उत्तराखंड शासन

STRATEGIC PLAN FOR RISK REDUCTION

Increasing resilience through effective

RESPONSE, RECOVERY, MITIGATION, & PREPAREDNESS

URBAN RISK HOTSPOT

DEHRADUN CITY

STATE LEVEL ENDORSEMENT

"The magnitude of hazards and frequency of extreme weather events in Uttarakhand has increased due to climate change. The traditional methods of disaster management need to be overhauled, earlier the traditional methods used to be relief, response and rehabilitation, but now the whole scenario has changed. We really have to upgrade our capacities and strengthen our people."

Mr. Amit Singh Negi

Disaster Management Secretary, Govt. of Uttarakhand

(State Workshop on "Strengthening Resilience to Climate Change Related Disaster Risks" held in Dehradun on 21st July 2017)

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1 INTRODUCTION

1.1 Overview of the Selected Hotspot

The Dehradun Strategic Risk Mitigation Plan presented here is intended to provide key strategies and their priority with respect to mitigation of the identified risks associated with earthquakes. The strategies are for municipal leaders and planners, and are not technical. They are easy to understand, realistic, and they are all achievable. Successful implementation of the strategies will reduce the risk profile of this location.

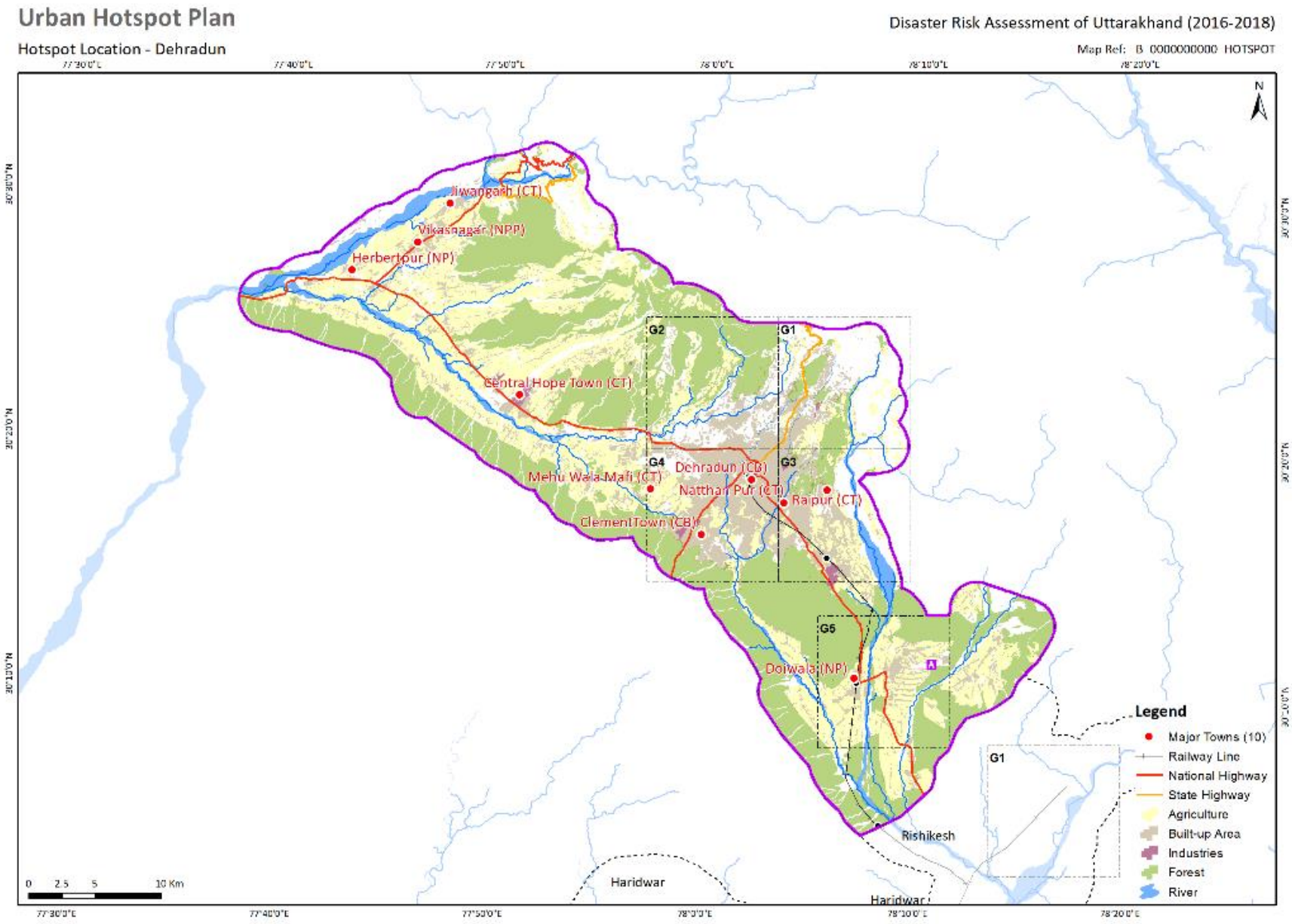
Earthquakes are considered the greatest risk the city and surrounds face and is rated as **High**. In particular there is a need to address congested urban areas such as the old markets with respect to the structural resilience of the buildings in the area.

Also, common in the markets are poorly engineered commercial facades that are not tied back appropriately to the building hence risking detachment from the building in the event of an earthquake. The rapid urban growth of the Dehradun hotspot has also led to many unsatisfactory suburban buildings, which are not adequately earthquake resistant.

Flooding in the city is seen largely as a result of urban drainage issues and not of a disaster risk category with the exception of those areas where urban development (presumably uncontrolled) has taken place in key waterways. This needs to be addressed as a planning and regulation issue as does rampant urban infilling where storm water drainage channels should be has led to a severe urban water logging.

Flash flooding is not a significant risk except in the context stated above for fluvial flooding. Landslides are seen as a low risk. Greater detail is provided in the Risk profile below.

The city is rapidly expanding. Exposure is increasing with this expansion, and planning and construction measures to address the vulnerability for the expanding city are presently inadequate. The strategies primarily address these issues and are for municipal leaders and planners, they are not technical. They are easy to understand, realistic, and they are all achievable. Successful implementation of the strategies will reduce the risk profile of this location. The geographical area relevant to the strategies proposed in this document is given in Map 1 below.



Map 1: Extent of the Dehradun Hotspot Boundary for Strategic Risk Reduction

1.2 About this Strategic Plan

This document is an output of the Disaster Risk Assessment. It is one of 14 strategic plans produced under the study that aim to reduce risk in the selected locations and serve as case studies for other areas of risk in the State.

This Strategic Plan is built upon the hazard risk analysis undertaken by the project and formulated around key elements of the disaster risk management (DRM) framework embodied in the Sendia Framework.

The DRM process is sequential (cyclic) in order to allow adaptive improvement over time in order to build back better. It is also intended to incorporate a focus on pre-impact preparation through planning in order to mitigate risk associated with incidents before they occur.

This approach has been adopted at the National level.

While response and recovery are recognised as being reasonably short time frame processes (hours and days to months), Mitigation and Preparation are seen as much more strategic processes over longer time frames (months to years).

The National DRMP recognises three recovery periods after a disaster: a) Early – three to eighteen months, b) Medium – within five years and c) Long-term – within five to ten years. The concept of "build back better" points to continuous improvement in the mitigation and preparation process and its implementation, over all time frames as funds and resources come to hand, risk profiles change, and skills and mitigation outcomes are increased or realised. Continuous improvement represents a learning curve reflecting successes and failure – what has worked, what has not worked and how do we do better into the future?

What is a Strategy?

"… a plan of action designed to achieve a long-term or overall aim."

A strategy gives recognition to an overall goal and the way it might be achieved, taking into account the resource limitations and other constraints being faced.

What is an Action?

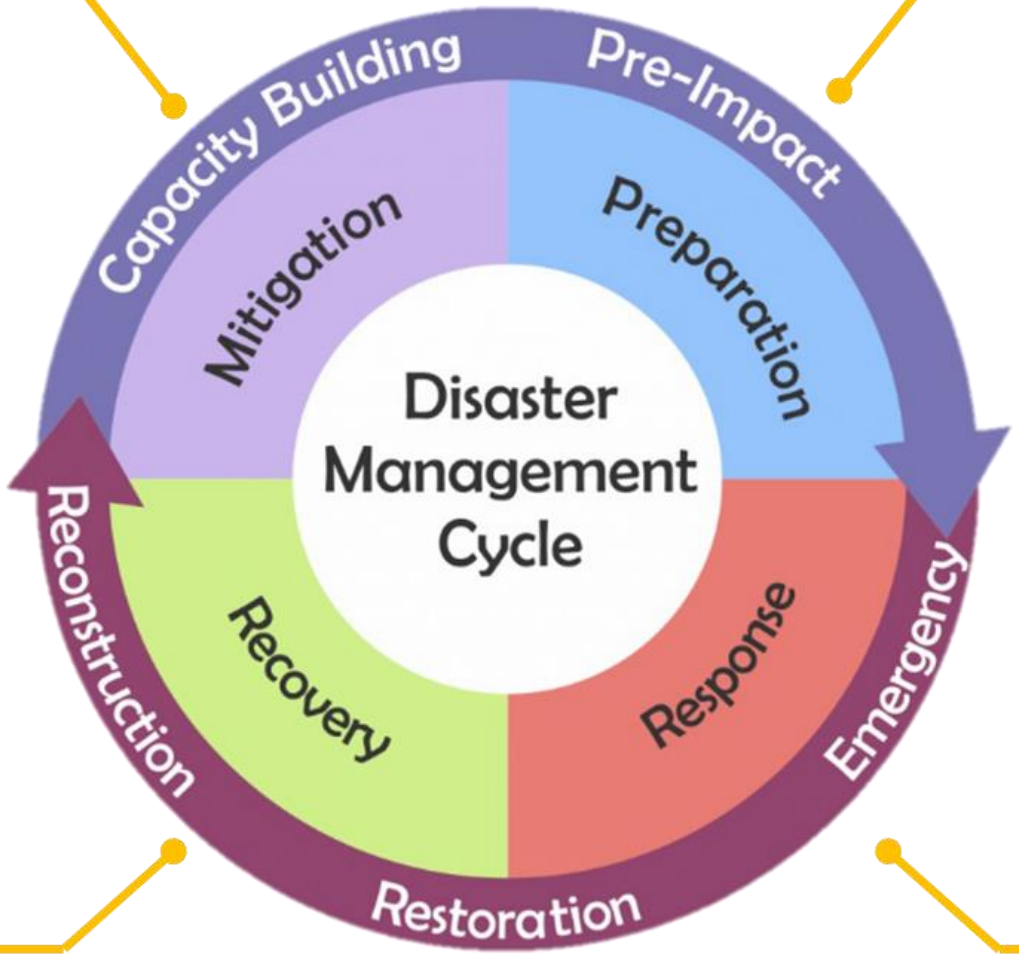
An Action is a key step to be taken in concert with other actions also needed for the strategy to succeed.

By developing strategies around the separate phases of DRM and recognizing the opportunity for improvements over time it is possible to prioritize the actions that need to be taken. For each strategy presented here there is an initial list of key Actions include as the start of the process.

The strategies offered here are intended to aid the Municipality and its citizens, local authorities, businesses, private residents, and local NGOs, with the intent of driving a ground up approach within a State level top down policy context. The challenge is for all organizations and individuals to take upon themselves the responsibility of being prepared and being better able to offset the risks and manage the consequences of these disasters.

Mid to Long Term
Understanding risk and identification of areas of greatest loss. Mitigate potential problems in advance of event.

Ongoing & Long Term
Prepare agencies, private sector and communities for the next event. Maintain state of "Readiness".



Short Term & Long Term
Once the event, and the immediate threat to life, property, and the environment is over, recovery can begin.

Damage Assessment, Stabilise & Provide
First repsonders save and secure lives and assess damage. Coordination of resources and provision of critical supplies.

1.3 Area and Community Profile

1.3.1 Topography

The city of Dehradun is situated in the Doon valley which is a Himalayan valley between the Outer Himalayas (also called the Shivaliks) and the Lesser Himalayas (known locally as the Mussoorie range). The valley is sandwiched between the Yamuna and the Ganges river systems forming a watershed. Various rivers and small streams flow through the valley finding their way into the Ganges or the Yamuna.

1.3.2 Climate

Dehradun enjoys a temperate and pleasant climate throughout the year with an average annual temperature of 21.8 °C although the months of May and June are moderately hot. In the winters, the average temperature drops to 15 °C with minimum temperature hovering at around 5 °C. The winters are not very windy with calm wind speeds varying between 1.8 to 3.6 Kms per hour. The summers are relatively windier with wind speeds varying between 1.8 to 5.4 Kms per hour. Dehradun receives rainfall of around 2000 mm annually with heavy rainfall in July and August, only around 5% of the rainfall falls in the winters.

1.3.3 Demographics

The city of Dehradun itself has a population of approximately 750,000, but the extended hotspot has a population of approximately 1.2M people, a literacy rate of 88% and a sex ratio of 896 females to 1000 males (Census 2011). A majority of the population consists of non-workers (66%) i.e. homemakers, students, retirees etc. A low percentage of population are engaged in agriculture (8%). Most workers are engaged in the "Others" category which consist of the secondary and tertiary sectors (public and private). The decadal growth rate of the district of Dehradun was 32.3% which is higher than that of Uttarakhand (18.8%) and India (17.64%) indicating a high inflow of migrants (census 2011 vs 2001). Moreover, this is line with the state decadal growth trends where urban areas have seen a growth of 40% whereas rural areas are growing at around 11%.

1.3.4 Economy

Real estate and Education have been major contributors to the economy of Dehradun. Dehradun with its array of reputed boarding schools has been a hub for primary and secondary education. The real estate sector has been booming due to limited supply (land scarcity) and high demand. Real estate demand has been high due to increase in population via migration and the appeal of second homes (or holiday homes) to people based in other major

cities of the region. Tourism also plays a significant role in the economy with local tourist spots within the city and tourists transiting to popular tourist locations like Mussoorie, Landour and beyond.

1.3.5 Development History

Dehradun had been a laid-back, quiet and peaceful l town which was the center of a prominent rice growing region up until it became the capital of the newly formed state of Uttarakhand in the year 2000. Post 2000, Dehradun started to urbanize at a rapid pace with many agricultural areas turned into residential/commercial buildings. Dehradun's famous basmati rice fields and litchi gardens gave way to concrete buildings as higher economic returns in real estate encouraged conversion of agricultural land to non-agricultural land. A dramatic increase in urbanization, population and road traffic has put severe pressure on civic amenities such as roads, waste management, sanitation, water supply etc. Dehradun is currently the most populated urban agglomeration of Uttarakhand. Dehradun has been selected in the smart cities mission wherein projects have been earmarked for making the city congestion free, slum free, eco-friendly, clean, economically vibrant and well planned by 2030.

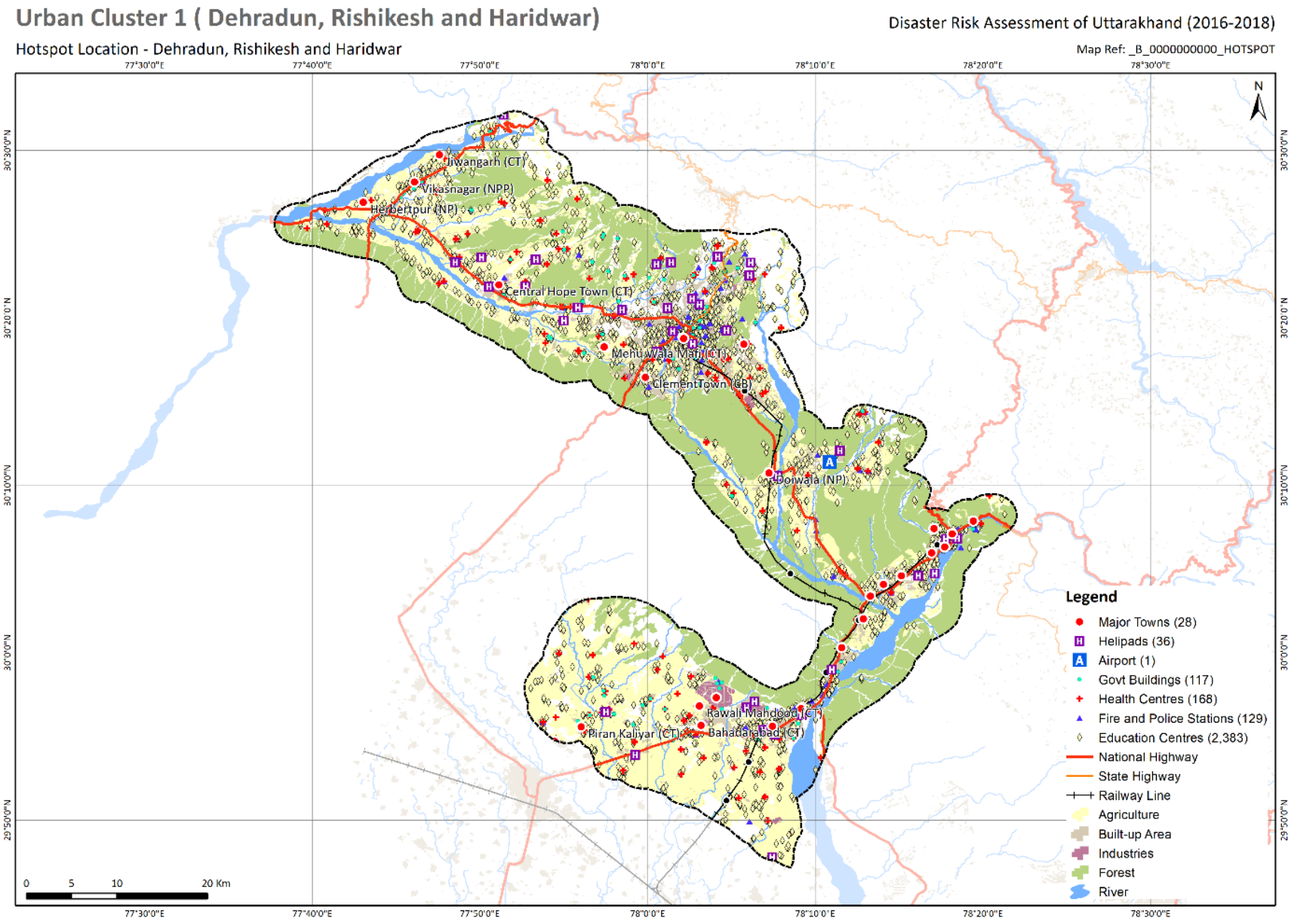
1.3.6 Regional Context

The area defined under the Dehradun hotspot stretches from Herbertpur and Vikasnagar in the west to Doiwala in the east encompassing the entire urban stretch of the valley. There are many forest zones around Dehradun where urbanization is not possible, however the remaining areas are swiftly being urbanized forming an increasingly homogenous entity.

There are 3 major roads that provide access to Dehradun. National highway 7 connects Dehradun to Rishikesh in the east and Paonta Sahib in the west. National highway 307 connects Dehradun to Saharanpur in the south. Mussoorie road to the north is the major road that connects Dehradun to the hilly areas (Map 3).

Dehradun is adjacent to Haridwar and Rishikesh that are also very prominent urban centers. Any policies related to the disaster risk mitigation of the region should look at the city trio as a whole from a development perspective as any changes in one city could potentially have significant ramifications for the other.

Hence, we present the case studies of Haridwar, Rishikesh and Dehradun as **Urban Cluster – 1** for the purpose of a consolidated view.



Map 2: Urban Cluster 1 - Dehradun - Rishikesh – Haridwar

1.3.7 Critical Facilities/Infrastructure

Dehradun is connected by air via Jolly Grant Airport which is around 22 kms south-east to the city. The airport is connected to Dehradun via National Highway 7 and a forest road via Thano forest. Various flyovers are being constructed on these routes to avoid railway crossings and busy junctions. Currently the national highway route to the airport is often riddled with heavy/slow moving traffic. The rail connectivity is via Dehradun railway station, which is connected with Haridwar. The Dehradun railway station is situated in a central location within the city, which is highly vulnerable to earthquakes. Below is a snapshot of lifeline buildings and helipads, which are important from the disaster risk management perspective:

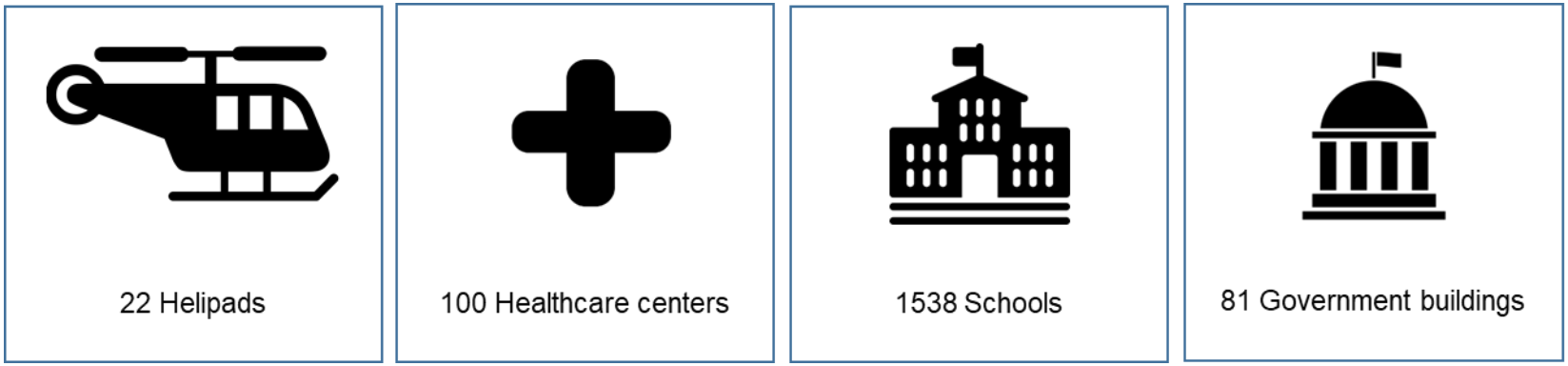


Figure 1: Snapshot of lifeline buildings and helipads

A large number of helipads in Dehradun are owing to its strategic importance as a state capital and major military cantonment. A majority of the healthcare centers are sub-centers (59%) whereas the rest are a mixture of PHC's, CHC's and hospitals. The total lifeline buildings in the Dehradun hotspot are approx. 1,660.

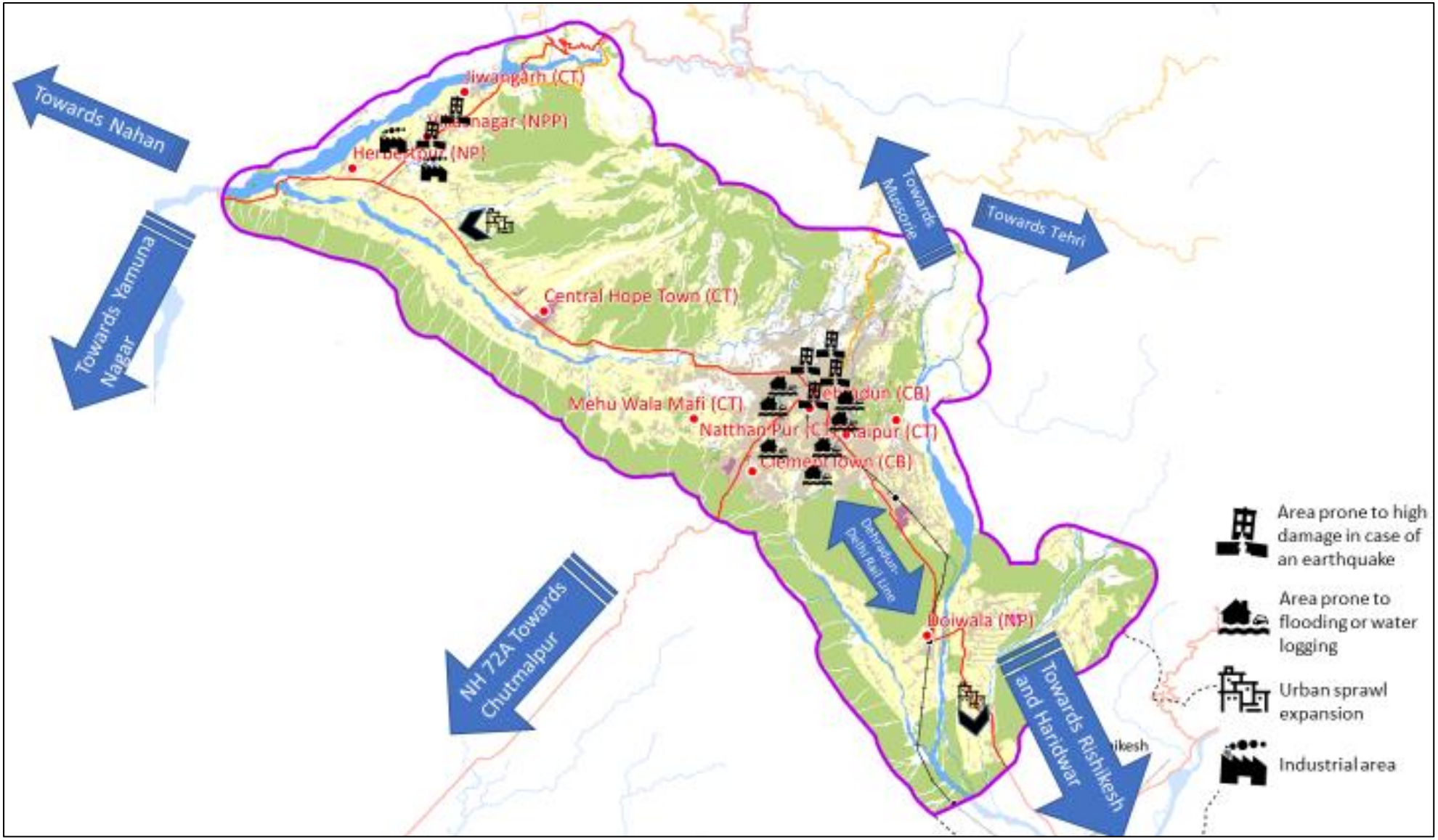
In the city of Dehradun, the sewage management is a mixture of piped systems and unorganized on-site sanitation systems. The water supply is mostly piped in urban areas with some rural areas relying on water table extraction with hand pumps or motor pumps. For cooking fuel, the urban areas mostly use LPG cylinders whereas in some rural areas firewood and cow dung is still used.

The Dehradun hotspot is broadly a mixture of rural, urban, military and forest areas. The administrations governing the hotspot are diverse. Some of the disaster risk management strategies may require efforts that cut across administrative boundaries.

Below is a general view of the different administrations involved in the Dehradun hotspot:

Table 1: List of the different administrative areas within the Dehradun Hotspot

Urban		Military	Rural	
			Blocks	Tehsils
Dehradun (M.Corp + OG)	Jiwangarh (CT)	Dehradun (CB)	Doiwala	Dehradun
Vikasnagar (NPP)	Central Hope Town (CT)	Clement Town (CB)	Raipur	Vikasnagar
Herbertpur (NP)	Raipur (CT)		Sahaspur	
Doiwala (NP)	Natthanpur (CT)		Vikasnagar	
	Mehu Wala Mafi (CT)			



Map 3: Dehradun Hotspot Contextual Map Map Highlighting Egress Routes and Key Areas of Concern Requiring High Priority

1.4 Dehradun Risk Profile

1.4.1 Social Vulnerability

The social vulnerability has been ascertained by analysing a combination of indicators that define certain characteristics or qualities (such as socio-economic and demographic attributes) within social systems that create the potential for loss or harm. According to this study, there are pockets labelled “very high” vulnerability but almost all of these are in low population density areas.

However, there are significant densely populated areas centred on Dehradun town that are labelled “High” vulnerability. In terms of the population that can be potentially effected, this central “high” vulnerability zone is a matter of concern.

Maps 4 – 15 illustrate the social vulnerability and population density in the key areas of Dehradun.

1.4.2 Earthquakes

Dehradun City and its surrounds is classified as being High Risk with respect to earthquakes. With the rapid pace of urbanization, the built-up area in the city has been increasing manifest over the years hence increasing the exposure to earthquakes.

The central market areas of Dehradun are particularly congested with narrow roads and non-resilient infrastructure. Again, the densely populated areas of the hotspot are a matter of concern with respect to earthquake risk.

The expansion of the city along the Doon Valley increase earthquake risk exposure over time.

Maps 16 – 18 illustrate the earthquake risk in the key areas of Dehradun over a 100-year return period probability.

1.4.3 Floods

LOW RISK

Fluvial flood risk for Dehradun is seen as Low. It resides in a small catchment and the rivers are small.

That being said, Dehradun experiences frequent inconvenience flooding due to poor urban drainage. It is also noted that that there are many people constructing illegal encroachments dangerously close to the Rispana and Bindal streams, hence risking their lives and property during the monsoons.

Maps 19 – 24 illustrate the limited scope of the flood risk in the key areas of Dehradun.

1.4.4 Flash Floods

LOW RISK

The threat of catastrophic flash flooding is very localised and a low risk to Dehradun, although encroachment along the major urban drains must be reversed.

As a result of its low significance to Dehradun overall, there are no detailed strategies developed specially with respect to this hazard.

Maps 25 – 30 illustrate the risk of flash floods in the key areas of Dehradun.

Fluvial vs. Flash Floods vs. Pluvial Floods

Fluvial Floods, or riverine flooding, occurs when excessive rainfall over an extended period causes a river to overflow its banks and to spread out over a wide area. The damage from a fluvial flood can be widespread.

Flash floods are intense, high velocity torrents of water that occur in an existing river channel with little notice. Flash floods are very destructive because of the force of the water and the debris they carry.

Pluvial Floods (Urban Flooding) flooding occurs when an extremely heavy downpour of rain saturates drainage systems and the excess water cannot be absorbed. It is a common nuisance in Haridwar, Dehradun, Haldwani, and other larger towns during the monsoon. The water quickly disappears when the rain stops. Integrated urban drainage systems are an appropriate solution, and pluvial flooding is not under the scope of this risk management strategy.

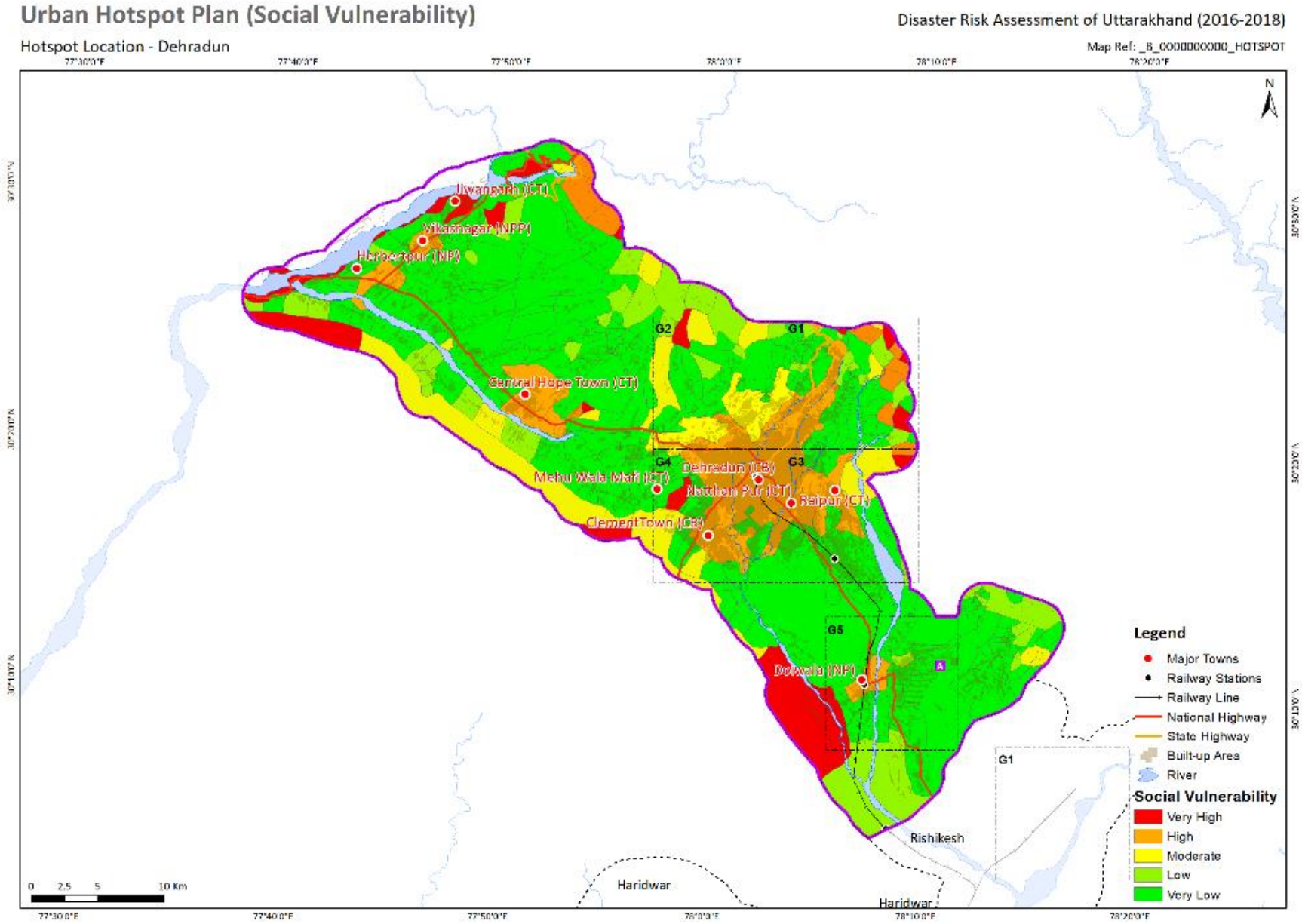
1.4.5 Landslide Hazard

VERY LOW RISK

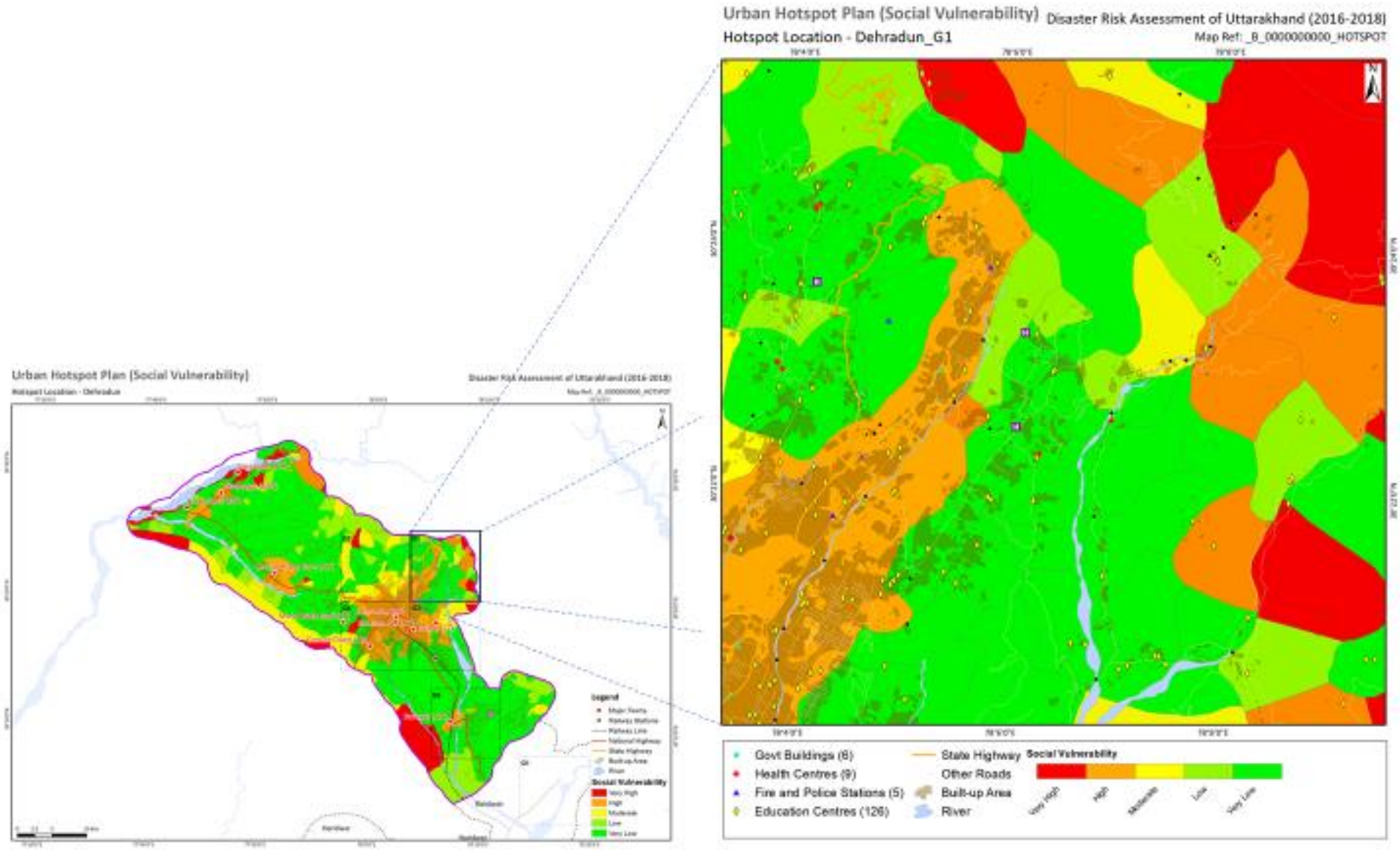
Landslides are a low and localized risk in the Dehradun hotspot. As a result, there is no need to develop detailed strategies with respect to this Hazard.

Maps 31 – 36 illustrate the negligible Landslide risk in the key areas of Dehradun.

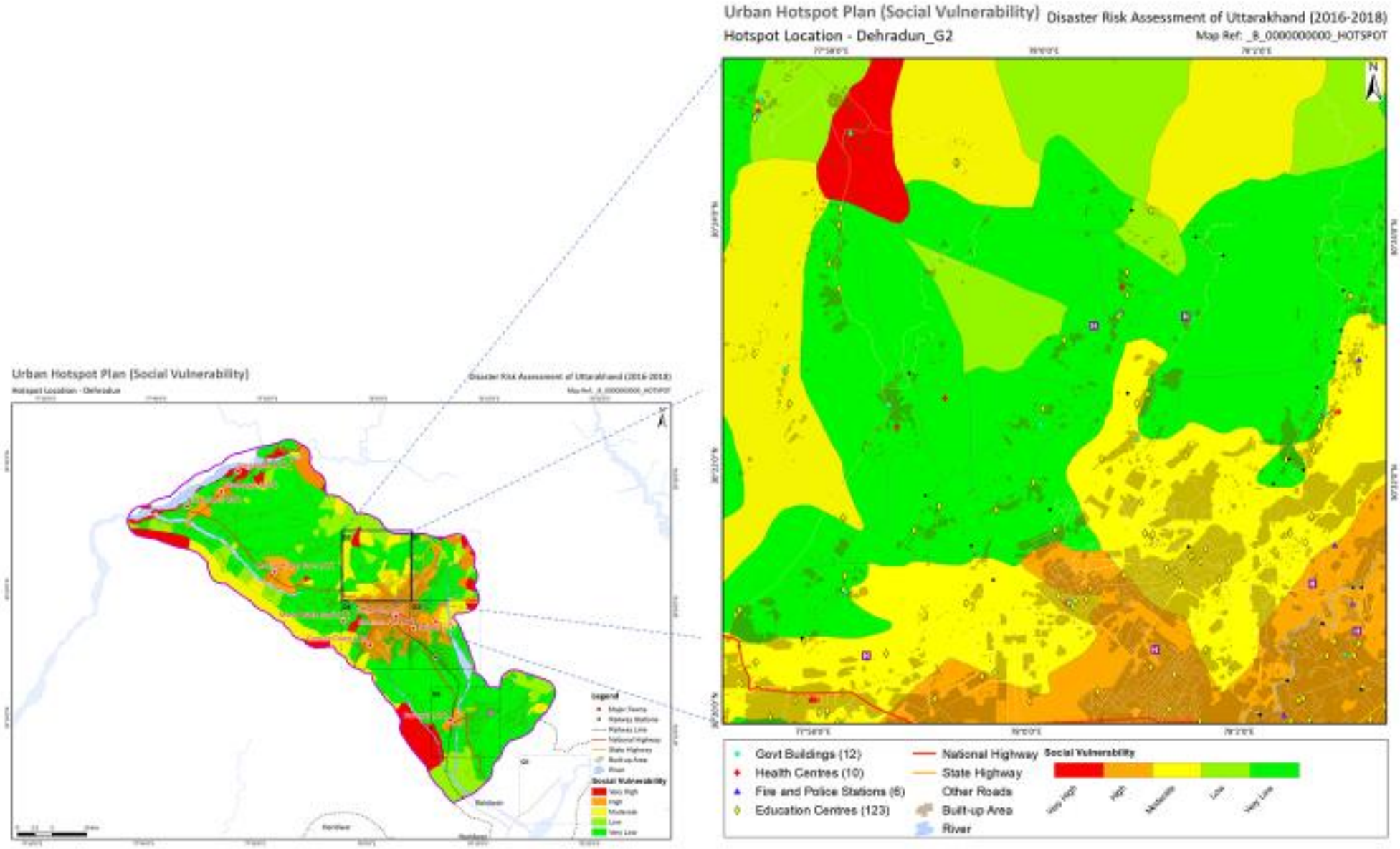
In those areas where there is some level of risk, more detailed mapping of the nature of that risk is required and the results from this mapping exercise then needs to be widely distributed within the statutory planning and regulatory process for the city and surrounds. At the same time, any particularly vulnerable groups need to be advised of the risk.



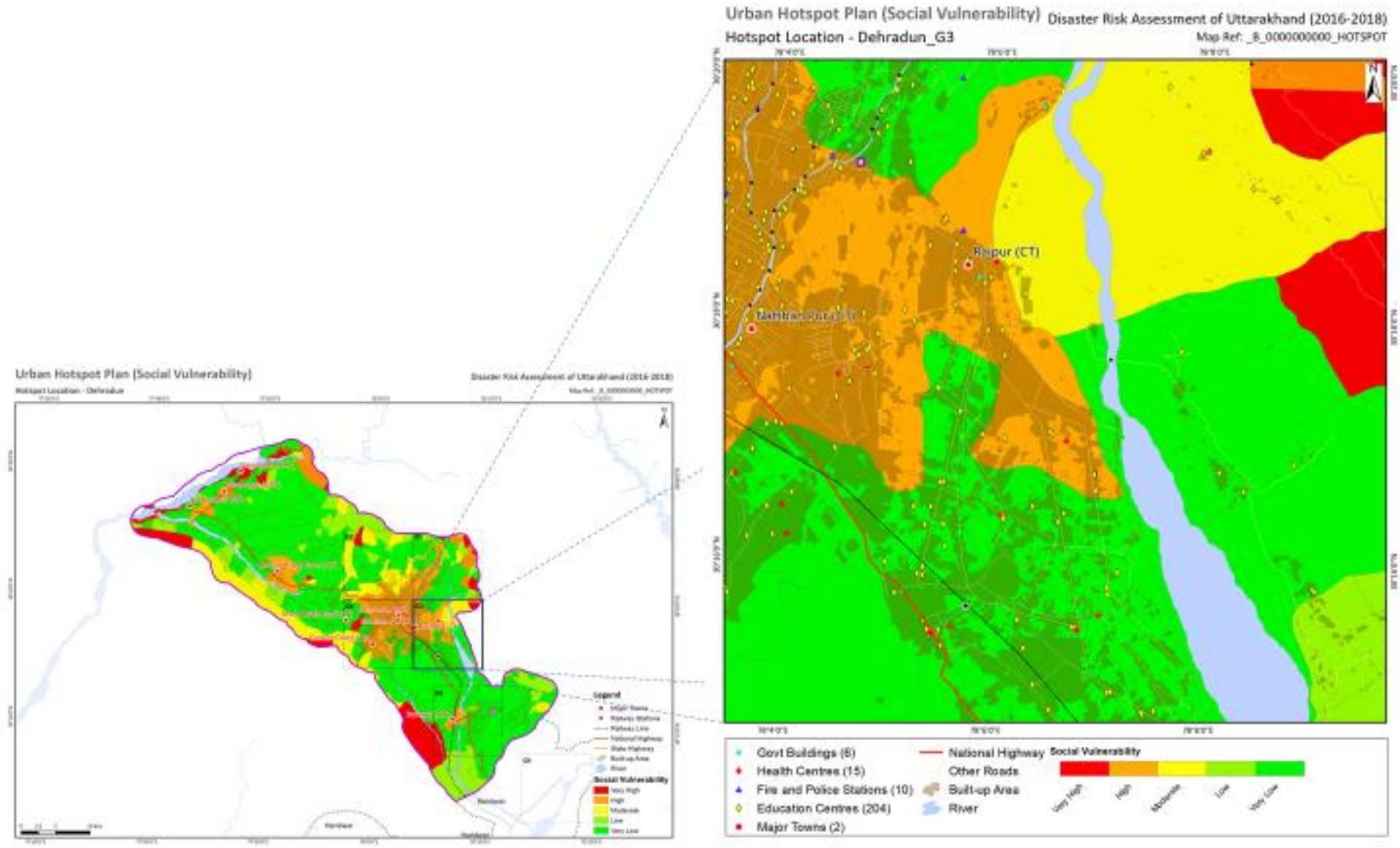
Map 4: Dehradun Integrated Social Vulnerability Index Map



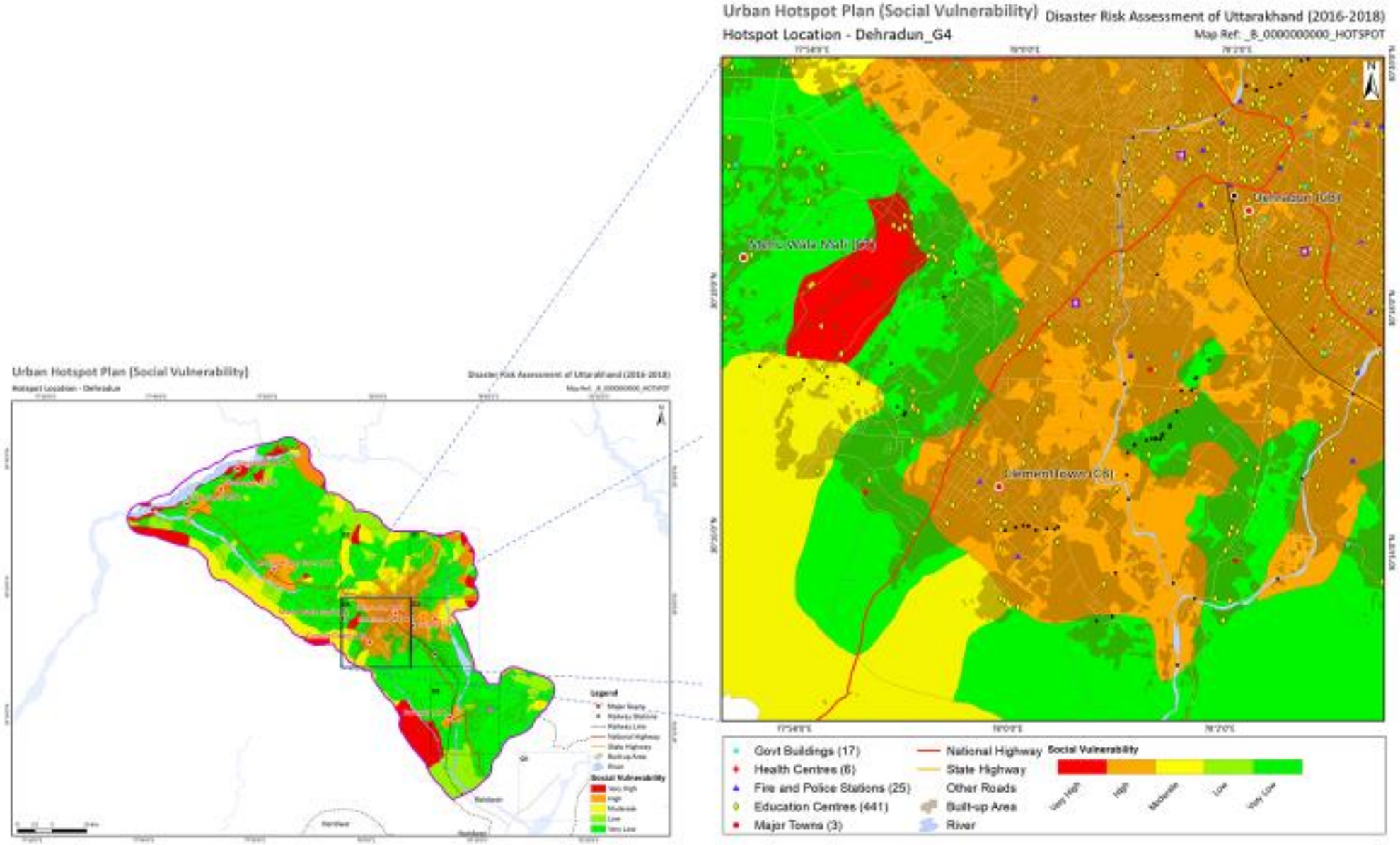
Map 5: Dehradun Integrated Social Vulnerability Index Map (Area G1)



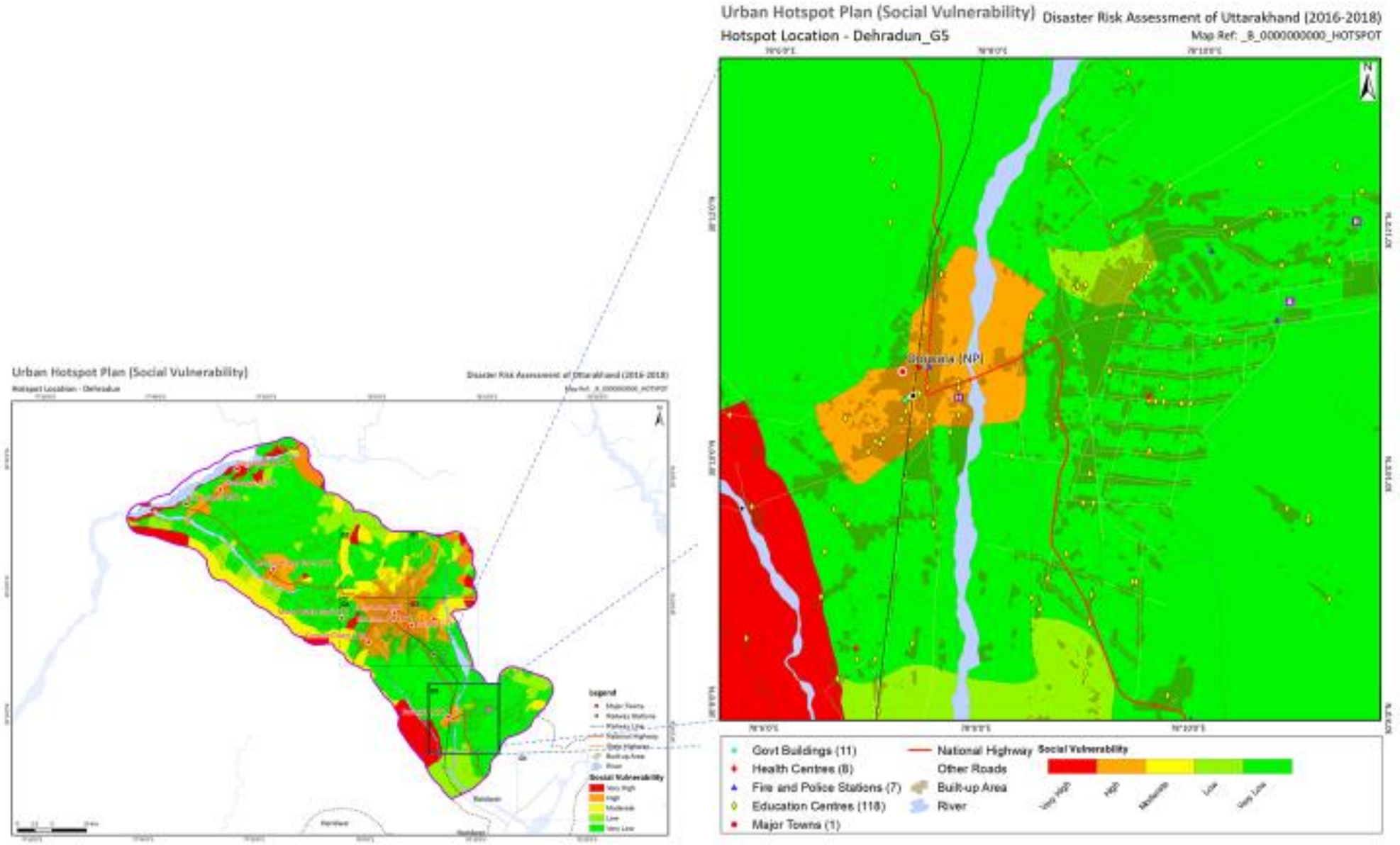
Map 6: Dehradun Integrated Social Vulnerability Index Map (Area G2)



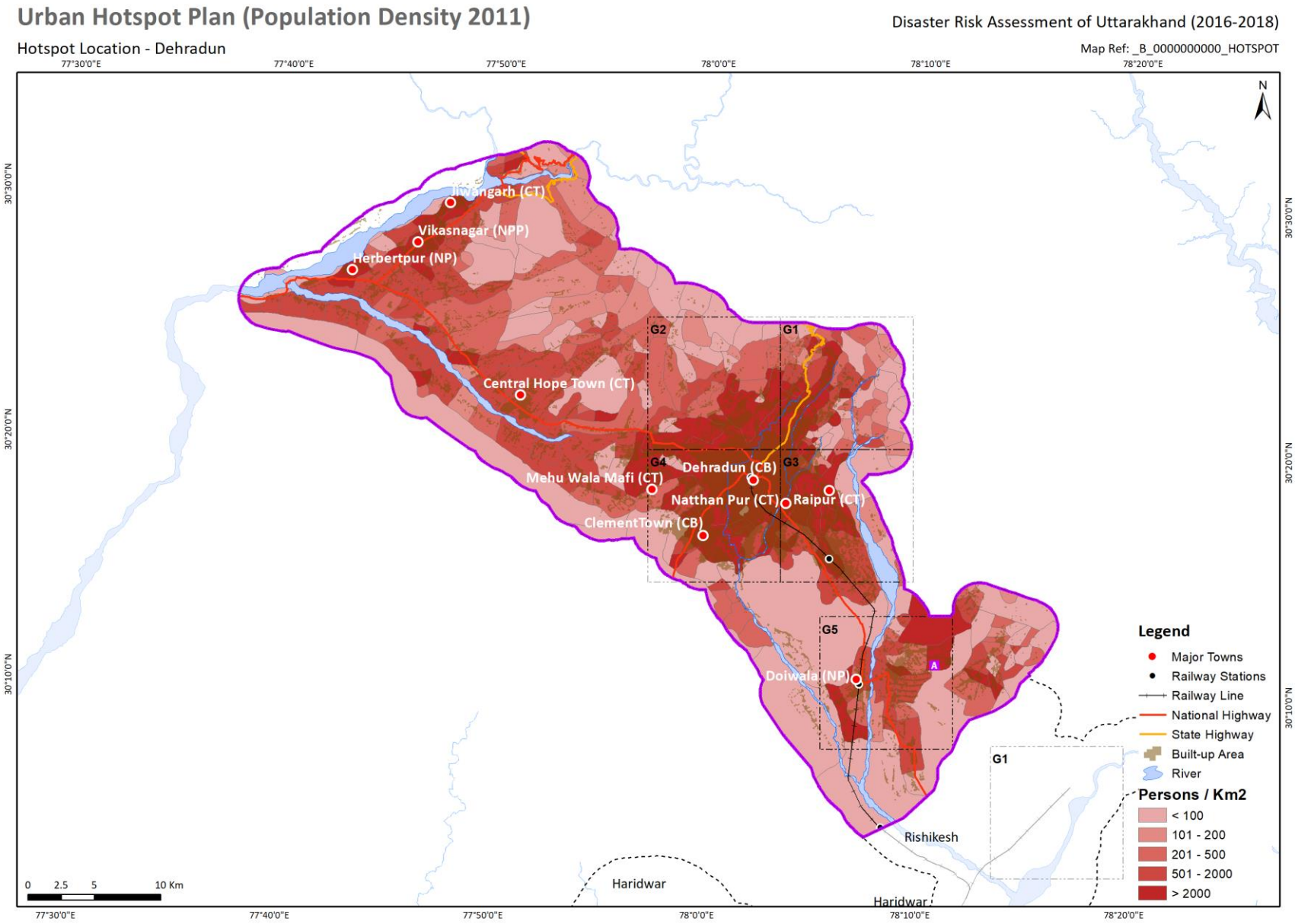
Map 7: Dehradun Integrated Social Vulnerability Index Map (Area G3)



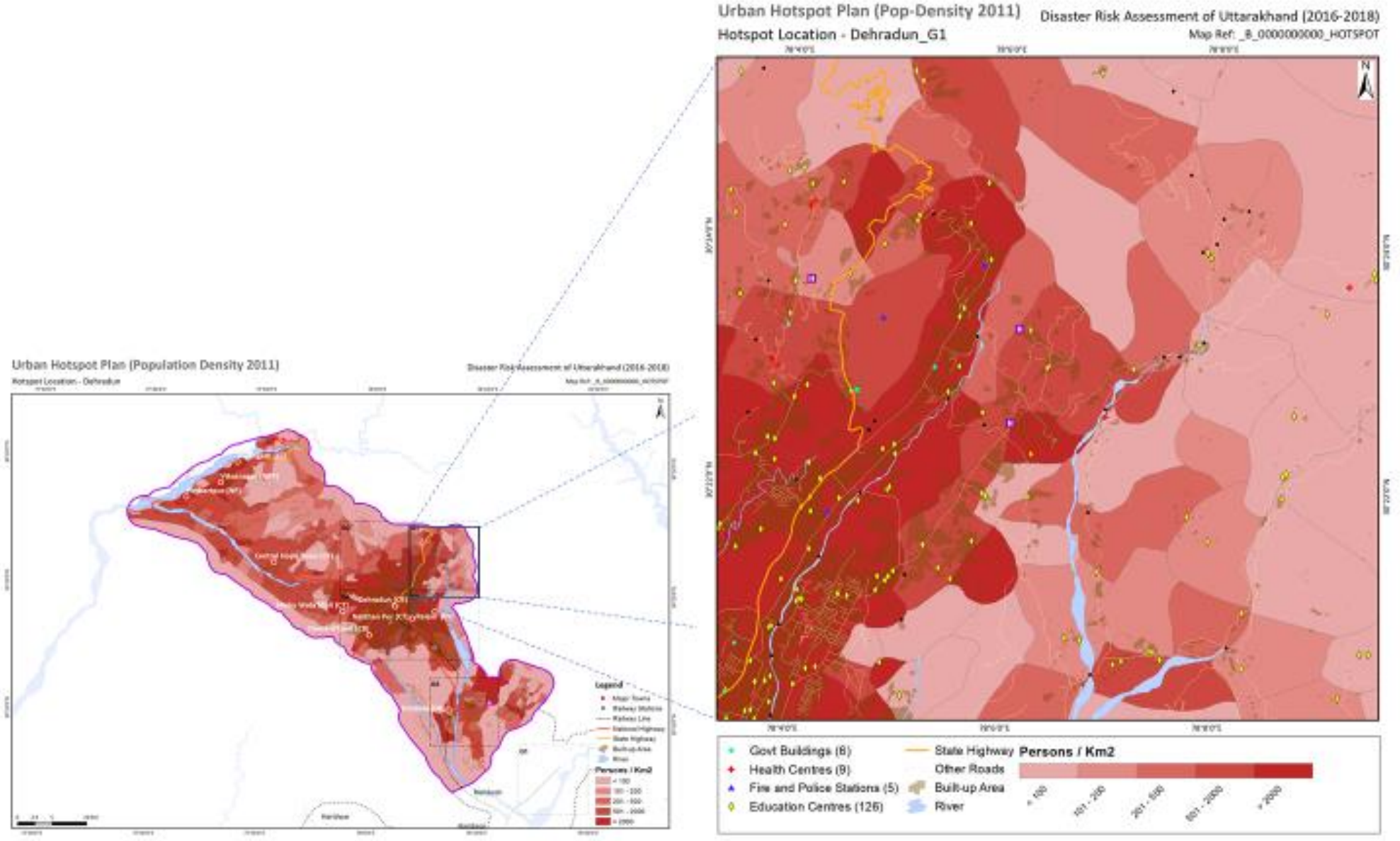
Map 8: Dehradun Integrated Social Vulnerability Index Map (Area G4)



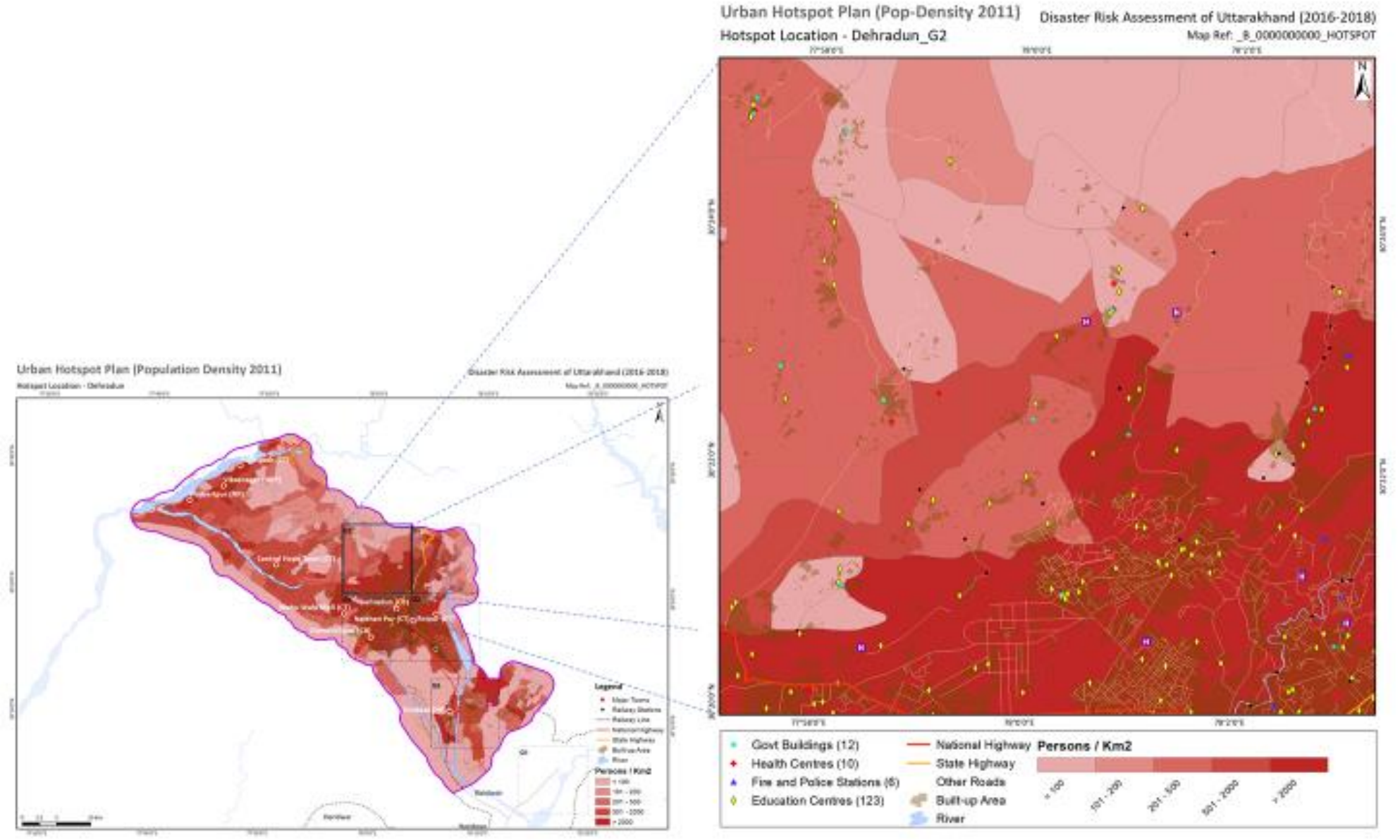
Map 9: Dehradun Integrated Social Vulnerability Index Map (Area G5)



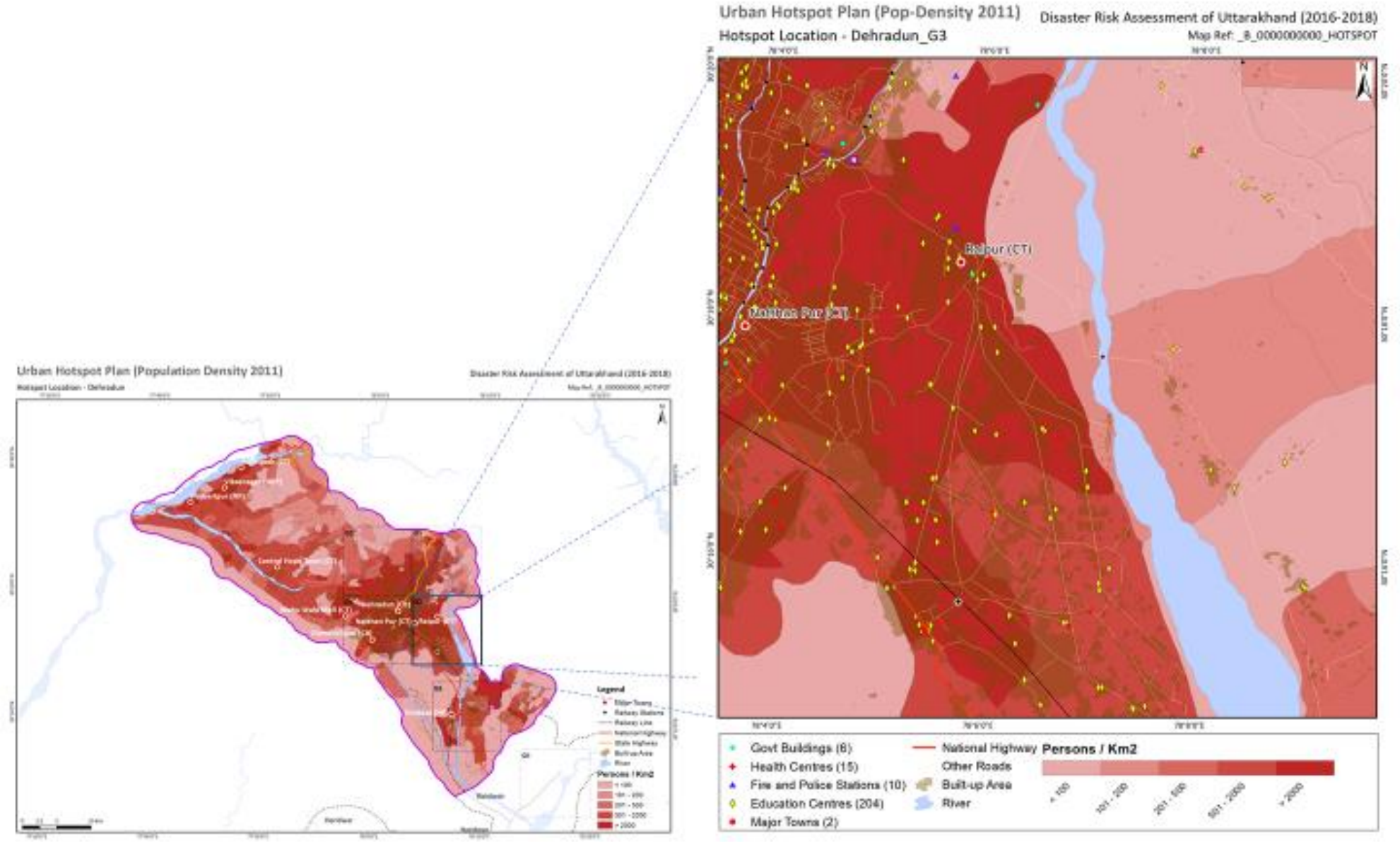
Map 10: Population Density Map – Dehradun



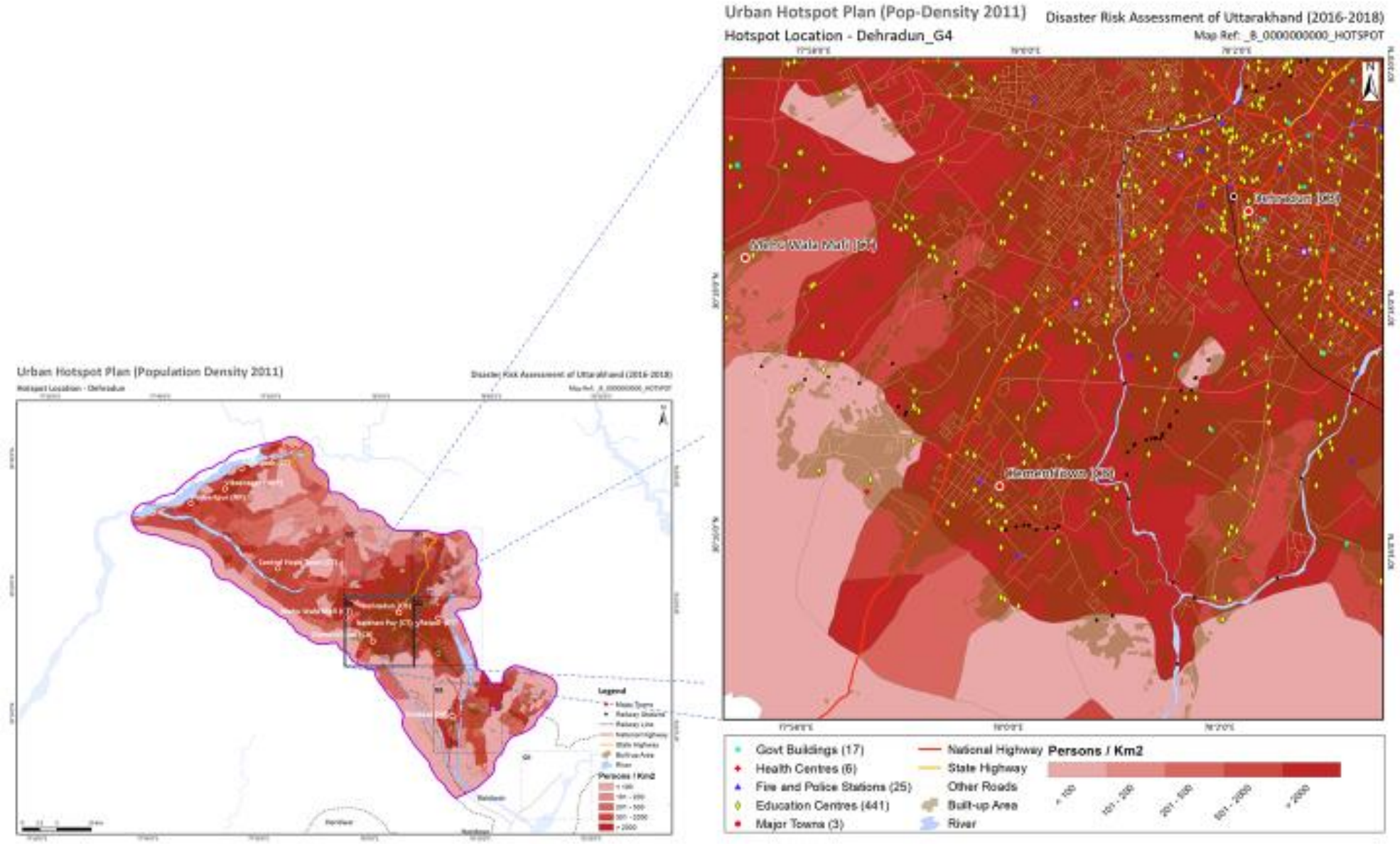
Map 11: Population Density Map for Dehradun (Area G1)



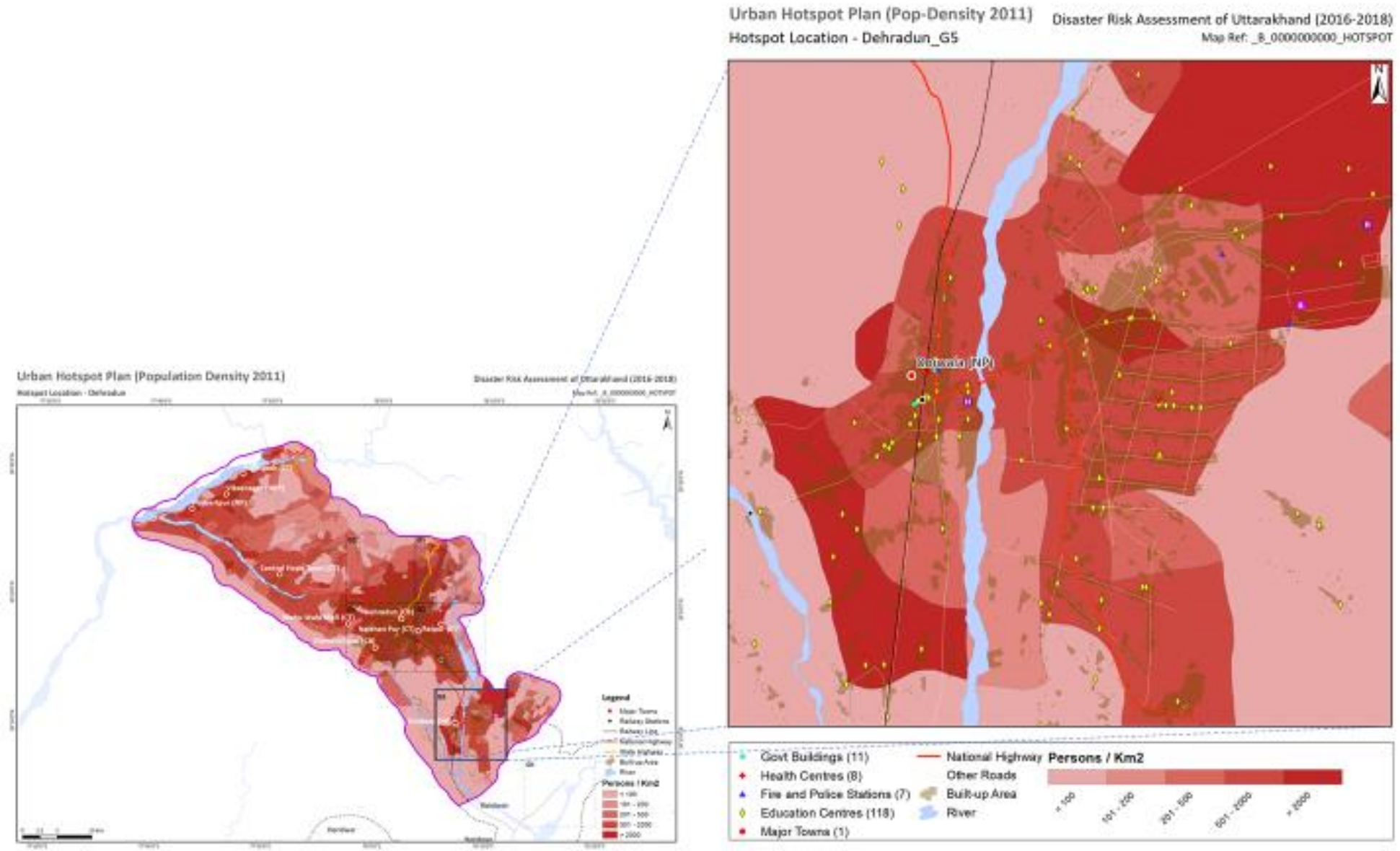
Map 12: Population Density Map for Dehradun (Area G2)



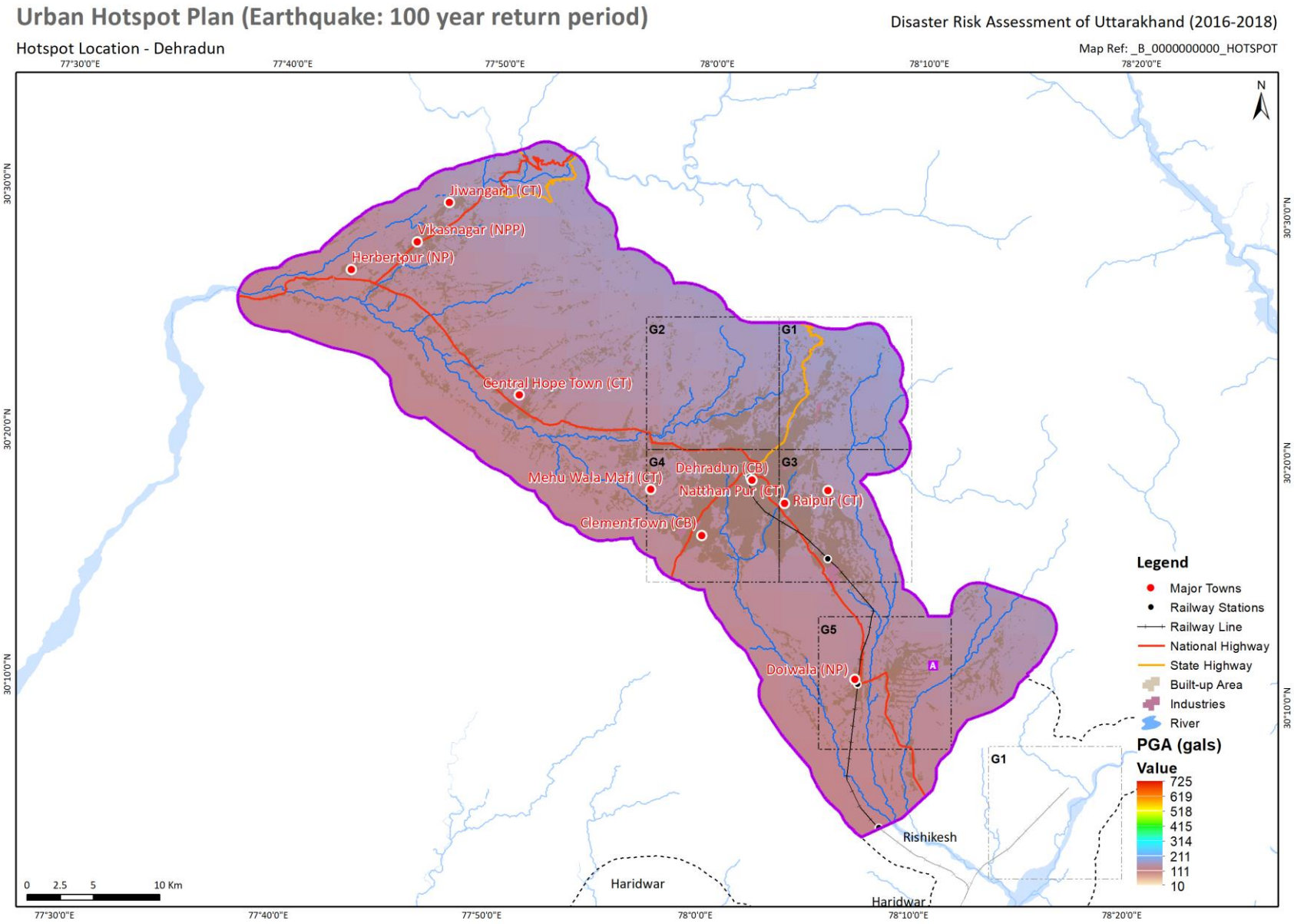
Map 13: Population Density Map for Dehradun (Area G3)



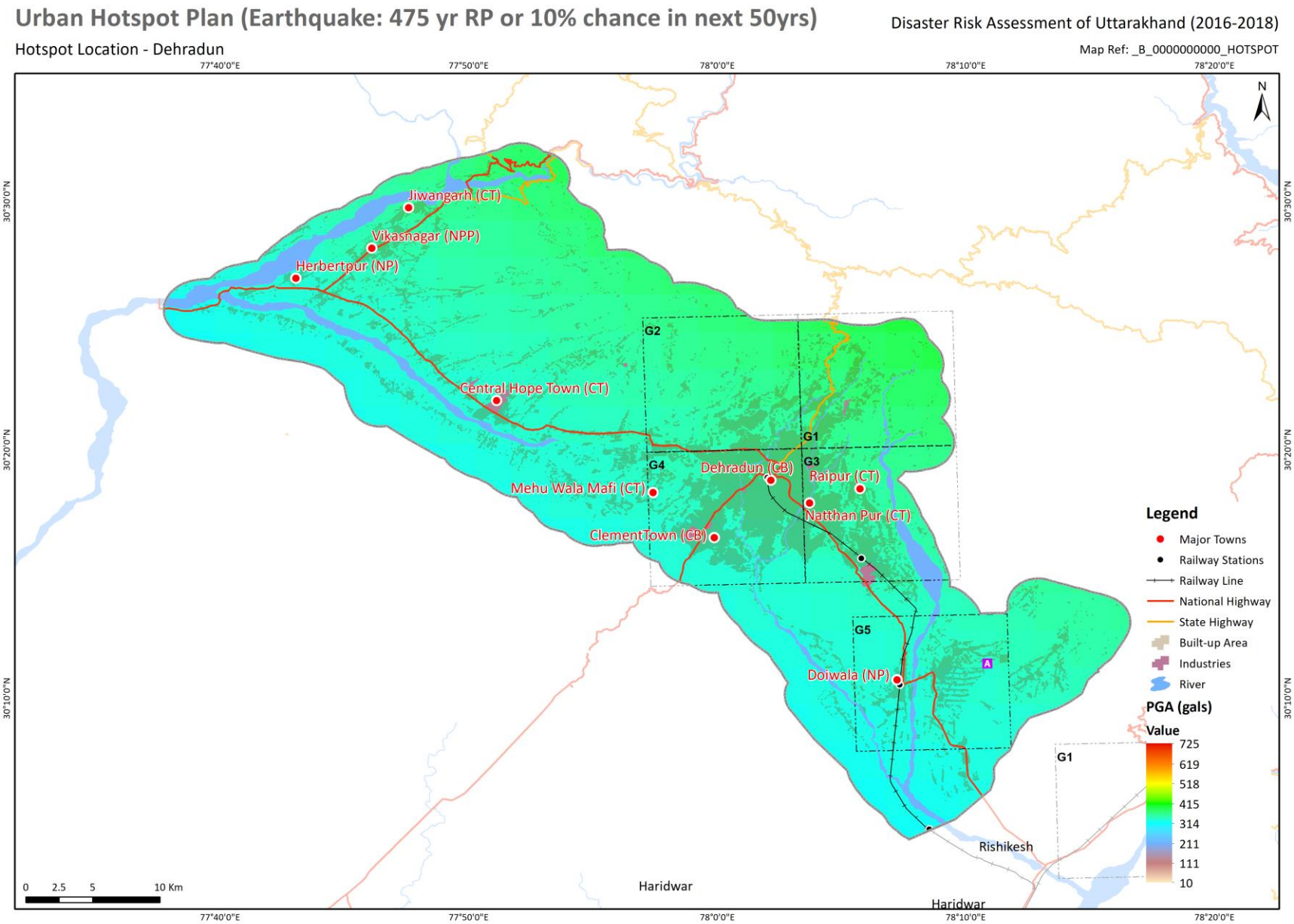
Map 14: Population Density Map for Dehradun (Area G4)



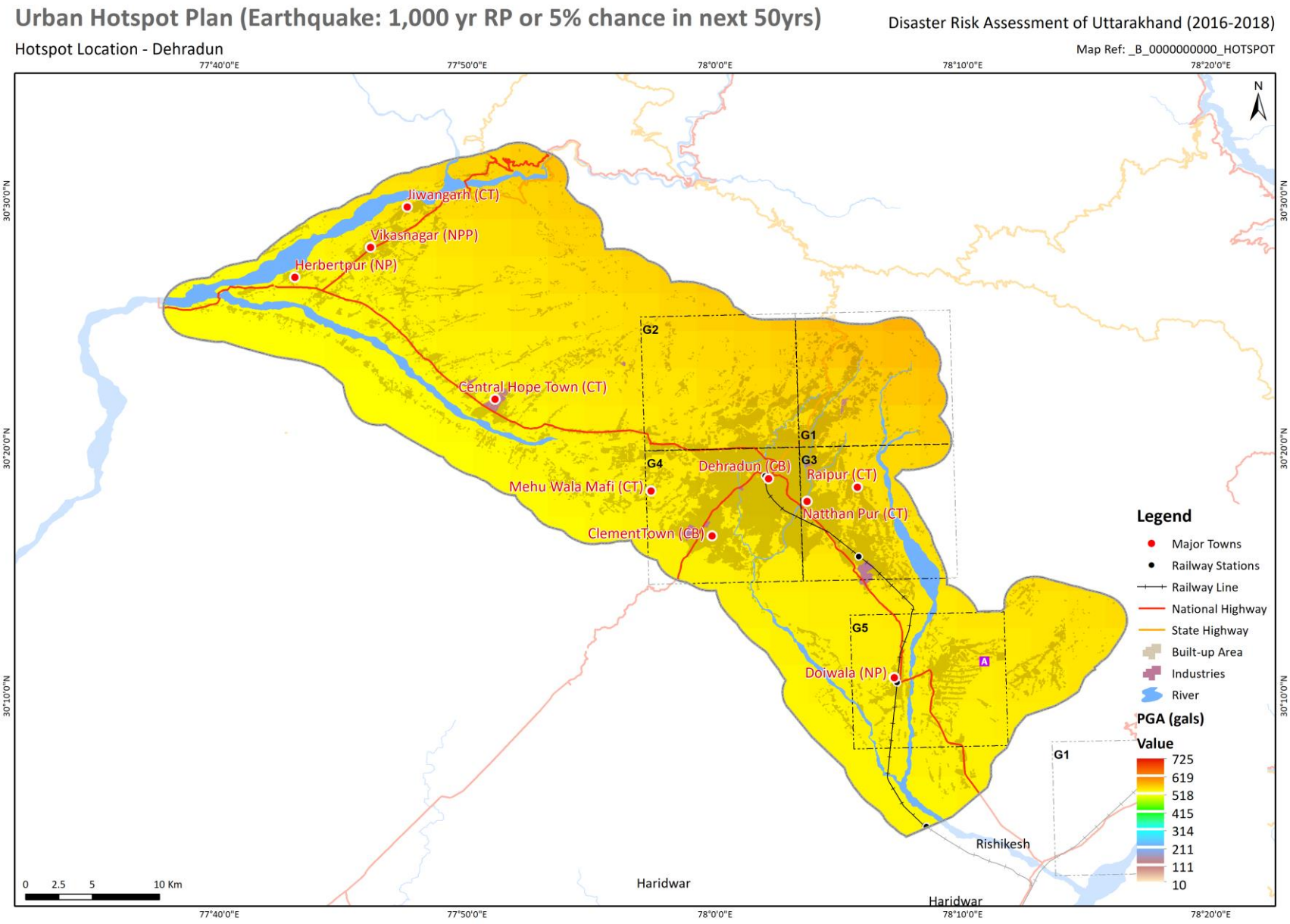
Map 15: Population Density Map for Dehradun (Area G5)



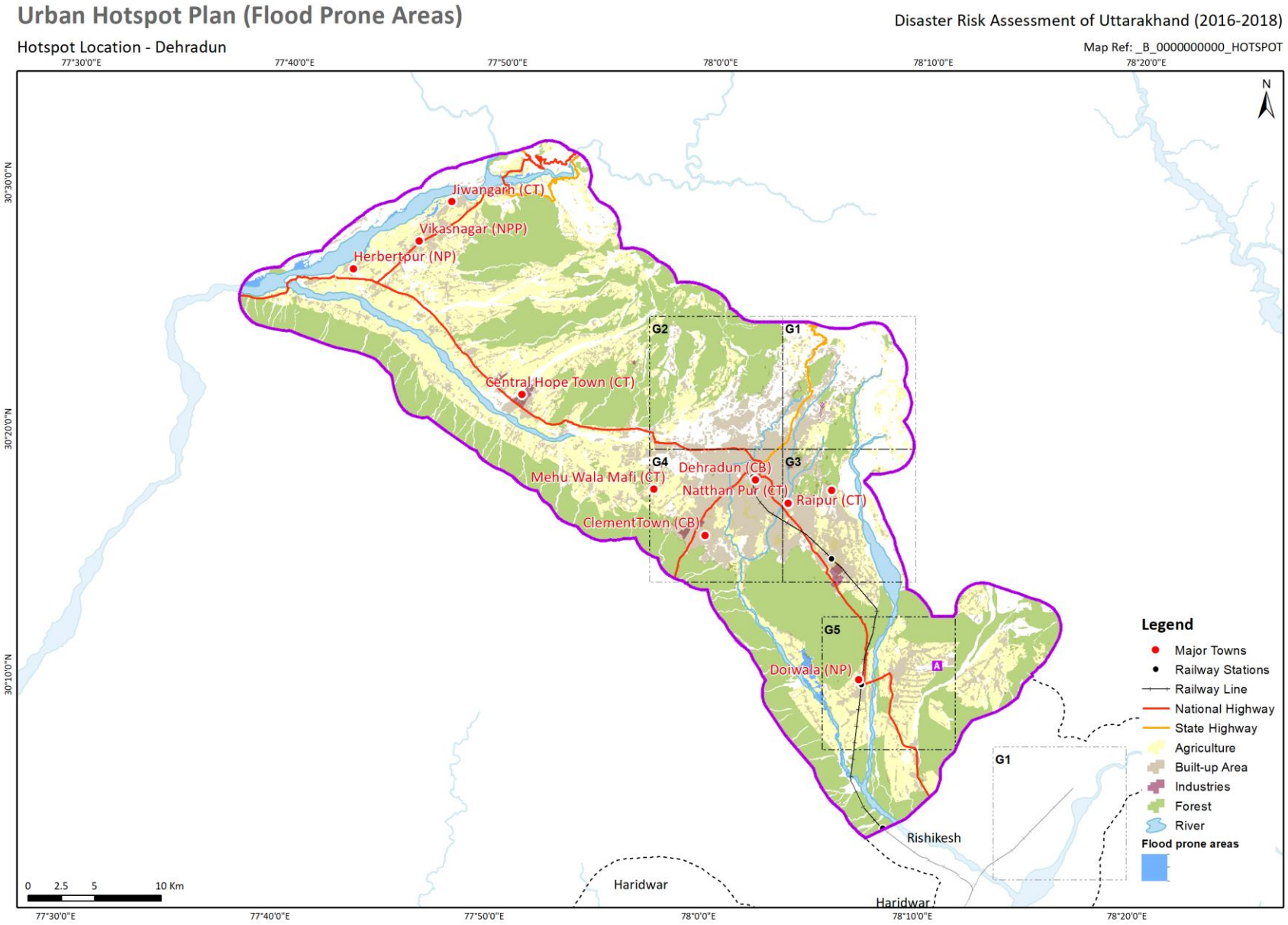
Map 16: Earthquake Hazard Intensity for the Dehradun Hotspot (100yr Return Period)



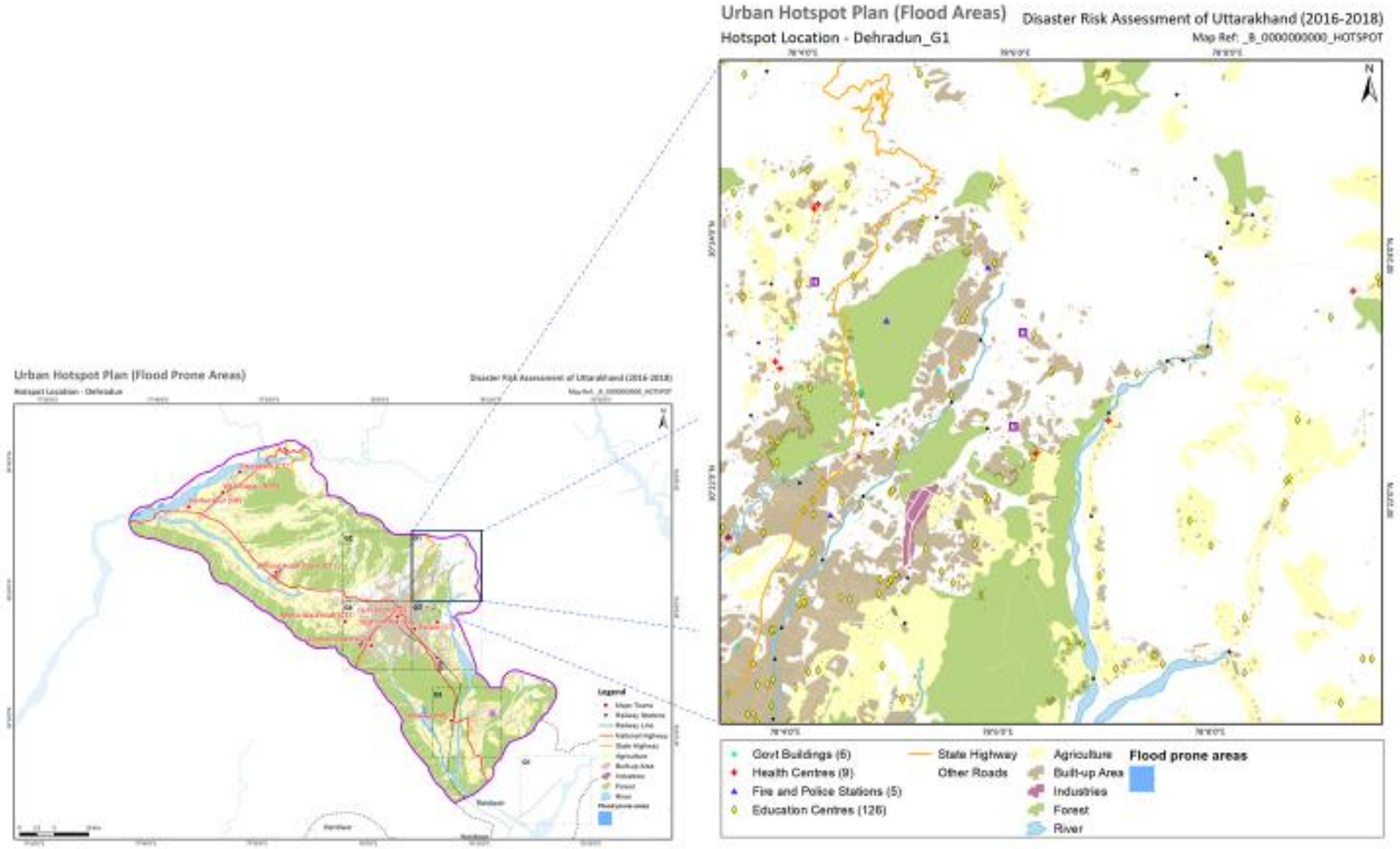
Map 17: Earthquake Hazard Intensity for the Dehradun Hotspot (475yr Return Period)



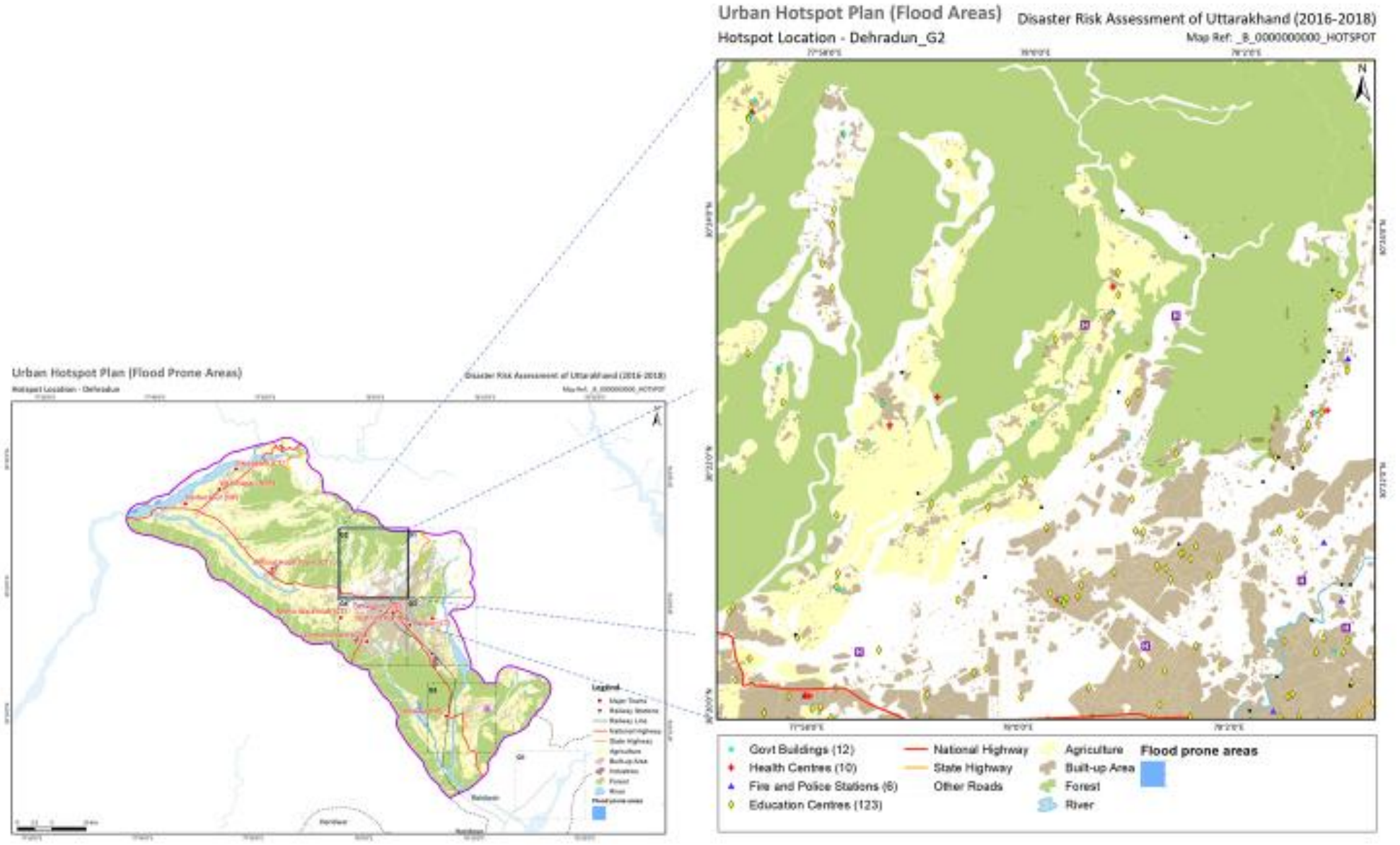
Map 18: Earthquake Hazard Intensity for the Dehradun Hotspot (1000yr Return Period)



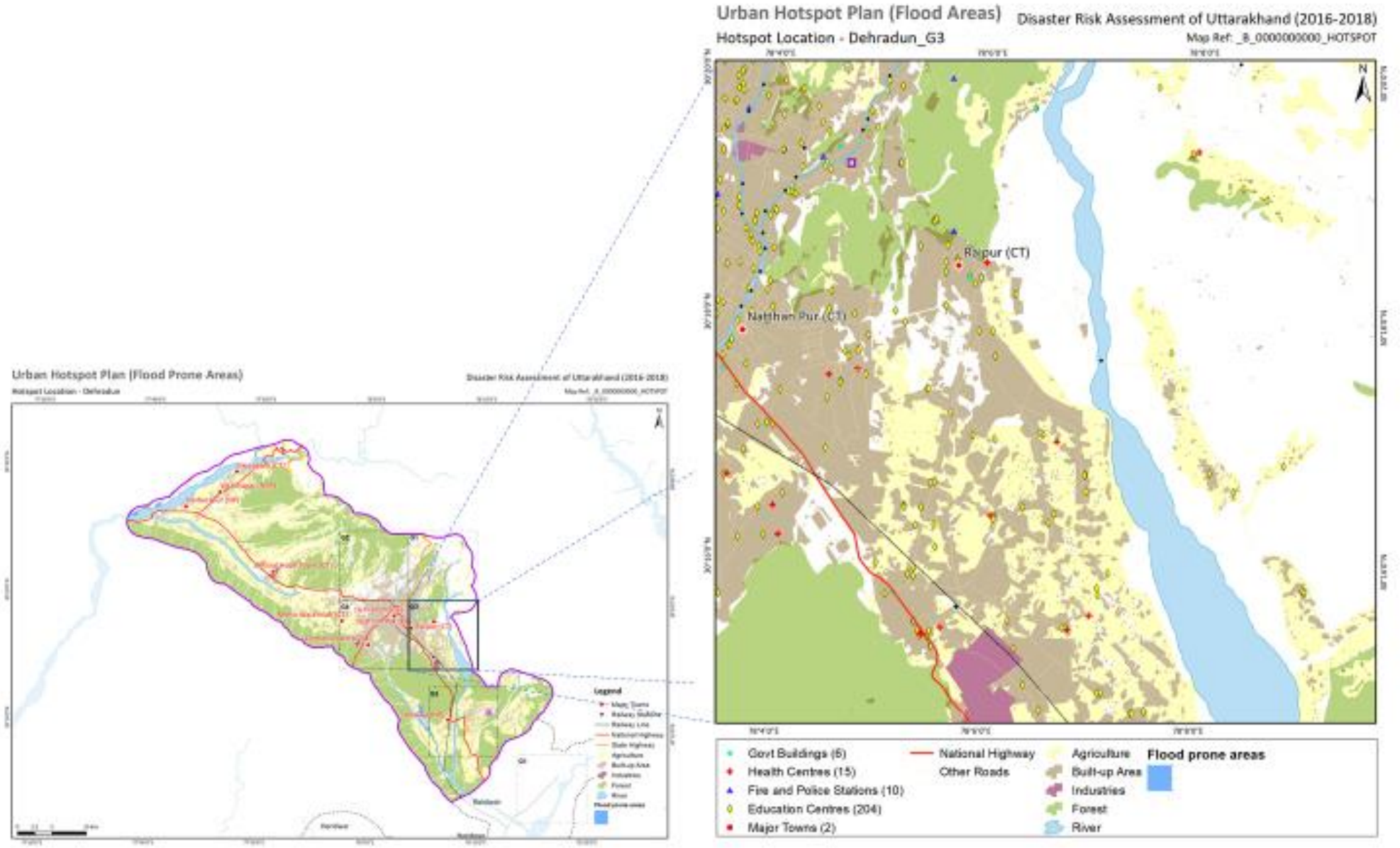
Map 19: Fluvial Flood Hazard Map - Dehradun



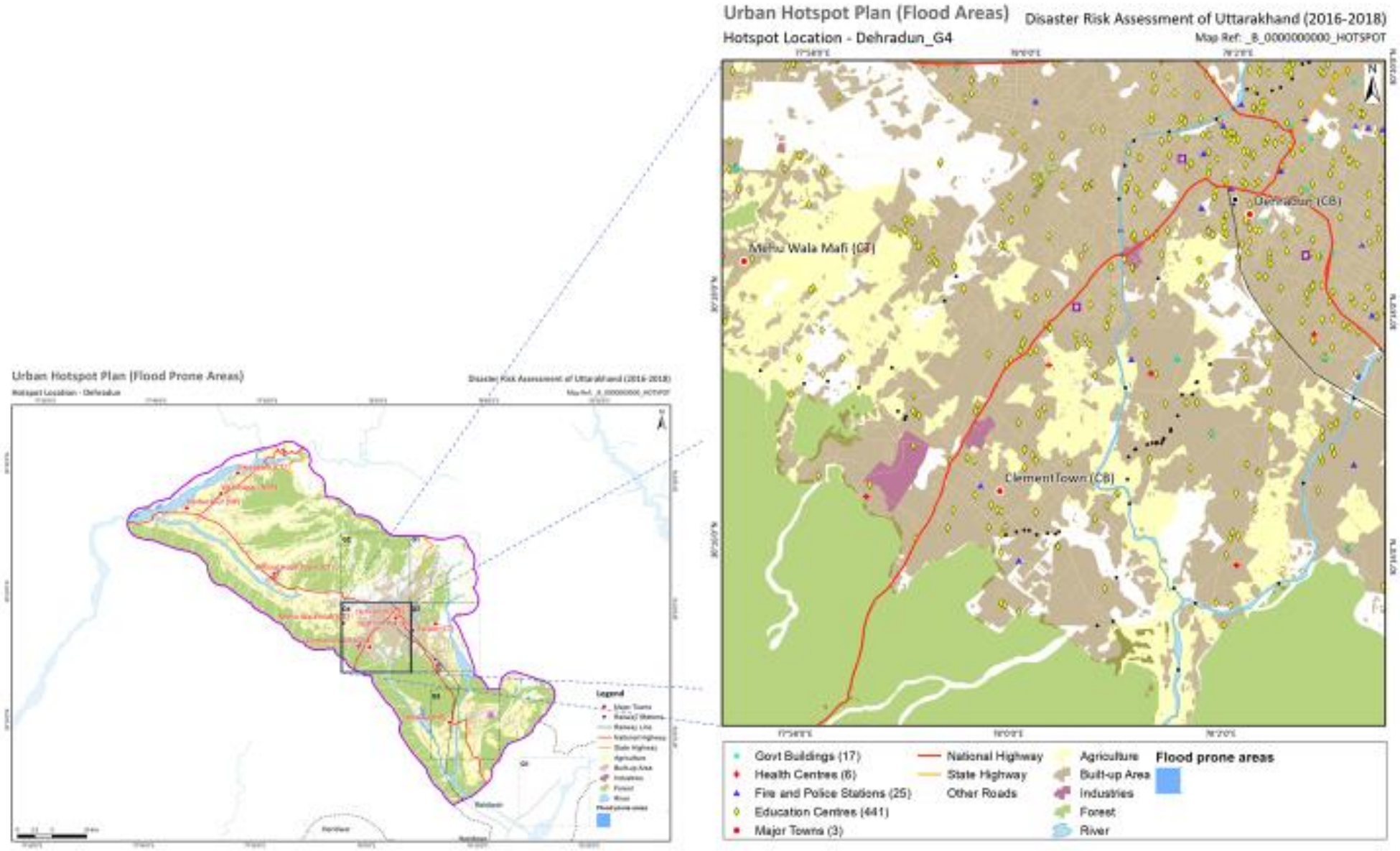
Map 20: Fluvial Flood Hazard Map - Dehradun (Area G1)



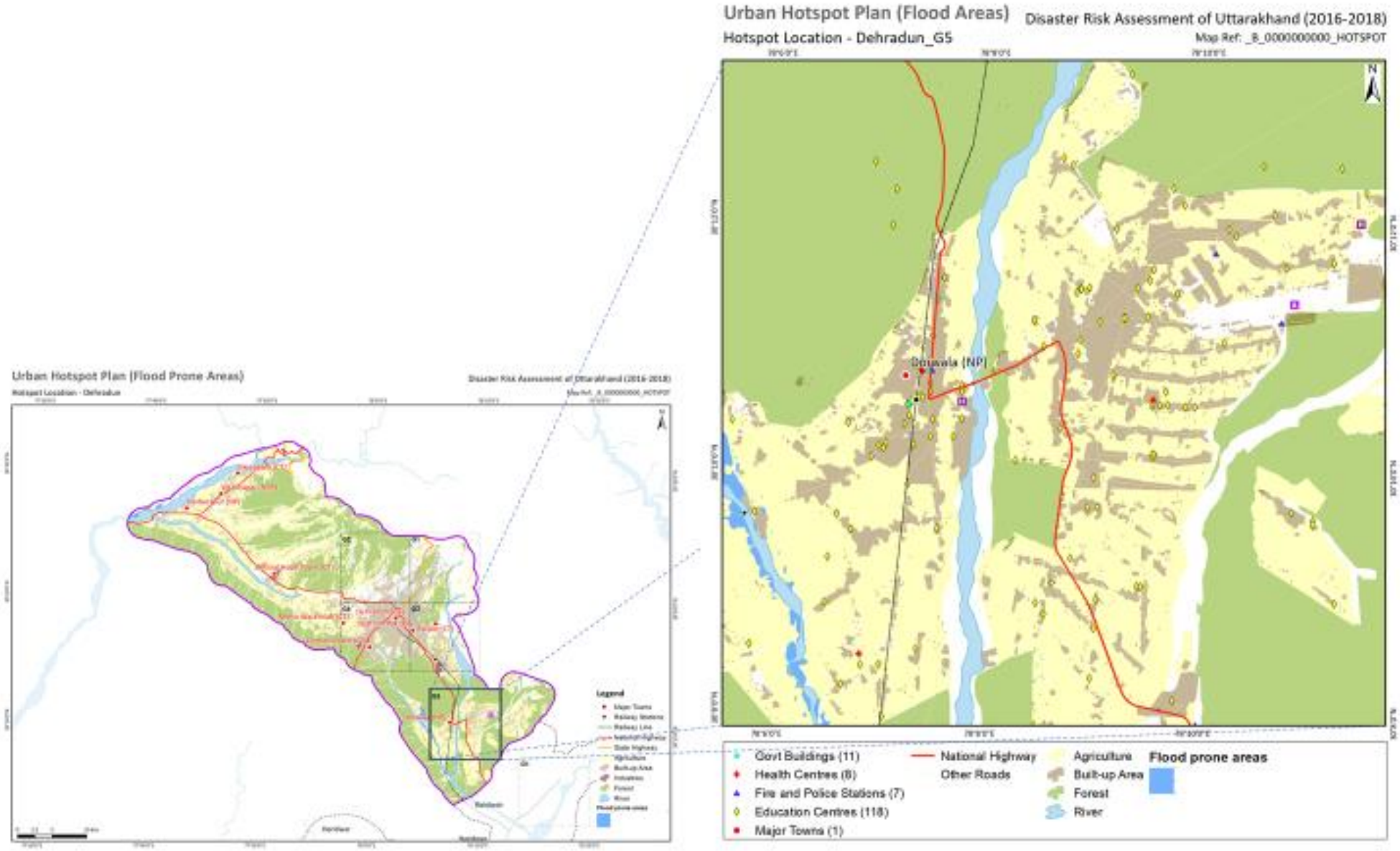
Map 21: Fluvial Flood Hazard Map - Dehradun (Area G2)



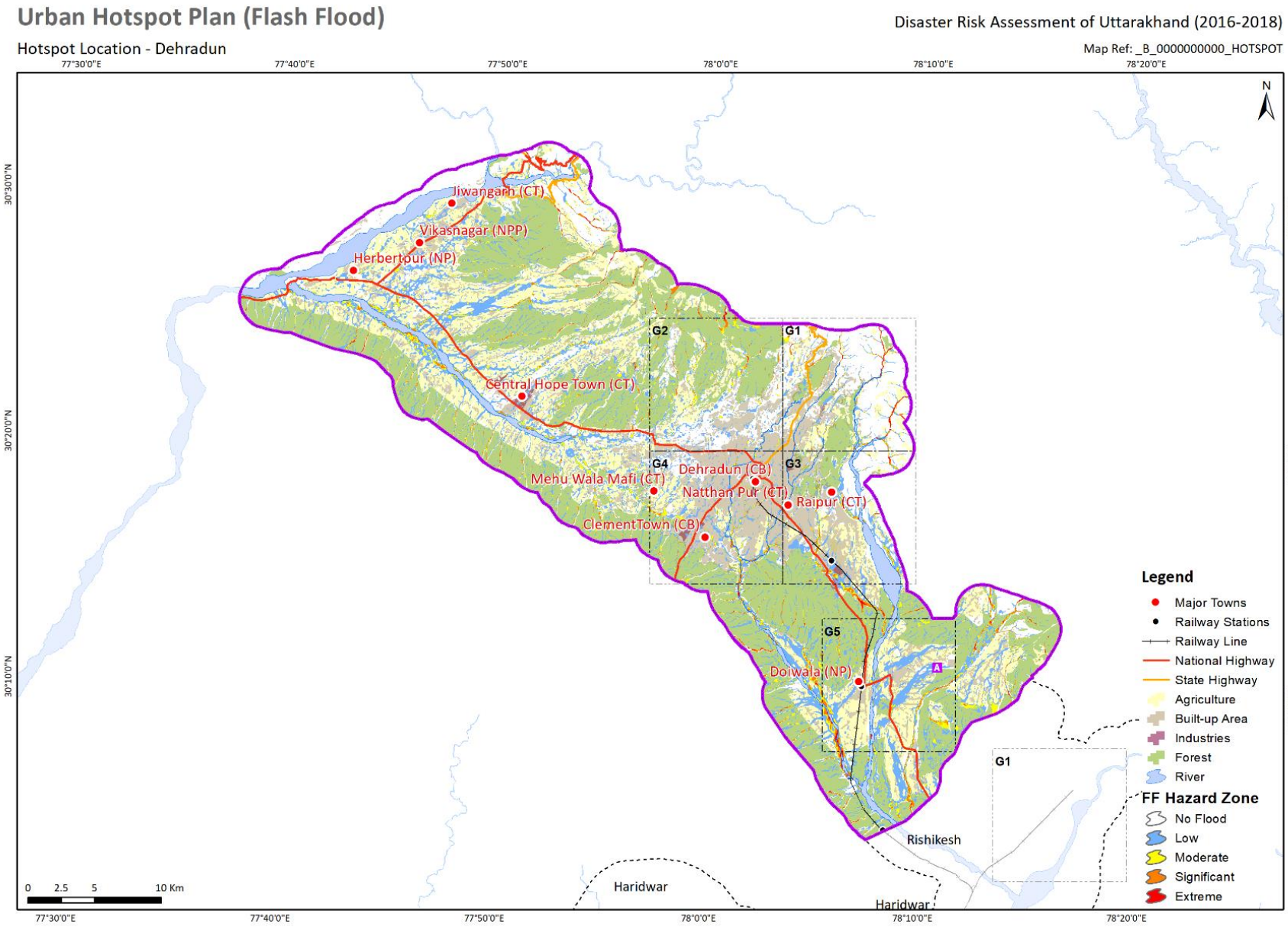
Map 22: Fluvial Flood Hazard Map - Dehradun (Area G3)



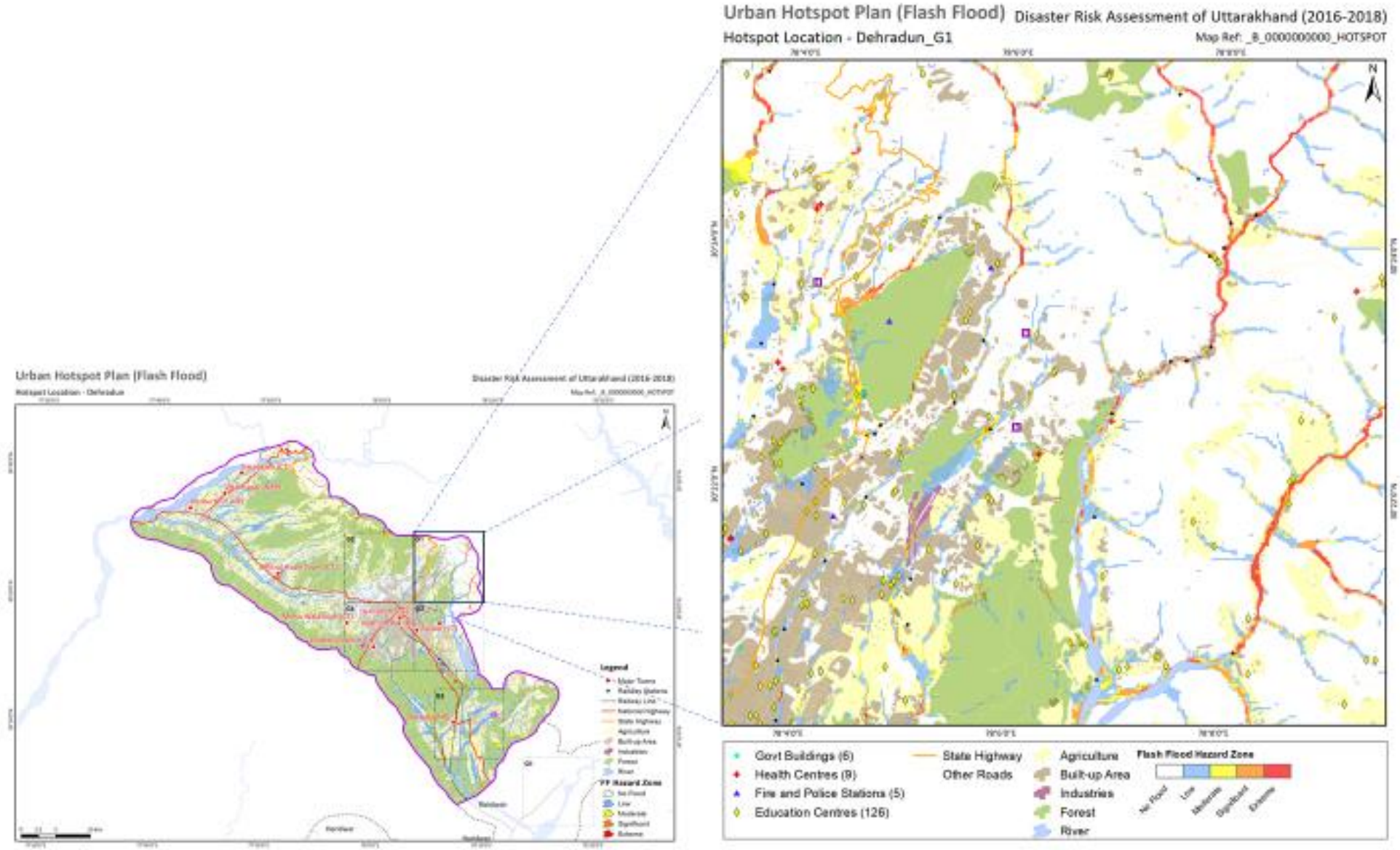
Map 23: Fluvial Flood Hazard Map - Dehradun (Area G4)



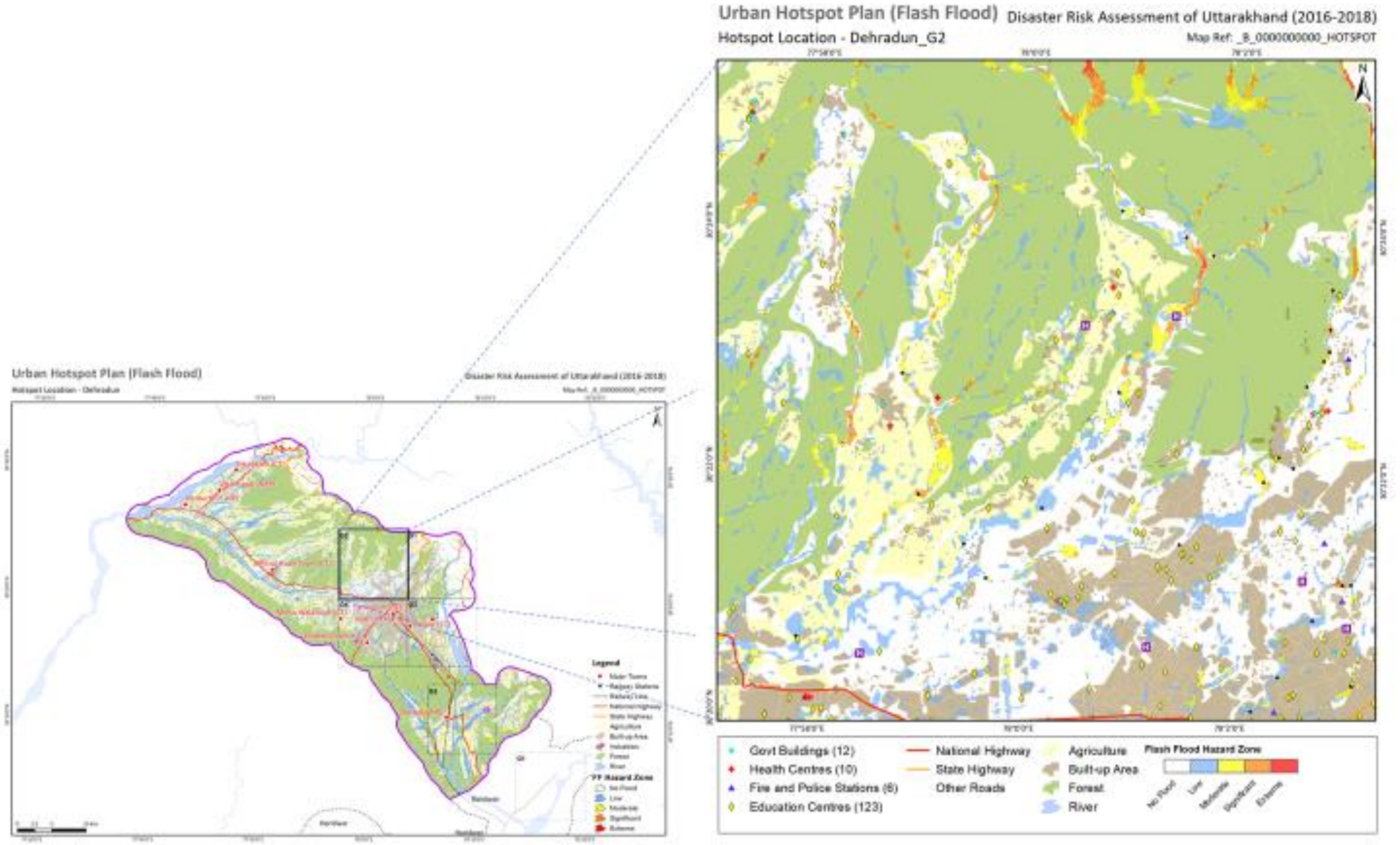
Map 24: Fluvial Flood Hazard Map - Dehradun (Area G5)



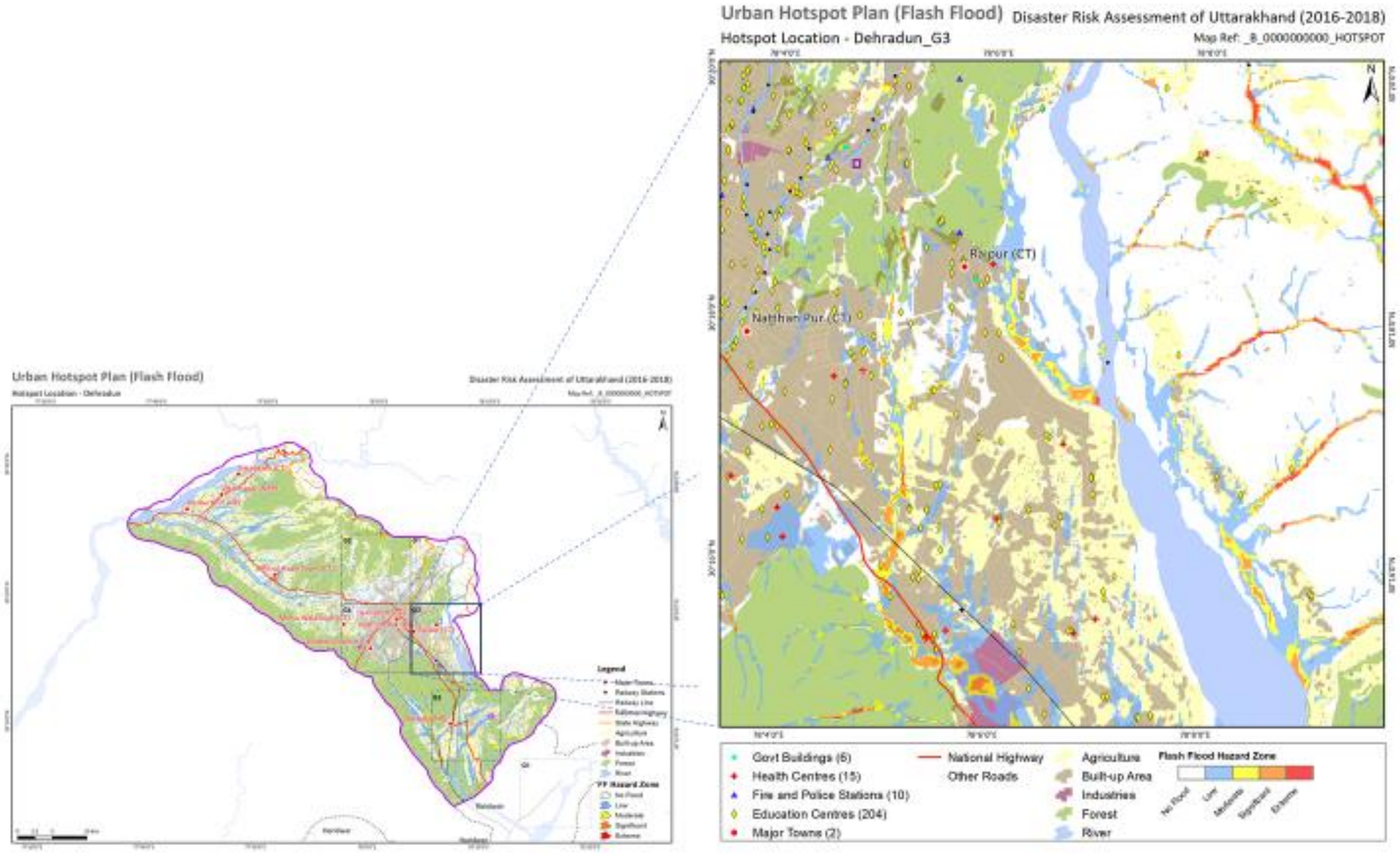
Map 25: Flash Flood Hazard Map – Dehradun



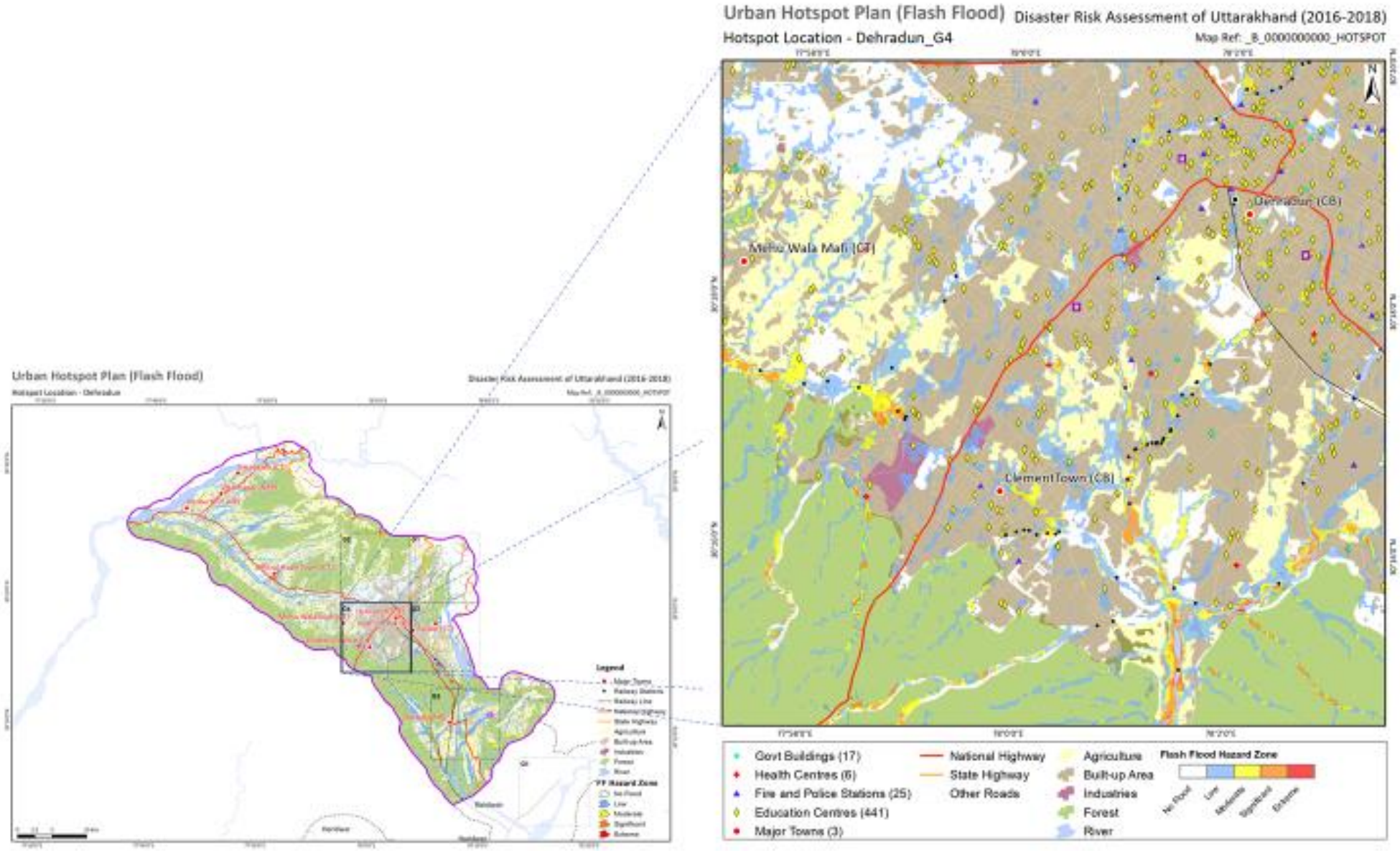
Map 26: Flash Flood Hazard Map - Dehradun (Area G1)



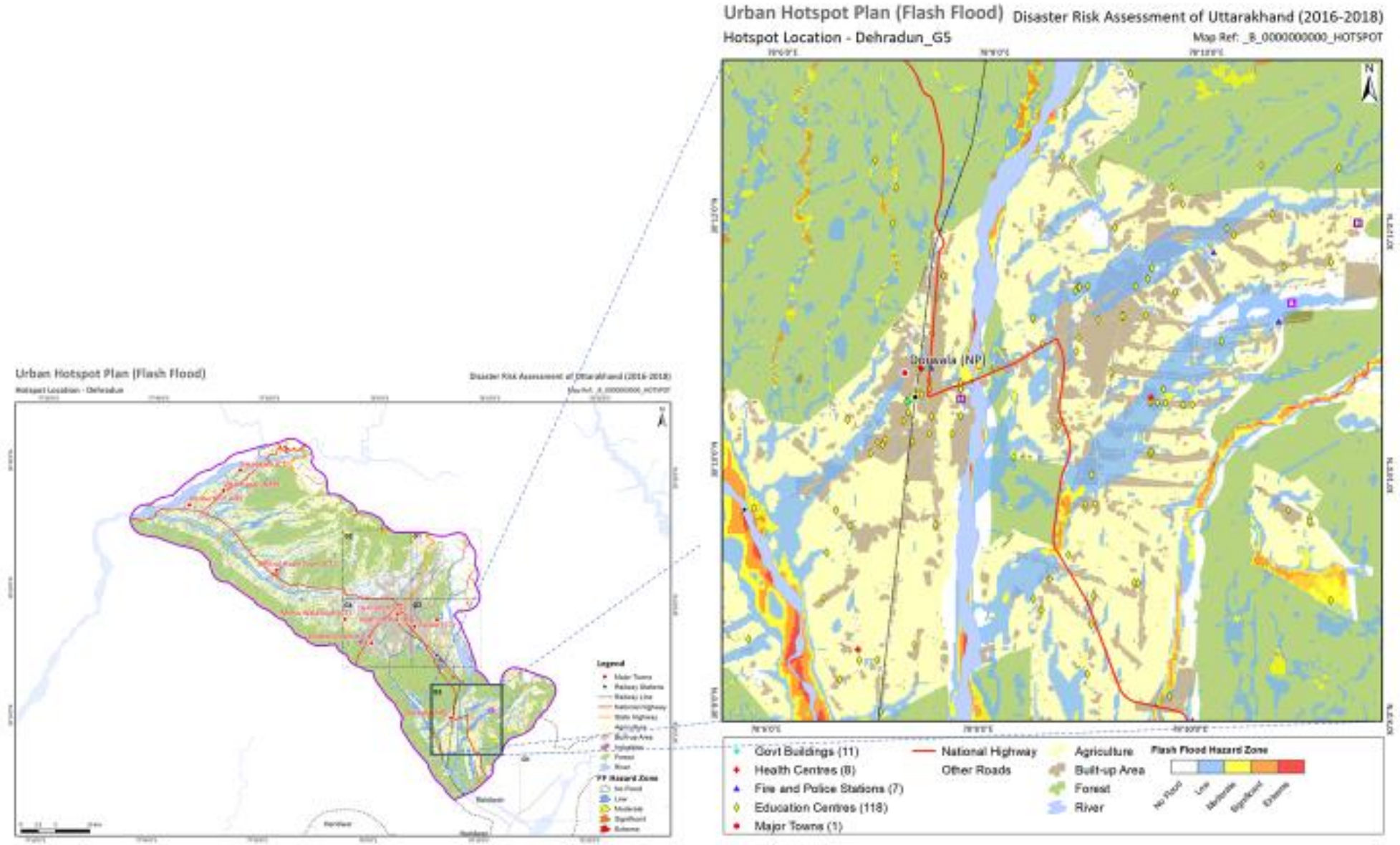
Map 27: Flash Flood Hazard Map - Dehradun (Area G2)



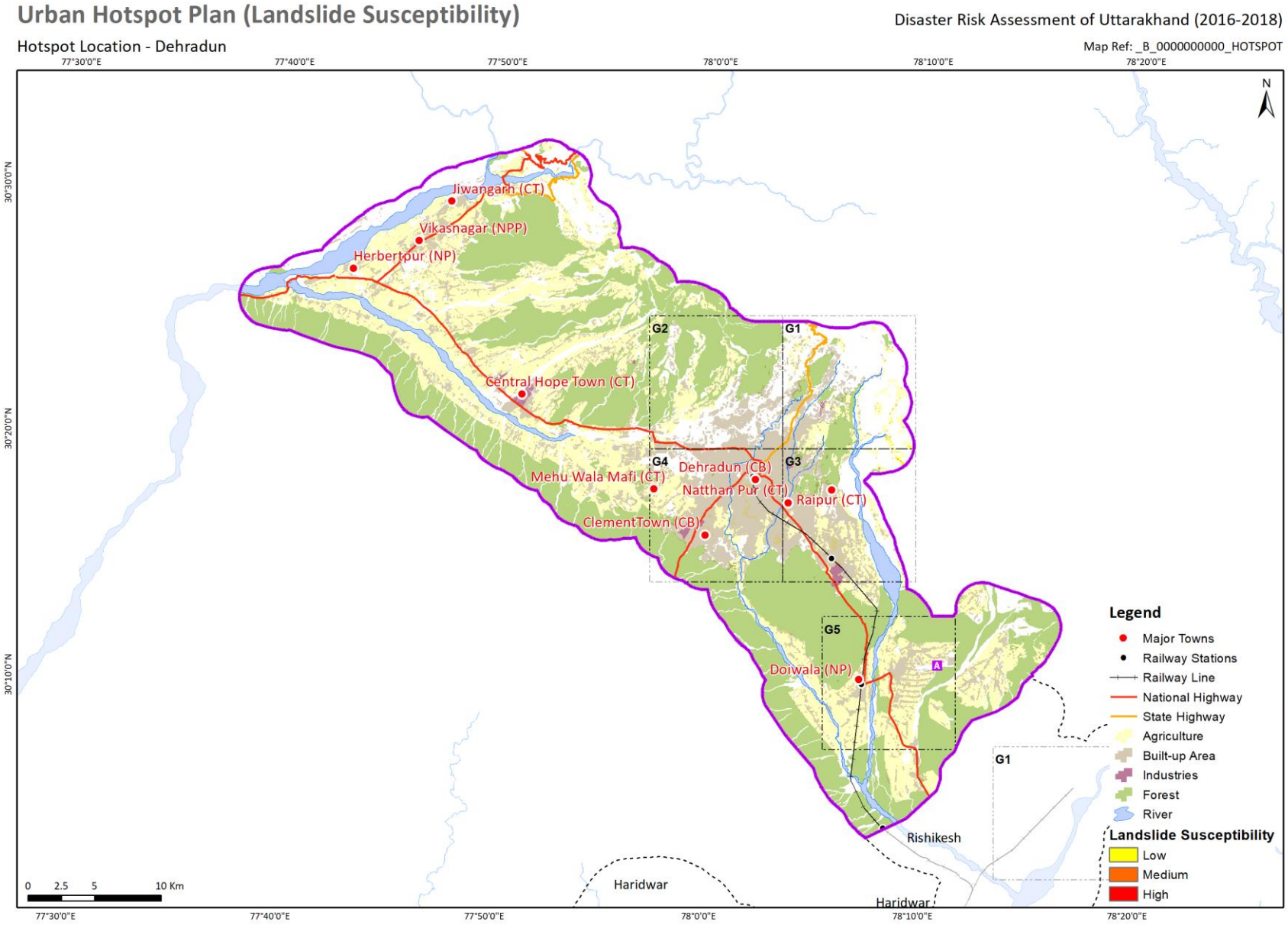
Map 28: Flash Flood Hazard Map - Dehradun (Area G3)



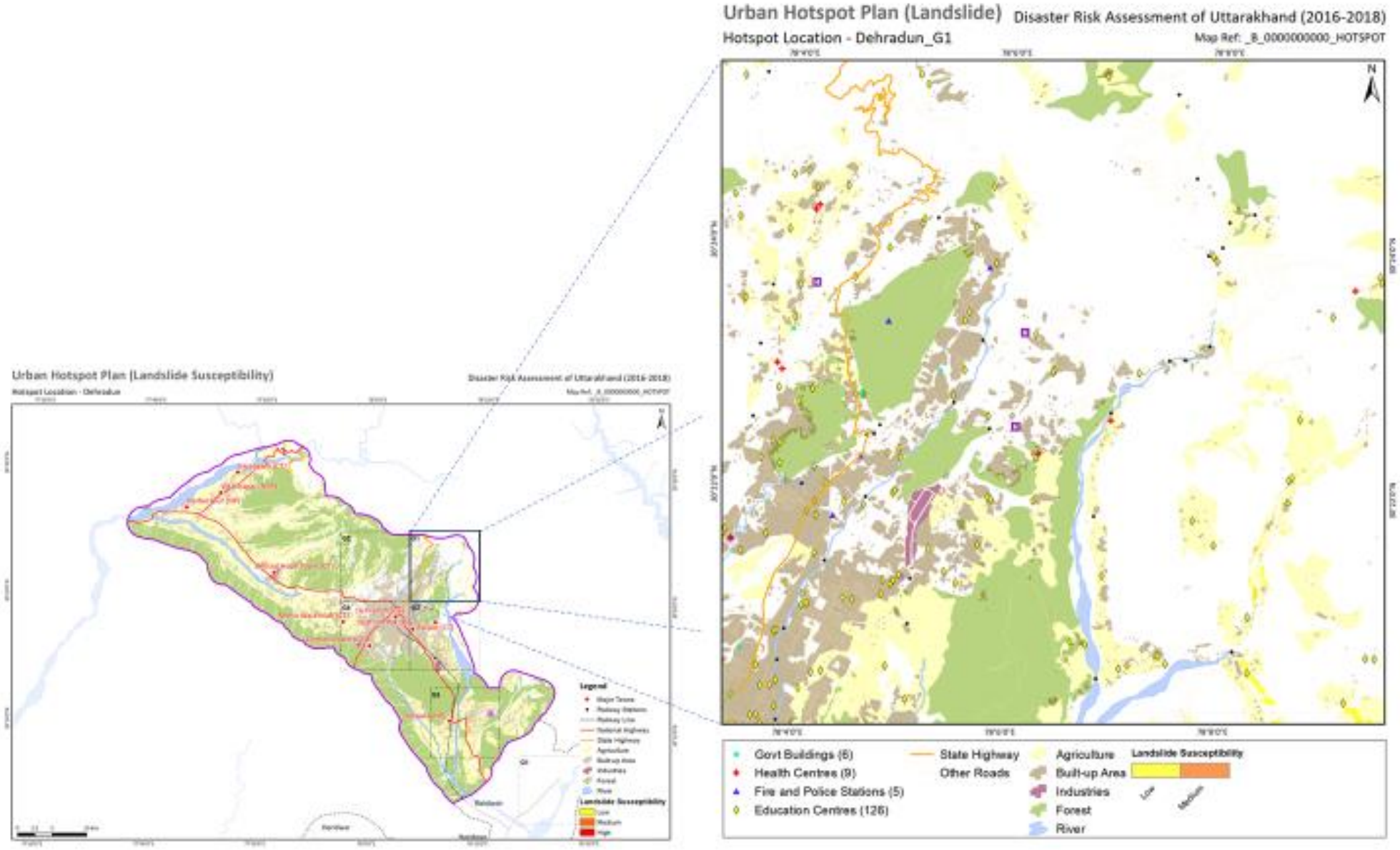
Map 29: Flash Flood Hazard Map - Dehradun (Area G4)



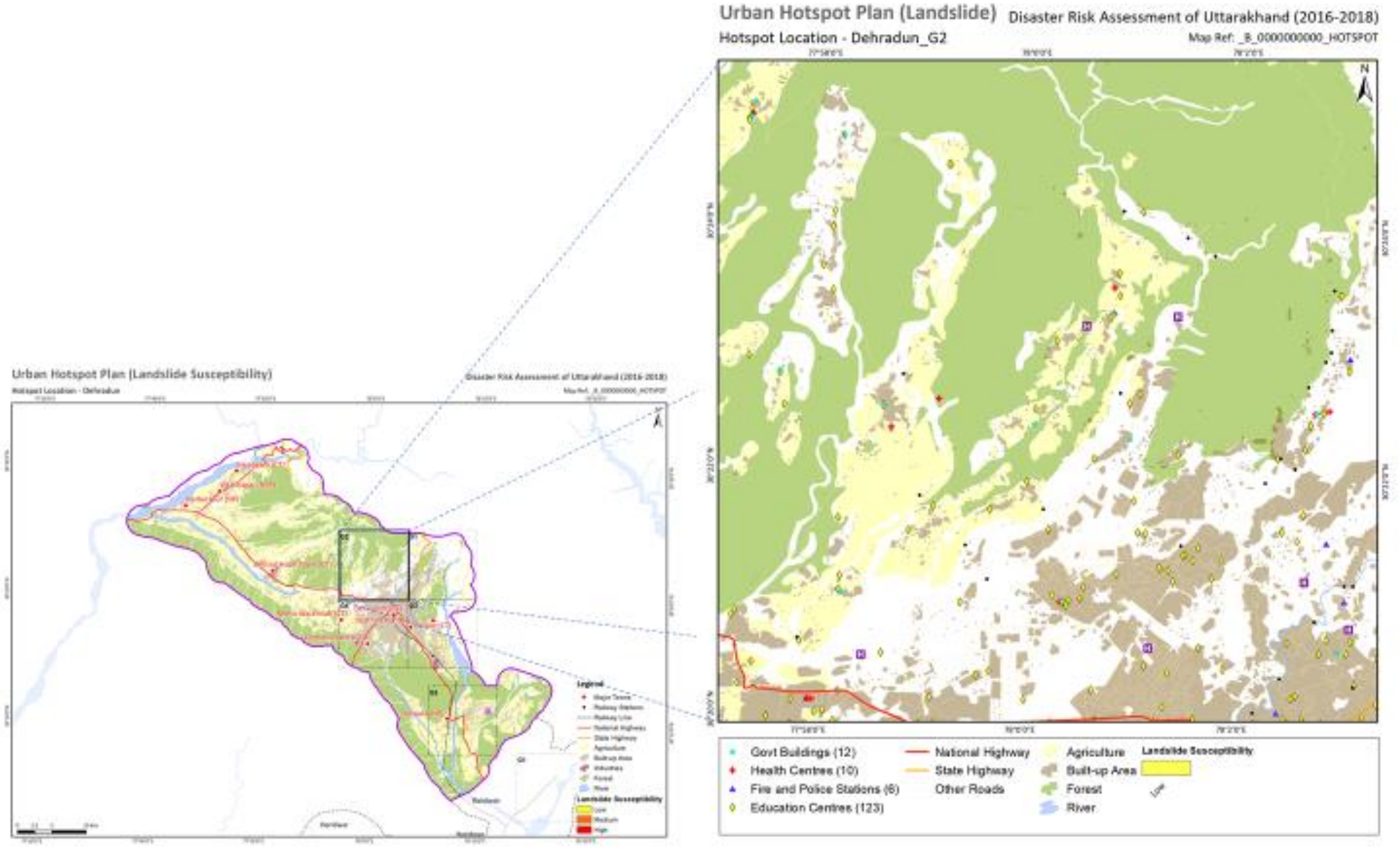
Map 30: Flash Flood Hazard Map - Dehradun (Area G5)



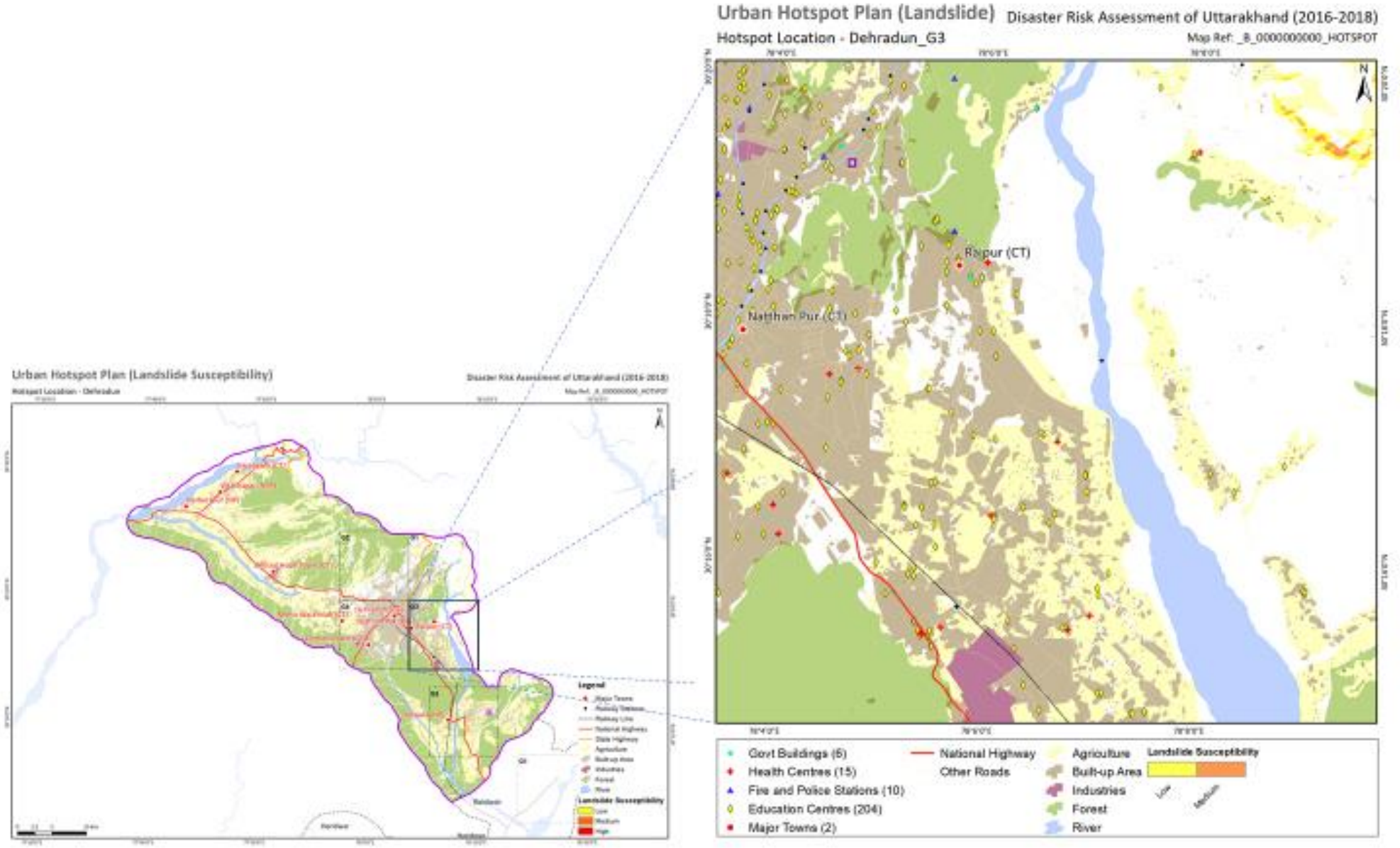
Map 31: Landslide Susceptibility Map – Dehradun



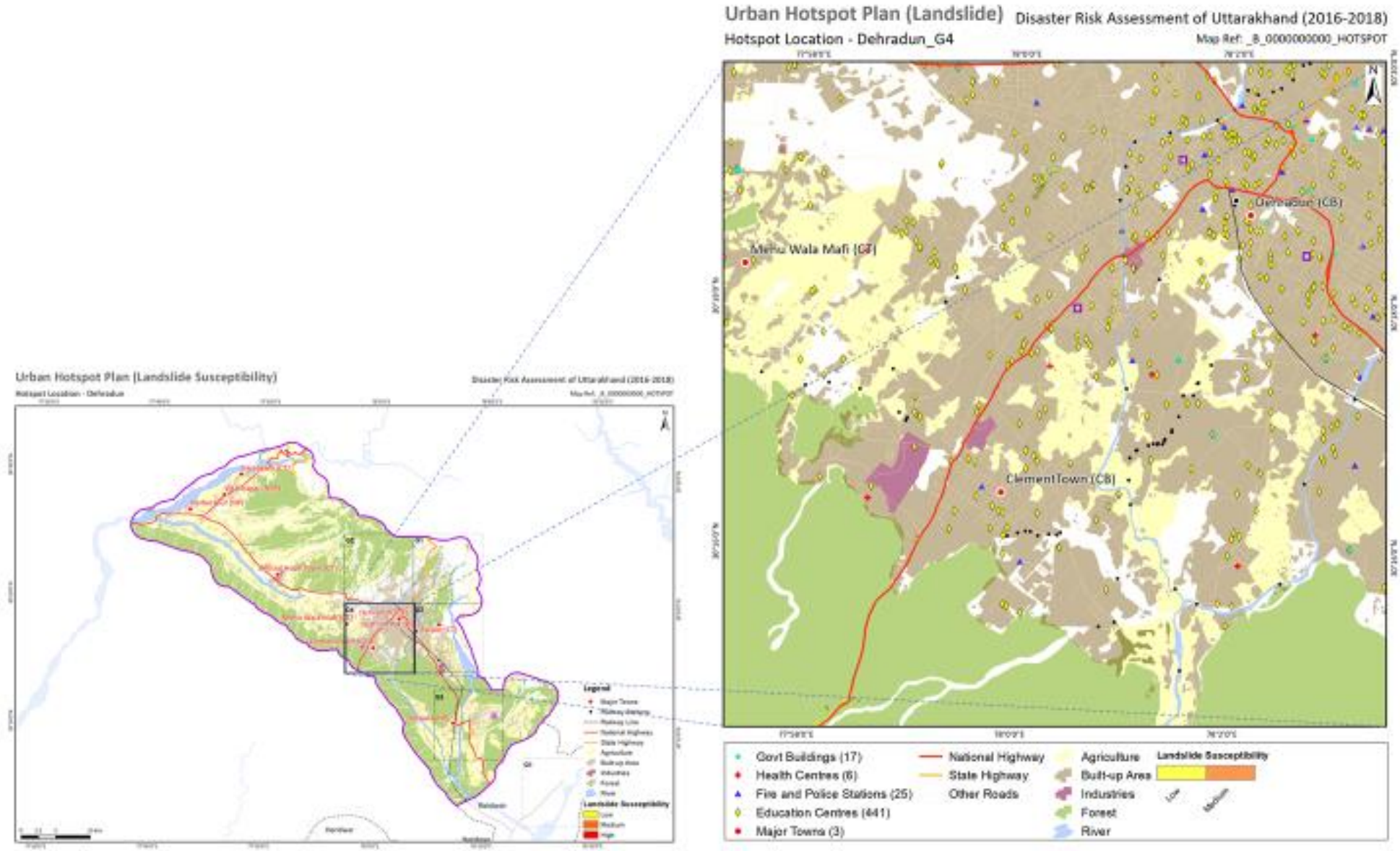
Map 32: Landslide Susceptibility Map - Dehradun (Area G1)



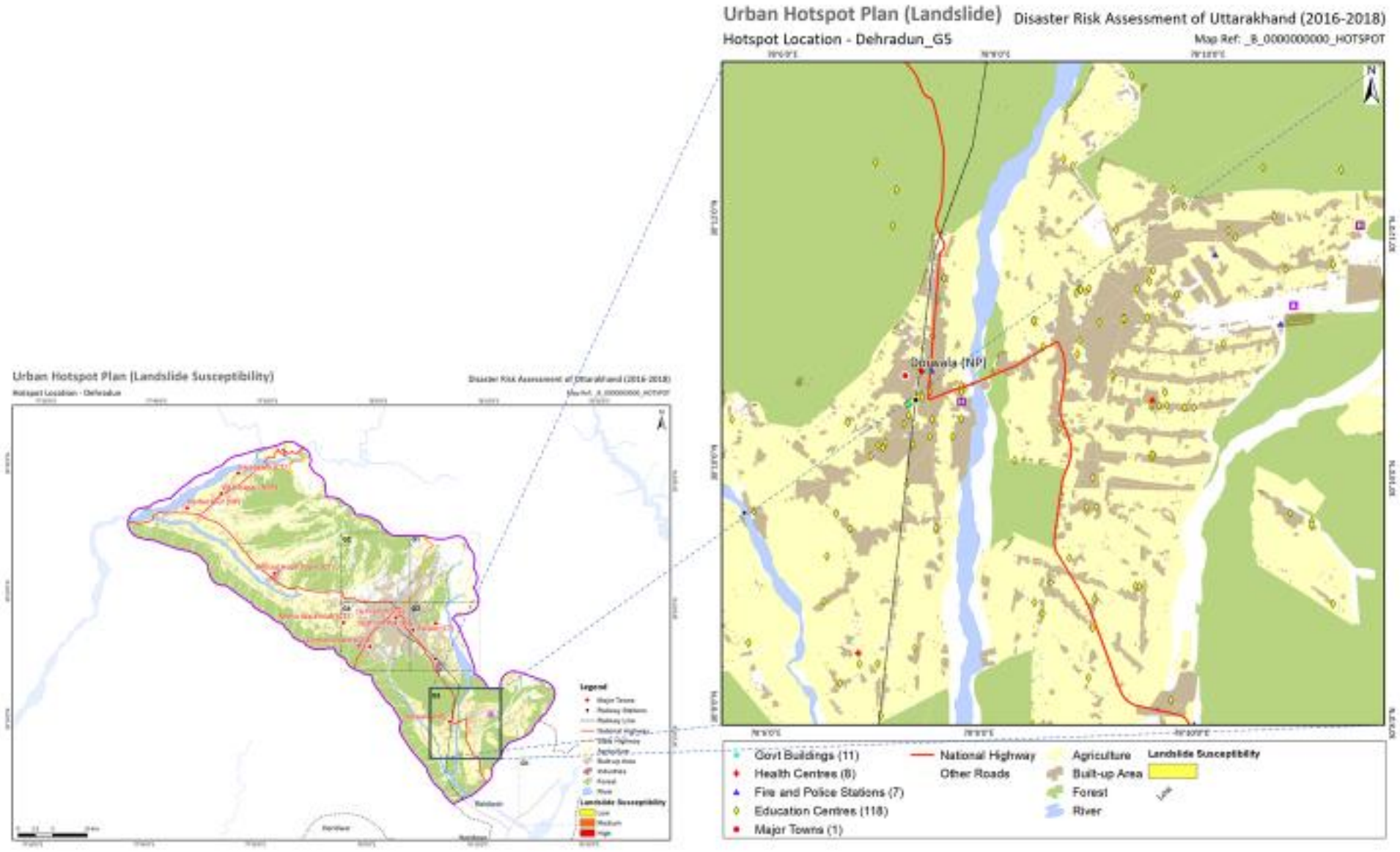
Map 33: Landslide Susceptibility Map - Dehradun (Area G2)



Map 34: Landslide Susceptibility Map - Dehradun (Area G3)



Map 35: Landslide Susceptibility Map - Dehradun (Area G4)



Map 36: Landslide Susceptibility Map - Dehradun (Area G5)

1.5 Strategy Implementation, Monitoring, Evaluation

1.5.1 Challenges in Implementation

Three challenges have been identified with respect to DRM in Dehradun and surrounds. In brief these are:

Finance & HR - Section 40(2) of the DM Act 2005 stipulates that every department of the State, while preparing the DM plan shall make the provisions for financing the activities proposed therein.

The marginal cost involved in mainstreaming DRM in existing programs, activities and projects of the department are not very sizable and the departments may not find it difficult to arrange such funds. However, funds for disaster prevention and mitigation may not be available so easily unless the departments are able to negotiate such projects with the planning and finance departments with proper Cost Benefit Analysis (CBA).

The relevant departments are also seen to be understaffed to enforce building compliance and other risk mitigation measures as a majority of officials are stressed with other operational works related to managing the massive tourist season in the region.

Technical – the way data and other information are acquired and transferred is still essentially dependent on manual processes. As a result, planning and awareness are both compromised, as is an ability to take an effective overview and achieve a 'whole of government' capacity to integrated strategic planning. Globally best practice statutory planning and regulation (including enforcement) is now done at this level using a spatial approach with a GIS and data sets available within all departments. It is time for the city to enter the digital age in this respect. First steps are related to recruiting young graduate qualified spatial planners and engineers to deliver access to the requisite GIS data sets and facilitate planning and regulation.

Integrated mitigation, planning and preparation - An integrated approach across Government, the private sector and the community is required to ensure fully effective DRM. A simple example is the need to pay much attention to Police & Fire, health specialisation viz; how to evacuate disabled, sick people or evacuation during fire/ smoke etc, During the development of any evacuation plan whether for city or rural, these specialisation need to be considered.

1.5.2 Proposed Management and Governance Structure

It is proposed that a Dehradun Hazard Mitigation Working Group is established by the Mayor/ or the Chairman of the Municipal Corporation as they can constitute a CDMC any time and then seek endorsement by the DDMA. The Municipal Commissioner/ or MNA (Mukhya Nagar Adhikari) should be the Secretary, with some Municipal Councilors, the city Chief of Police plus Head of relevant line Departments. City Trade Association, NGOs, CVOs, Civil

Defense also need to be considered as possible members (not more than 20 people). This CDMC will take care & report to the District Disaster Management Authority (DDMA).

Once established the Group is to become responsible for coordinating implementation of the DRM Plan and its associated strategies and undertake the recommended annual review and reporting process. In order to develop momentum for plan implementation, the Group needs to establish an appropriate timeframe for the meeting schedule as plan implementation begins, meeting quarterly, half yearly or annually, depending upon the hazard profile of the City.

The HMWG will meet annually to identify funding needs for the implementation of mitigation strategies, evaluate the effectiveness of the plan, and develop new mitigation strategies to reduce loss from natural hazards. The HMWG must have core level of funding to facilitate their own activities as well as giving effect to key recommendations at the municipal level. Reporting to the State on all such Expenditure is also an annual obligation, and all of the HMWG activities and accomplishments and plans should be summed up in an annual report card to the USDMA.

1.5.3 Monitoring and Evaluation

The National DMP calls for all DMPs to be updated annually through a process of stakeholder review and revision. It is proposed here that Uttarakhand State, the Districts and Sub-Districts undertake an annual assessment and adopt a reporting process on the status and progress made in implementing the strategies adopted in taking the respective DRMPs forwards. If formulated as a report card then this can be used as both a governmental and Institutional device to drive mitigation, planning and preparation processes and yielding political and funding benefits to support the continuation of the process.

For each strategy there is the need to determining indicators of progress and success. It is international best practice for all strategies to have a monitoring and evaluation component so that progress and can be measured and reported upon. Such a key performance indicator (KPI) needs to be defined using realistic time periods and a quantitative rather than a qualitative measure.

For each strategy presented here a Key Performance Indicator (KPI) has also been provided is a measurable value that demonstrates how effectively the strategy is being achieved. These KPIs are indicative and need to be agreed and adopted as implementation part of the implementation process the relevant stakeholders.

2 STRATEGIES

2.1 Overarching Strategies

Overarching strategies are intended to apply to all disaster types and provide the backbone to a strong disaster risk management approach to mainstream administration.

2.1.1 Mitigation

Mitigation			
STRATEGY	**DRIVER**	**OUTCOMES**	**KPI**
Constitute a City Disaster Management Committee (CDMC).	The key to effective cross organization collaboration is to make it top down with designated tasks to be reported upwards, and then run a process of participatory engagement.	A CDMC with responsibility to ensure all DMP are formulated, understood and implemented with an obligation to report to the respective city/ward and state government.	A committee established, and appropriate TOR agreed and signed off on within 6 months.
Development & updating of Disaster Management Plans at all levels within the Cities jurisdictions and across its departments.	At city level, DM Plans have not yet been developed.	DM Plans developed for all sectors of the City.	DM Plans developed within 12 months.
Ensure the City DM Plan/ Evacuation Plan (CDMP) is widely distributed and understood.	The DMP not only needs to be up-to-date but it needs to be part of mainstream administration of the city.	A well prepared and tested DMP that is regularly reviewed, amended and distributed.	Development of the DMP within 12 months followed by regular annual reviews. / Annual review of the DMP awareness of relevant agencies/officials and annual reviews of its relevance.
Development and implementation testing of Hospital/ Mass Casualty Plans.	DMP needs to be a mainstream component for both hospital and medical administrators as well as front line medical and support staff, including pharmacy and medical supply lines.	Demonstrated response capability within the medical and para medical support system of the city.	Development of the Hospital/Mass casualty plans in DMP within 12 months followed by regular annual reviews.

Development of school DMPs with appropriate simulations and debriefings.	School children not only need to be protected but are also a strong mechanism for dissemination of DRM thinking within families and the broader community.	Greater resilience at schools and school children equipped with demonstrated response capability.	Development of the school reach out and school DMP within 12 months followed by regular annual reviews.
Undertake an audit of the structural and lifeline support capability of all lifeline buildings to ensure that all are assessed and that the results of the comprehensive assessments are reported[1].	The National Institute of Disaster Management makes clear that preparedness and mitigation measures should include retrofitting of life-line buildings not only for saving lives of the vulnerable people, but also to ensure prompt and efficient response to disasters. Lack of information on this is an issue facing each hotspot and it needs to be a strategic priority so that appropriate works can be planned and budgeted for.	A report on the results of a comprehensive assessments of the structural resilience and life line support capability of all lifeline buildings so that appropriate works can be planned and budgeted for.	Twenty percent of all life line buildings assessed annually and a comprehensive report provided to the government.

2.1.2 Planning and Preparation

Planning and preparation			
STRATEGY	**DRIVER**	**OUTCOMES**	**KPI**
Increase public awareness, understanding, support & demand for hazard mitigation through a city-wide marketing strategy with a campaign focused on the private sector, communities, industry, city agencies, pilgrims and tourists.	As noted above planning for risk management and response is still to be undertaken. Community awareness, preparedness and response capability is predicated on risk awareness and right response behavior. This process needs	A risk management capable community/stakeholder lessening the level of probable loss of life and assets.	A public awareness campaign designed and sponsored within 12 months.

[1] There are now web based assessments available specifically designed for this task. See for example, http://www.retrota.com/

	to be fast tracked and focused on. A brand awareness needs to be built along with a "need to know" desire using professional education and publicity expertise which is focused on a complete DRM cycle approach within key "market" sectors: schools and youth.		
Sensitization meetings at municipal ward level/ awareness camps.	To generate awareness about various types of disasters and associated vulnerabilities amongst community, making them better prepared.	A well awakened and enabled community to make effective decisions about reducing loss from various hazards.	Sensitization and awareness camps on regular basis.
Sensitization of NGO/CVO & other civil organizations to disaster risk mitigation, planning and preparation.	NGOs, CVOs and other civil organizations have a vital role to play in disaster mitigation, planning and preparation. Frequently they have expertise and funding that strongly compliments the government capacity and capability and they also have strong international connections that can provide rapid response support and additional capability.	Trained volunteers of social organizations can be a good resource for District & State Govt. for all DM related activities.	Interaction and meetings with these organizations on regular basis.
Training of school staff, hospital staff, municipal councilors, officials, community members, city/ municipal ward level ERTs, students and teachers.	Training and testing of training through simulations and post-simulation debriefing/review sessions is critical for a deep response capacity within organizations and institutions.	A well trained and capable response capacity within and across key organizations and institutions.	Annual training and simulation testing developed within 12 months with annual testing and review.
Training of officials on damage & need assessment.	Training to undertake a damage and needs assessment across the entire city is critical to undertaking a successful assessment as a first step in building back better.	The assessment lays down the foundation for a fresh start in City's development efforts.	Designed training for 12 months. Annually tested.

Development of Standard Operating Procedure (SOPs) for DM within line departments, including delineated responsibilities down to individual level, resource inventories and training.	It is a first principal in organizational OH&S that SOPs are developed for disaster response with simple and clear directions as to how to respond and who has what responsibilities. This needs to include recovery planning such as the establishment of relief camps at identified safe zones and how these will be serviced.	A well trained and capable response capacity within and across organizations.	Development of organizational SOPs and lines of responsibility within 12 months; semiannual simulations and assessments undertaken and reported on the organizations executive management.
Building on the development of Standard Operating Procedure (SOPs) for DM within line departments, undertake a program of evacuation planning, training and practice within the City Public Safety Agencies such as Police & Fire, Health and the private sector.	Evacuation planning, training and practice within key response agencies such as Police & Fire, Health and the private sector and hotels is seen as a critical element in the planning and preparation process, particularly where multi-agency coordination is a vital component in response efficiency.	A well planned and trained response capability for all disasters that spreads across the City's Public Safety Agencies and the private sector.	It should be conducted on regular basis.
Development of Early Warning Systems and assessing their effectiveness within the city and surrounds.	Having effective and tested EWS capability is an important element of response planning and preparation as even several seconds warning may lead to the saving of many lives. Such systems should be graded so that if there is a level of early warning this can lead to better short-term preparation by all agencies and citizens.	A well founded, tested and serviced EWS for all critical response agencies and the community.	It should be established within 12 months and can be tested during regular mock exercises.

2.1.3 Response

Response			
STRATEGY	**DRIVER**	**OUTCOMES**	**KPI**
Establishment/ Activation of City level Emergency Operation Center (EOC).	A EOC is a combination of various line departments of Govt./ or other agencies whose services are generally required during incident response. At District level, EOCs are well established, however, at City level, this still needs to be done. Consideration should be given to incorporating EOC capacity into the existing processes for managing pilgrimage movements.	A well-established EOC directs the operations at the disaster site and coordinates at all levels to meet the conflicting demand at the time of disaster.	Establishment and functioning of EOC within 12 months.
Establishment of Incident Response Mechanism (IRS) at the city level.	Effective response to emergency situation requires a high degree of coordination amongst various departments and agencies within and outside Government at different levels for performing multiple tasks in an integrated and time bound manner for achieving specific results.	NDMA has developed an IRS as an effective mechanism for performing various tasks of disaster response and issued comprehensive guidelines for the same. In the State of Uttarakhand, all districts have adopted & established IRS. However, at City level, it is yet to initiated.	Establishment and functioning of IRS at City level within 12 months.
Establishment of Emergency Support Functions (ESF).	Disaster response is a multi-agency function. The Department of Disaster management is the Nodal Agency which will be responsible for managing/ coordinating all the functions of disaster response, while other agencies will provide necessary support and assistance in managing emergency situations.	In order that these functions are performed in smooth, effective and fail proof manner.	In specific context of Uttarakhand, important ESF should be identified with 12 months.

Deployment of ERTs.	Emergency response to be performed during disaster shall depend on the level of disaster. At local level, the emergency response teams, consisting volunteers from Wards, NGOs, CVOs & other organizations can be deployed.	A smooth & effective response by trained ERTs.	Performance/ level of readiness should always be checked on regular basis.
Development of regular set of simulation exercises around a designated disaster and area within the city.	Based on the given disaster scenario, the simulation or mock exercises can be performed at school, offices, market and ward level to check the level of preparedness & readiness of various ERTS and community.	Simulation or mock drills reduces the gaps in preparedness & increases the level of response.	The City DMG can develop a simulation exercise calendar annually.

2.1.4 Recovery (Short Term)

Recovery (Short Term)			
STRATEGY	**DRIVER**	**OUTCOMES**	**KPI**
Conduct damage & need assessment just after disaster as the basis to planning the restoration & improved disaster resilient housing, government buildings & cultural heritage in city.	A damage and needs assessment across the entire city that includes all structures and infrastructure support as well as non-structural attributes is the first step in building back better.	Foundation is laid for a fresh start in an area's development efforts as well as to reconstruct the damaged areas & contribute to the long-term development plan.	Assessments should be undertaken within 24 hours of disaster.
Provide community safety and effective management of victims through the establishment of relief camps at identified safe zones.	Based on pre-disaster planning adequate numbers of buildings/ open space shall be identified where relief camps can be set up during an emergency. This will be guided by the minimum standards of relief as laid down by the NDMA & the SDMA in	The affected community must be provided all assistance so as to ensure that they are able to live with dignity.	Members of ERTs can be designated to monitor the RF functioning.

	terms of Section 12 & 19 respectively of DM Act.		
Restoration of essential services: road connectivity, electricity supply, water supply etc.	Disruption in essential services hamper recovery efforts and are a cause of distress for the affected people.	Actions are taken swiftly with resolve in order to retain community confidence & minimize economic disruption.	Recovery plan should be developed, tested annually.

2.1.5 Recover (Long Term)

Recovery			
STRATEGY	**DRIVER**	**OUTCOMES**	**KPI**
Strengthen the capacity of people and communities to reduce the risks and vulnerability & enhance social cohesion through a Post Disaster Recovery Framework.	There is not at present a Post Disaster Recovery Framework (PDRF) for the State, however, all responsible agencies, the community and the private sector need to plan not for the inevitable disasters that will occur but also for recovery. The proposed City Disaster Management Committee (CDMC) needs to take the lead as part of its obligations.	A Post Disaster Recovery Framework that links to specific hazard responses, recovery Plans and the agencies responsible for pilgrim activities; as well as strategic growth strategies for the city and surrounds.	A first draft within three years.
Develop sector plans to restore & improve access to services & improve environmental resilience in rebuilding communities and community cohesion.	Sector specific plans should be used to guide, plan & estimate resource requirements for recovery & reconstruction at the sector level. Sector plans should also be developed into tools to monitor progress against targets on an ongoing basis. Similarly, social sectors which include education, shelter, food & nutrition, health also frequently are neglected, so social sector planning is very essential. The	To quantify the needs for each of the sectors to enable a convergent and coordinated recovery process wherein Govt., NGOs & corporate sectors could bring in their respective capacities & capabilities to implement the plan.	Each plan should be developed within 12 months. Updated annually.

	scope of the sectoral plans include both the development deficit & the needs/ damage emerging out of the recent disaster.		
Restore & improve disaster resilient housing, government buildings & cultural heritage in City.	Disaster Resilient Housing (multi-resistant) is a key priority in building back, whereby the owners will be responsible for and will manage their own reconstruction, make their own choices & mobilize their own resources i.e. in other words an Owner driven Reconstruction (ODRC). After the June 2013 disaster, this exercise was carried out by the State Govt., where more than 2500 houses were reconstructed across the State under ODRC.	The development of multi-hazard resistant housing as a fundamental rebuilding block for the city and surrounds.	Initiate once response & relief phase is over. Monitoring through team of experts. Guidelines for owners should be developed within 12 months.

2.2 Specific Strategies for Earthquakes

2.2.1 Introduction

Earthquakes of any magnitude in highly urbanized areas bring a particular challenge that means many people and much property is at risk as result of the high population and building density. Many - although not all - parts of Dehradun are definitely in a category where serious loss to life and property damage demands full attention to both structural and non-structural solutions in reducing risk and improving resilience.

2.2.2 Earthquakes - Planning and Preparation

Earthquakes - Planning and Preparation			
STRATEGY	**DRIVER**	**OUTCOMES**	**KPI**

Design & develop public education campaign for emergency preparedness & hazard mitigation for those who live & work in Dehradun city and surrounds.	Just as DM needs to become mainstream in the thinking and actions of Government institutions so should Disaster response awareness in businesses and the community generally be integral to their daily lives. This awareness will then play a key part in reducing vulnerability, raising resilience and reducing impacts of a disaster as a result of people responding in a well informed and disciplined manner. Significant research[2] shows that "shock" from traumatic situations can be very debilitating but can be overcome through awareness and training.	Create community resilience through emergency preparedness & hazard mitigation awareness programs via communication channels such as TV, print, pamphlets, street plays etc.	An awareness campaign plan should be developed for 12 months.
Increase the community resilience by expanding the number of Community Emergency Response Teams (CERT) in Dehradun City and surrounds.	CERTS are seen as excellent first responders as they are first on-site, have in-depth knowledge of resources and victim location likelihood, strongly motivated and effective networks. Funding remains an issue. As per the guidelines of GOI, 10% of State Disaster Response Fund (SDRF) can be spent on Training & capacity Building programs; Every DDMA needs a yearly allocation out of SDRF for this purpose.	Increased community resilience through first response capability by community members.	Formation of CERTS within 6 months & their training. follow-up trainings every 3 months.
Modify evacuation plans to incorporate City Public Safety Agencies such as Police & Fire, Health departments.	Evacuation plans need to be developed hazard specific & in consultation/collaboration with the specialized agencies.	A well updated & documented evacuation plan can reduce the life loss.	Ongoing process.
Train employees & practice City Facility Evacuation Plans.	The evacuation plans need to be well disseminated amongst community, business community, schools, city facility centers , offices.	Increases community resilience	Ongoing process. Practice every 3 months.

[2] See for example: Laurence Gonzales, *Deep Survival* , 2017;

2.2.3 Earthquakes - Mitigation

Earthquakes - Mitigation			
STRATEGY	**DRIVER**	**OUTCOMES**	**KPI**
Strengthen planning, management and regulation of EQ risks on infrastructure through improved understanding of existing and future risk (data) to private and public infrastructure, transport and communications.	Several State & National level Institutes/ Organizations in the State, are engaged in the researches concerning hazard zonation & risk/vulnerability assessment of the State, however the recommendations/ results of the studies are not commonly available to the concern authorities. Mapping should be done on a priority area basis focused on high density or vulnerability areas first.	Preparation & updating of Hazard Zonation maps of the City as the basis to planning and preparation procedures and training simulations.	Complete within a three year period mapping of all areas in the City with annual reporting of progress against an agreed plan of priority areas.
Review current building standard compliance and develop mechanisms to strengthen levels of compliance.	Enforcement of the most current Building Codes Standards to protect the built environment in the City is required as is retrofitting. The State has amended building by-laws and the Town & Country Planning Act, however due to non-compliance/ or lack of enforcement by the concerned authorities, the habitation of unsafe/high risk areas is expanding.	Effective compliance to building codes and statutory planning zonation and codes for the City and surrounds,	Ongoing process. Review every 6 months by State Govt.
In line with the overarching strategy to audit lifeline buildings, formulate a policy for retrofitting of existing public facilities & services according to contemporary standards.	The seismic safety of all lifeline buildings must be assessed in a time bound manner. A approach should be to selectively retrofit lifeline structures and buildings on the basis of priorities to be fixed by the Govt.	A detailed & comprehensive safety assessment of buildings/ structures to determine type of retrofit technique.	Assessment should be completed within 3 years.

Develop specific DMPs for high density areas such as the markets and older parts of the city	There is an urgent need to deal with high density poorly developed areas of the city such as the key market areas and associated surrounds. Commercial facades present a specific problem as does narrow roads, passage ways and poor response capability to earthquakes as a primary hazard and fires as secondary hazard	Structural and none structurally driven DMPs for high priority areas of the city.	Identification and planning for the development of DMPs to be a high priority within the first 12 months of the CDMC activity
Enforce Earthquake Safe Construction Technology in the City and incentivize with insurance benefits and/ or utility access.	All departments/ agencies must ensure that construction undertaken by their depts. and agencies under their control strictly comply with the standards & specifications prescribed by the Bureau of Indian Standards & further included in the NBC.	Appropriate mechanism for compliance & review of all construction designs submitted to ULBs/ Development Authorities/ construction agencies.	Ongoing process
As part of the overall awareness campaign, emphasize reduction of non-structural hazards in homes, schools, business centers & offices of the city.	Significant harm can occur to people in situations where non-structural hazards fall onto them during an earthquake. Awareness and subsequent repositioning/fastening etc. can significantly reduce the risks of damage.	Improved resilience to harm and likely damage as a result of awareness and small amounts of preparation/investment.	Ongoing process

2.2.4 Earthquakes – Response

See strategies listed in Overarching Strategies above. These already adequately address this component.

2.2.5 Earthquakes - Recovery (Short and Long-Term)

See strategies listed in Overarching Strategies above. These already adequately address this component.

3 LINKS TO NATIONAL AND STATE LEVEL PLANS

Sendai Framework
www.unisdr.org/we/coordinate/sendai-framework

National Disaster Management Plan
www.ndma.gov.in/en/national-plan.html

Uttarakhand State Disaster Management Authority
www.usdma.uk.gov.in

Uttarakhand State Disaster Management Plan
www.dmmc.uk.gov.in/files/pdf/complete_sdmap.pdf

Disaster Risk Assessment of Uttarakhand

Project Information Sheet

OVERVIEW

With support from the World Bank, the Uttarakhand State Government has engaged experts to complete a disaster risk assessment of the entire state so that it can understand the threat from natural hazards and the exposure of communities and critical infrastructure. This is the first attempt to develop an integrated disaster risk inventory for the state and is viewed as an important step to support the recovery efforts and to underpin future decision-making and planning.

This report is one of the outputs from the risk assessment and presents risk mitigation strategies for a location of high risk in the state. It serves as a case study for similar locations throughout Uttarakhand.

WHAT RISKS HAVE BEEN ASSESSED AND HOW?

This project assessed the threat and potential consequences of ***flooding*** (both fluvial and flash floods), ***earthquakes***, ***landslides***, and ***industrial hazards*** in Uttarakhand. It developed a comprehensive inventory of data for hazards and assessed the likelihood and consequence of these hazards in the future.

This hazard assessment adopted proven tools preferred by the World Bank for assessing risks, and the team collated existing data and completed field surveys to build up a strong profile of vulnerability and exposure across the state.

CAPRA

One of the tools is CAPRA. It is a software suite that is a free, modular, open-source, and multi-hazard tool for risk assessment. CAPRA provides a risk calculation platform integrating exposure databases and physical vulnerability functions under a probabilistic approach. CAPRA evaluates risk in terms of physical damage and estimates direct economic and human losses.

HOW WILL THE PROJECT BENEFIT UTTARAKHAND?

The outcomes from this project will help Uttarakhand to develop its resilience to natural and industrial hazards. The information will be used by the State Disaster Management Authority to support recovery efforts and future master planning. It will help them prioritise activities and investments in infrastructure.

The system deployed for is easy to maintain and manage and will add value for the State Government and communities. The team looks forward to engaging with local experts and stakeholders to understand the vulnerabilities and exposure of communities across the state.

THE TEAM

The project was completed by technical implementation experts from the following partner organisations:

DHI The expert in WATER ENVIRONMENTS — www.dhigroup.com

ERN International — www.ern.com.mx

Asian Institute of Technology 1959 — www.ait.ac.th

Earth Observatory of Singapore — www.earthobservatory.sg

PROJECT PROGRAMME

The project started in May 2016 and concluded at the end of October 2018.





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