



Odisha State Pollution Control Board

SYSTEM REQUIREMENT SPECIFICATIONS & DESIGN SPECIFICATIONS

Development of Geo-Database for Environmental Mapping
and Web based GIS application in Critically Polluted Area
in Odisha



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 **SPARC**

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DOCUMENT DESCRIPTION		
Document Title	System Requirement Specification & Design Specification Document	
Subject	System Requirement Specification & Design Specification Document for Development of Geo-database for Environmental Mapping and Web GIS based application for Critically Polluted Areas (CPAs) for the Odisha State Pollution Control Board (OSPCB), Govt. of Odisha	
Abstract	The development of the Geo-database for environmental mapping and Web GIS based Information System for the Critically Polluted Areas (CPAs) in the state shall facilitate availability of geo-spatial information on the environmental parameters to meet the need of effective planning, monitoring and decision making in implementation of the Comprehensive Environment Pollution Index (CEPI) and related Action Plan.	
Keywords	CEPI, Environment, Pollution, Critically Polluted Areas (CPAs), Action Plan	
Version	Ver1.0: Draft	25 th January 2017
Verification		
Project Description	The Central Pollution Control Board (CPCB), Govt. of India has developed a Comprehensive Environmental Pollution Index (CEPI) method to measure the environmental impact of the industries and industrial clusters. Two industrial clusters in the state of Odisha, namely Angul-Talcher, Ib-valley-Jharsuguda has been identified to have CEPI value more than 70 (critically polluted). A model environmental action plan focused on environmental development, has been prepared by OSPCB for abatement of pollution in these critically polluted industrial clusters. The present assignment shall meet the need of effective planning, monitoring and decision making in implementation of the Comprehensive Environment Pollution Index (CEPI) and related Action Plan.	
Project Title	Development of Geo-database for Environmental Mapping and Web based GIS application for Critically Polluted Areas (CPAs) of Odisha	

REVISION HISTORY		
Version	Date	Description of Changes

ABBREVIATIONS

CPA	Critically Polluted Area
OSPCB	Odisha State Pollution Control Board
CPCB	Central Pollution Control Board
CEPI	Comprehensive Environment Pollution Index
GIS	Geographic Information System
RF	Reserve Forest
AAQ	Ambience Air Quality
CPIC	Critically Polluted Industrial Cluster
ULB	Urban Local Bodies
SRS	System Requirement Specifications

1. Introduction

1.1 Background

Comprehensive Environmental Pollution Index (CEPI), a method to measure the environmental impact of the industries and industrial clusters, has been developed by the Central Pollution Control Board (CPCB), Govt. of India. The Odisha State Pollution Control Board (OSPCB) has been proactively implementing CEPI in the state. Two industrial clusters in the state, namely *Angul-Talcher*, *Ib-valley-Jharsuguda* has been identified to have CEPI value more than 70 (critically polluted). A model environmental action plan focused on environmental development, has been prepared by OSPCB for abatement of pollution in the these critically polluted industrial clusters.

Implementation of the CEPI as well as the Environmental Action Plan requires comprehensive Geo-spatial information on the industry locations, pollutants, monitoring stations, natural features such as Rivers and Forests for effective monitoring and decision making. The OSPCB has decided to develop a comprehensive Geo-database for the purpose of environmental mapping along with development of a Web GIS based information system to facilitate ready availability of geo-spatial information on environmental parameters to meet the need of effective planning, monitoring and decision making.

1.2 About this Document

The System Requirement Specification (SRS) aims at collection and analysis of the available data/ information requirement/ views and opinions of the concerned authorities about the proposed development of the Industrial Cluster CEPI Geo-database and development of the Web enabled GIS based System to define the functionalities, target audience, user interface, system/ software architecture, software requirements as well as its operational parameters.

The SRS is based on a detailed study of the related data, documents, procedures, information available at the OSPCB. The system analysts and the project development team visited the OSPCB state head office as well as the Laboratory facilities for focused discussions, fact gathering and collection of available input data. The project team had detailed interactions with the authorities to record the existing database, procedure and the information requirement. The project team utilized various data collection techniques to facilitate scientific interaction procedure in-order to capture the detailed information and to obtain a first-hand observation/ information requirement for development of the Geo-database and the proposed Web GIS base system. The specifications defined in this SRS document shall be used as the input document for development of the System Design Specification.

2. Objectives of the Assignment

- Development of Geo-database to facilitate environmental mapping of the Critically Polluted Area (CPAs) in Odisha (Angul-Talcher, Ib-valley-Jharsuguda) covering the following map layers
 - Administrative boundaries (District/ Block/ Village), geographic area of the CPAs along with location of Regional Offices
 - Natural features like Forest (RF/ PRF), River and drainage system within and around the Critically Polluted Industrial Cluster (CPIC) area
 - Location of Industry, Mines, Industrial Stacks, Ash Ponds, Waste water discharge points, Rain water harvesting facilities within the CPA area
 - Location of AAQ monitoring stations, surface water monitoring stations
 - Location of Settlement with population demography
 - Urban area and Solid waste dumping area of urban Local Body (ULB)
 - Health care Units Locations
 - Integration of Action plan for abatement of pollution in critically polluted area
 - Railway network in CPA area

- Integration of real-time air quality data sets collected from industry stacks and the AAQ monitoring stations
- Integration of Action Plan for abatement of population in critically polluted area (CPAs)
- Development of Web GIS based Application for planning, monitoring and decision support

3. System Study

a. Fact Gathering

On-site system study was conducted in the office of the OSPCB in consultation with the officials of the OSPCB, and the concerned Scientists at the OSPCB Laboratory facilities. A detailed study plan along with the date schedule was prepared and communicated for obtaining prior approval from the concerned officials to facilitate effective data collection from field.

The System Study was primarily focused on

- Collection of available input data from SPCB head office, regional office & central laboratory
- Development of an Analytical Platform for facilitating development of the Requirement Specification and Design Specification

The site visit plan was finalized in consultations with the OSPCB officials with request for official communications from OSPCB head office to the respective Laboratory/ regional office authorities in the three identified cities. A detailed representation of the official Interactions and data collection for the three cities are described as follows.

- a. **Document Review:** The offices and the laboratories of OSPCB have a rich collection of relevant documents on the environment, pollution, and their monitoring. The project team had a detailed study of the available relevant documents inform of paper files/ registers, reports, data formats, application forms, electronic documents to understand the available data, involved processes and the relevant information. A few examples of such documents studied in detail for the purpose of system study and analysis is presented below.
 - Implementation Status and Action Plan in Critically Polluted Areas (CPAs)– Talcher-Angul
 - Implementation Status and Action Plan in Critically Polluted Areas (CPAs)–Ib Valley-Jharsuguda
 - Water Quality of Major Rivers of Odisha
 - Annual Report on State Pollution Control

- b. **Questionnaire:** A detailed set of relevant questionnaire was prepared based on the references taken from the documents and the project understandings on different aspects of environment and pollution control to capture independent view of the concerned officials involved in the process. The questionnaires were used to collect the input data from the respective authorities.
- c. **Personal Interview:** Pre-appointed personal interviews were scheduled with the OSPCB officials as well as the scientists/ officials at the Laboratories and the Regional Offices to have in-depth discussion and to record their functional responsibilities, involvement in the pollution control process, suggestions and opinions. The questions in the interviews were meticulously drafted to be most relevant to the subject. The interviews were also planned/ staged in appropriate method to facilitate the interviewee officials to express themselves relevantly instead of answering the short-cut/ pre-defined answers.

Dates of Discussion	Officer	Sector	Subject of Discussion/ Data Collection
01/12/2016 & 16/12/2016	Dr. B N Bhol Sr.Env. Scientist	Central Laboratory	Water & Air Quality data requirement & finalization relevant data formats Collection of documents on Air Pollution & Water Pollution, Pollutant nature and permissible limits
03/12/2016	Dr. A K Swain Env. Engineer-I	Industry	Information Requirement for Industries and associate data requirements Finalization of relevant data formats and Data Structure
15/12/2016	Dr. D K Behera Sr. Env. Scientist-I	Industry	Information Requirement for Industries and associate data requirements Finalization of relevant data formats and Data Structure
22/12/2016	Sri C R Nayak Sr. Env. Scientist-II	Mines	Information Requirement for Mines and associate data Finalization of relevant data formats and Data Structure

Dates of Discussion	Officer	Sector	Subject of Discussion/ Data Collection
26/12/2016	Er. R N Prusty Sr. Env. Engineer-II	Industry	Information Requirement for Industry related (Products & Hazard waste) and Ambient Air Quality monitoring data and associate data Finalization of relevant data formats and Data Structure
30/12/2016	Dr. P K Prusty Sr. Env. Scientist-I	Municipality	General Information Requirement for ULB and Solid waste management at processing units and other associate data Finalization of relevant data formats and Data Structure
03/01/2017	Dr. S P Samantaray Env. Scientist	Biomedical	Information Requirement for Health Centre and other associate data (Biomedical waste management) Finalization of relevant data formats and Data Structure

- d. **Focus Group Discussions:** Based on the understandings and the information captured through the “document review” as well as the “questionnaire” procedures, the project team prepared the base papers/ GIS maps and requested the OSPCB authorities for user group discussion sessions. The information collection in the base paper/ GIS maps and documents were discussed with the OSPCB authorities in brain-storming sessions to gather their field experiences, expert opinions, finalize the input data, data formats, procedural steps involved as well the concurrent drawbacks/ difficulties in the existing process and the information requirement to facilitate efficient management of pollution control.
- e. **Observations:** The team engaged in the system study spent considerable sessions with the concerned officials to observe the usual work procedures followed in execution of the various related tasks to gather a first-hand experience on the work procedure which shall help to incorporate the key procedural aspects into the design / development of the proposed system. The procedural steps to accomplish a task were meticulously observed and recorded with assistance from the concerned authorities.

Analysis of the Facts & Documents

The data/ documents and the discussion inputs collected during the site visit and system study at the office of the OSPCB as well as the concerned offices/ laboratories were treated as very important documents and were properly documented / arranged in catalogues for reference. The data sets/ databases both inform of the non-spatial data as well as the spatial data sets were compiled and imported into the Database Management System Schema (RDBMS) to study the availability and organization of the relevant data in their data sets.

The Spatial Data Sets collected on the OPCB Jurisdictions, Regional Offices, Monitoring Stations, Industries were imported into the Geo-databases to represent on Geographic Information System (GIS) platform for observation and study.

A thorough review and study of the documents/ databases were conducted to analyze the origination, nature and content of the documents/ database from the perspective of the development of the proposed Environmental Geo-database as well as development of Web-enabled GIS based System. Each of the documents was subjected to the following Analyses.

- Events that triggers generation of the specified documents
- Procedure of preparation of the documents
- Entities responsible/ authorized for generation of specified documents
- The input sources of the Data for preparation of the Documents
- Purpose/ utilization of the document
- Format/ Mode of presentation of the document
- Storage of the Document
- Information/ Database required to be updated during preparation of the specified document
- Periodicity/ duration for which the document remains active

Analysis of the Documents/ Databases through the above process resulted in answers to/ identification of a number of relevant links to each of the documents/ databases and lead to identification of

- Input data
- Process/ procedure of generation of the Information
- Intermediate process / procedure for generation
- Source of each of the data items
- Interconnections of the processes leading to the generation of outputs

The Analysis process also involved adequate interactions with the concerned OPCB officials to facilitate resolution of the doubts/ clarifications and to reinforce the understanding of the existing data and relevant procedures.

Documenting the Facts/ Observations

The facts generated during the Analysis of the documents/ database and through the discussions on clarifications on the document are recorded in the *Analysis Description* documents to gather the entities, data, process, information generation and the inter-process links. The document shall describe the analytical outcomes of each functional aspects of the system in form of *Actionable Prompts* rather than record of actions.

b. Fact Modeling

The outcomes of the Analysis of the Facts and Documents collected along with the analytical inferences are collected in the Analysis Description document. The analysis description document describes the functional aspects of the proposed system in fragmented manner, however it is required to develop analytical model to combine the input data, process and outputs of each of the functional procedure/ processes into a logically combined structure to facilitate understanding of the whole system. The Analytical tool used for the proposed system is a Flowchart.

The System Flow Chart used in representation of the proposed Web GIS system shall include the standard notions and symbols to represent the Inputs, Procedure/ Processes, Decision Control, Data Flow, Data Store, Connectors and the Terminators to logically represent the entire system. The System Flow Chart for the proposed system is enclosed here at **Plate-1** for ready reference.

The System Flow Chart facilitated in understanding the individual components of the system along with the system as a whole. The Flow Chart was subjected to a walk through based discussion among the system design/ development team as well as it was presented to the OSPCB officials for reinforcing the understanding of the system as well as to identify/ clarify on any functional units on different aspects such as the input, process, output as well as the control decisions and the integration of one functional unit with the other functional unit.

The System Flow Chart facilitated defining the Functional components of the system and their inter-relationships with the other functions and the require exchange of parameter based data.

4. Description of Functional Requirements

4.1 Development of Geo-database

The project covers development of a comprehensive Geo-database of the CPA areas in the state including the spatial data sets and the attribute datasets. A list of the functional requirements to be covered under the Geo-database development is as follows.

Designing the Data Layers

- Defining the Geo-Spatial Data Layers along with the corresponding Attribute Details
- Preparation of Base map feature layers covering the following data
 - Topographic Map from Survey of India (SOI) OSM Series Map
 - Administrative Boundaries Map (District/ Block/ GP/ Village)
 - Boundary of the Critically Polluted Area (CPAs)
 - Jurisdiction Boundary of OSPCB
 - Forest boundary within the CPA areas
 - Water bodies in and around the CPA Areas such as Rivers/ Drains/ Canals/ Reservoir
 - Location of the Regional office locations
 - Transportation Network (Rail/ Road) in and around the CPA areas
- Defining the Geo-spatial relational data structure to contain the spatial data sets and the attribute data sets
- Defining the Group Data layers for Pollution Source (Industry/ Stacks) & Receptor (villages)
- Collection and Integration of the input data on the Industries, Monitoring Stations available at the office of the OSPCB
- Development of base map with integration of the input data collected from OSPCB
- Gap Analysis, Field survey Planning
- Field level Data Collection of Industry coordinates
- Mapping and Integration of the surveyed data to the Geo-database

- Review/ Testing of the Geo-database to ensure the data structure, implementation of the data integrity/ referential integrity and spatial rules
- Deployment of Geo-database on the GIS Server

Collection of Data from OSPCB

- Collection of CPA wise List of Industries/ Mine / Hospitals
- Collection of environmental pollution standards & Permissible limits for the Air & Water Pollutants
- Collection of Industry/Mine wise measurable pollutants and authorized pollution concentration limit as per the issued Consent to Operate (CTO)
- Type of action plans implemented and implemented locations for preventing the pollution within the CPA

Consideration of Geo-Database Aspects

- Defining the Projection System of the Geo-database
- Mapping and Validating the locations of pollution source and receptors
- Defining the Symbolic representation of feature layers
- Defining the Thematic layers
- Generation of Unique identification code as defined by OPCB
- Validating the Data integrity & Relationships between feature layers
- Integration of General Information to individual feature layers

4.2 Development of Web GIS based Application

Users & Information Requirements

The proposed system is envisaged to be used by two broad categories of users

- Public users
- Departmental users

The system shall facilitate dissemination of environment and pollution related location specific general information on a map interface to the general public. The generalized information to the general public shall be available on a easily navigable, menu based interface in the form of Maps/

Tables and Charts. The information accessibility to the Departmental User shall be kept secured. Such information can be accessed only through provision of the pre-allocated user-id and password combination. The departmental user is classified into three categories depending on their functional roles as follows.

General System Users

The General System User shall use this application to input/ manage the data and for generation of information through use of Query and Report Generation Application Components. Uploading / editing the periodic data of off-line monitoring stations. Tracking the views and issues raised by public, flagging the issues to supervisor for taking the actions.

Supervisory Managers

Supervisory Managers shall use this application to scrutiny the data input/ updated by General System Users. Shall view the map based thematic interface for visualization of different feature layers and associated information on environmental pollution and their parameter values. Generation of attribute/ geo-spatial queries through use of the Query Interface to facilitate Decision Support in Tactical/ Operational management. Generation of Reports in the form of Maps/ Tables/ Charts to augment the decision-making process.

System Administrator:

The designated System Administrator shall use this application for the purpose of User management including the management of Roles and System Privileges. The System Administrator shall be provided with the supervisory accessibility to the system resources for management/ configuration and tuning of the Geo-database as well as the Application System.

Consideration for Web GIS Application Development

- The Web GIS based system shall be represented on a Map based interface with the thematically organized data layers
- The proposed system shall facilitate web-based input interface for input/ update of the attribute data sets into the Geo-database

- The Web GIS based system shall be developed to disseminate location based information on the Industries, Pollution Monitoring Stations such as Ambiance Air Quality (AAQ) stations, Surface Water Quality sampling locations
- The Web GIS based system shall be represented on a Map based interface with the thematically organized data layers
- The proposed system shall facilitate web-based input interface for input/update of the attribute data sets into the Geo-database
- The proposed system shall facilitate integration with the RTDAS server system infrastructure to facilitate import of the real-time pollution data collected from the respective industries/ stacks
- The proposed system shall facilitate Decision Support through inclusion of query processing facility for generation and execution of spatial as well as attribute based queries
- The System shall facilitate generation of Reports as per the requirements of the different authorities during the system study
- The system shall be accessible through use of secured login-id and password with strict validation process through implementation of appropriate system authentication and authorization mechanism.
- The application security shall also cover the application component based access to different levels of users through allocation of the User Roles and Access Privileges

4.3 Web GIS functionality

The Web based GIS interface shall be broadly segregated into thematic content panel and the map view panel. The map view panel shall be utilized for display of the Vectorized maps data as well as the Raster Data in the form of Base map, Satellite Image etc. The GIS tool box shall be organized as a floating dock able tool bar with different iconic buttons representing the various command GIS functions. The GIS tool box shall have the command buttons such as Pan, Zoom, Measure (Area/ Length), Search, Information tool etc. The left side thematic Map layer panel shall contain the different thematic data layers with options for switching on/ off of each of the data layers. The thematic data layers shall also represent the appropriate legends for each of the displayed layers.

The Map View shall also contain map tools such as the north arrow icon, the scale bar and the interactive Zoom in/ Out bar for interactively working with the zoom in/ out facility on the map. The map view shall be interactive in nature and shall display the map components as the individual thematic features as the self-contained objects. Clicking on each of the thematic features shall open the information window displaying the attribute parameters and the corresponding values in the information window. The GIS application component shall provide the following application features and functionalities.

- Ergonomically designed Web-GIS Application Interface with logically organized Navigation Controls for easy Map maneuver, map based information accessibility
- Integration of WMS based Base Map (High Resolution Satellite Image, Topographic Maps, Hybrid maps)
- Table of Content (ToC) based organization of Spatial Data Layers (Regional Boundary/ City Boundary/ Sub city Boundary/ Neighborhood Boundary/ Block Boundary/ Parcel Boundary)
- GIS toolbar for Spatial Data Management (Pan, Zoom, Scale, Measurement – Distance/ Area, Identify/ Information Window, Search)
- Map based Query Builder interface for generation and execution of attribute/ geo-spatial queries on forestry/ wildlife management for Decision Support
- Map Extent Linked Asynchronous Retrieval/ filtration of Information on the properties in different administrative boundary scope. This shall facilitate interplay between the Map and Data View for quick/ objective based information retrieval
- Generation of pre-defined Map based reports such as map based environment status in the CPA areas, information on the location and readings of the Air Quality Monitoring Stations (AAQ), location and readings of the sampling locations, Impact area/ proximity area of environmental pollutions.

The proposed system shall facilitate spatial data management and periodic update of the spatial data through an application component with easy to use User Interface for upload of the up-to-date shape file group on to the GIS server.

4.4 Non-functional Requirements

4.4.a. Data Import/ Export

The Web GIS based Application shall facilitate import of the environmental data contained in the specific data format in to the system tables. However, the data import application component shall include appropriate data validation routines to validate the input data to ensure inclusion of valid data into the system database. The application shall also facilitate export of data present in the system database into the external data file formats such as CSV and XLSX. The report output can either be printed onto the printer or can be saved in a portable file format such as the PDF format.

4.4.b. System Access Control

The application will support User Role & Privilege based access control. The roles and their access levels will be configurable by the administrative user of the system. The application shall facilitate the User & Role Management Control Panel Screen to be used by the concerned system administrators. The application component shall facilitate dynamic control of the *Users, Roles* and *Privileges* in the system. The application shall facilitate following user access functionalities.

- Creation of new users/ update of profile of existing users / removal of existing users
- Creation of User Groups
- Generation/ Configuration of User Roles
- Assignment of the User Roles to the single User or a Group Users as per the requirement.
- Assignment of system component accessibility through defining Authentication and Authorization

4.4.c. Application component for user Help & Support

The application shall be provided with a User Manual describing the detailed features and functionalities of the Web GIS based Application. The System Manual shall contain the design specifications of the Geo-database in terms of the data structure and Geo-data models along with the process flow diagram and the data flow diagram to facilitate understanding of the underlying design of the software system. While the User Manual shall be used as reference manual for operation of the application system, the System Manual shall be utilized by the technical support personnel for

management and maintenance of the implemented system. The application shall also facilitate context sensitive help tips to assist the system operators in efficient management of the system.

5. System Design

The System Design Specification is aimed at defining solution to the Requirement Specifications in the form of blue print of the proposed Web based System. The Design Specification document provides insights into the mechanism of meeting the technical and operational requirements while maintaining the optimum system performance and system security. The System Architecture comprises of the High Level Design Specification document which establishes the integration and coordination between the different components of the proposed system.

5.1 System Architecture Considerations & Design Perspectives

The proposed Web enabled GIS based Property Tax System represents complex decentralized systems which requires to be represented in a manageable and comprehensible method to appropriately reflect the business and technical concerns. One of the time-tested design considerations is to observe the proposed system from different directions/ viewpoints simultaneously. The proposed system shall be partitioned into a number of separate but interrelated views, each of which describes a separate aspect of the architecture. Collectively, all the defined viewpoints shall describe the whole system. Use of viewpoints shall assist in better describe the High Level Design Architecture and shall help in better design representation through implementation the followings

Separation of concerns: Describing many aspects of the system via a single representation can cloud communication and, may result in independent aspects of the system becoming intertwined in the model. The design of the current application shall be implemented in form of separate modules into distinct (but related) which shall help in focused application development and maintenance.

Communication with OSPCB Offices: The proposed system shall be developed as user intensive application and shall require capturing the view-points of departmental users at different levels. The concerns of each user are typically different. The viewpoint-oriented design approach shall help considerably in development of the current system.

Management of complexity: The proposed system involves a number of application interfaces with the integration requirements the complexity arising out of the above

shall be conquered through development of separate viewpoints while designing the system

Design Viewpoints

Sl.	Viewpoint	Description
1	Functional	Describes the system's functional elements, their responsibilities, interfaces, and primary interactions. The functional view drives the design of other system structures such as the information structure, concurrency structure, deployment structure, and so on. It also has a significant impact on the system's quality properties such as its ability to change, its ability to be secured, and its runtime performance
2	Information	Design Architecture for data stores, management/processing's, management, and distribution of information. This viewpoint develops a complete but high-level view of static data structure and information flow. The information viewpoint provides design solutions for content, structure, ownership, latency, references, and data migration.
3	Concurrency	Describes the concurrency structure of the proposed system and map functional elements that will be executed concurrently and how this is coordinated and controlled.
4	Development	Development view shall communicate the aspects of the architecture to the application/ database developers in development and testing of the system
5	Deployment	This view shall capture the hardware environment required for deployment of the proposed system, the software environment requirements for each element, and the mapping of the software elements to the runtime environment that will execute them.
6	Operational	This design viewpoint shall specify how the proposed system shall be operated, administered, and supported in the production environment.

Design Perspectives

The application functionalities of the proposed Web-enabled System organizes the application into a set of interrelated models through utilization of the viewpoints as defined above. However, the qualitative aspects of the functionally correct application

components are defined by the design perspectives. The Design perspective shall be used to guide the architecture design of the proposed system.

Implementation of Agile Methodology

The proposed Web enabled GIS based System is an interactive User Interface specific application which envisages implementation of the iterative application development methodology for in-time incorporation of the user requirements/ logical change requests during the development phase. Iterative system development process (Agile Methodology) shall be implemented during the application development process which shall refer to the base Design Architecture & Design Specification document for code implementation. However, the change suggestions received from the stakeholders, if any, during periodic review meetings in the sprint cycle shall be considered for design inclusion and shall be implemented as per the modified design specification for the specific functional modules.

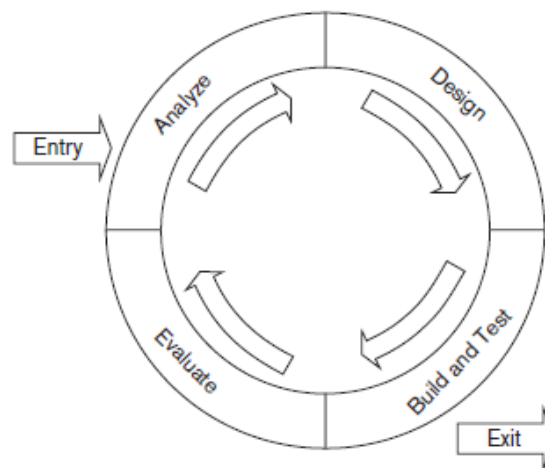


Fig- System Development Methodology

5.2 System Architecture

The proposed Web GIS based System shall be deployed in a cloud based server environment where the hardware & software environment shall be procured and maintained as the Platform as Service (PaaS) architecture on annual subscription basis.

5.2.1 Deployment Architecture

The Deployment Architecture for the proposed system shall define the deployment environment of the proposed Web enabled GIS based Property Tax System in terms of Hardware requirement, Platform Software requirement, Software requirement, Network requirement, Integration requirement along with the technology specifications. The Deployment Architecture shall focus on aspects of the production

system that are important after the system has been tested and is ready to go into live operation. The deployment architecture has the following components.

PaaS Hardware & Software

The Deployment Architecture shall define the hardware the system capacity requirements to be made available by the Platform Service provider including the processing requirement and storage capacity requirement. The Server Setup primarily comprises of two server units.

Cloud based GIS Server

The Cloud based GIS Server shall be procured as the bundle of operating system services as well as the GIS services from the Amazon EC2 deployed ArcGIS Online Server. The GIS server shall be configured with appropriate storage space and processing capability as per the requirement of the proposed system.

Hosted Application Server

The Web hosted server shall be procured to facilitate the services of the Web Server, Relational Database Management System, Application Execution Platform Software/ Framework. The Web server shall be configured to receive the HTTP based requests from the system users which shall be directed to the Application Software. The Application Software shall facilitate need based data request/ processing and retrieval from the database server.

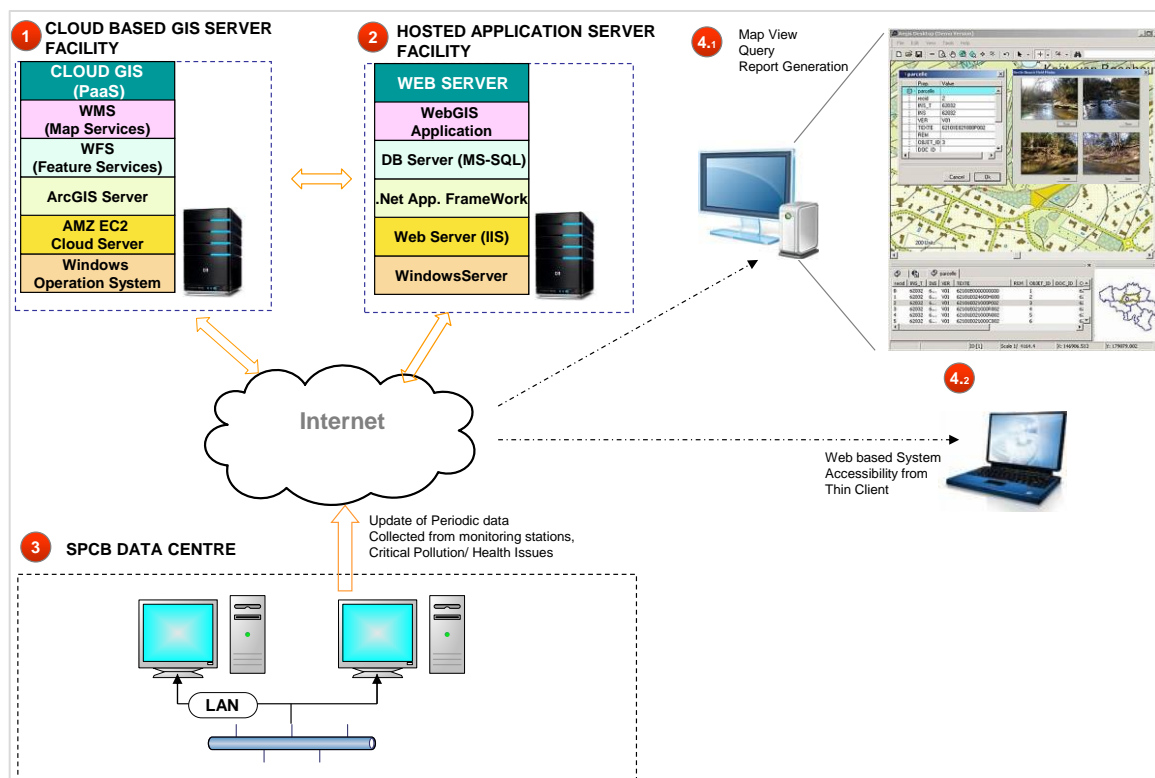


Fig-System Architecture Diagram (Physical)

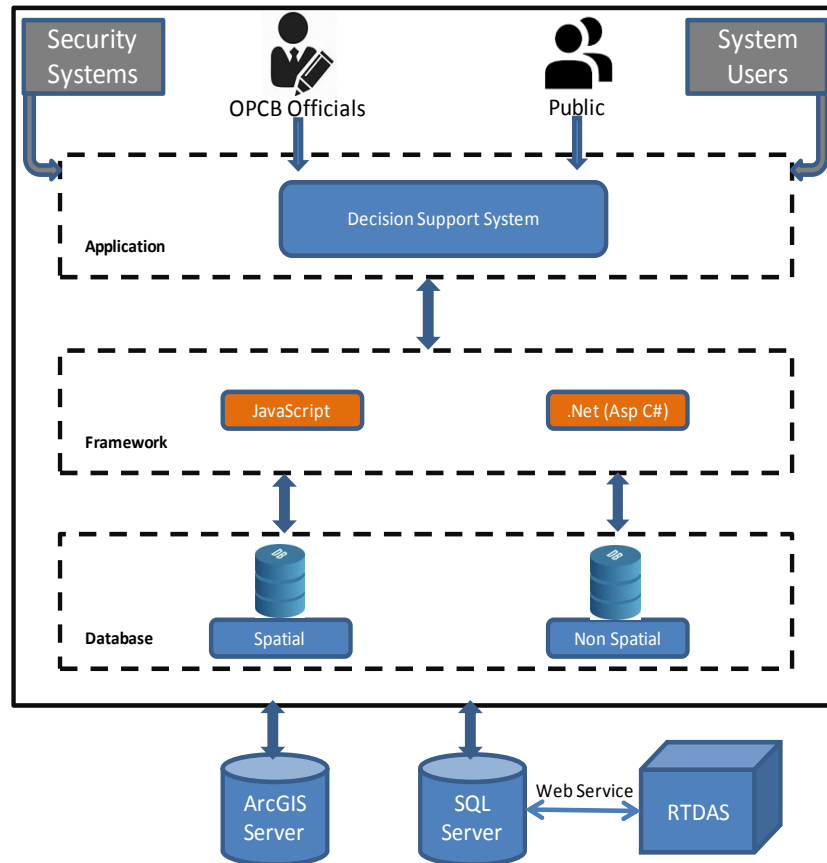


Fig-System Architecture Diagram (Logical)

5.2.2 Solution Architecture

The proposed system shall be developed in a n-tier architecture frame work. The system functions such as *presentation*, *application processing*, and *data management* shall be organized in physically separated layers. The separation of the layers into multiple tiers shall facilitate ripple free incorporation of change management and configuration management in the proposed system and shall facilitate a system environment for development of flexible and reusable system/ system components. A brief description of each of the software layers of the n-tier architecture are described as follows.

N-TIER ARCHITECTURE

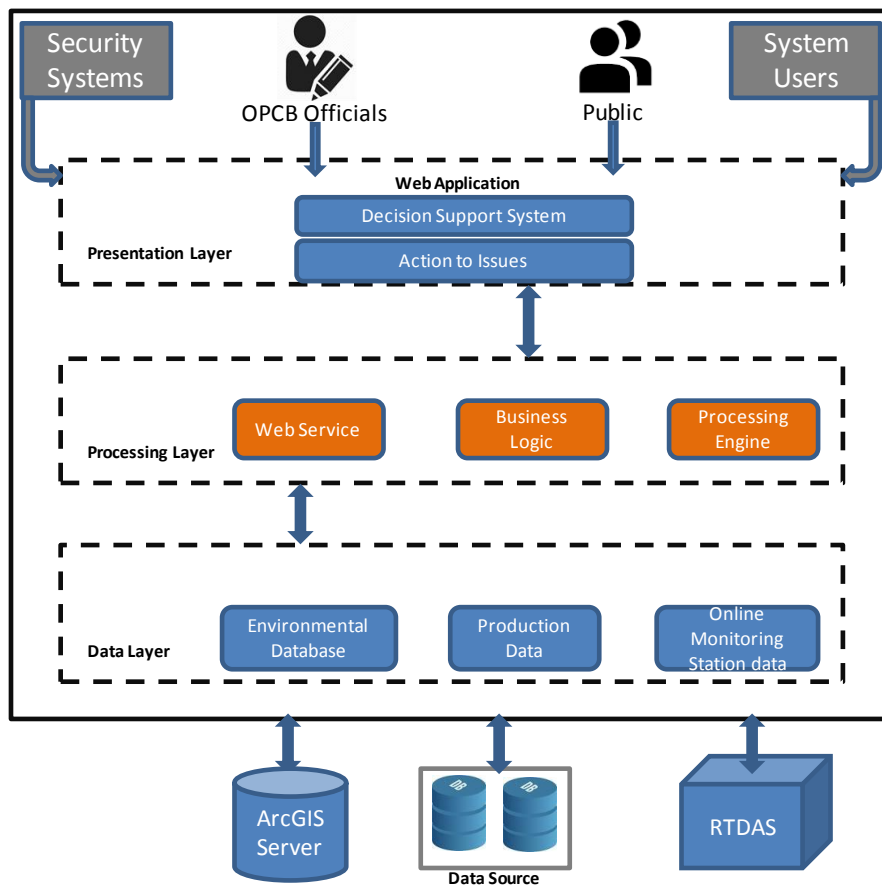
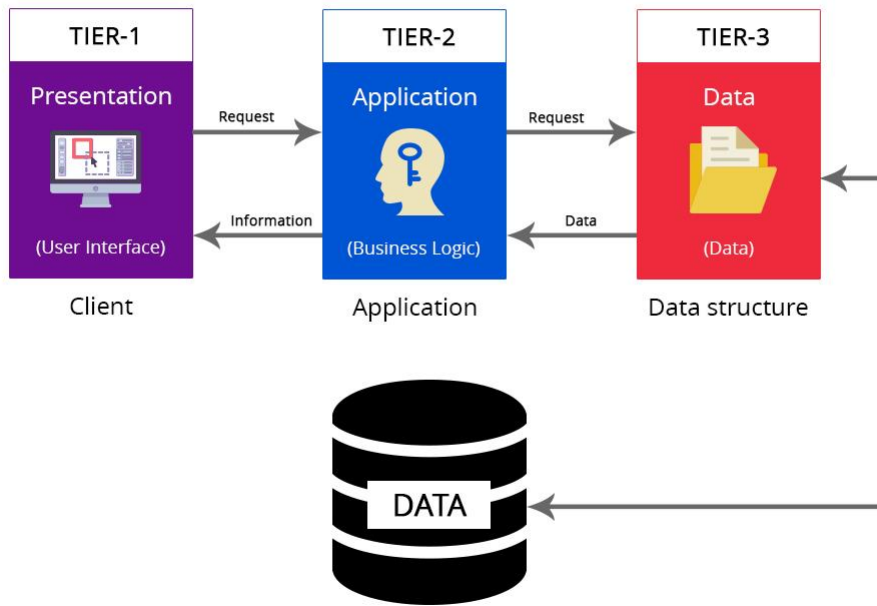


Fig-Solution Architecture Diagram (Logical)

a. Presentation layer

Presentation layer is the topmost level of the proposed system which shall provide User Interfaces through which the users can access the application components comprising of the Data Capture Screen, Reports, GIS Map Interface based on Graphical User Interface (GUI). The primary function of this layer is to translate the user tasks and to present the processed information to the concerned users.

b. Application layer

Application layer of the proposed system shall contain the Business Logic and shall coordinate the application components, processes the commands, makes logical decisions, evaluation, and performs computations. The application layer shall control the proposed system's functionality and shall coordinate the data movement and processing between the Presentation tier and the Data tier. The Application layer shall contain the Business Logic and Business Parameter Configurations for the functional components of the proposed system. A brief description of a few of the important design principles to be incorporated in the proposed system is as follows.

- **Separation of Concern:** The application components shall be separated on the basis of their functional concerns. This shall facilitate development of the application which shall be easier to build, maintain and incorporate future enhancement.
- **High Cohesion:** The application components kept together shall be highly cohesive in nature to produce the application components to reduce the error.
- **Loosely Coupled Components:** The application components shall be designed and developed as loosely coupled in nature to facilitate easy maintainability and open to the future scalability.
- **Security Architecture:**

The proposed System shall be implemented as a web enabled system and shall be inherently exposed to the data integrity threats. The Security Architecture proposed to be deployed in the system shall ensure system access/ control by the authorized users only. The system architecture shall include definition of the Security Policy, Identification of the Security Threats, Implementation of Security Mechanism, delegation of system Accountability leading to the system availability and in-time threat/ intrusion detection and system recovery. The System Security shall be implemented through deployment of the followings.

Role-based security shall be implemented to identity of the application user based on the corresponding Roles/ Privileges allotted the specific users. These roles may be Windows groups, enterprise roles. The Principal objects shall be passed to Web applications as part of the request to the identity of the authenticated user.

	Roles	Privileges
	Public	<ul style="list-style-type: none"> • User Registration • Submit issues/ Views • View the Area wise Pollution status
	OPCB Users	<ul style="list-style-type: none"> • Reviewing of the Issues and filtering the appropriate issues • Data update Forwarding to supervisor for scrutinizing the data • Map View interface • Report/Chart generation
	Supervisor	<ul style="list-style-type: none"> • Reviewing of the issues forwarded by user and generation of Action plans • Map View Interface • Report and chart generation
	System Administrator	<ul style="list-style-type: none"> • Managing the user roles • Generating the Login/Logout Report

Code Access security shall be applied to performs authorization when code attempts to access the file system, registry and network or perform privileged operations. Application of Code based security shall provide an additional level of granularity by enabling to set permissions on a piece of code.

Implementation Software Platform specific security features

The proposed application shall utilize the security namespaces provided by the Development Framework. Some of the .NET Framework security namespaces include System.Security, System.Web.Security, System.Security.Cryptography, System.Security.Principal, System.Security.Policy and System.Security.Permissions.

Utilization of System Security available in Application Framework

Development of Secured Class

Secure assembly design shall be practices to take into consideration such factors as privileged code, trust level of target environment, public interfaces, etc. Classes that are built with security in mind shall follow proper object-oriented design principles; prevent inheritance where it should not be allowed. Restriction shall be implied as to whom and what code can call them. The recommended principle for development of secure class design: restrict class and member visibility, seal non-base classes, restrict which users can call the code and expose fields using properties shall be meticulously implemented in the proposed system.

Exception Handling

Exception management shall be implemented to restrict information disclosure which may help malicious hackers to compromise the application. Poor exception management can also result in availability issues by allowing an attacker to launch a denial or service attack. The application shall incorporate structured exception handling, no log for sensitive data. The exceptions shall be implemented at granular level by catching specific exceptions rather than trying to lump them all into one by catching a generic exception.

Event Log

Although Event logging is very important for Audit Trail of the system, it may also expose the threats to tampering with the log, information disclosure of sensitive information stored in the log and log deletions in order to erase tracks. The log protection mechanism provided by is provided by the security features in the Windows operating system shall also be used for the purpose. Unauthorized access to the event log shall be restricted through implementation of Event Log. Write Event where, the existing records cannot be read or deleted.

Cryptography

Cryptography available in System-Security-Cryptography namespace shall be applied to the coding process to protect data confidentiality, hashing can be used to protect integrity by making it possible to detect tampering, and digital signatures can be used for authentication. Cryptography is typically used to protect data in transit or in storage. The two biggest mistakes that developers can

make related to cryptography are: using homegrown cryptographic solutions and not properly securing encryption keys. Developers need to pay special attention to the following issues in order for cryptography to be effective: using cryptographic services provided by the platform, secure key generation, secure key storage, secure key exchange, and secure key maintenance.

Implementation of System Security in System Development Process

The development process of the proposed system shall include appropriate steps for incorporation of the secured design principles while considering various threats on web based applications built with ASP.NET. The following Design Specifications focuses on some of the important threats and its design specification for mitigation measures.

Input Validation

Many of the security compromises are due to poor input validation. The proposed system shall implement the ASP.NET provided Validation Controls along with the secured programming techniques that would help implementation of secure input validation routines. The validation check shall involve validation of input data by performing type, length, format and range checks. Validation should be performed against a white list of allowed input, rather than a black list of prohibited input.

Requirement	Options
Type checks	.NET Framework type system. Parse string data, convert to a strong type, and then handle FormatExceptions. Regular expressions. Use ASP.NET RegularExpressionValidator control or Regex class.
Length checks	Regular expressions String.Length property
Format checks	Regular expressions for pattern matching .NET Framework type system
Range checks	ASP.NET RangeValidator control (supports currency, date, integer, double, and string data) Typed data comparisons

Regular expressions shall be applied to the programming codes which are an effective mechanism for restricting the range of valid characters, stripping unwanted characters and performing length and format checks. In order to restrict the input, regular expressions can

be constructed that the input must match. For that purpose, RegularExpressionValidator control and the Regex class available from the System.Text.RegularExpressions namespace shall be utilized. Web form input fields can be validated with the RegularExpressionValidator control. If HTML controls are used with no runat="server" property, then the Regex class is used either on the page class or in a validation helper method.

Input Validation & SQL Injection

All input used for data access shall be thoroughly validated, primarily in order to avoid SQL injection attacks which can happen if dynamic queries are generated based on user input without first thoroughly validating the user input. An attacker can then possibly inject malicious SQL commands that will be executed by the database. To validate input used for dynamic query construction regular expressions should be used to restrict input. For defense in depth the input should also be sanitized. Additionally, whenever possible, stored procedure shall be utilized for data access in order to make sure that type and length checks are performed on the data prior to it being used in SQL queries. The table below lists a common list of useful regular expressions that developers should use for input validation.

c. Data layer

The Data layer of the application shall store the spatial and non-spatial data in pre-defined data objects within the database schema. The data tier is responsible for maintaining the data integrity and referential integrity of the data components stored within the database and for processing and retrieval of the data requested by the application layer and presentation layers. The data tier shall facilitate API (Application Programming Interface) to the application tier which provides the methods of managing the stored data within the database.

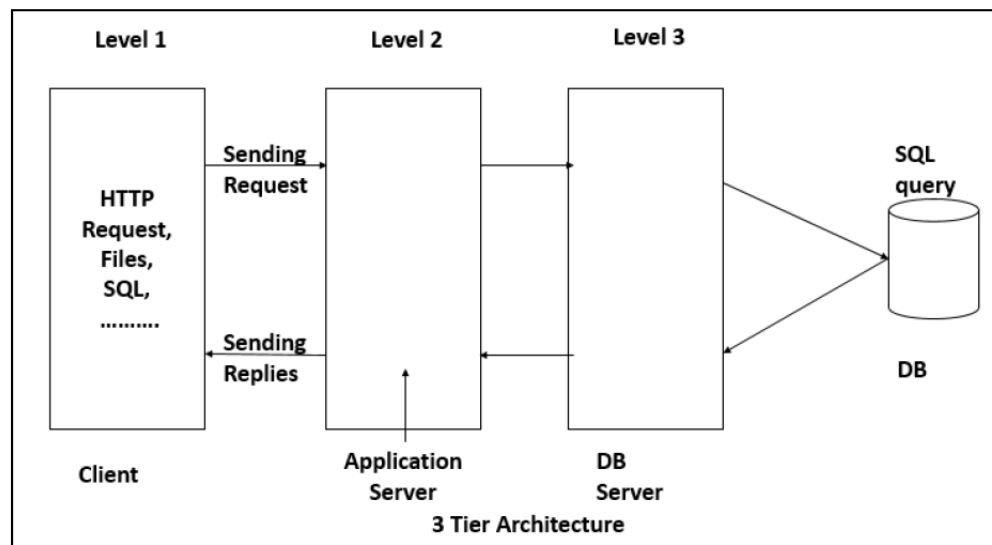


Fig- Schematic Diagram indicating Data Layer

Database Design

Database Design is crucial aspect of the proposed System as the proposed shall be dependent on a collection of spatial as well as non-spatial data entities. The database design shall consider the Relational Database Model to store and manage the spatial and non-spatial database through implementation of the Relational Database Management System (RDBMS).

Database Design involves modeling of the data in terms of established, rigorous, and generally understood analysis and modeling techniques. The modeling techniques to be followed in the design of the database for the proposed system are depicted below.

- **Static data structure model:** which analyze the static structure of the data
- **Information flow models:** which analyze the dynamic movement of information between elements of the system and the outside world
- **Information lifecycle models:** which analyze the way data values change over time

Data Structure Model

Entity-relationship modeling is an established technique of data analysis, shall be used for geo-data modeling for the proposed system where the data items of interest are referred to as entities, and their constituent parts are called attributes. The semantics of the data defines the static relationships

among entities. Each relationship has a cardinality, which defines how many instances of one of the entities can be related to an instance of the other.

Class models shall depict the entity-relationship models for the object-oriented methodology adopted in the proposed system to document the behavioral aspects of a system, such as interfaces and methods, and features specific to object-oriented analysis, such as inheritance.

Database Normalization process shall be applied on the data models to reduce the model to its purest form, in which there is no repeated, redundant, or duplicated record. The relational models shall be applied up to the third-normal form, and in a few cases, in order to maintain the system performance; controlled de-normalization shall be applied to some of the data tables.

Geo-database Design

The spatial database shall utilize the geo-database model to store the vector and raster datasets. The geo-database storage model is based on a series of relational database concepts and leverages the strengths of the underlying database management system (RDBMS). Data Tables and well-defined attribute types are used to store the schema, rule, base, and spatial attribute data for each geographic dataset. This approach provides a formal model for storage and behavioral aspects of the data. The structured query language (SQL)—a series of relational functions and operators—can be used to create, modify, and query tables and their data elements.

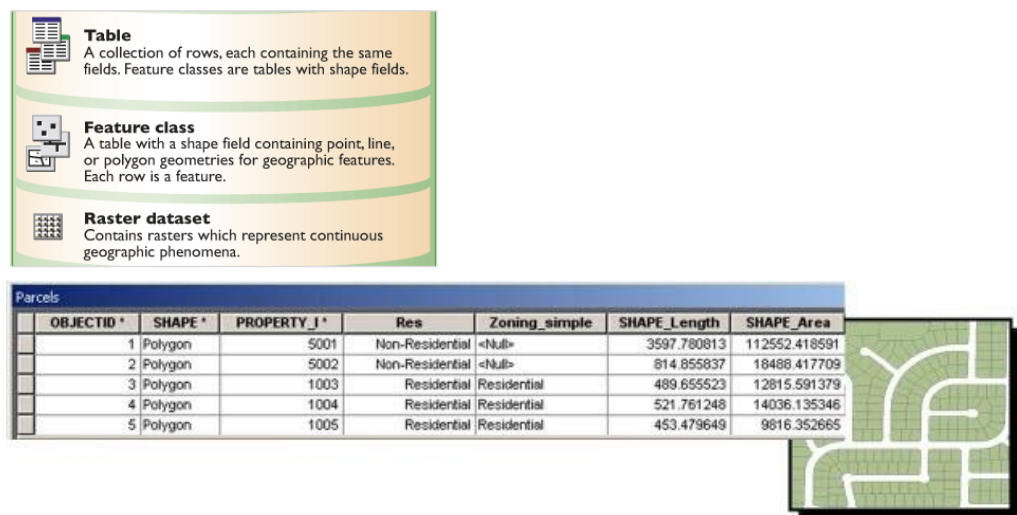


Fig- Schematic Diagram of Geo-database Design

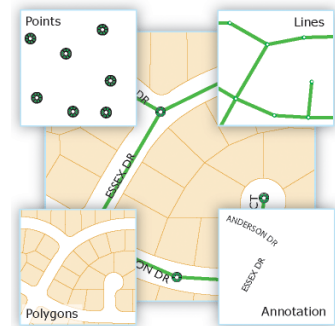
Data Modeling

The Design of Geo-database for the proposed System shall involve development of Geo-data model to depict the spatial database as well as the non-spatial database in the form of relational tables.

Feature Class

The Vector features (geographic objects with vector geometry) such as the District administrative boundaries, CPA Boundaries, Industries, Air Quality Monitoring Stations etc. in the proposed system shall be represented as feature classes. The features in the feature class shall be used to store the geographic representation of the feature object in form of a point, line, or polygon, as one of its properties in the row. Feature classes are homogeneous collections of features with a common spatial representation and set of attributes stored in a database table.

- **Polygons:** A set of many-sided area features that represents the shape and location of homogeneous feature types such as the *District Administrative Boundaries, CPA boundary*.
- **Lines:** Represent the shape and location of geographic objects, such as streams, transport network such as the roads and railway within the CPA area.
- **Points:** Features such as the industry location, location of the Air Quality Monitoring Stations, Surface Water Sampling Stations are represented as point locations



Attribute Tables

The attribute data tables shall contain the logically related data in rows and columns. Each of the table rows shall represent one entity. Each row in the Attribute Table shall have the feature id key (FID) and the Primary Key (PK) which shall be used to establish link to the corresponding feature in the feature database.

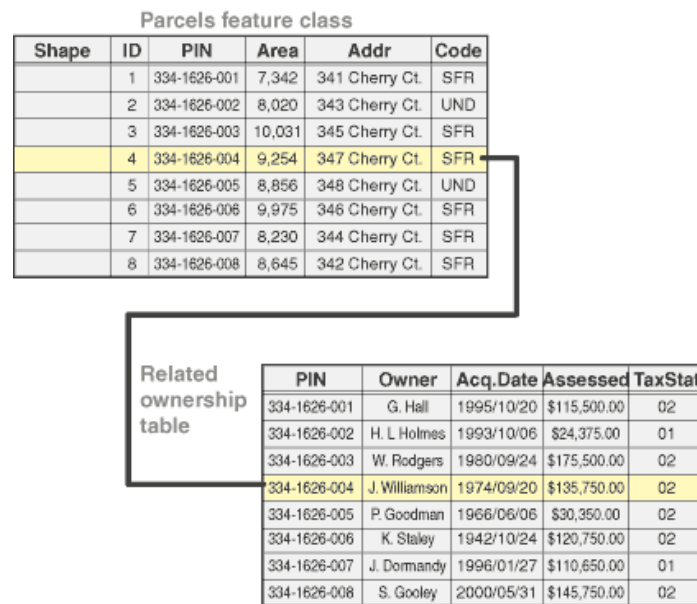


Fig- Schematic Diagram of Data Relationship

Datasets: The datasets shall represent the specifications for the feature classes such as the Administrative Boundaries (*District, Block, CPA Boundary etc.*). Each of the dataset shall consist of a set of geo-spatial features represented in spatial geometry such as Point, Line & Polygon.

Relationship classes: The relationship between the spatial features of the database and the corresponding attribute tables shall be defined through the GIS *Relationship Class* which shall define how rows in feature table can be associated with rows in the attribute table. Relationships have a direction of cardinality and other properties represented as one-to-many, or many-to-many relationship.

Spatial relationships and spatial rules: The relationship and the spatial rules shall be applied on the topologies and their properties which shall be used to model how features share geometry with other features and topologies. In the proposed system spatial rules shall be applied on the Administrative Boundaries as well as the CPA boundaries to implement the topographic sanctity.

Map layers: The map Layers in the proposed Property Tax system shall comprise of the Administrative Boundaries (*District Administrative Boundaries, CPA Boundaries, Industry Locations, Location of the Air Quality Monitoring Stations, location of Surface Water Sampling locations, Location of the regional OPCB Office locations etc.*). Each of the map layers shall contain the specific feature data layers containing the feature datasets.

Metadata Model: Metadata of the geo-database shall comprise of rules that describe the data items of interest—entities, attributes, relationships, etc. Metadata shall be used to record the properties/ attributes of the geo-spatial

data. The metadata shall be used as the information and documentation which makes data sets understandable and sharable for users. Metadata shall address a number of data aspects such as:

- Data format (syntax)
- Data meaning (semantics)
- Data structure
- Data context (the relationships among data items)
- Data quality

Data Requirement: The proposed system shall require the following Data sets to be appropriately structured and managed in Relational Database Management System for appropriate retrieval of the required information.

- OPB Administrative Office Details
- System Users and their Accessibility
- Industry/Mines/Hospital details
- Standard Limit of Ambient Air Quality master
- Permissible limit of Surface Water master
- Industry & Mine wise Production details
- Industry & Mine wise hazardous waste generation details
- Quality Monitoring Stations (Air & Surface water)
- Industrial stacks
- Processed waste water Outlets
- Village Demography Details
- Periodic Ambient Air Quality data
- Periodic Surface water Quality data
- Year wise Production of Mines & Plantation status
- Public Issues & Views

The Database model along with the geo-database model developed for the proposed system showing the data objects (tables) along with the categorization and the inter-relationships is annexed with this document at **Plate-2**. The details of the Data Structure of the Tables involved along with the Field Names, corresponding Data Types, Field Size and the applicable Data Integrity Constraints and the Referential Integrity Constraints are depicted in the Data Structure Section under **Annexure-I**

5.2 Operational Design Principles

The proposed system is designed around a number of configurable parameters to facilitate configurable system operation and to facilitate easy system maintenance and scalability.

Identify the Configuration Groups. The configuration values in the proposed system shall be broken into cohesive groups while maintaining the intergroup dependencies as far as possible. This shall facilitate to abstract the problem of managing the individual values to the level of managing large groups as a single unit. Each group shall be appropriately named to explain its purpose, and to explain how the configuration group would be managed.

Identification of Configuration Group Dependencies. The interdependency of the configuration groups shall be recorded to arrive at the dependencies among them. The dependencies shall allow to start understanding the problem of reconfiguring the system in production.

Identification of Configuration Value Sets. The configuration parameter values during the operational lifecycle shall be established. The characteristics of each value set shall be defined, and identify the configuration groups that change between different configurations.

Design the Configuration Change Strategy. The identified configuration required for system shall be designed, to identify the approach to achieve this in the deployment environment.

Configuration Groups

DBMS Parameters: Comprise of the initialization, operation, and performance characteristics of the database. The necessary SQL scripts, for the processes shall be prepared for implementation.

Web Server Parameters: Comprise of the Web Server parameters that control the initialization, operation, and performance characteristics of the server.

GIS Engine Parameters: Comprise of the ArcGIS Online Server Engine parameters that control the Datum/ Projection Systems and the rendering scheme for the geo-spatial data sets.

Configuration Dependencies

The Configuration Dependencies shall be identified so as to identify the configuration processed which are dependent on the other configuration sets to finalize the implementation approach for each configuration procedure.

5.3 Administrative Design Principles

The proposed system shall require system effective administration procedures to monitor it and keep it running smoothly. The administration design model to be incorporated into the software application shall include the following.

Monitoring and control facilities: The system shall be incorporate with monitoring and control facilities as part of the architecture such as the dash boards and user defined query builder application features, message services.

Required routine procedures: The system shall incorporate the list of routine administrative task each of the user shall carryout in a message board interface. any administrative work that needs to be performed on a regular basis or that may be required in exceptional circumstances. The ideal routine procedures include weekly backup and a monthly health check.

Backup: Operational data in the Database Server will need to be backed up. This will be affected by backing up the transaction at pre-defined time interval and backing up the application's databases at the end of each working day.

Management of Storage Memory: The system administrator shall manually require to certain used information developed in the secondary storage device during the system operations shall be required to prune when its volume starts to impact performance. The procedure for purging this stale information shall be designed and communicate to the administrator.

Likely error conditions: The administrators of the proposed system shall be made aware of the specific possible error conditions that are unique to the proposed system architecture. These specifications shall be built-in to the Training Content. Sample of some of the most likely error conditions are listed as follows.

Database out of Log Space: In case the transaction volume rises above a certain point, it is possible that the transaction log will fill. This will cause the system to suspend operation. Specifications shall be made for the Database administrators to back up the logs to free space.

Database out of Data Space: If the database runs out of data space, the system will stop operating. The specifications for purging the summary information or to add more data space to the system shall be incorporated. A written estimate of the amount of space required for various volumes of workload will be provided.

Web Server Failure: In situation of the Web Server malfunction, the system will completely become inaccessible. The specifications for the system recovery including the options for rebooting the system shall be defined.

5.4 Data Backup Procedure

As the system contains critical environmental/ pollution data of the CPA area, careful planning of data backup and restoration shall be implemented. The Backup procedure shall be implemented by the designated User Role (system administrator). The backup shall include backup of the Database.

- **Backup Strategy and Periodicity:**

The backup procedure shall involve both on-line as well off-line data replication methodology for the specific data sets. The backup of the database shall be initiated by the system administrator to replicate the operational database on the connected storage device.

- **Recovery/ Restoration:**

In case of the system/ database failure, the procedural application database backup shall be used to recover the database.

5.5 Load balancing for performance enhancement

Load balancing is a technique to distribute workload evenly across multiple computers, network links, CPUs, hard drives, or other resources, in order to get optimal resource utilization, maximize throughput, minimize response time, and avoid overload. The proposed GIS based System is a designed as a n-tier component based system distributed over a number of physical server computers such as the Cloud based GIS Server containing the GIS Engine and Geo-database and the Hosted Web Application Server containing the Web Server and the Application Components.

5.6 Integration with external system

The proposed system shall facilitate integration of the parameterized pollution data collected from the remotely located stacks installed in the respective industries. The proposed system shall facilitate web service based application component to import the selected data values from the database collected and stored at the OSPCB office through utilization of appropriate system access permission provided by the office of the OSPCB.

6. System Use Case and Functional Requirements

The following system use case statement describes the sequence of interactions between the proposed system and the system.

Use Case no.	Use Case
UC#1	User Registration
UC#2	User Log in
UC#3	Periodic Air Quality Data Update and forward to Supervisor for scrutiny
UC#4	Periodic Surface Water Quality Data Update and forward to Supervisor for scrutiny
UC#5	Fetching of online monitoring stations data from RTDAS server system
UC#6	Public can submit their Views & Issues relating to environmental pollution violations by Industry
UC#7	User can Post/Flagging the Views & Issues to Supervisor for take actions
UC#8	Scrutiny of Updated Periodic Air Quality data by Supervisor
UC#9	Scrutiny of Updated Periodic Surface water Quality data by Supervisor
UC#10	Action to Views & Issues flagged by Supervisor
UC#11	TOC based Map View Interface with thematic representation of Pollution Source and receptors locations
UC#12	Integration of Location Search facilities and Distance Measurement tools in Map View Interface
UC#13	Integration of Information window to map Interface
UC#14	Generate Reports/ Comparative Graphical Charts
UC#15	Link the RTDAS data to Monitoring stations and compare to prescribed standard limit
UC#16	Showing Industry/ Mine wise production details
UC#17	Demography status within the CPA
UC#18	Data Query/ Filtration
UC#19	System Administrator panel for defining the users roles

The broad system functionalities with reference to the defined Use Cases are defined as follows.

Module Name	Description/ User Case Reference
User Registration	This application automates the functions of create User ID, Password for accessing into the application Reference UC#: 1
User Login	This Web site/application allows an user to accessing the application by provide his /her user ID & Password Reference UC#: 2
Data Management	This application automates the functions to allow OPCB Users to update their Periodic data and forward to supervisor for scrutiny through the system Reference UC#:3 & 4
Issues & Views Management	This application automates the functions of to allow Public to submit their Issues & views related to Environmental Pollution with reason through the system or OPCB user can flagging the appropriate issues. Reference UC#:6 & 7
Integration with RTDAS Data server	This application automates the functions to allow OPCB user to fetch the real time quality monitoring data from RTDAS server and calculating the average value through the system Reference UC#:5
Data Scrutiny & Action Plans	This application allows to Supervisor to scrutiny the updated data. Set action plan against the issues and views raised by public. Reference UC#: 8,9,10
Map View Interface	This application allows to User & Supervisor to view pollution source/receptors and its details in a map view interface with toggle options for interchanging the base map layers. Reference UC#: 11,12,13,15,16,17& 18
System Administrator Panel for User Management	This application allows to Administrator to tracking the user login status & changing the user roles for accessing into the application Reference UC#: 19
Generation of Reports & Charts	This application allows to user/Supervisor to generate different type of textual reports & Graphical charts Reference UC#: 14

7. Geo-database/ Application Functionalities

Geo-database functionalities

- GIS Mapping of the administrative boundaries within the critically polluted area
- GIS Mapping of Geographic locations of Industry/ Industrial Clusters/ Mines/ Air and Water Quality Monitoring Stations/ Solid Waste Dumpsites/ Hazardous Waste Dump Sites/ Municipal Waste Dump Sites/ Hospitals and the associated periodic data sets
- Integration of attribute data on quality and quantity of emission, effluent and Solid Waste in Critically Polluted Area
- GIS representation of River and Drainage segments, status of vegetation. Demographic details, reported important health issues within the critically polluted area
- GIS analysis and for identification and mapping of pollution prone geographic area
- Integration of Industrial Cluster Data to be provided by SPCB for each Critically Polluted Area
- DGPS Survey and Collection of the Location coordinate data for the following within the Critically Polluted Area
 - Monitoring Stations
 - Treatment Plants
 - Effluent Discharge Points
 - Chimney Stacks
- Development of geo-database covering geo-referencing of the above geo-data sets with reference to the SOI OSM Topographic maps on feature registration basis

Web GIS Application Functionalities

- Development of Cloud based Web GIS application with integration with the Web Map Services
- User ID / password based login interface with multi-level security verification and authentication
- Standard GIS map features and GIS toolbar with Pan, Zoom, Scale, Measurement

- (Distance/ Area), Information Window, feature search etc.
 - Integration with Google Maps
 - Integration of Action Plan for abatement of pollution in critically polluted area with the associated environmental data sets such as Air Quality, Surface Water, Quality and Ground Water Quality.
 - Map View of the Industry locations & monitoring stations location along with display of associated information
 - Map View of the geographical spread of the Critically Polluted Area
 - Map View of habitations within the Critically Polluted Area
 - Map based dissemination of information on the settlements within the Critically Polluted Area
 - GIS interface shall provide options for selection of base maps provided by the Cloud GIS Server
 - Query Interface Query Builder for interactive generation and execution of attribute based/geo- spatial queries with options for creation of saved queries for future execution
 - On-screen Map Direction / Zoom Scale Control
 - ToC based representation of thematic data layers with appropriate Legends and layer control
 - Application feature to generate periodic reports
- **Responsive Application Software:** The Web GIS based proposed system shall be developed as a completely device responsive application which can be seamlessly accessed from the browser based computing devices like desktop system, laptop and mobile devices. The interface shall be designed in free flow dockable techniques which will fit to the interface requirement and screen size of the accessing device.

- **System Interface:** The proposed system is a user interface centric application and shall be built with special emphasis on the ergonomically designed GUI design and development. The application interface shall be designed to facilitate functional interfaces for input of data as well as output of information in the form query results/ reports and maps.

- **Data Interface**

The proposed system shall provide ergonomically designed, interactive interfaces to facilitate input of the required datasets into the system. The Input data entry screens shall be organized to be easily accessible from a navigation menu system. Each of the data input / capture screens shall be designed with relevant data input fields represented with the most appropriate data control to facilitate effective/ error free entry of data. The data controls shall be augmented with data validation controls as well as data validation routines to ensure input of correct data into the database. The data input formats shall also be associated with the corresponding context sensitive help text/ tips to ensure online assistance/ guidance to the data input operator.

- **GIS User Interface**

The GIS interface shall be built synonymous to the industry standard interfaces such as the prevalent Web Map Services (WMS). The GIS application component interface shall be broadly divided into a map view panel and the thematic content panel. The map view panel shall utilized for display of the vectorised maps data as well as the Raster Data in the form of Satellite Image, base map etc. The GIS toll box shall be organised as a floating dockable tool bar with different iconic buttons representing the various command GIS functions. The GIS tool box shall have the command buttons such as Pan, Zoom, Measure (Area/ Length), Search, Information tool etc. The left side Thematic Map layer panel shall contain the different thematic data layers with options for switching on/ off of each of the data layers. The thematic data layers shall also represent the appropriate legends for each of the displayed layers.

The Map View shall also contain various map tools such as the north arrow icon, the scale bar and the interactive Zoom in/ Out bar for interactively working with the zoom in/ out facility on the map. The map view shall be interactive in nature and shall display the map components as the individual thematic features as the self-contained objects. Clicking on each of the thematic features shall open the information window displaying the attribute parameters and the corresponding values in the information window. User friendly GIS tools for map maneuvering and other associated features like search location facilities and distance/area measurement tools and finding the Latitude/Longitude value of a location. Populate the Filtrations & Query facilities for data analysis. User can choose different type of base maps like (Topographic map/ Street map/ Satellite image/ Ocean map) for visualizing the current geographic scenario in and around of the Critically Polluted Area.

- **Query Interface**

The GIS interface shall facilitate the query facility to retrieve the geo-spatial information interface in response to the query registered by the user. The Query facility shall facilitate both fixed/ saved query as well as the user defined queries. The fixed format query shall be represented in the form of a list of saved queries which when fired shall retrieve the corresponding results from the geo-database and the result in the form of map features shall be rendered on the user interface.

The User Defined Query shall be based on a customized Query Builder Application Component which shall facilitate the selection of the geo-database tables, relevant columns from the dropdown list box, selection of the appropriate operator and the selection/ entry of the most appropriate operand. The user interface shall facilitate the logical operators (AND / OR/ NOT) as well as the numerical/ string operators to create the user defined query. On submission of the query, the system shall retrieve the geo-spatial result sets and render the output on the view panel.

The GIS component shall also facilitate the creation and submission of the spatial queries for generation of the spatial result set. A few examples of the queries are as follows

- Year wise cumulative production of minerals Vs reclamation
- Comparison of Air/ Surface water quality reading value with standard limit
- Fetching the on-line monitoring station data from RTDAS server
- Calculating the Annual Average value from real time datasets

○ **Report Interface**

The Application shall provide application interface for generation of reports through user interactive functions such as selection/ input of the report header/ footer/ content, page setup functionalities such as the page orientations/ page size etc. The interface shall provide feature of report view/ printing and export to different medium such as XLS file or a PDF for report communication. The Application interface shall also provide features to generate map based report for view/ print and export to the other file format.

○ **Data Management**

The system allows authorized OSPCB officials to modify the attribute data of Industry /Mine/ Hospital details. Update year wise Production/ Reclamation details of the mines. Upload the periodic quality monitoring data of Air & Surface water. Facilitates tracking of the issues and views submitted by public and forward appropriate issues to field officials for taking necessary action.

○ **Issues & Views Management**

The system also allows public User to registration his/her name on the system and to submit their environment related issues, views and health problems due to environmental pollution within the CPA and also post their complaint/ suggestions regarding the violations with the following details

- Type of Issue
- Place Name (Reference to the issue Location)
- Description of the Issue
- Remarks

- **Integration with RTDAS Data server**

The system allows OPCB users to fetch on-line real time quality monitoring data from RTDAS server through a Web Service URL to be provided by OSPCB. The system should allow to user to calculate the average value for a period and storing the information into the DSS Data server.

- **System Administrator Panel**

This application shall facilitate a Control Panel application component to the system Administrator nominated by the OSPCB to control User Authentication/ Authorization process, Control of the User Roles and Privileges, generate and review the system audit trial to control and ensure authorized system access.

8. System Software Platform

Sl.	Software Platform	Description
1	Operating System	Microsoft Windows
2	Web Server	Internet Information System (IIS)
3	Database Server	Microsoft SQL Server
4	GIS Server	ESRI ArcGIS Online
5	Application Framework	Microsoft .NET
6	Application Code Language	C#
7	Application Scripting Language	JavaScript, JQuery

9. System Testing

Testing is an important phase of the system development lifecycle. As the current system shall be developed using Agile Application Development Methodology, the testing of Geo-database and the Application System are integrated and continuous process in the System Development Life Cycle. The testing shall include the software testing to evaluate the accuracy, performance and integration of the application modules. The developed application shall also be tested for compliance to the User Acceptance Criteria specified in this document.

Software Testing:

Unit Testing

Each of the application modules shall be thoroughly tested against the pre-defined result sets to ensure the code integrity, removal of any logical error/ bugs and to ensure optimum performance and efficiency. Unit testing shall focus on the structure, definition and operation of the individual functions, classes, procedures and application interfaces in the individual application modules. Each of the input/ data capture interfaces shall also be tested for use of appropriate data control as well as validation of the input data so as to ensure input of error-free data into the geo-database.

Integration Testing

Integration testing shall be carried out on the Unit Tested application modules to ensure efficient integration and communication between the different application modules within the application. The integration testing shall also evaluate the performance of the integrated system as a whole ensuring to meet the project objectives.

User Acceptance Testing

The approved User Acceptance Criteria shall be used to develop the test cases along with the pre-defined result sets. The test cases shall be applied on the application modules to ensure delivery of the pre-defined result sets. Errors/ deviations if any, shall be studied to incorporate the required modifications in the application modules to ensure correctness. The User Acceptance Test shall also be conducted in presence of the concerned OSPCB officials for their approval and acceptance.

10. System Deployment

The proposed system shall be deployed in a distributed Physical Server Environment comprising of the Web GIS Server Environment and the Web Hosted Application Server Environment. The services of the Web GIS server shall be availed through ArcGIS Online Server subscription. The Web Hosted application server shall comprise of the logical server components such as the Web Server, Database Server and the Application Server with Application Development Framework (ADF) and the developed Application Software. The Server systems shall be appropriately configured as per the requirement of the developed Geo-database and the application software. The tested Geo-database as well as the Application Software shall be hosted and configured on the above described Servers. The initial user login details shall be separately emailed to the different authenticated users for system access.

11. User Training, Operationalization & Maintenance

The User Training program shall be planned, scheduled and conducted in consultation with the OSPCB authorities with objective to acquaint the officials in efficient utilization of the developed Web GIS based system. The details of the training schedule, participants and the training course content shall be discussed with the OSPCB authorities for their approval. The training program shall primarily be focused on the following.

User Training

- Regular operation and management of the Web GIS based system for input, process and generation of information
- Hands-on training to facilitate acquaintance with the different application interfaces provided by the application system
- Management (Addition/ Update/ Removal) of the Geo-database components (spatial features/ non-spatial attribute data sets)

Operationalization & Maintenance

- Operationalization support and application maintenance shall be for a period of 12 months from the date of installation and commissioning of the system
- Periodic update of the Geo-database as per the data input provided by OSPCB
- Trouble shooting of the application software and operation support to the OSPCB officials in case of any operational difficulties

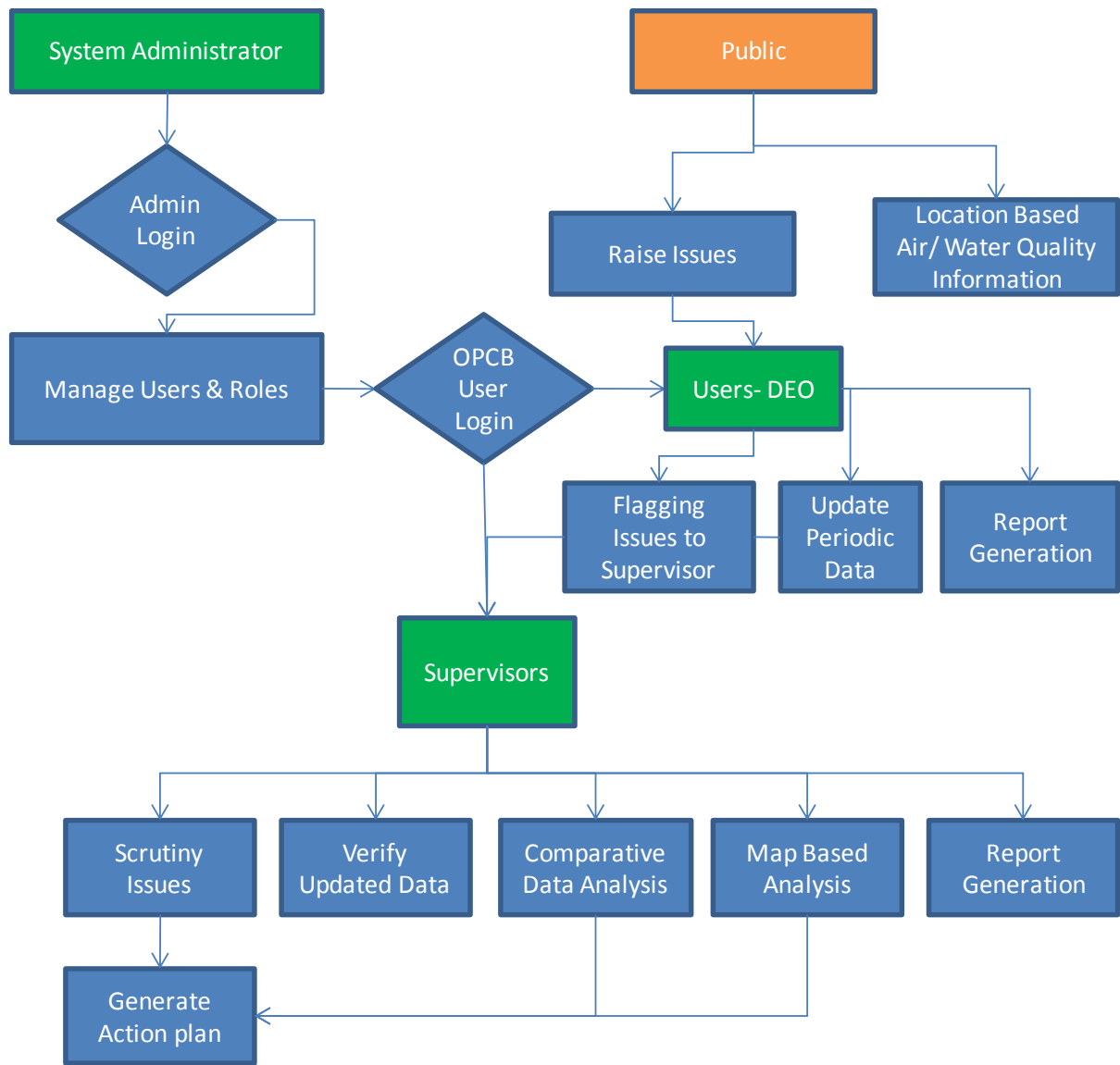
12. Timeline

Sl.	Work Description	Months											
		1	2	3	4	5	6	7	8	9	10	11	12
1	System requirement Study, Database Structure Finalization	█	█	█									
2	Primary and Field Data Collection		█	█	█	█	█	█					
3	Data Compilation & Establishment of data integrity and relationships			█	█	█	█	█	█				
4	Development of Comprehensive Geo-database			█	█	█	█	█	█				
5	Integration of the Geo-database with Cloud Environment							█	█				
6	Application User Interface Design					█	█	█	█				
7	GIS Application Development					█	█	█	█				
8	Application testing							█	█	█			
9	Application Deployment on Production Server on Web/ Cloud									█	█		
10	User Training												█

13. Conclusion

This document captures and describes the Requirement Specifications of the Geo-database as well as the proposed Web GIS based System in terms of the input data requirement, functional/ non-functional processing requirements and Information to be generated from the proposed system. The document also describes the System Design objectives, procedures and framework for achieving the requirements as specified in the Requirement Specification section. The document also specifies the User Acceptance Criteria prepared out of the Requirement Specifications and the Design Specifications described in the document. The document shall be submitted to the OSPCB for approval. The approved edition of this document shall be used as a guiding document for development of the Geo-database as well as the Application System. The document shall also be used to test the geo-database and the application system for compliance to the User Acceptance Criteria.

Process Flowchart



Data Model

Geo-database Data Structure

SPATIAL DATA SETS

A. Base Map Feature Layers

Feature Layer: River/ Streams (Polygon Geometry)

SL	Field Name	Description	Type	Width
1	RS_ID	River/ Stream ID	Numeric	3
2	RS_NAME	River/ Stream Name	Character	60
3	RS_TYPE	Type (River/ Stream)	Character	10

Feature Layer: Forest (Polygon Geometry)

SL	Field Name	Description	Type	Width
1	FOR_ID	Forest ID	Numeric	3
2	FOR_NAME	Forest Name	Character	60
3	FOR_TYPE	Forest Type (RF/PF/PRF)	Character	3
4	FOR_AREA	Forest Area (Ha)	Numeric	10.2

Feature Layer: Village Boundary (Polygon Geometry)

SL	Field Name	Description	Type	Width
1	VILL_ID	Village ID	Numeric	3
2	VILL_NAME	Name of the Village	Character	50
3	CENSUS_CODE	Census-2011 village code	Character	8
4	DIST_NAME	Name of the district	Character	50
5	BLOCK_NAME	Name of the Block	Character	50
6	GP_NAME	Name of the GP	Character	50
7	POP	Total Population	Numeric	6
8	MALE	Male Population	Numeric	6
9	FEMALE	Female Population	Numeric	6
10	SC	SC Population	Numeric	6
11	ST	ST Population	Numeric	6
12	<6YRS	Population less than 6 years old	Numeric	6
13	TOT_AREA	Village area in (ha)	Numeric	10,2
14	FOR_AREA	Forest area in (ha)	Numeric	10,2
15	AGR_AREA	Agricultural area (ha)	Numeric	10,2

Feature Layer: Settlement Locations (Point Geometry)

SL	Field Name	Description	Type	Width
1	SETL_ID	Settlement ID	Numeric	3
2	SETL_NAME	Settlement Name	Character	50
3	VILL_ID	Revenue Village ID	Numeric	3
4	VILL_NAME	Revenue Village name	Character	50
5	RS_ID	Nearest Surface water source ID	Numeric	3

Feature Layer: Railway (Line Geometry)

SL	Field Name	Description	Type	Width
1	RW_ID	Railway ID	Numeric	3
2	RW_NAME	Railway Name	Character	50
3	REMARK	Other Remarks	Character	80

Feature Layer: Road (Line Geometry)

SL	Field Name	Description	Type	Width
1	RD_ID	Road ID	Numeric	3
2	RD_TYPE	Road Type (NH/SH/Metal/Un-metal)	Character	10
3	RD_NAME	Road Name (If type is NH/SH)	Character	20

Feature Layer: ULB Boundary (Polygon Geometry)

SL	Field Name	Description	Type	Width
1	ULB_ID	Urban Local Body ID	Numeric	2
2	ULB_NAME	Urban Local Body Name	Character	40
3	DIST_NAME	District name	Character	40
4	CP_NAME	Name of Contact Person	Character	60
5	CP_DESG	Designation of Contact person	Character	40
6	CP_MOB	Contact No. of the Contact Person	Character	12
7	OFF_PH	Office Phone No.	Character	12
8	OFF_EMAIL	Email ID	Character	50
9	WARD_NOS	Number of Wards	Numeric	2
10	TOT_POP	Population	Numeric	10
11	AREA_SQKM	Area In Sqkm	Numeric	10
12	NWS_NAME	Nearby Water Course	Character	40
13	WAT_SRC	Source of Water (River / Ground Water)	Character	20
14	WWG_QTY	Quantity of Waste Water Generated (MLD)	Numeric	10,2
15	TREAT_TYPE	Type of Treatment	Character	40
16	TF_CAP	Capacity of Treatment Facility (MLD)	Numeric	10,2
17	WWD_QTY	Quantity of Waste Water Discharged (MLD)	Numeric	10,2
18	PD_LOCA	Point of discharge of Waste Water	Character	40
19	SWG_QTY	Quantity of Solid Waste Generated (TPD)	Numeric	10,2
20	SWC_SYS	Collection System for Solid Waste	Character	50

SL	Field Name	Description	Type	Width
21	MSW_NOS	No. of Temporary Intermediate Storage Facility of MSW	Numeric	3
22	MSW_TRAN	Transportation method of MSW	Character	60
23	SWT_FACL	Type of Solid Waste Treatment Facility	Character	80

B. Administrative Feature Layers

Feature Layer: Jurisdiction Boundary (Polygon Geometry)

SL	Field Name	Description	Type	Width
1	JU_ID	Jurisdiction ID	Numeric	2
2	JU_NAME	Jurisdiction Name	Character	50
3	JU_DESC	Description of Area (District names)	Character	150

Feature Layer: Administrative Office (RO/HO) Locations (Point Geometry)

SL	Field Name	Description	Type	Width
1	OFF_ID	Office ID	Numeric	2
2	OFF_TYPE	Office Type (HO/ RO)	Character	2
3	OFF_NAME	Name of the office	Character	50
4	RO_NAME	Name of the Regional Officer	Character	50
5	PH_NO	Office Phone No.	Character	10
6	EMAIL_ID	Email ID	Character	80

Feature Layer: Critical Polluted Area (CPA) Boundary (Polygon Geometry)

SL	Field Name	Description	Type	Width
1	CPA_ID	CPA ID	Numeric	2
2	CPA_NAME	CPA Name	Character	50
3	AREA_SQKM	Area in SqKm.	Numeric	10,2
4	CEPI_VALUE	Pollution Index value as per CEPI	Numeric	10,2

C. Environmental Source & Receptors Feature Layers

Feature Layer: Industry Locations (Point Geometry)

SL	Field Name	Description	Type	Width
1	IND_ID	Industry ID	Numeric	3
2	IND_NAME	Industry Name	Character	80
3	ESTB_YR	Year of the establishment	Numeric	4
4	IND_PHOTO	Photograph path	Character	80
5	IND_ADD	Address	Character	150
6	IND_CATG	Industry Category (RED-A/ RED-B/ ORANGE/ GREEN)	Character	10
7	IND_SECTOR	Sector of the Industry (Steel, Thermal, etc)	Character	30
8	IND_STS	Industry Status (Existing/ Proposed)	Character	10
9	MSL_HT	MSL Height in Mtr.	Numeric	4

SL	Field Name	Description	Type	Width
10	OCC_NAME	Occupier name	Character	40
11	OCC_MOB	Mobile no. of Occupier	Character	15
12	CONT_NAME	Name of the contact person	Character	60
13	CONT_DESG	Designation of contact person	Character	30
14	CONT_MOB	Contact person mobile No.	Character	15
15	PH_NO	Office Phone No.	Character	10
16	EMAIL_ID	Email ID	Character	80
17	CONS_ADM	Consent Administration (HO/RO)	Character	2
18	CTO_VALID	Validity date of CTO	Date	8
19	HWA_VALID	Validity date of Hazard waste Authorization	Date	8
20	WWD_QTY	Volume of wastewater discharge in m3 per day as per CTO	Numeric	10,2
21	DP_STS	Discharge Permitted (Yes/No)	Character	3
22	RS_NAME	If Discharge permitted, Recipient Water body	Character	40
23	WTF_STS	Existing of Waste Water Treatment Facility (Yes/No)	Character	3
24	WTF_DESC	Description of Waste Water Treatment Facilities existing	Character	100
25	STK_NOS	No. of Stacks as per CTO	Numeric	2
26	CEMS_NOS	No. of Continuous Emission Monitoring Stations	Numeric	2
27	CEQMS_NOS	No. of Continuous Effluent Quality Monitoring Stations	Numeric	2
28	CAAQMS_NOS	No of Continuous AAQ Monitoring station	Numeric	2
29	OL_NOS	No. of Outlets Allowed	Numeric	2
30	TW_NOS	No. of Test wells inside industry	Numeric	2
31	SWB_NAME	Nearby surface water body (River/ Nala/ Canal name)	Character	40
32	NR_VILL	Name of the Nearest two Villages	Character	100

Feature Layer: Mines Area (Polygon Geometry)

SL	Field Name	Description	Type	Width
1	MN_ID	Mine ID	Numeric	3
2	MN_NAME	Mine Name	Character	80
3	ESTB_YR	Year of the establishment	Numeric	4
4	MN_PHOTO	Photograph path	Character	80
5	MN_ADD	Address	Character	150
6	MN_TYPE	Mining Type (OC/UG)	Character	2
7	LEASE_AREA	Lease Hold area of the mines in Ha.	Numeric	10,2
8	MN_PROD	Products	Character	60
9	PROD_CAP	Production Capacity	Numeric	10,2
10	CAP_UNIT	Unit of Production Capacity	Character	20
11	MN_STS	Mines Status (Existing/ Proposed)	Character	10
12	OCC_NAME	Occupier name	Character	40
13	OCC_MOB	Mobile no. of Occupier	Character	15

SL	Field Name	Description	Type	Width
14	CONT_NAME	Name of the contact person	Character	60
15	CONT_DESG	Designation of contact person	Character	30
16	CONT_MOB	Contact person mobile No.	Character	15
17	PO_NAME	Name of the Project officer	Character	60
18	PO_MOB	project Officer Mobile no.	Character	15
19	CONS_ADM	Consent Administration (HO/RO)	Character	2
20	CTO_VALID	Validity date of CTO	Date	8
21	HWA_VALID	Validity date of Hazard waste Authorization	Date	8
22	DP_STS	Discharge Permitted (Yes/No)	Character	3
23	RS_NAME	If Discharge permitted, Recipient Water body name	Character	40
24	WTF_STS	Existing of Waste Water Treatment Facility (Yes/No)	Character	3
25	WTF_DESC	Description of Waste Water Treatment Facilities existing	Character	100
26	CAAQMS_NOS	No of CAAQ Monitoring station	Numeric	2
27	SWB_NAME	Nearby surface water body (River/ Nala/ Canal name)	Character	40
28	PH_NO	Office Phone No.	Character	10
29	EMAIL_ID	Email ID	Character	80
30	NR_VILL	Name of the Nearest two Villages	Character	100

Feature Layer: AAQ Monitoring Stations (Point Geometry)

SL	Field Name	Description	Type	Width
1	MS_CODE	AAQ Monitoring station code	Character	12
2	MS_LOCA	Location (Place name)	Character	80
3	MS_LAT	Latitude (DD)	Numeric	12,6
4	MS_LONG	Longitude (DD)	Numeric	12,6
5	MS_CATG	AAQ Monitoring station category (Ind-Res-Com/Sensitive)	Character	20
6	OL_MFCL	Online Monitoring Facility (Yes/ No)	Character	3
7	OWN_BY	Monitoring station Owner (CPCB /SPCB/ Industry/ Mines Name)	Character	80
8	IND_ID	Industry ID (if refer to an Industry)	Numeric	3
9	MN_ID	Mine ID (If refer to a Mine)	Numeric	3

Feature Layer: Surface Water Sampling Locations under NWMP/SWMP (Point Geometry)

SL	Field Name	Description	Type	Width
1	MS_CODE	SW Sampling Locations code as per CPCB	Character	12
2	MS_LOCA	Location	Character	80
3	RS_NAME	Surface Water Body Name (River/ Stream names)	Character	60
4	MS_LAT	Latitude (DD)	Numeric	12,6
5	MS_LONG	Longitude (DD)	Numeric	12,6
6	COMN_DT	Date of Commencement by the board	Date	8
7	DBU	Designated Best used Class name (A/B/C/D/E)	Character	1
8	CPA_NAME	CPA Name	Character	50
9	MS_CATG	Station category (NWMP/SWMP)	Character	12

Feature Layer: Waste Water Treatment Plant Locations (Point Geometry)

SL	Field Name	Description	Type	Width
1	TP_ID	Treatment plant ID	Numeric	3
2	TP_LOCA	Industry / Mines name	Character	80
3	TP_REF	Reference to (Mines/ Industry)	Character	10
4	TPREF_ID	Reference id of Industry/ Mines	Numeric	3
5	TP_LAT	Latitude (DD)	Numeric	12,6
6	TP_LONG	Longitude (DD)	Numeric	12,6
7	TP_CATG	TP category (STP/WWTP/WTP)	Character	4
8	TP_CAP	Treatment plant Capacity (MLD)	Numeric	10
9	TP_SD	Schematic Diagram (Path of Drawing)	Character	20
10	DSP_STS	Discharge Permitted or not (Yes/No)	Character	3
11	OL_ALLOW	No. of outlets allowed	Numeric	2
12	RS_NAME	If Discharge permitted, Recipient Water body name	Character	50
13	DISC_QTY	Quantity of treated waste water discharged (MLD)	Numeric	3
14	TP_DESC	Description of Treatment Facility	Character	150
15	OL_MFCL	Online Monitoring Facility (Yes/ No)	Character	3
16	CONFL_LOCA	Confluence point with water body (Place Name)	Character	60

Feature Layer: Discharge Point Locations (Point Geometry)

SL	Field Name	Description	Type	Width
1	DP_ID	Discharge Point Location ID	Numeric	3
2	DP_LOCA	Confluence Point (Place name) of treated effluent with water body	Character	80
3	IND_NAME	Industry name	Character	80
4	DP_LAT	Latitude (DD)	Numeric	12,6
5	DP_LONG	Longitude (DD)	Numeric	12,6
6	RS_NAME	Discharge to Surface water body	Character	50
7	TP_ID	Treatment plant ID	Numeric	3

Feature Layer: Chimney Stack Locations (Point Geometry)

SL	Field Name	Description	Type	Width
1	STK_ID	Chimney stack Location ID	Numeric	3
2	STK_LOCA	Stack Attached (Unit Name)	Character	80
3	PU_NAME	Name of the processing Unit where stack is attached	Character	60
4	STK_LAT	Latitude (DD)	Numeric	12,6
5	STK_LONG	Longitude (DD)	Numeric	12,6
6	IND_NAME	Industry Name	Character	80
7	RTMS_STS	Existing of real time Monitoring Station (Yes/ No)	Character	3
8	STK_IMP	Stack Importance (Primary/Secondary)	Character	10
9	RTMS_CODE	Real Time Monitoring station Code	Character	12
10	STK_HT	Stack height in (Mtr)	Numeric	3
11	STK_DIA	Diameter at the Top of the Stack (Mtr)	Numeric	3

SL	Field Name	Description	Type	Width
12	QTY_EMSN	Authorized Quantity of emission in m3/hr	Numeric	6
13	PM_PS	Prescribed Standard Value for (PM ug/m3)	Numeric	10,3
14	FLRD_PS	Prescribed Standard Value for (Fluoride ug/m3)	Numeric	10,3
15	SO2_PS	Prescribed Standard Value for (SO2 ug/m3)	Numeric	10,3
16	NO2_PS	Prescribed Standard Value for (NO2 ug/m3)	Numeric	10,3

Feature Layer: Outlet Locations (Point Geometry)

SL	Field Name	Description	Type	Width
1	OL_ID	Outlet Location ID	Numeric	3
2	OL_LOCA	Location / Area name	Character	80
3	IND_NAME	Industry Name	Character	80

Feature Layer: Water Intake Locations (Point Geometry)

SL	Field Name	Description	Type	Width
1	WI_ID	Water intake ID	Numeric	3
2	RS_NAME	Name of the River	Character	80
3	IND_NAME	Industry Name	Character	80

Feature Layer: Ash Pond Locations (Polygon Geometry)

SL	Field Name	Description	Type	Width
1	AP_ID	Ash pond ID	Numeric	3
2	AP_LOCA	Location/ Area name	Character	80
3	AREA_HA	Area in Ha.	Numeric	10,2
4	IND_NAME	Industry Name	Character	80

Feature Layer: Rain Water Harvesting Pond of Industry (Polygon Geometry)

SL	Field Name	Description	Type	Width
1	SWSP_ID	Surface Water Runoff treatment / management facility ID	Numeric	3
2	IND_ID	Industry ID	Numeric	3
3	IND_NAME	Industry Name	Character	80
4	ST_CAP	Storage Capacity (MLD)	Numeric	10
5	OL_ID	Outlet Location ID	Numeric	3

Feature Layer: Hospitals (Point Geometry)

SL	Field Name	Description	Type	Width
1	HC_ID	Hospital ID	Numeric	3
2	DP_LAT	Latitude (DD)	Numeric	12,6
3	DP_LONG	Longitude (DD)	Numeric	12,6
4	HC_NAME	Hospital Name	Character	80
5	HC_CATG	Category of the HC unit (Govt/Private/Trust)	Character	10

SL	Field Name	Description	Type	Width
6	HC_ADD	Address	Character	100
7	OCC_NAME	Occupier name	Character	40
8	OCC_MOB	Mobile no. of Occupier	Character	15
9	CONT_NAME	Name of the contact person	Character	60
10	CONT_DESG	Designation of contact person	Character	30
11	CONT_MOB	Contact person mobile No.	Character	15
12	OFF_PH	Office Phone no.	Character	10
13	EMAIL_ID	Office Email ID	Character	60
14	BED_NOS	No.of Bed	Numeric	3
15	CTO_ADM	Consent Admin Authority (HO/RO)	Character	2
16	CTO_STS	Validity date of CTO	Date	8
17	BMW_STS	Validity date of BMW	Date	8
18	WASTE_CATG	Category of Waste Generated	Character	60
19	WASTE_QTY	Total quantity Generated (Kg/Annum)	Numeric	10,2
20	BMW_TF	BMW Treatment Facility (On-site/CBWTF)	Character	10
21	BMWTF_FACL	If Treatment facility On-Site (Facilities available with capacity)	Character	250

Feature Layer: Urban Solid Waste Processing / Disposal Location (Point Geometry)

SL	Field Name	Description	Type	Width
1	SWDA_ID	Solid waste disposal area id	Numeric	3
2	ULB_NAME	Urban Local Body name	Character	50
3	SWDA_LOCA	Name of the Location/ Address	Character	80
4	CONT_NAME	Name of the contact person	Character	60
5	CONT_MOB	Contact person mobile No.	Character	15
6	OFF_PH	Office Phone no.	Character	10
7	ESTB_YR	Year Establishment	Numeric	4
8	SWDA_AC	Area in Acre	Numeric	10,2
9	LF_CAP	Capacity of land fill in Ton	Numeric	14,2
10	SWP_INVL	Process Involved at Site	Character	100
11	MSW_QTY	Quantity of MSW generation (TPD)	Numeric	10,2
12	SWP_QTY	Quantity of Waste processed at Site (TPD)	Numeric	16,2
13	DISP_QTY	Quantity to be disposed in the landfill (TPD)	Numeric	16,2
14	CTO_ADM	Consent Admin Authority (HO/RO)	Character	2
15	CTO_STS	Validity date of CTO	Date	8
16	MSW_STS	Validity of MSW authorisation	Date	8

2. Non- Spatial Datasets

A. Master Tables

National Ambient Air Quality Standard

SL	Field Name	Description	Type	Width
1	ID	Unique ID	Numeric	4
2	APLT_AGENT	Air Pollutants	Character	50
3	MMT_UNIT	Measurement Unit	Character	20
4	IRA_STDANL	Industrial, Residential, Rural an Other areas (Annual AAQ standard)	Numeric	10,2
5	IRA_STD24H	Industrial, Residential, Rural an Other areas (24 Hour AAQ standard)	Numeric	10,2
6	IRA_STD8H	Industrial, Residential, Rural an Other areas (8 Hour AAQ standard)	Numeric	10,2
7	IRA_STD1H	Industrial, Residential, Rural an Other areas (1 Hour AAQ standard)	Numeric	10,2
8	ESA_STDANL	Ecologically Sensitive Areas (Annual AAQ Standard)	Numeric	10,2
9	ESA_STD24H	Ecologically Sensitive Areas (24 Hour AAQ Standard)	Numeric	10,2
10	ESA_STD8H	Ecologically Sensitive Areas (8 Hour AAQ Standard)	Numeric	10,2
11	ESA_STD1H	Ecologically Sensitive Areas (1 Hour AAQ Standard)	Numeric	10,2

Surface Water Tolerance Limits

SL	Field Name	Description	Type	Width
1	ID	Unique ID	Numeric	4
2	WPLT_AGENT	Water Pollutants	Character	50
3	MMT_UNIT	Measurement Unit	Character	20
4	TL_A	Tolerance limits of Class-A	Numeric	12,3
5	TL_B	Tolerance limits of Class-B	Numeric	12,3
6	TL_C	Tolerance limits of Class-C	Numeric	12,3
7	TL_D	Tolerance limits of Class-D	Numeric	12,3
8	TL_E	Tolerance limits of Class-E	Numeric	12,3

Possible Health Impact due to Air/ Water Pollution

SL	Field Name	Description	Type	Width
1	ID	Unique ID	Numeric	4
2	PLT_AGENT	Air/ Water Pollutants Agent	Character	50
3	PLT_MEDIUM	Pollution Medium (Air/ Water)	Character	6
4	HH_IMPACT	Impact on Human Health	Character	250
5	OTH_EFFECT	Other effects	Character	250
6	PRE_TKN	Precautions to be Taken	Character	250

B. Other Additional Related Tables

Industry/Mines wise Products and Capacity Authorized as per CTO

SL	Field Name	Description	Type	Width
1	IND_ID	Industry/ Mine ID	Numeric	3
2	IND_NAME	Industry/ Mine Name	Character	80
3	PROD_NAME	name of Product	Character	60
4	PROD_UNIT	Product Unit per Annum	Character	60
5	CTO_CAP	Permitted capacity as per CTO (per Annum)	Numeric	14,2
6	EC_CAP	Permitted capacity as per EC (per Annum)	Numeric	14,2
7	ACT_CAP	Actual Capacity (per Annum)	Numeric	14,2

Industry/Mines wise Hazardous Waste(Authorized as per CTO)

SL	Field Name	Description	Type	Width
1	IND_ID	Industry/ Mine ID	Numeric	3
2	IND_NAME	Industry/ Mine Name	Character	80
3	HW_CATG	Category of hazard waste	Character	40
4	HWA_COMP	Authorized Hazardous Waste	Character	60
5	HWP_QTY	Quantity of Hazardous Waste Permissible	Numeric	10,2
6	HWP_UNIT	Hazardous Waste Permissible Unit	Character	60
7	HWD_MODE	Mode of Hazardous waste disposal	Character	80

Industry/Mines wise Solid Waste Generated Details & Disposal Process

SL	Field Name	Description	Type	Width
1	IM_ID	Industry/ Mine ID	Numeric	3
2	IM_NAME	Industry/ Mine Name	Character	80
3	SW_NAME	Solid Waste Name	Character	60
4	SW_QTY	Quantity	Numeric	14,2
5	SW_UNIT	Unit per annum	Character	60
6	SWD_PRCT	Solid Waste Disposal Practice	Character	100

Industry/Mines wise List of Pollutantsto be measured as per CTO

SL	Field Name	Description	Type	Width
1	ID	Unique ID	Numeric	4
2	IND_ID	Industry / Mine ID	Character	12
3	IND_NAME	Industry / Mine Name	Character	50
4	CPA_NAME	CPA Name	Character	20
5	PLT_TYPE	Medium of Pollutant Air/ SW/ GW	Character	10
6	PLT_AGENT	Pollutants Measured as per CTO	Character	50
7	PLT_PSV	Prescribed Standard Value	Numeric	14,2
8	PLT_UNIT	Unit	Character	20

C. Periodic Data Collection & Report Tables

Ambient Air Quality Periodic Data

SL	Field Name	Description	Type	Width
1	MS_ID	AAQ Monitoring station code	Character	12
2	APLT_AGENT	Air Pollutants Agent	Character	50
3	YEAR	Year	Numeric	4
4	MONTH	Month	Character	20
5	MIN_VAL	Minimum value	Numeric	10,3
6	AVG_VAL	Avg. Value	Numeric	10,3
7	MAX_VAL	Maximum value	Numeric	10,3
8	STD_LIMIT	Standard Limit	Numeric	10,3

Stack Air Quality Periodic Data

SL	Field Name	Description	Type	Width
1	STK_ID	Chimney stack Location ID	Character	12
2	APLT_AGENT	Air Pollutants Agent	Character	50
3	YEAR	Year	Numeric	4
4	MONTH	Month	Character	20
5	MIN_VAL	Minimum value	Numeric	10,3
6	AVG_VAL	Avg. Value	Numeric	10,3
7	MAX_VAL	Maximum value	Numeric	10,3
8	STD_LIMIT	Standard Limit	Numeric	10,3

Surface Water Quality Periodic Data

SL	Field Name	Description	Type	Width
1	MS_CODE	SW Sampling Locations code	Character	12
2	WPLT_AGENT	Water Pollutants	Character	50
3	YEAR	Year	Numeric	4
4	MONTH	Month	Character	20
5	TEST_VAL	Testing Value	Numeric	10,3
6	STD_LIMIT	Standard Limit of Class-C	Numeric	10,3

Year wise Production details of Mines

SL	Field Name	Description	Type	Width
1	MN_ID	Mine ID	Numeric	3
2	MN_NAME	Mine Name	Character	80
3	YEAR	Year	Numeric	4
4	MN_QTY	Mineral Production (MT)	Numeric	10,2
5	OB_QTY	Over burden (MT)	Numeric	10,2
6	DC_AREA	De-coaled area (Ha)	Numeric	10,2
7	DC_VOLUME	De-coaled volume (Mtr. Cube)	Numeric	10,2
8	DCR_AREA	De-coaled area reclaimed (Ha)	Numeric	10,2
9	DCR_VOLUME	De-coaled volume reclaimed (Mtr. Cube)	Numeric	10,2

Year wise Plantation details of Mines

SL	Field Name	Description	Type	Width
1	MN_ID	Mine ID	Numeric	3
2	MN_NAME	Mine Name	Character	80
3	YEAR	Year	Numeric	4
4	PLNT_NOS	No. of plants planted	Numeric	6
5	PLNT_LOCA	Locations of Plantation	Character	100
6	PLNT_AREA	Plantation area in Ha.	Numeric	10,2
7	SERV_PERC	Survival %	Numeric	6,2

Public Issues

SL	Field Name	Description	Type	Width
1	ISSUE_ID	Issue ID	Numeric	3
2	ISSUE_DT	Issue ID	Numeric	3
3	DESC	Issue Description	Character	250

Action Plan Details

SL	Field Name	Description	Type	Width
1	AP_ID	Action Plan ID	Numeric	3
2	DESC	Plan Description	Character	250

User Acceptance Criteria

A. User Acceptance Criteria for Geo-Database

- Geo Referencing the all feature dataset in WGS-1984 projection system
- All feature has a primary key field with specified coding pattern
- All point feature dataset has latitude and longitude co-ordinate value in degree/decimal format
- Data completeness and uniqueness in all fields/attribute as per the logical definition and structure defined by OPCB
- Thematic representation of features should be unique
- The geo-database extension with [.gdb] and it must open in ArcGIS environment

B. User Acceptance Criteria for Application Software

- Registered user can login to the system application through a valid User-ID and Password.
- The general user (Public) can access the application with registration his/her name.
- User management (new user creation, dropping existing user, changing role based access privileges) is available in the application, It is managed by System Administrator
- User can reset the password
- User wise module access is available after successful login to the application
- User wise dashboard is available for easy access to modules of the application.
- Public can access the module of the application, that contains submit their issues/views regarding the environmental related issues.
- User can update data, manage the public issues & analyze the RTDAS data from fetching data from RTDAS server and also view the map based interface.
- Supervisor can manage the public issues, generate the action plans, view the map based interface and also generate the reports & charts
- System Administrator can manage the user roles and generation of login/logout reports



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