75 m/sec
- Accuracy: ± 0.5 m/sec or better
- Resolution: 0.1 m/sec

- Sensor Type: Ultrasonic
- Threshold: 0.5 m/sec or less
- Response time: 10 sec or better

(b) WIND DIRECTION

- Range: 0 – 359 degree
- Accuracy: ± 5 degree or better
- Resolution: 1 degree
- Sensor type: Ultrasonic
- Threshold: 0.5 m/sec or less
- Response time: 10 sec or better

(c) AMBIENT TEMPERATURE

- Range: -10 o C to 60 o C
- Accuracy: ± 0.2 o C or better (with radiation shield)
- Response: 10 seconds in still air
- Sensor type: Resistance type
- Response time: 10 sec or better

(d) RELATIVE HUMIDITY

- Range: 0 to 100% RH
- Accuracy: ± 3.0 % or better
- Resolution: 1%
- Sensor type: Capacitive / Solid State
- Response Time: 10 sec or better

(e) SOLAR RADIATION

- Range: 0 to 1500 W/m2 or better
- Accuracy: ± 5.0 % or better
- Resolution: 5W/m2

(f) RAINFALL

- Range: 0.2 mm to 100 mm /hr
- Accuracy: ± 5% or better
- Resolution: 0.2 mm
- Sensor type : Tipping bucket rain gauge or any other

- Response Time : 10 sec or better

(g)TELESCOPIC CRANK – UP METEOROLOGICAL TOWER

The wind speed, wind direction, temperature, relative humidity and solar radiation sensors are to be mounted on the Meteorological Tower. The tower is to be a free standing four section telescopic towers provided with a hand crank to raise and lower the instruments mounted on the tower. Specifications are as follows:

- Extended Height : 10 meters
- Retracted Height : 2 metres
- Wind load Limit : 0.7896 sq. m. (8.5 sq. ft) at 50 mph
- Number of Sections : 4
- Construction material : Galvanised steel or aluminium

7 Specifications of Central Monitoring System (CMS)

The central Monitoring System shall be provided with hardware & software, which forms the heart of the Ambient Air Quality Monitoring & Weather monitoring System and is therefore a vital component of the system.

In general CMS should be industrial grade PC running latest windows OS and compatible software. It should be able to work unattended i.e. it captures analyzer values and sensor values automatically. If a user wishes to perform zero span checks or simply wishes to view the data, he should be able to login to the CMS through a valid username-password. In other words, the user can be located anywhere and not necessarily to close to the CMS. Data recorded in the CMS should also be accessible by remote computer and Smart Phone users for analysis & report viewing.

a. It should comprise of an Industrial PC running Windows latest version OS and compatible software.
b. The Data logging with central Monitoring System will be through GPRS from all the AAQMS and MMS system and should have an ability to program and log channels at different intervals and should have a capability of averaging and displaying real time data and averaged data over a period of 1 min, 10 min, ½ hr, 1 hr, 4 hr, 8, hr, 24 hr.
c. Real time or averaged data can be viewed quickly and easily through a remote CLIENT interface on the central computer.
d. The System should be able to perform nested calculations vector averaging and rolling averages.

e. It should have a feature for viewing instantaneous and historical data in the form of tables and graphs either locally or from a remote client.
f. Data retrieval from CMS via USB and DVD should be possible.
g. Generation of reports for pollution load, wind rose etc
h. Alarm annunciation of analyzer/sensor in abnormal conditions

The CMS should be able to collect and store meteorological data and air quality data from all instruments listed above. The CMS should be data logger designed to acquire, transmit, process and store data.

AAQMS and MMS shall be interfaced with DCS thro serial interface. The communication protocol shall be of Modbus RTU or Modbus over TCP/IP.

7.1 Specification of computer (minimum configuration)

Make	-	DELL / Compaq / HP
Processor	-	Intel Core2 Duo, Minimum 3.6 GHz processor or better
RAM	-	8GB RAM
Hard Disk	-	1TB
Other features:	-	DVD R/W Drive DVD-RW used for installation of software and backing up of data/configuration files Modem 9600 baud or greater Data averaging periods up to 4 independent data sets. Selected between 1 minute and 7 days. Calibration control Automatic span and zero control. Calibration data is stored separately. Mouse port USB port
Monitor	-	22 “ TFT color monitor

Port	-	2 serial, 1 parallel & 4 USB with LAN
Keyboard	-	104 keys keyboard Microsoft
Mouse	-	Optical Mouse + Pad
Operating system	-	Windows latest
Display	-	better than 800 x 600+ Display driver supporting up to 2048 x 1536 dual screen
Data storage	-	IDE Hard disk drive 1 TB Data Storage format Data stored in ASCII format
Modem Port	-	1 x RS232 DB9M

7.2 Specification of laser printer

Speed(pages per minute	-	At least 12
Resolution	-	1200 x 1200 dpi
RAM	-	8 MB expandable to 32 MB
Main tray capacity	-	At least 250 sheets
Interface	-	Parallel& USB
Operating System	-	Windows latest
Power Supply	-	230V AC, Single phase, 50 Hz

7.3 Specification of Analytical Software

- Windows latest version OS software for data acquisition from the CMS and for statistical analysis and reporting of the monitored parameters

mentioned above. Analysis and reporting software should possess following minimum features:

(i) Windows (latest version) compatible
(ii) File format conversion
(iii) Statistical analysis of data for maximum, minimum, average and standard deviation for various time intervals using the monitored data
(iv) Tabular and graphical format for report production
(v) Wind rose graphs
(vi) File export facility
(vii) Windows based printer support.

7.4 Report preparation and data validation software

- A typical online air quality monitoring station produces thousands of data values every month. The report preparation software is a vital aid to analyze the data recorded by the CMS. The software will be used to download data from the various field stations to a central location for analysis, long-term storage and dissemination of information. The software will be used to tabulate the data, export it to popular formats such as MS Excel or perform scientific analysis in the form of graphs/charts. For routine daily operation the user should be able to perform auto generation of suitable tables/graphs via templates configured as per need. Mandatory features of Report Preparation software are listed as below.

a. It should support communication to the CMS via a variety of mediums such as Ethernet, TCP/IP, GPRS, PSTN lines etc.
b. It should feature automatic data validation complete with data capture percentage
c. It should be able to manage more remote air quality monitoring stations in addition to the specified requirement.
d. It should be able to automatically collect data from various CMS at prescribed time interval i.e. it should allow programmable data download from the CMS
e. It should be able to display/tabulate online data of multiple stations
f. Should have the facilities for calculation of Arithmetic mean values, average, 30 min, 1 hr,2,hr, 3hr, 4 hr, 8 hr, 12 hr, 24 hr, weekly, monthly and yearly. Calculation for minimum, medium, percentile, maximum standard deviation frequency analysis and cumulative frequency analysis.

g. Capability to generate automatically wind roses, polar plots, Exceedance Curves, Histograms, Bar Charts etc.
h. Automatic reports preparation in the form of graphs/tables for a user defined period .User should be able to schedule time for the report to be generated
i. Auto mailing of the prepared report to a user-defined email id.
j. Features to export data to a variety of standard formats including standard image format, MS excel, HTML and ASCII text files.
k. It should allow setting up of alarm levels and provide automatic alerts of unexpected data and calibration levels via email to the system administrator.
l. Different users (or clients) should be able to customize the way they wish to interpret download values
m. Data evaluation and reporting software should be upgraded to a multi-user version that can store data in a MS SQL server 7 databases.

General

The Analyzer panel to be supplied as a completely assembled unit suitable for installation on a concrete Pad or as a stand-alone unit. All internal piping and tubing will terminate in bulkhead connections. Internal wiring will terminate in external junction boxes. All equipment including tubing, conduit fittings, junction boxes, etc. will be installed so as not to interfere with the removal of analyzers, sample handling systems and related equipment. Accessibility for maintenance will be given prime consideration. Suitable IP protection shall be provided since it is going to be used in the outside environment.

Fig. Analyzer panel

Construction

The Analyzer Shelter should consist of a self-framing exterior skin assembled on a rigid primed and painted steel superstructure. All materials used in the construction to be non-combustible.

The size of Panel shall be at least 5 feet x 3 feet with compartment for keeping the UPS Batteries and other accessories as required.

Air conditioning

Proper cooling arrangement shall be provided to the analyzer panel.

Lighting

The panel shall be provided with the minimum illumination level as required.

8 Water Quality Monitoring

The Field determination parameter shall be measured at the field itself and the data shall be sent online. The lab testing parameters shall be measured in the lab by collecting the samples and taken to the lab.

Criteria for Site Selection

The sampling site selection is generally linked with water quality monitoring objectives. For example if the monitoring is carried out for judging suitability of water for drinking water source then the monitoring site should be closer to the intake point whereas for outdoor bathing it should be near bathing Ghats. After understanding the factors affecting water quality thoroughly, it is necessary to select specific reaches or areas of the stream or river to sample. There is no set number of sampling stations that will be sufficient to monitor all the possible types of waste discharges. There is no routine methodology for site selection on a cook book basis. However, there are some basic rules. If these rules are carefully followed, a basically sound sampling design will be the result. Some general criteria for selecting appropriate sampling sites will be summarized under the following points:

- Always have a reference station up-stream of all possible discharge points. The usual purpose of a monitoring exercise is to determine the degree of man induced pollution, and the damage that is caused to aquatic life. The reference station serves to assess the situation with respect to background water quality and biological aspects, which may vary locally and regionally.
- Drinking water intake points, bathing Ghats, irrigation canal off-take points should be considered for monitoring.
- Sampling stations should be located upstream and downstream of significant pollution outfalls like city sewage drains and industrial effluent outfalls.
- All samples must be representative, which means that the determinants in the sample must have the same value as the water body at the place and time of sampling. In order to achieve this it is important that the sample is collected from well-mixed zone. A homogeneity test must be performed to identify the well-mixed zone.
- Additional downstream stations are necessary to assess the extent of the influence of an outfall, and locate the point of recovery.

- In large rivers like Ganga, Yamuna, Narmada, Krishna and Godavari, where mixing is poor and incomplete, the effluent may tend to follow one bank. Stations on both sides downstream are useful to make an estimate of the extent of the mixing zone.
- In large rivers a balance has to be found between the selection of a few stations giving poor coverage, and the selection of more stations having different substrates and dissimilar fauna, which cannot be compared spatially.
- In order to enable comparisons among sampling stations, it is essential that all stations be sampled approximately at the same time. Not more than two weeks should elapse between the sampling of the first and last station in a river.
- Sites for biological sampling should match with sites for chemical sampling.
- Biological sampling stations need to be selected with proper attention to representative habitats (kind of substrate, depth and flow). All sampling stations in a certain river should preferably be ecologically similar. To increase biological and chemical comparability, they should have similar substrate (sand, gravel, rock, or mud), depth, presence of rifles and pools, stream width, flow velocity, bank cover, human disturbances, etc.
- The conventional location of macro-invertebrate sampling stations in rivers arises not only from an assumed uniformity of substrate and fauna, but also from the ease with which it may be sampled by means of hand nets and stone lifting or kicking, and from the ease of access.
- For the estimation of the oxygen exchange rate of the river, a measurement of cross section is required. Any station should be typical with respect to the cross section of the river.
- The sampling team normally has to carry an appreciable burden of sampling gear and water samples, and the distance they can walk is limited. Easily accessible sites should be selected. The site should also be accessible under all conditions of weather and river flow. Accessibility is therefore an important consideration.
- With respect to preservation, samples are taken to perform analysis on three types of parameters: for some parameters, such as heavy metals, the samples need not be preserved. For other parameters, samples can be preserved by cold storage or by the addition of certain preservatives.

However, the samples for analysis of parameters like BOD and bacterial counts cannot be preserved and need to reach the laboratory shortly after taking the sample. The need to transport the samples to the laboratory will govern the range of determinations which can be carried out for a particular sampling site. Travel time greater than 24 hours between the site and laboratory is not recommended.

- The collection of samples can be hazardous at some locations in bad weather (such as high flow). Such sampling sites can better be avoided.
- There are many disturbing influences in the rivers, especially cattle wading, melon farming, fishing, sand recovery, etc.. These disturbances can drastically influence chemical processes and the nature of the biological community. Dams and barrages provide a different kind of habitat. Such sampling sites should be avoided.
- Availability of sampling facilities such as bridges, boats, and possibilities for wading are important criteria in the selection of sampling sites.
- In case of groundwater sampling select only wells (tube well, dug-well, handpump), which are in use.
- For groundwater pollution monitoring generally existing structures in the potentially polluted sites is selected.

- Since variation in groundwater quality is very high and unpredictable, it is practically not possible to cover assessment of groundwater quality of a particular area fully.
- It is also not practicable to create so many groundwater structures for sampling. Thus, a compromise has to be made between resources available and criticality of information required. It commonly agreed that groundwater quality is generally degraded in the urban, industrial, solid wastes (both municipal and hazardous from industries) dumpsites and agricultural areas. In such areas a reasonable network is adopted for groundwater quality monitoring depending on resources available. Sometimes groundwater structures need to be created in view of the criticality of the information needed for a particular area.

Fig: Representative picture of the sensor

The offline Water quality measuring parameters shall be done at the lab of surat Municipal Corporation. The measured parameter data shall be submitted on timely basis.

8.1 Instruments and Procedure for the Field measurement

Instruments

Some instruments and equipment are necessary to make the field analysis. Instruments and equipment must be brought to the field. Temperature should always be measured in the field:

- For measurement of Temperature, a (mercury) thermometer or thermistor is needed.
- For analysis of Electrical Conductivity, a conductivity meter is needed.
- For analysis of pH, a pH meter is needed.
- For analysis of Redox Potential, a pH meter (mV scale), reference electrode and oxidation-reduction indicator electrode are needed.

Note: It is possible that instead of separate meters for temperature, pH and conductivity, there is a single instrument with different probes which will measure all three parameters. These are called field monitoring kits. A supply of batteries and standard spare parts should also be carried along with the field instruments.

Field Analysis

Measurements of colour, odour, temperature, electrical conductivity, pH and dissolved oxygen are considered to be 'Field Determinations' and should be made as soon as possible after collecting a sample.

a) Colour

Determining the colour in the field is relatively easy. Pour an aliquot of approximately 10mL of sample into a glass test tube and judge the colour observed. Consider one of the following options:

- Light brown
- Brown
- Dark brown
- Light green
- Green
- Dark green
- Clear
- Other specify

b) Odour

Determining the odour should always be done in the field, as soon as possible after collecting a sample. After collection, fill a cleaned odourless bottle half-full of sample, insert stopper, shake vigorously for 2-3 seconds and then quickly smell the odour. Alternatively, pour an aliquot of approximately 5mL of sample into a glass test tube and judge the odour. Consider one of the following options:

- Odour free
- Rotten eggs
- Burnt sugar
- Soapy
- Fishy
- Septic
- Aromatic
- Chlorinous
- Alcoholic
- Unpleasant

c) Temperature

Water temperature should be measured in degrees Celsius, using a mercury thermometer or a thermistor. Normally, if temperature is measured electronically using a thermistor this device is built into an instrument which is capable of making other water quality measurements (e.g., pH and EC). Whenever possible, the temperature should be measured by directly dipping the thermometer in the natural body of water being studied. In case it is not possible, collect about 500 mL sample in a plastic or glass container and measure temperature by immersing the thermometer in the sample. Read the temperature after equilibration (no more change in the temperature reading). Report the Temperature on the sample identification form in degrees Celsius with 1 digit after the decimal point e.g. 13.2 o C.

d) pH

The most accurate method of measuring water pH in the field is by means of a portable purpose designed meter. Such meters are normally capable of measuring pH to the nearest 0.05 of a pH unit by using a ‘glass’ and a ‘reference’ electrode (although these are often combined in a single probe). Before measuring pH, it is necessary to calibrate the meter. This should be done at least once per day, before the first pH measurement is attempted. The procedure of this is as follows:

After removing their protective caps, the electrodes are rinsed in distilled water and carefully blotted dry with soft absorbent paper. NOTE: Care needs to be exercised here as the electrodes are very fragile.

- The electrodes are then placed in a fresh buffer solution and after following time for meter stabilisation, the pH reading of the meter is adjusted to the pH the buffer solution (normally pH = 7).
- The electrodes are then rinsed again with distilled water and blotted dry.
- If a pH measurement is not to be taken immediately, the electrodes should be replaced in their protective caps. Normally, the glass electrode cap is filled with distilled water before replacement to prevent the electrode drying out.
- Report the pH on the sample identification form in pH units showing one digit after the decimal point, e.g. 7.6.
- Once calibrated, the pH meter can be used to measure the pH directly by placing the electrodes in water sample immediately after it is obtained. Care should be taken to ensure that the electrodes are rinsed

with distilled water before and after each determination and that distilled water is placed in to the glass electrode cap for transportation.

e) Electrical Conductivity (EC)

EC can be measured in the field with a purpose-designed meter, see section 2.3. Before measuring conductivity it is necessary to calibrate the meter. This should be carried out at least once per day, before the first measurement is taken. Calibration is achieved by determining the conductivity of a known, fresh solution of potassium chloride and adjusting the meter accordingly. In order to ensure the conductivity reading is accurate, it is necessary to adjust the conductivity reading to compensate for temperature changes. In most modern meter this is done automatically. Once calibrated, the conductivity of the water can be measured by immersing electrode in a sample of water as soon as it is taken. It is important to remember that conductivity meters often take some minutes to stabilize. The reading must, therefore be taken after this stabilization has occurred. Report the EC at 25° C preferably in µmho/cm with no figure after the decimal point, e.g. 1135 µmho/cm.

8.2 Laboratory Analysis

The laboratory analysis is to be performed by the laboratory staff within stipulated time and precision. In order to make the procedures uniform and also presentation methods uniform a guideline is prepared. The analytical methods are prescribed for each parameter along with measurement unit and significant figure in the following table.

Parameters	Unit	Measurement methods	Significant figures after Decimal
Colour	-	**Visual Method**	
odour	-	**Manual**	
Temperature	Deg. C	**Thermometer**	1
pH	-	**pH meter**	1
Electrical	µS/cm	**Conductivity**	0

Conductivity		**meter**	
Dissolved Oxygen	mg/L	**DO meter**	1
Turbidity	NTU	**Nephelometer**	1
Ammonical Nitrogen	mg/L	Gravimetry	0
Nitrite + Nitrate-N	mgN/L	Colorimetry	1
Orthophosphate	mgN/L	Colorimetry	1
Biological Oxygen Demand	mg/L	DO consumption in 3 days at 27 °C	4
Chemical Oxygen Demand	mg/L	Potassium dichromate method	4
Sodium	mg/L	Flame photometry	1
Potassium	Mg/L	Flame photometry	1
Calcium	mgCaCO3/L	EDTA Titrimetric	1
Magnesium	mgCaCO3/L	EDTA Titrimetric	1
Carbonate as CaCO3	mgCaCO3/L	Titrimetric	1
Bicarbonate as CaCO3	mgCaCO3/L	Titrimetric	1
Chloride	mg/L	Argentometric titration	1
Sulphate	mg/L	Turbidimetry	1
Fluoride	mg/L	Ion meter, Colorimetry	2
Boron	mg/L	**Ion meter**,	2

		curcumin method	
Total Coliform	No./100mL	MPN or MF method	0
Fecal Coliform	No./100mL	MPN or MF method	0
% Sodium	-	calculation	2
SAR	-	calculation	2

The following Lab Instrument shall have to be procured for improving the Lab Capabilities and measurement of listed parameter.

Sr no	Instruments	Test
1	U.V.Visible Spectrometer	Phosphate, Nitrogen, COD etc.
2	Balance	SS,VSS,MLSS,MLVSS
3	Laminar Flow	Coliform Bacteria
4	Auto cleave	Disinfection
5	Microbiological Oven	Coliform
6	COD Reactor (Double Block)	COD etc
7	B.O.D. Incubator	B.O.D
8	Distillation Unit	Distilled water
9	Furnace	SS
10	Amm.Nitrogen assembly	Amm.nitrogen

8.3 Sampling

General Guidelines for Sampling

- Rinse the sample container three times with the sample before it is filled.
- Leave a small air space in the bottle to allow mixing of sample at the time of analysis.
- Label the sample container properly, preferably by attaching an appropriately inscribed tag or label. The sample code and the sampling date should be clearly marked on the sample container or the tag.
- Complete the sample identification form for each sample.
- The sample identification form should be filled for each sampling occasion at a monitoring station. Note that if more than one bottle is filled at a site, this is to be registered on the same form.
- Sample identification forms should all be kept in a master file at the laboratory where the sample is analysed.

Surface water Sampling

- Samples will be collected from well-mixed section of the river (main stream) 30 cm below the water surface using a weighted bottle or DO sampler.
- Samples from reservoir sites will be collected from the outgoing canal, power channel or water intake structure, in case water is pumped. When there is no discharge in the canal, sample will be collected from the upstream side of the regulator structure, directly from the reservoir.
- DO is determined in a sample collected in a DO bottle using a DO sampler. The DO in the sample must be fixed immediately after collection, using chemical reagents. DO concentration can then be determined in the field .

Sample Labeling

Label the sample container properly, preferably by attaching an appropriately inscribed tag or label. Alternatively, the bottle can be labelled directly with a water-proof marker. Information on the sample container or the tag should include:

- sample code number (identifying location)
- date and time of sampling
- source and type of sample
- pre-treatment or preservation carried out on the sample

- any special notes for the analyst
- sampler's name

Sample Preservation and Transport

Samples for BOD and bacteriological analyses should be stored at a temperature below 4Deg.C and in the dark as soon as possible after sampling. In the field this usually means placing them in an insulated cool box together with ice or cold packs. Once in the laboratory, samples should be transferred as soon as possible to a refrigerator. If samples collected for chemical oxygen demand (COD) analysis cannot be analyzed on the day of collection they should be preserved below pH 2 by addition of concentrated sulphuric acid. This procedure should also be followed for samples for ammoniacal nitrogen, total oxidized nitrogen and phenol analysis. Samples which are to be analyzed for the presence of metals, should be acidified to below pH 2 with concentrated nitric acid. Such samples can then be kept up to six months before they need to be analyzed; mercury determinations should be carried out within five weeks, however. After labeling and preservation, the samples should be placed in an insulated ice box for transportation. Samples should be transported to concerned laboratory as soon as possible, preferably within 48 hours. Analysis of bacteriological samples should be started and analyzed within 24 hours of collection. If samples are being brought to the laboratory they should be transported in less than 24 hours. The result of any test on the quality of the environment is no better than the result of all efforts that lead to this final result: collection of the samples, the handling and chemical treatment, the method of storage, the chemical analysis, the calculation and interpretation of the data. If any of these steps are carried out with insufficient care, the final result (e.g. the concentration of a given compound) will be no more than a figure without relation to the actual situation in the environment, and therefore be useless: the entire operation has been a waste of energy, time and money. In a situation where the tasks of sampling (and preservation) and chemical analysis belong to different specialized groups, lack of communication may easily lead to erroneous results. The optimum situation is there, where the entire procedure, from sampling to final analysis, is within the hands of one group of experts. However, this is due to managerial aspects not always possible. Therefore, instead of blaming each other for evident errors in analysis (often without proof), it is essential that both sampling team and chemical analysts work together to optimize the integrated task: the analysis. Both groups are specialized: the sampling party has the knowledge of the actual situation in the field, with the consequential restrictions and possibilities in terms of e.g. logistics (transport, accessibility, local

condition) and should already in the planning phase be consulted, the analytical party (chemical or biological) is specialized in aspects related to contamination control, sample- and sampling-bottle selection, cleaning and preservation methods etc. The necessity for close cooperation is evident and serves the ultimate goal: reliable analysis that reflects the actual situation in the environment.

Importance of the sampling procedures

It will be obvious that the result of any chemical or biological analysis can be no better than the sample that is offered to the analytical laboratory. Often the quality control aspects are only related to the analytical part, whereas the control procedures for the Sampling are neglected. There appears to be a need for a detailed description of the Sampling and preservation procedures. It is not possible, however, to specify one detailed description, valid for all parameters of interest, because of varied purposes and specific needs required in the analytical process.

The objective of sampling is to collect a portion of material from an environmental compartment (either water, sediment or biota) small enough in volume to be conveniently transported and handled in the laboratory, while still accurately retaining is representatively. This implies that the relative proportions or concentrations of the components of interest should be the same in the samples when they are being analyzed, as they were originally in the environment. This requires that the sample will be handled and, if necessary, treated in such a way that no significant changes in composition occur that may hamper proper analysis. In other words, no addition (e.g. contamination), loss (e.g. adsorption to the wall of the sample bottle) or deterioration (e.g. physico-chemical or biological degradation or transformation) can be allowed.

Types of Samples

Apart from a separation into compartments (water, sediment and biota) different types of samples can be collected:

a) Grab sample (also called spot - or catch samples)

One sample is taken at a given location and time. In case of a flowing river, they are usually taken from the middle of the flowing water (main) stream and in the middle of the water column. When a source is known to vary with time, spot samples collected at suitable time intervals and analyzed separately, can document the extent, frequency and duration of these variations. Sampling intervals are to be chosen on

the basis of the expected frequency with which changes occur. This may vary from continuous recording, or sampling every 5 minutes, to several hours or more.

b) composite samples

In most cases, these samples refer to a mixture of spot samples collected at the same sampling site at different times. This method of collection reduces the analytical effort, because variations are middle out in one analysis. It is a useful technique when daily variations occur and seasonal variations are the objective of the programme. If, however, the series of spot samples are not mixed but analyzed individually, also information on the daily variability can be obtained, and afterwards the average can be computed. Sometimes the indication 'time-composite' is used to distinguish from 'location composite' sampling. Time-composite sampling representing a 24-hour period is often used. For many determinations, the time interval between sampling events being 1-3 hours. To evaluate the nature of special discharges (e.g. variable in volume or irregular in time), samples should be collected at time intervals representing the period during which such discharges occur. Especially in effluents, one may sample a volume that is proportional to the discharge (flow based composite). This type of sampling is also required to measure the flux of pollution load discharged through a point source. Biota that is only active during certain periods of the day (e.g. activity during the night) can only be sampled accordingly. For parameters that will change after collection, and that cannot be preserved, in-situ determinations should be applied if possible. If preservatives are to be added, add them to each sample and not in the end to the composite sample.

c) Integrated samples

Sometimes samples are collected at the same location but, due to horizontal or vertical variation in the composition of the river (or in water flow) or lake, they come from different points in the cross-section that are regarded with a different relative importance. To evaluate the average composition, total load or mass balance, integrated samples are collected, often in proportion to the river flow of the areas of sample collection.

d) In-situ measurements

Some determinations are more likely to be affected by sampling and sample storage than others. In several cases the expected changes are so large, that it is impossible to store the sampled material for a correct analysis at a later moment. If possible,

these parameters should be analyzed on the sampling site or, even better, in-situ. Most important parameters that should (and can) be analyzed in situ are the pH, dissolved oxygen, temperature, conductivity and sometimes turbidity. For several measurements special portable measuring devices are available. The estimation on numbers and diversity of organisms is also to be considered as in situ analysis.

9 Cost Estimates:

1. FOR AAQMS and MMS

Sl no.	Item Description	Qty	Unit (Rs).	Total Price
1	Supply of AAQMS with shelter,UPS power supply, solar power supply, along with CMS & GPRS modem for central monitoring. Phase-I Analyzers Consisting of. - SO2 Analyzer - NOx Analyzer - CO Analyzer - CO2 Analyzer - PM 10 Analyzer - PM 2.5 Analyzer - PC CMS - UPS with 30 mins. Backup - Solar pwer supply - Weather Monitoring Station a) Relative humidity b) Wind speed and wind direction c) Solar radiation d) Temperature e) Rain gauge f) Ambient Pressure	7	43,50,000/-	3,04,50,000/-
2	Supervision of Installation &	L.S		2,50,000/-

	Commissioning Charges			
	Phase -II			
1	**Supply of AAQMS with shelter,UPS power supply, solar power supply, along with CMS & GPRS modem for central monitoring. Phase-II** **Analyzers Consisting of.** - **SO2 Analyzer** - **NOx Analyzer** - **CO Analyzer** - **CO2 Analyzer** - **PM 10 Analyzer** - **PM 2.5 Analyzer** - **PC CMS** - **UPS with 30 mins. Backup** - **Solar pwer supply** - **Weather Monitoring Station** **g) Relative humidity** **h) Wind speed and wind direction** **i) Solar radiation** **j) Temperature** **k) Rain gauge** **l) Ambient Pressure**	**7**	**43,50,000/-**	**3,04,50,000/-**
2.	**Supervision of Installation & Commissioning Charges**	**L.S**		**2,50,000/-**

	Phase -III			
1	**Supply of AAQMS with shelter,UPS power supply, solar power supply, along with CMS & GPRS modem for central monitoring. Phase-II** **Analyzers Consisting of.** - **SO2 Analyzer** - **NOx Analyzer** - **CO Analyzer** - **CO2 Analyzer** - **PM 10 Analyzer** - **PM 2.5 Analyzer** - **PC CMS** - **UPS with 30 mins. Backup** - **Solar pwer supply** - **Weather Monitoring Station** **m) Relative humidity** **n) Wind speed and wind direction** **o) Solar radiation** **p) Temperature** **q) Rain gauge** **r) Ambient Pressure**	**7**	**43,50,000/-**	**3,04,50,000/-**
2.	**Supervision of Installation & Commissioning Charges**	**L.S**		**2,50,000/-**

2. For Water Quality

Sl no.	Item Description	Qty	Unit (Rs).	Amount
1	Supply of Water Quality Analyzers (Online type) and lab instrument for the upgradation of Anjani STP - Turbidity analyzers - Dissolved Oxygen Analyzers - Conductivity Analyzers - pH - U.V.Visible Spectrometer - Balance - Laminar flow - Auto cleave - Microbiological Oven - COD reactor (Double block) - BOD incubator - Distillation Unit - Muffle furnace - Ammonical Nitrogen Assembly - Total organic carbon - Mobile van Charge	1	22,65,000/-	22,65,000/-
2	Supervision of installation and Commissioning Charges		50,000	50,000

Annexure – I for locations of CAAQMS.

PROPOSED LOCATIONS OF CONTINOUS AMBIENT AIR QUALITY MONITORING STATIONS & WEATHER MONITORING STATIONS

TCE.10196A-ST-3000-MP-31492

SURAT CITY MAP

wind blow direction mostly

LEGEND & ABBREVIATION

- IMPLEMENTATION OF AAQMS & MMS IN FIRST PHASE
- IMPLEMENTATION OF AAQMS & MMS IN SECOND PHASE
- IMPLEMENTATION OF AAQMS & MMS IN THIRD PHASE
- SW SOUTH WEST ZONAL OFFICE
- SE SOUTH EAST ZONAL OFFICE
- N NORTH ZONAL OFFICE
- W WEST ZONAL OFFICE
- S SOUTH ZONAL OFFICE
- E EAST ZONAL OFFICE

DO NOT SCALE

SURAT SMART CITY DEVELOPMENT LIMITED (SSCDL)

PROPOSED LOCATIONS OF CONTINOUS AMBIENT AIR QUALITY MONITORING STATIONS & WEATHER MONITORING STATIONS

TATA CONSULTING ENGINEERS LIMITED
MUMBAI

SCALE: NTS	APPROVED	DATE (RO ISSUE) 02.12.2016
DEL.CENTRE-DISC: MUM-IE		DATE (CURRENT ISSUE) 02.12.2016
DRN: JDT		
CHD:	DWG NO: TCE.10196A-ST-3000-MP-31492	ISSUE: PO

FOR RO ISSUE ONLY

DISC.	SIGNATURE	DATE
CIVIL		
ELEC		
I&C		
MECH		

ISSUE	REVISIONS	DRN	CLEARED CIVIL	ELEC	I&C	MECH	APPD	DATE

FILE NAME: F-040-Rev-R5.dwg

TCE FORM NO. 040 R5