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PART III

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1. Executive Summary

1.1 Existing Scenario

This report presents the second part of the consultancy work entitled “Integrated Masterplanning for Greater Mohali Region”. The report documents the Regional plan proposals and strategies for the Greater Mohali Region (GMR).

Greater Mohali Region (GMR) covers a geographical expanse of about 1190 sq.km. and is located towards the western part of Chandigarh in the state of Punjab. The entire region is divided into six local planning areas, namely, SAS Nagar, Zirakpur, Kharar, Mullanpur, Banur and Derabassi. The region holds a current population of about 0.7 million, about 60% of which is rural. A large proportion of the 40% urban population is concentrated in SAS Nagar and Zirakpur which have grown along the periphery of Chandigarh owing to development pressures from the capital city.

Located at the foothills of the Shivalik range, a large part of the area is designated as an environmentally sensitive zone. This includes a large number of protected and reserved forests and the north-western belt of the region locked under the Punjab Land Preservation Act (PLPA). The region has a relatively flat topography, with moderately gentle slope towards south- western part of the area, where all the rivers and streams drain intercept the GMR. Ghaggar River with its tributaries forms the main surface hydrological feature in the area. The soils in the area are very fertile with annual deposition of river silt and as such, are very productive for raising multiple crops in the year.

The Greater Mohali Region is strategically located within the northern part of the country. Four national highways intercept the region, namely, NH 21 to Ropar, NH 95 to Ludhiana, NH 22 to Shimla and NH 1 to Ambala and further to New Delhi. Thus, the entire area has a very well developed road network. The railways provide a means of inter-city transport to the masses. Outside the GMR, twin track railway lines run from the east viz from Delhi and Mumbai and meet at Ambala. From there, the railway line runs as a single track in the north-south direction from Ambala to Chandigarh. From Chandigarh the single track line further links to Kalka. From Kalka to Shimla the line is a narrow gauge single track. The single track of Chandigarh to Morinda line is newly built and serves the north-east and north-west part of the region. The air transport, however, is currently meekly developed owing to the absence of an international airport in the region. The domestic airport at Chandigarh currently hosts flights to major parts of the country including Delhi and Mumbai and is proposed to be expanded to cater to international flights.

Traditionally, agriculture has been the prime economic activity in the region. However, industrial and services sector has been gaining importance in the past few years. The industrial sector primarily constitutes chemical and pharmaceutical manufacturing units whereas the service sector comprises largely of the fast growing IT and Tourism industries. The potential of the tourism industry owes to its rich resource base including religious buildings, historical monuments, Mohali cricket Stadium and Chandigarh City. Real Estate, Biotech and Agro Processing have been identified as the key potential future economic drivers.

1.2 Key Development Strategies

Based on the assessment of the existing scenario and the future growth potential of the Greater Mohali Region, following key development strategies have been formulated to pave way for future development in the region.

- Attain a balance development within the GMR through reaffirming distribution and to promote development efficiency by concentrating development in certain corridors, linkages and nodes.

- Preserve and conserve natural, unique historical and open space resources to achieve a more wholesome, vibrant and sustainable life styles.
- Introduce critical strategic economic growth initiatives that will be the focal points for growth within the region.
- Plan and promote the growth of GMR as part of the Greater Chandigarh, Delhi and beyond.
- Promote comprehensive planned township that will enhance quality living
- Ensure accessibility through enhancing the regional and international linkages
- Manage overall growth particularly in the areas surrounding the designated urbanized Areas.
- The introduction of Technological-Knowledge-Business Park Corridors

1.3 Proposed Land use Plan

This Regional Plan maps out the vision for the GMR and long term physical development for a projected population of 4.5 million people. The various zones reflect the permissible predominant use of land within the areas demarcated. The Regional Plans also specify the ancillary, related or compatible activities allows within the permissible predominant use of the land.

Tables 1.1 and 1.2 illustrate the proposed distribution of various land uses within the Greater Mohali Region and the various local planning areas(LPA).

Table 1.1: Proposed Landuse Distribution for Greater Mohali Region

	Land-Use	Area (ha)	Percentage (%)
1	Urbanizable area	42,740	35.9
2	Industrial	2,478	2.1
3	Rural settlements	4,567	3.8
4	Agriculture area within LPA	18,483	15.5
5	Agriculture area outside LPA	24,990	21.0
6	Recreational	4,370	3.7
7	Forests	12,281	10.3
8	Waterbodies	2,890	2.4
9	Transportation	4,885	4.1
10	Restricted development zone	1,351	1.1
	Total	**119,036**	**100.0**

***1.2:* Proposed Landuse & Population Distribution for various Local Planning Area**

LANDUSE CLASSIFICATION	SAS NAGAR		MULLANPUR		ZIRAKPUR		DERABASSI		BANUR		KHARAR		KURALI		LALRU		NAYAGAON		TOTAL	
	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)
Residential	53%	5,369	43%	1,392	59%	2,140	30%	1,248	50%	5,804	64%	2,024	56%	795	54%	2,503	100%	790	52%	22,065
Commercial	19%	1,975	8%	273	8%	306	10%	411	6%	683	11%	333	10%	140	11%	533			11%	4,654
Industrial	15%	1,556	17%	542	16%	572	42%	1,740	14%	1,598	7%	215	10%	142	12%	549			16%	6,914
Institutional	13%	1,305	7%	226	8%	277	12%	486	17%	1,989	9%	298	16%	223	9%	409			12%	5,213
Recreation & Open Space			24%	782	9%	307	6%	239	13%	1,488	9%	301	9%	124	14%	653			9%	3,894
Total	**100%**	**10,205**	**100%**	**3,215**	**100%**	**3,602**	**100%**	**4,124**	**100%**	**11,562**	**100%**	**3,171**	**100%**	**1,424**	**100%**	**4,647**	**100%**	**790**	**100%**	**42,740**
Gross town density (pph)		125		50		125		100		50		100		100		100		50		97.27
Gross residential density (pph)		250		100		250		200		100		200		200		200		100		195
Population		**1,726,346**		100,000		**500,128**		**334,390**		348,526		300,000		150,000		**359,560**		**6,050**		3,825,000

Structure of the Report

The Regional Plan report is broadly classified into four sections:

Section I is an introduction to the overall region and the Chandigarh Periphery Act which governs the entire peripheral area of the city.

Section II highlights the broad population and economic projections for the area and hence the overall development strategies which shall guide the detailed Regional Plan.

Section III dwells upon the specific sectors like industries, housing, environment, transportation & infrastructure and the strategies for each of such development sector.

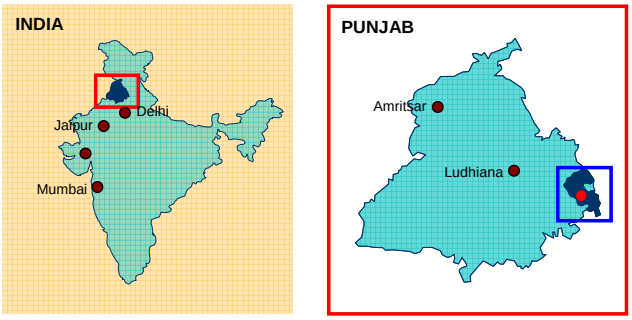
Finally, Section IV of the report elaborates the proposed land use plan, the zoning regulations and the development controls.

2. The Region: Greater Mohali

Greater Mohali Region (GMR), located towards the western side of Chandigarh in Punjab, grew as a sub-city to Chandigarh. Hence, much of the growth of GMR is dependent on the growth of Chandigarh and its peripheral region.

Chandigarh City was planned as capital of Punjab after the partition of the country. To develop it as model & modern city, the renowned International Planner Le-Corbusier was entrusted the preparation of Master Plan & Urban Design of Chandigarh city. Le-Corbusier prepared the Master Plan of city taking into consideration its physical landscape, location, functional status and modem planning techniques. He also proposed the periphery zone of about 16 kms. around the city to preserve the environment & ecological balance of the city region. The unique urban design and building controls were proposed for the city to make it a distinct city. Both social & physical infrastructures were also provided at a higher order for the efficient and sustainable functioning of city. Chandigarh started growing at a much faster pace, surpassing all projections and became one of the most sought after cities to live, in of the northern region. The rapid growth and development of Chandigarh resulted in additional demand and exerted pressure on its services and utilities and gave birth to two towns i.e. Mohali also called Sahibzada Ajit Singh Nagar (S.A.S Nagar) in Punjab and Panchkula in Haryana. More recently, a series of erstwhile village settlements on the fringes of Chandigarh were grouped to constitute the Notified Area Committees of Zirakpur and Nayagaon. This gave further fillip to development in this region.

Fig 2.1 Location of Punjab within India and GMR with the State of Punjab

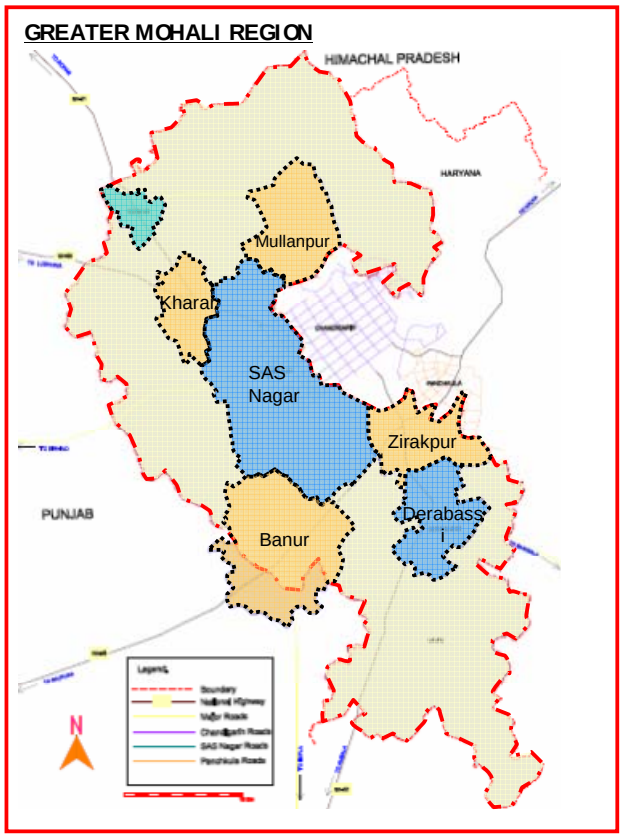


Since Chandigarh and its periphery area are most sought after by investors, developers, companies, professions and institutions, the State Government of Punjab intends to meet the aspirations of all the groups by developing this region as a world class destination. With this vision in mind, it wants that the planning of Chandigarh periphery area be done by a planner or consultant of international repute so as to dove-tail it with the planning of Chandigarh city. This area should not only have an international level infrastructure for attracting more investment in knowledge based industries, institutions, trade and commerce including congenial working and living environment, but it should also preserve the ecology, environment, historical and cultural heritage of the region.

SAS Nagar (Mohali) and its adjoining areas are now fast emerging as preferred destinations not only for the IT Industry, but also for quality housing and urban infrastructure related investments. This is because of better accessibility and declared public priority to provide world-class civic amenities. The improvements in infrastructure, development of parks and satisfactory law and order condition over the past many years have helped Mohali emerge as an independent town, and especially as an IT destination. It has become an important commercial and institutional hub, which houses regional offices of companies and institutions catering to several States. It has also become an important investment destination for Indian and multinational Companies. The Punjab Government has already

made its intentions known to develop it as Centre of Excellence for IT, Industry & allied services. With the twin objectives of ensuring planned future expansion and to prevent mushrooming of unplanned construction in and around Mohali, a comprehensive policy framework for the entire Chandigarh Periphery was approved by Council of Ministers and was subsequently notified on 20th January, 2006. In the meantime, SAS Nagar, with certain parts of Rupnagar and Patiala District has been upgraded to Mohali, as the 18th district of the State of Punjab.

Fig 2.2 Greater Mohali Region



For integrated development of the area to take place, an authority under the name Greater Mohali Area Development Authority (GMADA) with jurisdiction over six local planning areas, that is, SAS Nagar, Kharar, Banur, Zirakpur, Dera Bassi and, Mullanpur was notified. To ensure planned development and to optimise and define land use over an area of 1190 sq. kms, JURONG Consultants has been engaged to undertake preparation of the Vision Plan, Regional Plan and Master Plans for the six local planning areas. This report translates the Vision Plan for GMR (approved on 05th January, 2008) and presents the Regional Plan for 1190 sq.km of the entire Greater Mohali Region.

3. Chandigarh Periphery Act

The Punjab New Capital (Periphery) Act, 1952 extends within the distance of 16 kms on all sides from the outer boundary of the capital of the state at Chandigarh. The main objective of the Act was to ensure planned development in the new city and its extension and also to prevent the growth of slums and unauthorized development on the land at the periphery of the new city Chandigarh. The Committee proposed to address the following issues for the planned development.

3.1 Housing Schemes in Periphery

With only limited planned urban areas available in the cities of Chandigarh, S.A.S Nagar and Panchkula and growing demand for housing, those who could not afford shelter in these urban areas, sought unauthorized alternatives usually in adjoining settlements and villages, inside or outside the abadi areas on the fringes of the city. Considering the above situation, it is proposed that suitable pockets for housing in the Periphery area be earmarked for development by the private parties of government/ semi- government Agencies. While permitting such development, it must be ensured that adequate provisions are made for public utilities and services. Special care must be taken to ensure that housing needs of the economically weaker sections(EWS) are catered for adequately.

3.2 Institutions

Considering the fact that Chandigarh and S.A.S Nagar are emerging as fast developing nodes, it is natural that institution would increasingly be located here. In addition, the area becoming important for establishing sports, recreation, leisure and tourism- related activities. The committee feels that such institutions and activities, which require large open land but smaller built-up area, can be considered for location within the entire Periphery.

3.3 Existing Rural Settlements

Considering the existing needs of the villages falling within the Periphery as well as with a view to cater to their increasing population, it would be prudent to provide a sufficiently compact and contiguous belt of land around the village “phirni” for ensuring the organic growth of these villages. Any area falling between the ‘lal lakir’ and the ‘phirni’ of the village shall also be treated as a part of the extended belt. The area should be allowed to be used primarily for meeting individual residential and petty commercial needs of the village. Charges for change of land use should be levied on prescribed rates. No industrial uses should be permitted in such area. Similarly, formal colonization shall also not be permitted in the extended ‘abadi’ area on the pretext of this recommendation alone.

With these caveats, the Committee proposes to allow the village “Abadi” area extension by 60%, subject to a minimum of 50 meters and maximum of 100 meters in radial length from the ‘phirni’. However, where the existing Abadi Deh or a part thereof is an area which forms a part of the rural/agriculture and afforestation zone of the Outline Master Plan/Draft Comprehensive Master Plan/Comprehensive Master Plan prepared under the Punjab Regional and Town Planning & Development Act, 1995, the extent of such area shall be limited to 50 meters. Permitting construction in the notified forest areas falling in these villages would, of course, be subject to planning approval for change of land use. No permission should, however, be granted in any area which falls within the

sectoral grid of S.A.S Nagar (Mohali), as reflected in the Outline Master Plan. The extent of area where such constructions are to be permitted will be demarcated and certified for each village falling within the Periphery by the Revenue Authorities, subject to the final approval of Punjab Urban Development Authority (PUDA). In order to promote planned development, it is proposed that construction in the area should be regulated by a set of simple building norms, subject to payment of Land-Use conversion charges and in accordance with other details. However, to avoid hardship to villagers and land owners, the area in the extended Abadi Deh shall be exempted from the provisions of the Punjab Apartment and Property Regulation Act, 1995.

3.4 Free Enterprise Zone

The area declared as Free Enterprise Zone (FEZ) near Dera Bassi should continue to be used for industries, although institutions could also be permitted in accordance with the prescribed guidelines. In order to ensure rational development and provision of basic infrastructure and services in the area, a broad developmental framework needs to be prepared along with a development plan indicating roads/trunk infrastructure, as well as areas reserved for residential and institutional needs. There shall be no conversion or betterment charge for the new industrial units coming up in the FEZ. However, these shall be liable to pay the External Development Charges.

3.5 Industrial

Industrial Parks may also be permitted as “mega projects” in areas earmarked as industrial & residential for such uses respectively within the Outline Master Plan area of S.A.S Nagar (Mohali).

The Empowered Committee on Mega Projects has already permitted integrated mixed use Industrial Parks, where at least 60% of the land is used for industry, free of external development charges and change of land use charges in the periphery. This is a major policy incentive for making land available to industry at reasonable rates. In the Committee’s opinion such a policy may continue in respect of the industrial sectors in the Mohali sectoral grid and FEZ for general industry and for areas planned in Mohali’s Master Plan for IT Industry. The policy on grant of additional incentives to industry would, however, need to be periodically reviewed with a view to the continuation of such benefits.

3.6 Municipal Towns in Periphery

Committee recommends that the existing towns of Kharar, Banur, Zirakpur, and Dera Bassi should continue to provide avenues for future growth and development by ensuring adequate supply of developed land for residential, commercial, institutional and industrial purposes. Master Plans of these towns need to be prepared under the Punjab Regional and Town Planning & Development Act, 1995, within the overall ambit of the Controlled Area Plan. Further expansion in the municipal limits of these towns has also to be regulated so that it conforms to the overall Development Plan for the Periphery Area. It is proposed that the future expansion of municipal limits of the existing Periphery towns should be frozen, until these Master Plans have been finally notified. Thereafter, if need arises, such expansion can be considered, strictly in accordance with the approved Master Plan subject, of course, to the payment of the conversion charges as are being proposed in the Plan.

4. Regional Setting

4.1 Constituent Areas and Jurisdiction

The district of S.A.S. Nagar (Mohali) came into existence in April 2006 as the eighteenth district of Punjab. Prior to the creation of the district, the areas now forming part of the new district were in Rupnagar (generally referred to as Ropar) district (S.A.S. Nagar and Kharar) and Patiala district (Dera Bassi). The Government of Punjab (GoP) subsequently created Greater Mohali Area Development Authority (GMADA) as a dedicated agency for the planning and development of the Greater Mohali Region (GMR) adjoining Chandigarh in August 2006 following the provisions of the Punjab Town and Regional Planning & Development Act, 1995.

The Greater Mohali Region (GMR) to be covered by the Regional Plan does not correspond exactly to standard administrative units in the Indian context, i.e. state, district, sub-district[1], etc. Essentially, the Greater Mohali Region includes a part of the Rajpura sub-district of Patiala district (a part of the town of Banur and some villages near Banur located on the periphery of Chandigarh) in addition to the new district of S.A.S. Nagar.

The Greater Mohali Region includes the entire area of 1190 sq km that forms the new district of S.A.S. Nagar (Mohali) along with a small area around the town of Banur, which continues to remain part of the Rajpura tehsil of Patiala district but is included in the area under GMADA's jurisdiction in the notification issued by GoP for the constitution of GMADA in August 2006. Possibly, the inclusion of the area around Banur in the Greater Mohali Region was motivated by the fact that it is situated on a strip jutting into the S.A.S. Nagar district, and Banur itself located at the intersection of two arterial highways serving the Greater Mohali Region as shown in fig. 2.2 Greater Mohali Region.

4.2 Physiography

The elevation ranges from about 400m above msl in the foot hills to about 200m msl in the plains. The slope is moderate gentle towards south western part of the area, where all the rivers and streams drain through the GMR. Ghaggar River with its tributaries forms the main surface hydrological feature in the area. Due to the flat topography, at many places the water channels (locally known as choes) are dry during the inter-monsoon period but swells during the monsoons. The protection of these floodable zones is of paramount importance for ground water aquifers. The soils in the area are very fertile with annual deposition of river silt and as such very productive for raising multiple crops in the year.

4.3 Climate

The region experiences extreme weather conditions. Period of April to June experiences hot and dry season with the maximum temperature reaching 45ºC. November to February is subjected to cold weather and in winters the minimum temperature goes down to about 1ºC.

In Punjab, the average annual rainfall ranges from 58 cms in plains to 96 cms in sub mountain regions and decreases from North to South. The annual average rainfall in Greater Mohali Region is 114 cm and is heavy during the monsoon season. The monsoon season starts in the first week of July and continues till middle of September.

5. Population Growth, Characteristics and Projections

5.1 Introduction

The 2001 Census is the latest of the decennial census carried out in India by the Registrar General and Census Commissioner of the Government of India. The census is by and large the only comprehensive source of demographic data and information in India, with other exercises that record demographic data being largely based on samples and therefore require estimation of characteristics for the population as a whole.

The S.A.S. Nagar district came into existence only in April 2006. Thus, the latest Census (2001) does not directly provide information about the population of the Greater Mohali Region or for that matter the S.A.S. Nagar district. However, the information on the 2001 population of S.A.S. Nagar district can be extracted from the sub-district (tehsil/block) level information in Census 2001, given that the new district comprises two blocks that formed part of Rupnagar district and a third block that was part of Patiala district in 2001 and information on all three blocks is available in Census 2001. The demographic information on S.A.S. Nagar district extracted from Census 2001 has also been published by the Directorate of Census Operations (Punjab) recently (October 2007), which allows confirmation of the information collated from block level data.

However, the small part of Greater Mohali Region that continues to form part of the Rajpura tehsil of Patiala poses a problem. This has been addressed by identifying the villages in Patiala that lie in the Greater Mohali Region based on discussions with officials at the District Industries Centre (DIC) Patiala and extracting the information on the relevant villages from Census 2001. This, along with the population for Banur town thus provides the required information on population of the Greater Mohali Region as per Census 2001. The breakdown of population by gender and urban vis-à-vis rural population is summarized in further sections.

5.2 Population Growth and Migration

5.2.1 Population Growth: The population of the Greater Mohali Region was just over 0.7 mn in 2001, with 38.9% of the population residing in urban areas and the balance in rural areas. It may be said that the Greater Mohali Region is more urbanized compared to both India as a whole (27.8% urban population in 2001) and the state of Punjab (33.9%). In terms of distribution, the urban population of the Greater Mohali Region is spread across ten towns as shown in Table 5.1. There is a high degree of concentration in S.A.S. Nagar (Mohali), which accounted for close to 45% of the total urban population in 2001. Based on an assessment of population using National Sample Survey (NSS) data, Sample Registration System (SRS) data, etc. the current population (2006) of the Greater Mohali Region is estimated at 0.8 mn.

Table 5.1: Population of the Greater Mohali Region (Census 2001)

	Number of Households (HH)	Number of Persons	Number of Males	Number of Females
Urban Areas	58,730	276,699	149,022	127,677
Rural Areas	75,225	434,511	237,400	197,111
Total for Greater Mohali Region	133,955	711,210	386,422	324,788

Source: Primary Census Abstract (PCA), 2001

The concentration of population in S.A.S. Nagar (Mohali) described above also extends to the set of urban settlements in the Greater Mohali Region as a whole, with top three urban settlements (S.A.S.

Nagar (Mohali), Kharar and Zirakpur) together accounting for 69% of the urban population of the Greater Mohali Region in 2001 and the top five urban settlements accounting for close to 85%. The distribution of urban population in the Greater Mohali Region is shown in Table 5.2.

It is clear than urban population in the Greater Mohali Region is highly concentrated in S.A.S. Nagar (Mohali), which is understandable given that it is adjacent to Chandigarh. Its growth has been driven by this proximity due to a number of reasons including the limited area available in Chandigarh for industrial units and the spill-over of people employed in Chandigarh but unable to find suitable residential accommodation within the city limits. The growth in Mohali's population and its emergence as a part of the tri-city comprising Chandigarh, Panchkula and S.A.S. Nagar (Mohali) is a phenomenon that started in the seventies. The population of S.A.S. Nagar (Mohali) (then a village) was only 1229 in 1971 but grew by about 39% per year during the period 1971-81 to reach 32,351 in 1981. Though the rate of growth in Mohali's population has declined after 1981 due to a larger base population, it has remained high at over 9% per year during 1981-91 and over 4.5% per year during 1991-2001.

Table 5.2: Distribution of the Urban Population in Greater Mohali Region in 2001

Urban Settlement	Nos. of HH	Nos. of Persons	% Share of Urban Population	Cumulative % Share
S.A.S. Nagar	28,539	123,484	44.6%	44.6%
Kharar	8,118	42,289	15.3%	59.9%
Zirakpur	5,072	25,022	9.0%	69.0%
Kurali	4,220	23,047	8.3%	77.3%
Karoran	4,564	20,361	7.4%	84.6%
Dera Bassi	3,284	15,841	5.7%	90.4%
Bhankharpur	1,798	9,216	3.3%	93.7%
Mullanpur Garib Das	1,171	6,147	2.2%	95.9%
Bhabat	1,103	5,866	2.1%	98.0%
Banur[2]	861	5,426	2.0%	100.0%
Total:	58,730	276,699	100.0%	

Source: PCA, 2001

Despite this, the growth rate of Mohali's population at 4.6% p.a. fell below that of some other towns in the Greater Mohali Region like Dera Bassi and Kharar during 1991-2001 , it has remained higher than the growth rate for the S.A.S. Nagar (Mohali) district as a whole (2.0% p.a. over the period 1991-2001). The past trend of population growth in some of the urban settlements forming part of the Greater Mohali Region is shown in the Table 5.3 below:

Table 5.3: Population Growth Trends for Select Towns in the Greater Mohali Region

Population as per Census of	2001	1991	1981	1971
S.A.S. Nagar (Mohali)	123,484 (4.6%)	78,457 (9.3%)	32,351 (38.7%)	1,229 (4.4%)
Kharar	42,289 (4.9%)	26,109 (1.8%)	21,807 (7.4%)	10,686 (2.7%)
Kurali	23,047 (2.7%)	17,592 (3.4%)	12,637 (2.6%)	10,686 (4.3%)
Dera Bassi	15,841 (5.1%)	9,602 (2.6%)	7,421 (2.5%)	5,807 (3.7%)

Note: Figures in brackets indicate the annual growth rate of population over the ten years since the previous Census

[2] Based on discussions with the Manager of the District Industry Centre, Patiala it was learnt that only a part of the town of Banur was part of the Greater Mohali Region. These were identified as villages which are nevertheless under the jurisdiction of the municipal body of Banur – the population shown for Banur has been derived on this basis. The total population of Banur town as a whole as shown in the 2001 Census was 15,013.

5.2.2 Migration: Migrants plays a very significant role in Punjab's economy, with a bulk of the agricultural labour as well as workers in the unorganized manufacturing sector (brick kilns, for example) originating from Uttar Pradesh and Bihar, with neighboring Haryana and Rajasthan also accounting for significant numbers. As per the migration data pertaining to the 2001 Census, about 8.5% of the total population recorded in Punjab was from outside the State of Punjab[3]. The top five states from which such migration to Punjab occurred according to the Census data were Uttar Pradesh (22.3% of migrants), Haryana (17.5% of migrants), Bihar (11.6%), Himachal Pradesh (7.7%) and Rajasthan (6.6%) constituting for over 65% of the migrants in Punjab. Chandigarh accounted for 3.7% and the national capital of Delhi for 2.7% of the total migrants in Punjab.

In case of the Greater Mohali Region, however, agriculture is not expected to be a significant driver of migration into the area, given the relatively lower significance of agriculture in the area. The Census 2001 provides data on migrants at the level of districts and major towns for every state. Unfortunately, since the data is not made available at the level of blocks, an analysis of migration's contribution to the population of the Greater Mohali Region using the proxy of the three blocks of S.A.S. Nagar, Kharar and Dera Bassi is not possible. Instead it may be summarized that the data for the town of S.A.S. Nagar (Mohali) provides a good indication about the influence of migration. At the same time, it would not be representative to extrapolate this to the entire Greater Mohali Region since S.A.S. Nagar (Mohali) is the major urban settlement in the area with a large share of the employment opportunities that attract migrants. In fact, from the Census data it is observed that migrants formed 90.9% of the total population of S.A.S. Nagar (Mohali) in 2001, establishing that the rapid growth in the town's population has been driven largely by migration. The proportion of migrants in the total population of S.A.S. Nagar (Mohali) is much higher than that of Punjab as a whole (8.5%). As expected, migrants from within Punjab provided a bulk (43.7%) of the migrants settled in S.A.S. Nagar (Mohali). Of these migrants from other parts of Punjab, 43.6% came from within the Rupnagar district, thus accounting for 21% of all migrants.

Based on the above analysis, it is clear that the drivers and pattern of migration in the Greater Mohali Region is quite different from the state of Punjab as a whole. First, the migration of agricultural workers from states like Uttar Pradesh, Bihar, Haryana and Rajasthan does not appear to be significant in the Greater Mohali Region. Second, the migration data bears out the fact that the growth of S.A.S. Nagar (Mohali) town has been driven to a great extent by spill-over from Chandigarh. A brief comparison of the origin of migrants from outside the state for S.A.S. Nagar (Mohali) vis-à-vis Punjab is provided below:

Table 5.4: Composition of Migrants from Outside Punjab in S.A.S. Nagar (Mohali) vis-à-vis Punjab

State of Last Residence	S.A.S. Nagar (Mohali)	Punjab
Uttar Pradesh	10.7%	22.3%
Haryana	10.9%	17.5%
Bihar	2.7%	11.6%
Himachal Pradesh	6.7%	7.7%
Rajasthan	1.6%	7.8%
Chandigarh	45.0%	3.7%
Delhi	7.6%	2.7%

Note: The percent figures shown are with respect to all migrants from outside Punjab

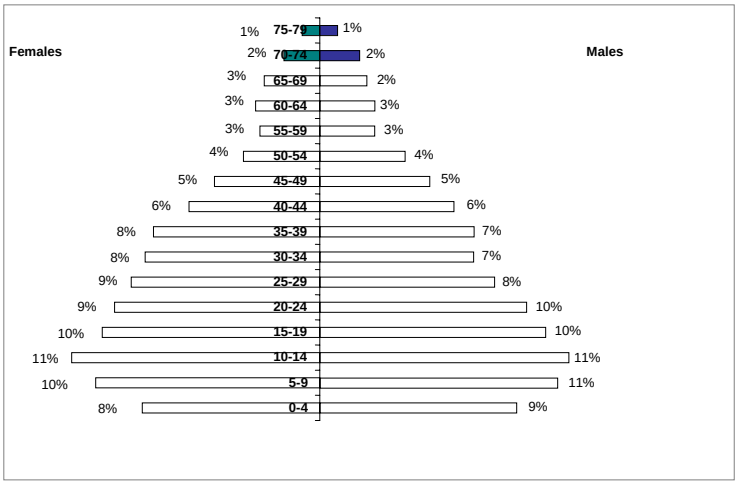
[3] The Census records data on the place of birth as well as the place of last residence. In the discussion above, place of last residence being outside the state has been considered to define migrants.

It is clear from the table above that there is hardly any correlation between S.A.S. Nagar (Mohali) and Punjab in terms of the origin of migrants. To summarize the demographic profile of the Greater Mohali Region, some key demographic indicators of the Greater Mohali Region, along with the same for the state of Punjab and India as a whole are provided in the Table 5.4 above. This is in line with the relatively lower importance of agriculture in the Greater Mohali Region compared to Punjab as a whole.

5.3 Demographic Characteristics

***5.3.1 Distribution by Age**:* India has a very young population with a median age of 24 years. About 65 percent of the total population is less than 35 years old. The Greater Mohali Region also reflects this demographic characteristic with the median age being close to the national level - about 66 percent of the total population is under the age of 35 years. The total working population, considering those in the age group 15-59 years, forms almost 60 percent of the total population. This offers a valuable resource for economic development of the city. However, if not provided optimum employment and income generating opportunities, the tendency to migrate will also be high within this age bracket.

Fig. 5.1: Distribution of Population by Age Group & Gender – Greater Mohali Region



5.3.2 Work Participation: In terms of the proportion of the population that is working[4], the 2001 Census data reveals that close to 39% of the population of the Greater Mohali Region formed the workforce in 2001, with 54.3% of the male population and 20.2% of the female population classified as workers. In comparison to the state as a whole, the proportion of working population in the Greater Mohali Region was higher than the state of Punjab (38.7% and 37.5% respectively). This trend is the same considering the urban population, with 34.3% of the urban population working in the Greater Mohali Region as compared to 33.5% for the state as a whole. Among the rural population, the corresponding numbers are 41.5% (GMR) as compared to 39.5% (Punjab). The same trend exists in comparisons by gender, with a higher proportion of both males and females being part of the workforce in the GMR as compared to the state as a whole. As compared to the national average, however, the proportion of workers in the population of the Greater Mohali Region was slightly lower at 38.7% compared to 39.1% for India. However, the proportion of males working was higher in the

[4] The Census classification distinguishes between main workers and marginal workers, based on a defined criterion in terms of the number of days of work in the past. However, the discussion above refers to the total number of workers – both main and marginal.

Greater Mohali Region at 54.3% compared to 51.7% for India and the overall work participation rate was pulled below the national average because of the significantly lower proportion of females working at 20.2% in the Greater Mohali Region compared to the all-India average of 25.6% of females working as shown in Table 5.5.

5.3.3 Literacy: Similar characteristics are visible in terms of literacy based on Census 2001 data, with the literacy rate in the Greater Mohali Region being higher at 78.3%[5] compared to 69.7% for the state of Punjab and 64.8% for India. As is the case all across India, there existed gaps between literacy rates among males and females as well as urban and rural areas in the GMR – 83.7% literates among males as opposed to 71.9% of females and 85.7% of the urban population as opposed to 73.5% of those residing in villages. However, in any given sub-set formed by gender and the urban-rural divide, the Greater Mohali Region has higher literacy rates compared to the state and country as shown in Table 5.5.

5.3.4 Gender Distribution: As in case of Punjab as a whole, the sex ratio in the Greater Mohali Region at 841 females per 1000 males was much lower than the national average (933). In fact, the sex ration in the Greater Mohali Region was lower than the state average of 876. As is generally the case, the sex ratio in urban areas under GMR (857) was higher than the rural portion of the Greater Mohali Region (830) as shown in Table 5.5.

Table 5.5: Key Demographic Indicators – GMADA Area Vis-à-vis Punjab & India (2001 Census)

Indicator	GMADA Area	Punjab	India
Population	711,210	24,358,999	1,028,737,436
Urban Population as % of Total Population	38.9%	35.7%	27.8%
Sex Ratio	841	876	933
Nos. of Workers	275,228 (38.7%)	9,127,474 (37.5%)	402,234,724 (39.1%)
Nos. of Literates	483,682 (78.3%)	14,756,970 (69.7%)	560,687,797 (64.8%)
Population of 0-6 years age group	93,542 (13.2%)	3,171,829 (13.0%)	163,819,614 (15.9%)

Note: Figures in brackets indicate percentage of total population; In case of literacy rate, the relevant base is the population above 6 years of a

5.4 Methodology for Population Projection

In order to project the population of the Greater Mohali Region over a 50-year time-frame, the assumptions made in projecting the variables involved in projections such as the base population of Greater Mohali Region in 2001, Age Specific Fertility Rates (ASFR), Mortality Rates, impact of migration on the population, etc. the following methodology was adopted.

5.4.1 Methodology: the Cohort Component Method

The cohort component population projection method follows each cohort of people of the same age throughout its lifetime according to its exposure to mortality, fertility, and migration. Starting with a base population by sex and age, the population at each specific age is exposed to the chances of dying as determined by projected mortality levels and patterns by sex and age. Once deaths are estimated,

[5] In line with the practice followed in the Census, the population in the age group 0-6 years is excluded from the population and the balance used for expressing the literacy rate as the percentage of literates in the population over 6 years of age. It may also be noted that literacy for the purpose of the Census is based on the limited ability to read and write and does not necessarily indicate completion of a minimum level of schooling. In fact, 29.4% of those classified as literate in the 2001 Census had not completed primary schooling.

they are subtracted from the population, and those surviving become older. Fertility rates are projected and applied to the female population in childbearing ages to estimate the number of births every year. Each cohort of children born is also followed through time by exposing it to mortality.

Finally, the component method takes into account any in-migrants who are incorporated into the population and out-migrants who leave the population. Migrants are added to or subtracted from the population at each specific age. The whole procedure is repeated for each year of the projection period, resulting in the projected population by age and sex, as well as birth and death rates, rates of natural increase, rates of population growth, and other summary measures of fertility, mortality, and migration for each year.

Key Assumptions: The module gives the underlying assumptions that were made to derive at a population projection for GMR for 25 years and 50 years. The assumptions were made keeping in mind the existing and planned socio-economic developments in GMR and the neighbouring areas of Chandigarh and Panchkula, the development scenario of the state and the overall development at the national level and its impact at the regional level.

Assumption on base year population and age distribution: One of the basic requirements to apply the component projection method is information on the age distribution of the population in five years age groups at the base year of start of projection. Since S.A.S. Nagar district, which forms the majority part of the GMR population, was only formed after the Census 2001, there was no recent evidence available for age distribution at five years interval. Thus, the age distribution for the region has been derived at after studying the age distribution patterns of Rupnagar and Patiala district. The comparability of the projected data on sex ratios and working population was checked and were found to be consistent with the statistical abstract of the given district. The relevant data used for this purpose is provided as Annexure 2.

Assumption on future trends in fertility: Assumptions on the future trends in fertility are made for the district based on the basis of extrapolation of the past trends in the values of total fertility rates (TFR) of the state. The projections are based on the information provided by the Sample Registration System (SRS), which has projected the ASFR and TFR for states till 2016.

The past trends in TFR available from1971-96 for the state were extrapolated in the future with an assumed floor value of 2.1. It was assumed that the fertility levels would not decline below 2.1, based on the projections made by SRS and UN for the fertility to be stable at that rate. The assumptions made regarding fertility were also made keeping in mind the fertility goals set in the various policy documents at the local and state level, which would be realized because of intensive efforts in this direction by both local and state governments. The past trends in TFR for Punjab are provided as Annexure 3 to this report.

Assumptions on mortality: For projecting the mortality in the future, it was assumed that in the state as a whole and in the district in particular, in the coming years there will be an improvement in the living conditions, health infrastructure and slum improvements which might positively impact the mortality rate. The past trends on mortality rates for the state were studied from 1971-97 and reasonable adjustments were made to project it for the next 25 and 50 years.

Assumptions regarding migration: The assumptions for the projections on migration have been made for four different scenarios; low, moderate, high and very high. The number of people migrating into and out of a region depends upon the variety of factors. Economic development of the region and an optimum standard of living are the two primary reasons for people to move from one place to another. Thus a lot would depend on the economic growth of the region, the job opportunities offered, the state of social infrastructure, health conditions and improved standard of living. Different rates of in-migration and out-migration have been incorporated under the three scenarios, where it is assumed

that net migration would be low or in some cases negative when the growth is low and would vary from high to very high in case of moderate and high growth scenario. It is assumed that the region would grow at a fairly high rate of growth for the first 15 years and would gradually stabilize at relatively lower rates in the latter half of the given period. We have also envisaged a very high growth scenario where migration rates are higher than those observed in high growth scenarios. Following are the migration patterns that have been assumed for low, moderate, high and very high growth scenarios.

Table 5.6: Migration Rates for Different Projection Scenarios

Scenario	Low	Moderate	High	Very High
2006-2021	8%	12%	15%	20%
2021-2041	4%	8%	12%	15%
2041-2056	2%	4%	6%	8%

5.5 Population Projection and Spatial Distribution

5.5.1 Findings and projections of the developed model: The population projections for the area have been done for four scenarios as mentioned above. The total population of the Greater Mohali Region in 2056 varies from 2.32 mn for low growth scenario, to the figure of 4.51 mn in the very high growth scenario. The results and findings of the four scenarios are discussed below.

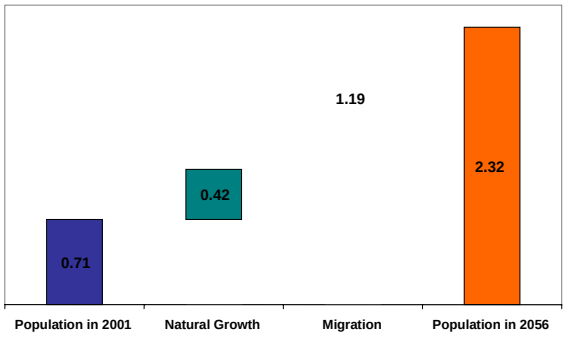
5.5.2 Low growth scenario: The projected population for Greater Mohali Region in 2056 under the low scenario is expected to be around 2.32 mn. The population is expected to grow by more than 2.25 times to reach to the said figure from the current level of 0.71 mn. The annual growth rate for the next 50 years is close to 2.077 percent. The population would a reach a figure of 1.54 mn by 2031 growing at an annual rate of 2.5 percent. The number of males in the total population in year 2056 is expected to be around 1.27 mn and the corresponding figure for females would be around 1.05 mn.

Table 5.7: Population Projections for Greater Mohali Region (Low Growth Scenario)

Population	Persons	Male	Female	Growth (5 years)	CAGR (5 years)	Sex Ratio
2001	711,210	380,320	330,890	-	-	870
2006	828,556	441,163	387,393	16.50%	3.10%	878
2011	958,321	506,207	452,113	15.66%	2.95%	893
2016	1,105,615	581,625	523,990	15.37%	2.90%	901
2021	1,269,041	666,157	602,884	14.78%	2.80%	905
2026	1,395,433	748,796	646,637	9.96%	1.92%	864
2031	1,538,380	833,617	704,763	10.24%	1.97%	845
2036	1,697,640	924,237	773,403	10.35%	1.99%	837
2041	1,858,770	1,015,727	843,043	9.49%	1.83%	830
2046	2,011,676	1,099,976	911,700	8.23%	1.59%	829
2051	2,162,129	1,183,807	978,321	7.48%	1.45%	826
2056	2,316,381	1,269,430	1,046,951	7.13%	1.39%	825

The increase in the population of GMR is expected to be lower on account of lower migration in the area. The increase in the population due to migration is expected to be around 1.19 mn whereas the same from natural growth is expected to be 0.42 mn.

Figure 5.2: Break-up of Projected Population Growth in Low Growth Scenario (mn)



The rate of migration would be low as the economy is expected to grow at a lower rate. The net migration from the period 2006-2021 is expected to be in the range of 7-8 percent. As the base population increases due to natural growth and migration, the existing capacity to contain the people would stabilize and the incremental growth in migration for the latter half of the said period is expected to be around 2-4 percent.

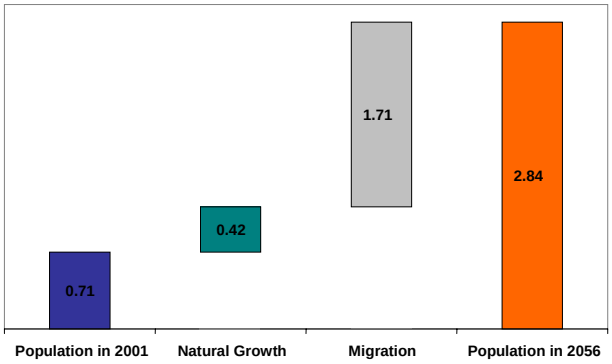
5.5.3 Moderate growth scenario: The population for GMR under moderate growth scenario is expected to reach a figure of 2.84 mn till 2056. The population is expected to grow by almost three times its current level during the given period. The CAGR for the next fifty years is expected to be close to 2.4 percent. The number of males and females in the total population is approximately 1.62 and 1.22 mn respectively.

Table 5.8: Population Projections for Greater Mohali Region (Moderate Growth Scenario)

Population	Persons	Male	Female	Growth (5 years)	CAGR	Sex Ratio
2001	711,210	380,320	330,890	-	-	870
2006	854,880	462,529	392,352	20.20%	3.75%	848
2011	1,015,715	555,704	460,011	18.81%	3.51%	828
2016	1,203,894	665,414	538,481	18.53%	3.46%	809
2021	1,416,127	789,448	626,678	17.63%	3.30%	794
2026	1,578,688	910,571	668,117	11.48%	2.20%	734
2031	1,782,208	1,037,888	744,319	12.89%	2.45%	717
2036	2,005,117	1,177,430	827,687	12.51%	2.38%	703
2041	2,243,211	1,326,187	917,024	11.87%	2.27%	691
2046	2,437,066	1,423,165	1,013,901	8.64%	1.67%	712
2051	2,635,160	1,520,765	1,114,395	8.13%	1.58%	733
2056	2,836,966	1,619,655	1,217,311	7.66%	1.49%	752

It is assumed that in moderate growth scenario, the economy will grow at a fairly higher rate, which would positively impact the migration. The rate of migration in period 2006-2021 is expected to be around 12 percent. The migration rate is then expected to gradually stabilize at 8 percent for the next twenty years from 2021-2040 and reduce to 4 percent from 2041-2056. The total increase in the population on account of migration is expected to be around 1.71 mn and the corresponding figure for increase due to natural growth to be around 0.41 mn.

Figure 5.3: Break-up of Projected Population Growth in Moderate Growth Scenario (mn)



5.5.4 High growth scenario: Here, it is assumed that there would be a rapid increase in socio-economic developments of the region, improved health conditions, increase in the job opportunities and private investments that would fuel the regions economic growth at a very rapid rate and thus lead to higher in-migration in the Greater Mohali Region.

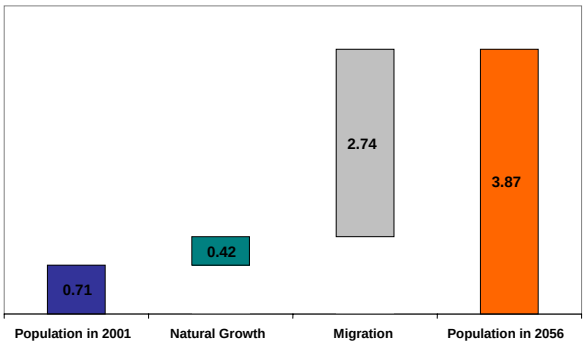
The population for GMR under high growth scenario is expected to reach a figure of 3.87 mn till 2056. The population will almost increase by 4.5 times its current level till 2056. The CAGR for the next 50 years is expected to be around 3.0 percent. The population is expected to grow at a CAGR of around 3.57 percent till 2031 and would then increase at annual rate of 2.43 percent for the next twenty five years. The number of males in the total population is 2.16 mn, and the corresponding number for total females is around 1.70 mn.

Table 5.9: Population Projections for Greater Mohali Region (High Growth Scenario)

Population	Persons	Male	Female	Growth (5 years)	CAGR Rolling 5 year period	Sex Ratio
2001	711,210	380,320	330,890	-	-	870
2006	879,987	477,038	402,949	23.73%	4.35%	845
2011	1,079,116	593,079	486,037	22.63%	4.16%	820
2016	1,321,003	735,192	585,811	22.42%	4.13%	797
2021	1,602,722	901,518	701,204	21.33%	3.94%	778
2026	1,815,794	1,064,642	751,152	13.29%	2.53%	706
2031	2,117,980	1,238,815	879,165	16.64%	3.13%	710
2036	2,466,274	1,438,991	1,027,283	16.44%	3.09%	714
2041	2,862,845	1,665,719	1,197,126	16.08%	3.03%	719
2046	3,190,128	1,831,418	1,358,710	11.43%	2.19%	742
2051	3,527,777	1,998,662	1,529,115	10.58%	2.03%	765
2056	3,865,760	2,164,225	1,701,535	9.58%	1.85%	786

The high increase in the population is expected to be largely on account of migration. The migration rates for high growth scenario have been assumed at 15 percent for the period 2006-2020, 12 percent for period 2021-2040 and 6 percent for the period 2041-2056. The total increase due to migration is expected to be close to 2.75 mn and that due to natural growth is expected to be around 0.41 mn.

Figure 5.4: Break-up of Projected Population Growth in High Growth Scenario (mn)



The following table gives the break up of the increase in the population due to migration and natural growth. The growth is assumed to be higher so as to be reflective of the higher growth in the economy. The population is expected to increased at a faster rate in the initial years from 2006-2021 and would gradually stabilize in the later half on account of higher increase in the initial years.

Table 5.10: Break-up of Population Growth for Greater Mohali Region in the High Growth Scenario

Year	Population	Migration	Natural growth	Total population
2001-2006	711,210	109,464	59,313	879,987
2006-2011	879,987	146,238	52,892	1,079,116
2011-2016	1,079,116	185,913	55,975	1,321,003
2016-2021	1,321,003	229,238	52,481	1,602,722
2021-2026	1,602,722	168,375	44,696	1,815,794
2026-2031	1,815,794	264,283	37,903	2,117,980
2031-2036	2,117,980	311,820	36,474	2,466,274
2036-2041	2,466,274	366,458	30,112	2,862,845
2041-2046	2,862,845	303,533	23,750	3,190,128
2046-2051	3,190,128	320,759	16,890	3,527,777
2051-2056	3,527,777	330,407	7,575	3,865,760

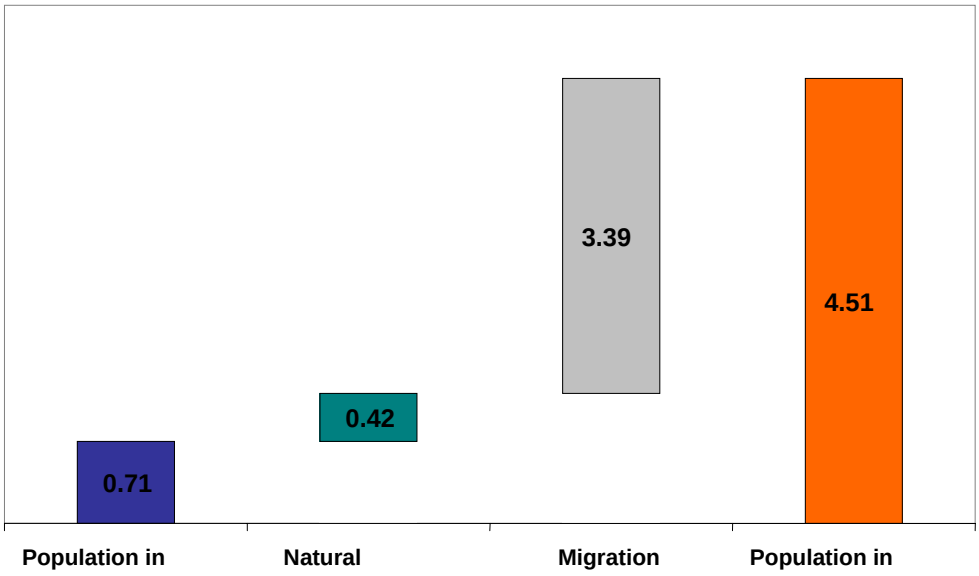
5.5.5 Very High growth scenario: Here, it is assumed that there would be a very rapid increase in socio-economic developments of the region, improved health conditions, dramatic increase in the job opportunities and private investments that would fuel the regions economic growth at a very rapid rate and thus lead to higher in-migration in the Greater Mohali Region.

The population for GMR under this very high growth scenario is expected to reach a figure of 4.51 mn till 2056. The population will increase by 5.3 times its current level till 2056. The CAGR for the period (2001-2056) years is expected to be around 3.4 percent.

Table 5.11: Break-up of Population Growth for Greater Mohali Region in the Very High Growth Scenario

Population Projections: Urban (2006-2056) - Very High Growth Scenario						
Population	Persons	Male	Female	Growth (5 years)	CAGR	Sex Ratio
2001	711210	380320	330890	-	-	870
2006	895838	485599	410239	25.96%	4.72%	845
2011	1119975	615811	504165	25.02%	4.57%	819
2016	1401002	780767	620235	25.09%	4.58%	794
2021	1741102	981433	759668	24.28%	4.44%	774
2026	1997865	1180399	817466	14.75%	2.79%	693
2031	2365861	1395222	970639	18.42%	3.44%	696
2036	2793853	1644217	1149635	18.09%	3.38%	699
2041	3289851	1930853	1358998	17.75%	3.32%	704
2046	3683284	2134954	1548330	11.96%	2.28%	725
2051	4094790	2344265	1750525	11.17%	2.14%	747
2056	4514846	2555119	1959727	10.26%	1.97%	767

Figure 5.5: Break-up of Projected Population Growth in Very High Growth Scenario (mn)



The following table gives the break up of the increase in the population due to migration and natural growth.

Table 5.12: Break-up of Population Growth for Greater Mohali Region in the Very High Growth Scenario

Year	Population	Migration	Natural growth	Total population
2001-2006	711,210	125,315	59,313	895,838
2006-2011	895,838	171,245	52,892	1,119,975
2011-2016	1,119,975	225,051	55,975	1,401,002
2016-2021	1,401,002	287,619	52,481	1,741,102
2021-2026	1,741,102	212,067	44,696	1,997,865
2026-2031	1,997,865	330,093	37,903	2,365,861
2031-2036	2,365,861	391,517	36,474	2,793,853
2036-2041	2,793,853	465,886	30,112	3,289,851
2041-2046	3,289,851	369,683	23,750	3,683,284
2046-2051	3,683,284	394,616	16,890	4,094,790
2051-2056	4,094,790	412,481	7,575	4,514,846

5.5.6 Urbanization Trends in Greater Mohali Region: As per Census 2001, the urban population in Greater Mohali Region, the percentage of urban population is reported to be 38%. In the four different projection scenarios discussed earlier, the trajectory in the urban population growth will differ significantly. The discussion below highlights the urbanization trends in Greater Mohali Region under the four scenarios.

5.5.7 Low Growth Scenario: As per this scenario, the urban population in Greater Mohali Region is estimated to be 50.9 percent in 2056.

Table 5.13: Urbanization Trends – Low Growth Scenario

Urban Population - Low Growth Scenario			
Population	Total	Urban	% Urban
2001	711,210	270,260	38.0
2006	828,556	331,422	40.0
2011	958,321	411,859	43.0
2016	1,105,615	506,816	45.8
2021	1,269,041	617,282	48.6
2026	1,,395,433	681,036	48.8
2031	1,538,380	761,927	49.5
2036	1,697,640	844,302	49.7
2041	1,858,770	928,637	50.0
2046	2,011,676	1,012,466	50.3
2051	2,162,129	1,094,409	50.6
2056	2,316,381	1,179,418	50.9

5.5.8 Moderate Growth Scenario: As per this scenario, the urban population in Greater Mohali Region is estimated to be 56.0 percent in 2056

Table 5.14: Urbanization Trends – Moderate Growth Scenario

Urban Population Moderate Growth Scenario			
Population	Total	Urban	% Urban
2001	711210	270260	38.0
2006	854880	341952	40.0
2011	1015715	433155	42.6
2016	1203894	547382	45.5
2021	1416127	685753	48.4
2026	1578688	754036	47.8
2031	1782208	877553	49.2
2036	2005117	997324	49.7
2041	2243211	1128424	50.3
2046	2437066	1273562	52.3
2051	2635160	1427113	54.2
2056	2836966	1587288	56.0

5.5.9 High Growth Scenario: As per this scenario, the urban population in Greater Mohali Region is estimated to be 64.7 percent in 2056.

Table 5.15: Urbanization Trends – High Growth Scenario

Urban Population High Growth Scenario			
Population	Total	Urban	% Urban
2001	711210	270260	38.0
2006	879987	351995	40.0
2011	1079116	458312	42.5
2016	1321003	596098	45.1
2021	1602722	767762	47.9
2026	1815794	845569	46.6
2031	2117980	1055063	49.8
2036	2466274	1293188	52.4
2041	2862845	1579455	55.2
2046	3190128	1863401	58.4
2051	3527777	2174148	61.6
2056	3865760	2499397	64.7

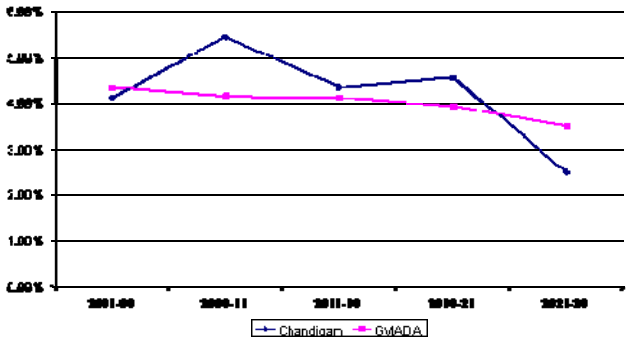
5.5.10 Very High Growth Scenario: As per this scenario, the urban population in Greater Mohali Region is estimated to be 84.6 percent in 2056.

Table 5.16: Urbanization Trends – Very High Growth Scenario

Urban Population Very High Growth Scenario			
Population	Total	Urban	% Urban
2001	711210	270260	38.0
2006	895837.9	358335	40.0
2011	1119975	548127	48.9
2016	1401002	771181	55.0
2021	1741102	1077951	61.9
2026	1997865	1208608	60.5
2031	2365861	1604007	67.8
2036	2793853	1973354	70.6
2041	3289851	2424094	73.7
2046	3683284	2850493	77.4
2051	4094790	3320711	81.1
2056	4514846	3818837	84.6

Population Growth Trends of Chandigarh vis-à-vis Greater Mohali Region: The population of Chandigarh as projected by the Census is expected to grow at an annual rate of 4.2 percent for the next 20 years. The growth is mainly on account of rapid economic developments, increased corporate investments, and education and health facilities. However, there is not much of scope for Chandigarh to grow horizontally as it is already more than optimally populated while scope for high rise re-development is unlikely given the sentiments attached to Le Corbusier's planning legacy. The city was planned with a target population of 0.5 mn for both phases I and II combined. The population grew at rapid rate to be around 0.9 mn in 2001 census. The existing population increase has led to development of the third phase adjacent to the Greater Mohali Region and growth is likely to spill over from thereon, into the Greater Mohali Region. This is likely to result in an iterative process with the growing population leading to increased economic development in the GMR

Figure 5.6: Projected Population Growth Rates - Chandigarh & Greater Mohali Region



Likely Population Scenario in 2056: The four different population scenarios have provided a population estimate for year 2056 ranging from 2.31 million to 4.51 million. The urbanization level in Greater Mohali Region at 38% in 2001 is higher than the national average of 27%. The current trends in Indian urbanization indicate that more than 50% of the population is expected to be living areas by 2050. The low growth scenario has estimated the urbanization rates to be in line with the projected national average in the 2050s. Given the positive investment climate provided by Greater Mohali Region and the recent investment activity does seem to indicate that urbanization rate of GMR region is unlikely to fall below the national average. The population of the GMR is more likely to be as per the high growth scenario presented above, with urbanization reaching the 65% level around 2056, well ahead of the same level of urbanization being reached by the country as a whole. The total population, the urban population and implied annual growth rates at 25-year and 50-year intervals are provided below for the four scenarios presented:

	2001		2031		2056	
Growth Scenario	Population	Urbanization	Population	Urbanization	Population	Urbanization
Low Growth	711210	38.00	1538380	49.5	2316381	50.9
Moderate Growth	711210	38.00	1782208	49.2	2836966	56.0
High Growth	711210	38.00	2117980	49.8	3865760	64.7
Very High Growth	711210	38.00	2365861	67.8	4514846	84.6

CAGR	2001 2031	2001 2056
Low Growth	2.61	2.17
Moderate Growth	3.11	2.55
High Growth	3.70	3.13
Very High Growth	4.09	3.42

6. Regional Economy

6.1 Introduction

Apart from population, the other aspect of the Greater Mohali Region that will impact the development plans critically is the level and composition of economic activity in the area. The two aspects are in fact linked since the Greater Mohali Region's ability to sustain and support the projected increase in population will depend on the creation of employment opportunities. Fuelled largely by the so-called "Green Revolution" during the sixties and seventies that raised agricultural output significantly, the state of Punjab had been the most prosperous state in India till recently.

Economic growth in Punjab suffered during the separatist movement of the eighties and though the state's economy has diversified over the years to include manufacturing and services from the early dependence on agriculture, the state has lagged in economic growth compared to the national average and this trend has continued during the last 4-5 years when the Indian economy has moved to a higher growth trajectory of over 8% p.a. However, given its proximity to Chandigarh, it is expected that economic growth in the Greater Mohali Region would be influenced by growth in Chandigarh's economy as well as Punjab's despite the much smaller size of Chandigarh's economy, which was about 9% that of Punjab in FY2006. This linkage with Chandigarh's economy has to an extent insulated the Greater Mohali Region from the limited economic growth of Punjab as compared to India as a whole because Chandigarh's economy has been growing at a much higher rate than the national average, generating in turn significant demand for real estate in the Greater Mohali Region. The contrast between the growth rates of Punjab and Chandigarh relative to India as a whole is clear from Table 6.1 below, which summarizes the Gross State Domestic Product (GSDP) of Punjab and Chandigarh as well as India's Gross Domestic Product (GDP) in the last 6-7 years.

Table 6.1: Size & Past Growth of the Economies of Punjab and Chandigarh in Relation to India - GSDP/GDP in INR Billion (bn) at Constant 1999-2000 Prices

FY	2000	2001	2002	2003	2004	2005	2006	2007
GDP – India	17,922.9	18,703.9	19,780.6	20,525.9	22,260.4	23,896.6	26,045.3	28,481.6
Growth Rate p.a.		4.4%	5.8%	3.8%	8.5%	7.4%	9.0%	9.4%
GSDP – Punjab	671.8	698.3	712.4	734.6	772.6	810.8	848.5	890.5
Growth Rate p.a.		3.9%	2.0%	3.1%	5.2%	4.9%	4.6%	5.0%
GSDP - Chandigarh	39.4	44.1	49.1	54.1	60.2	68.2	77.4	N.A.
Growth Rate p.a.		12.0%	11.4%	10.1%	11.4%	13.3%	13.5%	N.A.

It is clear that Punjab's economy has grown at a lower rate than that of India, with a CAGR of 4.1% p.a. during the period 1999-2000 to 2006-07 as compared to 6.8% p.a. for India. As explained previously, the impact on the Greater Mohali Region is to an extent mitigated by the high rate of economic growth of Chandigarh, with GSDP growing at a CAGR of 11.9% between 1999-2000 and 2005-06 compared to 6.4% for India and 4.0% for Punjab over the same period.

As mentioned in the introductory chapter, estimates of economic output are generally not prepared at district level in India. However, in order to establish a benchmark for the current size of the economy of the Greater Mohali Region and its share in the economy of the state, an estimate has been prepared using district and sub-district level estimates of population and market size prepared by Indicus Analytics, a New Delhi based economic/market research firm, using data from the NSS, SRS, and

other surveys like the Reproductive and Child Health Survey 2003-04, the National Data Survey on the Saving Patterns of Indians 2004-05 along with National Accounts Statistics. The output is published annually as "Market Skyline of India", which is available in versions covering all districts and sub-districts of India as well as separate versions for rural and urban markets. This data has been further analyzed and processed to arrive at estimates for the Greater Mohali Region including the part of Rajpura sub-district of Patiala district. Based on the proportion of the population of Rajpura sub-district estimated using Census 2001 data as explained in Chapter 5 earlier, 5% of the Rajpura's estimated domestic product and 5% and 2.5% of its urban and rural population has been added to arrive at the results.

Table 6.2: Estimated Economic Parameters for the Greater Mohali Region

Parameter	Value
Estimated Domestic Product of Greater Mohali Region in FY2007 expressed in current prices (INR mn)	36,301
Population of Greater Mohali Region (2006, estimated)	801,521
Share of Greater Mohali Region in Punjab's GDP (FY2007, estimated)	3.4%
Estimated Per Capita Domestic Product in Greater Mohali Region (FY2007 in current prices, INR)	45,290

Source: Market Skyline of India 2006-07: Block Profile, Indicus Analytics and customized estimated by Indicus Analytics based on data underlying Market Skylines of earlier years

Based on the estimates shown above, the current level of economic output in the Greater Mohali Region is SGD 1.45 bn (US$ 908 mn). The Greater Mohali Region accounts for about 3.4% of the state's GSDP with 3% of the state's population – the per capita economic output is thus higher in the Greater Mohali Region compared to the state of Punjab as a whole. It should be noted that the figures in Table 6.2 are not comparable to those in Table 6.1 earlier, which are expressed in constant prices of FY2000, the base year currently used in India for GDP, GSDP and similar measures of economic activity. The GSDP figure for Punjab that is comparable to the estimated economic output of the Greater Mohali Region shown in Table 6.2 is INR 1081 bn, of which the share of the Greater Mohali Region is INR 36.3 bn as shown in the table. Alternatively, the estimated economic output of the Greater Mohali Region as shown in current prices in Table 6.2 may be expressed in real terms (constant FY2000 prices) using the past trend of implicit GSDP deflator for Punjab as being in the range of INR 28.5 bn to INR 28.7 bn. Also, it may be noted that based on the estimated population for the Greater Mohali Region, the population of the Greater Mohali Region has grown at 3% p.a. during the intervening period after the 2001 Census.

An estimate of the past growth rates for economic output in the Greater Mohali Region was also obtained as a customized data product from Indicus Analytics, involving an analysis based on data underlying the "Market Skyline of India" publications for previous years. Based on the same, the growth in economic output between FY2002 and FY2007 is estimated at 6.6% p.a. This is higher than the corresponding growth rate for Punjab as a whole and demonstrates the fact that the Greater Mohali Region has been less affected by the slower economic growth of Punjab due to its proximity and linkages to Chandigarh with its rapidly growing economy.

6.2 Key Economic Drivers

It is clear that given the long period over which manufacturing activities have had the option of locating in the Greater Mohali Region, it is unlikely that manufacturing activities will drive the economy of the Greater Mohali Region to any great extent beyond the level already established. This is also indicated by the fact that the Greater Mohali Region, like the rest of the state of Punjab, is land-locked and will always face a competitive disadvantage in manufacturing given the distance from ports to handle imports and exports. In case of Greater Mohali Region, the extent of environmentally sensitive area within the GMADA boundaries also indicates that manufacturing will have to be largely restricted to "clean" industries with limited potential for damage to the environment.

On the other hand, the rapid growth in IT/ITeS units as well as employment and exports by these units in the Greater Mohali Region over the last 8-9 years indicates that IT/ITeS units have significant potential to drive the economic growth of the Greater Mohali Region. Apart from the established trend of rapid growth, the fit between IT/ITeS and the Greater Mohali Region is driven by a number of factors:

- Largely urban character of the Greater Mohali Region with proximity to Chandigarh providing access to connectivity by air. With the likely up-gradation of the Chandigarh airport to handle international flights, the limited drawbacks in terms of international travelers having to route through Delhi and Mumbai will also get addressed.
- The cosmopolitan nature of the population with migrants driving the growth in population, coupled with higher rates of literacy than the state and national average.
- Competitive advantages for IT/ITeS operations in terms of lower rentals/capital costs for floor space, lower manpower costs and lower levels of attrition in the employee base as compared to the metropolitan cities.
- The established base of institutions of higher education and the current pipe-line of institutes being set up provides a natural fit with IT/ITeS as well as other knowledge based economic activities.

The GoP has also identified the Greater Mohali Region as one of the four "Investment Regions" in Punjab, with a focus on knowledge-based industries. There are also examples of Indian cities like Bangalore, Pune and Hyderabad that have managed high rates of economic growth by focusing on IT/ITeS, biotechnology, etc. while also cultivating an established base of academic institutes to support and sustain such growth. It is felt that the Greater Mohali Region should be able to replicate this model with the added advantage that the availability of land is much higher as compared to the bigger metro cities that have necessarily had to curtail the scale of development projects because of land constraints. With agriculture accounting for a large proportion of land in the Greater Mohali Region, the transfer of such land for various development projects can be expected to drive growth in the area for years to come. As mentioned earlier, in addition to IT/ITeS, healthcare and education are other services with established basis and great potential in the Greater Mohali Region.

Apart from the knowledge based industries, another driver for the Greater Mohali Region emerges from the nature of the work force in these industries. Typically with a younger and higher income earning (and spending) workforce, these industries will drive demand for residential property as well as infrastructure for leisure and entertainment like shopping malls, restaurants, multiplexes, amusement/theme parks, clubs, sports facilities, etc. Such services have the potential to further drive economic growth by creating more job opportunities leading in turn to greater income generation and spending.

To assess the viability of the drivers for the Greater Mohali Region's economy identified above, information on the projects in the pipe-line for the Greater Mohali Region and expected to be implemented by 2011 was collected. This data clearly shows that the identified drivers are largely on the right track and the expected drivers for the Greater Mohali Region's economy in the years to come are likely to be as follows:

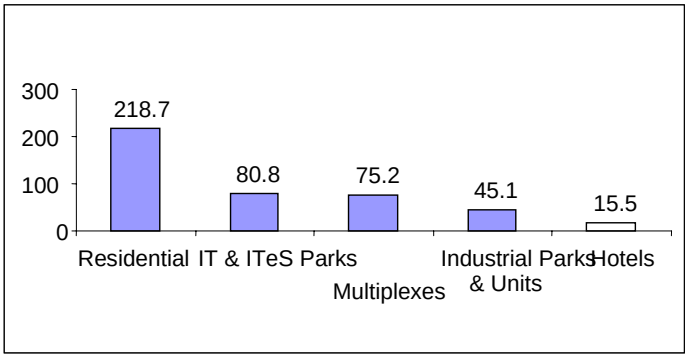
- Knowledge based industries/services like IT/ITeS, biotechnology, healthcare (including medical tourism), higher/technical education, creating direct demand for office space and telecommunication infrastructure.
- Secondary demand arising from the high income and cosmopolitan mix of employees of such knowledge based industries as well as those accessing the healthcare and education facilities, sustaining real estate development (residential property, shopping malls, hotels/restaurants, multiplexes, clubs, amusement parks, etc.) in the first instance and employment in trading, operation and maintenance, etc. in the second instance.
- The conversion of the Chandigarh airport into an international one, coupled with the ongoing boom in air traffic being witnessed in India and the access provided to several places of tourist and religious importance in Punjab and Himachal Pradesh from the Greater Mohali Region is also likely to lead to growth in logistics facilities in the area. The Meetings, Incentives, Conventions and Exhibitions (MICE) segment may also emerge as a key driver for the local economy.

The total investment in the mega projects in the Greater Mohali Region is estimated to be around INR 435 bn from 2007 to 2011, i.e. about twelve times the estimated economic output of the Greater Mohali Region in FY2007. The major investment in the Greater Mohali Region is expected in residential properties, business parks and office space to accommodate IT/ITeS operations, multiplexes, industrial parks and hotels. The investment in residential properties in the region is expected to be INR 218.7 bn which is over 50% of the estimated investments in the Greater Mohali Region. The major housing projects in the region those are of DLF Universal (INR 30 bn) and EMAAR MGF (INR 38.2 bn) from Sector 85 to 106 in Mohali city. EMAAR MGF is also developing integrated "golf and leisure city" in Mohali city at a projected cost of INR 27.8 bn. SAB Industries Ltd is developing an integrated township in Zirakpur at an estimated cost of INR 21.7 bn.

The planned investment in creating floor space for IT/ITeS operations in the Greater Mohali Region is INR 80.8 bn. The industrial park for IT/ITeS and high-tech knowledge based activities on the Zirakpur-Banur road is the biggest project in the sector which is expected to be completed by 2009 at an estimated investment of INR 15.8 bn by Futuristic Technology Infrastructure Private Limited. Twelve new industrial parks are expected to be developed in the Greater Mohali Region with 18% (INR 75.16 bn) of total proposed investments in the Greater Mohali Region.

More than 50 new multiplexes are being developed in the region with investments of INR 75 bn from 2007 to 2011. The planned investment in more than 25 new hotel properties in the Greater Mohali Region is INR 15.5 bn. Gulistan Infrastructure Pvt. Ltd and Fantasy Hotels Ltd are developing two hotel properties in Zirakpur at proposed investments of INR 2.02 bn and INR 1.31 bn respectively.

Figure 6.1: Planned Investments in the Greater Mohali Region during 2007-11 (Rs. Bn)



Source: Punjab Infotech

Some key real estate projects approved in principle by the Punjab Urban Planning & Development Authority (PUDA) or under implementation in the Greater Mohali Region are summarized in Table 6.3:

Table 6.3: Key Real Estate Projects in the Greater Mohali Region

Developer	Type of Project/Location/Other Details	Area (acres)
DLF Universal	Residential – Sectors 86 to 106 of Mohali	800
PACL India Limited	Residential – Sectors 104 & 105 of Mohali	200-260
EMAAR MGF Land Pvt. Limited	Integrated township with special education and wellness zones – Sectors 85 to 106 of Mohali	1000
EMAAR MGF Land Pvt. Limited	Integrated Golf & Leisure City, Chandigarh-Kharar Road	950
EMAAR MGF Land Pvt. Limited	Trade & Entertainment City , Chandigarh-Kharar Road	150
Rana Infrastructures Pvt. Limited	Residential – Sector 99, Mohali	103
Unitech Limited	Residential – Sector 107, Mohali	200
Taneja Developers	Residential - Kharar	160
Infinity Promoters & Developers Pvt. Limited	Residential - Mohali	100
IREO Funds Limited	Residential – periphery of Zirakpur	300
Silver City Housing & Infrastructure	Shopping Mall and Multiplex, Zirakpur	N.A.
Renaissance Buildcon Company Limited	Residential – Zirakpur-Patiala highway	300
Shipra Estate Limited	Residential – Zirakpur-Dera Bassi highway	650
Country Colonisers Pvt. Limited	Residential - Mohali	110

6.3 Economic Outlook for a Global Economy

For the Greater Mohali Region, the assessment of the current economic profile is based to a great extent on qualitative analysis based on data available, an indirect estimate of the current level of economic output without any trend of the past growth and no detailed break-down of economic output by sectors. The reasons for these limitations have been outlined in the introductory section. In this situation, a detailed projection of economic growth in the Greater Mohali Region using a macroeconomic model built on components like savings/investment rate, capital output ratio, etc. will

be meaningless as the assumptions required would necessarily have to be rather arbitrary. Rather the approach adopted has been to refer to the available economic projections for India as a whole and apply the same to the Greater Mohali Region along with an assessment of the growth prospects for the identified economic drivers for the Greater Mohali Region.

With this approach in mind, some key findings based on a review of the available economic projections for India and other forecasts relevant to the key economic drivers for the Greater Mohali Region[6] are outlined below:

- As per the revised version of the so-called "BRICS Report" prepared by Goldman Sachs in December 2005, the rate of growth of GDP in real terms (constant prices) in India is expected to be as follows over 5-year periods starting 2005:

2005 - 2010	6.2%
2010 - 2015	5.7%
2015 - 2020	5.5%
2020 - 2025	5.4%
2025 - 2030	5.7%
2030 - 2035	5.8%
2035 - 2040	5.7%
2040 - 2045	5.3%
2045 - 2050	4.9%

- India is expected to have sustained high rates of economic growth due to the favourable age profile of its population – the proportion of workers (age 15-59 years) in the population is expected to rise continuously from 58% in 2000 to a peak of 64% in 2035. In contrast, China has an older population currently and while the proportion of workers was high at 65% in 2000, the proportion of workers in China's population is expected to decline from 2020 onwards, affecting economic growth as well.
- A paper prepared under an Asian Development Bank Technical Assistance in December 2006 predicts a higher average annual growth rate of the Indian economy at 7.2% between 1997 and 2030, as compared to the BRICS Report cited above.
- The total revenues (domestic plus exports) of the Indian ITeS industry grew from US$ 1.61 bn in FY2002 to US$ 7.21 bn in FY2006, thus growing at an average rate of 45.7% p.a. during this period. In FY2006, India's share of the global ITeS segments vary from 15.6% in Finance & Accounts (US$ 2.5 bn of US$ 16 bn), 9.9% in customer care (US$ 2.8 bn of US$ 28.2 bn) to a low 1.2% in Human Resource processes (US$ 169 mn of US$ 14.6 bn). In higher value added services like legal processes, animation, bio-technology and pharmaceutical research, research and publishing, medical and healthcare services and engineering and design services, India's share is currently much lower. Overall, there is thus enough market potential for ITeS to sustain high rates of growth in the years to come.
- IT (software and services) exports from India have sustained growth at around 37.6% p.a. in the past ten years, growing from US$ 1.8 bn in FY1998 to US$ 31.9 bn in FY2007. Taking into account the domestic market as well, the IT industry has grown from US$ 4.8 bn in FY1998 to US$ 47.8 bn in FY2007, an average growth rate of 29.1% p.a. Employment in IT has grown

[6] The projections, reports referred to for this purpose are detailed in the "References" section at the end of the Draft Final Report.

steadily from 0.19 mn in FY1998 to 1.63 mn in FY2007 and share in India's GDP from 1.2% to 5.4% over the same period.

- While growth in the immediate future will be at lower rates, it is expected that ITeS exports will grow at 21% to reach US$ 21.1 bn in FY2012 from US$ 6.3 bn in FY2006.

Overall, it appears that the key drivers in the Greater Mohali Region of IT/ITeS will continue to grow at high rates. The huge investment in the pipeline in relation to the current estimated size of the Greater Mohali Region's economy is also expected to drive growth in economic output significantly. With the large number of residential real estate projects being completed and occupied in the next 3-4 years, rising local demand for goods and services should spur economic growth.

Keeping these factors in mind, it is felt that the Greater Mohali Region's economy is poised to grow at higher rates than the country as a whole at least in the next 3 years up to 2010. A figure of 10%-15% p.a. appears reasonable given the investment pipeline. A conservative approach would dictate assuming 10% p.a. Beyond 2010, it can be again conservatively assumed that the Greater Mohali Region's economy will grow at the same rate as India in line with the BRICS Report projections[7]. Based on these assumptions and the estimated economic output of INR 28.5 bn in FY2007 (in real terms, i.e. FY2000 prices), the projected level of economic output of the Greater Mohali Region would be as follows:

Table 6.4: Projected Economic Output of the Greater Mohali Region (INR Bn, FY2000 Constant Prices)

FY2007	FY2010	FY2015	FY2020	FY2025	FY2030	FY2035	FY2040	FY2045	FY2050	FY2055
28.5	**37.9**	**50.0**	**65.4**	**85.1**	**112.3**	**148.8**	**196.4**	**254.2**	**322.9**	**410.1**

Thus, as an input into the master plan for the GMADA region, it can be considered that the economy of the Greater Mohali Region would have grown to about four (4) times its current size in 25 years and to around 14.5 times in 50 years.

6.4 Projected Employment Generation

A projection of the likely number of workers across different sectors in the Greater Mohali Region is difficult on any reasonable basis. However, based on the projected population, a reasonable projection of the total number of workers is possible given the population projections presented earlier in Chapter 5. This requires an assessment of the likely changes in the overall work participation rate for the Greater Mohali Region. By and large, in line with the scenario for the nation as a whole, it is found that in all the population projection scenarios, the projected population in the 20-59 years category as a proportion of total population rises till 2031 before starting to decline and reaching approximately the current levels in 2051. This would tend to indicate an increase in the proportion of the total population rising from the 2001 level of 38.7% till 2031. Also, given the nature of economic drivers identified for the Greater Mohali Region as well as the current (2001) lower level of work participation among females compared to the national average, it may be expected that a higher proportion of the female population would join the workforce in the Greater Mohali Region. Taking into account these factors, the following assumptions about employment levels and approach have been made in order to project total number of workers in the Greater Mohali Region (using the high growth population scenario):

[7] For the period 2050-55, the rate prevailing during 2045-50 has been considered.

- For projected population in 2006, the overall work participation rate as percentage of the total population has been considered as 39% (38.7% in 2001). The overall proportion of persons in the age group 20-59 years in this year works out to 53.4%.
- In 2006, males in the age group 20-59 years have been considered as a percentage of the total males population (53.2%) and the number of males working has been taken as 102% of the males in the age group 20-59 years, leading to a work participation rate of 54.3% for males (same as in 2001).
- In 2006, females in the age group in the age group 20-59 years have been considered as a percentage of the total female population (53.7%) and the number of females working has been taken as 38% of the females in the age group 20-59 years, leading to a work participation rate of 20.4% for males (20.2% in 2001).
- For all subsequent years at 5-year intervals, the total number of workers in the Greater Mohali Region have been worked out by adjusting the overall work participation rate in direct proportion to the projected population in the 20-59 years age using 2006 as the base. For example, with the projected population in the 20-59 years age group in 2011 being 56.1%, the overall work participation rate has been worked out as 41.0%.
- A similar approach has been used separately to the projected male and female population to arrive at the projected numbers of male and female workers, summed up to yield total number of projected workers. In addition, an autonomous 0.5% upward increase in the proportion of females in the 20-59 years age group working has been made up to 2026 to factor in the expected increase in work participation rate.
- The total number of projected workers using the two methods outlined above has been averaged to project the number of workers.

Based on this approach, the total projected employment level in the Greater Mohali Region that may be considered for the purpose of planning is shown in Table 6.5 below.

Table 6.5: Projected Employment Levels in Greater Mohali Region (Nearest '000)

Year	Employment in Greater Mohali Region Projected ('000s)
2011	450 (42.5%)
2016	570 (44.0%)
2021	700 (44.5%)
2026	800 (44.9%)
2031	950 (45.7%)
2036	1120 (46.3%)
2041	1260 (44.8%)
2046	1340 (42.8%)
2051	1360 (39.3%)
2056	1400 (36.9%)

Note: Figures in brackets indicate the workers as percentage of total projected population

Thus, based on the above employment projections, the number of workers employed across all sectors of the economy in the Greater Mohali Region is expected to increase from about 275,000 in 2001 (38.7% of the total population) over the first 25-year period to about 800,000 in 2026 (44.9% of the total projected population) and further over the next 25-year period to about 1.36 million in 2051 (39.3% of the total population).

7. Regional Development Strategies

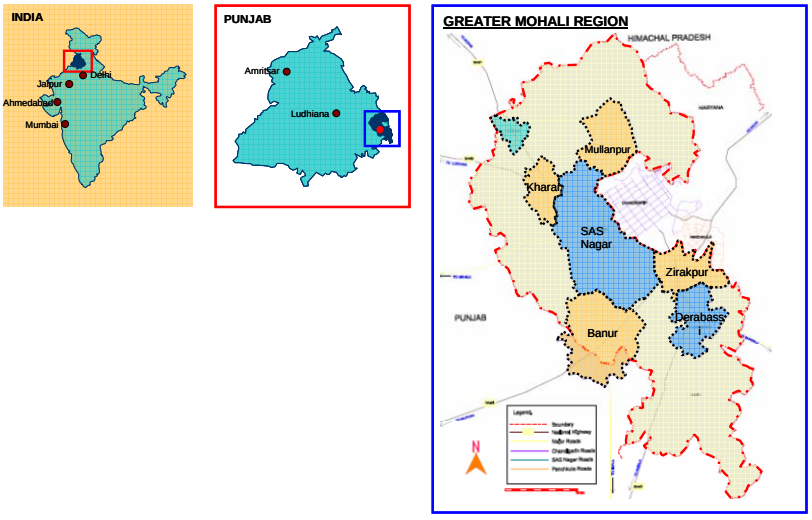
7.1 Introduction

The Regional Plan represents the first step in the development process by providing the necessary planning framework to develop GMR into a new unique community consisting of residential, commercial, recreational, educational and public infra-structure land-uses. The first objective of the regional plan is to evaluate the existing context of Greater Mohali Region in terms of its physical environment so as to be able to determine the appropriate land uses, their spatial requirements and finally, to establish a logical and sensitive growth and land utilization strategy.

This portion of the report covers the framework and strategies with regard to physical and spatial planning. It then seeks to evaluate the current land uses and development patterns within GMR and its immediate surroundings. Subsequently, it outlines the specific physical development strategies that include proposing growth nodes and corridors, conserving the ecological sensitive areas and balancing the man-made and the natural environment within Greater Mohali Region.

The planning area (GMR) is in the eastern corner of Punjab, bordering Pakistan. Geographically, the GMR is an area that stretches from the very north to the south-east portion of Chandigarh, covering an area of approximately 1190 sq.km. Six local planning areas; namely, Lalru, Banur, Derabassi, Zirakpur, S.A.S Nagar, Kharar and Mullanpur are found within the Greater Mohali Region. This region will directly benefit from the economic drivers that are to be introduced and promoted within this geographical area.

Fig 7.1: shows the Greater Mohali Region within Punjab, and Plan showing Punjab within India



7.2 Current Development Distribution and Existing Uses

The existing land use analysis through the GIS and site observations show that the present development pattern is quite imbalance as the most of the development are concentrated within the main urban centers particularly around S.A.S Nagar and the ribbons of primarily commercial and residential development along major roads and highways. The most developed part of the entire GMR is area that is at very close proximity to Chandigarh. The northern conurbation comprises S.A.S Nagar, Zirakpur and parts of Kharar. These areas experience the spill over effects of over-developed

Chandigarh. Hence, the main objective for the regional plan is to address this imbalance of growth by redirecting it along certain desired corridors or directions.

Industrial developments appear to be concentrated around the FEZ located towards the north-eastern portion of the Greater Mohali Region, some are within the S.A.S Nagar and still others located along the NH22 a major highway to Ambala. The major economic activities are shown in Table 7.1 Major economic activities in various LPA's within GMR and the spatial distribution in Fi.7.2 as follows:

Table 7.1: Major economic activities in various LPAs within GMR

Locations	Existing Activities
Lalru	Chemical Industry, Textiles, Steel industry, Petroleum-gas Industry, Food Processing
Derabassi	Pharmaceutical, Breweries, Electronics, Paper Mills, Poultry Farms, Textiles, Copper Industry and Life Sciences
Kharar	Textiles, pesticides/chemicals, warehousing. retail/hotel, small and medium industrial establishments
Mullanpur	Agricultural farming, limited tourism activities (presence of a small number of resort establishments)
Banur	Agricultural activities, Pharmaceutical, distillers
Zirakpur	Automobiles, warehousing commercial/retail activities (presence of malls)
S.A.S Nagar	Bulk material marketing, specialized medical activities, commercial/retail, tourism (presence of holiday resorts), warehousing, agriculture activities, entertainment, heavy equipment manufacturing (manufacturing of tractors),
Kurali	Limited industrial activities, limited tourism activities (presence of small resorts)

A large portion of the areas within the development site is designated as forest preservation area as well as ecologically sensitive zone. The Regional plan seeks to continue protecting these areas for the longest possible period. However, in order to maximize the conservation of these areas, limited access into such areas is proposed to be granted to the public to enjoy the flora and fauna which exist within them. The urbane encroachment into these areas has to be prevented, even restricted depending on the circumstances. Any limited development if allowed will have to be subjected to the strict adherence to the environmental measures set out by the relevant authorities.

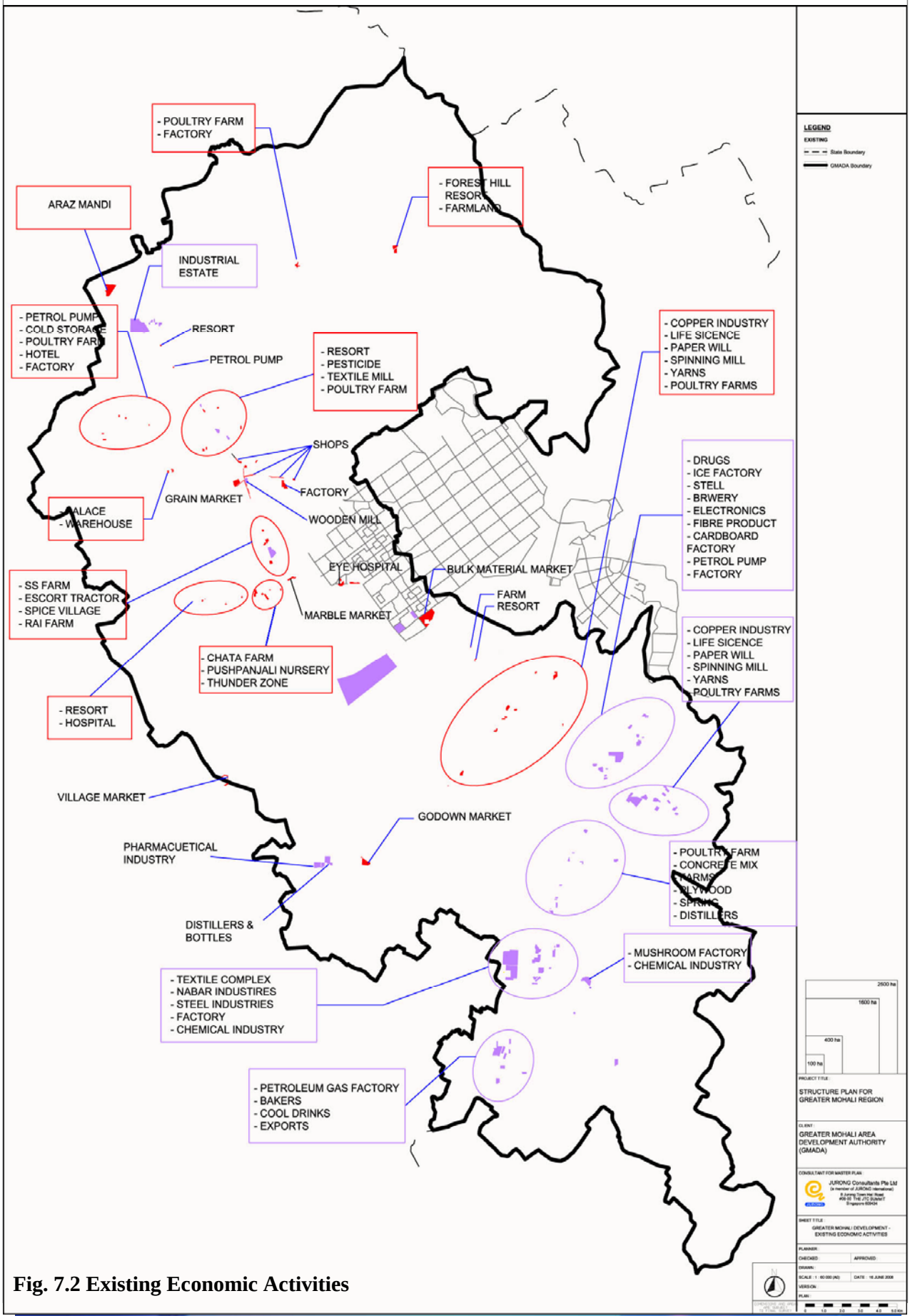


Fig. 7.2 Existing Economic Activities

Agriculture and Rural areas make up a large portion of the development area. The chief crops cultivated here include: wheat, paddy, maize and sugarcane. Agriculture has been and will continue to play a role in contributing economically as well as a provider of jobs within the region, though its future importance remain questionable. This is because of the eventual loss of agriculture lands when there is an increase in the salinity of the soil, as well as to urbanization. As such, fertile areas where the agricultural productivity is deemed high will have to be protected for as long as possible. One of the main objectives of the regional plan is to have a balance growth. Hence, there is a need to protect good agriculture land and ecologically sensitive areas for as long as possible from urban encroachment.

In terms of infrastructure, there is already quite established particularly in the more developed areas such as S.A.S Nagar and Zirakpur. These existing facilities can be upgraded and built upon as and when new developments or redevelopments take place. Hence, development has to be prioritized in a manner so as to take advantage of areas where the infrastructure has already being developed, for example the area along NH-22, NH-64, NH-95, and NH-21. The strategy of growth is to concentrate at least the 1st phase of growth where possible within established areas. In addition, growth in these areas should be regulated so as to prevent urban sprawl onto the rural, environmental sensitive, high yield agriculture land for as long as possible.

Based on JURONG's computation the built-up area occupies about 15260 ha which is only 12.8% of the total Greater Mohali Region.

Existing Land use	Area (ha)	Percentage (%)
Hard Area	15260	12.8
Green Area	12410	10.4
Water bodies	2890	2.4
Soft Area	88476	74.4
Total	**119 036**	**100**

7.3 Purpose of the Regional Plan & its Translation

Purely from the physical development stand point, the Regional Plan is to guide the development in the next 50 years. It is a tool that provides transparency in guiding decision makers, town planners and real estate developers to align their decisions with the overall vision for the development of Greater Mohali Region. The objective of the GMR Regional Plan is to provide a strategic direction for the region to attract not only investments both local and overseas but also a place to live, work and play.

The Vision for **GMR becoming a globally competitive metropolis, built on the principle of sustainability and offers unique lifestyles choices to its residents and visitors.** Hence the Regional Plan a **commitment to ensure the development of GMR is able to keep pace with the rest of the world and be constantly be relevant in the face of the fast changing global environment. At the same time, it should also be place where people would want very much to make their homes to sink their roots.**

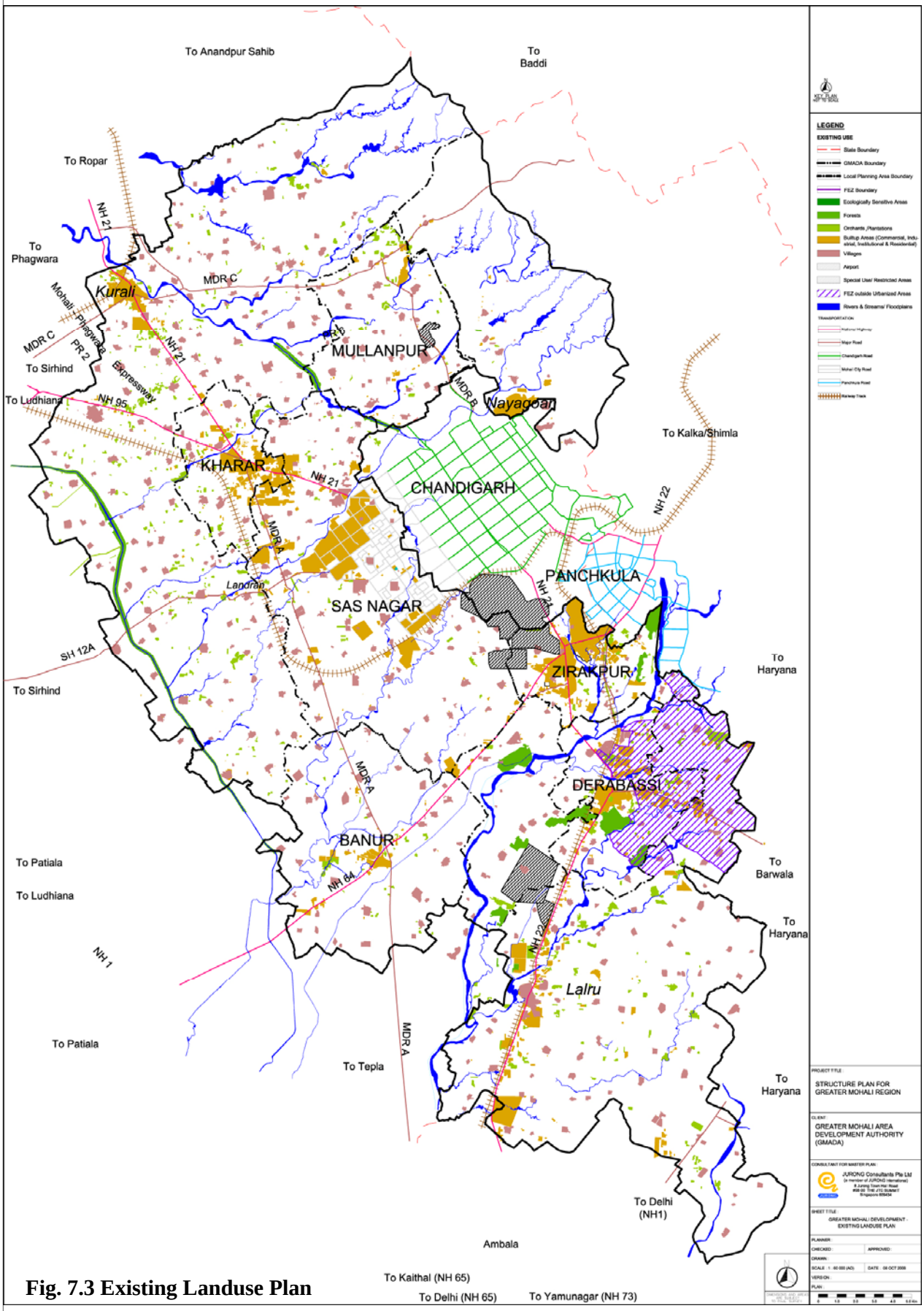
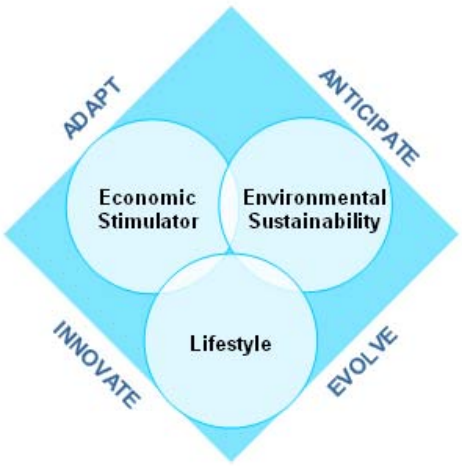


Fig. 7.3 Existing Landuse Plan

Fig. 7.4.: Shows the consolidation of the vision statement.

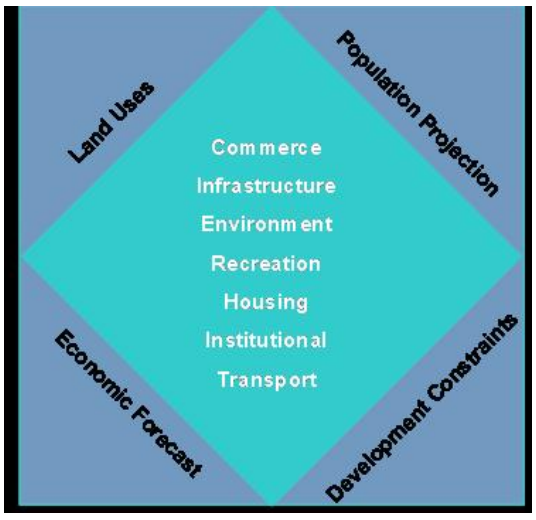


The Core Principles are:

- **7.3.1 Sufficient Safeguarding of Land:** The first objective is to ensure that there is sufficient land to accommodate residential development and support the types of economic activities for the next 50 years. There has to be enough land set aside to accommodate which will create a viable and sustaining economic growth and to balance the physical development as well as the natural environment. In addition, land has to be sufficient to be able to provide for a wholesome community development for the purposes of living, working and playing.

After accounting for the protected areas, committed areas, built-up areas and restrictive areas, there remains land available for development, otherwise known as 'soft lands'. These soft lands will have to be sufficient to meet the demand of major land uses like commercial, residential, industrial, open space/waterway and transportation. The future development of these soft lands or any reusable lands in the Greater Mohali Region will be guided by the broader Regional Plan intentions, ultimately seeks to provide for additional residential, recreational, industrial and commercials needs of the target population of 4.50M.

Fig.7.5 shows the relationship between the demand/supply of the various landscapes.



7.3.2 Balanced Development

- **Development versus Conservation of Nature:** One of the key objectives in the development of GMR is to achieve a balance growth. There is a need to regulate growth of the urbanized areas defining the urban boundary to limit the urban sprawl while at the same time protecting pristine nature areas and prime agriculture land. Rural Growth Centre may be introduced at strategic rural settlement areas as forms of limited urban activity centres that provide life lines connecting these rural settlements to the bigger urban areas.
- **Residential versus Place of Employment:** Based on a balance growth strategy, deliberate efforts will be made to distribute commercial and industrial developments in a systematic manner. This is to achieve even development across the region and increase the job to resident ratio. Hence, for the commercial developments, the strategy is to adopt a 'hierarchy of centre' approach. This means the commercial quantum to designated regional, sub-regional center and fringe centers, hence reducing the percentage share within the main metropolitan or CBD areas. Offices that do not need to be in the CBD area are encourage to be in the suburban areas where the rental will be less expensive, but more importantly these form employment nodes outside the CBD area; closer to residential homes. Nonetheless, the Central Business District (CBD) will function as the main commercial core of the entire Greater Mohali Region. It will contain the bulk of the office space provision.

  Likewise, industrial set-ups particularly those of the light and clean ones (non-pollutive, non-nuisance) are also planned to be located closer residential areas, hence cutting down traveling time for workers between homes and places of work.

7.3.3 An Integrated Approach in land Use Planning: The integrated planning approach will ensure Greater Mohali Region is not only well balance with a comprehensive and wide spectrum of residential, commercial, recreational, financial facilities and amenities, but that the activities of these land uses will complement and flow seamlessly with one another. For instance, the development of commercial/industrial network will tie in closely with the transportation network so as to facilitate the flow of business operations and transactions. Land development concepts may also benefit from the integration where there are complementary uses. For example, in areas where there are existing unique natural topographical, flora, fauna, geological features etc., these areas can be developed as commercial centers with resort like ambience to form regional recreational nodes as well.

7.3.4 Private – Public Partnership

It is important to involve the private sector in the planning process particularly when the vast majority of the land in GMR is in their hands. of the private sector. The public sector is at best, a facilitator in the whole planning process. Hence, there has to be this partnership forged between the public sector with the community at large (private sector) in coming up with plans as these plans may directly or indirectly affect their lives and livelihoods. At the end of the day, the private sector has to be involved as not only will they be funding the development, but their participation will foster community understanding about broader planning issues and priorities.

The State has institutionalized the Punjab Infrastructure Development Board (PIDB) as a governmental body to look into the public-private sector partnership in development of public projects. This is certainly a step in the right direction and this organization is to be strengthened at all cost. PIDB encourages the private sector to get involved in the government led development programmes via *BOO, BOOT* and such approaches.

7.3.5 Enhancement of Strategic Economic Activities

For GMR to be successful in the eyes of the community, it would have to exhibit capacity to generate enough work for the growing population. Otherwise, there will be no stopping of the brain drain from GMR towards the surrounding areas and even abroad. Thus, besides the few notable industrial pockets such as the FEZ, parts of S.A.S Nagar and areas in Lalru, there is a need to generate more economic activities and employment opportunities.

The future appears to be moving forward in the direction of the knowledge and skill intensive rather than land and labor-intensive based industrial activities. The Regional Plan addresses this need through the provision of designated planned industrial areas to allow for the establishment of free enterprises with a range of industrial uses including high tech and Research & Development. In addition, the Regional Plan allows for the development of Industrial Townships in conjunction with these business parks or industrial parks so as to create a total business environment of mixed uses. In a nutshell, the Regional Plan seeks to create a modern industrial environment within which the Economic, Business and Technological activities will flourish. Ultimately, such planned actions is to attract foreign investment & technology with quantitative and qualitative certainty; creation of low risk investment havens.

Business parks will be located at strategic locations near regional/sub-regional centers, along major transportation corridors and close to major educational institutions. This is to optimize the use of industrial land at locations of good accessibility and of close proximity to residential areas.

7.3.6 Encourage In-fill Development and Allow Redevelopment of Compatible Uses: This is to prioritize development in some “left-over” or “void” areas in the midst of very developed immediate surrounding areas. In such areas, very often the infra-structure has already been fully developed and matured. New developments are to be concentrated and encouraged particularly in areas where the general surrounding environment is capable of redevelopment and improvement. The main objective of focusing on the development of “left-over areas” is to contain growth within the already built up areas so as to defer or not release up the “new” areas outside when the infra-structure may not be ready as yet. Where the existing uses are not compatible with the predominant or proposed use of the area, incentives should be given to phase out these incompatible uses. Incentives can be in terms of a higher use type in accordance to the Master Plan prescribed use and higher Floor Space index (FSI).

7.3.7 Invoking the “Soul of the City”

There has to be a concerted effort on the part of the public as well as the private sector to consolidate the diverse cultural environment and elements that display the wide spectrum of Punjabi arts, humanities and culture. These have to be show-cased to the international communities. These constitute the soul of the city, for without a soul the city dies. Hence, special building will have to be custom built to house these activities. Museums, performance arts theatres, convention center will have be planned in the heart of the city (S.A.S Nagar) to promote the Punjabi arts and culture.

7.3.8 Enhancement and upgrading of Infrastructure

There is already quite an established an existing infrastructure network that supports the present population of Greater Mohali Region. The first principle of the infrastructure network planning has to be the evaluation of these existing structures is able to cater to the existing and future demand. Hence,

if the capacity and the technology are adequate then these are the areas where the initial proposed developments will be concentrated on. Other than these areas, the phasing will have to be in tandem with the infrastructure development, otherwise the whole development process will be jeopardy.

7.4 Framework for Development Strategies

These development strategies are direct derivatives of the vision statement as well as the core objectives as mentioned earlier. They have been formulated bearing in mind the strengths, threats, weakness, opportunities and the challenges of the global environment. Greater Mohali Region is expected to encounter in her quest to be a world-class community and an economic force. These strategies will ensure that the development direction is flexible and easily aligned to the global changing climate

- **To attain a balance development within the GMR through reaffirming distribution and to promote development efficiency by concentrating development in designated corridors, linkages and nodes.**

  This strategy is to strengthen the existing corridors of development where there are already existing established developments and infrastructure. At the same time, open up new corridors with innovative ideas of development being introduced in areas where there are fewer physical hindrances or encumbrances.

  These development corridors are encouraged to be punctuated at strategic locations by growth centers. These growth centers are locations where employment, retail, living, entertainment and higher education are planned for. The corridors provide the connectivity between growth centers; there are avenues for higher speed through traffic, particularly for heavy vehicular traffic, and for inter suburban buses plying along these corridors. Presumably, the use of public transportation could be encouraged in order to support the land uses that are located along these activity corridors.

  Zirakpur-SAS Nagar-Kharar-Mullanpur corridor will be targeted for immediate growth for the next 15-20 years. This corridor comprises the airport, the FEZ, S.A.S Nagar, Mullanpur and Zirakpur. There are already established commercial centres at Zirakpur, the southern extension of Chandigarh and at S.A.S Nagar. This corridor has 3 important links:

  - The link northwards towards Baddi, has the potential to attract workers from the industrial town in Haryana to set up homes at the foothills of the Shivalik. This will be proposed as a Family Hub, as an area with resort type of housing development in the midst of a wide expanse of open space. It also to GMR's advantage to upgrade and extend the road from Mullanpur towards Baddi. In addition, the southern portion of the Mullanpur that is close to the film city and education city of Chandigarh, offers yet another development potential, which is to develop a theme park cum Regional Park. This will complement the services and activities related to the film industry and housing along this narrow belt.

  - Development along the periphery of Chandigarh has the potential to capture the spill over effects (i.e. in terms of demand for residential, commercial and industrial spaces) of the already saturated Chandigarh City. This is especially so as S.A.S Nagar can offer alternative lifestyles that are as comparable as or even better than to Chandigarh in terms of more affordable prices (residential and commercial) and better environment. The portion of this belt will have project a more contrasting type of development from that of Chandigarh.

  - Linking south eastwards towards Panchkula, Zirakpur could become a commercial centre to capture the more residential oriented development at Panchkula. The existing airport is between the growth centres of Zirakpur and S.A.S Nagar. There is an already a **1028 ha** of land set aside

for airport expansion. Further, amount of land to the south of this area should rightfully be set aside for future use. This additional land could be planned for logistic and other aviation based industries such as aircraft repair and maintenance, precision engineering, food-catering for aviation needs, etc. In today's context, the airport cannot function solely as an airport per se; it has to be an **Aviation Hub** or an airport city.

There are already plans in place to upgrade and expand the present airport at Chandigarh where a portion of the airport expansion is within Greater Mohali Region. Adjacent to this expansion is a large expanse of uncommitted land; these could be capitalized upon to develop the airport hub. The critical industries to be developed here should comprise of logistic as well as aircraft maintenance related industries. International Exposition Centre development is another suitable form of development which could be located here.

Lalru-Banur-Kurali on the other hand, will be targeted for growth in the medium term say 20 to 30 years. These growth centre form the 2nd tier centers outside the main growth corridor as mentioned earlier. Those industries that do not need to be in proximity to the core economic corridor but so long as they are connected via important transportation corridors can be located here. Land intensive industries can also be located here since the price of will be lower, being away from the core economic area. Furthermore, Banur is targeted to be the intuitional hub to tie in with the business park corridor along the airport; the NH-64 corridor will be the conducive for development of residential apartments to cater work force living in the vicinity of the area. The excellent connectivity of the NH-64 towards the south to Rajpura, will further boost its development.

This corridor has 4 important links:

- From Banur to Rajpura in the south-west and Zirakpur/S.A.S Nagar/Airport in the north, north-east vide NH-64.
- From Kurali to Ropar in the north-west and Kharar/S.A.S Nagar to the south-east vide NH-21.
- From Lalru to Ambala in the south-west and Derabassi/Zirakpur/Airport in the north-east, vide NH-22.
- From Kharar to Ludhiana in the north-east and Derabassi/Zirakpur/Airport in the south-east vide NH-95.

These growth centres are further string together vide two proposed major linkages that run from the north-west to the south-east portions of GMR.

To preserve and conserve natural, unique historical and open space resources to achieve a more wholesome, vibrant and sustainable life styles.

There is a very urgent need to protect the natural environment, open spaces and heritage by conscious preservation, conservation and management of the resources. Environmental and heritage issues are to be **integrated into the land use planning**, management and development decision making at the earliest possible stage of any proposals. All planning decisions have to bring environment and heritage issues into **equal partnership with social and economic factors**.

There has to be a concerted effort to improve the quality of life by providing a **variety of open spaces** for recreation and leisure, particularly when the overall aspiration of the general public heightened. Also, there is a need to retain natural habitats and nature-like areas for the greater enjoyment of the general population. In this respect, nature reserve should be made **accessible** to

the public for recreational purposes. However, this use has to be monitored carefully so as to prevent the excessive use, as any degradation of sensitive environmental area is irreversible.

Efforts has to be expanded to achieve a **seamless interconnectivity** linking all planned recreational areas, environmentally sensitive areas, road buffers, and greenways, open spaces both natural and man-made into an integrated green network system. Greenways is proposed to function as corridors supporting compatible multiple uses and at the same time linking recreational, conservation and culturally important areas with particular emphasis on conservation of biodiversity. The proposed possible network orientates from the environmentally sensitive areas in the north-eastern Shivalik Hills to the various greenways along rivers and rivulet through the heart of the Greater Mohali Region.

Top priority is to be accorded to the preservation and the conservation of these natural and man-made greenways and green "lung" have to be safeguarded. Appropriate policies have to be formulated to ensure that the strategies could be carried out without any hitch. In view of this, two main regional park/theme park/botanical garden/zoo, have been safeguarded one in the south-east bounded by Banur, Derabassi Lalru and Zirakpur and the north-west bounded by Kurali, Mullanpur Kharar and SAS Nagar. These large "lungs" are connected vide a green corridor along the rivers and water bodies, roads, pylons lines. The Shivalik Hill areas in the very north are to be preserve under the Punjab Land Preservation Act, 1990.

- **To introduce critical strategic economic growth initiatives that will be the focal points for growth within the region.**

  GMR needs new growth catalyst and that will further boost the development to a greater plane and to redistribute the population to a much wider area. Strategically, there is a critical need to strengthen existing potentially profitable activities and to initiate new ones. This approach will give GMR a wider spectrum of economic activities to depend on for economic prosperity and well being.

  Both existing and new activities particularly those located within critical transportation routes and strategic locations should be able fuel the economy further. They are as follows:

  Airport Hub:

  As mentioned earlier, the portion to the south of the airport expansion should be set aside for the development of an air-port hub/city. This is an opportunity to expand the airports business outside the traditional ambit of the aviation business where the source of revenue is derived primarily from landing fees, gate leases, passenger service charges, passenger and cargo terminals and transits etc. As mentioned in the Vision Statement, the process of globalization alters the business operations of airports. International airports need to be diversified to survive the keen global competition. Their nature of business will have to be more holistic in its approaches and strategies. Hence, in most cases, these airports can no longer function as just airports per se but evolve into not only economic drivers but also as employment centers, ultimately bringing about economic prosperity to the region.

  As mentioned previously, it is often through the incorporation of a logistic business hub within its set-up that provide these airports with the ability to attract business from corporations or MNCs that rely heavily on time-sensitive manufacturing, e-commerce fulfillment, and telecommunications, etc. Currently, Internationally, Just-In-Time (JIT) industrial operations are wide spread; hence the reliability on the airport logistic to move essential industrial components is critical.

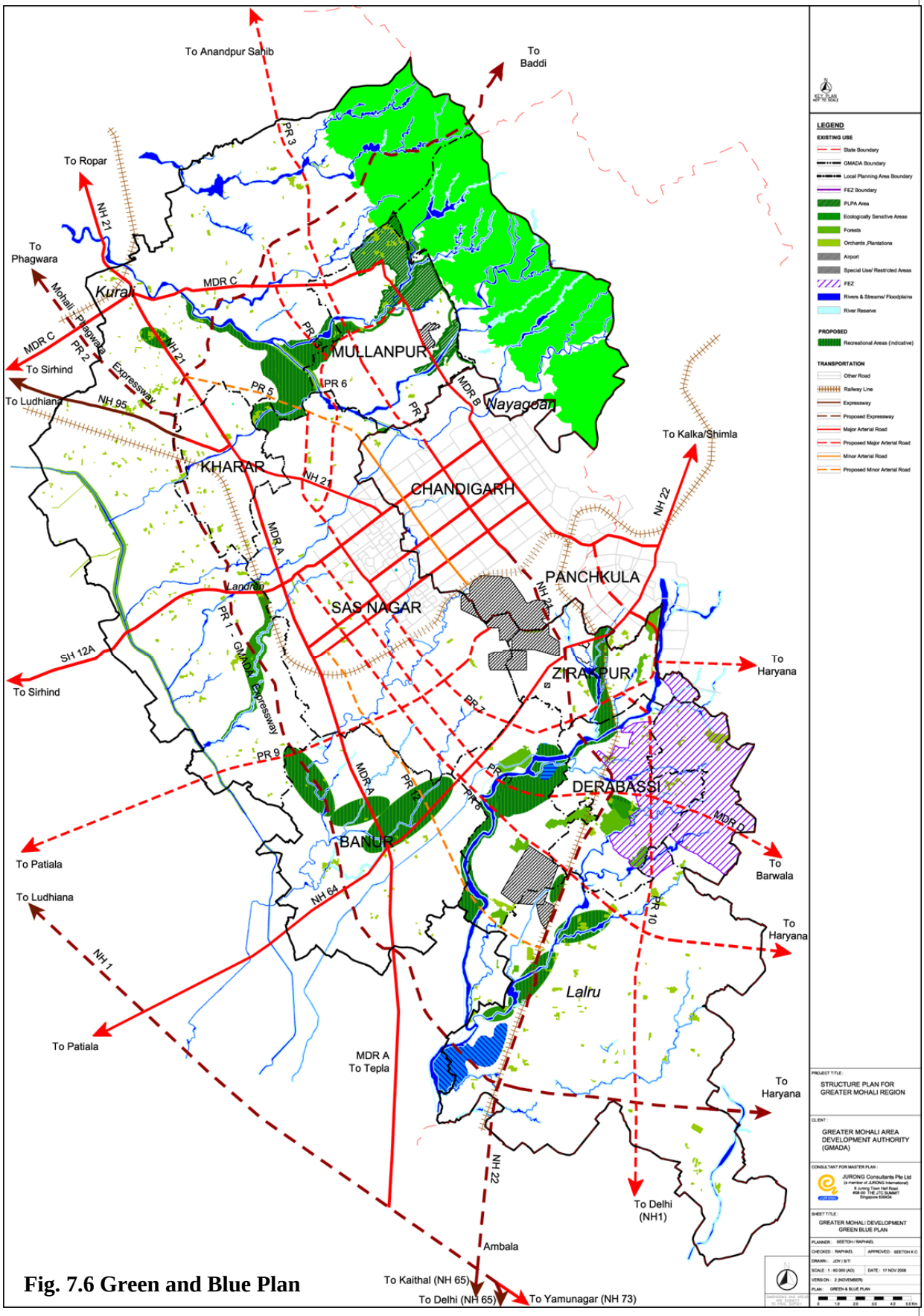


Fig. 7.6 Green and Blue Plan

The location of the GMR along major transportation routes and technological corridor will have the potential to elevate Punjab's standing to that of an International Airport Hub, besides offering to its residents all first rate conveniences to make it the best place to live in the region. The airport city would be well placed to have sustainable growth and will contribute substantially to the economy in the following areas:

- Build up a world class passenger airport to boost the growth of Mohali as an important international aviation destination.
- Provide a major cargo capacity to drive Mohali's industrial activity.
- Increase return by developing the most profitable airport related business such as exhibition/conference activities, education, logistic, inland port activities, finance/business, and IT & ITeS.
- Create high value industry base such as precision engineering and aircraft maintenance and servicing and manufacture and export of the parts.

Educational Hub

Currently there exist education institutions of higher learning around Banur which have twining programmes with established international institutions. These reputable international institutions should be given incentives to locate their campus here to further develop this educational cluster. Land has been set aside solely for this purpose all across GMR, particularly in areas in and around Banur.

Medical Hub

Located within Sector 62, Fortis Hospital has already established itself to be a world renowned medical centre. This is an advantage that GMR should capitalize on. More new medical fields or medical related services/activities should now be introduced into the already established Fortis Medical Institution, ultimately, turning it into a complete one-stop medical hub. The ultimate objective is to make Fortis a formidable medical icon for not only GMR but internationally as well. This will not only generate employment opportunities but also create another new source of income in terms of medical tourism for GMR. Incidentally, medical tourism is already established on a small scale in the Greater Mohali Region and this area may be expected to grow in terms of its contribution to the economy in the years to come. As this is located in close proximity to the CBD, medical tourist can rely on the convenience and availability of the full range of hotels and commercial establishments to enhance their visits.

CDB (S.A.S Nagar)

The CBD has always been and will always be recognized as the nerve centre and the dominant focal point for any metropolitan area. As a guide the core of CBD should be in the region of approximately 500ha.

As a guide the core of the CBD area should be in the region of approx 500 ha, is adopted as the defined boundary of the core CBD area. Facilities and buildings that have a regional catchments are to be appropriate located within this defined boundary, these include: libraries, museums, and symphony halls that constitute the "soul of the city".

Fig 7.7: Perspective Images of CBD area

Tourism/Family Hub

Tourism was previously defined as a travel predominantly for recreational and leisure purposes. But in this day and age, tourism is not only for people to travel and stay in places outside their usual environment for leisure, business but also for sports, medical and education related activities. Tourism has become an important industry, thus creating both opportunity for employment in service and hospitality sector.

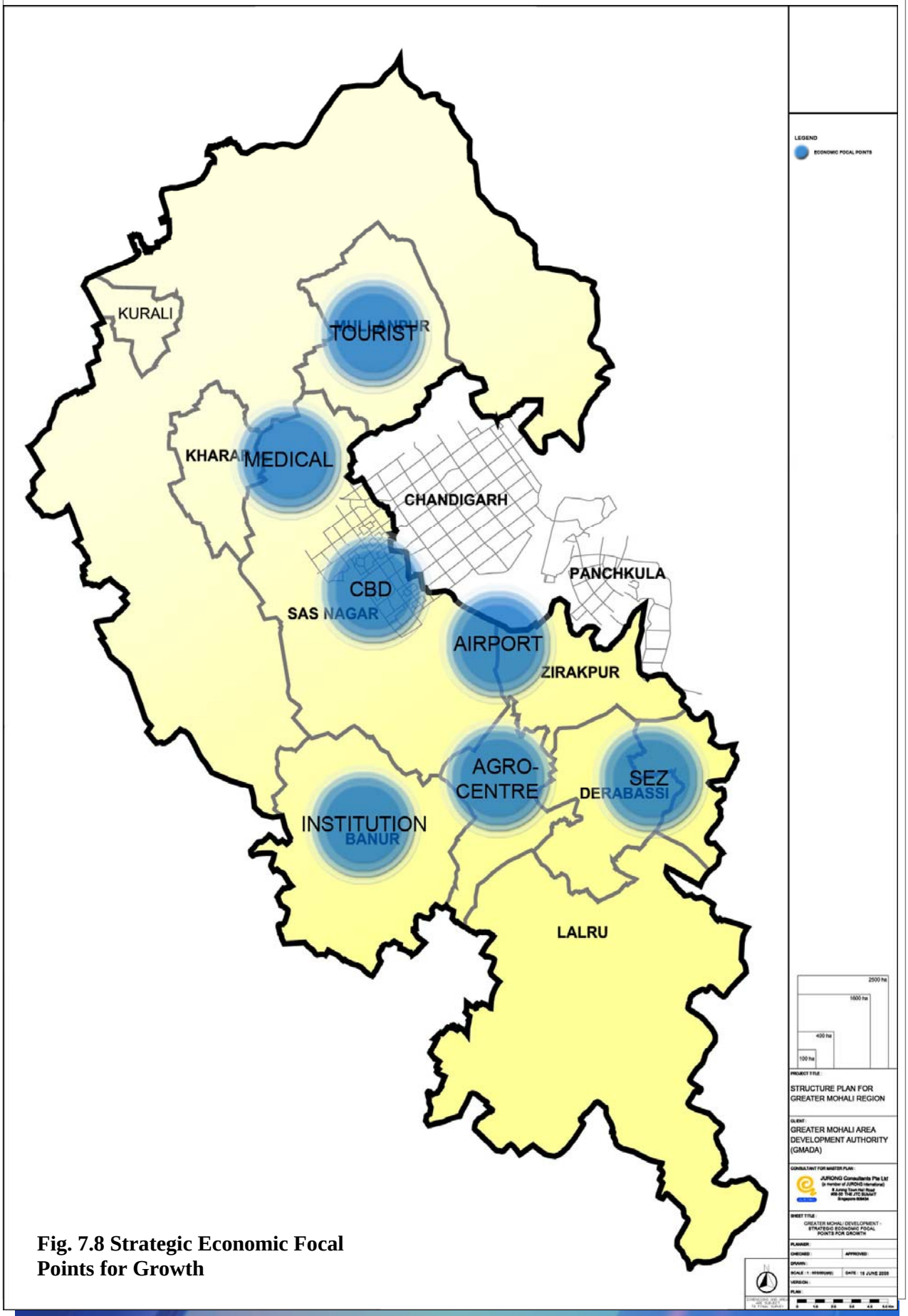


Fig. 7.8 Strategic Economic Focal Points for Growth

Typically, any tourist town would have some natural or man-made attributes to attract visitors to the place. With this in mind, Mullanpur seem to be the obvious choice to become the tourism hub for GMR. As of today, the areas around Shivalik hills parts of Mullanpur included are already renowned both for its beauty and reservoirs. Furthermore, with the proposed roads, Mullanpur will be well connected to the whole of Greater Mohali Region. This will make it very accessible from all parts of GMR.

- **To plan promote the growth of GMR as part of the greater Chandigarh, Delhi and beyond.**

  Geographically, there is a need to recognize that GMR is a part of India and located in very close proximity to Pakistan. It occupies a large proportion of the tri-city expanse constituted of Chandigarh-Mohali-Panchkula. The geographical proximity to these large population areas means that there is a ready pool of workforce to be tapped upon the development of the identified economic drivers. This same population will also form the requisite critical mass to drive the economy of GMR to a much higher notch through the demand of housing. In line with this, the Regional Plan has addressed firstly, the international linkages through the safeguarding of land not only for the international airport but an airport city. Secondly, the Regional Plan also safeguards enough land for the development of regional road/rail system that directly or indirectly connects GMR to these areas. Thirdly, the Regional Plan has safeguarded enough land for development of the tourist industries, the development of commercial and residential establishments and development of high end technological parks. Hence, there is enough safeguarding of land in place to set in motion development beyond the boundary of GMR.

- **To promote comprehensive planned township that will enhance quality living**

  One of the main objectives of the Greater Mohali Region is not only to attract investments both foreign and local but also to provide the residents and visitors alike, an environment where they can refer to as “homes” sink in their roots. In this respect, the evolution of such communities may begin with the built environment. Hence, comprehensively planned townships are used for this purpose. Specifically, a modular approach where distinct neighborhoods are planned with a complete provision of the whole spectrum of community facilities is adopted.. There has to be a cautious effort to ensure that within each neighborhood, the elements of livability, community integration, safety, communication and culture are integrated within the whole planning and designing set-up.

  There has to be a conscious effort to inject the limitability factors in all aspect of the design. These include the following:

  - The provision of a wider choice of types and affordability housing
  - The provision of accessibility to all community facilities, particularly those needed on a daily basis (i.e. examples, neighborhood parks and convenience stores).
  - The urban and building design will have to adopt from best practice

- **Ensure accessibility through enhancing the regional and international linkages**

  In order to have a strong economic base and to sustain this within the GMR, it is important to ensure the rail and road particularly to Delhi and Chandigarh be strengthened. The international linkage through the upgrading and expansion of the airport to an international standing should bring about further improvement in terms of accessibility, ultimately spurring greater economic growth for the GMR.

Fig 7.9: shows a typical plan of a township, adopted from HDB (Singapore).

Firstly, transportation corridors provide the necessary accessibility and connectivity that allows for the decentralization of economic activities and secondly, it also allows for the development of new areas for residential as well as commercial developments. In this respect, the east-west connectivity and accessibility is partially met vide NH64 to Rajpura and NH95 to Ludhiana. Based on the initial assessment, there has to be another east–west link from Chandigarh, through S.A.S Nagar to Sirhind. This serves to open up new growth nodes to the south-west of S.A.S Nagar being planned beyond the 20-year time frame.

Currently, the north-south connectivity and accessibility is partially fulfilled through the only existing connectivity; the NH21 to Ropar which runs across from S.A.S Nagar, through Kharar and Kurali and NH22 to Ambala. Preliminary evaluation indicates that there should be further additions to this existing road which is as follows:

- possibility of extension from Lalru (along NH22) through Banur (along NH64), then routing this north-east wards to Kurali all the way to Mullanpur continue on through the Shivalik Hills into Baddi.
- Extension of the present existing NH21 from S.A.S Nagar to Derabassi.
- Upgrading and Extension of the existing road from Chandigarh through Mullanpur into Anandpur Sahib.

In addition there is a mass transit line safeguarded from Chandigarh to S.A.S Nagar westwards. The detail of the actual transportation corridors and the proposed transit line will be dealt with in greater depth in the transportation chapter.

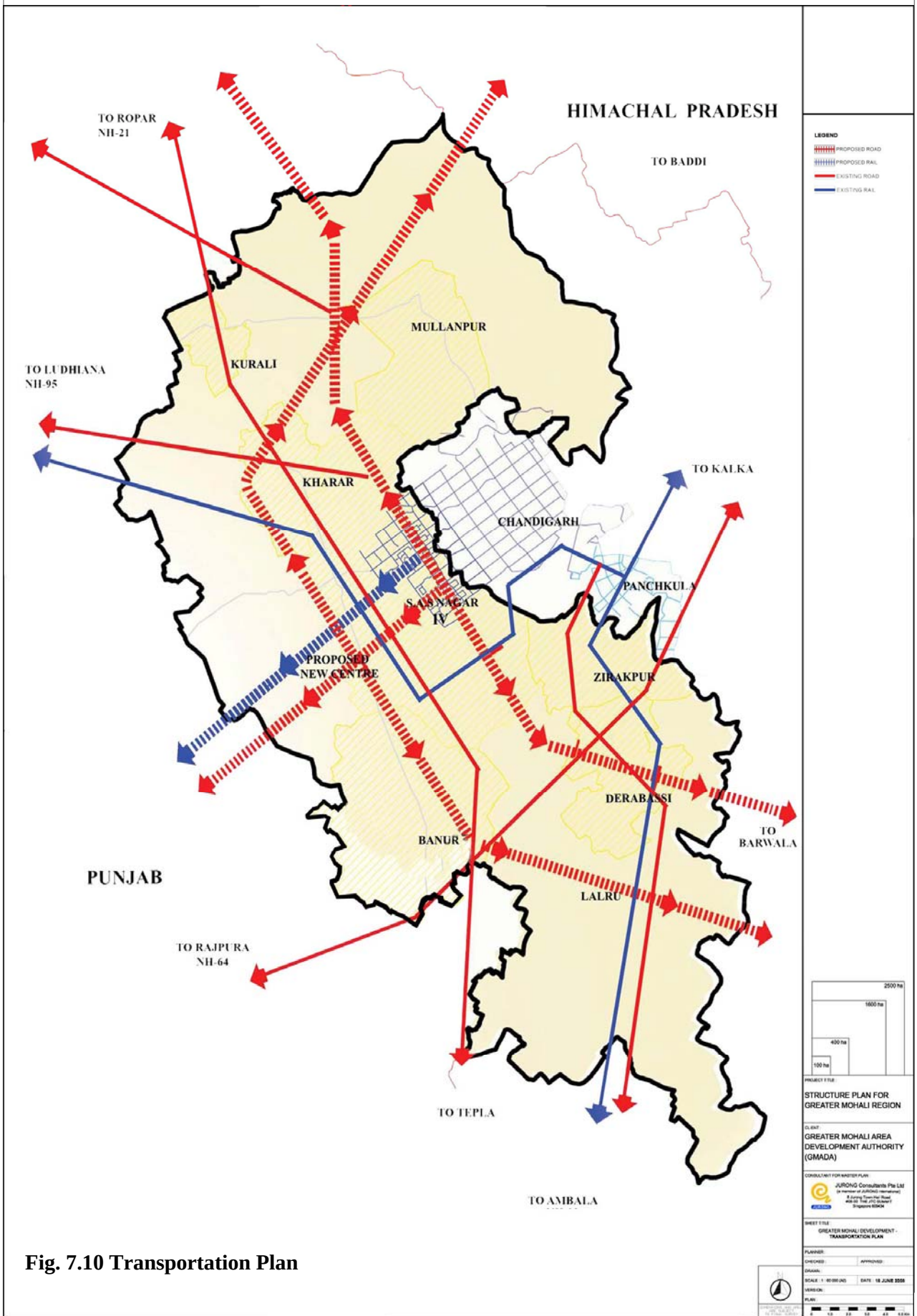


Fig. 7.10 Transportation Plan

- **Manage overall growth particularly in the areas surrounding the designated urbanized Areas.**

  Based on the projected population of 4.5mn people, the total urbanized area is in the region of 42 740ha, which is in the region of 35.9% of the total Greater Mohali Region. Based on the computation in terms of land use for residential, industrial and commercial use, the total "soft land" is more than sufficient to meet the demand of 4.5mn population, at the same time achieving the life styles envisaged. The main objective of confining the "urbane" developments within these designated urbanized zones and allowing the development densities to increase is to keep up to the infrastructure cost. The stringent control of the developments of the surrounding areas outside these zones can prevent developers from creating new subdivisions outside built-up areas. A well control urban zone can reduced potential for the "leap-frogging" of development to areas where land is cheaper, provided that the urbanized zones is sufficiently large enough to support the market and depending on the supportive policies introduced. In the case of GMR, there has already been sufficient safeguarding of land for the range of residential, industrial, commercial use for a population of 4.5 mn. Ultimately, these urbanized areas can reduce the total amount of land needed to accommodate a given population while preserving agriculture lands and environmentally or socially sensitive lands around the periphery.

- **The introduction of Technological-Knowledge-Business Park Corridors**

  This is a concept of creating a total modern business environment in location where it is considered to be most conducive for the clustering of similar and complementary industries. Such locations are being planned with land optimization and efficiency in mind. They are oasis for start–up companies where the concept of work, live, play and learn intertwined; a breeding ground for innovative industrial activities. Basically, the creation of these industrial "oasis" is to:

  - To attract foreign investment and technology
  - To create a low risk investment haven
  - To provide a conducive environment for free enterprise.

  Industrialists setting up shops would enjoy good, efficient internal transport system, supporting social amenities, infrastructure and utilities. Such industrial township will be ecologically sensitive with heavy emphasis on landscaping at all important critical nodes and entrances to the park so as to project itself as a garden industrial park and new urban image for GMR.

- **Two Technological Knowledge- Business Park Corridors are being planned:**

  - **The Banur- Zirakpur Corridor:**

    This is to take advantage of the already established institutional establishment concentrating around Banur, particularly along the major transportation corridor. Not only will this forms part of the Technological-Knowledge-Business Park Corridor but will also lead to the placement of education and training resources to improve employment possibilities and opportunities for the citizens at large.

  - **Airport-S.A.S Nagar Corridor:**

This is to take advantage of the expansion of the airport and the development of the CDB within S.A.S Nagar. The airport's proximal location to a principal growth centre like the downtown of S.A.S Nagar, will further enhances the related communities with an international business

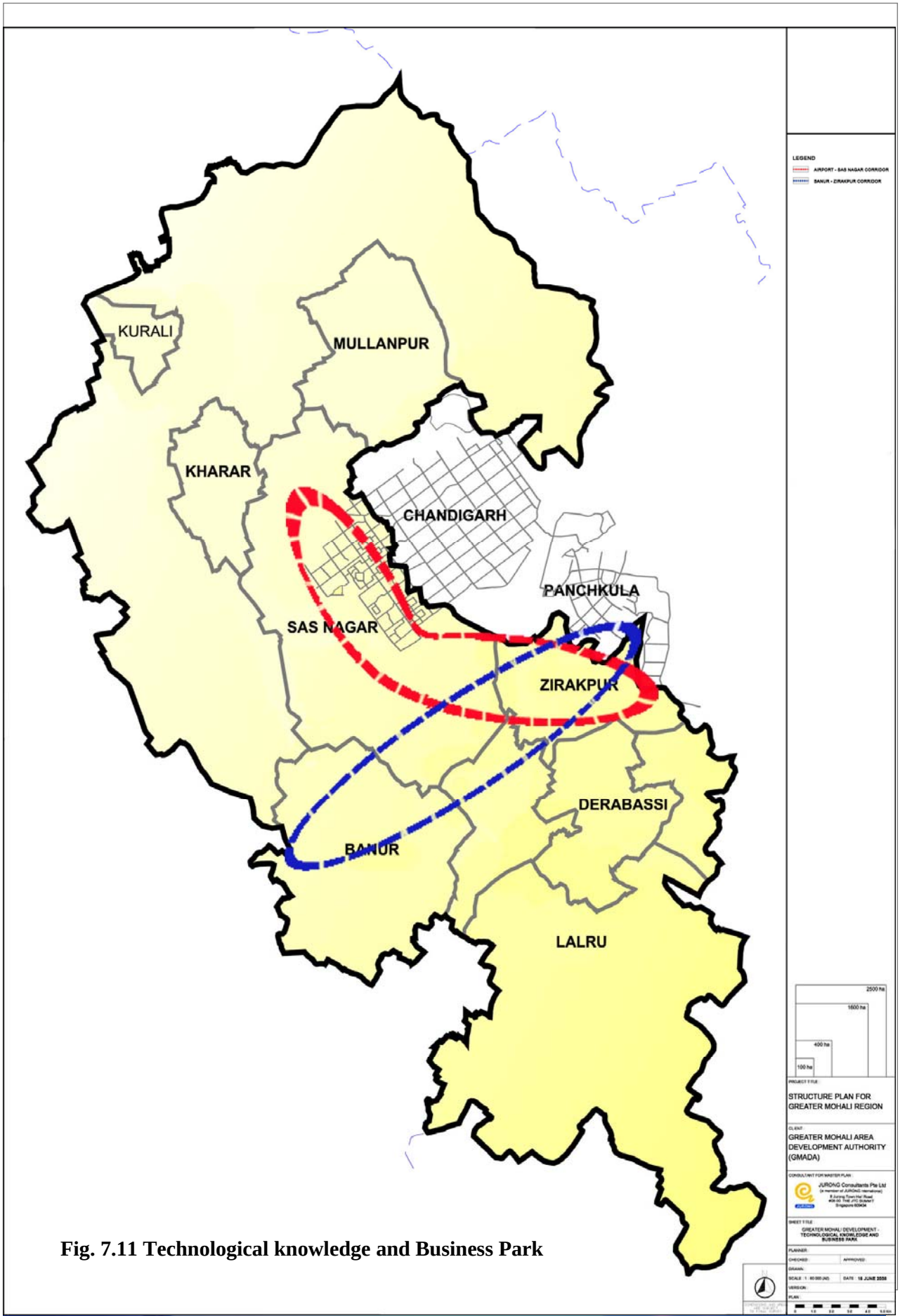


Fig. 7.11 Technological knowledge and Business Park

presence. The amalgamation of other aviation related engineering activities within the boundary of the airport will further boost the “twin growth poles”; airport and the CBD. These direct aviation economic activities will further attract supporting industries to its fold. Hence, the resultant multiplier effect for the whole economy will be considerable.

7.5 The Physical Development Planning- Consolidation

The strategies put forward in this regional plan aim at promoting and sustaining economic development through the proper use of the land and at the same time safeguard areas considered ecologically sensitive. In other words the regional plan balances between economic progress on one hand and the need for nature conservation and preservation on the other hand. This balance is maintained while at the same time fulfilling the need of the rising expectations and aspirations of the community.

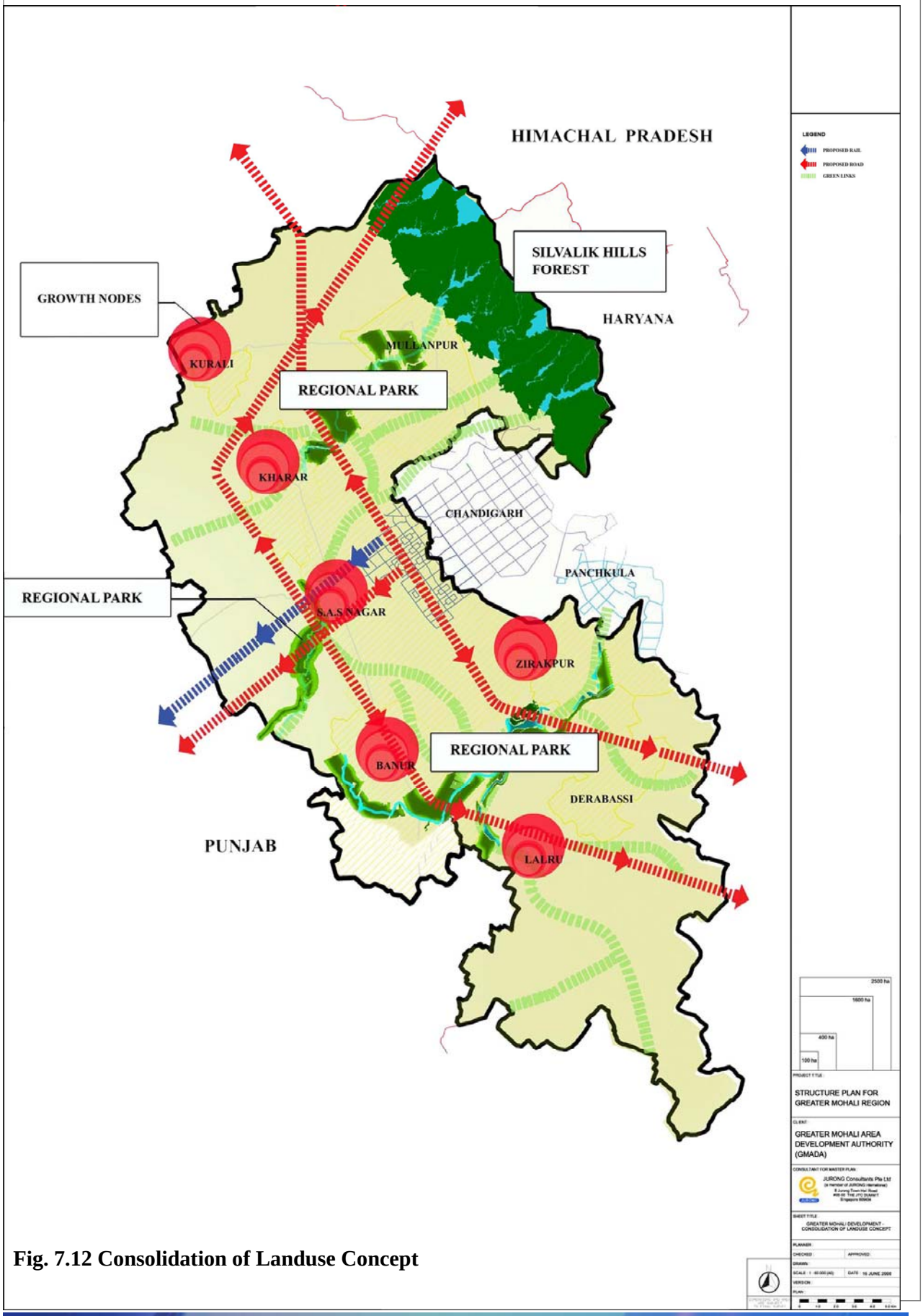


Fig. 7.12 Consolidation of Landuse Concept

Where there is inherent opportunity in the land, the regional plan seek to maximize and capitalize on these attributes but instances where there are constraints, the regional plan in turn mitigates these and in some instances convert them to good use; for example the low lying areas are being converted to water storage reservoirs and recreation spots.

7.6 Critical Economic Clusters/Zones

The GMR Regional Plan focus had identified the 7 key primary areas; potentially to be considered as critical mass economic zones, these are as follows:

Economic Cluster	Primary/Secondary Economic Activities
	CBD Financial District Arts and Culture Centre Administrative Centre
	Airport Hub Logistic Hub Aviation Related Industries
	Hardcore Manufacturing Warehousing Medium/small manufacturing
-	Instructional-Knowledge Belt Business-Technological Corridor Regional Park Southern Gateway (direct linked to Delhi)
Shivalik Hills	Nature Conservation and Preservation Public enjoyment of the fauna and flora Regional Ecological Park Micro-Climatic Modifiers
Mullanpur	Resort Centre Low Density Country Living Northern Gateway
	Diversification of Agriculture Activities RGC, critical mass approach to rural development Preservation of agriculture lands

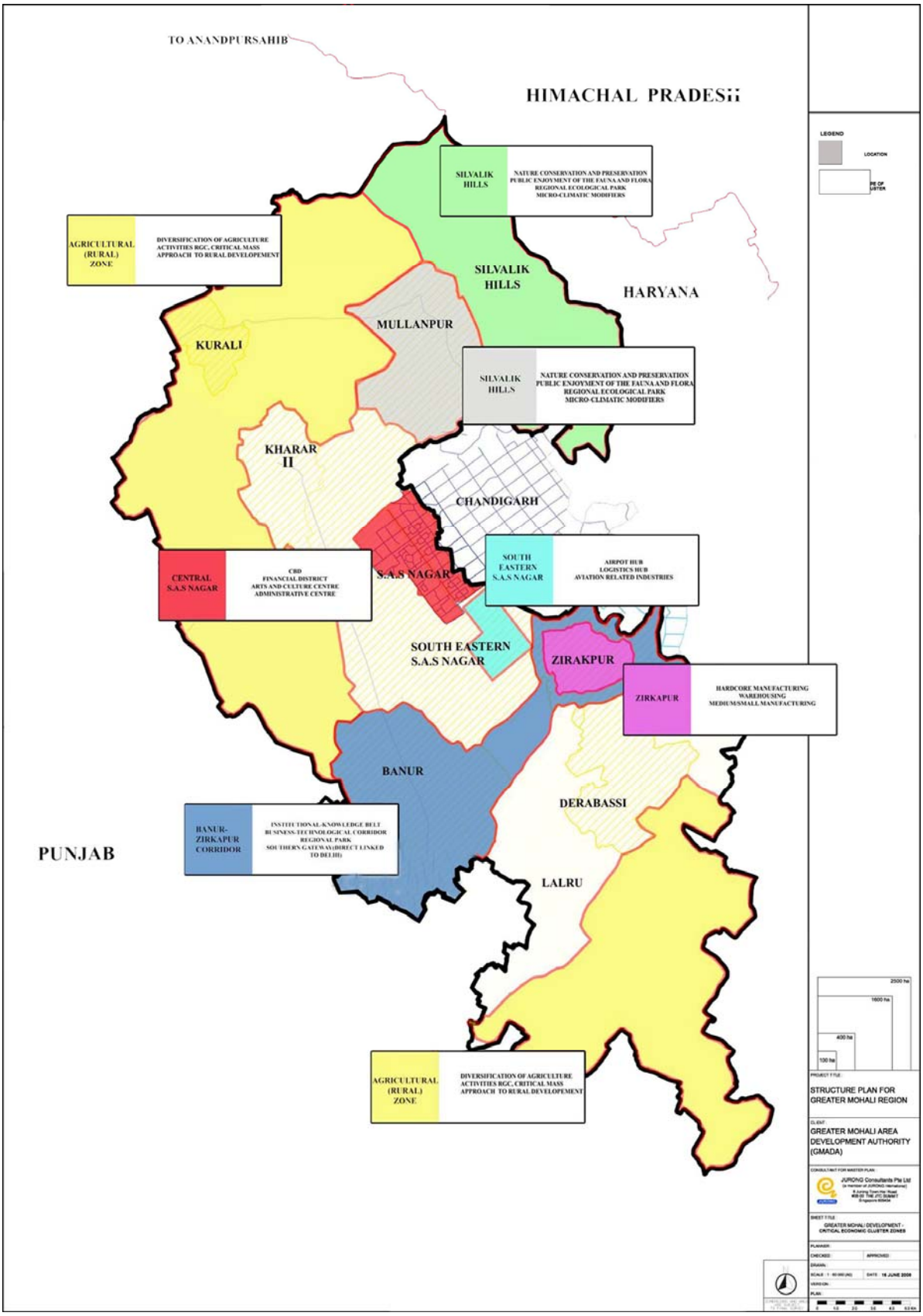


Fig. 7.13 Critical Economic Cluster Zones

8. Industrial Development Approach

8.1 Introduction

The vision for the 'Greater Mohali Area' is to create a conducive environment for work, live and play where multi – national and local manufacturing activities and various other land uses will co- exists harmoniously. The industrial activities in the region have been developing for over a span of about five decades, during which substantial structural changes have taken place. The region has done remarkably well in the field of agriculture and is now embarking on the path of rapid industrialization, having made significant progress especially in small and medium scale industries and in enlarging its export base.

8.2 Review of the existing industrial regulations

8.2.1 National

The economic and financial reforms undertaken by GoI largely affecting the trade, industrial and financial policy, have brought considerable changes in the economic landscape of the country. In light of these, the Government has recently undertaken a comprehensive review of the FDI policy and associated procedure. A series of steps have been taken to further liberalize and streamline the mechanism for both domestic and foreign direct investment.

The Government is also trying to attract high technology and foreign investment into India by Non Resident Indians (NRI) other than foreign investors. The GoI has laid down certain guidelines to allow foreign direct investment (FDI) for developing urban infrastructure, integrated townships, colleges, institutes and commercial centres etc.

i. FDI Guidelines: While the Government encourages FDI in all sectors, special considerations are also made for large FDI inflows for the development of infrastructural and technological upgrading of Indian industries and in projects having potential for creating employment opportunities on a large scale. The following are the salient features of the FDI guidelines:

- Government of India vide press note no. 7 (2000 series) approved up to 100% foreign equity for the Indian companies undertaking generation and transmission of electrical energy produced in power plants, which employ use of Hydro power, coal, oil and gas.
- 100% FDI is permissible in the hotel and tourism sector. The term hotels include restaurants, resorts, and other tourist complexes providing accommodation and/or catering and food facilities to tourists. The tourism sector includes travel agencies, tour operating agencies and agencies operating surface, air and water transport, units providing facilities for cultural, adventure and wild life experience, leisure, entertainment, amusement, sports, and health units as well as Convention/Seminar units and organization.

ii. SEZ Act 2005: India was one of the first countries in Asia to recognize the effectiveness of the Export Processing Zones (EPZ) model in promoting exports. With a view to overcome the shortcomings experienced on account of multiplicity of clearances, absence of world class infrastructure and to attract larger amount of FDIs, the SEZ policy was announced.

The Act provides for the establishment, development and management of SEZs in India. The prime objective of the legislation is to enable the SEZs to provide an internationally competitive environment and encourage investments in order to encourage greater economic activity, employment generation and dispersal of technical knowledge. The Act designates the Ministry of Commerce (GoI) as the competent authority for granting approval of SEZs. Further, the SEZ Rules of 2006 facilitate

and lay guidelines for development of SEZs in India as well as stipulate the minimum land requirement for developments based on their industry focus, and whether they are single product or multi- product SEZs. The policy also defines the management structure for development, operation and maintenance of SEZs. The following section would highlight select features of SEZ rules.

- **General Development Policies**

  The SEZ Rules outline the following guidelines for multi-product SEZs in India.

  - A Special Economic Zone for multi product shall have a contiguous area of one thousand hectares or more but not exceeding 5000 ha;

  - At least fifty per cent of the area shall be earmarked for developing the processing area.

  - For a SEZ of a specific sector or in a port or airport, the site area shall be a minimum of 100 ha for specific uses:

    i. For the electronics hardware, software and information technology enabled services; the area shall be a minimum 10ha with a minimum built-up area of 100,000 sq m for processing area.

    ii. For a bio-technology, non-conventional energy (including solar energy equipment/ cell), or gem and jewellery sectors, the area shall be minimum 10ha.

    iii. For a Free Trade and Warehousing SEZ, the site area shall be a minimum of 40ha with a minimum built-up of 100,000 sq m. Such use can be part of an SEZ for multi-products. However, if it is a specific sector SEZ, the free trade and warehousing zone may be permitted with no minimum area requirement but it shall not exceed 20% of the processing area.

- **Environmental Policies**

  SEZ units are required to obtain clearances from the State Pollution Control Board. A Unit as defined under the SEZ Act 2005 is one that is set up by an entrepreneur, such as an existing unit, offshore banking unit, or a unit in an international financial services centre, whether established before or established after the commencement of this Act.

  - Infrastructure: Under SEZ Rules 2006, infrastructure refers to facilities needed for development, operation and maintenance of an SEZ. It includes industrial, business and social amenities like roads, buildings, sewerage, effluent treatment facilities, solid waste management, port, including jetties, single point moorings, storage tanks and interconnecting pipelines for liquids and gases, Inland Container Depot or Container Freight Station, warehouses, airports, railways, generation and distribution of power, gas and other forms of energy, telecommunication, data transmission network, information technology network, hospitals, hotels, educational institutions, leisure, recreational and entertainment facilities, residential and business complex, water supply, including desalination plant and sanitation facilities[1].

    It is mandatory for the developer to provide adequate support facilities and infrastructure for industrial development[2]. However, the SEZ Policy also facilitates infrastructure provision by way of offering numerous incentives to the developer for setting up appropriate facilities. Some of these incentives are as follows:

[1] Section 2, Sub-section 1(s), Special Economic Zone Act of 1995, Government of India
[2] Section 5, Sub-section 4; ibid

i. The State Government shall endeavour to allow the SEZ and Developer to be exempted from electricity duty or taxes on sale of self-generated or purchased electric power for use in the processing area (Sub-Rule (5) of Rule 5 of SEZ Rules 2006);

ii. A liberal policy is being adopted for setting up of captive power units in SEZs (D.O. No. 23/43/2001-R&R dated 12 Oct 2001);

iii. Surplus power generated by the captive power plants of SEZ may be purchased by the State Electricity Board or any power company on mutually agreed terms. (D.O. No. 23/43/2001-R&R dated 12 Oct 2001);

iv. State Electricity Board/ Power Company would provide commitment for supply of back up power at reasonable rates. (D.O. No. 23/43/2001-R&R dated 12 Oct 2001);

v. Sale of power by generating companies directly to SEZ is allowed (D.O. No. 23/43/2001-R&R dated 12 Oct 2001).

- **Delineation of the Processing Area**

The processing area and Free Trade and Warehousing Zone shall be fully secured by boundary wall or wire mesh fencing having a height of at least 2 meters and 40 cms above plinth level with top 60 cms being barbed wire fencing (As per Rule 11-2).

Further, the Development Commissioner, appointed by the Central Government (Section 11, SEZ Act, 2005) shall be the authority to demarcate or approve the processing and non-processing areas within the SEZ (Section 11, SEZ Rules 2005)

8.2.2 State

In the industrial sector the economic reforms are slowly percolating to the various states. Every state government is in competition to attract more investment both domestic as well as foreign. Punjab is primarily an agrarian state but there has been tremendous development in the industrial sector. The region known for its rich agriculture resource base and its pool of highly skilled labour force would have a competitive advantage in the agriculture-based industries. The region has predominance of small scale industries approximately 0.2 million in number and 600 large and medium sized industries[3]. The industrial sector has created employment for approximately 1.18 million people in the state. The availability of raw material and investment opportunities in Punjab has contributed majorly to its industrial development.

During the past five years the average growth rate of the manufacturing industries has declined from 5.90% in 1999 – 2000 to 5.73% in 2000 – 2001, resulting in an unhealthy state of affairs for industries and low productivity. The revised industrial policy thus emphasizes the promotion of investment and development in the knowledge based industries and also the strengthening of existing small and medium scale industries.

i. Punjab Industrial Policy, 2003

Salient Features

- The industrial policy as notified by the state government in March, 1996 identified information technology, agro – based industries; tourism, electronic and export based industries as the thrust area and laid provision for special incentives to these industries.

[3] www.**punjab**govt.nic.in

- The policy also provides for the strengthening of single window concept of approval and time bound clearances for setting up of new industries.
- In addition to the sales tax exemption and investment incentives under the policy, modernization and technology up-gradation of existing industries were also introduced. This does not only encourage the industrial development but also a competitive environment for new industries and revive small scale 'sick' industrial units.
- Special incentives in terms of exemption from electrical duty, stamp duty, land and building tax and relaxation in FSI (floor space index) to the extent of 50% are provided by the state government to encourage IT and IT enabled services, electronic industries, knowledge parks and bio-technology parks. In addition Punjab government is encouraging private developers to develop and reinforce the infrastructure, which has a significant impact on the growth of these industries.
- All the industrial parks shall be developed through private sector or as joint venture of private sector and public sector undertaking.
- Punjab has the highest yield rate per hectare and highest net area irrigated in the country. Thus, the policy encourages agro – based industries which would involve production of value-added / high-end products from primary agriculture and horticulture crops available in the state. All the processing units are allowed to purchase agriculture products directly from farmers.
- There shall be no market fees and no rural output tax for the agriculture commodities other than paddy and wheat purchased by agro or food processing units.
- One of the most important steps taken by government in the industrial sector is the revival of small scale sick industrial units. There has been considerable pressure on the performance of small scale industries (SSI) with the globalization of economy. The state government has facilitated the process of surplus land disposal by sick industrial units. This process enables financial mobilization for the revival of these units.

8.2.3 Local

The industries are the major economic drivers in any city. The key challenge to the city's future management will be to control the type and nature of industrial development. These have to be compatible with the growth of other urban land – uses. The objective of planning of industrial development in the region is to minimize the adverse impact of (pollutive) industries on land optimization and also to provide for a balanced distribution of jobs and housing by the region.

There has been a phenomenal growth of small scale industries (SSI) which had a direct bearing on the environmental dimension of the region. It is mainly because of limited resources that SSI tends to waste resulting into more pollution per unit than other large units. In order to have uniform law, the ministry of environment and forest framed certain regulations for the industrial development which have been adopted by Punjab Pollution Control Board. The guidelines were formulated primarily to stop the haphazard development of industries and to implement pollution control laws.

The salient features of these guidelines are as follows:

- The industrial units shall be allowed to be located in industrial area, industrial estate, industrial focal point or FEZ areas as demarcated by town and country planning department.
- No approval shall be given to industries proposed to be established in approved residential area and Lal Lakir as notified in each village.

- All the industrial activities shall be confined to free enterprise zone (FEZ) in Derabassi – Mubarakpur belt, in permissible industrial use zone in the master plan of regional town falling within S.A.S Nagar area (Chandigarh periphery area) vide notification no. Sur/ST/ 184/ 64/ periphery/ tiny / 16831-B, dated September 28, 1992
- The board has categorized SSI into green and red category industries taking into consideration their pollution potential load (Table 8.1). All large and medium scale industries are considered in the same category as small scale red category industries.
- No new red category industry shall be given consent to establish within municipal limits except in the designated municipal area. All green category industries can be located in mixed category areas. The consent fee for all green category industries is 50% of the consent fee prescribed for red category industries.
- The board may grant consent to establish any green category industry to be located in the mixed category areas or predominantly industrial areas within the municipal limit of a town / city.

Table 8.1: List of Red category industries

Red Category Industries	
1.	Fertilizer (nitrogen / phosphate)
2.	Cement
3.	Tanneries
4.	Pulp & paper
5.	Manufacturing of dyes and dye intermediates
6.	Pesticides manufacturing of formulation except where no emissions are involved
7.	Basic drug, pharmaceutical and formulations
8.	Slaughter house above 70 no. total live weight killed or discharging effluent 1000 lts/ day and animal bone processing
9.	Heat treatment / tempering / electroplating/ surface coating and hardening
10.	Dyeing and processing cotton / woollen / synthetic yarn / fabrics discharging effluent 1500 lts / day
11.	Oil extraction , vegetables ghee / hard oil using hazardous substances in process
12.	Processing of paddy, rice, maize barley above 15t/ day or discharging effluent 1500 lts / day
13.	Stone crushers
14.	Processing industries for dairy, food, vegetables/ fruit discharging effluent more than 1500 lts / day
15.	Processing / manufacturing of chemicals including organic , inorganic acids and its compounds, zinc , lead oxides , chlorinated paraffin wax and zinc recovery etc
16.	Industrial units having induction furnace / arc furnace or other furnace using more than 150 kg/ hour of solid fuel or 100 lts / hr of liquid fuel
17.	Brick kiln and lime kiln
Green Category Industries	
	The industries not covered in above said red category

Together with these guidelines, specific buffers are being imposed, depending on the land use and types of industries. No industry shall be allowed to be located within 25 kms from the periphery of standard urban area limit of cities with population of more than 1 million. This would not apply to

electronics, computer software, printing, business parks and other non polluting industries. The industries, which propose to use solid fuel, should be located beyond 100m from *lal lakir*[4]. The above is not applicable to industries where location guidelines are prescribed as in table 8.2.

Table 8.2: Location guidelines framed by Pollution control board for setting up of industries

Sno.	Category	Buffer width for Brick Kilns/Cement plants/Grinding units/Hot mix plants/Stone Crushers	Buffer width for Rice Sheller
1.	Municipal corporation limits		2 Km
2.	Class A Town & cities limits		2 Km
3.	Other towns & cities limits		1 Km
4.	Village Lal Dora & Phirni		500 mts
5.	Wild life sanctuary / Zoo		500 mts
6.	National Highway		500 mts
7.	State Highway / Scheduled road		300 mts
8.	Residential area (15 pucca houses)		300 mts
9.	Educational institution/ Historical monuments / Religious places		300 mts

ii. Environment Clearances

The industrial progress in any city can bring along environmental problems. Many of these problems can be avoided if industries are located on the basis of environmental consideration. All the existing small scale industries and large or medium scale industries, which are likely to undergo expansion or modernization or any new project shall have to obtain environment clearance from Ministry of Environment and Forest. Although all the industrial projects may have some environmental impacts only the red category industries have to submit and environmental impact assessment (EIA) report for the clearance of their projects. It is a useful aid for decision making taking into consideration the environment implications including social, cultural and aesthetic concerns. These could be integrated with the analysis of the project costs and benefits. The EIA should address the following factors:

- Identification of environmental issues relating to zonal interactions.
- A review of site sensitivity issues

[4] Guidelines for entrepreneurs for compliance of environmental laws, Punjab Pollution control board

- Identification of key environmental issues in terms of ecology and other environmental resources, application of environmental standards and criteria
- Hazardous and non- hazardous waste management and disposal
- Disposal of industrial waste water and potential water quality impact
- Air quality impact from industrial emissions

From the national policy all the way to the local policy level, there is this urgent fervour to attract foreign as well as local investors. Policies have been formulated to entice and facilitate potential investors into the country. India is a large country; hence even though there is a national policy, local policies evolve over time to capitalize on the inherent local attributes. The Regional Plan and subsequent master plans shall given due consideration to such policies and incorporate them in the land-use plans.

8.3 Comparative analysis with other industrial development approaches

8.3.1 Indian cities

i. Delhi: Delhi is the capital city of India. It is the second largest metropolis in India after Mumbai, with a population of 11.5 million, with an extended metropolitan population of almost 22 million. Delhi is the focal point of its socio- economic activity as well as hub of political life and commercial centre of India. It has grown up to be a cosmopolitan city owing to the immigration of people from across the country. Rapid development and urbanization of Delhi and surrounding areas have led to higher average incomes.

The Government functions have expanded rapidly to cope with added essential functions, both administrative and socio- cultural. Owing to these activities the pressure comes to the core. Even the development which has taken along the periphery reflects the need for the expansion of the core.

- **Typology of industries:** The industrial sector plays a vital role in the economic development of the National Capital Territory of Delhi. The industrial activities in the National Capital Region (NCR) have been developing over a span of three decades. The industrial activities in the NCR have been largely confined to manufacturing and knowledge based industries. The manufacturing sector has been classified into large, medium and small scale industries and also other unorganized sector. The organized industrial sector consisting of large and medium scale units and small scale industries (SSI) have developed both in terms of number as well as growth of different industries. Delhi's manufacturing sector has grown in terms consumer goods industries. Delhi has a large consumer market and coupled with easy availability of skilled labour, has attracted foreign investment in region.

  The manufacturing sector comprises of a wide range of production such as electrical machinery, textile products, metal and metal products, food products printing, and caters to many sectors within the economy, for instance, construction, power, telecommunication, health, community services and real estate. The retail industry in Delhi is one of the fastest growing industries in India.

  Trade and commerce forms another important component of the economic base in the region. Distributive as well as wholesale trades, known to be one of the basic activities in the city have been instrumental in large scale employment generation in both formal and informal sectors.

  Percentage Share of various Industries in Total Number of Working

  Factories [Registered under Factories Act]

  - Food Products & Beverages [3%]

- Wearing Apparel: Dressing and Dyeing of fur [18%]
- Publishing, Printing & Reproduction of Recorded Media [6%]
- Chemicals and Chemical Products [4%]
- Electrical Machinery and Apparatus N.E.C. [6%]
- Rubber and Plastic Products 7%]
- Basic Metals [5%]
- Fabricated Metal Products except Machinery and
- Equipments N.E.C. [9%]
- Machinery and Equipments N.E.C. [8%]
- Others [34%]

Total 3,193 Factories

- **Industrial policy:**

There have been some major reforms in the policies supporting the current scenario. The main objectives are:

- To promote industrial growth in desired direction.
- To maximize production and optimize the utilization of resources.
- To upgrade technology of existing industries by providing technical and financial support.
- To promote hi- tech industries for a pollution free environment.
- To promote export oriented and import- substitution industries.
- To encourage activities allied to the industries, such as marketing related activities, consultancies, vocational training and entrepreneurial development programs.

The revised policy guidelines are:

- There will be a continuation of the total ban on setting up of hazardous industries as well as large/heavy industries which require investments in heavy machinery. In general only small scale industries will be permitted in Delhi.
- Small scale industries also would be discouraged unless they produce sophisticated goods and employ skilled labour.
- Suitable incentives and disincentives and other measures will be provided for shifting and relocation of industrial units not conforming to the land use intentions.
- Manufacturing activities which demand higher power, water, space etc than the permissible limit, shall be discouraged by charging of higher tariffs of electricity, water supply and property tax.
- The modernization and technological up-gradation of existing industries so as to make them more competitive and pollution free.

- The Government of Delhi would focus on promoting industries that are based on imagination, knowledge, content, innovation & creation.
- There will be a greater emphasis on service industries like banking, insurance, financing, accountancy, health care computers software development, entertainment, tourism and such other economic activities.
- All out thrust on Information Technology Industry so as to make Delhi, one of the major IT centres in the world. The growth and development of IT industry would be facilitated by providing necessary infrastructure support like setting up of software technology parks, information technology institutes, net-working infrastructure and other fiscal and non-fiscal incentives.
- To construct multi-storied flatted factories and complexes to save space and to have better management of services. The Government has set up an Udyog Sadan in the industrial area at Patparganj where all industry related agencies are being accommodated i.e. industries department, DSIDC, DFC & DKVIB. A single window system will be established in this building where all clearance for setting up of industries in approved industrial area will be available under one roof.
- To set up SEZs for IT Industries, making of gold/silver/platinum jewellery and articles. These SEZs should be equipped with facilities such as uninterrupted power supply, efficient tele-communications network, transportation and warehousing facilities, common effluent treatment plant and potable water supply. These special economic zones would be specifically delineated duty free enclave and shall be deemed to be foreign territory for the purposes of trade operations and duties and tariffs. Goods going into the SEZ area from domestic tariff area (DTA) shall be treated as exports and goods coming from the SEZ area into DTA shall be treated as imports.
- Existing industrial areas on Public Private Partnership basis will be up kept and maintained by providing 85% funds by the Government and 15% by the entrepreneurs of the respective estate through their association.
- Industries listed under prohibited category in MPD-21 shall not be permitted in Delhi. The existing industrial units under prohibited category will need to shift to conforming areas or to relocate themselves outside Delhi within a period of three years.
- The industrial units could be permitted only after registration by the Government of NCTD and clearance from the Pollution Control Authorities.
- In order to maintain the city's ambience and pollution free environment in important and historic areas of Delhi, following locations are categorized as 'No Industrial Activity Zone' where no industrial activity including household industry, shall be permitted:

  i. Lutyen's Bungalow Zone

  ii. Civil Lines Bungalow Area

  iii. Employer Housing

  iv. Group Housing.

- Development of new industrial areas should be largely planned for the purpose of relocation of existing industries and for the development of a limited type of new industries, which cannot operate in residential and other use zones. The focus of new industrial development should, as a matter of policy, be in the NCR.

- Industries may be grouped on the basis of common requirements such as effluent treatment, commercial needs, interdependence and nuisance value such as fire hazard, noise etc. as suggested below:

  i. Electronics and telecommunications.

  ii. Electrical goods including appliances.

  iii. Auto parts, light engineering and service industries.

  iv. Printing paper products and allied packaging.

  v. Service and supply units.

  In the last decade, urban Delhi has experienced a significant functional shift in its economic structure in favour of manufacturing and processing activities. The major focus of the policy is on curbing the industrial activities of Delhi and relocating and prohibiting pollutive industrial activity from being set up in Delhi. This has posed both challenges as well as opportunities for the economy. Thus, the industrial policy has recognized the importance of planned industrial areas, ensuring locational opportunities of the existing industrial set ups, public – private participation for setting up industries and upgrading infrastructure and the advanced setting up of SEZ to regularize the industrial growth.

ii. Bangalore: Bangalore is known as the Silicon Valley of India and has become the Asia's fastest growing city with a growth rate of 3.5% per annum. It is now regarded as a high tech city with office or development centers of a good number of mega software companies having wholly owned subsidiaries or joint ventures in Bangalore, including IBM, Hewlett-Packard, Texas Instruments, Oracle, Novell, Fujitsu, and Digital Equipment. The main reason for such a high tech development was liberalization of tax incentive by local government. Bangalore also is headquarters to a large number of Indian software companies and currently produces more than 45% of all software that India exports. In a short time, Bangalore has experienced rapid growth and international recognition in the field of software development, placing the city at a promising position in the international market for software. Presently with area of just 500 sq km, the city offers the opportunity of shorter travel times and distances yet with the same time opportunities similar to Delhi or Mumbai.

Bangalore has seen high demographic growth since 1941 when it had 0.4 million populations, to more than 1.5 million in the last decade (1991 – 2001) to reach the total of 5.68 million inhabitants during the census of 2001.It has traditionally been an important trading centre for textile and agro – products for a wider region. The city's location evolved as a congruence of ethnic and also agro – trade economic zones giving it both a strategic and economic importance. As a centre of trade for south India, Bangalore attracted different cultural groups specializing in particular parts of the economic process.

The city also attracts people from all over the world for its excellent schools and universities, such as the Indian Institute of Science, National Institute of Mental Health and Neurophysics, the Indian Space Research Organization, Indian Institute of Management (IIM) and Indian Institute of aero physics. Bangalore is even gaining the status of the "Floriculture Capital" due to the present boost of flower export from the city.

Bangalore has a well diversified economy in trade, manufacturing and rapidly growing service sector. While IT and ITeS are emerging as significant employers, traditional trade and wholesale market in the central city areas, and small scale manufacturing and fabrication in its central and peripheral areas still remain as major economic and employment nodes.

- **Typology of industries:** Economic growth was triggered after independence and during a forty-year period by high public investment in civil, military and spatial research. Since the sixties, several large public companies (BEL, HAL, HMT, ITI, and BHEL) were also set up. Development of private textile and garment companies (traditional activities), the electricity industry, machine tools (engineering), automobile sub – contracting, food and chemical industries were joined, during the last decade , by advanced technology , electronics, information technology and telecommunication industry. The pharmaceutical industry as well as automotive and components industries are also major contributors to the economy in terms of trade.

  Employment for the bulk of population of the city (about 70%) including the lower income groups and an estimated 60% of the economic product are from the Informal sector. These constitute low-end trading and manufacturing. Many of these activities happen within residential developments and neighborhood, where the real estate is much cheaper. Thus, the disparity is particularly stark for intensively pro- poor economies such as hawkers and the rest.

- **Industrial Policy:** The industrial policy's objectives are unambiguous and growth oriented with:

  - A high level committee for expeditious clearance of mega projects constituted.

  - A state level single agency set up for clearing projects.

  The government revised the package of incentives and concessions for the new industrial investment in the state from Nov. 1, 1990. These incentives shall cover all categories of industries from new, small, and medium to large scale units. There are special concessions as 100% sales tax exemption for a period of three to six years from the date of commencement of commercial production. These industries could be set up in various zones as applicable to the industries:

  - The agro-food processing, agro based industrial high – tech packaging units, cold storages, green houses, tissue culture labs, bio- fertilizer, bio- technology, growth regulators, seed production, informatics software units, units set up in the Bangalore urban agglomeration shall be eligible for 100% sales tax exemption for a period of three years.

  - 100% export oriented units (EOU) set up in Zone I including Bangalore Urban agglomeration area shall be eligible for incentives and concessions for a period of three years.

  - The policy offers a capital investment subsidy of 10% of the value of fixed assets, to set up units in Export oriented industrial zones (EOIZ) and also to all 100% EOU s set up in Bangalore urban and rural district Zone II and III, provided the units achieve a value addition of at least 25% and also employ local labour to the extend of at least 80% of the requirement.

  - The industrial policy also provides exemption for payment of Entry tax on all raw materials, components etc procured for processing in the EOU s/ EOIZ irrespective of their location.

  - All EOU s set up in the state are exempted from power cuts, which has been imposed by Karnataka Electricity Board on industrial concerns from time to time. In addition to the above concession, 100% EOU set up in EOIZ, Bangalore urban and rural areas shall be exempted from payment of sales tax, payable on the raw material, components, packaging materials, consumables, capital goods, semi finished goods and sub assemblies procured from the industrial units within the state. This is to promote exports of manufactured locally and also whole sale trade industry.

  - The IT corridor project in Bangalore was initiated by the Bangalore development authority and department of IT and was conceptualized by Jurong Town Corporation Pvt ltd of Singapore covering an area of 8000 Ha. This project was developed for knowledge based industries with state –of- art facilities.

- The policy offers several incentives and concessions to the companies providing basic infrastructure to the BPO sectors. Thus, the telecom industries as classified in the new industrial policy 2001-06 are exempted from stamp duty and registration charges on execution of lease and absolute sale deeds by the companies.

- The government has also encouraged industries in BPO sector to obtain ISO 9000, ISO 14000 to promote total quality management and other best practices. The policy also emphasizes on rapid technological upgrading for knowledge based industries. Also for establishing SEZ in the state, has to comply with the national SEZ act, 2005.

Bangalore has witnessed exceptional growth in IT services and product companies to be a large employment base. The recent investments and tax incentives have attracted a large number of BPO companies as well. Excellent telecom infrastructure, abundance of human resources, low cost of operations, good civic infrastructure and supportive regulations are some of the key factors for the growth of BPO sector. The department of IT in collaboration with confederation of Indian industry (CII) is estimating the creation of million plus jobs by 2010 in the state of Karnataka. In a nut shell the state is able to provide job opportunities for those looking for jobs but at the same time be able to formulate appropriate effective policies/ incentives to attract investments. Further more, the state recognizes that infrastructure plays a part in progress and is prerequisite to leap frog development.

8.3.1 Other cities

i. Singapore: Singapore has achieved substantial economic and social progress since independence in 1965. The population of Singapore grew to 4.35 million in 2006- 07, which is more than twice in 1965, and the GDP multiplied by over 20 times [(1)]. The world economic forum ranks Singapore 7th in growth competitiveness and 10th in the business competitiveness in the 2004-05 report. The per capita income has reached S$41,513 (US$24,560) in 2004, which is the highest in Asia.

Singapore industrial sector has progressed from labour intensive export manufacturing to capital and technology intensive manufacturing and high value added services. Singapore has achieved sustained prosperity through export led industrialization by inviting MNCs to locate regional headquarters and financial centres here. Policies in Singapore are supported by:

- Good governance
- The *" rule of law"*
- Well – functioning social contract resulting in political stability

  Singapore demonstrates the success of government intervention in the economy to create national competitive advantage through selective industrial policy. This has been displayed by openness to the international trade, investment and technology flow, macro – economic stability from fiscal and monetary prudence and high savings and investments.

- **Typology of Industries:** Since 1960s, Singapore economy has transformed from a regional *entrepot** into an export – manufacturing platform and a service hub and is now shifting towards knowledge – based economy. Manufacturing and service industries have been the pillar of Singapore's economy. The contribution of agriculture has been negligible. Manufacturing's share of GDP rose from 15% in early 1965 to over 25% in the past decade.

Table 8.3: Manufacturing Industries, 2004

Code	Industry	Output S$million	Workers Number	Output %distribution	Workers %distribution
15/16	Food, beverages, tobacco	3943.6	18756	2.19	5.31
17	Textiles, textile manufactures	247.2	1623	0.14	0.46
18	Wearing apparel	748.6	8424	0.42	2.39
19	Leather, leather products, footwear	219.3	1107	0.12	0.31
20	Wood, wood products	268.5	1618	0.15	0.46
21	Paper, paper products	850.0	4229	0.47	1.20
22	Printing, reproduction of recorded media	2688.7	18018	1.49	5.10
23	Refined petroleum products	27815.6	3067	15.44	0.87
24	Chemicals, chemical products	35952.7	19808	19.95	5.61
25	Rubber, plastic products	2597.5	19505	1.44	5.52
26	Nonmetallic mineral products	1372.7	5113	0.76	1.45
27	Basic metals	692.4	1395	0.38	0.40
28	Fabricated metal products	7060.0	37375	3.92	10.58
29	Machinery and equipment	9774.2	42404	5.42	12.01
30	Electrical machinery, apparatus	2066.4	8191	1.15	2.32
31	Electronic products, components	69460.1	90096	38.55	25.51
32	Medical, precision, optical instruments	3304.0	10494	1.83	2.97
33	Transport equipment	9317.5	50764	5.17	14.37
34	Furniture, other manufacturing industries	1180.0	10411	0.65	2.95
35	Recycling of metal, waste, scrap	622.3	728	0.35	0.21
	Total manufacturing	180181.9	353146	100.00	100.00

Source: Yearbook of Statistics, 2005

The share of service industry has been fluctuating between 62 – 64% during the last decade. Among the service sector, the share of trade has been declining, while the share of financial services and business services has been rising rapidly since country's independence. The share of transport and communications remained relatively unchanged.

The strategic location and natural deep water port gave Singapore a head start initially for international trade under the free trade policy and later for international shipping. Singapore's industrial strategy was on export-based industrialization and becaming an export production platform for MNCs.

Table 8.4: Singapore composition of exports

	1965	1970	1975	1980	1985	1990	1995	2000	2004
Total exports, S$million	3004	4756	12758	41452	50179	95206	167515	237826	303476
% distribution:	101.32	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Food	14.51	11.56	7.18	4.84	4.37	2.87	2.12	1.27	1.07
Beverages & tobacco	1.53	1.51	0.32	0.38	0.48	1.46	1.36	0.80	0.59
Crude materials	27.28	30.07	13.28	11.34	5.38	3.06	1.44	0.70	0.63
Mineral fuels	14.35	17.30	27.05	28.87	32.79	18.17	8.27	9.70	12.24
Animal& vegetable oils	2.00	2.95	1.92	2.64	3.06	0.80	0.43	0.16	0.15
Chemicals	3.65	2.71	3.73	3.42	5.41	6.27	5.97	6.93	11.68
Manufactures	13.21	8.90	8.52	8.30	7.17	6.99	6.34	3.79	3.73
Machinery & transport	10.49	10.95	22.69	26.75	33.02	50.14	65.67	67.45	61.06
Miscell.manufactures	5.09	5.21	6.90	6.21	6.73	8.93	7.49	8.15	7.90
Miscell. Transactions	9.22	8.85	8.41	7.25	1.59	1.32	0.91	1.05	0.95
Domestic exports, S$million	na	1832	7540	25805	32576	62754	98473	135938	166503
% distribution:	na	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Food	na	5.75	3.69	2.33	1.47	1.53	1.22	0.99	1.09
Beverages & tobacco	na	0.64	0.34	0.40	0.32	0.62	0.49	0.19	0.19
Crude materials	na	1.63	0.60	0.59	0.58	0.73	0.59	0.48	0.48
Mineral fuels	na	43.24	42.88	45.00	48.62	27.31	13.93	16.82	20.25
Animal& vegetable oils	na	2.66	0.74	1.53	1.93	0.94	0.34	0.21	0.23
Chemicals	na	2.36	2.76	2.22	4.91	5.77	5.71	7.88	17.23
Manufactures	na	9.27	6.45	5.13	3.73	3.39	2.97	2.26	2.46
Machinery & transport	na	10.78	22.37	25.45	31.11	51.55	68.80	63.15	49.41
Miscell.manufactures	na	7.89	8.86	7.31	6.81	7.75	5.41	7.41	7.93
Miscell. Transactions	na	15.76	11.32	10.06	0.51	0.42	0.54	0.60	0.71
Machinery & transport,S$millon	na	na	na	na	na	na	na	85851	82269
% distribution:	na	na	na	na	na	na	na	88.02	86.40
Electronic valves	na	na	na	na	na	na	na	30.91	32.45
Data processing machines	na	na	na	na	na	na	na	28.97	23.55
Parts for office & DP machines	na	na	na	na	na	na	na	15.63	15.83
Communications equipment	na	na	na	na	na	na	na	6.22	8.19
Electrical circuit apparatus	na	na	na	na	na	na	na	3.46	3.75
Electrical machinery	na	na	na	na	na	na	na	2.83	2.62

Source: Singapore Yearbook of Statistics, various years.

- **Industrial policy:** Singapore has been an oasis of political, social, legal and macroeconomic stability. The economic stability protected the asset of foreign investors. The key elements of Singapore's industrial strategy are strong government policy intervention. The industrialization encouraged specific types of activities; reliance on free trade and foreign direct investment , investment in physical infrastructure and human capital to ease supply constraints; stable macroeconomic environment and industrial relations and liberal use of fiscal incentives . It identified electronics, chemicals, engineering, life sciences, education, healthcare, communications, media and logistics as the industries to be encouraged.

  - The tax incentives in Singapore have led to core investment in consumer electronics and industrial electronic industries, where MNCs from US, Japan, Europe have opened their East Asia base. (However, there has been shrinkage in this industry in recent years in terms of number of establishment and total employment as many labour intensive setups were relocated out of Singapore and new or upgraded firms became more capital intensive.)

  - The strong macroeconomic environment characterized by high savings and investments and low inflation. The high savings rate reflects compulsory savings under Central Provident Fund (CPF) as well as public sector budgetary and operating surpluses. Full employment and CPF provide a social safety net for workers. In addition, subsidized public housing enables 85% of the population to enjoy home ownership.

  - The international business hub 2000 programme focused on the strategies to develop Singapore as a service hub, particularly in business and finance, logistics and distribution, shipping and communication and information. Thus, Singapore became the hub for Asia pacific for key economic activities.

  - The industrial policy strategizes to nurture the logistic and supply- chain management cluster, to develop Singapore into a leading integrated logistics hub for the Asia Pacific Region. A free trade logistics park has been established at Changi Airport and a chemical logistics hub in Jurong Island.

  - The chemical industry (including petrochemical) industry is the second largest, with its hub at Jurong Island, a 3200 ha of offshore chemical complex. It produced S$22 billion worth of goods in 2003.

  - The industrial strategy encouraged shipping industry to build oil rigs for major oil exploration companies. Keppel and Sembawang, which followed Jurong ship yard in ship – repair, are now among the world's largest oil – rig builders.

  - The industrial policy focuses on building the infocomms and media cluster into a global hub in Asia for the digital economy offering a wide range of initiatives and development in telecommunication, IT, media, e- commerce and internet.

  - In recent times, there has been the nurturing the life – science cluster with world class capabilities in pharmaceuticals, medical devices, biotechnology, agri- biotech products and food intermediates, thus enhancing the existing pharmaceutical bulk activities. More activities are also seen in R&D, product and process development, clinical trials and manufacturing.

- **Foreign direct investment:**

  - FDI have played a crucial role in Singapore in its pursuit of export manufacturing and development of its financial centre, despite its small domestic market.

- Singapore is the base for global and regional operations of 5,000 foreign MNCs.
- It has the largest inward FDI penetrations in the world, the largest concentrations are in manufacturing (37.6% in 2003) and in financial and insurance services (34.0%).
- The tax incentives cover industrial expansion, use of foreign technology, skill development, industrial upgrading, innovation and R&D and growing the service industry.
- There are investment allowances to encourage capital investment and reinvestment by Economic development board (EDB) established in 1961 and other government agencies for targeted capital- intensive strategic investments.
- The FDI policy is characterized by the use of tax incentives and lack of restriction. The extensive use of tax incentives compensate for the locational disadvantage such as high cost of land, labour and a small domestic market.

Singapore has achieved sustained growth in terms of its per capita income and standard of living, which is among the highest in Asia as well as in the world. It has pulled on its geographical advantage and developed an infrastructure that links it efficiently to the rest of the world. Singapore has been a model town for industrial development across the world. Some of the key factors of contributing to its success are:

Table 8.5: Singapore - stock of Foreign Direct Investment

Year	Inward FDI total	Major investing countries				Major sectors	
		UK	US	Japan	Netherlands	Manufac-turing	Financial services
	S$million	% of total				% of total	
1970	1,398.3	30.3	18.4	8.2	0.8	50.0	19.1
1975	4,649.5	28.1	18.3	9.7	2.4	50.3	21.7
1980	11,201.7	26.3	22.5	11.7	1.9	56.6	16.5
1985	22,354.9	16.1	26.7	14.1	3.5	50.5	28.0
1990	53,151.5	12.1	17.8	20.6	8.0	41.4	33.9
1995	92,840.7	10.4	17.4	19.4	5.0	38.2	37.3
2000	195,023.7	4.6	16.3	15.0	15.0	36.1	35.9
2003	244,390.8	16.2	15.4	13.5	11.1	37.6	34.0
2004	na	na	na	na	na	na	na
Year	Outward FDI total	Major destination countries				Major sectors	
		China	Malaysia	Hong Kong	Indonesia	Manufac-turing	Financial services
	S$million	% of total				% of total	
1976	1,015.1	na	na	na	na	na	na
1981	1,677.7	-	60.0	10.8	2.4	na	na
1985	2,257.2	2.6	43.1	20.4	2.9	na	na
1990	13,621.7	1.8	20.5	16.6	1.7	17.6	53.6
1995	49,570.8	7.5	20.9	13.5	7.9	25.1	48.1
2000	98,291.1	16.0	9.9	8.7	5.6	25.4	48.3
2001	133,612.4	11.8	8.4	8.6	4.2	20.1	55.3
2002	148,923.4	12.1	8.9	8.0	5.2	20.9	55.1
2003	153,484.2	12.4	8.6	7.6	6.5	20.8	55.7
2004	na	na	na	na	na	na	na

Sources: Singapore 2005 Statistical Highlights; Singapore Yearbook of Statistics, various years

- Consistency and coherence of its FDI policies
- Emphasis on human resource development and infrastructural development
- Singapore's economic development board pioneered the 'one –stop – shop' concept to service foreign investors.

- The free trade and other tax incentives gave Singapore an upper edge over the other countries in South –East Asia.
- An institutional setup that is proactive in the handling of foreign as well as domestic investors.

ii. Seoul, South Korea: Korea, inspite of the micro scale of its economy, has been a major receptor for US based investments. Korea attempted, with variable success, to import foreign technology and social innovation. At the turn of the century, the capital, Seoul, was the only East Asian city to have electricity, trolley cars, a water system, telephone system and telegraphs at the same time. It was occupied by Japan in 1905 and formally annexed in 1910. Japanese economic institutions and practices were transferred to the peninsula, and considerable industrialization and technological learning occurred during the Japanese colonial period. Employment rate increased during the period and the industry's share of GDP reached 29 percent in the year 1939 – 41. Initially industrialization was concentrated in light industry. By 1943, heavy industry accounted for nearly half of industrial output and the chemicals complex at Konan was by far the largest in East Asia.

The Korean War (1950-53) led to the mass movement of population, resulting in the net flow of human capital from North to South Korea. In the 1960's, government encouraged exports from local manufacturing firms, thus encouraging the local firms to compete in the international market. The exporters were provided with exemption from duties on imported intermediates, tax incentives, and preferential access to capital, and depreciation allowances on importing capital equipment. The financial liberalization policy was reversed in 1972, when interest rates were lowered and direct government control of banking system was increased in order to channel capital to preferred sectors, projects or firms. Capital channeling policies were augmented by extensive tax incentives for the priority industries.

The political disorder of 1980 coupled with slow down in the economy and complaints from businessmen, industrialists, and ordinary citizens about lack of facilities in Seoul caused by the decentralization measures led to abandoning of the major plan of building a new capital city, relaxing restriction on industrial location, delaying relocation orders etc. These changes were brought about largely as a part of the liberalization measures taken to boost the country's economy. Although the new Government in the post 1980 period announced its intention to pursue decentralization policies, the relaxation given earlier set an irreversible process of liberalization towards industrial location.

- **Typology of Industries:** The industrial location policies were introduced just about the time when Seoul began to experience natural decentralization of its population and manufacturing activities. The dispersal measures accelerated this process and succeeded in reducing concentration of manufacturing jobs in the CBD from 49,000 (17.5% of Seoul's jobs) in 1970 to 30,400 (5.7% in 1978) and deflecting much of the growth to the outer areas of Seoul region. Outside its CBD however, Seoul continued to grow regardless of dispersal measures.
- **Industrial policy:** In Korea, the Industrial Location Policy was a part of the package of decentralization policies introduced in 1964 to control growth of Seoul - which was then growing at 7% per year - to correct its unbalanced structure and to reduce disparities in the development of Seoul region and the rest of the country. The policy measures employed for this purpose were more diversified and thorough-going. They consisted of:
  - Infrastructure measures such as provision of land and infrastructure or industries;
  - Fiscal and financial incentives such as tax exemptions and concessions, building and machinery subsidy, preferential sale of land, and loan for covering relocation cost;

- Control measures such as reduction of industrial area in the Seoul city, restriction on setting up new units and in-situ expansion, issuance of relocation order and strict enforcement of pollution measures; and
- Direct action by the Government to relocate its own activities.

For the purpose of implementing the above measures the Seoul Region was divided into three Zones: a) Dispersal Zone; b) Status-quo Zone; and c) Inducement Zone.

For industrial policies to be successful, the market equilibrium must be suboptimal. The government was able to identify these opportunities for welfare – enhancing interventions based on the market scenario, also formulate and implement the appropriate policies and prevent political failure from leading the interventions astray. The policy led to the up gradation of manufacturing sector and local exports. On the other hand, tax incentives led to extensive import of machinery, which provided considerable potential for Korean firms to take advantage of foreign technology embodied in equipment.

8.4 Industrial Development Policy for Greater Mohali Region

To a certain extent, the Greater Mohali Region economy is does currently saddle with a slight structural problem caused by fairly dependence on agriculture. The key to enhancing the economy is to move from primary sector to the secondary and tertiary sector like manufacturing and services including tourism.

Currently, the industrial sector is still in an infant stage in terms of global market. The industrial sector is characterized by both large and medium scale manufacturing units. The existing industrial sector is mainly dominated by Punjab tractors limited, Ranbaxy laboratories, ICI paints and Godrej. The service industry is still establishing a base in Greater Mohali area.

The key findings for GMADA development area is that firstly, the future types of industrial activities that will be relevant to drive the economy will be industries that are knowledge and skill intensive rather than land and labor intensive. Secondly, industrial estates or developments will have to be total business orientation; mixed uses within the development of technological parks.

The industrial objective will have to be the provision of sufficient land for a range of industrial uses including high tech and R&D industries in support of economic development strategy. This approach will have to be accompanied by the balance distribution of jobs and housing by regions. Equally important, is also the need to remove or minimize the adverse impact of pollutive industries. This exercise is to selectively phasing out these industrial areas for higher value uses.

The creation of modern industrial park within designated zones of "Economic & Technological Development, is to have 3 objectives in mind:

- To attract foreign investment & technology
- To create a low risk investment haven
- To provide a conducive environment for free enterprise.

Strategically speaking, industrial lands, particularly that safeguarded for "Business parks development will have to be in at strategic locations near regional centers, along major transportation corridors and close to major educational institutions. This is to optimize the use of

industrial land at location of good accessibility. Industrial development has to be in tandem with housing strategy to ensure enough employment opportunities within the region.

Within each industrial estate or business park development, appropriate industrial zones to accommodate the various types of industries identified and to ensure industrial compatibility. Also to demarcate plot sizes to determine possible mix of industrial types which can be allocated within the industrial areas is equally important.

The review the phasing for industrial development and proposed sub-phasing will have to be regularly carried out to ensure their relevance and is in tandem with the changing global market situations. Lastly, there is also a need to integrate the planning of the industrial area with adjacent developments, particularly institutions of higher learning where the there is a lot of cross fertilization between R&D within the industry and the institutions of higher learning. In line with this, similar industries can be grouped or clustered together on planning and environmental grounds. By locating similar industrial types together, is to encourage the sharing of common facilities and to have linkages in production. More importantly, there will be strong synergy between such similar industries to support each other if the size of these sub zones is adequately large to create an optimal critical mass.

Based from a transportation aspect, Greater Mohali Region should be able to further develop its industrial sector. Greater Mohali Region is strategically well position, in the north-western part of India, this together with the vast transportation network, serves as the physical links to the rest of the region and the world. Greater Mohali Region is served mainly by a road network, namely existing NH-21, NH-95, NH-64 and NH-22, that links it to the other parts of the country, as well as the major urban centers and major transportation hubs. Greater Mohali Region enjoys close proximity to some of India's major urban and commercial centers, such as Delhi, Ludhiana and Amritsar. Additionally, with the upgrading of the airports, GMADA is within easy reach of the global market.

9. Shelter Needs and Strategies

9.1 Introduction

Housing is an essential need and connotes a better quality of life than that of "shelter". This chapter on Housing will reviews the general current conditions within the Greater Mohali region, highlights the issues and challenges and sheds light on the strategies to improve the provision of housing for all within the Greater Mohali region.

Housing is tied to employment, public facilities, finance, be it public finance, housing mortgage and affordability issues and eventually a sense of economic well-being of that city, village or urban centre. Making quality housing is a partnership of the authority that regulates through adequate legislation, the commercial viability of the public or private developers and the market response from the home buyer or investor. Homeownership reflects the personal aspirations of the individual and the social standing of the family unit the individual is part of. A high proportion of homeownership reflects the overall economic prosperity of the city, state or region and a sense of security for the individual homeowner.

9.2 Current Housing Condition

Per the Census 2001, the Greater Mohali Region has yet to be incorporated as the 18th District of Punjab. Hence, the statistics studied will be based on that of Patiala and Rupnagar. Table 1 show that there is a shortage of 79,763 houses at the State-level and 8,845 houses for Rupnagar and Patiala combined. (The Census 2001 does not further subdivide into different tehsils for this data and hence, the actual shortage within the current GMADA boundary cannot be conclusive but postulated).Table 9.1 also shows that 177,172 houses state-wide are dilapidated with 1,030 such houses in SAS Nagar (3.8% of 27,078). As such, there is a need for replacement units for the dilapidated units within Rupnagar and Patiala districts in addition to creation of new housing units to accommodate the households sharing a census house(s) as summarized in Table 9.1 below.

Table 9.1: Extent of Housing Shortage in Punjab, Rupnagar and Patiala

	Census Houses Used as Residences Table H 2, Census 2001				Residences occupied by HH Table H 2 (Appendix), Census 2001				Net Shortage			
	Total	Good	Livable	Dilapidated	Total	Good	Livable	Dilapidated	Total	Good	Livable	Dilapidated
Punjab	3,922,108	2,215,410	1,533,124	173,574	4,001,871	2,259,449	1,565,250	177,172	-79,763	-44,039	-32,126	-3,598
City - S.A.S. Nagar	26,378	23,773	1,605	1,000	27,078	24,384	1,664	1,030	-700	-611	-59	-30
Total Rup-nagar	215,627	154,082	53,862	**7,683**	219,190	156,689	54,701	7,800	-3,563	-2,607	-839	-117
Total Patiala	294,235	176,044	108,235	**9,956**	299,517	179,286	110,092	10,139	-5,282	-3,242	-1,857	-183
Total Rup-nagar & Patiala				**17,639**					-8,845	-5,849	-2,696	-300
Replacement demand for dilapidated units												17,639 DU
Creation of Housing Units for alleviate the housing shortage												8,845 DU
Net New Units Required for current Housing demand												**26,484 DU**

According to the Census 2001, a 'census house' is a building or part of a building used or recognized as a separate unit because of having a separate main entrance from the road or common courtyard or staircase, etc. It may be occupied or vacant. It may be used for a residential or non- residential purpose or both. Table 1 shows the actual census houses used solely for residences.

The term 'household' as in Census 2001, defines a group of persons who normally live together and take their meals from a common kitchen unless the exigencies of work prevent any of them from doing so. Persons in a household may be related or unrelated or a mix of both. However, if a group of unrelated persons live in a census house but do not take their meals from the common kitchen, then they are not constituent of a common household. Each such person was to be treated as a separate household. This report uses the concept of household to include that of nuclear families for the calculation of housing demand.

Table 9.2 shows the Distribution of Census Houses by Predominant Nature of Roof Material. For the purposes of this Report, houses with the predominant material of roof being Grass, Thatch, Bamboo, Wood, Mud and Plastic & Polythene will be considered "Katcha" housing and therefore forms part of the replacement demand. (Source: Table H-3A) The Census 2001 does not distinguish between Census Houses used for Residence and Residence-cum-Other Uses, therefore the Total number of Census Houses shown in Table 2 below is markedly larger than that for Table 1.

Table 9.2: Census Houses in Punjab by Roof Material in Punjab, Rupnagar and Patiala

Area Name	Total	Material of roof								
	number of census houses	Grass, Tha Bamboo, V Mud etc.	Plastic, Polythene	Tiles	Slate	G.I., Metal Asbestos sheets	Brick	Stone	Concrete	Any other material
State	5,967,476	657,717	20,701	2,134,285	30,544	96,546	901,092	12,848	2,087,883	25,860
Tehsil - Kharar 0003	68,031	11,245	239	14,194	204	3,744	2,491	123	35,370	421
Tehsil - Kharar 0003	42,085	9,123	199	12,830	105	1,437	1,438	42	16,684	227
Tehsil - Kharar 0003	25,946	2,122	40	1,364	99	2,307	1,053	81	18,686	194
Tehsil - S.A.S.Nagar (Mohali) 0	63,066	5,218	136	7,924	105	3,703	2,890	62	42,887	141
Tehsil - S.A.S.Nagar (Mohali) 0	27,376	4,729	123	7,320	97	1,133	2,722	53	11,085	114
Tehsil - S.A.S.Nagar (Mohali) 0	35,690	489	13	604	8	2,570	168	9	31,802	27
Town - Kurali	6,774	385	23	133	11	227	263	0	5,680	52
Town - Mullanpur Garib Dass	1,802	177	0	162	0	60	50	0	1,310	43
Town - Karoran (CT)	5,865	375	6	106	29	1,624	24	38	3,659	4
Town - (a) Kharar	11,505	1,185	11	963	59	396	716	43	8,037	95
Town - S.A.S.Nagar (Mohali)	34,153	463	8	137	7	2,507	160	8	30,836	27
Town - Bhabat	1,537	26	5	467	1	63	8	1	966	0
Tehsil - Dera Bassi 0005	57,941	12,513	266	13,303	182	1,761	3,289	42	26,299	286
Tehsil - Dera Bassi 0005	42,456	11,019	176	12,332	150	1,013	2,494	35	14,970	267
Tehsil - Dera Bassi 0005	15,485	1,494	90	971	32	748	795	7	11,329	19
Town - Rajpura	19,774	1,137	54	1,668	48	342	859	28	15,613	25
Town - Banur	4,335	681	21	891	7	60	926	6	1,738	5
Town - Dera Bassi	5,175	198	8	319	3	81	163	2	4,392	9
Town - Bhankharpur	2,661	429	3	372	5	176	216	3	1,456	1
Town - Zirakpur	7,649	867	79	280	24	491	416	2	5,481	9
TOTAL UNDER GMADA	421,365	51,362	1,234							
TOTAL CENSUS HOUSES WITH PERMANENT ROOF MATERIALS WITHIN GMADA									368,769	88%

Source: Table H - 3a: Distribution of Census Houses By Predominant Material of Roof, Census 2001

An estimated 12% of all Census Houses within GMADA is of Katcha roofing.

For Table 9.1, the condition of census houses was recorded as 'good' or 'livable' or 'dilapidated' based on the **subjective perception** and response of the respondent according to the local conditions which may vary from place to place and between and within rural and urban areas.

Therefore, in analysing Tables 9.1 & 9.2 together, it is likely that those who perceived their housing as "livable" are actually living in 'katcha' shelter (657,717 with grass, thatch, mud roof +20,701 with glass and polythene roofing = 678, 418 houses (11%) out of a total of 5,967,476 Census Houses state-wide) with as "dilapidated" housing only forms 4.43% state-wide (177,172 of 4,001,871, Table 9.1)

This also implies that affordability of residents for better housing is low and they make do with their current shelter.

9.3 Housing Demand

Based on the Report of the Technical Group (11th Five-Year Plan 2007-12) the household size is remain constant at 5.1 from 2001 to 2007. However, the current household size in Punjab is approximately 5.66. Table 9.3 and Diagram 9.1 shows the distribution of number of Households nationwide that is used as a basis for projecting housing demand for GMADA.

Table 9.3: Distribution of Number of Households by Income Groups

Income Group	Monthly HH income (Rs)	Estimated # HH (millions)	%
Economically-weak Section (EWS)	0 - 3300	21.81	32.90%
Lower-Income group (LIG)	3301 - 7300	27.57	41.58%
Middle-Income Group (MIG)	7301 - 14500 }	16.92	25.52%
Higher-Income Group (HIG)	> 14500 }		
		66.3	100.00%

Source: Report of the Technical Group (11th Five-Year Plan 2007-12, Ministry of Housing and Urban Poverty Alleviation, National Buildings Organization, GOI, page 13

Some authorities and city councils use the strategy of cross-subsidy of stipulating developers of housing for middle-Income and high-income groups to allocate a portion of their proposed number of housing units for EWS and LIG. Table 9.4 proposes setting aside 10% housing for the economically-weak section and 10% housing for the low-income group over and above the actual number of housing units proposed by the developers of middle and high-income groups.

Fig 9.1: Distribution of Number of Households by Income Groups

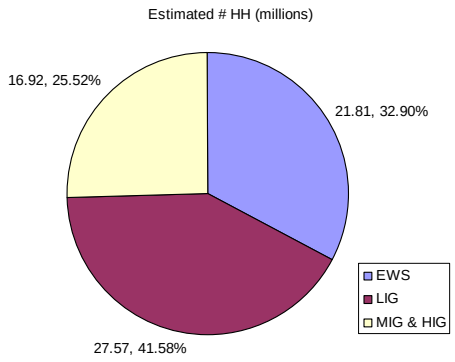


Table 9.4 shows the housing demand projected over the planning period taking into consideration the decreasing household size, rising income levels and hence, increase in absolute number of housing units. The findings of Table 9.4 are:

1. Pent-up demand of **26,484 DU** to meet the current demand (Year 2001 to current)
2. Demand for MIG and HIG is expected to surpass that for EWS and LIG **separately** at mid-planning period (Yr 2031 onwards) with a gradual decrease household size, especially for that of the EWS and LIG and rising income levels (Diagram 9.2). However, demand for MIG and HIG constitutes only **38%** of the **total** housing demand.

Inability of the "cross-subsidy" approach to alleviate the housing shortage (Table 9.4) Even at the end of the planning period (Yr 2056), only 14% (32,537 DU out of a total of 235,330 DU can be met.

Table 9.4: Housing Demand Projection for GMADA

Phase	Cumulative Population	Net Population Increase	Estimated Household size	Net Increase in HH	Cumulative Hsg Demand (# DU)	EWS	# DU	LIG	# DU	MIG & HIG	# DU	15% EWS	10% LIG	Total EWS & LIG subsidised by MIG & HIG	Net EWS & LIG Shortage
1	2	3	4	5	6	7	8	9		10	11	12	13	14	15
2001	711,210	711,210	5.6	26,484	133,955	50%	13,242	40%	10,594	10%	2,648	1,986	1,059	3,045	20,791
2011	1,015,715	304,505	5.5	55,365	189,320	30%	16,609	40%	22,146	30%	16,609	2,491	2,215	4,706	34,049
2021	1,416,127	400,412	5.4	74,150	263,470	28%	20,762	38%	28,177	34%	25,211	3,114	2,818	5,932	43,007
2031	1,782,208	366,081	5.3	69,072	332,542	26%	17,959	36%	24,866	38%	26,247	2,694	2,487	5,181	37,644
2041	2,243,211	461,003	5.2	88,654	421,196	24%	21,277	34%	30,143	42%	37,235	3,192	3,014	6,206	45,214
2051	2,635,160	391,949	5.1	76,853	498,049	22%	16,908	32%	24,593	46%	35,352	2,536	2,459	4,995	36,505
2056	2,836,966	201,806	4.9	41,185	539,234	20%	8,237	30%	12,355	50%	20,592	1,236	1,236	2,472	18,120
TOTAL	2,836,966			431,763	539,234		114,994		152,873		163,896	17,249.00	15,287	32,537	235,330

Note: Medium –growth scenario used for population projection for GMADA

Fig. 9.2: Comparison of Projected Demand by Income Groups

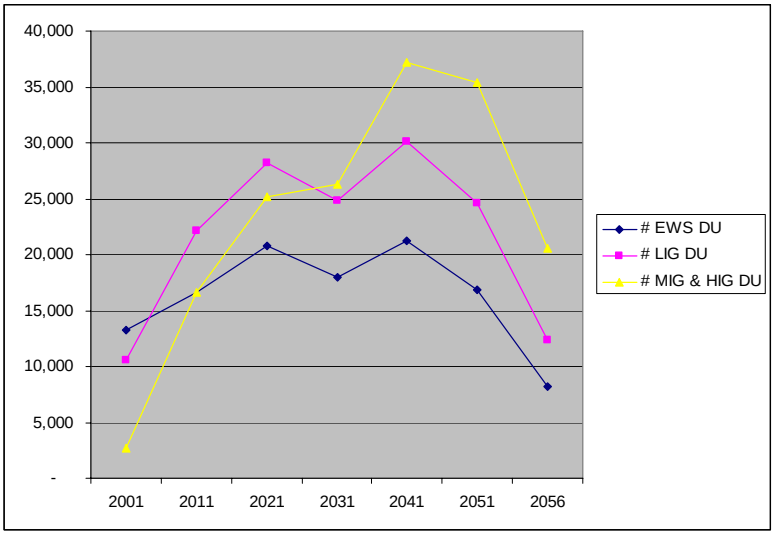


Fig 9.3: Widening Gap Between Projected Demand for EWS & LIG by Supply of EWS & LIG by Private Developers

9.4 Housing Supply

The Twenty-Point programme (www.mhupa.gov.in/pointprog1986.htm) under the auspices of the Ministry of Housing & Urban Poverty shows that in Punjab only 144 EWS housing units out of a targeted 4,275 (3%) had been achieved in the Year 2006-7. Another 144 LIG housing units out of a targeted 2,700 had been built during the same period.

The Report of the Technical Group (11th Five-Year Plan 2007-12) mentioned that "investment in housing sector has not been made to the extent it can eradicate housing shortage in the country, such investment has been restricted to the residential pucca units which has been mostly by the effluent section of society except a small portion attributable to Government-run schemes" (*Report of the*

Technical Group (11th Five-Year Plan 2007-12, Ministry of Housing and Urban Poverty Alleviation, National Buildings Organization, GOI, page 14)

In the pipeline are several projects for the private residential market which are listed as follows in table 9.4:

Developer	Type of Project/Location/Other Details	Area (acres)
DLF Universal	Residential – Sectors 86 to 1006 of Mohali	800
PACL India Limited	Residential – Sectors 104 & 105 of Mohali	200-260
EMAAR MGF Land Pvt. Limited	Integrated township with special education and wellness zones – Sectors 85 to 106 of Mohali	1000
Rana Infrastructures Pvt. Limited	Residential – Sector 99, Mohali	103
Unitech Limited	Residential – Sector 107, Mohali	200
Taneja Developers	Residential - Kharar	160
Infinity Promoters & Developers Pvt. Limited	Residential - Mohali	100
IREO Funds Limited	Residential – periphery of Zirakpur	300
Renaissance Buildcon Company Limited	Residential – Zirakpur-Patiala highway	300
Shipra Estate Limited	Residential – Zirakpur-Dera Bassi highway	650
Country Colonisers Pvt. Limited	Residential - Mohali	110

9.5 Practical Problems

Table 9.4 reveals that the overwhelming demand of the EWS and LIG housing cannot be fulfilled by private developers. At the end of the planning period (Yr 2056) even with the 10% EWS and 10% LIG required to be provided by private developers, only 14% of the total EWS and LIG housing demand can be fulfilled. Meanwhile, the housing shortage persists and the issue cannot be wished away.

For private developers of middle and high-income housing will be hard put to take on such a heavy responsibility of providing public housing which in turn drives up the cost of development and increases the price and hence competitive pricing for the housing units they actually are selling at a profit to cover the costs of providing EWS and LIG housing. Not to mention that such public housing schemes would be carried out on a piecemeal basis rather than one that is comprehensively-planned and adequately provided with standard infrastructure providing not just a “shelter” but truly basic pucca housing for the masses.

Unless the developers can have a sufficiently large land bank for housing development and deep pockets, they would be wary to locate housing for the masses within the vicinity of the housing for the middle- and high-income groups for fear of EWS and LIG housing affecting the saleability of the latter and property value of the latter in the long term.

Furthermore, the private residential market is not a perfect market and is subject to the rise and fall of the property cycle. Provision of housing, be it for any income group should not be dependent on market forces, especially housing for the masses.

In summary, alleviating housing shortage should not be left to the private developers or other small-scale initiatives by non-governmental organizations. Provision of EWS and LIG housing cannot be dependant on developers who are subject to the imperfections of the property market to provide housing for the masses.

9.6 Housing Strategies & Directions

It is therefore advocated that the responsibility of providing public housing be undertaken in full by the every city council, housing authority or development authority under whose jurisdiction it covers. Provision of public housing should form part of the standard "infrastructure" just like roads, sanitation, potable water, power supply. The development authorities should be empowered by law to facilitate and acquire private lands for public purposes as in public housing where the affected land owners will receive part of their compensation, proper housing.

A public housing authority for the GMADA region should be established and incorporated under the Government of Punjab (GoP) to develop the public housing and facilitate mortgage financing of the buyers of such units or the subsidized rental of smaller units and the staged ownership of housing to move the EWS out of the poverty cycle.

This authority will be empowered to:

- To acquire any immovable property for public purpose and prepare and execute proposals, town planning schemes and projects for —

  (i) the erection, conversion, improvement and extension of any building for sale, lease, rental or other purpose;

  (ii) the clearance and redevelopment of slum and urban areas;

  (iii) the development or redevelopment of areas designated by the GoP;

  (iv) the development of rural or agricultural areas for the resettlement of persons displaced by operations of the Authority or other resettlement projects approved by the GoP;

- To manage all lands, houses and buildings or other property vested in or belonging to the Authority;

- To carry out all investigations and the surveys necessary for the performance of the functions and duties of the Authority;

- To provide loans, with the approval of the GoP, to enable persons to purchase —

  (i) any developed land or any housing accommodation sold under public housing schemes or

  (ii) any other land belonging to the Authority for which planning permission to develop has been obtained under the Punjab Regional and Town Planning and Development Act 1995 and other prevailing Acts.

or any part thereof upon a mortgage of that land; In addition, the Authority may, with the approval of the GoP, make rules for or in respect of all or any of the following matters:

- Regulating the use and enjoyment of common property and open spaces in any land vested in or held in trust for the Authority;
- Prohibiting or regulating the parking of vehicles on such common property or in such open spaces other than parking places;

  (i) regulating the carrying out of any renovation in any flat, house or other building sold;

  (ii) prescribing the form or forms of the contract or agreement that shall be used by every owner of any such flat, house or other building and a purchaser other than the Authority;

  (iii) prescribing the conditions which, if used in any contract or agreement between any owner of any such flat, house or other building and a purchaser other than the Authority, shall be void;
- Prescribing that any act or omission in contravention of any rule shall be an offence punishable by a fine payable to the Authority for misuse of the public housing unit.

9.7 Financing of the Public Housing Authority

The Authority may, from time to time, through the enabling legislation, raise loans —

- From the GoP;
- With the approval of the GoP and subject to the provisions of any written law, within or outside Punjab by either mortgage, charge, creation and issue of debentures, stocks or bonds;
- From such other source within or outside Punjab as the GoP may direct.

The Authority shall pay interest on such loans at such rate and at such times, and shall make such provisions for the mode and time or times of repayment of principal, as may be approved by the GoP.

The Authority shall be empowered to raise loans shall include the power to make any financial agreement whereby credit facilities are granted to the Authority for the purchase of goods, materials or things.

9.7.1 Singapore's Housing and Development Board (HDB): An example of such a public housing authority is Singapore's Housing and Development Board (HDB). It was one of the two major organizations established by the Government of Singapore to address one of the 2 critical issues during the 1960s. (The other being the Economic Development Board, tasked to kick start industrial activities in Singapore in order to generate employment)

HDB's role has grown tremendously from just providing shelter for the masses to providing affordable and quality homes for 82% of Singaporeans within comprehensively-planned new towns located close to employment centres.

Through economies of scale and active research and development work, HDB ensures the public housing it provides is cost-effective with quality standards maintained and continually improved and caters to the evolving communities, different age-groups and family patterns. New towns are provided with various commercial, recreational, community spaces and social facilities and amenities for the convenience of residents. Through renewal and upgrading programme, new features, facilities, and improvements to the older estates and towns to ensure their vibrancy and continued relevance.

HDB has won the 1992 World Habitat award for Tampines Town (228,000 population (2006) living in 56,000 dwellings of which 500ha is allocated for public housing. It has also won the 2004 World Habitat award for Toa Payoh estate renewal built in the early 1970s whereby public participation was successfully engaged.

9.8 Conclusion

The GoP has engaged Jurong on this important task of master planning for the new State capital of SAS Nagar and it is imperative that the issue of provision of housing can be successfully implemented so that it can act as the springboard for other cities in India to emulate.

As such, it is recommended that a public housing authority be established and incorporated and with commitment and foresight of the administration, the housing issue can be overcome for the long-term benefit of Punjab residents, diasporas and potential investors alongside with the employment opportunities that the implementation of the master planning of GMADA can bring. Potential investors will be well-assured to invest if the housing for its potential employees is adequately catered for.

10. Urban Land Policy

10.1 Background

The Planning Commission is the nodal agency at the Union Government level that sets targets of national economic growth. It allocates budgetary outlays for various states along with grants and loans for various development activities. It is then left to the state governments to allocate its funds for various development activities depending on their priorities, as long as goals set out in the Five-Year Plans enumerated by the Planning Commission are met.

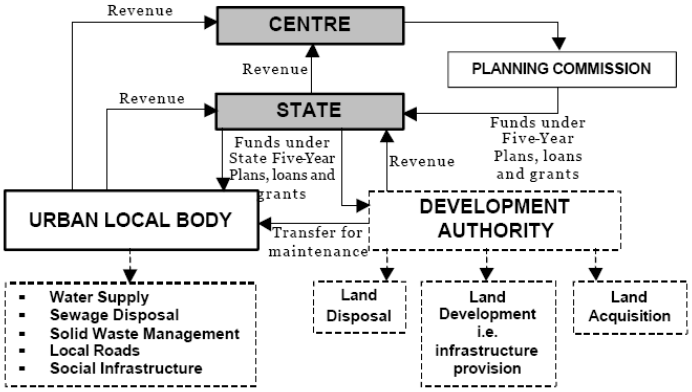


***Fig. 10.1:** Institutional mechanism for land development in India*

Prior to 1992, there were two tiers of government (as shown in Figure 10.1) and provision of serviced land, including water supply, sewage disposal, solid waste management, and roads, has long been the responsibility of state governments as provided in List II in Schedule 7 contained in Article 246 of the Constitution of India. This has been done to ensure that every citizen has equal access to land with equal opportunity irrespective of caste, creed, economic status, religion, etc. This is also done to ensure that the economically weaker strata of society are not marginalized and are provided with access to services at a reasonable cost.

There are four broad components that form the process of provision and maintenance of developed land. They are:

a. Land acquisition to assemble fragmented land for comprehensive development.
b. Land Development of key infrastructure to germinate development.
c. Allotment of land
d. Maintenance of the land

a) Land acquisition, currently performed under the Land Acquisition Act of 1894, usually by the District Collector, is a cumbersome process. It may take up to 5 years for the actual acquisition process to be successfully negotiated. It is also prone to litigation owing to large-scale contesting of compensation validity by the affected individuals. This also throws up the issue of rehabilitation of people that would be displaced on account of this acquisition.

b) The second component in this process is Land Development. This involves provision of core infrastructure facilities like roads, power and telecommunication networks, water supply and sewage disposal networks, and solid waste management for the acquired area. This part of the process is rife with instances of conflict between various plan implementation agencies and even within different departments of individual agencies. The provision of roads, for instance, is not an isolated activity. It also carries power and telecommunication networks, water supply and sewage disposal networks, and solid waste management requires the presence of these roads. While responsibility for initial provision of roads, water supply and sewage disposal, including capital investments, lies with the

development authorities; power and telecommunication being central subjects, these services are effected by various agencies in the central government. There is lack of co-ordination between these agencies leading to frequent digging of roads thereby reducing the effective lifespan of roads. This means that investments are required after a shorter duration for maintaining the quality of these roads. Apart from the issue of multiplicity of agencies, there are also instances of bureaucratic behaviour within public sector organizations, given the monopoly of the state in the provision of these services. In the absence of quality monitoring mechanisms, these services may already be of a poor quality before they are handed over to urban local bodies (ULBs) for maintenance.

c) The third component is disposal of land, subsequent to development. The development authorities will benefit from the proceeds generated by the sale of land to various consumers. This revenue will rest with the development authorities but not to the local bodies and municipalities. Consequently, while all the profits are taken away by the development authority, the ULBs are left with relatively weak revenue streams for the provision and maintenance of these services like roads, water supply and sewage disposal networks, etc.

d) The last component of this process is that of maintenance of these large areas. Subsequent to disposal of all developed land by the development authorities, this land is included within the municipal limits of the city and the responsibility for maintenance of these areas is lies with the ULBs. Revenue collection for all services is effected by the ULBs along with the responsibility of maintaining this infrastructure.

The traditional planning and development system in India encounters a number of obstacles for private participation. Some of these are listed as follows:

- There is considerable difficulty in assembly of land from private owners, since there is no overriding “public purpose” directive from the government.
- Payments for these land purchases are generally high, especially if large agricultural lands are to be aggregated. Access to such large sums of capital is generally not easy for the private sector.
- Deposit 30% of the receipts from sales into an ESCROW account to be used in stages for development of the colony. This leads to locking up of proceeds that would otherwise be used for more development activities.
- Obtaining permission and sanctions of authorities to undertake development. It may take from one to three years to complete the process. This delays the process of raising capital, and in case it is raised earlier, a large sum would then have to pay as interest.
- Payments by investors/purchasers of plots/ dwelling units are generally not made in time leading to irregular capital generation.
- Timely completion of the project is susceptible to a lot of externalities like access to capital, bureaucratic behaviour of various organizations, availability of labour, equipment, materials, etc.
- Lack of availability of financing. Access to short term loans for acquisition and on development of on-site infrastructure is limited by the commercial banking institutions.
- Payment of external development charges for off-site infrastructure such as water, sewerage, surface drainage, roads, and landscaping and community facilities while it is not provided on time by the government.
- Progress of external development is done at the Licensees' cost. Provision of `off site' infrastructure such as: development of roads, provision of power, water, sewerage and storm water drainage, garbage collection and disposal, street lighting, maintenance of parks and gardens, sewerage pump houses, maintenance of water supply system.

- Construction of social infrastructure such as school and medical facilities is another issue. While the onus of making investments for the provision of these services lies with the private sector, these may not generate financial resources for the private sector.
- Development of "off-site" infrastructure by the local bodies is generally not set to coincide with the development of colonies. As a consequence, while the private sector would complete the “in-site” infrastructure, there would be no buyers until the “off-site” infrastructure is provided by the local bodies or development authorities.
- Reservation of plots/dwelling units for LIG and EWS categories is a social objective for the government. However, the private sector has a lot of problems in this regard, since the government makes it a pre-condition for allowing large-scale development. Substantial investment is locked in the provision of these plots / dwelling units while the initial sales are slow for reasons mentioned above.

However, owing to such issues, a number of innovative urban development mechanisms encouraging private participation are now being followed across the country. A few successful models have been discussed below:

10.2 Town Planning Scheme

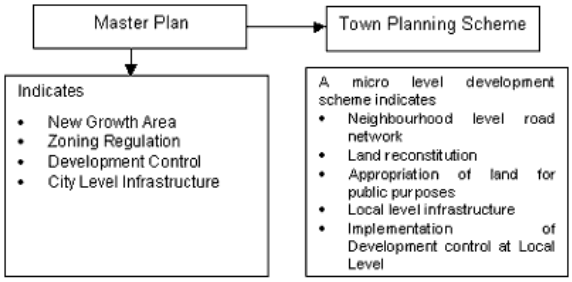
The conventional approach to land acquisition, even for public purpose, has become a time consuming process. Sometimes it leads to unending litigation and encourage speculative tendencies. The acquisition process besides being time consuming also becomes cost prohibitive while on the other hand the owners, whose lands are acquired, feel that they have not been adequately compensated. The Town Planning Scheme is being followed as an alternative method to assemble the land for urban development activities in a faster and financially affordable manner without taking recourse to compulsory acquisition of land. Town Planning Scheme (TPS) is in operation in some of the states of Indian Union in the form of plot reconstitution. It is basically an area planning technique patterned on the concept of land re-adjustment. In the state of Maharashtra, which is a pioneer in the field of TPS it is implemented under the Maharashtra Regional and Town Planning Act, 1966. In Gujarat, it is implemented under the Gujarat Town Planning and Urban Development Act, 1976.

In Gujarat, Town Planning Schemes as an instrument for urban development has a long history. The first Town Planning Scheme was taken up as early as in 1917 for Jamalpur area of Ahmedabad city. Perhaps Jamalpur area Town Planning Scheme was also the first TPS in the country. The Bombay Town Planning Act, 1915 provided for growth and development of various parts of the city which facilitated taking up Town Planning Schemes. The Act was modified and re-enacted in 1954 which made it obligatory for each local authority to carry out a survey of the area within its jurisdiction for preparation of development plan. With the re-organization of states in India in 1956, Gujarat was carved out as a separate state. After re-organization the state government enacted a separate Law known as the Gujarat Town Planning and Urban Development Act, 1976. This Act provides for Town Planning Scheme in detail. Under this Act the Town Planning Scheme is divided into 2 parts namely physical planning of the scheme and financial aspects of the scheme. It identifies the stages of TPS in the form of Draft Scheme. It identifies the stages of TPS in the form of Draft Scheme, Preliminary Scheme and the Final Scheme with a view to expedite the process of implementation of different stages.

Legal provisions for TPS in the Gujarat Town Planning and Urban Development Act envisage a socialistic and transparent approach for preparation and implementation of Town Planning Schemes. The concept of TPS is akin to land pooling technique in which lands of different owners is pooled together and after proper planning the same is re-distributed in a properly reconstituted plots after deducting the land required for open spaces, social infrastructure, services, housing for the weaker

section and street network. The process enables the local planning authority to develop the commonly pooled land without compulsorily acquiring the same. It facilitates the freedom of planning and design and the control on the growth and development. The practice of TPS is extensively in use in the Gujarat State.

In order to implement the Master Plan / Development Plan prepared under the Gujarat Town Planning and Urban Development Act, 1976, Town Planning Schemes are prepared at micro level for an area of about 100 hectares particularly in those pockets which are under pressure of urban development and need priority attention. The concept behind taking 100 hectares is that TPS becomes manageable and viable scheme for preparation and implementation at local level. The scheme is conceptualized as a joint venture between the local authority and the owners of land who voluntarily agree to pool their land, redistribute the reconstituted plots of land among themselves and share the development cost. For preparation of scheme land parcels with common ownership are marked with original survey number / plot number on a map. All such original plots form one area for planning purpose. In the layout plan taking out the area for roads and streets and public and semi-public spaces the remaining area is planned in regular plots known as final plots. The final plots though reduced in size better in shape, buildability and accessibility are allocated to the land owners preferably in close proximity to their original plots. The owner also gets compensation for the area reduced for public spaces and roads. Since the reconstituted plot has the better accessibility and good potential for development, its value gets enhanced. The difference between enhanced value and the original value is liable to get. Part of such increment in land value is contributed for the cost of development work in the schemes. Under the Act it is clearly provided that the landowners will get the net amount of the increment value of the plot worked out after deducting the amount of compensation payable for the loss in area.



As part of the stages of TPS in the first stage a draft scheme is as indicated in the figure10.2 (a):

Fig. 10.2(a): Town Planning Scheme-Process

A development authority selects an area for planning Town Planning Scheme and boundary of the same is demarcated on the map.

The draft is prepared after undertaking detailed and accurate total station survey to mark the land boundary, existing physical features of the site including topography, slope, plot boundaries, existing structure etc. Along with survey data is collected from revenue record to establish ownership of land. After that a base map is prepared incorporating the proposal of Master Plan/Development Plan for the

identified site of TPS. For planning purpose adjacent plot with the same owner are grouped together as one original plot. A map showing original plots is then prepared as indicted in the figure 10.2(b):

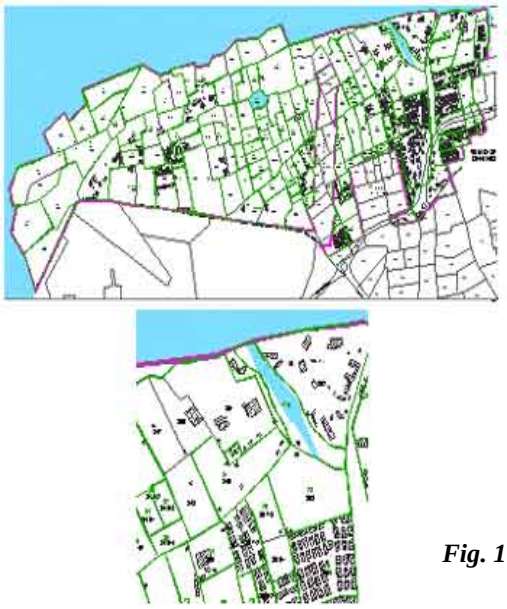


Fig. 10.2(b): Town Planning Scheme-Process

Once the map of the original plot is ready value of the original plot is assessed on the basis of recent transaction recorded in the adjoining areas. Keeping in view the proposal of the Development Plan recorded in the draft map layout plan and road network providing access to all the plots in the area is designed as in Fig 10.2 (c)

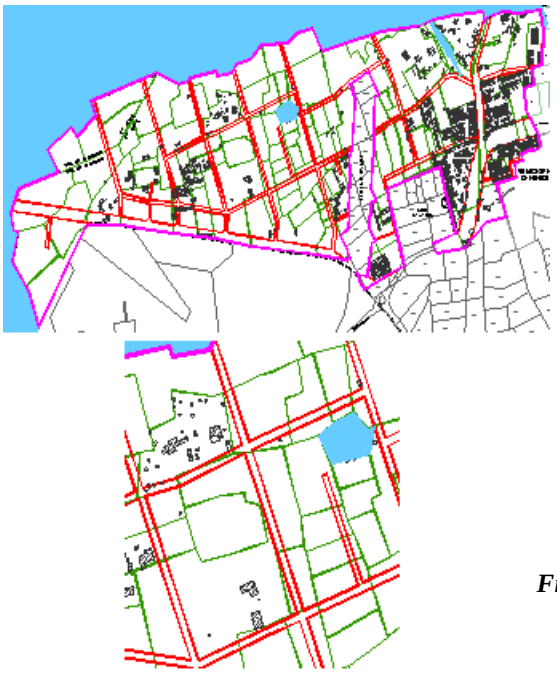


Fig. 10.2(c): Town Planning Scheme-Process

In the layout plan proportion of land likely to be deducted from each original plot for the provision of roads, public space, social infrastructure is worked out and the remaining area is reconstituted giving proper shape so as to locate the final plot nearer to the original plot (Fig 10.2(d))

Fig. 10.2(d): Town Planning Scheme-Process

Once the draft TPS is ready it is notified and all the land owners are called for a meeting by the authority. The scheme is explained to the owners and taking into consideration the views of the owners, if need be, the scheme is marginally modified. The corrected scheme is officially published in the Gazette for objection and suggestions to be accepted in one month period after notification. After considering the objections and suggestions the draft scheme is given a final shape.

At this stage also the financial aspects of the scheme are worked out in detail. In this process first the original plot value is worked out keeping in view the transaction made in this area. Compensation likely to be paid to the owner for the land deducted from his original plot is also worked. A semi-final-value of the final plot is worked out on the basis of infrastructure proposed to be provided in the scheme area. A final plot value is also worked out taking into consideration that the proposed infrastructure is provided in the scheme. Difference between the semi-final plot value and final plot value is considered to be an increment in value, which could result from implementation of the TP scheme. Half of the increment in value is adjusted against the compensation and the net demand/contribution of the owner is worked out. Simultaneously, the development cost and other infrastructure cost for implementation of the scheme are also worked out. The draft scheme continuing the physical proposal and the financial details along with financial part of the compensation and contribution of each plot are then submitted to the Government for approval which is called draft scheme. Once the Government approves the draft scheme it is referred to as Preliminary scheme.

In the second stage of TPS known as Preliminary Scheme, State Government appoints an officer who acts as a Quasi-Judicial Officer/Arbitrator between the Development Authority and land owners to finalize the TP Scheme. The officer is designated as the Town Planning Officer for the scheme. The Town Planning Officer verifies all the documents submitted along with the Draft Scheme. He collects the additional record and information of the scheme, if need be. He also serves the notice to all the owners individually requesting them to make the representation before him if the owners desire so. Based on the representation made by the owners, additional records, consultation with the Development Authority, Town Planning Officer makes appropriate changes, if necessary, in the physical proposals of the scheme. After making final proposals another chance is given to the owners to present their views or grievance, if any. The development authority is also consulted with regard to the final proposal of the scheme. Thereafter physical proposals of the scheme are submitted by the

Town Planning Officers to the Government for approval. After approval of the scheme the Government, Development Authority initiates the implementation of the scheme.

In the last stage of the scheme known as the Final Scheme, the Town Planning Officer verifies the financial aspects of the scheme by taking into consideration the sales transaction taken place. After verifying the financial details are worked out by the Development Authority, during the preparation of the scheme at draft stage, he invites the objections from the affected persons. The objections are invited with respect to financial part of the scheme i.e. original plot value, semi final-plot-value, final-plot-value, compensation, net contribution and demand of the owners. As soon as the financial part of the scheme is finalized it is sent to the Government for approval. The Government notifies the final scheme in the Gazette. After approval the scheme is known as Final Town Planning Scheme. At this stage the Development Authority can start implementing financial part of the scheme i.e. payment of Compensation to the land owners and collection of money from the plot owner. Although various stages involved in the TPS makes the process tedious and contentions it functions well solely because the owners know that on implementation of the TPS they will be the net gainers. Splitting of the scheme in two parts i.e. preliminary (physical part and final (financial part) in fact expedite the process in terms of physical implementation of the scheme and finalizing the scheme by the Town Planning Officer. This provides transparency and wide scope for participation of the community affected by the scheme.

Case study - Prahlad Nagar Town Planning scheme .

A typical case study of Prahlad Nagar Town Planning scheme of Ahmedabad reveal an interesting picture. In Ahmedabad delivery of serviced land has been managed through a 2 step process. At the first level decadal macro level Development Plan for the entire city has been prepared. While at the second level large number of micro level Town Planning Scheme covering about 100 ha. Each are prepared for the area identified for new development. Development plan indicated about 65 sq.km. of land for new urban development. It also laid out the sequence in which preparation and implementation of Town Planning Scheme would be taken up in the areas demarcated as a zone for new growth. Development Plan envisaged taking up of 113 Town Planning Schemes in Ahmedabad. Prahlad Nagar T.P. Scheme is considered as Model scheme to demonstrate the merits of the T.P. Scheme to emulate by others cities not only in Gujarat but across the country as well which are striving to provide well planned serviced land for rapid urban growth.

The break up of the landuse structure of the Ahmedabad. Prahlad Nagar T.P. Scheme scheme is given below.

Sl. No.	Item	Percentage of land
1.	Roads	19.83
2.	Water Bodies	1.24
3.	Institutional Area	5.54
4.	Parks and gardens	4.66
5.	Housing for weaker section	7.89
6.	Reconstituted plots for original owner	48.43
7.	Residential land Bank (for Authority)	7.77
8.	Commercial land Bank (for Authority)	4.64
	Total	100.00

The Ahmedabad Urban Development Authority implemented the ladnagar TP Scheme at a faster speed. Authority took possession of land under road with consent of land owners and constructed road with street lighting on priority. With their consent the reconstituted plots were given to the land owners and the land for the public purpose and road was taken by the Authority. On all such public purpose land Authority started development works by developing parks, gardens and community facilities and social services. In fact before approval and finalization of the scheme by the Govt. the authority has completed implementation of social and physical infrastructure.

At present 15 T.P. Schemes are under preparation stage covering an area of 1660 hectares in Ahmedabad. In most of these 15 TP Schemes construction of major roads provision of street lights tree plantation, development of gardens, rain water harvesting system, laying of sewerage lines within the scheme area is already complete within 3 years time span. As such Prahlad Nagar is a good example of TP Scheme with its well planned design, timely implementation and financial viability. In about 50 percent of final reconstituted plots development permission has also been issued and the people have started living in the area. Another example of Town Planning Scheme where computation of land value has been attempted using computer based GIS technique.

A critical examination of the TP Scheme reveals that the technique is rational, equitable and democratic. By implementing TP Scheme the buildability of the reconstituted plot increases with regular shape, improvement in accessibility, increased potential of development, availability of social and physical infrastructure in the neighborhood, better linkage with other part of the city and improvement in living environment.

Fig. 10.2(e): Town Planning Scheme-Process

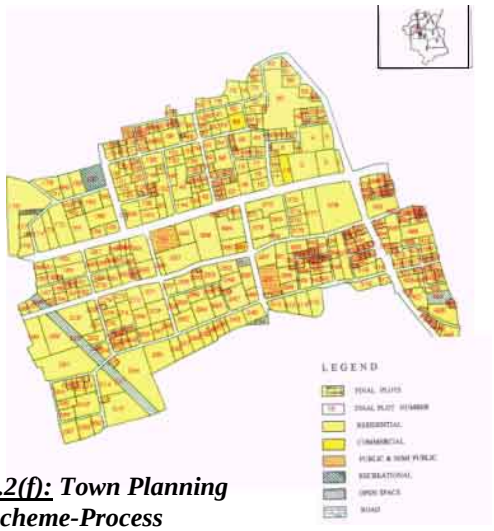


Fig. 10.2(f): Town Planning Scheme-Process

Land is rightly used as a resource with the increased buildability, market value of the land goes up. This results in accruing increment in land value to the owner. As the increment in land value is attributed to the implementation of the TP Scheme the Development Authority also takes part of it and use for development work. Thus increment value is ploughed back for developing infrastructure and other facilities.

The owners are the net gainers from the TP Scheme as such they can contribute towards the cost of development in proportion to their benefits. The owners also receive compensation for the land deducted from original plots for the roads and public purposes. Owners also get increment of land value in future.

Under TP scheme area for roads and public purposes is taken without dispossessing the owner totally. Such area for public purposes is almost equitably shared by all the landowners of the scheme in proportion to the area of their original plot.

TP Scheme is one of important planning and development scheme at local level, which encourages full participation of public/affected community at various stages of the scheme. People's participation is ensured under the provision of the Act and as such local authorities give due consideration to the land owners in preparation and implementation of the scheme.

Since the inception of TP Scheme development momentum is created and the owners desire various benefits out of the scheme. While retaining half of the incremental value at the stage of the scheme preparation, owners also get benefit with acceleration of development momentum rapidly in future also. They have easy access to the basic civic facilities available in the neighborhood.

10.3 Haryana Joint Development Model

Haryana Development and Regulation of Urban Areas Act, 1975 provides for development of urban infrastructure as under:

Land is owned by the private sector with Government giving license to private sector to develop townships in accordance with an approved master plan. Minimum area required for land assembly is 100 acres of contiguous land for plotted development and in case of group housing, 10 acres. States' Development Authorities provide 'off site' or external development at the licensees' cost through levy of external development charges.

Private sector identity is retained in separate townships developed by them where they also provide 'on site' infrastructure similar to the public sector development – thus providing a level playing field for both public & private sectors with the customer having a choice between the two. Social infrastructure is provided by both the private and public sector. Private sector contributes towards development of linkage through payment of extra development charges for 'off site' infrastructure. These charges are levied on buyers of plots and built properties.

Private sector provides social infrastructure in terms of medical, educational as also community facilities. Government reserves the right to assume these sites thereby ensuring private sector compliance.

Economically weaker sections are provided subsidized housing through cross subsidization of plots allotted for higher income groups. This model aims at distributing the responsibilities associated with large-scale development to the private sector completely. The government’s responsibility remains at providing infrastructure trunk networks while recovering charges towards the same from the developer who, in turn, passes on these costs to the purchasers. The government also ensures compliance of these private developers towards providing these services. However, one critical point in this model is that the regulatory agency is the government, and since the private developer is the only interface with the government, the probability of collusion, aided by political intentions, is quite high.

10.4 CIDCO Industrial Development Model

City & Industrial Development Corporation of Maharashtra Limited (CIDCO) was specially set up by the Government of Maharashtra as its fully owned company to plan and develop, in a systematic manner, a new metro centre i.e. Navi Mumbai (New Bombay) across the Mumbai (Bombay) Harbour

on a sprawling area of about 344 sq.km. Navi Mumbai had to be developed on a vast tract of totally undeveloped land, and funding was scarce.

Since its inception, CIDCO was aware that they would ultimately have to relinquish all its duties in the area to the urban local government, whenever it was created, and CIDCO would have to bear the burden of excess staff. This led to the adoption of a new approach whereby modalities of private sector participation were implemented to keep the expenditures of the company as low as possible. CIDCO, since the time of its inception, was entrusted with all the responsibilities associated with any development agency, except that it had been given more powers of managing finances, land, and other resources, to bring about the overall development of Navi Mumbai.

For providing shelter, and adequate housing, CIDCO invites reputed architects and developers, with proven past record, to develop residential townships / enclaves comprising of residential units with supportive infrastructure and open spaces, including commercial and institutional establishments. In this scheme, these private agencies were allotted 1000 to 1200 units to develop on a prescribed fee. Moreover, developers were allotted large tracts of land to execute housing schemes, on a turnkey basis, by employing their own architectural and engineering staff. Even the Project Management Consultancy is let out to the private sector. Thus, CIDCO was not saddled with excess staff leading to low operational costs. Another approach followed by CIDCO was to allot bulk land (measuring approximately 3 hectares each) for construction of mass housing. Basic guidelines were issued regarding permissible Floor-Surface-Index (FSI). Out of the total proposed built housing, private developers were to construct 35% of the houses for CIDCO as per CIDCO's specifications. These plots were intended for the Lower Income Group (LIG) and Economically Weaker Section (EWS) of the society. CIDCO were to pay a fixed sum per tenement to the private developer. The developer was also required to develop the entire area allocated to him. On the remaining 65%, the developer was permitted to construct houses of his choice as per the CIDCO-approved layout. Out of this, the builder was also permitted to use 5% of the area for commercial purposes. Occupancy Certificates were to be obtained for CIDCO's part of the housing first and the builder could keep on releasing tenements due to CIDCO at regular intervals. Thus, CIDCO was able to construct large number of houses in different localities simultaneously with the bare minimum investment and operational costs.

Maintenance of, thus developed areas is then, again, handed over to private sectors, ensuring vertical unbundling of each sector to avoid monopoly. In this manner, CIDCO saves approximately Rs. 42.60 lakhs per annum in the Solid Waste Management sector alone apart from not being managed by the 320 odd staff that would otherwise be on its payroll, thereby also eliminating the problem of trade unions adding to inefficiency. This also gives the opportunity for rehabilitating project-affected staff. In the water supply sector, CIDCO saves approximately 70% of the expected expenditure by contracting out various components of water supply. Maintenance of sewage treatment plants is also let out to the private sector operator at a fixed cost. Open parks, too, have been let out to the private sector including private companies, institutions, and social organizations to be developed by them. It is ensured, at the time of issuing contracts that they are given exclusively to the project-affected persons who belong to the area. In addition, CIDCO has mobilized retired government servants for collection of service charges thereby providing an efficient service at the same time releasing 1% of the total charges collected as commission to these community groups. Even computerized billing has been let out to a private sector operator. In all these cases, CIDCO has ensured that smaller level operators from the private sector are involved since their operational costs are low.

CIDCO has demonstrated remarkable foresight in generating innovative schemes and measures to tackle ground realities and convert problems into opportunities in order to develop Navi Mumbai. This is an approach that may be used as a model for formulating future partnerships between the

public and the private sector. CIDCO is currently developing Kharghar Township with an expected goal of releasing 6000 dwelling units every year for the next 3 years.

10.5 Proposed Land development policy for GMADA

Whilst the Regional Plan will provide the blue print for the Greater Mohali Region, the success of the blue print will depend on GMADA's land development policy to translate the plan into reality.

Till 2007, the task of developing townships in the Greater Mohali Region of Punjab was the monopoly of State-owned agencies, such as PUDA. GMADA was created following an Act of the Punjab Legislative Assembly. It has been assigned certain statutory authority to develop, regulate and managed land falling within the boundary of GMADA in the State of Punjab. There are various land development models that can be adopted for the development of Greater Mohali Region and will be listed below but its applicability to the GMADA context will have to depend on the political sensitivity of the area, the strength of the politicians and should be contextualized to the local cultural and social norms.

In the main there are various land development processes that have been adopted world wide. In India, the legal and policy framework are already in place to carry out these process and the effectiveness and speed of development are often linked to the bureaucratic and political system of the government elected into office. The options for the development process are as follows:

- Land acquisition and appointment of nodal agency for comprehensive development.
- Alternatives to Land Acquisition
- Transfer of development rights
- The way forward.

10.5.1 Government led- development and the Land Acquisition Act.

In Punjab, the State has the legal powers to acquire both private and alienate State land for development. GMADA has been empowered with the legal powers to acquire land development under the Land Acquisition Act 1894. While there is no national resettlement policy, land acquisition in India is covered by a national law, the 1894 Land Acquisition Act (LAA) and its subsequent amendments. The LAA allows for land acquisition in the national interest for water reservoirs, canals, plants, fly-ash ponds, transmission lines and highways to be carried out by the respective States, in accordance with its provisions. The existing legal provisions relevant to land acquisition and resettlement include:

- The Land Acquisition Act, 1894
- The National Highways (NH) Act, 1956
- National Policy on Resettlement and Rehabilitation for Project-Affected Families, 2003

The Land Acquisition Act, 1894 provides three methods for arriving at the value of land, which are

- government-approved rates;
- capitalized value of average annual income from the land; and
- prevalent market rate based on the average price paid in land transactions in the locality in recent times. These procedures consider land only as a commodity generating income.

GMADA can also acquire private land under Section 4 of the Land Acquisition Act 1894 for a public purpose. Land identified for the purpose of a project is placed under Section 4 of the LAA, which states that objections must be made within 50 days to the Collector (highest administrative officer) of the concerned District. The land is then placed under Section 6 of the LAA (or Section 7 of the CBA). This is a declaration that the Government intends to acquire the land. The Collector is directed to take steps for the acquisition, and the land is placed under Section 9. Interested parties are then invited to state their interest in the land and the price. Under Section 11, the Collector shall make an award within two years of the date of publication of the declarations. Otherwise, the acquisition proceedings shall lapse;

- In case of disagreement on the price awarded, within 6 weeks of the award the parties (under Section 18) can request the Collector to refer the matter to the Courts to make a final ruling on the amount of compensation;
- Once the land has been placed under Section 4, no further sales or transfers are allowed. However, since the time lag between Sections 4 and the others following it is about three years, land transfers are not uncommon;
- Compensation for land and improvements (such as houses, wells, trees, etc.) is paid in cash by the project authorities to the State government, which in turn compensates landowners. In the case of acquisition for coal projects, the coal companies make direct payments to landowners;
- The price to be paid for the acquisition of agricultural land is based on sale prices recorded in the District registrar's office averaged over the three years preceding notification under Section 4. The compensation is paid after the area is acquired, actual payment by the State taking about two or three years. An additional 30 percent is added to the award as well as an escalation of 12 percent per year from the date of notification to the final placement under Section 9. For delayed payments, after placement under Section 9, an additional 9 percent per annum is paid for the first year and 15 percent for subsequent years

The acquisition procedures, however, are long and cumbersome and the norm is that it will take a period of approximately ***2 years*** of publication of the Notification under Section 5A of the Act in the Government Gazette to conclude the acquisition process. The process of Land Acquisition in Punjab, and typical of most Indian States, is long and cumbersome. Determination of the right compensation to award to the land owners is a long, drawn out process and so is the land conversion process. There is a lot of red tape and bureaucratic procedures involved in land acquisition and conversion. Often the transparent compensation rates and packages are not transparent. Once land has been consolidated, the Land Allotment Rules should simplify and facilitate transfer, mortgage, sub-letting and subdivision of industrial plots.

10.5.2 Private Sector Development

Acquiring land is the most difficult area for the private sector. The specific issues associated with land acquisition are as follows:

- The land holding pattern in India is skewed towards small plots. This means that to acquire, say 100 acres of land, one has to deal with more than 50 families. Additionally, it is mandatory that all members of the family should give consent to the sale of land. Hence, acquisition of contiguous land is a serious problem as all owners may not be keen to sell their land.
- Poor maintenance of land ownership records invariably makes it difficult to verify the ownership pattern of the land. Hence, litigation leads to significant delays in the acquisition process.

- In India, there are no definite mechanisms for fixing the land price & the compensation package for standing assets. This is the most contentious issue in the land acquisition process.
- The conversion of land use pattern (if agriculture land is purchased) is time consuming and takes about 8 to 12 months. This delay could result in the investor losing interest in the project.
- Private corporations have to procure income tax clearance certificate (37-I) from the tax authorities for purchasing land, which is also a time consuming activity.
- Private sector corporations also have to deal with the pertinent local interest groups/ Gram Panchayats and their requests for employment assurance, community development programme etc.
- The stamp duty & registration act is project specific and ambiguous in most of the States. Hence, the fixing of these fees by the State Government is not transparent.

All these issues would need to be satisfactorily resolved through appropriate policy measures, in order to make the process of land acquisition simpler and less time consuming for the private sector investor. There are however, powerful and deep pocket private groups who are effective in buying land outright from farmers instead of involving the government agency. Such is the case for the special economic zones (SEZs) in Maharashtra, where the Mukesh Ambani-led Reliance group has decided to buy land directly from farmers. It is also understood that Reliance have paid farmers three times the government-listed rates on direct purchase of land at a couple of lakhs per hectare, against the market rate ranging Rs 40-Rs 75 lakh per hectare, depending on the location. Letting the private sector does its own land purchase is not bad but sometimes there are greedy land owners that will hold the developers to ransom and it will add to the cost of doing business in that State.

Whilst the private developer can proceed to do their own acquisition, but it is desirable that the State Development Authority (GMADA in the case of Greater Mohali Region) should play an active role in the acquisition process if there are errand landowners who hold the development to ransom. The spirit of the SEZ rules also similarly allows the State to step in for the remaining 10% of the acquisition if all avenues to resolve the acquisition deadlock fails. This would not only decrease the overall time frame for land acquisition & conversion of land (if required), but also would be a positive signal (indicating Government's seriousness) to the investors.

Despite past efforts, entrepreneurs have been facing difficulties in securing conversion of land from agricultural to residential and industrial. To resolve this problem, a provision has been made for the automatic conversion of land up to 5 hectares, like in Rajasthan. On expiry of 30 days from the date of application for conversion to the appropriate Revenue authority, the conversion shall be deemed to have taken place and the concerned Revenue Authority/GMADA will issue a certificate of deemed conversion. As for strategic projects desired by the State, GMADA should facilitate with the assembly of land parcels, getting the necessary approvals and land conversion so as to help expedite the process.

10.5.3 Alternatives to Land Acquisition

Much land currently acquired by the government, especially municipal and town development authorities may be quite unnecessary. One of the innovative methods is manifested in the form of "town planning (TP) scheme" of the Ahmedabad Urban Development Authority (AUDA). It described it as an easy way to pursue planned growth of city without acquisition as such and vastly reduced transaction cost.

The system works in the following manner. The Authority identifies a certain large region say on the western outskirts of the city for further urban development. The current use of the subject land is largely for agriculture and residences. In the master plan, the same area is demarcated into roads,

public parks and gardens, areas for other public utilities and water bodies, etc, and for possession by the Authority itself. The rest is available for private occupation subject to land use restrictions – floor space indices (FSI), zoning, and building bye-laws. The public land use plus that desired by the Authority for future sale and use is typically to about 30 per cent restricted. This means that each plot is shrunk by 30 per cent to make the pace for 30 per cent public land use and municipal ownership, leaving the owners with their current land which is now shrunken. In the layout, most plots have the same neighbours as before and substantial assets like houses generally do not have to be demolished. The "TP scheme" is then put up for the public to bring their individual objections, and accepted in due course. All landowners gain since there is no land transfer – only net public land transfer to the government. From the government's point of view there is little risk and contest and the government does not have to pay for the land. The value creation is implicit in the act of town planning, which if functional creates value.

10.5.4 'Necessary' Acquisition for vital infrastructure installations and Road Widening

Similar approaches, for instance, are possible for major infrastructure installations in highway widening. When a highway is required to be widened to improve the connectivity between 2 important designations, with much ribbon development along its length, the government can use the compulsory land acquisition act to secure the land for the road widening or public purposes. In many instances, the government would face high risks and costs to purchase and takeover land and build the road, where much ribbon development has already taken place. Typically, in ribbon development, the plots just adjacent to the highway would be highly priced with the prices falling off steeply from the first to the interior plots. Often, on the third plot from the highway with no vehicular access the price can be as low as one-third or less. This is because unplanned ribbon development along the entire road frontage is restricting the access of the interior plots to the road and does not allow land optimization and allowing the full potential of the land in the interior plots.

Under the current practice, the government can chose to invite companies to build the road on a BOT, BOOT basis and in most cases they will mark out a belt of 200 feet on both sides of the road to allow the road builder to enjoy the land enhancement to finance the road works.

In so doing; ribbon developments will prevail and an over concentration of linear commercial or mixed use land is not an optimum land use strategy to adopt and goes against the vein of good town planning principles. An alternative is for the government to still engage the private sector to construct the expressway but they should reframe from giving away the entire road side frontage potential on either side of the road to the developer. Having such linear development will dilute the concentration of commercial spaces within the town or city centre and add to traffic congestion along these roads which should ideally be for fast movement of vehicles and with limited direct access from these expressways.

The land to be paid to the developer of the expressway could be an equivalent area along one stretch of the expressway and in accordance with the Master plan.

10.5.5 Transfer of Development Rights (TDRs)

We now consider another approach that can considerably lower transaction costs of obtaining land for a public purpose that enhances social value. Thus, in the very same situation of converting ribbon development to corridor development, an alternative possibility is to lay out the land required for public purposes – the expressway subsidiary and feeder roads and other public amenities. To take these over through eminent domain and award coupons embodying rights to development to such persons whose lands is so taken over. Builders and developers on land elsewhere in the planning area

who are free to develop in accordance with a plan have to buy up these TDRs in a market in certain quantities related to the amount of construction or economic activity. A market for TDRs can also be encouraged and supported. This would ensure that those giving up land are automatically rewarded.

These can be at sufficiently large values to remove fears of value loss in giving up land, when the ratios or floor space index are correctly determined. TDRs can also be used to offset value changes that occur on zoning, and also to compensate for regulatory takings to preserve heritage and natural resources without being unfair to those whose land is so restrained. TDRs can be used most effectively even in the most congested cities to unlock vast amounts of land for public facilities, when such projects are accompanied by enhancement of FSI.

10.5.6 The Way Ahead

There should be a proper framework of land acquisition/rehabilitation to remove major risks and perversities and to ensure a fair process of land acquisition. Compulsory acquisition should be taken sensitively and compensation packages should be periodically updated to reflect true market price of land and displaced persons should be rehabilitated so that they will have the required skills to carry out a meaningful vocation. In most cases; in the Punjab state; where the residents may have a deep affinity for their land; compulsory acquisition of vast tracks of land may not be desirable politically. However, there is often no other option for the State , as there may be situation where they would require some land for important infrastructure development or for strategic public purposes. The term public purpose should be specified accurately in the law as arising when specific land is required. Thus, sites for dams, utility buildings, transport hubs, mines, roads and other network industries would be specific land.

Similarly, in urban areas, additionally those activities that are crucially to the community like hospitals; police and fire stations etc which require a central catchment would merit inclusion under public purpose. It is important to specify the public purpose rather than leave acquisition acts open to challenge.

Nevertheless, options to take particular proposals for land acquisition under eminent domain directly to the courts and or legislature need to be provided for since not all public purposes can be visualised in advance. In the use of eminent domain, the valuation of the land ought not to be carried out by the government but by independent professional bodies, and differences between such agencies when larger than 20 per cent or so should go to arbitrators/courts for resolution.

The capitalised rental value of the land may be an underestimate of the value even when all current distortions are removed and the value may be closer to the capitalised value of the value added in land, given that disguised unemployment and considerable poverty still exist in large parts of the country. Rehabilitation needs to be pareto-optimal. Those currently displaced should be compensated to cover the value of land, their current incomes rising at the planned growth rates of the economy need to be protected and the costs need to be internalised into the project.

Other innovations in rehabilitation and compensation such as equity stakes in projects are possible. In many states in India; land owners are compensated in dual forms; in terms of cash as well as a share in the project or given back a developed piece of land up to a certain percentage of the original land area. Similarly, tribal and other marginalised people displaced could be vested with some resettlement housing or housed in `model village'.

There are many ways to carry out road widening, town planning, value enhancing investments such as converting ribbon development to corridor development, providing public services through implicit acquisition, as in plot shrinking under "TP schemes" and in the use of TDRs. TDRs can also be used

to make the process of town planning and corridor development fair to all the beneficiaries including those who give up their land.

11. Rural Area Development Policy

11.1 Introduction

Based on the proposed Regional Plan, 3.8% of the total area falls under rural settlements. Outside the LPA area a large portion of the land is still under rural/agriculture use. Hence, there is a large portion of area and population will be outside the "planned urbanized area". As these areas are outside the "urbanized area" there is still a need to ensure that development if any is carried out in a relevant, proper and orderly manner. There is also a need to ensure that the rural communities are not left too far behind as the rest of GMADA develops with rapid speed.

Settlement wise, there are about 472 villages, by any standard, these is quite a high number of rural settlements in the study area. These are areas with the following characteristics: a low population base, fairly isolated and relatively low accessibility. The main economic activity of these areas is predominantly farming.

11.2 Approach

The Greater Mohali Region Master Plan vide the concept of Rural Growth Centers (RGC), proposed that these rural settlements be equipped with upgraded facilities and amenities for the betterment of the quality of life of the communities. The RGC concept focuses primarily on the diversification and value-add aspect to the existing rural economy, the provision of better infrastructure and the development of human resource to generate local entrepreneurship.

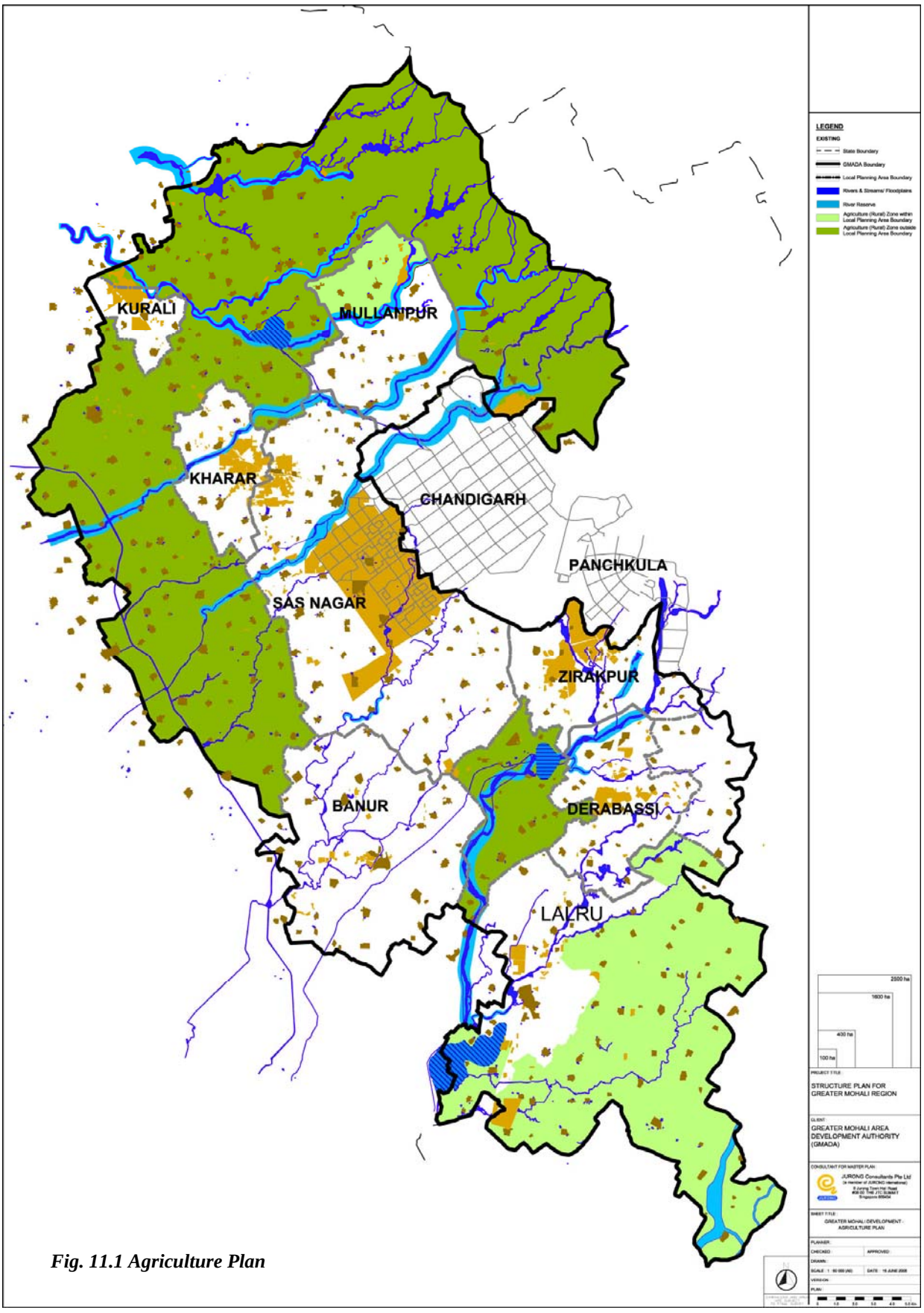


Fig. 11.1 Agriculture Plan

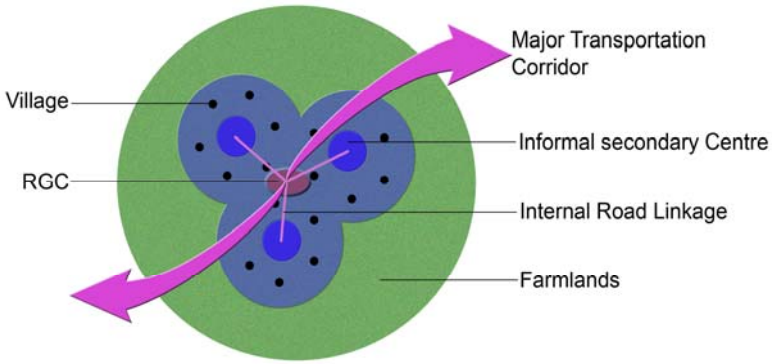


Fig. 11.2: Plan showing the conceptual presentation of the rural development policy

One of the principal objectives of GMADA is to have balanced development; hence the rural communities must not and should not be left out when the rest of GMADA progresses to a more modern society. There is a need to manage rural poverty and increase GDP per capita in the planned area. Two areas that are worth exploring are: one, to further promote the existing tourism industry through the expansion and diversification of tourism products/attractions in and around the vicinity of the existing villages and farms and two, to intensify development of the agriculture sector in tandem with the domestic and global demand. The development of tourism can be potentially be beneficial to both the area and the region as a whole. While tourism activities grow, other forms of growth such as visitors' accommodation such as farm-stay, budget hotels, arts and crafts, food, transportation and the other related agricultural/rural related functions will also follow.

11.2.1 Policy and Proposal

There is a need to involve the rural communities in the planning process, this, together with the government intervention and support, are critical in the success of the total rural development. Besides, the need to upgrade human resources, for the greater success of RGC projects, there is a need to focus on the physical aspect of development which includes:

- Improving existing informal centre; where commercial, industrial and institutional facilities are located.
- Intensifying commercially-viable agricultural crops and livestock, meat, poultry, organic fruits and vegetables;
- Setting up of marketing, commercial and industrial facilities,
- Improving the quality of life of the community by providing new and upgrading existing community facilities.

Plans formulated to address the above issues, must be sustainable and should not have adverse effects on the environment. Most of these initiatives will not only benefit directly the immediate rural population but also indirectly benefit the region as it provides jobs to the locals and business opportunities to various other industries.

- **Feasibility of Crops:** Where possible there has to be a constant revisiting in the area of crop relevance and their feasibility. The commercially viable crops will have to be identified and singled early to ensure that the most suitable area for cultivation of these crops is earmarked and protected.

- **Marketing:** With the advent of electronic media, every opportunity must be capitalised. The use of electronic marketing framework, together with e-market portal, for the exchange products and services online should also be promoted at all cost. It is through this medium of communication that provides the farmers current information on changes in market price, direct links or access to exporters & importers and reduces cost in terms of market channel. The cost cutting is the direct effect of bypassing transaction costs such as collectors/truckers and also the strengthening of their negotiating capabilities (i.e. as a result of prior knowledge of the most current market situation) when the middlemen dealers arrive to buy their crops. In terms of marketing their products and services globally, the electronic media is more effectively and should open up more business opportunities.

- **Local Community Participation:** Ultimately as mentioned earlier, in order for the rural development initiatives to be successful and sustainable, the active participation of the local community's most disadvantaged or the least privileged groups must be encouraged. Women, in particular, form a large section of the rural population, their needs and problems are also part of community development. Therefore, an increase in women's participation in development programme is highly recommended. Also along the same line, it maybe prudent that members of the local based organisation acquire the knowledge, skills and experience on village development so as to function effectively as pioneers of rural development. It is always an advantage by having training activities undertaken preferably by local experts in community development.

- **Setting Up of Independent Agency/Coordinator:** Integrating and coordinating the various authorities from government and non-government agencies should be carried out by a program coordinator or an independent body, which also will assume the overall responsibilities of the community development programme. In order to further boost the integration and the co-ordination of the various disciplines of the government and non-government agencies, the appointed program coordinator or an independent body could be set up to undertake overall responsibilities of the rural community development programme. The agency should be fully integrated under one management with a permanent administration in order to ensure continuity of the programme. The agency is responsibility to link the community based organisation to the governing authority in articulating their needs and desires in development, to conduct training and accountable for the programme undertaken.

  The agency concerned should be the executive body to undertake the overall responsibility of the village development programmes. The officers in the agency should be conversant with the concept of community development. They should be made aware that planning and decision-making in the context of community development requires direct involvement of the community and not the sole decision of the organisation supervising the activities of the community. In other words, the officers themselves should be trained on the concept of community development and as trainers before they themselves can guide in undertaking the development initiatives.

  'The Program Coordinator / Independent Body is held responsible for:

  - Mobilizing and building the capacity of the community in order to ensure effective utilization of the RGC's. Planning and implementing village development programmes and facilities together with the development agents. Planning include community needs identification and analysis, bearing in mind that the various aspects of life in a community are interdependent, therefore whatever action is taken, it has to be carefully analyzed and anticipate the consequences of the actions on the whole community. The Programme should be based on the availability of resources (physical, human and organisational resources) in the respective villages and should be realistic according to the needs of the people.

- Coordinating with the various development agents.
- Coordinating Training Programmes
- Disseminating of information on village development
- Monitoring and evaluating the effectiveness of the programmes and activities to ensure the programmes implemented are being carried out effectively.

12 Regional Infrastructure Master Plan

12.1 Introduction

The Greater Mohali Area Development Authority, GMADA wishes to establish world-class infrastructure services to create a competitive business environment. The Infrastructure Development plays a paramount role in determining the success of the planned township and with this in mind, GMADA needs to provide the highest standard and quality of infrastructure and utility services.

As the urban areas continue to expand and develop, there is an immediate need to improve the infrastructure to improve the infrastructure to support new development projects. These infrastructure and utility services need to be efficient and to be geared towards supporting a clean and high quality living environment.

12.2 Goals

The Regional Infrastructure Master Plan considers the strategic objectives, present situation, the various growth trends of the local planning areas and future issues. It integrates with the key influencing factors including the Greater Mohali's natural environment, its heritage, economic efficiency and social equity. The critical success factor for an integrated township development also hinges on the availability of all required infrastructure development in a timely manner.

The objectives for the provision of infrastructure are appended as follows:-

Infrastructure Goals

- To optimise use of existing infrastructure
- To integrate common aspects of infrastructure needs and requirements to ensure planning for sustainable and affordable development to meet the growth of the Greater Mohali Region
- To utilise modern and innovative technology in infrastructure provision to improve service levels and to attain a high quality environment within the Greater Mohali Region
- To control and coordinate all infrastructure and utility service providers and to set targets for quality water, energy resources and waste resources

In line with these goals, the planning of the infrastructure needs to take into consideration the following:-

- **Projections for population growth** (reference to Chapter 5 Population Growth, Characteristics and Projections)

- the prediction of growth and distribution of population and employment to ensure infrastructure is delivered on time

- **Planning for demand infrastructure**

- Infrastructure and utilities planning would need to base on realistic demand projections to optimize the use and efficiency of the infrastructure

- **Innovation**

- Seek to implement innovative practices that will improve service delivery

The services should be efficient, reliable and integrated, making use of the common facilities and service corridors. The public will be encouraged to participate in conservation and waste minimization activities, whilst latest technology will be used to ensure minimal environmental impact.

12.3 Water Supply System

12.3.1 Introduction

The success of water supply system is crucial to the sustainability of the development of Greater Mohali Region. The provision of sufficient and reliable water is essential to support the urban growth of the development.

Strategic Directions

- To transform the Greater Mohali Region into an exciting region with an efficient and reliable water supply system
- To achieve a 100% availability of water supply in the Greater Mohali Region

12.3.2 Existing Water Supply and Distribution System

One important source of the present water supply in the Greater Mohali region is ground water. Generally, the existing ground water supply and distribution system comprises the tube wells, storage or service reservoirs and an extensive network of pipelines. Water extracted from tube wells will be chlorinated prior to distribution to end users. After chlorination, the water will be pumped into service reservoirs and then distribute to users through a large network of mains of various sizes and types. **Figure 12.3.1** shows the overhead service reservoir.

The current municipal water supply and distribution system only covers certain areas of the Greater Mohali Region. For areas not covered under the current municipal water supply and distribution system, the residents will depend on private wells and storage tanks for their domestic water. **Figure 12.3.2** shows the overhead water tank used by villagers. **Figure 12.3.3 and 12.3.4** show the private well, pump and the ground level storage tank.

Figure 12.3.1 Overhead Service Reservoir

Figure 12.3.2 Overhead Water Tank

Figure 12.3.3 Private Well and Pump

Figure 12.3.4 Ground Level Water Tank

In addition, approval has been obtained for the planning of 6 pipe lines (20 MGD per pipe line) to supply water from the Bhakra Canal located about 25 km away from the Greater Mohali Region. Four of the pipe lines will be supplied to Chandigarh while the remaining two pipe lines are supplying to the Mohali. **Figure 12.3.5** shows the indicative alignment of the existing incoming water pipe lines from the Bhakra Canal water source to Bur Majra Water Works near Chandigarh.

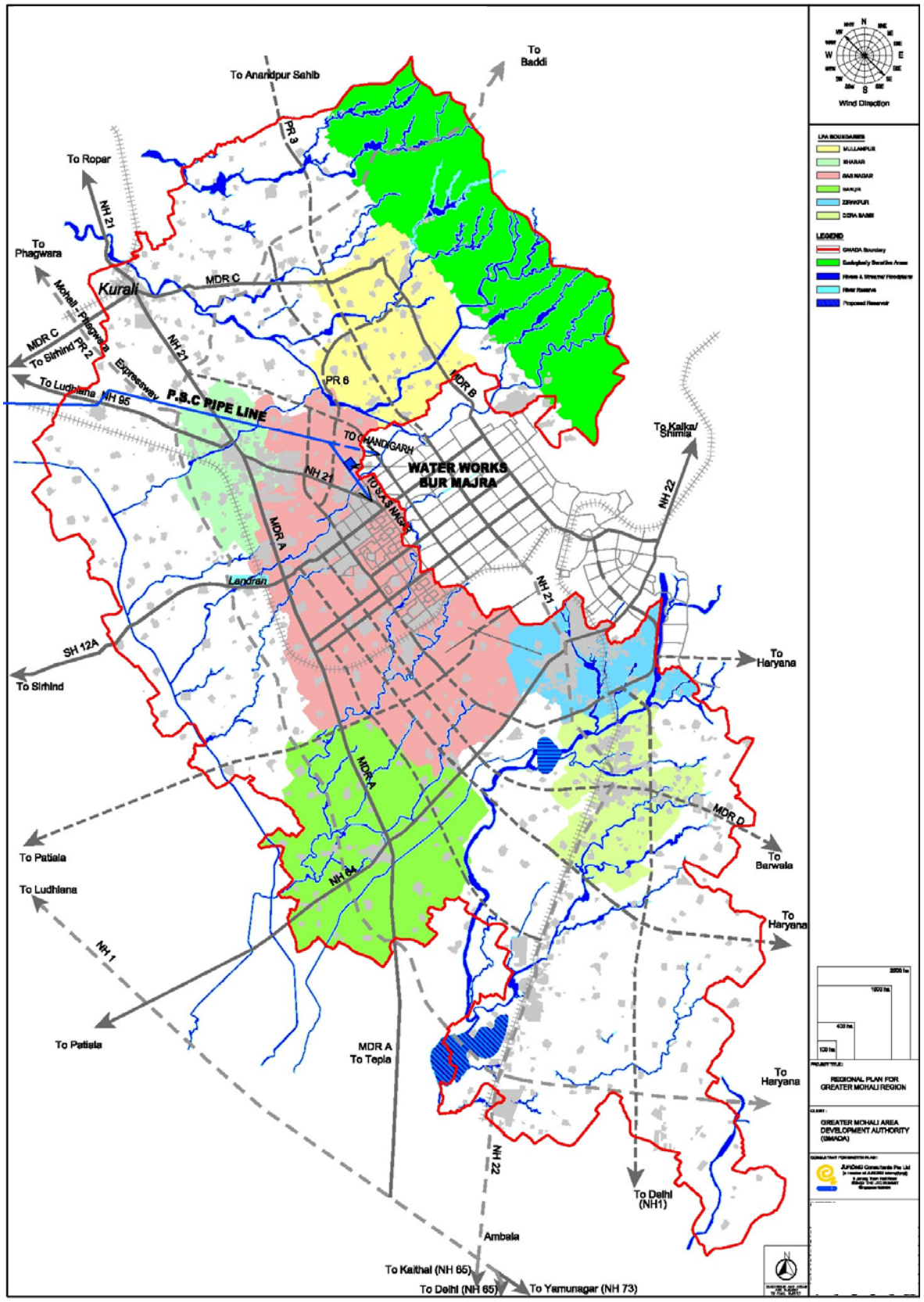


Figure 12.3.5 Existing Water Supply Line

12.3.3 Water Supply Norm

The proposed water supply for the Greater Mohali Region would need to be adequate, reliable and of equivalent to CPHEEO Standard to meet the growing demand requirements. It is thus critical to manage the supply end and demand end of the water supply timely.

The water supply norm depends on the social, economic growth and consumption behaviour of various land uses proposed in the development. These water norms considered are appended as follows: -

- **Unit Water Demand**

Land Use	Unit Water Demand*
Residential	**250 lpcd**
Rural Settlements	**100 lpcd**
Commercial, institutional, utilities	**45 cum/ha/d**
Industrial	**45 cum/ha/d**
Transportation (transport terminals)	**45 cum/ha/d**
Recreation & open space	**60 cum/ha/d**

* lpcd represents litre per capita per day

* cum/ha/d represents cubic metre per day per hectare

- **Fire fighting demand**

  Fire demand in kilolitres per day=$100\sqrt{p}$, where p=population in thousands
- **Water Transmission and Distribution Losses**

  Total Water Loss of 15% includes 5% transmission loss and 10% distribution loss
- **Workforce consumption** is incorporated into the respective unit demand
- **Recycled water** will be used mainly for irrigation purpose
- **Green Area**

  10% of the plot area (for residential, commercial, industrial, institutional, utility use) will be green area and gardening water for the green will be recycled water.

12.3.4 Projected Water Demand

Based on the land use distribution and population projection for the various planning areas, the water demand estimation has been worked out including urban area and non-urban area. The ultimate demand for total water requirements will reach 3,023.5 MLD by the year 2056. In which, the ultimate potable and recycled water requirements will reach 2,102.1 MLD and 921.4 MLD respectively by year 2056. **Table 12.3.1, 12.3.2 and 12.3.3** illustrate the projected water demand for Greater Mohali Region.

Table 12.3.1 Projected Total Water Demand for Entire Greater Mohali Region

	Local Planning Area	Projected Ultimate Demand (MLD)	Projected Demand (MLD)		
			Year 2020	Year 2035	Year 2056
Urban	SAS Nagar	749.3	133.3	273.7	749.3
	Mullanpur	136.4	22.0	47.0	136.4
	Zirakpur	228.4	86.4	145.6	228.4
	Dera Bassi	251.9	94.8	160.3	251.9
	Banur	427.4	152.0	266.8	427.4
	Kharar	152.2	42.2	72.0	152.2
	Kurali	79.9	23.4	39.1	79.9
	Lalru	227.4	81.0	142.0	227.4
	Nayagaon	7.5	0.5	1.6	7.5
Non-Urban	Industrial (outside urbanizable area)	128.2	128.2	128.2	128.2
	Rural Settlements	80.6	63.2	68.9	80.6
	Recreational	301.5	236.3	257.8	301.5
	Transportation (transport terminals)	252.8	198.1	216.2	252.8
	Total	3023.5	1261.4	1819.2	3023.5

Table 12.3.2 Projected Potable Water Demand for Entire Greater Mohali Region

	Local Planning Area	Projected Ultimate Demand (MLD)	Projected Demand (MLD)		
			Year 2020	Year 2035	Year 2056
Urban	SAS Nagar	678.9	120.8	248.0	678.9
	Mullanpur	66.5	10.7	22.9	66.5
	Zirakpur	183.4	69.4	116.9	183.4
	Dera Bassi	208.1	78.3	132.4	208.1
	Banur	254.3	90.4	158.7	254.3
	Kharar	112.6	31.2	53.3	112.6
	Kurali	62.0	18.2	30.3	62.0
	Lalru	154.9	55.2	96.7	154.9
	Nayagaon	2.0	0.1	0.4	2.0
Non-Urban	Industrial (outside urbanizable area)	111.1	111.1	111.1	111.1
	Rural Settlements	49.1	38.5	42.0	49.1
	Recreational	-	-	-	-
	Transportation (transport terminals)	219.1	171.7	187.4	219.1
	Total	2102.1	795.6	1200.1	2102.1

Table 12.3.3 Projected Recycled Water Demand for Entire Greater Mohali Region

	Local Planning Area	Projected Ultimate Demand (MLD)	Projected Demand (MLD)		
			Year 2020	Year 2035	Year 2056
Urban	SAS Nagar	70.4	12.5	25.7	70.4
	Mullanpur	69.9	11.3	24.1	69.9
	Zirakpur	45.0	17.0	28.7	45.0
	Dera Bassi	43.8	16.5	27.9	43.8
	Banur	173.1	61.6	108.0	173.1
	Kharar	39.6	11.0	18.7	39.6
	Kurali	17.9	5.3	8.8	17.9
	Lalru	72.5	25.8	45.3	72.5
	Nayagaon	5.5	0.4	1.1	5.5
Non-Urban	Industrial (outside urbanizable area)	17.1	17.1	17.1	17.1
	Rural Settlements	31.5	24.7	26.9	31.5
	Recreational	301.5	236.3	257.8	301.5
	Transportation (transport terminals)	33.7	26.4	28.8	33.7
	Total	921.4	465.9	618.3	921.4

12.3.5 Sources of Water Supply

The water source available for the Greater Mohali Region must be adequate to sustain the long term water requirements for the Greater Mohali Region. To ensure sustainable supply of water to the Greater Mohali Region, the alternative water sources that include the following can be explored:-

- surface water
- ground water
- rainwater harvesting & recharging
- recycled water

(a) Surface water

The perennial river source can be considered to be more reliable and sustainable supply of surface water. One possibility is to supply surface water by pumping from the Bhakra Canal located about 25 km away from the Greater Mohali Region. Another possibility, which is currently under feasibility study, is to provide surface water by gravity from Ganguwal that is 70 km away from the Greater Mohali Region.

(b) Ground water

As described earlier, ground water is considered to be one of the important source of the present water supply for the Greater Mohali Region. However, it may not be advisable to depend on the ground water source as the report* revealed that the ground water is depleting at a very fast pace and the water quality is also deteriorating due to over exploitation and contamination. In addition, unrestricted and unregulated abstraction of groundwater has serious long term environmental implications. Measures should be taken to discourage the consumers to extract ground water.

** Report on Dynamic Ground Water Resources of Punjab State (As on March 2004) published by Central Ground Water Board (North Western Region), Government of India, Chandigarh 2007*

(c) Rainwater harvesting & recharging

The rainwater collected can be stored for direct use or can be recharged into the ground to boost up the water table.

(d) Recycled water

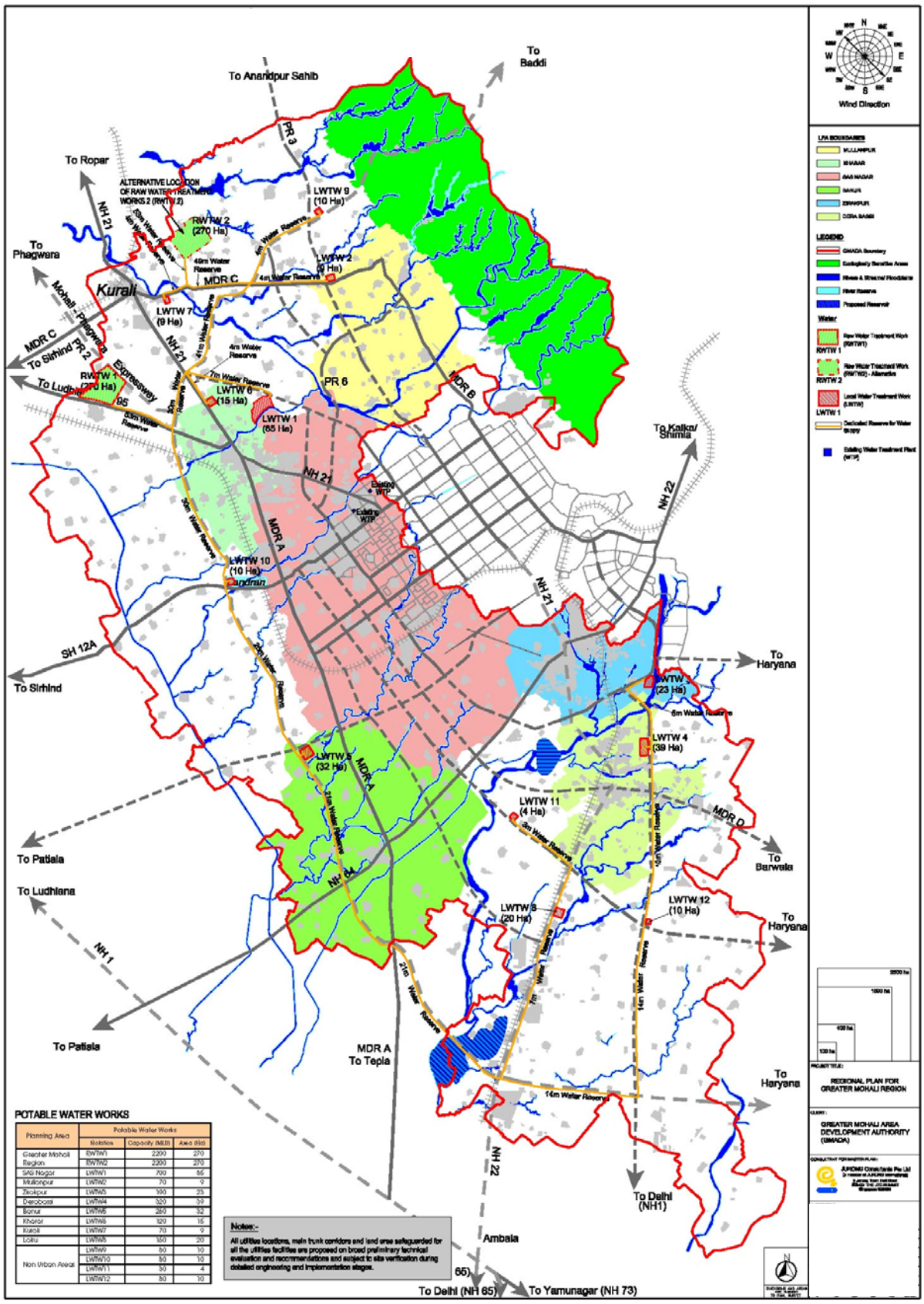
Adopted by many developed countries, water reclamation is a growing trend around the world. The waste water effluent can be treated up to tertiary level as recycled water where it will then be used for irrigation for public parks/green belts/open spaces. This will help to reduce the water load required for potable water quite substantially.

12.3.6 Water Supply and Distribution System

The water supply and distribution system comprises the water treatment & storage works and a large network of distribution mains. Development of dual pipeline systems would be proposed for potable water supply system and the recycled water supply system.

12.3.6.1 Potable Water

Figure 12.3.6 shows the proposed potable water works. For potable water supply and distribution, two (2) Raw Water Treatment Works (RWTW 1 & 2) are proposed to serve the entire Greater Mohali Region: RWTW1 is proposed in the light that the existing water source can be supplied from Bhakra Canal (by pumping) while RWTW2 is an alternative in the event that raw water can be supplied from Ganguwal by gravity (currently under feasibility study). RWTW 1 & 2 are located close to the Greater Mohali Region boundary as these are the probable locations where the raw water supply may enter into the Greater Mohali Region. Raw surface water is conveyed by pipelines to the waterworks where it is chemically treated, filtered, disinfected and stored. Treatment frees the water of harmful bacteria, makes it clear, sparkling, odourless, colourless, and safe for consumption. After treatment at RWTW 1 or RWTW 2, water will be supplied to twelve (12) Local Water Treatment & Storage Works (LWTW 1 to 12), where water can be further treated (if necessary) and stored for distribution to the local areas. LWTW 1 - 8 are mainly for the urban area while the non-urban area will be served by LWTW 9 -12. From the proposed local water treatment & storage works (LWTW), clear water can be pumped to customers directly or via the elevated service reservoirs where potable water were to supply to consumers by gravity. All the LWTWs will be located on relatively higher ground to facilitate water distribution by gravity means. In addition, LWTWs are located close to the road network for easy access and connection.



Planning Area	Potable Water Works		
	Notation	Capacity (MLD)	Area (Ha)
Greater Mohali Region	RWTW1	2200	270
	RWTW2	2200	270
SAS Nagar	LWTW1	700	85
Mullanpur	LWTW2	70	9
Zirakpur	LWTW5	190	23
Derabassi	LWTW4	320	39
Banur	LWTW3	260	32
Kharar	LWTW6	120	15
Kurali	LWTW7	70	9
Lalru	LWTW8	160	20
Non Urban Areas	LWTW9	80	10
	LWTW10	80	10
	LWTW11	30	4
	LWTW12	80	10

Figure 12.3.6 Proposed Potable Water Works

The details of the proposed potable water works are shown in **Table 12.3.4 Proposed Potable Water Works.** The locations and land area requirements of the proposed potable water works are only indicative and may subject to changes.

Table 12.3.4 Proposed Potable Water Works

Proposed Waterworks	Local Planning Areas	Capacity (MLD)	Land Area Requirements (Ha)
RWTW1	GREATER MOHALI REGION	2,200	270
RWTW2	GREATER MOHALI REGION	2,200	270
LWTW1	SAS NAGAR	700	85
LWTW2	MULLANPUR	70	9
LWTW3	ZIRAKPUR	190	23
LWTW4	DERABASSI	320	39
LWTW5	BANUR	260	32
LWTW6	KHARAR	120	15
LWTW7	KURALI	70	9
LWTW8	LALRU	160	20
LWTW9	NON-URBAN AREA	80	10
LWTW10	NON-URBAN AREA	80	10
LWTW11	NON-URBAN AREA	30	4
LWTW12	NON-URBAN AREA	80	10

12.3.6.2 Recycled Water

The recycled water supply and distribution system is an independent system and does not share the same water pipeline with the potable water supply system. The main source of recycled water is the treated effluent from the proposed sewage treatment plants located within the Greater Mohali Region. The recycled water will be used mainly for irrigation purpose.

12.3.7 Water Resource Management System

An integrated sustainable water resource management system is proposed for the Greater Mohali Region. At its core, a holistic view of water resource should be taken which will consider the various aspects of water resource in a linked fashion.

The strategies applied to the system:

i. Establish integrated water resource management agency

Water resource management involves various aspects, which could be under management of different authorities. It is imperative to establish a suitable integrated agency to coordinate and manage the water issues in the Greater Mohali Region.

ii. Diversify Water Sources

Regarding long term planning to cope with the water requirement, more sources will increase the reliability. The sources of water for the Greater Mohali Region include surface water, underground water, rainwater and recycled water. Surface water from perennial river source shall be the main source of water supply while ground water, rainwater and recycled water will supplement the water supply.

iii. Ensure Water Quality

To ensure that the water distributed to consumers meets quality requirements, water samples should be regularly collected and analysed chemically and bacteriologically at the water testing laboratory. Raw water from all sources, samples of water at various stages of treatment at all waterworks and selected points in the distribution network should be collected for daily or periodic analysis to ensure that the quality of treated water is within the guidelines set by the WHO and local authorities such as CPHEEO.

iv. Manage Water Demand

Securing an adequate supply of water is only half the solution. Managing the demand side of water is also very critical for water sustainability. As described earlier, the water demand has been worked out based on the landuse distribution and population projection. Thus, types of landuse (especially types of industries) should be selected and planned carefully so that the water requirement can be reduced. In addition, getting people to cut water consumption may also be helpful.

v. Improve Water Conservation

- Improve customer awareness of water conservation
- Promote new technology and the use of water - efficient household fittings and appliances
- Encourage the community to change their water usage behaviour and habits, and to educate them on the implications of living in water catchment areas.

12.3.8 Development Plan

A proper development plan is necessary to ensure that the proposed water supply and distribution system can be executed effectively and efficiently.

1. All the proposals must get approval from government authorities. Especially for the surface water source, it will affect not only the Greater Mohali Region but also other areas.
2. The development of the water supply and distribution system should coincide with the phasing plan of GMADA. As described earlier, the water supply and distribution system has been worked out based on the ultimate development of Greater Mohali in 50 years. However, it is not necessary for the water system to be executed in one step. Based on the phasing plan of the Greater Mohali Region, the water supply and distribution system will be carried out incrementally to meet the requirement in different development stages.

3. When planning the future water supply & distribution system, the existing facilities and networks (augmentation / upgrading, if necessary) should be taken into account to save cost and time.
4. The availability of funds is always a major factor influencing the water system development. The government would need to play a pivotal role in the development of water supply and distribution system. To relieve government of financial burden, various alternatives to attract private investment including public-private-participation (PPP) mode should be taken into consideration, especially for the development of raw water treatment works. In this aspect, a company could be formed to own and manage the treatment works. The company will be responsible for the raw water transmission and treatment. The bulk clear water will be sold to local authorities and other distributing agencies.

12.4 Power Supply System

12.4.1 Introduction

The per capita consumption of power supply is an index of quality of life and economic and social conditions of the community. The allocation of industries also depends on the availability of the desired quantity and quality of power supply.

Strategic Directions

- To provide reliable and quality power supply to the Greater Mohali Region
- Ensure adequate power supply for the domestic and industrial consumption
- Power is one of the most crucial infrastructures for the prosperity and growth of a region.

12.4.2 Findings of Previous Studies by PSEB

Punjab State Electricity Board (PSEB) has vast power infrastructure comprises Generation, Transmission & Distribution System that catered for 55.43 lac (or 5.543 Million) of consumers with connected load of 16,322 MW in the State where the per capita energy consumption is 806 kWh, which is the highest in the country.

Power availability in Punjab as at 31st March 2003 is appended as below.

12.4.2.1 Power Generation

Power from PSEB's Own Projects

Hydro Electric Projects	**1,006.65 MW**
Thermal Projects	**2,130.00 MW**

Power Shared from

Common Pool Projects	**1,331.84 MW**
Central Sector Projects	**1,233.10 MW**
Total Power Available =	**5701.595 MW**

12.4.2.2 Power Transmission System

The power transmission system of PSEB as at 31st March 2003 is appended in **Table 12.4.1 & 12.4.2** below.

Table 12.4.1 Transmission System

Grid Sub Stations	Nos.	Capacity (MVA)
220 KV	43	9,150
132 KV	73	4,272
66 KV	345	7,298
33 KV	108	1,111
Total =	569	21,831

Table 12.4.2 Transmission System

Transmission Lines	Length (km)
220 kV	3,890.895
132 kV	3,013.057
66 kV	4,745.10
33 kV	1,657.391
Total Length (km)	13,306.443

Shunt Capacitors 4,707.48 MVAR

12.4.2.3 Distribution System

The Distribution System of PSEB as at 31st March 2003 is appended in **Table 12.4.3**.

Table 12.4.3 Distribution System

Sl. No.	Particulars	
1	11 KV lines	102,533 Km
2	LT Lines	162,037 Km
3	Distribution Transformers	191,955 Nos
4	LT Shunt Capacitors	2,720 MVAR
5	LT Villages with Urban Pattern Supply	5,567 Nos.

12.4.2.4 Captive Power Units

Punjab State Electricity Board has very consumer friendly CPP / Co-generation / IPP Policy which has been devised after studying the policies on the subject of various industrially advanced States of India. Before this policy was made, it was publicly discussed with the Industrial Associations like CII & PHDCCI of the region. The Policy circulated vide CC No. 26 / 2002 read with CC No. 60 / 2002 has the following salient features:

Three categories have been allowed to the entrepreneur:

- **Category I** – Where plant owners has no connection with the PSEB but runs CPP independently. (i.e. on stand alone basis)
- **Category II** – Where consumer wants parallel operation with the Board's supply.
- **Category III** – Where a consumer wants to have PSEB as stand-by supply but will run plant for running his industry.

For the purpose, the plant owner is required to pay:

- **One time permission fee at a fixed rate of Rs. 50/- per KVA/month.**
- **Pay parallel operation charges @ Rs. 10/- per KVA.**
- **Can set up plant upto 200% of the sanctioned load of the consumer.**
- **Can** sell surplus power to PSEB against a specific agreement on the terms and conditions approved by State Electricity Regulatory Commission.
- **Banking of power is available against specific proposals.**
- Can avail PSEB supply as stand-by paying Rs. 200/- per KVA per month for a specific requirement of power supply during his plant failure
- The relevant instructions and the detailed captive power policy is available from PSEB.

There are 35 numbers of Captive Power Plants in the State. 33 numbers of Captive Power Plants with capacity 82,170 kVA meet their own requirement and do not have surplus power for supplying to PSEB.

Following which, 2 numbers of Captive Power Plants with installed capacity of 16 MW supply surplus power of 5MW to PSEB is shown in **Table 12.4.4.**

Table 12.4.4 Captive Power Plants

Name of Power Plant	Installed Capacity (Mw)	Date of commissioning	Surplus share for PSEB (MW)
M/s Rana Sugar Ltd., Butter Seviyan	1 x 6 = 6 2 x 2.5 = 5	23.1.98	4
M/s Faridkot Co-operative Sugar Mills Ltd., Faridkot	2 x 2.5 = 5	22.1.2000	1

12.4.3 Agencies Dealing with Power Supply

12.4.3.1 PSEB- Punjab State Electricity Board

The role of PSEB to make agreements with the state /Power generating plants for dedicated power supply in the state of Punjab. Greater Mohali area is a part of Punjab. Hence all arrangements to procure power essential in the state is the role of PSEB. PSEB is also responsible to transmit / reach power to the GMADA region.

12.4.3.2 PUDA – Punjab Urban Development Authority

Punjab Urban Planning and Development Authority is an apex institution established in July 1995 for the development of balanced urban growth in the State of Punjab. PUDA is committed to provide planned residential, commercial and industrial spaces incorporating the latest state of the art technology and town planning norms.

PUDA being the nodal agency is instrumental to ensure that the region outside of GMADA is ensured power in sync with GMADA region.

12.4.3.3 GMADA- Greater Mohali Area Development Authority

GMADA to improve, enhance and sustain a power distribution system that recognizes the needs of the present and also supports the future needs for the entire duration of the plan. Employ buffers using non- conventional energy system. Encourage a policy for industries and commercial establishments to tap non-conventional energy and earn green units for themselves and the city in general.

GMADA shall be responsible to ensure proper infrastructure essential for receiving power from PSEB and then transmitting the power in the entire region of GMADA. They shall reserve plots/ area essential for power infrastructure.

12.4.3 Existing Power Supply Status

Existing Power generation stations in and around Mohali are indicated in **Figure 12.4.1 Location of Power Plants.** The thermal power plants with their installed capacity (MW) include Ranjit TPS (600 MW), Ropar TPS (1,260 MW) and Bathinda TPS (860 MW).

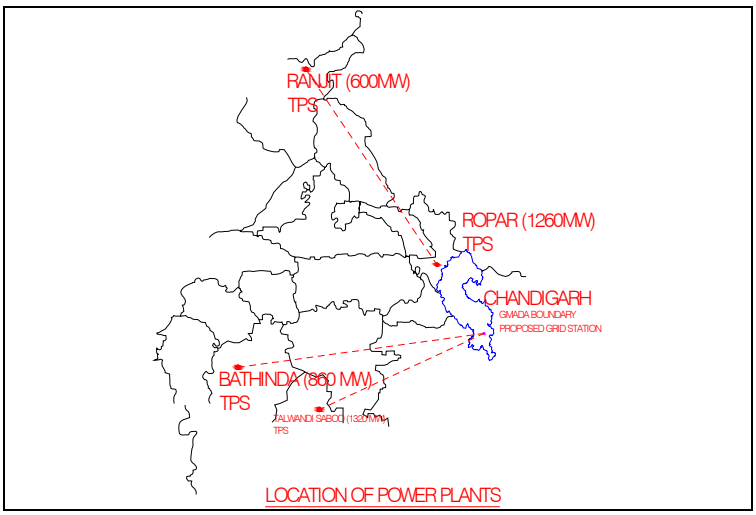


Figure 12.4.1 Location of Thermal Power Stations

Ropar Power Station

The Greater Mohali Region comprises SAS Nagar, Kharar, Banur, Zirakpur, Derra Bassi and Mullanpur is presently being fed from 220 kV sub stations at Mohali-1, Dera Bassi, Rajpura & 132 kV S/Stn Kharar which is to be upgraded to 220 kV, the power sources feeding this mothers s/stns to this region are Ropar thermal plant (6x210 MW)

National Power Grid

220 kV Main interlinking substation Ganguwal which in turn is fed from Bhakra and Dehar power houses of BBMB. 220 kV substation Mohali-I is being connected to 400/220 kV substation at Nalaghar of power grid through a 220 kV DC line to draw additional power from Nathpa Jhakhari HEP (6x250MW) in HP. In total, 2,760 MW power supply is available.

12.4.5 Power Supply Norms

Power Supply norms depend on the economic activities in a city, desired requirements and standards of population, its household income levels, and the availability. However, in practice, the norms actually get determined on the basis of the availability of Power, conveyance and distribution network, and whether Power is supplied through individual connections or stand posts. The Power supply norms considered for evaluating the demand position in this planning is shown in **Table 12.4.5 Power Supply Norms.**

Table 12.4.5 Power Supply Norms

Particulars	Norms
Residential	**Population *1.4KW**
Commercial	**1.5times normal load**
Industrial	**1.5times normal load**
Institutional	**0.5 times normal load**
Recreation & Open Space	**0.25 times normal load**
Transportation	**1.5 normal load**

12.4.6 Projected Power Demand Requirements

Based on the above norms, electricity demand load is evaluated. This load is calculated for each of the planning region in Greater Mohali Region as shown in **Table 12.4.6 Projected Power Demand.**

Table 12.4.6 Projected Power Demand

Planning Area		Projected Power Demand (MW)		
		Year 2020	Year 2035	Year 2056
Nayagaon	10.59	6.35	8.47	10.59
Mullanpur	550.12	330.07	440.10	550.12
Kurali	395.79	237.47	316.63	395.79
Kharar	761.65	456.99	609.32	761.65
SAS Nagar	4355.70	2613.40	3484.60	4355.70
Banur	1806.00	1083.6	1444.80	1806.00
Zirakpur	1246.20	747.75	996.99	1246.20
Dera Bassi	1479.30	887.56	1183.40	1479.30
Lalru	1093.10	655.83	874.44	1093.10
Rural/Agricultural Area	393.75	236.25	315.00	393.75
Estimated Total Power Demand (MW) =	**11,968.5**	**7,019.02**	**9,358.75**	**11,968.5**

This power projection is based on the "connected load" to the entire electrical system. However, the actual running load (peak) may only be only 35 to 50% of the connected load due to the diversity factor considered. It is a common practice to base power projection on the "connected load" so as to provide reliability and stability to the entire electrical system.

It is therefore envisaged that Greater Mohali Region would attain the estimated power demand of 11,968 MW by Year 2056.

12.4.7 Power Availability

The present total available power is 2760 MW and power demand is 2808 MW for the year 2011. The remaining power demand of 48 MW can be easily fulfilled by PSEB but for the year 2021 power demand will rise to 7,019 MW i.e. 4,211 MW short of supply. To meet this requirement, PSEB is advised to make agreements with the state /Power supply agencies for dedicated power supply. This power supply can be made available by enhancing existing one and from new-upcoming power stations in the regions.

Solar power is one possible source of power that GMADA can encourage its occupants to explore. Appropriate incentives can be offered to make the power production using Photo voltaic cell. As per one study, the area essential to produce 100MW of power in Indian sub continent is 0.67 sq Km. The whole of power demand of GMADA which is 9,359MW can be produced using solar energy by installation of solar cell / panel that cover an area of 64 sqkms. (This is 5% of total GMADA area)

For the year 2035, power demand will reach to 9,359 MW i.e. 2,340 MW short of supply. To meet this requirement we recommend a gas fired power station to be installed. The viability of the Gas based power station shall depend on the possible laying of the Gas pipe line to Punjab. These gas pipeline are expected to reach in the region within 5-10 years as informed by the PSEB authorities. We recommend to reserve two locations of 400 Ha each for the proposed gas fired power station having capacity of 5,000 MW. The North site is reserved in case the gas line from North comes into Punjab. However, if the gas line from South comes into Punjab first, the site reserved in the south shall be used to establish the power station.

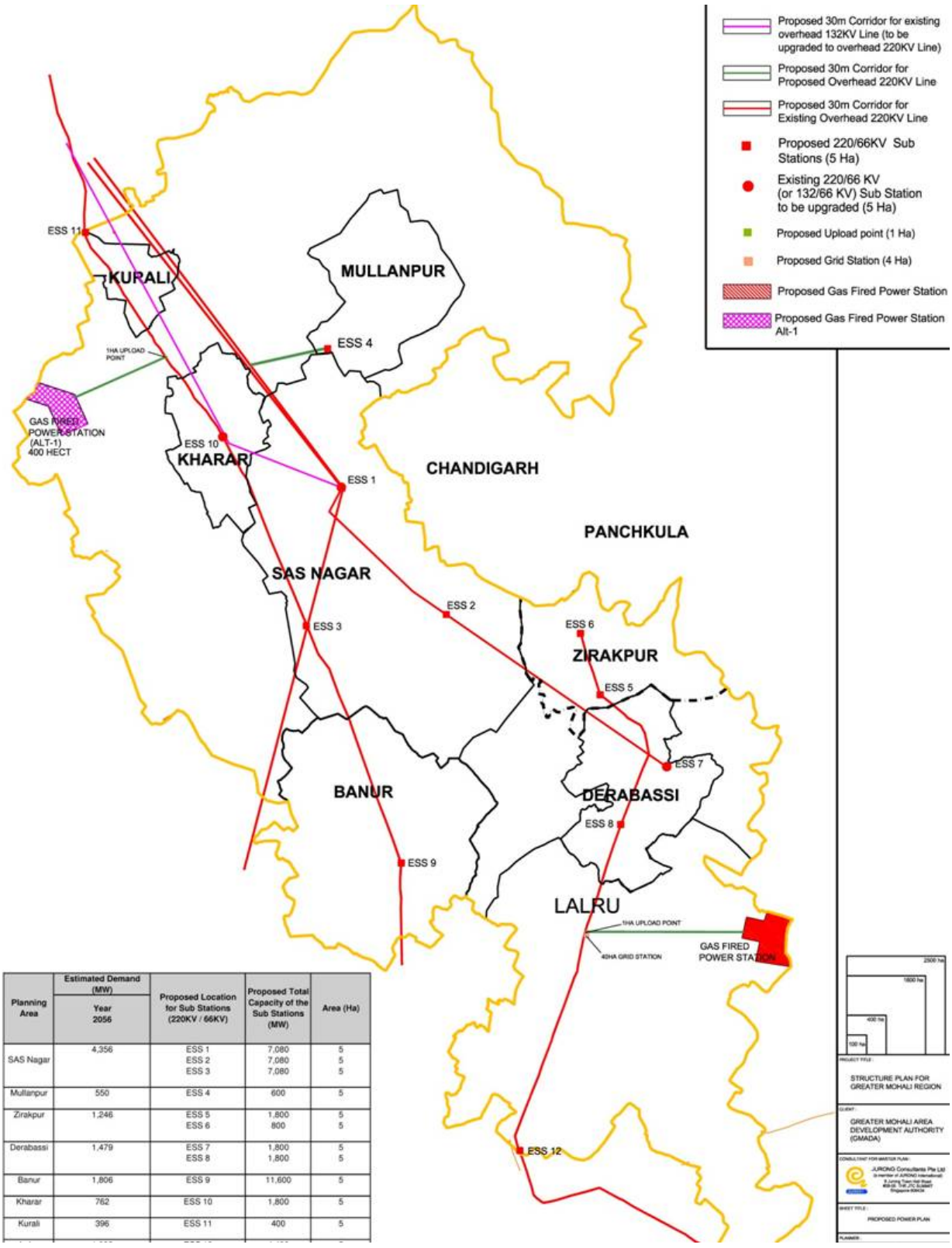
12.4.8 Power Distribution system.

Power distribution system shall be based on a series of substations and step down transformation is as shown in **Table 12.4.7** below. 220 kV substation having capacity 200 MW each will be placed in proper regions then it will be distribute to four number of 66 kV substations having capacity 50 MW each. Each of this 66kV sub-station shall distribute to 5 number 11 kV substations having capacity 10 MW Each. Then it will transfer to distribution boards to building units. A detailed drawing is shown in **Figure 12.4.2 & Figure 12.4.3.**

Power shall reach the area by 220 kV high tension overhead lines drawn on pylons. Regional Sub stations (220 kV) tap the required power and convert this voltage to 66kV. Electricity, then flows through underground armored cables to 66 kV substations for local distribution. Step down to 11 kV is achieved at this stage, before electricity flows to local 11 kV sub-station for local distribution. At this local sub station, electricity enters the local network of distribution boxes and cables where electricity flows at 220V and reaches each household.

Table 12.4.7 Power Distribution System

Planning Area	Estimated Demand (MW)			220KV substation				66 KV			11 KV		
	Year 2020	Year 2035	Year 2056	Proposed Location for sub stations	Proposed nos. of sub station	Proposed Capacity of each sub station (MW)	Proposed Total Capacity (MW)	Proposed Location for sub stations	Proposed nos. of sub station	Proposed total nos. of sub station	Proposed Location for sub stations	Proposed nos. of sub station	Proposed total nos. of sub station
SAS Nagar	2,613	3,485	4,356	S1	6	1,180	7,080	6	4	24	24	5	120
				S2	6	1,180	7,080	6	4	24	24	5	120
				S3	6	1,180	7,080	6	4	24	24	5	120
Mullanpur	330	440	550	M1	2	200	400	2	4	8	8	5	40
Zirakpur	748	997	1,246	Z1	3	600	1,800	3	4	12	12	5	60
				Z2	2	400	800	2	4	8	8	5	40
Derabassi	888	1,183	1,479	D1	3	600	1,800	3	4	12	12	5	60
				D2	3	600	1,800	3	4	12	12	5	60
Banur	1,084	1,445	1,806	B1	8	1,450	11,600	8	4	32	32	5	160
Kharar	457	609	762	KH1	3	600	1,800	3	4	12	12	5	60
Kurali	237	317	396	K1	2	200	400	2	4	8	8	5	40
Lalru	656	874	1,093	L1	5	880	4,400	5	4	20	20	5	100



Planning Area	Estimated Demand (MW) Year 2056	Proposed Location for Sub Stations (220KV / 66KV)	Proposed Total Capacity of the Sub Stations (MW)	Area (Ha)
SAS Nagar	4,356	ESS 1 ESS 2 ESS 3	7,080 7,080 7,080	5 5 5
Mullanpur	550	ESS 4	600	5
Zirakpur	1,246	ESS 5 ESS 6	1,800 800	5 5
Derabassi	1,479	ESS 7 ESS 8	1,800 1,800	5 5
Banur	1,806	ESS 9	11,600	5
Kharar	762	ESS 10	1,800	5
Kurali	396	ESS 11	400	5

Figure 12.4.2 Proposed Power Plan

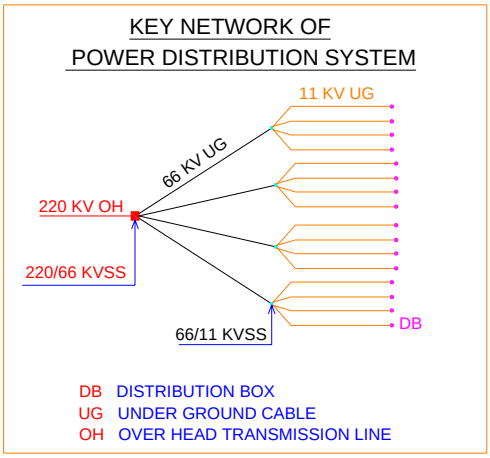


Figure 12.4.3 Power Distribution System

12.4.9 Non - Conventional Energy

Conventional power source is likely to exhaust after some time. Hence, considerable efforts across the world are looking into ways to develop non conventional energy sources. More economical solution through new technologies can be explored if more people were to use such non-conventional energy. People should be educated and financed to use non conventional energy.

12.4.9.1 Solar Energy

Solar energy is the most readily available and free source of energy since prehistoric times. It is estimated that solar energy equivalent to over 15,000 times the world's annual commercial energy consumption reaches the earth every year. India receives solar energy in the region of 5 to 7 kWh/m^2 for 300 to 330 days in a year.

Solar photovoltaic uses sun's heat to produce electricity for lighting home and building, running motors, pumps, electric appliances, and lighting. A few examples is shown in the figure 12.4.4 & 12.4.5 below

Figure 12.4.4 Photovoltaic Domestic and Streetlights

Figure 12.4.5 Solar Panels for street lights

If 5% of The Greater Mohali Region were to utilise to cover with solar panels it can fulfill the entire power demand requirement for the entire Greater Mohali Region. Such area need not be reserved as public spaces can be utilised for installation of the solar panels. Typical public areas can be considered for installing the solar panels

1. Roof tops of all parking sites.
2. Land fill site can be covered with it once the landfill site is fully used and needs to be allowed time to stabilized before using it for other activities.
3. All terraces of Govt. buildings shall be insisted to cover with solar panels.
4. People should be educated and financed to use solar panels

12.4.9.2 Bio Energy

Biomass available in the Greater Mohali Region comprises agricultural waste, cattle dung etc. and bio degradable solid waste capable of supplementing coal of about 3576 tons producing 0.3 MW of power in Greater Mohali Region.

Biomass can be used in three ways:

- Gas through gasifies for thermal applications
- In the form of methane gas to run gas engines and produce power
- Through combustion to produce steam and thereby power

This energy source can be used for Greater Mohali Region in STP and Landfill sites.

12.5 Surface Water Drainage System

12.5.1 Introduction

Surface water drainage is an essential element of infrastructure that helps to remove and dispose the surplus surface water or irrigation water from the land. The two (2) main aspects of surface water drainage system comprise the putting in place suitable flood control measure to alleviate flooding and providing appropriate drainage network system.

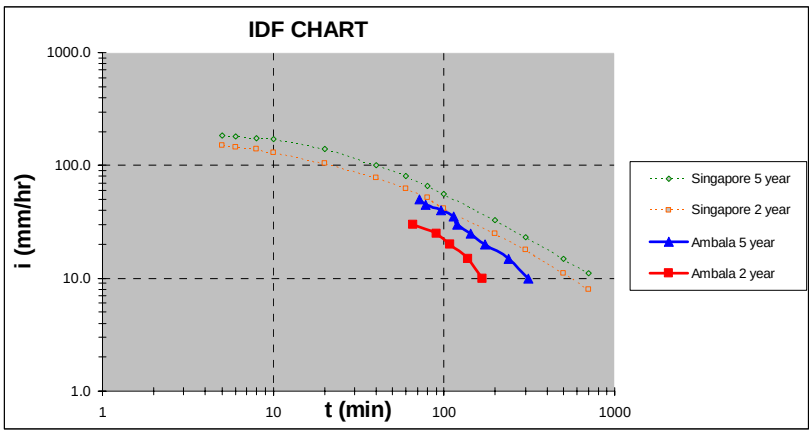
Hence, for the Greater Mohali Region (GMR), its strategic directions

Strategic Directions

- To control platform levels of new land developments to prevent flooding
- To put in place a drainage control plan to manage disposal of surface runoff
- To conserve rain water using various technologies like rainwater harvesting, ground water recharging, etc. area.

12.5.2 Existing Rainfall

The hourly records of the one-day highest rainfall in a year for Ambala for years 1972 – 2005 (except 1973, 1976, 1978, 1983, 1987, 1993) were obtained from the National Data Center at Pune. As Ambala is located just south of the planning boundary of Greater Mohali Region, these rainfall data could be applied for the Greater Mohali Region. The record is attached in **Annexure 12.5.1**. By analysing these data, the rainfall intensity-frequency-duration (IDF) chart of Ambala is derived as shown (with comparison to the IDF Chart of Singapore) in Figure 12.5.1:-



Source: National Data Centre Pune, and, PUB Singapore

Figure 12.5.1 IDF Chart of Ambala and Singapore

For a 1-hour rainfall, the rainfall intensity of Ambala (and Greater Mohali Region) is worked out to be approximately **32mm/hr** for a rainfall return frequency of 2 years, or approximately **53mm/hr** for a rainfall return frequency of 5 years. For rainfall duration of less than 1 hour, the intensity could be worked out using the following formula from the Indian Road Congress:-

$$I = I_o\left(\frac{2}{t+1}\right)$$

where I_o is the 1-hour rainfall intensity

t is the rainfall duration (of less than 1 hour)

I is the rainfall intensity corresponding to t

12.5.3 Existing Surface Water Drainage System

Presently, there is no surface water drainage system present within most parts of the Greater Mohali Region. Surface water surface runoff flows freely with the terrain to be discharged into the numerous non-perennial rivers crossing within the planning boundary of GMR (please refer to Figure 12.5.2). The only existing surface water drainage system is found in SAS Nagar, which has been designed to discharge into the non-perennial rivers of Patiala Ki Rao, Lakhnour Choe and Natural Choe. There are also some roadside drains serving the National Highways in Zirakpur, built by the National Highways Authority of India.

12.5.4 Existing Floods

Flooding have been recorded at several locations as shown in Table 12.5.1 (please refer to the green hatched areas shown in Figure 12.5.2):

Table 12.5.1 Floodable Locations in Greater Mohali Region

Flood Location	Flood Area* (ha)	Flood Depth* (m)	Frequency of Flood*	Time for Flood to Subside* (hrs)
north of Banur Town (along Nandialiwala Choe)	552	1.0 – 1.2	a few days per year	24
south of Lalru town (congruence point of Ghaggar river and Sarsini Nala river)	730	2.0	a few days per year	24
head of Banur Canal (near Chatt Bir Zoo)	55	1.0	a few days per year	24
in Zirakpur (near Baltana Choe)	49	0.6 – 1.0	a few days per year	24

Source: GIS plan of Punjab Engineering College and Discussions with Punjab Irrigation Board

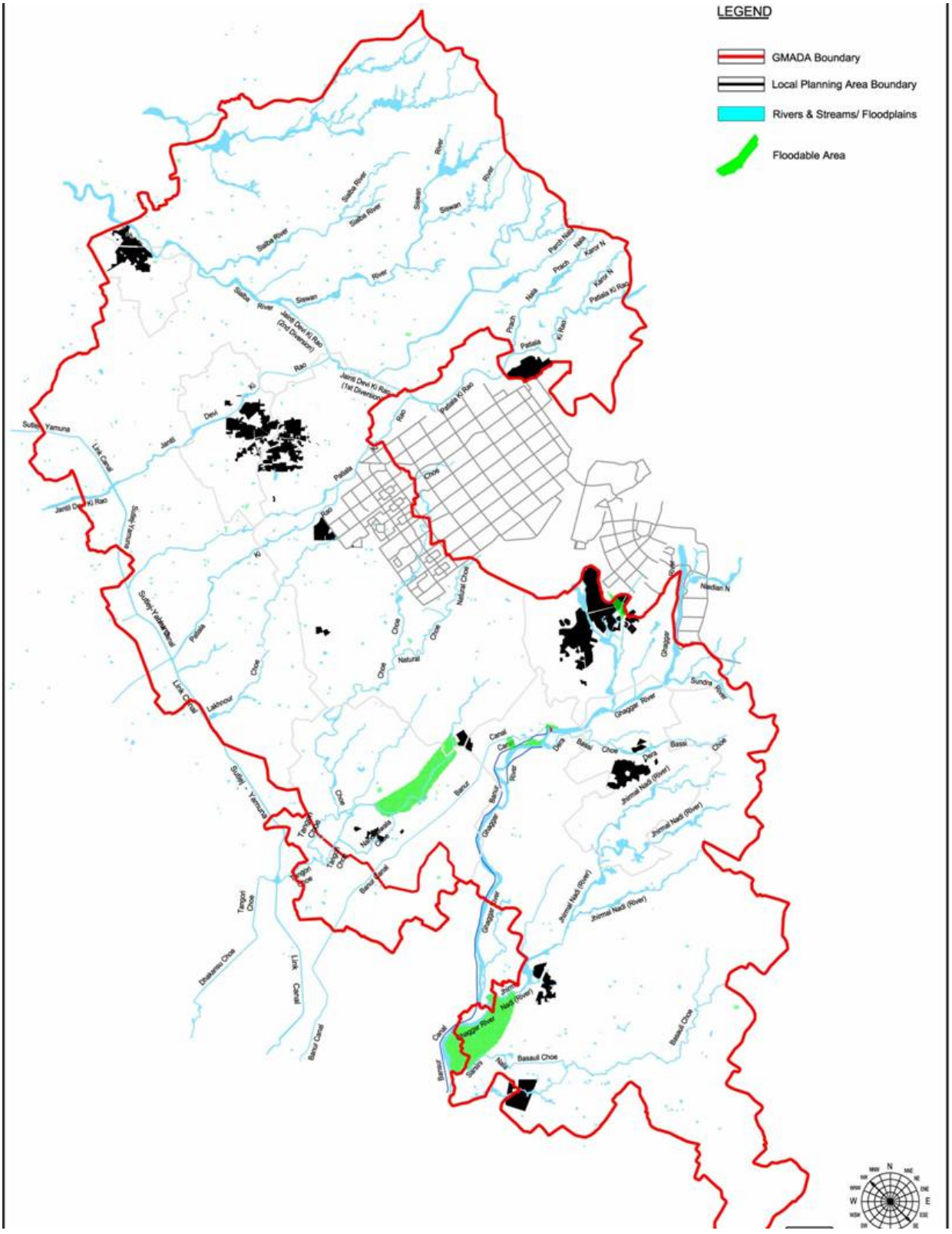
** Note: approximate figure*

Presently, whenever it floods at these locations, residents of those villages that are located within these floodable areas would be relocated and waited until the flood subsides after approximately 24 hours, before moving back to their villages.

12.5.5 Existing Practices on Surface Water Harvesting / Ground Water Recharging / Irrigation

Rain water harvesting for reuse and/or the recharging of ground water has not been extensively practiced in the Greater Mohali Region. For irrigation purpose, check dams have been built in Shivalik hills, to cater for irrigation in the local planning areas like Mullanpur and Kurali etc. According to the Irrigation Department, 9 more dams are currently being planned in the Shivalik hills. For the other agricultural fields in Greater Mohali Region, they use water from existing supply chain consisting of the Ghaggar River, small canals, village ponds system and irrigation from tube wells and open wells.

The proposed Sutlej-Yamuna Canal has yet to be completed. It is presently under dispute between Harayana and Punjab. Its purpose is to supply water from Sutlej to Harayana as well as to irrigate some areas in the Greater Mohali Region.



Source: GIS Plan of Punjab Engineering College

Figure 12.5.2 Existing Rivers

12.5.6 Proposed Marco Surface Water Drainage Scheme

Topography

Topographical spot levels and contours were obtained from the Survey of India office as well as the GIS plan provided by Punjab Engineering College through PUDA (please refer to Figure 12.5.3). Upon analysis, the terrain within GMR planning area is found to be highest at the north where Shivalik hills are. Here at the ridge of the Shivalik hills, the highest levels range from 495.0 m to 616.0 m. From here, the terrain gradually slopes downwards towards the Southwest i.e. towards Kharar town, Sutlej-Yamuna Link Canal, Banur town and Ambala town where the levels range from 274.0 m to 298.0 m.

Function of Existing Non-Perennial Rivers

There are various non-perennial rivers crossing the GMR planning boundary. From the existing topography of the site, the surface water catchments served by these rivers are derived and analyzed. It is observed that most of these non-perennial rivers do serve sizeable catchments areas as shown in Figure 12.5.4. Thus, it is recommended to retain these non-perennial rivers.

Broad Proposal For Surface water Drainage Network For Six Local Planning Areas

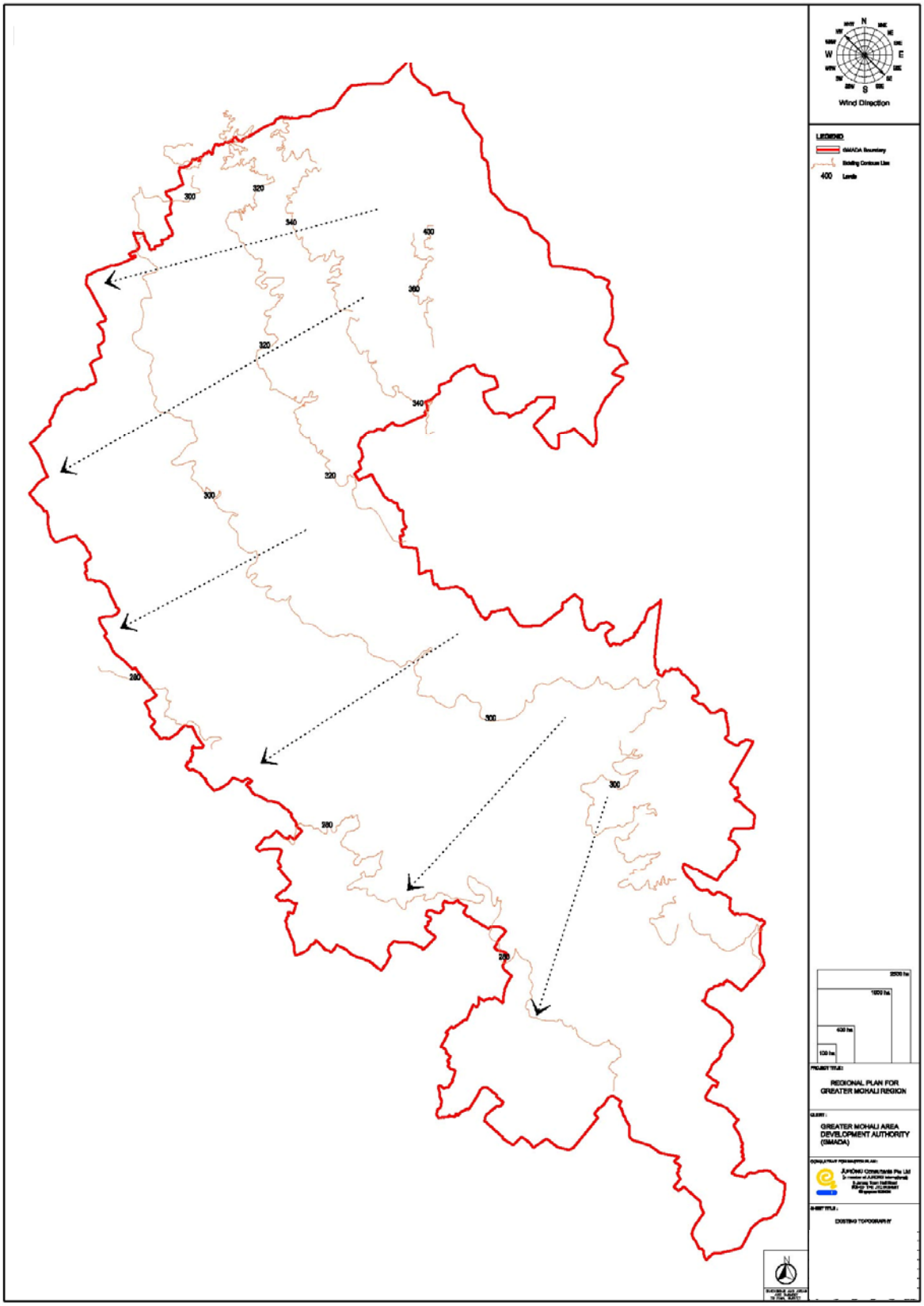
The retained non-perennial rivers shall be used as the discharge outlets for the future surface water drainage system proposed for each of the six local planning districts. Such proper drainage system must be imposed for efficient dissipation of the anticipated increase of catchments surface water runoff arising from the proposed urbanization of the Master Plan. The drainage system shall consist of smaller road side drains and larger outlet drains which will channel the catchments runoff to the discharge outlets at the rivers, or into the proposed water bodies. Part of the surface water could be harvested or recharged into the ground. This will be discussed in the later chapter.

Those retained rivers shall be strengthened and width to be regularized, if necessary, to cater for the increased catchments runoff due to urbanization. Detailed analysis of flow capacity of these rivers could be addressed in the detailed master plan for the six local planning areas upon availability of data regarding the rivers such as existing flow capacity, width and depth of the rivers.

Backfilling of Existing Non-Perennial Rivers

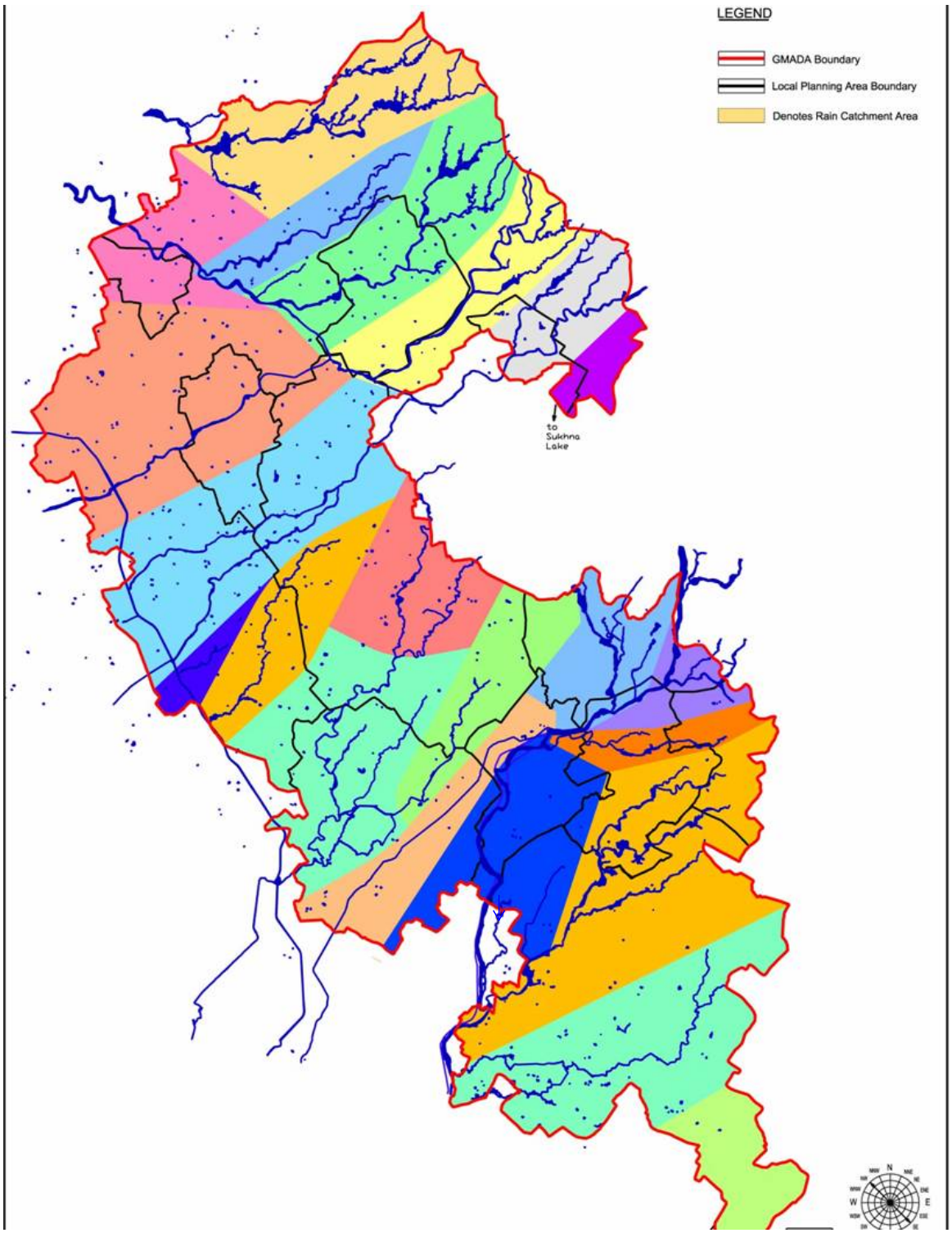
At this Regional Infrastructure Master Plan level, only 4 existing rivers in SAS Nagar, south of SAS Nagar, Banur and Dera Bassi are proposed to be backfilled with earth for other land use purposes. (please refer to proposed Blue Plan (Figure 12.5.5). The surface water runoff served by these rivers would be diverted to the proposed roadside drains. Further backfilling of other rivers could be proposed, subject to the proposed road layouts in the detailed master plan of the six local planning areas, as this would determine the feasibility of constructing new roadside drains to replace those rivers to be backfilled.

The macro Studies on the surface water drainage scheme is only limited to the area within the GMR planning boundary.



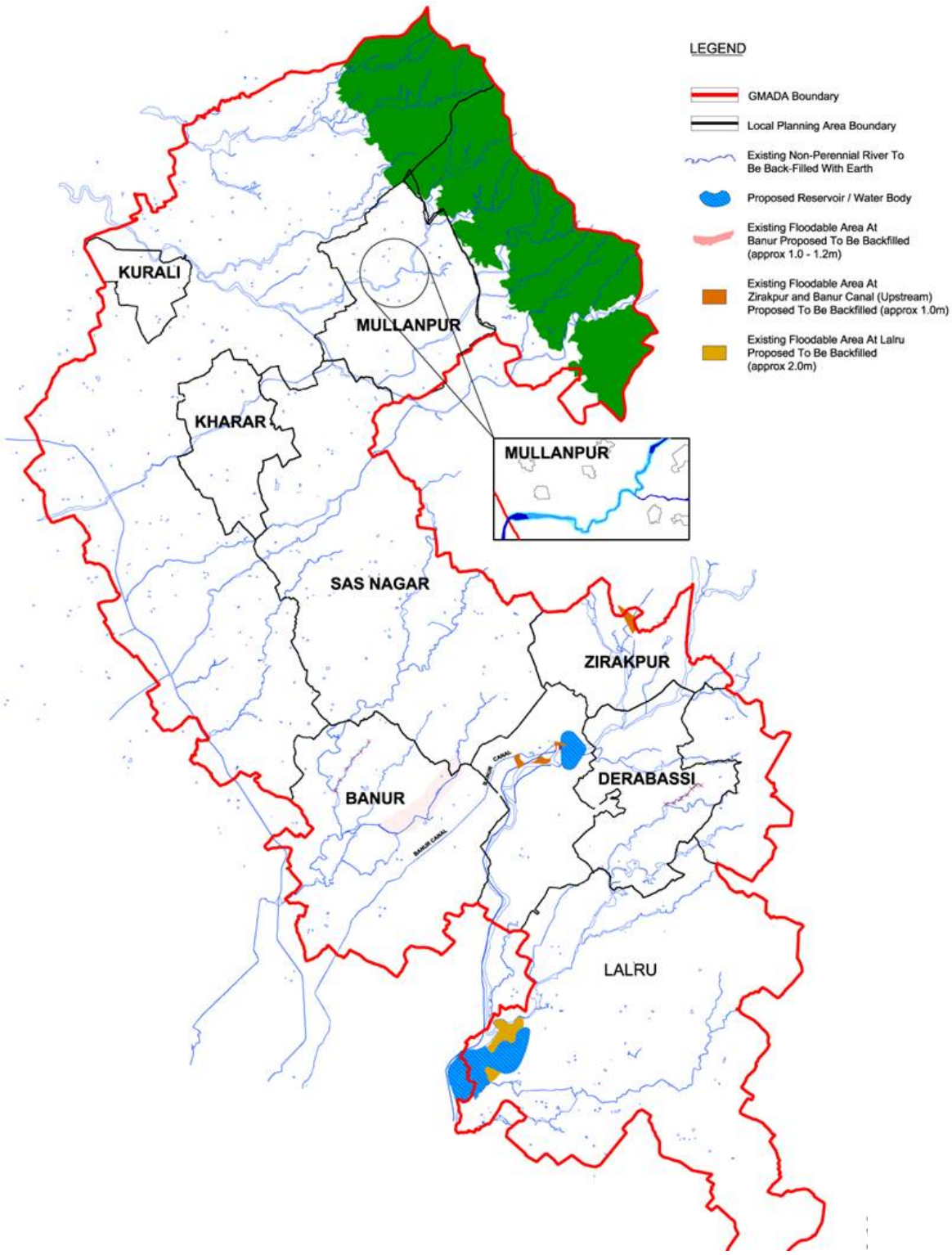
Source: GIS Plan of Punjab Engineering College

Figure 12.5.3 Existing Topography



Source: GIS Plan of Punjab Engineering College

Figure 12.5.4 Existing Rain Catchment Areas



Source: GIS Plan of Punjab Engineering College

Figure 12.5.5 Proposed Blue Plan

12.5.7 Introduction of Water Bodies for Reservoir and Recreation

Proposed water body at Mullanpur

This proposed water body would cover approximately 240ha with depth of about of 3m to 4m. The location is shown in Figure 12.5.6. It would be filled from the rain water collected by the catchments of the rivers Jainti Devi Ki Rao, Siswan River and Patiala Ki Rao up in the Shivalik hills (see Figures 12.5.2 and 12.5.4). The contribution catchment area from upstream is about 16,200 ha. Similar to the existing Sukhna Lake, a proposed bund wall of approximately 5m to 6m high would be built to retain the water. This proposed water body could be used for recreational purposes such as boating, fishing and the development of water-front resorts/houses/apartments.

Figure 12.5.6 Location of Proposed Water Body in Mullanpur

Proposed water body at Ghaggar River (near the upstream of Banur Canal)

Punjab Irrigation Department has plans to complete the proposed weir across Ghaggar River which could then fill up to farm a water body (about 185ha) up to approximately 1km upstream. Water collected would be channeled to the existing Banur canal which would flow to southwards to provide irrigation water for the agricultural fields. Any overflow of water will still be channeled to the downstream of Ghaggar River. This water body could also serve as a recreational lake for golfing.

Figure 12.5.7 Location of Proposed Water Body at Ghaggar River (near the upstream of Banur Canal)

Proposed Water Body at Ghaggar River (between Lalru and Ambala)

This is a low-lying area prone to floods of approximately up to 2m deep with occurrence of a few days in a year. It takes typically 24 hours for the flood water to subside. Ghaggar River, Jhirmal River and Sarsini Nala converge at this area which contributes quite a sizeable catchment runoff. Instead of backfilling with soil to raise its platform level, it is proposed to create a reservoir of about 712ha here. Only flood-affected existing villages land would be raised or bunded up. This water body could serve as a reservoir for rain water harvesting or irrigation of the agricultural field located in rural Lalru.

12.5.8 Determination Of Drainage Reserve Required On Both Sides Of The Existing River Banks.

Comparison on the Survey of India plans and the GIS plans from Punjab Engineering College yielded differences in the rivers alignment and width.

Rivers shown in the Survey of India plans tend to have wider widths and different alignment when compared to the same rivers shown in the GIS plans. It is believed that the GIS plan, being the latest plan, would show the updated alignment of the rivers. However, the GIS may have captured the widths of the rivers during dry seasons, i.e. showing narrower widths. JURONG therefore proposed to the Client previously in 4th March 2008 to adopt the river widths based on Survey of India Plans as the drainage reserve, but following the alignments of the GIS plan. The proposed drainage reserve will also includes 50m of green on each side of the banks, for the purposes of maintenance, landscaping and preventing developments from being developed too near to the river which could contribute to pollutions to the river.

The approach for determination of the drainage reserve of the existing rivers is proposed in Figures 12.5.8 and 12.5.9:

Figure 12.5.8 Setting out of drainage reserve for rivers

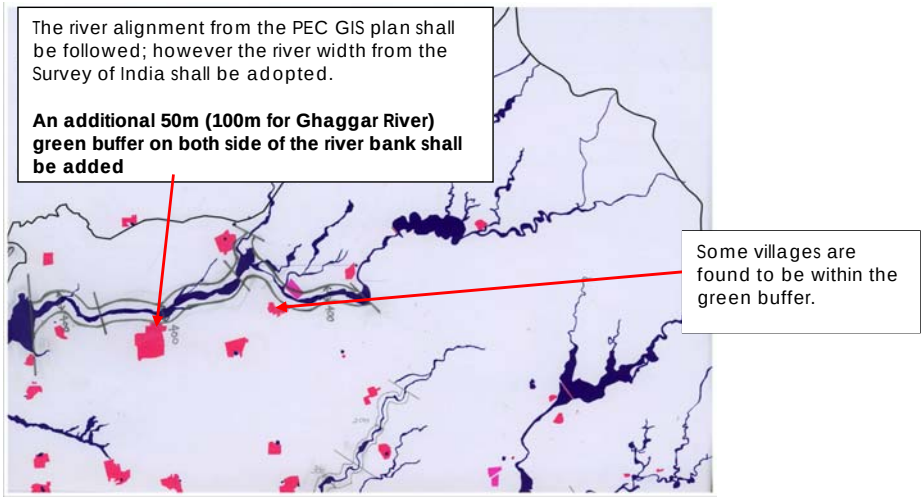
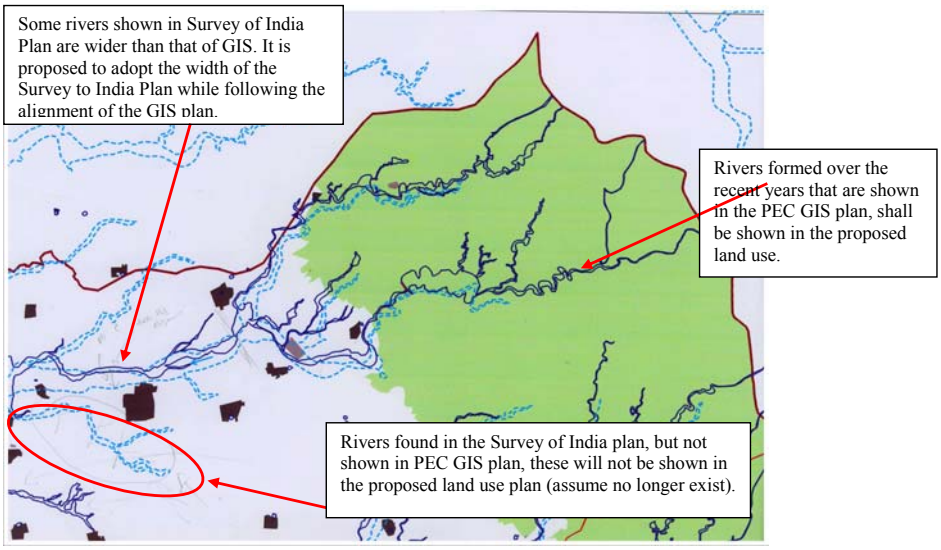


Figure 12.5.9 Superimpose of PEC GIS Plan Rivers (dark blue solid lines) with Survey of India rivers (light blue dashed lines)



The approach is to adopt the width of river (as shown in the Survey of India Plans) plus 50m (100m for Ghaggar River) green on each side and following the river alignment as shown in the GIS. Any other rivers shown in Survey of India but which is not shown in the GIS plan shall not be considered for land reservation. No new development shall be planned within this reserved land. Plan 12.5.6 shows the drainage reserve required for all the rivers within the Greater Mohali Region planning boundary.

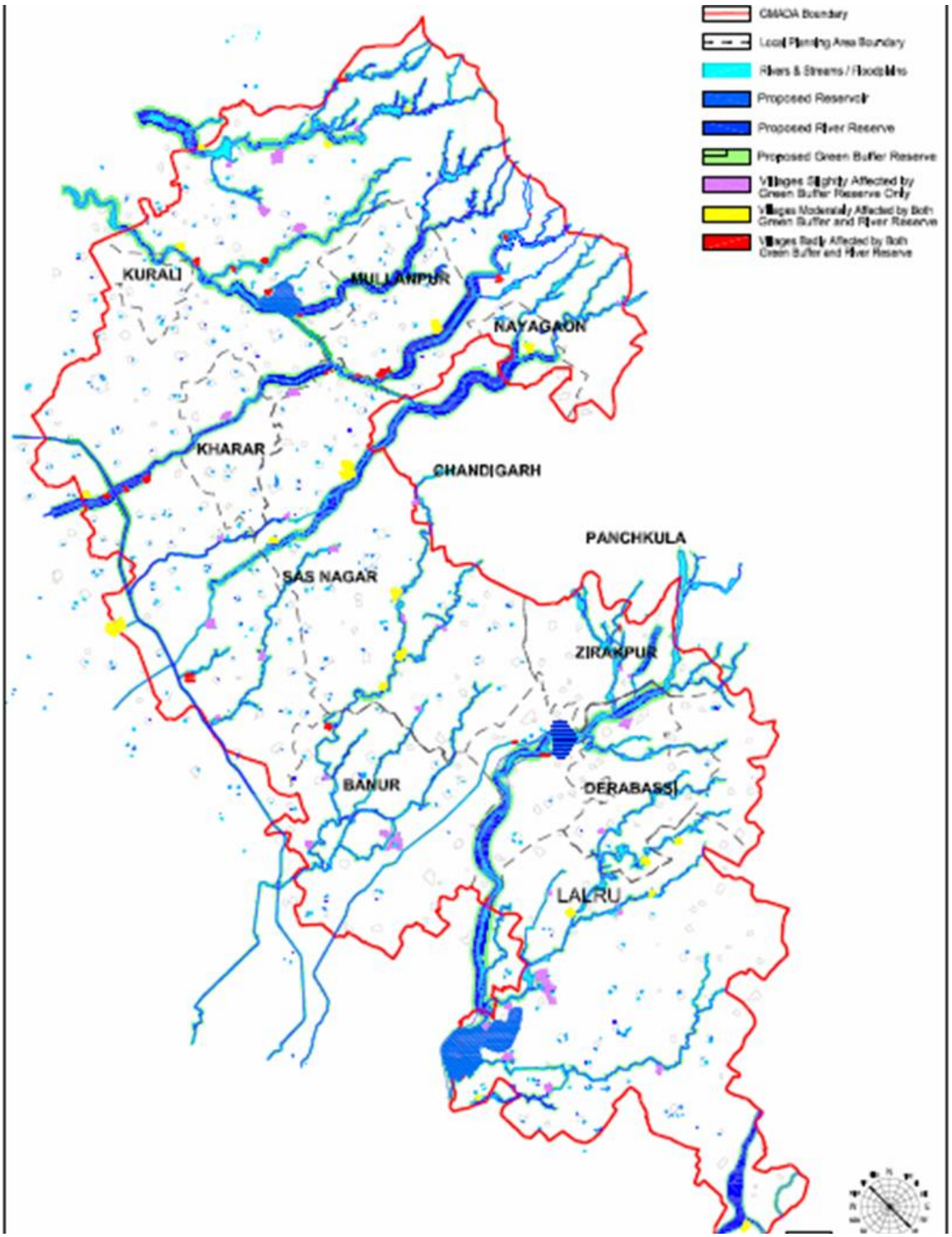


Figure 12.5.10 Proposed Drainage Reserve for Rivers

Villages that fall within the river outline or the green or both are appended in Table 12.5.2:

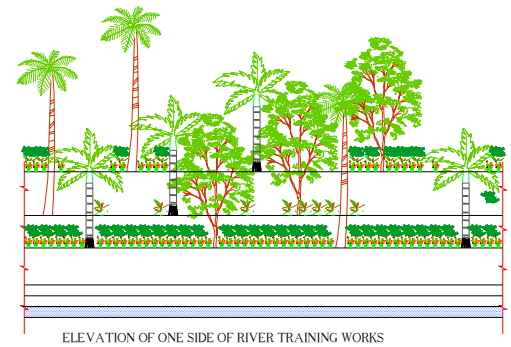
Table 12.5.2 Villages affected by the proposed river reserve and green buffer

Villages **Slightly** Affected by Green **Only**		Villages **Moderately** Affected by **Both** Green and River Outline		Villages **Badly** Affected by **Both** Green and River Outline	
Barsalpur	Khanpur	Salempur Khurd	Karaun danwala	Tarapur	Bir Chhat
Khizrabad	Jhandpur	Dorsana	Pawala	Fatehgarh	Dhakauli
Gochar	Chapar Chiri Khurd	Ghoga Kheri	Chuni Khurd	Shekhpur	
Mehrauli	Chudiala	Kallan		Chandpur	
Majri	Chila	Balaongi		Nagalian	
Rasanheri	Papri	Nada		Shiampur	
Machhlikalan	Chachu Mazra	Chou Mazra		Sotal	
Lakhnaur	Nandiali	Kheri Gujran		Mehmoodpur	
Patton	Gazipur	Mukandpur		Nabipur	
Devinagar	Sanauli	Dapper		Dehkalan	
Musepur	Mubarikpur	Bijanpur		Thaska	
Bhaswasi	Dehar	Dangdera		Raihanpur	
Sarsini	Tiwana	Khellan		Tira	
Basauli	Madanpura	Mullanpur Garibdass		Janti Majri	
Bair Mazra	Karoran	Abheypur		Kasauli	
Biro Majra		Manauli		Nogiari	
Batauli		Mauli Baidwan		Hansala	
Garhi		Mirzapur		Ibrahimpur	
Bari Nagal		Soonk Bari		Tanda Bagandi	

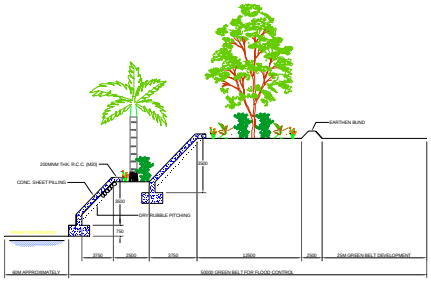
It is thus recommended that there shall not be any extension of works or construction expansion to be granted to the above listed villages. There should not be any new development or properties to be constructed within the proposed drainage reserve.

While strengthening the river banks at portions where erosion is prone, the drainage reserve including the green buffers could also be developed into aesthetically pleasing landscaped areas to provide recreational facilities for residents, as shown in Figure 12.5.11.

Figure 12.5.11 Strengthening river bank and landscaping of river green buffers



ELEVATION OF ONE SIDE OF RIVER TRAINING WORKS



CROSS SECTION OF ONE SIDE OF RIVER TRAINING WORKS

Such river training works all along the entire length of the river with proper bund constructed from dredged soil from the river and with protection of natural slopes by pitching and vegetation will reduce changes in bank profile and contain the river waters within the banks.

12.5.9 Flood Alleviation

Flooding is a natural feature of drainage systems and rivers and streams. When drainage channels are filled and rivers and stream can no longer accommodate excessive water generated by severe weather conditions, the channels overflow their natural or artificial banks and water enters the surrounding lands causing flooding especially if the surrounding land is low-lying. A flood is defined as any relatively high water flow that overtops the natural or artificial banks in any portion of a river or stream.

Two (2) main flood prone areas are found within the Greater Mohali Region and the locations are shown in Figure 12.5.2. One of the major flood prone area is located at the north (upstream) of Banur Canal while the other major flood prone area is located at the south of Lalru.

Flood Prone Area in Lalru

The one in Lalru cover an area of 730ha. Settlements Dehar, Alamgir, Tiwana and Mandi are affected by the flood. This is a low-lying area where 3 rivers, Ghaggar River , Jhimal River and Sasini Nala meet. This low-lying area is prone to floods of approximately 2m deep for a few days in a year. It takes about 24 hours for the flood water to subside.

Instead of backfilling with soil to raise its platform level, it is proposed to create a reservoir of about 712ha here. Only the nearby existing villages land would be raised or bunded up by wall. With the construction of weir at the upstream of Ghaggar river, the flooding condition at the downstream shall be further reduced as part of the catchment runoff will be retained in the proposed pond and part of the surface runoff will be diverted to Banur Canal.

Flood Prone Area in Banur

This is another major area prone to floods of about 1m depth for a few days a year. Settlement Shekhan Mazra is affected by the flood. From site observation, this flood prone area is mainly due to the low-lying platform level compared to the surrounding which tends to cause water to accumulate and stagnant there. It is proposed to backfilled with soil by about 1m high. At the same time, a diversion drain is proposed to be constructed upstream of this flood prone area, so as to reduce the area of rainfall catchment served by the Nadialiwala Choe, thus reducing the tendency of overflowing of Nadialiwala Choe.

Figures 12.5.12 & 12.5.13 Floodable Area in Banur

12.5.3.5 Rain Water Harvesting, Ground Water Recharging, Irrigation

The dominance of agricultural activities over the years has led to overexploitation of ground water resulting in rapid decline of water table. Other reason such as less than required availability of surface water or reservoir, free power supply to the agriculture sector, support prices and procurement facilities for only some crops and disproportionate installation of tube well by farmers have further deteriorate the underground water source. With the coming rapid urbanization in the Greater Mohali Region, infiltration of water into the sub-soil will decrease drastically and recharging of ground water will be further diminished and worsen the condition. Hence, it is important to preserve and recharge groundwater as much as possible.

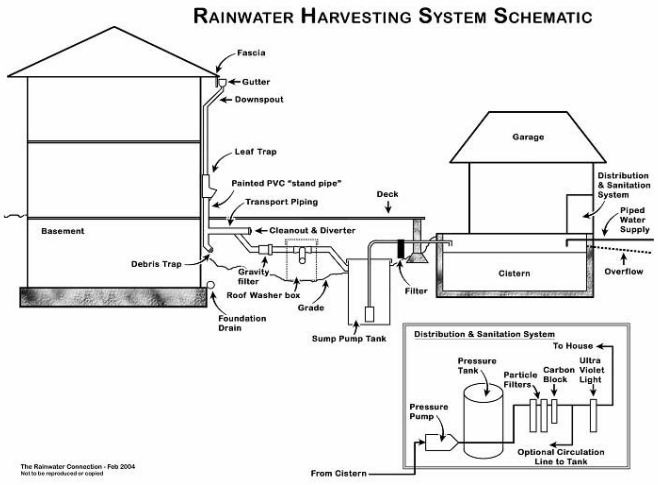
Rainwater harvesting is a technology used for collecting and storing rainwater from rooftops, the land surface using simple techniques such as jars and pots as well as more complex techniques such as underground tanks, ponds, check dams, weirs etc. Ground water recharging is a process to replenish water to an aquifer and it can be done naturally or artificially. Artificial recharge can be carried by using man-made scheme or facility consist of recharge pits, trenches, well, shafts and pump etc, in which the recharging rate is augmented at a rate exceeding that obtaining under natural conditions. Alternatively, the collected rain water could be reused for other uses e.g. irrigation, toilet flushing, floor washing, etc.

Rooftop Catchments

In this technique, rain water is collected from the roof through gutter connected to down-pipes, filtration system then into storage tank. The amount and quality of rainwater collected depends on the area and type of roofing material. Reasonably clean rainwater can be collected from roofs constructed with galvanized corrugated iron, aluminum /cement sheets, tiles and slates. Roofs with metallic paint or other coating are not recommended as they may impart taste or color to the collected water. Hence, as long as the roof top is clean, impervious, and made from non-toxic materials, relatively clean water can be obtained. This technique can be carried out very efficiently at the domestic level. However, it will incur installation and maintenance cost to the tenant which may not be favorable.

Hence, instead of having the individual filtration, pumping system and storage tank at each premises, rainwater runoff collected from the roof can be channeled to the drainage system provided surrounding each premises and further discharged into a centralized water treatment plant and reservoir.

Figure 12.5.14 Rooftop Catchments



Land Surface Catchments

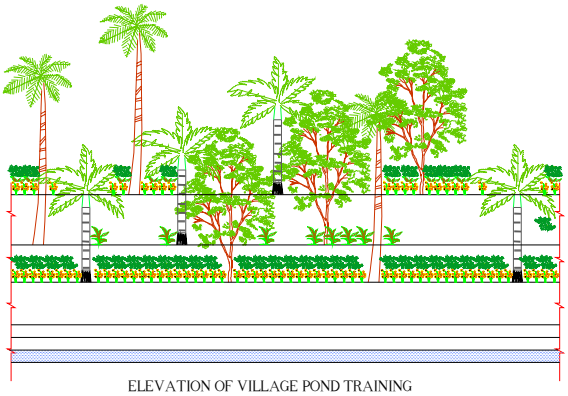
In this technique, rainwater runoff is collected from open land surface through drainpipes connected to storage tank, pond or reservoir. It provides more opportunity for collecting water from a larger surface area. It is important to improve the surface runoff capacity to make it more feasible. With the future urbanization in the region, surface runoff will be definitely increased and less infiltration to the ground. There is no other way better than to salvage this surface runoff water for recreational, agricultural, landscaping or ground water recharging purpose.

Village Ponds

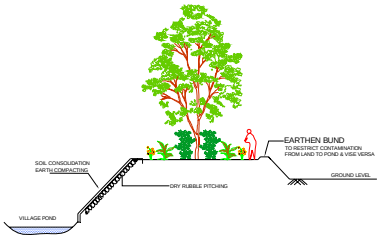
Ensure retaining the present 'village pond' rainwater harvesting system and further enhance its capabilities. Basic principle of this system is to collect the rainwater from available catchments areas, store it, and use it for irrigation and domestic or allied works. When the present village pond system is strengthened, the entire area shall have a network of such ponds which will aid the rising of ground water in the Greater Mohali Region or as irrigation water source. It is recommended to define the

command area of each village pond. All surface water shall be properly drained to these village ponds. To accommodate this water, ponds shall be strengthened as shown in Figure 12.5.15. In this way we can collect maximum rain water locally. Presence of village ponds is put to use in an effectively by ensuring all storm water drains are diverted to local ponds. The drains can also have properly designed silt and debris traps constructed at every 500m to 750m.

Figures 12.5.15 Proposed Training Works for Village Pond



ELEVATION OF VILLAGE POND TRAINING



CROSS SECTION OF VILLAGE POND TRAINING WORKS

River Water

Most of the rivers/ rivulets running in the Greater Mohali Region can be classified in two types namely those originating from the immediate northern hilly area where small and medium check dams have been constructed in recent past 20 to 30 years. The water in these rivulets is not perennial and depends on rains. They generally act as highways for rain water runoff. Adding more check dams can increase retention percentage. The other only river that passes through the Greater Mohali Region is River Ghaggar, which is more to the south of the region. This river is partially perennial with reduced flow during summer times.

Storm Water from Streets

Sump with sand traps shall be provided at intervals to the surface water drains of the streets. These sumps will design in such a way that storm water will be collected and it will reach down to enrich ground water table

ANNEXURE 12.5.1

One day Highest Rainfall in a Year Data for Ambala (Index No. 42103) :

INDEX : INDEX No. OF THE STATION
TOTRF : TOTAL R/F IN 24 HOURS IN MM
HRMAX : MAXIMUM R/F IN ONE HOUR IN A DAY IN MM
H1 H2 : OCCURRENCE OF HOURLY MAXIMUM R/F BETWEEN HOURS H1 AND H2
HR MI : DURATION OF TOTAL R/F IN A DAY IN HOURS AND MINUTES

Index	Year	Month	Date	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	TOTRF
42103	1972	8	17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.0	39.0	6.0	5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	90.3
42103	1974	7	4	18.3	2.5	2.2	7.8	4.2	1.8	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37.3
42103	1975	7	22	0.0	0.0	0.0	0.6	0.0	2.4	5.0	4.5	4.5	12.0	23.5	9.5	5.5	6.5	0.5	3.2	2.7	6.0	0.0	0.0	0.0	0.0	0.0	0.0	86.4
42103	1977	7	9	0.0	0.2	3.0	1.3	0.7	7.8	21.5	18.5	3.2	0.0	0.3	0.1	0.0	8.2	3.8	2.0	0.9	0.7	0.0	0.0	0.0	0.0	0.0	0.0	72.2
42103	1979	7	22	20.0	22.5	3.2	0.6	5.5	13.4	6.8	7.8	6.6	3.8	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	90.8
42103	1980	7	13	0.1	27.8	0.2	0.0	0.0	0.0	0.0	0.0	1.5	5.8	8.4	0.2	0.0	18.8	6.0	0.1	2.7	0.5	3.5	14.2	0.2	0.0	0.4	0.1	90.5
42103	1981	7	28	0.0	0.0	0.3	30.2	39.2	5.1	5.3	15.0	6.0	5.3	1.5	0.1	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	108.3
42103	1982	8	20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	74.0	9.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	83.2
42103	1984	2	19	2.7	0.2	1.6	0.0	0.0	12.7	7.3	1.5	0.0	15.0	6.4	1.6	0.0	0.0	0.0	2.3	16.0	2.1	0.1	0.1	0.4	0.0	0.0	0.0	70.0
42103	1985	8	6	0.1	8.3	0.0	0.5	0.0	0.2	3.2	5.9	5.5	18.5	23.0	16.9	3.3	6.2	1.0	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	97.2
42103	1986	9	28	0.0	0.0	0.0	10.0	6.4	22.9	22.5	0.4	1.0	6.0	34.0	7.4	11.6	25.0	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	149.6
42103	1988	9	23	0.4	2.6	4.8	2.2	0.1	0.1	25.7	8.0	10.4	10.0	6.5	5.3	0.8	0.2	1.0	6.2	9.8	4.5	7.0	5.5	4.4	4.4	4.7	10.7	135.3
42103	1989	8	1	0.0	0.0	0.0	2.8	3.4	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	4.8	2.8	54.2	36.8	1.8	1.0	7.7	0.2	118.9
42103	1990	7	28	7.9	6.9	12.8	13.8	24.0	12.8	24.9	4.9	16.9	15.7	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	142.3
42103	1991	8	4	7.5	4.7	2.5	2.9	23.4	7.7	5.7	2.3	2.0	0.5	4.7	1.7	0.0	0.0	0.4	1.2	2.1	0.0	0.0	0.2	0.0	0.0	0.0	0.0	69.5
42103	1992	8	19	0.0	0.0	1.0	11.0	28.0	31.2	0.2	0.4	1.7	10.7	6.8	1.5	0.0	0.7	1.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	94.9
42103	1994	7	20	14.2	32.3	14.0	7.2	7.8	4.5	5.3	5.0	10.6	6.3	6.0	3.2	1.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	117.6
42103	1995	8	29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	28.2	7.5	6.2	5.6	6.2	7.2	6.6	5.2	0.4	0.2	1.6	6.4	8.6	28.2	119.3
42103	1996	9	8	0.4	0.0	1.1	3.7	40.0	39.0	20.0	22.0	20.0	10.7	0.5	0.6	1.0	2.2	3.8	4.6	1.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	171.0
42103	1997	8	2	0.0	0.1	0.2	1.0	1.6	0.4	9.6	19.5	2.3	8.0	6.0	0.4	0.5	1.3	4.2	12.0	6.2	8.8	9.7	20.0	26.0	16.3	0.3	3.5	157.9
42103	1998	7	10	0.0	0.0	0.0	13.8	60.5	61.6	21.5	27.8	8.5	6.4	1.7	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	202.0
42103	1999	7	21	0.0	0.8	24.0	26.0	33.8	17.0	7.0	13.5	40.5	18.0	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	181.1
42103	2000	7	18	10.0	0.3	33.0	17.0	50.0	17.0	11.0	5.0	2.7	9.3	10.5	25.8	0.8	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	192.5
42103	2001	7	16	0.0	1.6	40.0	29.0	56.0	24.0	38.4	5.9	3.8	2.5	3.4	9.4	0.4	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	214.6
42103	2002	9	12	0.0	0.0	0.0	0.0	0.0	10.0	2.5	0.2	0.1	1.2	1.1	7.7	7.0	6.5	7.0	7.8	1.7	3.3	6.7	100.0	1.3	0.5	2.2	8.3	175.1
42103	2003	8	1	47.0	20.4	6.3	0.8	0.0	2.0	3.5	5.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.0	0.0	85.7
42103	2004	8	24	0.0	0.0	6.5	10.0	12.2	8.3	10.5	5.5	7.0	16.3	11.4	3.6	1.0	0.1	0.1	3.5	6.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	102.5
42103	2005	7	5	0.0	6.3	1.5	4.2	28.0	16.2	13.8	10.0	37.8	2.7	2.3	1.5	1.9	1.3	0.3	0.0	0.0	0.0	0.2	0.3	0.1	0.1	0.1	0.0	128.6

Source: National Data Centre, Pune

12.6 Sewerage System

12.6.1 Introduction

Sewerage system is the core element of physical infrastructure that determines the environmental status of any settlement and as such requires minute planning, development and management. Development of appropriate sewage carriage system with efficient treatment is the key element, which acts as a pre-requisite for facilitating balanced and harmonized development. Augmentation of existing inadequate systems, treatment facilities and the adoption of new technologies of waste treatment present a gigantic task and require demanding efforts.

Strategic Directions

- To put in place extensive sewerage network system appropriately mapped up and transformed into a model environment in the urbanized area
- All new developments are to be connected to the eco-friendly Sewage Treatment Plant (STP)
- To provide an efficient recycling system and infrastructure in the light of reducing the amount of wastewater and potable water usage

12.6.2 Existing Sewerage System

The sewerage network is currently fully covered in SAS Nagar and partial sewerage network is provided in Dera Bassi and Zirakpur, while there is no or negligible sewerage network provided in other part of the area within the Greater Mohali Region. There is no sewage treatment plant provided in most areas and some of the sewage is discharged into soak pits / septic tanks and in some areas, the sewage is discharged to the water bodies and open spaces untreated. **Figure 12.6.1** shows the existing sewage treatment plant in Panchkula which is located at the border of the Greater Mohali Region.

Figure 12.6.1 Existing Sewage Treatment Plant location

12.6.3 Proposed Sewerage System

The Infrastructure Master Plan identifies strategies and major infrastructure services for the public wastewater system to accommodate growth over the next 50 years. The planning of the wastewater systems has been developed based on the following objectives:

Protection: to protect public health and the long term health of the water environment

Reliability: to ensure the safe and continuous removal of wastewater

Demand Planning: to pursue demand planning as one of the most cost effective means of ensuring sustainability in the Greater Mohali Region wastewater system.

It is proposed that the Greater Mohali Region and priority towns should treat their sewage before it is discharged into the watercourses or on land or used for irrigation. Sewage should be treated to bring the pollution level to permissible limits as stipulated by the Bureau of Indian Standards (BIS), and Pollution Control Boards irrespective of the type of disposal of the sewage. Rural areas, where piped water supply system exists, should be provided with sewerage system with treatment facilities.

12.6.4 Projected Sewage Generated

Sewage Flow is the flow resulting from the use and discharge of water to the wastewater system. Most of the sewage flow will be generated from residential buildings and minor part will be from industrial, commercial properties and institutions.

Similar to the water supply system the urbanized area will be the focus for the development of Greater Mohali Region. The urban area of the Greater Mohali Region comprises nine local planning areas, namely SAS Nagar, Mullanpur, Zirakpur, Dera Bassi, Banur, Kharar, Kurali, Lalru And Nayagoan.

12.6.4.1 Sewage Generation Norm

The sewage generation computation is based on 80% of the average potable water demand plus 10% infiltration rate.

12.6.4.2 Estimated Sewage Flow

Based on the land use distribution and population projection of the various planning areas, the ultimate sewage generated for the urban area and non-urbanised area within the Greater Mohali Region will reach 1892 MLD by year 2056 (refer to Table 12.6.1).

Table 12.6.1 Estimated Sewage Generated

	Local Planning Area	Projected Ultimate Sewage Generated (MLD)	Sewage Generated (MLD)		
			Year 2020	Year 2035	Year 2056
Urban	SAS Nagar	611	106	223	611
	Mullanpur	60	10	21	60
	Zirakpur	165	62	105	165
	Dera Bassi	187	70	119	187
	Banur	299	81	143	229
	Kharar	101	28	48	101
	Kurali	56	16	27	56
	Lalru	139	50	87	139
	Nayagaon	1.8	0.1	0.4	1.8
Non-Urban	Industrial (outside urbanizable area)	100	100	100	100
	Rural Settlements	44	34.7	37.8	44
	Transportation (transport terminals)	197	154.5	168.7	197
	Total	1892	716	1080	1892

12.6.5 Proposed Sewage Treatment Works

The proposed sewerage treatment system for Greater Mohali Region comprises both the primary and the biological treatment in order to ensure effluent complies with Bureau of Indian Standards. A typical example of sewerage system and treatment plant is illustrated in Figure 12.6.2 below.

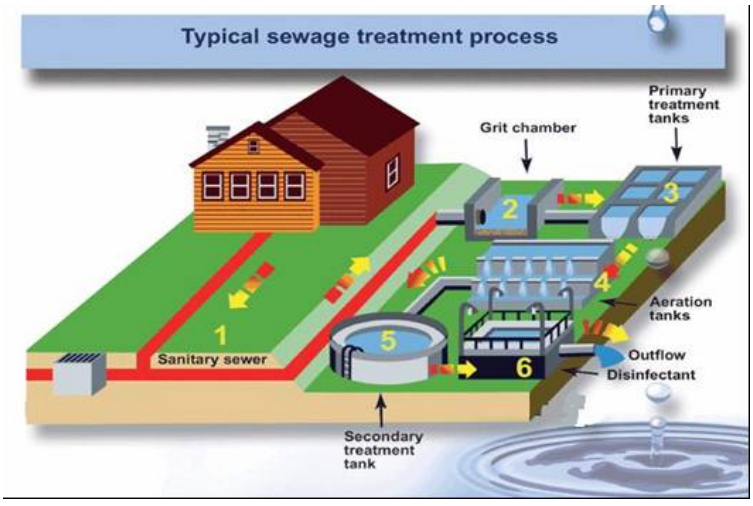


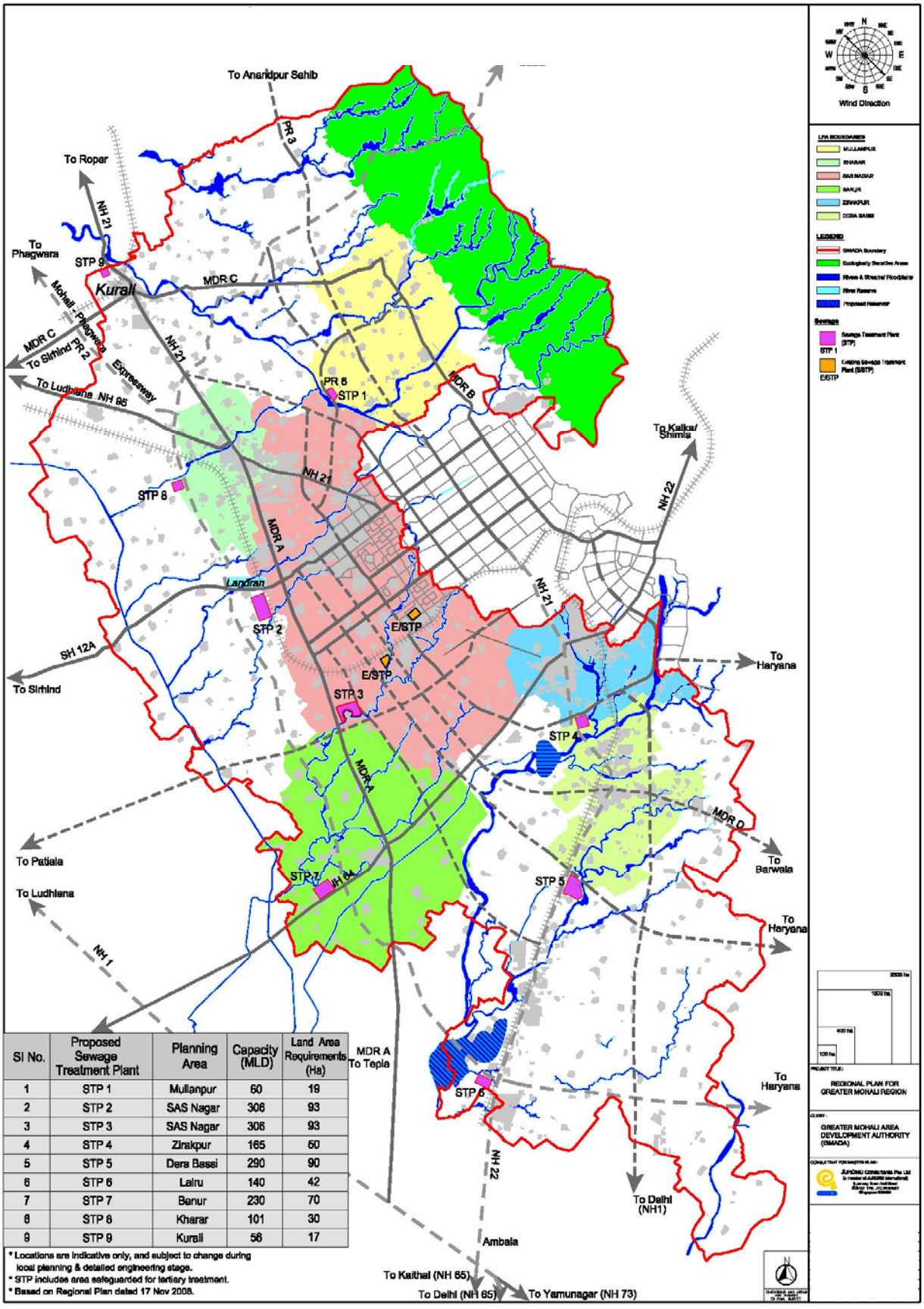

Figure 12.6.2 Examples of Sewage Treatment Plants

The details of proposed sewage treatment works are shown in **Table 12.6.2 Proposed Sewage Treatment Works** and their proposed locations are shown in **Figure 12.6.3 Location of Proposed Sewage Treatment Plants**. The locations and land area requirements of the proposed sewage treatment plants are only indicative and may subject to changes. The land area requirements for Sewage Treatment Plants are estimated based on conventional sewage treatment system (Activated Sludge Process) with tertiary treatment. However if modern sewage treatment methods like SBR (Sequential Batch Reactor), MBR (Membrane Batch Reactor), etc., were to be adopted, there will be substantial decrease (40 – 50%) in the land area requirement.

Table 12.6.2 Proposed Sewage Treatment Plants

Sl. No.	Proposed Sewage Treatment Plant	Planning Area	Capacity (MLD)	Land Area Requirements* (Ha)
1	STP 1	Mullanpur	60	19
2	STP 2	SAS Nagar	306	93
3	STP 3	SAS Nagar	306	93
4	STP 4	Zirakpur	165	50
5	STP 5	Dera Bassi	290	90
6	STP 6	Lalru	140	42
7	STP 7	Banur	230	70
8	STP 8	Kharar	101	30
9	STP 9	Kurali	56	17
10	STP 10	Nayagaon	2	1

* Sewage Treatment Plant includes the area safeguarded for tertiary treatment



Sl No.	Proposed Sewage Treatment Plant	Planning Area	Capacity (MLD)	Land Area Requirements (Ha)
1	STP 1	Mullanpur	60	19
2	STP 2	SAS Nagar	306	93
3	STP 3	SAS Nagar	306	93
4	STP 4	Zirakpur	165	50
5	STP 5	Dera Bassi	290	90
6	STP 6	Lalru	140	42
7	STP 7	Banur	230	70
8	STP 8	Kharar	101	30
9	STP 9	Kurali	56	17

* Locations are indicative only, and subject to change during local planning & detailed engineering stage.
* STP includes area safeguarded for tertiary treatment.
* Based on Regional Plan dated 17 Nov 2008.

Figure 12.6.3 Location of Proposed Sewage Treatment Works

12.6.6 Development Plan

- **Enforcement for sewerage discharge**

  To minimize pollution of the inland waters bodies, it is necessary to have enforcement acts which require all sewage from domestic and non-domestic premises to be discharged into a collection system of sewers. Industries to be required to pre-treat their trade effluent to stipulated standards before discharging into the sewerage system. Industries, which use or store large amounts of chemicals should also barred from being sited within water catchments areas. Hence, it is crucial for the Greater Mohali region area to be served with a series of properly designed sewerage reticulation system, including treatment plants.

- **Recycle/Reuse of treated wastewater**

  Besides having an efficient sewerage reticulation system, improving the recycling system and infrastructure will also be one of our main thrusts in reducing the amount of waste water. It is desirable the treated wastewater is recycled / reused for gardening, irrigation, etc. Treated effluent can be used on land for irrigation also wherever; such practices are possible or exist. Of course, the precaution for avoiding groundwater pollution has to be taken.

12.7 SOLID WASTE MANAGEMENT

12.7.1 Introduction

Solid Waste Management (SWM) is one of the most expensive municipal services that a local body has to provide as its obligatory municipal function. With the urbanization of Greater Mohali region, it is imperative to optimize this huge civic expenditure and evolve an indigenous low cost technology which is technically sound, financially viable, aesthetically beautiful and socially acceptable to public.

Vision plan proposed that solid waste disposal and management should be planned for a minimum period of 50 years and at least controlled tipping should be adopted in the disposal of the solid waste. Areas should be identified in all districts for sanitary landfill and, all districts should have arrangements for proper management of the waste disposal.

In the review of the vision plan, it is observed that substantial quantities of solid waste (garbage) are generated daily in the district of Greater Mohali, out of which very little is collected. There is no proper system of storage of waste at source. Most of the population disposes waste on the streets in the open space, rivers and water bodies etc. Public may not be aware of the proper waste disposal system.

Strategic Directions

- To transform into one of the most efficiently operated waste collection and disposal services in the region
- To reduce the need of incineration of waste and to achieve minimum landfill by high percentage of recyclable waste

12.7.2 Existing Situation and Issues

Studies have revealed that none of the town in the region is disposing off solid waste in environmental friendly manner. The dumping sites are not lined to protect the groundwater from leachate percolating into it.

In urban area, the household, shopping centre, offices, the street waste, etc generally dumped outside houses or at some collection site, and is left for municipal authorities for taking it to a common dumping ground. Despite having door-to-door waste collection system, garbage dumps are mostly seen in depression or in open grounds. Wide spread land, air, and water pollution is caused from these dumps. The dumping sites are not properly managed nor have been planted with suitable plan species to help in quick degradation of solid waste by way of creating conducive for the growth of micro-organism besides providing greenery.

Garbage bin

Plastic waste

In rural site, garbage includes household waste, animal waste, agro waste, etc, is being managed by personal efforts of the residents. The household waste, as well as animal waste is generally collected outside the house/ village at earmarked places. The most part of the animal waste can be use as fuel; the rest can be use in agricultural fields as manure. The characteristic feature of rural solid waste is that it is generally free from glass, metal or other non-biodegradable material. Although this garbage is getting managed, there is a need to dispose it of in an environmental friendly way. The garbage and waste pits create an unpleasant sight and odour if not covered properly and contribute to slush during rainy season.

The report of "State of Environment Punjab – 2007" revealed that a total of 72.8 ton/day of municipal waste was being presently generated in the region of Greater Mohali, of which the sub-district solid waste generation estimation is given in **Table 12.7.1.**

Table 12.7.1 Present Solid Waste Generated in Various Planning Areas of the Greater Mohali Region

Sl. No.	Name of the municipal committee	Age of land for development of landfill site	Area of existing landfill sites (as on 31.12.2006)	Quantity of solid waste generation (ton/day)
1	Municipal Council, Banur	> 20 years	7 Acres (2.8ha)	1.5
2	Nagar Panchayat, Mullanpur	No land	No land of its own	4.5
3	Municipal Council, Dera Bassi	12 years	2 Acres or 0.8ha (at Choe near River Ghaggar)	6.0
4	Municipal Council, Mohali	12 years	15 Acres land of Sohana Panchayat is used for disposal of solid waste (or 6 ha)	49.0
5	Nagar Panchayat, Zirakpur	8 years	2 Acres (village Bishanpur within MC limits) (0.8ha)	3.5
6	Municipal Council, Kharar	10 years	5 Acres (2 ha)	8.0
7	Municipal Council, Kurali	> 20 years	6 Acres (2.4 ha)	0.3
			Total	72.8

The above information is abstracted from 'State of Environment Punjab-2007' prepared by Punjab State for Science & Technology, Chandigarh, Annexure 3.1 – Status of land available for disposal of municipal solid waste and quantity of MSW generated by various municipal authorities of the state.

To convert Acres into Hectare, multiply by 0.4069

According to the information stated in the report of 'State of Environment Punjab-2007', presently the hazardous waste generated by industries in the state of Punjab is being stored in the premises of the industries in an environmentally sound manner. A common Treatment Storage and Disposal Facility (TSDF) has been developed in the state at Village Nimbuan, Tehsil Dera Bassi, District Mohali. The land area that it was allocated for TSDF is 20.64 acres (8 ha). The commission of this facility is likely to be by June 2007 with the expected life of about 15 years.

The present situation recognized that the routine and mechanical handling of solid waste suffered from a number of deficiencies such as institutional weakness, lack of strategic planning, shortage of financial and human resources, inefficient managerial practices, improper choice of technology, lack of regulations and policy and lack of public awareness. Waste disposal system was not emphasis. The details are mentioned below:

- Lack of knowledge and operational capacity from the local government bodies

  Local bodies adopt casual approach for the management of solid waste. Municipalities are not aware of the ways and means to dispose off solid waste that is generated in their respective towns. The collection and transportation system of solid waste is not done in environmental friendly manner.

- Lack of proper disposal facilities and system

  There is lack of storage facilities and system for waste. Most of the population's dispose their waste on the streets in the open spaces, water bodies etc. as and when waste was generated and it created a serious hazard for health and sanitation.

- No allocated land for waste disposal

  In most of the district, there is no land earmarked for the disposal of solid waste, neither as landfill site nor for disposal through other techniques.

  In the vision plan, It was mentioned that there is an existing landfill site on private lands in Greater Mohali Region. This landfill sites are maintained and managed by private organization which prohibit public use. There is a proposed 22 acres (or 8.8 ha) landfill site near Derra Bassi for the treatment, storage and disposal of hazardous waste. However, the proposal of expanding this landfill site is not brought forward due to the sensitivity of this location.

- Lack of Public Awareness

  Public are not aware of the harmful effects of solid waste that litters around the towns and cities in the region. Debris is deposited on the streets and open areas.

Improper disposal of municipal solid waste affect community health

12.7.3 Solid Waste Composition and Disposal System

With the diverse urban and rural activities moving into Greater Mohali Region, various types of solid wastes will be generated. Classification of the solid wastes is necessary as the handling of different composition of waste will require special efforts and careful planning. Types of solid waste are broadly classified into four categories:

- Municipal Solid Waste (MSW)
- Biomedical Solid Waste (BSW)
- Hazardous Solid Waste (HSW)
- Agricultural Waste (AW)

(a) Municipal Solid Waste (MSW)

Municipal solid waste encompasses of commercial, residential and clean industrial wastes generated in the municipal or notified areas in solid or semi-solid form excluding industrial hazardous waste, but includes treated biomedical wastes. The major types of municipal solid waste are food wastes, paper, plastic, rags, metal and glass, with some hazardous household wastes such as electric light bulbs, batteries, discarded medicines and automotive parts. Table 12.7.2 highlights the main source of municipal solid waste, the waste generators and types of municipal solid waste generated.

Table 12.7.2 Sources and Types of Municipal Solid Waste

Sl No	Sources	Typical facilities, activities & location	Types of Municipal Solid Waste (MSW)
1	Residential and Open areas	Single & multi family dwelling, streets, parks, bus stand	Food waste, rubbish ashes, street waste, packing, bottles, old paper, dead leaves etc.
2	Commercial and construction	Offices, institutions, markets, hotels, restaurants, stores, schools, religions places, shopping malls, medical facilities, streets etc.	Food waste, rubbish ashes, bottles, old paper, packing, street waste, brickbat, stones, wooden log etc.
3	Industrial	Small / medium scale industry, offices, canteen	Office waste, food waste packaging material etc.
4	Municipal Services	Street cleaning, landscaping, parks, beaches, recreational areas	Street sweepings, landscape and tree trimmings, general wastes from parks, beaches, and other recreational areas.

Solid waste management system for municipal solid waste generally consists of collection system, transportation system, scientific treatment and disposal and recycling. In achieving effective waste removal, collection facilities should be provided in full area occupied by people so that these municipal wastes could be collected efficiently from all the residential area within its municipal limits. Landfills are generally the cheapest and most common disposal method for municipal solid waste.

(b) Biomedical Solid Waste (BSW)

Biomedical solid waste comprises the waste generated from hospitals, medical institutions, nursing homes and other medical facilitators of biomedical waste. These wastes are generated during the

diagnosis, treatment or immunization of human beings or animals, or in research activities pertaining thereto, or in the production or testing of biological. The biomedical wastes generally includes non-liquid tissue, body parts, blood, blood products, and body fluids from humans and other animals, laboratory and veterinary wastes, which contain human disease-causing agents, and discarded sharps (including needles, syringes, blades, scalpels, slides, broken glass, etc.).

Usually disposal method of biomedical solid waste requires categorizing the wastes and laying down provisions for their segregation, packaging transportation and storage. Treatment and disposal options for these pathogenic wastes are disinfection followed by incineration and land filling (especially of infectious waste). Incineration is the mandatory treatment for hospital and it is compulsory for hospital to treat these wastes before conveying to landfill site.

(c) Hazardous Solid Waste (HSW)

With increase in industrial activities in Greater Mohali Region, the amount of industrial waste, including that from the hazardous industries will increase. The increasing quantities and diversity of hazardous waste is a cause of concern.

Most hazardous wastes are recognized as coming from industrial, agricultural and manufacturing processes, as well as from hospital and health-care facilities. It usually includes the wastes from industrial goods, use of lead acid batteries and electronic equipments. The electronic wastes from discarded electronic devices like computers and their peripherals, communication equipments, electronic typewriters, nickel cadmium batteries, picture tubes, electronic medical equipments etc. are hazardous in nature.

Hazardous wastes generated by industries are required to be stored properly and disposed in an environmentally sound manner. Disposal options for these wastes involved treating the hazardous waste and neutralization followed by incineration and sanitary land filling. It shall be noted that disposal of hazardous waste are guided by the Hazardous Waste (Management and Handling) Rules as stipulated by Ministry of Environment and Forest (MoEF).

In the effort of reducing waste, refining and recycling of used waste such as oil in an environmentally safe manner could serve as means of minimizing wastes.

(d) Agricultural Waste (AW)

The agro wastes mainly consists of animal dung, household and agro industries waste and other crops resides such as straws, shells, stalks and husks.

Live stock waste is a major component of rural agro waste and it could be basically managed in the following ways. The collected animal dung could be composted and used in fields as organic manure. The crop residues could be used as household fuel while the rest of the collected household waste could be disposed off in the sanitary landfill.

12.7.4 Rules Dealing with Solid Waste Management

In India, various regulations and standards have been introduced for waste management. Examples of acts/laws relating to waste management include:

1) Section dealing with conservancy and sanitation of Municipal acts of the state.
2) Hazard waste management and handling rules (1989) ; Ministry of Environment and Forest (MoEF)
3) Biomedical waste management and handling rules (1998) ; Ministry of Environment and Forest (MoEF)
4) Municipal solid waste management and handling rules (1998) ; Ministry of Environment and Forest (MoEF)
5) Special notifications from time to time by Ministry of Environment and Forest (MoEF).

12.7.5 Projected Waste Generation

Solid waste generation is expected to increase with an expanding population base and increasing economic activity. The forecast of future waste generation from year 2020 to 2056 is shown in **Table 12.7.3.** This table present the projected generation of solid waste at different timeline of development for various local planning area of Greater Mohali Region.

Table 12.7.3 Projected Generation of Solid Waste for Greater Mohali Region

Sl No	Local Planning Area		Projected Generation of Solid Waste (Ton/day)		
			Year 2020	Year 2035	Year 2056
1	SAS Nagar	1,726,346	429	724	1,360
2	Mullanpur	100,000	90	154	191
3	Zirakpur	500,128	193	314	419
4	Dera Bassi	334,390	550	839	990
5	Banur	348,526	210	401	661
6	Kharar	300,000	84	141	252
7	Kurali	150,000	36	71	136
8	Lalru	359,560	89	187	351
9	Nayagaon	6,050	1	2	3
10	Rural/Agricultural Area	675,000	134	148	169
	Total	4,500,000	1,816	2,981	4,532

Total solid waste generation is projected to be 4532 ton/day at the end of year 2056. This volume of solid waste consists of both materials that can be incinerated and the components that cannot be incinerated due to release of toxic gases on incineration.

Solid waste generation per capita (including recyclable waste) is broadly estimated and presented in **Table 12.7.4.**

Table 12.7.4 Estimated Solid Waste Generation Rate

Sl No	Source of solid waste	Solid Waste Generation
1	Residential	0.8 kg/capita/day
2	Commercial	0.4 kg/capita/day
3	Industrial	180 kg/ha/day
4	Institution	60 kg/ha/day
5	Recreation	30 kg/ha/day
6	Transportation	30 kg/ha/day
7	Rural / Agricultural	0.25 kg/capita/day

Density of the solid waste in the new development of Greater Mohali Region is estimated to be about 800 kg/m^3. For the purpose of reference, **Table 12.7.5** tabulates the solid waste densities founded in some countries.

Table 12.7.5 Solid Waste Densities in Developed and Developing Countries

COUNTRY	DENSITY OF SOLID WASTE kg/m^3
Developed Countries	
United States	**100**
United Kingdom	**150**
Developing Countries	
Tunisia	**175**
Nigeria	**250**
Thailand	**250**
Indonesia	**250**
Egypt	**300**
Pakistan	**500**
India	**500**

12.7.6 Proposed Solid Waste Disposal and Treatment System

With the increase in population, urbanization and consumerism, the generation of solid waste is increasing considerably, which is exerting load on the existing disposal site. It is envisaged that the disposal site area allocated at present is deemed to be inadequate. All municipal bodies do not have adequate infrastructure to handle the escalated amount of waste. The life of existing landfill sites is also expected to be reduced with the increase in volume of waste generation.

Therefore, the following recommendation highlight the proposal of basic infrastructure needed to handle, and dispose of the solid waste in proper and environmentally friendly manner.

(a) Sanitary Landfill

Appropriate lands are to be earmarked for solid waste management keeping in view a long-term perspective. The area required for solid waste disposal shall be reserved in the zonal plans. This shall include buffer zone of 'no development' around landfill sites. Location of landfill site needed to be selected carefully. Following are consideration for the site selection.

- No perennial stream within 300m down gradient of proposed landfill cell.
- No known rare or endangered species or protected forests are within 500m of landfill cell.
- No residential development within 250m from perimeter of proposed landfill cell.
- No visibility of proposed landfill cell from residential neighbourhood within 1km.
- No major lines of electrical transmission or other infrastructures are crossing the landfill cell.
- Climate condition, geology, prevailing wind direction and the environment impact is also taken into consideration when planning for the location of landfill site.

In this regional plan, three proposed landfill sites are identified. Landfill site 1, 2 and 3 are marked as **LFS1**, **LFS2** and **LFS3** in **Figure 12.7.1 Proposed Solid Waste Disposal and Treatment System**.

For northern solid waste disposal site, which is marked as LFS1, the proposed landfill site is located at east of Kurali, and west of Mullanpur. Landfill site LFS1 will serve the municipal waste disposal from district Mullanpur, Kurali, Kharar and Nayagaon. Municipal waste generated from district SAS Nagar and Banur will be disposed of into landfill site LFS2. For the southern area, the landfill site LFS3 is identified to be sited on a vacant land at far south of Greater Mohali, in Lalru Area. LFS3 serves the landfill site for disposal of the waste generated from Zirakpur, Dera Bassi and Lalru and the vicinity around it.

The projected land requirement for solid waste disposal in sanitary landfill is shown in **Table 12.7.6.**

Table 12.7.6 Projected Land Requirement for Solid Waste Disposal

Sl No	Landfill Site	Serving Local Planning Area	Projected Sanitary Landfill Required (ha)		
			Year 2020	Year 2035	Year 2056
1	LFS1	Mullanpur Kurali Kharar Nayagaon	15	40	100
2	LFS2	SAS Nagar Banur	30	100	270
3	LFS3	Zirakpur Dera Bassi (Includes Free Trade Zone) Lalru	36	125	300

Assumptions:

(1) Landfill area required includes receiving area, leachate / treatment and evaporation pond and buffer zone.

(2) Landfill depth shall be 10m.

The ultimate land required for three landfill sites are 100ha, 270ha and 300ha respectively, considering total height of landfill to be 10m. For that purpose 3.0 m deep trenches shall be provided in landfill site. Thus the waste will be 3.0 m below ground and 7.0m above the ground.

In conjunction with the plan phasing, the solid waste disposal is forecasted in three phases – Phase 1, Phase 2 and Phase 3. Phase 1 refers to the first ten years, from year 2010 to 2020, of the commencement of development. During this period of time, the solid waste generated in the development is projected to be 1,816 ton/day.

With the progress development of Greater Mohali Region from year 2021 to 2035, which denotes the Phase 2, the projected amount of solid waste generated of 2,981 ton/day will continue to be disposed of into landfill sites LFS1, LFS2 and LFS3.

In the long term, In Phase 3 (from year 2036 to 2056), landfill sites LFS1, LFS2 and LFS3 continue to serve the Greater Mohali Region with the waste disposal of 4,532 ton/day.

(b) Incineration Plant

Provision of incineration could start from year 2021 onward where most of the industries have moved into the Greater Mohali Region development. With the rise in the waste generated from the various activities in the development of Greater Mohali Region, the amount of waste generated escalated exponentially. This is envision as a more economical approach to implement incineration of waste at this stage

Incinerating of these wastes could serves as a good alternative by reducing the volume of wastes and at the same time moderate the potential health risk to both the people and the environment.

The advantage of incineration is that it offers substantial reduction in the volume of disposed waste by turning the solid waste into ash, thus lessen the amount of waste, mostly non-biodegradable waste, non-incinerable waste and incinerate ash, to be disposed off to the landfill sites. It also preserves the life of landfill site.

In this development, incineration plant is proposed to be located near the gas fired power plant at the southern end of Greater Mohali region. Alternative location of incineration plant is to site near the alternative location of gas fired power plant at the western side of Greater Mohali Region, near Kharar. The key reason for siting the proposed incineration plant near the gas fired power plant is to recover energy whilst burning the waste. In this way, it fulfills the long term objective of reusing, recycling and recovering waste by converting waste into an alternative source of energy.

(c) Transfer Station (also serve as Recycling Centre)

Each local planning area is allocated with a designated transfer station. Waste generated from every individual planning area is collected, segregated and stored in this collection point before sending for landfill disposal or incineration.

This station also provides facilities in sorting out and storing recyclable waste. Recycling of waste are highly recommended as it reduces the environmental impact of waste disposal for long term sustainability. This not only reduced the non-bio-degradable waste disposed of in the disposal site, at the same, minimize the amount of solid waste to be disposed.

Table 12.7.7 shows the various local planning areas with the designated transfer station.

Table 12.7.7 Proposed Designated Transfer Station

Sl No	Local Planning Area	Proposed Designated Transfer Station (TS)
1	SAS Nagar	TS 4
2	Mullanpur	TS 1
3	Zirakpur	TS 6
4	Dera Bassi	TS 7
5	Banur	TS 5
6	Kharar	TS 3
7	Kurali	TS 2
8	Lalru	TS 8

(d) Treatment Storage and Disposal Facility (TSDF)

It is noted that there is an existing common treatment storage and disposal facility (TSDF) in the state at Village Nimbuan, Tehsil Dera Bassi, District Mohali with an expected life of 15 years. The entire industrial hazardous waste from Punjab is proposed to be stored/ disposed at this facility. With the subsequent upcoming industrial development in Greater Mohali Region, it is envisaged that the amount of industrial wastes, including that from hazardous industries, will also be increased.

For the beginning of the development (say the first 5 years) whereby the development of the industries is starting off, disposal of industrial hazardous waste could be deposited at the existing treatment storage. As the industries increase, it is forecasted that the existing facilities may not be sufficient to deal with the heavy load of waste.

Therefore, it is proposed to have new treatment storage and disposal facility is located near the industrial activity zone. It is located at east of Dera Bassi district. The industrial hazardous and toxic waste from all districts within Greater Mohali Region shall be consolidated and treated in this facility.

12.7.7 Development Plan

The estimation of the total solid waste generation in the development would be about 4,532 ton/day by the year 2056 and accordingly, there will be needs to develop appropriate system for collection, transportation and disposal of solid waste in environmental friendly manner either through properly designed land filling or through other treatment methods.

Table 12.7.8 shows the main infrastructure required for the implementation of solid waste disposal and treatment system.

Table 12.7.8 Main Infrastructure Required for Implementation of Solid Waste System

Sl No	Projects	Location
1	**Proposed landfill 1 (Area = 100 ha)**	**Northern side of Greater Mohali Region, between Kurali and Mullanpur district.**
2	**Proposed landfill 2 (Area = 270 ha)**	**Central of Greater Mohali Region, near S.A.S Nagar district.**
3	**Proposed landfill 3 (Area = 300 ha)**	**Southern side of Greater Mohali Region, within Lalru district.**
4	**Proposed treatment storage and disposal facility**	**Southern side of Greater Mohali Region, within Dera Bassi district.**
5	**Proposed eight transfer stations**	**In all districts namely Mullanpur, Kurali, Kharar, S.A.S Nagar, Banur, Zirakpur, Dera Bassi and Lalru.**
6	**Proposed one incineration plant**	**Southern side of Greater Mohali Region, within Lalru district.** **Alternative location of incineration plant to be located western side of Greater Mohali Region, near Kharar.**

The above proposal entails the concern for the cost of design and construction, implementation, operation and maintenance of the solid waste infrastructure. It is envisaged that as the cost of solid waste system increases escalate over time, it rolls down to the cost of waste disposal in the municipal district. The increases in refuse disposal fees and waste minimisation are necessary to ensure that the waste disposal capacity is used at a more sustainable rate. And one viable option is by introducing privatisation of the waste disposal industry which will allow competition to keep such increases down.

In the following section, we explore into the possible ownership and operation of the entire solid waste management system. The ownership and operation of solid waste system could be existed in three options:

(a) Private Provision (Privatisation)

All aspects of service are own and managed by the private sector. Government acts as the regulator.

(b) Public-only own and operations

All aspects of facilities are provided by governmental entities. The option reflects the system is owned and operated by the public sector. Projects need would be met through public facilities or policies.

(c) Public-Private-Partnership (PPP)

Services would be provided by both the public and the private sector. This model could be in the form of joint-ventures, strategic partnerships etc to make better uses of government assets, Design-Build-Operate (DBO), Design-Build-Finance-Operate (DBFO), etc. Some common models can be use but are not limited to the following:

- Design-Build-Finance-Operate (DBFO) model

  DBFO is the most common form of PPP, involving the integration of these four functions, Design, Build, Finance and Operate within one PPP service provider. PPP provider will raise finance to develop the facilities needed to deliver services to the public sector. The provider will then build, maintain and operate the facilities to meet the public sector's requirements. The private provider will be paid according to the services delivered.

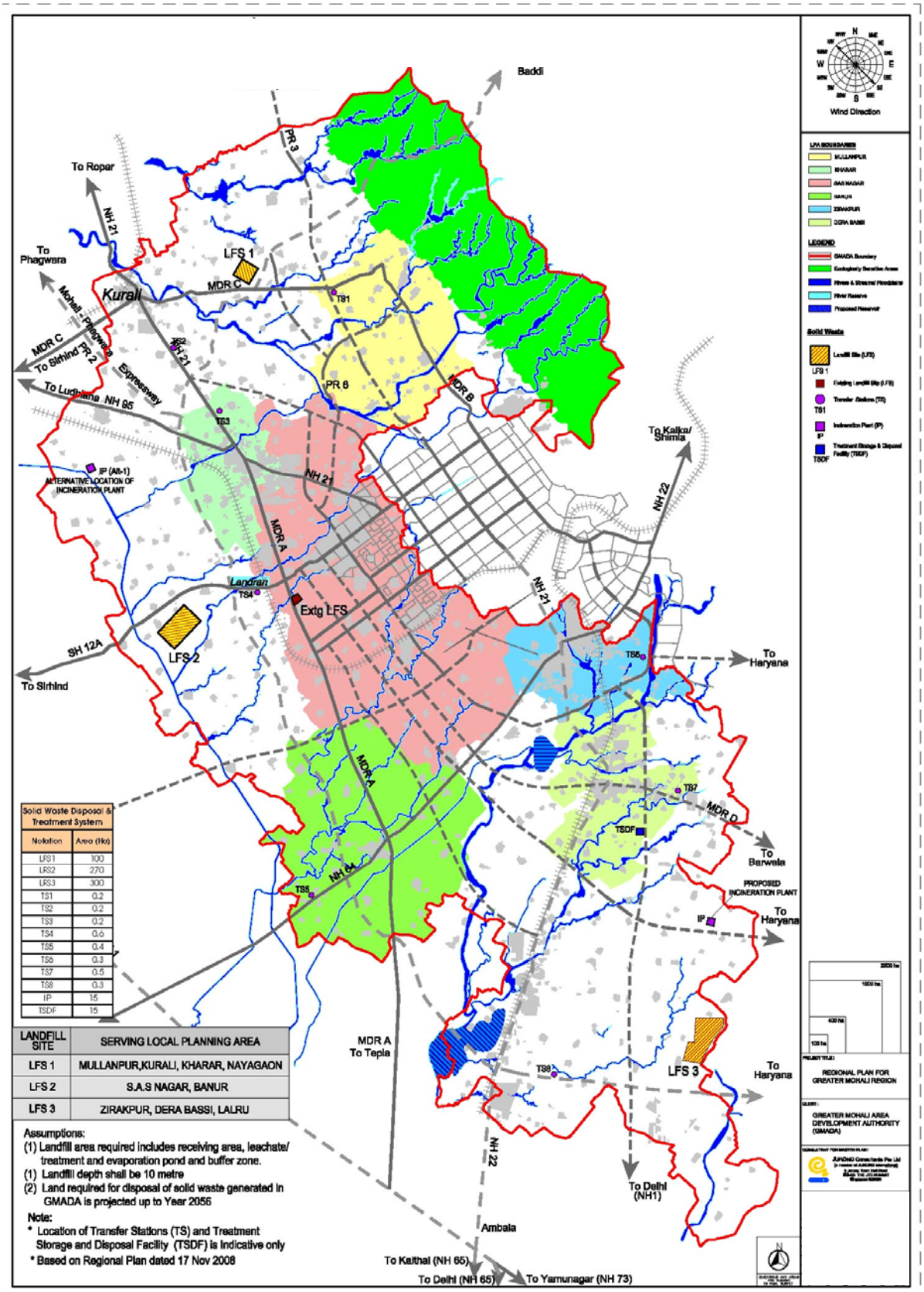
- Design-Build-Operate (DBO) model

  The public sector provides the funds for the design and building of the facility, and continues to engage the same private vendor to operate the facility. The operator is paid a management fee.

Table 12.7.9 shows the possible form of ownership and operation model adopted in the solid waste system in Greater Mohali Region. However, the implementation of any model shall require a detailed assessment and consideration of its economic implication.

Table 12.7.9 Possible Ownership & Operation Model for Solid Waste System

Projects	Possible Forms of Ownership and Operation Model
Proposed landfill site 1 (Area = 100 ha)	**Public own**
Proposed landfill site 2 (Area = 270 ha)	**Public own**
Proposed landfill site 3 (Area = 300 ha)	**Public own**
Proposed treatment storage and disposal facility	**Public own ; OR Public private partnership**
Proposed transfer stations	**Public own ; OR Private provision ; OR Public private partnership**
Proposed incineration plant	**Public own ; OR Public private partnership**



Solid Waste Disposal & Treatment System	
Notation	Area (Ha)
LFS1	100
LFS2	270
LFS3	300
TS1	0.2
TS2	0.2
TS3	0.2
TS4	0.6
TS5	0.4
TS6	0.3
TS7	0.5
TS8	0.3
IP	15
TSDF	15

LANDFILL SITE	SERVING LOCAL PLANNING AREA
LFS 1	MULLANPUR,KURALI, KHARAR, NAYAGAON
LFS 2	S.A.S NAGAR, BANUR
LFS 3	ZIRAKPUR, DERA BASSI, LALRU

Assumptions:
(1) Landfill area required includes receiving area, leachate/ treatment and evaporation pond and buffer zone.
(1) Landfill depth shall be 10 metre
(2) Land required for disposal of solid waste generated in GMADA is projected up to Year 2056

Note:
* Location of Transfer Stations (TS) and Treatment Storage and Disposal Facility (TSDF) is Indicative only
* Based on Regional Plan dated 17 Nov 2008

Figure 12.7.1 Proposed Solid Waste Disposal and Treatment System

12.8 Information and Communications Technology System

12.8.1 Introduction

Information and Communications Technology is one of the important elements in promoting economic growth and improving the lives of many people in the Greater Mohali Region through better IT systems for education, work and play.

Strategic Directions

- To facilitate the deployment of IT infrastructures to promote economic opportunities for all sectors
- To ensure that modern, secure and reliable telecommunications, broadband Internet, cable TV and video services are made available to all for educational, research, and outreach programs
- To lobby for Greater Mohali Region to be one of the principle telecommunication hubs in India
- To work with telecommunications operators and ISPs to build a modern, low cost infrastructure that not only caters for future growth but respects the environment in Greater Mohali Region as well

12.8.2 Existing Telecommunications Infrastructure

The Greater Mohali Region is currently served by a number of telecommunications service providers. Various technologies have been deployed. These include TDM, VOIP and XDSL technologies for fixed telecommunications. For wireless communications, GSM, CDMA, Wi-Fi, microwave, satellite and other proprietary wireless technologies are used for both narrow band voice, and data communications.

Although the Greater Mohali Region has deployed the latest technologies and has the second highest tele-density amongst the states in India, its tele-density is still relatively low compared with the more developed economies. The rural areas, in particular, are under served with tele-density of between 1% to 2%. Number of subscribers having access to Internet is also low. Broadband subscription is only about 3 million.

More and better ICT infrastructure needs to be provided if more value added ICT industries are to be encouraged to relocate to the Greater Mohali region. The improved infrastructure will enable more people to have better access to ICT services.

The decision for 3G, 3.5G and Wimax technologies to meet future wireless broadband needs has yet to be taken. The relevant authorities are still debating as to which service providers would qualify to bid for the licenses and what frequency bands should be allocated. Decision on this is expected to be made soon.

The existing telecommunication network within the Greater Mohali Region is shown in **Figure 12.8.1 Existing Telecoms Network**.

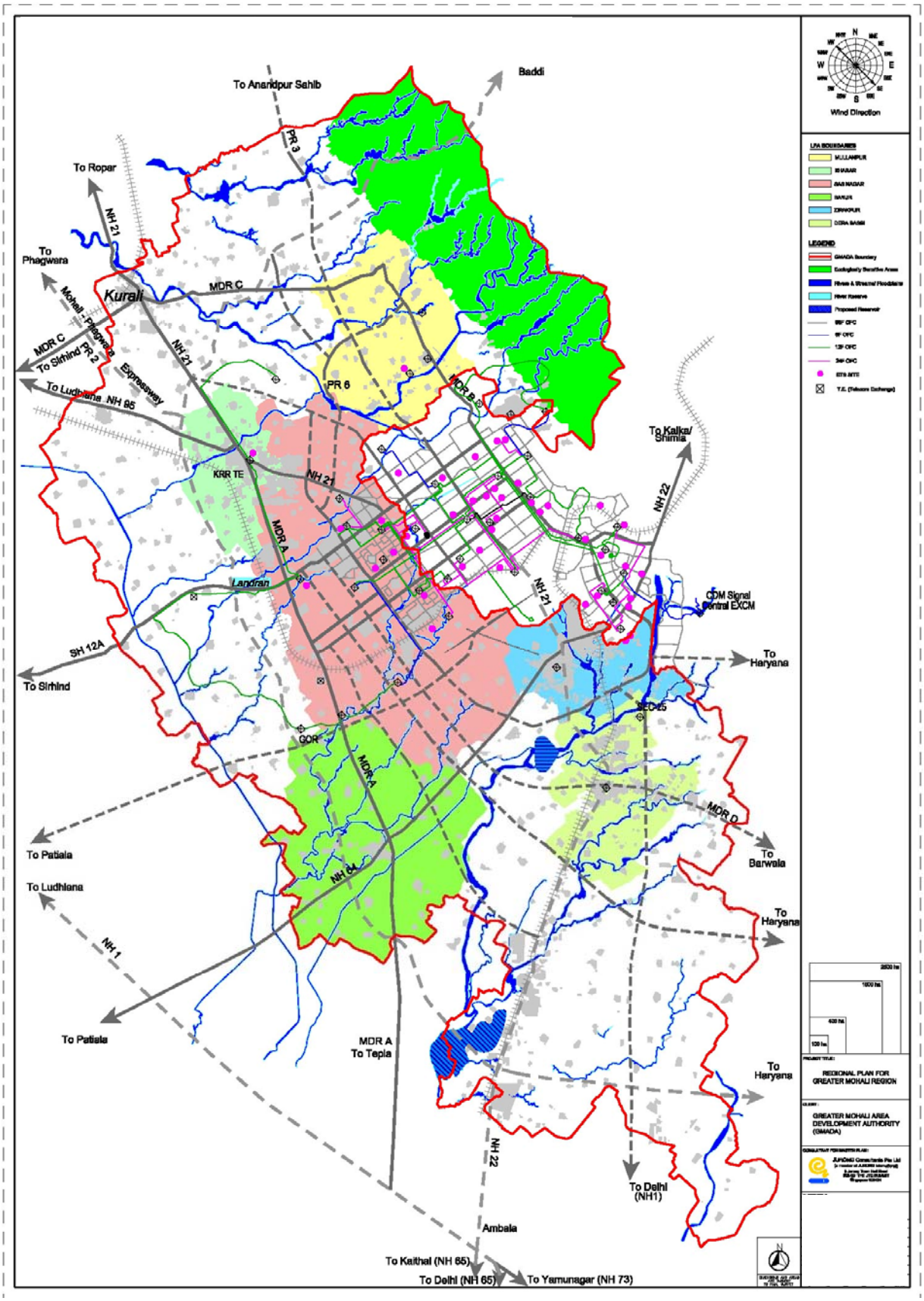


Figure 12.8.1 Existing Telecom Network

12.8.3 PAWAN

As part of its plan to provide better ICT infrastructure for the industries and e-Governance for its citizens, the Government of Punjab has formulated a Punjab Wide Area Network (PAWAN) as shown in **Figure 12.8.2**

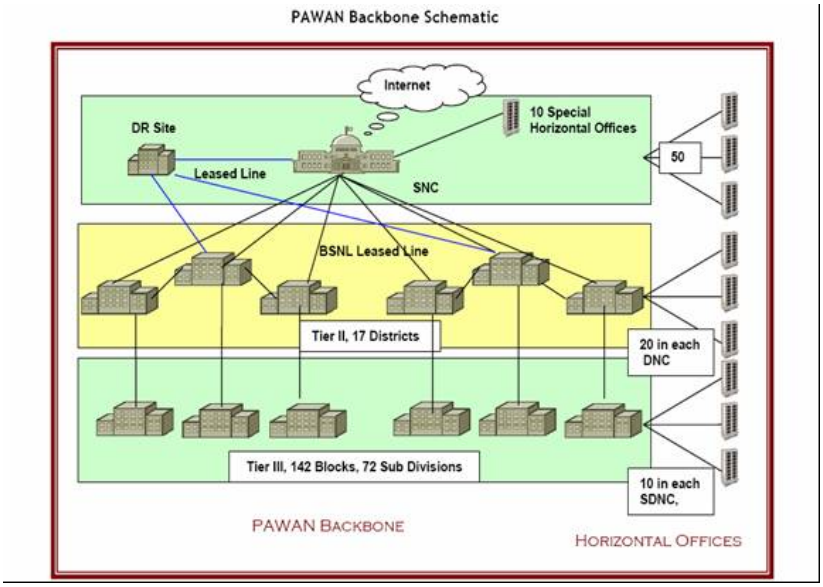


Figure 12.8.2 PAWAN Backbone Schematic

The WAN will be the core infrastructure to support all the communications needs of Punjab, including its e-initiatives. This backbone network will enable Punjab to achieve its objectives of providing reliable and cost effective communications to the population and ensure that they have access to Government services.

The PAWAN would have a 3-tier structure through POP (Point of Presence) across the various levels; viz.,

1st. Tier-----State Head Quarter or State Network Centre (SNC)

2nd.Tier-----District Head Quarter or District Network Centre (DNC)

3rd. Tier-----Sub Divisional Head Quarter or Sub Division Network Centre (SDNC) and the Block Head Quarters or Block Network Centres (BNC).

Each tier shall have a minimum 2Mbps bandwidth and can be scaled upwards.

The PAWAN would be constructed under the BOOT (Build, Own, Operate and Transfer) model.

The details on the status of the PAWAN project is as follows:

Has been approved by Government of India

Approved project cost of 62.23 crores over 5 years.

BSNL appointed as the Bandwidth Service Provider

PWC appointed as the Consultant.

12.8.4 New Generation Network

Existing voice and data services are delivered through separate networks. Fixed access networks are largely copper based. Backbones are largely optical fibres based, with microwave and satellite links being used for the more difficult terrains, and inaccessible areas.

With rising expectations for more broadband applications requiring huge bandwidth, both the access and backbone networks have to be upgraded, and they are increasingly optical fibre based.

To meet the increasing demands for voice, Internet, video and other interactive services, a New Generation Network is required.

Towards this end, the ITU (International Telecommunications Union), together with service operators and vendors, has proposed a conceptual topology that will accommodate both existing and new networks. It is a layered structure with 3 layers, viz., Service and Network Control Layer, Core Transport Layer, and Access Network Layer. Applications which sit at the top layer are accessible to all. The schematic is shown in **Figure 12.8.3.**

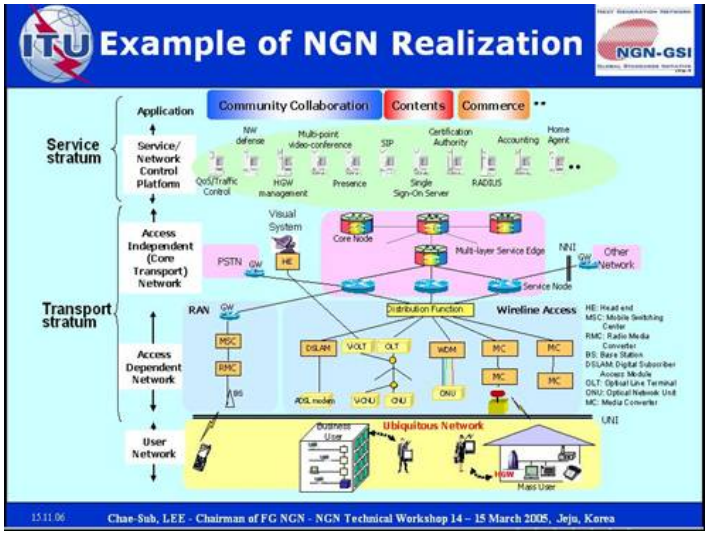


Figure 12.8.3 Example of NGN Realization

As new and future services will be very bandwidth intensive, ubiquitous, personal, mobile and fast changing, the topology must be flexible for the incorporation of new services. Technologies deployed must be future proof. As at this point in time, optical fibre is the technology which is best able to meet this need, particularly in the backbone network, as it has huge bandwidth capacity. However, this has to be complemented with broadband wireless technology to meet the mobility needs. It is therefore important that sufficient frequencies be made available for this purpose.

12.8.5 New ICT Infrastructure for Greater Mohali region

Existing and future telecommunications services in Greater Mohali region would likely continue to be provided by the various service providers, using a variety of technologies. However, as new and costly infrastructure would have to be provided for new and future services, thoughts should be given

on how to best manage the provision and maintenance of such infrastructure in a cost effective manner, and with the least inconvenience to the people.

To allow for flexibility to meet future growth, and to minimize maintenance cost, new shared basic infrastructure like ducts and sub ducts, and optical fibres, should be provided and managed by a common party. Cable ducts should be used for the fibre optical cables instead of directly burying the cables, as this will provide more flexibility for expansion. This will also minimize the fault rates. The common set of facilities can then be leased to the various service providers.

With competition and more and more services going wireless, the demand for space to mount antennae and outdoor wireless equipment will increase. Greater Mohali region may wish to draw up rules and guidelines to make certain critical sites available to all competitors (if there are no alternative sites available nearby) to mount their antennae to ensure there is adequate service by all service providers. Acquisition of non critical sites should be left to market forces.

12.8.5.1 Demand Norms for Telecom. Lines

The projection for telephone or telecom lines was computed based on the following assumptions:-

a) One telecom or telephone line per household for year 2056 and 2035 and 0.8 line per household for year 2020.

b) The number of people in one household is 5 for 2020 and 2035 and 4 for 2056.

c) For rural area, the number of household is 5 and the penetration is 1.

d) Including the business demand which is about 40% of the total demand.

12.8.5.2 Preliminary Forecast of Telecom Lines

The ultimate total demand for telecom lines is estimated to be about 1.0 Million by year 2056. The preliminary forecast of telephone lines is detailed out in **Table 12.8.1 Preliminary Forecast of Telephone Lines.**

Table 12.8.1 Preliminary Forecast of Telephone Lines

Local Planning Area		Projected Demand (No. of Lines)		
		Year 2020	Year 2035	Year 2056
SAS Nagar	431,587	49,142	126,118	431,587
Mullanpur	25,000	2,578	6,895	25,000
Zirakpur	125,032	30,264	63,745	125,032
Dera Bassi	83,598	20,142	42,552	83,598
Banur	87,132	19,832	43,505	87,132
Kharar	75,000	13,313	28,396	75,000
Kurali	37,500	7,043	14,673	37,500
Lalru	89,890	20,488	44,903	89,890
Nayagaon	1,513	66	253	1,513
Rural/Agricultural Area	54,000	42,316	46,178	54,000
Total	1,010,250	205,185	417,218	1,010,250

The tentative locations of the proposed nodes/exchanges that would be required for the Greater Mohali Region are indicated in **Figure 12.8.4 Proposed Telecom Network**. Existing exchange sites could be reused, with the necessary modification where possible.

Based on the preliminary estimation, 14 nodes/exchanges would be sufficient to serve the projected population, with 2 to 3 nodes/exchanges each serving the more densely populated regions. Refinements would be made when more planning details become available. Area requirement for each node/exchange is 1 Ha.

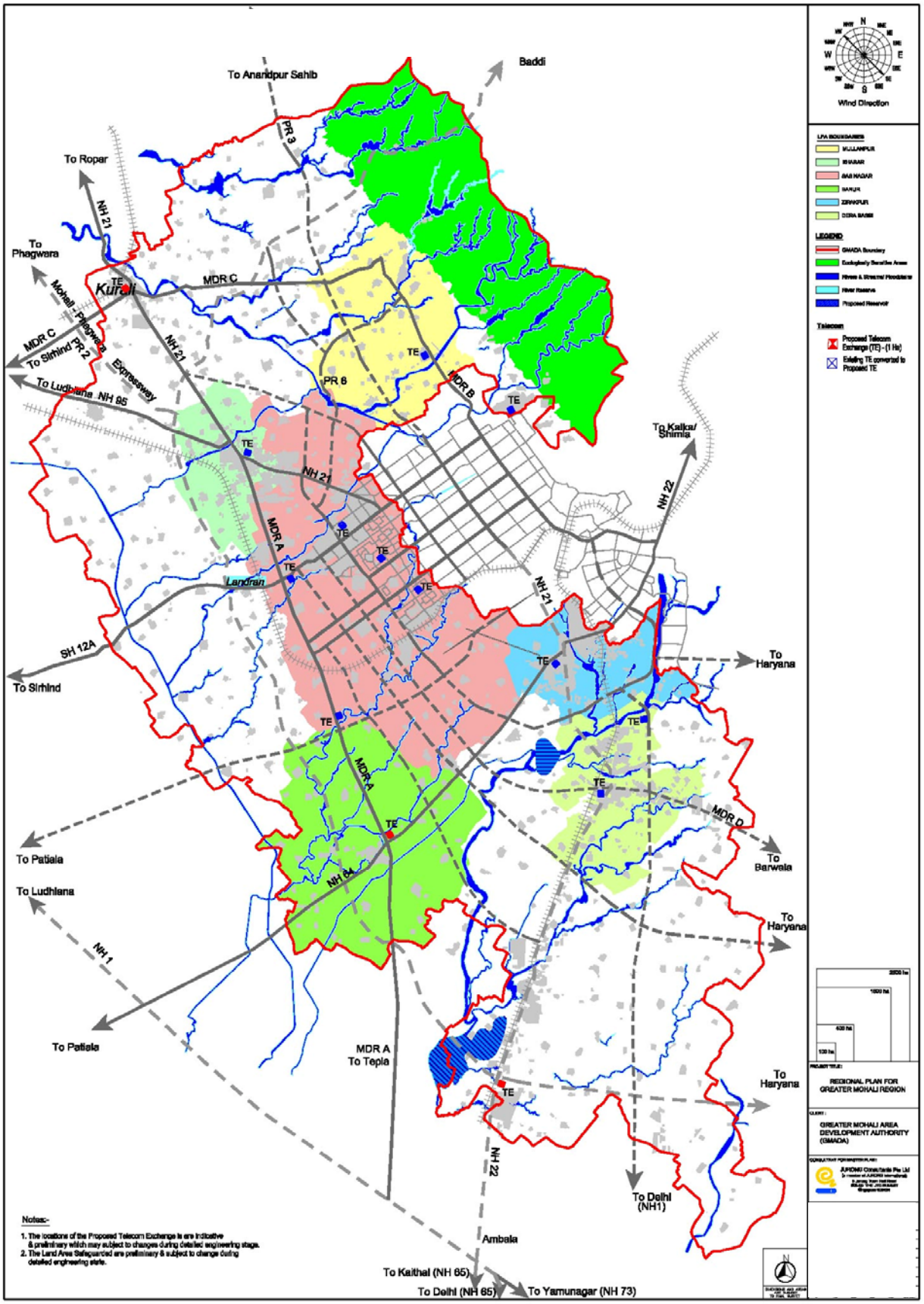


Figure 12.8.4 Proposed Telecom Network

There are a number of rural areas with scattered population which currently fall outside of the 6 planning zones, and which have no existing exchanges to serve them. We are recommending that these areas continue to be served via wireless and overhead infrastructure until such time when the demand justifies buried ducts and exchanges.

In order to build a resilient network with auto recovery capability, we are recommending that the nodes/exchanges be linked in a ring configuration to cater for both resiliency and unexpected growth. The distribution network into individual buildings can be a ring or tree structure depending upon needs. The schematic is shown in the **Figure 12.8.5** below.

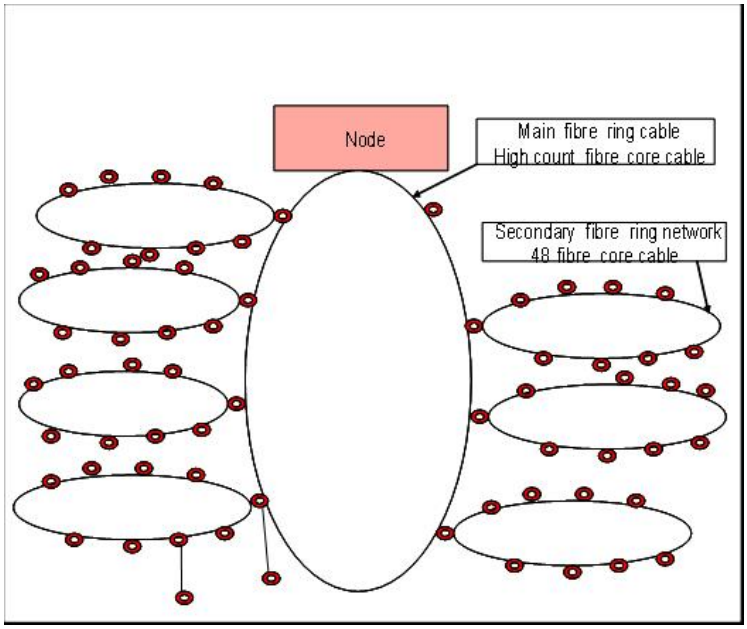


Figure 12.8.5 Network Configuration

Wireless technologies will increasingly become an important means in meeting communications needs. When the decision on 3G, 3.5G and Wimax has been made, such technologies would be incorporated accordingly into the Greater Mohali Region at the appropriate time.

12.8.6 Way Forward

When more planning details are available, the exact locations of the nodes/exchanges, the capacity and routes of the new infrastructure will be proposed. New technologies for voice, data and video communications would also be highlighted for consideration.

12.9 Gas Supply

12.9.1 Introduction

Strategic Directions

- To provide all possibilities of tapping for gas supply
- To provide a continuous, economical and safe supply of gas to the Greater Mohali Region in the near future for household and industrial consumption

12.9.2 Existing Conditions

There is no gas supply in the region now. But it is expected to reach the Greater Mohali Region in coming 5 to 10 years. It will come either from Iran- Pakistan or from neighboring states. It is thus recommended to keep provision for the gas distribution network accounting for both possible gas pipe line network. Hence planning has accounted for both the possible scenario.

12.9.3 Proposed Gas Supply And Distribution

12.9.3.1 Demand Estimate:

The ultimate gas demand or consumption is estimated to be about 2,025,000 SCM

12.9.3.2 Agency Dealing With Gas Service In The Region

Currently, there is neither an existing gas distribution network in the region nor there is no nodal agency in the region catering for such facility. However, the GAIL (Gas Authority of India Limited) can be considered to be the nodal agency. GAIL shall be responsible to decide the planned implementation of gas pipe line to bring gas to the Greater Mohali Region. They shall also ensure which of the two possible scenarios emerge. In the future, the Greater Mohali Region will have to establish either a PPP or a government nodal agency responsible for gas procurement and distribution within the Greater Mohali Region.

12.9.3.3 Distribution Network

Presently, there is no gas distribution network on site or in vicinity. But as recommended we shall earmark the land required for the working stations and storage. GAIL shall be responsible for conveying gas to the Greater Mohali Region through either a dedicated pipe line from the nearest pipe or through a general route pipe line passing near the Greater Mohali Region.

Once gas reaches the Greater Mohali Region, one city gate station shall have to be provided. It is planned to have such a city gate station in the same area reserved for Gas based power station as the Gas essential for Gas based power station will be also brought to the Greater Mohali Region. The City Gate station shall be responsible for controlling the entry of gas into the Greater Mohali Region. From here, each of the six regions / planning zones can be provided with individual dedicated pipe

line going from city gate station to each planning zone (eg CGS to Lalru zone, CGS to Sasnagar zone, CGS to Nayagaon zone etc).

The zonal regulating station is planned to be located within the same boundary as the Regional Service Station / Regional Service complex. Regional Service Center of Complex is a area demarcated in the planning frame work to act as a central area in each planned zone where all the infrastructure facilities are located centrally and also the departmental office block is also located. From the zonal regulating station pipe line distribution network is planned to move in the service corridor provided on each road. This service corridor shall be the main core of the network for gas distribution.

Other components of the gas distribution network inside each locality are as following (No area needs to be reserved for any of the below stated component of the network):-

The Service Regulator

It is housed in a blue fiber-glass kiosk, which reduces the gas pressure from 4 BAR to 100 m BAR and ensures the flow of gas at constant pressure at all time.

Buried Polyethylene Pipes

The pipes are installed at a safe and secure depth. It provides low-pressure gas (100 m BAR) to individual buildings. These lines/ conduits will be housed within the utility corridor by the MGL authorities.

The Riser Pipe (GI pipe)

This is an external connection on the building to each apartment. Each Riser Pipe (GI pipe) has an Riser Isolation Valve.

The Meter Control Valve

Fitted in each apartment, this valve is between the riser pipe and meter.

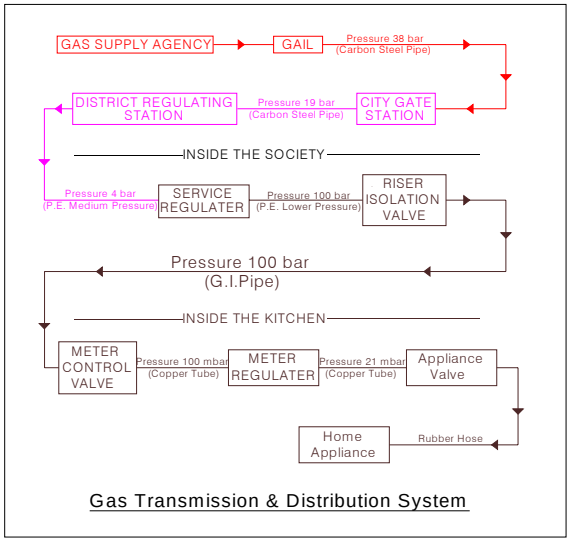
The Meter Regulator

Installed before the meter, the meter regulator reduces the gas pressure from 100 m BAR to 21 m BAR.

The Appliance Valve

This valve switches on/off the gas to burning appliance.

Figure 12.9.1 Proposed Gas Transmission & Distribution System



Gas Transmission & Distribution System

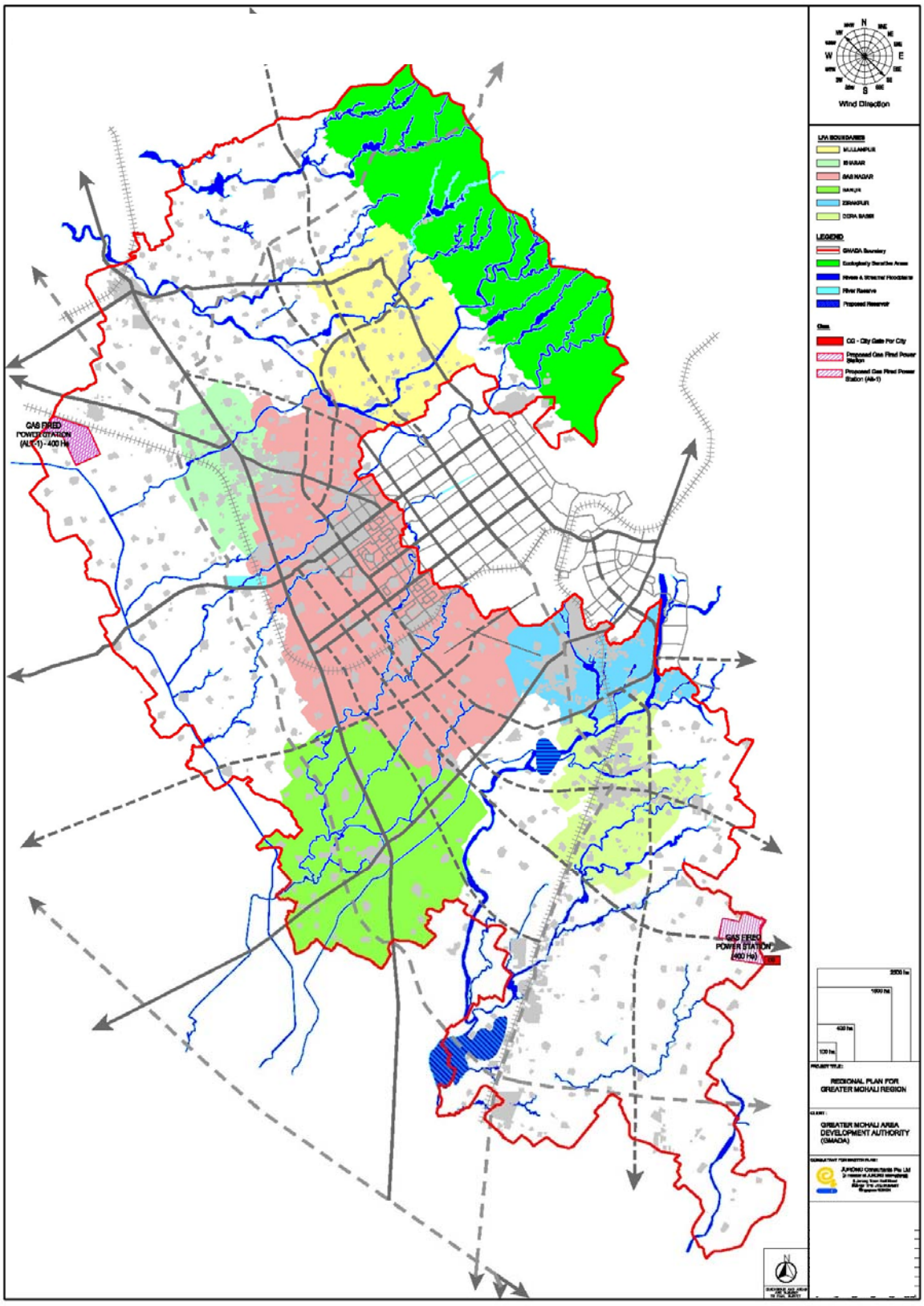


Figure 12.9.2 Proposed Gas Transmission & Distribution System

12.10 Overall Utilities Plan

The proposed locations and safeguarded land areas for various infrastructure utilities, including storm water drainage, water, sewerage, solid waste, power, telecom, gas, are shown in **Figure 12.10.1 Regional Utilities Plan**.

The proposed utilities locations and safeguarded land areas (by year 2056) are indicative only and subject to changes during site verification and detailed planning and design stage.

The siting criteria for infrastructure and utilities facilities are summarized as follows:

1. Water Supply

(1) Raw Water Treatment Work No. 1 (RWTW1) is proposed in the event that the raw water can be supplied from Bhakra Canal via pumping. Raw Water Treatment Work No. 2 (RWTW2) is proposed to be an alternative location if the raw water can be supplied from Ganguwal by gravity (currently under feasibility study).

(2) The proposed Local Water Treatment & Storage Works No. 1 to 12, LWTW1-12 are located on relatively higher altitudes within each local planning area) to facilitate water distribution by gravity means and located closer to the road network for ease of access, maintenance and connection.

2. Power Supply

The proposed gas-fire power plant (400ha) is located at the south of Greater Mohali District (at Lalru) in order to receive future gas pipeline which could come from Haryana, where an existing gas line (India internal network) is located in Sonepath, 80km south of GMADA. The proposed site is also close to river for water source for cooling purposes. The site area of 400ha for a gas-fired power station of capacity of about 4000MW – 5000MW was discussed with Punjab State Electricity Board in Patiala in January 2008.

An alternative site for gas-fire power plant (400ha) is located at the north of Greater Mohali District (south-west of Kurali). This alternative could be adopted if future gas pipeline supply from Iran were

to pass through the north of Punjab. This site is also located near river source and the proposed RWTW1 for cooling water supply.

3. Sewerage

(1) The proposed sewage treatment plants, STP 1-9 are located on the relatively lower altitude within each local planning area to facilitate sewage flow by gravity means and located also nearer to existing water bodies for any overflow of excess treated effluent.

(2) The land areas safeguarded for all STPs are based on area required for conventional sewage treatment system.

4. Solid Waste Management

Sanitary landfill site

Following is the siting criteria for sanitary landfill:

- Groundwater table's seasonally high level (i.e., 10 year high) should be at least 1.5 meters below the proposed base of any excavation or site preparation to enable landfill cell development.
- A minimum depth of 1 meter of soils above the groundwater table's seasonably high level exists.
- No underlying limestone, carbonate, fissured or other porous rock formations which would be incompetent as barriers to leachate and gas migration, where the formations are more than 1.5 meter in thickness and present as the uppermost geologic unit above sensitive groundwaters.
- No environmentally significant wetlands of important biodiversity or reproductive value are present within the potential area of the landfill cell development.
- No perennial stream within 300 meters down gradient of the proposed landfill cell development
- No siting within a floodplain subject to 10-year floods to eliminate the potential for washout.
- None of the areas within the landfill boundaries are part of the 10-year groundwater recharge area for existing or pending water supply development.
- No known rare or endangered species or significant protected forests are within 500 meters of the landfill cell development area.
- No open areas of high winds, otherwise windblown litter will not be readily manageable.
- No residential development within 250 meters from the perimeter of the proposed landfill cell development.

- No visibility of the proposed landfill cell development area from residential neighborhoods within 1 km.
- Avoid siting within 1 km of culturally sensitive sites where public acceptance might be unlikely (i.e., memorial sites, churches, schools) and avoid access roads which would pass by such sites.
- No major lines of electrical transmission or other infrastructure (i.e., gas, sewer, water lines) are crossing the landfill cell development area.

Incineration Plant

Incineration plant is proposed to be located near the gas fixed power plant at the southern end of Greater Mohali region. Alternative location of incineration plant is to situate near the alternative location of gas fixed power plant at the western side of Greater Mohali Region, near Kharar. The key reason being that the incineration plant burns waste that needs to be buried in landfills while produce electricity that can be use in generating the power plant. In this way, it fulfills the long term objective of reusing, recycling and recovering waste by converting waste into an alternative source of energy.

Transfer Station

Transfer stations are located within the local planning district to temporary store the solid waste before sending to landfill for disposal. Setting up of locational criteria for the transfer station shall be as follow:-

(a) Accessible to the transport movement

(b) Transfer station should have a buffer zone around it, up to a distance prescribed by regulatory agencies.

(c) No residential development within 250 meters from the perimeter of the proposed transfer station

(d) No known rare or endangered species or significant protected forests are within 500 meters of the transfer station.

(e) The site area safeguarded for transfer station has assumed daily removal of waste.

Treatment Storage and Disposal Facility

It is proposed to have new treatment storage and disposal facility is located near the industrial activity zone. It is located at east of Dera Bassi district. The industrial hazardous and toxic waste from all districts within Greater Mohali Region shall be consolidated and treated in this facility.

5. Information Technology & Communication

(1) Locations of the proposed exchanges are indicative at the moment. They can be re-sited to more appropriate sites if necessary.

(2) The proposal to consolidate, and reuse some existing exchanges is to achieve better efficiency.

(3) Several exchanges have been proposed in the SAS Nagar region to provide a more robust network as the more critical and important circuits could be served from different exchanges. These existing exchanges are selected based on the premise that they are the bigger exchanges serving more customers and thus have room for expansion. The exchanges can also be used to provide diversity for the Airport at Chandigarh.

As for the Mullanpur region, it is being planned to be an eco friendly area with low population and some light industries. We have proposed that the existing exchanges be consolidated to one. The proposed exchange should be sited away from the river bank to avoid damage to equipment in case of flooding. However, if at a later point, the demand grows and if it is determined that there should be better diversity, the requirement can be met by an exchange in SAS Nagar.

6. Gas Supply

The City Gate Station at Lalru for gas utility is not going to start immediately as there is no Natural Gas supply at present. It may start in near future say after 5-6 years and in that case it will come from Haryana. The same spot is meant for the proposed gas-fired power Station which is placed for the same reason. The city gate station would be located next to the proposed power station to receive the incoming gas supply.

The alternative Gas Station at Kurali is identified based on reasoning same as above. This gas line may come from Iran, through Pakistan on its way to south Asia. Due to non confirmation yet of the proposed line, it is proposed as alternative site location preference. The city gate station will be located next to the alternative site for gas-fired power station. Water requirement for cooling of power station is available at both location or can be organized easily.

Table 12.10.1 Overall Utilities Demand Projection

Sl No	Local Planning Area	Water Demand (MLD)	Power Demand (MW)	Sewage Generated (MLD)	Solid Waste Generated (Ton/day)	Telephone Lines (No. of Lines)
1	SAS Nagar	749.3	4355.70	611	32,985	431,587
2	Mullanpur	136.4	550.12	60	6,043	25,000
3	Zirakpur	228.4	1246.20	165	13,105	125,032
4	Dera Bassi	251.9	1479.30	187	33,696	83,598
5	Banur	427.4	1806.00	299	17,493	87,132
6	Kharar	152.2	761.65	101	6,437	75,000
7	Kurali	79.9	395.79	56	3,265	37,500
8	Lalru	227.4	1093.10	139	8,568	89,890
9	Nayagaon	7.5	10.59	1.8	32	1,513
10	Rural Settlements & Others	763.1	393.75	341	6,719	54,000
	Total	3023.5	11,968.5	1892	128,311	1,010,250

Table 12.10.2 Proposed Infrastructure/Utilities Facilities Required for year 2056

Sl No	Public Utility	Type of Infrastructure	Location	Capacity	Site Area (Ha)
1	Potable Water	Raw Water Treatment Works – 1	Southwest of Kurali	2200 MLD	270
		Raw Water Treatment Works - Alternate Location	North East of Kurali	2200 MLD	270
		Local Water Treatment Works - LWTW1	SAS NAGAR	700 MLD	85
		Local Water Treatment Works - LWTW2	MULLANPUR	70 MLD	9
		Local Water Treatment Works - LWTW3	ZIRAKPUR	190 MLD	23
		Local Water Treatment Works - LWTW4	DERABASSI	320 MLD	39
		Local Water Treatment Works - LWTW5	BANUR	260 MLD	32
		Local Water Treatment Works - LWTW6	KHARAR	120 MLD	15
		Local Water Treatment Works - LWTW7	KURALI	70 MLD	9
		Local Water Treatment Works - LWTW8	LALRU	160 MLD	20
		Local Water Treatment Works - LWTW9	NON-URBAN AREA	80 MLD	10
		Local Water Treatment Works - LWTW10	NON-URBAN AREA	80 MLD	10
		Local Water Treatment Works - LWTW11	NON-URBAN AREA	30 MLD	4
		Local Water Treatment Works - LWTW12	NON-URBAN AREA	80 MLD	10

Sl No	Public Utility	Type of Infrastructure	Location	Capacity	Site Area (Ha)
2	Power Supply		SAS Nagar – 18nos	1,180 MW	
			Mullanpur – 2nos	200 MW	
			Zirakpur (Z1)- 3nos	600 MW	
			Zirakpur (Z2)- 2nos	400 MW	
		220 KV Substation	Derabassi – 6 nos	600 MW	
			Banur – 8 nos	1,450 MW	
			Kharar – 3 nos	600 MW	
			Kurali – 2 nos	200 MW	
			Lalru – 5 nos	880 MW	
			SAS Nagar	72 nos	
			Mullanpur	8 nos	
		66 KV Substation	Zirakpur (Z1)	20 nos	
			Derabassi	24 nos	
			Banur	32 nos	
			Kharar	12 nos	
			Kurali	8 nos	
		66 KV Substation	Lalru	20 nos	
3	Sewage Treatment Plant	STP 1	Mullanpur	60 MLD	19
		STP 2	SAS Nagar	306 MLD	93
		STP 3	SAS Nagar	306 MLD	93
		STP 4	Zirakpur	165 MLD	50
		STP 5	Dera Bassi	290 MLD	90
		STP 6	Lalru	140 MLD	42
		STP 7	Banur	230 MLD	70
		STP 8	Kharar	101 MLD	30
		STP 9	Kurali	56 MLD	17

Sl No	Public Utility	Type of Infrastructure	Location	Capacity	Site Area (Ha)
4	Solid Waste Disposal & Treatment		Mullanpur		
		Landfill Site – LFS1	Kurali Kharar Nayagaon	582 ton/day	100
		Landfill Site – LFS1	SAS Nagar Banur Zirakpur	2021 ton/day	270
		Landfill Site – LFS1	Dera Bassi (Includes Free Trade Zone) Lalru	1760 ton/day	300
		Treatment Storage & Disposal Facility – TSDF	Tehsil Dera Bassi		15
		Incineration Plant	Adjacent to Proposed Power Station		15

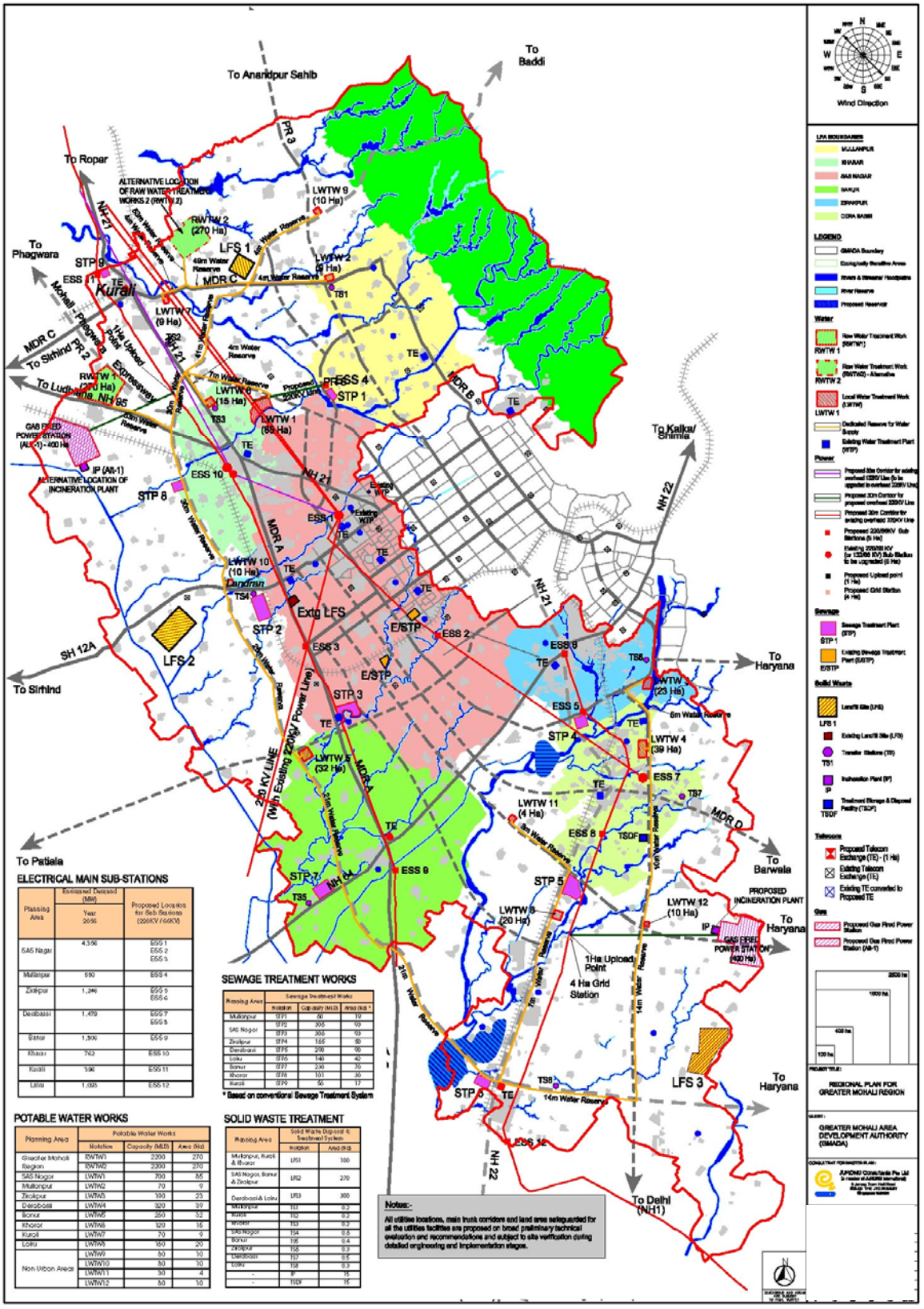


Figure 12.10.1 Regional Utilities Plan

13. Transportation Strategies

13.1 INTRODUCTION

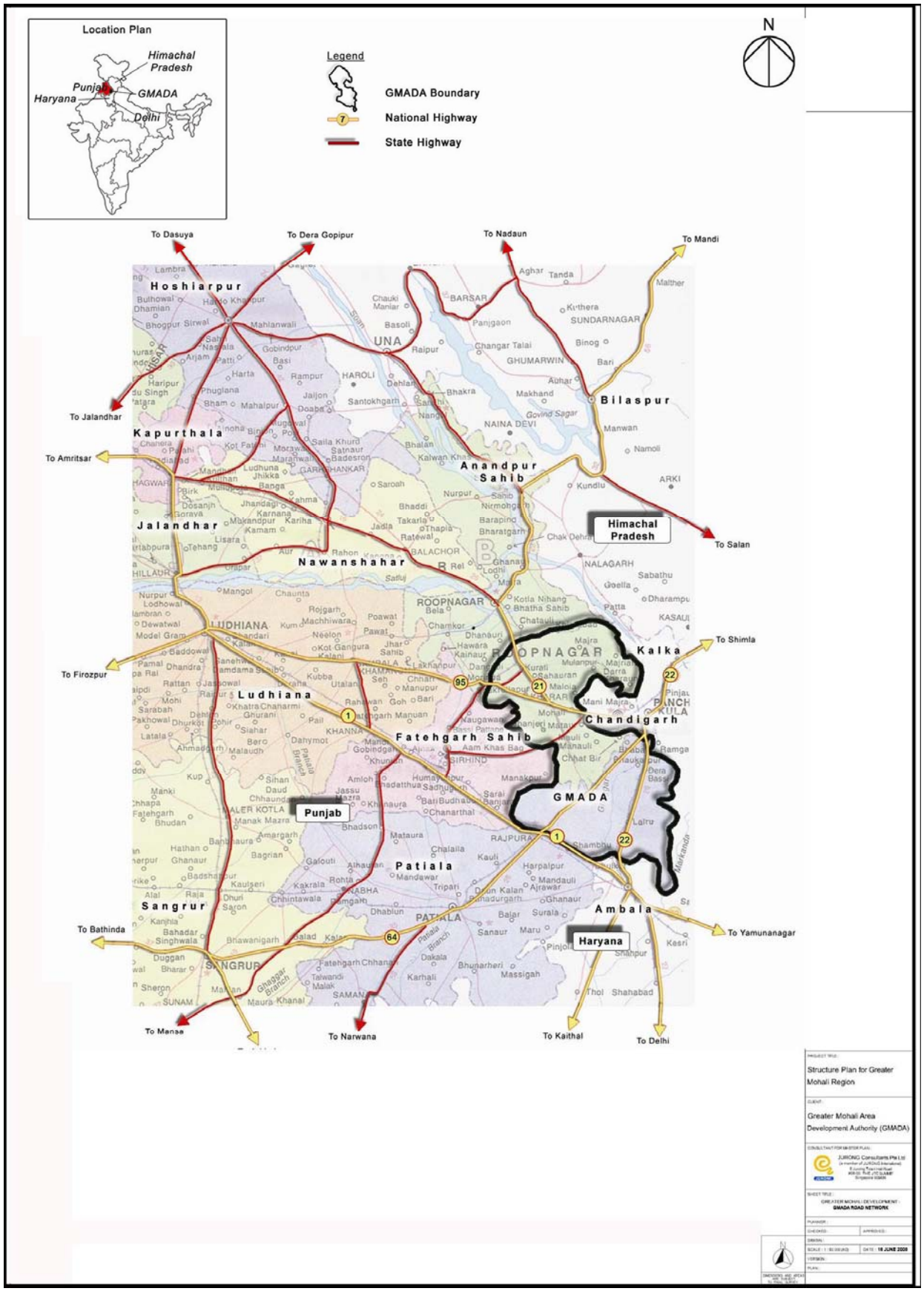
As part of the Regional Plan report for the Greater Mohali Region; this paper will specifically deal with the road planning for the integrated development of Greater Mohali Area Development Authority (GMADA) Punjab. The bus transport; MRT system and rail transport system and air transport will be detailed in the Transport Chapter of the Regional Plan.

13.2 THE EXISTING ROAD NETWORK

The study area is served by a good major road network which is part of the major road system serving Punjab State. Other major roads skirt round the study area to serve the region to the north, south and west of the study area. The routes of the National Highways (NH) and the, State Highways (SH) in the immediate surrounding region are shown in Figure 13.1. These roads link the study area to the rest of Punjab to its south and west, to neighbouring Haryana on its east and Himachal Pradesh to its north.

The major roads in the vicinity of the study area and in the study area are shown in Figure 13.2. These major roads include the following:-

- NH-1 which starts from the western edge of India to pass Punjab and onto Delhi
- NH-22 which starts in the north from Shimla to Kalka in Haryana to run southwards into Punjab to cross Zirakpur, Derabassi, and Lalru to end at Ambala in Haryana. At Ambala NH-22 links up with NH-1.
- NH-21 which starts in the east from Zirakpur through Chandigarh to Kharar and extends northwards to Anandpur Sahib linking Punjab with Himachal Pradesh.
- NH-64 which starts from Zirakpur to run generally southwards to Banur and intersecting NH-1 and running onto Patiala, Sangrur and Bathinda district in Punjab.
- NH-95 which starts from Kharar to run generally westwards to Ludhiana District where it meets NH-1 and then extends to Firozpur, running east-west through Punjab.
- SH-12A which runs generally in an east-west direction from Chandigarh/SAS Nagar through Mohali and Sirhind and connects to NH -1 outside the study area.
- MDR A which starts at Kharar where it meets NH-95 and NH-21 to run in a south-east direction to Landran at SH-12A, Banur at NH-64 and Tepla to link to NH-1 which heads towards Ambala.
- MDR B begins at Panchkula to run through Chandigarh (along Madhya Marg) and then westwards onto Mullanpur.
- MDR C starts in the Mullanpur area and runs westwards to Kurali and further westwards towards Sirhind.
- MDR D which starts at Derabassi where it intersects with NH-22 and runs eastwards to Barwala in Haryana, and
- The grid iron road system of Chandigarh and SAS Nagar.



13.1: Greater Mohali Area-Regional Road Network

The above National Highways (NH), State Highways (SH), and Major District Roads (MDR) link up all the existing urbanized areas in the study area, including Chandigarh, SAS Nagar, Zirakpur, Derabassi, Ambala, Banur, Kharar, Kurali, Lalru and Mullanpur. Connections between many of these existing urbanized areas are direct and efficient. Some movements for example Zirakpur to Kharar require cutting through Chandigarh/SAS Nagar or via Banur. The existing road network is most dense at Chandigarh and SAS Nagar which are presently the most urbanized areas of the study area.

The road classifications used in Punjab are based on the agencies responsible for that road's construction and maintenance. The functional role/hierarchy of the roads in the network is at present not clear viz whether the road is an expressway, a major arterial road or a minor arterial road or a collector road or distributor road in the overall road network. The identification of the road's functional role/hierarchy in road network planning is however important as its hierarchy identifies its role in the overall network. The functional role/hierarchy of a road is also important as that determines its design standard e.g. design speed and related geometric parameters and details of its cross sectional elements.

For the purpose of this study, the proposed road hierarchies for the different existing road classifications are shown on Table 13.1 below.

Table 13.1: Proposed Road Hierarchies for the Different Road Classifications in Punjab

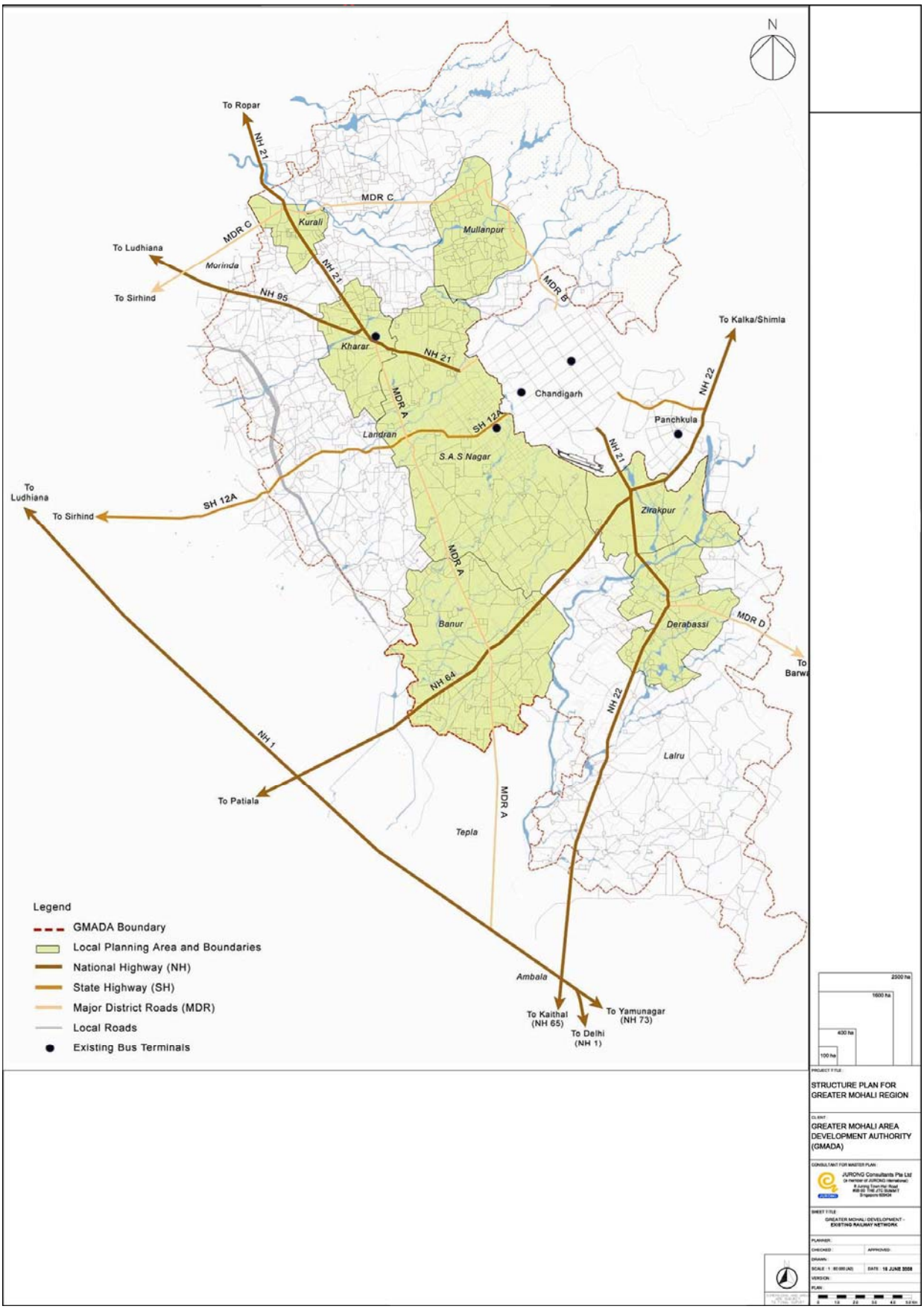
Road Hierarchies & Road Classifications		Right-of-Way (ROW) Width (m)	Road Type
Expressways	National Highway (NH)	52	Dual 4-lane divided
		52	Dual 3 lane divided
Major Arterial Roads	National Highway (NH) / State Highway (SH)	60	Dual 4 lane divided
		60	Dual 3 lane divided
		52	Dual 2 lane divided
Minor Arterial Roads	State Highway (SH) / Major District Roads (MDR)	36	Dual 3 lane divided
		36	Dual 2 lane divided
Collector Roads	Major District Roads (MDR) / Other District Roads (ODR)	28	Dual 2 lane divided
		28	Dual 2 lane divided

Source: Punjab State Road Sector Project Package IV (Phase 1): Institutional Development Study July 2007 Draft Final Report – Volume 1: Main Report and Space standards for roads in urban areas 1996 IRC: 69-1977

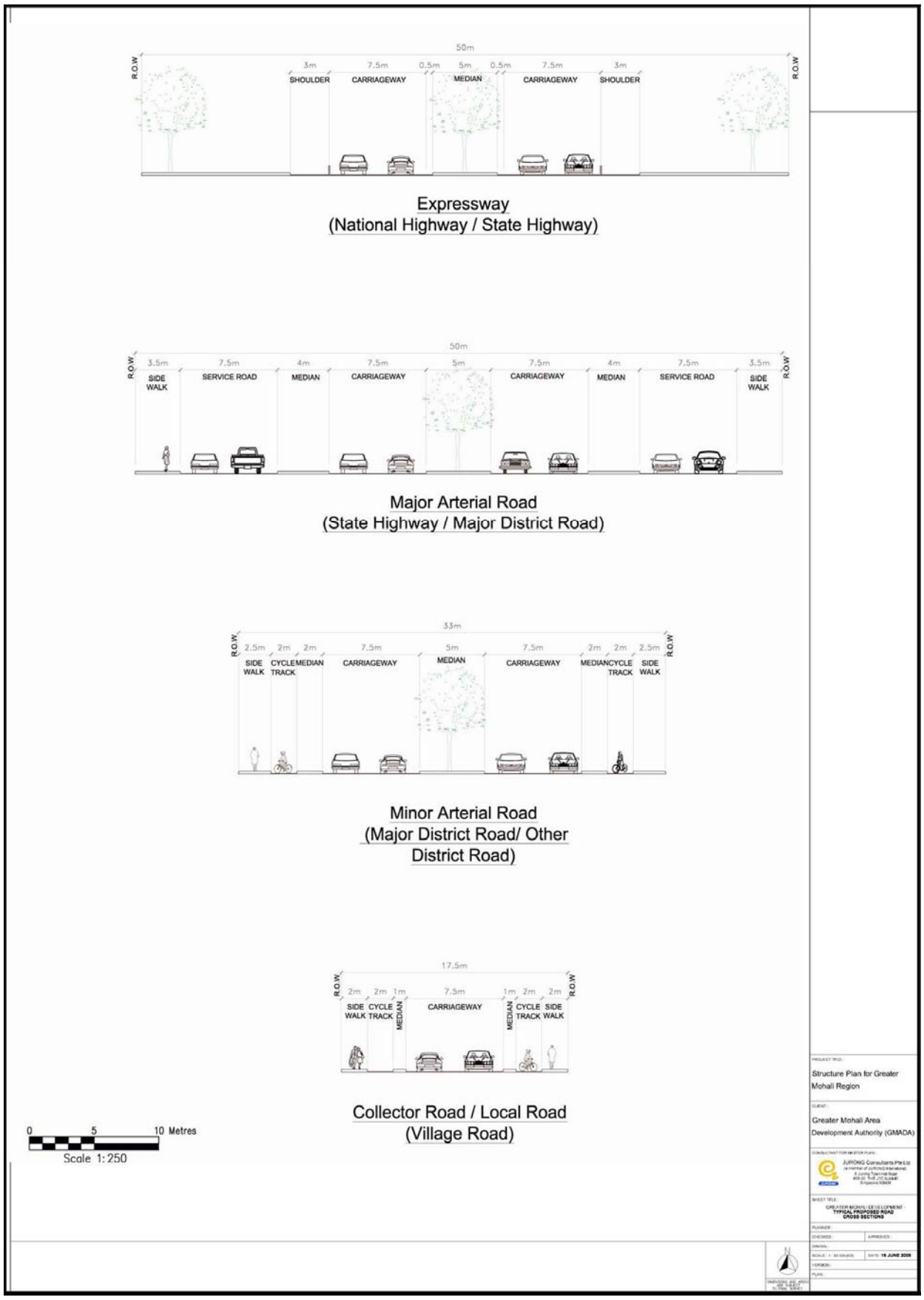
The rights-of-way for the different road classifications of roads in Punjab have been established using the Indian Road Congress standards and are shown in Table 13.1.

The typical cross sections for the different roads in the proposed road hierarchy are shown in Figure 13.3.

Currently many of the important roads in the study area are 2-way single carriageway roads with pavement widths varying from 5m – 7m and a right-of-way on average of about 20m. The provision for pedestrians such as proper footpaths and pedestrians crossings is mostly lacking. Lane markings and signage are generally lacking or poor. Most roads also lack proper roadside drainage. It is not clear on site whether a wider or an appropriate right-of-way is established by the road authority and safeguarded as buildings of varying set-backs are seen along many stretches of roads.



13.2: Greater Mohali Area-The existing road network



13.3: Typical proposed road cross-sections

13.3 EXISTING ROAD TRAFFIC

The sole source of traffic-related information for this study is the Punjab Roads and Bridges Development Board, Punjab State Road Sector Project which had made available their traffic data. The traffic data is however limited to that for a few roads which were the subject of a recent feasibility study the Board conducted. Traffic data for example - hourly cordon counts, composition counts, travel time studies, for the many NHs and SHs in the study area which would be relevant in the appraisal of the existing traffic operating conditions of these roads, was requested for at the onset of this study but are not available. Based on the Board's study results, the current typical traffic composition on SHs and MDRs based on the Passenger Car Unit (PCU) is shown in Table 13.2. It is assumed that the traffic composition is quite typical for other NHs and SHs. The traffic composition on these roads generally includes heavy goods vehicles, buses, passenger cars, motorized 3-wheelers / 2 wheelers, bicycles, rickshaws, farm vehicles and other machinery / construction vehicles. The total volumes of two wheelers, tractors and slow vehicles typically exceed 50% of the total traffic volume. Two wheelers make up almost 40% of road traffic. Cars make up about 25 to 40% of the traffic volume.

Table 13.2: Existing Average Traffic Composition in %

State Highway (SH) – Average Traffic (PCU) Composition in %								
Road Section	Two Wheeler	Auto	Car / Jeep	Bus	Truck	Tractor	Slow Vehicles	Total
Chandigarh – Sirhind	38.1	0.8	37.7	1.4	4.8	1.9	15.2	100

Major District Road (MDR) – Average Traffic (PCU) Composition in %								
Road Section	Two Wheeler	Auto	Car / Jeep	Bus	Truck	Tractor	Slow Vehicles	Total
Kharar – Tepla	33.1	1.2	24.0	3.0	22.1	3.2	13.3	100

Source: Punjab Roads & Bridges Development Board, Punjab State Road Sector Project Interim Report Part A: Feasibility Study Report Volume 1 Appendix 4.5

The Kharar-Landran-Banur-Tepla route carries a high percentage of inter-state goods vehicle and passenger vehicles. This is clearly seen in Table 13.3 which shows the percentage interstate and local traffic movements. Goods vehicles move between Haryana, Delhi, Rajasthan and north eastern Punjab. Passenger vehicles use this route to move between Delhi and Haryana.

Table 13.3: Interstate and Local Traffic Movement for routes within study area in %

Road Section	Local Traffic		Interstate Traffic		Total
	Passenger	Goods	Passenger	Goods	
Kharar-Landran-Banur-Tepla	30.9	19.1	69.1	80.9	100
Chandigarh-Landran-Sirhind	57.1	47.2	42.9	52.8	100

Source: Punjab Roads & Bridges Development Board, Punjab State Road Sector Project Interim Report Part A: Feasibility Study Report Volume 1

80% of goods vehicles and 69% of passenger vehicles that travel on the Kharar-Landran-Banur-Tepla road (a Major District Road) which cuts across the study area are inter-state traffic and use this route as an alternative to the NHs because of its directness. Clearly, the route is an important road link between Delhi and Punjab/Haryana. The Chandigarh-Landran-Sirhind route (a State Highway) carries 43% of Punjab interstate passenger traffic travel to towns like Patiala, Bathinda, Fatehgarh Sahib, Ludhiana and Sangrur and 53% of interstate goods vehicles that travel from states like Rajasthan and Haryana.

Recent observations along many major roads in the study area indicate that overall traffic conditions are satisfactory except for several localized congestion spots eg. at some traffic junctions within Chandigarh, SAS Nagar, the NH 22 junction at Kharar, the MDR junction at Landran, the MDR/NH 64 junction at Banur and at the NH 21/NH 22/NH 64 junction at Zirakpur.

There are many existing road widening and improvement projects being carried out to cope with traffic growth. One of the ongoing projects is the four-laning of NH-22 and NH-21 from Ambala to Chandigarh over a distance of 35 km. The project started construction in May 2006 and is a Build, Operate and Transfer (BOT) project by GMR Private Limited. Such projects are initiatives based on Private Partnership Projects (PPP). Such toll road projects are given to individuals or companies to build and operate for a certain period of time after which the government takes over. The arrangement helps reduce costs to government.

The Kharar-Landran-Banur-Tepla road (a Major District Road) is an important road link between Delhi and Punjab/Haryana. The road is being upgraded and widened to a dual two lane road from Kharar to Landran and to a two lane single carriageway road from Landran to Tepla by the Punjab Roads and Bridges Development Board. The road improvement is funded by the World Bank.

A major flyover project is now under construction at Zirakpur where the NH 21, NH 22 and NH 64 meet.

The Punjab State Road Sector Project Feasibility Study Report Volume 1 has indicated that traffic is growing on an average of 8% per annum for Punjab. The study has used an elasticity method which examines past trends and correlates traffic growth with relevant economic parameters.

13.4 THE ROAD TRAFFIC FORECASTING METHODOLOGY

The methodology used in the report is an appropriate approach for the projection of traffic growth along rural highways. However, the methodology is not appropriate for roads that will form part of an urban road network in an area that will be subjected to substantial urbanization, as in the case of the study area of this project. Under such circumstances, it is best to do a full scale land use-transportation study. Forecasting future travel demand is a crucial element in a major urban transport planning study. There are well established methodologies in which causal relationships are established between the different land uses e.g. residential, office, factories, institutional uses etc and travel demand in terms of their trip making propensities. These relationships (usually called the transport model) are used to estimate the future travel demand for the different land use dispositions and transport policies and networks.

The process of the four-stage model in the planning process is elaborate and requires a fair amount of time to carry out. In places with little or no land use and transport-related data, time is required to collect these via field surveys. Depending on the geography and nature of the study area, the survey process can take 12 to 24 months. The rest of the travel forecasting process, involving the analysis of the collected data, the building and calibration of the model and then the running of the model and the analysis of the results, can take another 12 months, depending on the deliverables. So a comprehensive land use-transportation study can take 24 to 36 months to conduct.

For the Greater Mohali Region, such a study is not part of the deliverables. Nevertheless, a more simplified travel demand forecast exercise has been conducted to establish the overall "ball-park" travel demand and more importantly to establish that the proposed road network is adequate for the forecast traffic in the design year. In the absence of transport-related data from the field and social economic data for the study area, the parameters used are drawn from data from Delhi and Punjab authorities and other Asian cities and modified based on the consultant's judgment on what would be apt for application for the Greater Mohali Regional Plan. Table 13.4 lists some relevant transport parameters of some key cities in India and Asia from which parameters for this study were drawn. The ultimate design year for 2056 is used in the forecasts for the Regional Plan.

The methodology involves the following steps:

1. The travel demand is estimated for the forecast year 2056 on the basis of per capita trips. The average daily person trip rate for some key cities in India and Asia are shown in Table 4.1. A higher trip rate is adopted for Greater Mohali Region as the planning horizon for about 50 years in the Regional Plan is very long. The projected daily trips according to the various planned urban areas and other existing towns in Greater Mohali Region are shown in Table 13.4. Based on the trip rate adopted, the total daily person trips are estimated to be 11.25 million for the projected population of 4.5 million. The numbers for the total daily person trips look right and in the correct ball-park.

Table 13.4: Cities in Comparison

City		Delhi	Mumbai Metropolitan Region	Chennai Metropolitan Area		Other Asian Cities					
			MMR	CMA		KL	Bangkok	Hanoi		HCMC	
Year		2021	2011	2021	2026	1997	1995	2005	2020	2002	2020
Population	million	23	22.4	11.2	12.6	4	5.6	3.2	4.8	7.7	10.0
Per capita trip rate	persons / day	1.25	-	1.60	1.65	2.4	2.3	2.7		3.0	
Modal Spl	Private Transport	20%	15%	35%	30%	80%		93%	71%	95%	66%

it	Public Transport	80%	85%	65%	70%	20%		7%	29%	5%	35%

Table 13.5: Daily Trips Forecast for Year 2056

No	Area	Year 2056		Daily person trip rate = 2.0
		Population ('000)	%	No of trips / day ('000)
1	SAS Nagar	1,811	31%	3,621
2	Zirakpur	585	10%	1,169
3	Derabassi	419	7%	837
4	Banur	433	7%	865
5	Kharar	385	7%	769
6	Mullanpur	185	3%	369
7	Kurali	235	4%	469
8	Lalru	450	8%	899
	TOTAL	**4,500**	**100%**	**9,000**

Notes:

a. The population includes rural area population that is widely distributed across GMADA.

2. Table 13.6 also shows the mode splits between public and private transport for the various cities. For Greater Mohali Region, Table 4.3 shows the projected daily trips of 2 scenarios, viz a high public transport and low public transport scenarios. As information on the current mode split in Punjab or Greater Mohali is unavailable, the high mode split in favour of public transport is adopted. This is line with the trend in the key Indian cities.

Table 13.6: Mode Split Year 2056

Mode Split	Private Transport	Public Transport	Daily Trips ('000)		
			Private Transport	Public Transport	Total
High Public Transport	30%	70%	2,700	6,300	9,000
Low Public Transport	50%	50%	4,500	4,500	9,000

3. The estimation of trip movements between areas within Greater Mohali Region and areas that are beyond the study area is part of the exercise in the study. For the later, the major areas include Patiala Ludhiana and Phagwara in Punjab and other cities and states such as Chandigarh, Panchkula, Delhi, Haryana and Himachal Pradesh. Additional trip forecast is used for important cities and towns that are immediately outside the study area and these include Chandigarh and Panchkula.

4. It is expected that the urbansiation of Greater Mohali Region will result in increasing intercity trips (between Greater Mohali and other areas). Based on the Delhi Master Plan report, the intercity trips is about 2-3 times higher that that of the intracity trips within the urban areas in Delhi. This is

likely for a country's capital city which attracts high interstate movements. For Greater Mohali, the report has assumed that the nature of the trips is more self-contained within Greater Mohali Region, Chandigarh and Panchkula. Therefore the proportion of the intracity trips is assumed to be higher than that for the intercity trips.

5. Table 4.4 shows the results of the broad trip generation in peak hourly person and vehicle trips for Greater Mohali, Chandigarh and Panchkula. It is estimated that the peak hour trips is about 1.7 million persons / hour and 0.3 million PCUs / hour based on the assumptions as listed below.

Table 13.7: Forecast Peak Hour Person and Vehicle Trips

No	Area	Person Trips ('000 pax / hr)			Vehicle Trips ('000 pcus / hr)		
		Inter-City	Intra-City	Total	Inter-City	Intra-City	Total
1	SAS Nagar	155	361	516	26	62	88
2	Zirakpur	50	117	167	8	20	28
3	Derabassi	36	84	119	6	14	20
4	Banur	37	86	123	6	15	21
5	Kharar	33	77	110	6	13	19
6	Mullanpur	16	37	53	3	6	9
7	Kurali	20	47	67	3	8	11
8	Lalru	38	90	128	6	15	22
9	Chandigarh	86	200	285	14	34	48
10	Panchkula	34	80	114	6	14	19
	TOTAL	**504**	**1,177**	**1,682**	**85**	**201**	**286**

Notes:

b. According to the Delhi Master Plan, the peak hour factor is 10%. The peak hour factor used for this study is set at a more conservative 15%.
c. There are some long distance trips by rail and this is assumed to be generally low during the peak hour.
d. The proportion for intercity and intracity trips is assumed to be 30/70. Reference is made to the Delhi Master Plan (see above).
e. Trips are converted to average PCU units using assumptions from GMADA road study reports.
f. To account for freight traffic, a 20% increase in total peak hour vehicle trips is added on. This assumption is adopted from GMADA road study reports.

6. The total peak hour vehicle trips are distributed between pairs of origins and destinations. For the intercity trips, the areas are grouped into major external zones and the distribution factors assumed are shown in Table 13.8. It is assumed that there is a greater relative attraction of other districts in Punjab than other states. Hence the total distribution between Greater Mohali and Patiala, Ludhiana, Phagwara & the vicinity in Punjab is about 50% of the total peak hour intercity trips.

Table 13.8: External Areas Distribution

External Zones	% of Intercity Trips
Delhi & South	15%
Patiala & vicinity	15%
Ludhiana & vicinity	20%
Phagwara & vicinity	15%

Haryana & East	20%
Himachal Pradesh & North	15%
Total	**100%**

7. For the intracity trips, the peak hour trips are distributed according to the relative densities of planned employment in the different areas as shown in Table 13.9. Assumptions are used for the intra-trips made within each zone. For major cities such as SAS Nagar and Chandigarh, it is assumed that these cities will generate more self contained intra-trips as they will remain as large employment centres.

Table 13.9: Internal Areas Distribution

Internal Zones	Employment Distribution (%)	% Intracity Trips contained within each zone
SAS Nagar	20%	30%
Zirakpur	8%	20%
Derabassi	12%	20%
Banur	6%	20%
Kharar	5%	20%
Mullanpur	6%	20%
Kurali	4%	20%
Lalru	13%	20%
Chandigarh	16%	40%
Panchkula	10%	20%
Total	**100%**	-

8. The results of the distribution are shown in Table 13.10.
9. **Table 13.10: Total Trip Distribution**

No	Internal Zones	Trip Production ('000 pcus / hr)	Trip Attraction ('000 pcus / hr)	Intra-trips contained within each zone ('000 pcus / hr)
1	SAS Nagar	50.1	35.7	11.1
2	Zirakpur	15.2	12.2	2.2
3	Derabassi	7.3	13.9	0.9
4	Banur	10.5	8.8	1.5
5	Kharar	9.3	7.4	1.3
6	Mullanpur	3.5	6.2	0.4
7	Kurali	5.7	4.9	0.8
8	Lalru	7.8	15.1	0.9
9	Chandigarh	24.2	26.3	6.8
10	Panchkula	9.0	12.1	1.2
	External Zones			
11	Delhi & South	6.4	6.4	-
12	Patiala & vicinity	6.4	6.4	-
13	Ludhiana & vicinity	8.5	8.5	-
14	Phagwara & vicinity	6.4	6.4	-
15	Haryana & East	8.5	8.5	-
16	Himachal Pradesh & North	6.4	6.4	-
	Total	**185.1**	**185.1**	**27.2**

10. The peak hour road traffic forecasts are broadly loaded on the proposed major road and highway network for the design year. Trips between pairs of origins and destinations are assigned onto the most direct and sensible routes on the road network.

11. To account for future base traffic on the proposed road network that are generated by areas beyond Greater Mohali Region, the resultant link flows from the trip assignment are increased by 10-15% depending on the road hierarchy. It is noted that the future base traffic on some links may be higher or lower than these assumptions depending on the growth areas in the region, the travel propensities between these areas and the future regional transport network plan in the very long term. Hence there is a fair amount of uncertainties here.

12. During the forecast process, important corridors with high demand loadings are identified. These are potentially roads with inadequate capacities to carry the projected peak hour demand. Major links are added and some redundant ones are removed where appropriate. The required lane provisions of relevant roads are then determined and adjusted as part of the iterative process till a balanced road network is achieved. Traffic at major road intersections is also assessed to determine if grade separation is likely to be required. This is important, especially at the next stage of work dealing with the master plan of local areas.

The maximum peak hour link flows from the road traffic forecasts described in the preceding section. And the lane requirements of the major roads are summarized in Table 13.11 below.

Table 13.11: Maximum Peak Hour Link Flows and Proposed Lane Requirements of Major Roads

Roads in GMADA Study Area		Maximum Link Flows (pcus/hr)	Proposed Maximum No. of Lanes
Existing Roads within GMADA Study Area	NH 22	7,300	4
	NH 21	8,300	4
	NH 64	6,500	4
	NH 95	8,300	4
	SH 12A	6,200	4
	MDR A	6,700	4
	MDR B	6,100	2
	MDR C	4,400	3
	MDR D	3,800	3
Proposed Roads within GMADA Study Area	PR 1	8,600	4
	PR 2	6,300	3
	PR 3	2,400	2
	PR 4	4,600	3
	PR 5	1.200	2
	PR 6	3.100	3
	PR 7	5.600	4
	PR 8	6.100	4
	PR 9	3.600	3
	PR 10	5.100	3
	PR 11	6.100	4
	PR 12	4.800	3

Based on the above methodology, travel demand would require an overall road network shown on Figure 13.5. The figure depicts the overall major road layout, comprising expressways, major arterial roads and minor arterial roads. The maximum number of traffic lanes along the major road network that are required to carry the forecast peak period traffic is shown in Table 13.11.

Aside from the new GMADA Expressway and the Mohali-Phagwara Expressway, the forecasts require the upgrading to expressway standard for the following 3 existing National Highways:

- National Highway 22 from Zirakpur to National Highway 1.
- National Highway 21 from Zirakpur to the eastern edge of Chandigarh.
- National Highway 95 from Kharar towards Ludhiana.

The forecasts show that these 3 expressways will require dual 4 traffic lanes.

It is also envisaged that National Highway 1 which runs along to the south of the study area will also require upgrading to an expressway in the future.

Many are existing roads that will require widening and upgrading to dual 2, dual 3 lane and dual 4 lane arterial roads to carry the forecast traffic. In addition, many new multi-lane major and minor arterial roads will need to be built to complement the existing major road network. Together with the proposed expressways, they form a grid of major roads covering the study area and linking to various destinations in the surrounding region.

For completeness, roads through Chandigarh and Panchkula that will form part of the major road system in the study area have also been shown, although Chandigarh and Panchkula which abut the region are not in Greater Mohali.

These existing and proposed major roads are briefly described in ensuing paragraphs.

13.5 THE PROPOSED ROAD NETWORK

The proposed road network for the Greater Mohali Region as shown in Figure 13.5 has been developed closely with and complements the proposed land use Regional Plan. The proposed road network has been developed to have the following features:

- The network is built around the existing road network to strengthen and improve the existing road network's effectiveness and coverage.
- The road network has adequate capacity to cater for the projected traffic flows.
- The network links major destinations directly to facilitate the direct the routing of trips and to avoid the routing of extraneous traffic through urbanized areas.
- In areas where existing conflicts are identified, traffic flows are planned to be directed through other proposed routes to mitigate potential congestion and its adverse environmental impact.
- The network permits staging of construction so that roads need only be built and extended when required to serve new areas of development.

The following existing National Highways (NH), State Highways (SH) and Major District Roads (MDR) will form an integral part of the future road network. These roads are expected to require widening, realignment and upgrading to carry the forecast traffic in the Greater Mohali Region as well as to the surrounding region:

- NH-1 from the west passing through Punjab and running onto Delhi.
- NH-22 from Shimla in Haryana to Ambala in Haryana. At Ambala NH-22 links up with NH-1.
- NH-21 from Zirakpur through Chandigarh to Kharar and northwards to Anandpur Sahib.
- NH-64 from Zirakpur to Banur and onto Patiala, Sangrur and Bathinda district.
- NH-95 from Kharar to Ludhiana District where it meets NH-1.
- SH-12A from Chandigarh through Mohali and Sirhind to NH-1.
- MDR A from Kharar where it meets NH-95 and NH-21 to run in a south-east direction to Landran at SH-12A, Banur at NH-64 and Tepla to link to NH-1 which heads towards Ambala and Delhi.
- MDR B from Sector 7 Panchkula to run through Chandigarh (along Madhya Marg), and onto Mullanpur.
- MDR C from the area near Mullanpur to run westwards to intersect NH 21 near Kurali and continue further westwards to intersect NH 95 and go towards Sirhind.
- MDR D from Derabassi where it intersects with NH-22 to run eastwards onto Barwala in Haryana, and
- The road networks of Chandigarh and SAS Nagar.

In addition to the existing major road system listed above, the following new major roads are proposed to form part of the proposed road network: (Please see GMADA Regional Plan showing the Road Network within the GMADA Study Area)

- The **GMADA Expressway (PR 1).** Its proposed alignment has been safeguarded and shown in the Regional Plan. This proposed expressway through the study area will link up Lalru, Banur, Kharar and Mullanpur as well as the planned developments at Baddi. The proposed alignment runs close to Mullanpur, Kharar, SAS Nagar, Banur and Lalru. The GMADA Expressway will offer an alternative route to the Kharar-Landran-Banur-Tepla road (MDR A) which at present is the only route between the northern and southern parts of the study area. PIDB will be developing this expressway road as part of its private-public partnership scheme. The safeguarded right of way is 100m wide for a maximum of a dual 5-lane expressway with side service roads.

- The **Mohali-Phagwara Expressway (PR 2)** is a spur off the proposed GMADA Expressway near Kharar and runs in an east-west alignment to lead to Phagwara which is 110km away from Chandigarh. Phagwara is largely an industrial area with sugar, textile and starch mill factories. This expressway will offer a high speed, high capacity expressway link between the GMADA area and other cities and towns in Jalandhar District and other districts along its route.

- **PR 3:** A proposed major arterial road which is a westward extension of PR4 from Mullanpur. The proposed road which will intersect the GMADA Expressway, will reduce journey times from Chandigarh to northern Punjab. It then extends further north-westwards to Anandpur Sahib and forms one of the main linkages to Himachal Pradesh.

- **PR 4**: A proposed northwest major arterial road extension from Chandigarh between Sectors 25 and 38 (Dakshin Marg) through Mullanpur to intersect MDR C. This proposed extension will provide a new direct link between Chandigarh and the proposed urbanized areas at Mullanpur. (**please see the Regional Plan and the Mullanpur local plan)**

- **PR 5**: A proposed minor arterial road which forms a westward extension from Chandigarh between Sectors 39 and 56. En route this road intersects PR 6 and end at the GMADA Expressway. The interchange with the proposed GMADA Expressway is proposed to be away from the existing major intersection at Kharar. Part of the route of PR 5 is based on the route of a Ring Road shown in the SAS Nagar Master Plan (1996 – 2016).

- **PR 6:** This proposed major arterial road runs in a north direction between Sectors 73 and 74, SAS Nagar to Mullanpur and Anandpur Sahib. En route, it intersects NH 21, the proposed PR 5 and towards Mullanpur to cut across PR 4 and end at the MDR B as a 100 feet local road along the river front.. Part of the route of PR 6 through SAS Nagar to PR 5 falls within the SAS Nagar Local Plan.

- **PR 7**: **(Airport road)** This proposed major arterial road runs in a south-easterly direction between Sectors 66-A and 81, SAS Nagar, to intersect with NH 64, NH 22 and PR 10 for better access between SAS Nagar and Zirakpur, Derabassi and Panchkula. The proposed road is further extended eastwards to connect to Haryana. PR 7 will also provide a direct link to the new Chandigarh Airport terminal from Zirakpur and Panchkula to the Chandigarh airport in the future. It will provide the alternative route to NH 21 to reduce through traffic at Zirakpur. This new major arterial road will also offer a more direct route connecting between the new towns and urbanized areas in the study area and enable SAS Nagar eastbound traffic to bypass Chandigarh. West of SAS Nagar, this major arterial road system continues as the PR 6.

- **PR 8:** This proposed major arterial road runs in a generally south-easterly direction and is south of PR7 and roughly parallel to it. It is as an extension of the proposed road between Sectors 84 and 100 in SAS Nagar to intersect PR 9, NH 64, NH 22 and PR 10 before heading further eastwards into Haryana. PR 8 is intended to complement PR 7 to provide vital road capacity between SAS Nagar and the planned urbanization at Derabassi and Lalru.

- **PR 9:** This proposed major arterial road runs in a north-south direction from the proposed new Airport Terminal Building in the north to serve the proposed `**Aerotropolis**' site south of the airport. This road then continues southwards to meet MDR A, the proposed GMADA Expressway and NH 1 and goes further southwards towards Patiala. PR 9's linkage to NH 1 and the proposed GMADA Expressway will provide faster and direct access from many parts of Punjab to the airport.

- **PR 10:** This proposed major arterial road runs generally southwards from Panchkula Sector 20 along an alignment generally east of and parallel to NH 22 to the proposed GMADA Expressway and further southwards towards Delhi.
  PR10 will bypass the major and congested Zirakpur intersection of NH-21, NH-22 and NH-64. This proposed road will serve the proposed industrial areas planned at Derabassi and will provide a direct linkage for the freight traffic to other areas and states.

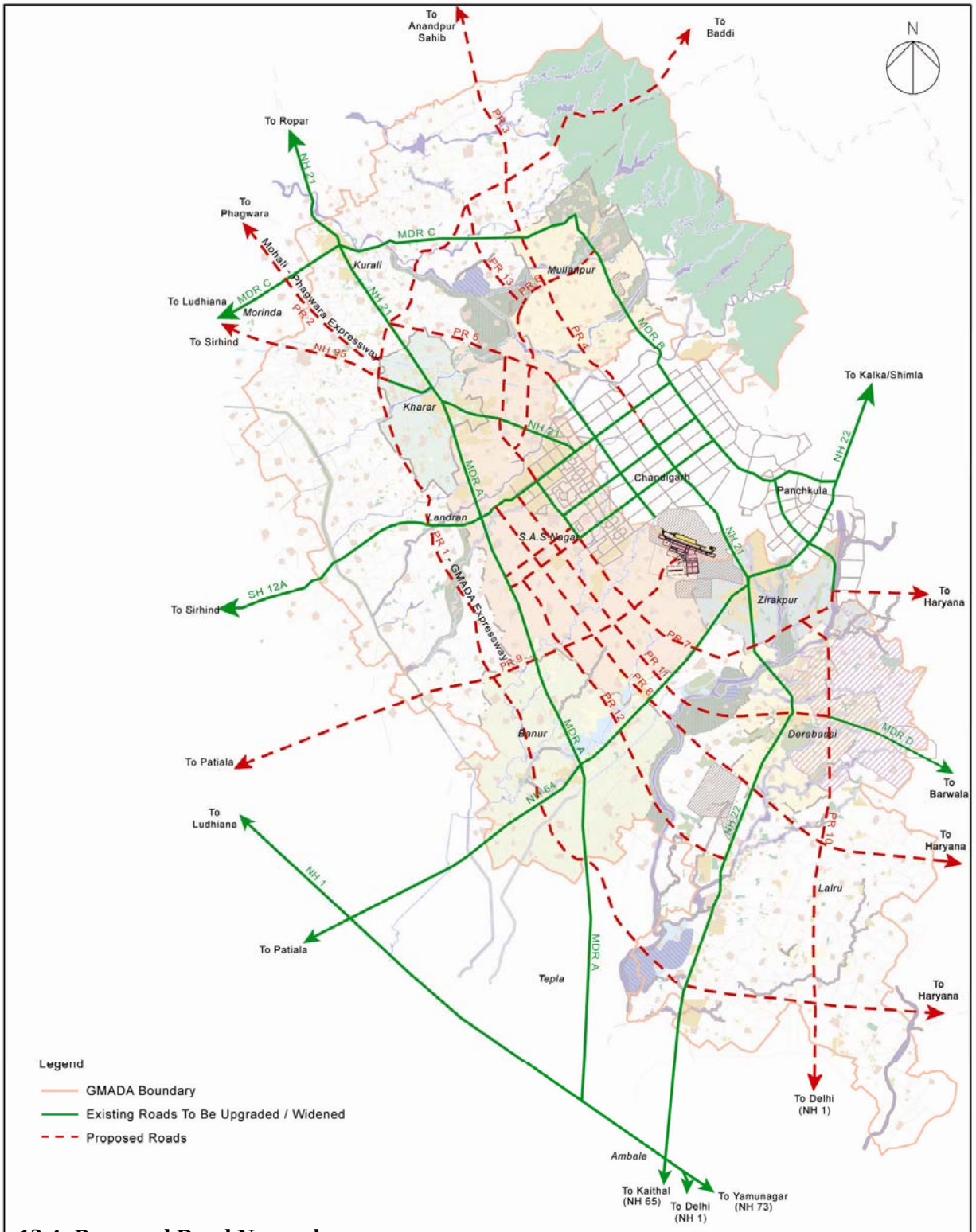
- **PR 11: Connection to Derra Bassi.** This proposed major arterial road running in a south-easterly direction north of PR 8 is required to cater for the high demand flows in the south-eastern direction from SAS Nagar. The road will intersect PR 9, NH 64, NH 22 and PR 10 to serve road trips between SAS Nagar and areas in the eastern part of the study area e.g. Zirakpur, Derabassi and Lalru. At Derabassi, the proposed road connects to the existing MDR D.

- **PR 12:** Together with PR 11, this proposed minor arterial road running in a south-easterly direction south of PR 8 is also required to cater for the high demand flows in the south-eastern direction from SAS Nagar. This road will also intersect PR 9, NH 64, NH 22.

- **PR 13:** is a major arterial road that starts at PR 6 at its eastern end to run north westwards to intersect MDR C, the proposed GMADA Expressway. In the very long term plan if the need arises, PR 13 could be extended to intersect with PR 3 and continues further north-westwards to Anandpur Sahib. Together with PR 3, PR 4 and PR 6, this proposed road will provide vital road capacity to the planned urbanised areas at Mullanpur.

  In addition, several existing roads in SAS Nagar and Chandigarh will require widening and upgrading to form main road linkages connecting the proposed roads described above to form the major road network in the Regional Plan. These are described in detailed in the Regional Plan.

  More details of the above roads will be given at the Local Plan stage.



13.4: Proposed Road Network

Rev.	Amendment	By	Date

Project Title: Master Planning For The Integrated Development of GMADA Punjab

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Drawing Title: The Proposed Road Network

Drawn By	NAY WT	Date	NOV 2008
Checked By	S KAUR	Scale @ A3	N.T.S
Drawing No.	Figure 13.5		Rev -

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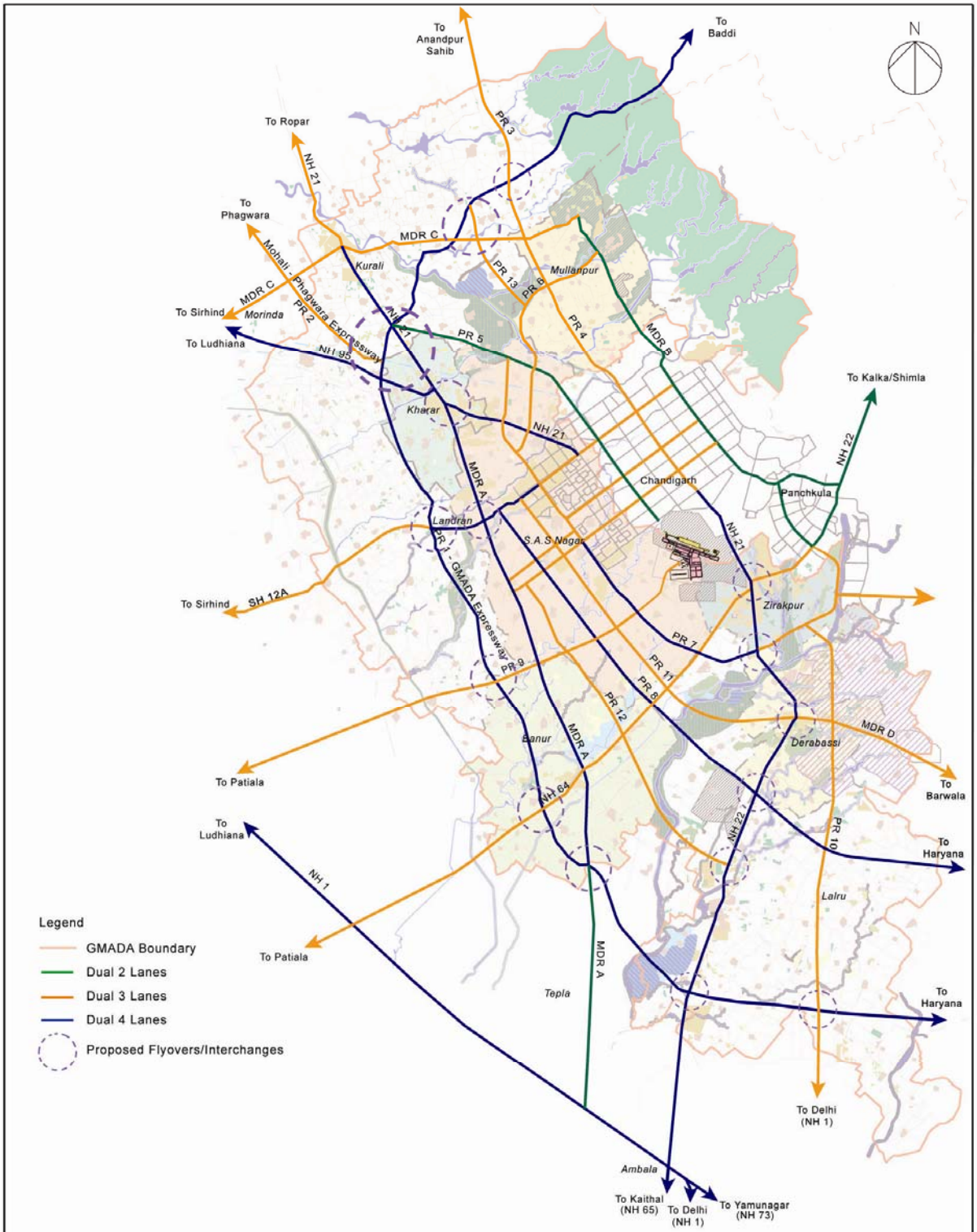

13.5: Proposed road network, lane requirement and proposed interchanges

Rev.	Amendment	By	Date

Project Title: Master Planning For The Integrated Development of GMADA Punjab

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Drawing Title: Proposed Road Network and Lane Requirement and Proposed Interchanges

Drawn By	NAY WT	Date	NOV 2008
Checked By	S KAUR	Scale @ A3	N.T.S
Drawing No.	Figure 13.6		Rev -

13.6 THE EXISTING BUS TRANSPORT SYSTEM

The Chandigarh Transport Undertaking (CTU) provides local bus transport in Chandigarh and the nearby towns of Panchkula and Mohali. In addition, the CTU operates suburban routes and interstate routes to adjoining states. Buses form the basic primary mode of public transport although trishaws and auto-trishaws serve as convenient and cheap public transport modes.

The general condition of the bus fleet is poor and spartan but meets the basic daily needs of the bus commuter. Buses provide the primary form of public transport complemented by an army of auto-trishaws and trishaws. Fares are low and made affordable at Rs 5 regardless of distance travelled. The bus service is subsidized. The daily load capacity of the undertaking is about 800,000 passengers. The CTU had in 2005 introduced a grid system for its local buses in Chandigarh using new low floor buses which has proven to be popular.

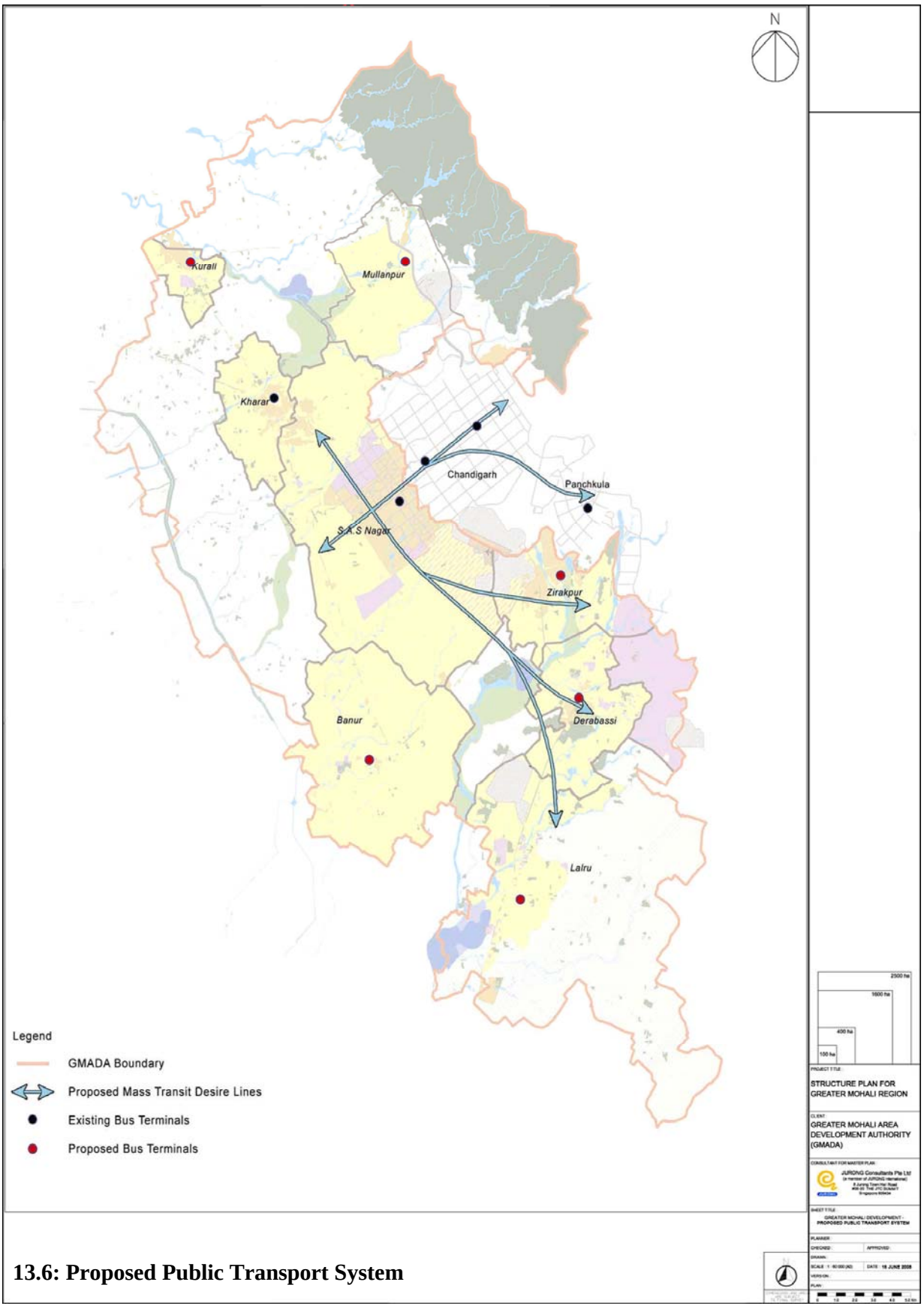
Currently there are 5 purpose-built off-street bus terminals in the study area as shown in Figure 14.2, viz in Sectors 17 and 43 Chandigarh, Sector 62 SAS Nagar, Sector 5 Panchkula and at Kharar. Sector 17 buses serve passengers traveling to major destinations in neighbouring states while the Sector 43 buses serve passengers traveling within Punjab State. There are also longer distance bus services to the large surrounding region. Facilities at these terminals are very basic.

13.7 THE FUTURE OF THE BUS AS A PUBLIC TRANSPORT MODE

With rising income the expectation of the bus commuter will rise. It is crucial to recognize the need to develop and improve the public transport system to cater to the travel needs of people who do not own private transport modes. It must however be recognized that buses will remain a basic public transport mode in the urbanized areas even when metro and LRT systems have been built along the heavier transport corridors. They will continue to provide trunk public transport services to the other corridors. Buses will also provide feeder services to metro hubs and interchanges. Bus services are flexible. Bus routes can be easily changed and schedules adjusted to meet changing demand. There are buses of different capacities and performance to meet the different requirements of bus operators. In short, buses are the most popular and most ubiquitous form of public transport mode. This will also be so in the GMADA area. Figure 13.6 shows the existing and future bus terminals in the study area.

There are many areas in which improvements will need to be considered to make bus travel more comfortable. The bus commuter's total travel experience includes his experience at the bus interchange or bus stop, his ride on the bus and his walk at the start and end of his journey. Improvements to all these facets can be addressed. These would include better and more comfortable buses, better bus terminals and interchanges with facilities for waiting passengers and display of bus arrival and departure schedules, better and more comfortable bus shelters at bus stops, covered pedestrian linkways from bus stops to the nearby buildings, bus priority measures eg all day bus only lanes, along the major roads, integrated ticketing system for all transit services and better routing and schedules. Some of these measures are illustrated in Figure 13.7.

With the planned urbanization of the GMADA area over the next few decades, bus travel demand will grow in tandem. New bus terminals in the new urbanized areas will need to be developed to serve the new and expanded bus services and routes. Opportunity must be taken to integrate these terminals vertically and horizontally with the commercial development of the urban centres. The commercial development can include offices, shops, department stores, supermarkets, food courts, medical suites, gymnasiums, etc. The attractiveness of such commercial areas will be enhanced due to their excellent accessibility while the heavy movements of bus commuters and pedestrians will be made seamless. In doing so, the bus as a public transport mode will be enhanced. Such integration is indeed a brilliant business idea as the human traffic from the offices and shopping malls to the bus interchange is extremely heavy.



13.6: Proposed Public Transport System

13.7: Examples of Singapore Buses & Terminals

13.8 THE EARLIER MASS TRANSIT SYSTEM STUDIES

The Punjab, Haryana and Chandigarh administrations have for many years considered the building of an underground and elevated metro rail transport (MRT) to help ease traffic congestion within their states and to provide connectivity between their states. The administrations viewed that the MRT system could cater to the growing population and trip demand. At the same time MRT stations located in Mohali and Panchkula would help to generate and speed up developments in these cities. The MRT can reduce road traffic and encourage people to transfer to public transport if complemented with suitable policies and regulations to support the public transport initiatives.

However, The Urban Development Authority (UDA) has suggested a light-rail transport (LRT) system or a road based system like the tramway or the bus rapid transit system (BRT) due to the low density population in the Union Territory (UT). The Government of India has also expressed concerns on the cost of implementation of the MRT which would be very costly for both the administrations and the commuters. Ball park construction costs of Rs.10 million / km for the elevated MRT and Rs.600,000 to 1 million / km for a BRT have been quoted.

Earlier, RITES a consultancy firm commissioned by the Chandigarh Administration, had submitted a feasibility report for either a monorail or elevated Metro rail along 2 corridors. In response, the ministry expert committee appointed to review the proposal had recommended a surface light rail system for the 2 corridors. The committee considered that the forecast peak hour directional load of 25,000 passengers can be satisfactorily hauled by a light rail system. Few details of the system and the routes are however made available for this study.

The committee has suggested that the choice of the mode can be confirmed after a Detailed Project Report (DPR) is done. The press has also reported that the Government of India is not keen for a metro here, favouring a bus rapid transit system.

There are major and distinct differences in the system capacities and characteristics and the physical infrastructure required between the MRT, LRT and BRT systems. The MRT (metro rail transit) is a type of rapid and heavy rail transit system offering high capacity, frequency and speed and is capable of carrying high passenger loads usually in urban areas. The right-of-way for such a transit system is an exclusive and grade separated track or guideway. Typically, the line capacity of the metro system can be up to 90,000 passengers per hour per direction.

For light rail transit (LRT) systems, there are also various applications that can operate on fixed and segregated rights-of-way. The tracks or guideways can be grade-separated or share road space at grade level. The latter will be equivalent to a tram system. The LRT typically has lower speeds and capacities than that of the metro system. Generally, the maximum capacity of the LRT is estimated to be about 25,000 passengers per hour per direction.
The bus rapid transit (BRT) has the lowest capacity among the three modes. It is estimated that the BRT's maximum capacity is about 16,000 passengers per hour per direction. The capacity and performance of the system is however determined by the level and standard of provision of the BRT facilities and measures. The BRT can operate in various ways such as using bus lanes, bus priority measures, guided tracks or dedicated busways with physical separation at street level.

13.9 THE RECOMMENDED MASS TRANSIT STUDY

There is no information on the scope of the DPR. Our strong recommendation is that it is imperative to carry out an exhaustive technical, economic and financial feasibility study for the proposed transit systems and the transit networks. These studies are necessary to short list the appropriate mass transit systems and assess whether these systems are economically and financially viable over their design life. The optimum years for implementation and operation should be established with supporting patronage and costs. Additionally, the number of lines, number of stations and extent of the route of the transit network should be determined in the exercise. An appropriate system and network should only be selected after such exhaustive studies are conducted.

There are systematic and established methodologies used in transportation planning studies to determine the city's longer term public transport requirements. Often, the methodology is an integral part of the transportation planning process. The process would usually include the following steps:

- The development of long term land use plans;
- The conceptualization of the long term road network;
- The conceptualization of alternative long term bus and other transit networks;
- The determination and assessment via transport models of the impact and "performance" of these networks;
- The economic and financial evaluation and ranking of these alternative systems;
- The selection of the most appropriate systems;
- The determination of the staging of their implementation;
- The development of preliminary engineering studies of the selected systems to determine their routes and rights-of-way and station locations for route protection and safeguarding purposes.

Depending on the size of the city, many probable alternative transit systems are selected for testing and evaluation. These could include buses in mixed traffic, buses on dedicated bus lanes, BRT systems, trams and alternative track based MRT and LRT systems. The results of the simulations of these alternatives in terms of their performances eg total system travel times, system travel delays, accident costs, mode splits etc have to be studied and evaluated. The alternatives can be ranked in terms of "performance" and the "best" system recommended for further study and implementation.

Although many alternative metro systems had been reported to have been examined, from the information gleamed from interviews with key officers and the recent press articles in Punjab, the consultant's assessment is that rigorous routings and economic and financial evaluations of these proposed Metro systems had not been conducted to assess whether these systems are optimally routed and economically and financially viable over their design life as part of the decision making process. Nor are their optimum years for implementation and operation rigorously established with supporting cost and patronage numbers. Neither is the total required number of metro lines established in this rigorous manner.

13.10 PUBLIC TRANSPORT DEMAND FORECAST

For the GMADA study, such a comprehensive and rigorous study which can take 12 to 18 months, is not part of the deliverables. Nevertheless, a more simplified travel demand forecast exercise has been conducted to establish the overall "ball-park" travel demand. A brief description of the methodology has been given in earlier sections. The results have been used to assess that the proposed road network is adequate for the forecast traffic in the design year. The methodology has also yielded the estimated public transport demand for the design year.

Table 13.12 shows the forecast peak period public transport trips among the internal zones of the study area.

Table 13.12: Forecast Peak Hour Public Transport Trips

No	Internal Zones	Public Transport Trip Production ('000 person / hr)	Public Transport Trip Attraction ('000 persons / hr)	Intra-trips contained within each zone ('000 persons / hr)
1	SAS Nagar	151.7	92.9	45.5
2	Zirakpur	44.9	32.7	8.9
3	Derabassi	17.5	44.7	3.5
4	Banur	30.2	23.2	6.0
5	Kharar	26.9	18.9	5.4
6	Mullanpur	9.0	20.0	1.8
7	Kurali	16.4	13.3	3.3
8	Lalru	18.8	48.7	3.7
9	Chandigarh	69.8	78.2	27.9
10	Panchkula	25.1	37.8	5.0
Total		410.4	410.4	111.2
Total		820.8		

The results suggest that the heaviest public transport demand corridors are between SAS Nagar, Chandigarh, Panchkula, Zirakpur, Derabassi and Lalru. The total estimated number of trips distributed between these areas is about 96,000 in the peak hour. This is 12% of the 821,000 peak hour public transport trips for the whole study area. This is not unexpected considering the population and employment distribution in the study area. Travel between Chandigarh and SAS Nagar is forecast to be the highest between the two zones as these areas are expected to be the most urbanized.

Figure 13.6 shows the mass transit desire lines in the GMADA Regional Plan area. It must be stressed that these desire lines are representations of the densest demand corridors and are very preliminary. No mass transit type or route can be recommended at this stage. Much more study is warranted to establish the case for a metro system in GMADA.

13.11 RAILWAYS

There are 5 major railway lines running through Punjab and these connect the State to major cities eg Delhi and Amritsar. The major stations are located at Amritsar, Ambala, Ludhiana and Chandigarh. The major railway lines that run through and around the study area are shown in Figure 13.8. There are two railway lines that cross the study area. The railway network in the study area is part of the extensive Indian Railway network.

Outside the study area, twin track railway lines run from the east viz from Delhi and Mumbai and meet at Ambala. From there, the railway line runs as a single track in the north-south direction from Ambala to Chandigarh. From Chandigarh the single track line further links to Kalka. From Kalka to Shimla the line is a narrow gauge single track. The single track Chandigarh to Morinda line is newly built and serves the north-east and north-west of the study area. There are plans to extend this railway line further westwards from Morinda to Ludhiana. These are shown in Figure 13.9.

The railway system provides the basic long distance travel needs of the population. Fares are kept affordable. About 20 trains operate a day from Ambala to Chandigarh in both directions. The railway's share of the transport of cargo is small. Trucks move the bulk of cargo despite the ban of truck movements in many large cities and towns.

The land use proposals in the master plan will take into account the routes of the existing railway lines and the constraints they can impose in the study area. Appropriate land uses eg heavy industrial and warehousing, that can benefit from rail access can be proposed to capitalize on sites that abut the railway lines. Such sites could include areas in the vicinity of Derabassi and Lalru. The use of the railway for the movement of raw materials and finished goods will help reduce goods vehicle traffic along the major roads.

The railway system is unlikely to ferry many of the forecast interzonal commuters estimated in an earlier chapter. There are many reasons for this, viz

- The railway route is not along the major travel demand directions,
- The railway stations are badly sited relative to the major catchment areas,
- The railway operational frequencies of the single track system are unattractive to urban interzonal commuters.

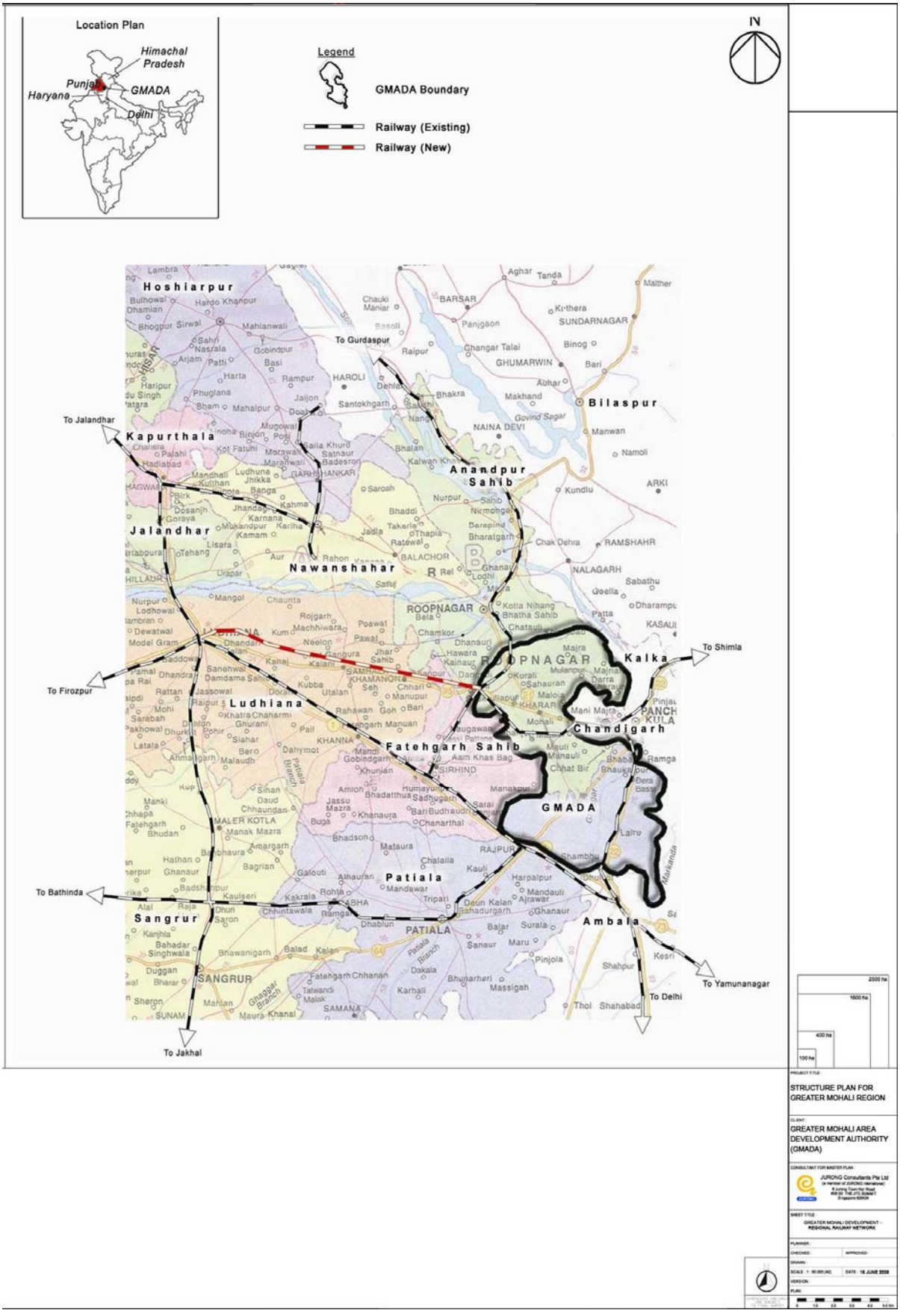


Fig 13.8: Regional Railway Network

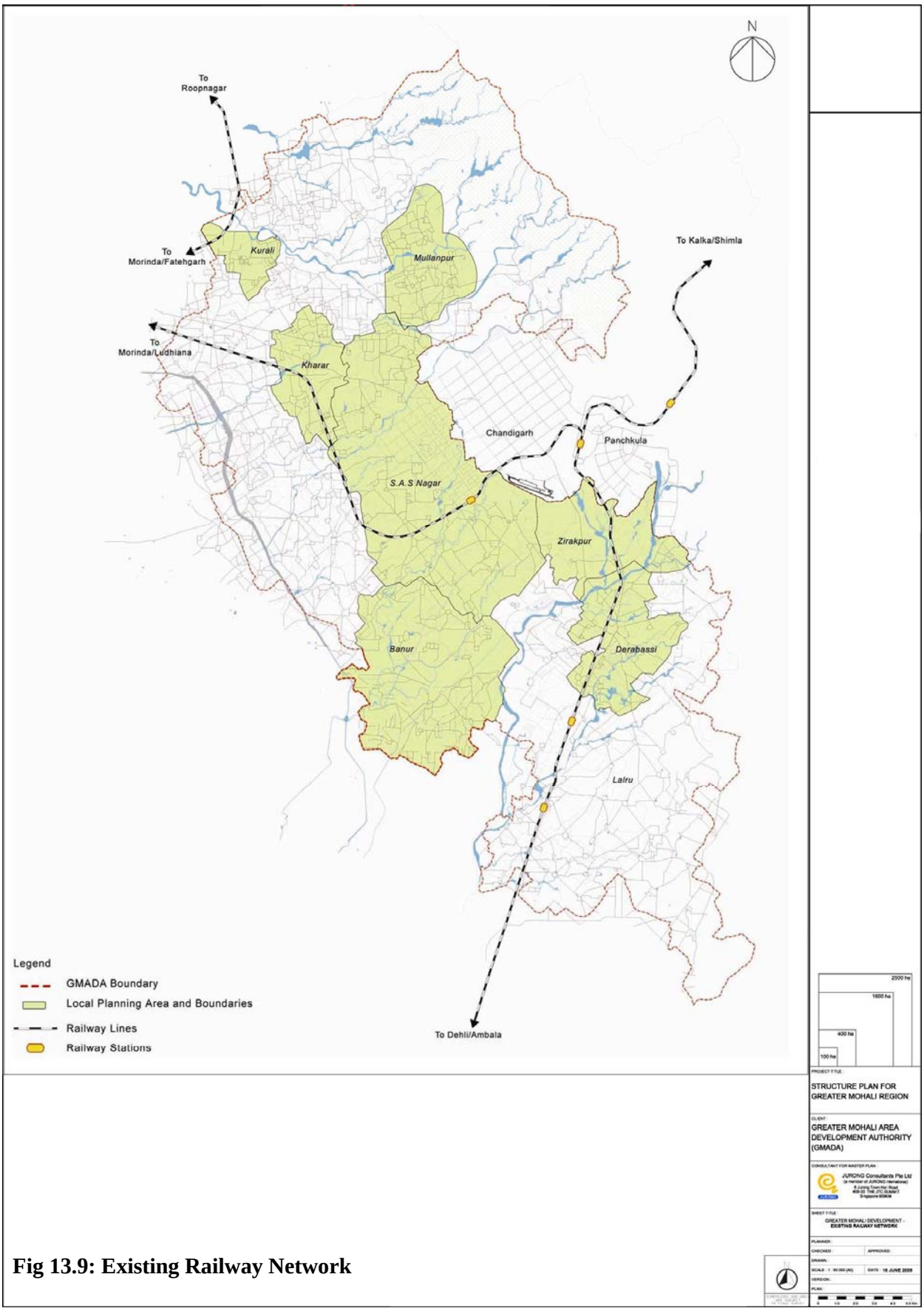


Fig 13.9: Existing Railway Network

13.12 CHANDIGARH AIRPORT

The existing airport is a regional airport sited about 12 km to the east of Chandigarh. It presently serves a relatively small number of flights, viz 3 flights daily to Delhi and 1 flight to Mumbai via Delhi and 1 flight to Jammu, totaling of 5 daily flights or a total of 10 aircraft movements.

The runway is 9,000 feet (2,700 metres) long (orientation 11/29) with an asphalt surface. The airport has a parking apron sufficient for 4 aircraft and a small terminal building on the north side of the runway. The existing terminal building has a capacity to handle 200 passengers at any one time. A small surface car park serves air passengers and visitors. The terminal building is linked to National Highway 21 (NH 21) via one access road.

The present annual load is 155,000 passenger movements and 3000 aircraft movements. Air traffic in India is growing rapidly. Air travel in India is predicted to grow at an average of 7.7% to year 2025, compared to 4.8% globally. Demand for domestic air travel saw an increase of about 23% in passenger traffic last year. Chandigarh Airport is expected to experience growth in air traffic of the same order of scale.

To cater for the immediate growth in air passengers, the existing airport terminal is being expanded to cater for 400 passengers at any one time at an estimated cost of Rs 8 million..

Proposed Upgradation to International airport.

An MOU was recently signed between the Airport Authority of India (AAI) and the Punjab and Haryana governments for the building of a new international airport terminal on the south side of the runway at Mohali. See Figure 13.11. This new terminal will be built on a 300 acre site and will have all the facilities of that of a modern international airport, viz centrally air-conditioned, passenger boarding bridges, in-line baggage conveyor system and car parking facilities. The new terminal area will be accessible via a proposed new access road from Chandigarh and SAS Nagar known as airport road.

An international airport at Mohali is considered viable, given that the Amritsar Airport has been very successful and experiencing a rapid growth rate. Though the absolute numbers of international passengers at Amritsar airport (480,000 for 2006-07) were just 7.3 per cent of Delhi's 6.6 million, the number of international passengers at Amritsar Airport grew 37.4 per cent over the corresponding month of the previous year. In comparison, Delhi's traffic grew just 6.9 per cent. It is observed that non-resident Indians hailing from Punjab form a large part of the international passengers using Delhi Airport and would prefer an airport nearer home. Making Chandigarh Airport an international airport will no doubt help to enhance air access to the region and also stimulate more economic development in the Region.

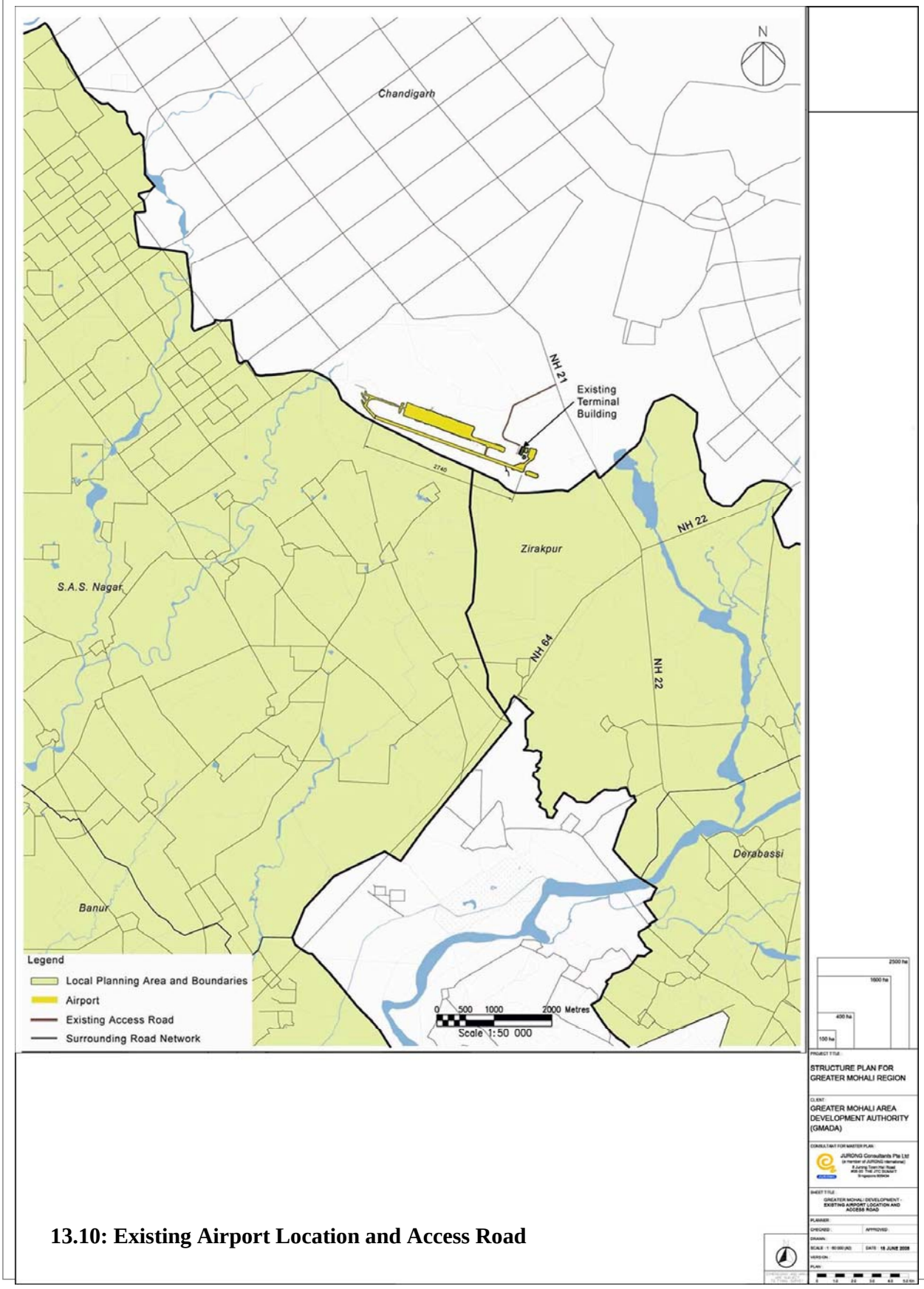
Whilst traditionally, an airport is seen as a transport infrastructure, the trend is towards developing an airport city as an economic driver for the region. Air logistics, aviation and aerospace industries will require sizeable land often with direct access into the runway and very good land side access. Such airport-related development is recommended for consideration to the south side of the new airport terminal area.

The current airport is a military airport and is close to Chandigarh city and highly accessible but it there is a lack of available un-encumbered land if significant growth including the development of an air logistic park and supporting uses and a possible second runway , is anticipated. The present

runway orientation already imposes height constraints on many areas in SAS Nagar and the areas around Zirakpur and limits their development potential. The existing airport had served Chandigarh well.
However with the planned urbanization of the Greater Mohali Region, the airport and its required expansion will pose a constraint on future development. The possible extension of the existing runway to cater for bigger and longer range aircraft on long international flights and the need for a second runway in the longer term future have also to be borne in mind.

These new airport expansion works will impose further limits on the development potential of the surrounding area. These factors would need to be addressed if the upgrading and further expansion of the existing airport to a large international one catering for bigger and longer range aircraft is contemplated in the longer term future. Other options could be considered and carefully evaluated at the appropriate time.

In a preliminary study by the transportation consultant of this study, it is estimated that the present runway has to be extended to 4,200 metres to cater to longer range and heavier aircraft e.g. Boeing 747 and Airbus 330/340, taking into account the airport's altitude and the area's ambient temperature.



13.10: Existing Airport Location and Access Road

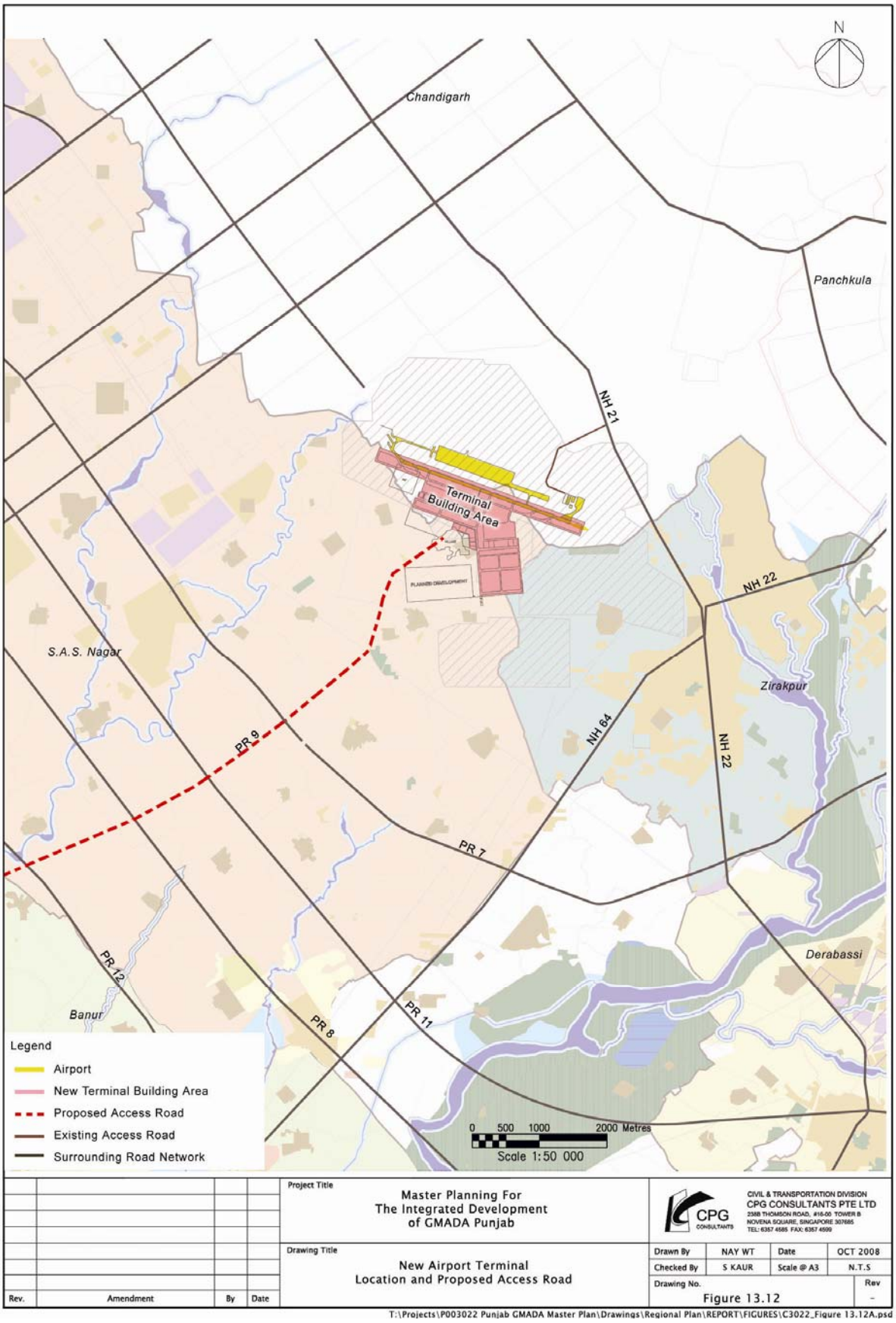


Fig 13.11: New Airport Terminal Location and Proposed Access Road

The Proposed Transportation Systems

Figure 13.12 shows the total proposed transportation system, viz

- The major road network by road hierarchy
- The locations of the bus terminals and interchanges
- The major public transport desire lines.
- The route of the railway system, and
- The airport.

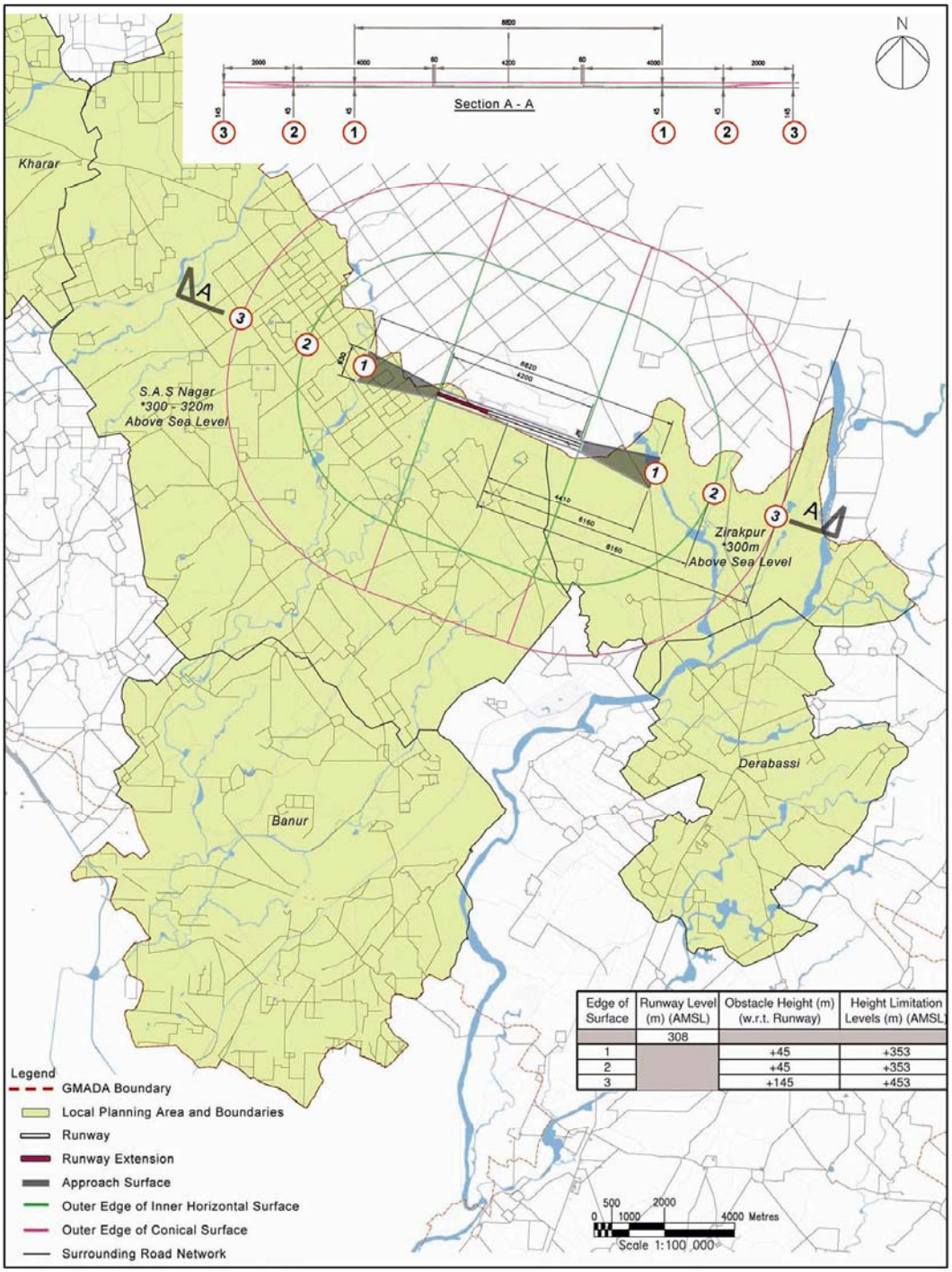


Fig 13.12: Airport Obstacle Height Limitation Chart

APPENDIX A

(Proposed PR 6 – SAS Nagar to Mullanpur Road –Plan A)

In order to provide a direct road access from S.A.S Nagar to Anandpur Sahib, an arterial road is being proposed via Mullanpur. The above proposed major arterial road (PR6) runs in a north direction between Sectors 73 and 74 of SAS Nagar to Mullanpur and Anandpur Sahib. En route, it intersects NH 21, the proposed PR 5 and towards Mullanpur to cut across PR 4 and end at the MDR B as a 100 feet local road along the river front. At PR4, it will join the PR3 and proceed westwards towards the Gmada expressway and Anand Sahib. This proposed new road extension from SAS Nagar, is shown in the attached Plan A. The new road will provide good and direct access to the Proposed Chandigarh International Airport from Mullanpur. The PR6 is 60 m (200 feet) wide and extend for a distance of 7.0 km.

The PR6 will also serve to provide access to the land between NH21 and PR5.

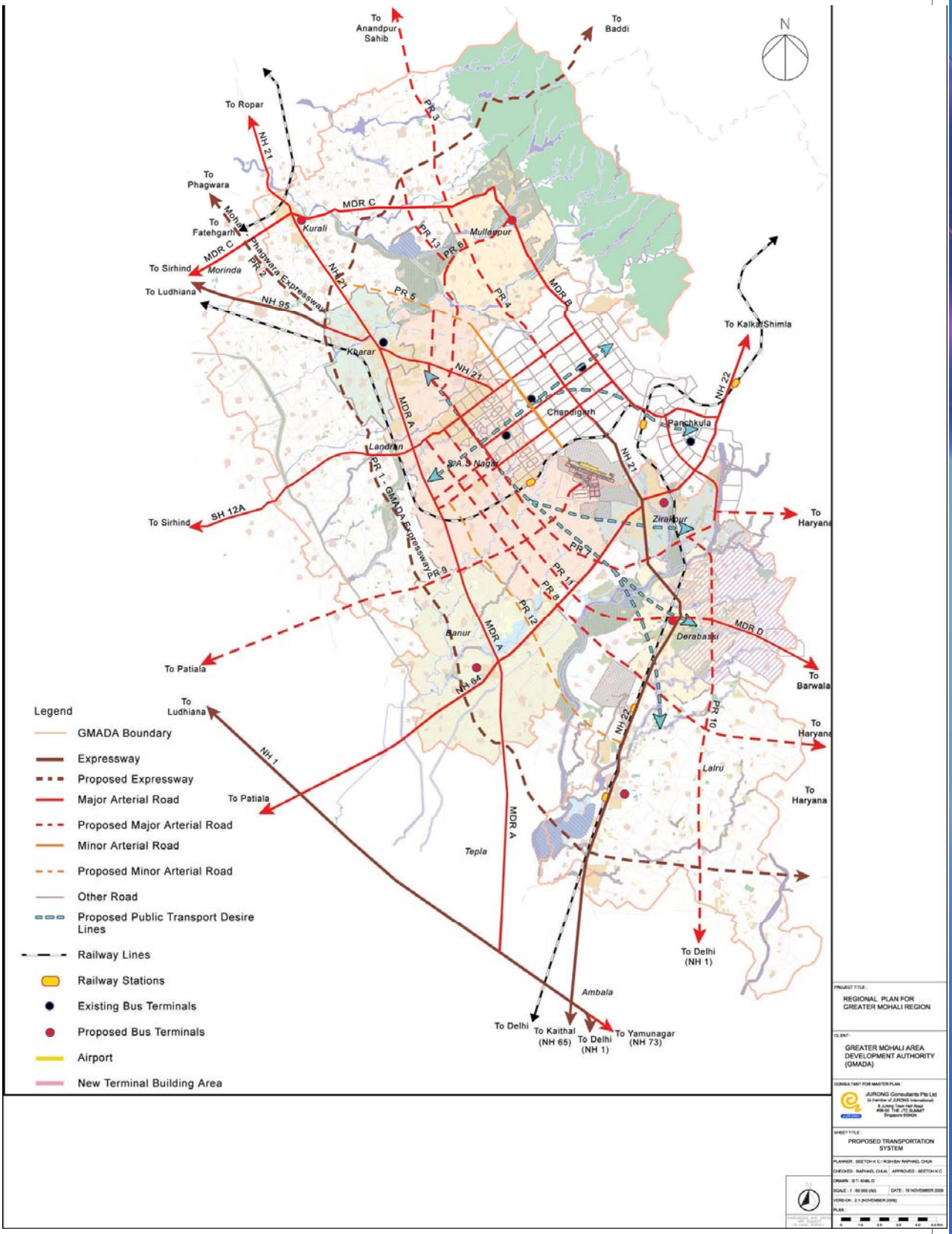


Fig 13.13: Proposed PR 6 – SAS Nagar to Mullanpur road –Plan A

APPENDIX B

(Proposed PR7 – from SAS Nagar to Zirakapur and Panchkula) Plan B

An MOU was recently signed between the Airport Authority of India (AAI) and the Punjab and Haryana governments for the building of a new international airport terminal on the south side of the runway at Mohali. With the building of a new international airport terminal; there is a need to provide a direct access from the tri city of SAS Nagar; Chandigarh and Panchkula to the international airport. This proposed new road extension from SAS Nagar Sector 66, is shown in the attached Plan B. This road PR7 & 9 is proposed to serve the expanded airport and the airport-related development. The new road will provide good and direct access to the airport from Chandigarh, SAS Nagar, Panchkula, Patiala, Ambala, Shimla etc.

Aerotropolis Development (Plan B)

The proposed PR7 (Airport road) is 60m (200 feet) and extends from Sector 66 to Zirakpur and Panchkula for a distance of 17.8 km. There will be a 30 m green buffer on both sides of the road and a 300m wide band of Mix use 1 along this stretch of the highway within the SAS Nagar local plan. Mix use 1 denotes that commercial use is allowed with minimum site area of 5 acres. This area is termed the `Aerotropolis" as it will house all the airport related uses such as flatted houses; service apartments; cluster housing; hotels; commercial offices; institutions; shopping malls and multiplexes and other airport supporting uses etc. The maximum ground coverage shall be 40% and the height controls shall comform with the airport height restriction.

As the PR7 extends towards Zirakpur and outside the local planning areas; near the village of Bir Chhat; in order to check the mushrooming of unauthorized developments along this stretch of the road; it is proposed that a strip of land be zoned for mix use (which includes flatted houses; service apartments; cluster housing; hotels; commercial offices; institutions; shopping malls and multiplexes) so that private developers can construct quality buildings and participate in the `Aerotropolis' development. However, the mix land use along PR7 in SAS Nagar LPA up to NH 64 shall be developed exclusively by GMADA. This PR7 alignment is the best possible solution for the regional connectivity and the objections received from the deputy commissioner have been taken care in the plan.

The setback requirements from PR7 is as follows:

Location	Buffer setback from road on both sides	Width of mixed use
PR7 within SAS Nagar LPA up to NH 64	30 (10m green & 20m physical)	300m
PR 7 between NH 64 and NH 22	15 (5 m green & 10 m physical)	As shown on sketch
PR7 from NH 22 up to Panchkula	15 (5 m green & 10 m physical)	Please see Zirakpur local plan

Note : FAR 1.0 for buffer setback shall be given to promoter free of cost.

There is also a 300 feet wide road that is an offshoot of PR7; termed PR9 that connects the arterial road to the future international airport. In order not to prejudice the possibility of a future 2nd runway alongside the existing runway at Chandigarh; a 2nd runway is being proposed ' Land around the 2nd runway is also safeguarded for this purpose only and termed as agriculture and unscheduled area in the SAS Local plan.

West of PR9; by virtue of its proximity to the proposed international airport; 2 parcels of land have been set aside to complement the airport development.

1. The **Parcel 1** is a triangular piece of land of about 75 ha just outside of the proposed 2nd runway boundary for Mix use 1. The recommended and permitted uses for this triangular parcel of land just next to the airport boundary can be for uses such as warehouses, exposition and exhibition halls; hotels; aviation academy; aircraft catering services; aircraft related offices. There is a triangular piece of land at the north-eastern corner (0.8 ha) measured 75m from the apex of the triangle, shall be reserved as open space only (no construction zone) being within the influence of the 2nd runway. The maximum ground coverage shall be 35% and the height restriction shall be based on the regulation by the Airport Authority.

2. The **Parcel 2** of about 150 ha is designated for airport supporting uses. Commercial uses is not allowed and the permitted uses are institutional or aviation industries, export and import houses, logistics companies, warehouses and cold stores. The maximum ground coverage shall be 35% and the height restriction shall be based on the regulation by the Airport Authority.

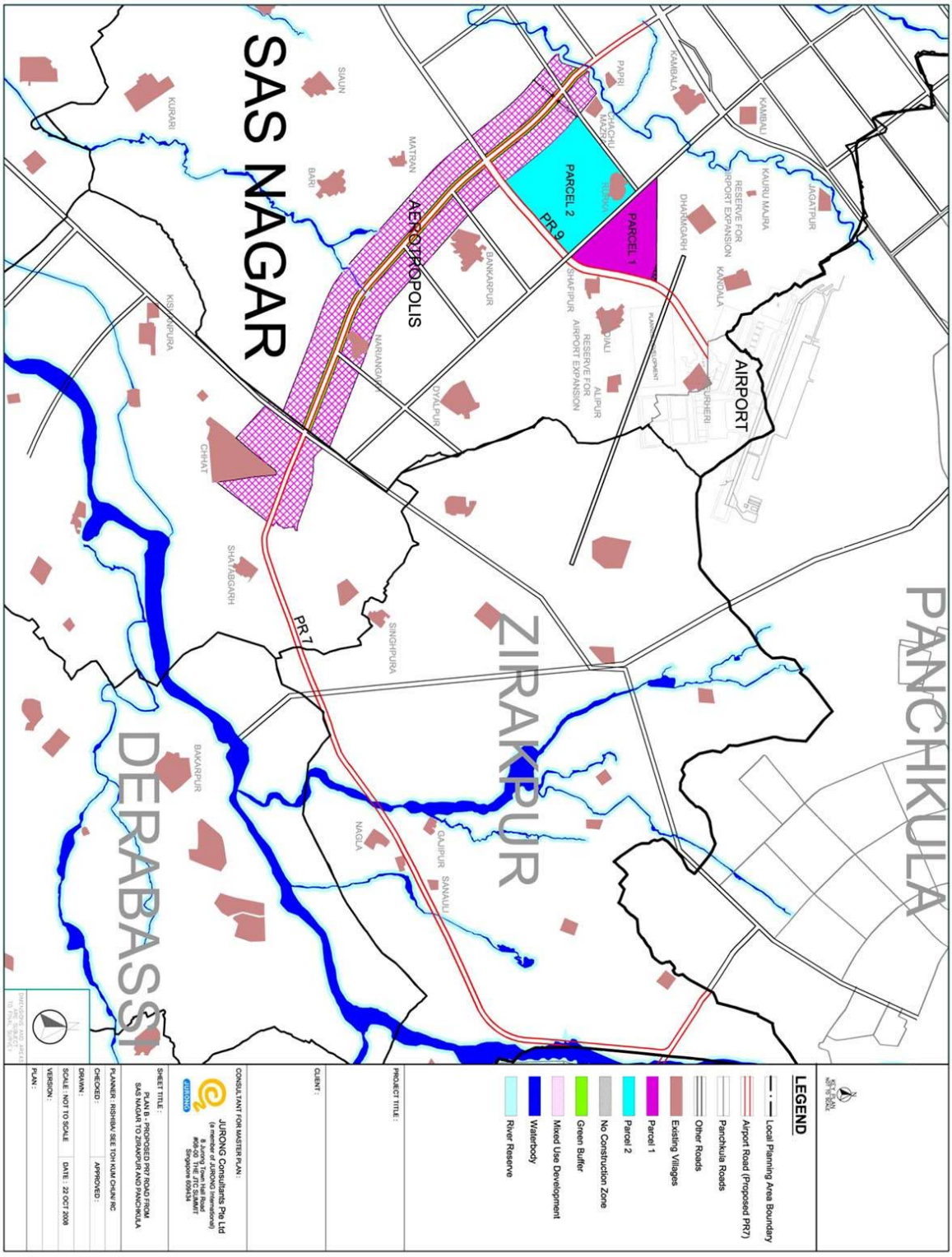


Fig 13.14: Proposed PR7 – from SAS Nagar to Zirakapur and Panchkula - Plan B

14. Environment Management

14.1 Introduction

The basic guideline of the National Environment Policy is directed towards achieving sustainable development in all spheres of development. It not only envisages conservation and enhancement of environmental resource base but it also directs development to achieve intergenerational and intra generational equity.

In the field of urban development and in the context of a Perspective Plan for the Greater Mohali Area, basic endowments which need to be conserved are the following:

- Water
- Land
- Air and climate
- Forest and Biodiversity
- Human Habitation

Although six areas have been identified in order to form urban growth nodes there are several other large settlements as well as large number of villages within the area delineated under the jurisdiction of GMADA. It would be imperative that the entire region develops in a system of well balanced distribution of human settlements and a symbiotic relationship between the urban and rural emerges. This is particularly feasible in view of the high productivity agricultural land and affluent villages in the area. Therefore, the symbiotic relationship can be achieved with imaginative sharing of environmental resources.

The vision plan marks the projected population at 4.5 million by 2056 with an urban population of 3.82 million. According to 2001 census the area has close to 450,000 rural populations. It is this population that is also likely to grow over the next sixty years. In order to accommodate rural growth, the Chandigarh Peripheral Act Committee have allowed expansion of all the villages up to maximum of 100 mts and minimum of 50 mts in radial length all around. Since the existing population according to 2001 census is 711,210 and urban population is 276,699 it is evident that this area is mainly rural dominated.

The area is mainly dominated by rural population and their main source of employment is agriculture. Since the output from the agriculture is not comparable with return from urban land use, it is very necessary to offer them with economically viable option to retain them in agricultural occupation. Conservation of agricultural land is very necessary. Unlike other villages in India, Punjab villages are not poor. They are very rich and since they have the fertile land, their main occupation is agriculture. Thus there should be a proper coexistence between people living in urban areas with those living in rural areas. They should be provided with facilities to improve their soil quality so the production from the agriculture is more.

Garbage and sewage disposal and other infrastructural facilities should also be made available to these areas.

14.1.1 Water

The current source of water supply for Greater Mohali Region is ground water, which is available at 150 to 300 feet depth and sufficient for present day use. Punjab Water Supply and Sewerage Board (PWSSB) is responsible for the water facilities of urban areas in Greater Mohali Region, while the

Fig 13.12: Airport Obstacle Height Limitation Chart

respective Local Government Municipal Councils are responsible for supply in the rural areas. According to PWSSB, the water demand for the Greater Mohali Region is approximately 45 MLD.

14.1.2 Surface water

Water should be conserved. There are series of *chos* flowing through this region. They are usually dry bed, but they get recharged during the monsoon season. This recharged water can be used for irrigation and other purposes during season when the *chos* are dry. They can be stored in reservoir and used. Sukhna Lake of Chandigarh is an example where a lake has been made from the *chos*. The water is preserved and then converted in to a beautiful lake. Through this process, water is being given back and groundwater is also recharged and replenished.

14.1.3 Ground water

Since the main source of water is ground water in this region it becomes very important to preserve groundwater. Since this area will grow in future due to it nearness to centres of growth and accessibility, the consumption would also go high. Since the rate of consumption is high in urban areas the water must be recycled and reused.

14.1.4 Industries

Industries should develop in these areas but mainly for agricultural products or to support these industries. The existing industrial sector characterized mainly by cottage industries and local enterprises concentrating in the manufacture of handicraft and some resource based industries. Currently, the industrial sector in Greater Mohali Region is not well developed, characterized by small manufacturing establishments and primary processing industries. However, of late, higher value-added industries are being set up in the Greater Mohali Region. As market forces are a good indicator of the attractiveness of the region for manufacturing; the recent growth of new industries in the Greater Mohali Region indicates that there must be some intrinsic value in this location.

Since these industries have started coming in this region it should be seen that industries which fall under RED and ORANGE category should not be encouraged since they are most hazardous industries which would contaminate the environment. Though areas have been designated for industrial development it should be seen that they do not cross the designated area and enter the residential and other areas.

14.1.5 Climate

Since this area is in its development phase and near to Chandigarh, there would be growth in population, industries, and other facilities. Climate is a very important factor which needs to be taken into account in framing land uses and built form. Further, air pollution is one of the primary considerations, it should be seen that pollution does not cross the maximum permissible range. So, monitoring station should be put to keep a check on the pollution level.

Conservation and improvement of the environment is a priority of the Government of India. The NEP was drafted into 2004 and circulated to all the States. After wide public consultation National environment Policy (NEP) with the following objectives has been adopted.

14.1.6 The Objectives of NEP 2006

The principal objectives of this policy are enumerated below. These objectives relate to current perceptions of key environmental challenges. They may, accordingly, evolve over time:

- **Conservation of Critical Environmental Resources**

To protect and conserve critical ecological systems and resources, and invaluable natural and man-made heritage which are essential for life support, livelihoods, economic growth, and a broad conception of human well-being

- **Intra-generational Equity: Livelihood Security for the Poor**

To ensure equitable access to environmental resources and quality for all sections of society, and in particular, to ensure that poor communities, which are most dependent on environmental resources for their livelihoods, are assured secure access to these resources.

- **Inter-generational Equity**

To ensure judicious use of environmental resources to meet the needs and aspirations of present and future generations.

- **Integration of Environmental Concerns in Economic and Social Development**

To integrate environmental concerns into policies, plans, programmes, and projects for economic and social development.

- **Efficiency in Environmental Resource Use**

To ensure efficient use of environmental resources in the sense of reduction in their use per unit of economic output, to minimize adverse environmental impacts.

- **Environmental Governance**

To apply the principles of good governance (transparency, rationality, accountability, reduction in time and costs, and participation) to the management and regulation of use of environmental resources.

- **Enhancement of Resources for Environmental Conservation:**

To ensure higher resource flows, comprising finance, technology, management skills, traditional knowledge, and social capital, for environmental conservation through mutually beneficial multi stakeholder partnerships between local communities, public agencies, and investors.

14.2 The Regional Context of Greater Mohali Region

The Greater Mohali Area Development Authority (GMADA) with jurisdiction over six local planning areas, i.e., SAS Nagar, Kharar, Banur, Zirakpur, Dera Bassi and, Mullanpur, with an area of approximately 1190 sq km, is desirous to have a Regional Plan for the entire area, with a time horizon of 50 years.

Map14.1: *Location of GMADA Region in Northern India*

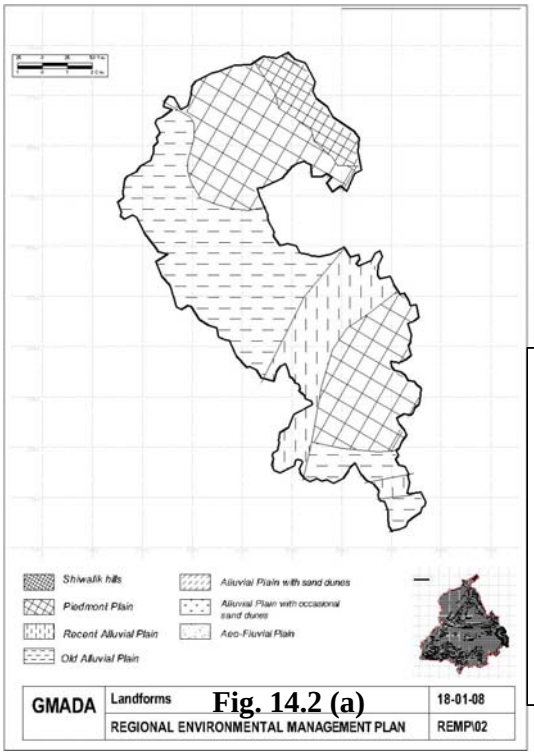
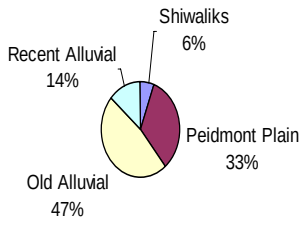


Fig. 14.2 (a)

Fig. 14.2 (b) Landforms in GMADA (sq km)



The Greater Mohali Region is a part of the State of Punjab. The state occupies 1.5% of national land mass and hosts about 2.4% of its population. Greater Mohali Region lies in an extensive hinterland girdling the modern city of Chandigarh in the North, West and the South. It has recently been formed by merging parts (Kharar & Mohali tehsils) of Rupnagar District and Dera Bassi tehsil of Patiala District. This area bears a special significance in the regional context. It forms an extension to the vibrant tri-city of Chandigarh, Mohali and Panchkula.

Greater Mohali Region sports diverse landforms, Shivalik Hills in the north followed by Piedmont Plain. The Piedmont along with old alluvial plain occupies about 80% of Greater Mohali Region. Recent alluvial plain along river Ghaggar is the most productive part of the region. It is worth mentioning that any physical development of large scale should ideally stay clear of recent alluvial plains.

According to the report on Punjab by the National Bureau of Soil Survey and Land Use Planning, the soils in piedmont plains are likely to suffer erosion, high run off, low fertility and poor water storage. Northern and eastern part of the district is characterized by this soil type. Eastern side has a higher rate of urban settlements due to greater accessibility and is rapidly developing. Greater care needs to be exercised in allocating land uses in this area to conserve soil and prevent soil erosion. The central part of the district is occupied by rich alluvial soil. Unfortunately, this area is under intense pressure for urbanization. Therefore, it is important to ensure that minimum amount land is consumed by intense urban form.

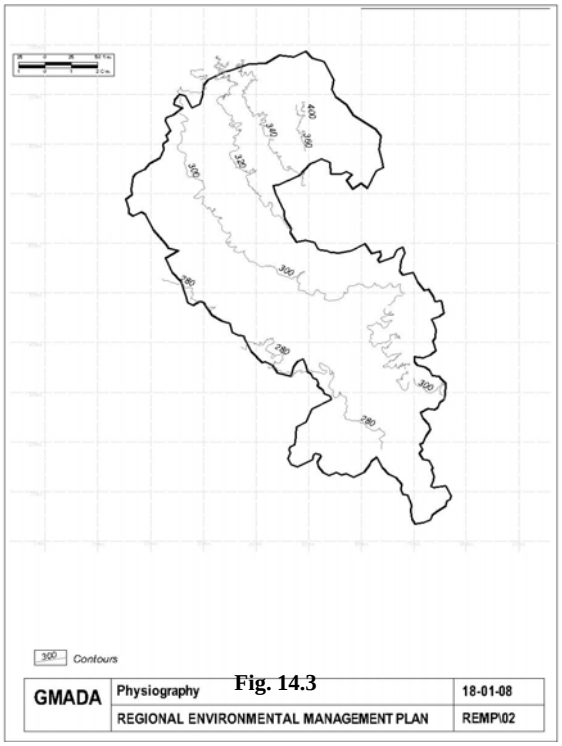


Fig. 14.3

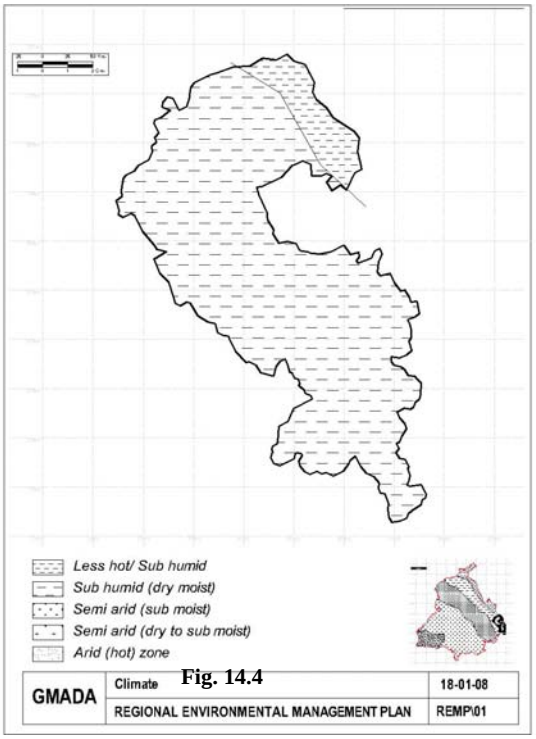


Fig. 14.4

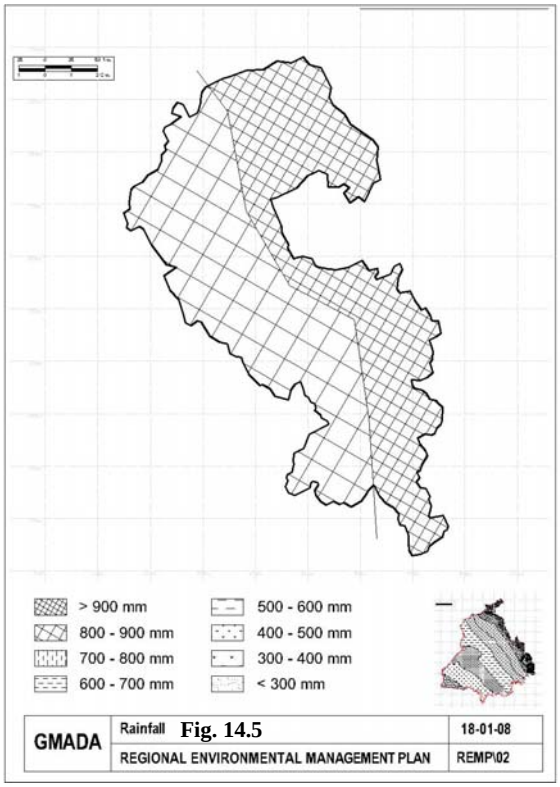
The elevation in Greater Mohali Region ranges from about 400m above msl in the foot hills to about 280m msl in the plains. The change in terrain occurs over a span of about 225 km, thus resulting in average gradient of a meter in 500m. The slope is gentle towards SW of the area, where all the rivers and streams drain. It is important to observe this drainage pattern. Otherwise it may give rise to water logging due to gentle slope and cause expensive surface drainage measures. Le Corbusier had taken

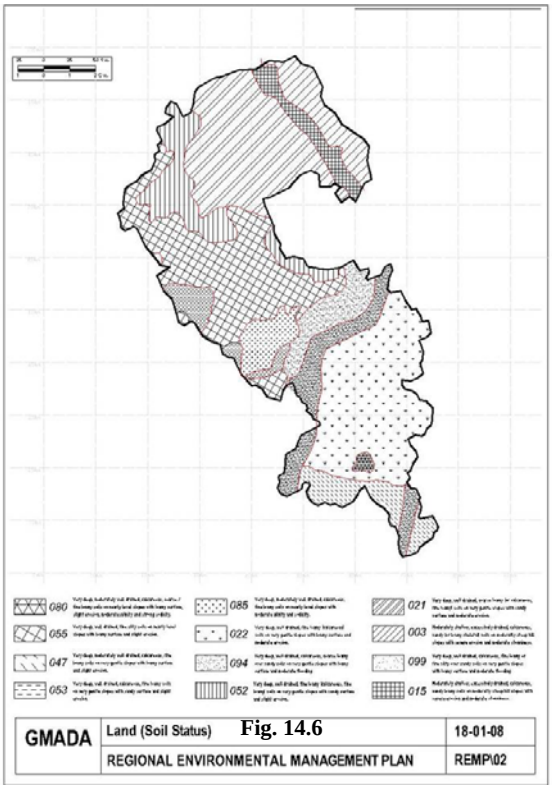
cognizance of this factor and the grid for Chandigarh not only allows easy drainage, it also allows for funneling of air facilitating natural ventilation.

14.2.1 Climate

The region experiences extreme weather conditions. Period of April to June experiences hot and dry season. In summers the maximum temperature goes up to 45ºC. November to February is subjected to cold weather and in winters the minimum temperature goes down to about 1ºC.

The built environment should suitably respond to the temperature and precipitation conditions. The physical planning should consider these aspects while laying of streets, orientation of buildings, and allocation of land use for optimal sun exposure and wind circulation. The buildings should further have provisions to incorporate principles of active and passive solar design, to reduce consumption of conventional energy by means of byelaws, zoning regulations, incentives etc.





In Punjab, the average annual rainfall ranges from 58 cms in plains to 96 cms in sub mountain regions and decreases from North to South. The annual average *rainfall in Greater Mohali Region is 114 cm.* The rainfall in the entire region in the monsoon season is heavy. The monsoon season starts in the first week of July and continues till middle of September.

The region receives fair amount and distribution of rainfall. The varying precipitation rates – annual mean, seasonal load, 1 hour average and 15min. storm should be appropriately incorporated in the planning scheme to harness the full potential of rainwater harvesting. There should be emphasis to maintain a hydrological balance in the region, by having greater permeable/ semi-permeable surfaces, lesser and dispersed paved areas, regular retention chambers intercepting gullies out falling into large

surface water bodies etc. The same will also benefit in reducing the loads on municipal drainage and sewerage systems.

Harvesting of rain water and storing the waters of the seasonal Choes by formation of reservoirs as done in the case of Chandigarh should be part of the planning of land uses and infrastructure development.

14.2.2 Soil Status

Soil sample survey in Greater Mohali Region has categorized soils in terms of series and given those numbers. No. 21, 22 and 55 are predominant which have characteristics of very deep, well drained, coarse to fine loamy (or calcareous, fine loamy) soils on very gentle slopes with sandy surface and moderate erosion. No. 94 & 99 is located in floodplains and is very fertile from agricultural point of view.

It is thus imperative to exclude these spatial units from being encroached by pockets of over-development. Conservation of good soil should be a priority in developing land use distribution and intensity of development.

14.2.3 Land Degradation

The degradation of land in the region is on account of both natural and anthropogenic factors. The southern belt of the State is prone to dust storms arising of Rajasthan while the North-eastern boundary is susceptible to water induced erosion. The lands in Greater Mohali Region form part of such a region, facing water induced soil erosion. The phenomenon is particularly active during the monsoons, when rivulets and streams emanating from Shivalik gush through the terrain, thus eroding the nutrient rich topsoil.

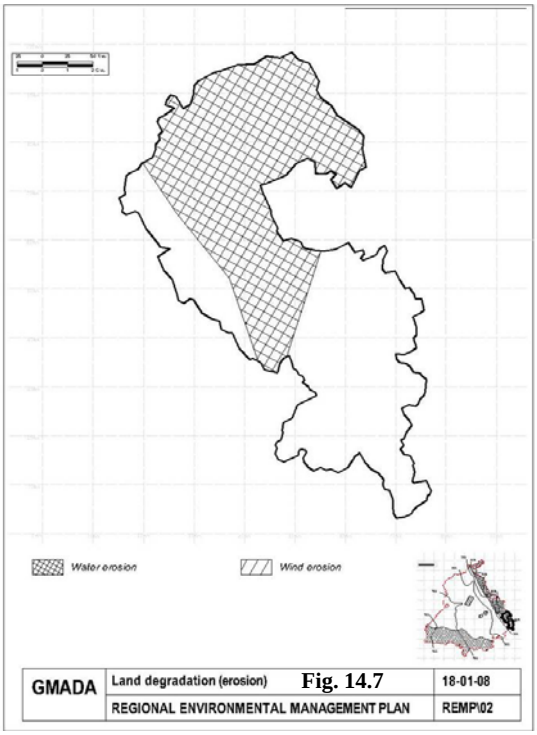


Fig. 14.7

Degradation of land due to overdosing of inorganic substances and their toxicity to the food chain is an established fact. The State has witnessed similar trends in the last few decades. This may be understood by the excessive use of chemical fertilizers and pesticides hitherto. This aspect is being managed by the State Land Use Board and development should be done in consultation with them. Since a substantial area would continue under agricultural activity and agricultural product of this area is vital for food security of the country, conservation and management of soil is critical issue.

14.2.5 Surface Hydrology

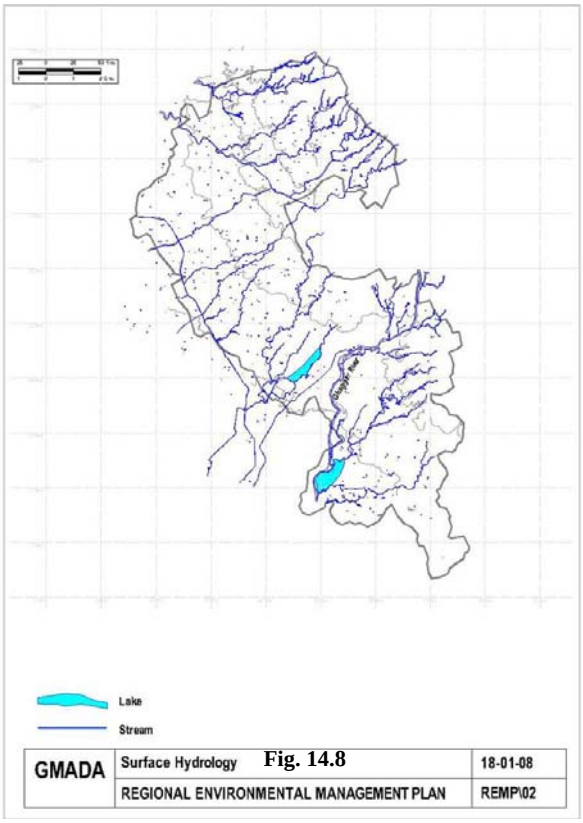


Fig. 14.8

Ghaggar River with its tributaries forms the main surface hydrological feature in the area. Due to the flat topography, at many places the water channels swells in the monsoons (locally known as choes) that remain dry during the inter-monsoon period.

Water quality has been classified as per scheme for zoning and classification of lakes and rivers (surface/fresh water) as per Central Pollution Control Board. The prescribed tolerance limits with respect to certain selected parameters are given below. Further, the Irrigation Department classification of water for irrigation is also stated.

Water quality in the aquatic ecosystems of Punjab is being monitored by the Punjab Pollution Control Board at 37 locations. The monitoring is being carried out under the National Water Quality Monitoring Program (NWMP) funded by CPCB. At each monitoring location, samples are collected every quarter (in the months of January, April, July and October) and analyzed for physico-chemical parameters. The river wise data is as under.

Ghaggar River is a predominantly monsoonal stream. There are 12 sampling locations on the river. A general increasing trend in the BOD and COD values is observed since 1995 onwards indicating increase in pollution over the years. The fecal coli form values are also very high at times crossing the 5000 MPN/100ml limit specified for 'Class-C' quality water. The physico–chemical parameters are also depicted. These indicate high pollution near Jharmal Nadi and downstream Dhankansu nallah.

Box 1.2 Classification of water quality for use in irrigation

Utility for Irrigation	Electrical Conductivity (EC)	Residual Sodium Carbonate (RSC)
Fit	< 2000 mmhos	< 2.5 mg/l
Marginally fit	2000- 4000 mmhos	2.5- 5.0 mg/l
Unfit	>4000 mmhos	> 5.0 mg/l

Box 1.1 Primary water quality criteria for various uses of fresh water

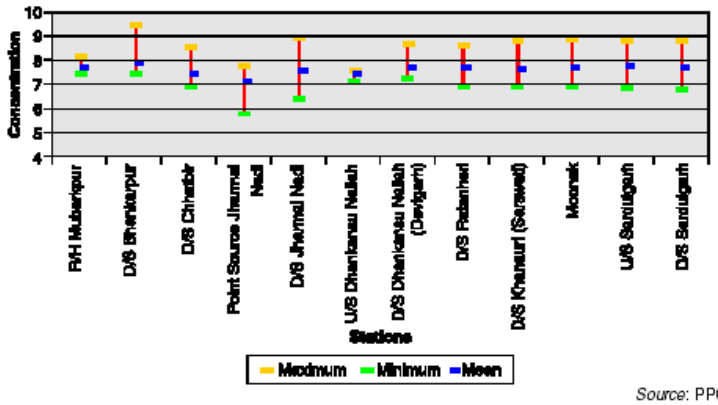
Constituent	Designated Best Use Class				
	A	B	C	D	E
1. Dissolved oxygen, mg/l, Min.	6	5	4	–	–
2. Biochemical Oxygen Demand, mg/l, Max.	2	3	3	–	–
3. Total coliform Organisms MPN/100 ml, Max.	50	500	5000	–	100
4. pH Value	6.5-8.5	6.5-8.5	6-9	6.5-8.5	6-8.5
5. Free ammonia (As N) mg/l, Max.	–	–	–	1.2	–
6. Electrical conductivity us/cm max.	–	–	–	–	2250
7. Sodium absorption ratio, Max.	–	–	–	–	2.6
8. Boron, mg/l, Max.	–	–	–	–	2

Min. minimum level desired Max. maximum allowable value

- If the coliform is found to be more than the prescribed tolerance limits the criteria for coliform shall be satisfied if not more than 20 percent of samples show more than the tolerance limits specified and not more than 5 percent of samples show values more than 4 times the tolerance limits. There should be no visible discharge of domestic and industrial water into class 'A' water. In case of class 'B' and 'C' the discharges shall be so regulated/treated as to ensure maintenance of the stream standards.
- If the ambient water quality of the rivers is examined in the light of the tolerance limits prescribed, the classification arrived at on the basis of a single parameter may not necessarily be the same as that based on other parameters. In such cases the lowest class scored in respect of any one of the criteria should normally indicate the water quality status of a particular reach of the river.

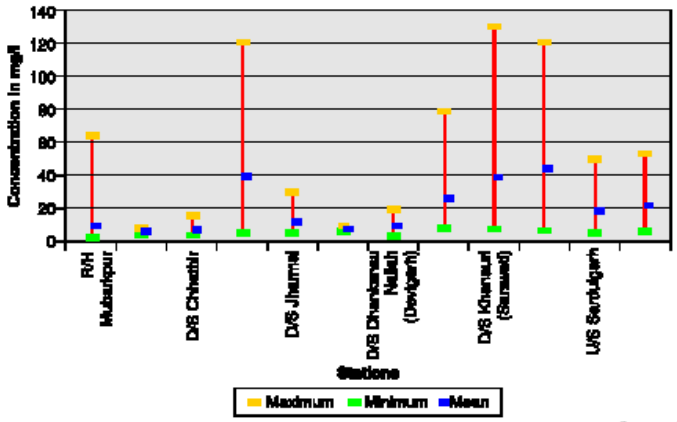
A: Drinking water sources without conventional treatment but after disinfection.
B: Organised outdoor bathing
C: Drinking water source with conventional treatment followed by disinfection
D: Propagation of wild life and fisheries
E: Irrigation, industrial cooling and controlled water disposal

Fig. 14.9 pH range at different monitoring locations at river Ghaggar (1988-2003)



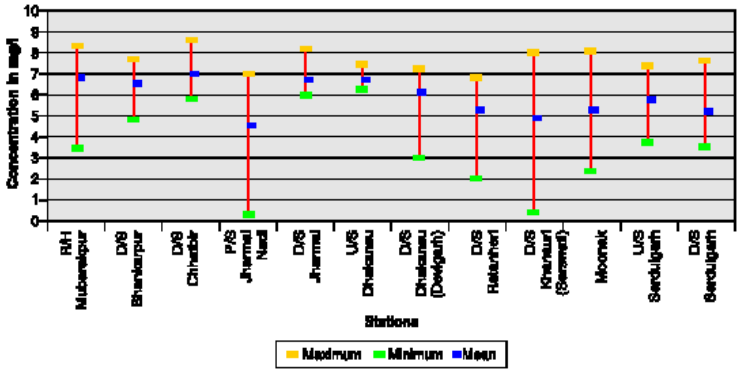
Source: PPCB, 2005

Fig. 14.10 BOD range at different monitoring locations at river Ghaggar (1988-2003)



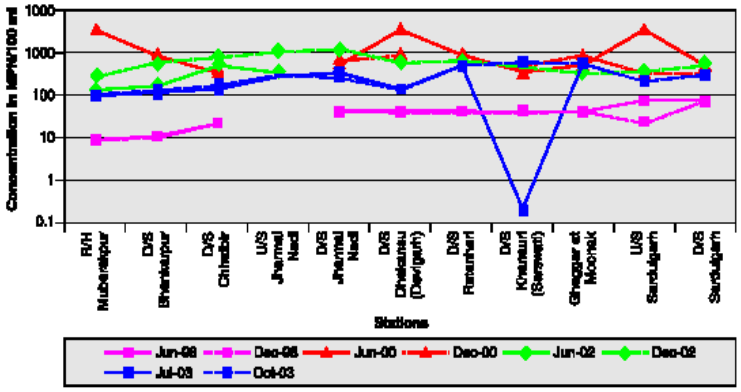
Source: PPCB, 2005

Fig. 14.11 DO range at different monitoring locations at river Ghaggar (1988-2003)



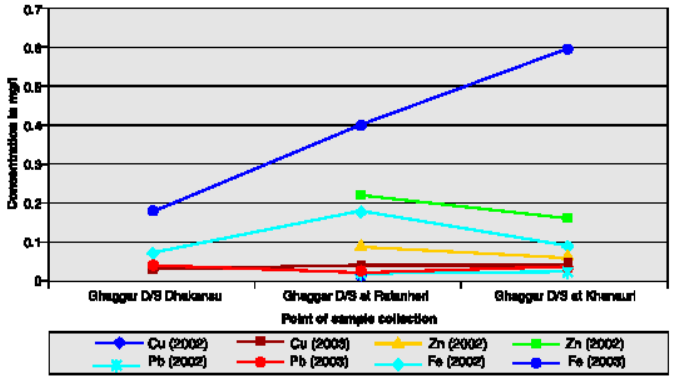
Source: PPCB, 2005

Fig. 14.12 Yearwise summer/winter average concentration of feacal coliform at different monitoring locations at river Ghaggar



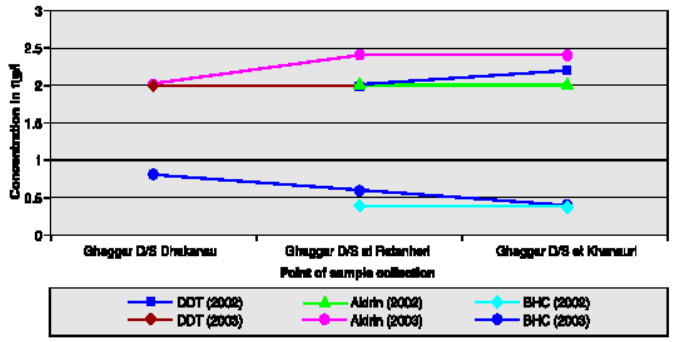
Source: PPCB, 2005

Fig. 14.13 Concentration of heavy metals in water samples at different monitoring locations at river Ghaggar (2002 & 2003)



Source: PPCB, 2005

Fig. 14.14 Concentration of pesticides in water samples at different monitoring locations at river Ghaggar (2002 & 2003)



Source: PPCB, 2005

The Board has initiated heavy metal and pesticide monitoring in the river at three locations i.e. D/S Dhakansu nallah, D/S Ratanheri and D/S Khanauri since 2002. Further, with regard to pesticides, high values have been reported D/S Khanauri, in water.

The protection of these floodable zones is of paramount importance for ground water aquifers. The soils in the area are very fertile with annual deposition of river silt and as such very productive for raising multiple crops in the year. There are a number of such choes in Greater Mohali Region, that may be tapped, to act as recharge zones, climate modifiers and as recreational feature as has been done with Sukhna lake in Chandigarh.

14.2.6 Ground Water

The ground water table has been receding near Mohali to the tune of 16m from 1975-2003. The decline has been 4m in Dera Bassi District. Although in Ropar District, where Mohali originally used to belong to the recharge of ground water is 50% higher than the rate of extraction. In Mohali area there has been significant depletion. Whereas in Dera Bassi, where extraction exceeds recharge by 50%, the depletion of ground water has been

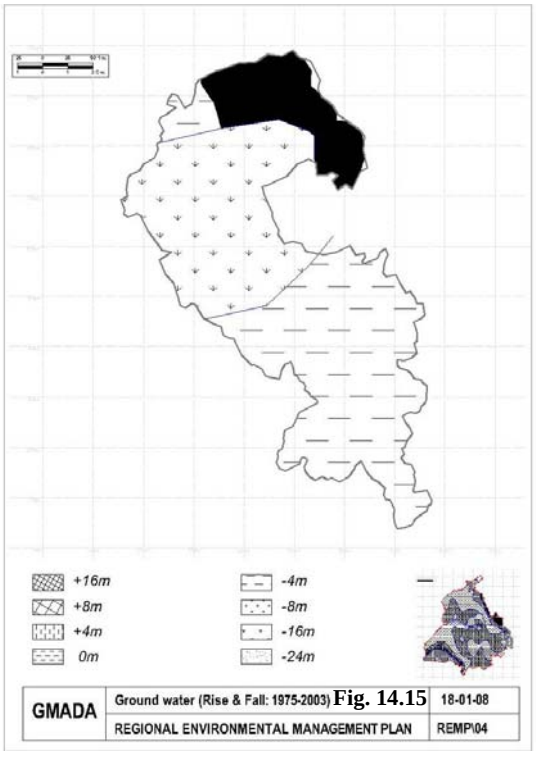


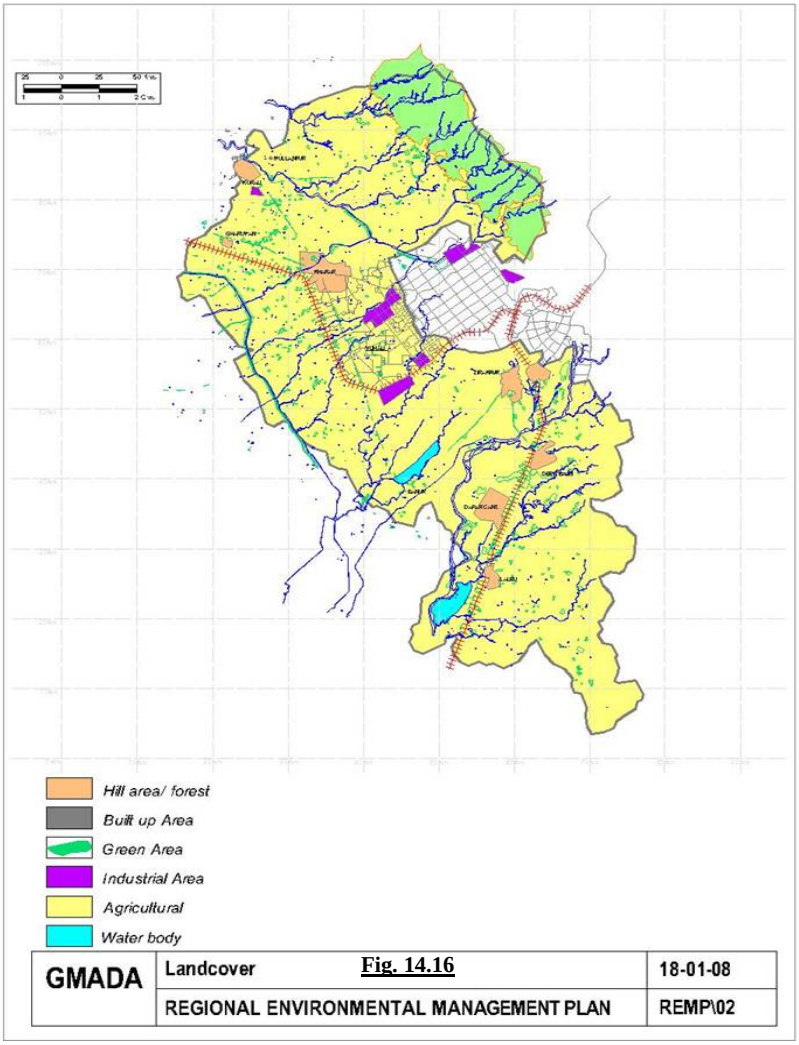
Fig. 14.15

comparatively less (4m) form 1975-2003. This clearly indicates that urbanization in Mohali has had serious impact on ground water table. Therefore recharge and conservation of ground water will be a critical issue.

14.2.7 Land cover

Land is the fundamental basis for most of the human or natural activities and is one of the major natural resources on earth. Agricultural productivity is entirely dependent on the availability of suitable land. The availability of vast tracts of fertile land was a major factor responsible for the agricultural success of Punjab. The region is a part of Indo Gangetic plain formed by the alluvial deposits by rivers of Indus system and their tributaries. The Indo-Gangetic Plain is a rich, fertile and ancient land encompassing most of northern and eastern India.

14.2.8 Forests



GMADA	Landcover	Fig. 14.16	18-01-08
	REGIONAL ENVIRONMENTAL MANAGEMENT PLAN		REMP\02

Greater Mohali Area been recently carved out from districts of Ropar and Patiala, the occurrence of Shivalik forests and Bir forests (originally dominant in the two districts) is evident. The Shivalik forests are predominantly found in the NW portion of Greater Mohali Region territory forming an area of about 100 sq km (8.3% of GMR).

14.2.9 Bio-diversity

- **Crop diversification:** To give a boost to the diversification of agriculture in Punjab, a multi-crop multi-year, Contract Farming Scheme was launched in the state in 2002. The twin objectives of this programme are to reduce area under wheat and paddy and prepare farmers to cultivate quality and marketable produce based on demand supply chain. The Punjab Agro Foods Corporation (PAFC) is the nodal agency to coordinate contract farming. It arranges high-yielding seed varieties for farmers from reputed companies, provides technical supervision, follow-up on agronomic practices and buy back facility for the entire produce with returns comparable to, or better than, those what farmers receive from paddy and wheat. The PAFC had already signed agreements with reputed companies to implement contract farming in the

state. The programme was first initiated in rabi 2002 season covering 8.9 thousand ha with 9100 farmers and by the kharif 2005 season, an area of more than 19 thousand ha involving more than 0.1 million farmers has been covered under the programme (Source: PAFC, 2005).

- **Role of Agro forestry:** Agro-forestry is ecologically based natural farming system which involves growing trees along with various crops. As recommended by PAU, trees like Poplar (Populus deltoids), Kikar (Acacia nilotica), Subabul (Leucaena leucocephala), Drek (Melia azaderach) can be successfully grown with main crops as per agro-climatic conditions of Punjab. Though eucalyptus was popular in the state in early eighties, its cultivation declined due lack of proper marketing and reports about its adverse impact on soil, as well as ground water. Now, the state's farmers have shown their interest in poplar plantation (mainly because poplar is considered good for intercropping, has high growth rate and gives good economic returns due to better marketing which is further due to demand of several plywood units in the state). Cultivation of potato + fodder crops and sugarcane as inter-crop in the early stages of Poplar plantation has been found to be profitable and better than wheat-paddy rotation

As per Remote sensing data for 2004, Punjab has an area of 18.88 thousand ha (0.37% of total geographical area) under agro forestry plantation of mainly Poplar, Safeda (Eucalyptus) and Sheesham/Tahli (Dalbergia sissoo), out of which 0.13% area is under poplar. The Gurdaspur, Faridkot and Nawanshehar districts have 0.5-1.05 % area under agroforestry. In the remaining districts, the area under agroforestry plantation is less than 0.5% of their respective geographical areas (Source: PRSC, 2006).

Year	Cattle	Buffaloes	Horses & Ponies	Donkeys	Sheep	Goats	Camels	Pigs	Total livestock	Poultry
1972	3390	3796	50	65	388	537	102	46	8646	3017
1977	3312	4110	76	61	498	722	74	128	8996	5539
1990	2832	5578	33	36	508	537	43	96	9678	15276
1997	2639	6171	34	23	436	414	30	93	9858	11022
2003	2039	5995	29	5	220	278	4	29	8607	10779

Source: Statistical Abstract of Punjab, 2005

The farmers of the state are usually not willing to block the land for longer periods under agroforestry plantation, but commonly prefer boundary plantation of Poplar, Eucalyptus, Drek, etc. in North-South direction, which acts as wind breaks. Along with financial benefits to farmers, agroforestry can play a vital role in balancing the ecology. Pollution can be mitigated by planting good biomass producing trees. Vast potential of agroforestry in different parts of the state needs to be exploited to meet the growing demands of timber, fodder and firewood on one hand and to conserve the much endangered ecological balance by reducing the pressure on reserve forests on the other.

- **Diversity of domesticated fauna:** Livestock plays an important role in the rural economy of the state. It has contributed 11.77 % to the Gross State Domestic Product (GSDP) at constant (1993-94) prices in 2004-05 (Q). Livestock can also be an effective instrument to cope with the problem of low income related to agriculture by supplementing the same and providing employment to small and marginal farmers and land-less agricultural labourers. As per the 17th livestock census, 2003, the state of Punjab had 1.10% of cattle, 6.12% of buffaloes, 0.36% of sheep, 0.22% of goats and 0.22% of pig population of the country. The poultry population is 2.2% of the country's total poultry population. In numerical terms total livestock population amounts 8.6 million and total poultry population including ducks stand out as 10.78 million. The milk, egg and wool production in state was 8391 thousand tonnes (second in rank among the states), 3.06 billion numbers and 554 thousand kgs, respectively during the year 2003-04. (Source: Department of Animal Husbandry, Punjab). The change in live stock and poultry population in Punjab during the period 1972 to 2003, indicates that the total

livestock in the state has decreased from 9.85 million to 8.60 million during the inter-census period of 1997 to 2003 and shown an overall decrease of 12.7%. The crossbred cattle has decreased by 16.3% (from 1.828 million in 1997 to 1.53 million in 2003) and indigenous cattle decreased by 37.3% (0.80 million in 1997 to 0.57 million in 2003). Thus an overall decrease of

22.7% has been recorded in total cattle population between 1997 and 2003 (Source: Department of Animal Husbandry, Punjab). The buffalo population has also shown a decline of 2.9% during the period. The population of sheep, goats and pigs has also decreased by 49.5%, 32.9% and 69.8% respectively. There has also been a slight decrease (2.2%) in the poultry population in the state during this period.

White revolution has been promoted in the state since the nineties. Though the number of cattle and buffaloes has decreased, but with up gradation of germplasm the production of milk and other animal products has increased. Milk production stands at 8.9 million metric tones (MMT). The cattle in the state are 75% crossbred with high production potential. Decrease in numbers of sheep, goat is due to shortage of grazing areas due to conversion of wastelands into agriculture/ cultivable land.

The domesticated agricultural faunal diversity of Punjab includes three breeds each of cows, buffaloes and sheep, two breeds each of goats and poultry and five breeds of horse. Out of these Murrah and Nili Ravi breeds of buffaloes, Hariana and Sahiwal breeds of cattle and Beetal breed of goat are indigenous. A summary of the indigenous and threatened breeds of domesticated animals is presented in the following table.

Domestic Animal	Existing breeds	Indigenous breeds	Threatened breeds
Cattle breeds	Hariana, Sahiwal, cross-bred Jersey, Holstein,	Hariana, Sahiwal	Sahiwal*
Sheep	Lohi, Nali, Desi, Cross bred*	Lohi, Nali, Desi*	Lohi
Horse	Bhutia, Thorough Bred (for stud farm)*, Grey Sindhi*, Marwari*, Kathiawari*	Bhutia*	Bhutia, Grey Sindhi*
Buffalo	Nili ravi, Murrah, Murrah graded	Murrah, Nili-Ravi	Nili-Ravi
Goat	Desi, Beetal	Beetal	Beetal
Poultry	White leg horn, Desi	Punjab Brown	–

Source: MoEF, 1998 and *Deptt of Animal Husbandry, Govt. of Punjab, 2007

- **Aquatic Fauna:** Fish farming not only provides diversification from growing crops but is also highly remunerative. Punjab has very good resources for the development of social fisheries in the form of village ponds, low-lying lands and numerous irrigation dams that had been constructed in the kandi area which could be used for the development of fisheries. Punjab has achieved first position in the country with regard to average fish production of 6 ton/ ha which is 3 times more than the national average. The area under fish cultivation has been progressively increasing and already gone up from 2469 ha in 1990-91 to 9032 ha in 2004-05 (Source: Dept of Animal Husbandry, Dairy Development and Fisheries, GoP, 2005).

The major fish species which are being promoted for pisciculture in the state are Labeo rohita (Rohu), Catla catla (Katla), Cyprinus carpio (Common carp), Ctenopharyngodon idella (Grass carp) and Hypophthalmichthys molitrix (Silver carp). The department is also focusing on propagating culture of fresh water prawns in the state to diversify pisciculture and provide handsome returns to fish farmers. As per information provided by the department, some progressive farmers of the state have taken up cultivation of fresh water prawn in Jalandhar, Patiala and Sangrur districts during 2005 and produced more than 2,200 kg of prawns.

Special emphasis has been laid on increasing the production of fish seed at various government fish seed farms. The state has 14 fish seed farms in 14 districts at Jalandhar, Mukatsar, Moga and Faggan Majra (Fatehgarh Sahib), Dhandua (Nawanshahr), Rajasansi (Amritsar), Hariana (Hoshiarpur), Benra (Sangrur) and at five other places with a production of more than 28.5 million fingerlings during 2003. The ornamental fish production has also been introduced at Government fish seed farm at Ropar to meet existing demand of aquarists and develop an interest in aquarium keeping.

In nutshell, considering the rural dominance and interests of the majority population, there is a great potential to develop Poultry, Cattle rearing and Pisciculture alongside mainstream agriculture in Greater Mohali Region. This includes enabling institutional mechanisms for the spread of technical, marketing facilities and allocating space to promote such activities. Further, keeping in consideration the food demand of domesticated animals, the agricultural fields should be judiciously taken for development.

In addition to this, there should be greater emphasis to conserve the large and small natural water bodies for aquaculture. There should be special focus to keep these hydrological reserves free from indiscriminate pollution from insecticides, sewerage, municipal and hazardous wastes.

14.3 Landuse Suitability

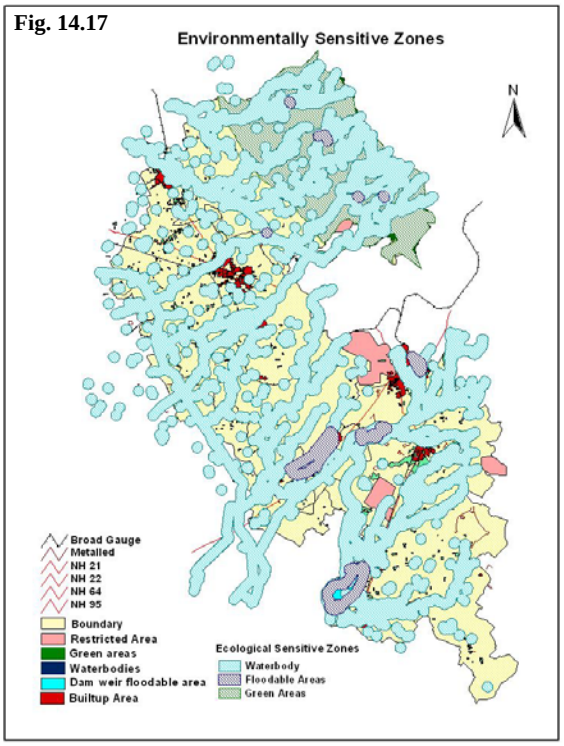
Determination of land use suitability is guided by several factors. In this chapter, only the environmental considerations and their spatial constraints and potentials have been examined for a few of the major land uses as follows:

- Residential (which includes all socio-economic local recreational infrastructures in addition to housing)
- Commercial (offices, shopping complexes etc.)
- Major institutions (college, universities and technical institutions)
- Industries
- Recreational (open space, golf courses, play fields etc.)
- Landscape (parks, water bodies, gardens, forests etc.)
- Agricultural
- Transportation
- Environmentally sensitive areas.

The land use allocation potential has been assessed irrespective of demand on the basis of locational criteria for the environmentally sensitive areas, such as forests, flood plains of rivers and tributaries, potential water recharge zones, large water bodies. Govt of India through the CPCB has formulated parameters for zoning of industries. For the purposes of zoning industries have been classed according to pollution potential in terms of air and water. Industries have been grouped into four classes on the basis of pollution potential and intense criteria have been assigned. We have used these over the various attributes and spatially located them.

14.3.1 Environmentally Sensitive Zones

Fig. 14.17



Areas which are environmentally sensitive or incompatible are not at all suitable for any type of urban development as per as guidelines provided by the Central Pollution Control Board, Ministry of Environment & Forest, Govt. of India. These areas should be avoided for sitting an industry or carrying of process or operations. Forest, wetlands, floodable area are environmentally sensitive zones. No development is possible within 5 km buffer distance from existing forest. This zone can only be utilized for recreation, agriculture or greenery. Any type of urban development is not possible within half kilometer buffer distance on either side of the water bodies. Floodable areas are also environmentally sensitive and thus not suitable for development *(Ref. Map No. 1).*

14.4 Industrial Location Suitability

Industries have been broadly classified according to pollution potential 1. Air Polluting, 2. Water polluting, 3. Air and Water Polluting. The industries have been further classified according to industrial production typologies, and size of operation. Locational criteria are based on distances.

14.4.1 Site Suitability for potentially Air Polluting Industries

For siting a potentially air polluting industry, different physical as well environmental parameters are taken into consideration as per as the guidelines provided by Central Pollution Control Board. Industries are categorized into different categories based on their pollution impact potential.

Industry Category	Impact Potential
A1	> 7 km
A2	5 to 7 km
A3	2 to 5 km
A4	< 2 km

Table 14.1 Categorization of Air Polluting Industries

(impact potential considered without pollution control equipment in operation)*

Industries can be developed at a certain distance from existing green areas, residential areas, water bodies, restricted areas and road networks based on their pollution impact potential. Different zones are delineated based on the buffer distance as mentioned in the CPCB guidelines. Based on the guidelines, the site suitability for industries of different category is discussed later on.

Table14.2 Site Suitability for Air Polluting Industries

Air pollution sensitivity / Industry category	Environmentally Sensitive Zones or Areas to be avoided	Zone-1 (<2 km)	Zone-2 (2 to 5 km)	Zone-3 (5 to 7 km)	Zone-4 (>7km)
A1 (> 7 km)	Not Suitable	Not Suitable	Not Suitable	Not Suitable	Possible
A2 (5 to 7 km)	Not Suitable	Not Suitable	Not Suitable	Possible	Suitable
A3 (2 to 5 km)	Not Suitable	Not suitable	Possible	Suitable	Suitable
A4 (< 2 km)	Not Suitable	Possible	Suitable	Suitable	Suitable

14.4.2 Green Areas

Zone 1 is only suitable for A4 category of industries having less than 2 km pollution potential. Industries of A3 category can be developed beyond zone 1. In Greater Mohali Region most of the area can be identified as zone 1 based on the distance from existing forest and green areas *(Ref. Fig. No. 14.8a).*

Fig. 14.18 (a)

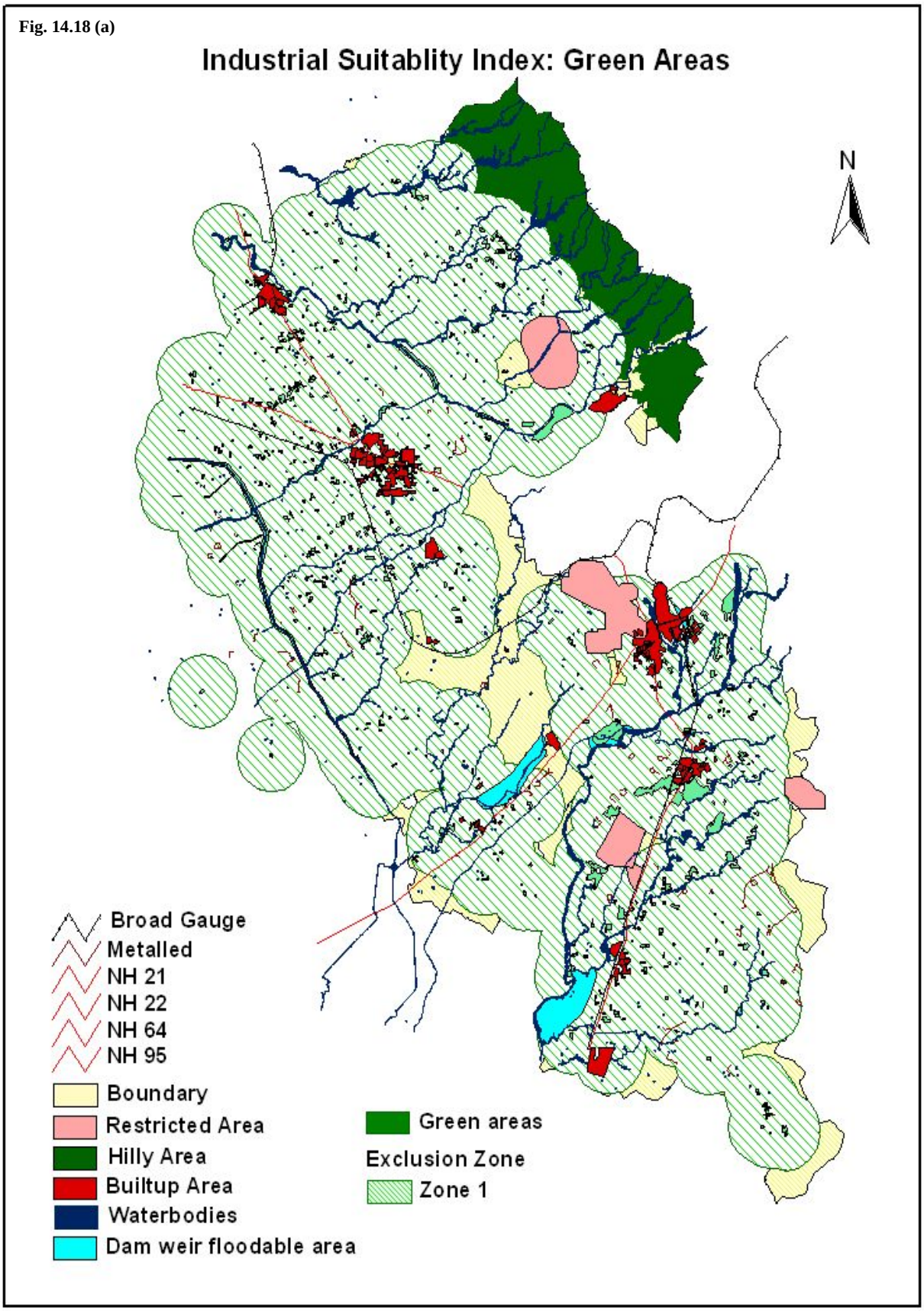
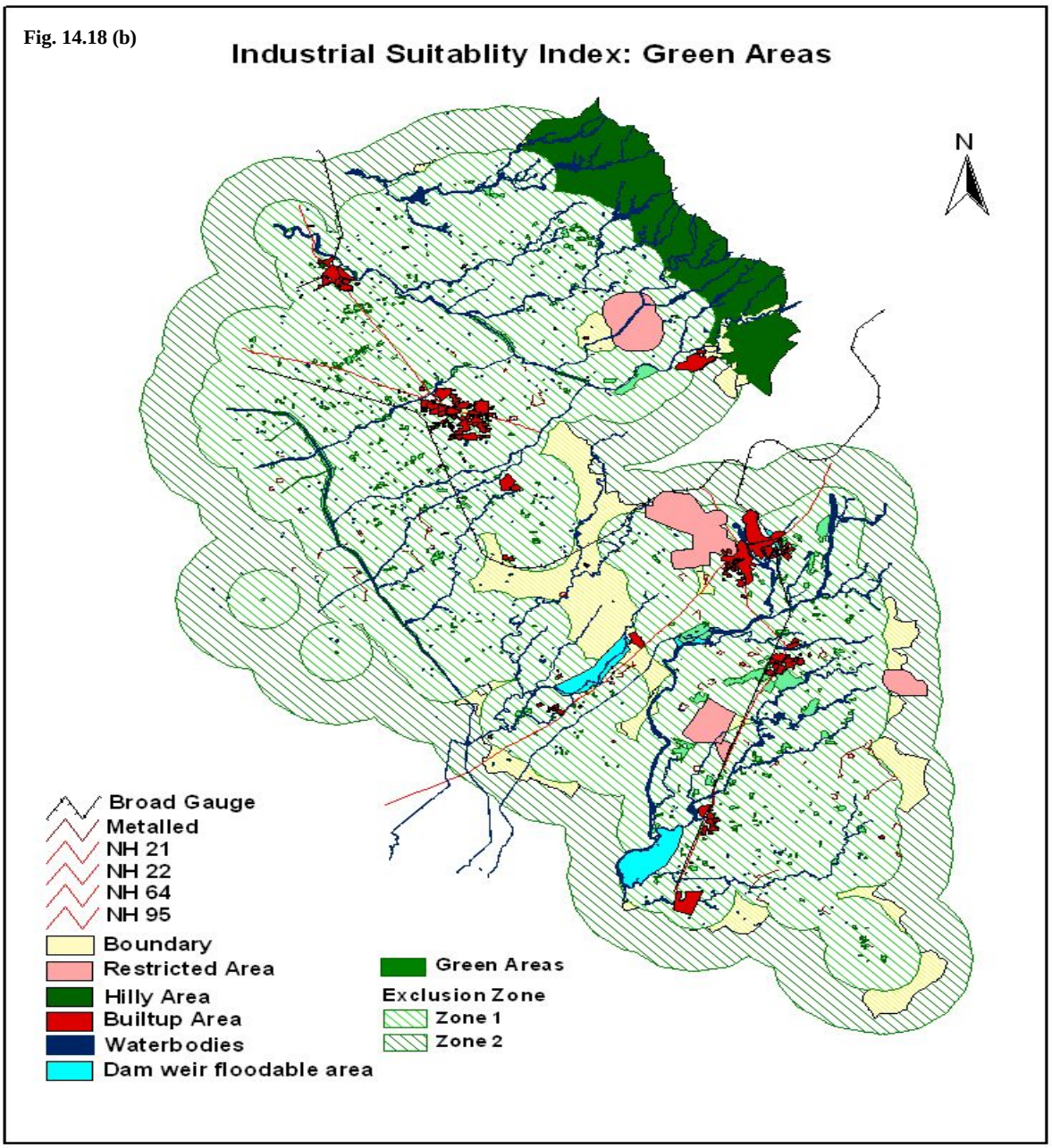
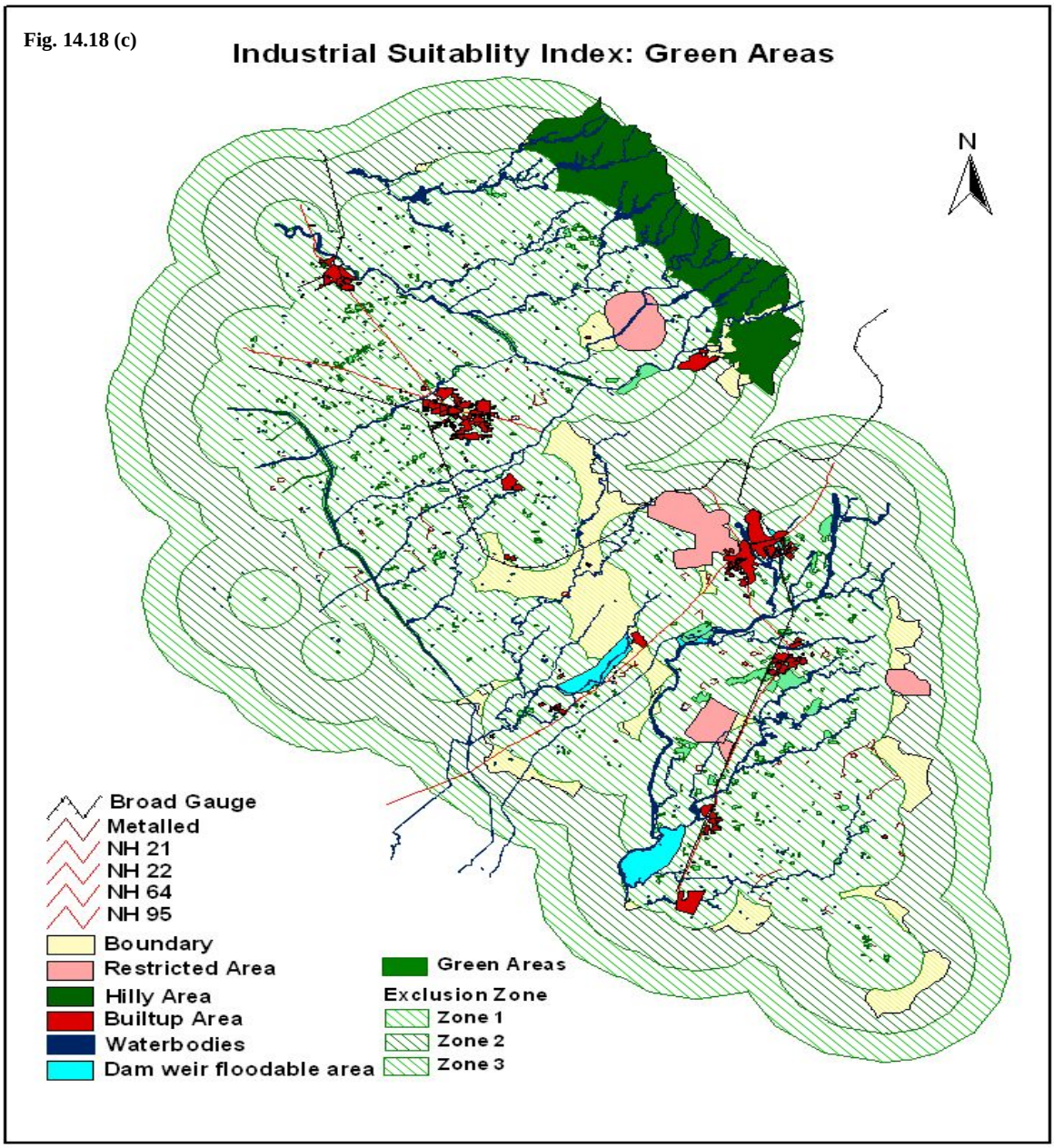

Industrial Suitablity Index: Green Areas
N
Broad Gauge
Metalled
NH 21
NH 22
NH 64
NH 95
Boundary
Restricted Area
Hilly Area
Builtup Area
Waterbodies
Dam weir floodable area
Green areas
Exclusion Zone
Zone 1

Fig. 14.18 (b)



Industries of A3 category having 5 km impact on environment can be developed in zone 2 (beyond zone 1). It is also possible to develop industry of A4 category in the zone 2. The entire Greater Mohali Region is mostly categorized as zone 2, so A3 & A4 category industry can be developed considering the other pollution parameters *(Ref. Map No. 2B).*

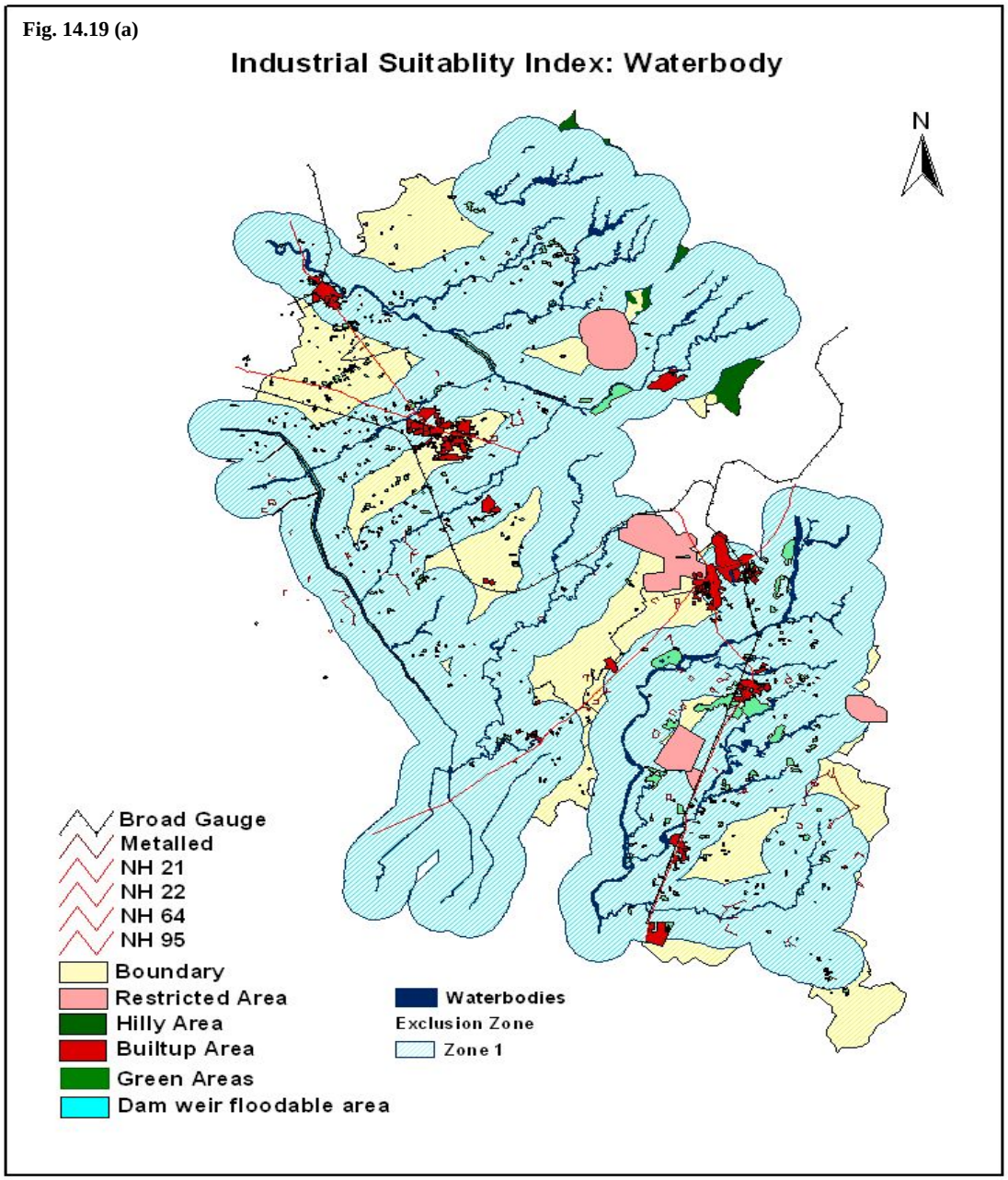
Fig. 14.18 (c)



Industries of A2 category having more than 5 km impact can be developed in zone 3. The zone 3 is also favorable for A3 & A4 category. Thus it can be summarized that zone 1 (buffer distance of 2 km) can be used for only A4 category industries, zone 2 (buffer distance of 5 km) can be used for both A3 and A4 category and zone 3 (buffer distance of 7 km) is suitable for A2, A3 & A4. The industries of A1 category of higher potential impact can be develop beyond the outer fringe of zone 3 i.e. beyond 7 km.

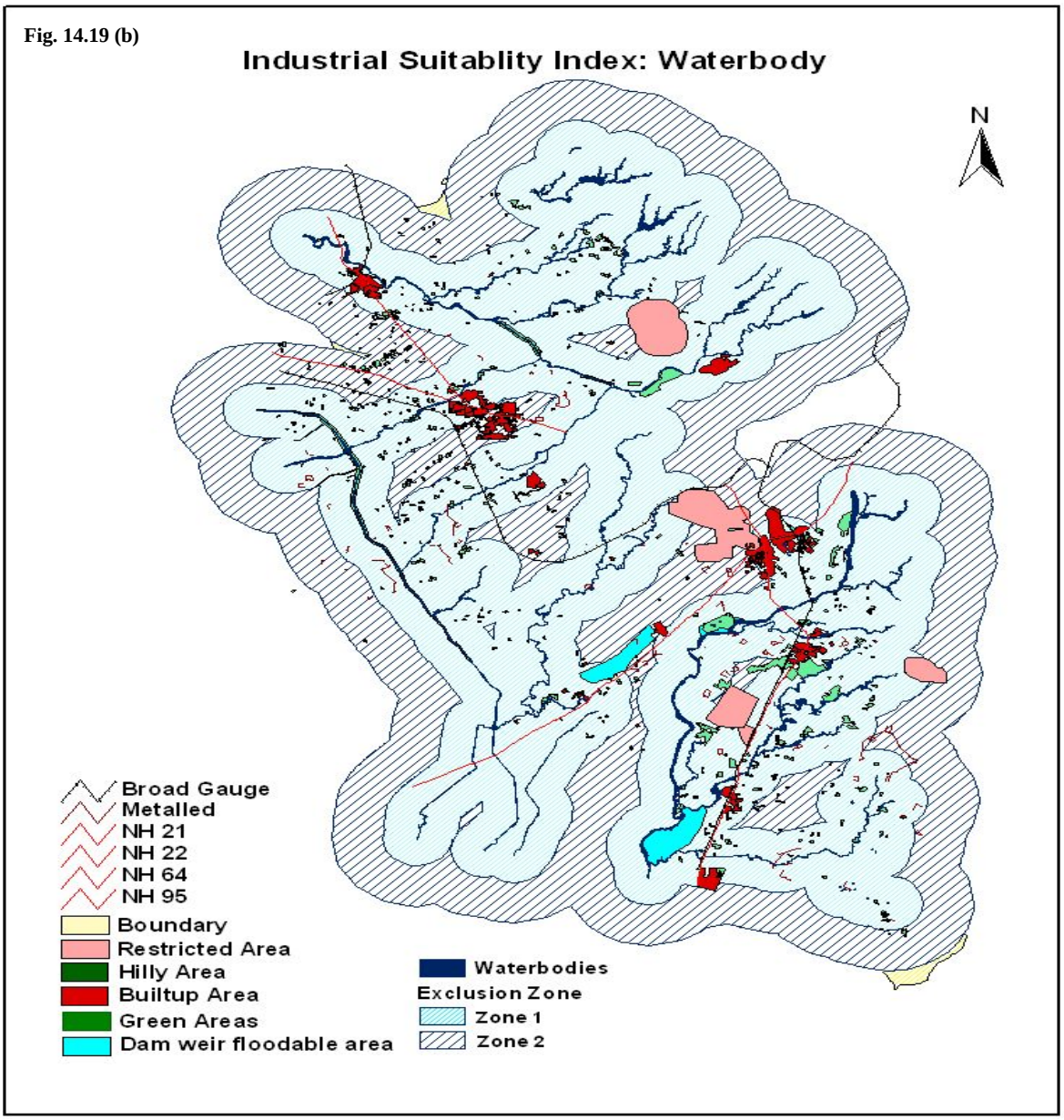
14.4.3 Water body

Fig. 14.19 (a)



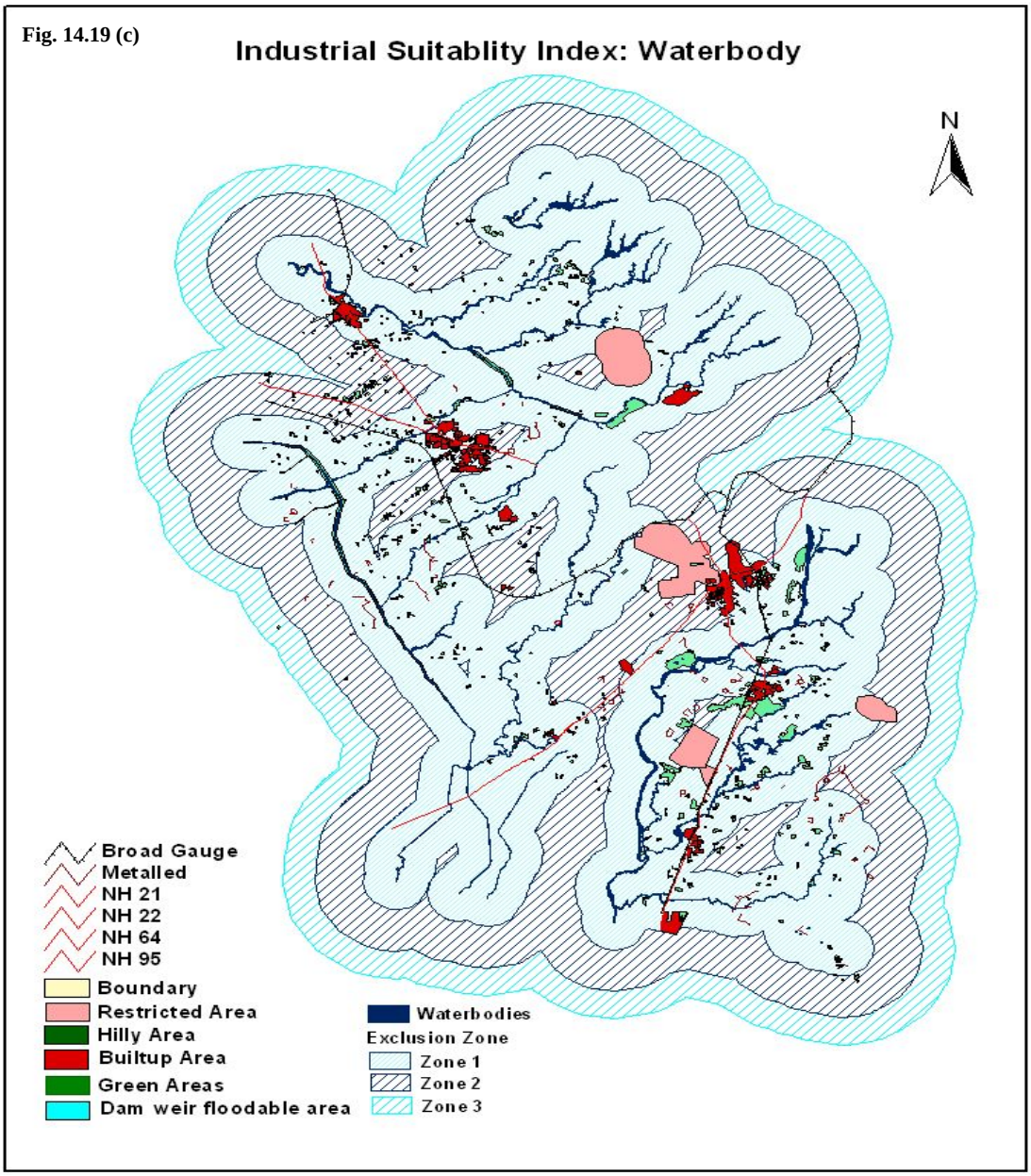
The distance from existing water bodies is another important factor for sitting an air polluting industry. As per as CPCB guidelines, the development of A4 categories of industries having very low environmental impact can be possible in zone 1.

Fig. 14.19 (b)



Zone 2 having buffer distance of 5 km from the water body can be utilized for A4 and A3 category industries. A3 industries can only develop beyond zone 1.

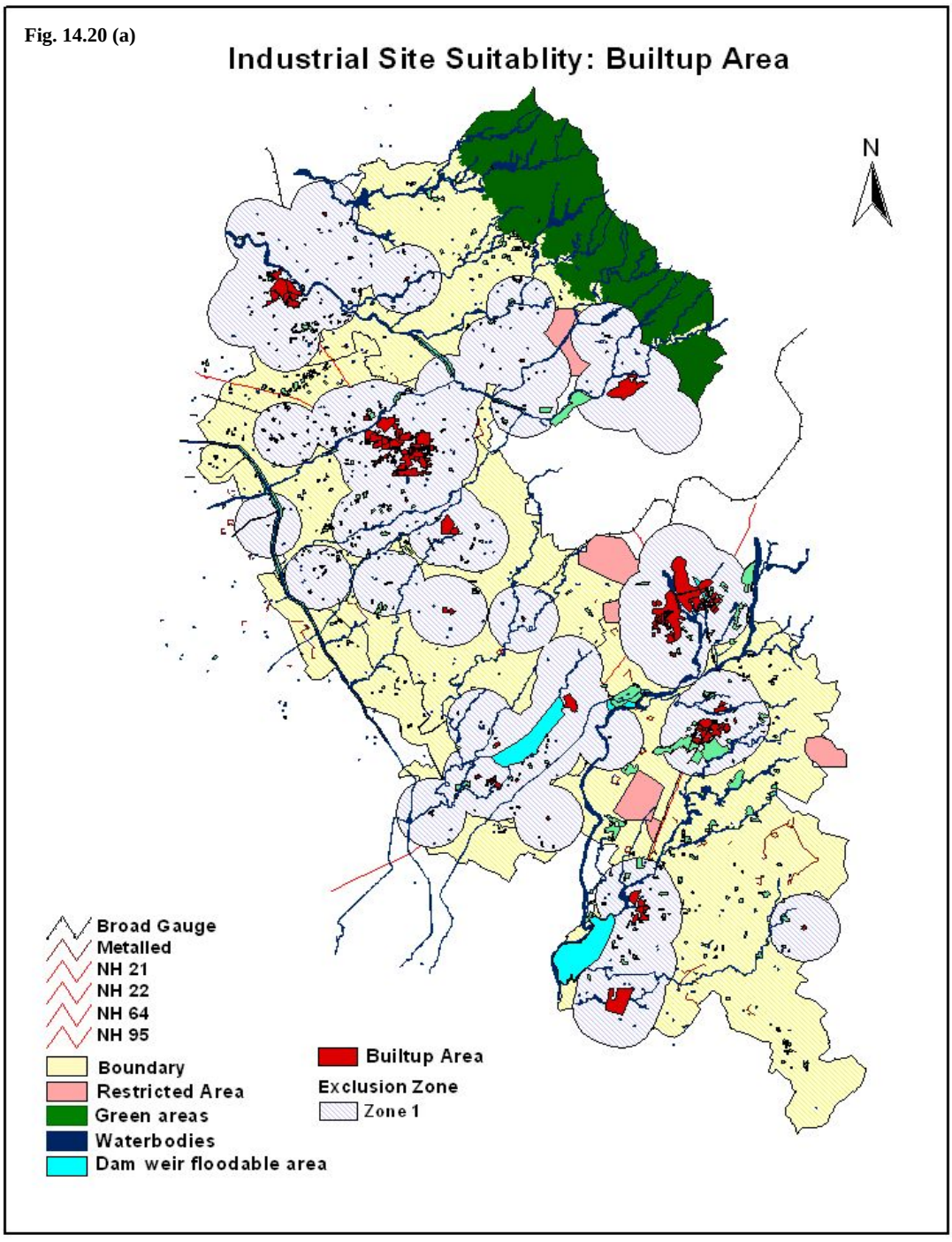
Fig. 14.19 (c)



- Industries of A2 category having higher impact potential more than 5 km can be developed in the zone 3 beyond zone 2. Zone 3 is also favorable for the A3 & A4 category.

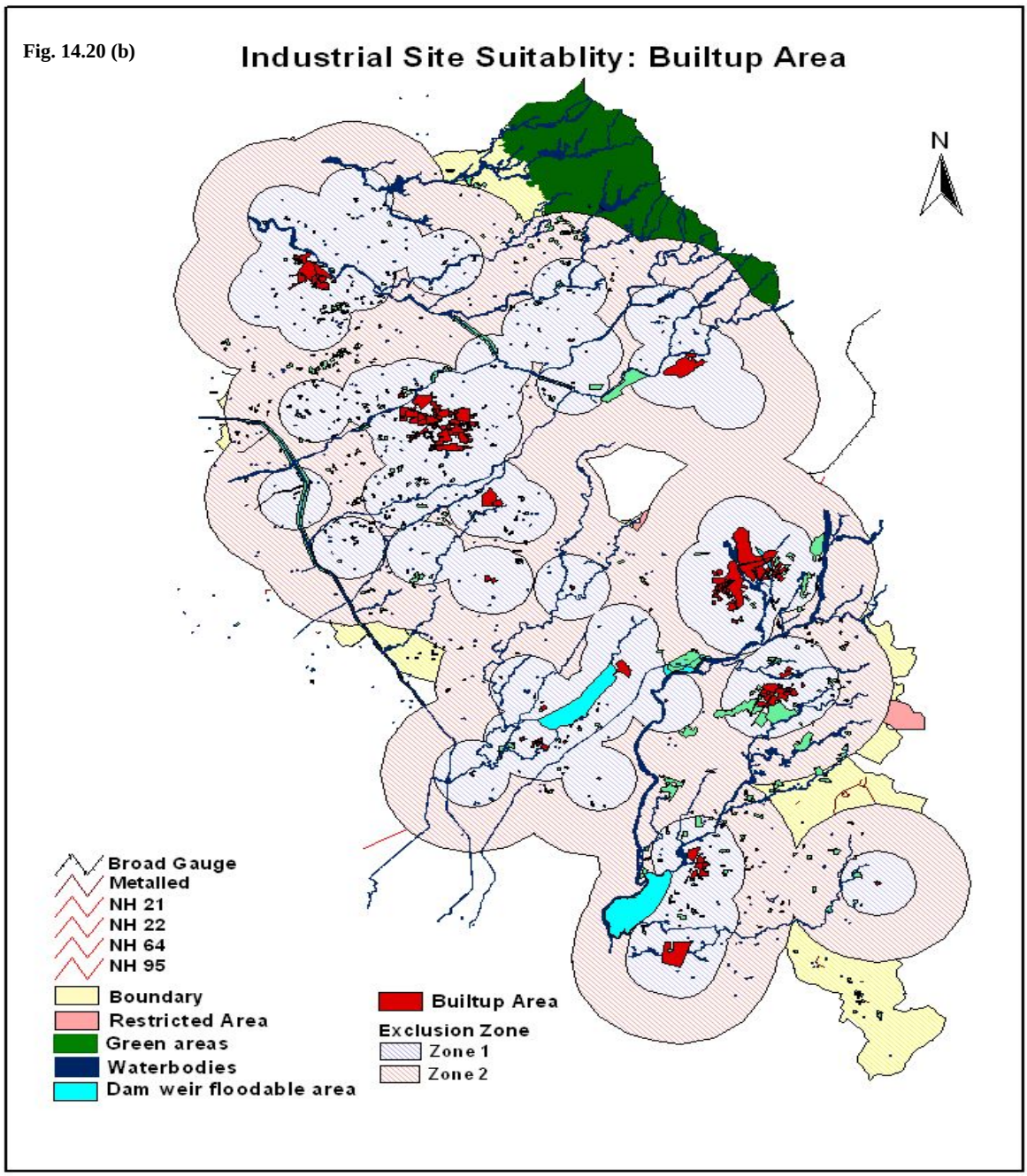
14.4.4 Residential Area

Fig. 14.20 (a)



Industries of different category having higher potential impact shouldn't be developed in the vicinity of residential area. As per as CPCB guidelines, different zones are delineated on the basis of distance from residential area. Zone 1 having buffer distance of 2 km is suitable only for A4 category.

Fig. 14.20 (b)



A3 categories of industry can be developed in zone 2 beyond zone 1. A4 category can also be developed in the zone 2.

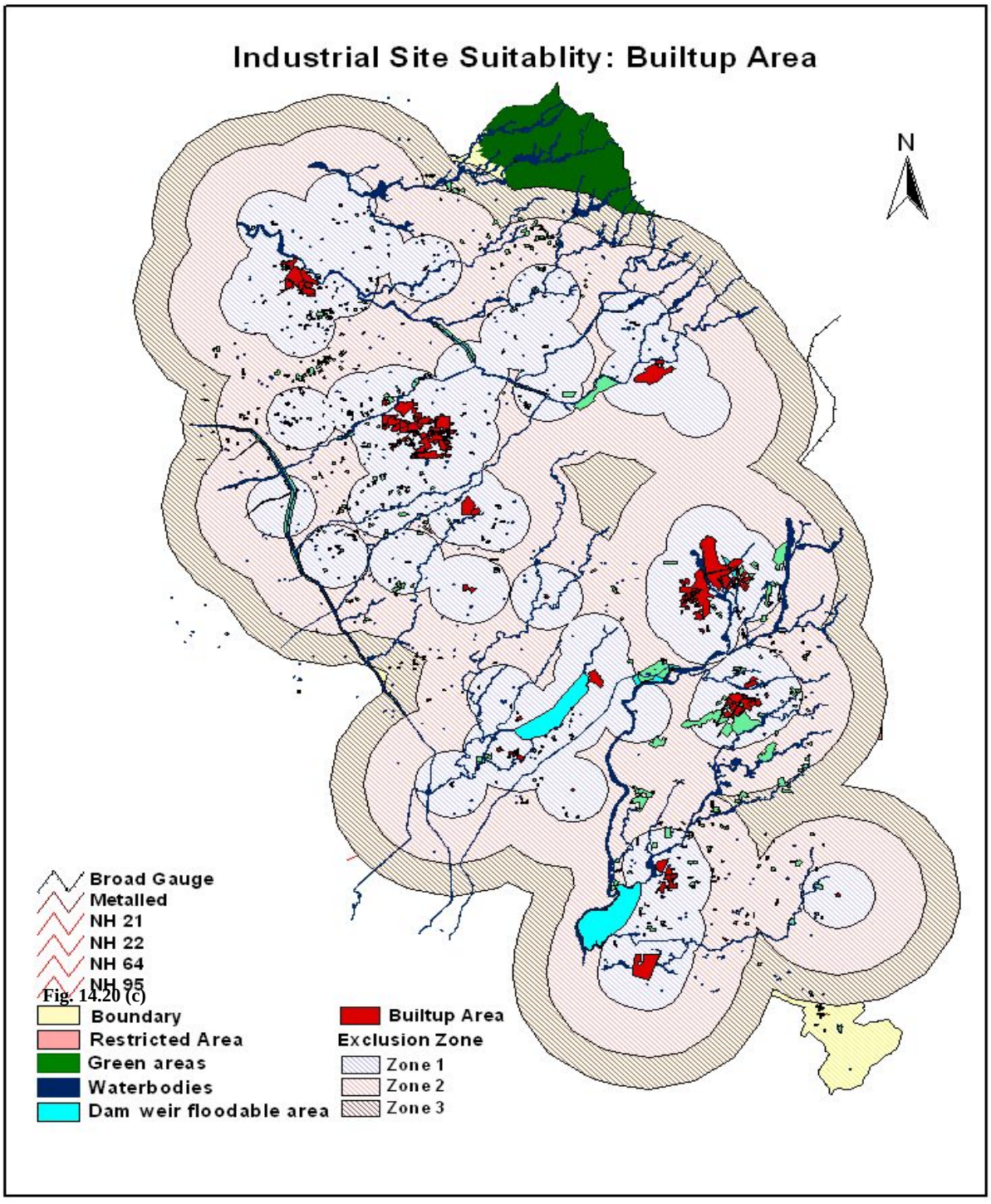
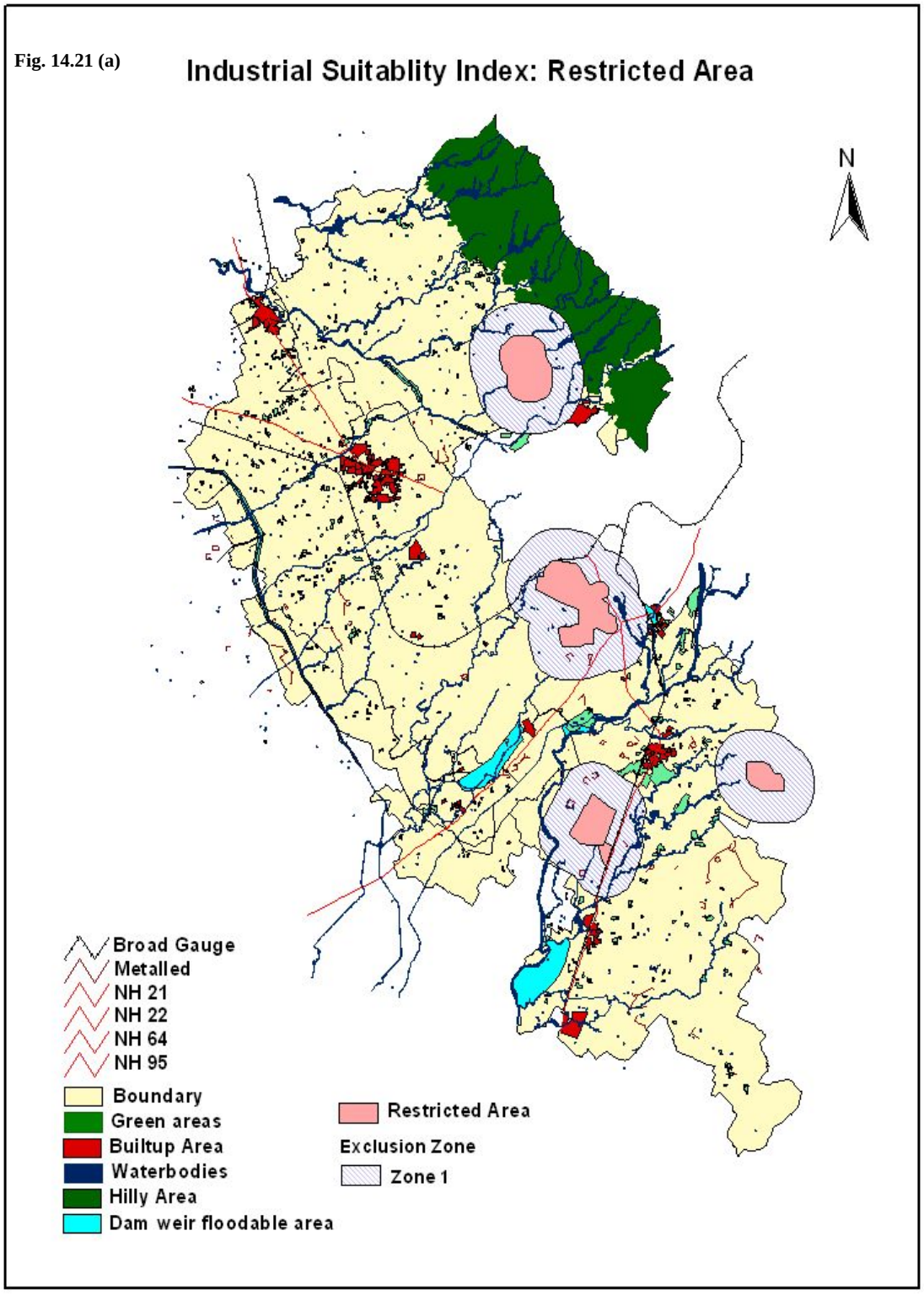


Fig. 14.20 (c)

In the zone 3, A2 category industry having more than 5 km impact on environment can be developed. A1 category having higher impact can be possible to develop beyond zone 3. Thus it can be summarized that the Greater Mohali Region is not suitable for A1 category industry; A2, A3 & A4 category industries can be possible in different zones based on the impact potential.

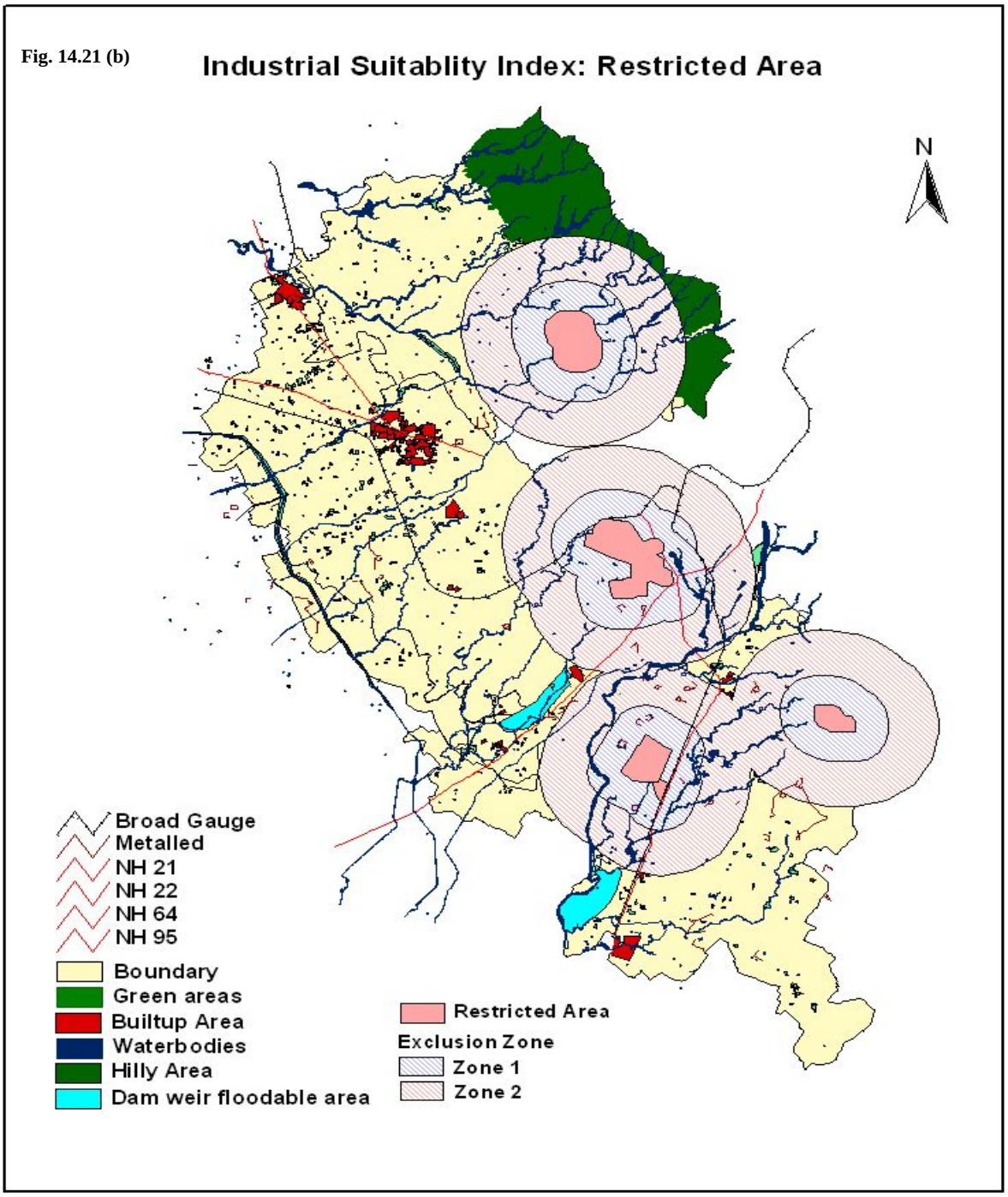
14.4.5 Restricted Area

Fig. 14.21 (a)



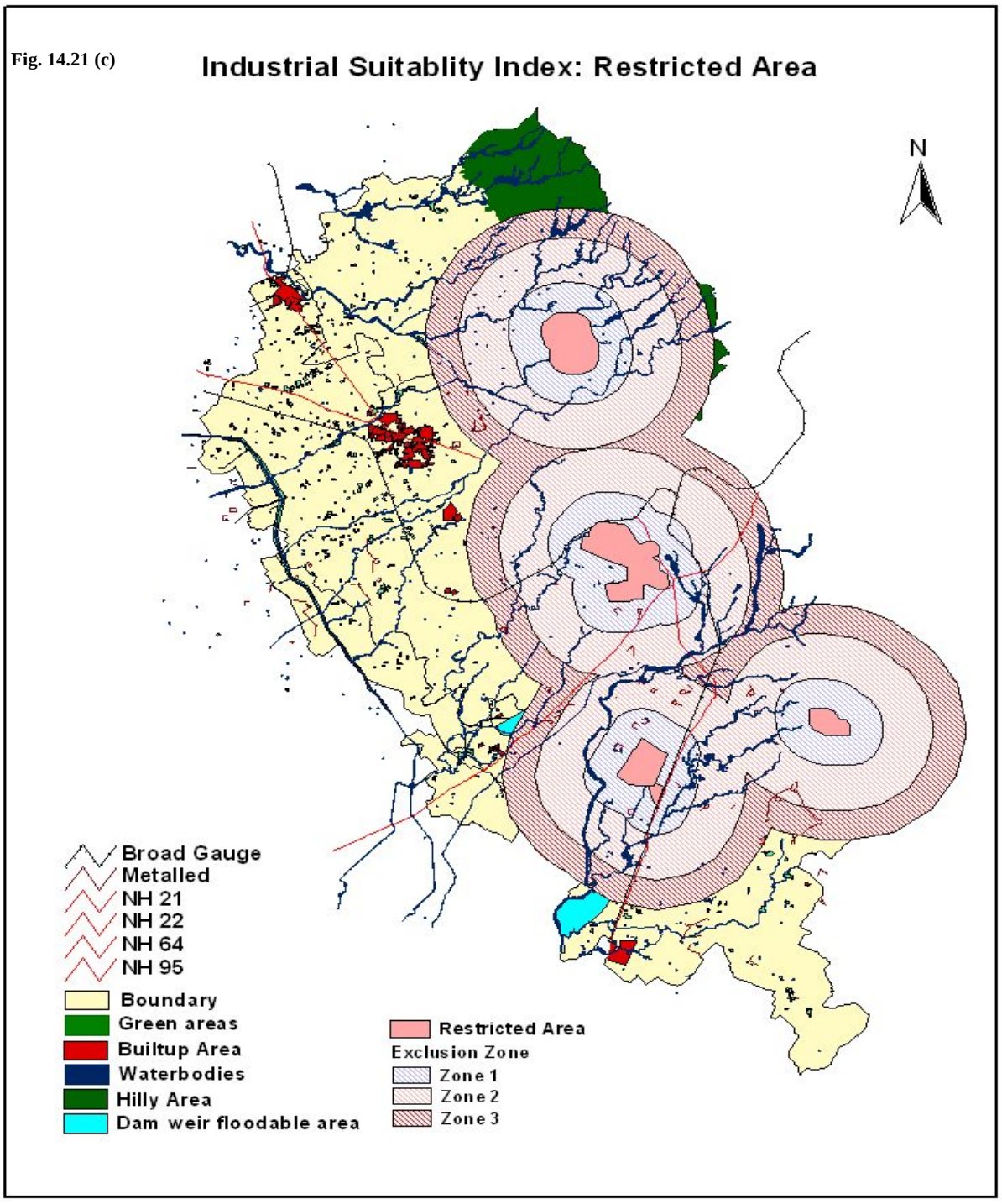
For siting of industries having potential impact on environment, distance from restricted area should be considered. According to CPCB guidelines, different zones are delineated on the basis of distance from industry. Zone 1 having a buffer distance of 2 km is suitable only for A4 category.

Fig. 14.21 (b)



Zone 2 is suitable for A3 and A4 category. Industries of A3 category can only be developed beyond zone 1.

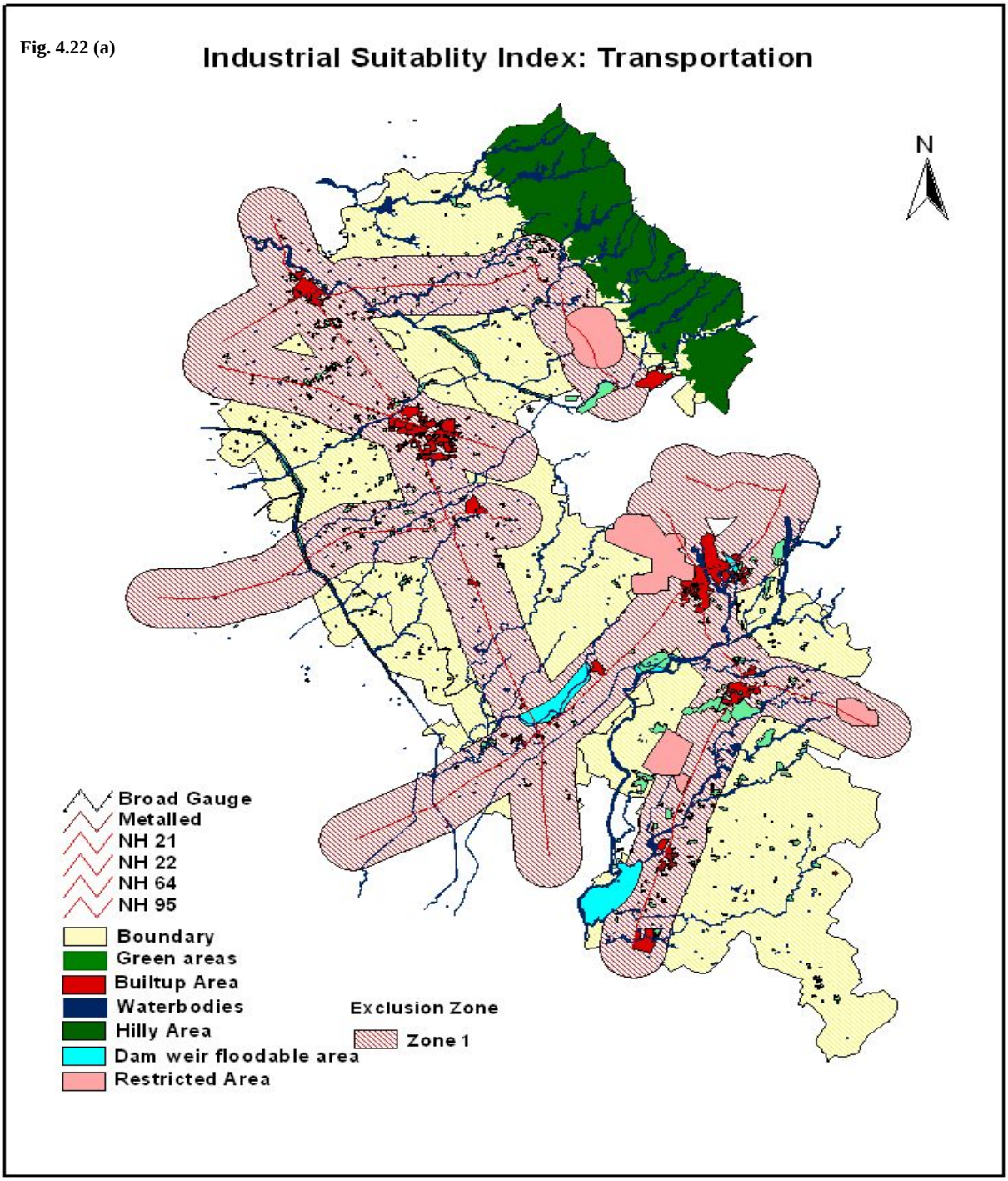
Fig. 14.21 (c)



A1 category can be possible to develop beyond zone 3. Thus it can be concluded that the Greater Mohali Region is not suitable for A1 category industry; A2, A3 & A4 category industries can be possible in different zones based on the impact potential.

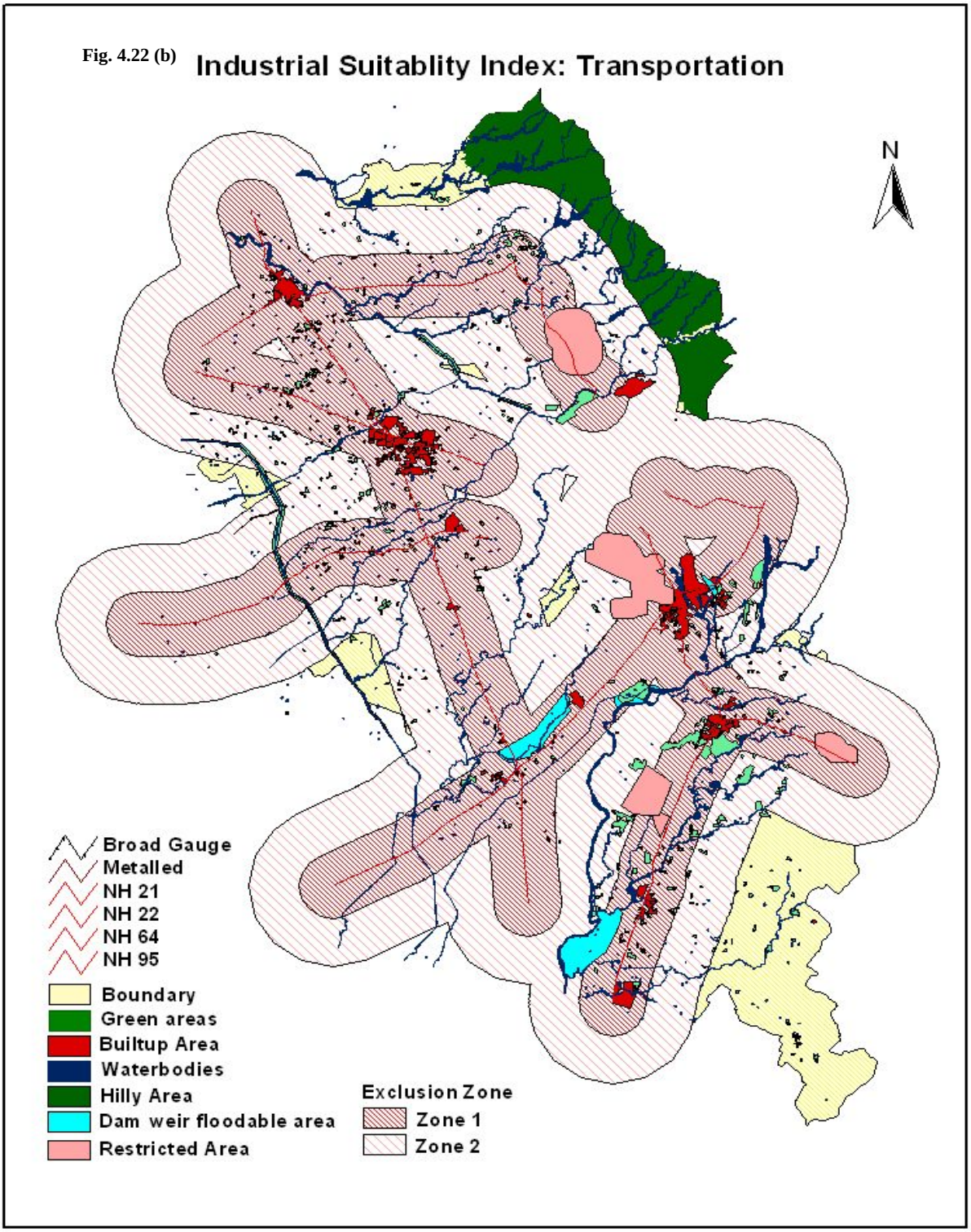
14.4.6 Road Network

Fig. 4.22 (a)



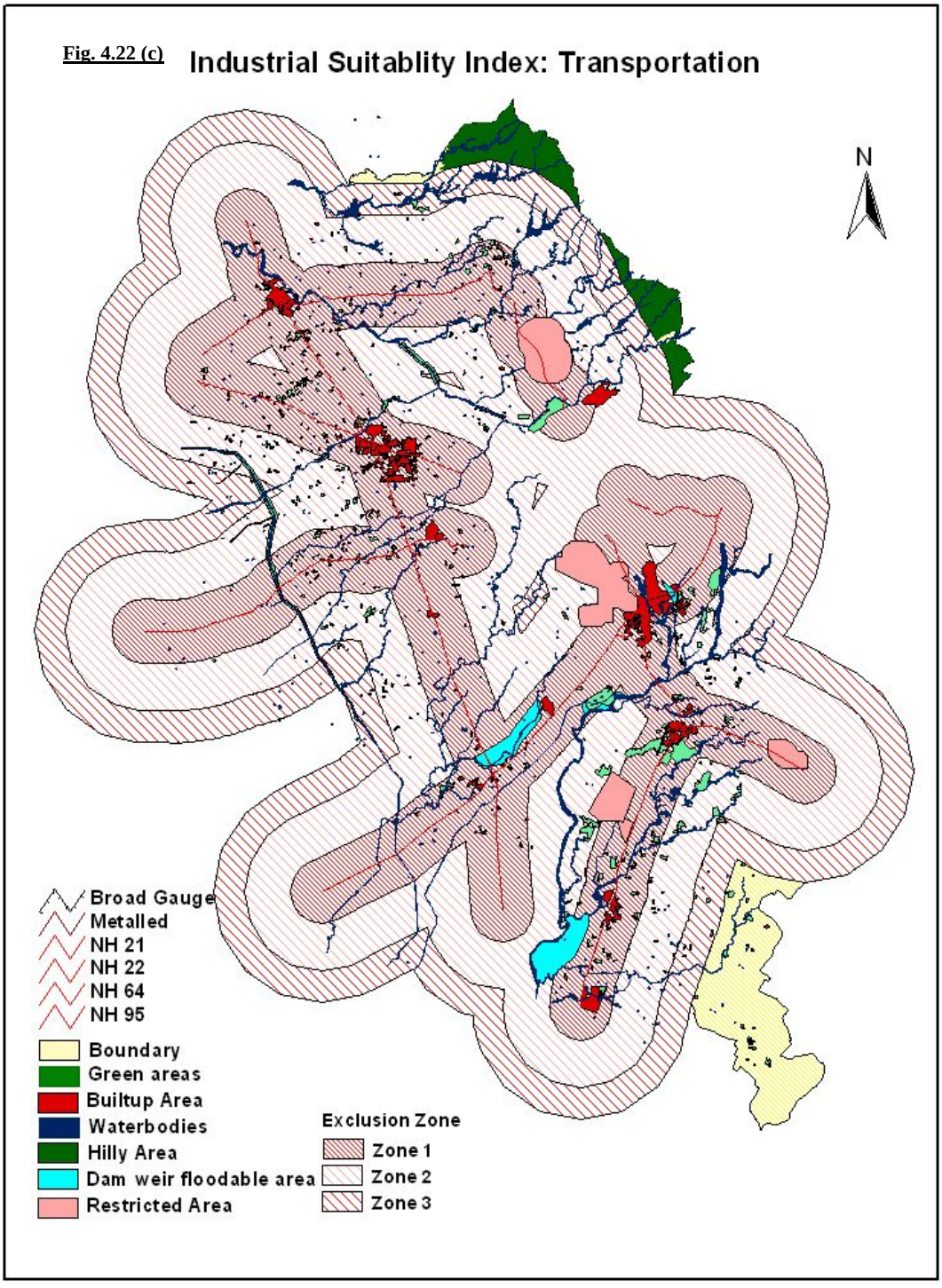
Road network is an important parameter for sitting an industry. According to CPCB guidelines, different zones are delineated on the basis of distance from industry. Zone 1 having a buffer distance of 2 km is suitable only for A4 category.

Fig. 4.22 (b) Industrial Suitablity Index: Transportation



Zone 2 having buffer distance of 5 km from the road network is suitable for A3 category industry. Industries of A4 category can also be developed in this zone.

Fig. 4.22 (c) Industrial Suitablity Index: Transportation



Zone 3 is suitable for A4, A3 & A2 category. A1 category can be possible to develop beyond zone 3. In the Greater Mohali Region development of A1 category industry; A2, A3 & A4 category industries can be possible in different zones based on the impact potential.

14.5 Site Suitability for potentially Water Polluting Industries

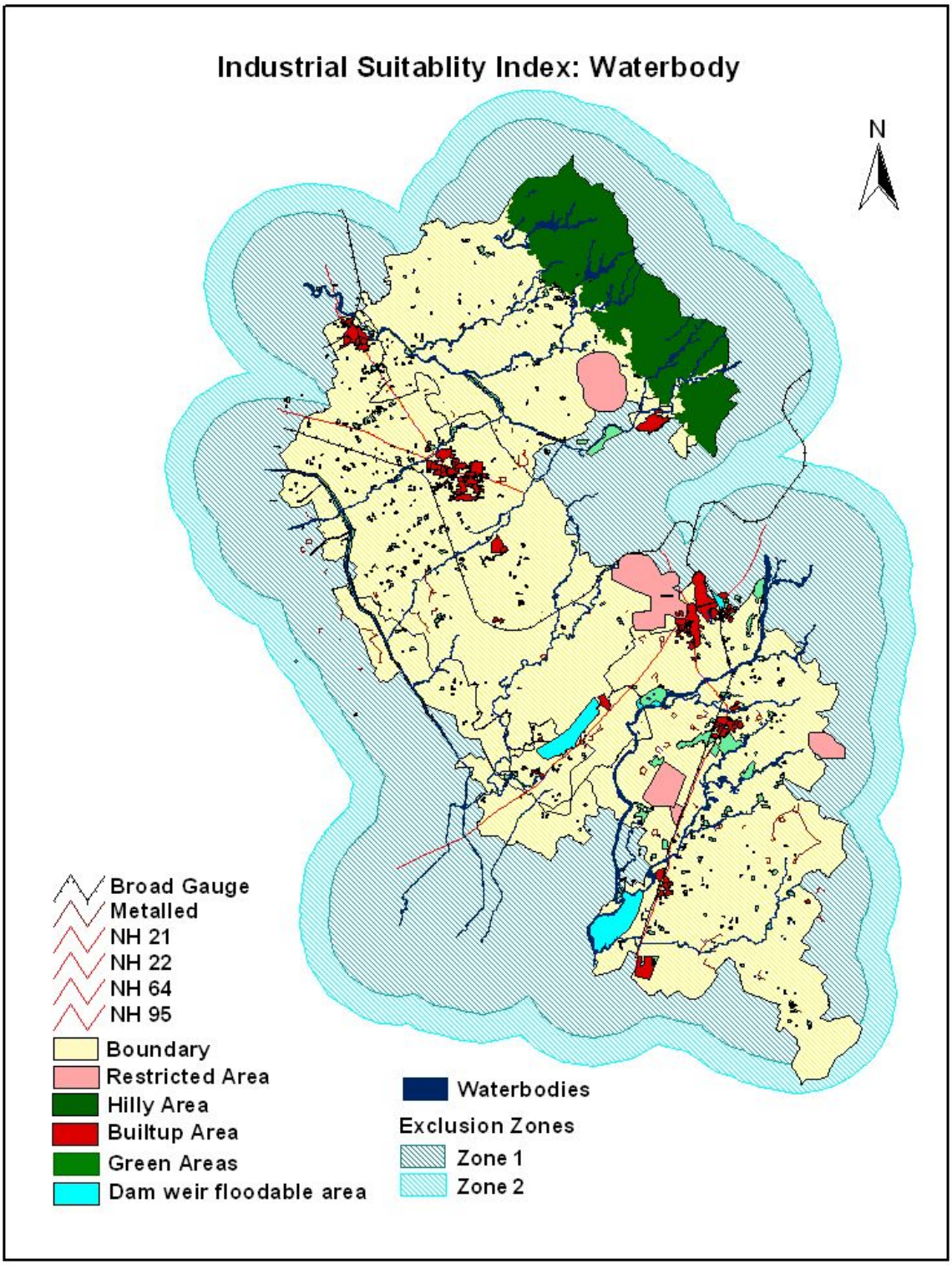
Like air polluting industries, different environmental parameters are taken into consideration for sitting a water polluting industry, as per as the CPCB guidelines. Industries can also categorize into different categories based on their pollution impact potential.

Table14.3: Categorization of Water Polluting Industries

Industry Category	Impact Potential*
W1	Very High
W2	High
W3	Medium to High
W4	Low

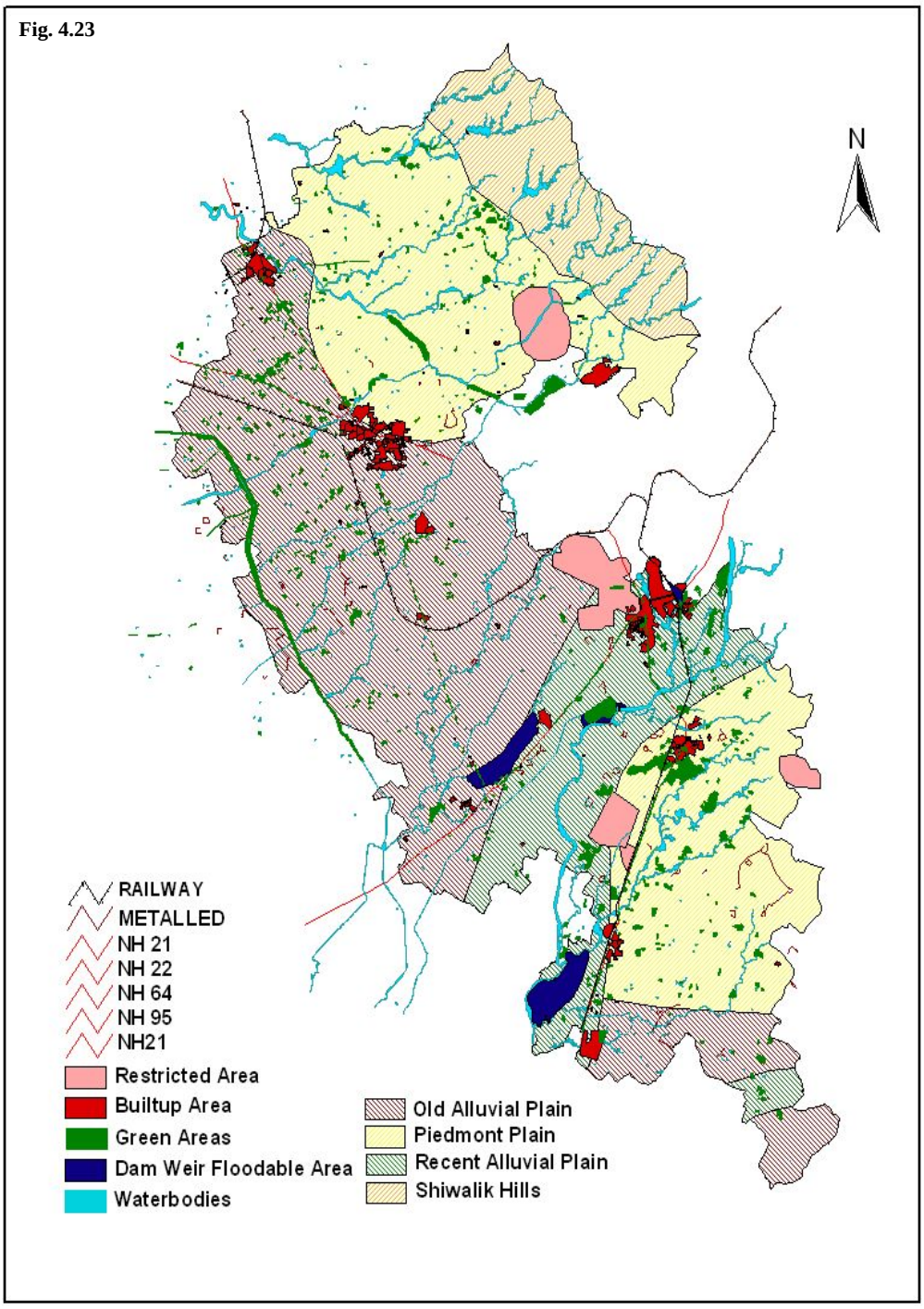
Table14.4: Site Suitability for Water Polluting Industries

Water pollution sensitivity Industry category	Environmentally Sensitive Zones/ Areas to be avoided	High Sensitivity Zone	Medium Sensitivity Zone	Low Sensitivity Zone
W1(very high potential)	Not Suitable	Not Suitable	Not Suitable	Possible
W2 (high potential)	Not Suitable	Not Suitable	Possible for limited number with BAT	Possible
W3 (medium to high potential)	Not Suitable	Not suitable	Possible	Suitable


Industrial Suitablity Index: Waterbody
N
Broad Gauge
Metalled
NH 21
NH 22
NH 64
NH 95
Boundary
Restricted Area
Hilly Area
Builtup Area
Green Areas
Dam weir floodable area
Waterbodies
Exclusion Zones
Zone 1
Zone 2

14.6 Other Parameters

Fig. 4.23



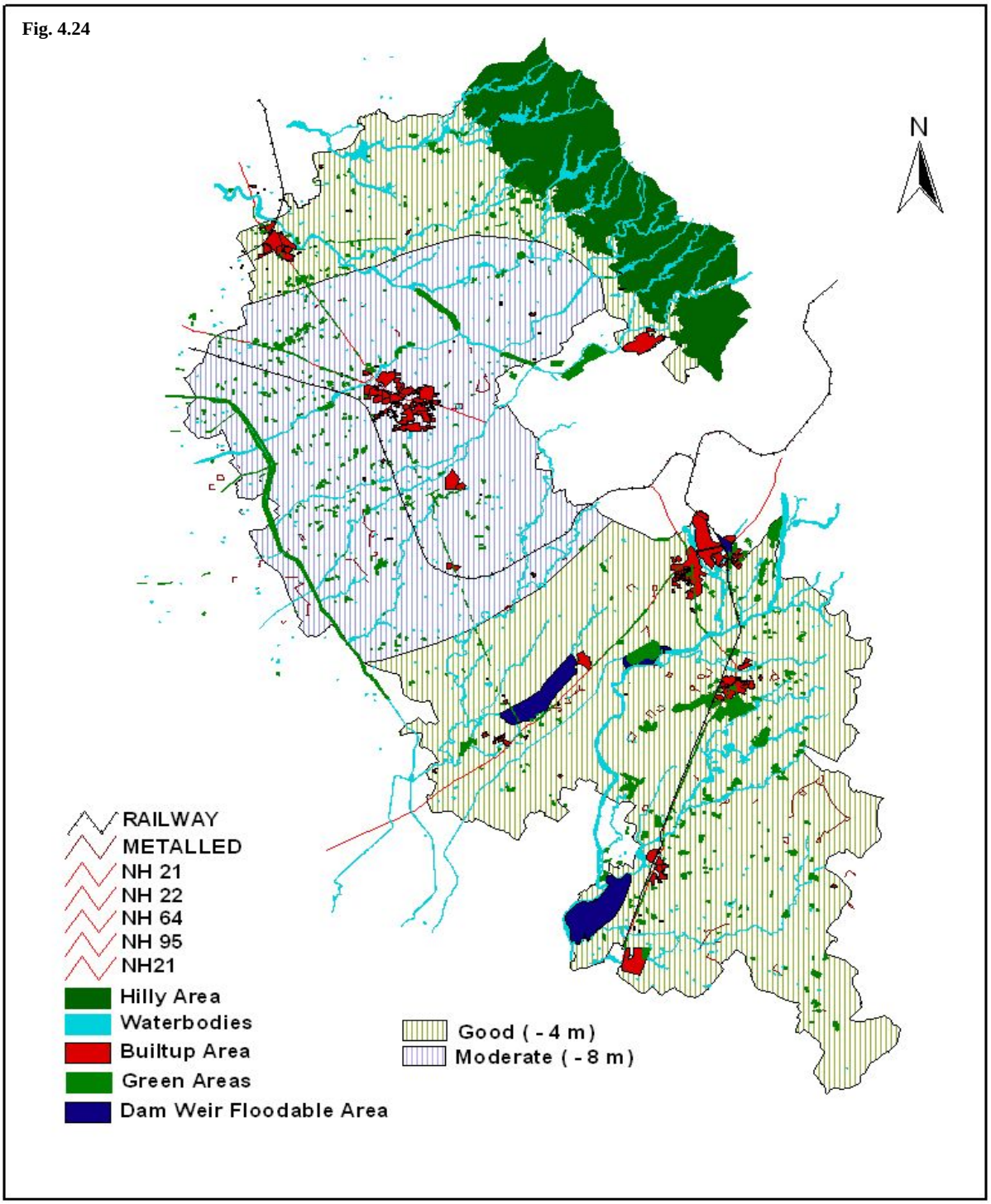
14.6.1 Soil

Rocky surface of Shivalik hills with steep or moderate slope is not at all suitable for settlement, industry and agriculture but suitable for recreation and vegetations. Old alluvial plains are mostly suitable for all types of land use development. On the other side recent flood plain in the southern part is good for agriculture, recreation and green areas, but the active alluvial plain is not at all suitable for settlement and industry. The active and recent flood plains can only be used for agricultural and recreational purpose.

14.6.2 Ground Water

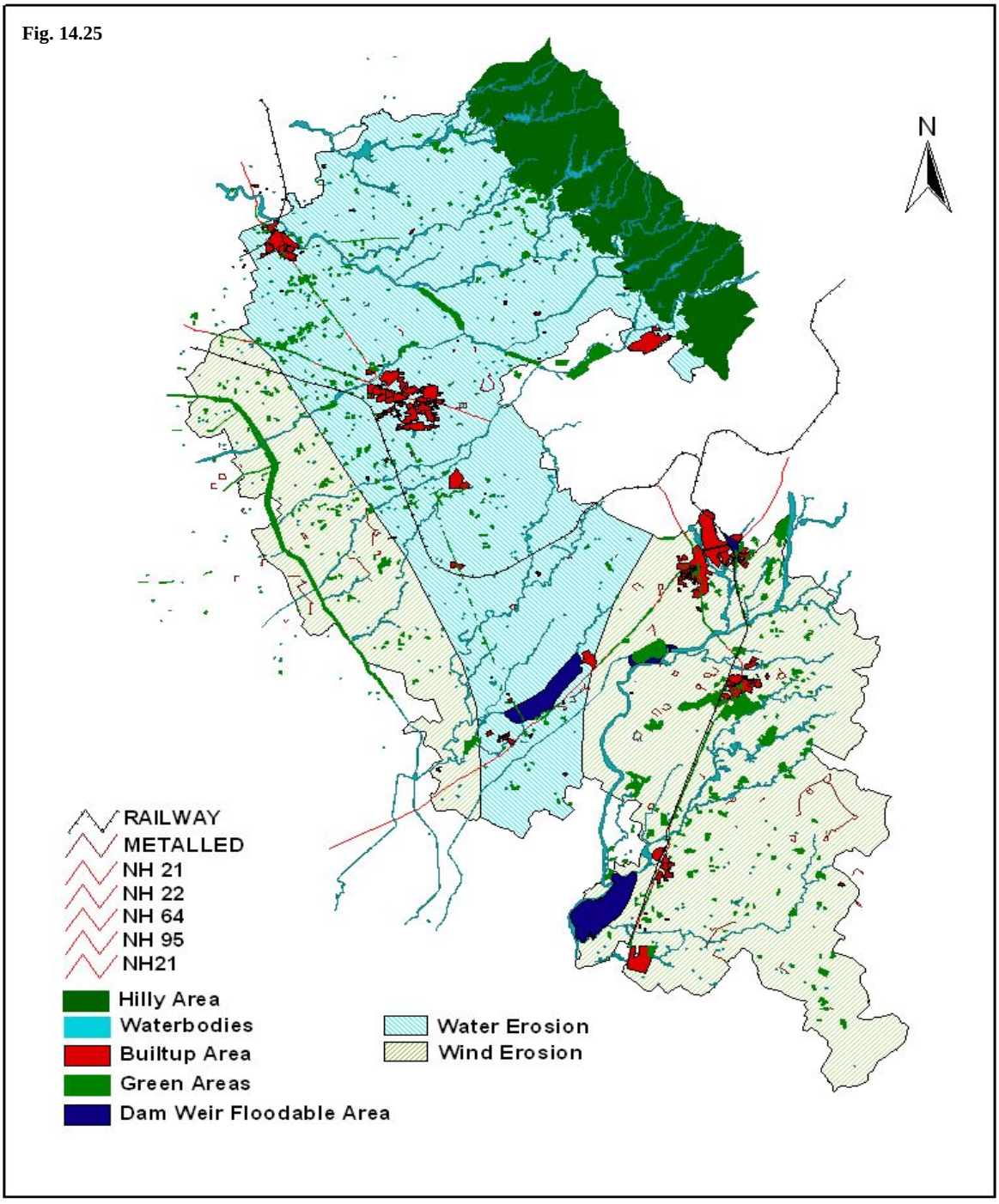
Areas having good ground water prospect and quality is ideal for any type of land use. On the other side, development of settlement, industry and agriculture should be restricted in the areas having poor / moderate prospect. The middle part of Greater Mohali Region the ground water table is almost 8 meters below ground so the extraction of ground water should be restricted in this area *(Ref. Map No. 23).*

Fig. 4.24



14.6.3 Wind and Water Erosion

Fig. 14.25



Land conservation required for the areas which are susceptible to wind and water erosion.

14.6.4 Slope

Area having gentle slope (1 to 15%) is suitable for the development of settlement, industry, agriculture, recreation and vegetation while moderately steep slope (15 to 35%) area is not suitable for the industry and settlement. Moderately steep area can be useful for agriculture, recreation and

green areas development. In Greater Mohali Region, industry and settlement cannot be developed in the northern Shivalik area for having higher slope. Agricultural practice is possible in this area, highly suitable for greens areas as well as for recreation.

14.6.5 Existing Settlement

In the near vicinity of existing settlement all types of development is possible. Within 2 km buffer distance from any existing settlements industry of any category cannot be developed.

14.6.6 Existing Vegetated Area

Further development of any settlement or industry or agriculture is not possible within the existing vegetative area. This area can be developed for recreational purpose only.

14.7.7 Existing Recreational Area

No development is possible in the existing recreational areas like Regional Park, District Park and Neighborhood Park etc. These areas are highly suitable for recreation and green areas development.

14.6.8 Accessibility

Areas within 4 km from existing road and rail network, is highly suitable for any type of development. Beyond 4 km is moderately suitable for recreation and settlement.

14.6.9 Flood Prone Areas

Active flood plains and flood prone areas are not at all suitable for settlement as well as for industries. Flood prone areas can be used for agriculture, recreation and green areas.

14.7 Land Development Potential

Land requirement is based on population projection. Population has been projected for 50 years. It is showing a growing population. However, the growth rate of population is declining in India over the decades. The net growth in population has witnessed a declining trend over the decades starting from 1961. The decadal growth of population of 21.34 per cent in 1991-2001, witnessed the sharpest decline since independence with the average growth rate for the corresponding period declining to 1.93 per cent per annum.[1]

The Registrar General of India had anticipated that the population of India will stabilize by 2025-2030. Some of the southern states have already reached nearly zero population growth. The growth rate of population in the State of Punjab during the last decade was 19.76 against all India growth rate of 21.34.

The population of S.A.S. Nagar (Mohali) (then a village) was only 1229 in 1971 but grew by about 39% per year during the period 1971-81 to reach 32,351 in 1981. Though the rate of growth in Mohali's population has declined after 1981 due to a larger base population, it has remained high at over 9% per year during 1981-91 and over 4.5% per year during 1991-2001. This is a reflection of demand which has not been met by Chandigarh due to its restrictive development policies and may not be a true reflection of growth momentum. This indicates a volatile situation where deterministic prescriptions may be replaced by flexible approach.

Considering the past trend of growth in population of the urban settlements forming part of the Greater Mohali Region, it is clear that S.A.S. Nagar (Mohali) has driven the growth in urban population after 1971, though with the population base increasing after two decades of rapid growth, the growth rate of Mohali's population at 4.6% p.a. fell below that of some other towns in the Greater Mohali Region like Dera Bassi and Kharar during 1991-2001 though it has remained higher than the growth rate for the S.A.S. Nagar (Mohali) district as a whole (2.0% p.a. over the period 1991-2001). The past trend of population growth in some of the urban settlements forming part of the Greater Mohali Region is shown in the table below:

Table 14.5: Population Growth Trends for Select Towns in the Greater Mohali Region

Population as per Census of	2001	1991	1981	1971
S.A.S. Nagar (Mohali)	**123,484**	**78,457**	**32,351**	**1,229**
	(4.6%)	**(9.3%)**	**(38.7%)**	**(4.4%)**
Kharar	**42,289**	**26,109**	**21,807**	**10,686**
	(4.9%)	**(1.8%)**	**(7.4%)**	**(2.7%)**
Kurali	**23,047**	**17,592**	**12,637**	**10,686**
	(2.7%)	**(3.4%)**	**(2.6%)**	**(4.3%)**
Dera Bassi	**15,841**	**9,602**	**7,421**	**5,807**
	(5.1%)	**(2.6%)**	**(2.5%)**	**(3.7%)**

Note: Figures in brackets indicate the annual growth rate of population over the ten years since the previous Census

[1] Census of India 2001

From the above table it is visible that Mohali has a declining growth rate. The population has been projected for 50 years and the proposed infrastructure development is based on the projection and land use has been designated on the basis of population projection. Development is made dependant on population growth. In the event of population failing to reach the target of growth, it could lead to infractuous development of the proposed centralized infrastructure. In view of this and in consideration of poor economic base of majority of urban governments, the Government of India encourages development of decentralized system of construction and management of infrastructure. Several appropriate technologies have been recommended, which can be employed to respond to the uncertainties of the situation.

In India development and environment are given equal importance and hence Indian government has given some guidelines and made conservation of environment a very important aspect of development. It is now mandatory to ensure that development and conservation of resources and environment go together. Thus it is mandatory to conserve and harvest water, recycle sewage waste water, recycle organic garbage and put to use. In addition certain guidelines for site selection for disposal waste (municipal waste, hazardous waste and biomedical waste have been issued , which are required to be followed when selecting a site. All waste disposal sites designated for domestic waste, industrial waste, hazardous waste and biomedical waste require prior environmental clearance. Therefore the rules and regulations regarding site selection need to be observed.

It is advisable to follow the CPCB guidelines for siting of industries. These are based on the pollution and hazard potential. Ministry of Environment, Government of India has classified industries into Green, Orange and Red category according to pollution potential and except Green category; their establishment require prior environmental clearance. In addition, CPCB has issued guidelines for siting of industries according to locational criteria.

14.7.1 Water

It is mandatory to harvest rain water in developments of land of more than 2 acres for residential, commercial, and industrial purposes. Reuse of water is a must. In this region main source of water is ground water, which is sufficient for present population, but if not conserved it could lead to scarcity of water in future. There has been significant depletion of ground water and the table has gone down. Also the physio-chemical properties of the water have deteriorated. Due to built development the rate of run-off would increase creating imbalance between recharge and extraction. In order to redress the balance carefully crafted rain water harvesting and run off management need to be incorporated in the development paradigms and reflected in land use designation. Constructed wetlands which also act as sewage treatment facilities and amenable to decentralized system need serious consideration.

Punjab Water Supply and Sewerage Board (PWSSB) are responsible for the water facilities of urban areas in Greater Mohali Region, while the respective Local Government Municipal Councils are responsible for the rural areas. Generally, the ground water supply and distribution system comprises tube wells, storage or service reservoirs and an extensive network of pipelines.

The current municipal water supply and distribution system only cover certain percentage of Greater Mohali Region. For areas not covered under the current municipal water supply and distribution system, the residents will depend on private wells and storage tanks for their domestic water. This will put demand on water resources since areas which are not getting regular municipal water will extract form tube well or reservoir thus depleting the ground water resources.

Any development which will occur near the water bodies should follow the guidelines given by CPCB. The buffer zones should be maintained in order to surpass any accident, tragedy on a large scale. Proper care should be taken before constructing any Industry near these water bodies. This area is very flood prone zone thus proper care should be taken before the construction.

14.8 Recommendations

Land in this part is a critical report since it is agriculturally highly productive and is considered to be India's gain basket. Therefore land must be conserve in agriculturally land use as much as possible. This is possible by high density and high intensity built form which will be attractive from investor's point of view.

The population is likely to grow incrementally and the growth predictions may need continuous updating. In view of this modules of development which may take place within a five year period may be developed which will be flexible and responsive to changing circumstances.

Water although plentifully available at the moment need to be conserved as per directions of the Ministry of Environment as well as The Supreme Court of India. This area presents good opportunity for harvesting rainwater both in the form of surface storage as well as recharge of ground water. These must be incorporated into the development fabric.

Water conservation is also achieved by adoption of alternative and appropriate technology of sewage management. Several models have been recommended by Government of India for adoption in settlements. These are amenable to modular development and can have a very symbiotic relationship with rural areas in terms of resource sharing.

The sewage disposal system may therefore respond to these options rather than centralized system of sewage disposal.

Air and water polluting uses particularly industries should be designated according to their pollution potential which have been extensively discussed earlier. Some of the areas of industrial allocation in the perspective Plans may be re-examined in terms of land use locational suitability. The typology of industries should conform to locational typology recommended by CPCB and MoEF.

Apart from Shivalik there are several pockets of forest distributed all over the Greater Mohali Region, these have to be conserved and the buffer zone recommended should be protected against urban development. These buffer zones have been indicated earlier.

Entire development have to be sustainable over a period of times in terms of conservation of environmental resources and provide an efficient development pattern flexible enough to respond to variations in situation over the next 50 years.

15. Tourism and Recreation

15.1 Introduction

According to the Tourism Statistics[2] in 2006, tourist visits to India is generally increasing. In 2006, it was recorded that 4.4 million tourists arrived in India. This shows an increase of about 14.6 % from the 2005. Total Foreign exchange earnings have increased to US$ 6569 million in 2006. There are many reasons for the increasing pattern of tourist visits into India. India has always been a popular exotic spot for the Europeans and Americans. In addition, India is opening up all of its markets, lands and estates to welcome global industrialization and commercialization. With more affordable cost of living, low labour costs and overheads, less capital needed to set up businesses, India presents an attractive business location for overseas investors.

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Fig. 15.1 Foreign Tourist Arrivals in India, 1996 to 2006

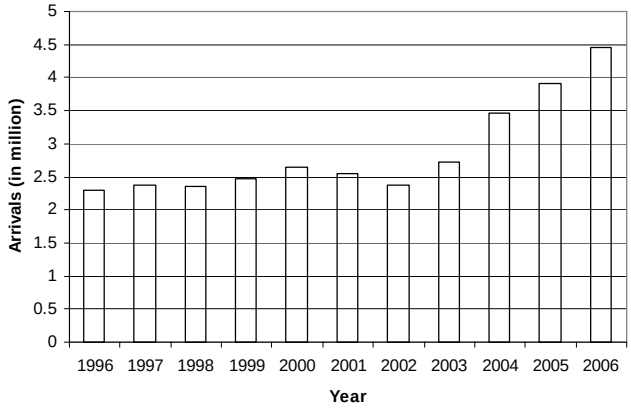
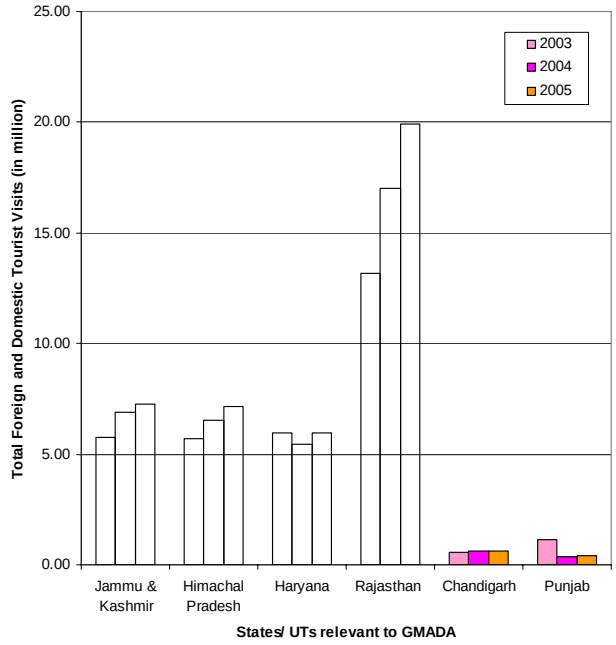


Fig. 15.2 State/ UT Wise Domestic and Foreign Tourist Visits, 2003 - 2005

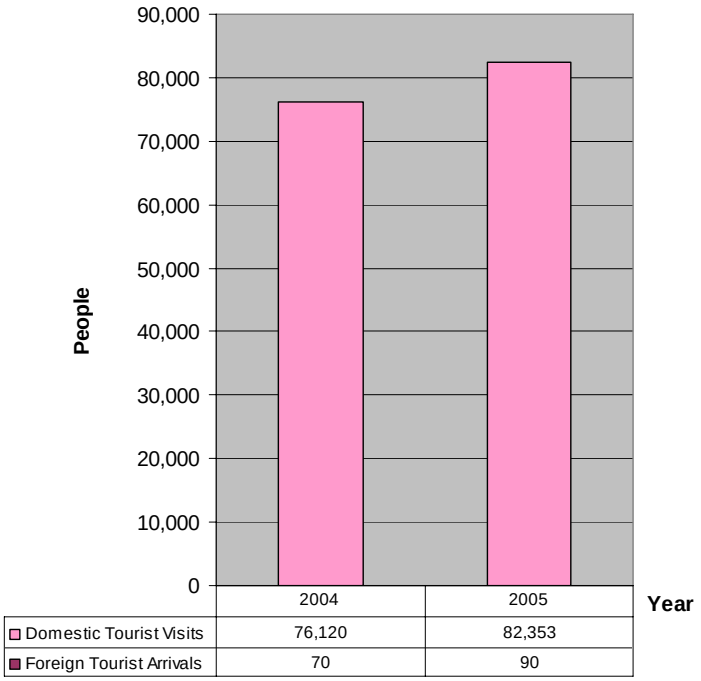


[2] Tourism Statistics 2006 at Glance, Incredible India

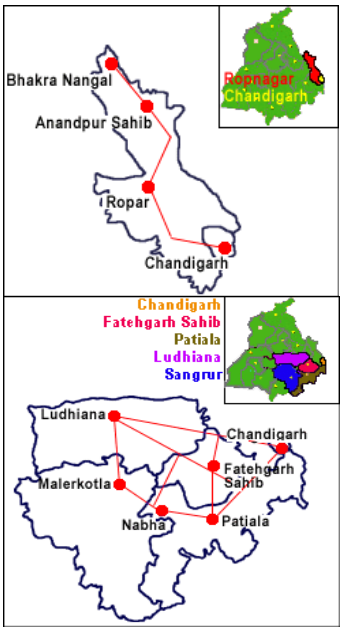
The people in India are now more affluent and able to make short travels to the various states in India or even long travels out of India. India had 461.6 million domestic tourists in 2006, an increase of 18.1% from 2005[3]. This signifies good prospect for the development of the tourism sector in India and Punjab, in particular. Punjab, being one of the more affluent Indian states with the lowest rate of poverty[4], and a major contributor to India's growing tourism. According to the Punjab government website, poverty alleviation is one of Punjab's planned programmes. Various funding and assistance from the Punjab government have helped to narrow the gaps amongst various income levels.

The tourist statistics[5] in the various states of Punjab has shown a positive trend of increasing number of tourists. In 2005 alone, a total of 0.44 million people visited Punjab, accounting for 18.5 % increase of the tourist inflow as compared to 2004. This indicates opportunities of growth for Greater Mohali Region.

Fig. 15.3 Domestic and Foreign Tourist visited Chandigarh Circle, (including GMADA area), 2004 - 2005



On a more micro level, Greater Mohali Region and Chandigarh share the same tourist pool. This is recognized in the rising tourists count in the Chandigarh Circle[6]. According to India Tourism Statistics 2006, in 2005 there were 82,443 visitors to Chandigarh Circle and some could have possibly stayed in Greater Mohali Region.



Tourism plays an important role in strengthening the economy of Punjab. Punjab is best known throughout the world for being one of Asia's most exotic spots and has attracted tourists from all walks of life. The unique mix of multi-racial and religion living together in one state, the bold

[3] ibid
[4] http://punjabgovt.nic.in
[5] Tourism Statistics 2005, Market Research Division Ministry of Tourism, Government of India
[6] Tourism Statistics 2005, Market Research Division Ministry of Tourism, Government of India

colours of saris, the eclectic mix of spices and curries, its long-established universities and expanding medical facilities, have made Punjab a 'must' place to experience. Punjab, home of rich cultural history with its historical embodiments and heritage, is one of the favourite tourists' spots in India. Geographically, Punjab borders Pakistan. Environmentally, Punjab is divided into 4 natural regions[7]: the Majha, the Doaba, the Malwa and Puadh. Greater Mohali Region covering the areas of Mullanpur, Kharar, SAS Nagar, Banur, Dera Bassi and Zirakpur, straddles various regions and sub-regions of Punjab. Greater Mohali Region has a range of micro-environments. This is an added advantage to Greater Mohali Region in its tourism development.

For example, within the Ropar district (SAS Nagar and Kharar), the valley of river Sutlej, was the seat for Sikhism for almost 80 years. The Gurudwara Bhatta Sahib[8] is located in the village Kotla Nihang, on the outskirts of Ropar town. This was built in memory of Guru Gobind Singh in 1914. A fair is held there every August to commemorate the death anniversary of Baba Jiwan Singh. Another fair held there in December attracts a large number of people to visit this place. The valley is also full of historical landmarks and the world's highest straight gravity dam known as the Bhakra Nangal Dam which is situated in the valley at Bhakra.

Patiala district (Dera Bassi) is best known for its palaces, museums, sports, cuisines and fashion ware. This district is also home to many eminent personalities like cricketers Navjot Sidhu, Mohinder Amarnath, Reetinder Sodhi; Bollywood stars Jimmy Shregill, Om Puri; Punjabi singers Gurdas Mann and Harbhajan Mann, Jet Airways Chairman Naresh Goyal and also, Sq Ldr Rakesh Sharma, the first and only Indian to date in space.

[7] http://www.punjabgovt.nic.in, http://patiala.nic.in
[8] http://rupnagar.nic.in

15.2 Existing Tourism and Recreation Resources

There are no sizeable botanic, thematic gardens and health resorts in the Greater Mohali Region. Much of the green space is located within Chandigarh. As illustrated in Figure 1, the green areas in Greater Mohali Region comprising forests , orchards, plantations and other green areas totaling about 12280 ha. In addition, reservoirs and water bodies occupy some 2890 ha.

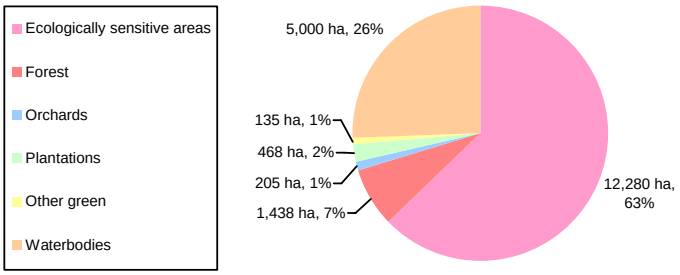


Figure 15.4: *Existing green and blue areas within GMADA*

There are a number of places of interest in and around Mohali, some of which have been mentioned earlier. The places of tourist interest within this region include:

- Sukhna Lake in Sector 1, Chandigarh
- Rock Garden in Sector 1, Chandigarh
- Vatika Gardens and musical fountains in Panchkula
- Pinjore Gardens in Pinjore
- Nada Sahib Gurudwara in Nada, Mohali
- Cricket stadium in Mohali
- Sector 17 shopping area
- Bhakra Nangal Dam
- Anandpur Sahib – “The Holy City of Bliss”
- Musical fountain in Sector 70
- Thunder Zone in Landran, Banur
- Fun City in Ramgarh
- Art Museum in Sector 10 Chandigarh

15.2.1 Sukhna Lake

The Sukhna Lake, a manmade picturesque lake located at the foothills of Shivalik hills, provides a tranquil place for nature, a great picnic spot for families and exciting water sports activities such as boating, yachting and water skiing. The 3km long lake is fringed by the Forest Hill Golf Course to the south and the famous Rock Garden of Chandigarh to the west. This lake comes alive in the evenings with families and tourists thronging the promenade, the Chef Lakeview, CITCO's fast food joint, shops and the jetty for a boat ride. The lake has been the venue for the Asian Rowing

Championships as it has the longest channel for rowing and yachting events in Asia. Sukhna Lake is also the venue for many festive celebrations. The most popular is the Mango Festival held during the monsoons when many varieties of mangoes are on display. From time-to-time other food festivals, featuring specialties from different Indian States, are held here, along with cultural performances.

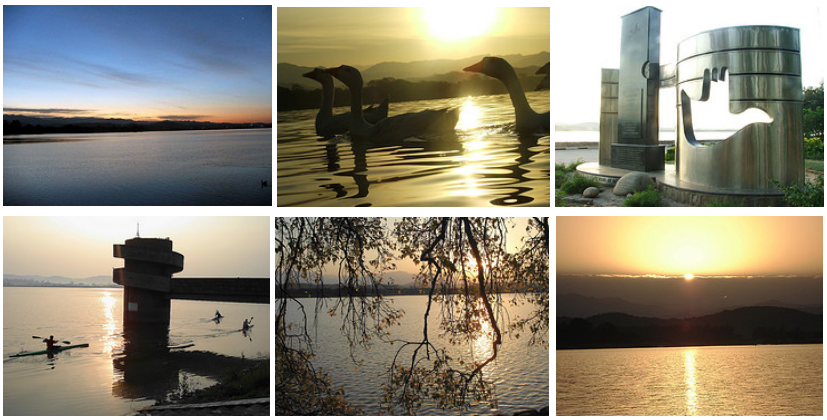


Figure 15.5: *Different views of the Sukhna Lake*

15.2.2 Rock Garden

Located between the Capitol Complex and Sukhna Lake, the 44-acre sculpture Rock Garden is an epitome of creativity and innovation. It is a unique garden that consists of various art objects. Each of the artwork in the Rock Garden has been made from industrial and urban waste like discarded frames, mudguards, forks, handle bars, metal wires, play marbles, porcelain, auto parts, broken bangles, etc. Visitors come from different parts of the world to see this amazing garden.

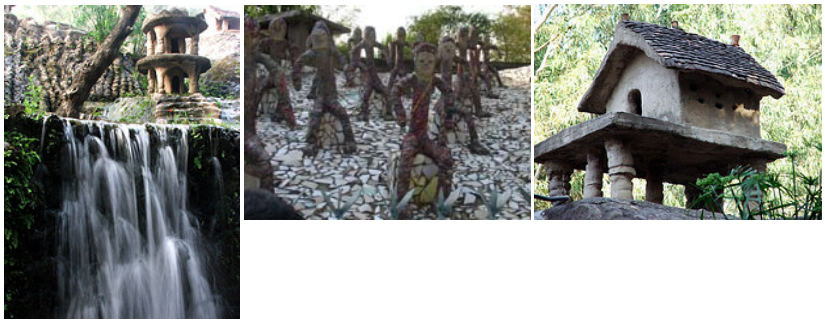


Figure 15.6: *Scenes captured from the Rock Garden*

Within the districts which make up the Greater Mohali Region, there are some existing leisure green lands, wetlands and beautiful gardens such as the Satluj Water body Wetland in Ropar and Zoological Park Chhatbir.

15.2.4 Satluj Water body Wetland, Ropar

Over 250 species of migratory birds have been spotted here. The 30 km of crystal clear waters in scenic surroundings makes it a popular spot for angling, kayaking, canoeing, boating and long distance swimming.

15.2.5 Zoological Park Chhatbir

Located 20 km from Chandigarh and 55 km from Patiala, this park spreads over 202 acres of raw scrubland. It houses 52 species of animal and 62 species of birds in a simulated natural habitat. The park is famous for its Lion Safari and is the biggest park of its type in India.

15.2.6 Existing parks

Name of parks	Location	Description
Bougainvillea Park	**Sector 3**	**Started in 1976. Covers an area of about 20 acres. Home to hundreds different types of bougainvillea. About 65 different varieties of bougainvillea shrubs are planted in this garden. A few flowering trees have also been planted to maintain a colourful effect to fill the gap in bougainvillea flowering season.**
Topiary Park	**Sector 35**	**Started in 1987. Many animal shapes are created out of creepers and bushes attract children to the Topiary Park. A large variety of ornamental plants add to the park's charm.**
Smriti Upavan	**Sector 1**	**This space has been set aside to allow the people to plant trees in memory of the deceased. The resultant forest is intended to be a place of silence and remembrance. Smriti means "remembrance" and Upavan means "forest". This is a forest where every tree commemorates someone who is no more. It was formally inaugurated on 14 November 1988 when the then Adviser Sh. Ashok Pradhan planted a banyan tree in the memory of the first Prime Minister of India, Pandit Jawahar Lal Nehru.**
Rajendra Park	**Sector 1**	**Started in 1954, this park is has a vast area of land of about 400 acres, abutting the Secretariat building on its eastern side. On the southern side of the park are the residences of Chief Ministers and Ministers. Le Corbusier himself designed the landscape scheme of this park. Trees with round canopies and evergreen foliage have been planted here along with a few groups of flowering species.**
Shanti Kunj	**Sector 16**	**The Shanti Kunj is situated between the Rose Garden and the Cricket Stadium in Sector 16. This is a completely noise-free area with natural troughs. The natural stream running through this garden divides the park into 5 areas. The 5 parts of the garden depict different kinds of trees such as medicinal plants, vertical shaped trees, flowering trees, trees for shade and environmentally suitable trees.**
Children's Traffic Park	**Sector 23**	**Concrete paths are laid out to form "roads and intersections" and furnished with all sorts of road signs. This place, safe from heavy speeding vehicles is useful for children who are learning to cycle, and designed to teach them the rules of road safety. This garden was once planted with different varieties of cannas which could not be maintained because of the shortage of water. It is thus also known as the Canna Garden.**

15.3 Natural Resources

15.3.1 Forests

Punjab officially has 6% of its land under forest though satellite imagery indicates only about 3.9% of land under forest cover. The major forest areas in the state are Shivalik Forests: Districts Ropar, Gurdaspur and Hoshiarpur; Bir Forests: District Patiala; Mand Forests: Districts Amritsar and Kapurthala. The forest land in the north of Greater Mohali Region is part of the larger forest range of Shivalik Forests.

15.3.2 Biodiversity

Punjab has rich biodiversity. About 1900 species of angiosperms have been recorded. More than 500 species of birds and 130 species of fishes are recorded in the state. The foothills of Shivalik support a variety of endangered, threatened, rare and special interest species of flora and fauna.

15.3.3 Agriculture Preservation

There are 8.6 million livestock and 10.78 million poultry including ducks in Punjab. Punjab's milk, egg and wool production is the second highest in India. Its fish production is the highest in the country with an average of 6 ton per ha which is 3 times more than the national average (Department of Animal Husbandry, Punjab). Pisciculture also provides diversification from crops and is highly remunerative.

Agriculture has invested the Greater Mohali Region with a typical rural landscape of sparsely spaced buildings hugging cultivated farms, regularly intercepted by flowing natural and man-made water channels. The local dwellings are typically clustered as farmsteads. The buildings are of permanent RCC type with ordinary to expensive material finishes.

15.3.4 Scenic Amenity

The foothills of Shivalik are a scenic amenity of Greater Mohali Region, calling for careful preservation. This outcome will require forward planning to maximize the sustainability of conservation values.

15.4 Built Resources

The resource includes golf courses, bicycle tracks, sports stadiums and other built facilities for leisure and recreation.

The golf courses are mainly located in Chandigarh, where the area has been mostly well-built and established. The Chandigarh Golf Club is located in Sector 6 of Chandigarh, is an 18-hole golf course and is the site where the prestigious Chandigarh Golf Open Championship in India is annually held. This exclusive club is also home to some fine professional golfers, the most noted being Jeev Milkha Singh.

According to CITCO website, a 12 km Bicycle Safari was started in 1999. Its route passes through two villages of UT and Haryana and also some forest area. The track completely encircles Sukhna Lake and consists of 10 km pucca (metalled) road and 2 km of kuchha path (non-metalled). The kuchha path was made cycle-able by CITCO, who started this sporting event. This track has not been metalled for fear of encouraging illegal construction and also to ensure that the place does not lose its natural ambience. In addition, there is 5 km long bicycle track running from the roundabout near the Cricket Stadium in Sector 16 to Sukhna Lake.

In addition, sports stadiums have been built for local population's recreation. Of note is the cricket stadium called the Punjab Cricket Association Stadium in Mohali, Chandigarh.

15.4.1 Punjab Cricket Association Stadium

Figure 15.7: *View taken during a test match (left), India team winning the match over Pakistan in the World Cricket Cup 2007 (centre), fans during Test match India vs England in 2006 (right)*

The Punjab Cricket Association Stadium is located in Sector 63within SAS Nagar. It is popularly referred to as the Mohali Stadium. The stadium is home to the Punjab cricket team. Punjab's 2nd international cricket stadium has been approved by BCCI in Bathinda, Punjab. The new stadium when built will have special lighting which is different from most other cricket stadiums. The light pillars are kept at very low height. The reason for this is that there is an airport nearby. The low lighting height would avoid any collision between aircraft and light pillars.

Most of the Punjab-based national cricketers train in Mohali, including Yuvraj Singh, Harbhajan Singh, Dinesh Mongia, and Gagandeep Singh.

The 19th and youngest Test cricket venue in India is also in Greater Mohali Region. This is one of the larger grounds in the country and sports a lush outfield. The pitch has a reputation for being lively and supporting pace bowlers. It was inaugurated with a one-day international match between India and South Africa during the Hero Cup on 22 November 1993. To date, 7 Test matches and 9 One Day International have been played at this venue.

Apart from sports and recreation facilities, other built resources include the long-established universities-the Chandigarh College of Architecture, and state-of-the-art medical facilities in sector 62. The cost of surgery in India is comparatively lower than USA and Western Europe, offering scope for medical tourism growth.

15.4.2 Historical Embodiments – Gurudwaras

Punjab can be said to be a pilgrim's paradise. There are many historical temples, mosques, mausoleums and gurudwaras distributed throughout Punjab. A gurudwara, meaning "doorway to the Guru" is the Sikh worship place and is usually referred to as a Sikh temple. There are many gurudwaras in the Mohali District. To name some:

- Gurudwara Akalgarh Sahib (Gharuan)
- Gurudwara Ambb Sahib
- Gurudwara Nabha Sahib
- Gurudward Pudha Sahib
- Gurudwara Sant Mandal Angitha Sahib
- Gurudwara Singh Shaheedan (in rebuilding)
- Gurudwara Sacha Dhan
- Gurudwara Akal Ashram

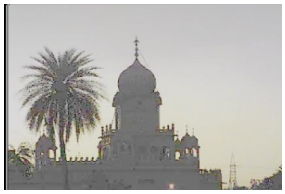
These gurudwaras attract many religious aficionados into the region. Each year, many would travel to these historical gurudwaras during the religious festivals and fairs to pay homage and obeisance. The high influx of people into the Greater Mohali Region and the neighbouring region during these periods, to some extent, has indirectly contributed to the tourism of the Greater Mohali Region.

Gurudwara Akalgarh Sahib

- **9km from Kharar**
- **in Gharuan village on Chandigarh-Ludhiana road**

Gurudwara Ambb Sahib

- **in Sector 62, Mohali**



Gurudwara Nabha Sabib

- **15km from Chandigarh**
- **Patiala-Zirakpur highway**

Gurudwara Pudha Sahib

- **1km from Zirakpur**

Gurudwara Sant Mandal Angitha Sahib

- **in Sector 62 Mohali**

Gurudwara Sacha Dhan

- **one of the main gurdwara in city Mohali**

Table 15.1: *Pictures of the various Gurudwaras in Mohali*

15.5 Fairs and Festivals

Fairs and festivals are part of local community life. Farmers bring their agriculture produce to the weekly fairs for sale to consumers. The agriculture calendar is celebrated through various local festivals such as Lohri and Vaisakhi. Sikhs use the solar Sikh calendar, Nanakshahi calendar, the Hindu calendar and also the Vaishnav calendar. There are more than 40 other festivals that are not included in the list below. Thoses include Parkesh Utsav, Gurgadi, Jotijot and much more. All Sikh festivals are to be celebrated by going to a gurudwara, paying obeisance to the Guru Granth Sahib Ji and listening to Gurbani.

Festival	Date observed (2007)	Description
Guru Gobind Singh Javanthi	**January 5**	**Sikhs offer their prayers at a local Sikh temple for the birth of Guru Gobind Singh Ji.**
Lohri	**January 13**	**Lohri is a harvest festival, originally celebrated in Punjab. Although it has nothing to do with the Sikh religion but Sikhs being the predominant farmers in Punjab makes it look like a Sikh festival. Nowadays it is celebrated more as a tradition than anything else. Any beliefs that Lohri is celebrated only at the birth of a boy is because of the discrimination of women faced in old Hindu societies, the very thing opposed strongly by all Sikh Gurus and other saints like Kabir. Nowadays even at the birth of a daughter, some families celebrate Lohri. Lohri would be more correctly termed a Punjabi festival rather than a Sikh festival.**
Maghi	**January 13**	**Maghi commemorates the martyrdom of the "Forty Immortals," forty followers of Guru Gobind Singh who had previously deserted him, fought bravely against overwhelming Mughal army forces and were martyred in Muktsar. Guru Gobind Singh blessed them as having achieved mukti (liberation) and cremated them at Muktsar On Maghi. During this festival, the Sikhs visit gurdwaras and listen to kirtan (hymns). Naturally, the largest gathering is at Muktsar where an annual fair is held.**
Holi/ Hola Mohalla	**Feb/March**	**In Punjab, this is celebrated at Anandpur Sahib and in other cities such as Ludhiana where the Hindus and Sikhs celebrate together. In Punjab and other major cities like Mumbai, Delhi, Kolkata, Sikhs and Hindus come together for Hola Mahalla. But again, Holi is actually a Hindu festival having no place in Sikhism with Sikh participation limited to Hola Mohalla where Sikhs display their martial skills.**
Vaisakhi/ Baisakhi	**April 13**	**Vaisakhi is a Hindu and Sikh festival that celebrates the beginning of the harvest season in India. It is also celebrated for the Birth of the Khalsa, or Sikh religion. Vaisakhi is celebrated at a large scale at Harimandar Sahib, Amritsar. In Canada, USA, and other Sikh and Hindu populated areas, South Asians come together for a public mela or parade, and enjoy free food of all sorts of Indian cuisine. The main part of**

		the mela is where a gurudwara has a beautiful Indian theme float where the Guru Granth Sahib (Sikh Holy Book) is located and everyone must offer their prayers by touching the float.
Martydom of Guru Arjan Dev Sahib	June 16	Guru Arjan Dev Sahib was martyred on this day, according to the Nanakshahi calendar.
Parkash Divas	September 1	Parkash Divas is the day where the Guru Granth Sahib was instituted. Sikhs go to a Gurdwara for a prayer and hymns.
Diwali/Bandi Chod Divas	Oct/Nov	On the day of the Hindu festival Diwali, Sikhs celebrate the Bandi Chod Divas. It celebrates the release of Guru Hargobind Singh from Gwalior Fort with him freeing 52 other kings as well. It is celebrated by lightning divas and going to a gurdwara to listen to gurbani.
Guru Nanak Ji's Jayanthi	Nov	On this day, Guru Nank was born in Nanakana, which is a small town in Pakistan. Every year Sikhs go to a Gurdwara and offer their prayers there. Sometimes divas are lit in front of the gurudwara, in honor of the Guru Ji's birthday.
Martyrdom of Guru Tegh Bahadur Sahib	November 24	On this day Guru Tegh Bahadur was martyred when he refused to convert to Islam. On this day Sikhs go to a gurudwara for a prayer.

15.6 Outdoor Recreation

Punjabis enjoy the outdoors. A favourite pastime is going to the hill resorts. Greater Mohali Region is well positioned in terms of travel to hill resorts. The hill resorts may be visited as day, weekend or longer trips.

15.6.1 Hill Resorts

Several of the hill resorts around the Greater Mohali Region, for example[9], the Kikar Lodge, Yorks Health Resort, Timber Trail Parwarnoo, can be visited as day or weekend trips.

Kikar Lodge is located near Ropar, just 1.5 hours drive away from Chandigarh, Ludhiana and Jalandhar. Nestled in the foothills of the Shivaliks, the Kikar Lodge is located barely a few kilometres from the shimmering blue band of the "Ropar Wetlands". This hill resort is an ideal getaway for those who wish to engage in some outdoor activities or for those who just want to do nothing and chill out.

Yorks Health Resort is an enchantingly beautiful 40 acres resort, nestled amidst the foothills of Shivalik Hills. It is 10 km from Pinjore in Haryana and 31 km from Chandigarh, in all, a 5 hours drive just off the Delhi-Shimla route. A river bed on one side and thick bamboo forest on the other makes a wonderful environment to stay in the lap of nature.

Timber Trail Parwanoo is situated just a stone's throw from Chandigarh and is a small Himachali town. Take the Timber Trail trolley ride up by about 2000 ft. in 8 minutes flat to get to this resort. The advantage of this place is, having to stay at a greater altitude without having to drive in the hills through serpentine roads. Timber Trail at Parwanoo is a unique resort concept and experience which was the first in India when first introduced. Timber Trail has a resort both at the base and at the top of the hill and is a great hit with both Delhites and Chandigarh city dwellers. It is a great experience, moving slowly up and over the valley between two mountains, to the resort.

15.6.2 Sports

Punjabis enjoy sports--cricket, golf, hockey, football and the traditional Kabbadi to name a few. Harbhajan Singh (left inset), Yuvraj Singh, Bishan Bedi, Dinesh Mongia and Navjot Singh Sidhu are some of the many prominent Punjabi cricket players. Cricket, which can be considered a National Sport, is well-loved throughout India so it is only natural that this sport has garnered so many cricket fanatics even among Punjabi families and their women. During the Cricket Test matches, Punjabi families can be seen participating and supporting the Punjabi cricket team at the stadium.

The famous Punjabi golfer, Jeev Milka Singh (left inset), has stirred greater interest for the young Punjabis in the sport. Jeev Milka Singh was the winner of the 2006 Asian Tour Order of Merit Winner and the first Indian to compete on the

[9] www.arounddelhi.com

European Tour and at the Masters. Jeev was the highest ranked Indian golfer in the world, breaking into the top 100 in October 2006. He is the son of the famous Indian athlete Milkha Singh and he lives in the city of Chandigarh.

In hockey, Punjabi hockey players are reigning at Premier Hockey Leagues and collecting win series against other European countries. Among many Indian key players, Sandeep Singh (right inset) and Prabhjot Singh are just few of the many names who make the daily headlines in the hockey world.

The traditional Kabbadi can be said to be the National Sport for Punjabis. The name, often chanted during a game, derives from a Hindi word, meaning "holding of breath", which is a crucial aspect of play. This team sport now, is gaining popularity and has spread to Southeast Asia, Japan and Iran. The Punjabi style of Kabaddi is also known as circle Kabaddi, or ring Kabaddi. The World Kabbadi Federation in India has passed a policy to even promote this sport among the Non Resident Indian (NRIs). Due to its popularity, this sport was well-received in the 2006 Asian Games in Doha (left inset).

15.6.3 Sports in school

An article in The Tribune[10], Chandigarh, India dated 23 March 2003, stated that sports would be a compulsory subject in all schools from 2003. ,Mr Khushal Behl, Education Minister had said that physical fitness was essential for all-round development of students. The students would have to play two games of their choice. In all 15 sports had been selected by the government.

[10] http://www.tribuneindia.com/

15.7 Medical Tourism

India has been touted as the favourite destination for information technology majors and in recent years it is emerging as a preferred destination for medical or health tourism. The Government of India, State tourism boards, travel agents, tour operators, hotel companies and private sector hospitals are exploring the medical tourism industry for tremendous opportunities. They are seeking to capitalise on the opportunities by combining the country's popular leisure tourism with medical tourism.

15.7.1 What makes medical tourism in India attractive?

The Indian medical tourism industry, growing at an annual rate of 30 percent, caters to patients chiefly from the US, Europe, West Asia and Africa. Although in its infant stage, the industry is growing faster compared to similar industries of other countries such as Greece, South Africa, Jordan, Malaysia, Philippines and Singapore.

In 2004, 150,000 medical tourists have visited India. The medical tourism industry in India is presently earning revenues of $333 million. Encouraged by the incredible pace of growth exhibited by the industry, the Confederation of Indian Industry (CII) and McKinsey have predicted that the industry will grow to earn additional revenue of $2.2 billion by 2012. Whilst the chief cities attracting foreign patients to India at present are Mumbai, Bangalore, Hyderabad, Kolkata and Chennai. Punjab should also gear itself to take up part of the foreign medical tourism pie. This is made easy by the fact that about 40%-50% of the NRIs of Punjabi origin are residing overseas and can easily be coax to come back to Punjab to seek medical and dental treatment at a fraction of the cost.

15.7.2 Why Medical tourism is so attractive?

- Foremost is the cost factor. The medical costs in India are one-tenth of the costs in western countries. For instance, a heart surgery costs $6,000 in India as against $30,000 in the US. Similarly, a bone marrow transplant costs $26,000 in India as compared to $250,000 in the US.
- Secondly, foreign patients throng Indian hospitals to pass up the long waiting lists and queues in their native countries. Indian hospitals provide immediate attention to patients rather than asking them to wait for several months like in most western countries. Further, foreign patients need not tackle cumbersome insurance and national medical systems in India.
- India offers the best treatments in modern medicine and in every medical division such as cardiology, orthopaedic surgery, eye care, gynecology, cosmetic surgery and dental surgery. It also provides traditional methods of treatment such as Ayurveda, Homeopathy, Naturopathy and Yoga.
- India's private hospitals have gained international recognition for their state-of-the-art facilities and diagnostic centres besides unsurpassed skills due to the sheer numbers of patients treated. Their technology and procedures are on par with hospitals in developed nations and quality of the ward can be upgraded easily to suit the paying `foreign tourism patients'.
- Foreign patients can get package deals including flights, transfers, hotels, treatment and post-operative vacation for their medical visits to India.
- Many foreign patients prefer to combine their leisure and relaxation visits to India with healthcare. The medical tourism potential is good as there are huge numbers of Punjabi visitors making annual visits to parents and relatives in Punjab.
- The Government of India is encouraging medical tourism in the country by offering tax breaks and export incentives to participating hospitals. In addition, obtaining medical visas for treatment in India is made very easy lately.

15.7.3 The top Indian medical institutions offering medical tourism facilities

The speciality hospitals that are the forerunner in the medical tourism industry in the country are:

- Escorts Heart Institute and Research Centre Limited,

- All India Institute of Medical Sciences,
- Manipal Heart Foundation,
- B. M. Birla Heart Research Centre,
- Breach Candy Hospital,
- Wockhardt Hospitals
- Christian Medical College,
- Asian Heart Institute,
- PD Hinduja National Hospital and Medical Research Centre,
- Jaslok Hospital,
- Apollo Hospital,
- Apollo Cancer Hospital,

The Indian hospitals can also tie up with world renown hospital chains for this purpose such as :

- John Hopkins Group
- Wockhardt hospital Group
- El Camino Hospital
- Parkway Group

15.8 Regional Tourism

GMADA is a convenient stopover in regional travel. It is at the crossroads of major national highways linking Delhi and the northern and western parts of India. Many of the visitors to the Shivalik hills and hill stations would break journey in Chandigarh. Many other local and international visitors would travel to see Chandigarh, the modern city master planned by Le Corbusier.

The Chandigarh College of Architecture is one of the best in the country, offering a natural magnet to scholars and students, presenting a potential hub for education tourism, regionally and internationally. The expanding state-of-the-art medical facilities of Chandigarh are another potential growth sector of regional and international medical tourism. According to the latest CII study, India can attract 1 million medical tourists per year. Punjab, Chandigarh and Mohali with its expanding high-class medical institutions have the potential to attract a number of these tourists.

15.8.1 Regional open space

The Greater Mohali Region is within easy commuting distance of Chandigarh, the City Beautiful where much of the existing local and community parks are located. There is however 2000 ha of regional open space. A range of urban parks including roadside greenery and greenways would expand recreation opportunities, aesthetic beauty and other benefits of green spaces to the Greater Mohali Region urban areas.

15.8.2 Tourist trends and potentials

The existing tourist inflow to Mohali/Chandigarh is primarily composed of transient population, i.e., people traveling to Shimla and other hill stations located in Himachal Pradesh. A sizeable number of such people take a day trip in Chandigarh to admire Le Corbusier's city planning and architecture. However, not many people at the present time visit Mohali due to a lack of tourist attractions or good hotels. Occasionally, in the event of a cricket match, Mohali would be crowded with thousands of people for a span of 1-2 days.

Tourism is vital to the economy and future growth of Greater Mohali Region. About 2 million NRIs visit Punjab each year. There is significant growth potential. For the period 2007-2016, tourism estimates indicate an annualised real growth of 8% for India.

Tourism is the world's top industry. International tourism is a US$662 billion industry, contributing 10.3% of global economic output and employing 234 million people. The World Tourism Organisation has forecasted an annual growth of about 4% over the next decade for global outbound travel. International tourism to India is projected to grow. Several major trends suggest that tourism offers excellent potential for continued growth in Greater Mohali Region, from local as well as international visitors:

- Cheap international air travel is expanding the number of international tourists;
- An increasing number of visitors from Europe and North America are attracted to medical treatment and relaxation facilities in Asia because of price advantages, short or no waiting lists and on par professional standards;
- People are now in pursuit of travel to and within unfamiliar territory;
- Outdoor and adventure tourism will grow;

- Cultural and heritage tourism will also grow;
- The appeal of Chandigarh will continue;
- Tourists will seek learning travel experiences;
- Tourists will seek authentic, not fabricated experiences;
- Off-season winter travel will grow but at a slow rate at first.

a. Tourism and Recreation Development Policy

The immediate goal is:

To enhance the tourism and recreation sector as it currently operates within Greater Mohali Region.

The medium and longer term goal is:

To create a dynamic and trend setting tourism and recreation sector offering which will position Greater Mohali Region to the fore of tourism.

The primary appeal of Greater Mohali Region draws strength from its historic essence and key location. The discerning domestic and international tourist will find it essential to have visited the area and experienced the developing quality tourism products. A well-managed environment, both urban and rural, will be coupled with a variety of new and refreshed products to encourage diversified growth in tourism that balances economic growth with environmental, cultural and community values. This is translated into the following key objectives:

- Attract first time and repeat visits from both new and existing markets, in both leisure and business tourism;
- Position Greater Mohali Region as a vibrant and continually evolving 'must see' destination;
- Maximize Greater Mohali Region's role as a gateway to Chandigarh, Himalaya and the rest of India;
- Continue to develop Greater Mohali Region as a leading national and global sporting, cultural and business events city.

To achieve sustainable increase in tourism revenue while reflecting above four guiding principles-respect for the environment, respect for Greater Mohali Region people, sustainable communities, growth and prosperity-the regional policy thrust on tourism development should take cognizance of the following issues:

Embrace emerging markets and technologies: The world market for tourism is undergoing dramatic change with emerging markets in Russia, China and Middle East likely to transform the traditional pattern of overseas promotional activities. New markets may have differing needs and expectations of Greater Mohali Region, presenting challenges to update and support the traditional image of India by reflecting the diversity and creativity that Greater Mohali Region has to offer. As mentioned earlier, education tourism and medical tourism are two fast emerging markets.

Education tourism may include ecotourism, heritage tourism, rural/farm tourism and student exchanges between educational institutions, i.e. any travel programmes with the primary purpose of engaging in a learning experience directly related to the location. The size of the world market for

education tourism is also fast expanding. It is estimated to have increased 66% from 4.8 million trips in 1985 to 8 million in 1996[11]. According to Smith and Jenner (1997), approximately 0.9% of tourist visits to India is for the purpose of study while for the UK, USA and Australia edu-tourists is about 2-3% of all visitors. There is potential to expand this sector given India's high education standard and the cultural and historic places in and around Greater Mohali Region.

India is among the world's leading countries for biotechnology research, including stem cell research. India is also the world's leading country in promoting medical tourism and medical outsourcing. The market for medical tourism is expected to continue to expand. Studies have estimated that medical tourism to India is growing at a rate of 30% per year and could generate approximately US$2 billion per year for India by 2012[12]. Punjab, Chandigarh and Mohali with its expanding health care sector, state-of-the-art medical facilities and fine post-operation vacation sites like the hill resorts have the potential to attract a number of these tourists.

In addition, modern technology developments are moving incredibly fast; their impact on our lives is set to grow. Take Asia-Pacific countries as an example. These countries account for almost half of the 118 million wi-fi (wireless internet connection) users worldwide. Mobile devices are becoming ever more sophisticated and increasingly a telephone is no longer just a phone but a portable source of information. This presents new opportunities for targeted destination marketing and information delivery to potential visitors.

- **Contribute to the achievement of environmental sustainability:** Environmental performance within the tourism sector must be improved across a range of issues, in particular, encouraging businesses to reduce climate-changing emissions, water use and waste generation. Factors such as climate change will affect tourist behaviour in the longer term. Greater Mohali Region has to more actively incorporate and strengthen environment-friendly features in its tourism sector development. The need to protect, manage and enhance areas of significant biodiversity, nature and cultural conservation is an essential component of national, state, regional and local planning. Of significance are the measures to manage tourism product development and the use of transport, industry, energy and natural resources to minimize any adverse impacts on the atmosphere and environment. Significant scenic amenity areas and features including its good agricultural land should be acknowledged, protected and managed in the regional landscape. These are assets in the tourism development strategy. The design and location of buildings and infrastructure must consider potential impacts on scenic amenity values.

- **Promote the breadth and diversity of Greater Mohali Region's cultural offer:** Greater Mohali Region's tourism product encompasses far more than the traditional heritage package of Chandigarh and the Himalaya that has for so long been a feature of visitor expectation. Greater Mohali Region can build on existing asset, both indigenous and non-indigenous connectivity with natural, rural and scenic landscapes, to offer a unique sense of place. At core is the need for planning of new development and redevelopment to maintain and reflect local community characteristics and sense of identity.

It can develop and offer rural/farm and eco-tourism. It can develop its health sector to more fully participate in medical tourism. It can develop the arts, culture, education and creative resources to improve Greater Mohali Region's cultural life for both visitors and residents. The visitor economy

[11] Smith, C., & Jenner, P. (1997). Education tourism. Travel and Tourism Analyst, 3,60- 75.
[12] http://www.indiamedicaltourism.net/medical_tourism_india_medical_tourism/index.html

can help to sustain a range of cultural activities throughout the day and into the night such as theatres, museums, galleries, entertainment businesses—cafes, restaurants—shopping and cultural events. It can attract more 'signature' facilities and offer the greatest range of restaurants, attractions, retail and leisure experiences to be found anywhere in the world. In other words, Greater Mohali Region should seek to develop an exciting year-round events programme, implement place marketing and present something unique to come and see whatever the season.

Greater Mohali Region shall provide sufficient areas for a range of open space and recreational opportunities to meet the needs of an expanding population and tourism. The goal is not just to protect the green legacy of Chandigarh but also to ensure that open space becomes an integral part of the Greater Mohali Region urban communities to be enjoyed by present and future generations. The Greater Mohali recreation policy is illustrated in Figure 2, indicating the distribution of existing and future open space areas and parks, forest areas, mineral resource areas, agricultural areas slated for retention and proposed greenways and nature walking trails system.

Figure 15.8 identifies the potential open space opportunities for Greater Mohali Region where these opportunities are connected with existing and planned open spaces, helping to visualize existing and potential linkages. This effort does not, however, signify that all of the lands shown as opportunities are recommended, available or currently planned for preservation as open space. It simply indicates where open space features and resources currently exists that should be considered by GMADA. The plan will continue to need refinement. Recreation needs are not static but change over time, as do potential and available opportunities to fulfil those needs. As a regional plan, it does not contain the level of details and specificity of local plans. The information provided in this plan is intended to be a starting place for completing the Greater Mohali Region's open space system. As the plan is fulfilled, Greater Mohali Region's reputation as a green and growing city will expand and remain strong.

The regional plan recognizes that adequate provision of a network of green open spaces and recreational facilities that is accessible, inter-connected, provides opportunities for all citizens and visitors to enjoy is a fundamental consideration. The following policies are instituted to ensure adequate provision:

- Greater Mohali region shall identify historical, cultural and archaeological resources and seek means to assure that the heritage is preserved;
- Greater Mohali Region shall preserve 'Grade A' agricultural lands. The amount of agricultural lands to be preserved should be sufficient to maintain the rural agricultural character and to ensure a viable economic unit for continuing agricultural production;
- Greater Mohali Region shall identify and preserve a corridor of public open space for greenways, trails and wildlife habitat along the waterways and rivers;
- Greater Mohali Region shall support efforts to preserve the surrounding mountains and hills which provide scenic visual backdrop to the community;
- Greater Mohali Region shall encourage cooperation among the administration, private sector, schools and all other public interest groups to maximize recreational opportunities of open spaces;
- Greater Mohali Region shall incorporate open space and parks amenities in proximity to new and existing housing;
- Greater Mohali Region shall work with the community to identify park and recreational needs in each of the neighborhoods.

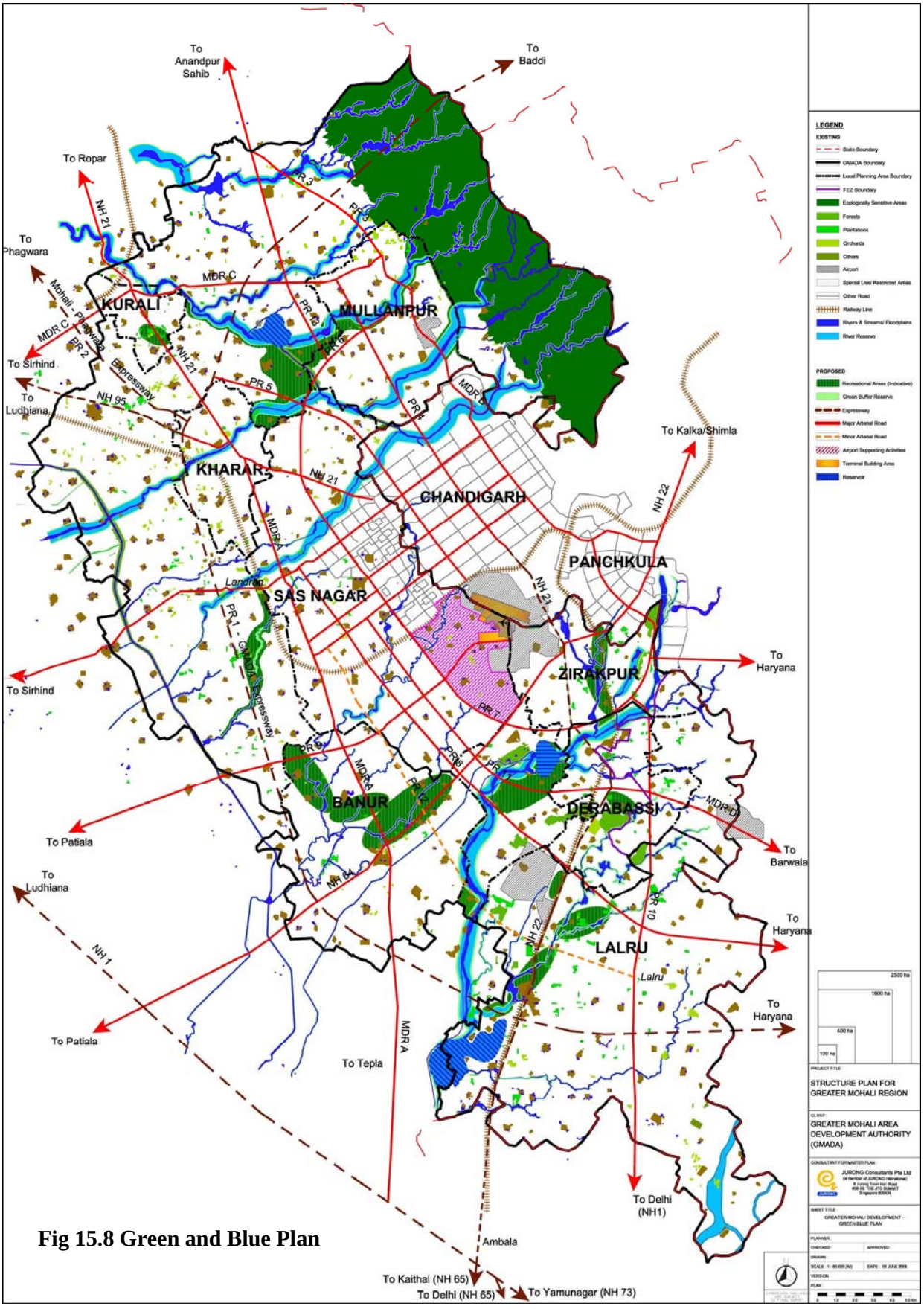


Fig 15.8 Green and Blue Plan

Greater Mohali Region shall use a variety of methods to ensure that open space, parks and recreational opportunities are established. The first is open space standard. International benchmarking indicates that the US national standard for open space is 10 acres (about 4 hectares) of open space per 1,000 residents. Not all American cities meet this standard. For example, San Francisco has 3.1 hectares per 1000 residents, New York 1.8 hectares per 1000 residents and Seattle 4.33 hectares per 1000 residents. Vancouver in Canada has 3.5 hectares per 1000 people and its city planners require developers to provide 2.75 acres of parks for every 1,000 new residents they add. According to the Open Space and Recreation Needs Study in 2006, Sydney in Australia has 2.36 hectares per 1000 residents. The city of Melbourne has 7.38 hectares per 1000 people.

For Greater Mohali Region, a provision of 1.2 hectares per 1000 people is proposed. It is the recommendation of this plan that, at a minimum, the Greater Mohali Region protects and preserves 124 ha or 11% green space cover by 2050. This is an increase over current provision. GMADA can protect many more acres of open space through the concerted action of local government with private, state and federal assistance and community support. The regional open space goal should be reassessed and revised as needed in the next 10, 25 and 50 years to continue to address the immediate needs and opportunities for open space protection related to population growth and urban development.

The second is a network of diverse open space with access for all. The network represents a continuum of open space accommodating the needs and aspirations of people of all abilities, cultures and ages. Urban open space should include appropriate forest areas, watercourses, golf courses, active and passive park areas to offer recreation opportunities, physical and aesthetic enjoyment of the outdoors as Greater Mohali Region grows. Regional open spaces are grouped into six broad categories:

- natural open space such as forest and wooded areas, nature reserves, wildlife habitat areas and other areas of ecological and cultural merit which will be preserved;
- major parks and gardens such as regional, city and neighbourhood parks;
- sports and recreation grounds including sports stadiums, horse-riding grounds and golf courses;
- boundary separators such as green buffers and urban planting;
- greenways, nature walking trails and waterways network to provide accessible and appropriate space for outdoor recreation activities; and
- other open spaces including agricultural areas, mineral areas and archaeological sites.

Greater Mohali Region's network of open space should include a diversity of recreational opportunities in response to changing community needs and values. The network also involves protection and improvement of a diversity of representative environmental, landscape and cultural values. These open spaces also contribute to the character of Greater Mohali Region, preserve agricultural resources and protect prominent geographical, geological and cultural features and resources.

Even as new parks are created, the management and maintenance of park and open space lands should not be neglected. Many valued parks and recreation areas require cyclical redesign and renovation due to normal wear and tear, weathering, obsolesces and over-use. Thematic development of specific parks, for example, wetlands, skateboard and youth adventure park, arboretum, etc. could be introduced to improve the appearance and vitality of existing parks.

Programmes emphasizing special events such as agriculture fairs, concerts in the parks, environmental education and community care for the park could be introduced to increase community participation and involvement. Multiple uses, for example, cooperate with local community to provide community farming allotments in neighborhoods and community parks and tot lots within 0.5 mile of unincorporated population concentrations could be introduced to broaden visitor and resident interests. The multi-purpose opportunities of open space should not be overlooked. These opportunities could be enhanced through the use of trail linkages and through coordinating recreation, flood control, water quality enhancements, irrigation ditches and bicycle-pedestrian transport systems to increase the net efficiency of open spaces.

As an aspiring dynamic city, Greater Mohali Region should create and take advantage of the potential opportunities to advance the open space system as a way to promote its citizen's health and well-being and enhance liveability and quality of life in its neighborhoods within the total framework of geographic economic competitiveness.

16. Proposed Land use

16.1 Proposed Land Use Development Plan

The proposed land use plan outlined in this chapter captures the essence of the various land uses within the greater GMADA planning area. The main objective is ensuring that future proposals within the development area are in conformity with the prescribed zonings. In addition, the proposed zonings ensure that the uses proposed in a geographical area are in harmony with one another and are in direct alignment with the overall objectives of the GMADA planning area.

This Regional (Zoning) Plan maps out the vision for GMADA and long term physical development for a population of 4.5 million people. The various zones reflect the permissible predominant use of land within the areas designated. The zoning plans also specify the ancillary, related or compatible activities allowed within the permissible predominant use of the land.

16.2 Objectives

- The Regional Plan seeks to ensure that sufficient land has been safeguarded for a spectrum of uses to meet the local community needs as well as the global economic challenges.
- It seeks to regulate and optimize urban developments so that the outlying areas of fertile agriculture lands, natural features, water catchments and ecologically sensitive areas are conserved and preserved for as long as possible.
- It seeks to schedule development phasing so that it is in tandem with the availability of the infrastructure and community facilities.
- It seeks to encourage sustained economic growth and at the same time improve the quality of living and working environment.

Table 16.1Land Use Zoning

Controlled / Regulated Zone **(Urbanized Area)**	Within the urbanisable area proposed in the Master Plan/ Development Plan of the respective towns, the functions and uses designated as under should be continued: i) Residential ii) Commercial iii) Industrial iv) Government offices, Public and semi-public v) Recreational vi) Utility Services vii) Transport and communications viii) Open spaces, parks and playgrounds ix) Grave yards / cemeteries and burning ghats The local authority according to the prescribed uses in the Master Plans / Development Plans will govern detailed land uses within the urbanisable area. The Master Plans/ Development Plans of all the towns will be prepared with the framework of the RP-2021 and Sub-Regional Plans, under the Acts & Rules of the participating States.
Agriculture (Rural) Zone within Development / Controlled/ Regulated Areas	1. Agricultural, horticultural crops and cash crops 2. Diary and poultry farming including milk chilling station and pasteurization plant 3. Social forestry / plantation including afforestation 4. Land drainage irrigation by hydro-electric works and tube well for irrigation 5. Sanitary landfill, compost processing plant and other such activity sites with adequate protected belt as prescribed in the CPHEEO Manual of the Ministry of Urban Development & Poverty Alleviation and the notifications issued by the Ministry of Environment and Forests from time to time. 6. Mining and extraction operations including lime and brick kilns, stone quarries and crushing subject to the rules and approved site. 7. Bus queue shelter and railway station 8. Airports with necessary buildings 9. Wireless Station 10. Grain godowns, storage spaces at site approved by competent authority 11. Weather station 12. Telephone and electric transmission lines and poles 13. Cremation and burial grounds 14. Fuel filling station, Service stations and repair workshops 15. Power plant / substation / water works / treatment plants and other Utility Services 16. Storage go-downs for inflammable petroleum products such as LPG, petrol, diesel, kerosene, aviation turbine fuel, light diesel oil and other petroleum products & lubricants with the approval of competent authority 17. Village houses within *abadi-deh* 18. Farm houses outside *abadi-deh*, and

Agriculture (Rural) Zone within Development / Controlled/ Regulated Areas	19. Expansion of existing villages outside local planning areas contiguous to *abadi-deh* including social institutions like schools, dispensaries, veterinary centres and police posts strictly for the requirements of the village located within 500 metres of *abadi-deh*, if undertaken as a project approved or sponsored by the Central Government or State Governments.
Green Buffer	1. Approach / service roads 2. Agriculture and horticulture 3. Social forestry / plantation including afforestation 4. Fuel filling stations with amenities like toilets, STD booths, small repair shop, small tea/soft drink & snack bar (with no cooking facility) 5. Toll Plaza, bus queue shelters, police booth, first aid centres, and telephone booth
Highway Corridor Zone	Access to the Expressways and Highways will be regulated by the Competent Authority.
Natural Conservation Zone	In this zone the following uses activities may be permitted: 1. Agriculture and horticulture 2. Pisciculture 3. Social forestry / plantation including afforestation
Agriculture (Rural) Zone outside Development / Controlled Areas	In the agriculture (rural) area zone outside development / controlled areas the following activities / uses may be permitted in addition to the activities / uses permitted in the "agricultural zone within development area / controlled area" paragraph 16.5 (b): 1. Intensive agriculture and allied activities such as dairying and poultry farming 2. Afforestation especially on the waste lands and barren lands 3. Regional recreation uses such as, regional parks, wild life sanctuary etc. 4. Cemeteries, schools, hospitals, etc. 5. Quarrying 6. Brick kilns 7. Existing village *Mandis* / agricultural markets; and 8. Rural industries 9. Farm houses

16.3 The Proposed Physical Plan

The Structure (Zoning) Plan governs the type of uses within GMADA; spelling out the precise control over the use of the land in the different parts of the GMADA planning area. This serves to establish transparency and direction of growth for the region as a whole. In other words, the uses specified within certain areas not only provide certainty but also confidence to investors and residents alike. This will provide the basic planning and development framework to shape the future progress for the area. See Figure 16.1 for the proposed settlement pattern of the GMADA region.

16.4 Land Zoning

As mentioned, the formulation of the regional plan has taken into consideration of the quantum and the location of the different land uses to accommodate the economic climate envisaged and the population projected up to 2056. A balanced growth strategy and the vision of GMADA form the basis that determines the direction of growth and development. Table 16.1 shows the predominant uses. Generally, the predominant uses:

Table 16.2: Predominant Uses

	Land use	Area (ha)	Percentage (%)
1	Urbanizable area	42,740	35.9
2	Industrial	2,478	2.1
3	Rural settlements	4,567	3.8
4	Agriculture area within LPA	18,483	15.5
5	Agriculture area outside LPA	24,990	21.0
6	Recreational	4,370	3.7
7	Forests	12,281	10.3
8	Water bodies	2,890	2.4
9	Transportation	4,885	4.1
10	Restricted development zone	1,351	1.1
	Total	**119,036**	**100.0**

Notes: 1. All land use figures are gross, i.e., include roads and railway lines

2. Transportation land use includes only the large parcels of land dedicated for transport terminals

The Structure (Zoning) Plan will specify not only the quantitative aspect in terms of the area required for the targeted population but also the qualitative aspect of uses in terms of their strategic geographical locations. The former relates to the quantifiable aspect of the different uses through the application of the amount of land area set aside for a specific use as well as the intensity specified for these uses. The qualitative aspect, on the other hand relates to the optimal geographical location for the various land uses. As mentioned, this depends very much on the inherent quality of the local areas, the existing critical transportation nodes, the policy direction and the development schedule. The geographical land use allocation and the quantum will have to be flexible as they will have to be planned and implemented in tandem with the changing market situation both domestically as well as globally.

Based on the inherent qualities of each of the Local Planning Areas (LPA), as well as the stage of development they are in, the proposed character and ultimate size (be it a CBD, regional centre, sub-regional centre, etc.,) of each of the LPA is determined. The proposed character and the ultimate size once determined is benched marked against cities of similar sizes and character in the world as well as those in India. The objective of this exercise is to be able to determine the appropriate density for residential uses (the largest uptake of land in any countries) and the broad land use composition for the different land uses. The demand for industrial uses; the second most important land use, is further refined through the computation based on the workers participation and the types of industries involved or projected. Table 16.2 below shows the broad land use composition for the LPA.

Table 16.3: Land Use Classification

	SAS NAGAR	MULLANPUR	ZIRAKPUR	DERABASSI	BANUR	KHARAR	KURALI	LALRU	NAYAGAON	TOTAL
PROJECTED POPILATION-2056	1,726,346	200,000	430,128	334,390	396,526	300,000	150,000	279,560	6,050	3,825,000
% OF POPULATION GROWTH EXPECTED BY 2031 (assupmtions based on Overall Phasing Strategy)	72%	80%	30%	21%	30%	40%	25%	5%	80%	
PROJECTED POPILATION-2031	1,242,369	160,000	129,038	70,222	119,558	120,000	37,500	13,978	4,840	1,898,105
CLASSIFICATION OF TOWN	Regional Metropolitan Center	Tourism/ Recreational	Regional Center	Industrial Town	Institutional Town	Sub-regional Center	Sub-regional Center	Industrial Town	Village Center	3825000
AVAILABLE LAND AREA (HA)	16,525	4,434	4,024	4778	10,079	3,171	1,424	21,289	121	65,724
GROSS TOWN DENSITY (ppa)	125	50	125	100	50	100	100	100	50	97.27
GROSS RESIDENTIAL DENSITY (ppa)	175	100	250	200	100	200	200	200	100	195
RESIDENTIAL LAND REQUIREMENT (ha) - Projected Population 2031/Gross Residential Density	7,103	1,600	516	351	1,196	600	188	70	48	11,671

LANDUSE CLASSIFICATION	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)
Residential	45	7,103	30	1,600	50	516	35	351	35	1,196	50	600	50	188	35	70		121	41%	11,623
Commercial	8	1263	10	533	8	83	8	80	7	239	8	96	8	30	8	16			8%	2,340
Industrial	8	1263	10	533	8	83	25	251	4	137	8	96	8	30	25	50			9%	2,442
Institutional	10	1578	6	320	5	52	6	60	20	683	5	60	5	19	6	12			10%	2,784
Recreation & Open Space	10	1578	25	1333	10	103	6	60	15	512	10	120	10	38	6	12			13%	3,757
Transportation	12	1894	12	640	12	124	12	120	12	410	12	144	12	45	12	24			12%	3,401
Utility	6	947	6	320	6	62	7	70	6	205	6	72	6	23	7	14			6%	1,713
Contingency	1	158	1	53	1	10	1	10	1	34	1	12	1	4	1	2			1%	283
Total	**100**	**15,784**	**100**	**5,333**	**100**	**1,032**	**100**	**1,003**	**100**	**3,416**	**100**	**1,200**	**100**	**375**	**100**	**200**	**-**	**121**	**100%**	**28,343**

NOTE:

1. The overall population for 2031is 2.36 million (projected by CRISIL). Considering rural population of 450,000 as constant, the urban population by 2031 is estimated to be 80% of the total projected population by 2031
2. % of landuse distribution for each of the towns has been derived based on an initial benchmarking study for different types of towns
3. Residential Land Requirement = Projected Population/Gross Residential Density
4. Total land requirement = (residential land requirement/% of land under residential use for that specific town)*100

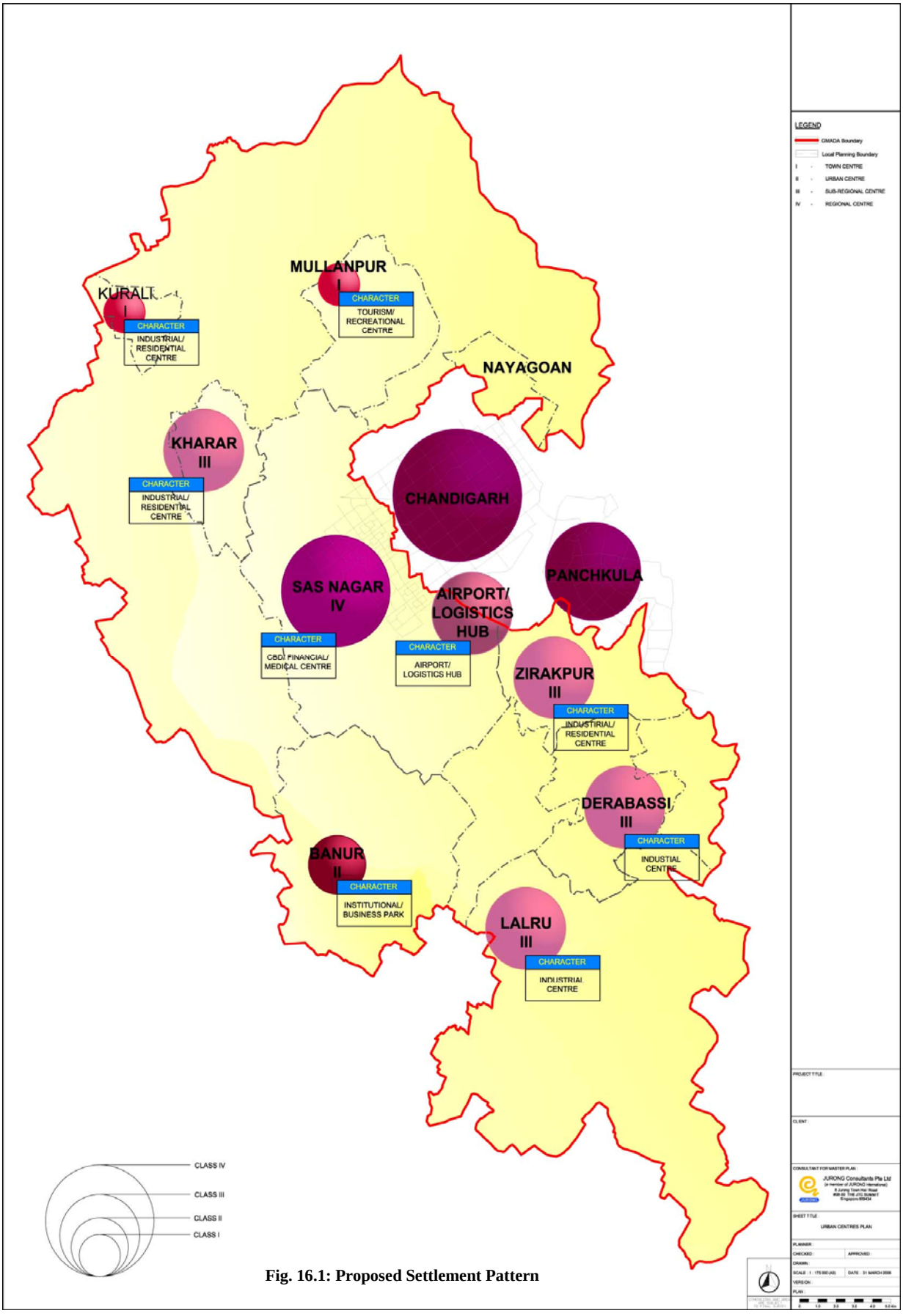


Fig. 16.1: Proposed Settlement Pattern

All agencies, government or otherwise, will have to rely on the Regional Plan to guide and manage future developments in the GMADA area. The plan has been formulated taking into considerations the demand for the different uses for a population of 4.5 million people by year 2056. It is to ensure that sufficient land has been safeguarded to accommodate the needs based on the envisaged population, life styles desired, economic climate projected, and a balanced growth. All these have been planned within the framework of GMADA's Vision to be a globally competitive metropolis, built on the principle of sustainability and offering unique lifestyle choices to its residents and visitors by 2056.

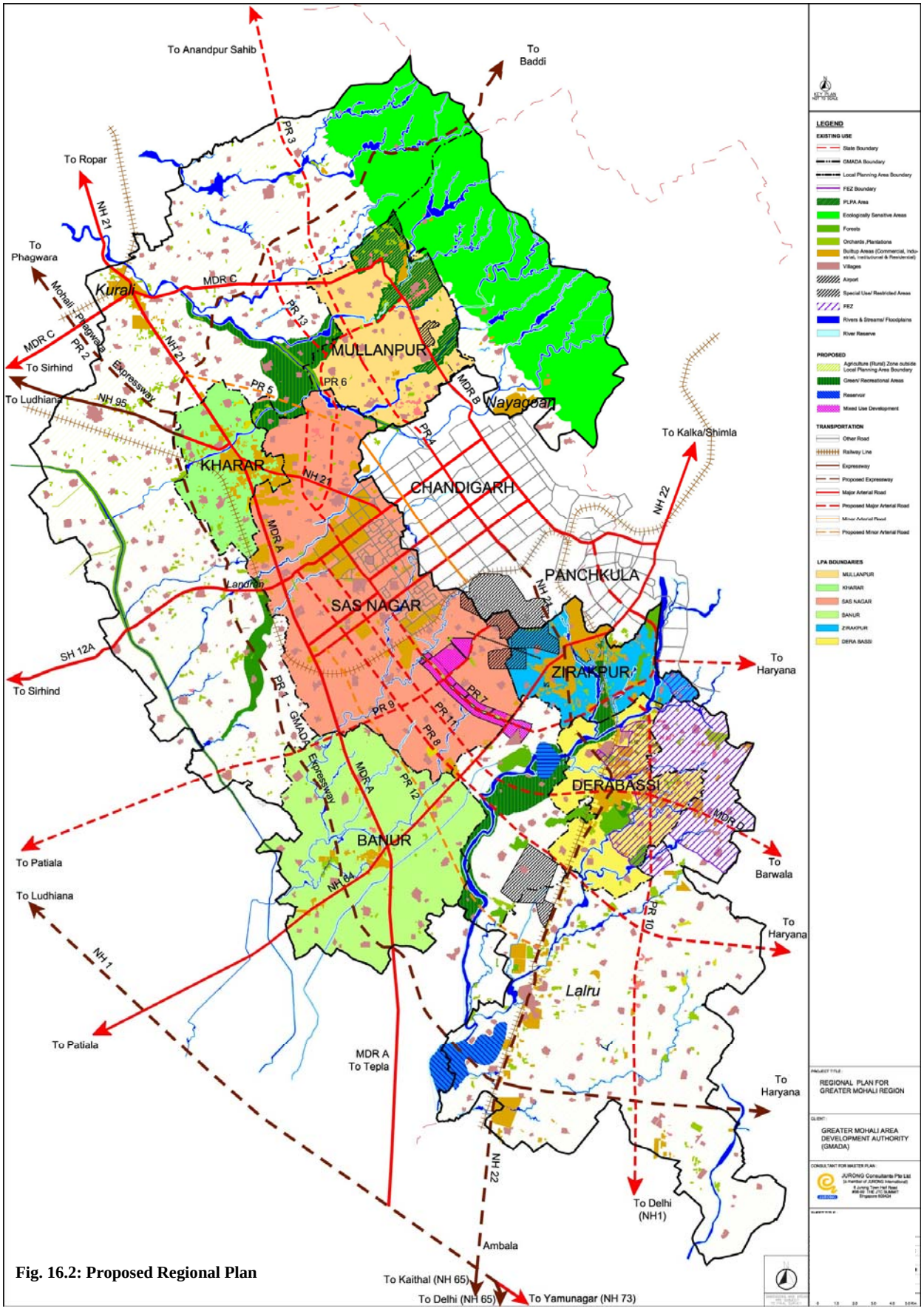


Fig. 16.2: Proposed Regional Plan

16.5 Development Density

The land use in the urbanized areas can be controlled not only through the extent of the land area required for a particular use but also through the intensity of use through the plot ratio or floor space index (FSI) control. This density approach is another planning tool to maximize the land use as and where necessary. For example, for residential areas that are in close proximity to transportation nodes and/ or to commercial centers, the intensity of the residential development is to be increased accordingly. This is to ensure that the community and infrastructure facilities developed will serve the largest possible number of people. On the other hand, for commercial use, it is a common practice to assign the appropriate FSI depending on the hierarchy of the commercial centre in question. Under normal circumstances, the Central Business District will have a higher FSI than a normal town centre, and a normal town centre in turn will have a higher FSI than a neighborhood centre. Similarly, the plot ratio or FSI assigned for industrial development depends very much on their operational needs. Industries that can be housed in multi-storey building will have FSI higher than those require larger expanse of ground contact such as warehousing.

16.5.1 Residential (Housing Demand)

With increasing urban development, there will be a commensurate shift of population from the rural areas to the cities. Hence, it is projected that 3.8 million people, or 85% of the total 4.5 million people envisaged in this region by Year 2056, will reside in the urban areas.

Based on the average gross residential density assigned, otherwise known as persons per acre (ppa), the total residential land required has been computed to be in the region of 22,065 ha. The detailed breakdown is as illustrated in Table 16.3:

Table 16.4: Residential Land Requirement

Local Planning Area	Average Density (ppa)	Total Land Required (ha)
Banur	100	5,804
Derabassi	200	1,248
Kharar	200	2,024
Kurali	200	795
Lalru	200	2,503
Mullanpur	100	1,392
SAS Nagar	175	5,369
Zirakpur	250	2,140

Super Mega mixed use integrated industrial park projects falling in the GMADA region of M/s EMAAR MGF land ltd (1200 acres and 300 acres), M/s Chandigarh Infotech private ltd (1170 acres) approved by empowered committee of the state government in its meeting held on 28th May, 2008 and M/s PACL India Ltd (750 acres) in the empowered committee meeting held on 3rd Sept,2008 stand incorporated in the regional plan and master plans of the local planning area as approved by the empowered committee and Punjab Region Town and Country Planning Development Board.

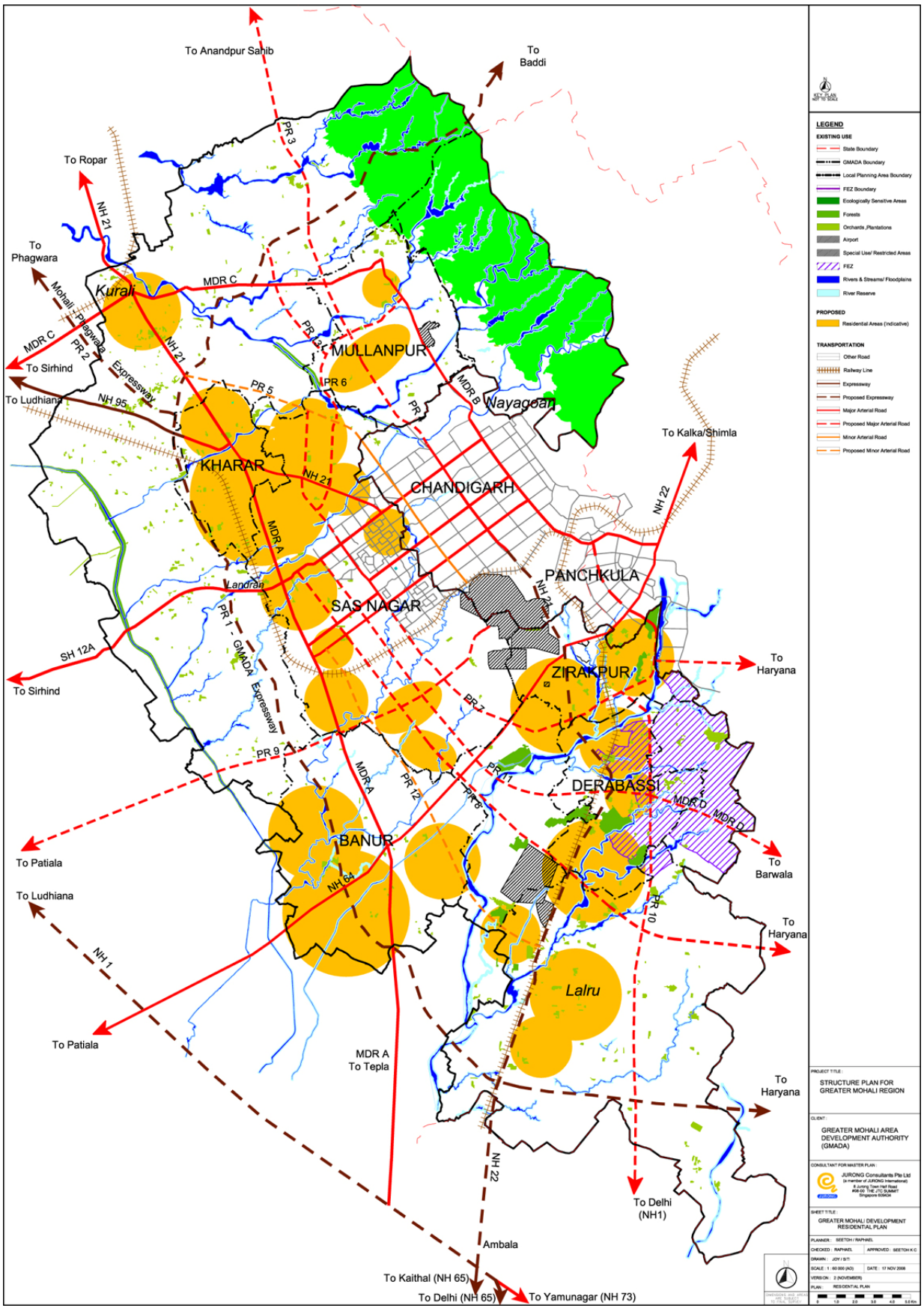


Fig. 16.3: Proposed Residential Zones

16.5.2 Commercial

For commercial redevelopment, the FSI and floor space area (FSA) will be recommended in accordance to the hierarchy of these centers. The distribution of proposed commercial nodes in the GMADA region is shown in Figure 16.5. The recommendations of FSA for the various tiers are as follows:

Table 16.6: Commercial Centre Hierarchy

Hierarchy	FSA (m2) recommended (approximately)	Land Area (ha) (approximately)
CBD	15,000,000	1, 800
Regional Centre	1,500,000	70
Sub-Regional Centre	150,000-300,00	35
Town Centre (commercial centre outside the category 1,2,3),subsumed as part of the residential land	60,000	30
Neighborhood Centre	12,000	6 to 9

Generally, there are 5 levels of commercial hierarchy with the different levels providing for different level of goods and services. See Fig 16.4 for the representation of hierarchy of commercial centres. The highest is the CBD, where one can expect to find the regional HQs of banks, financial institutions, manufacturing companies, MNCs, high end entertainment centers and regional distribution centers. The commercial multiplexes located here will carry higher order goods such as branded imported goods, and "white goods" such as high end electrical home appliances, bulky items like washing machines, television, refrigerators and so fore.

At the other lower end of the commercial hierarchy; the neighborhood centre, caters At the other lower end of the commercial hierarchy is the neighborhood centre, catering solely for the daily necessities of the surrounding communities they serve. The consumer's daily needs are provided through the various provision shops. Lower -end personal services like barber and tailor shops, bicycle repair shops, small super markets and wet markets for the sale of fresh fruits and vegetables are also commonly found in a typical neighborhood centre. The neighborhood centre serves smaller catchments populations than that of a CBD or regional centre.

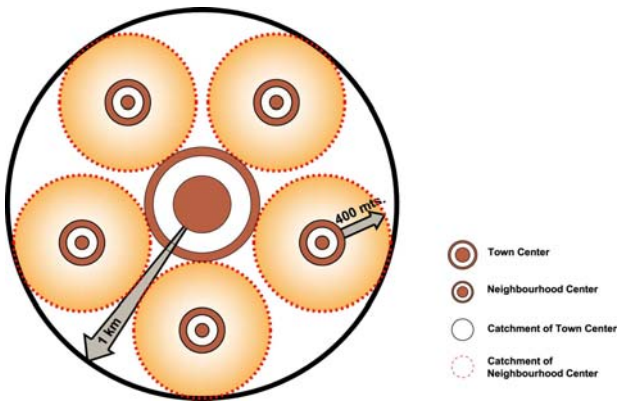


Fig 16.4: Conceptual Representation of Commercial Centres

The CBD, where a wide range of institutions and commercial establishments are located contain employment opportunities which are diverse and wide-ranging. As these establishments have dealings with businesses beyond the boundary of GMADA, i.e. engaging directly or indirectly with the global economies, the employment situation can hence, be volatile. This is inevitable as the global economy fluctuates from time to time. On the other hand, the employment opportunities in a neighborhood context may be limited but they are reasonably stable. Often, these business outlets have established themselves over many years. These existing business establishments, though small, provide employment for the local living within the area and indirectly stabilize the local economies. The small commercial establishments within a neighborhood, because of the less complex operations tend to employ lesser number of staff and usually with lower level skills.

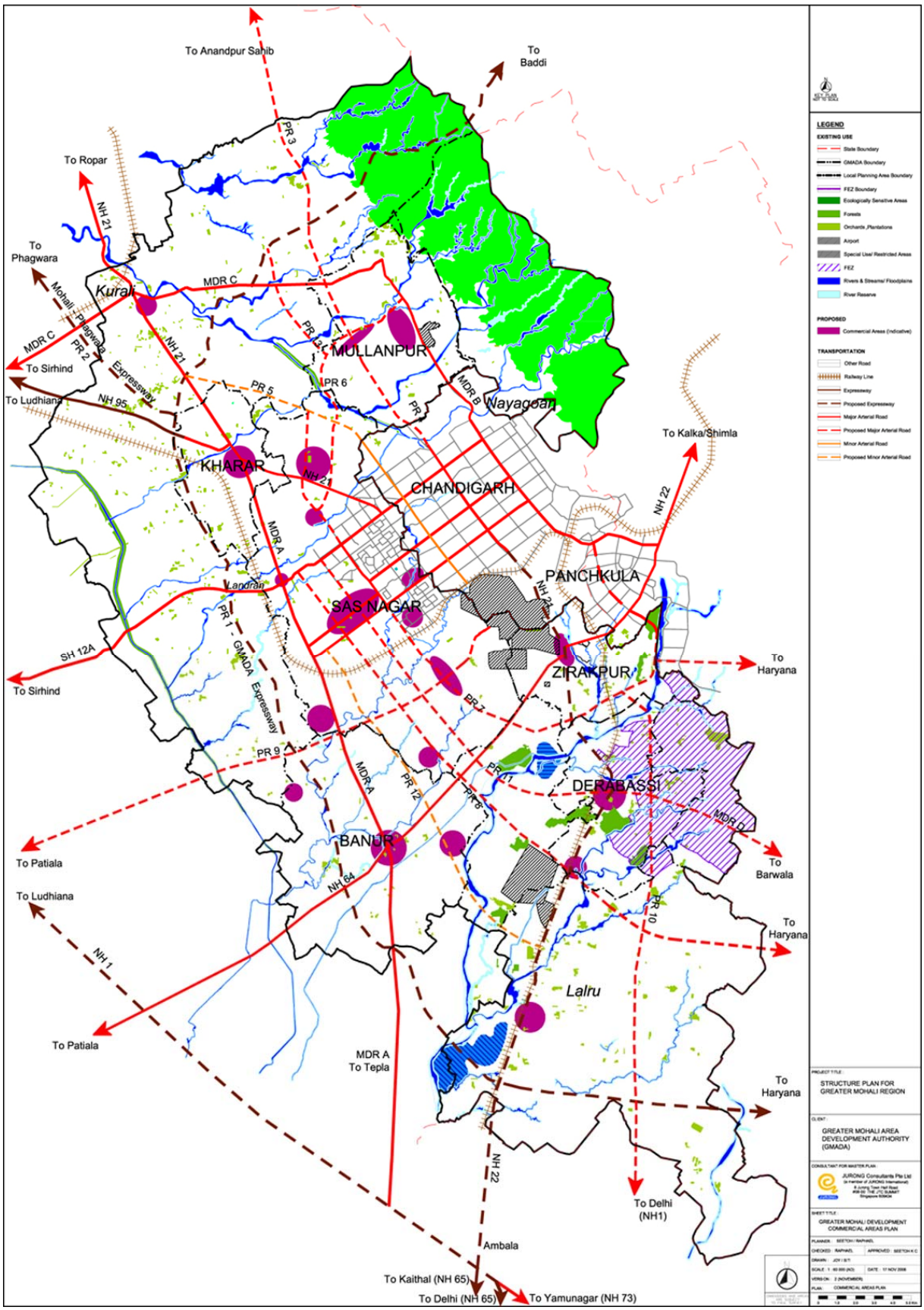


Fig. 16.5: Proposed Commercial Nodes

16.5.3 Industry

For industrial uses, the FSI depends very much on the operational needs and also the suitability to house the industrial activities within multi-storey structures. For example, for IT& ITeS, activities which can be housed in multi-storey Business Park developments, the FSI can be as high as 2.00 while warehousing, normally a single-storey structure with a large volume of storage space for stacking, can only manage an FSI of 0.5. The FSI allocated will depend on the types of industrial activities proposed within the concerned area.

As mentioned in the previous section, industries will continue to play an important role in contributing to the economic progress of GMADA. The nature of these industries may change from a manufacturing base to more knowledge-based type industries. Following calculations, 2474 ha of land have been safeguarded for the development of not only the predominantly knowledge-based and light and clean industry but also for hard core manufacturing comprising both medium and small scale establishments. The distribution of industrial land is shown in Table 16.7 below and in Figure 16.6.

Table 16.7: Industrial Land Distribution

Local Planning Area	Industrial Land Allocated (ha)	Possible Types of Industries
Banur	1598	Light Manufacturing
Derabassi	1740	Light Manufacturing
Kharar	215	Light Manufacturing
Kurali	142	Light Manufacturing
Lalru	533	Light Manufacturing
Mullanpur	542	Business park, Media-Oriented Industries
SAS Nagar	1556	Light Manufacturing
Zirakpur	572	Manufacturing

Besides the locational criteria for industrial land, other factors have also been taken into consideration in the allocation of industrial lands such as:

- To ensure that clustering of similar industries is possible within a small geographical area. This is to take advantage of the synergistic nature of their operations, and possibility of shared facilities such as common infrastructure corridors, common distribution centres and lecture halls.
- To ensure that there are enough park-like, self-contained environments conducive enough (i.e. to introduce the concept of live, work and play) for the development of knowledge-based science and technological parks. Also, ensuring that enough areas adjacent to or in close proximity to higher institutions of learning are also made available for the development of these parks as these two types of developments tend to forge symbiotic relationships with each other.
- To strengthen areas where existing manufacturing activities are acceptable and at the same time to regenerate or redevelop areas where industries are deemed incompatible.

16.5.4 Community Facilities

We have also planned for the various types of communal facilities. These are important as they form part and parcel of the residential fabric. Generally, the demand for land for each of the facilities is often small, except for large educational institutional sites and hence, the majority of these uses are subsumed under the residential land use in the regional plan.

The preferred locations depend very much on the catchments these facilities serve. Those facilities serving the neighborhood level will be appropriately located within each neighborhood while the ones serving the regional catchments will be located at strategic locations where the ease of accessibility from all parts of GMADA is ensured.

In terms of the FSI/ FSA it varies from facility to faculty. Generally, to optimize the land use, if 2 or 3 institutional uses are compatible, they can be co-located together or within the commercial complexes. The purpose-built facilities are often expensive and very often private developer is reluctant to set aside land for the development of community facility. Some innovative ideas or compensation have to be work out to get around this issue. As explained in the next section, one of the compensation methods can be vide the transfer of development rights for the developer concerned. The table below illustrates the recommended norms in terms of provisional standards and site area standards.

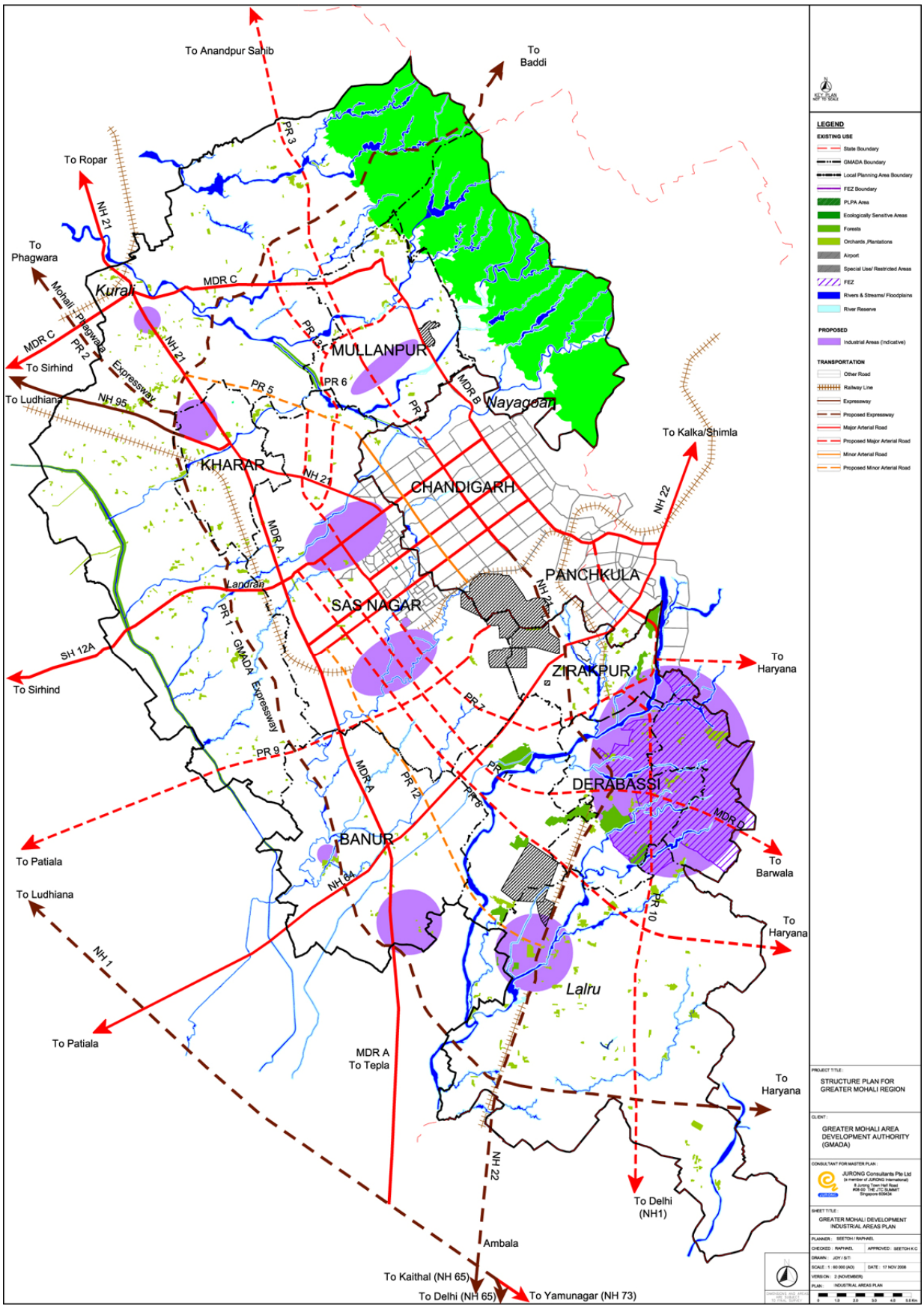


Fig. 16.6: Proposed Industrial Zones

Table 16.8: Provision Standard of Social Facilities

PROVISION STANDARD OF SOCIAL FACILITIES			
S.No	Land uses	RECOMMENDED	
		Provision Standard	Site area standard (Ha)
1	**Residential**		
	1.1 Low Density Housing		
	1.2 High/ Medium Housing		
2	**Commercial**		
	2.1 Regional Centre	1 per town of 100,000 DU	60
	2.2 Town Centre	1 per town	40
	2.3 Neighbourhood Centre[a]	1 per 4000 - 6000DU	3
	2.4 Informal market	1 for 10000 DU	2
	2.5 wholesale market	1 per 200,000 DU	15
3	**Education**		
	3.1 Professional college (engg)	1 per 100,000 DU	-
	3.2 Medical college	1 per 500,000 DU	-
	3.3 Junior college	1 per new town	8
	3.4 Secondary school	1 per 6000 DU	3
	3.5 Primary school	1 per 2500 DU	1.8
	3.6 Pre primary school	1 per 1500 DU	0.4
	3.7 Vocational Institutions [t]	1 per new town	1.5
	3.8 Special school	1 per 50,000 DU	1.5
4	**Institutions**		
	4.1 community centre	1 per 15000 DU	0.4
	4.2 Polyclinic[c]	1 per 15,000 DU	0.4
	4.3 Library	1 per 50,000 DU	0.3
	4.4 Home for aged	1 per 100,000 DU	0.3
	4.5 Orphanage	1 per 100,000 DU	0.2
	4.6 Working women - men hostel	1 per 100,000 DU	0.1
	4.7 Reserve site [b]	2 per neighbourhood centre	8
5	**Parks and gardens**		
	5.1 Town park	1 per new town	25
	5.2 Town centre Garden	1 per 10,000 DU	4
	5.3 Neighbourhood Park	1 per 2000 DU	1
	5.4 Open space / plaza	1 per 1000 DU	0.5
6	**Sports and Recreation**		
	6.1 indoor stadium	1 per 50,000 DU	1
	6.2 Sports complex	1 per 50,000 DU	5
	6.3 Swimming complex	1 per 20,000 DU	1.5
	6.4 Recreation club [e]	1 per 10,000 DU	0.45
	6.5 Multi- purpose hall	1 per 10,000 DU	0.2
7	**Transports**		
	7.1 Bus interchange [d]	1 per new town	2
8	**Reserve site for Unanticipated Future Uses**	**1 per town**	**3**
9	**Health Care Facilities**		
	9.1 hospital - 100 beds	1 per 20,000 DU	0.4
	9.2 hospital - 101 - 200 beds	1 per 20,000 DU	1
	9.3 hospital - 201 - 500 beds	1 per 100,000 DU	3.5
	9.4 hospital - 500 beds	1 per 100,000 DU	5

S.No	Land uses	RECOMMENDED	
		Provision Standard	Site area standard (Ha)
10	**Miscellaneous**		
	10.1 Veterinary hospital	1 per 100,000 DU	0.4
	10.2 police station	1 per 50,000 DU	1
	10.3 fire station	1 per 40,000 DU	1
	10.4 post office	1 per 500,000 DU	0.25
	10.5 Burial ground / cemetery	1 per 200,000 DU	1
	10.6 Cremation Ground	1 per 100,000 DU	0.4

Notes:

(a) Neighbourhood centre includes milk booths , three wheeler / taxi stand , service market, local shopping, convenience shopping , police post etc

(b) Reserve sites includes religious buildings , training centres etc

(c) Polyclinic includes dispensary, nursing home , family welfare centres, maternity homes etc.

(d) Bus interchange includes bus terminal and bus depot

(e) Recreation clubs includes Socio cultural activities etc

(f) Vocational institute includes research and development centres, polytechnic , teachers training institute etc

Police post - void decks of residential building / commercial centresfor above

(g) Area for above facilities if less than the prescribed above shall meet the area requirement of different agencies / rules and requirements such as high school area should be as per CBSE norms and alike.

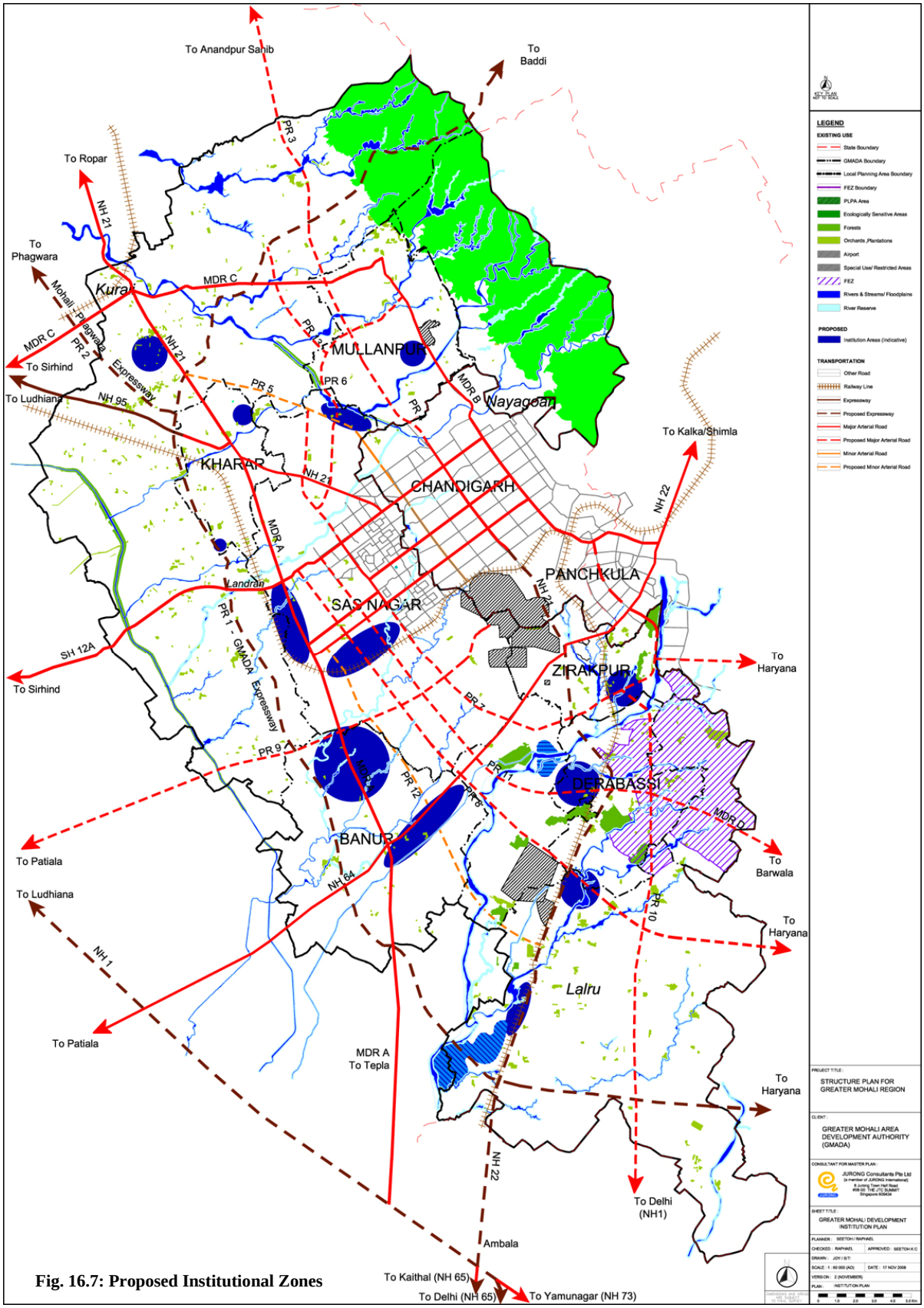


Fig. 16.7: Proposed Institutional Zones

16.6 Development Incentives

Intensity expressed in terms of assigned FSI can also be used as a development incentive for phasing out for land uses that are incompatible with the proposed or current predominant land-uses within an area. In Singapore, one of the methods of phasing out of industries within a predominantly residential area is to increase the density from a lower industrial use to the prescribe density and use as proposed in the Master Plan. For example, in the case where the industry is located in the midst of an area where the Master Plan has zoned it as residential, the site of the industry will be accorded residential use at a higher FSI without the change in the ownership of the land. Hence, this provides the push factor or incentive for the existing industries to move out as the same piece of industrial land may enable the owner to experience a windfall gain terms of higher land value through a higher FSI and use. The phasing out of industries through this method has been quite successful, as the majority, if not all, of the industries within areas zoned residential in Singapore have been relocated.

The above principle can also be applied, in cases where private land owners are being requested to surrender for the development of a "public good" for example a public park or buffers along a major road. The development rights will be transferred to the rightful owner in terms of the FSI and use entitled for that particular piece of land had it not been surrendered to the State. This entitlement can be transferred to the adjacent land. Hence, in this way, the owner surrenders the land to the government for the development of a public good without suffering any loss in terms of development rights and value.

16.7 Development Focused Areas

Strategically, the whole GMADA development area can be divided into 2 broad zones: Zone of the Urban Areas and Zone of the Rural/Agriculture Areas. For ease of discussion the former area is further classified into Primary Urban Development Areas and the Secondary Urban Development Areas. The criterion for this division depends on the timing, the type of development and the influence of adjacent existing development and policy directives.

16.7.1 Primary Urban Development Areas

This development area refers to the belt comprising Mullanpur, S.A.S Nagar, Airport, and Zirakpur/Derabassi Belt. These areas are in very close proximity to Chandigarh and will experience the full "spill over" development impact from it particularly when there is intention to designate Chandigarh as a Heritage City. Once this has been approved, the developmental growth will be restricted within Chandigarh itself. Hence, the pressure of development will most likely have a direct impact on the immediate adjacent areas of Mullanpur, S.A.S Nagar, the Airport, and the Zirakpur/Derabassi Belt. These areas will have to be comprehensively planned with a whole host of uses ranging from residential, planned with a whole host of uses ranging from residential, commercial, institutional, etc. to cope with the demand of the spill over population from Chandigarh as well as their own.

These areas are well connected to one another by the proposed road that runs from north-west to the south-east portion of the belt.

Growth will be focused on 4 key growth nodes:

Table 16.9: Key-Activity Initiatives

	Growth Poles	Activities Initiatives
1		Initiating rapid development of this area into the CBD for the whole of GMADA area. This will contains the financial establishment, entertainment establishment, cultural and administrative centers
2		Capitalizing on the airport expansion, with the introduction of logistic, precision engineering, air-craft maintenance industries, etc. to convert this area into an aviation hub. All major transportation corridors will need to have direct access to the airport to allow for greater accessibility for goods and services to be exported internationally.
3	Mullanpur	To initiate the development of resort centers within Mullanpur to cater for the eco-tourist that will be attracted to the Silvalik hills areas. Also, as this area is located in close proximity to the industrial town of Baddi in the north, there is a potential to developed low density housing as there is a demand for these from the people that work in the industrial town of Baddi to the north
4	FEZ	Consolidation of the existing industrial activities as well as the introduction of the new ones

The main guiding principles include:

- Ensuring the ease of access and mobility within the proposed transportation corridor that connects Dabbi in the north-west to Barwala in the south-east.
- Intensification of residential and commercial developments particularly around and within close proximity to the core transportation nodes particularly where these nodes are confluences of major transportation links.
- Promotion and development of major regional parks that run along major water bodies and reservoirs.
- Encourage in-fill development within the built-up areas as well as initiate the redevelopment of existing incompatible uses
- Upgrading of rural areas in close proximity to the targeted urban areas.
- Strengthen the already established industrial areas such as the FEZ and the existing commercial nodes.
- Initiate new employment centers such as the airport, the resort recreation centers of Mullanpur and the extension area of the airport incorporating the logistics and business parks

16.7.2 Secondary Urban Development Areas

The secondary areas are those which will develop at a later stage being areas further away from the main development pressure points. , Hence the initial growth for these areas will be focused along the major transportation corridors and selected growth poles to kick start the development so that the

development will spread to the rest of the areas. These are areas that are planned so as to channel the development along a particular direction, balancing the regional development growth and to guide development along an intended direction.

Growth will be focused on 3 key growth nodes:

	Growth Poles	Activities Initiatives
1		A green field site where new concepts of new town planning ideas can be carried out without much constraint imposed by existing building or commitments. This forms the southernmost growth pole; a magnet to redirect the development direction toward the very south of Chandigarh.
2		Banur lies in the southern most tip of the institutional/business park belt that runs from the airport extension in the north. The "institutional node" has to be initiated in south so as to allow the spill over effect "northward" in order to consolidate the institutional/business park/regional park belt.
3	Lalru	Within the linear green and the waterbody that runs along the north to south of the area is the provision of a natural feature where residential developments low to medium rise and recreational developments can capitalized on.

The main guiding principles include:

- Promotion of growth within the established transportation corridors.
- Ensure the ease of access and mobility within proposed 3 transportation corridors:
  - Zirakpur through Derabassi, Lalru towards Ambala
  - Zirakpur through Banur-Rajpura
  - Chandigarh through S.A.S Nagar, Kharar to Ludiana
- Consolidation and intensification of the institutional areas particularly within Banur to be in tandem with the development of the regional park nearby and the development of the business park.
- Kickstart the new town development (the south extension of S.A.S Nagar), initiating the growth within the intersection of the major transportation corridor and also along the corridor.

16.7.3 Agriculture, Tourism and the Rural Growth Centres Areas

At the present moment, wheat, paddy, maize and sugarcane are the four major crops which are produced in the district. Hence, these areas have to be safeguarded for as long as possible for cultivation purposes or for that matter designated as a permanent agriculture zone, particularly areas in between NH-64 and NH-22.

As most agriculture products are perishable, there is therefore a need to be able to transport products from the source to their final destination as fast as possible. This objective can be achieved through the proposed rural growth centers that seek to connect all the agricultural areas to the main transportation corridors. These rural growth centers double up as collection centers whereby the

products from the immediate agriculture areas can be collected and redistributed to the rest of the country via the major transportation corridors and nodes.

At the foothills and even within the Shivalik Hills, eco-tourism should be encouraged. Within Mullanpur, resort-like commercial centers should be developed to complement the eco-tourism planned for the area. However as this area is ecologically very sensitive, the number of tourist activities has to be controlled and restricted so as not to exceed the carrying capacity envisaged for this area.

The main guiding principles include:

- Protecting these areas from the spread of the urban sprawl.
- Upgrading these areas in term of infrastructure and community facilities.
- Introducing the concept of Rural Growth Centres. These centers have to be integrated with the growth centers within the main towns through important transportation corridors.
- Capitalizing on the natural attributes of the area to form part of the infrastructure set-up/network (e.g. reservoirs) and also to form part of the public green and recreational network (e.g. regional parks). Natural lakes to be converted to rain water collection areas, banks of river to be developed as linear parks, and floodable areas to be set aside for wet lands development (i.e. breeding stops for migratory birds)
- Encouraging a home or ⁄farm-stay concept of tourism.
- Promoting eco-tourism particularly in the Shivalik Hills area.

Figure 16.8 shows the proposed phasing strategy of the GMADA region.

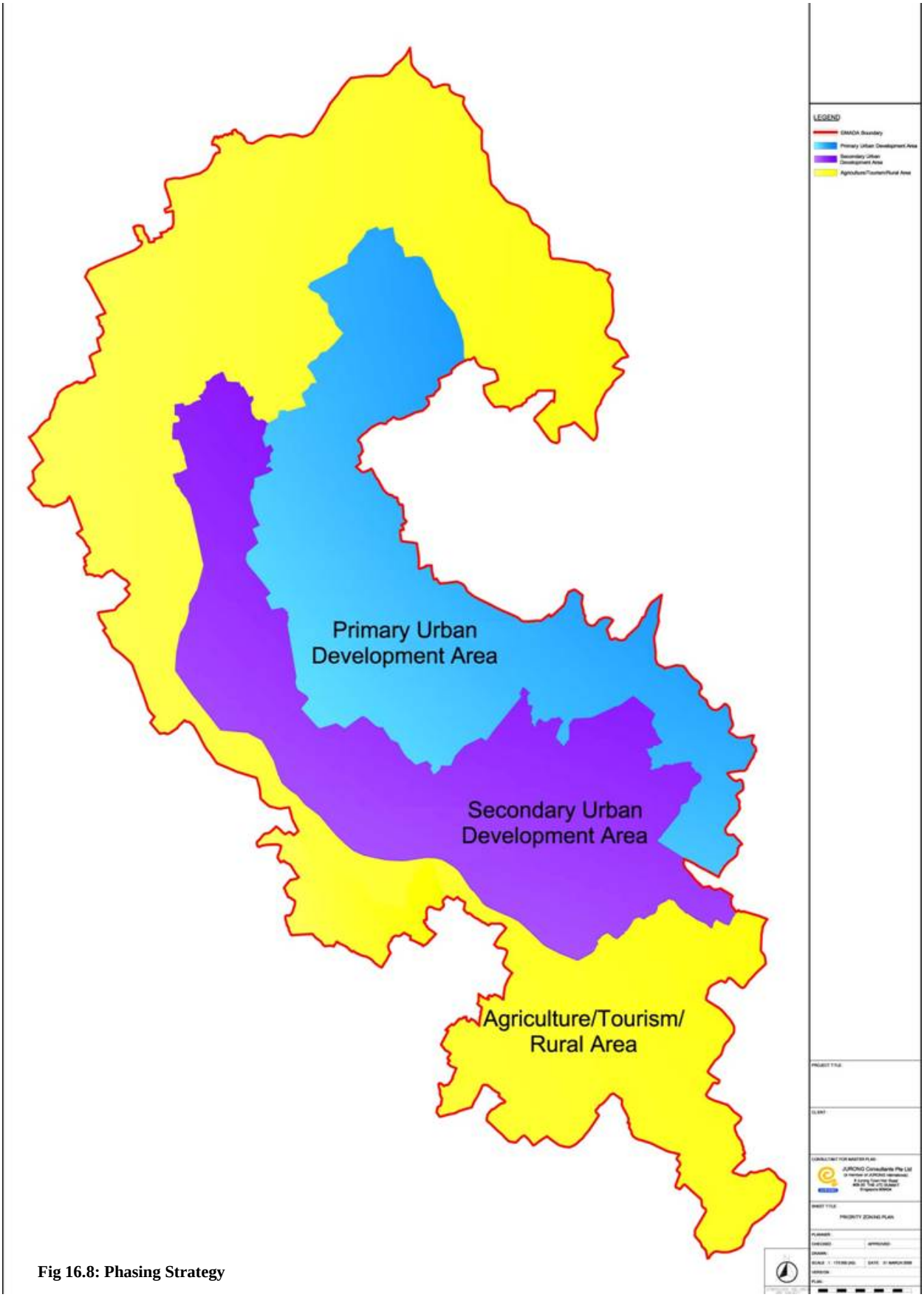


Fig 16.8: Phasing Strategy

16. 8 Development Phasing

It is proposed that the urbanized area is to be developed in phases over the 50 year period. It is neither feasible nor desirable to develop the entire site simultaneously. A phasing plan will be formulated to ensure that the development of the various land uses within the GMADA is well coordinated, particularly with the development of infrastructure. This will permit more cost effective use of existing and proposed investments in infrastructure.

Development phasing is to allow for incremental growth over time, in order to minimize the need for large concentrated investments at any point in time. Phasing is also to recognize that development growth takes place by small increments as and when resources are available.

16. 9 Broad Development Phasing Sequencing

It is recommended that the 1st phase be set at approximately 26,987 ha with the 2nd and 3rd phases at approximately 17,273 ha and 13,433 ha respectively. See Figure 16.9. This will permit more cost effective use in terms of the initial outlay for investment particularly in infrastructure development. This should not be cast in concrete but flexible enough to be revised in tandem with changing socio-economic climate.

The 1st phase development areas have to be not only sufficiently large but prominent. This is to ensure that the areas selected have the capacity to be able to act as developmental “catalysts”. These areas should demonstrate financial and environment viability to ensure a higher chance of initial success. These starter areas have to establish the high standards expected for the developments of the latter phase to emulate. One step in the right direction is to initiate the development of Sector 62 that makes up a part of the designated CBD area as a show case development.

Like in any other parts of the world, it is not unusual that a certain amount of industries is required to act as catalysts for growth. Hence, areas that are zoned as industries will also have to be initiated accordingly. In addition, an appropriate quantum of commercial space for the business center and retail, hotels can also proceed, but their progress will have to keep pace with the other developments such as residential and institutional use within the immediate surrounding area.

The GMADA’s first phase of the development is concentrated in and around the industrial parcel in close proximity to the airport expansion area’s south-eastern portion, and some of the commercial uses at parts of urbanized area such as Zirakpur, S.A.S Nagar, Mullanpur, contiguous with the existing development at Chandigarh and Panchkula. It is proposed that development logically proceeds from the north to the south and progressively from the east to west. The start-up area boundary is drawn up taking into consideration the mix of land use types, the proximity to the existing highway and built-up areas, and the ease of infrastructure connections.

With the completion of the 1st phase, there will be sufficient residential population and workers to justify the commencement of the additional administrative, entertainment, commercial and institutional elements within the CBD proposed within S.A.S Nagar. The CBD development will proceed with incremental commercial quantum to cater for the immediate development areas such as the airport expansion area, Zirakpur and even Mullanpur to the very north. The commercial quantum will have to be progressively enlarged to accommodate the development pace of the greater GMADA area.

Infrastructure and utilities development such as the roads, electrical substations, sewers, bridges etc has to be constructed and laid first because of the long lead time of 1 to 2 years. However, as mentioned earlier the construction progress of the critical infrastructure has to be scheduled to tie in with the development phasing to reduce the high capital outlay and holding cost. The phasing

boundary is designated to ensure a well co-coordinated development of the various land uses within GMADA taking into account the availability and timing of utilities, the ease of infrastructure and road connection.

The actual speed or pace of development of each phase will depend upon the take-up rate of land for predominantly industrial as well as the residential land. In any case, the boundary of the start up phase is drawn taking into consideration a good mix of land use, proximity to the existing highway for greater visibility and ease of infrastructure connections. The main use will be industries, residential and some commercial.

2010 - 2020

- Consolidate urban developments along all existing transportation routes/nodes.
- Accelerate the urbanization of areas along the periphery of SAS Nagar, Derabassi, Kharar and Zirakpur in order to relieve the urbanization pressure from Chandigarh.
- Accelerate the growth of Mullanpur in conjunction with the increase in demand for housing coming from the industrial town of Baddi and also to develop Mullanpur as a resort centre in line with the intention of to further develop the eco-tourism at Shivalik Hills.
- Accelerate the airport extension and the associate industries such as logistics, air- craft maintenance, high-tech etc.

2021- 2035

- Further expansion of urbanized area along the periphery of Chandigarh.
- Further development along the institutional and industrial spine, particularly along the main transportation spine within Banur so as initiate the “southern growth pole” of the spine.
- Further developments in tandem with new infra-system network.

2035 - 2056

- Further expansion of urbanized area into other “new” areas within the existing LPA outside the developed core areas.
- Complete the urbanization along fringe area of Lalru and Kurali.

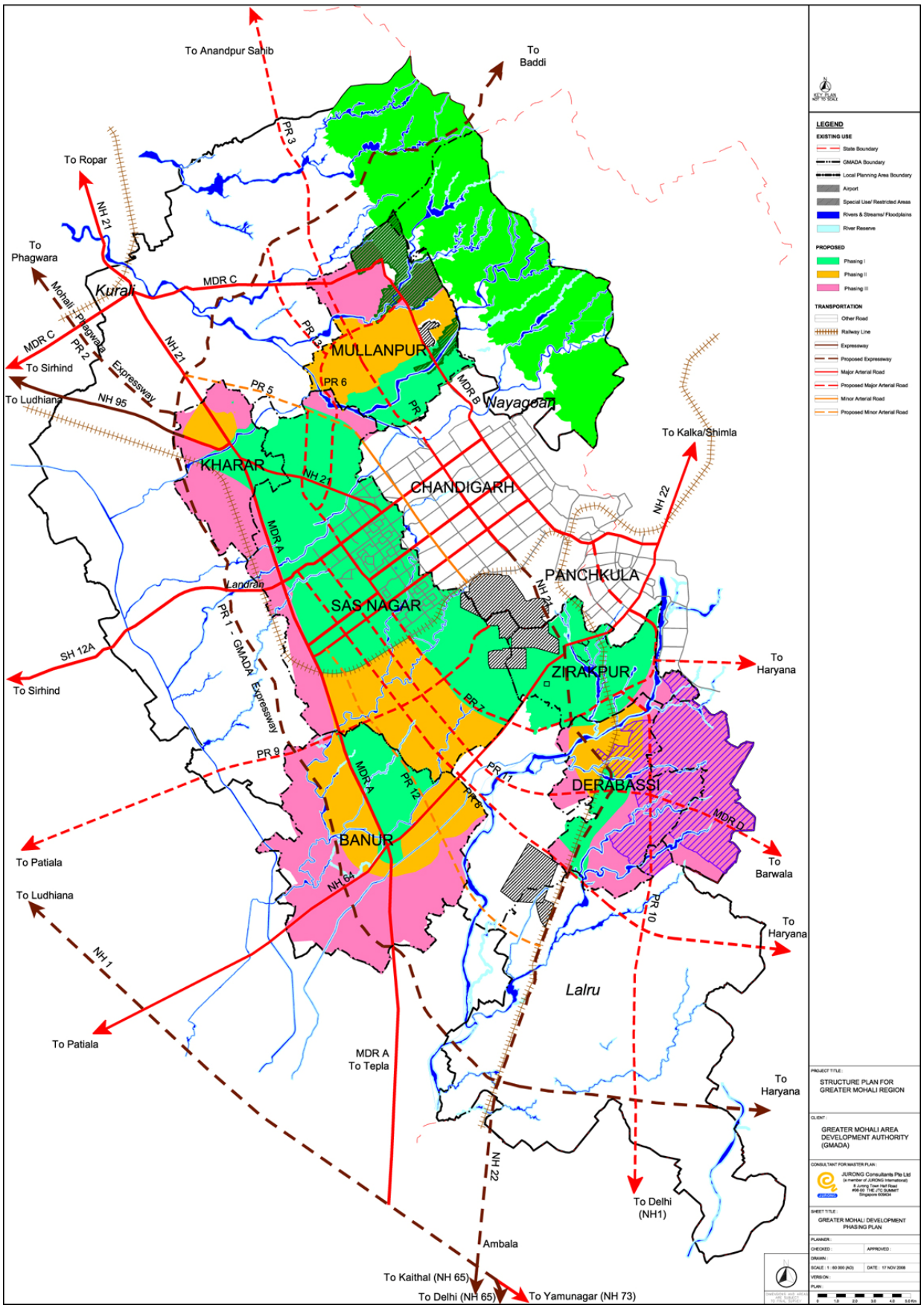


Fig. 16.9: Development Phasing

16.10 Formulation of Core Objectives for the GMADA Regional Plan

Yr 2056 Regional Plan Objectives	Core Regional Plan Objectives	Categories of Specific Regional Plan Objectives
To adequately provide for the comprehensive range of land use, space and contingency requirements of a 4.5 million population in Year 2056	To ensure an optimal mix of land uses, adequate floor space capacity and judicious designation of development intensity zones in accordance with the intentions of the vision statement and the regional plan	• To provide adequate amount of floor space and land area in accordance with the projected population distribution throughout the GMADA development area • To plan for developments of different intensities in new areas to create different characters for the different towns • To safeguard against intensification of existing local environments particularly environmentally sensitive areas and good agriculture lands.
To enhance the green and blue image of GMADA	To create the greenery and waterways network plans for the GMADA development area.	• Provision of the open spaces according to the acceptable standard based on bench-marking studies of a number of overseas examples/norms. • Preserving and enhancing existing waterways and creating new ones; doubling up as rain water harvesting sites or reservoirs

Yr 2056 Regional Plan Objectives	Core Regional Plan objectives	Categories of Specific Regional Plan Objectives
A balance development relating jobs to homes, and living space to working space.	To plan for a balanced community by providing adequate land for a wide variety of housing, communal and recreational facilities, as well as for matching employment and investment opportunities for the resident population.	• Creating economic objectives/employment opportunities for job seekers • Provision of widest possible ranges of living, working and recreational environments • Provision of adequate and quality of recreational activities
The development of total land use and transport strategy to facilitate socio-economic growth		• Sufficient commercial facilities to cope with the demand. • Transportation efficiency in terms of provision of appropriate corridors, and public transport facilities. Safeguarding of future possible corridors.

Yr 2056 Regional Plan Objectives	Core Regional Plan Objectives	Categories of Specific Regional Plan Objectives
	• To create a quality living and working environment through land use optimization, preservation of heritage, accentuation of the inherent natural assets of the area and planning of a green open space/pedestrian network and waterways • To provide development opportunities and controls to create visually interesting variations in the urban form, particularly for the CBD within S.A.S Nagar.	• Land use optimization rather than maximization throughout the GMADA development area. • Preservation of heritage and ecologically sensitive areas • Accentuation of natural assets for the greater enjoyment of the public • Adequacy of public open spaces for the use of the general public in accordance to the norms recommended based on the study of the various oversea examples • Achieving varied urban form based on the typology of development, intensities, building heights and having different urban textures • Achieving urban-scape of distinctive identity through sensitive urban design i.e. spatial arrangement of building forms, plazas and public gardens/open spaces.
Flexibility and contingencies incorporated within the regional plan	To incorporate into the regional plan (master plan) contingency in terms of reserve sites and also to allow for a “computation discount” in the estimation of land area availability.	Specific timeframe and site availability for implementation and land allocation

17. Development Control Regulations

17.1 Introduction

The urban areas in the GMA are vibrant with activities and life. Intrinsic to these urban areas are the residential areas harmoniously integrated into the urban fabric, even at the commercial centers. In the drawing up of the Regional Plan, this unique urban quality will be considered. To guide the implementation of the Regional Plan for GMADA in an orderly manner according to the planning vision, Development Control Regulations for the relevant Land Uses. Unlike Euclidean zoning, some flexibility will be built into the Development Control Regulations.

It is envisaged that the proposed Development Control Regulations will be administered closely and will be reviewed periodically with the maturing of the planning and development control process and changing public aspirations throughout the planning period.

Any existing uses that are approved prior to the gazette of the Regional Plan will be respected. Any unauthorized existing use will be considered non-conforming and subject to evaluation and approval of the competent authority.

No development shall be allowed on the land reserved under PLPA that fall within the any of the following areas although it may not be specifically zones as “Ecologically-Sensitive Area” in the Regional Plan.

- Aquifers, recharge areas and other watershed lands;
- Grasslands, fields or forest lands;
- Fresh and salt water marshes and other wetlands;
- Water bodies, rivers, streams, lake and pond frontage;
- Scenic vistas;
- Land for wildlife habitat or biodiversity or natural preserves.

17.2 Urbanisable Areas

There are existing Built-up areas within some of these urbanisable areas. These existing Built-up areas will be allocated a land use appropriate to the planning intention embodies in the Regional Plan and Master Plan.

The Regioanl Plan acknowledges that existing villages may be located within the urbanisable areas that are incongruent with the planning intention under the Regional Plan and the Master Plan. As such, land pooling and reconstitution are allowed to improve the living environment and to guide he development of these existing villages so that such adjoining lands under different ownership can be pooled together and after proper planning the same is re-distributed in a properly reconstituted plots after deducting the land to be used for open spaces, access roads, developed areas and infrastructure to support new uses while complying the development parameters.

Within the proposed Urbanisable Areas, there are three key Land Uses which are as follows:

17.3 Commercial

These are areas used or intended to be used mainly for commercial development.

Examples of commercial developments are:

- Office
- Mixed Use (e.g. Office/ Shopping/ Cinema/ Hotel/ Flat)
- Convention/Exhibition Centre
- Commercial School
- Bank
- Market/Food Centre/ Restaurant
- Cinema
- Entertainment
- Foreign Trade Mission/ Chancery
- Hotel
- Recreation Club
- Private medical facilities
- Private Educational facilities
- Wedding Hall: only for the stand-alone facilities. If this is integral to a Place of Worship, then it shall not be more than 10% of the permissible covered area.

Each commercial use will be assigned specific planning parameters on floor-area-ratio, ground coverage, building setback, maximum height and specific building uses according to the hierarchy of commercial centres. These specific regulations will be elaborated upon under each Master Plan.

Mixed Use developments are allowed on specific sites to enhance the unique character of that particular area. These are usually a combination of residential and commercial uses. However, the owner or developer may subdivide the site in the following ways:

- Vertically: Such a development can subdivide the plot into a wholly residential development and a separate commercial development. Development control regulations will be applied separately to each land use.
- Horizontally: Such a development can take the form of a shopping podium with an apartment tower block or “SOHO” small office-home office types, EDC, CLU and license fee shall be charged proportionately.

17.4 Residential

Residential developments will be subdivided into:

- Plotted housing
- Group housing
- Residential with Commercial use on the ground floor

17.4.1 Plotted housing

This housing type is typically low density and low-rise and comprise 3 housing type possibilities:

- Terrace House
- Semi-Detached House
- Detached House and larger plots of homesteads, individual two storyed (G+1) bungalows on minimum 2.5 acre land with 2% ground coverage in Residential Zone of Mullanpur LPA being ecofriendly and Garden City.

17.4.2 Group Housing

Under group housing, the proposed housing type would be a resultant of the planning parameters for that subject site, especially the allowable density or floor-area-ratio. There are many housing forms which can include:

- Apartments with or without common facilities
- Townhouse
- Gated communities (a combination of low-rise and medium-rise housing forms)
- Retirement Housing
- Student Hostel

17.4.3 Residential with Commercial use on the ground floor

Due to the predominantly residential character of the surrounding environment, the commercial use will be restricted only to the ground floor.

17.5 Industrial

These are areas used or intended to be used for non-pollutive industries, warehouse, public utilities, and telecommunication uses and other public installations for which the relevant Pollution Control Board does not impose a nuisance buffer greater than 50m. Such uses can be themed as in IT, Apparel, Pharmaceuticals, Bio-tech, Gems and Jewellery and Business parks. Industries listed under the 'green' and 'orange' list of the Pollution Control Board will be allowed subject to the approval of the Punjab Pollution Control Board.

General industries and warehousing zone

No new red category industries shall be allowed within SAS Nagar, Mullanpur, Banur, Kharar. Only light (green industries) and general industries (orange industries) are allowed. The classification shall be as per PPCB guidelines.

Developments within this (red category industries) zoning generally produce some odour, fumes, noise and may generate considerable quantities of solid wastes. They may also require treatment plants for liquid wastes. These industries are usually located further away from the residential, commercial areas as well as factories for the food processing.

- In this FEZ out side MC limit, there shall be a buffer distance of at least 100m between red category industrial building and the nearest residential building or mixed use zone. Roads, parking and plantation is permitted in this buffer zone including small ancillary utility buildings like substations, toilets; etc. The project where building plans have been approved by Chief Town Planer; Town and country Planning Dept. Punjab, first shall have precedence, the projects whose building plan area approved later shall have to keep this minimum distance.

- In this FEZ out side MC limit, there shall be a buffer distance of at least 50m between orange industrial building and the nearest residential building. The project where building plans have been approved by Chief Town Planer; Town and country Planning Dept. Punjab, first shall have precedence, the projects whose building plans are approved later shall have to keep this minimum distance.
- There is no requirement of any buffer between clean industries and IT / Knowledge Industries from the residential buildings.
- Factories within the general industries shall install, operate and maintain pollution control equipment to minimise air, water and noise pollution arising from its operations as specified by the Authorities
- Sufficient space should be set aside for the installation of treatment facilities
- Toxic and dangerous materials must not be produced
- These industries may produce some odour, fumes and noise and may generate considerable quantities of solid and liquid wastes. They must be generally sited in designated industrial estates or zones only.

7.6 Institutional

These areas cover the public and semi-public facilities

- Civic & Community Institutions: sports complexes, police station, fire station, community clubs, associations, libraries and museums
- Educational Institutions: schools, colleges, universities
- Medical facilities: government Clinics and hospitals
- Places of Worship: at least 60% of the total floor area shall be used for worship. Ancillary uses shall constitute the 10% and include facilities such as wedding hall, shops for religious articles and refreshment areas.

17.7 Areas outside Urbanisable Areas

Within the outlying Urbanisable Areas, there are other Land Uses of which the following Land Uses are of pertinence.

The administration of Development control Regulations on these areas is two-fold:

- to protect a valuable land resource and highly fertile arable land rather than to give order to development, particularly for Agricultural (Rural) Zone Within Or Outside Local Planning Area Boundary;
- to encourage a less sprawling form of development, thus preserving open space.

The Regional Plan acknowledges that existing villages may be located within the areas proposed for agriculture use or green/ recreation use. As such, land pooling and reconstitution are allowed to facilitate this flexibility so that such adjoining lands under different ownership can be pooled together and after proper planning the same is re-distributed in a properly reconstituted plots after deducting the land to be used for the following non-agriculture or recreation uses as the in case of

Green/ Recreation use, taking into consideration the development parameters of only 10% hard surface and 5% Floor Area Ratio. With the stipulated coverage, the balance land is to remain agricultural or Open Space in character, where applicable.

17.8 Agricultural (Rural) Zone within or Outside Local Planning Area Boundary

These areas are currently zoned agricultural.

Under the Punjab Regional and Town Planning and Development Act, 1995, addition to experience tendency in GMADA, agricultural uses includes horticulture, farming, growing of crops, fruits, vegetables, flowers, grass, fodder and trees; or any kind of cultivation of soil, breeding and keeping of livestock including cattle, horses, donkeys, mules, pigs, fish, poultry, and bees; the use of land which is ancillary to the farming of land or any other agricultural purposes; but does not include the use of any land attached to a building for the purposes of garden to be used along with such building and the expression "agricultural" shall be construed accordingly.

The projects / Mega Housing Projects within the Agriculture / Rural Zone of Regional Plan of GMADA and Local Planning Areas falling in GMADA Region already approved by the Govt / Empowered Committee of the Punjab Government and Punjab Regional and Town Planning and Development Board shall be allowed to develop as Residential Projects subject to the condition that promoters get their CLUs done by 31.3.2009. Periphery Policy dated 20.1.2006 shall stand amended to this extent.

Rural Zone outside LPA of SAS Nagar falling in between Sector 109 to 112 and Railway line, shall be residential as an integral part of these sectors, as per the decisions of PRPTD Board meeting dated 29.06.2006. The Periphery Policy dated 20.1.2006 shall stand amended to this extent.

17.9 Green/ Recreational Areas / PLPA/ Forest Area

These are Open Spaces intended to be used mainly for sports and recreational purposes. The Regional Plan acknowledges that some of these areas are currently proposed for agriculture use and is allowed to continue in agriculture use. The Zoning Regulations applicable to **Agricultural (Rural) Zone Within Or Outside Local Planning Area Boundary** shall be applicable for these Green/ Recreational Areas.

Some flexibility is allowed in these Zoning Regulations subject to the planning approval of the competent authority and other relevant competent authorities without compromising the open space character of the environment.

Tourism Projects on land notified under Punjab Land Preservation Act and Forest Act in GMADA Regional Plan area, as approved by Ministry of Environment and Forest, Government of India shall be permissible and Periphery Policy dated 20.1.2006 shall stand amended to this extent.

17.10 Transferable Development Right

It is necessary to speed up the process of development. For that, the development of public utilities such as roads, parks, green belts etc., should be done on top priority which will encourage the urbanization. To make it realistic, it is necessary that the land falling under roads, parks and green belts should be transferred to Urban Development Authorities. To acquire this land, the prevalent way adopted till date, is the cash payment of land acquired and 2nd option is to get the land through land pooling scheme which has been approved by the Govt.. To speed up the development process and to protect the interest of land owners, the land owners may be given 3rd option in addition to above two options i.e. transfer of development rights on the pattern of Maharashtra.

Under this scheme if land owner transfers the land falling under roads, parks, green belts etc., to the concerned Urban Development Authority, he/she shall be entitled for additional FAR @ 1:1. No CLU, EDC, Licence/permission fees shall be charged on this FAR. The land owners according to their own choice can sell it in total or in parts to any other person. The record regarding TDR shall be maintained by the concerned Urban Development Authority on the pattern of Mumbai (Maharashtra). With this the farmer/land owners shall have 3rd option in addition to cash compensation and land pooling. To generate the value of TDR in the market, the present practice vide notification no. 17/17/01-5HG2/7623 dt.19.9.07 for additional FAR on additional payment shall, in area under GMADA jurisdiction, stop immediately. GMADA shall come out with detailed guidelines on operation of TDRs.

Mega/super Mega projects in which more than 1.75 F.A.R for commercial or more than 2.0 FAR for Group Housing is permissible or have been allowed shall also have to purchase additional FAR from land owners. This FAR shall be purchased from within same Local Planning Area in which it is to be used. The non Mega projects shall also be entitled to purchase additional FAR on similar pattern. The development projects (Roads, Park, Green belts etc.), to be under taken by the Urban Development Authorities, shall be announced from time to time and TDRs shall be usable from such projects alone. The TDRs shall not be transferable from one Local Planning Area to other Local Planning Area.

Annexure 1: Legislative Provisions

Legislative provisions for ensuring conservation and management of environment to lead to sustainable development have been enacted in many areas of concern.

18.1 Environment (Protection) Act, 1986

Parliament passed the Environment (Protection) Act, designed to act as umbrella legislation on the environment. The Environment (Protection) Act, 1986 was the parliament's response to the Bhopal gas case. This Act is an umbrella legislation designed to provide a framework for the co-ordination of central and state authorities established under the Water (Prevention and Control) Act, 1974 and Air (Prevention and Control) Act, 1981. Under this Act, the central government is empowered to take measures necessary to protect and improve the quality of the environment by setting standards for emissions and discharges, regulating the location of industries, management of hazardous wastes, and protection of public health and welfare.

It is also an 'enabling' law, which articulates the essential legislative policy on environmental protection and delegates wide powers to the executive to enable bureaucrats to frame necessary rules and regulations. Since the time it entered the statute book, the Act has served to back a vast body of subordinate environmental legislation in India. The scope of the EPA is broad, with 'environment' defined to include water, air and land and the interrelationships which exist among water, air and land, and human beings and other living creatures, plants, micro organisms and property. This Act is a directive statute which lays down the duties for the persons who are carrying on any industrial activity, and, or handling any hazardous substance which is capable of causing environmental pollution. The Act also entrusts regulatory powers and provisions to the Central Government and other allied governmental departments and agencies, as prescribed by the Central Government under the provisions of this Act, to control, prevent and abate environmental hazards to human beings, other living creatures, plants and property.

18.2 Water (Prevention and Control of Pollution) Act, 1974

This Act provided for the prevention and control of water pollution and for the establishment of Boards both at Central and State levels for the prevention and control of water pollution. The Act prohibits the discharge of pollutants into water bodies beyond a certain standard as given under the Act, and also lays down criminal and financial penalties for non-compliance.

The Act was further amended in 1988 to conform to provisions of the Environment Act, 1986. It set up an institutional framework for regulating and enforcing the provisions of the Act by constituting Central Pollution Control Board (CPCB), which also lays down standards for the prevention and control of water pollution. At the State level, the State Pollution Control Board, constituted under the same Act, function under the direction of the CPCB and the state government.

18.3 The Water (Prevention and Control of Pollution) Cess Act, 1977

This is an Act to provide for the levy and collection of a cess on water consumed by persons carrying on certain industries and by local authorities, with a view to augment the resources of the Central

Board and the State Boards for the prevention and control of water pollution constituted under the Water (Prevention and Control of Pollution) Act, 1974.

This Act authorizes central and state boards with the authority to levy and collect a tax on water consumed by the industries. The tax is calculated on the basis of how much water is consumed. It aims at augmenting the resources of the central and state boards for prevention and control of water pollution. Following this Act, The Water (Prevention and Control of Pollution) Cess Rules were formulated in 1978 for defining standards and indications for the kind of and location of meters that every consumer of water is required to install.

18.4 The Air (Prevention and Control Of Pollution) Act, 1981

The Air (Prevention and Control Of Pollution) Act, 1981 (Air Act) was enacted to provide for the prevention, control and abatement of air pollution, for the establishment, with a view to carrying out the aforesaid purposes, of Boards, for conferring on and assigning to such Boards powers and functions relating thereto and for matters connected therewith. The Air Act was constituted to ratify the decision taken at the United Nations Conference on the Human Environment held in Stockholm in June, 1972, in which India participated, in order to take appropriate steps for the preservation of the natural resources of the earth which, among other things, include the preservation of the quality of air and control of air pollution.

18.5 Standards for emission from automobiles

In 1988, the Motor Vehicles Act was enacted to regulate vehicular traffic, besides ensuring proper packaging, labeling and transportation of the hazardous wastes. Various aspects of vehicular pollution have also been notified under the EPA of 1986. Mass emission standards were notified in 1990, which were made more stringent in 1996. In 2000 these standards were revised yet again and for the first time separate obligations for vehicle owners, manufacturers and enforcing agencies were stipulated.

18.6 Various notifications issued to control Environment, Air and Water Pollution

- Environment Impact Assessment (EIA) notification: Restrictions & Prohibitions on the Expansion & Modernization of any activity or new projects unless Environmental Clearance has been accorded, as amended up-to-date
- Delegation of Powers to State Governments for EIA of Thermal Power Project
- Environment (Sitting for Industrial Projects) Rules, 1999
- Dumping and disposal of fly ash discharged from coal or lignite based thermal power plants on land
- Notifications declaring Eco-sensitive Zone
- Various notifications Delegating Powers under Environment (Protection) Act, 1986
- National Ambient Air Quality Standards.
- Noise Pollution (Regulation and Control) Rules, 2000

18.7 Hazardous Substances Management

Under the EPA 1986, the MoEF has issued several notifications to tackle the problem of hazardous waste management. These include:

- The Batteries (Management and Handling) Rules, 2001
- The Municipal Solid Wastes (Management and Handling) Rules, 2000
- The Recycled Plastics Manufacture and Usage Rules, 1999 as Amendment in 2003
- Prohibition on the handling of Azodyes
- The Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996
- The Rules for the Manufacture, Use, Import, Export and Storage of Hazardous micro-organisms, genetically engineered organisms or cells
- The Manufacture, Storage and import of Hazardous Chemical Rules, 1989
- The Hazardous Wastes (Management and Handling) Rules, 1989
- The Bio-Medical Waste (Management and Handling) Rules, 1998

18.8 Ecologically Sensitive Areas (ESAs)

From time to time the central government issues notifications under the EPA for the protection of ecologically-sensitive areas or issues guidelines for matters under the EPA. Ecologically Sensitive Areas (ESAs) are an important part of India's legal regime for promotion of conservation. The Environment (Protection) Act 1986 gives power to the central government i.e., the Union Ministry of Environment and Forests to take necessary measures to protect and improve quality of the environment and to prevent and control environmental pollution. To meet this objective the Central Government can restrict areas in which any industries, operations or processes or class of industries, operations or processes shall not be carried out or shall be carried out subject to certain safeguards.(Refer section 3(2)(v) of the Act.)

Under the Environment (Protection) Rules, 1986, the central government can prohibit or restrict the location of industries and carrying on certain operations or processes on the basis of considerations like the biological diversity of an area, maximum allowable limits of concentration of pollutants for an area, environmentally compatible land use, and proximity to protected areas.

18.9 Hazardous Waste Management Rules

Hazardous Waste (Management and Handling) Rules, 1989 was enacted under Sections 6, 8 and 25 of EPA, 1986. They apply to hazardous wastes specified in the schedule and the rules give a detailed system of authorization for handling hazardous wastes. It requires the person handling the waste to follow a particular system of storage. It also requires the central government to prepare an inventory of disposal sites. Based on the regional EC environmental law, the 'Seveso Directive' and legislations enacted by many other countries, the government enacted the 'Manufacture, Storage and Import of Hazardous chemicals (MSI) Rules, 1989 under EPA, 1986. It identified 432 chemicals in Schedule I, 189 in Schedule II and 27 in Schedule III. High level controls apply to all sites using chemicals above the second threshold quality and require such sites to prepare and submit a 'safety report' akin to the British 'safety case'.

18.10 Noise Pollution (Regulation and Control) Rules, 2000

Most recently, in February 2000, the Union Ministry of Environment and Forests has notified new norms for regulating noise pollution. The regulations prescribed ambient levels of noise in the residential, commercial, and industrial zones and regulate the use of loudspeakers.

18.11 Fly Ash and Ash Content Notifications

Ash Content Notification (1997), required the use of beneficiated coal with ash content not exceeding 34% with effect from June 2001, (the date later was extended to June 2002). This applies to all thermal plants located beyond one thousand kilometres from the pithead and any thermal plant located in an urban area or, sensitive area irrespective of the distance from the pithead except any pithead power plant.

The main objective of the 'Disposal of Fly Ash' Notification (1999) was to conserve the topsoil, protect the environment and prevent the dumping and disposal of fly ash discharged from lignite-based power plants. The salient feature of this notification is that no person within a radius of 50 km from a coal-or lignite-based power plant shall manufacture clay bricks or tiles without mixing at least 25% of ash with soil on a weight-to-weight basis.

18.12 The Mines and Minerals (Regulation and Development) Act of 1957

The Mines and Minerals (Regulation and Development) Act of 1957 as the title suggests, is to promote the prospecting of minerals and the development of mines. Recognizing the devastating environmental impact of mining activity in several regions across the country, Parliament amended the Act in 1986 to introduce provisions which would require greater environmental sensitivity whilst conducting mining operations. Section 4A permits government to terminate a prospecting license or mining lease in order to preserve the natural environment or prevent pollution or harm to public health, monuments, buildings and other structures. Sections 13 and 15 empower the centre and the states to frame rules to restore vegetation destroyed by mining operations in any area.

18.13 The Wildlife (Protection) Act, 1972, Amendment 1991

The Wild Life Protection Act 1971 enables creating 'sanctuaries' and 'national parks' and the protection of various species of flora and fauna. In 1972, Parliament enacted the Wild Life (Protection) Act pursuant to the enabling resolutions of 11 states under Article 252(l) of the Constitution. The Wild Life Act provides for state wildlife advisory boards, regulations for hunting wild animals and birds, establishment of sanctuaries and national parks, regulations for trade in wild animals, animal products and trophies, and judicially imposed penalties for violating the Act. Harming endangered species listed in Schedule I of the Act is prohibited throughout India. Hunting other species, like those requiring special protection (Schedule II), big game (Schedule III), and small game (Schedule IV) is regulated through licensing. A few species classified as vermin (Schedule V) may be hunted without restrictions. The Act is administered by wildlife wardens and their staff. Comprehensive amendments to the parent Act in 1991 resulted in the recognition of the needs of tribal groups and forest dwellers and introduced changes to advance their welfare.

18.14 The Indian Forest Act, 1927

The Indian Forest Act, 1927 was a product of British rule in 1927. The legislation granted the government uncontested rights over natural resources, with state governments authorized to grant licenses to lumber contractors and oversee protection of the forests. The Forest Act of 1927, on which most 'state' forest acts are modeled, targets the creation of 'reserve', 'protected', and 'village' forests.

18.15 The Forest (Conservation) Act, 1980

Although the Indian Forest Act of 1927 embodies the colonial policies of the pre-independence era, it remains in force. This Act consolidates, with minor changes, the provisions of the Indian Forest Act of 1878 and its amendment acts. The 1927 Act deals with four categories of forests, namely, reserved forests, village forests, protected forests, and non-government (private) forests. A state may declare forest lands or waste lands as reserved forests, and may sell the produce from these forests. The Forest Conservation Act of 1980 places the Union government in a commanding position to refuse 'permission' for non-forest activity in all forest areas. Any unauthorized felling of trees, quarrying, grazing and hunting in reserved forests is punishable with a fine or imprisonment, or both. Reserved forests assigned to a village community are called village forests. The state governments are empowered to designate protected forests and may prohibit the felling of trees, quarrying and the removal of forest produce from these forests. The preservation of protected forests is enforced through rules, licences and criminal prosecutions.

18.16 The Factory Act, 1948

The 1987 Amendment to The Factories Act of 1948 was passed shortly after the Bhopal tragedy and the Supreme Court's judgment in the Shriram Gas Leak Case to introduce special provisions on hazardous industrial activities. The 1987 Amendment empowers the states to appoint site appraisal committees to advise on the initial location of factories using hazardous processes. The occupier of every hazardous unit must disclose to her workers, the factory inspector and the local authority, all particulars regarding health hazards at the factory and the preventive measures taken. These preventive measures must be publicized among the workers and nearby residents. Every occupier must also draw up an emergency disaster control plan, which must be approved by the chief inspector. The occupier is required to maintain workers' medical records and must employ operations and maintenance personnel who are experienced in handling hazardous substances. The permissible limits of exposure to toxic substances are prescribed in the second schedule to the Act. Safety committees consisting of workers and managers are required periodically to review the factory's safety measures. The Factories Act after its 1987 Amendment defines 'occupier' as a very senior level manager. Such person is held responsible for compliance with the Act's new provisions relating to hazardous processes. Non-compliance exposes the occupier to stiff penalties.

18.17 Public Liability Insurance Act, 1991

Public Liability Insurance Act was enacted in 1991. It focused on strict liability as against the age-old practice based on the Ryland v. Fletcher rule; the Act covers accidents involving hazardous substances and insurance coverage for these. Where death or injury results from an accident, this Act makes the owner liable to provide relief as is specified in the Schedule of the Act. The PLIA was amended in 1992, and the Central Government was authorized to establish the Environmental Relief Fund, for making relief payments.

The Public Liability Insurance Act, 1991 was promulgated to provide for public liability- insurance for the purpose of providing immediate relief to the persons affected by accident occurring while handling any hazardous substance and for matters connected therewith or incidental thereto. The measure mandates that business owners operating with hazardous waste take out insurance policies. An Environmental Relief Fund was established and is maintained by industry operators.

18.18 National Environment Tribunal Act, 1995

India participated in the United Nations Conference on Environment and Development held at Rio de Janeiro in June, 1992. In affirmation of the decision taken there which called upon the States to develop national laws regarding liability and compensation for the victims of pollution and other environmental damages, The National Environment Tribunal Act 1995 was enacted. It provides for strict liability for damages arising out of any accident occurring while handling any hazardous substance and for the establishment of a National Environment Tribunal for effective and expeditious disposal of cases arising from such accident. , This was with a view to giving relief and compensation for damages to persons, property and the environment and for matters connected therewith or incidental thereto.

This Act gave *suo moto* powers which provided relief, compensation and restitution to victims of accident while handling hazardous substances and for environmental damages. Noncompliance of the Tribunal's directions or orders was made punishable with imprisonment up to three years, and a fine of Rs 5 lakh which could extend up to Rs 10 lakh or both. The National Environment Tribunal Act (NETA) of 1995 builds on the foundation laid in the PLIA and substantially alters the law of torts relating to toxic substances in India. NETA extends the principle of 'no-fault' liability, which first received statutory recognition under the PLIA, *beyond* the statutory compensation limits prescribed under the 1991 Act. NETA applies in cases where death or injury to any person or damage to any property is caused by an accident during the handling of any hazardous substance. Both Acts adopt the same definition for the expressions 'accident' and 'handling'.

18.19 The National Environment Appellate Authority Act, 1997

National Environment Appellate Authority has been enacted to hear appeals with respect to restriction of areas in which any industries, operations or processes or class of industries, operations or processes shall not be carried out or shall be carried out subject to certain safeguards under the Environment (Protection) Act, 1986 and for matters connected therewith or incidental thereto. Any person aggrieved by an order granting environmental clearance in the areas in which any industries, operations or processes or class of industries, operations and processes shall not be carried out or shall be carried out subject to certain safeguards may, within thirty days from the date of such order, prefer an appeal to the Authority in such form as may be prescribed: Provided that the Authority may entertain any appeal after the expiry of the said period of thirty days but not after ninety days from the date aforesaid if it is satisfied that the appellant was prevented by sufficient cause from filing the appeal in time.

The Authority is not bound by the procedure laid down in the Code of Civil Procedure, 1908, but only guided by the principles of natural justice and subject to the other provisions of this Act and of any rules made by the Central Government. The Authority also has power to regulate its own procedure including the fixing of places and times of its inquiry and deciding whether to sit in public or in private. The Authority also have, for the purposes of discharging its functions under this Act, the same powers as are vested in a civil court under the Code of Civil Procedure, 1908, while trying a suit. Under Section 15 of the Act, it has been provided for that with effect from the date of establishment

of the Authority, no civil court or other authority shall have jurisdiction to entertain any appeal in respect of any matter with which the Authority is so empowered by or under this Act.

The Act specifies that an aggrieved person must challenge the grant of an environment clearance within 30 days of the grant decision. If a person is unable to fulfill this requirement, an outer period of up to 90 days is allowed. But to qualify for this exemption, the petitioner must be proven that there was sufficient reason for not being able to file the appeal within the 30 days time.

18.20 The Biological Diversity Act, 2002

This act provides for conservation of biological diversity, sustainable use of its components and fair and equitable sharing of the benefits arising out of the use of biological resources, knowledge and for matters connected therewith or incidental thereto.

Each State shall establish a State Biodiversity Board under Sec. 22 of the Act. The State Board may in consultation with the local bodies concerned and after making such enquiries as it deems fit, prohibit or restrict any such activity, which might be detrimental or contrary to the objectives of conservation and sustainable use of biodiversity or equitable sharing of benefits arising out of such activity.

Every local body shall constitute a Biodiversity Management Committee within its area for the purpose of promoting conservation, sustainable use and documentation of biological diversity including preservation of habitats, conservation of land races, folk varieties and cultivars, domesticated stocks and breeds of animal and micro organisms and chronicling of knowledge relating to biological diversity. The National Biodiversity Authority and the State Biodiversity Boards shall consult the Biodiversity Management Committees.

18.21 Land Acquisition Act, 1894

The legislative mandate for acquiring land for public purposes comes from the Land Acquisition Act of 1894. In accordance with the Act, the legal process for land acquisition is initiated by the project proponents to the District Collector (DC) of the respective district.

18.22 Electricity Act, 2003

The first legislation on this subject was the Electricity Act, 1887 which provided for the protection of person and property from any risk or injury consequent to the supply and use of electricity. This Act was, however, repealed by the Indian Electricity Act, 1903 which was replaced in 1910 by the Amendment Act. The Indian electricity Act, 1910 provided a basic legal framework for the electricity supply industry.

Where the Indian Electricity Act, 1910 dealt with the supply and use of electricity as well as the rights and obligations of the licensees, the subsequent enactment, the Electrical (Supply) Act, 1948 dealt with the Statutory powers and functions of the Central Electrical Authority, the State Electricity Boards ("SEBs") and Generating Companies. One of the fundamental reasons for its enactment was the extension of the process of electrification to rural and semi-urban areas. The 1956 amendment to this Act saw an increase in the role of the State Government. The State Government now had supervisory control over the SEBs that led to huge losses in their operation and widening of the gap between the demand and supply of electricity.

Electricity Act has been enacted to consolidate the laws relating to generation, transmission, distribution, trading and use of electricity and generally for taking measures conducive to development of electricity industry, promoting competition therein, protecting interest of consumers and supply of electricity to all areas, rationalisation of electricity tariff, ensuring transparent policies regarding subsidies, promotion of efficient and environmentally benign policies constitution of Central Electricity Authority, Regulatory Commissions and establishment of Appellate Tribunal and for matters connected therewith or incidental thereto.

In addition environmental impact assessment is required for designated categories of development as per notifications of 2006. The special feature of this notification is that it has brought urban development into the ambit of environmental clearance.

18.23 Environment Impact Assessment (EIA)

The Central government originally posted the Environmental Impact Assessment (EIA) notification as a draft notification in January 1993 to be circulated among the public for comments. The draft notification contained three schedules. Schedule I

listed projects that would need environmental clearance from the Centre, while Schedule II listed projects that would have to get clearance from the State subject to a threshold criteria in terms of area/production capacity/size/volume, for which clearance would have to be obtained from the Centre. Schedule III gave the composition of the Expert Committee referred to in the notification.

However, when the final notification was issued a year later, it differed significantly from the draft. First, the original draft brought within its scope a wide variety of projects through the first two schedules; but the final notification made Central environmental clearance applicable to just 29 categories of projects listed in Schedule I. Secondly, the authority of the States to grant clearance was completely done away with, with the result that many projects originally required to seek clearance from the State were completely removed from the purview of the notification. Petrochemical complexes, bulk drugs and pharmaceuticals, viscose staple fiber and filament yarn,and mining projects were some of the categories removed from the list of State Clearance.

Thirdly, the draft notification used the standard of size/area/production capacity to determine the intensity of the likely impact of the project and to decide the level of environmental clearance which would have to be sought from the Centre or the State. This is far more preferable to what the final notification has done i.e. using the criteria of investment cost to assume the intensity of likely impact and so decide whether a project should come under the purview of the EIA notification or not.

The comprehensive statutory environment impact assessment (EIA) programme began on 27 January 1994 when the Union Ministry of Environment and Forests issued a notification dealing with mandatory EIA. The notification mandates a public hearing and requires the project proponent to submit an EIA report, an environment management plan, details of the public hearing and a project report to the impact assessment agency for clearance, with further review by a committee of experts in certain cases. The impact assessment agency is the ministry itself. The EIA regulations apply to 32 designated projects/industries which are enumerated in Schedule I to the notification.

As per EIA notification, all projects listed under Schedule I require environmental clearance from the MoEF, the projects under the delicenced (non-licence?) category of the New Industrial Policy also require clearance from the MoEF. It also mandated for all developmental projects whether or not under the Schedule I, to obtain MoEF clearance if within ecologically fragile areas. Industrial projects with investments above Rs 500 million must obtain MoEF clearance and are further required to

obtain a LOI (Letter Of Intent) from the Ministry of Industry, and an NOC (No Objection Certificate) from the SPCB and the State Forest Department if the location involves forest land. Once the NOC is obtained, the LOI is converted into an industrial license by the state authority.

The notification also stipulated procedural requirements for the establishment and operation of new power plants. As per this notification, a two-stage clearance for site-specific projects such as pithead thermal power plants and valley projects is required. Site clearance is given in the first stage and final environmental clearance in the second. A public hearing has been made mandatory for projects covered by this notification. This is an important step in providing transparency and a greater role to local communities.

The new legislation has spawned new enforcement agencies and strengthened the older ones. Some of these agencies perform specialized tasks. Consider the authorities constituted under the Environment Impact Assessment (EIA) Regulations of 1994. The Union Ministry of Environment and Forests is responsible for evaluating EIA reports submitted by project proponents. Generally, for large projects, the review is carried out in consultation with a committee of experts. Responding to a suggestion by the Supreme Court, the Union government has established a National Coastal Management Authority and corresponding state level agencies.

In April 1997, the ministry took a first step towards decentralizing the EIA regulatory machinery by shifting the responsibility for environmental site clearance in respect of thermal power projects to the states. This notification describes the categories of thermal power plants falling within state government purview and broadly replicates the procedure under the principal notification of 1991.

Public hearings under the Environment Impact Assessment Regulations of 1994 provide a forum to non-governmental organizations to voice their concerns to project proponents. Citizens' initiative provisions, together with a statutory 'right to information', now enable an aggrieved citizen to directly prosecute a polluter after examining government records and data. The technology-forcing deadlines, issued under the central Motor Vehicles Rules of 1989, compel the manufacturers of petrol and diesel vehicles to upgrade their technologies (perhaps even re-tool their plants) to meet the prescribed emission standards by a particular date. Mandatory workers' participation in plant safety and stringent penalties on high-level management for the breach of factory safety regulations are expected to reduce industrial accidents.

The measure provides guidelines for location of industries and mining areas, for permitting and restricting industries in environmentally sensitive areas, coastal zone regulations and environmental impact assessments of development projects. Committees convened to conduct EIAs must have disciplines in eco-system and water resource management, air and water pollution control, flora and fauna conservation, land use planning, social sciences, ecology and environmental health. Public hearings are also pre-requisites for project clearance. The measure also delineates a system where a manufactured product can receive certification as environmentally friendly or compatible.

In India, the Ministry of Environment and Forests at New Delhi introduced the EIA law through a gazette notification passed on 27 January 1994 for obtaining "environmental clearance" for certain types of projects. To make it more participatory the provision of "public hearing" was added, which was definitely a step forward. The main EIA notification has been amended twelve times in the past eleven years.

Obtaining environmental clearance for developmental projects from the Ministry of Environment and Forests (MoEF) was a mere administrative requirement till January 1994. Since then, the Environment Impact Assessment (EIA) Notification (under the Environment Protection Act, 1986) has made it mandatory for 32 industrial and developmental activities to get environmental clearance from the central government. Since then establishment and expansion of a range of activities relating to infrastructure, industrial processes and operations need to follow a procedure laid down in the

notification, one of them being the preparation of a detailed EIA report. The report is then looked into by an Impact Assessment Agency comprising of officials of the Ministry of Environment and Forests before granting environmental clearance to a project. If deemed necessary, it consults a committee of Experts.

In its essence the notification presented a very important tool in the process of environmental decision making in the country. It was introduced with the purpose of identifying and evaluating the potential impacts (beneficial and adverse) of developmental projects and to understand their environmental, social, cultural and aesthetic consequences. This is essential to determine the viability of a project and thereby forms an important basis to decide if a project should at all be granted environmental clearance. And if yes, on what conditions.

For most activities, the notification directs that a public hearing for a project seeking environmental clearance needs to be conducted. This was made possible with an amendment to the notification in 1997. It provides a forum where the local residents and concerned groups come face to face with the project proponents and government authorities to voice their suggestions and objections regarding that particular activity or project. This important space has been used as a medium for people's participation in environmental decision-making in several instances.

The public hearing is presided over by a public hearing panel whose conclusions are merely 'recommendatory' and not mandatory. Currently, if the overwhelming majority at the hearing is in favour of rejecting the project and the public hearing panel agrees, this view will only be 'considered' while granting the clearance.

In May 1994, the first significant amendment inserted phrases such as "if deemed necessary" and "subject to public interest" in several places where the notification called for consultation with groups such as the Committee of Experts or affected populations and environmental groups. It made access to documents like the summary of reports, Environmental Management Plan (EMP), the recommendations and conditions subject to which environmental clearance is given and compliance reports "subject to public interest". Access to such documents was unconditional prior to this amendment. In other words this amendment subtly subverted transparency in the whole clearance procedure.

There were some progressive changes as well. The April 1997 amendment making Public Hearings mandatory did bring back to the public access to the Executive Summary of the project report. But it was silent with regard to access to the EMP and the recommendations and conditions subject to which environmental clearance is given. The June 2002 amendment has provided concerned persons access to the EIA report, but the rules remain silent on the issue of access to the EMP.

One section of the EIA notification also deals with the conditions under which projects are exempted from its entire purview. This part has seen several additions. Item (b) includes a list of projects that are exempt from environmental clearance based on investment value. Highway projects were included in this exempt list in the May 1994 amendment. In December 2000 defence related road projects in border areas were also exempted from the purview of notification.

There has been some back and forth in policy making. In January 2000 another amendment removed projects like Petro-chemical complexes, Hydrocyanic acid and chlor-alkali industries from this list, thus effectively bringing them within the purview of the EIA notification regardless of the investment cost. However, two and a half years later, in June 2002 while one would have expected more stringent protection measures to be set in place with the increase in knowledge of the adverse impacts of these industries, the MoEF saw it fit to reinsert the Petro-chemical complexes and chlor-alkali industry into this list of exemptions. Thus it is now mandatory to conduct EIA studies for these projects only if the investment values are above the specified threshold limit. The June 2002 amendment raised this

threshold limit for investment values to Rs 100 crores for new projects and Rs. 50 crores for all expansions/modernizations of projects. Also exempted in June 2002 were modernisation projects in the irrigation sector if the additional area commanded is less than 10,000 hectares or if the project cost is less than Rs. 100 crores.

18.24 Industrial Classification

For industrial developments, the GOI has categorized industries into Green, Orange and Red categories and classified hazardous waste from industries which requires special disposal facilities and detailed guidelines and location of hazardous waste have been made for these.

18.25 Waste Disposal

Similarly guidelines for the locational criteria of waste collection and disposal sites have been made.

For sewage disposal of population up to 250,000 the CPCB has recommended decentralized sewage systems which are cost effective and environmentally appropriate. Several technologies have been suggested.

18.26 Relevant Punjab State Legislations and Regulations

In addition, the State of Punjab has taken several measures to conserve the environment:

18.26.1 Chandigarh Periphery Act:

In order to control unplanned development in Chandigarh, the Chandigarh Periphery Act was brought into force with the following main provisions.

a. Existing Rural Settlements: Considering the existing as well as future development needs of the villages falling within the Periphery as well as with a view to cater to their increasing population, it would be prudent to provide a sufficiently compact and contiguous belt of land around the village "phirni" for ensuring the organic growth of these villages. Any area falling between the 'lal lakir' and the 'phirni' of the village shall also be treated as a part of the extended belt. The area should be allowed to be used primarily for meeting individual residential and petty commercial needs of the existing and future population of a village. However, charges for change of land use should be levied on prescribed rates, except in the case of bona fide residents. No industry should be permitted in such area. Similarly, formal colonization shall also not be permitted in the extended 'abadi' area on the pretext of this recommendation alone.

With these caveats, the Committee proposes to allow the village "Abadi" area extension by 60%, subject to a minimum of 50 metres and maximum of 100 metres in radial length from the 'phirni'. However, where the exiting Abadi Deh or a part thereof is an area which forms a part of the rural, agriculture and afforestation zone of the Outline Master Plan/Draft Comprehensive Master Plan/Comprehensive Master Plan prepared under the Punjab Regional and Town Planning & Development Act, 1995, the extent of such area shall be limited to 50 metres. Permitting construction in the notified forest areas falling in these villages would, of course, be subject to due approval as regards change of land use. No permission should, however, be granted in any area which falls within

the sectoral grid of SAS Nagar (Mohali), as reflected in the Outline Master Plan. The extent of area where such constructions are to be permitted will be demarcated and certified for each village falling within the Periphery by the Revenue Authorities, subject to the final approval of PUDA. In order to promote planned development, it is proposed that construction in the area should be regulated by a set of simple building norms, subject to payment of Land Use conversion charges and in accordance with other details. However, to avoid hardship to villagers and land owners, the area in the extended abadi deh shall be exempted from the provisions of the Punjab Apartment and Property Regulation Act, 1995.

b. Free Enterprise Zone: The area declared as Free Enterprise Zone (FEZ) near Dera Bassi should continue to be used for industries, although institutions could also be permitted in accordance with the prescribed guidelines. In order to ensure rational development and provision of basic infrastructure and services in the area, a broad developmental framework needs to be prepared along with a development plan indicating roads and trunk infrastructure, including areas reserved for residential and institutional needs. There shall be no conversion or betterment charge for the new industrial units coming up in the FEZ. However, these shall be liable to pay the External Development Charges.

c. Industrial: Industrial Parks may also be permitted as "mega projects" in areas earmarked as industrial & residential for such uses respectively within the Outline Master Plan area of SAS Nagar (Mohali).

The Empowered Committee on Mega Projects has already permitted integrated mixed use Industrial Parks, where at least 60% of the land is used for industry, free of external development charges and change of land use charges in the periphery. This is a major policy incentive for making land available to industry at reasonable rates. In the Committee's opinion such a policy may continue in respect of the industrial sectors in the Mohali sectoral grid and FEZ for general industry and for areas planned in Mohali's Master Plan for IT Industry. The policy on grant of additional incentives to industry would, however, need to be periodically reviewed with a view to the continuation of such benefits.

d. Municipal Towns in Periphery*:* The Committee recommends that the existing towns of Kharar, Banur, Zirakpur, Derabassi should continue to provide avenues for future growth and development by ensuring adequate supply of developed land for residential, commercial, institutional and industrial purposes. Master Plans of these Towns need to be prepared under the Punjab Regional and Town Planning & Development Act, 1995, within the overall ambit of the Controlled Area Plan. Further expansion in the municipal limit of these towns will also have to be regulated so that it conforms to the overall Development Plan for the Periphery Area. It is proposed that the future expansion of municipal limits of the existing Periphery towns should be frozen, until these Master Plans have been finally notified. Thereafter, if the need arises, such expansion can be considered, strictly in accordance with the approved Master Plan subject, of course, to the payment of the conversion charges as are being proposed in the report. New Municipal Councils or Nagar Panchayats within the Periphery should be notified only after the overall Development Plan has been put in place.

Hariyali Act was specifically brought in with aim of involving village communities in the implementation of watershed projects under all the area development programmes. These are Integrated Wastelands Development Programme (IWDP), Drought Prone Areas Programme (DPAP),

Desert Development Programme (DDP) and the Guidelines for Watershed Development. To further simplify procedures and involve the Panchayat Raj Institutions (PRIs) more meaningfully in planning, implementation and management of economic development activities in rural areas, new Guidelines for Hariyali have been issued.

Applicability

New projects under the area development programmes shall be implemented in accordance with the Guidelines for Hariyali with effect from 1.4.2003. Projects under DPAP and DDP will be taken up in the blocks identified under the respective programme and projects under IWDP shall generally be taken up in the remaining blocks. Projects sanctioned prior to this date shall continue to be implemented as per the Guidelines of 2001.

Objectives

The objectives of projects under HARIYALI will be: -

- Harvesting every drop of rainwater for purposes of irrigation, plantations including horticulture and floriculture, pasture development, fisheries etc. to create sustainable sources of income for the village community as well as for drinking water supplies.
- Ensuring overall development of rural areas through the Gram Panchayats and creating regular sources of income for the Panchayats from rainwater harvesting and management.
- Employment generation, poverty alleviation, community empowerment and development of human and other economic resources of the rural areas.
- Mitigating the adverse effects of extreme climatic conditions such as drought and desertification on crops, human and livestock population for the overall improvement of rural areas.
- Restoring ecological balance by harnessing, conserving and developing natural resources i.e. land, water, vegetative cover especially plantations.
- Encouraging village community towards sustained community action for the operation and maintenance of assets created and further development of the potential of the natural resources in the watershed.
- Promoting use of simple, easy and affordable technological solutions and institutional arrangements that make use of, and build upon, local technical knowledge and available materials.

Sanction of Projects

The projects will be sanctioned by the Department of Land Resources in the Ministry of Rural Development, Government of India as per procedure in vogue. The Department may amend or relax this procedure from time to time. For interpretation of any of the provisions of these Guidelines, the Department of Land Resources will be the final authority.

e. Punjab state land use and waste land (SLUV) Board brought out the notification as the following. They have also brought out the Perspective Plan for conservation, management and development of land use resources in Punjab (2010).

Annexure 2: Census 2001 Data

Population of GMADA Area As Per 2001 Census						
Name of Town (Census Category)	**Sub-District**	**Nos. of HH**	**Pop - Persons**	**Male**	**Female**	**Sex Ratio**
S.A.S. Nagar (Municipal Council)	S.A.S. Nagar (Mohali)	28,539	123,484	65,642	57,842	881
Kharar (Municipal Council plus Outgrowth)	Kharar	8,118	42,289	22,707	19,582	862
Zirakpur (Nagar Panchayat)	Dera Bassi	5,072	25,022	14,199	10,823	762
Kurali (Municipal Council)	Kharar	4,220	23,047	12,306	10,741	873
Karoran (Census Town)	Kharar	4,564	20,361	11,355	9,006	793
Dera Bassi (Municipal Council)	Dera Bassi	3,284	15,841	8,585	7,256	845
Bhankharpur (Census Town)	Dera Bassi	1,798	9,216	4,923	4,293	872
Mullanpur Garib Das (Census Town)	Kharar	1,171	6,147	3,284	2,863	872
Bhabat (Census Town)	S.A.S. Nagar (Mohali)	1,103	5,866	3,092	2,774	897
Total Urban Population of S.A.S. Nagar district		***57,869***	***271,273***	***146,093***	***125,180***	***857***
Banur (Municipal Council)	Rajpura (Patiala district)	861	5,426	2,929	2,497	853
Total Urban Population of GMADA Area		***58,730***	***276,699***	***149,022***	***127,677***	***857***
Rural Population of S.A.S. Nagar (Mohali) District		74,024	427,044	233,440	193,604	829
Rural Population of GMADA area in Patiala district		1,201	7,467	3,960	3,507	886
Total Rural Population of GMADA Area		***75,225***	***434,511***	***237,400***	***197,111***	***830***
Total Population of GMADA Area		**133,955**	**711,210**	**386,422**	**324,788**	**841**

Source: Primary Census Abstract Vol-I (CD), Census 2001, Office of Registrar General & Census Commissioner, India

Name of Town (Census Category)	Nos. of Workers (Total)	Nos. of Workers (Male)	Nos. of Workers (Female)	Pop. (0-6 yrs) (Total)	Pop. (0-6 yrs) (Male)	Pop. (0-6 yrs) (Female)	Nos. of Literates (Total)	Nos. of Literates (Male)	Nos. of Literates (Female)
S.A.S. Nagar (Municipal Council)	41,812	32,918	8,894	13,148	7,410	5,738	101,691	55,130	46,561
Kharar (Municipal Council plus Outgrowth)	13,727	11,370	2,357	4,886	2,745	2,141	31,296	17,612	13,684
Zirakpur (Nagar Panchayat)	9,084	7,987	1,097	3,914	2,082	1,832	15,587	9,593	5,994
Kurali (Municipal Council)	7,408	6,362	1,046	2,814	1,570	1,244	16,654	9,312	7,342
Karoran (Census Town)	7,263	6,028	1,235	3,217	1,747	1,470	12,996	8,127	4,869
Dera Bassi (Municipal Council)	5,153	4,532	621	2,146	1,199	947	11,969	6,796	5,173
Bhankharpur (Census Town)	3,627	2,703	924	1,283	731	552	6,460	3,629	2,831
Mullanpur Garib Das (Census Town)	2,141	1,789	352	838	446	392	4,386	2,469	1,917
Bhabat (Census Town)	2,102	1,671	431	827	448	379	3,954	2,245	1,709
Total Urban – S.A.S. Nagar district	***92,317***	***75,360***	***16,957***	***33,073***	***18,378***	***14,695***	***204,993***	***114,913***	***90,080***
Banur (Municipal Council)	2,644	1,594	1,050	753	443	310	3,164	1,870	1,294
Total Urban - GMADA Area	***94,961***	***76,954***	***18,007***	***33,826***	***18,821***	***15,005***	***208,157***	***116,783***	***91,374***
Rural Population of S.A.S. Nagar (Mohali) District	177,706	130,570	47,136	58,738	33,061	25,677	270,658	160,021	110,637
Rural Population of GMADA area in Patiala district	2,561	2,136	425	978	547	431	4,867	2,811	2,056
Total Rural - GMADA Area	***180,267***	***132,706***	***47,561***	***59,716***	***33,608***	***26,108***	***275,525***	***162,832***	***112,693***
Total - GMADA Area	**275,228**	**209,660**	**65,568**	**93,542**	**52,429**	**41,113**	**483,682**	**279,615**	**204,067**

Source: Primary Census Abstract Vol-I (CD), Census 2001, Office of Registrar General & Census Commissioner, India

Annexure 3: Past population growth in urban centers of Greater Mohali Area

Name of Town (Census Category)	Sub-District	2001	1991	1981	1971	1961	1941
S.A.S. Nagar (Municipal Council)	S.A.S. Nagar (Mohali)	123,484 (4.6%)	78,457 (9.3%)	32,351 (38.7%)	1,229 (4.4%)	797	N.A.
Kharar (Municipal Council)	Kharar	42,289 (4.9%)	26,109 (1.8%)	21,807 (7.4%)	10,686 (2.7%)	8,216 (1.5%)	6,072
Zirakpur (Nagar Panchayat)	Dera Bassi	25,022	N.A.	N.A.	N.A.	N.A.	N.A.
Kurali (Municipal Council)	Kharar	23,047 (2.7%)	17,592 (3.4%)	12,637 (2.6%)	9,776 (4.3%)	6,390	N.A.
Karoran (Census Town)	Kharar	20,361	N.A.	N.A.	N.A.	N.A.	N.A.
Dera Bassi (Municipal Council)	Dera Bassi	15,841 (5.1%)	9,602 (2.6%)	7,421 (2.5%)	5,807 (3.7%)	4,051 (-1.1%)	5,070
Bhankharpur (Census Town)	Dera Bassi	9,216	N.A.	N.A.	N.A.	N.A.	N.A.
Mullanpur Garib Das (Census Town)	Kharar	6,147	N.A.	N.A.	N.A.	N.A.	N.A.
Bhabat (Census Town)	S.A.S. Nagar (Mohali)	5,866	N.A.	N.A.	N.A.	N.A.	N.A.
S.A.S. Nagar (Mohali) District		698,317 (2.0%)	572,644				

Source: Table 3.16, Statistical Abstract of Punjab, 2006

Figures in brackets indicate annual growth rates of population during the corresponding period.

Annexure 4: Data on population distribution by age used in the population projection model

Kharar (2001)	Total			Rural			Urban		
	Persons	Males	Females	Persons	Males	Females	Persons	Males	Females
All ages	**257,505**	**137,703**	**119,802**	**165,661**	**88,610**	**77,051**	**91,844**	**49,092**	**42,752**
Young population	**78,497**	**42,790**	**35,708**	**52,176**	**28,357**	**23,819**	**26,321**	**14,433**	**11,889**
0-4	22,140	12,369	9,772	14,918	8,342	6,576	7,222	4,027	3,196
5-9	27,180	14,872	12,308	18,192	9,937	8,254	8,988	4,934	4,054
10-14	29,177	15,549	13,628	19,066	10,077	8,988	10,111	5,472	4,640
Working population	**154,527**	**82,125**	**72,401**	**96,203**	**51,218**	**44,984**	**58,324**	**30,907**	**27,417**
15-19	25,726	14,003	11,724	16,736	9,060	7,676	8,990	4,942	4,048
20-24	24,056	12,983	11,072	15,457	8,420	7,037	8,599	4,563	4,036
25-29	21,386	11,033	10,352	13,287	6,946	6,341	8,099	4,087	4,010
30-34	19,231	9,736	9,495	11,793	5,964	5,829	7,438	3,771	3,666
35-39	18,723	9,641	9,082	11,398	5,911	5,487	7,325	3,730	3,595
40-44	15,651	8,493	7,158	9,373	5,057	4,316	6,279	3,436	2,843
45-49	12,888	7,055	5,833	7,744	4,194	3,550	5,144	2,861	2,283
50-54	9,845	5,536	4,309	6,031	3,403	2,629	3,813	2,134	1,680
55-59	7,021	3,644	3,377	4,383	2,263	2,120	2,638	1,381	1,257
Old age	**24,481**	**12,788**	**11,693**	**17,282**	**9,035**	**8,248**	**7,199**	**3,753**	**3,445**
60-64	7,265	3,625	3,640	4,875	2,392	2,483	2,390	1,233	1,157
65-69	6,243	3,109	3,134	4,392	2,179	2,214	1,851	931	920
70-74	4,716	2,638	2,078	3,475	1,960	1,515	1,241	678	564
75-79	2,252	1,233	1,019	1,640	906	734	612	327	285
80+	3,282	1,777	1,505	2,471	1,355	1,116	811	422	389
Age not stated	722	406	316	429	243	186	293	163	130

S.A.S Nagar (2001)	Total			Rural			Urban		
	Persons	Males	Females	Persons	Males	Females	Persons	Males	Females
All ages	**229,757**	**122,747**	**107,010**	**100,407**	**53,707**	**46,700**	**129,350**	**69,041**	**60,309**
Young population	**68,693**	**37,485**	**31,209**	**31,624**	**17,187**	**14,437**	**37,070**	**20,297**	**16,772**
0-4	19,213	10,720	8,494	9,042	5,056	3,986	10,171	5,663	4,508
5-9	23,684	12,962	10,722	11,026	6,023	5,003	12,658	6,939	5,719
10-14	25,796	13,803	11,993	11,556	6,108	5,448	14,240	7,695	6,545
Working population	**140,450**	**74,509**	**65,941**	**58,308**	**31,043**	**27,265**	**82,142**	**43,466**	**38,676**
15-19	22,805	12,442	10,363	10,144	5,491	4,653	12,661	6,951	5,710
20-24	21,479	11,521	9,958	9,368	5,103	4,265	12,111	6,418	5,693
25-29	19,459	9,958	9,501	8,053	4,210	3,843	11,406	5,748	5,658
30-34	17,623	8,919	8,704	7,148	3,615	3,533	10,475	5,304	5,171
35-39	17,225	8,829	8,396	6,908	3,583	3,326	10,317	5,246	5,071
40-44	14,524	7,898	6,626	5,681	3,065	2,616	8,843	4,833	4,010
45-49	11,938	6,566	5,372	4,694	2,542	2,151	7,244	4,024	3,220
50-54	9,026	5,063	3,963	3,656	2,062	1,593	5,371	3,001	2,370
55-59	6,372	3,314	3,058	2,657	1,372	1,285	3,716	1,942	1,774
Old age	**20,613**	**10,754**	**9,859**	**10,475**	**5,476**	**4,999**	**10,138**	**5,278**	**4,861**
60-64	6,321	3,184	3,137	2,955	1,450	1,505	3,366	1,734	1,632
65-69	5,269	2,629	2,640	2,662	1,320	1,342	2,607	1,309	1,298
70-74	3,854	2,141	1,713	2,106	1,188	918	1,748	953	795
75-79	1,856	1,009	847	994	549	445	862	460	402
80+	2,640	1,415	1,225	1,498	822	676	1,142	593	549
Age not stated	673	376	297	260	147	113	413	229	184

Dera Bassi (2001)	Total			Rural			Urban		
	Persons	Males	Females	Persons	Males	Females	Persons	Males	Females
All ages	**223,948**	**119,870**	**104,078**	**168,443**	**90,189**	**78,254**	**55,505**	**29,681**	**25,824**
Young population	**70,934**	**39,192**	**31,742**	**55,084**	**30,439**	**24,645**	**15,850**	**8,753**	**7,096**
0-4	20,014	11,318	8,696	15,720	8,931	6,789	4,294	2,388	1,907
5-9	24,691	13,698	10,993	19,297	10,701	8,596	5,394	2,997	2,398
10-14	26,228	14,176	12,052	20,067	10,807	9,260	6,161	3,369	2,792
Working population	**133,466**	**70,609**	**62,857**	**98,153**	**51,875**	**46,278**	**35,313**	**18,734**	**16,579**
15-19	24,082	13,082	11,000	18,183	9,888	8,295	5,899	3,194	2,705
20-24	21,860	11,674	10,186	16,168	8,670	7,498	5,692	3,004	2,688
25-29	18,339	9,564	8,775	13,543	7,065	6,478	4,796	2,500	2,297
30-34	16,552	8,231	8,321	12,302	6,068	6,234	4,250	2,163	2,088
35-39	16,284	8,496	7,789	11,927	6,226	5,701	4,357	2,270	2,088
40-44	13,118	7,043	6,075	9,460	5,057	4,403	3,658	1,986	1,672
45-49	10,360	5,596	4,764	7,395	3,989	3,406	2,965	1,607	1,358
50-54	7,602	4,296	3,306	5,411	3,072	2,339	2,192	1,224	967
55-59	5,268	2,627	2,641	3,765	1,840	1,925	1,503	787	716
Old age	**19,548**	**10,069**	**9,479**	**15,206**	**7,875**	**7,331**	**4,342**	**2,194**	**2,148**
60-64	5,774	2,803	2,972	4,400	2,118	2,283	1,374	685	689
65-69	5,140	2,494	2,645	3,992	1,950	2,042	1,148	544	604
70-74	3,843	2,195	1,649	3,038	1,761	1,277	806	434	372
75-79	1,670	875	795	1,303	683	621	367	192	175
80+	2,556	1,374	1,182	2,061	1,122	938	495	251	244
Age not stated	565	329	236	412	241	171	153	88	65