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Fire Hazard and Risk Analysis in the Country for Revamping the Fire Services in the Country

Final Report – State Wise Risk Assessment, Infrastructure and Institutional Assessment of Phase-I States (Chandigarh, Haryana, Himachal Pradesh, Punjab, Uttarakhand, and Uttar Pradesh)

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Submitted by

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Executive Summary

Fire service is one of the most important emergency response services in the country, which comes under the 12th schedule of the constitution dealing with Municipal functions. At present, fire prevention and fire fighting services are organized by the concerned States and Union Territories (UTs), and Urban Local Bodies (ULBs). Directorate of National Disaster Response Force and Civil Defence (NDRF&CD, Fire Cell), Ministry of Home Affairs (MHA) render technical advice to the States, UTs, and central ministries on fire protection, prevention, and legislation. Fire services in Maharashtra, Haryana, Gujarat, Chhattisgarh, Madhya Pradesh (excluding Indore), and Punjab are under the respective Municipal Corporations. In the remaining States, it is under the respective Home Department.

The growth of fire-services in the country has been on an ad-hoc basis, without much scientific analysis of existing risks in different parts of the country. Varying risk scenarios need different types of equipment. The risk varies with geographical location such as hilly-area, coastal-area, desert–area, and with residential (high-rise, medium, and low rise-buildings), industrial, commercial area or a combination of these. Moreover, lack of knowledge management for future planning and institutional capacity and funds are also seen as one of the major challenges in addressing improvements in fire and emergency services in the country. As per a recent analysis by the Standing Fire and Advisory Council (SFAC), the overall deficiency in the country in terms of number of Fire Stations is 97.54%, in terms of fire fighting and rescue vehicles is 80.04% and in terms of fire personnel is 96.28%, respectively, which is quite alarming (NDMA Guideline, 2012, CR SFAC, 2011). In consideration of this and the increasing fire risks from various hazards, the Directorate of NDRF&CD, Fire Cell, MHA planned a study called "**Fire Hazard and Risk Analysis in the Country for Revamping the Fire Services in the Country**", to identify existing gaps in terms of availability and requirement of Fire Stations, capacity-building, trained man-power and fire-fighting, rescue, and other specialized equipment.

The **broad objectives** of the study are:

- To carry out GIS thematic map based Fire Hazard and Risk analysis though overlaying hazards and quantified risk, and classify the districts as base units into appropriate risk categories such as very high, high, medium, or low.
- To prepare a detailed Investment and Financing Plan for next 10 years for up-gradation, expansion and modernization of Fire Services, based on existing situation analysis and risk based actual requirements.
- To develop an open-source GIS based software called as a Fire Decision Support System (FDSS) containing administrative boundaries, quantified risk GIS layers and with capability of estimation of financial implications for desired capacity development.
- To prepare an Institutional Assessment and Capacity Building Plan, based on field-data collection, enquiry, spatial analysis and understanding of the availability and gaps in the fire service infrastructure.

Role of Fire Services

The primary role of fire services has been to attend to fire incidents. Besides firefighting, fire department also attends to other emergencies such as building collapse, road traffic accidents, human and animal rescue etc., and other special service calls. Some fire services also attend medical emergencies for transportation of casualties through ambulances maintained by them. Similarly, some States, like Delhi, have separate flood department with rescue boats and trained divers. The Fire Services maintain skeletal facilities to act as *'first*

responders' and wait until assistance from the flood department arrives. It is therefore, considered appropriate that the specialized facilities for such jobs is maintained and operated by the concerned department.

As indicated in the National Disaster Management Authority (NDMA) guidelines, Fire Service is one of the Emergency Support Functions (ESF). Based on DM Act 2005, various States have also formulated State Disaster Management Authorities (SDMA's) and District Disaster Management Authorities (DDMA's) both of which consider Fire Service as an ESF. It is, therefore, evident that the role of Fire Services has become multi-dimensional that includes not only attending fire incident calls but also various other emergencies. Accordingly, fire services in the jurisdiction of the respective Fire Station are required to be prepared with suitable types of equipment to deal with various emergencies.

The role of fire services also includes effective fire prevention, creating awareness on fire safety, and enforcing the inbuilt fire protection arrangements for various types of occupancies in line with National Building Code (NBC) part – IV. However, some of the States/Municipal Fire Services are unable to enforce the fire safety provisions due to a lack of appropriate directives from the authorities controlling the function of fire services. Some of the Fire Services do not adhere to NBC and have created their own fire-safety building bye-laws, e.g., Mumbai Fire Brigade. It may be noted that in-built fire safety arrangements and escape facilities are much more important than having a fire service within the premises without the above facilities. It is, therefore, necessary to enforce the fire-safety provisions through appropriate directives to all the States/UTs by the Ministry of Home Affairs (MHA) directly or through DG, NDRF & CD office.

In addition to the regular fire services, various other organizations/ industries, such as Ports, Airports, Defence, Power, Oil and Gas, Steel, Heavy Engineering, Fertilizers, Chemicals etc. have their own fire service set-ups (including their own captive resources), in order to provide fire protection to their facilities and some of them at times provide support to local fire services on request. All of them have their rules and regulations concerning fire safety. For example, Oil India Safety Directorate (OISD) norms for Oil and Gas Industries, International Civil Aviation Organization (ICAO) norms for Airports, Tariff Advisory Committee (TAC) regulations- now discontinued, for industries etc. and Electricity Rules for power sector.

Safety of highly hazardous processing and storage industries requires 100 percent round the clock built-in and functional fire protection arrangements with trained fire fighters as well as onsite and off-site disaster management plans. Fire services are not expected to create the infrastructure to independently tackle such emergencies within the industry, as it may be not be possible to do so. However, they are expected to support any on-site and off-site fire fighting to protect surrounding populations and handle such incidents during transportation through the civil areas. Moreover, local fire services should have mutual-aid schemes with all the industries in their jurisdiction and must be aware of the various arrangements available with them in order to provide efficient support, in case of an emergency.

Phased Approach

In order to conduct this study for India, a vast country covering all the States and Union Territories (UTs), it was decided to conduct this study in a phased manner. In this initial phase, the pilot study comprises of 6 States and UTs (Jammu & Kashmir, Rajasthan, Maharashtra, Delhi, Andaman & Nicobar Island, and Puducherry).

Field Surveys for Fire Infrastructure Data

To collect and collate the information on Fire Infrastructure of these Pilot States/ UTs, RMSI team developed two detailed forms "Headquarter Data Collection Form" and individual "Fire Station Field-Survey Form". RMSI team field-surveyed all the Fire Stations in pilot States/UTs for collecting detailed fire Infrastructure information. The detailed information collected includes address of Fire Station, name of Fire Station in-charge, emergency contact numbers, communication between Fire Station control room, public and headquarter control room; Fire Station building including staff accommodation and barracks; fire fighting vehicles and specialized equipment; fire personnel, their duty pattern and pay-scales; water availability and water sources for fire vehicles, fire-risk in the jurisdiction of Fire Station and its geographical coordinates (latitude, longitude -by using a Global Positioning System, GPS) etc. All this information for each Fire Station has been digitally converted and is available through Fire Decision Support System (FDSS), which can generate a Fire Station report at the click of a button.

GIS based Fire Hazard and Risk Analysis

In general, fire risk is defined as the combination of hazard potential, exposure, and vulnerability:

Risk = F (**H**azard potential x **E**xposure x **V**ulnerability)

The occurrence of fire incidents that constitute a threat for the population and exposed infrastructure of a certain region is associated with economic and human losses, always as a function of the exposure conditions and the vulnerability of the exposed assets in that particular region. Different natural hazards such as seismic (earthquake), climatic, and wind are considered in risk analysis. Additionally hill zone are also considered in risk analysis due to increased fire risk from wooden houses and heating provisions in cold areas.

For estimating exposure and its vulnerability, detailed urban agglomerate classification maps generated from high-resolution satellite images have been used. With the help of remote sensing techniques applied on high-resolution satellite imageries, various types of urban agglomeration areas have been demarcated. These include urban, semi-urban, building blocks, and industrial and rural villages' built-up areas of different densities (high medium, low). For exposure vulnerability, 4 different layers such as population density, residential built-up areas, high-rise building block density, and industrial areas have been developed individually at district level. For assessing fire risk, both absolute built-up areas in sq km as well as built-up areas percent (ratio of built-up areas to the total area) are considered as important parameters. It is obvious that industrial areas in districts have much lower percentages than residential built-up areas. However, presence of industrial areas in a district has a significant influence in assessing fire risk. Hence, industrial areas in absolute terms (sq km) have been considered in risk ranking.

In order to assess the impact of each exposure vulnerability type, a vulnerability score/ ranking has been assigned to each layer at their base unit. The vulnerability score represents the level of vulnerability (very high to negligible) of a specific type of exposure in response to the occurrences of small and medium fire incidents. The natural break in value distribution has been considered for defining the ranking class.

After developing ranking of individual units of hazard and exposure vulnerability, GIS layers have been overlaid on top of each other and a spatial analysis has been performed for integration in GIS environment. For combining hazard and risk, Weighted Factor Analysis (WFA) in GIS environment has been performed. Weighted ranking scores have been used in the integration analysis and quantified risk distribution for each district. Values of weighted factor depend upon the importance of a particular hazard/ vulnerability class in risk analysis. For integration of hazards, equal weights have been assigned to wind, seismic and climatic hazards, while double weights have been given to hill zoning. This is because, in hilly terrain,

wooden houses and heating provisions in buildings increase the chances of fire-incidences, and thus have been given higher weightage.

After obtaining integrated individual weighted score for hazard and exposure vulnerability, fire risk categories have been obtained in quantitative terms by further integration of hazard and exposure vulnerability. It is obvious that in the occurrence of the number of fire incidents in a given district, exposure vulnerability has more importance than the prevailing hazard. Hence, in quantified integration, double weights have been assigned to exposure vulnerability. The quantified numeric values of district risk scores are again grouped into four descriptive categories of district level risk ranking (very high, high, medium, and low).

As per project scope of work, countrywide district level fire hazard and risk analysis has been carried out. However, it is obvious that the fire risk is not uniformly distributed throughout the districts in both urban and rural areas. Considering the above fact, RMSI has performed GIS based risk analysis, based on distribution of population agglomeration by defining built-up areas into different risk categories, such as high-density urban, low-density urban, sub-urban, and village. Moreover, distinct demarcated industrial areas have also been considered in the analysis.

Review of International and National Norms

To estimate the gaps from the existing position in terms of number of Fire Stations and their appropriate location, the RMSI team followed scientific and innovative GIS based response time network analysis approach involving various norms and regulations. Various international and national norms on response time have been reviewed. Response time is defined as "*en route time (in minutes) taken by the fire fighting vehicle from the Fire Station to the fire emergency scene.*" Different counties follow different norms on response time such as:

Germany: response time in urban areas varies from 8 to 15 minutes

Japan: response time varies from 5 to 10 minutes, depending upon the location of the building

USA: response time varies from (3-4) to 8 minutes

United Kingdom: response time varies from 5 to 8 minutes

India: SFAC norms recommended response time for first fire tender is 3, 5, and 7 minutes respectively depending on risk category A, B, and C in urban area and 20 minutes in rural area. The norms also defined one Fire Station in an area of 10 sq km in urban area; and 50 sq km in rural area.

To investigate the practicability of SFAC norms, RMSI team carried out a number of simulations using GIS based network analysis. With these simulations, RMSI demonstrated that two SFAC norms (response time and area-based) are not in synchronization with each other, and recommended revised response time based norms for positioning a Fire Station, as response area will vary from place to place depending upon the road network.

- ***Depending upon the risk category, the recommended response time for first fire tender is 5 to 7 minutes in urban areas and 20 minutes in rural areas***

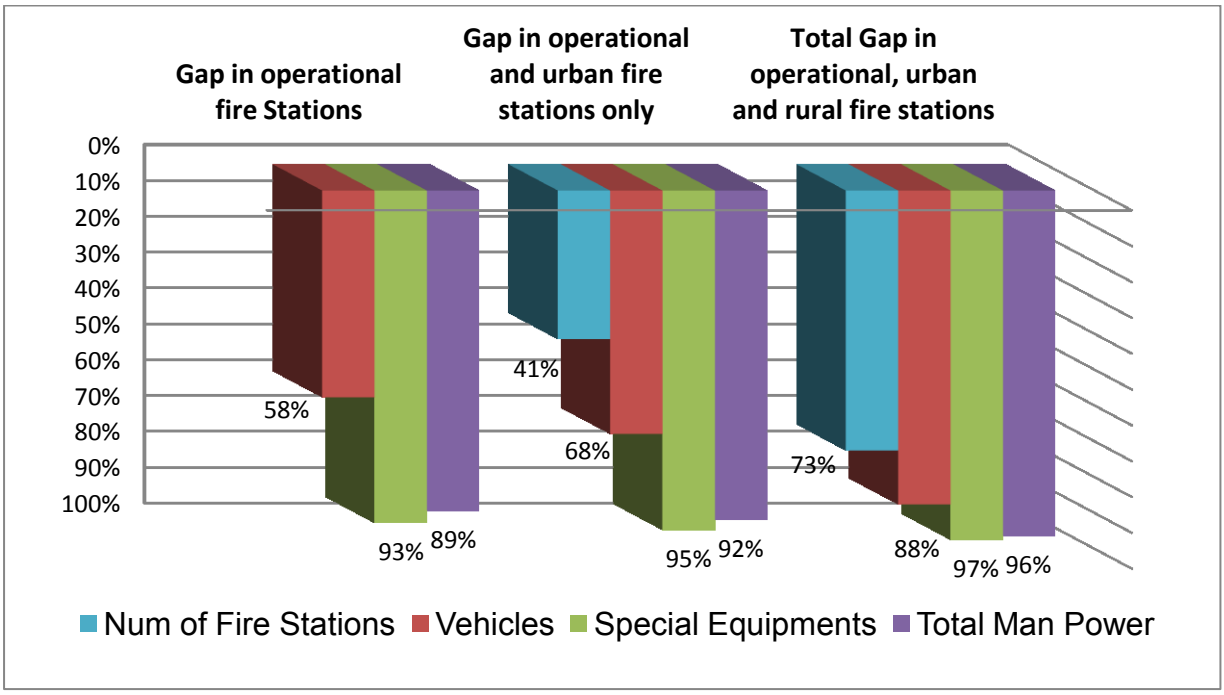
Summary of Findings for Punjab State

Presently, Punjab State Fire Services has 48 operational Fire station in urban areas and none existing in rural areas.

Based on detailed demarcated built-up areas and GIS based network analysis (response time analysis), ideal jurisdiction boundaries have been demarcated for all operational Fire Stations excluding areas served by other agencies, such as airport, military cantonment, thermal power plants etc. The remaining areas, not covered under ideal jurisdiction of operational Fire Stations, are also divided for ideal jurisdictions of new proposed Fire Stations. The requirements for fire fighting and rescue vehicles and specialized equipment are based on ideal served population, population density, and built-up areas within ideal jurisdiction boundary.

Fire Station Gap Analysis

As per detailed GIS based analysis, the State would require additional 34 Fire stations in urban areas and 93 Fire stations in rural areas. Thus, this study proposes a further additional of 34 urban Fire Stations and 93 rural Fire Stations, which is an overall deficiency of 73% in terms of number of Fire Stations in Punjab (for details, please refer to section 16.3.1).



Firefighting and Rescue Vehicle and Equipment Gap Analysis

For estimating the gap in fire fighting and rescue vehicles and specialized equipment in operational as well proposed Fire Stations both in urban and rural areas, the RMSI team modified the SFAC norms with expert opinions. These modifications also helped in optimization of resources and are detailed in 16.3.2. Thus, this study finds an overall gap of about 88% in fire fighting and rescue vehicle and about 97% in specialized equipment for both operational and new Fire Stations in urban and rural areas.

Fire Personnel Gap Analysis

For estimating the gap in fire personnel in operational as well new proposed Fire Stations both in urban and rural areas, the RMSI team used Administrative Reform Department (ARD, Delhi) norms based on duty pattern (double-shift) prevalent in Delhi as ARD has

already optimized the fire manpower requirement in comparison to what has been suggested in SFAC norms. The current duty pattern in Punjab is double shift duty pattern (for details refer to section 16.3.3). Thus this study finds an overall gap of about 96% in fire personnel for double duty shift pattern.

Fire Prevention Wing

In addition to fire fighting staff, there is an urgent need for fire prevention wing for inspection, awareness generation, and training for schools, hospitals, high-rise buildings, govt. offices, public buildings etc., need further strengthening, so that recurrence of the fire incidences similar to that at the Advance Medical Research Institute (AMRI), Kolkata, in terms of their magnitude and frequency can be reduced. Accordingly, to support Director, Deptt. of Local Govt., Punjab, additional officers at the levels of Director (Technical), Chief Fire Officers (CFO), Dy Chief Fire Officers (Dy-CFO), Division Officers (DO), and Assistant Divisional Officer (ADO) have been recommended (for details, please refer to section 16.3.3).

Fire Station, District and State Level Report Generation

The detailed report of Operational Fire Stations, district and State levels for fire infrastructure and gap analysis is also available through the Fire Decision Support System (FDSS), which can generate reports for each Operational Fire Station, district, and State level at the click of a button.

Roadmap for Investment and Financial Plan for Next 10 Years

The other tasks include the development of Investment and Financial Plan, Institutional Assessment & Capacity Building Plan along with a Fire Decision Support System (FDSS). As detailed in section 16.4, the detailed investment and financial plan at district level includes estimation of capital cost for infrastructure cost, fire fighting and rescue vehicles, and specialized fire and communication equipment. The recurring expenditure cost includes fire personnel cost depending upon pay-scales at various levels; staff uniform cost, and Personnel Protective Equipment (PPE); annual vehicle and specialized equipment maintenance cost, petrol, diesel, and lubricant (PDL); building maintenance; office and training expenses etc. The detailed roadmap and investment plan (section 16.5) for the next 10-years includes both capital and recurring expenditures. ,RMSI analysis estimates a total investment of **about Rs. 9,633 Crores** spread over a period of 10 years for Delhi State including inflationary factors and after filling the gaps for both operational and proposed urban and rural Fire Stations.

Prioritization of New Fire Stations

The prioritization of new Fire Stations in Punjab State for both rural and urban areas has been detailed in section 16.6. Accordingly, separate priority ranking for both urban and rural areas are given in Tables 16-42 and 16-43, respectively.

Avenues for Fund Generation

Punjab Fire Service can generate new avenues for funds from the following:

- Introduction of Fire Tax (1% of existing property tax)
- Training programs at different levels and durations to private sector employees on chargeable basis
- Capitation fees can be charges for scrutiny of building plans.
- Sale of condemned fire appliances, equipment, uniform articles and general store items.

Capacity Building and Training Facilities

The Capacity Building and Training facilities and training need assessment for various levels have been given in section 16.8.

Limitations of the Study

Limitations of study have been discussed in section 16.9.

Recommendations

The report concludes with the recommendation for the Punjab State Fire Services and is detailed in section 16.10. In short, Punjab State Fire Services can be revamped in the next 10 years to desired level discussed in this report, if sufficient funds and trained resources are made available.

Report Structure

This report for the Phase I States/UTs is divided in two parts:

Part A: This part comprises of chapters 1-6, which are common for all the 35 States/UTs Fire Services for which this study is conducted.

- Chapter 1 provides brief details of project background, role of fire services, objective and scope of study
- Chapter 2 outlines the methodology adopted and data development
- Chapter 3 provides details on GIS based fire hazard and risk analysis
- Chapter 4 provides a brief overview of field-survey of individual Fire Station and headquarter data collection and approach for stakeholder analysis
- Chapter 5 briefly explains the Development of Fire Decision Support System (FDSS)
- Chapter 6 examines international and national norms

Part B: This part comprises of Chapters 13-18, which are specific to the State/UT being discussed.

- Chapter 13 provides detailed analysis for the Chandigarh UT
- Chapter 14 provides detailed analysis for the Haryana State
- Chapter 15 provides detailed analysis for the Himachal Pradesh State
- Chapter 16 provides detailed analysis for the Punjab State
- Chapter 17 provides detailed analysis for the Uttarakhand State
- Chapter 18 provides detailed analysis for the Uttar Pradesh State

For Part-B, this report consists of Chapter 16, which is for the Punjab State.

PART -A

1 Introduction

1.1 Background

Fire service is one of the most important emergency response services. In India, Fire services come under the 12th Schedule of the constitution dealing with Municipal functions. At present, fire prevention and fire fighting services are organized by the concerned States and Union Territories (UTs), and Urban Local Bodies (ULBs). Ministry of Home Affairs (MHA) renders technical advice to the States, UTs, and central ministries on fire protection, prevention, and legislation. Fire services in Maharashtra, Haryana, Gujarat, Chhattisgarh, Madhya Pradesh excluding Indore, and Punjab are under the respective Municipal Corporations. In remaining States, it is under the Home Department (Figure 1-1).

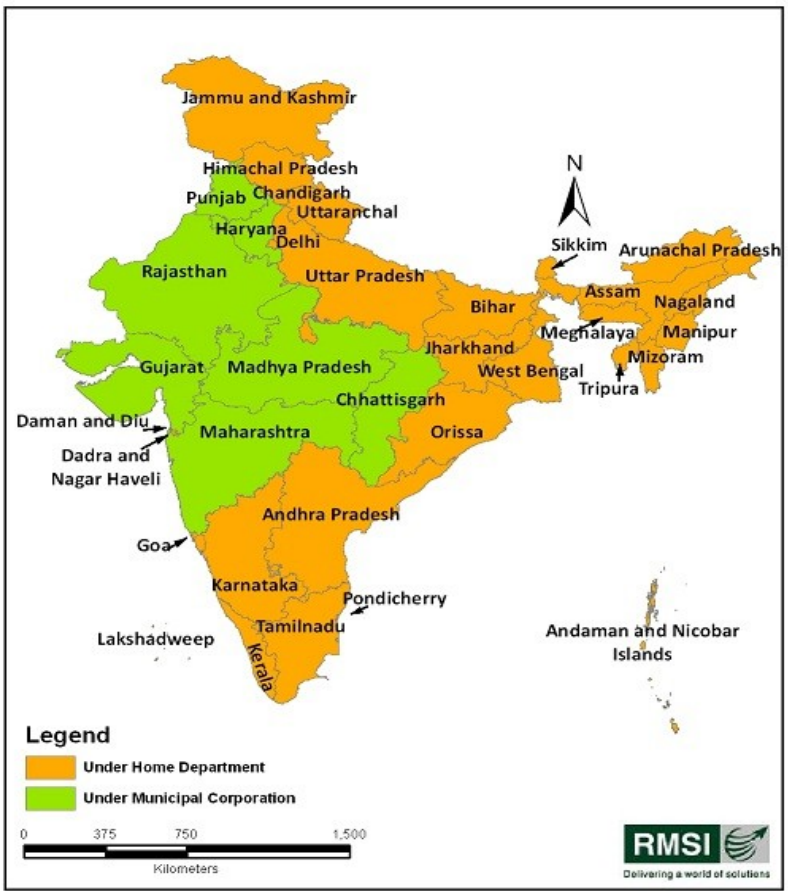


Figure 1-1: Distribution of fire services by various States/UTs by administrative organization

1.2 Role of Fire Services

As far as the role of fire services is concerned, the primary job of fire services has been to attend to fire incidents. However, they also attend to other emergencies like rescue from building collapse, road traffic accidents, human and animal rescue etc., and other special service calls. Some fire services also attend medical emergencies for transportation of casualties through ambulances maintained by them. Similarly, some States have separate flood department with rescue boats and trained divers, like Delhi. The Fire Services maintain skeleton facility to act as 'first responder' and wait until assistance from flood department is

reached. It is therefore, considered appropriate that the specialized facilities for such job is maintained and operated by the concerned department.

As indicated in the National Disaster Management Authority (NDMA) guidelines, Fire Services is one of the Emergency Support Functions (ESF). Based on DM Act 2005, various States have also formulated State Disaster Management Authorities (SDMA's) and District Disaster Management Authorities (DDMA's) both of which consider Fire Service as an ESF. It is therefore evident that the role of Fire Service is multi-dimensional that includes attending various emergencies. Accordingly, fire services are required to be prepared with suitable types of equipment to deal with various emergencies arising in the jurisdiction of the respective Fire Station.

The role of fire services also includes effective fire prevention, creating awareness on fire safety, and enforcing the inbuilt fire protection arrangements for various types of occupancies in line with National Building Code (NBC) part – IV. However, majority of the States/Municipal Fire Services are unable to enforce the fire safety provisions due to a lack of appropriate directives from the authorities controlling the function of fire services. Some of the Fire Services do not adhere to NBC and have created their own fire-safety building bye-laws, e.g., Mumbai Fire Brigade. It may be noted that in-built fire safety arrangements and escape facilities are much more important than having a fire service within the premises without the above facilities. It is, therefore, necessary to enforce the fire-safety provisions through appropriate directives to all the States/UTs by the Ministry of Home Affairs (MHA) directly or through DG, NDRF & CD office.

In addition to the regular fire services, various other organizations/ industries, such as Ports, Airports, Defence, Power, Oil and Gas, Steel, Heavy Engineering, Fertilizers, Chemicals etc. have their own fire service set-ups (including their own captive resources), in order to provide fire protection to their facilities and some of them at times provide support to local fire services on request. All of them have their rules and regulations concerning fire safety. For example, Oil India Safety Directorate (OISD) norms for Oil and Gas Industries, International Civil Aviation Organization (ICAO) norms for Airports, Tariff Advisory Committee (TAC) regulations- now discontinued, for industries etc. and Electricity Rules for power sector.

Safety of highly hazardous processing and storage industries requires 100 percent round the clock built-in and functional fire protection arrangements with trained fire fighter as well as onsite and off-site disaster management plans. Fire services are not expected to create the infrastructure to independently tackle such emergencies within the industry, as it may be not be possible to do so. However, they are expected to support any on-site and off-site fire fighting to protect surrounding populations and handle such incidents during transportation through the civil areas. Moreover, local fire services should have mutual-aid schemes with all the industries in their jurisdiction and must be aware of the various arrangements available with them in order to provide efficient support, in case of an emergency.

The growth of fire-services in the country has been on an ad-hoc basis, without much scientific analysis of existing risks in different parts of the country. Varying risk scenarios need different types of equipment depending upon the risk and geographical location such as hilly-area, coastal-area, desert–area, and residential (high-rise, medium, and low rise-buildings), industrial, commercial area or a combination of these. Moreover, lack of knowledge management for future planning and institutional capacity and funds are also seen as major challenges in addressing improvements in fire and emergency services in the country. As per a recent analysis by the Standing Fire and Advisory Council (SFAC), the overall deficiency in the country in number of Fire Stations is 97.54%, in fire fighting & rescue vehicles 80.04% and in fire personnel is 96.28%, respectively, which is quite alarming (NDMA Guideline, 2012, CR SFAC, 2011).

In consideration of this and the increasing risks from various hazards, such as Fire Following an Earthquake (FFEQ), and the rapid pace of urbanization and industrialization in the country, the Directorate of National Disaster Response Force and Civil Defence (NDRF&CD, Fire Cell), MHA felt the need for a comprehensive study to identify existing gaps in terms of availability and requirement of Fire Stations, capacity-building, in terms of trained man-power and fire-fighting, rescue, and other specialized equipment. This comprehensive study **aims at preparing a perspective plan for the next 10 years for revamping the fire services in the country**.

1.3 Objective of the study

The broader objective of this study is to prepare a Capital Investment and Institutional Strengthening plan for accelerated development of fire services in the country.

1.4 Scope of the study

The study area for this assignment is the entire country under the Directorate of NDRF & Civil Defence (Fire). The scope of the assignment will include, inter alia, the following activities:

1. **Fire Hazard & Risk Analysis:** Carry out a GIS (Open Source) based fire hazard and risk analysis and identify the gaps in fire services in terms of fire fighting vehicles, specialized equipment, and trained fire personnel.
2. **Investment and Financing Plan:** Assess the status, availability and distribution of the fire service infrastructure under the Directorate of NDRF & Civil Defence (Fire Cell) by conducting field investigations and interviews. It is expected to conduct an investigation to assess the gaps and needs for future planning and up gradation/ modernization of the fire service infrastructure in the country in a quantified approach. As part of the Investment and Financing Plan, it is also expected to estimate the Capital and O&M Investment plan for the next 10 years and the investment priorities.
3. **Institutional Assessment and Capacity Building Plan:** Based on field-data collection, enquiry, spatial analysis and understanding on the availability and gaps in the fire service infrastructure, and prepare an institutional assessment and capacity-building plan for the department. Institutional Assessment and Capacity Building Plan will include but will not be limited to understanding the policies, regulations, strategies and programs of the department; existing legal and institutional mechanisms, issues and constraints of effective management; and training needs and capacity of the department's resources. Based on a comprehensive understanding of the mentioned variables, it is expected to prepare a consolidated national report and key recommendations for the Directorate of NDRF & CD (Fire Cell). It is also expected to explore the possibility of funding sources and provide recommendations for improvements to ensure appropriate financing mechanisms for capital expenditure, and for operation and maintenance.

2 Technical Details on Methodology and Data Development

2.1 Understanding of the Scope of Work

The primary objective of this comprehensive study on "Fire Hazard and Risk Analysis in the Country" is to prepare a capital investment and institutional strengthening plan for accelerated Development of Fire Services in the country. To achieve this objective of the study, the Directorate of NDRF & CD has defined the broad scope of the work as:

1. Risk and Hazard Analysis
    - Identifications of gaps in the existing fire services
2. Investment and Financial Plan
3. Institutional Assessment and Capacity Building Plan
    - Including survey of NFSC Nagpur and regional fire training Centers

As part of the Risk and Hazard Analysis, it is expected to carry out a GIS based hazard, risk analysis at base unit (district) level, and identify the gaps in the existing fire services. Risk assessment of forest fire is not included under the present scope of work. The infrastructures of forest department, privately owned fire safety infrastructure, infrastructures in restricted areas like military cantonments and airbases, and ammunition depots; nuclear facilities such as nuclear power plants, nuclear research reactors, heavy water plants; and mines, ports, airports, and oil exploration and oil refineries are excluded from the study. While assessing the infrastructure for the Investment and Financing Plan, RMSI has focused specifically on the fire States/ UTs Fire Services. ***However, it may please be noted that RMSI team is also making efforts to get details of areas served by other agencies as well, so that requirement of establishing Fire Stations in these areas does not become part of the Gap analyses.***

As part of the 'Investment and Financing Plan', it is expected to assess the status, availability and distribution of the fire service infrastructure under the jurisdiction of Director General (NDRF & Civil Defence) through conducting field investigations and interviews. It is also expected to conduct an investigation to assess the gaps and needs for future planning, up gradation/ modernization of the fire service infrastructure in the country through a quantified approach. As part of the Investment and Financing Plan, it is also expected to estimate the Capital and O&M Investment plan for the next 10 years and the investment priorities. Based on the field data collection, enquiry, spatial analysis and understanding on the availability and gaps in the fire service infrastructure, it is expected to prepare an institutional assessment and capacity-building plan for the department. Institutional Assessment and Capacity Building Plan will include but not limited be to understanding the polices, regulations, strategies and programs of the department; existing legal and institutional mechanisms, issues and constrains of effective management; training needs and capacity of the department's resources. Based on a comprehensive understanding of the mentioned variables, it is expected to prepare a consolidated National Report and key recommendations for the Director General (NDRF & Civil Defence) for all the Fire Stations under jurisdiction of the Directorate of NDRF & CD. Moreover, the possibility of funding sources are also be explored, and recommendations are made for improvements to ensure good financing mechanisms for capital expenditure and operation and maintenance.

2.2 Study Area

The study area for this assignment is the entire fire service area of the country under the Directorate of NDRF & Civil Defence (Fire Cell). RMSI has out physical survey of all the Fire Stations under the Directorate of NDRF & CD (Fire Cell) (Figure 2-1) across the country.

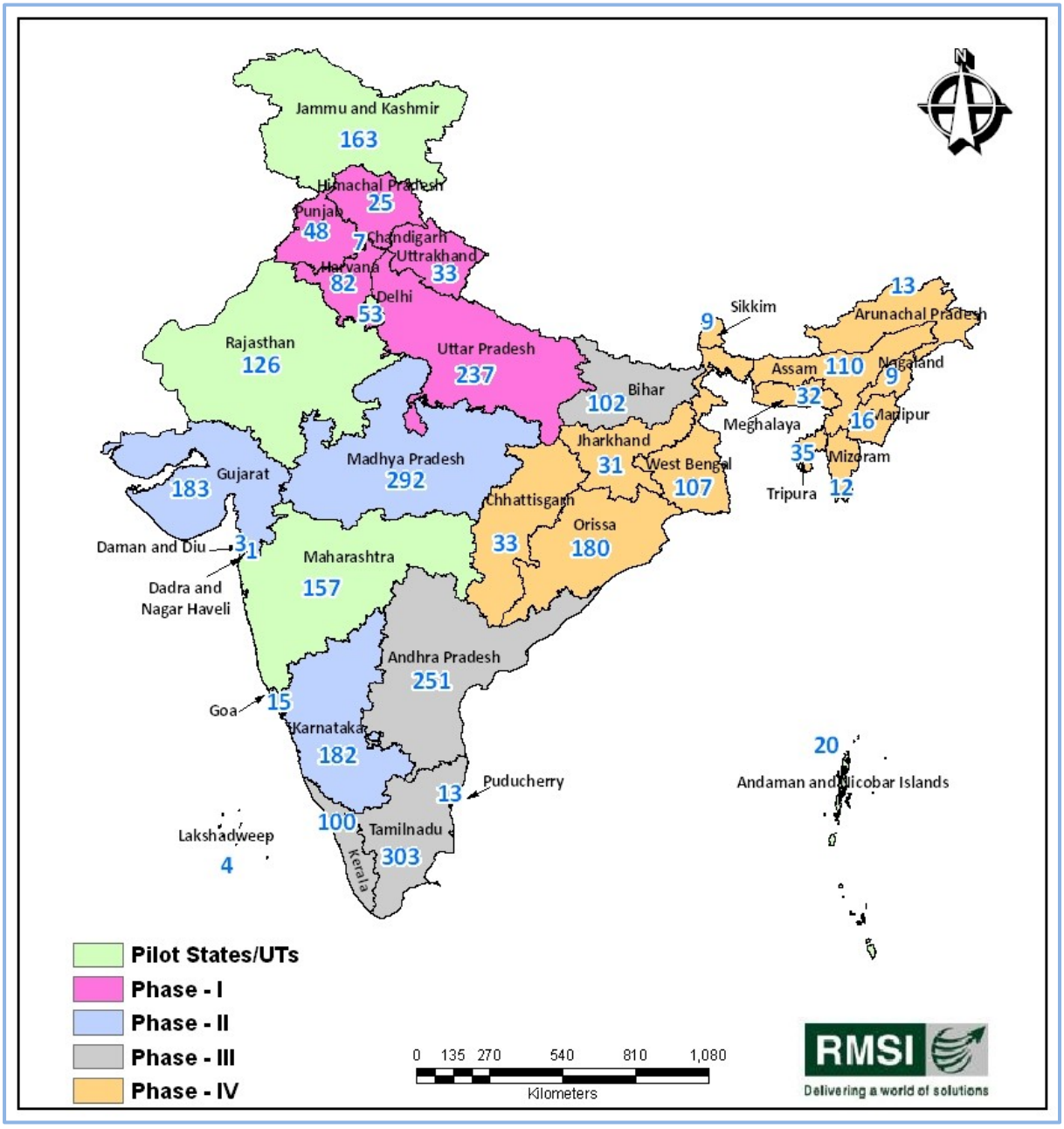


Figure 2-1 : State/UT wise distribution of fire service stations in India

2.3 Phased Approach

As India is a vast country and in order to conduct this study for all the States and Union Territories (UTs), it was decided to conduct this study in a phased manner (Table 2-1).

The initial phase pilot study comprises of six States and UTs - **Jammu & Kashmir, Rajasthan, Puducherry, Maharashtra, Andaman & Nicobar Island, and Delhi**. Remaining States/UTs have taken up in subsequent Phases (Phase I to Phase IV). The

Fire- Infrastructure of all States/ UTs has been Field–Surveyed by RMSI team and fire hazard and risk analyses have been carried out. The other tasks include development of Investment and financing plan, Institutional assessment & capacity building plan along with a prototype Fire Decision Support System (FDSS). The outcomes of pilot study were submitted to the Expert Group of the project for their review and approval and detailed discussions were held with senior Fire Officials, MHA and respective State/UT representatives. The approved report are used as a template for conducting the study for the remaining States/ UTs in the phased manner indicated in Table 2-1.

It may be noted that there could be region specific modifications and variations in the requirements of different kinds and types of firefighting equipment depending upon the risk category of the district (base unit) of Fire Station, its geographical location such as coastal-area, hilly-area and desert–area. Phase wise list of States/UTs also includes corresponding number of districts (Census, 2011), number of Talukas/ Mandals/ Tehsils (Census, 2001), and number of Fire Stations (Table 2-1).

Table 2-1: Phase wise distribution of various States/UTs in the Country

States/UTs	No of Districts (Census 2011)	No of Talukas/ Tehsils/ Mandals (Census 2001)	No of Fire Stations
Pilot Phase			
NCT of Delhi	9	27	53
Maharashtra	35	355	157
Puducherry	4	15	13
Andaman & Nicobar Islands	3	7	20
Rajasthan	33	241	126
Jammu & Kashmir	22	59	163
Phase I			
Chandigarh	1	1	7
Haryana	21	67	82
Punjab	20	72	48
Himachal Pradesh	12	109	25
Uttarakhand	13	49	33
Uttar Pradesh	71	300	237
Phase II			
Madhya Pradesh	50	259	292
Gujarat	26	227	183
Daman & Diu	2	2	3
Dadra & Nagar Haveli	1	1	1
Karnataka	30	175	182
Goa	2	11	15
Phase III			
Kerala	14	63	100

States/UTs	No of Districts (Census 2011)	No of Talukas/ Tehsils/ Mandals (Census 2001)	No of Fire Stations
Lakshadweep	1	4	4
Tamil Nadu	32	202	303
Andhra Pradesh	23	1110	251
Bihar	38	533	102
Phase IV			
West Bengal	19	343	107
Assam	27	145	110
Manipur	9	38	16
Meghalaya	7	32	32
Mizoram	8	25	12
Sikkim	4	9	9
Tripura	4	38	35
Nagaland	11	93	9
Arunachal Pradesh	16	149	13
Orissa	30	398	180
Chhattisgarh	18	97	33
Jharkhand	24	210	31
Total	**640**	**5,466**	**2,987**

3 GIS based Fire Hazard and Risk Analysis

Based on RMSI's vast experience of executing large projects at State and country levels, RMSI team has adopted the following approach (detailed below) to carry out this assignment. This approach has also been presented and discussed in a series of meetings with the officials of the Directorate of NDRF & CD, MHA, Government of India.

The risk of fire in urban areas has increased over the years and the rising cost of fire losses would seem to indicate that they are increasing at a greater rate than the measures devised to control them. Cities are growing in size and complexity day by day; therefore, they need to be managed more efficiently.

Geographic Information System (GIS) is an important and efficient tool that can be used by local administrations to minimize natural disasters (Recep Nisanci, 2010). Although there are many formal definitions of GIS, for practical purposes GIS can be defined as a computer-based system to aid in the collection, maintenance, storage, analysis, output and distribution of spatial data information (Bolstad, 2005). Thus, GIS technologies have been used in fire analysis related to the optimum location of Fire Stations. For example, Habibi et al. (2008), has made spatial analysis of urban Fire Stations in Tehran, using an analytical hierarchy process and GIS. Yang et al. (2004) also carried out studies concerning the selection of Fire Station locations using GIS.

Unlike a flat paper map, a GIS-generated map can represent many layers of different information. This representation provides a unique way of thinking about geographic space. By linking map databases, GIS enables users to visualize, manipulate, analyze and display spatial data. GIS technology based approach is cost-effective and provides accurate solutions in an expanding range of applications. RMSI team is adopting following approach for fire risk analysis of Indian States.

3.1 GIS Data Compilations

GIS Map based fire hazard and risk analysis is one of the main tasks of this assignment. In order to undertake hazard and risk analysis, various GIS layers and other associated thematic maps have been created for each of the pilot States/UTs that form the basis for risk ranking of base units (districts). The following is a list of selected GIS layers as base administrative layers and other dependant layers that have been used in GIS based fire risk analyses.

1. State administrative boundary layers
2. District administrative boundary layers
3. Rail network
4. Major (highways) and main road networks
5. Minor roads/ street road networks
6. Locations of cities, and major towns with their names
7. State level Land use land cover maps
8. Demarcation of residential, commercial and industrial built-up areas
9. Census population data (2011)
10. Geographical locations (latitude, longitude) of operational Fire Stations

11. Other collateral data such as information from city development plans (if available), and demarcation of fire-station jurisdictional areas.

These data layers and their attribute data have been expanded according to needs analyses. The needs analyses include query information for the data needed for generating risk maps and effective fire fighting planning.

After taking into account all requirements and data types, RMSI team has generated various GIS data layers for further GIS spatial analyses. District boundaries were considered as the base unit for analysis in assessing fire services infrastructure gaps, risk quantifications, and risk classifications.

GIS maps for administrative boundary layers such as State, and district are based on published Census 2011 data. **Currently, Census 2011 has published only district level demographic data.** In comparison to previous census (Census 2001), several new districts have been created. These new districts have been considered in the analysis.

Classified land use and land cover data is the backbone in fire hazard and risk analysis. Latest vintage satellite images have been used to capture the various features such as road networks, forest areas and habitat/settlement areas (Figure 3-1). The various land use land cover classes were extracted from latest vintage satellite images at 25m resolution for the selected States and UTs, and at higher resolution for major cities. The extraction is based on a semi-automated classification approach to distinguish the classes based on their reflectance values in the source satellite imagery. Data quality and data validation checks have been carried out for each stage of data generation.

For LULC classification, remote sensing satellite images were geo-referenced and classified to generate different LULC layers such as vegetation, built-up area, water bodies, and streets, based on their spectral reflectance i.e. DN (Digital Number) values. In this process, through a semi-automated process, these DN values of satellite images are classified into respective LULC classes to generate the clutter data. These clutter data layers are further subdivided into their respective sub-classes and merged together to give preliminary clutter data. The output clutter goes through standard validation processes and quality checks to produce high quality final clutters. Table 3-1 shows a list of classified LULC data at 25-meter resolution. Figure 3-1 displays delineated LULC classes for different parts of western Maharashtra (districts– Mumbai, Mumbai sub-urban, Thane, Pune and Raigarh). Figure 3-2 shows an enlarged view of classified urban agglomerate of Pune city areas.

Table 3-1: Cluster class morphology in land use maps

ID	Class Name	Description
0	**Unclassified**	Edge of the database
1	**Urban High Density**	Areas within urban perimeters, Inner city, very little/negligible vegetation. Closely packed buildings indicative of high density with only major streets and roads being visible. Absence of large open spaces.
2	**Urban Medium Density**	Medium density of buildings, vegetations are less but higher than the dense urban, major pedestrian zones being partially visible and streets and roads visible. Comparatively more open spaces exist within this region
3	**Urban Low Density**	Low density of buildings, vegetations / open area are higher than the medium urban, major pedestrian zones being partially visible and streets and roads visible. Comparatively more open spaces than medium density exist within this region
4	**Suburban High Density**	Suburban areas surrounding big cities (Outer parts of the city) with loosely packed built up and little vegetation.
5	**Suburban Low Density**	Sparse Suburban areas in outskirt of big cities (Outer parts of the city) with loosely packed built up and little vegetation.

ID	Class Name	Description
6	**Building Blocks**	Systematic groups of buildings, parallel or not, that may be separated by large open spaces.
7	**Villages**	Unsystematic small pockets /clusters of buildings, within large agriculture / open spaces
8	**Industrial**	**Industrial:** Factories, Warehouse, Garages, Shipyards, Mostly situated outside the main cities.
9	**Commercial Areas**	**Commercial:** Central Mall, Office Complexes with large building footprints, Central Business districts, Commercial buildings within the city (like petrol pumps, gas filling stations etc.) etc. will be classified as commercial areas
10	**Forest**	All kinds of dense forest in rural areas, over hills/ mountains, Natural Parks with high tree density.
11	**Low Dense Vegetation**	Low density of trees, low vegetation, bushes, scrubs with low tree density.
12	**Agriculture/Fellow**	All kinds of agriculture/fellow cultivated areas, croplands, farmlands etc.
13	**Water**	Inland permanent water bodies. This class will consist of lakes & dams.
14	**Open**	No buildings, no vegetation e.g. desert, beach, and open lands mostly barren.
15	**Quasi Open**	Areas with some obstruction like scattered trees or bushes with some mixed built-up, open, agricultural fallow lands etc
16	**Airport**	Airstrip and terminal buildings
17	**River/Canal**	Linear water features like streams and rivers.
18	**Seasonal Water Body**	Seasonal water body
19	**Sea**	Sea

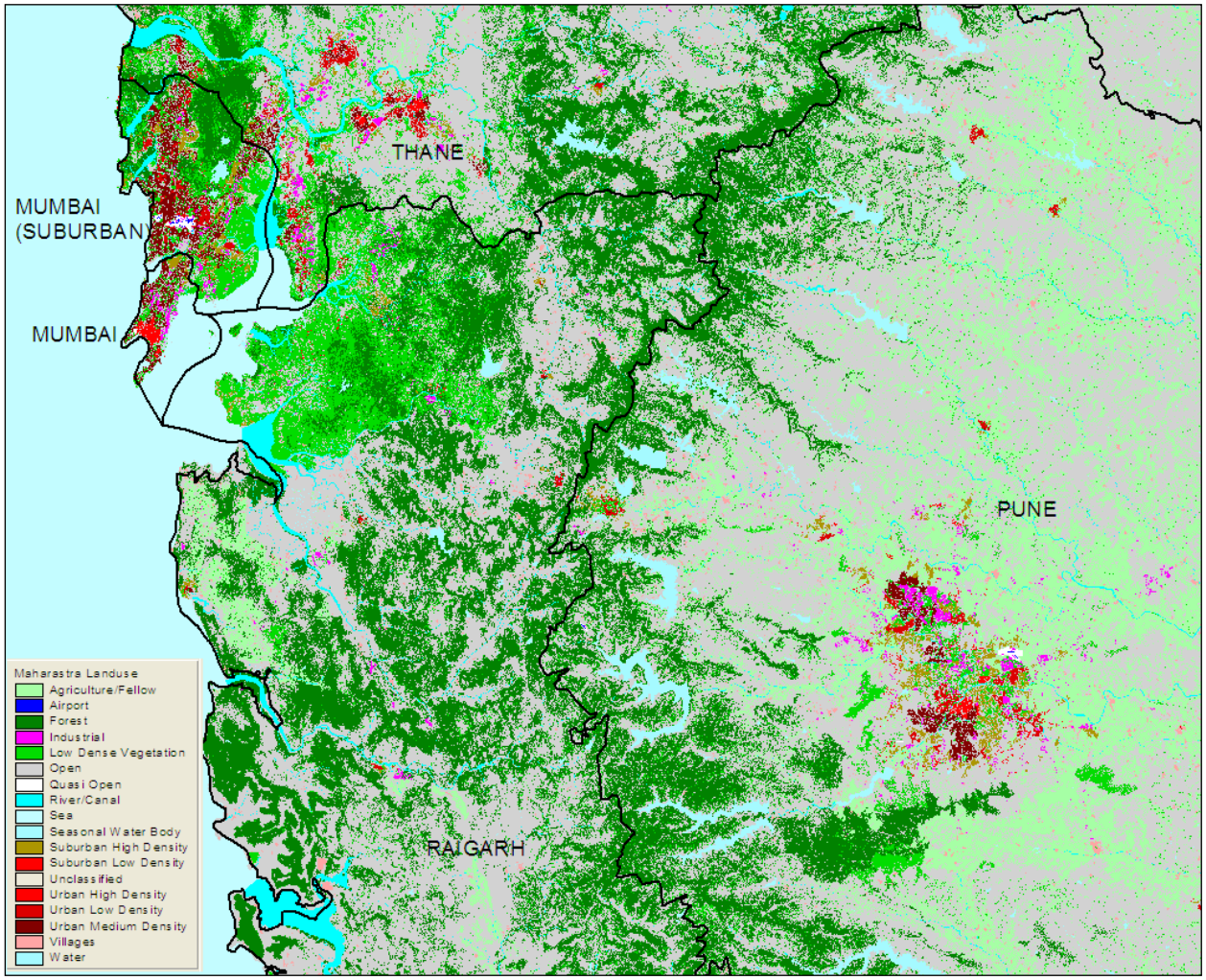


Figure 3-1 : An example of a Land use classification at 25m pixel. The example shows parts of Western Maharashtra (districts – Mumbai, Mumbai sub-urban, Thane, Pune, and Raigarh)

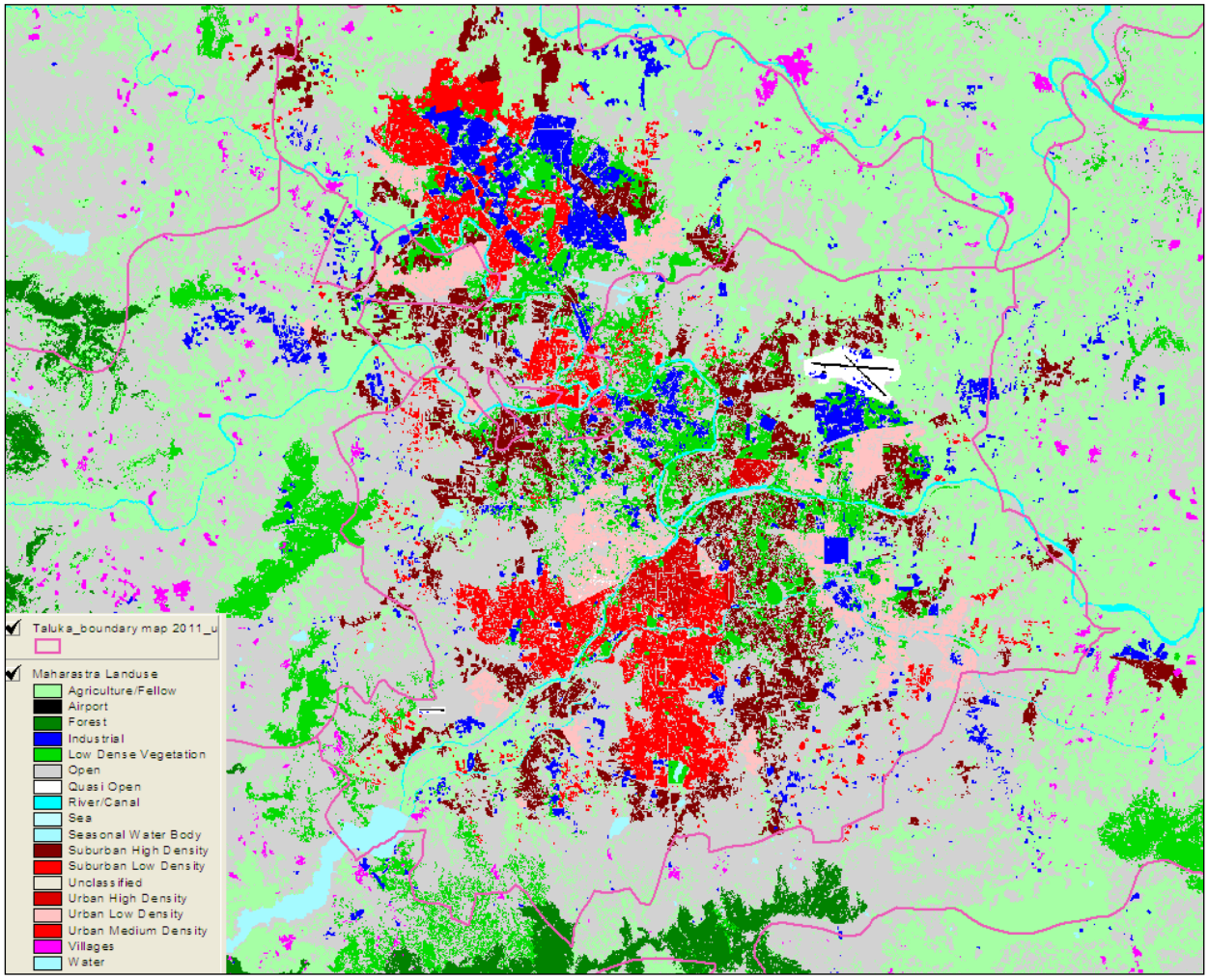


Figure 3-2 : Example of an enlarged view of classified. The example shows urban agglomeration classification in Pune city areas

For major city areas, classifications that are even more detailed have been created with a high-resolution data layer as shown in Figure 3-3. For major cities / towns, besides the other classified units, such as highways and main roads, minor roads/streets and localities, have been captured. After the field survey of individual Fire Stations, GPS locations of all Fire Stations have been displayed for gap analysis.

3.2 GIS - Overlay Analysis

The basic way to create or identify spatial relationships among various GIS layers is through the process of spatial overlay. Overlay is a GIS operation in which layers with a common, registered map base are joined on the basis of their occupation of space. (Keith C. Clarke, 1997). Spatial overlay is accomplished by joining and viewing together separate data sets that share all or part of the same area. The result of this combination is a new data set that identifies the spatial relationships.

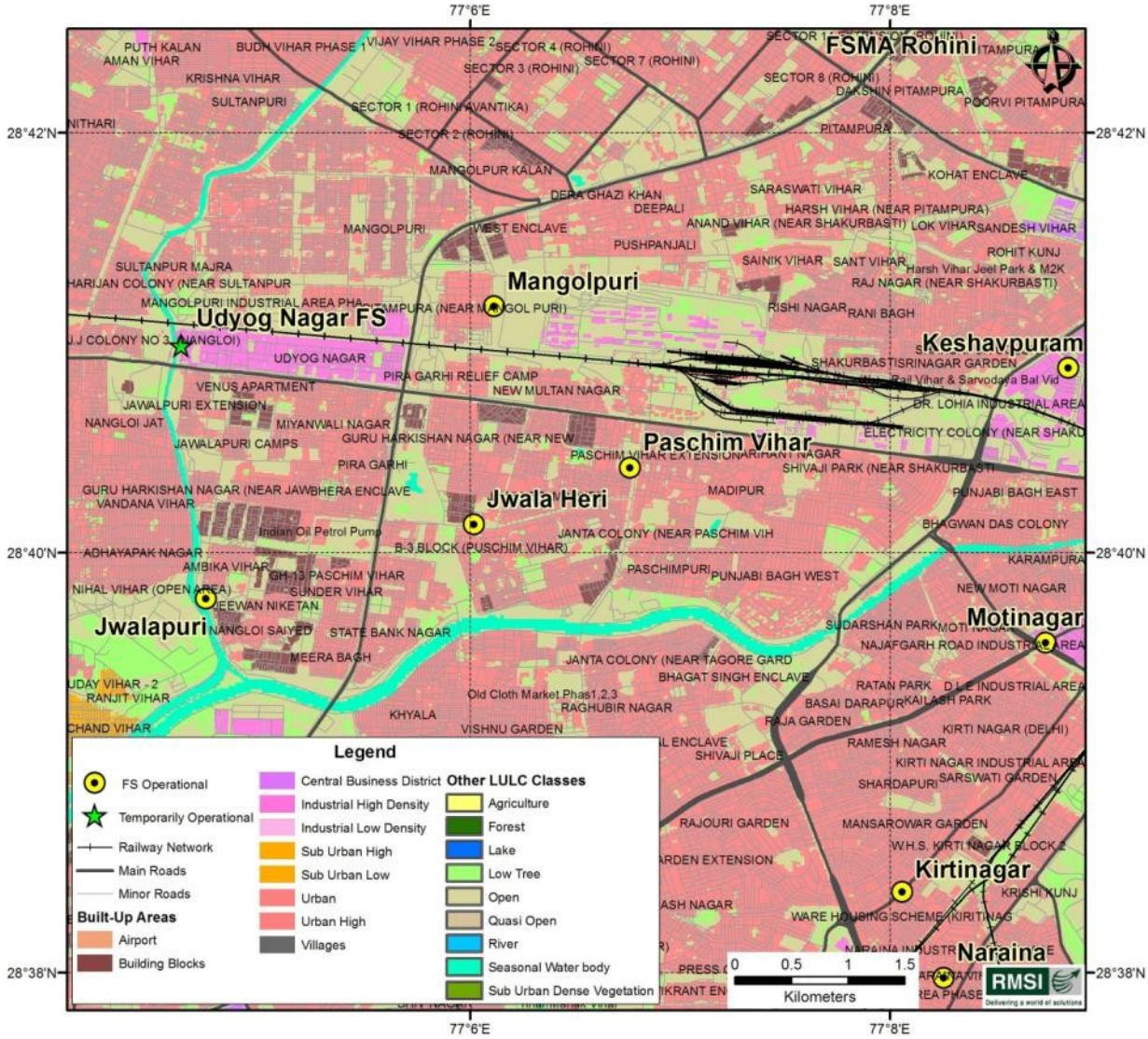


Figure 3-3 : An example of a detailed classified urban agglomerate area. The example shows parts of Delhi with overlay of GPS locations of Fire Stations

Overlay analysis is a common, widely used method of analyzing and evaluating geospatial data. Overlay analysis utilizes map layers in GIS to discover relationships across the layers. Overlay analysis is used to investigate geographic patterns and to determine locations that meet specific criteria. Spatial overlay is illustrated and highlighted in Figure 3-4. Various data layers, such as Land Use Land Cover (LULC), composite hazard, demographic exposure, road network, administrative boundary and Fire Station locations have been used through overlay analysis by combining diverse data sets for hazard analysis and Fire Station gap analysis.

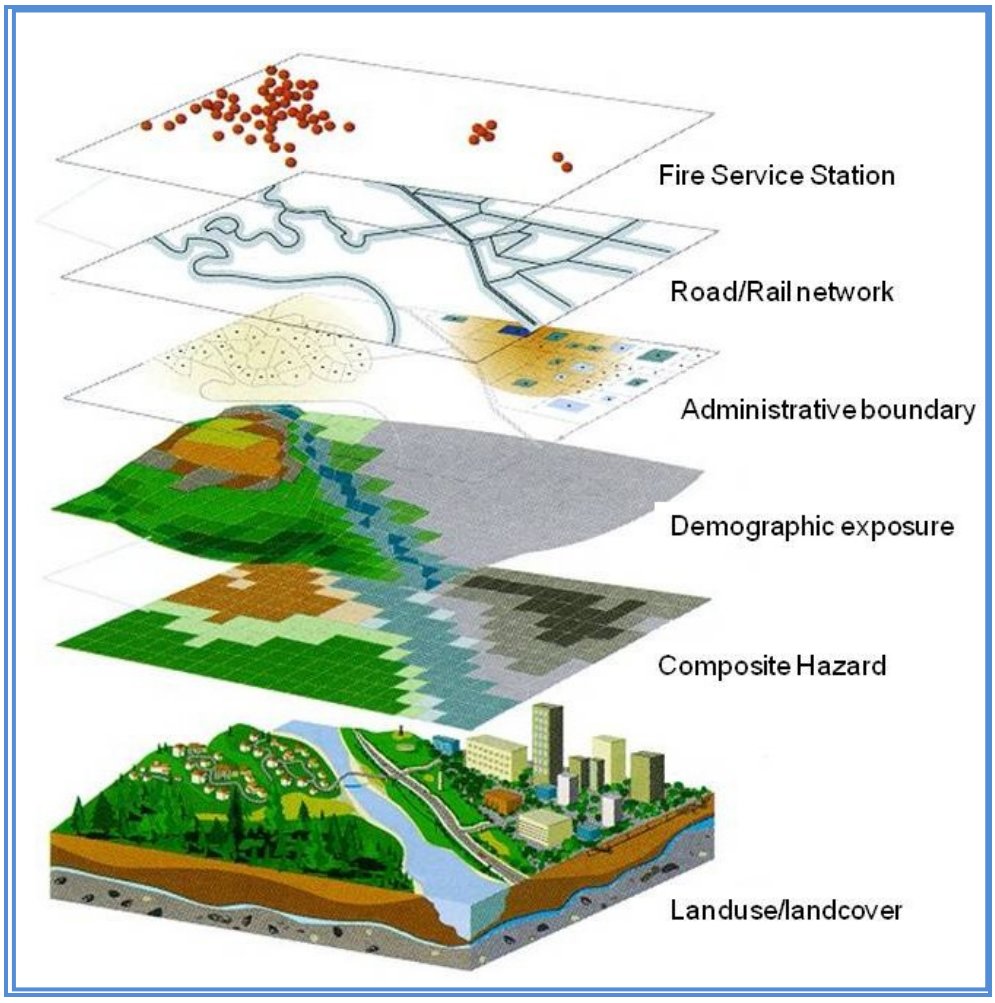


Figure 3-4 : Overlay analysis for Fire Risk Assessment

3.3 Fire Hazard and Risk Analysis

The first-turnout of fire vehicles normally originates from the Fire Station under whose jurisdiction the fire-call has been received. Sometimes, calls go to a centralized control room, from where they are directed to the concerned Fire Station. To provide an effective response, Fire Station infrastructure in the form of fire fighting and rescue vehicles, specialized equipment and manpower should also take into consideration of fire risks in addition to road conditions and population distribution. Thus, hazard and risk analysis of the base unit (district) should be on a scientific basis.

In general, fire risk is defined as the combination of hazard potential, exposure, and vulnerability:

Risk = F (**H**azard potential x **E**xposure x **V**ulnerability)

The occurrence of fire incidents that constitute a threat for the population and the exposed infrastructure of a certain region is associated with economic and human losses, always as a function of the exposure conditions and the vulnerability of the exposed assets in that particular region. In the present scope, fire risk can be defined as associated with the number of small and medium fire incidents and their locations.

3.4 Hazard Ranking

Earthquake (Seismic zones)

Besides loss of life, property damage, building collapses, and loss of basic amenities such as bridge and road damage, earthquakes can also induce small to large fires. Hence, earthquake zoning is an important parameter for fire risk analysis.

Based on occurrence of earthquakes of different intensities, the Seismic Zoning Map of India (IS 1893, 2001; BMTPC, 2006; NBC 2005) divides the country into 4 seismic zones as shown in Figure 3-5. Seismic Zone V is the highest risk zone where earthquakes having intensity of IX+ on Modified Mercalli Intensity (MMI) scale can take place. Earthquakes of intensities between VIII to IX can be experienced in seismic Zone IV, whereas earthquakes can occur between VI and VIII intensity in seismic Zone III.

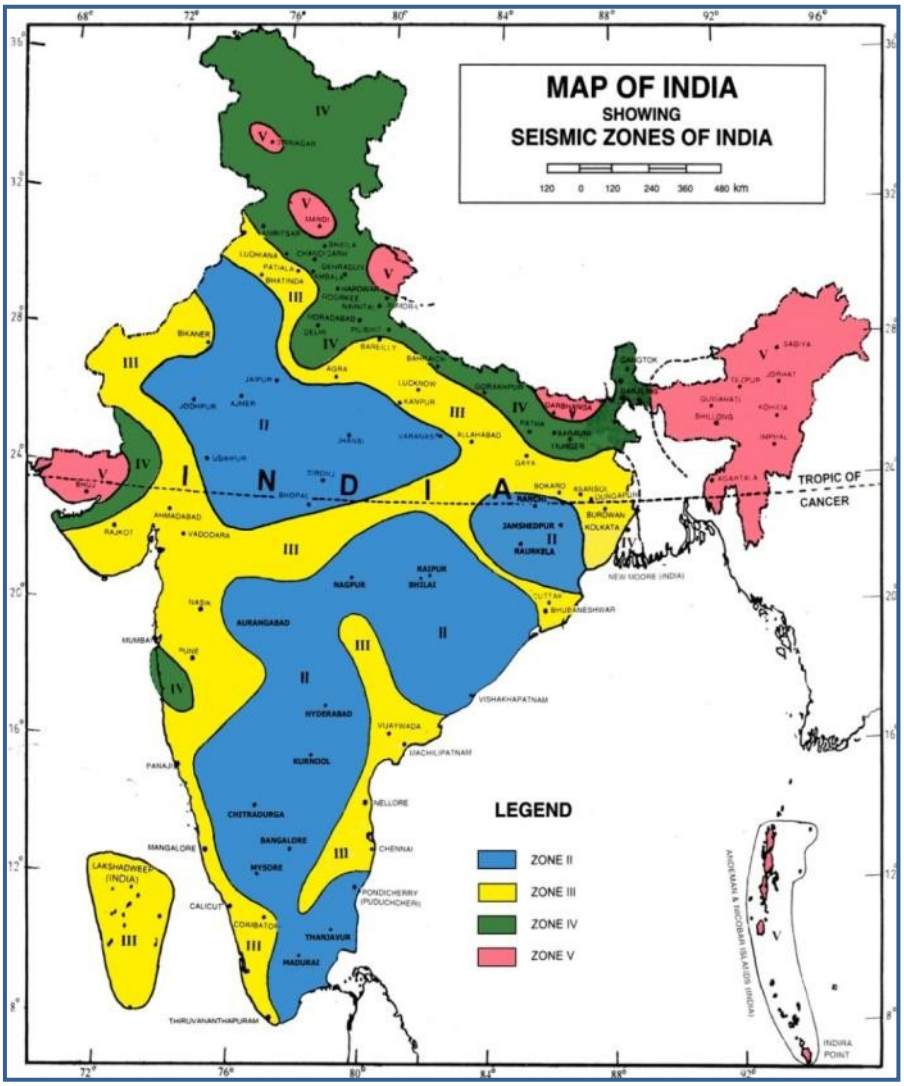


Figure 3-5 : Seismic zones of India

With GIS overlay analysis, district areas falling within each seismic zone have been computed. In order to compare seismic risk among various districts, district level ranking of seismic zones has been assigned, based on the scheme shown in Table 3-2. District level seismic ranking for pilot States/UTs is shown in Table 3-3.

Wind Zones

Prevailing wind speed is one of the important parameters in assessing fire risk in the area. Wind speed has a noticeable influence on fire spread. The wind zone map illustrates the areas vulnerable to high wind speeds (Figure 3-6). There are six basic wind speeds considered for zoning, namely:

- 55m/s (198 km/hr) Very High Damage Risk Zone-A
- 50m/s (180 km/hr) Very High Damage Risk Zone-B
- 47m/s (169.2 km/hr) High Damage Risk Zone
- 44m/s (158.4 km/hr) Moderate Damage Risk Zone-A
- 39m/s (140.4 km/hr) Moderate Damage Risk Zone-B
- 33m/s (118.8 km/hr) Low Damage Risk Zone

The coastal areas are subjected to severe windstorms and cyclonic storms. A full-grown cyclone is 150 to 1,000 km across and 10 to 15 km high. Macro-level wind speed zones of India have been formulated and published in IS 875 (Part-3) – 1987. It is known that in certain events, the wind gusts could appreciably exceed the given basic wind speeds. For assessing vulnerability and fire risk to buildings, above macro-level zonings have been considered. Based on wind speed, risk ranking has been assigned to each wind zone following the schema described in Table 3-2. District wise estimated wind risk from GIS overlay analysis is shown in Table 3-3.

Table 3-2: Risk ranking schema for earthquake, wind and climatic zones

Wind Zone	Ranking
Very High Damage Risk Zone - A (Vb=55m/s)	4
Very High Damage Risk Zone - B (Vb=50m/s)	3.5
High Damage Risk Zone (Vb=47m/s)	3
Moderate damage Risk Zone - A (Vb=44m/s)	2
Moderate damage Risk Zone - B (Vb=39m/s)	1.5
Low Damage Risk Zone (Vb=33m/s)	1
Importance Factors/ Weightage	**20%**

Seismic Zone	Ranking
ZONE V	4
ZONE IV	3
ZONE III	2
ZONE II	1
20%	

Climatic Zones	Ranking
Hot and Dry	3
Composite, Temperate	2
Warm and Humid	1
Cold Climate	1
20%	

Hill Zoning	Ranking
Cold climate	5
Other climates	1
Importance Factors/ Weightage	**40%**

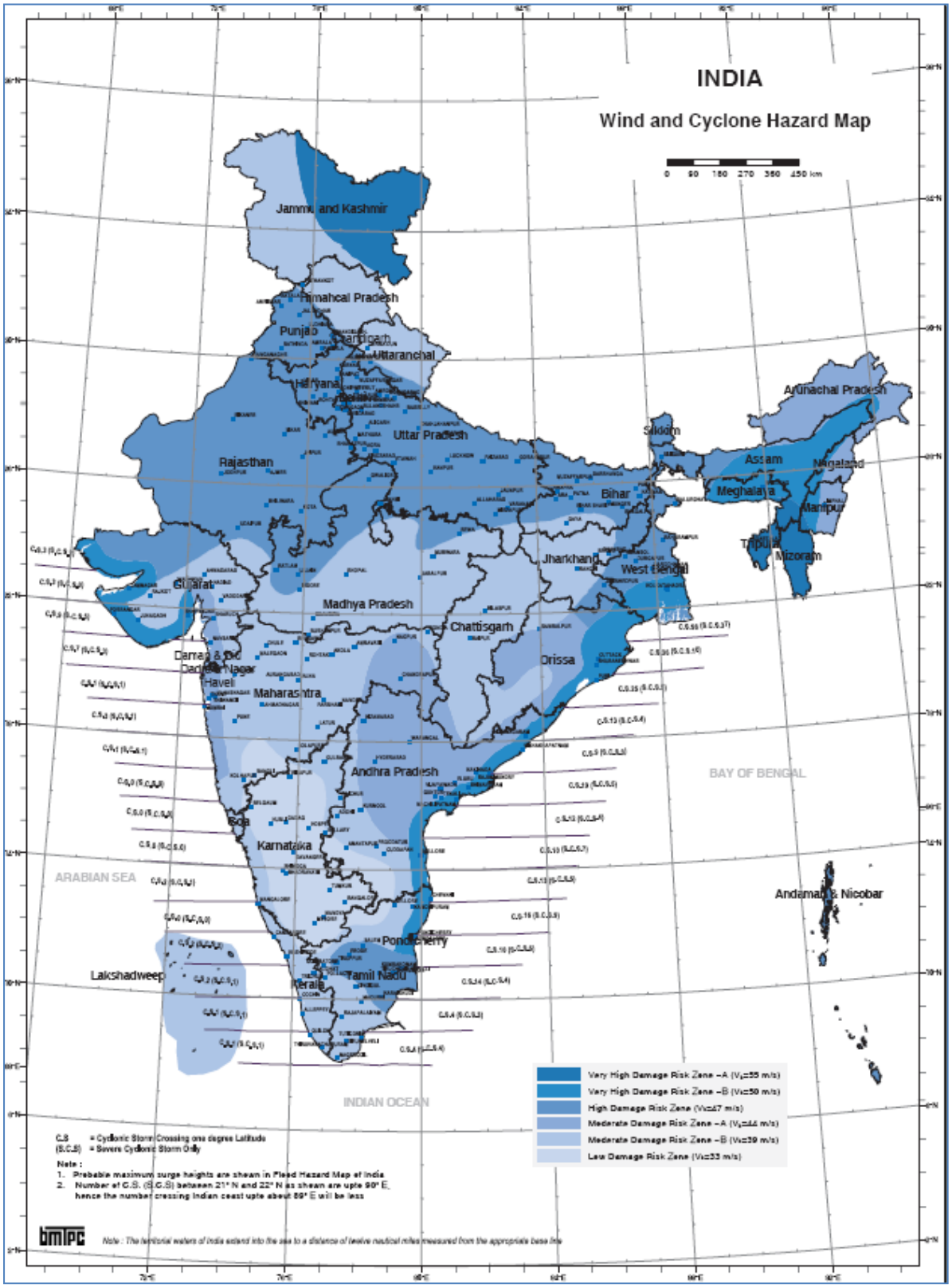


Figure 3-6 : Wind zone map of India (BMTPC, 2006)

Climatic Zones

Regions having similar characteristic features of climate are grouped under one climatic zone. According to a recent code of the Bureau of Indian Standards, the country has been divided into the following five major climatic zones:

- Hot & Dry (mean monthly temperature >30 and relative humidity <55%);
- Warm & Humid (mean monthly temperature >25-30 and relative humidity >55-75%);
- Temperate (mean monthly temperature 25-30 and relative humidity <75%);
- Cold (mean monthly temperature <25 and relative humidity – can be any values);
- Composite (This applies when six months or more do not fall within any of the other categories meaning sharing characteristics of two or more of the above categories in a year).

Map of climatic zones is shown in Figure 3-7. The hot and dry zone lies in the western and the central parts of India; Jaisalmer, Jodhpur and Sholapur are some of the towns that experience this type of climate. In this zone, solar radiation and movement of hot winds are higher. The warm and humid zone covers the coastal parts of the country, such as Mumbai, Chennai and Kolkata. Pune and Bangalore are examples of non-coastal cities that fall the under moderate climatic zone. Generally, the Himalayan region experiences cold type of climate. The composite zone covers the northern Indo-Gangetic plains, such as New Delhi, Kanpur, and Allahabad.

With GIS overlay analysis, district overlap areas falling within each climatic zone have been computed. In order to compare impact of being a district in a climatic zone, district level ranking has been assigned based on the scheme shown in Table 3-2. District level climatic zone ranking for pilot States/ UT is shown in Table 3-3.

Hilly Areas and Building Class Zones

Extreme cold climate, rugged topography and use of flammable material in building construction (such as wood) and the use of heating provisions in houses during cold weather is an important factor for causing fire incidents in that region. To capture such elements in fire risk hazard, Hilly Areas and Building Class Zones have been created. This class is directly linked to the cold climate zone. All hilly districts, (such as all districts of Jammu & Kashmir in the Pilot study) fall under this category. In such districts, a ranking of five has been assigned. Importance of this zone in terms of occurrence of number of fire incidents is quite high. Hence, while integrating, a double weightage of 40% has been assigned to this layer.

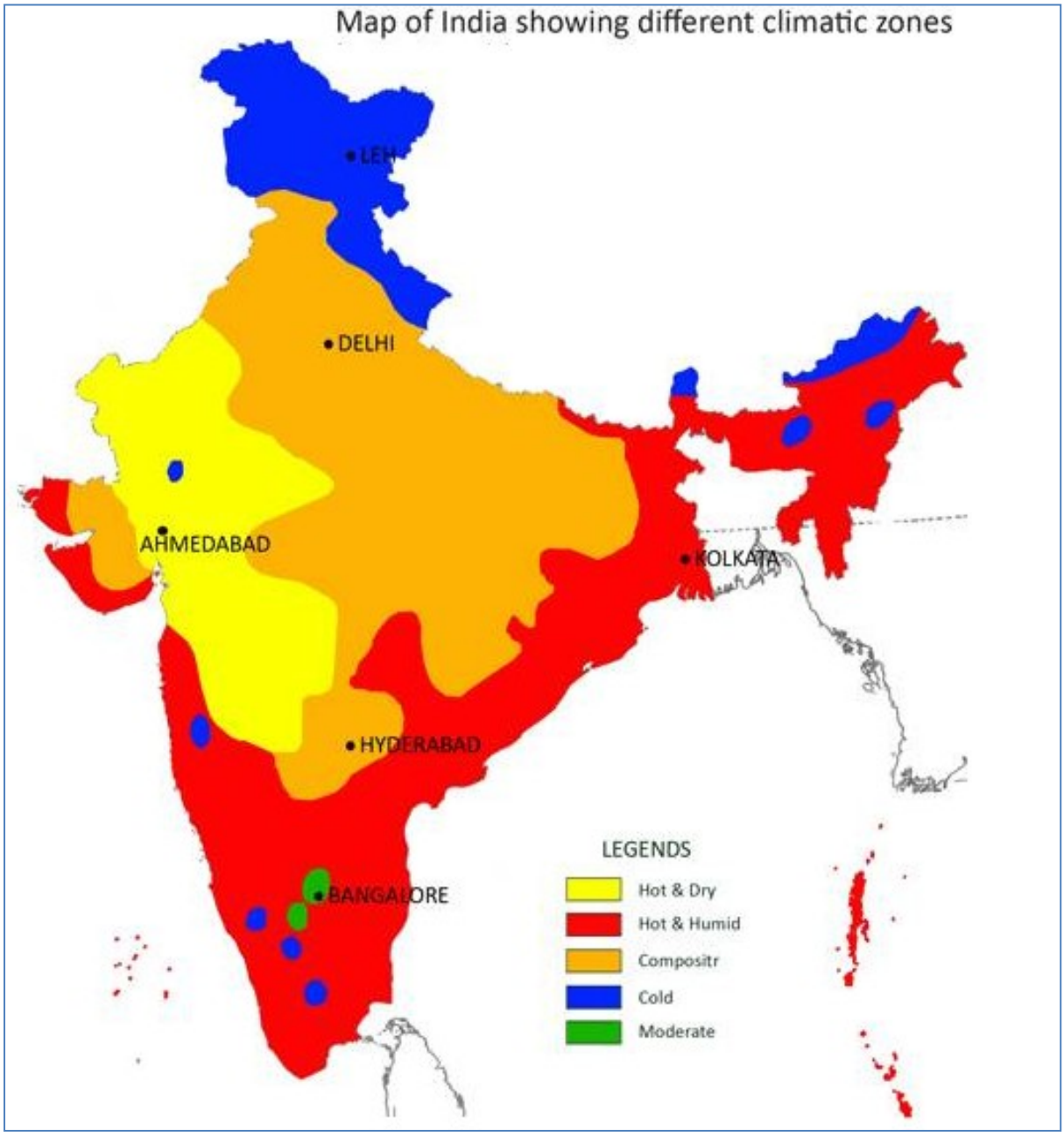


Figure 3-7 : Climatic Zones of India

Table 3-3: District level ranking for individual (earthquake, wind and climatic) hazard and integrated hazards

Importance Factor			20%	20%	20%	40%	Integrated Hazard Zoning
State/UT	District	Geographical Area (Sq km)	Wind Zoning	Seismic Zoning	Climate Zoning	Hill Zoning	
Himachal Pradesh							
	Chamba	6,487	1.5	3.1	1.7	4.5	3.1
	Kangra	5,704	1.5	3.4	2.0	4.0	3.0
	Lahul & Spiti	13,841	1.5	3.0	1.2	5.0	3.1
	Kullu	5,513	1.5	4.0	1.2	5.0	3.3
	Mandi	3,963	1.5	4.0	1.7	4.5	3.2
	Hamirpur	1,123	2.7	1.6	2.0	4.0	2.8
	Una	1,541	2.4	3.0	2.0	4.0	3.1
	Bilaspur	1,167	1.7	3.3	2.0	4.0	3.0
	Solan	1,937	2.0	3.1	2.0	4.0	3.0
	Sirmaur	2,837	1.9	3.0	2.0	4.0	3.0
	Shimla	5,171	1.5	3.6	1.4	5.0	3.3
	Kinnaur	6,495	1.5	3.2	1.0	5.0	3.1
Punjab							
	Gurdaspur	3,600	2.6	3.0	2.0	1.0	1.9
	Kapurthala	1,661	3.0	2.9	2.0	1.0	2.0
	Jalandhar	2,601	3.0	2.9	2.0	1.0	2.0
	Hoshiarpur	3,366	2.9	3.0	2.0	1.0	2.0
	Shahid Bhagat Singh Nagar	1,276	3.0	3.0	2.0	1.0	2.0
	Fatehgarh Sahib	1,145	3.0	3.0	2.0	1.0	2.0
	Ludhiana	3,703	3.0	2.5	2.0	1.0	1.9
	Moga	2,238	3.0	2.0	2.0	1.0	1.8
	Firozpur	5,255	3.0	1.7	2.0	1.0	1.7
	Muktsar	2,633	3.0	1.8	2.0	1.0	1.8
	Faridkot	1,465	3.0	2.0	2.0	1.0	1.8
	Bathinda	3,366	3.0	2.0	2.0	1.0	1.8
	Mansa	2,209	3.0	1.8	2.0	1.0	1.8
	Patiala	3,368	3.0	2.3	2.0	1.0	1.9
	Amritsar	2,648	3.0	2.9	2.0	1.0	2.0
	Tarn Taran	2,404	3.0	2.3	2.0	1.0	1.9
	Rupnagar	1,370	3.0	3.0	2.0	1.0	2.0
	SAS Nagar	1,067	3.0	3.0	2.0	1.0	2.0
	Sangrur	3,583	3.0	2.0	2.0	1.0	1.8
	Barnala	1,404	3.0	2.0	2.0	1.0	1.8
Chandigarh							
	Chandigarh	120	3.0	3.0	2.0	1.0	2.0
Uttarakhand							
	Uttarkashi	7,971	1.5	3.0	1.2	5.0	3.1

Importance Factor			20%	20%	20%	40%	Integrated Hazard Zoning
State/UT	District	Geographical Area (Sq km)	Wind Zoning	Seismic Zoning	Climate Zoning	Hill Zoning	
	Chamoli	7,901	1.5	3.6	1.0	5.0	3.2
	Rudra Prayag	1,942	1.5	3.0	1.1	5.0	3.1
	Tehri Garhwal	3,929	1.5	3.0	1.8	4.5	3.1
	Dehradun	3,097	1.5	3.0	2.0	4.0	2.9
	Garhwal	5,301	1.9	3.0	2.0	4.0	3.0
	Pithoragarh	7,263	1.5	4.0	1.0	5.0	3.3
	Bageshwar	2,283	1.5	4.0	1.0	5.0	3.3
	Almora	3,127	1.5	3.0	1.4	5.0	3.2
	Champawat	1,765	1.8	3.0	1.5	5.0	3.3
	Nainital	4,049	2.7	3.0	2.0	4.0	3.1
	Udham Singh Nagar	2,559	3.0	3.0	2.0	4.0	3.2
	Haridwar	2,305	1.8	3.0	2.0	4.0	3.0
Haryana							
	Panchkula	915	3.0	3.0	2.0	1.0	2.0
	Ambala	1,458	3.0	2.8	2.0	1.0	2.0
	Yamuna Nagar	1,722	3.0	2.8	2.0	1.0	2.0
	Kurukshetra	1,666	3.0	2.0	2.0	1.0	1.8
	Kaithal	2,285	3.0	2.0	2.0	1.0	1.8
	Karnal	2,489	3.0	2.0	2.0	1.0	1.8
	Panipat	1,260	3.0	2.0	2.0	1.0	1.8
	Sonipat	2,179	3.0	2.0	2.0	1.0	1.8
	Jind	2,763	3.0	2.0	2.0	1.0	1.8
	Fatehabad	2,490	3.0	1.4	2.0	1.0	1.7
	Sirsa	4,254	3.0	1.0	2.0	1.0	1.6
	Hisar	4,092	1.7	1.2	2.0	1.0	1.4
	Bhiwani	4,631	2.1	1.0	2.0	1.0	1.4
	Rohtak	1,673	3.0	1.8	2.0	1.0	1.8
	Jhajjar	1,908	1.7	2.0	2.0	1.0	1.5
	Mahendragarh	1,939	3.0	1.1	2.0	1.0	1.6
	Rewari	1,528	3.0	2.0	2.0	1.0	1.8
	Gurgaon	1,241	3.0	2.7	2.0	1.0	1.9
	Mewat	1,475	3.0	3.0	2.0	1.0	2.0
	Faridabad	744	3.0	3.0	2.0	1.0	2.0
	Palwal	1,411	3.0	3.0	2.0	1.0	2.0
Uttar Pradesh							
	Saharanpur	3,742	2.9	2.7	2.0	1.0	1.9
	Muzaffarnagar	4,077	3.0	2.4	2.0	1.0	1.9
	Bijnor	4,389	3.0	3.0	2.0	1.0	2.0
	Moradabad	3,615	3.0	3.0	2.0	1.0	2.0
	Rampur	2,668	3.0	3.0	2.0	1.0	2.0

Importance Factor			20%	20%	20%	40%	Integrated Hazard Zoning
State/UT	District	Geographical Area (Sq km)	Wind Zoning	Seismic Zoning	Climate Zoning	Hill Zoning	
	Jyotiba Phule Nagar	2,283	3.0	3.0	2.0	1.0	2.0
	Meerut	2,620	3.0	3.0	2.0	1.0	2.0
	Baghpat	1,347	3.0	2.4	2.0	1.0	1.9
	Ghaziabad	2,014	3.0	3.0	2.0	1.0	2.0
	Gautam Buddha Nagar	1,425	3.0	3.0	2.0	1.0	2.0
	Bulandshahr	3,523	3.0	3.0	2.0	1.0	2.0
	Aligarh	3,746	3.0	3.0	2.0	1.0	2.0
	Mahamaya Nagar	1,771	3.0	2.8	2.0	1.0	2.0
	Mathura	3,359	3.0	3.0	2.0	1.0	2.0
	Agra	4,032	3.0	2.0	2.0	1.0	1.8
	Firozabad	2,411	3.0	2.0	2.0	1.0	1.8
	Mainpuri	2,708	3.0	2.0	2.0	1.0	1.8
	Budaun	5,094	3.0	2.6	2.0	1.0	1.9
	Bareilly	3,834	3.0	3.0	2.0	1.0	2.0
	Pilibhit	3,621	3.0	2.9	2.0	1.0	2.0
	Shahjahanpur	4,675	3.0	2.1	2.0	1.0	1.8
	Kheri	7,756	3.0	2.5	2.0	1.0	1.9
	Sitapur	5,822	3.0	2.0	2.0	1.0	1.8
	Hardoi	6,041	3.0	2.0	2.0	1.0	1.8
	Unnao	4,628	3.0	2.0	2.0	1.0	1.8
	Lucknow	2,558	3.0	2.0	2.0	1.0	1.8
	Rae Bareli	4,655	3.0	1.9	2.0	1.0	1.8
	Farrukhabad	2,191	3.0	2.0	2.0	1.0	1.8
	Kannauj	2,086	3.0	2.0	2.0	1.0	1.8
	Etawah	2,332	3.0	1.3	2.0	1.0	1.7
	Auraiya	2,015	3.0	1.2	2.0	1.0	1.6
	Kanpur Dehat	3,207	3.0	1.1	2.0	1.0	1.6
	Kanpur Nagar	2,915	3.0	1.3	2.0	1.0	1.7
	Jalaun	4,590	3.0	1.0	2.0	1.0	1.6
	Jhansi	5,120	3.0	1.0	2.0	1.0	1.6
	Lalitpur	5,066	1.8	1.0	2.0	1.0	1.4
	Hamirpur	4,283	2.7	1.6	2.0	4.0	2.8
	Mahoba	2,933	3.0	1.0	2.0	1.0	1.6
	Banda	4,584	3.0	1.0	2.0	1.0	1.6
	Chitrakoot	3,136	3.0	1.0	2.0	1.0	1.6
	Fatehpur	4,207	3.0	1.0	2.0	1.0	1.6
	Pratapgarh	3,753	3.0	1.8	2.0	1.0	1.8
	Kaushambi	1,838	3.0	1.0	2.0	1.0	1.6
	Allahabad	5,507	3.0	1.0	2.0	1.0	1.6
	Barabanki	3,891	3.0	2.0	2.0	1.0	1.8

Importance Factor			20%	20%	20%	40%	Integrated Hazard Zoning
State/UT	District	Geographical Area (Sq km)	Wind Zoning	Seismic Zoning	Climate Zoning	Hill Zoning	
	Faizabad	2,701	3.0	2.0	2.0	1.0	1.8
	Ambedkar Nagar	2,368	3.0	2.0	2.0	1.0	1.8
	Sultanpur	4,468	3.0	2.0	2.0	1.0	1.8
	Bahraich	4,370	3.0	2.6	2.0	1.0	1.9
	Shrawasti	2,531	3.0	2.9	2.0	1.0	2.0
	Balrampur	3,365	3.0	3.0	2.0	1.0	2.0
	Gonda	4,081	3.0	2.1	2.0	1.0	1.8
	Siddharthnagar	2,871	3.0	3.0	2.0	1.0	2.0
	Basti	2,774	3.0	2.2	2.0	1.0	1.8
	Sant Kabir Nagar	1,771	3.0	2.4	2.0	1.0	1.9
	Maharajganj	2,947	3.0	3.0	2.0	1.0	2.0
	Gorakhpur	3,417	3.0	2.4	2.0	1.0	1.9
	Kushinagar	2,939	3.0	3.0	2.0	1.0	2.0
	Deoria	2,604	3.0	2.3	2.0	1.0	1.9
	Azamgarh	4,449	3.0	2.0	2.0	1.0	1.8
	Mau	1,589	3.0	2.0	2.0	1.0	1.8
	Ballia	3,064	3.0	2.0	2.0	1.0	1.8
	Jaunpur	4,086	3.0	2.0	2.0	1.0	1.8
	Ghazipur	3,440	3.0	2.0	2.0	1.0	1.8
	Chandauli	2,574	2.8	2.0	2.0	1.0	1.8
	Varanasi	1,569	3.0	2.0	2.0	1.0	1.8
	Sant Ravidas Nagar	1,021	3.0	1.0	2.0	1.0	1.6
	Mirzapur	4,596	2.9	1.2	2.0	1.0	1.6
	Sonbhadra	6,897	1.6	1.9	2.0	1.0	1.5
	Etah	2,468	3.0	2.0	2.0	1.0	1.8
	Kanshiram Nagar	2,023	3.0	2.2	2.0	1.0	1.8

3.5 Exposure Vulnerability Ranking

For estimating exposure and its vulnerability, detailed urban agglomerate classification maps generated from high-resolution satellite images have been used. With the help of remote sensing techniques applied on high-resolution satellite imageries, 10 types of urban agglomeration areas have been delineated (Figures 3-1 and 3-2). For major city areas, even more detailed urban agglomerate classification has been created with high-resolution data layers as shown in Figure 3-3. These include urban, semi-urban, building blocks, industrial and rural villages' built-up areas. District level census 2011 population has been distributed to each population agglomeration cluster. For exposure vulnerability, 4 different layers viz. population density, residential built-up areas, high-rise building block density, and industrial areas have been developed individually at district level. Table 3-4 shows district level geographical area, population, population density, residential built-up area, industrial area, and residential built-up area in percentage.

Table 3-4: District level geographical area, population, population density, residential built-up area, residential built-up area in percentage, and industrial area

District	Geographical Area (sq km)	Population 2011	Population Density	Residential Built-Up area (sq km)	Industrial Area (sq km)	Residential Built-Up area (in percentage)
Himachal Pradesh						
Chamba	6,487	518,844	79.98	7.09	0.47	0.11%
Kangra	5,704	1,507,223	264.23	44.84	0.32	0.79%
Lahul & Spiti	13,841	31,528	2.28	0.33	-	0.00%
Kullu	5,513	437,474	79.36	10.39	-	0.19%
Mandi	3,963	999,518	252.21	13.85	0.05	0.35%
Hamirpur	1,123	454,293	404.55	17.12	-	1.52%
Una	1,541	521,057	338.09	39.42	0.60	2.56%
Bilaspur	1,167	382,056	327.42	6.28	0.22	0.54%
Solan	1,937	576,670	297.64	20.18	5.17	1.04%
Sirmaur	2,837	530,164	186.90	10.06	0.92	0.35%
Shimla	5,171	813,384	157.31	13.72	0.17	0.27%
Kinnaur	6,495	84,298	12.98	2.25	-	0.03%
Punjab						
Gurdaspur	3,600	2,299,026	638.59	51.39	0.19	1.43%
Kapurthala	1,661	817,668	492.39	17.90	0.20	1.08%
Jalandhar	2,601	2,181,753	838.81	45.56	0.28	1.75%
Hoshiarpur	3,366	1,582,793	470.20	39.29	0.11	1.17%
Shahid Bhagat Singh Nagar	1,276	614,362	481.29	15.79	0.07	1.24%
Fatehgarh Sahib	1,145	599,814	523.95	13.91	0.10	1.22%
Ludhiana	3,703	3,487,882	941.96	72.75	1.26	1.96%
Moga	2,238	992,289	443.39	23.90	0.25	1.07%
Firozpur	5,255	2,026,831	385.69	48.47	0.30	0.92%
Muktsar	2,633	902,702	342.79	22.40	0.23	0.85%
Faridkot	1,465	618,008	421.89	15.82	0.12	1.08%
Bathinda	3,366	1,388,859	412.61	31.41	0.42	0.93%
Mansa	2,209	768,808	348.04	18.68	0.18	0.85%
Patiala	3,368	1,892,282	561.86	42.68	0.34	1.27%
Amritsar	2,648	2,490,891	940.79	51.76	0.52	1.96%
Tarn Taran	2,404	1,120,070	465.87	23.90	0.09	0.99%
Rupnagar	1,370	683,349	498.79	16.92	0.16	1.23%
SAS Nagar	1,067	986,147	924.04	20.51	0.37	1.92%
Sangrur	3,583	1,654,408	461.75	39.96	0.52	1.12%
Barnala	1,404	596,294	424.68	14.37	0.10	1.02%
Chandigarh						
Chandigarh	120	1,054,686	8,811.64	18.91	0.13	15.80%
Uttarakhand						

District	Geographical Area (sq km)	Population 2011	Population Density	Residential Built-Up area (sq km)	Industrial Area (sq km)	Residential Built-Up area (in percentage)
Uttarkashi	7,971	329,686	41.36	16.14	0.04	0.20%
Chamoli	7,901	391,114	49.50	15.78	0.03	0.20%
Rudra Prayag	1,942	236,857	121.95	8.40	-	0.43%
Tehri Garhwal	3,929	616,409	156.90	24.35	0.19	0.62%
Dehradun	3,097	1,698,560	548.54	99.30	1.71	3.21%
Garhwal	5,301	686,527	129.51	45.23	0.30	0.85%
Pithoragarh	7,263	485,993	66.91	17.25	-	0.24%
Bageshwar	2,283	259,840	113.79	14.68	-	0.64%
Almora	3,127	621,927	198.92	36.30	-	1.16%
Champawat	1,765	259,315	146.91	9.83	-	0.56%
Nainital	4,049	955,128	235.86	47.12	1.30	1.16%
Udham Singh Nagar	2,559	1,648,367	644.24	68.25	10.35	2.67%
Haridwar	2,305	1,927,029	836.06	67.04	8.78	2.91%
Haryana						
Panchkula	915	558,890	611.01	14.31	0.11	1.56%
Ambala	1,458	1,136,784	779.43	22.78	0.17	1.56%
Yamuna Nagar	1,722	1,214,162	704.94	24.69	0.29	1.43%
Kurukshetra	1,666	964,231	578.94	20.92	0.26	1.26%
Kaithal	2,285	1,072,861	469.59	25.16	0.28	1.10%
Karnal	2,489	1,506,323	605.22	26.99	0.51	1.08%
Panipat	1,260	1,202,811	954.34	21.71	0.81	1.72%
Sonipat	2,179	1,480,080	679.17	29.48	0.53	1.35%
Jind	2,763	1,332,042	482.10	29.57	0.22	1.07%
Fatehabad	2,490	941,522	378.12	23.66	0.20	0.95%
Sirsa	4,254	1,295,114	304.41	34.36	0.14	0.81%
Hisar	4,092	1,742,815	425.87	38.19	0.37	0.93%
Bhiwani	4,631	1,629,109	351.78	39.61	0.21	0.86%
Rohtak	1,673	1,058,683	632.97	21.17	0.18	1.27%
Jhajjar	1,908	956,907	501.60	20.07	0.38	1.05%
Mahendragarh	1,939	921,680	475.40	18.42	0.01	0.95%
Rewari	1,528	896,129	586.47	18.43	0.30	1.21%
Gurgaon	1,241	1,514,085	1,220.36	34.70	0.76	2.80%
Mewat	1,475	1,089,406	738.81	19.54	0.06	1.33%
Faridabad	744	1,798,954	2,416.42	34.17	0.69	4.59%
Palwal	1,411	1,040,493	737.54	21.43	0.13	1.52%
Uttar Pradesh						
Saharanpur	3,742	3,464,228	925.80	124.00	3.56	3.31%
Muzaffarnagar	4,077	4,138,605	1,015.13	160.87	4.67	3.95%
Bijnor	4,389	3,683,896	839.26	0.08	-	0.00%
Moradabad	3,615	4,773,138	1,320.41	166.79	3.90	4.61%

District	Geographical Area (sq km)	Population 2011	Population Density	Residential Built-Up area (sq km)	Industrial Area (sq km)	Residential Built-Up area (in percentage)
Rampur	2,668	2,335,398	875.18	88.77	1.81	3.33%
Jyotiba Phule Nagar	2,283	1,838,771	805.55	76.85	2.62	3.37%
Meerut	2,620	3,447,405	1,315.85	150.65	5.32	5.75%
Baghpat	1,347	1,302,156	966.69	62.08	1.06	4.61%
Ghaziabad	2,014	4,661,452	2,315.02	152.24	18.76	7.56%
Gautam Buddha Nagar	1,425	1,674,714	1,175.40	91.01	12.99	6.39%
Bulandshahr	3,523	3,498,507	993.10	138.03	4.31	3.92%
Aligarh	3,746	3,673,849	980.64	143.53	1.19	3.83%
Mahamaya Nagar	1,771	1,565,678	884.02	53.26	0.38	3.01%
Mathura	3,359	2,541,894	756.74	106.36	5.16	3.17%
Agra	4,032	4,380,793	1,086.59	153.44	6.51	3.81%
Firozabad	2,411	2,496,761	1,035.77	80.81	2.15	3.35%
Mainpuri	2,708	1,847,194	682.17	76.11	1.31	2.81%
Budaun	5,094	3,712,738	728.86	143.30	2.22	2.81%
Bareilly	3,834	4,465,344	1,164.65	142.46	3.62	3.72%
Pilibhit	3,621	2,037,225	562.62	61.94	0.99	1.71%
Shahjahanpur	4,675	3,002,376	642.28	99.89	2.61	2.14%
Kheri	7,756	4,013,634	517.48	151.76	3.52	1.96%
Sitapur	5,822	4,474,446	768.55	175.29	0.93	3.01%
Hardoi	6,041	4,091,380	677.23	135.06	1.58	2.24%
Unnao	4,628	3,110,595	672.14	151.74	2.50	3.28%
Lucknow	2,558	4,588,455	1,793.61	196.29	4.14	7.67%
Rae Bareli	4,655	3,404,004	731.33	176.39	2.54	3.79%
Farrukhabad	2,191	1,887,577	861.67	54.16	2.05	2.47%
Kannauj	2,086	1,658,005	794.95	56.12	0.36	2.69%
Etawah	2,332	1,579,160	677.22	64.69	1.88	2.77%
Auraiya	2,015	1,372,287	681.17	60.93	2.61	3.02%
Kanpur Dehat	3,207	1,795,092	559.82	80.62	1.71	2.51%
Kanpur Nagar	2,915	4,572,951	1,568.62	175.63	14.47	6.02%
Jalaun	4,590	1,670,718	364.01	79.06	1.05	1.72%
Jhansi	5,120	2,000,755	390.78	90.77	3.00	1.77%
Lalitpur	5,066	1,218,002	240.44	47.52	0.76	0.94%
Hamirpur	4,283	1,104,021	257.76	17.12	-	0.40%
Mahoba	2,933	876,055	298.70	45.23	0.08	1.54%
Banda	4,584	1,799,541	392.57	90.90	5.47	1.98%
Chitrakoot	3,136	990,626	315.87	48.12	0.26	1.53%
Fatehpur	4,207	2,632,684	625.73	121.43	0.65	2.89%
Pratapgarh	3,753	3,173,752	845.76	145.95	0.55	3.89%
Kaushambi	1,838	1,596,909	868.91	71.84	0.27	3.91%
Allahabad	5,507	5,959,798	1,082.27	238.62	4.37	4.33%

District	Geographical Area (sq km)	Population 2011	Population Density	Residential Built-Up area (sq km)	Industrial Area (sq km)	Residential Built-Up area (in percentage)
Barabanki	3,891	3,257,983	837.32	119.86	1.10	3.08%
Faizabad	2,701	2,468,371	913.75	75.17	0.59	2.78%
Ambedkar Nagar	2,368	2,398,709	1,012.83	90.75	0.42	3.83%
Sultanpur	4,468	3,790,922	848.48	177.28	2.41	3.97%
Bahraich	4,370	3,478,257	795.98	106.27	0.65	2.43%
Shrawasti	2,531	1,114,615	440.40	73.97	0.00	2.92%
Balrampur	3,365	2,149,066	638.75	76.23	0.01	2.27%
Gonda	4,081	3,431,386	840.88	111.35	0.48	2.73%
Siddharthnagar	2,871	2,553,526	889.39	106.60	0.04	3.71%
Basti	2,774	2,461,056	887.18	67.22	0.50	2.42%
Sant Kabir Nagar	1,771	1,714,300	968.10	59.66	0.21	3.37%
Maharajganj	2,947	2,665,292	904.31	111.24	2.22	3.77%
Gorakhpur	3,417	4,436,275	1,298.43	188.75	2.33	5.52%
Kushinagar	2,939	3,560,830	1,211.56	94.39	0.12	3.21%
Deoria	2,604	3,098,637	1,189.76	97.62	0.42	3.75%
Azamgarh	4,449	4,616,509	1,037.73	196.28	0.70	4.41%
Mau	1,589	2,205,170	1,387.93	74.09	0.39	4.66%
Ballia	3,064	3,223,642	1,052.05	126.29	0.06	4.12%
Jaunpur	4,086	4,476,072	1,095.47	193.42	1.36	4.73%
Ghazipur	3,440	3,622,727	1,052.97	157.16	0.18	4.57%
Chandauli	2,574	1,952,713	758.75	73.33	0.74	2.85%
Varanasi	1,569	3,682,194	2,347.36	139.57	2.85	8.90%
Sant Ravidas Nagar	1,021	1,554,203	1,521.79	56.13	0.58	5.50%
Mirzapur	4,596	2,494,533	542.80	72.09	0.88	1.57%
Sonbhadra	6,897	1,862,612	270.07	68.32	5.58	0.99%
Etah	2,468	1,761,152	713.60	70.84	1.48	2.87%
Kanshiram Nagar	2,023	1,438,156	711.05	54.02	0.50	2.67%

In order to assess the impact of each exposure vulnerability type, a vulnerability score/ ranking has been assigned to each layer at its base unit. The vulnerability score represents the level of vulnerability (very high to negligible) of a specific type of exposure in response to the occurrences of small and medium fire incidents. Base unit for vulnerability ranking is the district boundary. The natural break in value distribution has been considered for defining the ranking class.

Based on Census 2011 population, district-level population densities have been computed and grouped into five ranges based on the schema shown in Table 3-5. A ranking of 5 has been assigned to highly dense districts, having populations greater than 10,000 per sq km, and 1 to sparsely populated districts having less than 200 people per sq km area.

Table 3-5: Grouping schema for ranking of exposure and vulnerability layers

Population density	Ranking
>10,000	5
1,000 to 10,000	4
500 to 1,000	3
200 to 500	2
<200	1
Residential Built-up area sq km	**Ranking**
>190	5
100 to 190	4
50 to 100	3
20 to 50	2
<20	1

Built-up area %	Ranking
>35 %	5
14% to 35 %	4
2% to 14 %	3
1% to 2 %	2
<1 %	1
Industrial area sq km	**Ranking**
>10	5
5 to 10	4
2 to 5	3
1 to 2	2
< 1	1

As described earlier, various types of residential built-up areas have been delineated using high-resolution images. For assessing fire risk, both absolute built-up areas in sq km as well as built-up areas percent (ratio of built-up areas to the total area) are important parameters. Figure 3-8 illustrates an example of district level ranking of residential built-up area percent and corresponding residential built up area in absolute terms (i.e. area in sq.km.). An example of this is shown in Figure 3-8 for Maharashtra. It can be seen that Pune district has the highest residential built-up area, while in terms of residential built-up area in percentage, Pune district comes at fifth rank (Figure 3-8).

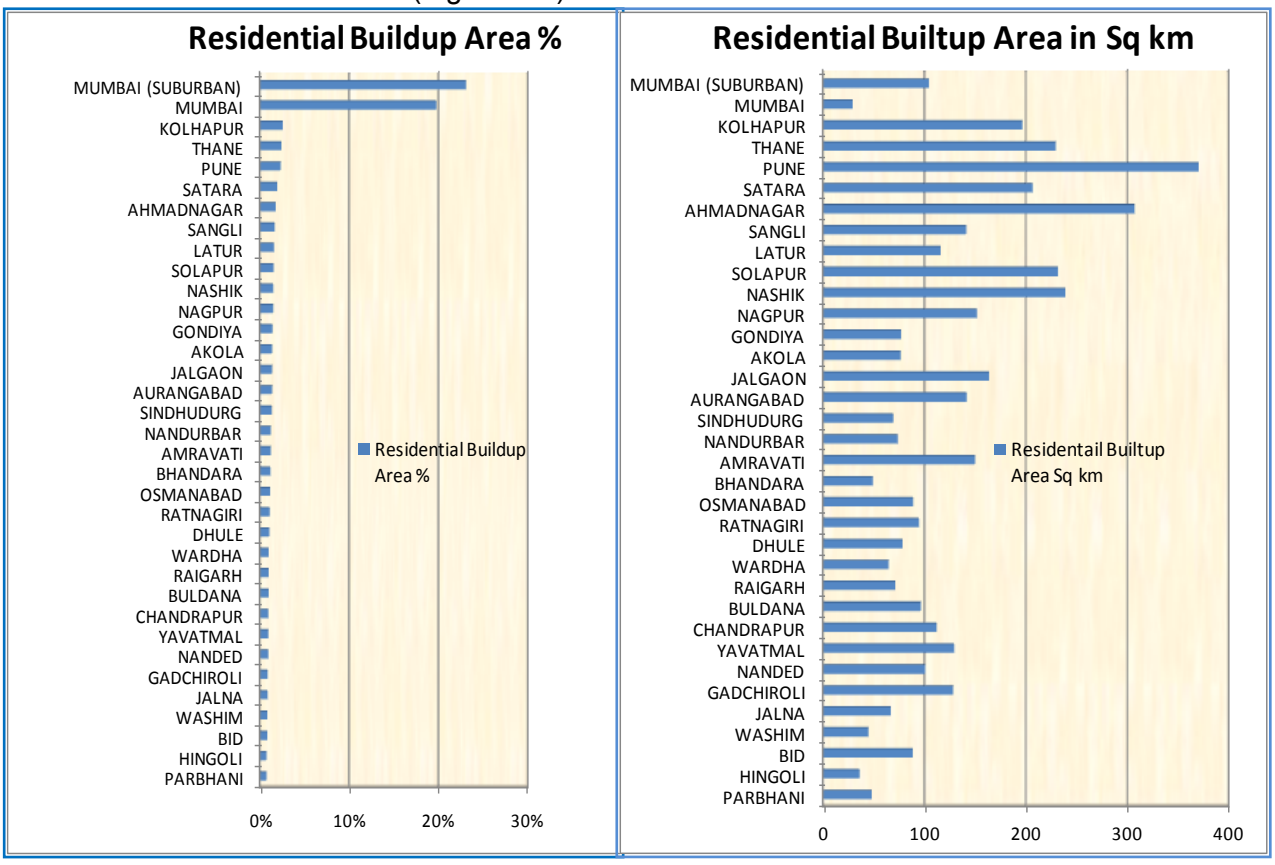


Figure 3-8 : Example of comparison of district level rankings for residential built-up area percentages and absolute areas (in sq km). The example shows a comparison for all 35 districts of Maharashtra State

District level values of residential built-up area in percent and in absolute terms (i.e. area in sq km.) have been grouped separately into five classes and assigned a ranking score of 1- 5 based on the schema shown in Table 3-5. Districts having > 35% residential built-up have been assigned 5th ranking, while districts having <1 % built-up area as whole have been assigned a rank of 1. Similarly, 5 ranking has been assigned to district wise residential built-up areas in sq km based on schema shown in Table 3-5. This schema has been prepared based on natural breaks of value distribution considering all 106 districts of the pilot study area. Because of its appropriateness, the schema has been used for ranking all the districts in the remaining 29 States/UTs also.

It is obvious that industrial areas in districts have much lower percentages than residential built-up areas. However, presence of industrial areas in a district has a significant influence in assessing fire risk. Hence, industrial areas in absolute terms (sq km) have been considered in risk ranking. In a similar fashion, district wise industrial areas have been grouped into five classes and vulnerability ranking has been assigned based on the schema described in Table 3-5. Districts having more than 10 sq km industrial plot area are ranked at 5, while districts having industrial area of less than 1 sq km are ranked at 1 (Table 3-5).

An example of district level total residential built-up areas in sq km and industrial areas for all 35 districts of Maharashtra have been plotted for direct comparison in Figure 3-9. Industrial as well residential built-up area is the highest in Pune district. In contrast, Ahmadnagar, has second ranking in terms of residential built-up area, but in terms of industrial area, Thane district holds second ranking (Figure 3-9).

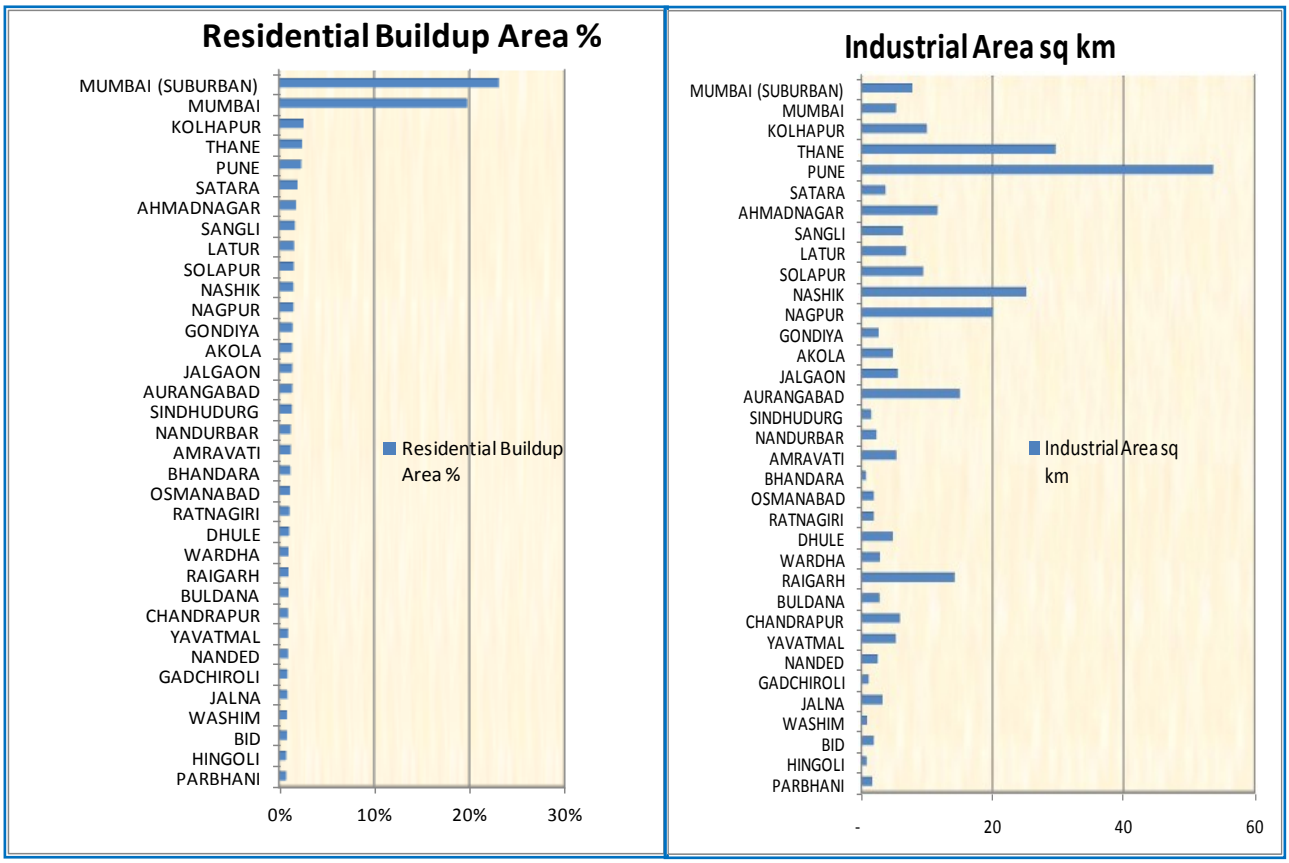


Figure 3-9 : Example of comparison of district level rankings for residential built-up areas and industrial areas (in sq km). The example shows a comparison for all 35 districts of Maharashtra State

Integrated Risk Analysis

After developing ranking of individual units in terms of hazard and exposure vulnerability, GIS layers have been overlaid on top of each other and a spatial analysis has been performed for integration in GIS environment. For combining hazard and risk, Weighted Factor Analysis (WFA) in GIS environment has been performed. Weighted ranking scores have been used in the integration analysis and quantified risk distribution for all districts. Values of weighted factor depend upon the importance of a particular hazard/ vulnerability class in risk analysis. For example, temperate zone hazard value of a district has a much lower weight than the population density of a district.

For integration of hazards, equal weights have been assigned to wind, seismic, and climatic hazards, while double weights have been given to hill zoning (Table 3-5). This is because, in hilly terrain, wooden houses, and heating provisions in buildings increase the chances of fire-incidences, and thus have been given higher weightage.

Four layers of exposure/ vulnerability, such as population density, residential built-up area percentage, residential built-up area in sq km and Industrial area in sq km seem to have equal importance in the occurrence of the number of fire incidents in a district. Hence, equal weights have been assigned in integration of these layers (Table 3-6).

After obtaining integrated individual weighted score for hazard and exposure vulnerability, fire risk categories have been obtained in quantitative terms by further integration of hazard and exposure vulnerability. It is obvious that in the occurrence of the number of fire incidents in a given district, exposure vulnerability has more importance than the prevailing hazard. Hence, in quantified integration, double weights have been assigned to exposure vulnerability (Table 3-6).

Table 3-6: Weightage assigned in risk scoring schema for integration of hazard and exposure vulnerability into fire risk categories

Hazard		Weightage	
H1	Wind Zoning	W1	0.2
H2	Seismic Zoning	W2	0.2
H3	Climate zoning	W3	0.2
H4	Hill zoning	W4	0.4
Integrated Hazard		H1*W1+H2*W2+H3*W3+H4*W4	

Exposure/ Vulnerability Class		Weightage	
EV1	Population Density	W1	0.25
EV2	Residential built-up area %	W2	0.25
EV3	Residential built-up area in sq km	W3	0.25
EV4	Industrial area in sq km	W4	0.25
Integrated Exposure Vulnerability		EV1*W1+EV2*W2+EV3*W3+EV4*W4	

Fire Risk score = Integrated Hazard x 2 (Integrated Exposure Vulnerability)

The quantified numeric values of district risk scores are again grouped into four descriptive categories of district level risk ranking (very high, high, medium, and low) as depicted in Table 3-7.

Table 3-7: District risk rankings for all Phase I States/UTs

State	District	Population Density Ranking	Res Built-up Area sq km Ranking	Res Built-up Area Percentage Ranking	Industrial Area Ranking	Integrated Ranking	Overall District Risk Ranking
Himachal Pradesh							
	Chamba	1.00	1.00	1.00	1.00	7.10	Medium
	Kangra	2.00	1.00	2.00	1.00	7.47	Medium
	Lahul & Spiti	1.00	1.00	1.00	1.00	7.27	Medium
	Kullu	1.00	1.00	1.00	1.00	7.67	High
	Mandi	2.00	1.00	1.00	1.00	7.71	High
	Hamirpur	2.00	2.00	1.00	1.00	7.19	Medium
	Una	2.00	3.00	2.00	1.00	8.16	High
	Bilaspur	2.00	1.00	1.00	1.00	7.26	Medium
	Solan	2.00	2.00	2.00	4.00	8.51	Very High
	Sirmaur	1.00	1.00	1.00	1.00	6.95	Medium
	Shimla	1.00	1.00	1.00	1.00	7.63	High
	Kinnaur	1.00	1.00	1.00	1.00	7.26	Medium
Punjab							
	Gurdaspur	3.00	2.00	3.00	1.00	6.09	Medium
	Kapurthala	2.00	2.00	1.00	1.00	5.47	Low
	Jalandhar	3.00	2.00	2.00	1.00	5.96	Low
	Hoshiarpur	2.00	2.00	2.00	1.00	5.72	Low
	Shahid Bhagat Singh Nagar	2.00	2.00	1.00	1.00	5.50	Low
	Fatehgarh Sahib	3.00	2.00	1.00	1.00	5.73	Low
	Ludhiana	3.00	2.00	3.00	2.00	6.31	Medium
	Moga	2.00	2.00	2.00	1.00	5.35	Low
	Firozpur	2.00	1.00	2.00	1.00	4.99	Low
	Muktsar	2.00	1.00	2.00	1.00	5.03	Low
	Faridkot	2.00	2.00	1.00	1.00	5.10	Low
	Bathinda	2.00	1.00	2.00	1.00	5.08	Low
	Mansa	2.00	1.00	1.00	1.00	4.78	Low
	Patiala	3.00	2.00	2.00	1.00	5.71	Low
	Amritsar	3.00	2.00	3.00	1.00	6.20	Medium
	Tarn Taran	2.00	1.00	2.00	1.00	5.20	Low
	Rupnagar	2.00	2.00	1.00	1.00	5.50	Low
	SAS Nagar	3.00	2.00	2.00	1.00	6.00	Medium
	Sangrur	2.00	2.00	2.00	1.00	5.35	Low
	Barnala	2.00	2.00	1.00	1.00	5.10	Low
Chandigarh							
	Chandigarh	4.00	4.00	1.00	1.00	6.50	Medium
Uttarakhand							
	Uttarkashi	1.00	1.00	1.00	1.00	7.27	Medium

State	District	Population Density Ranking	Res Built-up Area sq km Ranking	Res Built-up Area Percentage Ranking	Industrial Area Ranking	Integrated Ranking	Overall District Risk Ranking
	Chamoli	1.00	1.00	1.00	1.00	7.42	Medium
	Rudra Prayag	1.00	1.00	1.00	1.00	7.24	Medium
	Tehri Garhwal	1.00	1.00	2.00	1.00	7.36	Medium
	Dehradun	3.00	3.00	3.00	2.00	8.56	Very High
	Garhwal	1.00	1.00	2.00	1.00	7.21	Medium
	Pithoragarh	1.00	1.00	1.00	1.00	7.59	High
	Bageshwar	1.00	1.00	1.00	1.00	7.58	High
	Almora	1.00	2.00	2.00	1.00	7.87	High
	Champawat	1.00	1.00	1.00	1.00	7.52	High
	Nainital	2.00	2.00	2.00	2.00	8.25	High
	Udham Singh Nagar	3.00	3.00	3.00	5.00	9.90	Very High
	Haridwar	3.00	3.00	3.00	4.00	9.19	Very High
Haryana							
	Panchkula	3.00	2.00	1.00	1.00	5.75	Low
	Ambala	3.00	2.00	2.00	1.00	5.92	Low
	Yamuna Nagar	3.00	2.00	2.00	1.00	5.93	Low
	Kurukshetra	3.00	2.00	2.00	1.00	5.60	Low
	Kaithal	2.00	2.00	2.00	1.00	5.35	Low
	Karnal	3.00	2.00	2.00	1.00	5.60	Low
	Panipat	3.00	2.00	2.00	1.00	5.60	Low
	Sonipat	3.00	2.00	2.00	1.00	5.60	Low
	Jind	2.00	2.00	2.00	1.00	5.35	Low
	Fatehabad	2.00	1.00	2.00	1.00	4.87	Low
	Sirsa	2.00	1.00	2.00	1.00	4.70	Low
	Hisar	2.00	1.00	2.00	1.00	4.23	Low
	Bhiwani	2.00	1.00	2.00	1.00	4.34	Low
	Rohtak	3.00	2.00	2.00	1.00	5.53	Low
	Jhajjar	3.00	2.00	2.00	1.00	5.07	Low
	Mahendragarh	2.00	1.00	1.00	1.00	4.48	Low
	Rewari	3.00	2.00	1.00	1.00	5.35	Low
	Gurgaon	4.00	3.00	2.00	1.00	6.38	Medium
	Mewat	3.00	2.00	1.00	1.00	5.75	Low
	Faridabad	4.00	3.00	2.00	1.00	6.50	Medium
	Palwal	3.00	2.00	2.00	1.00	6.00	Medium
Uttar Pradesh							
	Saharanpur	3.00	3.00	4.00	3.00	7.07	Medium
	Muzaffarnagar	4.00	3.00	4.00	3.00	7.28	Medium
	Bijnor	3.00	1.00	1.00	1.00	5.50	Low
	Moradabad	4.00	3.00	4.00	3.00	7.50	High

State	District	Population Density Ranking	Res Built-up Area sq km Ranking	Res Built-up Area Percentage Ranking	Industrial Area Ranking	Integrated Ranking	Overall District Risk Ranking
	Rampur	3.00	3.00	3.00	2.00	6.75	Medium
	Jyotiba Phule Nagar	3.00	3.00	3.00	3.00	7.00	Medium
	Meerut	4.00	3.00	4.00	4.00	7.75	High
	Baghpat	3.00	3.00	3.00	2.00	6.50	Medium
	Ghaziabad	4.00	3.00	4.00	5.00	8.00	High
	Gautam Buddha Nagar	4.00	3.00	3.00	5.00	7.75	High
	Bulandshahr	3.00	3.00	4.00	3.00	7.25	Medium
	Aligarh	3.00	3.00	4.00	2.00	7.00	Medium
	Mahamaya Nagar	3.00	3.00	3.00	1.00	6.42	Medium
	Mathura	3.00	3.00	4.00	4.00	7.49	Medium
	Agra	4.00	3.00	4.00	4.00	7.34	Medium
	Firozabad	4.00	3.00	3.00	3.00	6.85	Medium
	Mainpuri	3.00	3.00	3.00	2.00	6.35	Medium
	Budaun	3.00	3.00	4.00	3.00	7.11	Medium
	Bareilly	4.00	3.00	4.00	3.00	7.48	Medium
	Pilibhit	3.00	2.00	3.00	1.00	6.22	Medium
	Shahjahanpur	3.00	3.00	3.00	3.00	6.65	Medium
	Kheri	3.00	2.00	4.00	3.00	6.82	Medium
	Sitapur	3.00	3.00	4.00	1.00	6.35	Medium
	Hardoi	3.00	3.00	4.00	2.00	6.60	Medium
	Unnao	3.00	3.00	4.00	3.00	6.83	Medium
	Lucknow	4.00	3.00	5.00	3.00	7.35	Medium
	Rae Bareli	3.00	3.00	4.00	3.00	6.81	Medium
	Farrukhabad	3.00	3.00	3.00	3.00	6.60	Medium
	Kannauj	3.00	3.00	3.00	1.00	6.10	Medium
	Etawah	3.00	3.00	3.00	2.00	6.07	Medium
	Auraiya	3.00	3.00	3.00	3.00	6.28	Medium
	Kanpur Dehat	3.00	3.00	3.00	2.00	5.98	Low
	Kanpur Nagar	4.00	3.00	4.00	5.00	7.32	Medium
	Jalaun	2.00	2.00	3.00	2.00	5.45	Low
	Jhansi	2.00	2.00	3.00	3.00	5.70	Low
	Lalitpur	2.00	1.00	2.00	1.00	4.21	Low
	Hamirpur	2.00	1.00	1.00	1.00	6.94	Medium
	Mahoba	2.00	2.00	2.00	1.00	4.95	Low
	Banda	2.00	2.00	3.00	4.00	5.95	Low
	Chitrakoot	2.00	2.00	2.00	1.00	4.95	Low
	Fatehpur	3.00	3.00	4.00	1.00	5.95	Low
	Pratapgarh	3.00	3.00	4.00	1.00	6.27	Medium

State	District	Population Density Ranking	Res Built-up Area sq km Ranking	Res Built-up Area Percentage Ranking	Industrial Area Ranking	Integrated Ranking	Overall District Risk Ranking
	Kaushambi	3.00	3.00	3.00	1.00	5.70	Low
	Allahabad	4.00	3.00	5.00	3.00	6.96	Medium
	Barabanki	3.00	3.00	4.00	2.00	6.60	Medium
	Faizabad	3.00	3.00	3.00	1.00	6.10	Medium
	Ambedkar Nagar	4.00	3.00	3.00	1.00	6.35	Medium
	Sultanpur	3.00	3.00	4.00	3.00	6.85	Medium
	Bahraich	3.00	3.00	4.00	1.00	6.58	Medium
	Shrawasti	2.00	3.00	3.00	1.00	6.19	Medium
	Balrampur	3.00	3.00	3.00	1.00	6.48	Medium
	Gonda	3.00	3.00	4.00	1.00	6.39	Medium
	Siddharthnagar	3.00	3.00	4.00	1.00	6.75	Medium
	Basti	3.00	3.00	3.00	1.00	6.16	Medium
	Sant Kabir Nagar	3.00	3.00	3.00	1.00	6.27	Medium
	Maharajganj	3.00	3.00	4.00	3.00	7.25	Medium
	Gorakhpur	4.00	3.00	4.00	3.00	7.26	Medium
	Kushinagar	4.00	3.00	3.00	1.00	6.75	Medium
	Deoria	4.00	3.00	3.00	1.00	6.48	Medium
	Azamgarh	4.00	3.00	5.00	1.00	6.85	Medium
	Mau	4.00	3.00	3.00	1.00	6.35	Medium
	Ballia	4.00	3.00	4.00	1.00	6.60	Medium
	Jaunpur	4.00	3.00	5.00	2.00	7.09	Medium
	Ghazipur	4.00	3.00	4.00	1.00	6.60	Medium
	Chandauli	3.00	3.00	3.00	1.00	6.02	Medium
	Varanasi	4.00	3.00	4.00	3.00	7.08	Medium
	Sant Ravidas Nagar	4.00	3.00	3.00	1.00	5.96	Low
	Mirzapur	3.00	2.00	3.00	1.00	5.49	Low
	Sonbhadra	2.00	1.00	3.00	4.00	5.50	Low
	Etah	3.00	3.00	3.00	2.00	6.35	Medium
	Kanshiram Nagar	3.00	3.00	3.00	1.00	6.18	Medium

4 Field Surveys of Fire Stations for Data Collection

At present, there is a lack of a comprehensive centralized database on the distribution of fire service infrastructure, and the stock of existing fire fighting vehicles, manpower and specialized equipment, their types, and their quantities. Most of the information is either disaggregated or not updated. This information is required for undertaking the gap analysis, future planning, and improvement of institutional capacity, financial planning, and creating a roadmap for the next 10 years for revamping the fire services in the country. To have first-hand information on the distribution of the fire service stations across the country, trained human resources, infrastructure availability and their status, RMSI project team has carried out surveys of Fire Stations and collected data from Headquarters of all the States under the jurisdiction of DG, NDRF & CD (Fire) in the country. In addition to the survey of Fire Stations, the team has also collected the location (latitude, longitude) of Fire Stations using GPS. The geographical coordinate information is used for plotting all the Fire Station locations on the map to perform GIS based spatial analysis. This is required for the analysis of distribution of Fire Stations and gap analysis on fire-infrastructure, based on risk-category, response time, and population.

4.1 Field-Survey of individual Fire Station and collection of Headquarter Data

RMSI project team has designed a comprehensive “Fire Headquarter Data Collection Form” (*Annexure-1*) and individual “Fire Station Survey Form” (*Annexure-2*) to collect all the required information for each State/UT in the country.

The information includes but is not limited to:

i. Location (latitude, longitude) and location description of the Fire Station

ii. Name of fire-station in-charge and his contact details

iii. Fire Vehicles type, numbers, their model, year of manufacture/induction at the Fire Station, and general condition of fire vehicles

iv. Specialized firefighting equipment, their type, and quantity

v. Road access and connectivity to vulnerable areas

vi. Infrastructure facilities (accommodation) of fire-personnel and their distance from Fire Stations

vii. Duty patterns

viii. Staff details at different levels

ix. Water availability etc.

The Fire Headquarter Data Collection Form and individual Fire Station Survey Form have been designed in such a way as to extract most of the common information including communication, human resources, specialized equipment, fire-statistics etc. applicable for the entire State, in a quantitative way, which might help the analysis at a later stage. In addition to infrastructure information, RMSI also attempted to collect information/indicators related to vulnerability and risk through indirect questions like:

i. Year wise information on the number of events each unit had attended during the last 5 years and losses caused by fire events both in terms of assets and life.

ii. Few questions on the general perception of the fire officer and in charge of the unit on various types of risks in the Fire Station jurisdiction.

Analysis on the information of events over time and the loss can provide an understanding of the vulnerability and risk as well as the susceptibility trend over the year. The fire officer would be the key person who faces actual needs on the ground as well as in using the infrastructure for the service.

During the field survey in the pilot study, the RMSI team members have interacted with Fire Station In-charges to gather the required information. In addition to discussions with the Fire Station in charge, other key department officials have been contacted to know their perception about the fire risks and the difficulties that fire department is facing. The project team is ensuring that the Headquarter Data Collection Forms and Individual Fire Station Survey Forms are comprehensive and contain all information required for this assignment.

The field data collected by the survey team have undergone through quality checks and the project team has created a database with all collected information. The database has been designed in such a way that the data can be used for spatial and non-spatial analysis. All the Fire Stations have a unique code as identifier.

4.2 Stakeholder Analysis

Apart from the quantitative data collection on the distribution of fire service infrastructure, stock of the existing equipment and their quality, the RMSI team also interacted with some of the key fire officials and senior members in DGCD, MHA and NDRF. The focus of such discussions was more on institutional aspects (issues in the service delivery and suggestions), capacity, and future requirements. As these interactions are mostly with senior personnel of fire department, the focus has been to derive a broader picture in terms of requirements, investment, and institutional capacity building. This information has been compiled and summarized under various heads, for instance, requirement, investment, institutional capacity building, etc. RMSI key experts have been analyzing the diverse opinion of various fire officials and are providing their recommendations.

Any significant issue that was observed during this process, in terms of issues in the process of the delivery/bottlenecks in smooth operation were highlighted along with RMSI's suggested solution.

Finally, RMSI team held discussions with officials of the DG NDRF & CD and members of project review to present the summary of observations for discussions in several meetings

5 Development of Fire Decision Support System (FDSS)

This chapter discusses the modeling software solution named FDSS (Fire Decision Support System), developed by RMSI as part of the deliverables. FDSS is a dynamic web-based system aimed at supporting decision makers take optimal decisions on complex tasks, such as resource prepositioning, gap analysis, prioritization, and resource optimization along with the day-to-day tasks. The most important aspect of FDSS is that it enables the apex fire management authority to provide the entire country's fire agencies information on a single platform.

5.1 Salient Features

Following is a brief description of the FDSS platform. The platform is built on a framework that is state-of-the-art and is the most suitable solution for users' needs.

The salient features of the FDSS platform include:

- Web based application built using .NET Framework 3.5 utilizing the GIS capabilities of an open source GIS Platform.
- Multi-tier system architecture that follows the Object Oriented Programming model with the following objectives:
    - Loose coupling between the various tiers – presentation, business and data
    - Ease of development and deployment
- Ability to navigate, query and render the spatial data
- Exposure view, query and update capabilities that will help the user to keep the information in the system up-to-date
- Ability to view and query the outputs in a tabular format
- A powerful reporting engine that enables a set of pre-formatted reports that provide various views of the outputs from the model
- A thematic map generator that uses the underlying GIS platform to depict the outputs from the model as pre-designed thematic maps.

5.2 High Level Design

FDSS has a multi-tier architecture to allow for modularity and scalability. The architecture follows the Object Oriented Programming model. The various tiers of the system are as shown in Figure 5-1.

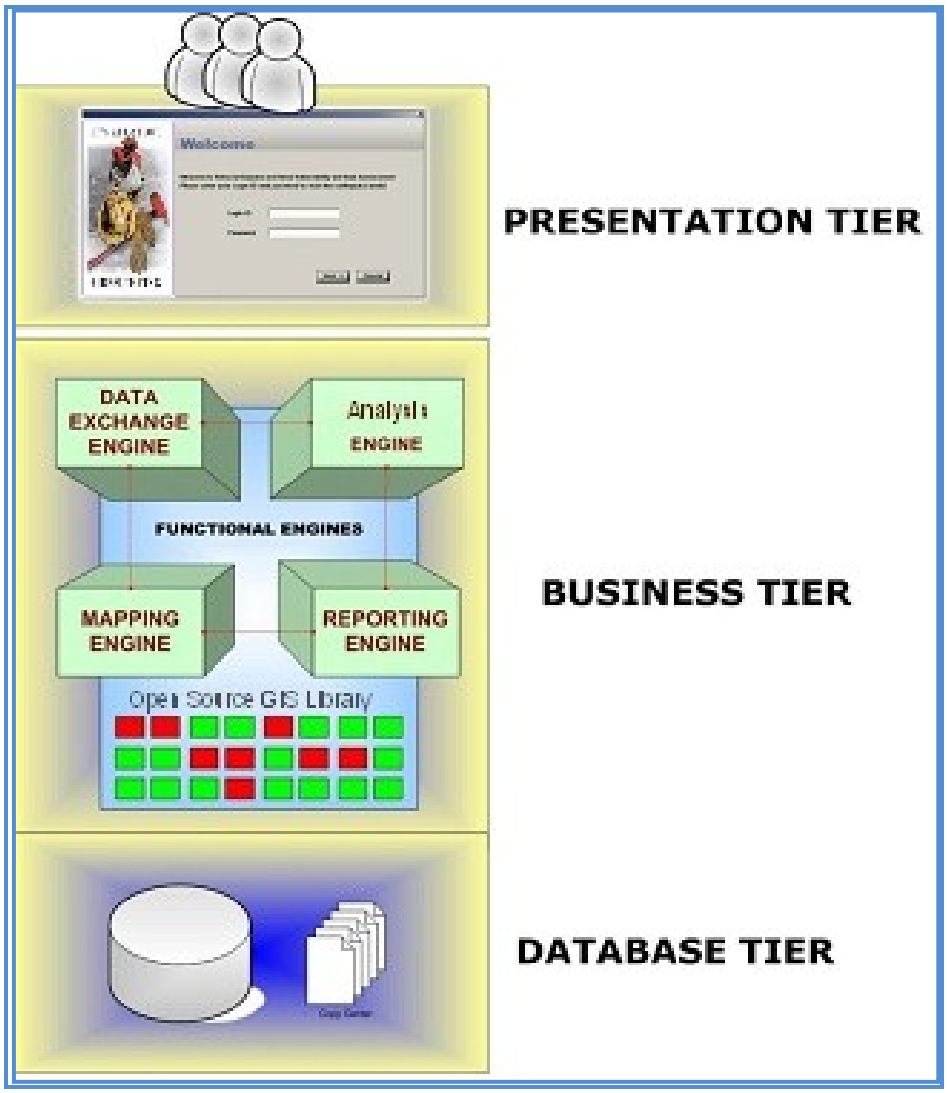


Figure 5-1 : Three-tier architecture

- **Presentation tier:** This user interface is responsible for gathering inputs from the user and passing on the same to the business layer for processing. The presentation layer ensures that the communications passing through are in the appropriate form for the recipient business objects in the business tier. In FDSS, the user interface constitutes this tier.
- **Business tier:** consists of the system business rules and computing logic as a set of business objects. This tier also interfaces with the data tier. The Mapping engine, Data Access engine, Reporting engine, and Analysis engine constitute this tier.
- **Database tier:** consists of the environment that allows persistence of user information – both lookup and computed data. Physical implementation of this layer can be files on the system or databases. In FDSS, relational database constitutes this tier and houses both spatial and non-spatial data.

Figure 5-2 shows the high-level design for the FDSS platform. The whole architecture is modular. The major modules are user Data Warehouse, Platform Components, and User Interface. The model components are stand-alone and are not dependent on the platform

components. Both perform their respective tasks working with the same data on the backend and are guided by the same user interface on the front end. The following sections discuss the various modules in detail and showcase how all the requirements has been delivered by the FDSS platform.

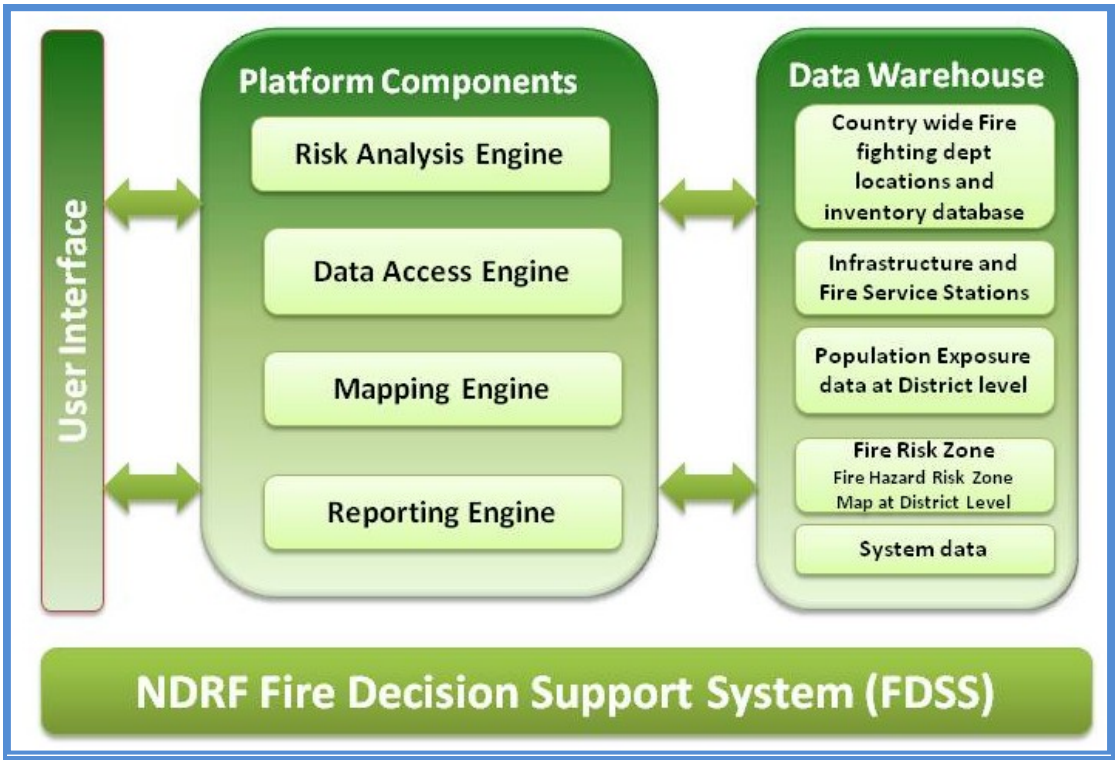


Figure 5-2 : High level design of FDSS

5.2.1 DATA WAREHOUSE

Data warehouse represents the Database tier. It stores all the input data to the model, system data, and the output results. The data can be categorized as spatial and non-spatial. All the spatial data resides either in the form of ESRI shape files and grids or Postgres based PostGIS database. Post GIS/ Postgres is an open source geo-spatial relational database system. All the non-spatial data is stored as tables in the Postgres database.

Spatial Data Layers: The spatial data layers stored in the data warehouse are:

- Fire station locations and inventory data at Fire Station level
- Land Use Land Cover classes by their use or occupancy
- Fire Risk Zone Map at district level
- Population density map at district level
- Road and Rail Network

5.3 Platform Components

Platform components represent the Application Tier. These components focus on the application logic for all data access, mapping and reporting. These are generic components that operate directly on the data warehouse and present the data in different views to the user.

Data Access Engine: Data Access Engine provides access to all non-spatial data that are stored in the Data Warehouse. This includes data viewing and editing capabilities. This allows for bulk building inventory updates and extraction of results so the outcome of the analysis can be reused for other applications.

Mapping Engine: Mapping engine provides all mapping capabilities to the application. The major component in mapping engine is the Map Viewer that loads the spatial data and displays the map and provides all basic map navigation functions like Zoom, Pan, Identify tool and calculate distance. This engine also provides spatial querying capabilities like buffer query and point in polygon query. In addition to this, the mapping engine also provides capabilities for defining symbology for various map layers including themes based on a range of values and unique values. All the layers are loaded with a predefined symbology. The mapping engine provides the ability to view the hazard, damage and loss on maps using predefined themes based on a range of values.

Reporting Engine: Reporting engine generates all the reports. FDSS provides a set of preformatted predefined reports that can be printed or exported into Excel format. This provides the ability to format the data into tables, generate summations, and create graphs. The following reports are generated at district and State levels by the reporting engine:

- Infrastructure Report
- Gap Analysis Report
- Status report for individual Fire Stations, district and State levels for and other reports required for decision making

The FDSS provides functionality to run GAP Analysis at two levels:

- State
- District

This system provides the option for running gap analysis for firefighting and rescue vehicles specialized equipment, fire fighting manpower, and building, Infrastructure. User can also opt to get output based on all the analysis parameters available.

User Interface: User Interface (Figure 5-3) comprises of the Presentation tier. This is the part of the FDSS platform that the user interacts with. User Interface for FDSS can be categorized into two types:

1) System Administration Interface
2) Application Interface

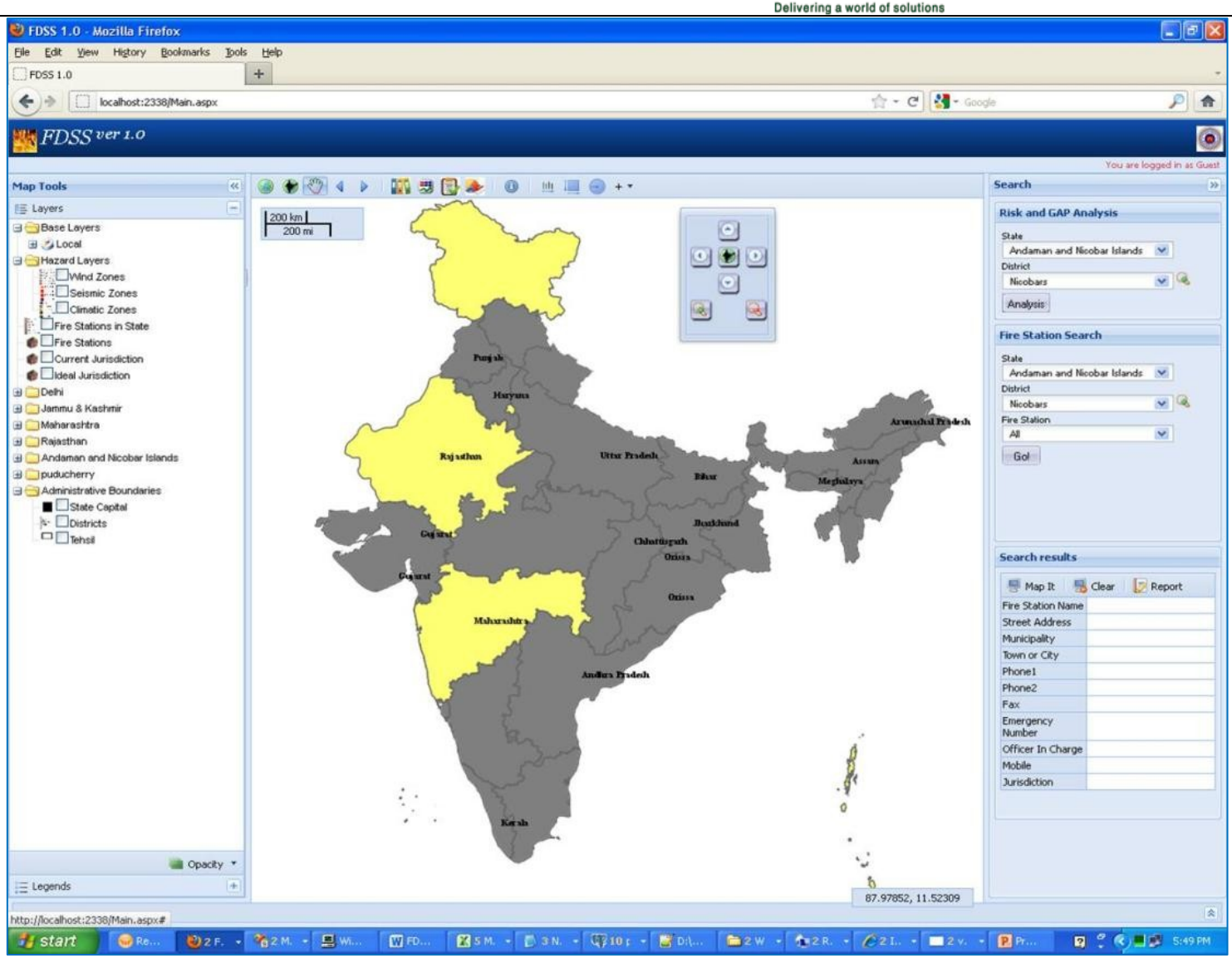


Figure 5-3 : User Interface for Base Analysis in FDSS. The example shows the States covered in the Pilot Phase of the study

5.4 System Administration Interface

This is an individual stand alone component run at the server only. This desktop interface allows the administrator to manage users and update exposure, thereby providing security for other users and preventing unauthorized updation of the building exposure data. All the data updation and maintenance is done through the system administration interface. Figure 5-4 shows the system administration interface of the application.

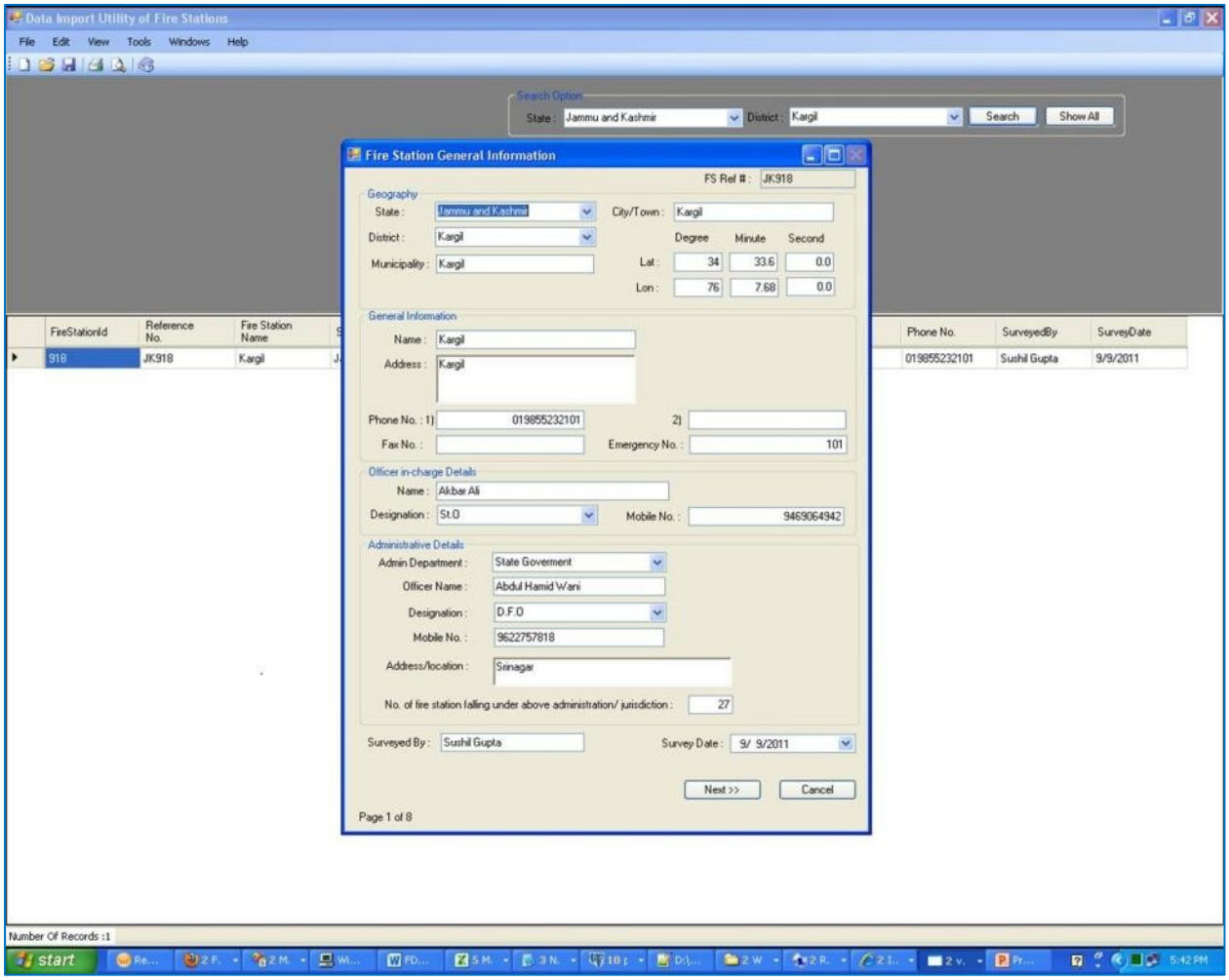


Figure 5-4 : System administration interface

5.5 Application Interface

Data Management: Exposure management provides the ability to view and query the underlying default demographic and Fire Station inventory datasets.

Map Management: The Map management interface provides support for viewing the information on a map by utilizing the Mapping Engine component from the Application Logic tier. It offers the following functionalities:

- Displays the following layers by default as the application is loaded:
    - Location of Fire Stations
    - Administrative boundary maps
    - Land use land cover map
    - Road / Rail network
    - Fire Risk Zone map

- Basic GIS tools like zoom, pan, zoom to selection, zoom to entire layer, location attribute information etc.
- Creates following maps based on analysis results:
    - Gap Analysis Map – showing gaps in existing resource, equipment and fire tenders (Figure 5-4)
- Adds custom layers to the layer manager and performs visual overlays
- Views attributes information, queries and analyzes the spatial data layers
- Enables users to view thematic maps based on defined attribute values.

Analysis Management: The analysis management interface provides the ability to execute the analysis. It allows the user the following options:

- View the fire risk analysis for any district
- Gap analysis at State and district levels

Results Management: This entails generating displays of results in pre-defined formats based on user selection. Following are the various types of result views that are available in FDSS.

- Reports providing predefined content in predefined format. This utilizes the Reporting Engine Component to display various reports. Following is a list of various reports:
    - Fire Station Profile report
    - Gap Analysis report

5.5.1 TECHNOLOGY

The physical servers also represent the logical needs elaboration servers and the physical clients also represent the logical clients.

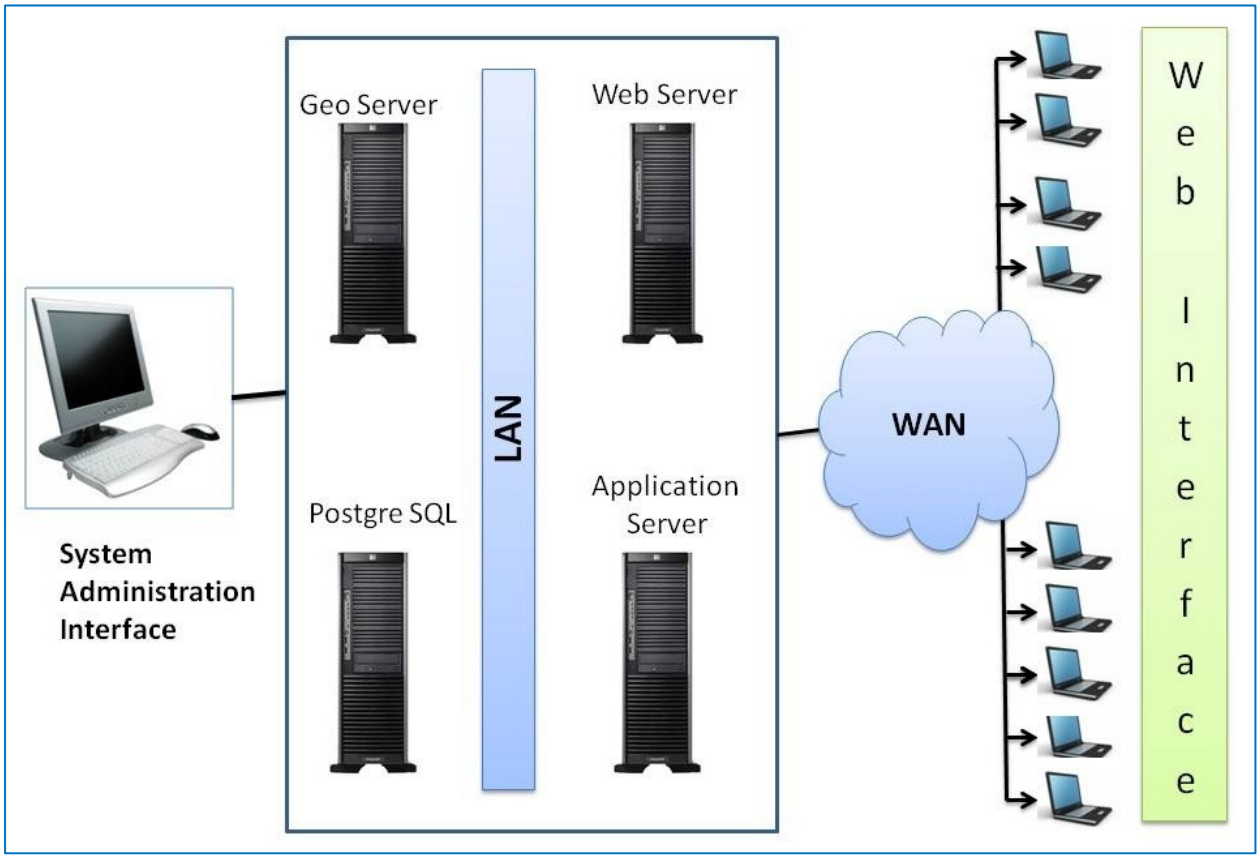


Figure 5-5 : FDSS - Systems Architecture

- The Frontend is web based, and registered users can view all kinds of maps and reports.
- Middleware: It is the Web server that hosts the web site and coordinates between the client and the backend servers for publishing maps and reports. Application Server serves as the main point of contact for the web server for all functionalities other than serving maps and GIS analyses. The application server is hosted in IIS 5.1 or higher and requires Dot net Framework 3.5.
- The backend consists of the following two components:

- Geo server and Geo web cache: This server handles map publishing and all the GIS functionalities. For all GIS analyses, it relies on the Post GIS database server. Geo server and Geo web cache are published in Apache Tomcat Server.
- Post GreSQL Database Server: This serves all the GIS and attributes data to both the application and map servers. In addition, it also takes care of all GIS analyses required for any functionality.

The technological framework for FDSS utilizes the following platforms:

Hardware Configuration

- Rack Server 2U having Intel Xeon (Quad Core) E5410 or higher processor support for dual multi core processor
- 16 GB DDR2-533 FB DIMM or higher ECC memory
- SVGA Video Controller with 16 MB RAM
- SAS Raid Controller having 128 MB buffer memory with battery backup and supporting RAID 0,1 and 5 Dual Gigabit Server Ethernet controller with teaming, load balancing and auto fail over feature
- 5X146GB SAS HS HDDD, IDE DVD ROM Drive with (N) hot swap Redunt Hot SEAP power supply

Software Configuration

- Operating System: Windows Server 2008
- Web Server: IIS 7.0
- Framework: .net Framework (3.5)

Supported Browser

- Internet Explorer 6.0 or higher
- Mozilla Firefox 3.0 or Higher

5.6 Advantages of Open Source Platform

The application software is built on open source GIS platform. The open source GIS platform has several advantages (Table 5-1) of production and development allowing users and developers not only to see the source code of software but also modify it and easily implement it in web applications.

Table 5-1: Advantages of Open Source Platform

Advantages	Open Source Platform	Proprietary Software Platform
Control and Audit 	Gives power to control software code and hence modification can be carried out to suit the requirements	Forces users to adhere to standards and flexibility provided in the software only. Modifications are based solely on vendor discretion
Low ownership Cost 	No license fees are required thereby reducing annual license fees cost to zero, zero cost of scale as open source doesn't require additional licenses as the installation grows	License fees are required
Quality and Excellence	It's available publicly. A large no. of reviewers analyze the code making it more secure, increasing the quality and	Not available publicly.

Advantages	Open Source Platform	Proprietary Software Platform
	excellence in design	
Flexibility & customization 	There is scope to customize the software toward end users' needs	Limited scope of customization

5.7 Identification of Gaps in Infrastructure, Up-gradation and Modernization Requirement

Gap identification is carried out using the information captured as part of the field surveys and stakeholder interviews, distribution of Fire Stations and risk analysis. The gaps in infrastructure can be in terms of number of Fire Stations in both served and un-served areas, availability of fire vehicles, fire-personnel and building infrastructure in the operational Fire Stations, and availability of open area. Through the input of field survey work, risk categorization, and infrastructure requirement norms, gap analysis is performed in FDSS at the district and State level.

Gaps will primarily address the three areas:

5.7.1 Infrastructure Gaps

This covers served/ un-served areas, unsuitable locations of Fire Stations, etc. This gap analysis is conducted by using suitably modified SFAC Norms, population density maps, existing Fire Station distribution and other infrastructural information obtained as part of the field surveys. In addition, the risk information has been used to reflect certain aspects of risk that affect the infrastructure. The outcomes of this analysis are information and maps that show the infrastructure deficiency at district and State levels.

5.7.2 Equipment Gaps

The objective of this analysis is to identify gaps in equipment existing at various Fire Stations against the population they serve, the hazards that the jurisdiction they serve is exposed to, trained map-power available, average response time to a fire call, etc. This will result in the identification of new types of equipment required, phasing out of old equipment and their replacement, and equipment effectiveness analysis.

5.7.3 Capacity Gaps

This would cover the shortage of fire fighting personnel and additional training requirements for existing teams, etc. This analysis is conducted using infrastructure analysis information, equipment analysis information, population density, SFAC norms and risk information as the primary datasets, and average response time. The primary outcomes would include the gap in capacity in terms of number of additional fire fighting personnel required, and the additional requirement of trainings on equipment, tools, technologies and emergency management approaches.

Similarly, district/State/ country level reports on up gradation and modernization requirements of existing Fire Stations including MIS, GIS, and communication systems are

generated by comparison of availability of existing resources and up gradation and modernization requirements through gap analysis.

The outcomes of the above analyses are integrated to the Fire Decision Support System (FDSS), so similar analyses at a later stage may also be performed by changing the underlying datasets as things change on the ground.

5.8 Preparation of detail cost estimates with Capital and O&M Investment Plan

Once gaps in terms of number of Fire Stations, fire-personnel, infrastructure (building, vehicles and equipment), up gradation and modernization requirements of existing Fire Stations including MIS, GIS, and communication systems are finalized, the investment and financial analysis is performed in FDSS. This involves reviewing the outcomes of the gap analysis, prioritizing them by district and estimating the cost of investment.

The investment costs are estimated separately for infrastructure development and improvements, capacity building, and equipment procurement and modernization. This is where the extensive experience of RMSI team in fire department operations, equipment procurement, and training needs assessment and planning has been applied. For more detailed information regarding the specification of firefighting and rescue vehicles and equipment, please refer to the Vehicle and Equipment Specification report submitted by RMSI.

The outcomes of this process are a detailed investment plan that shows year-by-year investments prioritized by district, gaps and associated benefits. The financial plan addresses investment for next 10-years in a year-by-year phased manner approach. The financial tool has been integrated to the FDSS, which helps in generating various reports related to detailed cost estimates with Capital and O&M Investment Plan for next 10 years, and to prioritize investments. This is based on the current cost estimate and technological enhancement. However, the tool have flexibility to change/modify the cost of various infrastructural elements and re-regenerate reports for prioritization of the investment plan.

5.9 Institutional Assessment and Capacity Building Plan

The National Fire Service College (NFSC), Nagpur and other State Fire Training Centres across the country are key institutions involved in improving the level of fire personnel knowledge and their overall capabilities to face the challenges of fire-fighting. The RMSI team surveyed NFSC Nagpur and Pilot State/UTs Fire Training Centres across the country and studied their programs to delineate their role and relationship for improvement in training facilities for fire personnel in the country.

Human resource bottlenecks at various levels of training fire officials (such as refresher's training, breathing training in smoke, industrial training, specialized training to handle high rise fires, etc.) to different cadre of officials, issue of language in training; physical fitness; duty patterns (8 hours and 12 hours versus 24 hours); availability of accommodation in fire-stations; pay-scale structures, and promotion progression etc. are studied in detail and recommendations are made for their implementation.

There are many ways of discovering funding avenues, such as introduction of Fire Tax, training programs to private sectors, tapping MP Local Area Development (MPLAD) funds etc. These issues are important since fire personnel need to be dedicated and motivated all times. For similar reasons, improvements in governance structure are imperative. Lack of

fire-personnel is another challenge. For this, revamping training facilities in the country is another important aspect in any capacity building plan.

Computerization of fire and emergency services and strict audit by a central authority can be one mechanism to ensure a good finance mechanism for capital expenditures and operation and maintenance. Training of fire personnel in the use of computers is another aspect, which is very important from the implementation perspective.

It may be noted that RMSI team is aware of past studies on the subject such as the Recommendations by the SFAC and kept these studies in mind while making recommendations for the Capacity Building Plan.

RMSI team has also prepared a detailed Roadmap for the Capacity Building Plan at country level for its implementation in next 10 years.

6 International and National Norms

6.1 Literature Survey

Under this task, standards and practices that are being followed in various developed countries for fire safety norms, such as in USA -NFPA (1211, 1710, 1720), Japan, UK, and Germany, are studied and compared.

As per literature survey and personnel communications with fire officials in different countries, international norms regarding response time *(defined as **en route time taken by the fire fighting vehicle from the Fire Station to fire emergency scene, and turnout time is not included in it**)* differs from country to country.

6.2 Response Time

The practices regarding response time of fire tenders/ambulances in different countries are as follows:

6.2.1 GERMANY

The response from Germany (27.10.2011) is as follows:

*"1. **Concerning the response time in Berlin**. On the basis of an agreement between CFO and the Ministry of Interior the options are:*

*Calls in Risk Areas class A (higher risks) - 15 fire-fighters must arrive in **max.15 minutes** at 90% of all calls and*

Calls in Risk Areas class B (lower risks) - 15 fire-fighters must arrive in max.15 minutes at 50% of all calls.

*The standard turn out time of a fire truck is **60 seconds for professionals**, as **for volunteers** the turn out time should not be higher **4 minutes**, otherwise the Control Centre will automatically send a professional fire truck.*

*Ambulance cars must be at the scene within **8 minutes** in 75% of all calls."*

2. Temperature problem - heating devices in the garage (close the doors) and additional a electrical wire is going to the motor section of the vehicle for saving working temperature of the trucks."

From the above, it may be inferred that in Germany, areas have been divided only into two Risk Categories (higher, lower) and **response time** in urban areas varies from **8 - 15 minutes**. As far as turnout time is concerned, it varies from 1 to 4 minutes.

6.2.2 JAPAN

Fire Service laws of Japan and its background:

1. The Japanese system of laws and regulations regarding fire service law (Hierarchy structure)
   A .Law: Fire Service Act
   B. Cabinet order: Order for Enforcement of the Fire Service Act
   ・Specify the type of building fire protection
   ・Technical standards for installation and maintenance of fire prevention equipment
C Ministerial ordinance: Rule for Enforcement of the Fire Service Act
   ・Details of technical standards for installation and maintenance of fire prevention equipment"
D. Municipal ordinances: Fire prevention ordinance"

2. Requirements for Fire prevention equipment
All Fire prevention equipment are necessary to have national certification in Japan (regulation not standard).

3. Background of Japanese fire service
・Fire service in Japan consists of **one unit per municipality**.
・Under the laws, fire prevention regulations are enacted by each of the municipalities.
・Fire prevention regulations are slightly different for each individual municipality.

- **Japanese Regulation, the response time has not been determined.**

According to the Fire Service Law Enforcement Order (**not regulation**), the fire panel shall be installed where there are always people in Japan.

In large buildings, the fire panel has been installed in Guard Room. Security people are always monitoring the fire panel.
At the same time the alarm is sounded, Fire tenders will rush to the site for extinguishing the fire.
Time to reach the site, which varies depending on the building, assumed at **5 to 10 minutes. (not determined by law).**

2. Since, there are several Islands in Japan, is there any different Regulations for Islands? Almost the same.

As you know, Japan is made up of three islands and many small islands. There has prefectures, among which are divided into municipalities regardless of islands."

From the above, it may be inferred that in Japan, each municipality has at least one Fire Station and response time varies from 5 to 10 minutes, depending upon the location of building.

6.2.3 USA

"There are three National Fire Protection Association (NFPA) standards that contain time requirements that influence the delivery of fire and emergency medical services. These are:

1. **NFPA 1221**, Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems;
2. **NFPA 1710**, Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments; and
3. **NFPA 1720**, Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Volunteer Fire Departments.

NFPA 1710 contains time objectives that shall be established by career fire departments as follows:

- **Turnout time:** One minute (60 seconds) for turnout time
- **Fire response time:** Four minutes (240 seconds) or less for the arrival of the first arriving engine company at a fire suppression incident and/or eight minutes (480 seconds) or less for the deployment of a full first alarm assignment at a fire suppression incident
- **First responder or higher emergency medical response time:** Four minutes (240 seconds) or less for the arrival of a unit with first responder or higher-level capability at an emergency medical incident
- **Advanced life support response time:** Eight minutes (480 seconds) or less for the arrival of an advanced life support unit at an emergency medical incident, where the service is provided by the fire department

The standard States that the fire department shall establish a performance objective of not less than 90 percent for the achievement of each response time objective. NFPA 1710 does contain a time objective for dispatch time by requiring that "All communications facilities, equipment, staffing, and operating procedures shall comply with NFPA 1221." For the purposes of NFPA 1710, the following definitions apply:

- **Dispatch time:** The point of receipt of the emergency alarm at the public safety answering point to the point where sufficient information is known to the dispatcher and applicable units are notified of the emergency
- **Turnout time:** The time that begins when units acknowledge notification of the emergency to the beginning point of response time
- **Response time:** The time that begins when units are en route to the emergency incident and ends when units arrive at the scene

NFPA 1720 contains a time objective for dispatch time by requiring that "All communications facilities, equipment, staffing, and operating procedures shall comply with NFPA 1221, Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems." NFPA 1720 contains no time requirements for turnout and response times.

NFPA 1221 requires that 95 percent of alarms shall be answered within 15 seconds, 99 percent of alarms shall be answered in 40 seconds, and the dispatch of the emergency

response agency shall be completed within 60 seconds 95 percent of the time. The time lines for dispatching are taken from NFPA 1221:

- After the receipt of a call for assistance, the fire department will respond with the first unit to that location within three minutes.
- After receipt of a call for assistance, the fire department will respond with a unit to that location, within four minutes, to 90 percent of area served.

After receipt of a call for a medical emergency, the fire department will respond with an engine company to that location within four minutes and an ambulance within six minutes."

From the above, it may be inferred that in USA, response time varies from **(3 - 4 minutes) to 8 minutes.**

6.2.4 UK

The London Fire Brigade (LFB) is run by the London Fire and Emergency Planning Authority as part of a group of organizations operating under the 'umbrella' of the Greater London Authority. It is the third largest firefighting organization in the world, with **111 Fire Stations** (plus 1 River Thames-based station) from which it operates across the 1,587 sq km of Greater London, with its resident population of some 7.4 million. This increases by a further 500,000 each day during working hours.

In the year 2005/06 the London Fire Brigade answered some 268,000 emergency calls and attended nearly 156,000 incidents. On an average, the first fire engine arrived at an incident **within 8 minutes on 92 per cent of occasions**, meeting the Brigade's target, and **within 5 minutes on nearly 65 per cent of occasions**. When required, a second fire engine was on scene within ten minutes on 93 per cent of occasions, exceeding the target. (Hooper, Nov-Dec, 2006; http://www.cadcorp.com/pdf/PA-firebrigade_ukv4i5.pdf).

Another recent review of "Fire and Rescue Service response times" (Fire Research Series 1/2009) concludes that response times have increased due to traffic conditions, which was similar to the finding of the London Fire and Emergency Planning Authority thematic report, which concluded that it now ***takes 50 seconds longer for a 1st appliance to arrive on average and one minute longer for a second appliance.***

From the above, it may be inferred that in UK, response time varies from **5 to 8 minutes.**

6.2.5 INDIA

"Standing Fire and Advisory Council (SFAC) reviewed the norms in various countries, and as given in the RFP, has laid down norms for the Fire and Emergency Services throughout the country based on:-

- *Response time, fire risk, and population*
- *Depending on risk category A, B, and C the recommended response time for first fire tender is 3, 5, and 7 minutes, respectively*
- *One Fire Station per 10 sq. km in urban areas and one Fire Station per 50 sq. km in rural areas*
- *One Rescue Tender per 3 – 10 lakhs population*
- In rural areas, the recommended response time is 20 minutes

From the above, it can be inferred that SFAC norms are based on the idealized conditions of the western world and would be too demanding, thus requiring some modifications.

To see the practicability of SFAC norms, RMSI did several simulations through *network analysis* taking different average vehicle speeds for Delhi State. These different speed simulations were presented on Nov. 02, 2011 to DFS officials and on Nov 03, 2011 to Fire Advisor and Deputy Fire Advisor at DG, NDRF, MHA. After discussions with both DFS and MHA officials, the average fire vehicle speeds on main roads has been taken as 40 km/hr and minor roads as 20 km/ hr. While, for congested areas, such as Sadar Bazar, Delhi, the average fire vehicle speed on main roads has been taken as 20 km/hr and for minor roads as 10 km/hr, respectively. RMSI choose Delhi, because it has a high density of Fire Stations in comparison to the rest of the States/UTs.

Taking SFAC norms as a guideline, RMSI analyzed the requirements of Fire Stations in Delhi, keeping a response time of 3 minutes for very high-risk category, 5 minutes for high category and taking response time in rural area as 20 minutes. *It may be noted that areas served by other agencies, such as the Airport and Military Cantonment have been excluded from the gap analysis, so that there is no duplicity of Fire Stations in those areas. Additionally, areas covered by forests, rivers, sparsely inhabited (small pockets of a few houses, say in a river channel) etc. have also not been considered in the gap analysis.* To make a distinction, the Fire Stations in rural areas are designated as **Fire Stations/Fire Posts**.

Thus, taking the vehicle speeds discussed earlier, and response time as per SFAC norms, Delhi requires additional **120** Fire Stations in urban areas and **10** rural Fire Stations/posts in rural areas (Table 6-1).

Table 6-1: Number of operational and additional Fire Stations and Fire Posts required in Delhi

Urban		Rural	
Operational Fire Stations	Additional Fire Stations	Operational Fire Station/ Fire Post	Additional Fire Stations/ Fire Posts
51	**120**	**1**	**10**

As per SFAC norms, one Fire Station is required per 10 sq. km in urban areas and per 50 sq. km in rural areas. This seems to be based on average area per station over a large area/State.

From the above analysis, the average area per Fire Station in urban areas in Delhi comes to 4.7 sq km, while in rural area; it comes to 62.5 sq km. This analysis also shows that the average Fire Station coverage area in urban areas is too low when compared to the norms specified by SFAC, which is 10 sq km in urban area. Moreover, population covered in such a small area of less than 5 sq km is sometimes very low to justify opening of a new Fire Station, thus contradicting the area based norm of SFAC. Moreover, additional required number of Fire Stations will be too high and it may not be possible to set-up so many Fire Stations in Delhi, where land availability in urban areas is scarce.

Thus, keeping in view the above analyses, RMSI reanalyzed the requirements of Fire Stations in Delhi, by modifying the response time of 5 - 7 minutes for various risk categories and keeping the response time in rural area as 20 minutes. Accordingly, the proposed requirement of additional number of Fire Stations in urban and rural areas is shown in Table 6-2. In terms of average area and population served by the revised response time, the average area served comes to 8.38 sq km (close to 10 sq km) in urban areas serving an average population of 1, 61,289.

Table 6-2: Revised number of operational and additional Fire Stations and Fire Posts required in Delhi

Urban		Rural		Total
Operational Fire Stations	Additional Fire Stations	Operational Fire Station/ Fire Post	Additional Fire Stations/ Fire Posts	
51	**46**	**1**	**9**	**107**

As discussed in section 6.2.4, Greater London Authority operates 112 Fire Stations in an area of 1,587 sq km of Greater London, which is equivalent to on an average one Fire Station per 14.2 sq km. A comparison of the proposed 107 Fire Stations serving an area of 1483 sq km Delhi shows that in Delhi there will be one Fire Station on an average area of 13.9 sq km, which is almost equal to the average area per Fire Station in Greater London.

Thus, keeping in view the above analyses, RMSI recommend to modify the SFAC norms *(response time and area based)* to *response time based* norms for positioning a Fire Station, as response area will vary from place to place depending upon the road network:

Depending upon the risk category, the recommended response time for first fire tender is 5 - 7 minutes in urban areas and 20 minutes in rural areas.

Annex-1: Fire Headquarter Data Collection Form

This questionnaire is prepared in consultation with Directorate General NDRF & CD for collecting basic information all fire infrastructure in the country as part of the project "Fire-Risk and Hazard analysis in the Country" with an objective to Prepare Capital Investment and Institutional Strengthening Plan for Accelerated Development of Fire Services in the Country. All information collection through this questionnaire will be kept confidential and will only be used for the preparation of the report and other deliverables of the project. Directorate General NDRF/ CD has entrusted RMSI Private Limited to carry out this assignment and State Officials are requested to provide required authentic information which is very important for preparation of this report and future development plans of the department.

HQ Ref #.....

A. Fire Headquarters General Information

Location Details

Fire Headquarters/Zone/District Office ---------- State ----------

Address ……..

Office Phone numbers (with STD code):…… Fax …… Web site(if any)……

Name & Designation of the Head of Department: ……

Name & Designation of the nominated person by the dept. for providing data: ……

Mobile number ……..

Email (s):……..

Area under Jurisdiction

Zonal Office (name and street address)	Num of districts covered	Census 2011 Population (to be filled by RMSI)	Num of Fire stations (Operational)	Num of Fire stations (under Construction)	Num of Fire stations proposed for future expansion

Surveyed by: **Date:** (Signature of the official provided the information)

B. Area under Jurisdiction in each Zonal Office

Name of Zonal office …….

S.N.	Name of Fire stations	Name of district	Under direct Jurisdiction control of [1]	Population (to be filled by RMSI)	Num of Fire stations (Operational)	Num of Fire stations (under Construction)	Num of Fire stations proposed for future expansion	Any additional Information

Name of Zonal office …….

S.N.	Name of Fire stations	Name of district	Under direct Jurisdiction control of [1]	Population (to be filled by RMSI)	Num of Fire stations (Operational)	Num of Fire stations (under Construction)	Num of Fire stations proposed for future expansion	Any additional Information

[1] State Government Fire Department Police Department Municipal Corporation Others specify

Please add additional sheets if required

S.N.	Name of Fire stations	Name of district	Under direct Jurisdiction control of [1]	Population (to be filled by RMSI)	Num of Fire stations (Operational)	Num of Fire stations (under Construction)	Num of Fire stations proposed for future expansion	Any additional Information

Please add additional sheets if required

C. Details of Proposed Fire Station

S.N.	Name of the Site for Proposed Fire Station	District	**Status of Work in Progress**, (e.g. approval awaited, plan cleared, land acquired/ allocated, % of construction completed)	Remarks

Please attach additional sheets if required

D. Human Resources and Staff Welfare (Please attach additional sheets for each zonal, divisional, and sub-div. Fire Stations)

Organization Structure and Human resources (Operational Staff including higher level officers)

By State/ zonal Level Zone Name ……..

Level	Designation	Pay-scale	Duty Pattern	Number of sanctioned posts	Total Number of Filled posts	Total No of Vacant posts	Remark, if any
11	Director General / Asst. Director General						
10	Director / Deputy Director						
9	Divisional Officer (D.O.)/ Fire Prevention Officer						
8	Station Officer (St. O)						
7	Sub Officer (S.O)						
6	Fire Engine Operator cum Driver (FEOD)/ Leading Fire Operator (LFO)						
5	Fire Operator (FO)						
4	Cleaner/ Sweeper						

Level	Designation	Pay-scale	Duty Pattern	Number of sanctioned posts	Total Number of Filled posts	Total No of Vacant posts	Remark, if any
3	Other Officers (Chief Mobilizing Officer/ Mobilizing Officer/ Asst. Mobilizing Officer)						
2	Other Officers (Mechanical Superintendent/ Foreman)						
1	Other Staffs (Mechanic/ Mechanic-Helper)						
Any Other							

Please attach additional sheets if required for each Fire zonal region/ division human resources *(broad categories of designations are mentioned below for reference)*

Level 10*: Director General/ Director;* ***Level 9****: CFO/ CO;* ***Level 8****: Deputy CFO/Joint Director;* ***Level 7****: AD/Deputy Controller/Deputy Director/DO;* ***Level 6****: ADO/ Inspector/EO/Fire Supervisor;* ***Level 5****: DFO/ADFO/AFO/Fire In-charge;* ***Level 4****: St.O/Sub Inspector/Station In-charge/ASt O./AEO;* ***Level 3****: S O/Assistant Sub Inspector/ASO/Sub-Fire Officer/;* ***Level 2*** *: LFM/ Mechanic Driver/Head Constable/Store Superintendant;* ***Level 1*** *: FM/ FM Driver/Radio Technician/ SGFM/ Driver/ Police Constable/ Wireless Technician/ Radio Technician/ Asst FM/ Sanitary Inspector, FO/FO Driver/Driver Operator/Driver/Ambulance Driver/ Clerk;* ***Level 0:*** *Cleaner, Fire Coolie, Supporting Staff, Attendant, Labourer, Peon, Security Guard, Tindal.*

Recruitment Rules for entry level in organization chart (Please provide copy of State recruitment rules in detail)

Level	Designations	Essential qualification as per recruitment rule	Preferential	Training / Experience	Departmental Reservation policy if any
8					
7					
6					
5					
4					
3	FEOD				
2	Leading Fire Operator				
1	Fire Operator				
Any Other					

Staff Welfare:

Please list the Staff welfare measures being followed in the State:

Ration money: Rs…….
Sports facilities: …….
TV for common room: …….
Cash rewards and recognition: Rs…….
Incentives, through benevolent fund: Rs…….. ……
Insurance: Rs…….....
Other schemes etc……

Measures to Improve Staff Efficiency

S. no	Type of Drill	Frequency *(Daily/Weekly, Bi-Monthly, Quarterly)*	Remarks
1.	**Squad Drill**	Daily	
2.	**Pump/ Hose Drill - Dry**	Weekly	
3.	**Pump/ Hose Drill - Wet**	Bimonthly	
4.	**Ladder/ Rescue Drill**	Monthly	
5.	**Rope Rescue Drill**	others	
6.			
7.			

E. Training Details

Name of State Training Centre and address: ……

……

Number of Faculty/Trainers with Designation: ……

……..

……

……

S. N.	Name of Training Courses	Duration (months)	Maximum capacity	Number of personnel Trained annually	Year
1					
2					
3					
4					
5					
6					

Training obtained by fire-staff annually (sub-officer course and above)

Year	Type of Training Obtained/ name of training course	Within State Training Centre	At NFSC, Nagpur	Other State Training Centre (mention City, State)	Foreign country	Total Number of personnel Trained
2011						
2010						
2009						
2008						
2007						
2006						

Please provide yearly break-up for the last 5 years

Training Centre Infrastructure for basic training and sub-officer course: Provide details of facilities at the training centre, short comings etc.

……
……
……
……
……

F. Inventory of Equipment

Division Wise Fire Vehicles

Fire Station Name ----------

Division/ Station Name	Number of Deployment of fire fighting units											
	water tender	Water Browser	Foam Tender	Dry Chemical Powder Tender	Emergency Tender/Rescue Tender/ Rescue Responder	Motor Pump	Motor Cycle	BA Van	Hose Tender	Aerial Ladder Platform	Hazmat Van	Others

Please provide separate list for working, non-working and under procurement

Additional Equipment

Fire Station / District/ Division Name ----------

Division/ Station Name	Gas Cutters	Bolt Cutters	B.A. Sets with B.A. Comp	Circular Saw with Diamond Blade(Electric)	Electric Hammer	Chain Saw-Concrete	Chain Saw-Wood	Pneumatic Lifting bags	Hydraulic Spreader and Cutters/ Cobmi-tool	Rescue Boats

Any other not covered in above list

……

Please provide separate list for each division/district

G. Communication between HQ and Zonal/district office

Details of Control rooms

Centralized Control Room for the entire State: Yes / No, if yes please provide location and street address:

S.No	Name of Control Room for the Division/district	Size in terms of number of Emergency Fire Telephone (EFT) lines	Command and Control		Remark
			Manual	Computerized	
1					
2					

State Communication centre is connected with Zonal/District office through: Internet/Intranet/Wireless/Telephone lines

State Communication centre is connected with individual Fire Station through: Internet/Intranet/Wireless/Telephone lines

Frequency of Fire Report Transmission:

From Individual Fire Station to District/Zonal Hq: Instantaneous, daily, weekly, bi-weekly/monthly
From Individual Fire Station to State Hq: Instantaneous, daily, weekly, bi-weekly/monthly
From Individual District/Zonal Hq to District/Zone Hq: Instantaneous, daily, weekly, bi-weekly/monthly

Does State have a communication policy?*, if yes, please provide a copy of the report:*

Does State have any approved plans to improve communication?, if yes, please provide a copy of the plan:

H. Financial Details

Name of Zone ……

(If information provided zone wise)

Budget for year ……..

Plan			Non-Plan		
Capital (Rs)	**Revenue (Rs)**		**Capital (Rs)**	**Revenue (Rs)**	
	Equipment			Equipment	
	Maintenance			Maintenance	
	POL			POL	

Please repeat if information is available for each zone/ State more than one year

I. Fire and other Incidences Summary (last 5 years)

Please provide information for each Fire Station, and District/division and Headquarter Level summary

Name of Station ……

Number of Fire and other Incidence (P= Public and FS= Fire Service)

Year	Total Calls (A+B+C+D)	Total Fire Incidence (A)	Occupancy wise break up of fire incidence				Total Rescue incidence (B)	Break up of Rescue incidence				Special service calls (C)	False/ malicious calls (D)	Total injured		Num of Deaths	
			Residential	Industrial	Institutional/ commercial	Others		Road Accidents	Building collapse	Animal	Others			P	FS	P	FS
2010-11																	
2009-10																	
2008-09																	
2007-06																	
2006-07																	

Severity of fire incidences at each Fire Station, and District/division and Headquarter Level summary

Year	Total no of Small Fire Incidence	Total no of Medium Fire Incidence	Total no of Serious Fire Incidence	Brief description of Major Fire Incidence
2010-11				
2009-10				

Year	Total no of Small Fire Incidence	Total no of Medium Fire Incidence	Total no of Serious Fire Incidence	Brief description of Major Fire Incidence
2008-09				
2007-06				
2006-07				

(Attach additional sheets for each region/ and addition year)

Please provide definition of fire types

……

……

……

Severity of events: Small fire – estimated loss of Rs. 10 Lakhs, Medium – Rs. 10 to 50 Lakhs, Serious - >Rs. 50 Lakhs, any fire where there is human death to be consider as Serious fire. (As per the compendium, even there is causalities, it is considered as serious, but the causality severity not mentioned

J. Public Awareness Programmes

Public Awareness Programmes organized in last One Year

Name of Zonal/district Office …….

Total no. of programs in the year including Fire Safety Week (a +b + c)	**Total no. of persons attended** (d + e + f)	**No of Programs Organized**			**No of Persons attended**			**Brief description of the programmes**
		Govt./ PSU (a)	**Pvt. Locations** (b)	**Schools** (c)	**Govt./ PSU** (d)	**Pvt. Locations** (e)	**Schools** (f)	

K. Suggestions/views of the department for improvement of fire and emergency service in the State

1.
2.
3.
4.
5.
6.
7.
8.

Contact person Details for Communication at RMSI (On behalf of DGCD, Fire Project Cell):

Postal Address:

Mr Sushil Gupta
General Manager,
Risk Modeling and Insurance,
A-7, RMSI, Sector-16, NOIDA
PIN 201301 (U.P.) INDIA

Mobile- +91 9818798715
Phone (Office): +91 0120 2511102/ 2512101 ext 2612
(Office): +91 120 4040512 (direct)
Fax (Office): +91 0120 2511109/ 2510963
email<Sushil.Gupta@rmsi.com>
<sushilgupta74@yahoo.com>
www.rmsi.com

Annex-2: Fire Station Survey Form

This questionnaire is prepared in consultation with Directorate General NDRF & CD for collecting basic information all fire infrastructure in the country as part of the project "Fire-Risk and Hazard analysis in the Country" with an objective to Prepare Capital Investment and Institutional Strengthening Plan for Accelerated Development of Fire and Emergency Services in the Country. All information collection through this questionnaire will be kept confidential and will only be used for the preparation of the report and other deliverables of the project. Directorate General NDRF has entrusted RMSI Private Limited to carry out this assignment and State Officials and Official in-charge of Fire Station are requested to provide required authentic information which is very important for preparation of this report and future development plans of the department.

SW FS Ref #.....

A. Fire Station General Information

State	District	City/ Town	Block / Tehsil	Municipality	Latitude , Longitude (to be filled by RMSI)(DDM format)		ID

Fire Station Name .....

Address of the Fire Station (with landmark) .....

Station Phone number(s) with STD code: 1) ..... 2)..... 3).....

Fax No: ..... Emergency No: .....

Fire Station Type based on served area: Urban ☐ ***Rural*** ☐

Name of officer in-charge ..... Designation ..... Mobile number *(officer in-charge)* : .....

Fire station is under the administration of (put tick mark in the box)

State Government ☐ Municipal Corporation ☐ Police Department ☐ Others specify.....

The Fire Station falls under the jurisdiction of (Division/Zone/Municipality) -.....

Name of Administrative District/Divisional/Zonal Fire Officer- .....Mobile.....

Address/location of District/Divisional/Zonal HQ- .....

Number of total Fire Stations fall under above jurisdiction/ administration- .....

Surveyed by: **Date:**

(Signature of Witness from Fire Department)

Name & Designation

B. Fire Station Infrastructure Details

Does Fire station has its own building: Yes in good condition , Yes, but condition is not good & need new building.

No permanent building

If Fire Station is temporarily operational from borrowed/ rented building of ……(Private, Municipality, Police, any other ……)

Please mentioned the status : Land acquired -…Yes/ No… and building under construction -……Yes/ No….

How many bay station should be in new Fire Station building

If permanent building - Fire station belongs to State Fire Department / State Government / Municipal Corporation / Police fire Service/ any other

Provide building details

Number of Floors	Number of Rooms	Approx Plot Area (SQM)	Approx Built-up Area (SQM)

Whole Fire Station Building Structure Type : Pacca - Reinforced concrete (RCC) frame structure Pacca -Masonry with RCC Roof
Pacca Masonry walls with flexible Roof Kachha masonry walls with Tin Roof Kaccha Tin shade Temp Porta- cabins
Kaccha wooden structure with tin Roof Others kaccha type specify ……

Mixed (kachha and pacca) (in case different parts of Fire Stations has different structure types)

If whole station building is not a permanent (Pacca) building structure and need new partial building, please specify the details of partial components that needs to be build

Vehicle bays (with num of bays) Fire station office building Barracks Staff quarters

Age of building structure/ year of construction- …….. (write year in the blank space and tick in the box below)

Less than 5yrs 5-10 yrs 10-20yrs More than 20 yrs

Number of Bays/Garages for the Fire Vehicles - How many fire vehicle parked within Bay/ Garage

Structure of Bay/ Garage- Pacca- RCC/Masonry Kaccha Tin Shade Open any other kaccha ……..

Availability of Staff Quarters - Yes No If Yes, mention numbers……

Availability of Barracks - Yes No , If Yes, mention numbers and total capacity……

Availability of T.V. in Barracks - Yes ☐ No ☐ Any other entertainment indoor/ outdoor……

Provision of Mess/ Canteen facilities in Fire Station- Yes ☐ No ☐

Availability of Watch room /Control Room- Yes ☐ No ☐ If yes, is it computerized - Yes ☐ No ☐

Is Watch room /Control room online/ internet connected with zonal/ headquarter Yes ☐ No ☐

Availability of drill/ parade ground - Yes ☐ No ☐ Availability of hose drying/ drill tower - Yes ☐ No ☐

Power Supply in the Fire Station Watch Room/ Control Room -

Electricity: Uninterrupted 24 Hrs ☐ Interrupted supply ☐ Availability of standby generator ☐ Inverter for control room ☐

Does the Fire Station maintain ambulance unit ? Yes ☐ No ☐

C. Communication Systems

1. Between Public and Fire control room/ watch room
   i. Landline Telephone: Yes ☐ No ☐ , If 'Yes', mention number of land line phone in operation…….
   ii. Emergency phone number- 101 or,……..Connection Type : Direct ☐ Indirect ☐ Not Available ☐
2. Hotline between Important agencies and Fire control room
   Oil industries/ storage ☐ Airport ☐ PCR ☐ Banks ☐ District Magistrate Office ☐
   Others specify……
3. Automatic Fire Alarm between High Rise Buildings and Fire Station: Yes ☐ No ☐ If yes, num. of buildings …….
   If with any other agency, specify: ……

Availability of GPS on Fire Engines and other vehicles - Yes ☐ No ☐ , If Yes, mention number of vehicles: ……..

4. Between Fire Station Control Room and Fire Vehicles
   Static Wireless Set in watch room Yes ☐ No ☐ If 'Yes', mention number of operational phones …….
   Number of Mobile wireless sets: ☐ Number of Walky-Talky: ☐ Number of Satellite Phones: ☐
5. Type of Frequency used- HF ☐ VHF ☐ UHF ☐

D. Water Supply Details for Fire Fighting Purpose

Whether 24 hours water available in fire vehicles? Yes ☐ No ☐

Water sources used by Fire Vehicles within Fire station

Direct supply… ☐ b) Overhead tank ☐ c) Pumping from underground tank … ☐

d) Pumping by Tube well ☐ e) any other ……

Any storage of water within Fire Station for fire vehicles- Yes ☐ No ☐

Water sources regularly used by Fire Vehicles outside Fire station (also mention distance in km from Fire Station)

City over-head tank with coupling arrangements ☐ River ☐ Stream ☐ Well ☐ Pond ☐ Lake ☐

Other location / static fire hydrant available in the vicinity - Yes ☐ No ☐ , If 'Yes', provide number and distance (km) ……,……..…

Overall, is there any scarcity of water for fire vehicles- Yes ☐ No ☐

E. Human Resources

Permanent Staff Details- :

S. no.	Designation	Total Number of Permanent Working Staff	Duty pattern/ Shifts (hrs)	Vacant, but sanctioned posts	Numbers of temporary/ contract persons (if any)
1.	Senior Fire Officers		24 hrs		
2.	Station Officer (St.O)/(FSO)				
3.	Sub Officer (S.O)/FSSO				
4.	Leading Fire Men (LFM)				
5.	Driver				
6.	Fire Man (FM)				

S. no.	Designation	Total Number of Permanent Working Staff	Duty pattern/ Shifts (hrs)	Vacant, but sanctioned posts	Numbers of temporary/ contract persons (if any)
7.	Sweeper				
8.	Cook				
9.	Any other				
10.	Any other				

Total Permanent Staff in the Fire Station [ ] Details of Temporary staff/ Contract persons (if any)……

***Level 10**: Director General/ Director; **Level 9**: CFO/ CO; **Level 8**: Deputy CFO/Joint Director; **Level 7**: AD/Deputy Controller/Deputy Director/DO; **Level 6**: ADO/ Inspector/EO/Fire Supervisor; **Level 5**: DFO/ADFO/AFO/Fire In-charge; **Level 4**: St.O/Sub Inspector/Station In-charge/ASt O./AEO; **Level 3**: S O/Assistant Sub Inspector/ASO/Sub-Fire Officer/; **Level 2** : LFM/ Mechanic Driver/Head Constable/Store Superintendant; **Level 1** : FM/ FM Driver/Radio Technician/ SGFM/ Driver/ Police Constable/ Wireless Technician/ Radio Technician/ Asst FM/ Sanitary Inspector, FO/FO Driver/Driver Operator/Driver/Ambulance Driver/ Clerk; **Level 0:** Cleaner, Fire Coolie, Supporting Staff, Attendant, Labourer, Peon, Security Guard, Tindal.*

Mode to maintain Physical Fitness

S. no	Type of Drill	Yes/No	S. no	Type of Drill	Yes/No
8.	P.T./ Parade	Daily/……	4.	Vehicle maintenance	Weekly/Monthly/Quarterly/……
9.	Fire Drill	Daily/Weekly……	5.	Any other	……
10.	Games	Daily/ ……			

F. Fire Risk Covered in the Area under Jurisdiction

Jurisdiction of Fire Station (in approx sq km) ……*(collect current* jurisdiction *map from the Fire Station)*

Fire Risk	If Yes, Brief description of its Name, Type, Risks involved	Dist. From FS (km)	No. of Units
Old city Area/ congested areas			
Jhuggi -Jhopdi (Thatched House Clusters)			
Industrial Area (also mention whether small/medium/large scale)			
Industrial Area (any other)			
High-Rise Buildings (>15m height)			
Major Scrap yards (Iron/Wood etc)			
Oil Mills/Storage/Processing Units			
Refineries			
Underground Gas pipe lines			
LPG Bottling Plant			
Water –Treatment Plant (chlorine cylinders)			
Bulk Fuel Storage Area/ Petrol Pump			
Major Hazardous (MAH) units			

Fire Risk	If Yes, Brief description of its Name, Type, Risks involved	Dist. From FS (km)	No. of Units
Explosive manufacturing/stores			
Port/ dockyard area			
Railway Station			
Airport Area			
Wild Forest-Area			
Vicinity to Coast			
Army Ammunition Storage			
Cross-Border Shelling			
Any other			
Any other			

Availability of water for Fire Fighting in High-Rise Building as per National Building Code (NBC) All ☐ Few ☐ No ☐

Applicability of NBC/ local laws in District/ State for fire safety of High-Rise building - All ☐ Few ☐ No ☐

Applicability of NBC/ local laws for fire safety in industrial and other buildings- All ☐ Few ☐ No ☐

G. Status of Fire Fighting Vehicles (attach separate sheet if number of vehicle are more than space provided below)

(Total number of Fire Fighting Vehicles at station ……..…)

Sl No	Fire Vehicle Type	Fire Dept. Vehicle Number	Vehicle Registration Number	Make	Year of Fabrication (age)	Size/ water capacity (ltr)	Pumping capacity/ size (LPM)	Comm. System mounted on vehicle	If not in running condition (off road)
	Water Tender (WT) 1							Wireless / GPS	Minor/ Major/Condemned
	Water Tender (WT) 2							Wireless / GPS	Minor/ Major/Condemned
	Water Tender (WT) 3							Wireless / GPS	Minor/ Major/Condemned
	Water Bowser (WB) 1							Wireless / GPS	Minor/ Major/Condemned
	Water Bowser (WB) 2							Wireless / GPS	Minor/ Major/Condemned
	Foam Tender (FT)							Wireless / GPS	Minor/ Major/Condemned
	DCP Tender					kg		Wireless / GPS	Minor/ Major/Condemned
	Multi-purpose Tender							Wireless / GPS	Minor/ Major/Condemned
	Hose Tender (HT)							Wireless / GPS	Minor/ Major/Condemned

Sl No	Fire Vehicle Type	Fire Dept. Vehicle Number	Vehicle Registration Number	Make	Year of Fabrication (age)	Size/ water capacity (ltr)	Pumping capacity/ size (LPM)	Comm. System mounted on vehicle	If not in running condition (off road)
	Rescue / emergency tender/ responder							Wireless / GPS	Minor/ Major/Condemned
	Advanced Rescue Tender (with inst. to handle hazardous materials)							Wireless / GPS	Minor/ Major/Condemned
	Aerial Ladder Platform (ALP)							Wireless / GPS	Minor/ Major/Condemned
	Turn Table Ladder (TTL)							Wireless / GPS	Minor/ Major/Condemned
	Hazmat Van							Wireless / GPS	Minor/ Major/Condemned
	B.A. Van							Wireless / GPS	Minor/ Major/Condemned
	Quick Response Tender (QRT)							Wireless / GPS	Minor/ Major/Condemned
	Motor Cycle Mist 1							Wireless / GPS	Minor/ Major/Condemned
	Motor Cycle Mist 2							Wireless / GPS	Minor/ Major/Condemned
	Rescue Boat							Wireless / GPS	Minor/ Major/Condemned

Sl No	Fire Vehicle Type	Fire Dept. Vehicle Number	Vehicle Registration Number	Make	Year of Fabrication (age)	Size/ water capacity (ltr)	Pumping capacity/ size (LPM)	Comm. System mounted on vehicle	If not in running condition (off road)
	Fire Boat							Wireless / GPS	Minor/ Major/Condemned
	High Pressure Light Van							Wireless / GPS	Minor/ Major/Condemned
	Any Other							Wireless / GPS	Minor/ Major/Condemned

Details of Vehicles- other than Fire Fighting/ Official Use

Sl No	Fire Vehicle Type	Vehicle Registration Number	Make	If allotted to individual	Comm. System mounted on vehicle	If not in running condition (off road)
	Ambulance				Wireless / GPS	Minor/ Major/Condemned
	Motor cycle (office use)				Wireless / GPS	Minor/ Major/Condemned
	Motor cycle (office use)				Wireless / GPS	Minor/ Major/Condemned
	Jeep/ Gypsy (office use)				Wireless / GPS	Minor/ Major/Condemned
	Jeep/ Gypsy (office use)				Wireless / GPS	Minor/ Major/Condemned
	Bus/ Mini Bus				Wireless / GPS	Minor/ Major/Condemned

Sl No	Fire Vehicle Type	Vehicle Registration Number	Make	If allotted to individual	Comm. System mounted on vehicle	If not in running condition (off road)
	Other Transport Vehicle				Wireless / GPS	Minor/ Major/Condemned
	Any other				Wireless / GPS	Minor/ Major/Condemned

H. Specialized Equipment provided (mention total quantity for all equipment including vehicle and storage)

Equipment	Number/ Quantity	Equipment	Number/ Quantity
Self rescue units ropes/slugs (ft)		Ladders (extension + hook)	
Foam compound (ltr.)		Hand controlled nozzle/ branches	
Foam making branches (tool)		Fog/ Mist Branch	
Breathing Apparatus (B.A.) Sets		B.A. Compressor	
Personal Protection Suits (multi-layer suits etc)		Combi-Tool	
Personal Protection Equipment (PPE) (protection suit with BA sets etc)		Jumping cushion / sheets	
Chemical Suit		Dry Chemical Powder (DCP) Extinguisher	
Lock cutter		First-Aid Box	
Hydraulic Rescue Tool (spreader, cutter, rams)		Portable Pump	

Equipment	Number/ Quantity	Equipment	Number/ Quantity
Electric powered hammer/ floor breaker		Submersible Pumps	
Electric chain saw for wood		Pneumatic Lifting Bag (capacity -Ton)	
Electric powered concrete cutter saw		Thermal Imaging Camera	
Electric chain saw for concrete		Life Locator Equipment	
Petrol Powered Concrete Cutter Saw		Chemical Leakage/Gas Detection Kit	
Petrol Chain Saw for Concrete		Radio-active Leakage Detection Kit	
Petrol Chain Saw for Wood		Curtain Spray Nozzle	
Hydraulic Chain Saw for Wood		Escape Chutes (length m)	
Long Branch		Search Light	
Short Branch		Generator Set	
Diffuser		Robots if any	
Lifebuoy		Fire-Curtain	
Life Jacket		Floating Pump	
Diving Suit (Wet / Dry)		Smoke Exhauster/ PPV	
Fire Beater		Any Other…	
Inflatable Lighting Tower		Any Other…	

I. Other Dress Accessories

Normal Dangri	Individual issue / Group use	
Helmets (steel/leather/fiber)	Individual issue / Group use	
Gum Boots	Individual issue / Group use	
Fire retardant Dangri	Individual issue / Group use	
Any Other		

Any other incentives for staff such as ration money, insurance etc

Ration money – Yes ☐ No ☐ Amount (Rs) ……..

Insurance - Yes ☐ No ☐ Amount (Rs) ……..

J. Suggestions/views of fire-official for improvement of fire and emergency service at the station

1)……
2)……..……

3) ……

K. Other Fire Station (nearby) not belonging to Fire Service Department

Airport / Defence Installations / Power Plant (all type) / Oil Refineries / Private Agency / Other Industries etc.

a) Name/Agency-…… cooperation with the above Fire Station …….
(in large fire only/ all small & big fires/ no cooperation)

Details of any mutual-aid scheme / ……

b) Name/Agency-…… cooperation with the above Fire Station …….
(in large fire only/ all small & big fires/ no cooperation)

Details of any mutual-aid scheme / ……

c) Name/Agency-…… cooperation with the above Fire Station …….
(in large fire only/ all small & big fires/ no cooperation)

Details of any mutual-aid scheme / ……

L. Fire Calls and other Incidence Statistics (last 3-5 years) Name of Fire Station ……

Monthly number of fire calls and other special service calls (use additional sheet to pen down the Fire Statistics for last 5 years)

Month-Year	Total Calls (A+B+C+D)	Total Fire Incidence calls (A)	Occupancy wise break up of fire incidence (if any)				Total Rescue incidence (B)	Break up of Rescue incidence (if any)				Special service calls (C)	False/ malicious calls (D)	Total injured		Total Death
			Residential	Industrial	Institutional/ commercial	Others		Road Accidents	Building collapse	Animal	Others			Minor	Major	
12-Jul																
12-Jun																
12-May																
12-Apr																
12-Mar																
12-Feb																
12-Jan																
11-Dec																
11-Nov																
11-Oct																
11-Sep																
11-Aug																
11-Jul																
11-Jun																
11-May																
11-Apr																

Month-Year	Total Calls (A+B+C+D)	Total Fire Incidence calls (A)	Occupancy wise break up of fire incidence (if any)				Total Rescue incidence (B)	Break up of Rescue incidence (if any)				Special service calls (C)	False/ malicious calls (D)	Total injured		Total Death
			Residential	Industrial	Institutional/ commercial	Others		Road Accidents	Building collapse	Animal	Others			Minor	Major	
11-Mar																
11-Feb																
11-Jan																
10-Dec																
10-Nov																
10-Oct																
10-Sep																
10-Aug																
10-Jul																
10-Jun																
10-May																
10-Apr																
10-Mar																
10-Feb																
10-Jan																
9-Dec																
9-Nov																
9-Oct																

Month-Year	Total Calls (A+B+C+D)	Total Fire Incidence calls (A)	Occupancy wise break up of fire incidence (if any)				Total Rescue incidence (B)	Break up of Rescue incidence (if any)				Special service calls (C)	False/ malicious calls (D)	Total injured		Total Death
			Residential	Industrial	Institutional/ commercial	Others		Road Accidents	Building collapse	Animal	Others			Minor	Major	
9-Sep																
9-Aug																
9-Jul																
9-Jun																
9-May																
9-Apr																
9-Mar																
9-Feb																
9-Jan																
8-Dec																
8-Nov																
8-Oct																
8-Sep																
8-Aug																

Please send Fire call statistics to :

Mr. Sushil Gupta (General Manager), Risk Modeling & Insurance,
A-7, RMSI, Sector 16, Noida 201301, Fax: 0120 2511109
Mobile: 08826100332, Phone: 0120 4040512(direct)
Sushil.Gupta@rmsi.com

PART B

7 Delhi State

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8 Rajasthan State

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9 Maharashtra State

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10 Jammu and Kashmir State

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11Puducherry UT

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12 Andaman & Nicobar Islands UT

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13Chandigarh UT

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14Haryana State

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15Himachal Pradesh State

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16Punjab State

16.1Introduction

Punjab State, with an area of 50,362 km^2, is located in northwestern India extending from the latitudes 29.30° North to 32.32° North and longitudes 73.55° East to 76.50° East (Figure 16.1). The State shares borders to the west with Pakistan, to the north with Jammu and Kashmir, to the northeast with Himachal Pradesh, and to the south with Haryana and Rajasthan. It forms a part of the larger Punjab region. The State capital is the UT of Chandigarh, which is also the capital of the neighboring State, Haryana. And Ludhiana, Amritsar, Patiala, Jalandhar, Firozpur, Bathinda, and Mohali are some of the major cities in the State.

The Punjab province was divided after partition of British India between India and Pakistan in 1947. The Indian Punjab was further divided in 1966, when parts of it formed the new States of Haryana and Himachal Pradesh.

Agriculture is the largest industry in Punjab and the State is the largest single provider of wheat to India. Other major industries include the manufacturing of scientific instruments, agricultural goods, electrical goods, financial services, machine tools, textiles, sewing machines, sports goods, starch, tourism, fertilizers, bicycles, garments, and the processing of pine oil and sugar. The State also has the largest number of steel rolling mills in India.

The State's climate is characterized by extreme hot conditions (40°C) during the summers and extreme cold conditions (-2°C) during the winters . Extreme temperatures can reach 47°C in summer and −4°C in winter. The foothills lying to the northeast near the Himalayas receive heavy rainfall, whereas the area lying further south and west receives less rainfall and experiences higher temperatures. Average annual rainfall ranges between 960 mm in the sub-mountain region and 460 mm in the plains.

Most of the State lies in a fertile alluvial plain with many rivers and a highly developed and extensive irrigation canal network. The average elevation in the State is 300 meters above msl and the highest point does not rise above 500 meters.

Except for a very small portion of southwest Punjab under seismic zones II (low-damage risk zone), major areas of the State lies in seismic zone III (moderate-damage risk zone), and IV (high-damage risk zone).

As per the 2011 census, Punjab ranks 15th in terms of total population among the Indian States. It accounts for 2.29% of the total population and 1.5% of the total land area of the country. The total population of the State is 2.77 Crores and with a population density of 550, it is more densely populated than the national average of 382 (Table 16-1). Ludhiana (975) is the most densely populated district in Punjab. The State ranks 21st among the States in terms of literacy rate (76.7%).

Presently, Punjab State Fire Services is headed by a Director, Department of Local Govt., Punjab, one State Chief Fire Officer (officiating), and one Assistant Divisional Fire Officer (ADFO) in each district of Amritsar, Barnala, Fathehgarh Sahib, Gurudaspur, Jalandhar, and Patiala.

Currently, there are 48 Fire Stations operational in Punjab, and on an average serving more than 5.7 lakhs population per Fire Station (Figure 16.2, and Table 16-2).

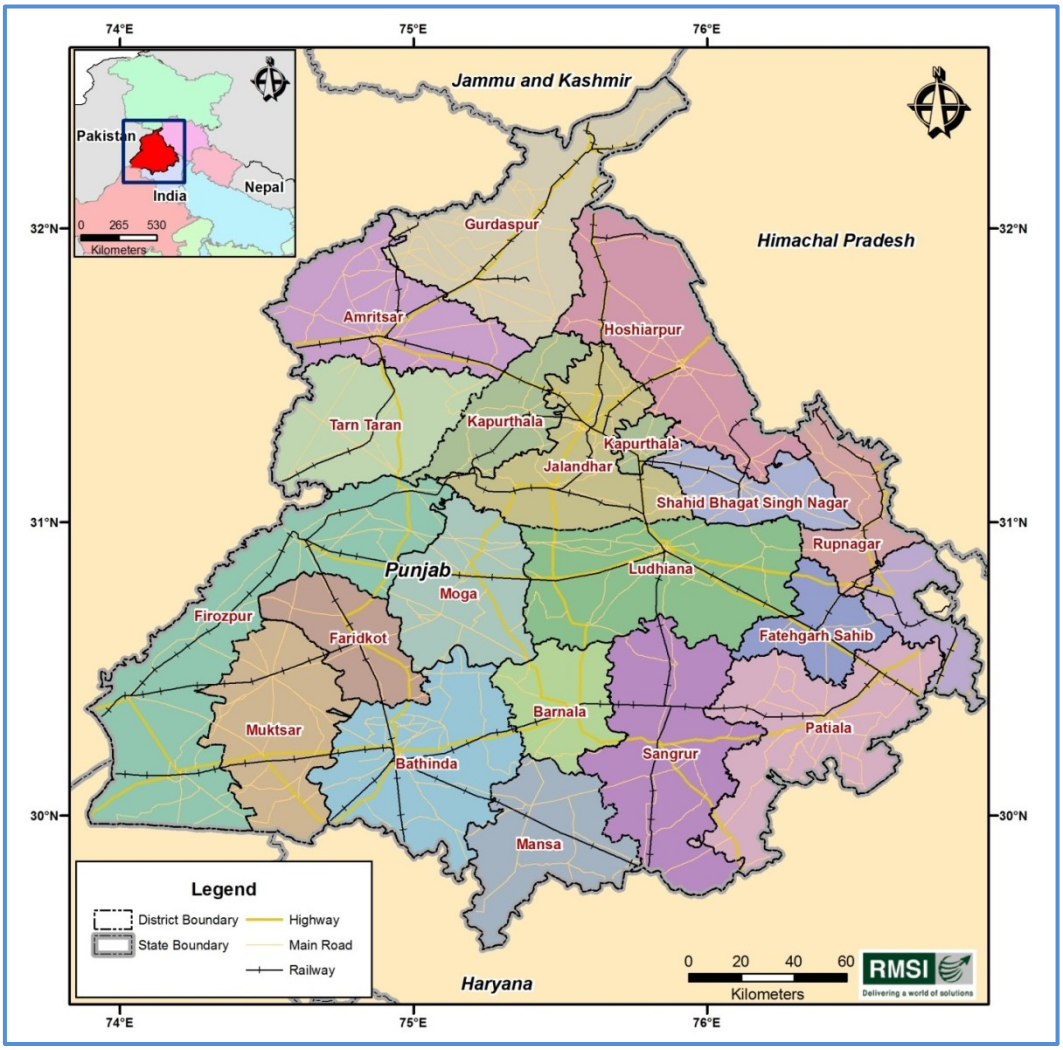

Figure 16-1: District map of Punjab with major road and rail network

Table 16-1: Punjab Demography as per Census 2011

Punjab State			
No. of Districts	20		Percentage of Urban Population
No. of Sub-Districts	72		
No. of Towns	222		37
No of Villages	12,673		
Population			
	Total	**Rural**	**Urban**
Persons	27,704,236	17,316,800	10,387,436
Males	14,634,819	9,086,466	5,548,353
Females	13,069,417	8,230,334	4,839,083
Sex Ratio (females per 1,000 males)	893	843	851

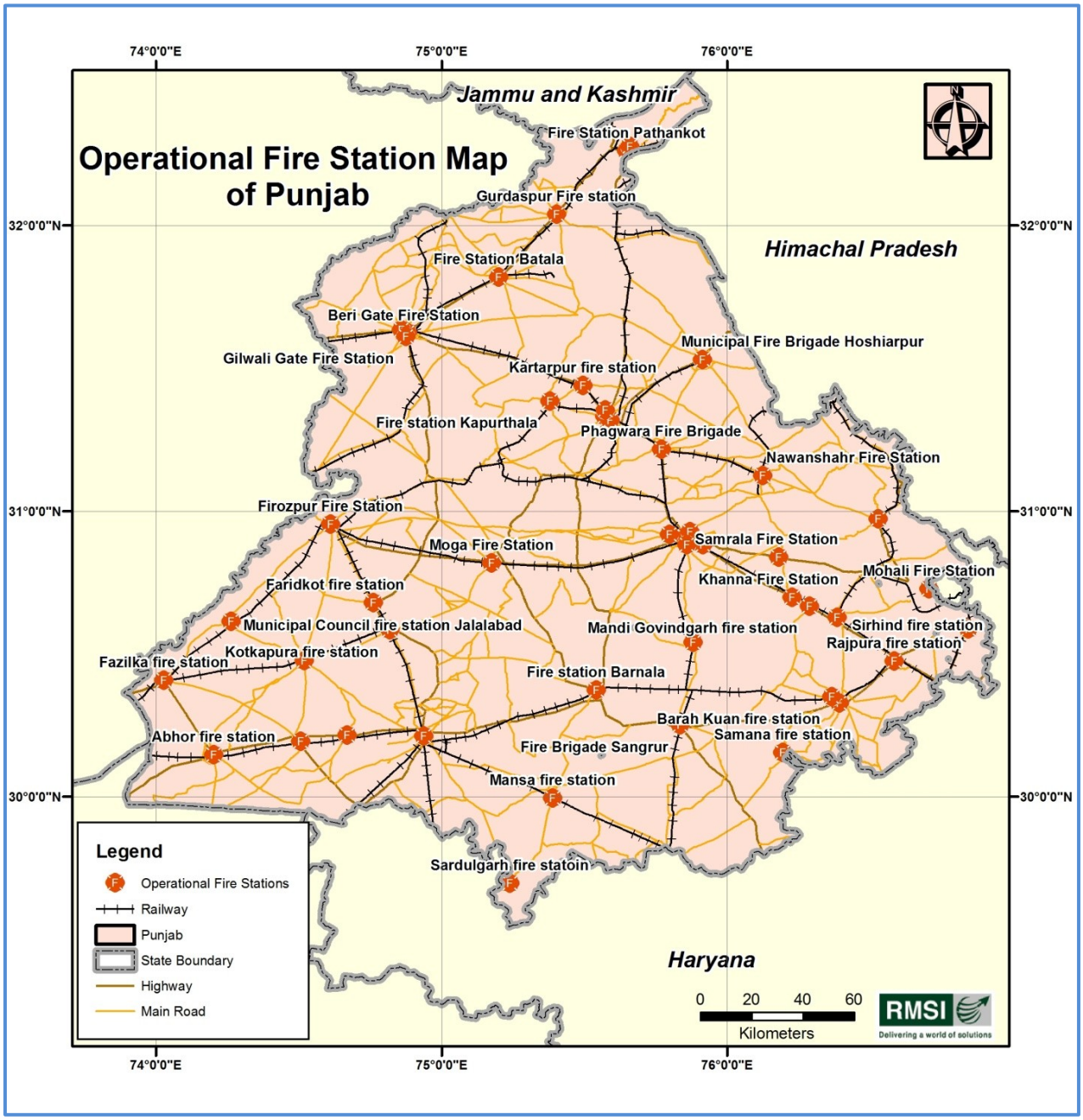

Figure 16-2: Location of operational Fire Stations in Punjab State with road and rail networks

Table 16-2: Summary of District level operational Fire Stations in Punjab

District	Area (in sq km)	Total Population (Census 2011)	Population Density	Number of Fire Station	Average Population per Fire station
Amritsar	2651.83	2,490,891	939	4	622,723
Barnala	1406.61	596,294	424	1	596,294
Bathinda	3372.41	1,388,859	412	1	1,388,859
Faridkot	1467.49	618,008	421	2	309,004
Fatehgarh Sahib	1146.36	599,814	523	2	299,907
Firozpur	5264.10	2,026,831	385	4	506,708
Gurdaspur	3605.46	2,299,026	638	4	574,757
Hoshiarpur	3371.02	1,582,793	470	1	1,582,793
Jalandhar	2605.16	2,181,753	837	4	545,438
Kapurthala	1663.27	817,668	492	2	408,834
Ludhiana	3708.69	3,487,882	940	7	498,269
Mansa	2213.16	768,808	347	2	384,404
Moga	2241.89	992,289	443	1	992,289
Muktsar	2638.20	902,702	342	3	300,901
Patiala	3372.76	1,892,282	561	4	473,071
Rupnagar	1371.67	683,349	498	1	683,349
SAS Nagar	1068.38	986,147	923	2	493,074
Sangrur	3589.06	1,654,408	461	2	827,204
Shahid Bhagat Singh Nagar	1278.26	614,362	481	1	614,362
Tarn Taran	2408.21	1,120,070	465	0	0
Total	**50,444**	**27,704,236**	**11,002**	**48**	**577,172**

16.2 Field Surveys of Fire Stations for Data Collection

To have first-hand information on the distribution of the fire service stations across the country, trained human resources, infrastructure availability and their status, RMSI project team has carried out detailed surveys of Fire Stations and collected data though individual “Fire Station Survey Form” and Fire Headquarter Data Collection Form” as shown in Annexure 1 & 2. The collected information for each Fire Station are following categories.

- Fire Station General Information
- Fire Station Infrastructure Details
- Communication Systems
- Water Supply Details for Fire Fighting Purpose
- Human Resources
- Fire Risk Covered in the Area under Jurisdiction
- Status of Fire Fighting Vehicles
- Specialized equipment provided (specify whether kept in vehicle or in stores)
- Other Accessories
- Fire Calls and other Incidence Statistics (last 3-5 years)

Besides the collection of field survey data, RMSI team has also collected the location coordinates (latitude, longitude) of Fire Stations using GPS. The geographical coordinate information is used for plotting all the Fire Station locations in the map to perform GIS based spatial analysis. This is also used in the analysis of distribution of new proposed Fire Stations and gap analysis on fire-infrastructure, based on risk-category, response time, and population.

16.3 Fire Infrastructure Gap Analysis

16.3.1 Fire Station Location Gap Analysis

As discussed in section 6.2.5, response time of 5-7 minutes in urban areas and 20 minutes in rural areas has been considered as appropriate. Considering the response time, using network analysis and travel distance, ideal jurisdiction areas have been delineated for all the operating Fire Stations. In delineation of ideal jurisdiction areas, built-up areas such as various types of residential areas and industrial areas with estimated population has also been considered. After delineation of ideal jurisdiction area, un-served gaps in urban agglomeration have been identified. These un-served gaps are also shown to be filled by new proposed urban Fire Stations. Table 16-3 shows district level summary of number of operational and new proposed Fire Stations with population covered within their ideal jurisdiction areas.

Rural areas are also covered with new rural Fire Stations. Locations of rural Fire Stations are demarcated to the nearest bigger village having population more than 5,000 - 10,000 or major roads intersection. District level numbers of new proposed rural Fire Stations are given in Table 16-3. Figures 16-3 to 16-17 depict representative detailed maps showing delineated ideal jurisdiction areas for operational and new proposed urban Fire Stations and location of new rural Fire Station at various places in the State.

Detailed list of delineated operational, new urban and new rural Fire Stations are given in Tables 16-44 and 16-45.

Table 16-3: District level number of operational and additional Fire Stations required in the State

Districts	Number of Operational Fire Stations	Ideal Population severed under operational Fire Stations	Number of New Urban Fire Stations	Ideal Population severed for new Urban Fire Stations	Number of New Rural Fire Stations	Total number of Fire Stations
Amritsar	4	714,538	5	488,241.00	6	15
Barnala	1	116,858	0	0.00	3	4
Bathinda	1	250,707	2	83,814.00	6	9
Faridkot	2	196,875	1	42,152.00	1	4
Fatehgarh Sahib	2	172,407	0	0.00	1	3
Firozpur	4	360,348	1	36,712.00	9	14
Gurdaspur	4	450,177	3	187,346.00	10	17
Hoshiarpur	1	155,700	0	0.00	8	9
Jalandhar	4	482,334	4	419,412.00	4	12
Kapurthala	2	223,495	0	0.00	4	6
Ludhiana	7	1,148,044	6	720,337.00	7	20
Mansa	2	108,831	0	0.00	3	5
Moga	1	157,057	0	0.00	3	4
Muktsar	3	274,442	0	0.00	5	8
Patiala	4	434,442	4	344,129.00	6	14
Rupnagar	1	50,327	1	76,639.00	4	6
SAS Nagar	2	159,155	3	299,629.00	1	6
Sangrur	2	271,862	2	135,054.00	5	9
Shahid Bhagat Singh Nagar	1	91,670	0	0.00	3	4
Tarn Taran	0	0	2	125,211.00	4	6
Total	**48**	**5,819,269**	**34**	**2,958,676**	**93**	**175**

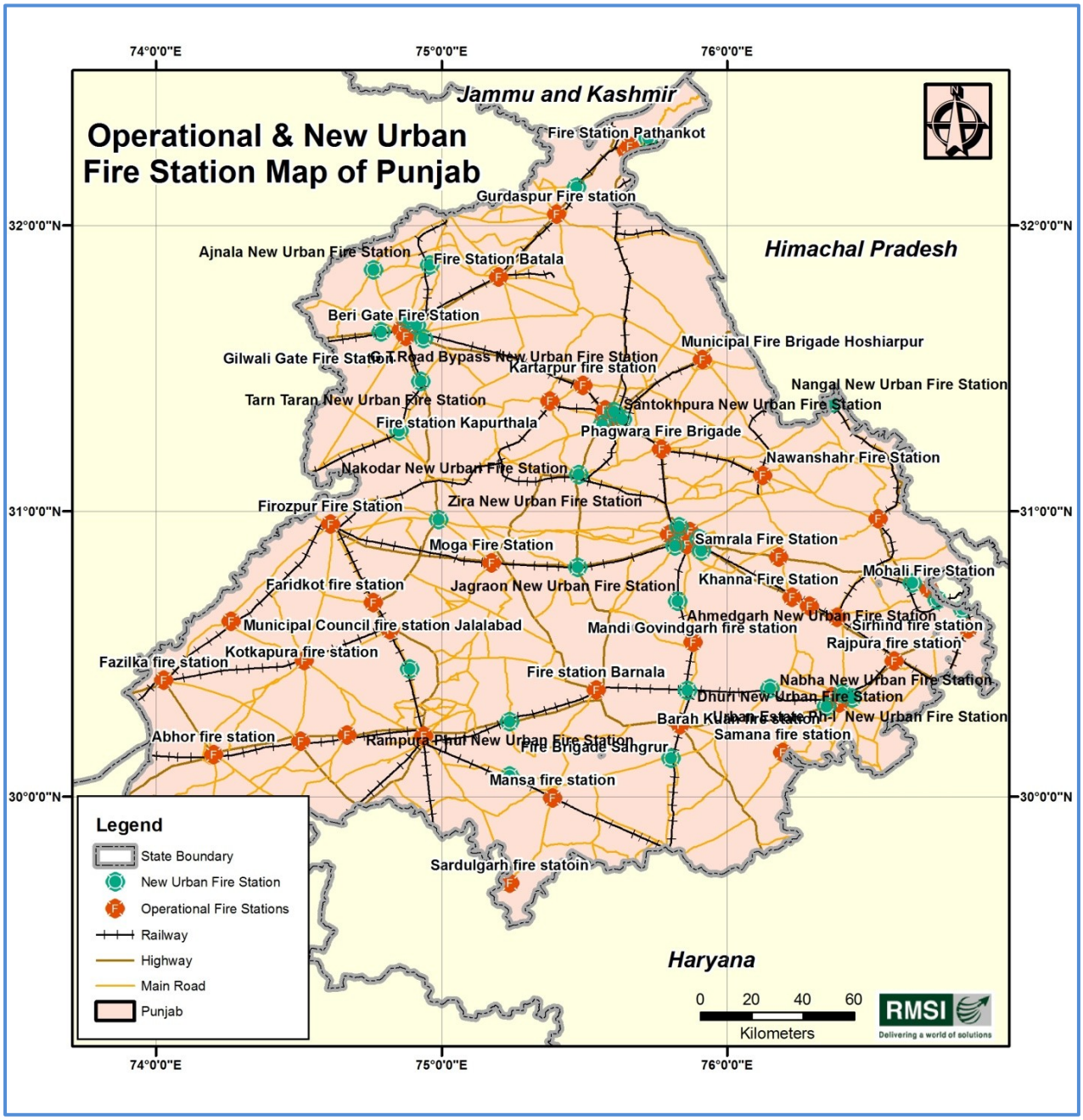

Figure 16-3: Map for operational and new urban Fire Stations in Punjab

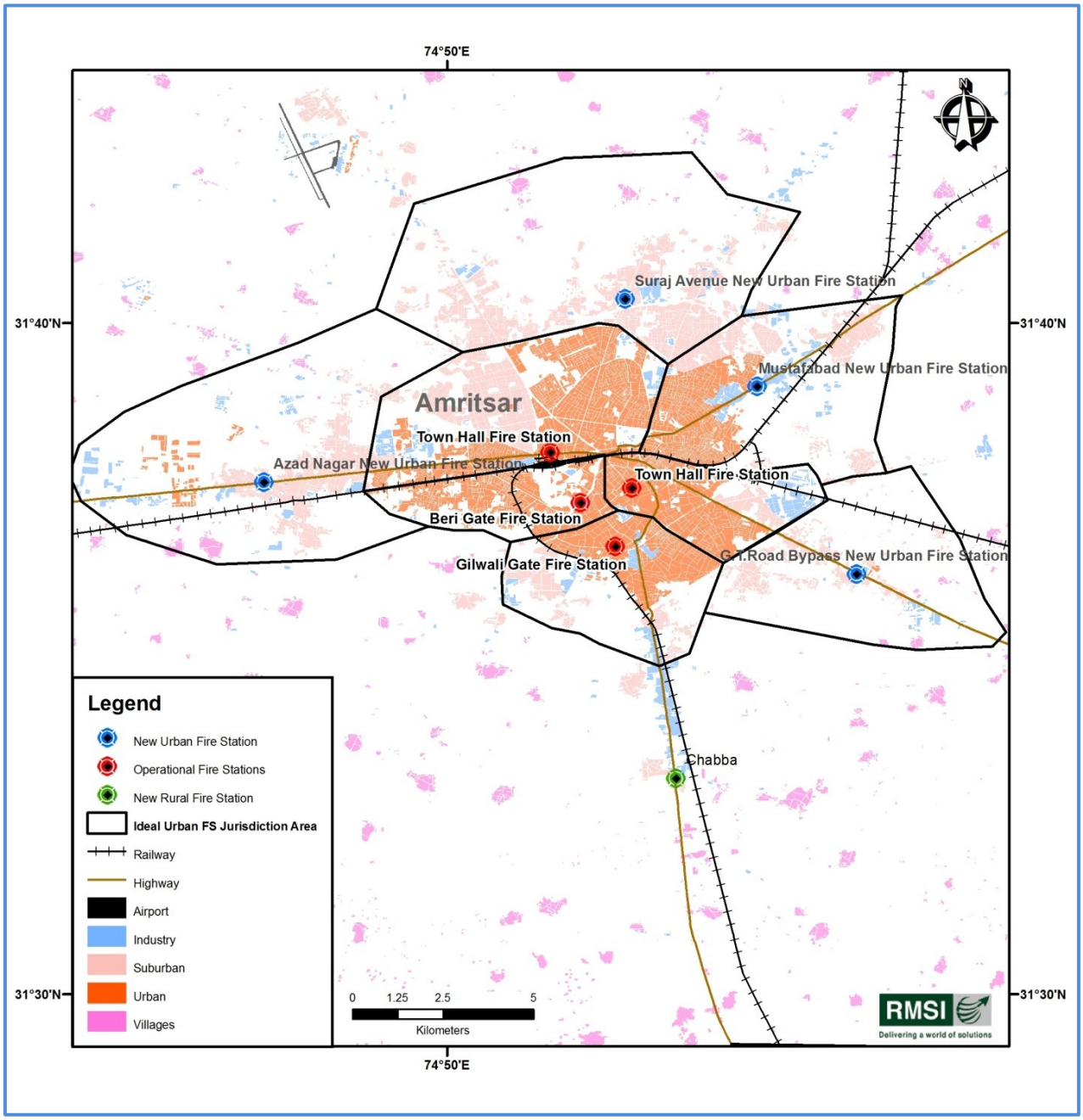

Figure 16-4: Fire stations gap analysis for Amritsar urban areas

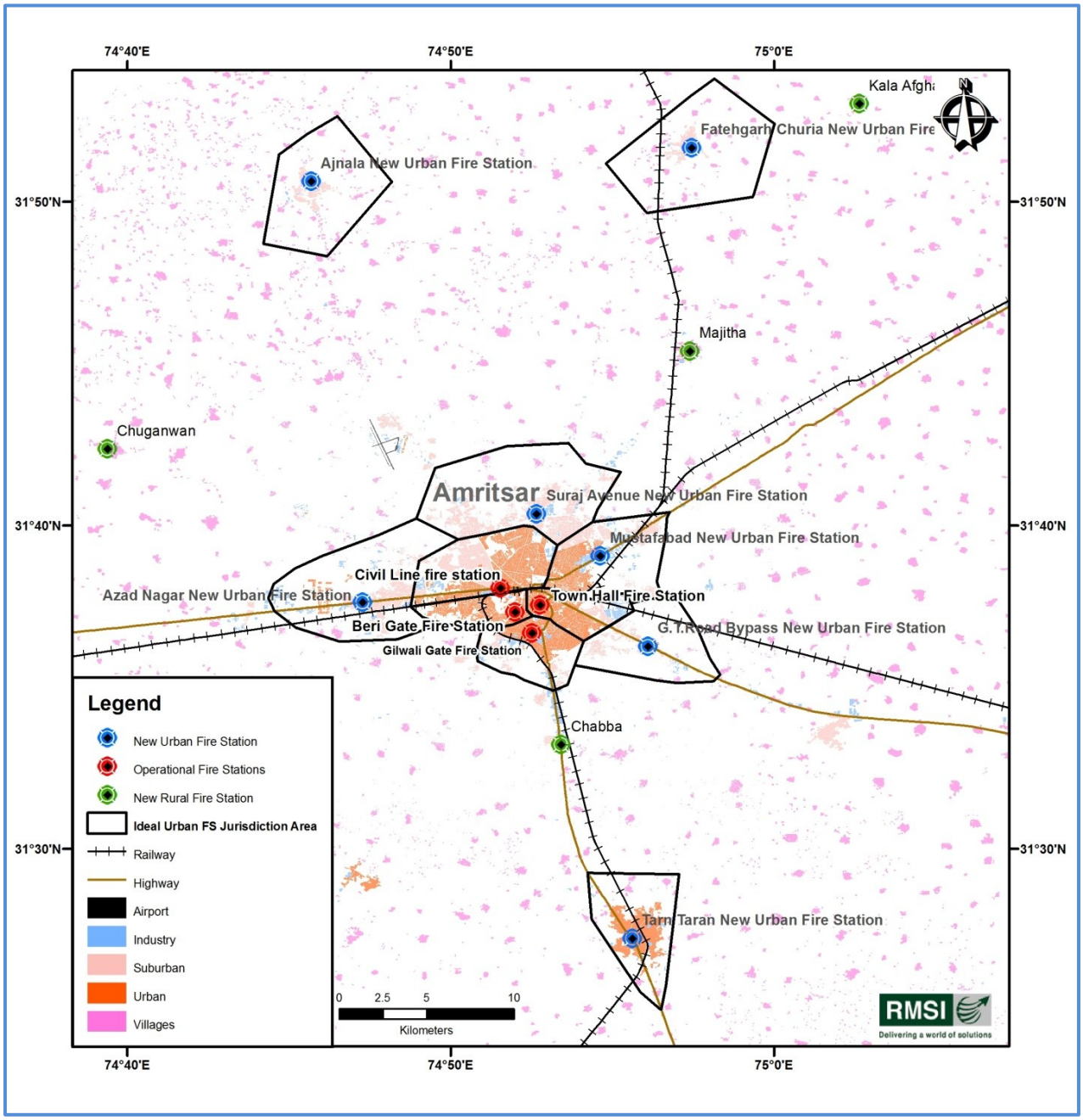

Figure 16-5: Fire stations gap analysis for Amritsar rural areas

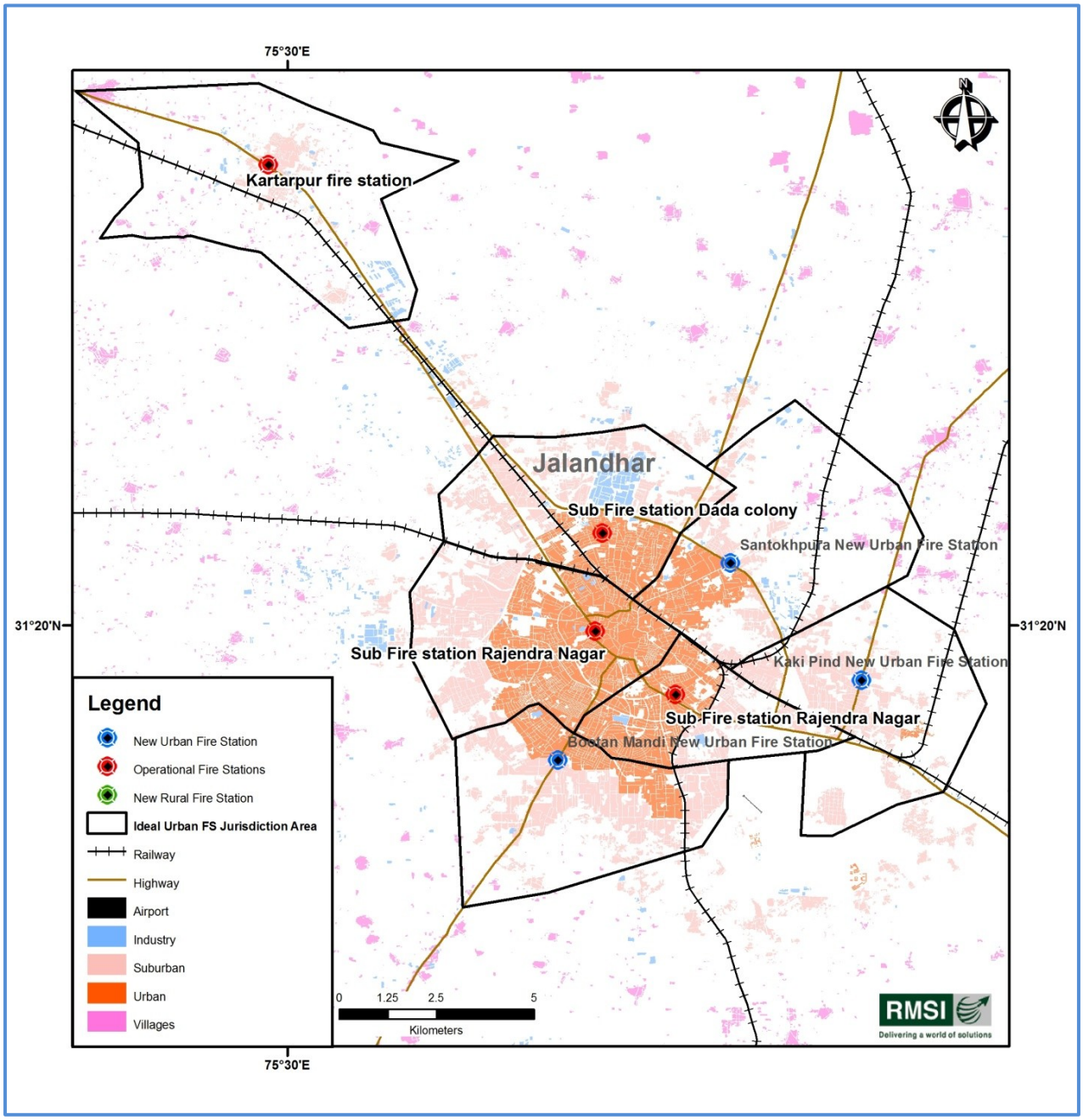

Figure 16-6: Fire stations gap analysis for Jalandhar urban areas

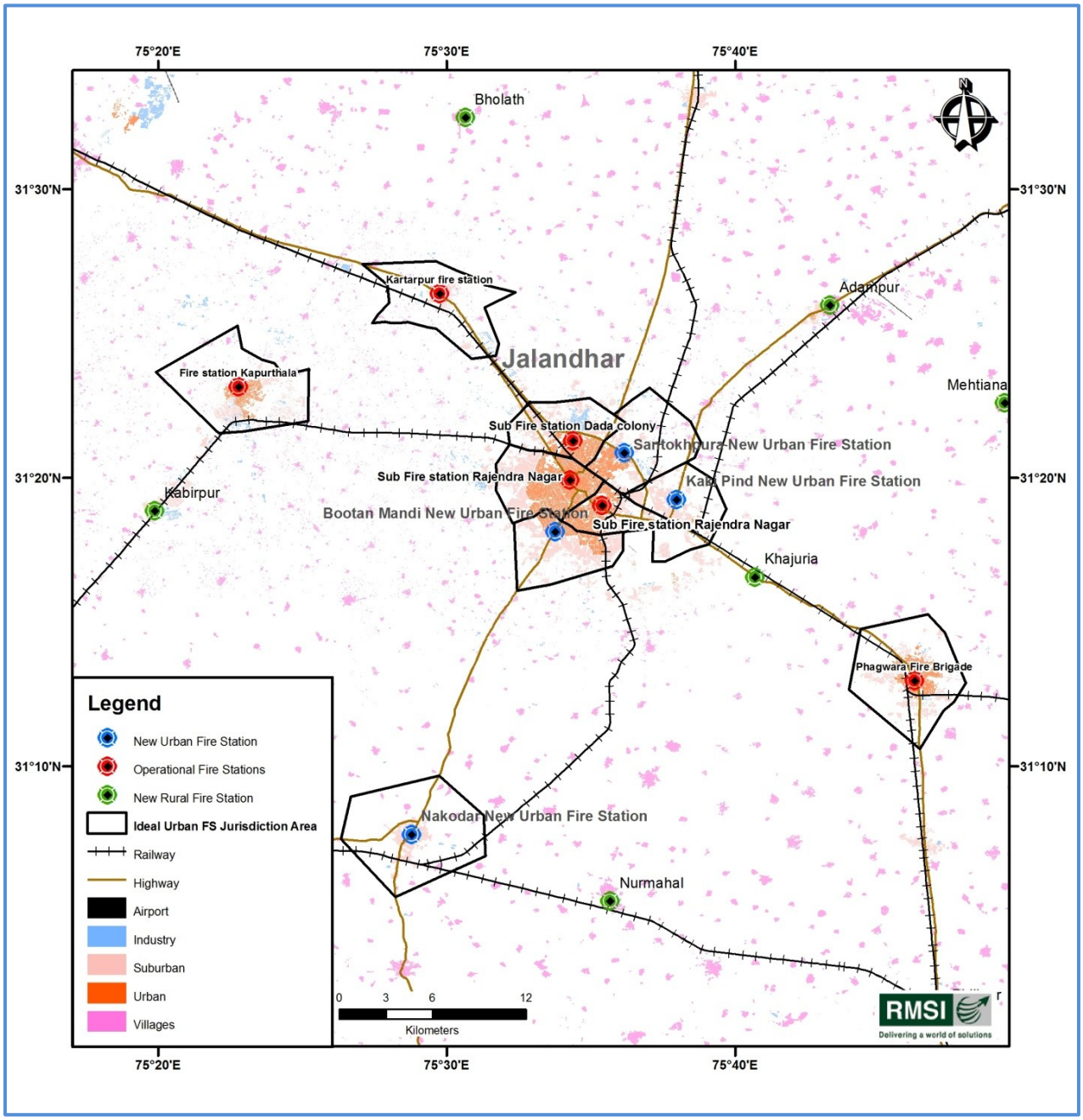

Figure 16-7: Fire stations gap analysis for Jalandhar rural areas

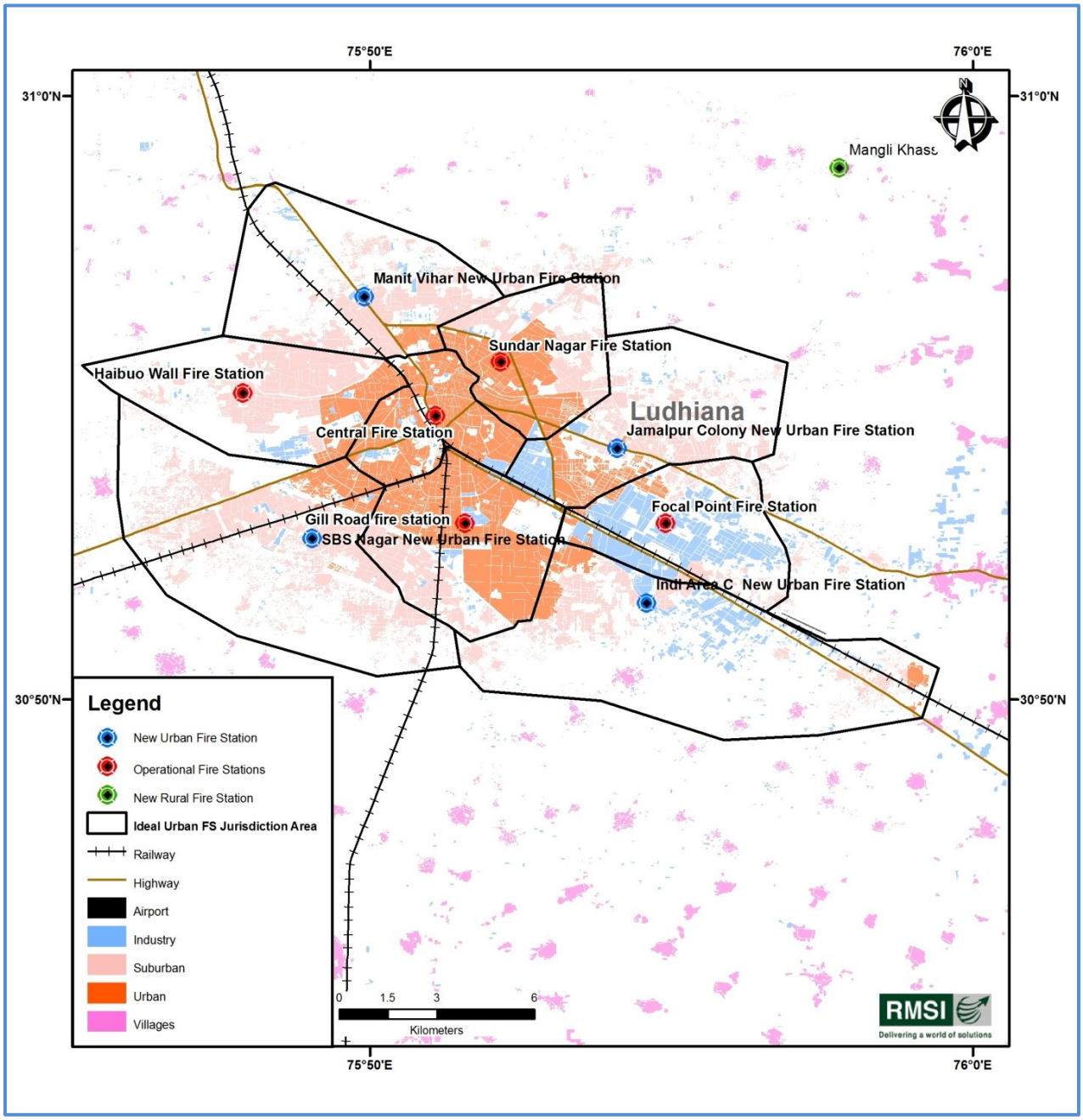

Figure 16-8: Fire stations gap analysis for Ludhiana urban areas

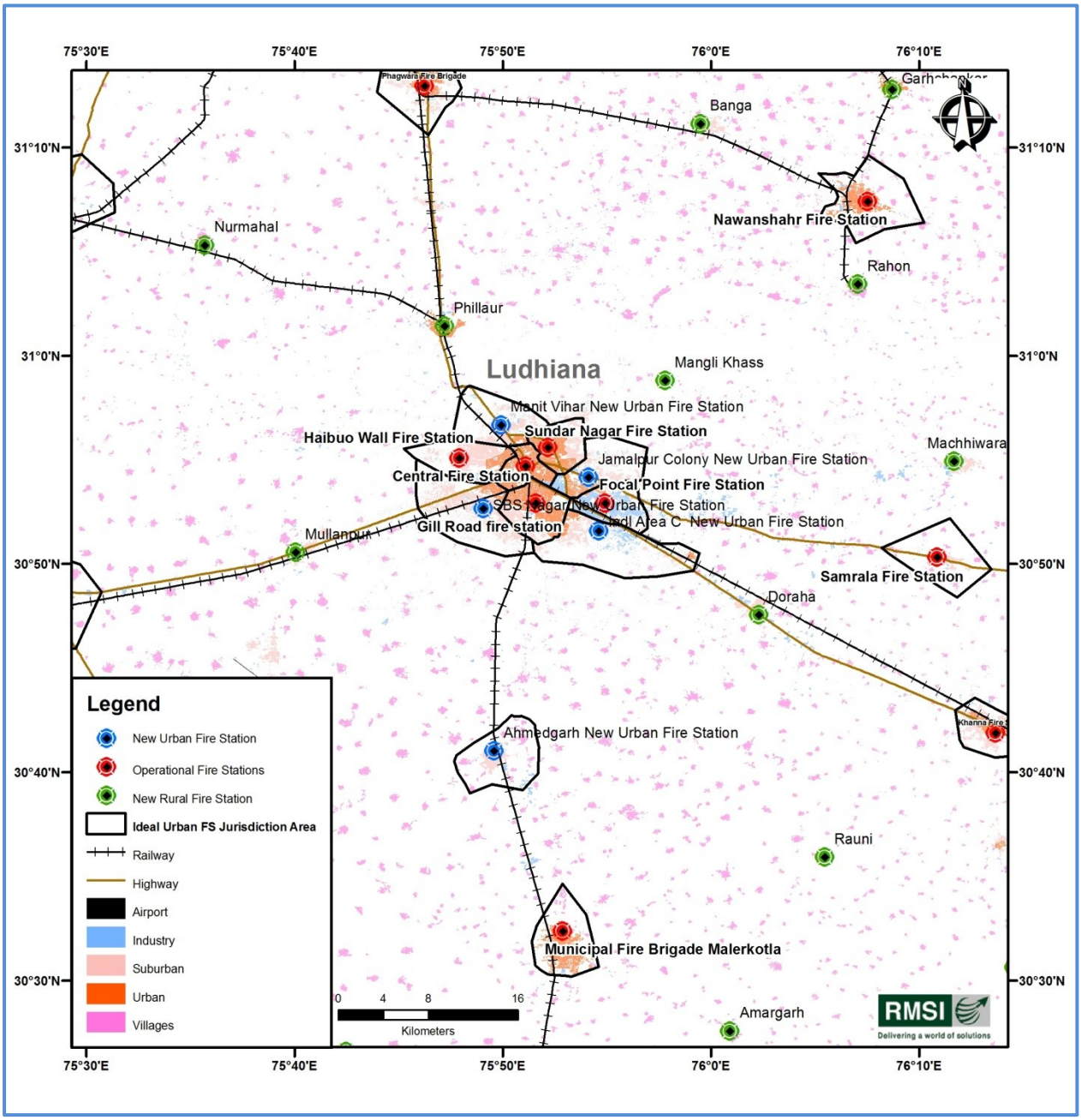

Figure 16-9: Fire stations gap analysis for Ludhiana rural areas

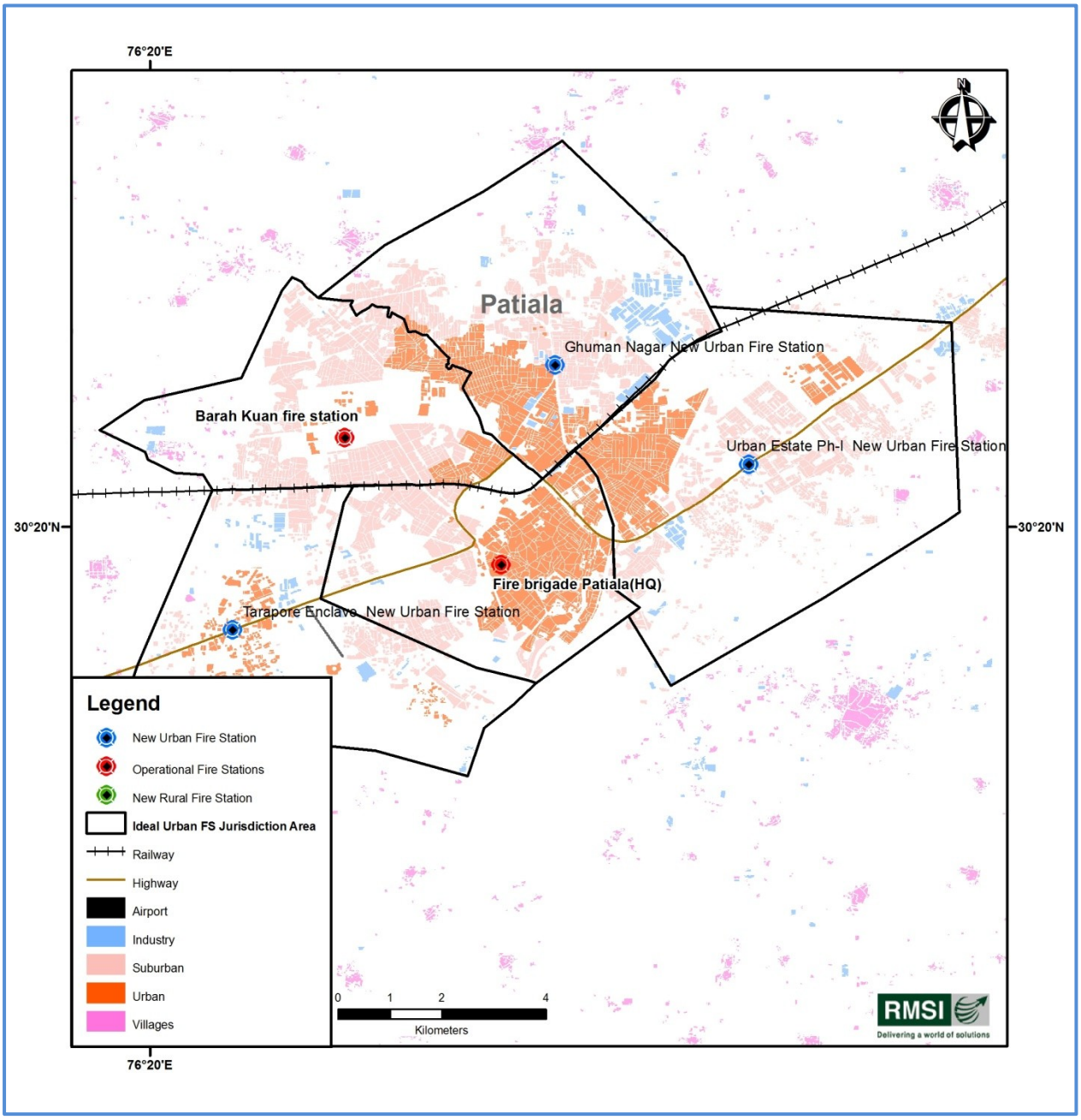

Figure 16-10: Fire stations gap analysis for Patiala urban areas

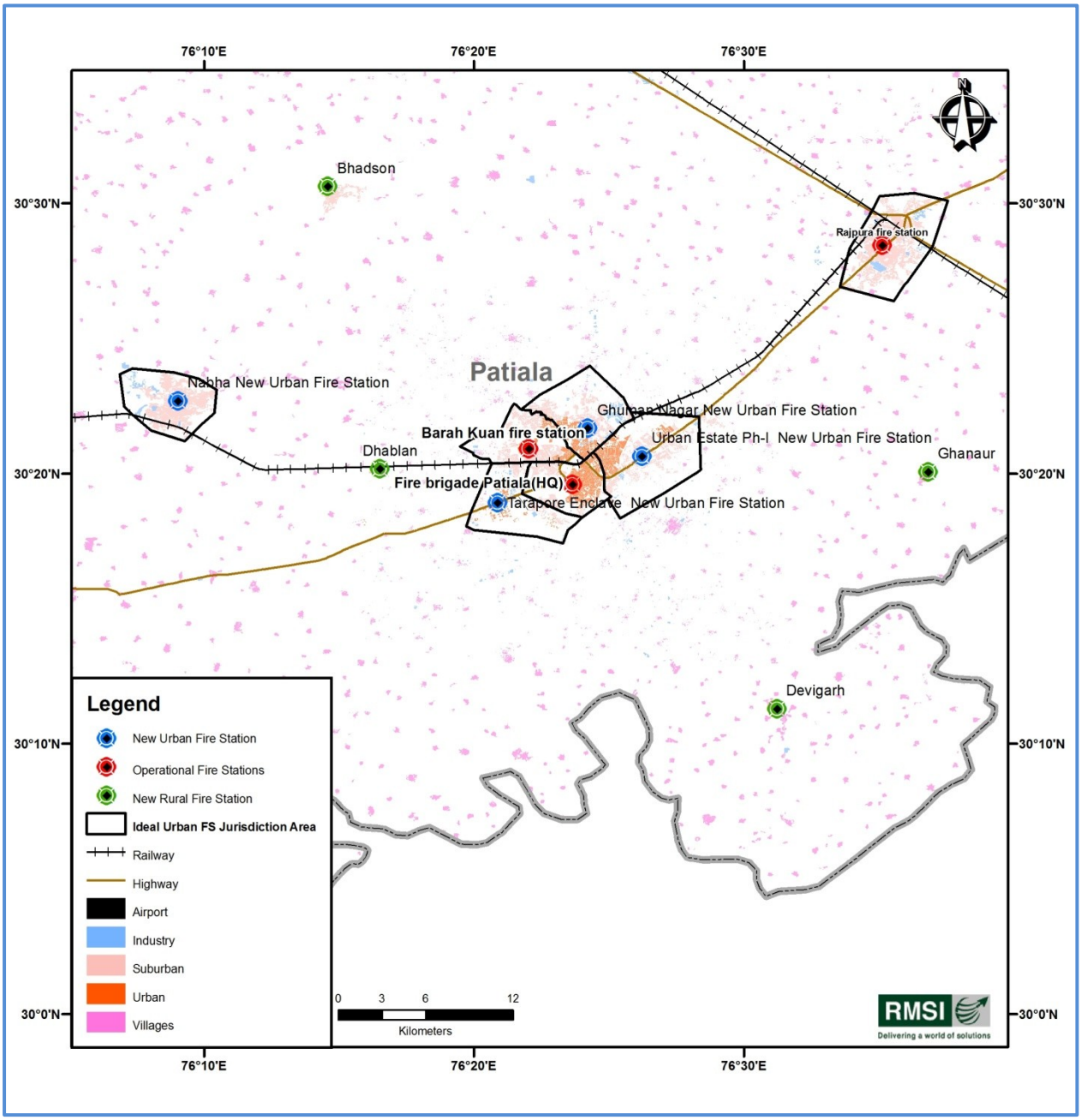

Figure 16-11: Fire stations gap analysis for Patiala rural areas

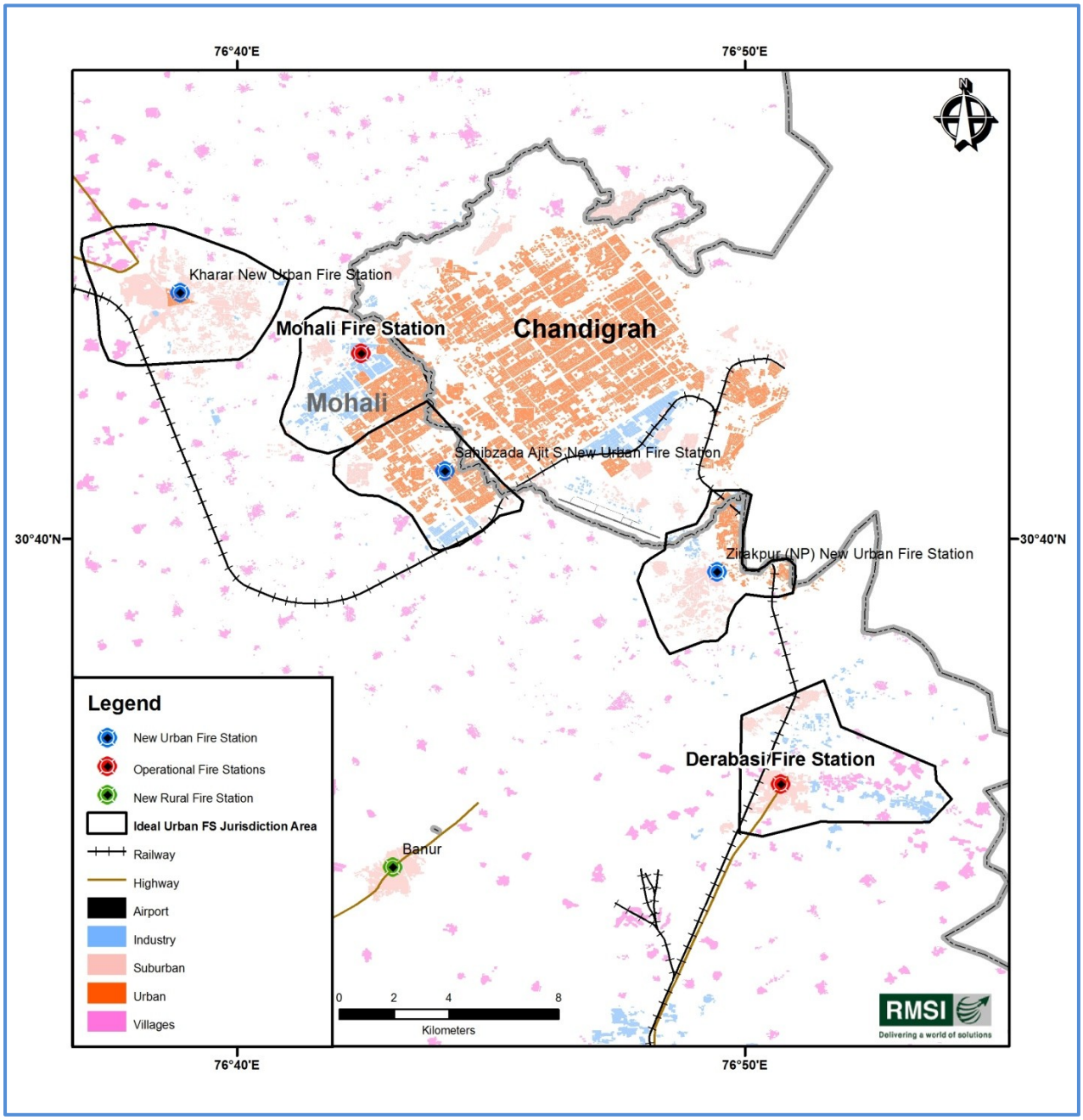

Figure 16-12: Fire stations gap analysis for Mohali urban areas

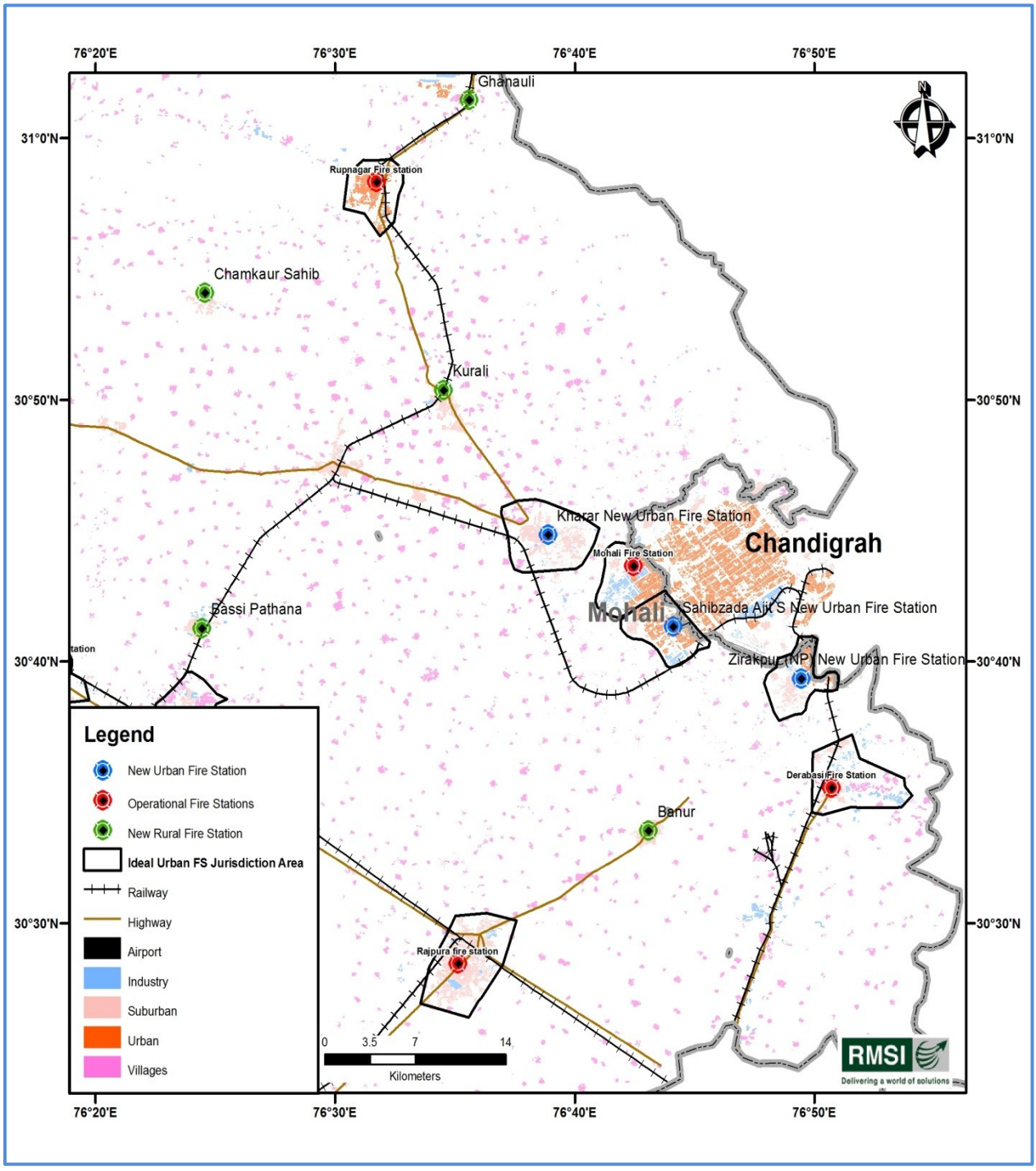

Figure 16-13: Fire stations gap analysis for Mohali rural areas

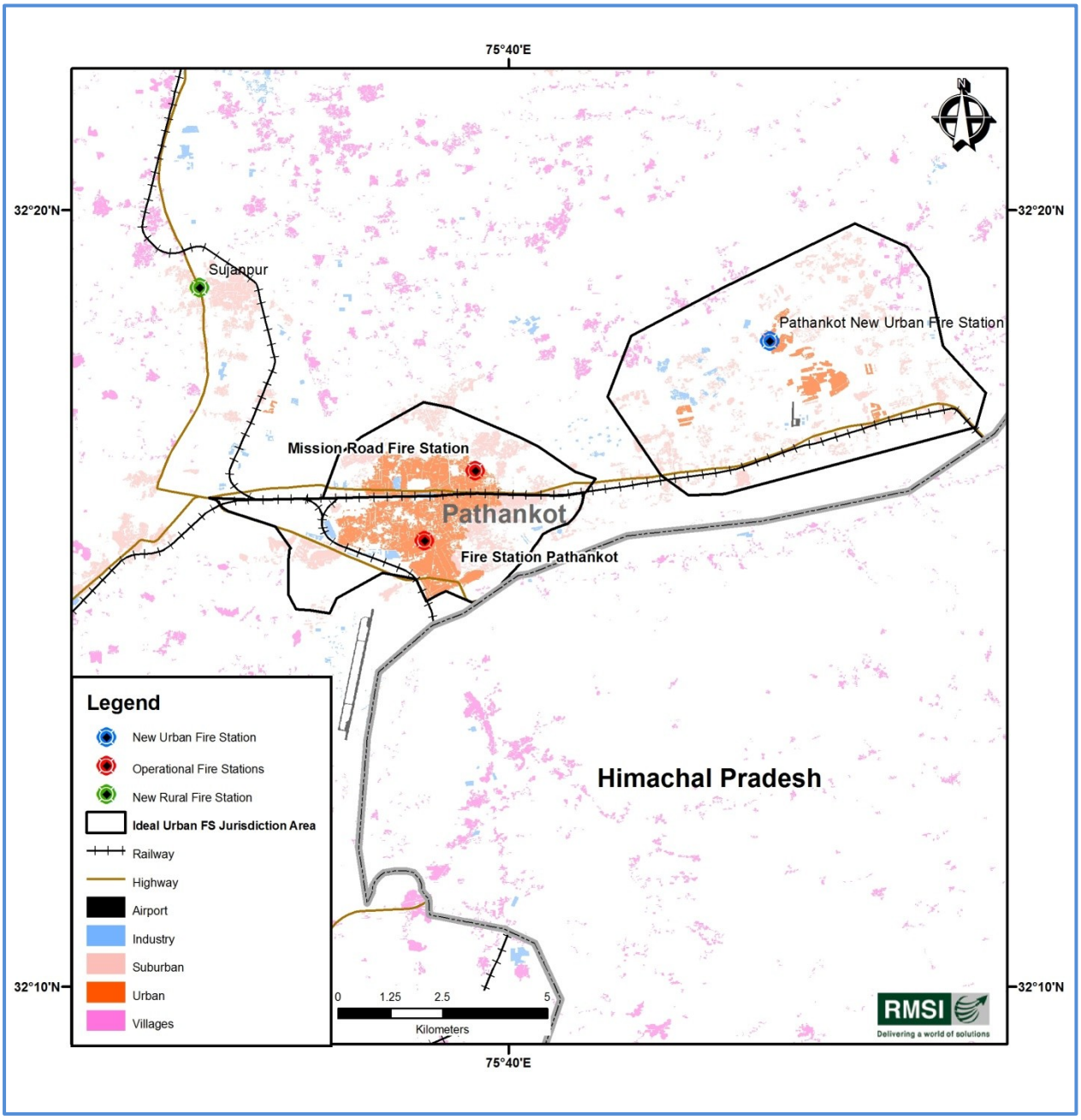

Figure 16-14: Fire stations gap analysis for Pathankot urban areas

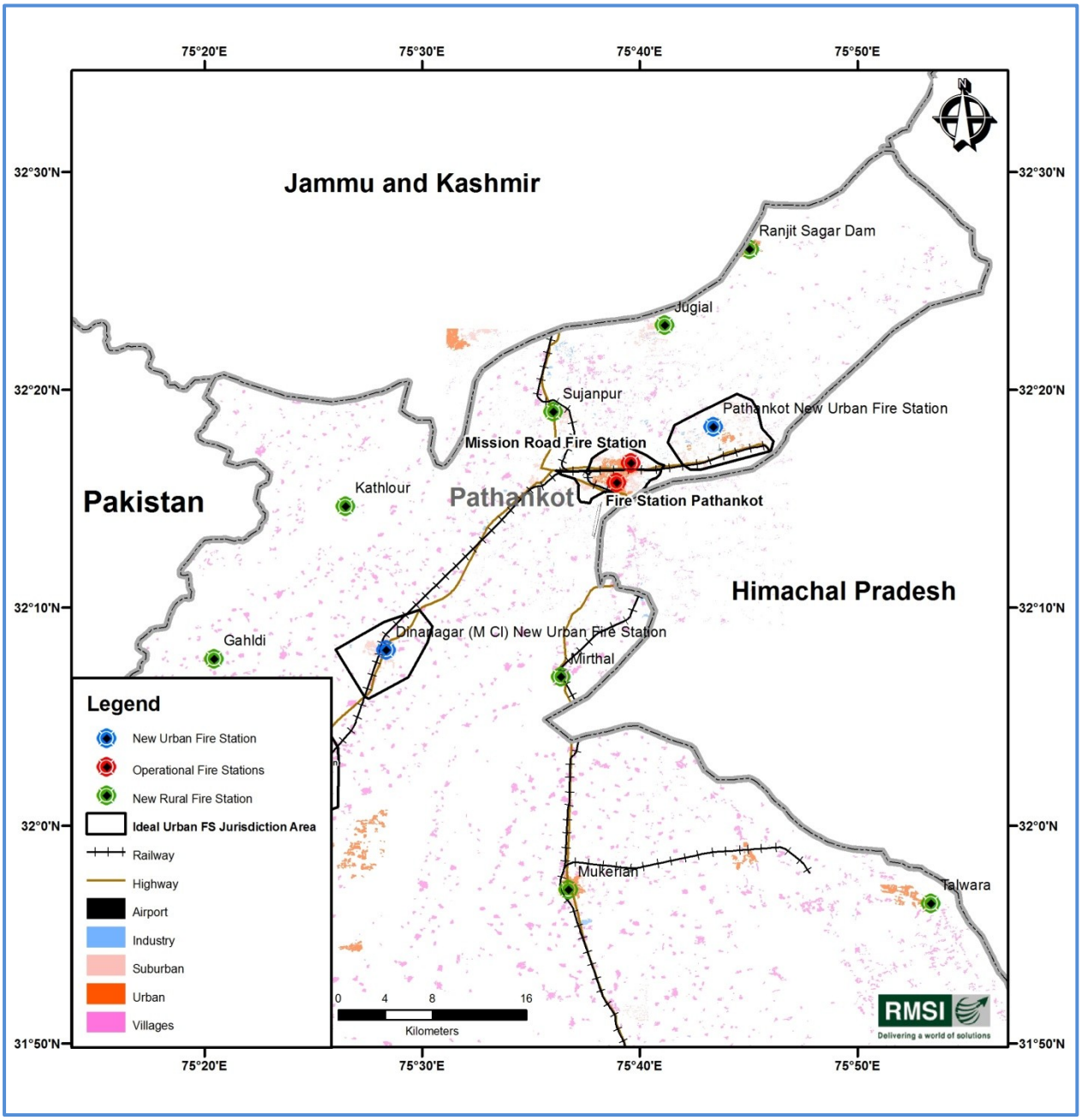

Figure 16-15: Fire stations gap analysis for Pathankot rural areas

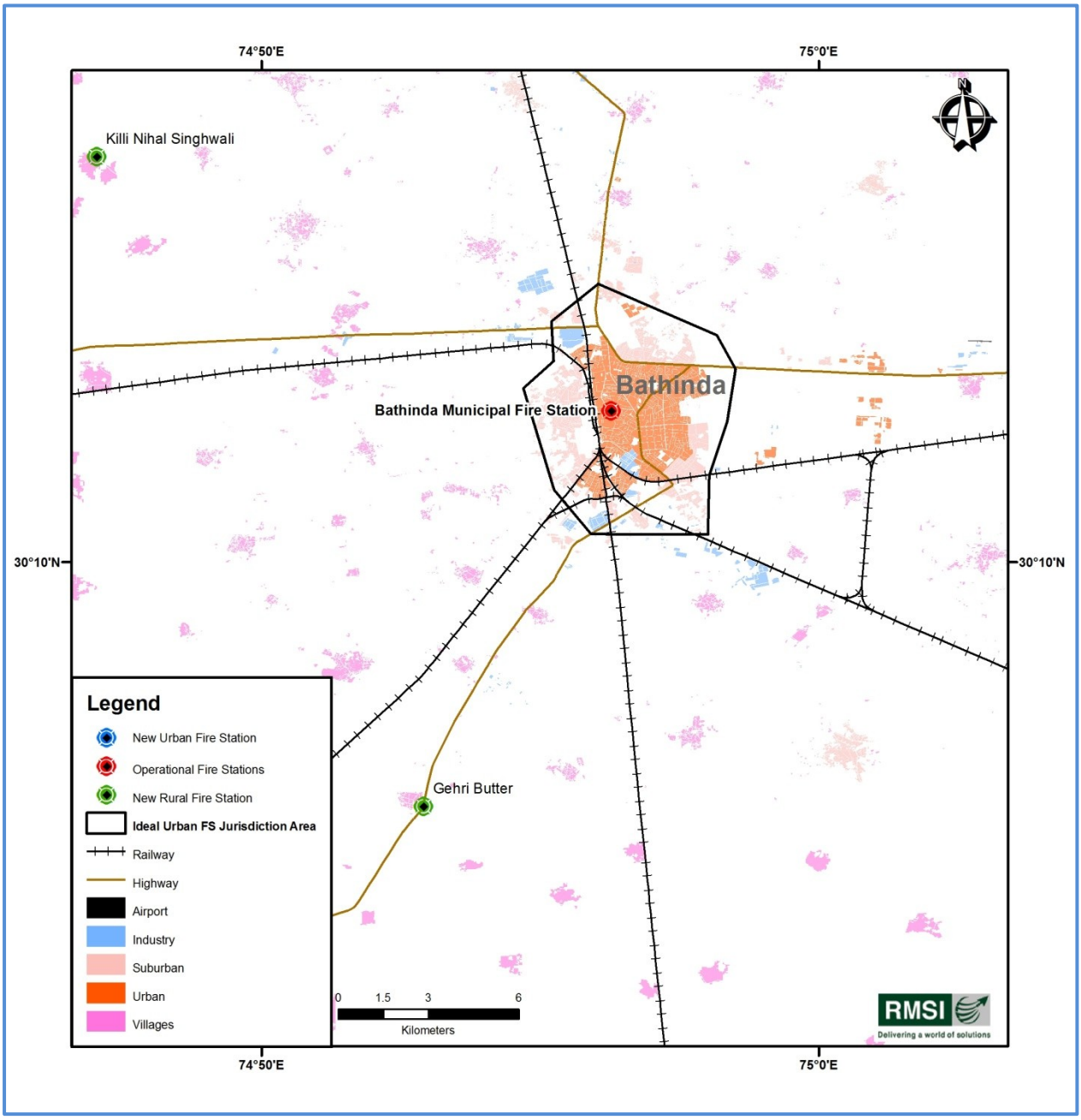

Figure 16-16: Fire stations gap analysis for Bathinda urban areas

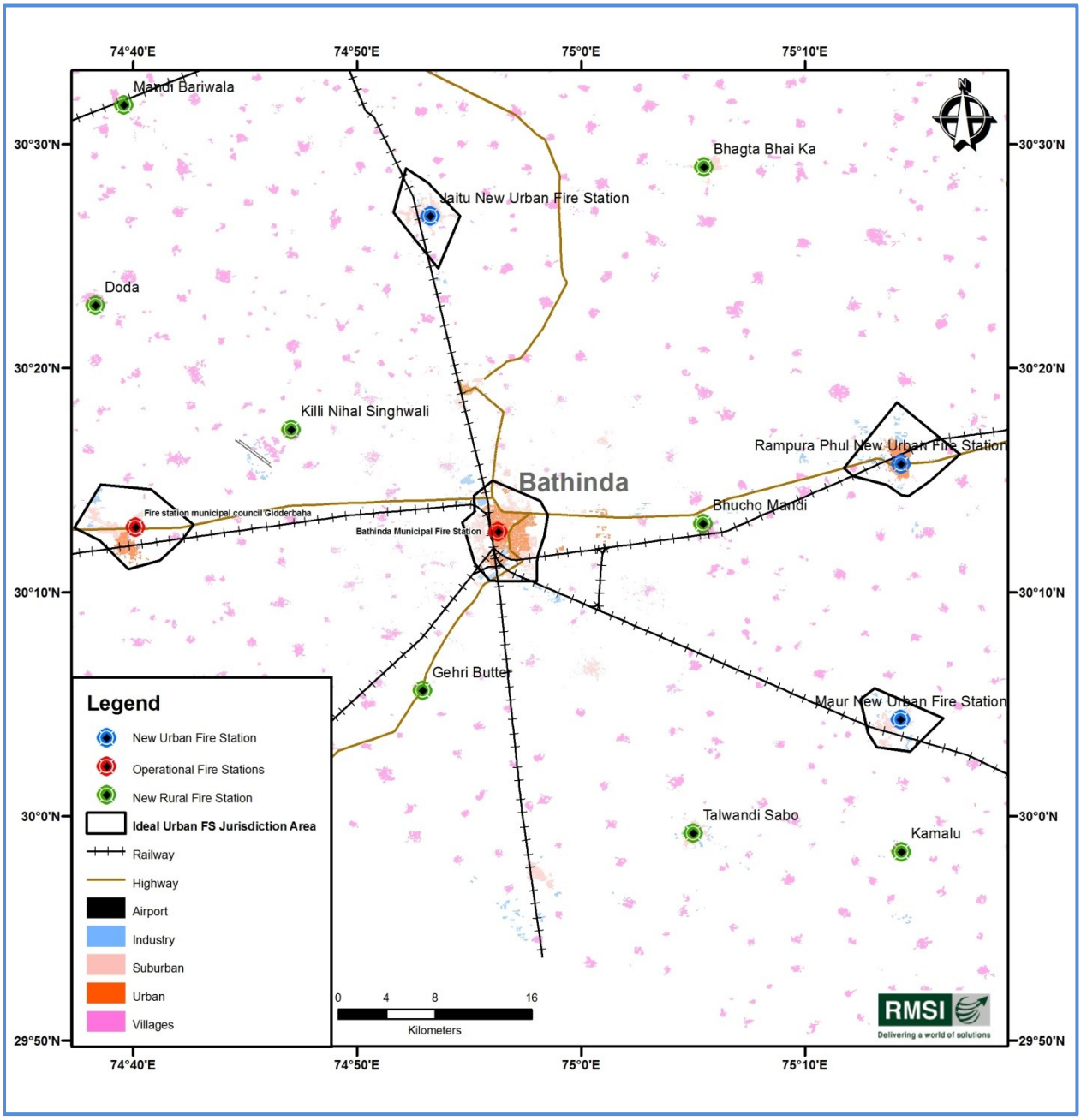

Figure 16-17: Fire stations gap analysis for Bathinda rural areas

16.3.2 FIREFIGHTING AND RESCUE VEHICLES AND EQUIPMENT GAP

For firefighting and rescue vehicles and specialized equipment gap analysis at the operational Fire Stations and the new Fire Stations in urban areas and Fire Stations in rural areas, the following criteria have been followed, which have been basically taken from SFAC norms and minor changes have been made with expert opinion, for optimization of resources.

- **Pumping Unit:** For counting of existing pumping units at various DFS Fire Stations, equipment such as Fire Tender, Water Bowser, Water Mist Mini Fire Tender, Foam Tender, Crash Fire Tender, Fire Engine, Jumbo Tanker, and Multi-purpose Tender have been counted as one pumping unit. The SFAC criteria with some modifications have been proposed for estimating the requirement of pumping units. Accordingly, one pumping unit per 50,000 populations (subject to minimum one) up to three Lakhs population has been considered. For population of more than three Lakhs, one additional pumping unit per Lakhs of population has been considered. For example, if the population is 3, 50,000 or more but less than 4, 50,000, there should be 7 pumping units. At Fire Stations, where pumping unit requirements are coming to 2 or more units, half the units will be Water Tender and half the units will be Water Bowser, for example, for 2 pumping unit requirement, one will be Water Tender and one Water Bowser, however, for 3 pumping unit requirement, 2 will be Water Tender and 1 will be Water Bowser.
- **Note:** we have considered pumping unit as a complete unit with water carrying capacity pumping unit, however, trailer fire pump with towing vehicle or a jeep fire engine, QRT with mist unit, or motor cycle with mist set have not been considered as a pumping unit. QRT with mist unit or motor cycle with mist set has been considered as a unit to cut response time in congested areas in urban areas.
- **Foam Tender:** For those Fire Stations, in whose jurisdiction small industrial area also lie, one Water Tender should be replaced with Foam Tender.
- **DCP Tender:** Minimum one per district or one for 8-10 Fire Stations. Fire stations having a large industrial plot area (in their ideal jurisdiction of above) 1.0 - 3.0 sq km, should have additionally one DCP tender. For industrial areas more than 3.0 sq km to 6.0 sq km, there should be two DCP Tenders and so on.
- **Advanced Rescue Tender:** One per district (minimum) up to 10 Lakhs population, and one additional unit for every 10 Lakhs urban population.
- **Hydraulic Platform/ALP/TTL:** One per district (minimum) depending upon the presence of building blocks having high rise buildings (height more than 15 m). Additional unit is to be provided for districts having a large number of such building blocks, i.e., Central Business Districts. *It may be noted that ALP/TTL is not a replacement for in-built systems in high-rise buildings. Moreover, equipment is heavy and maneuvering on roads becomes difficult, where there are overhead electrical lines.*
- **HAZMAT Van:** Hazmat van is used rarely and is a very costly equipment requiring highly trained manpower. Hence, to optimize on resources and manpower, HAZMAT van is not recommended for future procurement in the State. However, for that purpose, an Advanced Rescue Responder is proposed (at Sr. No 4), which will have equipment to handle hazardous material release.
- **Crash Fire Tender:** Crash fire Tender is not recommended for State Fire Services. Instead, for Fire Stations in the funnel area on either side of the airport, one WT should be replaced with Foam Tender depending upon the State policy.

- **BA Van, Light Van and Control Van:** One each per district. However, to optimize on resources and manpower, we are proposing a BA Van- cum-Light Van – cum-Control Van.
- **Hose Tender:** One per district (minimum) or one for 8-10 Fire Stations.
- **Trailer Pump:** Though Trailer Pumps are prescribed in SFAC norms, it is not recommended for future use, as this needs an additional towing vehicle. In place of this, procurement of Portable Pump are recommended, which will be part of a Fire Tender (**(Specialized Equipment** Sl. No. 12).
- **QRT:** One each at Fire Stations serving a population density (total population in the FS jurisdiction/area of jurisdiction, in sq km) above 30,000 persons/sq km in metro and big cities, above 15,000 persons/sq km in other cities, or in congested areas based on field-survey.

  Note: The criteria of population density has been relaxed for hilly State from 15,000 person/sq km (in plains) to 5,000 person/sq km in the Fire Station jurisdiction
- **Motorcycle with 2 water mist set:** One each at Fire Stations serving population density above 10,000 with QRT
- **Ambulance:** It is seen that Ambulance services are also with some of the State fire services and in few other States this is looked after by the Ministry of Health department of the States. In case of Delhi, the ambulance service was initially with Delhi Police then transferred to DFS in the year 1985-86 and then transferred to CATS (Centralized Accident Trauma Service, Ministry of Health).

It is observed during visit to the Fire Stations by the RMSI team that wherever the Ambulance are available with fire services, they neither have the Paramedic staff, nor adequate life support/normal equipment, and cannot be considered as an efficient system. It is therefore felt that either ambulance service should be run by Health Department through various hospitals / health centers or provide fully trained staff to fire services with properly equipped Ambulances. Accordingly, cost of the ambulance is not included in the gap analysis of the present study. However, the ambulance cost may be added, in case, it is decided in a particular State that Ambulance service should be part of fire services.

- **Educational Van**: One per district and one additional unit for every 30 Lakhs district population

At rural Fire Station/ Fire Post level, if the estimated pumping units is two, then one water tender with a QRT on pickup truck having 500 - 600 liters of water mist capacity along with a motor cycle with two water mist backpacks will be provided. This will help in quick response, as a majority of inside roads within rural villages is narrow in width and congested. This will also help in optimization of resources.

It may be noted that if a fire is responded to immediately, it may not flare-up into large fire; hence, QRT and Motorcycle are considered as a quick responder and not as full-fledged fire units. In case of large fires, nearby Fire Station(s) will provide support with Water Tenders and Water Bowsers.

For reserve requirement, RMSI estimated reserve requirement of 20% at district level, and these will be distributed to individual Fire Stations by the concerned fire officials. This will help in optimizing the additional requirements of minimum one reserve at each Fire Station.

Specialized Equipment:

Specialized equipment for Fire Stations in urban areas shall be provided as per the following criteria:

- **Hydraulic Rescue Tool:** One for each Fire Station depending upon the seismic Zone IV and V, or Fire Station having urban population more than 1.5 Lakhs in its ideal jurisdiction including Hydraulic Cutter, Hydraulic Spreader, Hydraulic Pump, Power Wedge, and Hydraulic Rescue Ram depending upon the seismic Zone IV and V.
- **Combi-Tool:** One Combi-Tool set shall be provided with each fire fighting vehicle.
- **B.A. Set with BA Compressor:** Four B. A. Sets per fire fighting vehicle with minimum 1 compressor per Fire Station
- **First Aid Box:** One for each fire fighting vehicle (minimum 2 at each Fire Station) with regular replacement of expired medicines
- **Thermal Imaging Camera:** One for each Fire Station depending upon the seismic Zone IV and V, or Fire Station having urban population more than 1.5 Lakhs in its ideal jurisdiction
- **Personal Protection Equipment (PPE):** One Set for each pumping unit or a minimum of 2 for each Fire Station
- **Hydraulic Chain Saw/Cutter for Wood:** One for each Fire Station
- **Electric/Petrol Chain Saw/Cutter for Wood:** One for each Fire Station
- **Electric/Petrol Chain Saw/Cutter for Concrete**: One for each Fire Station
- **Hand Held Gas Detector:** One piece per Vehicle
- **Victim Location Device (Acoustic**): One for each Fire Station depending upon the seismic Zone IV and V, or Fire Station having urban population more than 1.5 Lakhs in its ideal jurisdiction
- **Smoke Exhauster/PPV:** One per Fire Stations located in urban areas (minimum one per district)
- **Portable Pump:** One for each fire fighting unit
- **Pneumatic Lifting Bags:** One set for each Fire Station depending upon the seismic Zone IV and V, or Fire Station having urban population more than 1.5 Lakhs in its ideal jurisdiction
- **Inflatable Lighting Tower:** One per Fire Station
- **High Capacity LED Torch Light:** One piece per vehicle

Note: Other smaller equipment such as ropes, Fireman Axe, Small Hammer, different Branches/Nozzles, Foam Compound has not been mentioned separately, as these are standard items for any Fire Station/post.

For rural Fire Stations/ Fire Posts, following specialized equipment has been recommended:

- **B.A. Set with BA Compressor:** Two B. A. set per QRT and four B.A. Sets per fire fighting vehicle with one compressor per Fire Station/post
- **Personal Protection Equipment (PPE):** One set per fire fighting vehicle
- **Electric/Petrol Chain Saw/Cutter for Wood:** One per Fire Station/post

- **Hydraulic Chain Saw/Cutter for Wood:** One per Fire Station/post
- **Portable Pump:** One for each fire fighting unit
- **Inflatable Lighting Tower**: One per Fire Station
- **High Capacity LED Torch Light:** One piece per fire fighting vehicle
- **First Aid Box:** One per fire fighting vehicle

For reserve requirement, RMSI estimated reserve requirement of 20% at district level, and these will be distributed to individual Fire Stations by the concerned fire officials. This will help in optimizing the additional requirements of minimum one reserve at each Fire Station.

Communication Equipment:

For better coordination between Fire Station and fire fighting staff, communication plays an important role. Hence, there is a need that each fire vehicle and Fire Station is equipped with a communication device. Accordingly, following communication equipment for urban Fire Station are recommended:

- **Static Wireless Set (VHF):** One set at each Fire Station
- **Mobile Wireless Set (VHF):** One per vehicle including QRT
- **Walky-Talky:** One per vehicle
- **Megaphone:** One set per Fire Station/post
- Additionally, at each rural Fire Post, each QRT should be equipped with one mobile wireless set and one walky-talky.

Detailed district level list of currently operational firefighting and rescue vehicles available with Punjab Fire Services (As on May, 2012), vehicle gap in operational Fire Stations for ideal Jurisdiction area, additional firefighting and rescue vehicle required for new urban and rural Fire Stations and total firefighting and rescue vehicle gap for existing and new Urban Fire stations are shown in Table 16-4 to 16-8.

In the similar manner, gap analyses of specialized fire equipment are shown in Tables 16-9 to 16-18.

Table 16-4: List of operational firefighting and rescue vehicles available with Punjab Fire Service (As on May, 2012)

District	Num of Fire Stations	Ideally Served Population Estimates	Water tender	Water Bowser	Foam tender	Advanced Rescue Responder	Sky Lift/ TTL	DCP tender	Hose Tender	BA Van	QRT	Motor cycle mist	Ambulances	Education Van	Total Vehicles
Amritsar	4	714,538	6	0	0	0	0	0	0	0	0	0	0	0	6
Barnala	1	116,858	2	0	0	0	0	0	0	0	0	0	0	0	2
Bathinda	1	250,707	6	0	0	0	0	0	0	0	0	0	1	0	7
Faridkot	2	196,875	3	0	0	0	0	0	0	0	0	0	0	0	3
Fatehgarh Sahib	2	172,407	4	0	0	0	0	0	0	0	0	0	0	0	4
Firozpur	4	360,348	5	0	0	0	0	0	0	0	0	0	0	0	5
Gurdaspur	4	450,177	8	0	0	1	0	0	0	0	0	0	1	0	10
Hoshiarpur	1	155,700	4	0	0	0	0	0	0	0	0	0	0	0	4
Jalandhar	4	482,334	13	1	1	0	0	0	0	0	0	0	0	0	15
Kapurthala	2	223,495	4	0	0	0	0	0	0	0	0	0	0	0	4
Ludhiana	7	1,148,044	13	3	1	0	0	0	0	0	0	0	0	0	17
Mansa	2	108,831	4	0	0	0	0	0	0	0	0	0	0	0	4
Moga	1	157,057	2	0	0	0	0	0	0	0	0	0	0	0	2
Muktsar	3	274,442	6	0	0	0	0	0	0	0	0	0	1	0	7
Patiala	4	434,442	9	0	0	0	0	0	0	0	0	0	2	0	11
Rupnagar	1	50,327	2	0	0	0	0	0	0	0	0	0	0	0	2
Sahibzada Ajit Singh Nagar	2	159,155	7	1	1	0	0	0	0	0	1	0	0	0	10
Sangrur	2	271,862	3	0	0	0	0	0	0	0	0	0	0	0	3
Shahid Bhagat Singh Nagar	1	91,670	2	0	0	0	0	0	0	0	0	0	0	0	2
Tarn Taran	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**48**	**5,819,269**	**103**	**5**	**3**	**1**	**0**	**0**	**0**	**0**	**1**	**0**	**5**	**0**	**118**

*: Fire fighting vehicles, which are under condemnation or off road for major repairs are not included. Replacement of such vehicles can be accounted for reserve vehicles in operational Fire Stations.

Table 16-5: Firefighting and rescue vehicle gap in operational Fire Stations for their ideal jurisdiction area

District	Num of Fire Stations	Ideally Served Population Estimates	Water Tender	Water Bowser	Foam tender	Advanced Rescue Responder	Sky Lift/ TTL	DCP tender	Hose Tender	BA Van	QRT	Motor cycle mist	Education Van	Total Vehicles
Amritsar	4	714,538	2	6	4	1	1	1	1	1	2	2	1	22
Barnala	1	116,858	0	0	1	1	0	1	1	1	0	0	1	6
Bathinda	1	250,707	-2	1	1	1	1	1	1	1	0	0	1	6
Faridkot	2	196,875	0	0	2	1	0	1	1	1	0	0	1	7
Fatehgarh Sahib	2	172,407	-1	0	1	1	0	1	1	1	0	0	1	5
Firozpur	4	360,348	0	1	3	1	0	2	1	1	0	0	1	10
Gurdaspur	4	450,177	-2	1	4	0	0	1	1	1	0	0	1	7
Hoshiarpur	1	155,700	-2	1	1	1	0	1	1	1	0	0	1	5
Jalandhar	4	482,334	-3	0	2	1	1	2	1	1	1	1	1	8
Kapurthala	2	223,495	0	0	2	1	0	1	1	1	0	0	1	7
Ludhiana	7	1,148,044	0	7	4	2	1	2	2	1	4	4	1	28
Mansa	2	108,831	-1	0	1	1	0	1	1	1	0	0	1	5
Moga	1	157,057	0	1	1	1	0	1	1	1	0	0	1	7
Muktsar	3	274,442	-1	1	2	1	0	2	1	1	0	0	1	8
Patiala	4	434,442	-2	2	4	1	1	1	1	1	0	0	1	10
Rupnagar	1	50,327	0	0	0	1	0	0	1	1	0	0	1	4
Sahibzada Ajit Singh Nagar	2	159,155	-4	0	0	1	1	2	1	1	0	0	1	3
Sangrur	2	271,862	0	2	2	1	0	0	1	1	0	0	1	8
Shahid Bhagat Singh Nagar	1	91,670	-1	0	1	1	0	1	1	1	0	0	1	5
Tarn Taran	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**48**	**5,819,269**	**-17**	**23**	**36**	**19**	**6**	**22**	**20**	**19**	**7**	**7**	**19**	**161**

Table 16-6: Additional firefighting and rescue vehicle required for new urban Fire Stations for their ideal jurisdiction areas

District	Num of Fire Stations	Ideally Served Population Estimates	Water tender	Water Bowser	Foam tender	Advanced Rescue Responder	Sky Lift/ TTL	DCP tender	Hose Tender	BA Van	QRT	Motor cycle mist	Education Van	Total Vehicles
Amritsar	5	488,241	6	3	3	0	0	1	1	0	0	0	0	14
Barnala	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bathinda	2	83,814	2	0	1	0	0	1	0	0	0	0	0	4
Faridkot	1	42,152	1	0	0	0	0	0	0	0	0	0	0	1
Fatehgarh Sahib	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Firozpur	1	36,712	1	0	0	0	0	0	0	0	0	0	0	1
Gurdaspur	3	187,346	3	1	1	0	0	0	1	0	0	0	0	6
Hoshiarpur	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jalandhar	4	419,412	5	2	3	0	0	0	0	0	0	0	0	10
Kapurthala	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ludhiana	6	720,337	7	5	6	0	0	2	0	0	0	0	0	20
Mansa	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Moga	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Muktsar	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patiala	4	344,129	4	2	3	0	0	0	0	0	0	0	0	9
Rupnagar	1	76,639	1	0	1	0	0	1	0	0	0	0	0	3
Sahibzada Ajit Singh Nagar	3	299,629	4	2	2	0	0	0	0	0	0	0	0	8
Sangrur	2	135,054	2	0	1	0	0	2	0	0	0	0	0	5
Shahid Bhagat Singh Nagar	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tarn Taran	2	125,211	2	0	1	1	0	1	1	1	0	0	1	8
Total	**34**	**2,958,676**	**38**	**15**	**22**	**1**	**0**	**8**	**3**	**1**	**0**	**0**	**1**	**89**

Table 16-7: Total firefighting and rescue vehicle gap for operational and new urban Fire Stations

District	Num of Fire Stations	Ideally Served Population Estimates	Water tender	Water Bowser	Foam tender	Advanced Rescue Responder	Sky Lift/ TTL	DCP tender	Hose Tender	BA Van	QRT	Motor cycle mist	Education Van	Total Vehicles
Amritsar	9	1,202,779	8	9	7	1	1	2	2	1	2	2	1	36
Barnala	1	116,858	0	0	1	1	0	1	1	1	0	0	1	6
Bathinda	3	334,521	0	1	2	1	1	2	1	1	0	0	1	10
Faridkot	3	239,027	1	0	2	1	0	1	1	1	0	0	1	8
Fatehgarh Sahib	2	172,407	-1	0	1	1	0	1	1	1	0	0	1	5
Firozpur	5	397,060	1	1	3	1	0	2	1	1	0	0	1	11
Gurdaspur	7	637,523	1	2	5	0	0	1	2	1	0	0	1	13
Hoshiarpur	1	155,700	-2	1	1	1	0	1	1	1	0	0	1	5
Jalandhar	8	901,746	2	2	5	1	1	2	1	1	1	1	1	18
Kapurthala	2	223,495	0	0	2	1	0	1	1	1	0	0	1	7
Ludhiana	13	1,868,381	7	12	10	2	1	4	2	1	4	4	1	48
Mansa	2	108,831	-1	0	1	1	0	1	1	1	0	0	1	5
Moga	1	157,057	0	1	1	1	0	1	1	1	0	0	1	7
Muktsar	3	274,442	-1	1	2	1	0	2	1	1	0	0	1	8
Patiala	8	778,571	2	4	7	1	1	1	1	1	0	0	1	19
Rupnagar	2	126,966	1	0	1	1	0	1	1	1	0	0	1	7
Sahibzada Ajit Singh Nagar	5	458,784	0	2	2	1	1	2	1	1	0	0	1	11
Sangrur	4	406,916	2	2	3	1	0	2	1	1	0	0	1	13
Shahid Bhagat Singh Nagar	1	91,670	-1	0	1	1	0	1	1	1	0	0	1	5
Tarn Taran	2	125,211	2	0	1	1	0	1	1	1	0	0	1	8
Total	**82**	**8,777,945**	**21**	**38**	**58**	**20**	**6**	**30**	**23**	**20**	**7**	**7**	**20**	**250**

Table 16-8: Additional vehicle required for new rural Fire Stations under their ideal jurisdiction areas

District	Num of Fire Stations	Ideally Served Population Estimates	Water tender	Water Bowser	Foam tender	Advanced Rescue Responder	Sky Lift/ TTL	DCP tender	Hose Tender	BA Van	QRT	Motor cycle mist	Education Van	Total Vehicles
Amritsar	6	1,702,011	21	11	5	0	0	2	0	0	6	6	0	51
Barnala	3	690,977	7	4	3	0	0	1	0	0	3	3	0	21
Bathinda	6	1,090,005	9	5	6	0	0	3	0	0	6	6	0	35
Faridkot	1	219,074	2	1	1	0	0	1	0	0	1	1	0	7
Fatehgarh Sahib	1	249,781	2	2	1	0	0	0	0	0	1	1	0	7
Firozpur	9	1,673,695	15	8	9	0	0	0	0	0	9	9	0	50
Gurdaspur	10	1,440,708	15	6	7	0	0	1	0	0	10	10	0	49
Hoshiarpur	8	1,643,905	16	10	8	0	0	0	0	0	8	8	0	50
Jalandhar	4	836,985	9	4	4	0	0	0	0	0	4	4	0	25
Kapurthala	4	759,328	8	3	4	0	0	1	0	0	4	4	0	24
Ludhiana	7	1,726,354	21	9	7	0	0	4	0	0	7	7	0	55
Mansa		536,948	6	2	3	0	0	1	0	0	3	3	0	18
Moga	3	766,403	8	5	3	0	0	1	0	0	3	3	0	23
Muktsar	5	820,087	7	3	5	0	0	0	0	0	5	5	0	25
Patiala	6	1,410,353	16	8	6	0	0	1	0	0	6	6	0	43
Rupnagar	4	596,985	5	3	3	0	0	1	0	0	4	4	0	20
Sahibzada Ajit Singh Nagar	1	358,359	3	1	0	0	0	1	0	0	1	1	0	7
Sangrur	5	1,141,993	12	6	5	0	0	3	0	0	5	5	0	36
Shahid Bhagat Singh Nagar	3	494,944	5	2	3	0	0	0	0	0	3	3	0	16
Tarn Taran	4	767,396	9	3	3	0	0	0	0	0	4	4	0	23
Total	**93**	**18,926,291**	**196**	**96**	**86**	**0**	**0**	**21**	**0**	**0**	**93**	**93**	**0**	**585**

Table 16-9: List of specialized equipment available with Punjab Fire Service department (As on May, 2012)

District	Fire Stations	Ideally Served Population Estimates	Hydraulic Rescue Tools	Combi Tools	B.A. Sets	BA Compressors	First-Aid Boxes	Thermal Imaging Cameras	Electric Chain Saws / Cutters / Hammers for Concrete	Electric Chain Saws / Cutters/ Hammers for Wood	Hydraulic / Manual Chain Saws / Cutters for Wood	Personal Protection Equipment	Hand Held Gas Detector Kits	Life Locator Equipment	Portable Pumps	Floating Pumps
Amritsar	4	714,538	0	0	0	0	0	0	1	0	0	0	0	0	1	0
Barnala	1	116,858	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Bathinda	1	250,707	0	0	1	0	6	0	0	0	0	2	0	0	1	0
Faridkot	2	196,875	0	0	2	0	1	0	1	0	0	0	20	0	0	0
Fatehgarh Sahib	2	172,407	0	0	4	0	3	0	0	0	0	0	0	0	0	0
Firozpur	4	360,348	0	0	0	0	2	0	2	0	0	0	0	0	0	0
Gurdaspur	4	450,177	0	0	1	0	3	0	0	1	0	0	0	0	3	0
Hoshiarpur	1	155,700	0	0	2	0	2	0	1	1	1	0	0	0	1	0
Jalandhar	4	482,334	0	0	2	0	3	0	0	0	0	0	0	0	3	0
Kapurthala	2	223,495	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Ludhiana	7	1,148,044	0	2	2	0	7	0	16	3	0	0	19	0	1	0
Mansa	2	108,831	0	1	1	0	2	0	0	0	0	1	0	0	1	0
Moga	1	157,057	0	0	1	0	1	0	2	1	0	0	2	0	0	0
Muktsar	3	274,442	0	1	1	0	2	0	2	0	0	0	10	0	1	0
Patiala	4	434,442	0	1	4	0	5	0	0	0	0	2	0	0	0	0
Rupnagar	1	50,327	0	0	1	0	2	0	0	0	0	0	0	0	0	0
Sahibzada Ajit Singh Nagar	2	159,155	0	0	10	0	0	0	1	0	0	6	0	0	3	0
Sangrur	2	271,862	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shahid Bhagat Singh Nagar	1	91,670	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Tarn Taran	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**48**	**5,819,269**	**0**	**5**	**32**	**0**	**42**	**0**	**27**	**6**	**1**	**11**	**51**	**0**	**15**	**0**

Table 16-10: List of specialized equipment available with Punjab Fire Service department (As on May, 2012) continued..

District	Fire Stations	Ideally Served Population Estimates	Diving Suits (Dry Type)	Diving Suits (Wet Type)	Inflatable Lighting Towers	Smoke Exhausters / PPV	Pneumatic lifting bags	High Capacity LED Torches	Rescue Boats	Static Wireless Set	Mobile Wireless Set	Walky Talky	Mega Phone	Total
Amritsar	4	714,538	0	0	0	0	0	3	0	0	0	0	0	5
Barnala	1	116,858	0	0	0	0	0	2	0	0	0	0	0	4
Bathinda	1	250,707	0	0	0	0	0	6	0	0	0	0	0	16
Faridkot	2	196,875	0	0	0	0	0	1	0	1	0	0	0	26
Fatehgarh Sahib	2	172,407	0	0	0	0	0	2	0	8	0	1	0	18
Firozpur	4	360,348	0	0	0	0	0	1	0	2	1	3	0	11
Gurdaspur	4	450,177	0	0	0	0	0	3	0	0	0	0	0	11
Hoshiarpur	1	155,700	0	0	0	0	0	1	0	0	0	0	0	9
Jalandhar	4	482,334	0	0	0	0	0	8	0	0	0	0	0	16
Kapurthala	2	223,495	0	0	0	0	0	2	0	0	0	0	0	3
Ludhiana	7	1,148,044	0	0	0	0	0	12	0	0	2	1	0	65
Mansa	2	108,831	0	0	0	0	0	1	0	1	0	2	0	10
Moga	1	157,057	0	0	0	0	0	0	0	0	1	0	0	8
Muktsar	3	274,442	0	0	0	0	0	3	0	1	4	6	0	31
Patiala	4	434,442	0	0	0	0	0	4	0	0	0	0	0	16
Rupnagar	1	50,327	0	0	0	0	0	0	0	0	0	0	0	3
Sahibzada Ajit Singh Nagar	2	159,155	0	0	1	0	0	1	0	0	0	0	0	22
Sangrur	2	271,862	0	0	0	0	0	3	0	0	0	0	0	3
Shahid Bhagat Singh Nagar	1	91,670	0	0	0	0	0	2	0	0	0	0	0	3
Tarn Taran	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**48**	**5,819,269**	**0**	**0**	**1**	**0**	**0**	**55**	**0**	**13**	**8**	**13**	**0**	**280**

Table 16-11: Specialized Equipment Gap in operational Fire Stations for ideal jurisdiction area

District	Fire Stations	Ideally Served Population Estimates	Hydraulic Rescue Tools	Combi Tools	B.A. Sets	BA Compressors	First-Aid Boxes	Thermal Imaging Cameras	Electric Chain Saws / Cutters / Hammers for Concrete	Electric Chain Saws / Cutters/ Hammers for Wood	Hydraulic / Manual Chain Saws / Cutters for Wood	Personal Protection Equipment	Hand Held Gas Detector Kits	Life Locator Equipment	Portable Pumps	Floating Pumps
Amritsar	4	714,538	6	26	136	7	20	6	5	7	7	35	26	6	19	0
Barnala	1	116,858	1	4	12	2	6	1	1	2	2	7	4	1	3	0
Bathinda	1	250,707	1	9	53	3	8	1	1	3	3	11	8	1	5	0
Faridkot	2	196,875	1	6	27	3	7	1	2	3	3	7	-14	1	5	0
Fatehgarh Sahib	2	172,407	2	5	15	2	2	2	2	2	2	5	5	2	4	0
Firozpur	4	360,348	1	11	80	7	20	1	3	7	7	20	11	1	9	0
Gurdaspur	4	450,177	6	15	43	4	8	4	4	3	4	11	11	4	8	0
Hoshiarpur	1	155,700	1	6	54	3	13	1	0	2	2	15	4	1	3	0
Jalandhar	4	482,334	6	17	84	6	21	6	6	6	6	24	18	6	10	0
Kapurthala	2	223,495	2	6	45	3	11	2	2	3	3	12	8	2	6	0
Ludhiana	7	1,148,044	9	40	194	11	46	9	-7	8	11	52	23	9	31	0
Mansa	2	108,831	1	2	26	3	6	1	2	3	3	7	3	1	2	0
Moga	1	157,057	1	5	35	2	8	1	-1	1	2	9	3	1	4	0
Muktsar	3	274,442	0	8	50	5	11	1	2	5	5	12	-1	1	6	0
Patiala	4	434,442	1	14	87	7	19	1	6	7	7	9	15	1	11	0
Rupnagar	1	50,327	1	1	19	2	5	1	1	2	2	6	1	1	1	0
Sahibzada Ajit Singh Nagar	2	159,155	3	8	18	3	8	3	2	3	3	2	8	3	2	0
Sangrur	2	271,862	0	10	28	4	16	1	3	6	6	9	9	1	7	0
Shahid Bhagat Singh Nagar	1	91,670	1	2	21	2	6	1	0	2	2	5	2	1	2	0
Tarn Taran	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**48**	**5,819,269**	**44**	**195**	**1027**	**79**	**241**	**44**	**34**	**75**	**80**	**258**	**144**	**44**	**138**	**0**

Table 16-12: Specialized Equipment Gap in Operational Fire Stations for ideal jurisdiction area (continue …)

District	Fire Stations	Ideally Served Population Estimates	Diving Suits (Dry Type)	Diving Suits (Wet Type)	Inflatable Lighting Towers	Smoke Exhausters / PPV	Pneumatic lifting bags	High Capacity LED Torches	Rescue Boats	Static Wireless Set	Mobile Wireless Set	Walky Talky	Mega Phone	Total
Amritsar	4	714,538	0	0	7	6	6	32	0	7	36	37	7	444
Barnala	1	116,858	0	0	2	1	1	6	0	2	14	8	2	82
Bathinda	1	250,707	0	0	3	1	1	9	0	3	25	14	2	165
Faridkot	2	196,875	0	0	3	3	1	7	0	2	11	8	3	90
Fatehgarh Sahib	2	172,407	0	0	2	2	2	3	0	-6	5	3	2	63
Firozpur	4	360,348	0	0	7	5	1	20	0	5	34	19	7	276
Gurdaspur	4	450,177	0	0	4	4	4	8	0	4	11	11	4	175
Hoshiarpur	1	155,700	0	0	1	1	1	14	0	3	15	15	3	158
Jalandhar	4	482,334	0	0	7	6	6	15	0	7	23	24	7	311
Kapurthala	2	223,495	0	0	3	2	2	10	0	3	12	12	4	153
Ludhiana	7	1,148,044	0	0	11	9	9	38	0	11	50	52	11	627
Mansa	2	108,831	0	0	3	2	1	3	0	2	8	6	3	88
Moga	1	157,057	0	0	2	1	1	10	0	2	15	9	2	113
Muktsar	3	274,442	0	0	3	4	1	12	0	2	11	1	5	144
Patiala	4	434,442	0	0	7	6	1	23	0	6	43	23	7	301
Rupnagar	1	50,327	0	0	2	1	1	5	0	2	5	6	2	67
Sahibzada Ajit Singh Nagar	2	159,155	0	0	2	3	3	7	0	3	8	8	3	103
Sangrur	2	271,862	0	0	4	2	1	14	0	4	27	16	4	172
Shahid Bhagat Singh Nagar	1	91,670	0	0	2	1	1	3	0	2	6	6	2	70
Tarn Taran	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**48**	**5,819,269**	**0**	**0**	**75**	**60**	**44**	**239**	**0**	**64**	**359**	**278**	**80**	**3602**

Table 16-13: Additional specialized equipment required for new urban Fire Stations under their ideal jurisdiction areas

District	Fire Stations	Ideally Served Population Estimates	Hydraulic Rescue Tools	Combi Tools	B.A. Sets	BA Compressors	First-Aid Boxes	Thermal Imaging Cameras	Electric Chain Saws / Cutters / Hammers for Concrete	Electric Chain Saws / Cutters/ Hammers for Wood	Hydraulic / Manual Chain Saws / Cutters for Wood	Personal Protection Equipment	Hand Held Gas Detector Kits	Life Locator Equipment	Portable Pumps	Floating Pumps
Amritsar	5	488,241	5	12	48	5	14	5	5	5	5	14	12	5	12	0
Barnala	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bathinda	2	83,814	0	3	12	2	4	0	2	2	2	4	3	0	3	0
Faridkot	1	42,152	0	1	4	1	2	0	1	1	1	2	1	0	1	0
Fatehgarh Sahib	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Firozpur	1	36,712	0	1	4	1	2	0	1	1	1	2	1	0	1	0
Gurdaspur	3	187,346	3	5	67	6	19	3	3	6	6	19	6	3	5	0
Hoshiarpur	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jalandhar	4	419,412	4	10	40	4	11	4	4	4	4	11	10	4	10	0
Kapurthala	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ludhiana	6	720,337	4	18	72	6	18	4	6	6	6	18	18	4	18	0
Mansa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Moga	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Muktsar	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patiala	4	344,129	0	9	36	4	10	0	4	4	4	10	9	0	9	0
Rupnagar	1	76,639	1	2	8	1	2	1	1	1	1	2	2	1	2	0
Sahibzada Ajit Singh Nagar	3	299,629	3	8	32	3	8	3	3	3	3	8	8	3	8	0
Sangrur	2	135,054	0	3	12	2	4	0	2	2	2	4	3	0	3	0
Shahid Bhagat Singh Nagar	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tarn Taran	2	125,211	1	3	31	3	8	1	2	3	3	8	3	1	3	0
Total	**34**	**2,958,676**	**21**	**75**	**366**	**38**	**102**	**21**	**34**	**38**	**38**	**102**	**76**	**21**	**75**	**0**

Table 16-14: Additional specialized equipment required for new urban Fire Stations under their ideal jurisdiction areas (Continue ….)

District	Fire Stations	Ideally Served Population Estimates	Diving Suits (Dry Type)	Diving Suits (Wet Type)	Inflatable Lighting Towers	Smoke Exhausters / PPV	Pneumatic lifting bags	High Capacity LED Torches	Rescue Boats	Static Wireless Set	Mobile Wireless Set	Walky Talky	Mega Phone	Total
Amritsar	5	488,241	0	0	5	5	5	12	0	5	12	14	5	210
Barnala	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bathinda	2	83,814	0	0	2	2	0	3	0	2	3	4	2	55
Faridkot	1	42,152	0	0	1	1	0	1	0	1	1	2	1	23
Fatehgarh Sahib	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Firozpur	1	36,712	0	0	1	1	0	1	0	1	1	2	1	23
Gurdaspur	3	187,346	0	0	7	3	3	17	0	6	17	19	6	229
Hoshiarpur	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jalandhar	4	419,412	0	0	4	4	4	10	0	4	10	11	4	171
Kapurthala	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ludhiana	6	720,337	0	0	6	6	4	18	0	6	18	18	6	280
Mansa	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Moga	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Muktsar	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patiala	4	344,129	0	0	4	4	0	9	0	4	9	10	4	143
Rupnagar	1	76,639	0	0	1	1	1	2	0	1	2	2	1	36
Sahibzada Ajit Singh Nagar	3	299,629	0	0	3	3	3	8	0	3	8	8	3	132
Sangrur	2	135,054	0	0	2	2	0	3	0	2	3	4	2	55
Shahid Bhagat Singh Nagar	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tarn Taran	2	125,211	0	0	3	2	1	7	0	3	7	8	3	104
Total	**34**	**2,958,676**	**0**	**0**	**39**	**34**	**21**	**91**	**0**	**38**	**91**	**102**	**38**	**1461**

Table 16-15: Total gap in specialized equipment for operational and new urban Fire Stations

District	Fire Stations	Ideally Served Population Estimates	Hydraulic Rescue Tools	Combi Tools	B.A. Sets	BA Compressors	First-Aid Boxes	Thermal Imaging Cameras	Electric Chain Saws / Cutters / Hammers for Concrete	Electric Chain Saws / Cutters/ Hammers for Wood	Hydraulic / Manual Chain Saws / Cutters for Wood	Personal Protection Equipment	Hand Held Gas Detector Kits	Life Locator Equipment	Portable Pumps	Floating Pumps
Amritsar	9	1,202,779	11	38	184	12	34	11	10	12	12	49	38	11	31	0
Barnala	1	116,858	1	4	12	2	6	1	1	2	2	7	4	1	3	0
Bathinda	3	334,521	1	12	65	5	12	1	3	5	5	15	11	1	8	0
Faridkot	3	239,027	1	7	31	4	9	1	3	4	4	9	-13	1	6	0
Fatehgarh Sahib	2	172,407	2	5	15	2	2	2	2	2	2	5	5	2	4	0
Firozpur	5	397,060	1	12	84	8	22	1	4	8	8	22	12	1	10	0
Gurdaspur	7	637,523	9	20	110	10	27	7	7	9	10	30	17	7	13	0
Hoshiarpur	1	155,700	1	6	54	3	13	1	0	2	2	15	4	1	3	0
Jalandhar	8	901,746	10	27	124	10	32	10	10	10	10	35	28	10	20	0
Kapurthala	2	223,495	2	6	45	3	11	2	2	3	3	12	8	2	6	0
Ludhiana	13	1,868,381	13	58	266	17	64	13	-1	14	17	70	41	13	49	0
Mansa	2	108,831	1	2	26	3	6	1	2	3	3	7	3	1	2	0
Moga	1	157,057	1	5	35	2	8	1	-1	1	2	9	3	1	4	0
Muktsar	3	274,442	0	8	50	5	11	1	2	5	5	12	-1	1	6	0
Patiala	8	778,571	1	23	123	11	29	1	10	11	11	19	24	1	20	0
Rupnagar	2	126,966	2	3	27	3	7	2	2	3	3	8	3	2	3	0
Sahibzada Ajit Singh Nagar	5	458,784	6	16	50	6	16	6	5	6	6	10	16	6	10	0
Sangrur	4	406,916	0	13	40	6	20	1	5	8	8	13	12	1	10	0
Shahid Bhagat Singh Nagar	1	91,670	1	2	21	2	6	1	0	2	2	5	2	1	2	0
Tarn Taran	2	125,211	1	3	31	3	8	1	2	3	3	8	3	1	3	0
Total	**82**	**8,777,945**	**65**	**270**	**1393**	**117**	**343**	**65**	**68**	**113**	**118**	**360**	**220**	**65**	**213**	**0**

Table 16-16: Total gap in specialized equipment for operational and new urban Fire Stations (continue…)

District	Fire Stations	Ideally Served Population Estimates	Diving Suits (Dry Type)	Diving Suits (Wet Type)	Inflatable Lighting Towers	Smoke Exhausters / PPV	Pneumatic lifting bags	High Capacity LED Torches	Rescue Boats	Static Wireless Set	Mobile Wireless Set	Walky Talky	Mega Phone	Total
Amritsar	9	1,202,779	0	0	12	11	11	44	0	12	48	51	12	654
Barnala	1	116,858	0	0	2	1	1	6	0	2	14	8	2	82
Bathinda	3	334,521	0	0	5	3	1	12	0	5	28	18	4	220
Faridkot	3	239,027	0	0	4	4	1	8	0	3	12	10	4	113
Fatehgarh Sahib	2	172,407	0	0	2	2	2	3	0	-6	5	3	2	63
Firozpur	5	397,060	0	0	8	6	1	21	0	6	35	21	8	299
Gurdaspur	7	637,523	0	0	11	7	7	25	0	10	28	30	10	404
Hoshiarpur	1	155,700	0	0	1	1	1	14	0	3	15	15	3	158
Jalandhar	8	901,746	0	0	11	10	10	25	0	11	33	35	11	482
Kapurthala	2	223,495	0	0	3	2	2	10	0	3	12	12	4	153
Ludhiana	13	1,868,381	0	0	17	15	13	56	0	17	68	70	17	907
Mansa	2	108,831	0	0	3	2	1	3	0	2	8	6	3	88
Moga	1	157,057	0	0	2	1	1	10	0	2	15	9	2	113
Muktsar	3	274,442	0	0	3	4	1	12	0	2	11	1	5	144
Patiala	8	778,571	0	0	11	10	1	32	0	10	52	33	11	444
Rupnagar	2	126,966	0	0	3	2	2	7	0	3	7	8	3	103
Sahibzada Ajit Singh Nagar	5	458,784	0	0	5	6	6	15	0	6	16	16	6	235
Sangrur	4	406,916	0	0	6	4	1	17	0	6	30	20	6	227
Shahid Bhagat Singh Nagar	1	91,670	0	0	2	1	1	3	0	2	6	6	2	70
Tarn Taran	2	125,211	0	0	3	2	1	7	0	3	7	8	3	104
Total	**82**	**8,777,945**	**0**	**0**	**114**	**94**	**65**	**330**	**0**	**102**	**450**	**380**	**118**	**5063**

Table 16-17: Additional specialized equipment required for new rural Fire Stations

District	Fire Stations	Ideally Served Population Estimates	Hydraulic Rescue Tools	Combi Tools	B.A. Sets	BA Compressors	First-Aid Boxes	Thermal Imaging Cameras	Electric Chain Saws / Cutters / Hammers for Concrete	Electric Chain Saws / Cutters/ Hammers for Wood	Hydraulic / Manual Chain Saws / Cutters for Wood	Personal Protection Equipment	Hand Held Gas Detector Kits	Life Locator Equipment	Portable Pumps	Floating Pumps
Amritsar	6	1,702,011	0	0	184	6	49	0	0	6	6	43	0	0	43	0
Barnala	3	690,977	0	0	74	3	20	0	0	3	3	17	0	0	17	0
Bathinda	6	1,090,005	0	0	116	6	32	0	0	6	6	26	0	0	26	0
Faridkot	1	219,074	0	0	22	1	6	0	0	1	1	5	0	0	5	0
Fatehgarh Sahib	1	249,781	0	0	26	1	7	0	0	1	1	6	0	0	6	0
Firozpur	9	1,673,695	0	0	182	9	50	0	0	9	9	41	0	0	41	0
Gurdaspur	10	1,440,708	0	0	172	10	48	0	0	10	10	48	0	0	38	0
Hoshiarpur	8	1,643,905	0	0	184	8	50	0	0	8	8	50	0	0	42	0
Jalandhar	4	836,985	0	0	92	4	25	0	0	4	4	25	0	0	21	0
Kapurthala	4	759,328	0	0	84	4	23	0	0	4	4	23	0	0	19	0
Ludhiana	7	1,726,354	0	0	190	7	51	0	0	7	7	44	0	0	44	0
Mansa	3	536,948	0	0	62	3	17	0	0	3	3	14	0	0	14	0
Moga	3	766,403	0	0	82	3	22	0	0	3	3	19	0	0	19	0
Muktsar	5	820,087	0	0	90	5	25	0	0	5	5	20	0	0	20	0
Patiala	6	1,410,353	0	0	156	6	42	0	0	6	6	37	0	0	36	0
Rupnagar	4	596,985	0	0	68	4	19	0	0	4	4	15	0	0	15	0
Sahibzada Ajit Singh Nagar	1	358,359	0	0	18	1	5	0	0	1	1	4	0	0	4	0
Sangrur	5	1,141,993	0	0	122	5	33	0	0	5	5	28	0	0	28	0
Shahid Bhagat Singh Nagar	3	494,944	0	0	58	3	16	0	0	3	3	13	0	0	13	0
Tarn Taran	4	767,396	0	0	84	4	23	0	0	4	4	19	0	0	19	0
Total	**93**	**18,926,291**	**0**	**0**	**2066**	**93**	**563**	**0**	**0**	**93**	**93**	**497**	**0**	**0**	**470**	**0**

Table 16-18: Additional specialized equipment required for new rural Fire Stations (continued...)

District	Fire Stations	Ideally Served Population Estimates	Diving Suits (Dry Type)	Diving Suits (Wet Type)	Inflatable Lighting Towers	Smoke Exhausters / PPV	Pneumatic lifting bags	High Capacity LED Torches	Rescue Boats	Static Wireless Set	Mobile Wireless Set	Walky Talky	Mega Phone	Total
Amritsar	6	1,702,011	0	0	6	0	0	43	0	6	49	49	6	496
Barnala	3	690,977	0	0	3	0	0	17	0	3	20	20	3	203
Bathinda	6	1,090,005	0	0	6	0	0	26	0	6	32	32	6	326
Faridkot	1	219,074	0	0	1	0	0	5	0	1	6	6	1	61
Fatehgarh Sahib	1	249,781	0	0	1	0	0	6	0	1	7	7	1	71
Firozpur	9	1,673,695	0	0	9	0	0	41	0	9	50	50	9	509
Gurdaspur	10	1,440,708	0	0	10	0	0	48	0	10	48	48	10	510
Hoshiarpur	8	1,643,905	0	0	8	0	0	50	0	8	50	50	8	524
Jalandhar	4	836,985	0	0	4	0	0	25	0	4	25	25	4	262
Kapurthala	4	759,328	0	0	4	0	0	23	0	4	23	23	4	242
Ludhiana	7	1,726,354	0	0	7	0	0	44	0	7	51	51	7	517
Mansa	3	536,948	0	0	3	0	0	14	0	3	17	17	3	173
Moga	3	766,403	0	0	3	0	0	19	0	3	22	22	3	223
Muktsar	5	820,087	0	0	7	0	0	20	0	7	33	41	5	283
Patiala	6	1,410,353	0	0	6	0	0	37	0	6	42	42	6	428
Rupnagar	4	596,985	0	0	4	0	0	15	0	4	19	19	4	194
Sahibzada Ajit Singh Nagar	1	358,359	0	0	1	0	0	4	0	1	5	5	1	51
Sangrur	5	1,141,993	0	0	5	0	0	28	0	5	33	33	5	335
Shahid Bhagat Singh Nagar	3	494,944	0	0	3	0	0	13	0	3	16	16	3	163
Tarn Taran	4	767,396	0	0	4	0	0	19	0	4	23	23	4	234
Total	**93**	**18,926,291**	**0**	**0**	**95**	**0**	**0**	**497**	**0**	**95**	**571**	**579**	**93**	**5805**

16.3.3 FIRE MANPOWER GAP

SFAC guidelines have suggested manpower (Table 16-19), including reserve for duty off, training, leave for Station Officer, Sub-Officer (75%) and Leading Firemen and lower staff (25%). However, the duty pattern varies from State/UT to State/UT. In Punjab State, presently prevailing duty pattern is of three-shifts.

Delhi Administrative Reform Department (ARD), Govt. of India has studied the fire manpower requirement, and optimized it further for two shifts duty pattern (Table 16-20). Thus for optimization on resources, following man-power criteria (double - shift) have been suggested for manpower gap analysis.

From Tables 16-19 and 16-20, it is quite clear that The Administrative Reform Department (ARD, Delhi), has already optimized the fire manpower requirement in comparison of what has been suggested in SFAC norms. It may be noted that total number of staff is coming in decimal places, as calculations are on pumping units including reserve staff, which has been rounded of in the fire man power gap analysis at district and State levels (Table 16-21).

Accordingly, total manpower gap in both urban and rural Fire Stations in Punjab State has been estimated, which comes to 15,666 (Tables 16-22 to 16-25) persons against a total present manpower of about 581 persons.

The three shifts versus two shifts duty patterns have been discussed with MHA officials in the project review meeting held on January 09, 2012. The outcome of the discussion is that RMSI team should recommend 2-shifts duty pattern as it further optimize the huge man-power gap and is advantageous in comparison to 3-shifts duty pattern (Tables 16-19 and 16-20).

Table 16-19: Manpower requirement for Station officer and lower staff as per SFAC norm (2- shifts)

Sr No	Size of Station (Pumping Unit)	Station Officer	Sub-Officer*	Leading Firemen (L.F.)	Additional LFM	Total LFM	Drivers/ Operators	Fire men	Additional FM per FS (FAD,HID, DISP,WRO)	Total Fire men	Total
1	One	0	1.75	2.5	1.25	3.75	5	15	10	25	35.50
2	Two	1.75	1.75	5	1.25	6.25	7.5	30	10	40	57.25
3	Three	1.75	3.5	7.5	1.25	8.75	10	45	10	55	79.00
4	Four	3.5	3.5	10	1.25	11.25	15	60	10	70	103.25
5	Five	3.5	5.25	12.5	1.25	13.75	17.5	75	10	85	125.00
6	Six	3.5	7	15	1.25	16.25	22.5	90	10	100	149.25
7	Seven	5.25	7	17.5	1.25	18.75	25	105	10	115	171.00

**: Where extent of fire risk may justify Sub-Officers may be replaced with Station Officers*

Table 16-20: Manpower requirement for Station officer and lower staffs as per ARD, Delhi (2-shifts)

Sr No	Fire Station (Pumping Unit)	Station Officer	Sub-Officer	LFM	Firemen-cum-Driver-cum Operator	Total Staff
1	One	0	2.5	2.5	15.625	20.6
2	Two	1.25	2.5	2.5	31.250	37.5
3	Three	1.25	3.75	7.5	46.875	59.4
4	Four	2.5	4.6875	9.375	60.000	76.6
5	Five	2.5	5.625	11.25	73.125	92.5

Sr No	Fire Station (Pumping Unit)	Station Officer	Sub-Officer	LFM	Firemen-cum-Driver-cum Operator	Total Staff
6	Six	3.75	6.5625	13.125	87.188	110.6
7	Seven	3.75	7.5	15	101.250	127.5

Accordingly, as per Table 16-20, gap analysis for all the districts in Punjab State have been carried out (Tables 16-22 to 16-25).

Since, in Punjab State, there is a system of Municipal fire service, which are not functioning in a well- coordinated manner in the State. Thus, in addition to fire fighting staff, there is an urgent need of senior level fire officers for making a well coordinated State level hierarchy and fire prevention wing for inspection, awareness generation and training, so that recurrence of the fire incidences, similar to that of Advance Medical Research Institute (AMRI), Kolkata, in terms of their magnitude and frequency can be reduced. Accordingly, to support Director, Deptt. of Local Government, additional officers, in the Technical Wing, at the levels of Director, Chief Fire Officers (CFO), Dy Chief Fire Officers (DyCFO), Division Fire Officers (DFO), and Assistant Divisional Officer (ADO) have been suggested. To meet the ideal requirement of officials, following numbers of total officials have been proposed (including existing officials), which may be recruited in a phased manner approach:

- Director (technical): 1
- CFO: 20
- Dy CFO 20
- DFO 22 (one per 8 Fire Stations)
- ADFO 44 (one per 4 Fire Stations)

It may be noted that for sweeper/cleaner staff, we recommend hiring of sweeper/cleaners on contract basis. For computation in financial analysis, we have assumed a fixed salary of Rs 7,000/pm, and without any reserve over that.

Accordingly, existing fire manpower and gap analysis for all the districts in Punjab State have been carried out.

Table 16-21: List of manpower available for operational Fire Stations (As on May, 2012)

District	Fire Stations	Level 10	Level 9	Level 8	Level 7	Level 6	Level 5	Level 4	Level 3	Level 2	Level 1	Level 0	Total Staff
Amritsar	4	0	0	0	0	0	1	1	11	9	34	1	57
Barnala	1	0	0	0	0	0	1	1	2	1	12	0	17
Bathinda	1	0	0	0	0	0	0	0	2	1	13	0	16
Faridkot	2	0	0	0	0	0	0	2	2	0	11	0	15
Fatehgarh Sahib	2	0	0	0	0	0	1	1	5	3	8	0	18
Firozpur	4	0	0	0	0	0	0	3	6	7	21	0	37
Gurdaspur	4	0	0	0	0	0	1	0	3	3	40	0	47
Hoshiarpur	1	0	0	0	0	0	1	1	2	2	10	0	16
Jalandhar	4	0	0	0	0	0	1	0	14	0	44	0	59
Kapurthala	2	0	0	0	0	0	0	1	2	1	13	0	17
Ludhiana	7	0	0	0	0	0	0	3	9	18	59	3	92
Mansa	2	0	0	0	0	0	0	1	2	3	10	0	16
Moga	1	0	0	0	0	0	0	2	2	0	7	0	11
Muktsar	3	0	0	0	0	0	0	3	8	5	28	1	45
Patiala	4	0	0	0	0	0	1	1	10	8	39	0	59
Rupnagar	1	0	0	0	0	0	0	0	1	0	0	0	1
Sahibzada Ajit Singh Nagar	2	0	1	0	0	0	0	1	6	3	28	0	39
Sangrur	2	0	0	0	0	0	0	1	3	3	9	1	17
Shahid Bhagat Singh Nagar	1	0	0	0	0	0	0	1	1	0	0	0	2
Tarn Taran	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**48**	**0**	**1**	**0**	**0**	**0**	**7**	**23**	**91**	**67**	**386**	**6**	**581**

- Temporary/ private staff or staff on contract are not accounted in above

Level 10: *Director/Joint Director****;*** ***Level 9:*** *CFO/ CO;* ***Level 8:*** *Deputy CFO;* ***Level 7:*** *Deputy Controller;* ***Level 6:*** *DFO/ADO/Fire Officer/Fire Supervisor/Astt. Controller/Revenue Inspector;* ***Level 5:*** *DFO/ADFO/AFO/Fire In-charge;* ***Level 4****: St.O/Sub Inspector/Station In-charge/ASt O./AEO;* ***Level 3****: S O/Assistant Sub Inspector/ASO/Sub-Fire Officer/;* ***Level 2*** *: LFM/ Mechanic Driver/Head Constable/Store Superintendant;* ***Level 1*** *: FM/ FM Driver/Radio Technician/ SGFM/ Driver/ Police Constable/ Wireless Technician/ Radio Technician/ Asst FM/ Sanitary Inspector, FO/FO Driver/Driver Operator/Driver/Ambulance Driver/ Clerk;* ***Level 0:*** *Cleaner, Fire Coolie, Supporting Staff, Attendant, Labourer, Peon, Security Guard, Tindal.*

Table 16-22: Fire Manpower gap in operational Fire Stations for ideal jurisdiction area

District	Fire Stations	Level 10	Level 9	Level 8	Level 7	Level 6	Level 5	Level 4	Level 3	Level 2	Level 1	Level 0	Total Staff
Amritsar	4	0	1	1	0	2	3	13	17	56	381	3	477
Barnala	1	0	1	1	0	1	1	4	6	24	159	1	198
Bathinda	1	0	1	1	0	1	2	6	9	31	215	1	267
Faridkot	2	0	1	1	0	1	2	4	9	27	191	2	238
Fatehgarh Sahib	2	0	1	1	0	1	1	4	5	14	124	2	153
Firozpur	4	0	1	1	0	1	2	6	11	22	203	4	251
Gurdaspur	4	0	1	1	0	1	1	9	15	28	197	4	257
Hoshiarpur	1	0	1	1	0	1	1	4	7	25	180	1	221
Jalandhar	4	0	1	1	0	1	1	10	8	51	296	4	373
Kapurthala	2	0	1	1	0	1	2	5	10	31	205	2	258
Ludhiana	7	0	1	1	0	1	2	18	36	86	548	4	697
Mansa	2	0	1	1	0	1	2	3	8	14	107	2	139
Moga	1	0	1	1	0	1	2	3	7	27	183	1	226
Muktsar	3	0	1	1	0	1	2	4	7	30	221	2	269
Patiala	4	0	1	1	0	1	1	9	8	31	254	4	310
Rupnagar	1	0	1	1	0	1	2	3	5	11	73	1	98
Sahibzada Ajit Singh Nagar	2	1	0	1	0	2	4	4	6	21	123	2	164
Sangrur	2	0	1	1	0	1	2	6	9	21	152	1	194
Shahid Bhagat Singh Nagar	1	0	1	1	0	1	2	3	6	15	101	1	131
Tarn Taran	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**48**	**1**	**18**	**19**	**0**	**21**	**35**	**118**	**189**	**565**	**3913**	**42**	**4921**

Level 10: *Director/Joint Director****;*** ***Level 9:*** *CFO/ CO;* ***Level 8:*** *Deputy CFO;* ***Level 7:*** *Deputy Controller;* ***Level 6:*** *DFO/Fire Officer/ADO/Fire Supervisor/Astt. Controller/Revenue Inspector;* ***Level 5:*** *DFO/ADFO/AFO/Fire In-charge;* ***Level 4****: St.O/Sub Inspector/Station In-charge/ASt O./AEO;* ***Level 3****: S O/Assistant Sub Inspector/ASO/Sub-Fire Officer/;* ***Level 2*** *: LFM/ Mechanic Driver/Head Constable/Store Superintendant;* ***Level 1*** *: FM/ FM Driver/Radio Technician/ SGFM/ Driver/ Police Constable/ Wireless Technician/ Radio Technician/ Asst FM/ Sanitary Inspector, FO/FO Driver/Driver Operator/Driver/Ambulance Driver/ Clerk;* ***Level 0:*** *Cleaner, Fire Coolie, Supporting Staff, Attendant, Labourer, Peon, Security Guard, Tindal.*

Table 16-23: Additional Fire manpower required for new urban Fire Stations under their ideal jurisdiction areas

District	Fire Stations	Level 10	Level 9	Level 8	Level 7	Level 6	Level 5	Level 4	Level 3	Level 2	Level 1	Level 0	Total Staff
Amritsar	5	0	0	0	0	0	0	7	19	33	211	5	275
Barnala	0	0	0	0	0	0	0	0	0	0	0	0	0
Bathinda	2	0	0	0	0	0	0	1	6	10	63	2	82
Faridkot	1	0	0	0	0	0	0	0	2	2	16	1	21
Fatehgarh Sahib	0	0	0	0	0	0	0	0	0	0	0	0	0
Firozpur	1	0	0	0	0	0	0	0	2	2	16	1	21
Gurdaspur	3	0	0	0	0	0	0	2	9	12	94	3	120
Hoshiarpur	0	0	0	0	0	0	0	0	0	0	0	0	0
Jalandhar	4	0	0	0	0	0	0	5	13	22	154	4	198
Kapurthala	0	0	0	0	0	0	0	0	0	0	0	0	0
Ludhiana	6	0	0	0	0	0	0	12	24	43	303	6	388
Mansa	0	0	0	0	0	0	0	0	0	0	0	0	0
Moga	0	0	0	0	0	0	0	0	0	0	0	0	0
Muktsar	0	0	0	0	0	0	0	0	0	0	0	0	0
Patiala	4	0	0	0	0	0	0	3	12	20	141	4	180
Rupnagar	1	0	0	0	0	0	0	1	4	7	47	1	60
Sahibzada Ajit Singh Nagar	3	0	0	0	0	0	0	3	10	17	125	3	158
Sangrur	2	0	0	0	0	0	0	2	6	10	78	2	98
Shahid Bhagat Singh Nagar	0	0	0	0	0	0	0	0	0	0	0	0	0
Tarn Taran	2	0	1	1	0	1	2	4	10	17	117	2	155
Total	**34**	**0**	**1**	**1**	**0**	**1**	**2**	**40**	**117**	**195**	**1365**	**34**	**1756**

Level 10: *Director/Joint Director****;*** ***Level 9:*** *CFO/ CO;* ***Level 8:*** *Deputy CFO;* ***Level 7:*** *Deputy Controller;* ***Level 6:*** *DFO/Fire Officer/ADO/Fire Supervisor/Astt. Controller/Revenue Inspector;* ***Level 5:*** *DFO/ADFO/AFO/Fire In-charge;* ***Level 4****: St.O/Sub Inspector/Station In-charge/ASt O./AEO;* ***Level 3****: S O/Assistant Sub Inspector/ASO/Sub-Fire Officer/;* ***Level 2*** *: LFM/ Mechanic Driver/Head Constable/Store Superintendant;* ***Level 1*** *: FM/ FM Driver/Radio Technician/ SGFM/ Driver/ Police Constable/ Wireless Technician/ Radio Technician/ Asst FM/ Sanitary Inspector, FO/FO Driver/Driver Operator/Driver/Ambulance Driver/ Clerk;* ***Level 0:*** *Cleaner, Fire Coolie, Supporting Staff, Attendant, Labourer, Peon, Security Guard, Tindal.*

Table 16-24: Total Fire manpower gap for existing and new urban Fire Stations

District	Fire Stations	Level 10	Level 9	Level 8	Level 7	Level 6	Level 5	Level 4	Level 3	Level 2	Level 1	Level 0	Total Staff
Amritsar	9	0	1	1	0	2	3	20	36	89	592	8	752
Barnala	1	0	1	1	0	1	1	4	6	24	159	1	198
Bathinda	3	0	1	1	0	1	2	7	15	41	278	3	349
Faridkot	3	0	1	1	0	1	2	4	11	29	207	3	259
Fatehgarh Sahib	2	0	1	1	0	1	1	4	5	14	124	2	153
Firozpur	5	0	1	1	0	1	2	6	13	24	219	5	272
Gurdaspur	7	0	1	1	0	1	1	11	24	40	291	7	377
Hoshiarpur	1	0	1	1	0	1	1	4	7	25	180	1	221
Jalandhar	8	0	1	1	0	1	1	15	21	73	450	8	571
Kapurthala	2	0	1	1	0	1	2	5	10	31	205	2	258
Ludhiana	13	0	1	1	0	1	2	30	60	129	851	10	1085
Mansa	2	0	1	1	0	1	2	3	8	14	107	2	139
Moga	1	0	1	1	0	1	2	3	7	27	183	1	226
Muktsar	3	0	1	1	0	1	2	4	7	30	221	2	269
Patiala	8	0	1	1	0	1	1	12	20	51	395	8	490
Rupnagar	2	0	1	1	0	1	2	4	9	18	120	2	158
Sahibzada Ajit Singh Nagar	5	1	0	1	0	2	4	7	16	38	248	5	322
Sangrur	4	0	1	1	0	1	2	8	15	31	230	3	292
Shahid Bhagat Singh Nagar	1	0	1	1	0	1	2	3	6	15	101	1	131
Tarn Taran	2	0	1	1	0	1	2	4	10	17	117	2	155
Total	**82**	**1**	**19**	**20**	**0**	**22**	**37**	**158**	**306**	**760**	**5278**	**76**	**6677**

Level 10: *Director/Joint Director****;*** ***Level 9:*** *CFO/ CO;* ***Level 8:*** *Deputy CFO;* ***Level 7:*** *Deputy Controller;* ***Level 6:*** *DFO/Fire Officer/ADO/Fire Supervisor/Astt. Controller/Revenue Inspector;* ***Level 5:*** *DFO/ADFO/AFO/Fire In-charge;* ***Level 4****: St.O/Sub Inspector/Station In-charge/ASt O./AEO;* ***Level 3****: S O/Assistant Sub Inspector/ASO/Sub-Fire Officer/;* ***Level 2*** *: LFM/ Mechanic Driver/Head Constable/Store Superintendant;* ***Level 1*** *: FM/ FM Driver/Radio Technician/ SGFM/ Driver/ Police Constable/ Wireless Technician/ Radio Technician/ Asst FM/ Sanitary Inspector, FO/FO Driver/Driver Operator/Driver/Ambulance Driver/ Clerk;* ***Level 0:*** *Cleaner, Fire Coolie, Supporting Staff, Attendant, Labourer, Peon, Security Guard, Tindal.*

Table 16-25: Additional Fire manpower required for new rural Fire Stations under their ideal jurisdiction areas

District	Fire Stations	Level 10	Level 9	Level 8	Level 7	Level 6	Level 5	Level 4	Level 3	Level 2	Level 1	Level 0	Total Staff
Amritsar	6	0	0	0	0	0	0	23	48	125	714	6	916
Barnala	3	0	0	0	0	0	0	10	20	46	235	3	314
Bathinda	6	0	0	0	0	0	0	14	33	75	374	6	502
Faridkot	1	0	0	0	0	0	0	3	7	15	78	1	104
Fatehgarh Sahib	1	0	0	0	0	0	0	3	7	15	78	1	104
Firozpur	9	0	0	0	0	0	0	18	47	107	528	9	709
Gurdaspur	10	0	0	0	0	0	0	15	47	101	490	10	663
Hoshiarpur	8	0	0	0	0	0	0	21	47	111	547	8	734
Jalandhar	4	0	0	0	0	0	0	10	24	55	273	4	366
Kapurthala	4	0	0	0	0	0	0	10	22	50	258	4	344
Ludhiana	7	0	0	0	0	0	0	24	52	141	816	7	1040
Mansa	3	0	0	0	0	0	0	8	17	37	193	3	258
Moga	3	0	0	0	0	0	0	11	22	50	263	3	349
Muktsar	5	0	0	0	0	0	0	9	23	51	254	5	342
Patiala	6	0	0	0	0	0	0	18	41	110	605	6	780
Rupnagar	4	0	0	0	0	0	0	6	18	40	203	4	271
Sahibzada Ajit Singh Nagar	1	0	0	0	0	0	0	3	7	15	78	1	104
Sangrur	5	0	0	0	0	0	0	16	34	78	407	5	540
Shahid Bhagat Singh Nagar	3	0	0	0	0	0	0	5	15	33	166	3	222
Tarn Taran	4	0	0	0	0	0	0	9	22	50	242	4	327
Total	**93**	**0**	**0**	**0**	**0**	**0**	**0**	**236**	**553**	**1305**	**6802**	**93**	**8989**

Level 10: *Director/Joint Director****;*** ***Level 9:*** *CFO/ CO;* ***Level 8:*** *Deputy CFO;* ***Level 7:*** *Deputy Controller;* ***Level 6:*** *DFO/ADO/Fire Officer/Fire Supervisor/Astt. Controller/Revenue Inspector;* ***Level 5:*** *DFO/ADFO/AFO/Fire In-charge;* ***Level 4****: St.O/Sub Inspector/Station In-charge/ASt O./AEO;* ***Level 3****: S O/Assistant Sub Inspector/ASO/Sub-Fire Officer/;* ***Level 2*** *: LFM/ Mechanic Driver/Head Constable/Store Superintendant;* ***Level 1*** *: FM/ FM Driver/Radio Technician/ SGFM/ Driver/ Police Constable/ Wireless Technician/ Radio Technician/ Asst FM/ Sanitary Inspector, FO/FO Driver/Driver Operator/Driver/Ambulance Driver/ Clerk;* ***Level 0:*** *Cleaner, Fire Coolie, Supporting Staff, Attendant, Labourer, Peon, Security Guard, Tindal.*

16.3.4 FIRE STATION BUILDING INFRASTRUCTURE GAP

Depending upon the number of pumping units, no of bays in a Fire Station has been estimated. However, in order to consider future growth in population and expansion of Fire Station, a minimum two bay Fire Station has been proposed, even at a Fire Station having requirement of one pumping unit. Accordingly, gaps in operational Fire Stations, new urban Fire Stations, and new rural Fire Stations have been given in Tables 16-26 and 16-27.

Table 16-26: Fire station building required for gap in operational and new urban Fire Stations (no of Bays)

District	Fire Stations	Bay1	Bay2	Bay3	Bay4	Bay5	Bay6	Bay7
Amritsar	9	1	0	0	1	1	0	2
Barnala	1	0	0	0	0	0	0	1
Bathinda	3	1	0	1	0	0	0	0
Faridkot	3	1	1	-1	0	0	0	1
Fatehgarh Sahib	2	0	1	0	-1	0	0	0
Firozpur	5	1	0	-1	1	0	0	0
Gurdaspur	7	1	1	1	0	1	0	0
Hoshiarpur	1	0	0	0	0	0	0	1
Jalandhar	8	1	2	1	1	0	0	0
Kapurthala	2	0	0	0	0	0	0	0
Ludhiana	13	0	2	1	2	1	0	0
Mansa	2	0	0	0	0	0	0	1
Moga	1	0	0	0	0	0	0	1
Muktsar	3	-1	1	0	0	0	0	1
Patiala	8	0	2	2	0	0	0	1
Rupnagar	2	0	0	1	0	0	0	0
Sahibzada Ajit Singh Nagar	5	0	2	2	0	0	0	1
Sangrur	4	0	1	1	0	0	0	1
Shahid Bhagat Singh Nagar	1	0	0	0	0	0	0	1
Tarn Taran	2	1	0	0	0	0	0	1
Total	**82**	**6**	**13**	**8**	**4**	**3**	**0**	**13**

Table 16-27: Fire station building required for new rural Fire Stations (no of Bays)

District	Fire Stations	Bay1	Bay2	Bay3	Bay4	Bay5	Bay6	Bay7
Amritsar	6	0	0	1	0	0	2	3
Barnala	3	0	0	0	1	1	1	0
Bathinda	6	0	1	1	2	2	0	0
Faridkot	1	0	0	0	0	1	0	0
Fatehgarh Sahib	1	0	0	0	0	1	0	0
Firozpur	9	0	2	3	2	1	1	0
Gurdaspur	10	2	3	2	2	0	0	1
Hoshiarpur	8	0	0	2	3	2	1	0
Jalandhar	4	0	0	1	1	2	0	0
Kapurthala	4	0	1	0	1	2	0	0
Ludhiana	7	0	1	1	1	1	0	3
Mansa	3	0	1	0	1	0	1	0
Moga	3	0	0	0	1	0	1	1
Muktsar	5	0	2	1	2	0	0	0
Patiala	6	0	0	2	2	0	0	2
Rupnagar	4	0	2	1	0	1	0	0
Sahibzada Ajit Singh Nagar	1	1	0	0	0	0	0	0
Sangrur	5	0	0	1	0	1	3	0
Shahid Bhagat Singh Nagar	3	0	1	1	0	1	0	0
Tarn Taran	4	1	0	0	1	2	0	0
Total	**93**	**4**	**14**	**17**	**20**	**18**	**10**	**10**

16.4 Investment and Financial Analysis

16.4.1 Capital Cost

Building Infrastructure Cost:

Tables 16-28 and 16-29 provides details of the Fire Station gap analysis in Punjab State. The ideal requirement of land for a Fire Station is 2½ acres, however, a 2 bay Fire Station may be constructed even in a one acre land. It may be noted that land cost will vary from time to time and place to place; hence it has not been added in cost estimates. The civil construction cost estimation involves cost of Fire Station building including stores, offices, residential quarters, static water tanks, which will vary in size depending upon the number of bays (garage) in a Fire Station. Accordingly, total cost estimates for one, two, three, five, and seven bay Fire Stations (based on the P.W. D. norms) is about 150 Lakhs, 300 Lakhs, 450 Lakhs, 700 Lakhs, 950 Lakhs respectively (Tables 16-28 to 16-29). To start with, rural-Fire Station/ Fire Post may be stationed in a government building, such as school/ hospital or a Panchayat ghar.

Table 16-28: Cost of Fire Station building (no of bays) required for gap in operational and new urban Fire Stations (in Lakhs Rupees)

District	Fire Stations	Bay1	Bay2	Bay3	Bay4	Bay5	Bay6	Bay7	Total Bay
Amritsar	9	150.00	0.00	0.00	575.00	700.00	0.00	1,900.00	3,325.00
Barnala	1	0.00	0.00	0.00	0.00	0.00	0.00	950.00	950.00
Bathinda	3	150.00	0.00	450.00	0.00	0.00	0.00	0.00	600.00
Faridkot	3	150.00	300.00	-450.00	0.00	0.00	0.00	950.00	950.00
Fatehgarh Sahib	2	0.00	300.00	0.00	-575.00	0.00	0.00	0.00	-275.00
Firozpur	5	150.00	0.00	-450.00	575.00	0.00	0.00	0.00	275.00
Gurdaspur	7	150.00	300.00	450.00	0.00	700.00	0.00	0.00	1,600.00
Hoshiarpur	1	0.00	0.00	0.00	0.00	0.00	0.00	950.00	950.00
Jalandhar	8	150.00	600.00	450.00	575.00	0.00	0.00	0.00	1,775.00
Kapurthala	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ludhiana	13	0.00	600.00	450.00	1,150.00	700.00	0.00	0.00	2,900.00
Mansa	2	0.00	0.00	0.00	0.00	0.00	0.00	950.00	950.00
Moga	1	0.00	0.00	0.00	0.00	0.00	0.00	950.00	950.00
Muktsar	3	150.00	300.00	0.00	0.00	0.00	0.00	950.00	1,100.00
Patiala	8	0.00	600.00	900.00	0.00	0.00	0.00	950.00	2,450.00
Rupnagar	2	0.00	0.00	450.00	0.00	0.00	0.00	0.00	450.00
Sahibzada Ajit Singh Nagar	5	0.00	600.00	900.00	0.00	0.00	0.00	950.00	2,450.00
Sangrur	4	0.00	300.00	450.00	0.00	0.00	0.00	950.00	1,700.00
Shahid Bhagat Singh Nagar	1	0.00	0.00	0.00	0.00	0.00	0.00	950.00	950.00
Tarn Taran	2	150.00	0.00	0.00	0.00	0.00	0.00	950.00	1,100.00
Total	**82**	**900.00**	**3,900.00**	**3,600.00**	**2,300.00**	**2,100.00**	**0.00**	**12,350.00**	**25,150.00**

Table 16-29: Additional cost of Fire Stations building (no of bays) required for rural Fire Stations (in Lakhs Rupees)

District	Fire Stations	Bay1	Bay2	Bay3	Bay4	Bay5	Bay6	Bay7	Total Bay
Amritsar	6	0.00	0.00	450.00	0.00	0.00	1,650.00	2,850.00	4,950.00
Barnala	3	0.00	0.00	0.00	575.00	700.00	825.00	0.00	2,100.00
Bathinda	6	0.00	300.00	450.00	1,150.00	1,400.00	0.00	0.00	3,300.00
Faridkot	1	0.00	0.00	0.00	0.00	700.00	0.00	0.00	700.00
Fatehgarh Sahib	1	0.00	0.00	0.00	0.00	700.00	0.00	0.00	700.00
Firozpur	9	0.00	600.00	1,350.00	1,150.00	700.00	825.00	0.00	4,625.00
Gurdaspur	10	300.00	900.00	900.00	1,150.00	0.00	0.00	950.00	4,200.00
Hoshiarpur	8	0.00	0.00	900.00	1,725.00	1,400.00	825.00	0.00	4,850.00
Jalandhar	4	0.00	0.00	450.00	575.00	1,400.00	0.00	0.00	2,425.00
Kapurthala	4	0.00	300.00	0.00	575.00	1,400.00	0.00	0.00	2,275.00
Ludhiana	7	0.00	300.00	450.00	575.00	700.00	0.00	2,850.00	4,875.00
Mansa	3	0.00	300.00	0.00	575.00	0.00	825.00	0.00	1,700.00
Moga	3	0.00	0.00	0.00	575.00	0.00	825.00	950.00	2,350.00
Muktsar	5	0.00	600.00	450.00	1,150.00	0.00	0.00	0.00	2,200.00
Patiala	6	0.00	0.00	900.00	1,150.00	0.00	0.00	1,900.00	3,950.00
Rupnagar	4	0.00	600.00	450.00	0.00	700.00	0.00	0.00	1,750.00
Sahibzada Ajit Singh Nagar	1	150.00	0.00	0.00	0.00	0.00	0.00	0.00	150.00
Sangrur	5	0.00	0.00	450.00	0.00	700.00	2,475.00	0.00	3,625.00
Shahid Bhagat Singh Nagar	3	0.00	300.00	450.00	0.00	700.00	0.00	0.00	1,450.00
Tarn Taran	4	150.00	0.00	0.00	575.00	1,400.00	0.00	0.00	2,125.00
Total	**93**	**600.00**	**4,200.00**	**7,650.00**	**11,500.00**	**12,600.00**	**8,250.00**	**9,500.00**	**54,300.00**

Thus, total estimated capital cost for the Fire Stations building development for all the proposed and new urban Fire Stations is **Rs. 251.50 Crores**. In addition, **Rs. 543.00 Crores** will be required for rural Fire Station building structure.

Firefighting & Rescue Vehicles and Specialized Equipment Cost:

The costs of different fire vehicles and specialized equipment including communication sets (static and mobile VHF sets) have been taken as approximate rates quoted by fire equipment supplier. Accordingly, capital cost for fire vehicles and equipment for all the districts in Punjab has been estimated (Tables 16-30 -16-35).

Table 16-30: Cost estimates (in Lakhs Rupees) for gap in fire fighting vehicles for operational and new urban Fire Stations

District	Fire Stations	Water Tender	Water Bowser	Foam Tender	Advanced Rescue Responder	Sky Lift/ TTL	DCP Tender	Hose Tender	BA Van	QRT	Motor Cycle Mist	Education Van	Total Vehicle cost
Amritsar	9	280.00	270.00	280.00	500.00	500.00	70.00	60.00	30.00	18.00	13.50	20.00	2041.50
Barnala	1	0.00	0.00	40.00	500.00	0.00	35.00	30.00	30.00	0.00	0.00	20.00	655.00
Bathinda	3	0.00	30.00	80.00	500.00	500.00	70.00	30.00	30.00	0.00	0.00	20.00	1260.00
Faridkot	3	35.00	0.00	80.00	500.00	0.00	35.00	30.00	30.00	0.00	0.00	20.00	730.00
Fatehgarh Sahib	2	-35.00	0.00	40.00	500.00	0.00	35.00	30.00	30.00	0.00	0.00	20.00	620.00
Firozpur	5	35.00	30.00	120.00	500.00	0.00	70.00	30.00	30.00	0.00	0.00	20.00	835.00
Gurdaspur	7	35.00	60.00	200.00	0.00	0.00	35.00	60.00	30.00	0.00	0.00	20.00	440.00
Hoshiarpur	1	-70.00	30.00	40.00	500.00	0.00	35.00	30.00	30.00	0.00	0.00	20.00	615.00
Jalandhar	8	70.00	60.00	200.00	500.00	500.00	70.00	30.00	30.00	9.00	6.75	20.00	1495.75
Kapurthala	2	0.00	0.00	80.00	500.00	0.00	35.00	30.00	30.00	0.00	0.00	20.00	695.00
Ludhiana	13	245.00	360.00	400.00	1000.00	500.00	140.00	60.00	30.00	36.00	27.00	20.00	2818.00
Mansa	2	-35.00	0.00	40.00	500.00	0.00	35.00	30.00	30.00	0.00	0.00	20.00	620.00
Moga	1	0.00	30.00	40.00	500.00	0.00	35.00	30.00	30.00	0.00	0.00	20.00	685.00
Muktsar	3	-35.00	30.00	80.00	500.00	0.00	70.00	30.00	30.00	0.00	0.00	20.00	725.00
Patiala	8	70.00	120.00	280.00	500.00	500.00	35.00	30.00	30.00	0.00	0.00	20.00	1585.00
Rupnagar	2	35.00	0.00	40.00	500.00	0.00	35.00	30.00	30.00	0.00	0.00	20.00	690.00
Sahibzada Ajit Singh Nagar	5	0.00	60.00	80.00	500.00	500.00	70.00	30.00	30.00	0.00	0.00	20.00	1290.00
Sangrur	4	70.00	60.00	120.00	500.00	0.00	70.00	30.00	30.00	0.00	0.00	20.00	900.00
Shahid Bhagat Singh Nagar	1	-35.00	0.00	40.00	500.00	0.00	35.00	30.00	30.00	0.00	0.00	20.00	620.00
Tarn Taran	2	70.00	0.00	40.00	500.00	0.00	35.00	30.00	30.00	0.00	0.00	20.00	725.00
Total	**82**	**735.00**	**1140.00**	**2320.00**	**10000.00**	**3000.00**	**1050.00**	**690.00**	**600.00**	**63.00**	**47.25**	**400.00**	**20045.25**

Table 16-31: Cost estimates (in Lakhs Rupees) for gap in firefighting vehicles for new rural Fire Stations

District	Fire Stations	Water Tender	Water Bowser	Foam Tender	DCP Tender	QRT	Motor Cycle Mist	Total Vehicle cost
Amritsar	6	735.00	330.00	200.00	70.00	54.00	40.50	1429.50
Barnala	3	245.00	120.00	120.00	35.00	27.00	20.25	567.25
Bathinda	6	315.00	150.00	240.00	105.00	54.00	40.50	904.50
Faridkot	1	70.00	30.00	40.00	35.00	9.00	6.75	190.75
Fatehgarh Sahib	1	70.00	60.00	40.00	0.00	9.00	6.75	185.75
Firozpur	9	525.00	240.00	360.00	0.00	81.00	60.75	1266.75
Gurdaspur	10	525.00	180.00	280.00	35.00	90.00	67.50	1177.50
Hoshiarpur	8	560.00	300.00	320.00	0.00	72.00	54.00	1306.00
Jalandhar	4	315.00	120.00	160.00	0.00	36.00	27.00	658.00
Kapurthala	4	280.00	90.00	160.00	35.00	36.00	27.00	628.00
Ludhiana	7	735.00	270.00	280.00	140.00	63.00	47.25	1535.25
Mansa	3	210.00	60.00	120.00	35.00	27.00	20.25	472.25
Moga	3	280.00	150.00	120.00	35.00	27.00	20.25	632.25
Muktsar	5	245.00	90.00	200.00	0.00	45.00	33.75	613.75
Patiala	6	560.00	240.00	240.00	35.00	54.00	40.50	1169.50
Rupnagar	4	175.00	90.00	120.00	35.00	36.00	27.00	483.00
Sahibzada Ajit Singh Nagar	1	105.00	30.00	0.00	35.00	9.00	6.75	185.75
Sangrur	5	420.00	180.00	200.00	105.00	45.00	33.75	983.75
Shahid Bhagat Singh Nagar	3	175.00	60.00	120.00	0.00	27.00	20.25	402.25
Tarn Taran	4	315.00	90.00	120.00	0.00	36.00	27.00	588.00
Total	**93**	**6860.00**	**2880.00**	**3440.00**	**735.00**	**837.00**	**627.75**	**15379.75**

Table 16-32: Cost estimate (in Lakhs Rupees) for gap in specialized firefighting equipment for operational and new urban Fire Stations

District	Fire Stations	Hydraulic Rescue Tools	Combi Tools	B.A. Sets	BA Compressors	First-Aid Boxes	Thermal Imaging Cameras	Electric Chain Saws / Cutters / Hammers for Concrete	Electric Chain Saws / Cutters/ Hammers for Wood	Hydraulic / Manual Chain Saws / Cutters for Wood	Personal Protection Equipment	Hand Held Gas Detector Kits	Life Locator Equipment	Portable Pumps	Floating Pumps
Amritsar	9	165.00	95.00	73.60	18.00	3.40	110.00	8.00	6.00	3.60	122.50	11.40	71.50	62.00	0.00
Barnala	1	15.00	10.00	4.80	3.00	0.60	10.00	0.80	1.00	0.60	17.50	1.20	6.50	6.00	0.00
Bathinda	3	15.00	30.00	26.00	7.50	1.20	10.00	2.40	2.50	1.50	37.50	3.30	6.50	16.00	0.00
Faridkot	3	15.00	17.50	12.40	6.00	0.90	10.00	2.40	2.00	1.20	22.50	-3.90	6.50	12.00	0.00
Fatehgarh Sahib	2	30.00	12.50	6.00	3.00	0.20	20.00	1.60	1.00	0.60	12.50	1.50	13.00	8.00	0.00
Firozpur	5	15.00	30.00	33.60	12.00	2.20	10.00	3.20	4.00	2.40	55.00	3.60	6.50	20.00	0.00
Gurdaspur	7	135.00	50.00	44.00	15.00	2.70	70.00	5.60	4.50	3.00	75.00	5.10	45.50	26.00	0.00
Hoshiarpur	1	15.00	15.00	21.60	4.50	1.30	10.00	0.00	1.00	0.60	37.50	1.20	6.50	6.00	0.00
Jalandhar	8	150.00	67.50	49.60	15.00	3.20	100.00	8.00	5.00	3.00	87.50	8.40	65.00	40.00	0.00
Kapurthala	2	30.00	15.00	18.00	4.50	1.10	20.00	1.60	1.50	0.90	30.00	2.40	13.00	12.00	0.00
Ludhiana	13	195.00	145.00	106.40	25.50	6.40	130.00	-0.80	7.00	5.10	175.00	12.30	84.50	98.00	0.00
Mansa	2	15.00	5.00	10.40	4.50	0.60	10.00	1.60	1.50	0.90	17.50	0.90	6.50	4.00	0.00
Moga	1	15.00	12.50	14.00	3.00	0.80	10.00	-0.80	0.50	0.60	22.50	0.90	6.50	8.00	0.00
Muktsar	3	0.00	20.00	20.00	7.50	1.10	10.00	1.60	2.50	1.50	30.00	-0.30	6.50	12.00	0.00
Patiala	8	15.00	57.50	49.20	16.50	2.90	10.00	8.00	5.50	3.30	47.50	7.20	6.50	40.00	0.00
Rupnagar	2	30.00	7.50	10.80	4.50	0.70	20.00	1.60	1.50	0.90	20.00	0.90	13.00	6.00	0.00
Sahibzada Ajit Singh Nagar	5	90.00	40.00	20.00	9.00	1.60	60.00	4.00	3.00	1.80	25.00	4.80	39.00	20.00	0.00
Sangrur	4	0.00	32.50	16.00	9.00	2.00	10.00	4.00	4.00	2.40	32.50	3.60	6.50	20.00	0.00
Shahid Bhagat Singh Nagar	1	15.00	5.00	8.40	3.00	0.60	10.00	0.00	1.00	0.60	12.50	0.60	6.50	4.00	0.00
Tarn Taran	2	15.00	7.50	12.40	4.50	0.80	10.00	1.60	1.50	0.90	20.00	0.90	6.50	6.00	0.00
Total	**82**	**975.00**	**675.00**	**557.20**	**175.50**	**34.30**	**650.00**	**54.40**	**56.50**	**35.40**	**900.00**	**66.00**	**422.50**	**426.00**	**0.00**

Table 16-33: Cost estimate (in Lakhs Rupees) for gap in specialized firefighting equipment for operational and new urban Fire Stations (Continued……)

District	Fire Stations	Diving Suits (Dry Type)	Diving Suits (Wet Type)	Inflatable Lighting Towers	Smoke Exhausters / PPV	Pneumatic lifting bags	High Capacity LED Torches	Rescue Boats	Static Wireless Set	Mobile Wireless Set	Walky Talky	Mega Phone	Total
Amritsar	9	0.00	0.00	25.20	11.00	55.00	17.60	0.00	3.24	8.16	6.12	3.60	879.92
Barnala	1	0.00	0.00	4.20	1.00	5.00	2.40	0.00	0.54	2.38	0.96	0.60	94.08
Bathinda	3	0.00	0.00	10.50	3.00	5.00	4.80	0.00	1.35	4.76	2.16	1.20	192.17
Faridkot	3	0.00	0.00	8.40	4.00	5.00	3.20	0.00	0.81	2.04	1.20	1.20	130.35
Fatehgarh Sahib	2	0.00	0.00	4.20	2.00	10.00	1.20	0.00	-1.62	0.85	0.36	0.60	127.49
Firozpur	5	0.00	0.00	16.80	6.00	5.00	8.40	0.00	1.62	5.95	2.52	2.40	246.19
Gurdaspur	7	0.00	0.00	23.10	7.00	35.00	10.00	0.00	2.70	4.76	3.60	3.00	570.56
Hoshiarpur	1	0.00	0.00	2.10	1.00	5.00	5.60	0.00	0.81	2.55	1.80	0.90	139.96
Jalandhar	8	0.00	0.00	23.10	10.00	50.00	10.00	0.00	2.97	5.61	4.20	3.30	711.38
Kapurthala	2	0.00	0.00	6.30	2.00	10.00	4.00	0.00	0.81	2.04	1.44	1.20	177.79
Ludhiana	13	0.00	0.00	35.70	15.00	65.00	22.40	0.00	4.59	11.56	8.40	5.10	1157.15
Mansa	2	0.00	0.00	6.30	2.00	5.00	1.20	0.00	0.54	1.36	0.72	0.90	96.42
Moga	1	0.00	0.00	4.20	1.00	5.00	4.00	0.00	0.54	2.55	1.08	0.60	112.47
Muktsar	3	0.00	0.00	6.30	4.00	5.00	4.80	0.00	0.54	1.87	0.12	1.50	136.53
Patiala	8	0.00	0.00	23.10	10.00	5.00	12.80	0.00	2.70	8.84	3.96	3.30	338.8
Rupnagar	2	0.00	0.00	6.30	2.00	10.00	2.80	0.00	0.81	1.19	0.96	0.90	142.36
Sahibzada Ajit Singh Nagar	5	0.00	0.00	10.50	6.00	30.00	6.00	0.00	1.62	2.72	1.92	1.80	378.76
Sangrur	4	0.00	0.00	12.60	4.00	5.00	6.80	0.00	1.62	5.10	2.40	1.80	181.82
Shahid Bhagat Singh Nagar	1	0.00	0.00	4.20	1.00	5.00	1.20	0.00	0.54	1.02	0.72	0.60	81.48
Tarn Taran	2	0.00	0.00	6.30	2.00	5.00	2.80	0.00	0.81	1.19	0.96	0.90	107.56
Total	**82**	**0.00**	**0.00**	**239.40**	**94.00**	**325.00**	**132.00**	**0.00**	**27.54**	**76.50**	**45.60**	**35.40**	**6003.24**

Table 16-34: Cost estimate (in Lakhs Rupees) for gap fire fighting specialized equipment for new rural Fire Stations

District	Fire Stations	Hydraulic Rescue Tools	Combi Tools	B.A. Sets	BA Compressors	First-Aid Boxes	Thermal Imaging Cameras	Electric Chain Saws / Cutters / Hammers for Concrete	Electric Chain Saws / Cutters/ Hammers for Wood	Hydraulic / Manual Chain Saws / Cutters for Wood	Personal Protection Equipment	Hand Held Gas Detector Kits	Life Locator Equipment	Portable Pumps	Floating Pumps
Amritsar	6	0.00	0.00	73.60	9.00	4.90	0.00	0.00	3.00	1.80	107.50	0.00	0.00	86.00	0.00
Barnala	3	0.00	0.00	29.60	4.50	2.00	0.00	0.00	1.50	0.90	42.50	0.00	0.00	34.00	0.00
Bathinda	6	0.00	0.00	46.40	9.00	3.20	0.00	0.00	3.00	1.80	65.00	0.00	0.00	52.00	0.00
Faridkot	1	0.00	0.00	8.80	1.50	0.60	0.00	0.00	0.50	0.30	12.50	0.00	0.00	10.00	0.00
Fatehgarh Sahib	1	0.00	0.00	10.40	1.50	0.70	0.00	0.00	0.50	0.30	15.00	0.00	0.00	12.00	0.00
Firozpur	9	0.00	0.00	72.80	13.50	5.00	0.00	0.00	4.50	2.70	102.50	0.00	0.00	82.00	0.00
Gurdaspur	10	0.00	0.00	68.80	15.00	4.80	0.00	0.00	5.00	3.00	120.00	0.00	0.00	76.00	0.00
Hoshiarpur	8	0.00	0.00	73.60	12.00	5.00	0.00	0.00	4.00	2.40	125.00	0.00	0.00	84.00	0.00
Jalandhar	4	0.00	0.00	36.80	6.00	2.50	0.00	0.00	2.00	1.20	62.50	0.00	0.00	42.00	0.00
Kapurthala	4	0.00	0.00	33.60	6.00	2.30	0.00	0.00	2.00	1.20	57.50	0.00	0.00	38.00	0.00
Ludhiana	7	0.00	0.00	76.00	10.50	5.10	0.00	0.00	3.50	2.10	110.00	0.00	0.00	88.00	0.00
Mansa	3	0.00	0.00	24.80	4.50	1.70	0.00	0.00	1.50	0.90	35.00	0.00	0.00	28.00	0.00
Moga	3	0.00	0.00	32.80	4.50	2.20	0.00	0.00	1.50	0.90	47.50	0.00	0.00	38.00	0.00
Muktsar	5	0.00	0.00	36.00	7.50	2.50	0.00	0.00	2.50	1.50	50.00	0.00	0.00	40.00	0.00
Patiala	6	0.00	0.00	62.40	9.00	4.20	0.00	0.00	3.00	1.80	92.50	0.00	0.00	72.00	0.00
Rupnagar	4	0.00	0.00	27.20	6.00	1.90	0.00	0.00	2.00	1.20	37.50	0.00	0.00	30.00	0.00
Sahibzada Ajit Singh Nagar	1	0.00	0.00	7.20	1.50	0.50	0.00	0.00	0.50	0.30	10.00	0.00	0.00	8.00	0.00
Sangrur	5	0.00	0.00	48.80	7.50	3.30	0.00	0.00	2.50	1.50	70.00	0.00	0.00	56.00	0.00
Shahid Bhagat Singh Nagar	3	0.00	0.00	23.20	4.50	1.60	0.00	0.00	1.50	0.90	32.50	0.00	0.00	26.00	0.00
Tarn Taran	4	0.00	0.00	33.60	6.00	2.30	0.00	0.00	2.00	1.20	47.50	0.00	0.00	38.00	0.00
Total	**93**	**0.00**	**0.00**	**826.40**	**139.50**	**56.30**	**0.00**	**0.00**	**46.50**	**27.90**	**1,242.50**	**0.00**	**0.00**	**940.00**	**0.00**

Table 16-35: Cost estimate (in Lakhs Rupees) for gap fire fighting specialized equipment for new rural Fire Stations (Continue….)

District	Fire Stations	Diving Suits (Dry Type)	Diving Suits (Wet Type)	Inflatable Lighting Towers	Smoke Exhausters / PPV	Pneumatic lifting bags	High Capacity LED Torches	Rescue Boats	Static Wireless Set	Mobile Wireless Set	Walky Talky	Mega Phone	Total
Amritsar	6	0.00	0.00	12.60	0.00	0.00	17.20	0.00	1.62	8.33	5.88	1.80	333.23
Barnala	3	0.00	0.00	6.30	0.00	0.00	6.80	0.00	0.81	3.40	2.40	0.90	135.61
Bathinda	6	0.00	0.00	12.60	0.00	0.00	10.40	0.00	1.62	5.44	3.84	1.80	216.1
Faridkot	1	0.00	0.00	2.10	0.00	0.00	2.00	0.00	0.27	1.02	0.72	0.30	40.61
Fatehgarh Sahib	1	0.00	0.00	2.10	0.00	0.00	2.40	0.00	0.27	1.19	0.84	0.30	47.5
Firozpur	9	0.00	0.00	18.90	0.00	0.00	16.40	0.00	2.43	8.50	6.00	2.70	337.93
Gurdaspur	10	0.00	0.00	21.00	0.00	0.00	19.20	0.00	2.70	8.16	5.76	3.00	352.42
Hoshiarpur	8	0.00	0.00	16.80	0.00	0.00	20.00	0.00	2.16	8.50	6.00	2.40	361.86
Jalandhar	4	0.00	0.00	8.40	0.00	0.00	10.00	0.00	1.08	4.25	3.00	1.20	180.93
Kapurthala	4	0.00	0.00	8.40	0.00	0.00	9.20	0.00	1.08	3.91	2.76	1.20	167.15
Ludhiana	7	0.00	0.00	14.70	0.00	0.00	17.60	0.00	1.89	8.67	6.12	2.10	346.28
Mansa	3	0.00	0.00	6.30	0.00	0.00	5.60	0.00	0.81	2.89	2.04	0.90	114.94
Moga	3	0.00	0.00	6.30	0.00	0.00	7.60	0.00	0.81	3.74	2.64	0.90	149.39
Muktsar	5	0.00	0.00	14.70	0.00	0.00	8.00	0.00	1.89	5.61	4.92	1.50	176.62
Patiala	6	0.00	0.00	12.60	0.00	0.00	14.80	0.00	1.62	7.14	5.04	1.80	287.9
Rupnagar	4	0.00	0.00	8.40	0.00	0.00	6.00	0.00	1.08	3.23	2.28	1.20	127.99
Sahibzada Ajit Singh Nagar	1	0.00	0.00	2.10	0.00	0.00	1.60	0.00	0.27	0.85	0.60	0.30	33.72
Sangrur	5	0.00	0.00	10.50	0.00	0.00	11.20	0.00	1.35	5.61	3.96	1.50	223.72
Shahid Bhagat Singh Nagar	3	0.00	0.00	6.30	0.00	0.00	5.20	0.00	0.81	2.72	1.92	0.90	108.05
Tarn Taran	4	0.00	0.00	8.40	0.00	0.00	7.60	0.00	1.08	3.91	2.76	1.20	155.55
Total	**93**	**0.00**	**0.00**	**199.50**	**0.00**	**0.00**	**198.80**	**0.00**	**25.65**	**97.07**	**69.48**	**27.90**	**3897.5**

16.4.2 Recurring Cost

Manpower Cost

The manpower cost estimation per year have been carried out by taking into account pay-scale structure for different levels of employee. Accordingly, cost estimate for manpower requirements at various levels (district level) is shown in Tables 16-36 and 16-37 considering 2-shifts duty pattern.

Table 16-36: Annual cost estimate (in Lakhs Rupees) for manpower for Punjab Fire Service after filling gaps in operational and new urban Fire Stations

District	Fire Stations	Level 10	Level 9	Level 8	Level 7	Level 6	Level 5	Level 4	Level 3	Level 2	Level 1	Level 0	Total
Amritsar	9	0.00	13.75	8.61	0.00	12.80	17.16	101.00	154.80	294.59	1,918.08	6.72	2,527.51
Barnala	1	0.00	13.75	8.61	0.00	6.40	5.72	20.20	25.80	79.44	515.16	0.84	675.92
Bathinda	3	0.00	13.75	8.61	0.00	6.40	11.44	35.35	64.50	135.71	900.72	2.52	1,179.00
Faridkot	3	0.00	13.75	8.61	0.00	6.40	11.44	20.20	47.30	95.99	670.68	2.52	876.89
Fatehgarh Sahib	2	0.00	13.75	8.61	0.00	6.40	5.72	20.20	21.50	46.34	401.76	1.68	525.96
Firozpur	5	0.00	13.75	8.61	0.00	6.40	11.44	30.30	55.90	79.44	709.56	4.20	919.60
Gurdaspur	7	0.00	13.75	8.61	0.00	6.40	5.72	55.55	103.20	132.40	942.84	5.88	1,274.35
Hoshiarpur	1	0.00	13.75	8.61	0.00	6.40	5.72	20.20	30.10	82.75	583.20	0.84	751.57
Jalandhar	8	0.00	13.75	8.61	0.00	6.40	5.72	75.75	90.30	241.63	1,458.00	6.72	1,906.88
Kapurthala	2	0.00	13.75	8.61	0.00	6.40	11.44	25.25	43.00	102.61	664.20	1.68	876.94
Ludhiana	13	0.00	13.75	8.61	0.00	6.40	11.44	151.50	258.00	426.99	2,757.24	8.40	3,642.33
Mansa	2	0.00	13.75	8.61	0.00	6.40	11.44	15.15	34.40	46.34	346.68	1.68	484.45
Moga	1	0.00	13.75	8.61	0.00	6.40	11.44	15.15	30.10	89.37	592.92	0.84	768.58
Muktsar	3	0.00	13.75	8.61	0.00	6.40	11.44	20.20	30.10	99.30	716.04	1.68	907.52
Patiala	8	0.00	13.75	8.61	0.00	6.40	5.72	60.60	86.00	168.81	1,279.80	6.72	1,636.41
Rupnagar	2	0.00	13.75	8.61	0.00	6.40	11.44	20.20	38.70	59.58	388.80	1.68	549.16
Sahibzada Ajit Singh Nagar	5	14.76	0.00	8.61	0.00	12.80	22.88	35.35	68.80	125.78	803.52	4.20	1,096.70
Sangrur	4	0.00	13.75	8.61	0.00	6.40	11.44	40.40	64.50	102.61	745.20	2.52	995.43

District	Fire Stations	Level 10	Level 9	Level 8	Level 7	Level 6	Level 5	Level 4	Level 3	Level 2	Level 1	Level 0	Total
Shahid Bhagat Singh Nagar	1	0.00	13.75	8.61	0.00	6.40	11.44	15.15	25.80	49.65	327.24	0.84	458.88
Tarn Taran	2	0.00	13.75	8.61	0.00	6.40	11.44	20.20	43.00	56.27	379.08	1.68	540.43
Total	**82**	**14.76**	**261.25**	**172.2**	**0.00**	**140.8**	**211.64**	**797.9**	**1,315.80**	**2,515.6**	**17,100.72**	**63.84**	**22,594.51**

Table 16-37: Additional annual cost estimates (in Lakhs Rupees) for manpower requirement for new rural Fire Stations

District	Fire Stations	Level 10	Level 9	Level 8	Level 7	Level 6	Level 5	Level4	Level3	Level2	Level1	Level 0	Total
Amritsar	6	0.00	0.00	0.00	0.00	0.00	0.00	116.15	206.40	413.75	2,313.36	5.04	3,054.70
Barnala	3	0.00	0.00	0.00	0.00	0.00	0.00	50.50	86.00	152.26	761.40	2.52	1,052.68
Bathinda	6	0.00	0.00	0.00	0.00	0.00	0.00	70.70	141.90	248.25	1,211.76	5.04	1,677.65
Faridkot	1	0.00	0.00	0.00	0.00	0.00	0.00	15.15	30.10	49.65	252.72	0.84	348.46
Fatehgarh Sahib	1	0.00	0.00	0.00	0.00	0.00	0.00	15.15	30.10	49.65	252.72	0.84	348.46
Firozpur	9	0.00	0.00	0.00	0.00	0.00	0.00	90.90	202.10	354.17	1,710.72	7.56	2,365.45
Gurdaspur	10	0.00	0.00	0.00	0.00	0.00	0.00	75.75	202.10	334.31	1,587.60	8.40	2,208.16
Hoshiarpur	8	0.00	0.00	0.00	0.00	0.00	0.00	106.05	202.10	367.41	1,772.28	6.72	2,454.56
Jalandhar	4	0.00	0.00	0.00	0.00	0.00	0.00	50.50	103.20	182.05	884.52	3.36	1,223.63
Kapurthala	4	0.00	0.00	0.00	0.00	0.00	0.00	50.50	94.60	165.50	835.92	3.36	1,149.88
Ludhiana	7	0.00	0.00	0.00	0.00	0.00	0.00	121.20	223.60	466.71	2,643.84	5.88	3,461.23
Mansa	3	0.00	0.00	0.00	0.00	0.00	0.00	40.40	73.10	122.47	625.32	2.52	863.81
Moga	3	0.00	0.00	0.00	0.00	0.00	0.00	55.55	94.60	165.50	852.12	2.52	1,170.29
Muktsar	5	0.00	0.00	0.00	0.00	0.00	0.00	45.45	98.90	168.81	822.96	4.20	1,140.32
Patiala	6	0.00	0.00	0.00	0.00	0.00	0.00	90.90	176.30	364.10	1,960.20	5.04	2,596.54
Rupnagar	4	0.00	0.00	0.00	0.00	0.00	0.00	30.30	77.40	132.40	657.72	3.36	901.18
Sahibzada Ajit	1	0.00	0.00	0.00	0.00	0.00	0.00	15.15	30.10	49.65	252.72	0.84	348.46

District	Fire Stations	Level 10	Level 9	Level 8	Level 7	Level 6	Level 5	Level4	Level3	Level2	Level1	Level 0	Total
Singh Nagar													
Sangrur	5	0.00	0.00	0.00	0.00	0.00	0.00	80.80	146.20	258.18	1,318.68	4.20	1,808.06
Shahid Bhagat Singh Nagar	3	0.00	0.00	0.00	0.00	0.00	0.00	25.25	64.50	109.23	537.84	2.52	739.34
Tarn Taran	4	0.00	0.00	0.00	0.00	0.00	0.00	45.45	94.60	165.50	784.08	3.36	1,092.99
Total	**93**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1,191.80**	**2,377.90**	**4,319.55**	**22,038.48**	**78.12**	**30,005.85**

Level 10: *Director/Joint Director****;*** ***Level 9:*** *CFO/ CO;* ***Level 8:*** *Deputy CFO;* ***Level 7:*** *Deputy Controller;* ***Level 6:*** *DFO/ADO/Fire Officer/Fire Supervisor/Astt. Controller/Revenue Inspector;* ***Level 5:*** *DFO/ADFO/AFO/Fire In-charge;* ***Level 4****: St.O/Sub Inspector/Station In-charge/ASt O./AEO;* ***Level 3****: S O/Assistant Sub Inspector/ASO/Sub-Fire Officer/;* ***Level 2*** *: LFM/ Mechanic Driver/Head Constable/Store Superintendant;* ***Level 1*** *: FM/ FM Driver/Radio Technician/ SGFM/ Driver/ Police Constable/ Wireless Technician/ Radio Technician/ Asst FM/ Sanitary Inspector, FO/FO Driver/Driver Operator/Driver/Ambulance Driver/ Clerk;* ***Level 0:*** *Cleaner, Fire Coolie, Supporting Staff, Attendant, Labourer, Peon, Security Guard, Tindal.*

Annual Vehicle and Equipment Maintenance & Repairs, PDL, Office and Training

For Gap analysis, annual maintenance & repairs costs, office expanses and training expenses have been estimated based on the current expenditure (average factor of total vehicles in cost in percentage on vehicle maintenance & repairs, specialized equipment, building maintenance, office expenses, training expenses and Petrol, Diesel & Lubricant (PDL)). The total estimated cost on vehicle & equipment maintenance & repairs, PDL, annual office expenses, and training expenses will be Rs. 41.54 Crores per year after filling the total gap (Table 16-38).

Table 16-38: Annual Recurring Cost estimates (in Lakhs Rupees) for petrol, diesel, and lubricants in operational and new urban areas

District	Num of Fire Stations	Annual Vehicle Maintenance	Annual PDL Cost	Annual Equipment Maintenance	Annual Building Maintenance	Office Expenses	Training Expenses
Amritsar	9	54.04	40.53	70.71	90.50	171.76	29.99
Barnala	1	17.40	13.05	7.61	28.00	46.46	8.11
Bathinda	3	35.52	26.64	16.21	28.50	77.68	13.56
Faridkot	3	20.04	15.03	11.10	28.00	58.67	10.24
Fatehgarh Sahib	2	18.24	13.68	10.60	17.50	37.43	6.53
Firozpur	5	24.24	18.18	19.96	29.50	66.26	11.57
Gurdaspur	7	29.52	22.14	46.32	53.00	90.25	15.76
Hoshiarpur	1	18.12	13.59	11.60	28.00	51.03	8.91
Jalandhar	8	48.50	36.37	57.73	47.50	133.27	23.27
Kapurthala	2	20.04	15.03	14.30	12.00	58.97	10.30
Ludhiana	13	81.67	61.25	95.27	125.00	248.81	43.44
Mansa	2	18.24	13.68	8.39	25.00	34.05	5.94
Moga	1	18.12	13.59	9.27	28.00	51.03	8.91
Muktsar	3	22.68	17.01	11.93	34.00	67.11	11.72
Patiala	8	46.08	34.56	28.00	64.00	116.11	20.27
Rupnagar	2	18.24	13.68	11.44	15.00	34.87	6.09
Sahibzada Ajit Singh Nagar	5	38.74	29.05	32.56	58.00	78.24	13.66
Sangrur	4	24.12	18.09	14.64	49.00	66.36	11.59
Shahid Bhagat Singh Nagar	1	16.56	12.42	6.65	28.00	29.50	5.15
Tarn Taran	2	17.40	13.05	8.60	22.00	34.05	5.94
Total	**82**	**587.50**	**440.63**	**492.88**	**810.50**	**1,551.89**	**270.97**

16.5 Detailed Roadmap for Financial and Investment Plan

State level summary of Capital and recurring expenditure required for filling the gap is shown in Table 16-39 and 16-40 respectively.

Table 16-39: State level summary of capital expenditure required for filling the gap (in Crores Rupees)

Capital Expenditure				
Operational Type	**Fire Station Building Infrastructure**	**Vehicles Cost**	**Equipment Cost**	**Total Capital Cost**
Operational Fire Stations	153.75	44.34	1.58	199.67
Gap in Operational Fire Stations	121.00	164.65	41.49	327.14
New Urban Fire Stations	130.50	35.80	18.55	184.85
Total Gap in New Urban and Operational Fire Stations	251.50	200.45	60.03	511.98
New Rural Fire Stations	543.00	153.80	38.98	735.77
Total Gap in New Urban, New Rural and Operational Fire Stations	794.50	354.25	99.01	1,247.76

Table 16-40: State level summary of recurring expenditure required for filling the gap (in Crores Rupees)

Recurring Expenditure								
Operational Type	**Annual Staff Salary**	**Annual Vehicle Maintenance**	**Annual Maintenance Contract (Specialized Equipment)**	**Annual Petrol diesel and Lubricant Cost**	**Annual Building maintenance**	**Annual Office Expenses**	**Annual Training Expenses**	**Total Recurring Expenditure**
Operational Fire Stations	20.39	1.06	0.13	0.80	3.08	1.28	0.22	26.96
Gap in Operational Fire Stations	167.53	3.95	3.32	2.96	2.42	10.55	1.84	192.58
New Urban Fire Stations	58.42	0.86	1.48	0.64	2.61	3.68	0.64	68.34
Total Gap in New Urban and Operational Fire Stations	225.95	4.81	4.80	3.61	5.03	14.23	2.49	260.92
New Rural Fire Stations	300.06	3.69	3.12	2.77	10.86	18.90	3.30	342.70
Total Gap in New Urban ,New Rural and Operational Fire Stations	526.00	8.50	7.92	6.38	15.89	33.14	5.79	603.62

All the above detailed capital and recurring expenses have been taken into consideration, while finalizing the detailed investment plan for Punjab State. The detailed investment plan for next 10-years for Punjab Fire Services considering 2-shifts duty pattern are given in Tables 16-41 and 16-42.

A few assumptions have been made, while preparing the detailed roadmap for investment plan for the next 10 years. For example, existing gaps in terms of manpower, firefighting and rescue vehicles, and specialized equipment will be filled up in first two years and 40% gaps

in Fire Station buildings will be filled up in first two year, and subsequently 10% gap in each year. The average annual rate on expenses on fire vehicle maintenance, petrol, diesel & lubricants, and office expenses, training, uniform will remain the same as that in F.Y. 2010-11, however, on top of that an annual inflation factor of 8% (fire vehicle maintenance, petrol, diesel & lubricants), 5% (office expenses, training, uniform) has been added. Building construction cost will increase on an average by about 11% per year and building maintenance cost by about 1% of total building construction cost as in 2010-11. The salary costs at each level have been estimated from the present pay scales for each level and an annual growth of 12% has been added for subsequent years.

Table 16-41: State level Investment plan (in Crores Rupees) for Punjab Fire Services only considering gap in operational and new urban Fire Stations

	Capital Expenditure		Recurring Expenditure					
Year	Building Infrastructure	Vehicles and Equipment	Annual Vehicle Maintenance & PDL AMC	Annual Staff Salary	Annual Office Expenses	Annual Training Office Expenses	Annual Bldg. maintenance	Total
First Year	50.30	103.07	7.11	104.15	6.56	1.15	4.29	276.62
Second Year	55.83	108.22	13.20	210.46	13.26	2.17	5.55	408.70
Third Year	30.99	11.98	14.95	250.37	15.77	2.42	6.14	332.63
Fourth Year	34.40	12.58	16.90	296.83	18.70	2.69	6.74	388.84
Fifth Year	38.18	6.61	18.66	341.65	21.52	2.90	7.08	436.60
Sixth Year	42.38	6.94	20.59	392.94	24.76	3.13	7.42	498.16
Seventh Year	47.04	7.28	22.71	451.62	28.45	3.37	7.77	568.26
Eighth Year	52.22	7.65	25.04	518.73	32.68	3.63	8.13	648.08
Ninth Year	0.00	8.03	27.60	595.44	37.51	3.91	8.49	680.99
Tenth Year	0.00	8.43	30.41	683.10	43.04	4.20	8.86	778.04
Total	**351.33**	**280.79**	**197.18**	**3,845.30**	**242.26**	**29.58**	**70.47**	**5,016.91**

Table 16-42: Investment plan (in Crores Rupees) for Punjab Fire Services only considering gap in operational, new urban and new rural Fire Stations

	Capital Expenditure		Recurring Expenditure					
Year	Building Infrastructure	Vehicles and Equipment	Annual Vehicle Maintenance & PDL AMC	Annual Staff Salary	Annual Office Expenses	Annual Training Office Expenses	Annual Bldg. maintenance	Total
First Year	158.90	103.07	7.11	104.15	6.56	1.15	4.29	385.22
Second Year	176.38	108.22	13.20	210.46	13.26	2.17	5.55	529.24
Third Year	97.89	54.49	17.19	325.65	20.52	3.15	8.35	527.24
Forth Year	108.66	57.21	21.73	465.46	29.32	4.22	11.21	697.81
Fifth Year	120.61	30.04	25.18	577.72	36.40	4.91	12.73	807.58
Sixth Year	133.88	31.54	29.04	710.22	44.74	5.66	14.27	969.35
Seventh Year	148.60	33.12	33.35	866.20	54.57	6.47	15.84	1,158.16
Eighth Year	164.95	34.77	38.17	1,049.39	66.11	7.35	17.45	1,378.20
Ninth Year	0.00	36.51	43.55	1,264.08	79.64	8.30	19.08	1,451.16
Tenth Year	0.00	38.34	49.55	1,515.18	95.46	9.32	20.74	1,728.59
Total	**1,109.88**	**527.31**	**278.07**	**7,088.52**	**446.58**	**52.69**	**129.51**	**9,632.55**

16.6 Prioritization of Fire Stations/Fire Posts

For prioritization of Fire Stations, the RMSI team has strictly followed risk categorization and population as criteria. Accordingly, the priority for establishing new urban Fire Stations and rural Fire Stations/posts has been given in Tables 16-44 and 16-45, respectively.

It may be noted that actual implementation of priority depends upon a number of factors such as land availability, land possession, tackling any encroachment on available land, getting construction clearances from various authorities for implementation of construction work by PWD. Hence, Punjab State Fire Services may change the priority of a Fire Station depending upon the local situation and requirements.

16.7 Avenues of Fund Generation

Punjab State can generate new avenues for funds from the followings:

- Introduction of Fire Tax (1% of existing property tax)
- Introduction of Fire Cess, which can be collected for auditing and inspecting various types of occupancies (residential, commercial, and industrial) for adoption of fire safety measures besides training public for use of first aid firefighting equipment
- Training programs at different levels and duration to private sector employee on chargeable basis
- Capitation fees can be charged for scrutiny of building plans
- Fire service charges on clearance of building plans from fire safety point of view
- Sale of condemned fire appliances, equipment, uniform articles and general store items
- The fee on deployment of members of fire services along-with necessary equipment and appliances beyond the jurisdiction of the State fire services
- Standby charges on deployment of members of fire services along-with equipment and appliances in the area to stand by for a specific duration, which can be made exceptional for the visits of government authorities or in public interest asked by the district administration

16.8 Capacity building and Training Facilities

The roles of firefighter cannot be performed until and unless sufficient training is imparted to the fire service personnel. The types of training and duration depend upon the type of entry to the fire service department or change of responsibility on promotion. The State has framed Recruitment Rules (RR) for each level, and these are adhered to for filling the vacant positions. Broadly, there are two entry levels in Fire Services in India; 1) Fireman Level and 2) Middle Level (Sub Officer/ Asstt. Station Officer). Immediately after joining the Fire Services, it is mandatory that every firefighter needs to undergo professional training.

Presently, Punjab State does not have a Fire Training Centre of its own, and imparts a short-duration basic training (2-3 months). for newly joined firefighter. However, there is a need to have a compulsory 6-month training for firefighters either at its own Headquarter or at any State/regional/Nagpur training centre There is an urgent need of a State training centre for basic training for fireman and leading fireman. A few senior level officials have been trained at NFSC Nagpur. And a few firemen have been trained for short duration basic training courses at neighbouring States fire training institute. However, in general, Punjab State lacks trained manpower in firefighting.

In order to strengthen the Punjab Fire Service, the gap in training has been estimated for each type of training. The Fire Station survey and gap analysis reveal that there is significant gap in training need for existing staff. The previous section (section 16.3.3.) details about huge gap in manpower in for operational Fire Stations and need of additional firefighters for new urban and new rural Fire Stations. As the guidelines of SFAC, immediately after recruitment, fire personnel should undertake professional training. Moreover, there should be refresher training courses at an interval of 3 to 5 years for every fire personnel. The following sections details about the estimation of training need at every level (fireman, leading fireman, station officer, sub-officer etc.).

16.8.1 Basic Training for Fireman

The basic training course should provide practical experience of fire fighting to meet the challenge in fire fighting operations. Firefighter should also be trained for operation and maintenance of fire fighting vehicles and equipment.

Estimated number of fire personnel who require basic training for fireman in operational Fire Stations (after filling the gap of manpower), and additional new recruitment for new urban and new rural Fire Stations is shown in Table 16-43. Additional requirement of Refresher Training Course for Fireman after 3-5 years service as fireman is also shown the Table 16-43. Some of the special training for specialized equipment such as Breathing Apparatus, Global-positioning system etc should also be part of the refresher course. As a whole Punjab Fire Service would require to train 18,622 firefighters in basic and refresher training in next 10 years. Therefore, State training centre/neighboring State/NFSC Nagpur should have adequate capacity and infrastructure for meeting such training requirement.

Table 16-43: Estimated training requirements for fire personnel in Punjab Fire Services

Basic Training for Fireman		
	Number of Fire Personnel in Operational Fire Stations	4029
	Number of Fire Personnel in New Urban Fire Stations	1365
	Number of Fire Personnel in New Rural Fire Stations	6802
	Total Number of Fire Personnel for Training	12196
Refresher Training for Fireman		
	Total Number of Fire Personnel	6426
Leading Fireman Training Course		
	Number of Fire Personnel in Operational Fire Stations	585
	Number of Fire Personnel in New Urban Fire Stations	195
	Number of Fire Personnel in New Rural Fire Stations	1305
	Total Number of Fire Personnel for Training	2085
Other specialized Training Course		
	Total Number of Fire Personnel for Training	780
Junior Officer Training Course		
	Number of Fire Personnel in Operational Fire Stations	341
	Number of Fire Personnel in New Urban Fire Stations	157
	Number of Fire Personnel in New Rural Fire Stations	789
	Total Number of Fire Personnel for Training	1287
Divisional Officer Training Course		
	Number of Fire Officers in Operational Fire Stations	95

	Number of Fire Officers in New Urban Fire Stations	5
	Total Number of Fire Officers for Training	100
Fire Prevention Course		
	Total Number of Fire Officers for Training	106

16.8.2 Training Course for Leading Fireman

While promotion from fireman to leading fireman, fire personnel should undertake a training course for Leading Fireman. This training will provide both theoretical and practical training required for effective deployment of fire vehicles and fire equipment and personnel. In case, State Training Centre does not have adequate infrastructure and capacity, the Leading Fireman training should be provided at NFSC Nagpur, or any other suitable State/Regional Training Centre. Presently, Punjab State does not have such a training centre and there is an urgent need of a training centre for providing training to firemen and leading firemen.

Estimated number of fire personnel who require training for leading fireman in operational Fire Stations (after filling the gap of manpower), and additional new recruitment for new urban and new rural Fire Stations is shown in Table 16-43.

16.8.3 Other Specialized Training Courses

Besides undertaken normal training course for Leading Fireman, every leading fireman should also undergo at least one special training course for multi-tasking performance in due course of time. In many cases, fire services need to face new challenges and has to play an important role in other emergencies. Therefore, fire personnel must be well trained to perform in all possible situations. Thus, it is important that they undergo other specialized training as well.

Following are some of the other specialized trainings courses:

- Medical First Responder,
- Breathing Apparatus
- Collapsed structure – Search & Rescue,
- Advanced Search & Rescue,
- Flood Rescue,
- Chemical Disaster,
- Flood / Cyclone Disaster Response
- Earthquake Disaster Response
- Emergency Response to Rail Accidents
- Hazardous Material Emergency

The syllabus of above courses are provided in SFAC guidelines. In due course of time, every leading fireman should undertake at least one special training course. Number of leading fireman needed for specialized course is also shown in Table 16-43. In total, Punjab Fire Service would need to train at least 780 leading fireman for specialized course in next 10 years. Therefore, State Fire Service should make arrangements to have adequate capacity and infrastructure for meeting such training requirement within the State or in some other State training centre.

16.8.4 JUNIOR OFFICER TRAINING COURSE

While promotion from leading fireman to sub-officer/station officer, fire personnel should undertake a Junior Officer Training Course. This course should provide an understanding of Fire Station administration, fire safety management and leadership as to be able to command a Fire Station and also command a fire crew in case of an emergency. Upon successful completion of training, Fire officers will be able to identify components of an effective fire service organization and planning requirement. He will be responsible for implementation of fire safety and prevention programs at their assigned Fire Station.

Junior Officer Training Course should be undertaken at national training centre such as NFSC, Nagpur or similar upcoming national/regional/State training centers. Every region comprising of few State should have a regional national training centre.

Estimated number of fire officers who require Junior Officer Training Course in operational Fire Stations (after filling the gap of manpower), and additional new recruitment for new urban and new rural Fire Stations is shown in Table 16-43. After filling gap in operational Fire Stations and new urban and rural Fire Stations, Punjab Fire Service would require to train 1,287 junior officers in next 10 years. Therefore, national training centre should have adequate capacity and infrastructure for meeting such training requirement from Punjab fire service.

16.8.5 DIVISIONAL FIRE OFFICER TRAINING COURSE

On promotion to additional divisional officer/divisional officer, every fire officer should undertake a Divisional Fire Officer (DFO) Training Course. This course should provide with theory, the principles and practice of Fire Station management, facilities, fire inspection as well as effective guidelines to command fire crew and control at an incident site. This course should prepare them for their roles as senior fire officers. Upon successful completion of training, officer will be able to identify components of an effective fire service organization, and implementation of fire prevention and fire safety programs at their assigned Fire Station and its jurisdiction area.

Divisional Officer Training Course should be undertaken at national or international training institutes, such as NFSC, Nagpur or similar upcoming national training institute.

Estimated number of fire officers who require Divisional Officer Training Course in operational and new Fire Stations (after filling the gap of manpower) is shown in Table 16-43. There would be 100 fire officers in Punjab Fire Service who would require this training in next 10 years.

16.8.6 AWARENESS GENERATION PROGRAMS

Besides attending regular fire and other recue calls, the State fire services should also work in awareness generation programs, and it should conduct regular awareness programs in schools, colleges, hospitals, cinema halls, shopping malls, residential areas, NCC camps, oil and gas plants, public and private offices, industries etc.. Present numbers of awareness programs conducted so far by Punjab Fire Service are not up to satisfactory levels. There is urgent need to enhance such activities. For capacity development, each district is recommended with an Education Van equipped with short video films as produced by MHA, distribution of pamphlets on “DO”s and “DON’T”s generated by MHA may be translated in local language by Punjab Fire Services, and live- demonstrations of how to use “Portable Extinguishers” and handle small kitchen fires. Fire service should use these in their awareness generation programs.

16.9 Limitations of the study

1. In fire hazard and risk analysis, fire-load of specific industry has not been taken into consideration. However, weightage has been given to the size of industrial area in the fire hazard and risk analysis of the base unit (district level). An attempt has also been made even in the present assignment to go further down at lower levels. Providing special weightage of type of industry will require building level survey including estimation of fire-load for each industry, which is out of scope of present assignment.
2. Currently, Census 2011 has published only district level demographic data (the Tehsil/ Taluka/Block level data is still unavailable), which has been used for further estimation and analysis purpose.
3. Floating population in cities has not been considered for distribution over the land use (built-up area); this may be attempted in future detailed studies.
4. Non-availability of a uniform level of fire statistics of all the fire events in the past 5 years.
5. Designation, rank structure and administrative control are very heterogeneous from State/UT to State/UT, which in the present State creates ambiguity while brining in at National level. For example, Director Position pay scale in one State/UT may not be equal to that of Chief Fire Officer in another State/UT. For the purpose of present assignment, we have divided the rank/designation structure into 11 levels (level 0 to level 10). For this, a system needs to be put in place through having a uniform administrative structure at national level to State/UT level. This may require development and implementation of National Fire Act, which MHA is trying to develop in near future.
6. The fire fighting infrastructure of forest department, privately owned companies/ organizations, military cantonment and airbases, nuclear power plants, nuclear research reactors, heavy water plants, mines, ports, airports, oil exploration and oil refineries are out of scope of present study. However, RMSI has tried to get information about the fire-fighting infrastructure for these, and included, whatever information available, as there are limitations due to security concerns. This is more so, as result of this study may be made available in public domain with their spatial location. Studying fire infrastructure in above areas will require special MOU's with MHA and controlling agencies, and may be attempted in future studies to have a complete coverage of the country..

16.10 Recommendations for Punjab State Fire Services

1. At present, State does not have Punjab Fire Act and Fire Policy. So there is an urgent need for such an act and strict implementation of National Building Code (NBC) for high rise buildings, industrial units, and public and private buildings.
2. The Punjab State lacks trained manpower and there are a large number of vacancies at all levels in the State in operational Fire Stations, which need to be filled up soonest possible.
3. Fire statistics of the past fire events (last past 5 years) in the State is scanty. The State Fire Services should issue strict order to all the Fire Stations to prepare fire – statistics data in the prescribed performa for future fire calls, and ensure their compliance.
4. Since availability of trained manpower is an issue, and it is more pertinent in case of Punjab, there is a need that State should fill up the gap of manpower in operational Fire Stations and provide at-least 6-months training at NFSC, Nagpur or in the training centre of some other States. In parallel, State Fire Services should take proactive measures to start a Punjab State Fire Training Institute for leading fireman and lower levels, as their numbers will be large for ideal requirement of Fire Stations and manpower.
5. Many of the fire services like UK and Delhi fire services do not have rank of driver, instead they do have post of Fireman designated as Fire Operator who will be person with heavy vehicle driving license as well. Thus, State fire services should abolish the rank of Driver in fire services, and Instead of having fireman, driver, and operator separately, the State should recruit fireman-cum-driver-cum-operator. This will help in optimizing the huge manpower requirement. Since, these may not be readily available, the State should train the new recruit in a systematic manner, and encourage all existing staff, specially, firemen and leading firemen to obtain heavy vehicle driving license. The State may offer some incentive towards this, as this will help in optimization of resources. The other advantages are in term of heavy additional vehicles can be used as water carrier, in case of bigger fire incidence. This ensures that absence of lone driver, which can lead to whole of the fire crew immobile. This can also solve problem of drivers, who don't have promotional avenue during their long service leading to frustration, and last but not least, in terms of optimization of resources. Even presently working fireman and leading fireman can be encouraged to get a license for heavy vehicle Driver by providing additional incentives.
6. The State fire service should adopt a system of payment of incentives for driving specialized vehicles like ALP / TTL/Hydraulic Platform.
7. Based on prioritization of Fire Stations, State Fire Services needs to add new Fire Stations at a faster pace, as there is a huge gap both in urban and rural areas.
8. To have a Computerization of Punjab Fire Services, training of fire personnel in use of computers is most important aspect, which is very important from the modernization point of view.
9. Online Vehicle tracking through GPS and development of a fully computerized response system is another area for improvement.
10. Though fire services in the State are creating public awareness programs for schools, Govt. offices, etc. however, it is not to the desired level. For that purpose sufficient manpower at senior officer levels are recommended to have an effective fire prevention wing. The fire prevention wing should have trained officials for fire inspection, awareness and training, so that fire incidences similar to that of AMRI,

Kolkata should not be repeated in future. The State should have a dedicated "Education Van" in each district for the purpose. The van should be equipped with short video films as produced by MHA, distribution of pamphlets on "DO"s and "DON'T"s generated by MHA and DFS, and live demonstration of how to use "portable extinguishers" and handle small fires.

11. Periodic fire drills and fire-inspection of important buildings, such as schools, hospitals, multi-storied buildings, and major industrial centres should be taken care by the State fire services.
12. Fire fighting vehicles should not be diverted for cleaning drains, sever linings, and water supply. This may delay the response, in case; there is a fire incidence during that time. Such use of fire vehicles should be discouraged at all levels, as a small fire incident can turn into a major fire disaster.
13. For congested areas, and by-lanes where movement of Water Tender and Water Bowser is difficult, QRTs and motorcycle with mist sets should be used for the fastest response, supplemented by the Water Tenders and Water Bowsers by laying the large hose pipelines. Additionally, State Fire Service should identify congested areas and request district administration to decongest such areas with the help of police. The congestion could be in terms of illegal extension of residential buildings, shops, unauthorized parking on roads. For unauthorized parking, State traffic department can also play an important role. Here role of fire prevention officials is important as such exercises are not one time exercise and should be carried out regularly.
14. As emphasized in section 16.3.3 (manpower gap analysis), the Punjab State is having Municipal Fire Services and there is not much coordination among them at State level. At Municipal level, fire service does not have promotional avenues, and fire officer is struck up at the level of Chief Fire Office. Hence, there is an urgent need to have merit-based promotion, so that deserving employees remain motivated and do not leave the organization at midst of their career. Moreover, there is no uniformity on the applicability of building by-laws on fire safety and Municipalities can deviate from the applicability of national Building code of fire safety (NBC). Each Municipality cannot be made self sufficient in isolation to deal with serious nature of fire emergency, and in general, municipalities do not have mutual aid schemes. Hence, because of these reasons, RMSI team recommends that Municipal fire services should come under State fire services. Accordingly, a hierarchy should be created to have proper co-ordination at all levels as suggested in section 16.3.3.
15. Audit by a central authority should be carried out routinely to ensure good finance mechanism for capital, and O&M expenditures.

Table 16-44: Details of operational and new proposed urban Fire Stations with their ideal jurisdiction area and estimated ideal served population under ideal jurisdiction

District	FS Ref No	Name	Town/City Name	Operational Type	Pop density	Arial distance (in km) to nearest Fire Station	Priority Ranking
Amritsar	PB1205	Town Hall Fire Station	Amritsar Cantt.	Operational Urban	19,425	1.28	
Ludhiana	PB1206	Central Fire Station	Ludhiana	Operational Urban	19,399	2.39	
Amritsar	PB1216	Gilwali Gate Fire Station	Amritsar Cantt.	Operational Urban	17,115	1.46	
Ludhiana	PB1211	Sundar Nagar Fire Station	Ludhiana	Operational Urban	13,855	2.39	
Ludhiana	PB1220	Gill Road Fire Station	Ludhiana	Operational Urban	12,072	3.38	
Jalandhar	PB1291	Jalandhar MC Fire Station	Jalandhar	Operational Urban	11,800	2.40	
Ludhiana	PB1208	Haibuo Wall Fire Station	Ludhiana	Operational Urban	10,602	4.35	
Amritsar	PB1212	Civil Line Fire Station	Amritsar	Operational Urban	9,444	1.56	
Jalandhar	PB1295	Rajendra Nagar Sub Fire Station	Jalandhar	Operational Urban	8,535	2.40	
Gurdaspur	PB1236	Mission Road Fire Station	Pathankot	Operational Urban	8,288	1.96	
Amritsar	PB1209	Beri Gate Fire Station	Amritsar Cantt.	Operational Urban	8,284	1.28	
Jalandhar	PB_Nw_Urban-12	Jalandhar-2 New Urban Fire Station	Jalandhar	New Urban	7,886	3.08	1
Patiala	PB1261	Patiala(HQ) Fire Station	Patiala	Operational Urban	7,657	3.57	
Gurdaspur	PB1233	Pathankot Fire Station	Pathankot	Operational Urban	7,090	1.96	
Jalandhar	PB1297	Dada Colony Sub Fire Station	Jalandhar	Operational Urban	6,994	2.51	
Bathinda	PB1222	Bathinda Fire Station	Bathinda	Operational Urban	6,756	14.18	
SAS Nagar	PB_Nw_Urban-34	Sahibzada Ajit S New Urban Fire Station	Sahibzada Ajit S	New Urban	6,449	5.03	2
Ludhiana	PB1234	Khanna Fire Station	Khanna	Operational Urban	6,267	6.82	
Patiala	PB1266	Barah Kuan Fire Station	Patiala	Operational Urban	5,913	3.57	
Patiala	PB_Nw_Urban-19	Nabha New Urban Fire Station	Nabha	New Urban	5,378	12.87	3
SAS Nagar	PB1701	Mohali Fire Station	S.A.S.Nagar (Mohali)	Operational Urban	5,365	5.03	
Patiala	PB1248	Rajpura Fire Station	Rajpura	Operational Urban	5,278	15.74	

District	FS Ref No	Name	Town/City Name	Operational Type	Pop density	Arial distance (in km) to nearest Fire Station	Priority Ranking
Ludhiana	PB_Nw_Urban-15	Ludhiana-1 New Urban Fire Station	Ludhiana	New Urban	5,220	4.07	4
Amritsar	PB_Nw_Urban-7	Amritsar-3 New Urban Fire Station	Amritsar	New Urban	5,199	3.93	5
Sangrur	PB1288	Malerkotla Fire Station	Malerkotla	Operational Urban	5,184	15.63	
Hoshiarpur	PB1224	Hoshiarpur Fire Station	Hoshiarpur	Operational Urban	4,982	13.80	
SAS Nagar	PB_Nw_Urban-14	Kharar New Urban Fire Station	Kharar	New Urban	4,978	6.11	6
Jalandhar	PB_Nw_Urban-11	Jalandhar-1 New Urban Fire Station	Jalandhar	New Urban	4,904	2.92	7
Ludhiana	PB1214	Focal Point Fire Station	Ludhiana	Operational Urban	4,900	2.50	
Jalandhar	PB_Nw_Urban-13	Jalandhar-3 New Urban Fire Station	Jalandhar	New Urban	4,763	4.11	8
Ludhiana	PB_Nw_Urban-17	Ludhiana-3 New Urban Fire Station	Ludhiana	New Urban	4,726	2.62	9
Ludhiana	PB_Nw_Urban-16	Ludhiana-2 New Urban Fire Station	Ludhiana	New Urban	4,635	4.11	10
Barnala	PB1302	Barnala Fire Station	Barnala	Operational Urban	4,588	17.74	
SAS Nagar	PB_Nw_Urban-33	Zirakpur (NP) New Urban Fire Station	Zirakpur	New Urban	4,418	7.97	11
Patiala	PB_Nw_Urban-21	Patiala-1 New Urban Fire Station	Patiala	New Urban	4,362	3.74	12
Amritsar	PB_Nw_Urban-6	Amritsar-2 New Urban Fire Station	Amritsar	New Urban	4,327	3.93	13
Moga	PB1314	Moga Fire Station	Moga	Operational Urban	4,303	14.87	
Patiala	PB1223	Samana Fire Station	Samana	Operational Urban	4,214	18.77	
Sangrur	PB1228	Sangrur Fire Station	Sangrur	Operational Urban	3,974	13.39	
Faridkot	PB1306	Faridkot Fire Station	Faridkot	Operational Urban	3,962	12.01	
Muktsar	PB1311	Malout Fire Station	Malout	Operational Urban	3,942	9.67	
Tarn Taran	PB_Nw_Urban-26	Tarn Taran New Urban Fire Station	Tarn Taran	New Urban	3,827	11.59	14
Firozpur	PB1265	Abhor Fire Station	Abohar	Operational Urban	3,802	20.13	
Gurdaspur	PB1221	Fire Station Batala	Batala	Operational Urban	3,779	16.40	

District	FS Ref No	Name	Town/City Name	Operational Type	Pop density	Arial distance (in km) to nearest Fire Station	Priority Ranking
Fatehgarh Sahib	PB1250	Sirhind Fire Station	Sirhind Fatehgarh	Operational Urban	3,644	6.94	
Rupnagar	PB1275	Rupnagar Fire Station	Rupnagar	Operational Urban	3,461	8.44	
Kapurthala	PB1298	Phagwara Fire Station	Phagwara	Operational Urban	3,407	11.01	
Patiala	PB_Nw_Urban-22	Patiala-2 New Urban Fire Station	Patiala	New Urban	3,382	3.74	15
Firozpur	PB1301	Firozpur Fire Station	Firozpur	Operational Urban	3,129	15.15	
Mansa	PB1258	Mansa Fire Station	Mansa	Operational Urban	3,120	14.76	
Kapurthala	PB1280	Kapurthala Fire Station	Kapurthala	Operational Urban	3,086	9.18	
Faridkot	PB1320	Kotkapura Fire Station	Kot Kapura	Operational Urban	3,058	12.01	
Amritsar	PB_Nw_Urban-5	Amritsar-1 New Urban Fire Station	Amritsar	New Urban	3,039	6.79	16
SAS Nagar	PB1686	Derabasi Fire Station	Dera Bassi	Operational Urban	2,989	7.97	
Fatehgarh Sahib	PB1305	Mandi Govindgarh Fire Station	Gobindgarh	Operational Urban	2,891	6.82	
Muktsar	PB1315	Sri Muktsar Shib Fire Station	Muktsar	Operational Urban	2,881	14.82	
Ludhiana	PB_Nw_Urban-18	Ludhiana-4 New Urban Fire Station	Ludhiana	New Urban	2,780	2.50	17
Rupnagar	PB_Nw_Urban-20	Nangal New Urban Fire Station	Nangal	New Urban	2,712	19.94	18
Gurdaspur	PB1284	Gurdaspur Fire station	Gurdaspur	Operational Urban	2,683	11.32	
Shahid Bhagat Singh Nagar	PB1226	Nawanshahr Fire Station	Nawanshahr	Operational Urban	2,673	7.38	
Gurdaspur	PB_Nw_Urban-2	Dinanagar New Urban Fire Station	Dinanagar	New Urban	2,521	12.35	19
Sangrur	PB_Nw_Urban-9	Dhuri New Urban Fire Station	Dhuri	New Urban	2,418	13.56	20
Firozpur	PB1227	Jalalabad Fire Station	Jalalabad	Operational Urban	2,382	12.63	
Gurdaspur	PB_Nw_Urban-1	Pathankot New Urban Fire Station	Pathankot	New Urban	2,270	6.71	21
Ludhiana	PB_Nw_Urban-10	Jagraon New Urban Fire Station	Jagraon	New Urban	2,144	14.35	22
Firozpur	PB1263	Fazilka Fire Station	Fazilka	Operational Urban	2,131	13.31	

District	FS Ref No	Name	Town/City Name	Operational Type	Pop density	Arial distance (in km) to nearest Fire Station	Priority Ranking
Amritsar	PB_Nw_Urban-8	Amritsar-4 New Urban Fire Station	Amritsar	New Urban	2,093	5.67	23
Faridkot	PB_Nw_Urban-27	Jaitu New Urban Fire Station	Jaitu	New Urban	2,089	16.54	24
Patiala	PB_Nw_Urban-23	Patiala-3 New Urban Fire Station	Patiala	New Urban	2,055	4.13	25
Ludhiana	PB_Nw_Urban-31	Ahmedgarh New Urban Fire Station	Ahmedgarh	New Urban	2,025	16.82	26
Muktsar	PB1299	Gidderbaha Fire Station	Giddarbaha	Operational Urban	1,924	13.74	
Bathinda	PB_Nw_Urban-24	Rampura Phul New Urban Fire Station	Rampura Phul	New Urban	1,618	14.99	27
Bathinda	PB_Nw_Urban-32	Maur New Urban Fire Station	Maur	New Urban	1,601	10.91	28
Tarn Taran	PB_Nw_Urban-29	Patti New Urban Fire Station	Patti	New Urban	1,586	12.16	29
Sangrur	PB_Nw_Urban-25	Sunam New Urban Fire Station	Sunam	New Urban	1,565	10.51	30
Amritsar	PB_Nw_Urban-4	Ajnala New Urban Fire Station	Ajnala	New Urban	1,283	18.23	31
Jalandhar	PB1282	Kartarpur Fire Station	Kartarpur	Operational Urban	1,161	11.38	
Jalandhar	PB_Nw_Urban-28	Nakodar New Urban Fire Station	Nakodar	New Urban	1,155	11.73	32
Ludhiana	PB1270	Samrala Fire Station	Samrala	Operational Urban	1,140	8.60	
Mansa	PB1254	Sardulgarh Fire Statoin	Sardulgarh	Operational Urban	1,123	10.01	
Gurdaspur	PB_Nw_Urban-3	Fatehgarh Churia New Urban Fire Station	Fatehgarh Churia	New Urban	1,102	8.56	33
Firozpur	PB_Nw_Urban-30	Zira New Urban Fire Station	Zira	New Urban	966	13.11	34

Table 16-45: Details of operational and new proposed rural Fire Stations with estimated ideal served population and population density

District	FS Ref No	Name	Tehsil Name 2001	Operational Type	Pop density	Arial distance (in km) to nearest Fire Station	Priority Ranking
SAS Nagar	PB_Nw_Rur-23	PB_Nw_Rur-23 New Rural KuraliFire Station	Kharar	New Rural	1,035	12.35	1
Gurdaspur	PB_Nw_Rur-6	PB_Nw_Rur-6 New Rural SujanpurFire Station	Pathankot	New Rural	831	7.08	2
Hoshiarpur	PB_Nw_Rur-14	PB_Nw_Rur-14 New Rural Urmar TandaFire Station	Dasua	New Rural	675	16.03	3
Gurdaspur	PB_Nw_Rur-8	PB_Nw_Rur-8 New Rural DhariwalFire Station	Gurdaspur	New Rural	646	12.60	4
Amritsar	PB_Nw_Rur-50	PB_Nw_Rur-50 New Rural RayyaFire Station	Baba Bakala	New Rural	630	15.38	5
Ludhiana	PB_Nw_Rur-62	PB_Nw_Rur-62 New Rural MullanpurFire Station	Ludhiana	New Rural	598	14.87	6
Ludhiana	PB_Nw_Rur-65	PB_Nw_Rur-65 New Rural DorahaFire Station	Payal	New Rural	594	14.35	7
Jalandhar	PB_Nw_Rur-79	PB_Nw_Rur-79 New Rural AdampurFire Station	Jalandhar	New Rural	571	11.45	8
Amritsar	PB_Nw_Rur-53	PB_Nw_Rur-53 New Rural MahtaFire Station	Baba Bakala	New Rural	563	15.38	9
Jalandhar	PB_Nw_Rur-60	PB_Nw_Rur-60 New Rural PhillaurFire Station	Phillaur	New Rural	557	9.79	10
Gurdaspur	PB_Nw_Rur-78	PB_Nw_Rur-78 New Rural JugialFire Station	Dhar Kalan	New Rural	555	8.87	11
Shahid Bhagat Singh Nagar	PB_Nw_Rur-85	PB_Nw_Rur-85 New Rural BangaFire Station	Nawanshahr	New Rural	549	14.52	12
Hoshiarpur	PB_Nw_Rur-11	PB_Nw_Rur-11 New Rural MukerianFire Station	Mukerian	New Rural	543	15.44	13
Hoshiarpur	PB_Nw_Rur-13	PB_Nw_Rur-13 New Rural Dasuya CityFire Station	Dasua	New Rural	542	15.44	14
Amritsar	PB_Nw_Rur-55	PB_Nw_Rur-55 New Rural ChuganwanFire Station	Ajnala	New Rural	538	15.23	15
Jalandhar	PB_Nw_Rur-59	PB_Nw_Rur-59 New Rural NurmahalFire Station	Phillaur	New Rural	524	11.73	16
Amritsar	PB_Nw_Rur-1	PB_Nw_Rur-1 New Rural MajithaFire Station	Amritsar	New Rural	522	11.61	17

District	FS Ref No	Name	Tehsil Name 2001	Operational Type	Pop density	Arial distance (in km) to nearest Fire Station	Priority Ranking
Moga	PB_Nw_Rur-63	PB_Nw_Rur-63 New Rural Badhni KalanFire Station	Nihal Singhwala	New Rural	502	19.41	18
Kapurthala	PB_Nw_Rur-51	PB_Nw_Rur-51 New Rural BholathFire Station	Bhulath	New Rural	501	11.38	19
Ludhiana	PB_Nw_Rur-35	PB_Nw_Rur-35 New Rural RaikotFire Station	Raikot	New Rural	485	20.01	20
Tarn Taran	PB_Nw_Rur-57	PB_Nw_Rur-57 New Rural Chaudhry WalaFire Station	Tarn-taran	New Rural	482	12.16	21
Gurdaspur	PB_Nw_Rur-5	PB_Nw_Rur-5 New Rural MirthalFire Station	Pathankot	New Rural	473	12.83	22
Gurdaspur	PB_Nw_Rur-10	PB_Nw_Rur-10 New Rural GahldiFire Station	Gurdaspur	New Rural	471	11.32	23
Hoshiarpur	PB_Nw_Rur-18	PB_Nw_Rur-18 New Rural GarhshankarFire Station	Garhshankar	New Rural	470	10.12	24
Gurdaspur	PB_Nw_Rur-92	PB_Nw_Rur-92 New Rural Kala AfghanaFire Station	Batala	New Rural	461	8.56	25
Gurdaspur	PB_Nw_Rur-7	PB_Nw_Rur-7 New Rural KathlourFire Station	Pathankot	New Rural	461	12.56	26
Gurdaspur	PB_Nw_Rur-52	PB_Nw_Rur-52 New Rural QadianFire Station	Batala	New Rural	460	15.12	27
Ludhiana	PB_Nw_Rur-64	PB_Nw_Rur-64 New Rural RauniFire Station	Payal	New Rural	460	17.06	28
Amritsar	PB_Nw_Rur-56	PB_Nw_Rur-56 New Rural ChabbaFire Station	Amritsar	New Rural	454	6.54	29
Gurdaspur	PB_Nw_Rur-9	PB_Nw_Rur-9 New Rural KalanaurFire Station	Gurdaspur	New Rural	449	17.31	30
Tarn Taran	PB_Nw_Rur-49	PB_Nw_Rur-49 New Rural Goindwal SahibFire Station	Khadur Sahib	New Rural	445	17.18	31
Patiala	PB_Nw_Rur-29	PB_Nw_Rur-29 New Rural PatranFire Station	Samana	New Rural	441	22.69	32
Hoshiarpur	PB_Nw_Rur-12	PB_Nw_Rur-12 New Rural Talwara CityFire Station	Mukerian	New Rural	441	25.58	33
Kapurthala	PB_Nw_Rur-81	PB_Nw_Rur-81 New Rural KhajuriaFire Station	Phagwara	New Rural	426	6.58	34
Rupnagar	PB_Nw_Rur-19	PB_Nw_Rur-19 New Rural Anandpur SahibFire Station	Anandpur Sahib	New Rural	423	19.94	35
Patiala	PB_Nw_Rur-24	PB_Nw_Rur-24 New Rural BanurFire	Rajpura	New Rural	412	12.58	36

District	FS Ref No	Name	Tehsil Name 2001	Operational Type	Pop density	Arial distance (in km) to nearest Fire Station	Priority Ranking
		Station					
Hoshiarpur	PB_Nw_Rur-16	PB_Nw_Rur-16 New Rural MahilpurFire Station	Garhshankar	New Rural	412	19.95	37
Hoshiarpur	PB_Nw_Rur-17	PB_Nw_Rur-17 New Rural MehtianaFire Station	Hoshiarpur	New Rural	410	11.45	38
Moga	PB_Nw_Rur-4	PB_Nw_Rur-4 New Rural Bagha PuranaFire Station	Bhagha Purana	New Rural	405	16.64	39
Tarn Taran	PB_Nw_Rur-47	PB_Nw_Rur-47 New Rural BhikhiwindFire Station	Patti	New Rural	400	16.63	40
Jalandhar	PB_Nw_Rur-58	PB_Nw_Rur-58 New Rural ShahkotFire Station	Shahkot	New Rural	398	14.40	41
Kapurthala	PB_Nw_Rur-80	PB_Nw_Rur-80 New Rural KabirpurFire Station	Kapurthala	New Rural	393	9.18	42
Firozpur	PB_Nw_Rur-41	PB_Nw_Rur-41 New Rural Guru Har SahaiFire Station	Jalalabad	New Rural	390	16.50	43
Sangrur	PB_Nw_Rur-67	PB_Nw_Rur-67 New Rural SherpurFire Station	Dhuri	New Rural	389	16.79	44
Ludhiana	PB_Nw_Rur-82	PB_Nw_Rur-82 New Rural MachhiwaraFire Station	Samrala	New Rural	388	8.60	45
Ludhiana	PB_Nw_Rur-84	PB_Nw_Rur-84 New Rural Mangli KhassFire Station	Ludhiana	New Rural	380	10.42	46
Shahid Bhagat Singh Nagar	PB_Nw_Rur-83	PB_Nw_Rur-83 New Rural RahonFire Station	Nawanshahr	New Rural	378	7.38	47
Rupnagar	PB_Nw_Rur-22	PB_Nw_Rur-22 New Rural Chamkaur SahibFire Station	Rupnagar	New Rural	377	13.83	48
Barnala	PB_Nw_Rur-34	PB_Nw_Rur-34 New Rural BhadaurFire Station	Barnala	New Rural	375	22.18	49
Rupnagar	PB_Nw_Rur-93	PB_Nw_Rur-93 New Rural Paroul Fire Station	Kharar	New Rural	371	11.59	50
Mansa	PB_Nw_Rur-31	PB_Nw_Rur-31 New Rural BohaFire Station	Budhlada	New Rural	371	22.67	51
Fatehgarh Sahib	PB_Nw_Rur-3	PB_Nw_Rur-3 New Rural Bassi PathanaFire Station	Bassi Pathana	New Rural	371	6.94	52
Sangrur	PB_Nw_Rur-88	PB_Nw_Rur-88 New Rural AmargarhFire Station	Malerkotla	New Rural	368	15.63	53
Muktsar	PB_Nw_Rur-36	PB_Nw_Rur-36 New Rural MehnaFire Station	Malout	New Rural	364	21.92	54

District	FS Ref No	Name	Tehsil Name 2001	Operational Type	Pop density	Arial distance (in km) to nearest Fire Station	Priority Ranking
Bathinda	PB_Nw_Rur-75	PB_Nw_Rur-75 New Rural Bhagta Bhai KaFire Station	Rampura Phul	New Rural	362	19.96	55
Firozpur	PB_Nw_Rur-42	PB_Nw_Rur-42 New Rural Talwandi BhaiFire Station	Firozpur	New Rural	353	13.11	56
Patiala	PB_Nw_Rur-26	PB_Nw_Rur-26 New Rural DevigarhFire Station	Patiala	New Rural	352	18.55	57
Amritsar	PB_Nw_Rur-54	PB_Nw_Rur-54 New Rural Ram DasFire Station	Ajnala	New Rural	347	12.31	58
Sangrur	PB_Nw_Rur-28	PB_Nw_Rur-28 New Rural BhawanigarhFire Station	Sangrur	New Rural	344	15.92	59
Firozpur	PB_Nw_Rur-77	PB_Nw_Rur-77 New Rural GhubhayaFire Station	Jalalabad	New Rural	343	12.63	60
Patiala	PB_Nw_Rur-27	PB_Nw_Rur-27 New Rural BhadsonFire Station	Nabha	New Rural	341	17.14	61
Shahid Bhagat Singh Nagar	PB_Nw_Rur-20	PB_Nw_Rur-20 New Rural BalachaurFire Station	Balachaur	New Rural	337	17.82	62
Sangrur	PB_Nw_Rur-69	PB_Nw_Rur-69 New Rural AkalgarhFire Station	Moonak	New Rural	334	22.69	63
Ludhiana	PB_Nw_Rur-61	PB_Nw_Rur-61 New Rural Sidhwan BetFire Station	Jagraon	New Rural	332	14.35	64
Bathinda	PB_Nw_Rur-74	PB_Nw_Rur-74 New Rural Killi Nihal SinghwaliFire Station	Bathinda	New Rural	325	13.74	65
Sangrur	PB_Nw_Rur-30	PB_Nw_Rur-30 New Rural ChhajliFire Station	Sunam	New Rural	325	10.51	66
Moga	PB_Nw_Rur-43	PB_Nw_Rur-43 New Rural DharmkotFire Station	Moga	New Rural	322	14.87	67
Bathinda	PB_Nw_Rur-72	PB_Nw_Rur-72 New Rural Bhucho MandiFire Station	Bathinda	New Rural	320	14.71	68
Bathinda	PB_Nw_Rur-32	PB_Nw_Rur-32 New Rural Talwandi SaboFire Station	Talwandi Sabo	New Rural	315	15.04	69
Firozpur	PB_Nw_Rur-89	PB_Nw_Rur-89 New Rural MamdotFire Station	Firozpur	New Rural	314	17.85	70
Faridkot	PB_Nw_Rur-90	PB_Nw_Rur-90 New Rural GolewalaFire Station	Faridkot	New Rural	312	13.18	71
Mansa	PB_Nw_Rur-70	PB_Nw_Rur-70 New Rural BhikhiFire Station	Mansa	New Rural	311	15.42	72
Kapurthala	PB_Nw_Rur-48	PB_Nw_Rur-48 New Rural Sultanpur	Sultanpur	New Rural	308	17.49	73

District	FS Ref No	Name	Tehsil Name 2001	Operational Type	Pop density	Arial distance (in km) to nearest Fire Station	Priority Ranking
		LodhiFire Station	Lodhi				
Tarn Taran	PB_Nw_Rur-46	PB_Nw_Rur-46 New Rural Khem KaranFire Station	Patti	New Rural	307	21.63	74
Patiala	PB_Nw_Rur-25	PB_Nw_Rur-25 New Rural GhanaurFire Station	Rajpura	New Rural	294	15.74	75
Barnala	PB_Nw_Rur-66	PB_Nw_Rur-66 New Rural BadbarFire Station	Barnala	New Rural	293	16.70	76
Firozpur	PB_Nw_Rur-45	PB_Nw_Rur-45 New Rural KulgarhiFire Station	Firozpur	New Rural	288	15.15	77
Bathinda	PB_Nw_Rur-73	PB_Nw_Rur-73 New Rural Gehri ButterFire Station	Bathinda	New Rural	285	14.18	78
Muktsar	PB_Nw_Rur-87	PB_Nw_Rur-87 New Rural Mandi BariwalaFire Station	Muktsar	New Rural	282	14.82	79
Muktsar	PB_Nw_Rur-40	PB_Nw_Rur-40 New Rural DodaFire Station	Giddarbaha	New Rural	279	15.63	80
Firozpur	PB_Nw_Rur-76	PB_Nw_Rur-76 New Rural Khui KheraFire Station	Fazilka	New Rural	277	13.31	81
Muktsar	PB_Nw_Rur-38	PB_Nw_Rur-38 New Rural BhamFire Station	Malout	New Rural	275	19.76	82
Barnala	PB_Nw_Rur-33	PB_Nw_Rur-33 New Rural Pakho KalanFire Station	Barnala	New Rural	275	18.11	83
Bathinda	PB_Nw_Rur-91	PB_Nw_Rur-91 New Rural KamaluFire Station	Talwandi Sabo	New Rural	274	10.91	84
Patiala	PB_Nw_Rur-68	PB_Nw_Rur-68 New Rural DhablanFire Station	Patiala	New Rural	271	7.34	85
Firozpur	PB_Nw_Rur-44	PB_Nw_Rur-44 New Rural MakhuFire Station	Zira	New Rural	270	15.36	86
Rupnagar	PB_Nw_Rur-21	PB_Nw_Rur-21 New Rural GhanauliFire Station	Rupnagar	New Rural	259	8.44	87
Firozpur	PB_Nw_Rur-39	PB_Nw_Rur-39 New Rural Kallar KheraFire Station	Abohar	New Rural	247	26.13	88
Firozpur	PB_Nw_Rur-37	PB_Nw_Rur-37 New Rural Sito GunnoFire Station	Abohar	New Rural	240	20.28	89
Mansa	PB_Nw_Rur-71	PB_Nw_Rur-71 New Rural Fatta MalokaFire Station	Sardulgarh	New Rural	236	10.01	90
Hoshiarpur	PB_Nw_Rur-15	PB_Nw_Rur-15 New Rural HarianaFire Station	Hoshiarpur	New Rural	218	13.80	91

District	FS Ref No	Name	Tehsil Name 2001	Operational Type	Pop density	Arial distance (in km) to nearest Fire Station	Priority Ranking
Muktsar	PB_Nw_Rur-86	PB_Nw_Rur-86 New Rural AulakhFire Station	Malout	New Rural	209	9.67	92
Gurdaspur	PB_Nw_Rur-2	PB_Nw_Rur-2 New Rural Ranjit Sagar DamFire Station	Dhar Kalan	New Rural	175	8.87	93

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