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PREFACE

On 22nd June 2007, the Greater Mohali Area Development Authority (GMADA) appointed JURONG Consultants Pte. Ltd. to study and propose a comprehensive integrated master plan for its six Local Planning Areas (LPAs):

- Banur
- Dera Bassi
- Kharar
- Mullanpur
- S.A.S. Nagar
- Zirakpur

This project involved the co-operation of several agencies, namely the Punjab Urban Development Authority (PUDA), the Centre for Computational Engineering (CEC) at the Punjab Engineering College (PEC) and GMADA.

JURONG Consultants would like to thank the following persons, whose unwavering support and assistance had helped to make this report possible:

Vice-Chairman (GMADA)	Dr. Sukhbir Singh Sandhu
Chief Administrator (GMADA)	Mr. Vivek Pratap Singh
Chief Town Planner (Punjab)	Mr. Kuldeep Singh
District Town Planner	Mr. Guprit Singh
Manager (PEC)	Ms. Sandeep

In addition, this report reflects the commitment and dedication of various authorities and public agencies in Punjab, whose co-operation and guidance are greatly appreciated. Specifically, we would like to acknowledge the assistance of the following agencies:

- Punjab Infrastructure Development Board (PIDB)
- Government of Punjab – Department of Forests & Wildlife Preservation
- The Louis Berger Group, INC

We also wish to thank all those who have contributed in one way or another to the completion of this report, particularly the officers from PUDA who have kindly accompanied us on the various field trips.

The above-stated list is not meant to be exhaustive and we would like to express our regret if we have inadvertently left out anyone.

This report is the *Banur Local Planning Area Master Plan 2006 – 2031* and consists of the following sets of reports and supporting documents:

Executive Summary

Banur LPA Master Plan

- Regional Framework
- Existing Conditions
- Planning Analysis
- Development Framework
- Planning Proposals
- Infrastructure Proposals
- Implementation and Phasing
- Special and Detailed Controls
- Conclusion

This report is accompanied by the Banur LPA land use master plan (A1 size).

Note:

In the event of conflict in interpretation of data within the study area, the information in the GIS format will be deemed as the accurate version and shall prevail.

INTRODUCTION

This report presents the third part of the consultancy work titled *Integrated Master Planning for the Greater Mohali Region* and documents the planning proposals and development strategies for the Banur LPA, one of the six LPAs of the Greater Mohali Region (GMR).

The Banur LPA is located at the south-western side of the GMR. It is served by two major roads, NH 64 and MDR A. As stipulated in the second part of the consultancy work under *Regional Plan 2006 – 2056*, the master plan will include proposals to construct new roads, including PR 1, PR 8, PR 9 and PR12.

There are nine sections in this report. Section 1 reiterates the regional framework. Section 2 highlights the existing conditions in terms of land use and demography. Section 3 analyses the LPA's strengths, weaknesses, threats and opportunities.

The development framework will be elaborated upon in Section 4. Sections 5 and 6 outline the planning and infrastructure proposals respectively. Section 7 covers the implementation and development phasing, while specific and detailed controls for developments will be covered in Section 8.

The report concludes by reiterating the vision for the Banur LPA and the methodology to achieve that vision.

Executive Summary

1 Development Framework

The ultimate vision for the Banur LPA is to develop it into a world-class and premier institutional hub to serve the GMR and beyond. This is a further enhancement of the original proposal to develop the Banur-Zirakpur Corridor into a knowledge-business-technological belt.

The strategies to achieve the vision are:

- To respond effectively to the regional impact of the fast-growing neighborhood towns of S.A.S. Nagar and Zirakpur.
- To ensure direct connectivity to important transportation nodes such as airports and bus terminals, and more importantly, to the regional transportation network.
- To safeguard and enhance the value of land along major existing and proposed roads.
- To align the development of Banur with the proposed Banur-Zirakpur Corridor.
- To safeguard sufficient sites for the future development of educational institutions and to cluster these future development sites with existing colleges.
- To facilitate the development of a whole spectrum of institutions with their respective specializations, in order to attract local and foreign students, as well as foreign talents.
- To boost institutional tourism in the region, which will in turn create new economic and employment opportunities.
- To develop world-class educational and research institutions – including medical colleges and hospitals – as tourism drivers.

2 Existing Conditions

As at 2001, the total population within the municipal boundary of Banur is 15,013, of which 36.1% (5,426) is in the urban area, while the balance 63.9% (9,587) is in the rural area (existing villages).

The municipal area of Banur is located at the intersection of the two major roads NH 64 and MDR A. It is an existing built-up area with mixed uses, occupying an area of 104.1 ha.

The urban population within the Banur municipal area accounts for only 2% of the GMR's total urban population.

The population in Banur is entirely dependent on the primary sector. Hence, it is not surprising that almost 92% of the land is being used for rural and agriculture purposes. Apart from that, there are also some brick kilns located adjacent to the village settlements.

Industrial activities – specifically, pharmaceuticals and distillery – are concentrated in the western portion of the town. In addition to green buffers around the industrial plants, there is a treatment plant to handle the discharge effluents.

There is a variety of existing institutional uses, including government institutions within the municipal area and a concentration of educational institutions in the western portion of the LPA.

3 Planning Parameters

Parameters that were taken into consideration when formulating the land use plan included the projected population and economic growths for the Banur LPA, as well as the larger context of the growth of the entire GMR.

For the purpose of land use planning, the scenario of very high population growth was assumed. The resultant projected population for Banur by Years 2031 and 2056 is 119,558 and 398,526 respectively.

At the economic front, the Banur-Zirakpur Corridor is likely to generate substantial employment opportunities and boost economic growth for the LPA and the larger region.

4 Planning and Infrastructure Proposals

With the vision of developing Banur into an institutional town, institutional use will become the third most predominant land use by Year 2031 (after residential and mixed uses), occupying **8%** of the total land area within the LPA.

To further enhance the living environment and make it conducive and attractive for educational institutions and research institutes to be set up within the LPA, there is

generous provision of open spaces and parks (**6%** of total land area).

Industrial use is seen as the second engine of economic growth for the LPA. This use will occupy **2.4%** of the total land area, which is slightly larger than the size of the existing built-up area.

The predominant land use is residential use, occupying **18.1%** of the total land area. This is to cater for the projected population growth, as well as provide operational flexibility for investors and property developers at the implementation stage.

The proper and well-timed development and implementation of the following infrastructure facilities will support the envisioned growths in population and the economy:

- Water supply and distribution
- Surface water drainage
- Power supply and distribution
- Sewerage
- Solid wastes management
- Information technology and communication
- Gas supply and distribution

The targets of economic development and urbanisation can be achieved without compromising the quality of living. Given the availability of unencumbered land, the increased population can be accommodated at the relatively low gross residential density of 100 ppa/220 ppha.

In addition, existing natural features, such as forests and water bodies, will be retained and incorporated as parks and open spaces to create a park-like setting.

5 Implementation & Phasing

A market-oriented, entrepreneurial approach is proposed for the development of the Banur LPA. Apart from the essential services, all other forms of development should be spearheaded by the private sector or via public-private partnerships.

A 2-stage development phasing plan has been proposed for the LPA for cost-effectiveness and sustainability. The first phase, to be completed by Year 2031, involves **46%** of the total land area within the LPA (4,782.5 ha).

When the second phase has been fully implemented by Year 2056, **62.1%** of the total land area (6,446.1 ha) will be urbanised.

6 Special and Detailed Controls

In addition to the common development control parameters which are applicable to the whole of the GMR, special and detailed controls are to be applied to the following land uses within the Banur LPA:

a) Residential
b) Institution

The special and detailed controls include:

- Width of road
- Width of road buffer (green and physical)
- Setback controls
- Parking provision
- Use quantum
- Minimum size
- Maximum floor area ratio
- Maximum ground coverage
- Maximum number of storeys
- Maximum height
- Maximum hard surface area
- Permissible uses and facilities
- Green reserves along waterbodies
- Transferable development rights

7 Conclusion

The planning and infrastructure proposals for the Banur LPA have to be implemented through a strong and effective public-private partnership. When the vision is realised, the economy and standard of living within the LPA and the entire GMR will be greatly enhanced.

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1 Regional framework

1.1 Vision for Regional Development

The vision for the GMR is for it to become a globally-competitive metropolis with a self-built resilience capacity to sustain the pace of economic and urban development in Punjab. The region will also offer unique lifestyle choices and memorable experiences to its residents and visitors.

The primary objective as set forward at the regional plan level is to ensure that enough land resources have been allocated to meet the target population by the year 2056. This safeguarding shall not only be for the ultimate population, but also in alignment with the intended economic and infrastructure development.

The major objectives and goals for development of the GMR are as follows:

- To build and transform the region into an attractive place to live, work, play and learn.
- To strengthen the economic, social and cultural well being of the region.
- To regulate and optimise urban development so that the outlying areas of fertile agriculture land, natural features, water catchments and ecologically-sensitive zones are conserved and preserved.
- To prioritize development in areas with existing infrastructure development, community facilities and other commercial entities.
- To encourage sustained economic growth, thereby improving the quality of the living and working environments.
- To promote growth in tourism in accordance with the growth strategy of the GMR.
- To encourage creation and expansion of new businesses and growth areas like e-commerce, environmental science and research, aviation and logistics as well as the creative sector.
- To preserve and enhance the network of green and open spaces.
- To create a good variety of housing types and ample job opportunities for the residents.
- To conserve and enhance the region's historical, architectural and cultural assets.

1.2 Broad Planning Intention for the Banur LPA

In the *GMADA Regional Plan 2006 – 2056*, the total amount of land that can be urbanized is 42,740 ha, which constitutes 35.9% of the region's overall land area. This is to be distributed among the region's six LPAs. The objective is to establish a logical and sensitive growth and land utilisation strategy for the region.

In addition, seven economic clusters have been identified in the *GMADA Regional Plan 2006 – 2056*. Each cluster is to have its own distinctive group of primary and secondary economic activities (see Table 1.1 and Figure 1.1).

Table 1.1: An overview of the economic clusters within the GMR

Economic Cluster	Primary / Secondary Economic Activities
Central S.A.S. Nagar	CBD Financial district Arts and cultural centre Administrative centre
South-Eastern S.A.S. Nagar	Airport hub Logistic hub Aviation-related industries
Zirakpur	Heavy manufacturing Warehousing Medium/small-scale manufacturing
Banur Zirakpur Corridor	**Education knowledge belt** **Business technological corridor** **Regional park** **Southern gateway (with a direct link to New Delhi)**
Shivalik Hills	Nature conservation and preservation Public enjoyment of the local flora and fauna Regional ecological park Micro-climatic modifiers
Mullanpur	Resort centre Low-density country living Northern gateway
Agriculture (Rural) Zone	Diversification of agriculture activities Regional growth center – Critical mass approach to rural development Preservation of agriculture lands

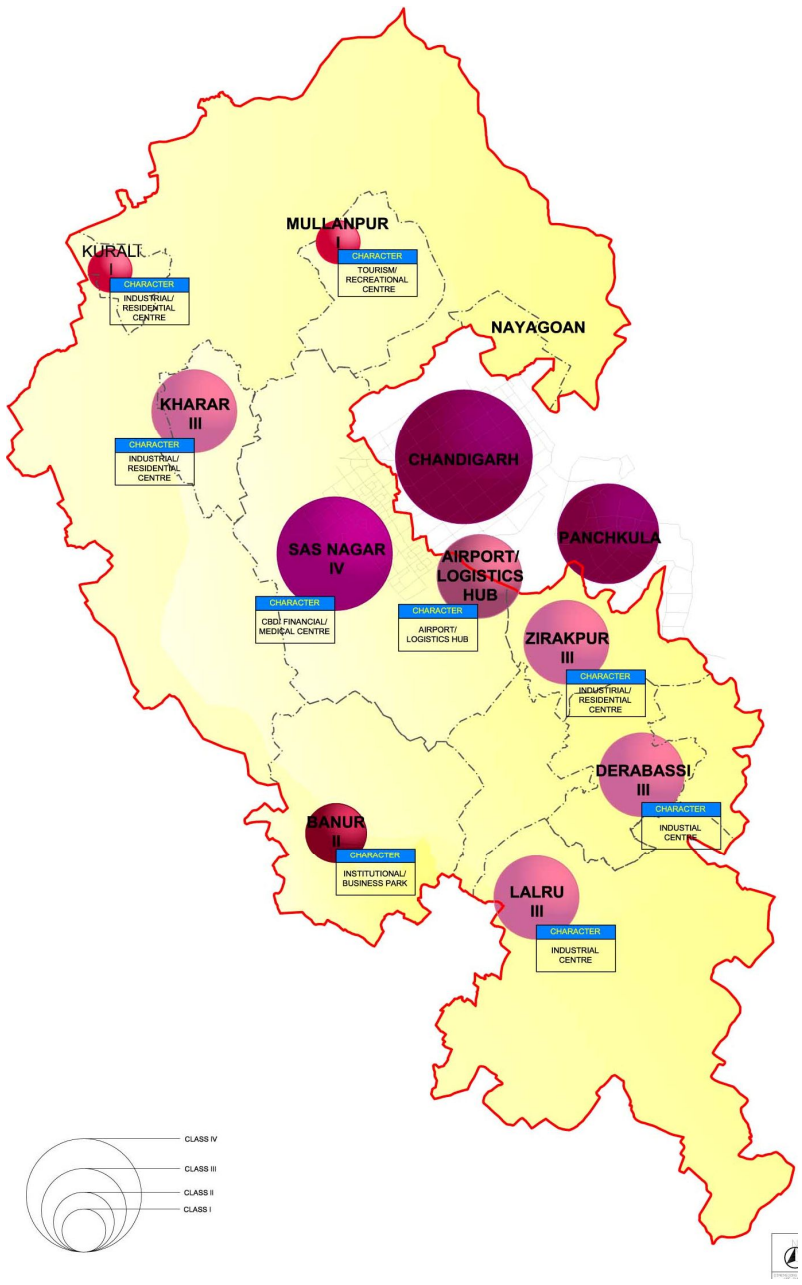

Fig. 1.1: Proposed development strategies for the GMR

The broad planning intention for the Banur LPA is derived from the broader vision and objectives of the *GMADA Regional Plan 2006 – 2056*.

The immediate objective for the Banur LPA is *"to operationalise the concept of an institutional town within a park setting, through integration of residential, institutional, commercial and green/open space uses, ultimately to achieve a harmonized sustainable development."*

The medium and long-term objective is *"to develop Banur in alignment with the regional development strategies and to intensify the educational, community and cultural facilities to support the development of the intended institutional hub."*

Ultimately, the vision is to develop Banur into a world-class and premier institutional hub.

Banur's proximity to Patiala [located to the west of the GMR], S.A.S. Nagar and Zirakpur (see Figure 1.2) provides it with a large population catchment, including students at the various stages of education. This facilitates the positioning of Banur as the nucleus for educational, knowledge and research-based activities, which is in line with the vision to develop the Banur-Zirakpur Corridor as a knowledge-business-technological belt.

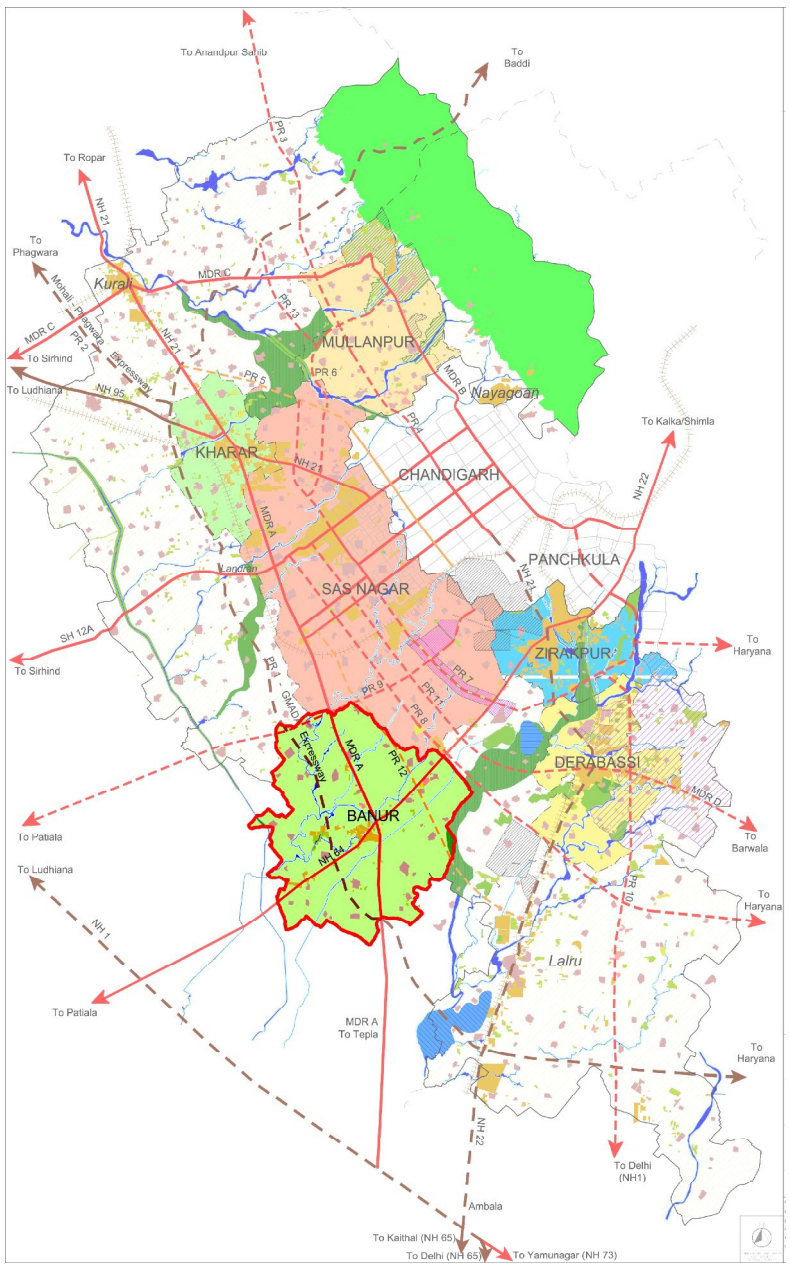

Fig. 1.2: The Banur LPA

The strategies to achieve the vision for the Banur LPA are as follows:

- To respond effectively to the regional impact of the fast-growing neighborhood towns of S.A.S. Nagar and Zirakpur.
- To ensure direct connectivity to important transportation nodes such as airports and bus terminals, and more importantly, to the regional transportation network.

- To safeguard and enhance the value of land along major existing and proposed roads.
- To align the development of Banur with the proposed Banur-Zirakpur Corridor.
- To safeguard sufficient sites for the future development of educational institutions and to cluster these future development sites with existing colleges.
- To facilitate the development of a whole spectrum of institutions with their respective specialisations in order to attract local and foreign students.
- To boost institutional tourism in the region, which will in turn create new economic and employment opportunities.
- To develop world-class educational and research institutions – including medical colleges and hospitals – as tourism drivers.

1.3 Development framework for the Banur LPA

The vision for the Banur LPA, together with the various supporting strategies, goals and objectives, will guide its development over the medium- to long-term, as well as the basis on which the planning authority can evaluate individual development proposals.

This is to ensure that all future development proposals will conform to the target population and land use intentions stipulated in the draft *Master Plan 2031*.

This report includes an evaluation of the broad planning intentions and strategies adopted for the physical development of the Banur LPA, as well as specific recommendations to realise the vision of Banur as an institutional hub. The major components of such a hub, as well as the major growth nodes and key economic drivers, will also be elaborated upon.

A preliminary development framework for the Banur LPA is shown in Table 1.2.

Table 1.2: Preliminary development framework for the Banur LPA

Parameters	
Existing total population *	43,330
Projected total population as at Year 2056	398,526
% of population growth to be expected by Year 2031 (based on the overall phasing strategy for the GMR)	30%
Projected total population as at Year 2031	119,558
Classification/type of town	Institution
Available land area (ha)	10,380.2
Gross town density (ppa)	50
Gross residential density (ppa)	100
Residential land requirement (acre) = Projected population in Year 2031 / Gross residential density	1,196

*: This includes the population living in the villages and rural settlements distributed over the entire LPA (including the municipal area of Banur, as well as other areas).

The following assumptions have been taken into account in the preparation of the *Banur LPA Master Plan*:

- For the ultimate population projection, the scenario of very high growth was adopted.
- The average family size adopted was five.
- In-migration and other economic catalysts will contribute to population growth.

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2 Existing Conditions

2.1 Land use and settlement pattern

The Banur LPA, located to the south of S.A.S. Nagar, has a total land area of 10,380.2 ha. It is predominantly a rural area (see Table 2.1 and Figures 2.1 and 2.2).

Table 2.1: Existing land use distribution

Land use	Area (ha)	Percentage (%)
Rural & agriculture	9,541.5	91.9
Panchayat & wasteland	232.0	2.2
Water body	200.5	1.9
Residential	158.3	1.5
Institution	85.1	0.8
Forest & plantations	75.8	0.7
Commercial	52.1	0.5
Industry	34.9	0.3
Total	**10,380.2**	**100**

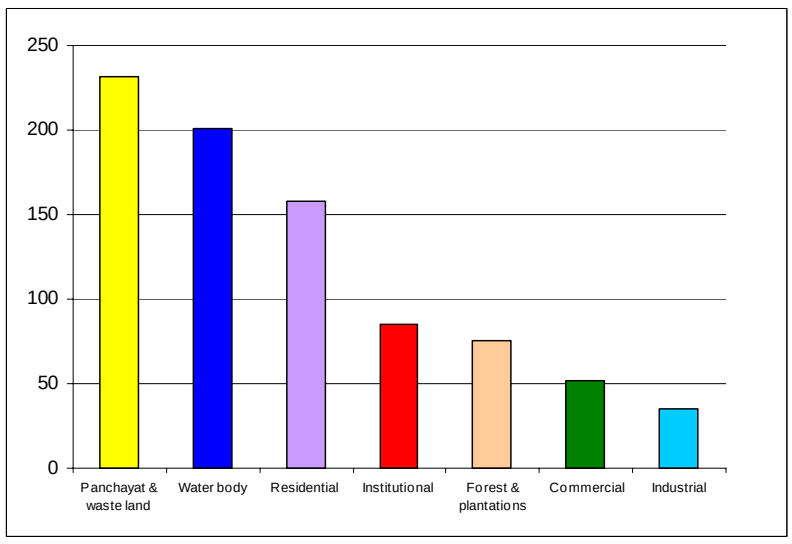

Figure 2.1: Distribution of existing land uses by size (excluding rural and agriculture land)

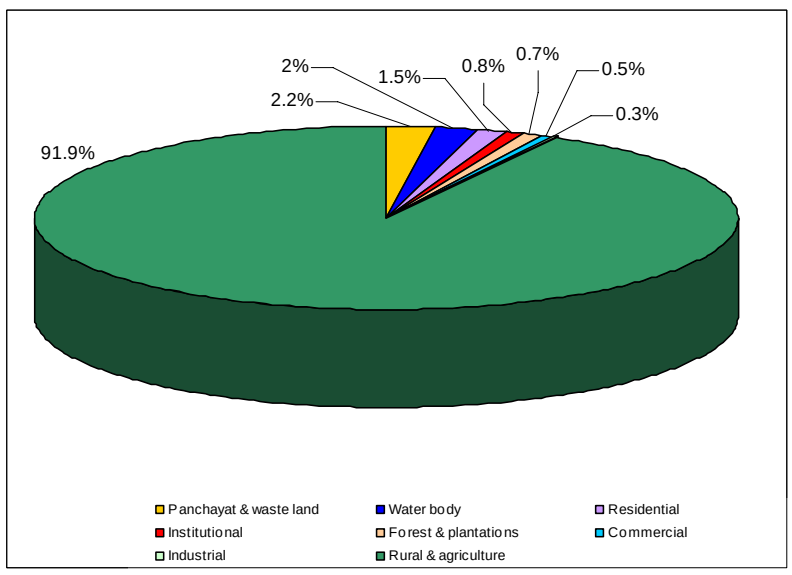

Fig 2.2: Distribution of existing land uses by percentage

There are 31 existing villages scattered throughout the entire LPA, occupying a total land area of approximately 158 ha (Figure 2.3). There are approximately 9,587 people residing in these villages.

2.1.1 Commercial and Residential areas

The size of the municipal area of the Banur LPA is 104.1 ha, which amounts to only 1% of the total land area. Located at the intersection of the two major roads National Highway (NH) 64 and Major District Road (MDR) A, it comprises mainly residential and some commercial uses.

The commercial uses comprise shops, markets, hotels and bank branches. These front the two major roads, as can be seen in the photographs.

The existing residential area, comprising mainly low-density housing, is similarly concentrated in the town center and at the road intersection.

The majority of Banur's population resides in villages located outside the town center. Small-scale commercial and social facilities (such as schools, petty shops and religious buildings) serve the needs of the residents there.

2.1.2 Industrial area

Industrial activities are concentrated in the western portion of the town, in a zone occupying an area of about 35 ha.

The major industrial activities include pharmaceuticals and distilleries, which can pollute the environment. The discharge effluents from these industries are sent to a waste treatment plant located within the industrial zone for processing.

Apart from the two major industrial uses, there are kilns located near the villages for the manufacturing of bricks. In addition, a few cottage/domestic industries – mainly agriculture-based – can be found.

There is a major truck terminal located next to the industrial zone. However, this use has encroached onto the adjacent land: Trucks are parked along the roads leading to the industrial zone.

2.1.3 Institutions

Institutional uses include educational, medical, public/government, historical and religious buildings, as well as other social facilities. The total land take is approximately 85 ha.

Government institutions and buildings are located within the municipal area, while educational institutions are concentrated in the western part of the LPA. Medical, nursing and engineering colleges are located along NH 64, the national highway. Engineering colleges can be found along MDR A, the major district road.

Apart from the various colleges stated above, there are also other schools and technical institutes. Together, these form the social infrastructure for the residents of Banur.

2.1.4 Open spaces

Being a predominantly rural and agricultural area (comprising almost 92% of the total land area), there are lots of open spaces within the LPA. In addition, water bodies, canals and streams occupy about 200 ha of the total land area. These open spaces and water bodies can be integrated with future developments as recreational areas.

Some parts of the LPA are occupied by forests and plantations, with a total land take of approximately 76 ha. These are reserved areas that will not be scheduled for future development.

2.2 Demography

The existing population of the Banur LPA was derived from the *Primary Census Abstract 2001*, the most recent nation-wide population census carried out by the Registrar General and Census Commissioner of the Government of India.

This population census is the only comprehensive source of demographic data and information for India. Although other sources of demographic data are

available, these are not used as they are mainly based on selected samples. Generalising the sampled data to the national level involves estimation and use of various assumptions, the final result of which may not be representative of the population as a whole.

Being a rural area, Banur's share of the GMR's total urban population is very small (see Table 2.2). Its low population density is due to the following reasons:

- Agriculture is the predominant economic activity, with rural and agricultural areas occupying almost 92% of the total land area.
- Arising from the lack of major industries and financial institutions, economic activities in the secondary and tertiary sectors are limited.
- Banur is over-shadowed by S.A.S. Nagar, a major commercial node with better employment opportunities.

Table 2.2: Distribution of urban population within the GMR, 2001

Urban settlement	No. of households	No. of persons	% share of urban population
S.A.S. Nagar	28,539	123,484	44.6
Kharar	8,118	42,289	15.3
Zirakpur	5,072	25,022	9.0
Kurali	4,220	23,047	8.3
Karoran	4,564	20,361	7.4
Dera Bassi	3,284	15,841	5.7
Bhankharpur	1,798	9,216	3.3
Mullanpur Garib Das	1,171	6,147	2.2
Bhabat	1,103	5,866	2.1
Banur [1]	**861**	**5,426**	**2.0**
Total:	**58,730**	**276,699**	**100**

Source: Primary Census Abstract (PCA), 2001

Given the limited employment opportunities in Banur, its adult working population is largely dependent on S.A.S. Nagar and Chandigarh for job prospects.

[1] The total population of the entire Banur town as stated in the *2001 Census* was 15,013. The figure indicated in this table is smaller because only those villages directly under the jurisdiction of the municipal body of Banur were included as part of the GMR.

Arising from the situation stated above, the size of the migrant population in Banur is insignificant. This is in contrast with the situation for the entire region, where migrant workers play a very significant role in the overall economy. Specifically, the two sectors of agriculture and unorganised manufacturing (for e.g., in the brick kilns) depend largely on the pool of migrant workers.

The bulk of the migrant worker population in the GMR originates from Uttar Pradesh and Bihar, but a significant proportion also comes from the neighboring Haryana and Rajasthan.

2.3 Economic profile

As stated earlier, the local economy of Banur is predominantly based on the primary sector, specifically, agriculture. There are very few activities in the secondary and tertiary sectors. Existing ones include a few bank branches that provide basic services (savings/deposits and agriculture loans) and some small-scale and unorganised industrial activities.

In recent years, educational institutions have been established in Banur, creating employment opportunities and attracting migrant population. This in turn has a positive impact on the growth and development of the local economy.

2.4 Environment

2.4.1 Climate

The entire GMR experiences a wide range of weather conditions, with annual temperatures ranging from a minimum of 1 degree Celsius in winter to a maximum of 45 degrees Celsius during the hot and dry season (April to June).

The average annual precipitation level in Banur is approximately 58 mm. Precipitation is especially heavy during the monsoon season, which is usually between the first week of July and mid-September every year.

The water supply in Banur – for domestic and agricultural purposes – is dependent on ground water, which is recharged during the monsoon season.

However, surface runoff is also very high during that period. The Banur Canal was built as a tributary of the Ghaggar River to tap on the surface runoff for agricultural use.

The physical planning of the Banur LPA has to take into consideration the varying temperature and precipitation conditions. Planning elements such as street layout, building orientation and land use allocation can be manipulated in order to optimise sun exposure and wind circulation, thereby allowing the built environment to respond suitably to local weather conditions.

2.4.2 Ecology

The existing land use of Banur shows that it is a Class IV town, surrounded by agricultural fields and a main highway cutting through the town. Apart from the Ghaggar River, there are several water courses passing through this area. There is also a substantial amount of wasteland in the area. This is basically an agricultural service centre town.

The main ecological considerations of the site would be agricultural lands, small forests and orchards, the series of rivers and waterways and the protection of the flood plains of Ghaggar River.

2.4.3 Land use suitability

The topography of the Banur LPA is relatively flat and as such, is suitable for all type of developments. Nevertheless, while considering the major land uses to be proposed for this draft master plan, the impact of these uses on the environment have been taken into consideration.

Specifically, the land use allocation potential of environmentally-sensitive areas (such as forests, flood plains of rivers and tributaries, large water bodies etc.) has been assessed independently of the demand for land at those locations. The development constraints posed by these natural areas can be mitigated through the latter's integration with future developments, for example, as open spaces or for sports and recreation use.

2.4.4 Industrial location suitability

The Central Pollution Control Board (CPCB) under the Ministry of Environment & Forest determines the areas where the various types of industries can or cannot be permitted to operate.

CPCB broadly classifies industries according to their potential to pollute air and/or water, as well as the typology and size of operation of the industries. Polluting and general industries are not allowed in certain areas. Even for non-polluting and light industries, these have to comply with the regulations and guidelines stipulated to ensure that disamenity will not be created for the surrounding uses. Mitigation measures include the provision of physical and green buffers, i.e. roads and plantings.

For the Banur LPA specifically, general and polluting industrial uses are not permitted within the built-up area (shown bounded by the red line in Figure 2.4). Only light and non-polluting industries are permitted there.

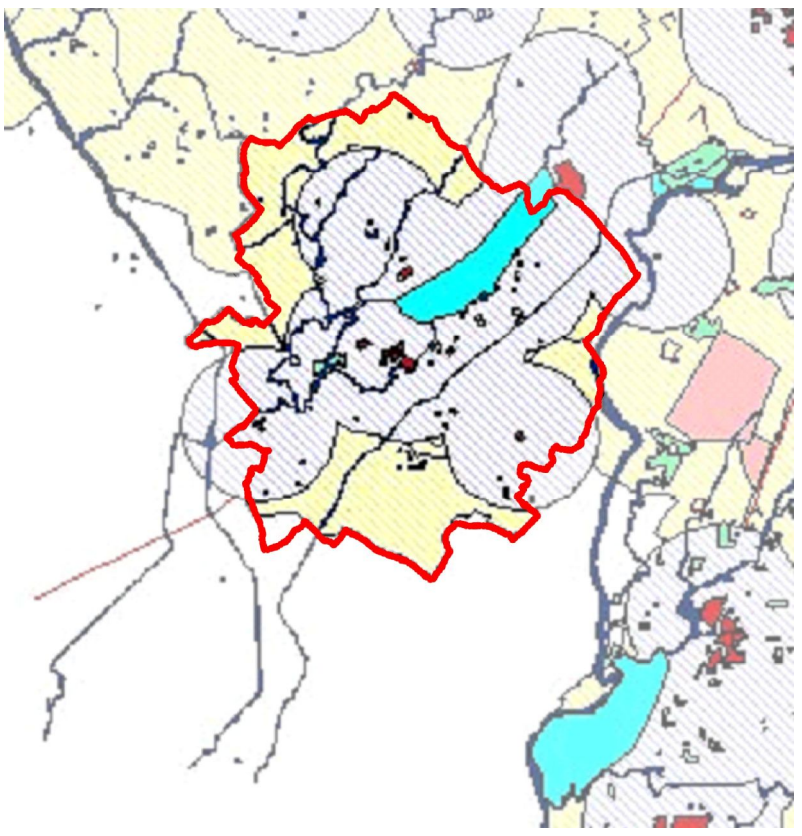

Figure 2.4: Industrial location suitability within the Banur LPA

2.5 Transportation

The *GMADA Regional Plan Report – Transportation*, which contains a review of the existing transportation infrastructure for the GMR, serves as the framework for the preparation of the transportation plan for the Banur LPA.

2.5.1 Existing roads

The existing road network for the Banur LPA is shown in Figure 2.5.

The town is served by two major roads:

- NH 64:
  This dual two-lane carriageway starts from Zirakpur (where it intersects with NH 22) and heads south towards Banur. There, it intersects with NH 1 before continuing southwards to Patiala, Sangrur and the Bathinda district in Punjab.
- MDR A:
  This road originates from the southern part of S.A.S. Nagar – where it intersects with NH 1 – and extends to Kharar, Banur and Tepla. Starting from the intersection with NH 21 (located in Kharar), MDR A runs in a south-east direction, intersecting with SH 12A at Landran and NH 64 at Banur. It is originally a 2-way single-carriageway road and is currently being upgraded/widened to a dual two-lane carriageway by the Punjab Roads and Development Board as part of a World Bank development project.

These two roads form a prominent intersection within the town center of Banur.

The existing road network is surrounded by poorly-regulated and generally poorly-constructed buildings of mixed vintage. Small unmade roads tap off the main road network to serve the surrounding sprawling developments. These small roads are predominantly 2-way single-carriageways. There are also several crossings where these roads intersect with the local rivers.

Further away from the town center, existing villages are mostly located close to the highways and major district roads. The rest of the villages are connected by small village roads.

2.5.2 Current traffic conditions

The roads within the Banur LPA are badly-built and poorly-maintained, making the experience of vehicular rides very bad. This problem is compounded by poorly-executed (or even non-existent) traffic-management tools, such as lane markings and traffic signages. Proper roadside drainage systems and street lightings are also lacking, while the laying of underground utility services has been poorly-regulated.

In some cases, regular road alignment (and sometimes, even proper connection) cannot be achieved due to the presence of sprawling villages. To avoid these villages, localised sharp bends are created along the roads, making traffic flow inefficient. At other locations, properly-paved roads terminate at the boundary of the villages and give way to local unmade roads that continue through and beyond the villages.

Pedestrian pavements along the roads are generally lacking, subjecting pedestrians to unnecessary risks and intimidation by vehicular traffic. Even in areas where there are pedestrian pavements, the presence of pot-holes, together with irregular widths at many areas, makes it difficult for pedestrians to navigate the town. Pedestrian spillage onto the roads in turn impedes the flow of traffic.

The lack of proper crossing facilities along major roads and at junctions makes it hazardous for pedestrians to get from one side of the roads to the other. However, they seem to have taken this matter in their strides and treat that as part of their daily life.

In addition, it was noted that whenever new roads were opened, proper diversion signs were not put up. Pedestrian pavements affected by road works were also poorly restored.

Specific traffic-related information for the LPA is not available. Based on general observations of the GMR, traffic on the roads typically comprises heavy-goods vehicles, buses, passenger cars, motorized 3-wheelers/2-wheelers, bicycles, rickshaws etc.

The total volume of two-wheelers and slow-moving vehicles typically exceeds 50% of the total traffic volume, while passenger cars comprise another 25-40%.

Slow-moving vehicles, poor driver discipline, indiscriminate on-street parking and road-side loading/unloading activities are some of the factors that severely handicap the capacity of existing roads and impede the smooth flow of traffic.

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3 Planning Analysis

Having assessed the existing conditions found within the Banur LPA, this section presents the SWOT (strength, weakness, opportunity and threat) analysis. It involves a review of the present and future regional and local situations/trends that may have an impact on the development of Banur. It is also a timely opportunity to assess the greater competing environment in which it operates. This contextual analysis will help to define Banur's potential strategic market position and guide the master planning approach for the town.

3.1 Strengths and Opportunities

Strengths and opportunities refer to those factors or conditions that will facilitate change and/or enhance development options. These provide a positive impetus for growth and development.

The following are the strengths and opportunities affecting the execution of development strategies and the realisation of the planning vision for the Banur LPA.

3.1.1 Location

Banur is strategically located to the south of S.A.S. Nagar (the commercial hub of GMR) and south-west of Zirakpur (see Figure 3.1). It is also in close proximity to Chandigarh, the capital city and administrative centre for both Punjab and Haryana.

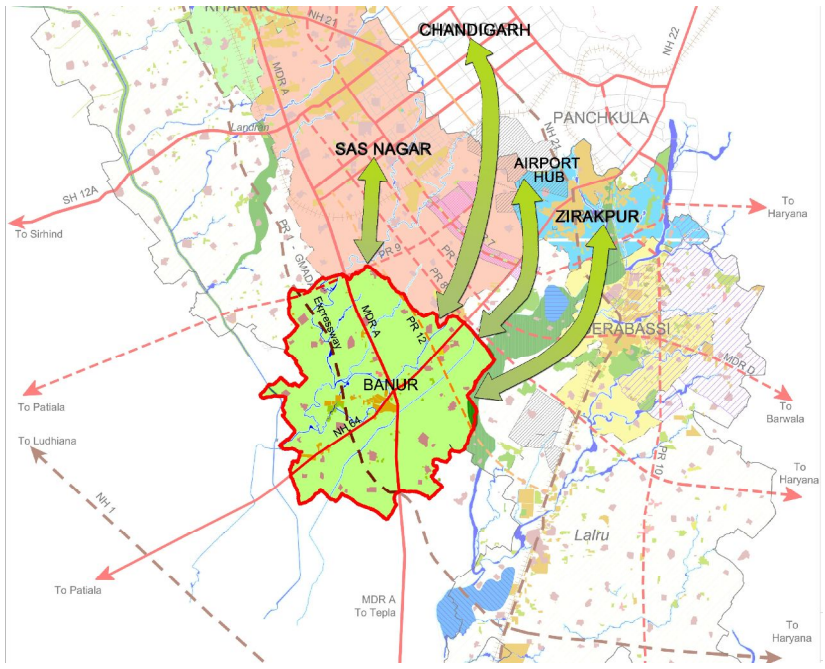

Figure 3.1: Proximity to other major cities

Due to its unique location, Banur is also in close proximity to the administrative and commercial centre of Patiala, thus exerting a strong influence over that adjacent district.

3.1.2 Linkages and accessibility

Banur is well-linked to the surrounding region via a road network comprising a national highway, a major district road and other smaller roads (see Figure 3.2).

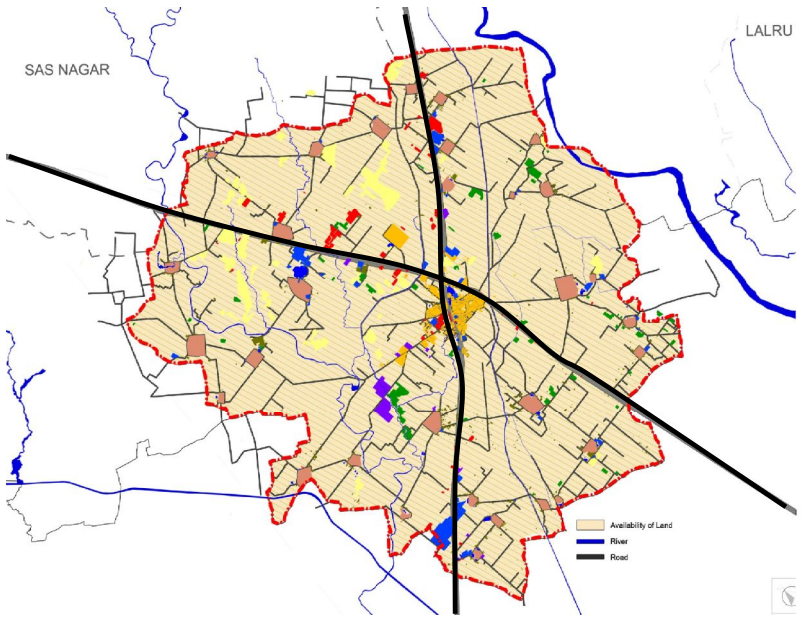

Figure 3.2 Accessibility and land availability

NH 64 runs through the LPA in an east-west direction, connecting Banur with Zirakpur and Patiala. On the other hand, MDR A connects it with S.A.S. Nagar to the north and Tepla to the south. Located at the intersection of these two major roads is a large signalised junction, the center point of the Banur municipal area.

It is foreseen that the highway and major district road will play a significant role in supporting the proposed development of the Banur-Zirakpur Corridor, thereby speeding up the economic growth of the region.

3.1.3 Land availability

Apart from the existing built-up areas around the junction of the two major roads, there are no other major existing developments in the entire LPA (see Figure 3.2).

The bulk of the remaining land is actually a green-field site, with the exception of some existing village settlements, agriculture areas and waste land. Hence, the implementation of any proposed developments should be relatively easy and hindrance-free.

3.1.4 Topography

The topography of the entire LPA is relatively flat and unencumbered, which paves the way for the introduction of innovative planning approaches.

Another advantage is the ample amount of soft land available for urban and infrastructure development, especially land-intensive and sprawling uses such as college campuses, research-based institutions and business parks.

3.1.5 Proposed educational institution cum medical hub

There are already several existing educational institutions within the LPA. Mainly located along NH 64 and MDR A, these include engineering, medical and nursing colleges.

Recognising the presence of these institutions and the opportunity presented by the amount of soft land available, it is envisioned that the LPA be positioned as an educational institution cum medical hub, serving the entire GMR and beyond.

When Banur develops into an institutional town, it will attract students and visitors from all over the country. New employment opportunities will be created in terms of provision of goods and services to meet the needs of local residents, students, academic staff, researchers, workers and other in-migrants. All this will in turn help to sustain and even further boost the local economy.

3.1.6 Existing open spaces and water bodies

Rivers and streams originating from the Ghaggar River run through the entire Banur LPA. Besides underground water, these surface runoffs serve as additional water sources for agricultural use.

The existing open spaces and water bodies can be tapped upon to soften the urban built environment and to provide visual relief. Doing so will also help to preserve natural environmental resources.

Even for the proposed educational institution cum medical hub, the planning intention is to incorporate elements of the existing open spaces and water bodies as integral parts of the campus developments. The same concept is to be applied to the planning and development of business parks as well.

3.2 Weaknesses and constraints

These refer to conditions and factors that will likely hinder future developments within the LPA. After being identified and assessed, the negative impacts of these factors can be mitigated through proper land use planning and the upgrade of existing infrastructure.

To complement positive changes that will be made to the hardware (through land use planning and infrastructure upgrade), the software aspects (in terms of financial and fiscal policies) can also be assessed and improved upon, where necessary. Specifically, viable monetary measures, subsidy schemes and preferential taxation policies can be considered for implementation.

The major weaknesses pertaining to the Banur LPA will be elaborated upon next.

3.2.1 Limited economic activities

As explained previously in Chapter 2, Banur is entirely dependent on the primary sector – especially agriculture – as its main form of economic activity. There are only some basic financial institutions and industries to generate activities in the secondary and tertiary sectors. Consequently, the adult working population in the LPA has to seek out employment opportunities in the adjacent towns.

To create new employment opportunities, a substantial core economic activity has to be introduced. Specifically, the vision of an educational town is proposed. Arising from this core activity, there will be other supporting and ancillary uses, which will further boost the local and regional economies.

3.2.2 Lack of crossings over water bodies

There are a number of rivers, streams and other water bodies cutting through the LPA (see Figure 3.3). These hinder accessibility and mobility for both vehicular and pedestrian traffic. To address this issue, bridges or other forms of crossings have to be built over the water bodies at different parts of the town. However, doing so will incur substantial infrastructure costs. Hence, where possible, crossings will only be proposed at the narrower portions of these rivers.

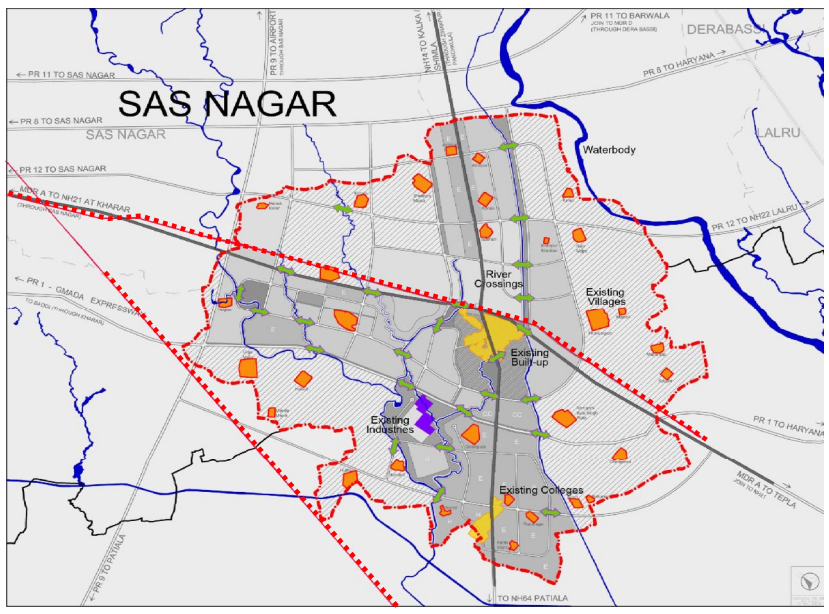

Figure 3.3: Existing water bodies, villages and high-tension power line

This issue can be further mitigated through proper land use planning and parcellation. If proposed developments are well-integrated with the existing built-up environment, the number of crossings that are needed will be minimised to only the critical few. This will help to reduce infrastructure cost further.

3.2.3 Constraints posed by existing villages

Approximately 9,587 people reside in 31 existing villages and small settlements (see Figure 3.3). These are distributed across the entire LPA and occupy a total land area of 158 ha.

Given the vast number of villagers involved and the widespread spatial distribution of the settlements, it will be very difficult to carry out relocation, physically as well as politically.

A more viable alternative will be to adopt a comprehensive planning strategy such that the existing settlements will be properly integrated with future developments. This will involve, among other things, the improvement of connectivity through the upgrading of existing roads and/or construction of new access roads.

3.2.4 Presence of high-tension power line

A 220 KV high-tension power line runs along MDR A to Tepla, effectively bisecting the town (see Figure 3.3). At ground level, a 30-m wide pylon reserve has been safeguarded, where no development is allowed.

There is no intention or the necessity to realign the existing power line. Since part of the pylon reserve overlaps with the width of the road buffer requirement for MDR A, the constraint on land use potential has been minimised to a certain extent. In addition, the pylon

reserve can actually double up as a green corridor or connector.

3.2.5 Existing industries as environmental threats

Within the LPA, there are some small-scale industries involved in distillation/liquor manufacturing and pharmaceuticals. Their operations can potentially threaten existing environmental conditions.

However, the threat has been reduced through the provision of an effluent treatment plant to treat waste water generated by these industries. In addition, a plantation located next to the industrial area helps to act as a green buffer.




Apart from the above-stated industries, there are also brick kilns located adjacent to the various existing villages, acting as a source of pollution to the settlements.

To ensure that residents' health and quality of life is not compromised, the kilns are surrounded by buffers, the minimum widths of which were based on the guidelines stipulated by the Central Pollution Control Board.

Given that the existing industries are not compatible with the long-term vision of Banur as an institutional town, they will be phased out eventually and replaced by clean uses such as research-based industries, biotechnology and business parks.

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4 Development Framework

This chapter details the planning vision and objectives for the Banur LPA, which will in turn guide the following:

- Development direction;
- Development strategies; and
- Evaluation of future land use proposals.

4.1 Planning Vision and Objectives

The vision for the GMR is to become a globally-competitive metropolis with a self-built resilience capacity to sustain the pace of economic and urban development in Punjab. The region also aims to offer unique lifestyle choices and memorable experiences to its residents and visitors.

The immediate objective for the Banur LPA is:

> *"To operationalise the concept of an institutional town within a park setting, through integration of residential, institutional, commercial and green/open space uses, ultimately to achieve a harmonized sustainable development."*

The medium and long-term objective is:

> *"To develop Banur to align with the regional development strategies and to intensify the educational, community and cultural facilities to support the development of the intended institutional hub."*

Ultimately, the vision is to develop Banur into a world-class and premier institutional hub for the region and beyond. For residents and visitors alike, it will be a unique showcase environment in which to live, work, play, and learn.

Banur's proximity to Patiala, S.A.S. Nagar and Zirakpur provides it with a large population catchment, including students at the various stages of education. This facilitates the positioning of Banur as the nucleus for educational, knowledge and research-based activities, which is in line with the vision to develop the Banur-Zirakpur Corridor as a knowledge-business-technological belt.

The strategies to achieve this vision for the Banur LPA are as follows:

- To respond effectively to the regional impact of the fast-growing neighborhood towns of S.A.S. Nagar and Zirakpur.
- To ensure direct connectivity to important transportation nodes such as airports and bus terminals, and more importantly, to the regional transportation network.
- To safeguard and enhance the value of land along major existing and proposed roads.
- To align the development of Banur with the proposed Banur-Zirakpur Corridor.
- To safeguard sufficient sites for the future development of educational institutions and to cluster these future development sites with existing colleges.
- To facilitate the development of a whole spectrum of institutions with their respective specialisations in order to attract local and foreign students.
- To boost institutional tourism in the region, which will in turn create new economic and employment opportunities.
- To develop world-class educational and research institutions – including medical colleges and hospitals – as tourism drivers.

4.2 Planning Parameters

In order to effectively plan the future development of the GMR in general and the Banur LPA in particular, it is necessary to take into consideration the following factors:

- Natural population growth;
- In- and out-migration;
- Level of urbanisation;
- Economic growth of the Punjab region; and
- Economic growth of India.

Understanding the past trends and current status of the various factors stated above will help to produce a feasible scenario for years 2031 and 2056.

4.2.1 Population projection analysis

The population figure for the GMR, derived from the *Primary Census Abstract 2001*, was used as the baseline for population projection. To derive the projected population figures for Year 2056, four growth scenarios using different levels of urbanisation – size of urban vis-à-vis total population – were considered (see Table 4.1).

Table 4.1: Growth scenarios

Growth level	% of urban population
Low	**50.9**
Moderate	**56.0**
High	**64.7**
Very high	**84.6**

The resultant projected population figures are shown in Table 4.2.

Table 4.2: Population figures for the GMR based on various growth scenarios

	Population size (mil.)			
Growth Level	**Low**	**Moderate**	**High**	**Very high**
Year 2001	0.71			
Natural Growth	0.42			
In-migration	1.19	1.71	2.74	3.38
Year 2056	**2.32**	**2.84**	**3.87**	**4.51**

For land use planning purposes, the scenario of 'very high growth' was adopted. This is to ensure that sufficient land will be safeguarded to accommodate the highest level of demand and to maximize the development potential of the GMR.

The projected population for the GMR was distributed among the various LPAs based on the development strategies laid out in the *GMADA Regional Plan 2008 – 2058*. The specific planning parameters for the Banur LPA are stated in Table 4.3.

Table 4.3: Planning parameters for the Banur LPA

Parameters	Banur
Classification of town	**Institutional**
Available land area (ha)	**10,380.2**
Projected population – 2031	**119,558**
Projected population – 2056	**398,526**
Gross residential density (ppa)	**100**

4.2.2 Economic projection analysis

The level and composition of economic activities in the GMR is intrinsically linked to the growth of the greater Punjab state and its population. In turn, the GMR's ability to support and sustain the projected increase in population will depend on the creation of employment opportunities there.

In addition, it is projected that the growth of Chandigarh and S.A.S. Nagar will have spillover effects on the rest of the GMR. As a result, the overall GMR economy is anticipated to grow as well.

At the industry sector level, the GMR is known for manufacturing and services, particularly the IT industry. Over the past 7 – 8 years, the region has established a strong presence in the IT industry and leads the Punjab state in terms of volume of exports.

Specifically, the Software Technology Park of India (STPI) at Mohali has triggered the flow of investments into the region. With established companies such as Dell Computer, Tata Interactive Services and Quark Media House investing in the STPI, the volume of exports from Chandigarh alone in FY 2007 already constitutes 57.1% (INR 3.21 bn) of total exports. Since the various LPAs play complementary roles to Chandigarh, they stand to benefit from the latter's growth.

Using the current situation as the baseline, the projected economic output of the GMR is shown in Table 4.4.

Table 4.4: Projected economic output of the GMR

Financial Year (FY)	INR (bn) [1]
2007	28.5
2010	37.9
2015	50.0
2020	65.4
2025	85.1
2030	112.3
2035	148.8
2040	196.4
2045	254.2
2050	322.9
2055	410.1

[1]: Based on FY 2000 constant prices.

Based on the projection, it is anticipated that the GMR's economy will grow to about four and 14.5 times its current size in 25 and 50 years respectively. The anticipated economic growth will in turn drive the region's pace of urbanization, spurring further growth of the various towns, including Banur.

Despite being predominantly dependent on the primary sector, Banur is nevertheless emerging as one of the rapidly-growing cities in the region. The proposed Banur-Zirakpur Corridor will become the region's knowledge, technological and entrepreneurial belt, positioning Banur as the southern gateway for the GMR. This will generate substantial employment opportunities to support the economic growth of the Banur LPA.

Other than the above, there is also scope for Banur to develop its financial sector by tapping on the existing banking infrastructure of the neighbouring Patiala, where private, public and foreign banks operate.

4.3 Planning Strategies

Based on the planning parameters and analysis explained above, several key strategies are proposed for the Banur LPA (see Table 4.5).

Table 4.5: Proposed key strategies

Objective	Strategies
– To respond effectively to the regional impacts created by the fast-growing neighbouring towns of S.A.S. Nagar and Zirakpur.	– Contextual planning (in relation to the surrounding areas) is to be done. – The impacts of adjacent towns and regional centers on the LPA will be taken into consideration.
– To ensure direct connectivity with important transportation nodes such as the airport and bus terminal, as well as the regional transportation network.	– A safe and efficient public transport system has to be established. It should provide adequate levels of accessibility and mobility, catering to the needs of the residents.
– To safeguard and enhance the value of land along major existing/proposed roads.	– Prime land located along arterial and major roads will be reserved for significant developments. This will also eliminate the possibility of any unauthorised developments in the future.
– To align the development of the LPA with the proposed Banur-Zirakpur Corridor.	– The development of the Banur-Zirakpur Corridor will be supported by the proposed educational institution and medical hub.
– To cluster land parcels proposed for institutional use with the existing colleges.	– The proposed educational institution and medical hub will integrate existing colleges with future similar developments. This will facilitate the sharing of common facilities and infrastructures.
– To facilitate the development of a whole spectrum of institutions capable of attracting locals and foreigners.	– It is envisioned that world-class educational and research institutions, as well as medical colleges and hospitals, will be established in the proposed educational institution and medical hub.

Objective	Strategies
	– Adequate active and passive open spaces will be provided in the hub to meet the needs of users and to create a conducive environment.
– To boost institutional tourism in the region so as to create additional economic opportunities.	– A comprehensive range of educational, health, recreational, religious and cultural facilities of high quality will be provided and situated in convenient locations. These facilities will aim to meet the needs of the community, taking into consideration the specific needs of existing residents as well as future migrant population.

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5 Planning Proposals

5.1 Land Use Distribution

As stated earlier, the planning vision for the Banur LPA is to develop it into an institutional town – with the supporting physical and social infrastructure facilities – to serve the GMR and beyond. To achieve that, the land use plan will include the major land uses as follows:

- Residential
- Institution
- Industry
- Mixed Use
- Open Spaces
- Transport Facilities
- Rural & Agriculture

The concept behind the planning of the LPA is illustrated in Figure 5.1.

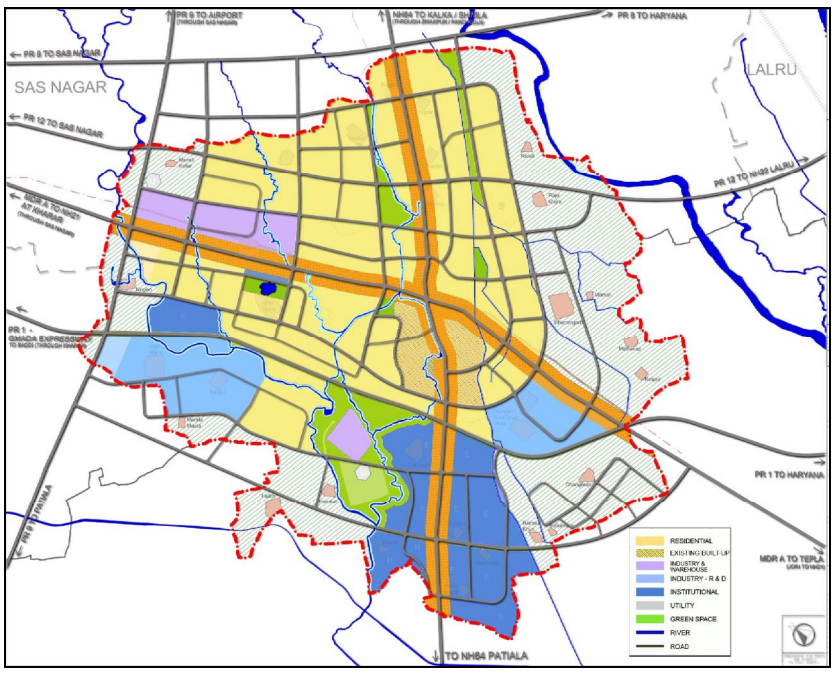

Figure 5.1 Planning structure for the Banur LPA

In order to realise the vision of Banur as an institutional town, sites with existing colleges were first identified for retention.

Next, sites around these colleges were evaluated for their suitability to be developed into one of the following types of institution:

- Educational
- Health and medical care
- Research and development
- Business Parks

To reinforce the character of Banur as an institutional town, it is proposed that these sites be included in the first phase of development. This will in turn support the implementation of the Banur-Zirakpur Corridor (BZC).

As the various institutions develop and become established, it is expected that there will be a significant influx of migrants to Banur over time. This will comprise students, academic and teaching staff, as well as other administrative and support staff.

Sufficient residential land has to be safeguarded to cater to the housing needs of this projected population, without compromising the generous provision of green and open spaces that are typical of campus developments.

The proposed land use master plan for the Banur LPA as at Year 2031 is shown in Figure 5.2, while the breakdown (in terms of area and percentage of composition) of the various land uses is shown in Table 5.1.

Table 5.1: Breakdown of proposed land uses

Land Use	Area (ha)	%
Residential	1,880.7	18.1
Mixed Use	886.4	8.5
Institution	829.4	8.0
Open Space	631.9	6.1
Industry	254.5	2.4
Existing Built-up	207.2	2.0
Utility	78.0	0.8
Transport Facilities	14.4	0.1
Urbanised areas	**4,782.5**	**46.0**
Rural & Agriculture	4,204.7	40.5
Road	599.9	5.8
Water body	547.0	5.3
Existing Village	246.1	2.4
Total	**10,380.2**	**100**

Open spaces have been generously provided within the LPA, especially along the banks of local rivers to tap on the water frontages. The various open spaces will provide much-needed relief for the crowded conditions, especially in the existing town center.

Recognising the planning authority's desire not to worsen the crowded situation in the town centre (in terms of vehicular and human traffic), the planning intention was to prevent further intensification of existing commercial activities there. This was achieved by zoning the town center as an existing built-up area, instead of a commercial or mixed use zone. However, existing commercial activities will be allowed to continue operating there.

To further reduce congestion, commercial activities are decentralised by designating both sides of MDR A and NH 64 as mixed use zones, where mixed residential and commercial activities are allowed.

In addition to institutional use, another supplementary driver of economic growth and creation of employment opportunities will come from industrial uses. This includes existing general industries and warehouse uses, as well as proposed light and research-based industries.

It is foreseen that the various existing and proposed economic activities will lead to a fast pace of urbanisation in Banur over the next two decades. As a result, the amount of land for rural and agriculture uses will decrease correspondingly.

5.2 Residential

The projected population for the entire Banur LPA in the target years of 2031 and 2056 is 119,558 and 398,526 respectively. This population growth will arise from the proposed vision of Banur as an institutional town, where the economic drivers will act as catalysts for growth and creation of employment opportunities. This growth will in turn increase the demand for infrastructure facilities.

To accommodate the target population for Year 2031, the number of dwelling units needed is estimated to be about 24,000. This translates to more than 1,880 hectares of land, which comprises **18.1%** of the total area of the LPA.

In order to achieve and maintain the character of an institutional town, and given the availability of land within the LPA, the residential density for the LPA will be deliberately kept low. The only exception is the town center, where medium-density housing will be allowed.

The proposed gross density for the LPA is 110 persons per hectare (50 persons per acre), while the proposed gross residential density for the town centre is 220 persons per hectare (100 persons per acre).

5.2.1 Housing Forms

The housing forms within the LPA will comprise two main types:

- Rural (villages)
- Urban

a) Rural housing

Rural housing is found in the 31 existing villages, which occupy an area of 246.1 hectares. Other than residential use, the built-up area in these villages also includes small-scale social and community facilities such as schools, temples, banquet halls, marriage palaces etc.

The existing villages will not be affected by any proposed or future developments because separate access roads will be provided for them. However, their size will be contained as-is and they will not be allowed to expand any further.

In addition, if existing villages are located within areas intended for non-residential uses in the master plan, future developments are to set back at least 12 m (40 feet) from the boundaries of the existing villages. This is to ensure that access to the villages will be safeguarded.

Due to future developments that will come up in the vicinity of these villages, there is the possibility that land prices of these villages will escalate. If so, the villagers will stand to enjoy a windfall gain if they were to subsequently sell their land collectively for redevelopment.

b) Urban housing

Demand for urban housing within the LPA is expected to come from the following population groups:

1. Natural growth of the local population within Banur in the short- to medium-term;
2. Influx of new migrants in the medium- to long-term, arising from the future institutional and industrial developments; and
3. Spill-over population from the neighbouring S.A.S. Nagar in the long-term, when the latter has become fully urbanised.

Sufficient land has been safeguarded to cater to these demands.

In terms of housing forms, the standard typologies are:

- *Low-density:*

  30 persons per hectare/**12** persons per acre. Examples include landed and plotted housing developments (see Figure 5.3).
- *Medium-density:*

  60 persons per hectare/**24** persons per acre. Examples are cluster/group housing and walk-up apartments (see Figure 5.4).
- *High-density:*

  90 persons per hectare/**36** persons per acre. Examples include high-rise flats and condominium developments.

Figure 5.3: Examples of low-density housing

Figure 5.4: Examples of medium-density housing

To enhance the overall character of Banur as an institutional town, the density of residential developments will be deliberately kept low. No high-density housing areas are proposed.

Instead, there will be a combination of medium- and low-density housing areas. The former will be located in the town center, while the latter will be found in the various suburbs. The overall residential plan is shown in Figure 5.5.

These residential densities will allow for different housing types to be developed, catering to the needs and affordability of residents from various social strata of the population.

Since the private sector is expected to play a major role in the development of the property market, the relevant authorities may have to monitor the evolving housing situation. This is to ensure that quality standards will not be compromised and that property prices are maintained at affordable and reasonable levels.

The existing transport infrastructure and other basic facilities should be able to support the proposed residential densities. As such, major investments in new infrastructure are not foreseen.

Nevertheless, there should still be small-scale and localised upgrading of infrastructure and improvements made to enhance connectivity within the LPA. These will help to improve the residents' quality of life.

5.2.2 Commercial Use within Residential Areas

a) Town Center

Being located at the junction of the two major roads NH 64 and MDR A, the central part of the Banur LPA is highly-accessible and already serves as the natural town centre. The existing uses there comprise residential, commercial and mixed-use developments.

As mentioned at the beginning of this chapter, the town center will be recognised as an existing built-up area rather than for commercial or mixed uses. This is because from the planning perspective, a regional center within the LPA is not needed. Further intensification of existing commercial activities within the town center must also be contained so as not to worsen the crowded pedestrian and vehicular traffic conditions there.

However, it is recognised that commercial activities are needed to serve the needs of the community and residents living in the area. This is addressed through the mixed use zones proposed along MDR A and NH 64.

For existing commercial activities within the town centre, the planning intention is not to relocate or phase them out. Rather, a set of criteria will be imposed to guide and control commercial developments located there, as well as areas intended for residential use. These criteria will be elaborated upon in Chapter 8 (Special and Detailed Controls).

b) Outside Town Center

In the residential areas, there will be provisions for small-scale commercial facilities at the local level. These are intended to serve the needs of local residents only and will not be shown separately in the master plan as they will be subsumed under the predominant land use.

Going by the provision standards (Table 5.2), there will be three informal markets and five neighbourhood centers located at various parts of the Banur LPA.

Table 5.2: Provision standard for commercial facilities

	General		Specific (Banur LPA)	
Use	**Provision standard**	**Site area (Ha)**	**Number to be provided**	**Total site area (Ha)**
Town center	1 per town	40	**1**	**40**
Neighbour-hood center	1 per 3,000 – 5,000 du	3	**5**	**15**
Informal market	1 for 10,000 du	2	**3**	**6**

The neighborhood centers contain small-scale and basic commercial facilities such as mini marts, provision shops, convenience stores, laundromats, postal and banking outlets, milk booth, three wheeler/taxi stand etc.

Located near to or within residential areas, the sole purpose of the neighbourhood centers is to meet the basic needs of local residents.

5.2.3 Industrial Use within Residential Areas

This use is only allowed for the two government-approved developments within the Banur LPA. Although the predominant approved land use is 'Industry' (60% quantum), the site is zoned 'Residential' to give the developers flexibility to implement pure residential developments should the need arise.

Details of these two approved developments will be elaborated upon in Chapter 8 (Special and Detailed Controls).

5.2.4 Other Non-residential Uses

Within residential areas in general, social facilities have to be provided to meet the residents' needs for public services. These include schools, libraries, health facilities, police and fire posts, government offices/departments etc. (please refer to Table 5.3 for the complete list).

These facilities serve complementary roles and can be clustered or co-located to optimise land use and create synergy.

Table 5.3: List of social facilities

Use	Facilities
Education	– Kindergarten – Nursery – Crèche – Preparatory school – Special school – Primary school – Secondary school – High school – Junior college – Vocational institute – Training center – Polytechnic – College – University – Student hostel – Campus accommodation
Social	– Community centre – Community hall – Central library – Branch library – Home for the aged – Home for the physically-challenged – Orphanage – Home for displaced workers
Religion	– Gurudwara – Hindu temple – Church – Mosque – Prayer ground – Cremation hall – Crematorium – Columbarium – Mausoleum – Cemetery
Medical and healthcare	– Health clinic – Polyclinic – Pharmacy – Dispensary – Hospital (100, 101 – 200 and 500 beds) – Family care center – Nursing home – Medical centre – Specialist clinic
Safety and security	– Police station – Police posts – Fire station – District jail
Transport	– Bus interchange – Bus depot
Communication	– Main post office – Sub-post office – Postal outlet – Postal counter – Courier service – Telephone exchange – Telegraphic counter
Administration	– Branch of various government offices and departments
Open space/ Park	– Town garden – Neighbourhood park – Open space / plaza
Sports and recreation	– Swimming complex – Sports stadium – Indoor stadium – Recreation club – Multi-purpose hall
Miscellaneous	– Veterinary dispensary – Veterinary hospital

For the convenience of residents, these facilities should be easily accessible, with adequate parking spaces provided.

The detailed list of social facilities to be provided within the Banur LPA, together with the respective numbers and land-take, is shown in Annex 1. These are worked out based on the overall projected population and number of dwelling units in the LPA by Year 2031.

5.3 Mixed Use

8.3% of the LPA's total land area (868 hectares) has been designated for integrated developments comprising residential and other uses. These are 200-metre wide linear corridors on both sides of NH 64 and MDR A. Specifically, the allowable use is Mixed Use 1 (Figure 5.6).

Commercial uses, including shopping malls, multiplexes, offices, cinemas and hotels, are allowed in this zone. However, the minimum size requirement of 2.5 acres is to be complied with. Small infill pockets of retail shops are discouraged.

To prevent this zone from being converted to pure residential uses, only high-end residential developments are allowed on the upper floors of the integrated developments.

Mixed use developments can foster a stronger and more sustainable sense of community and a higher quality of life for residents and visitors. Successful communities require a full range of local services and facilities,

including commercial, educational, health, spiritual and civic uses. These facilities need to be conveniently sited and connected to residential areas by safe and comfortable routes.

The benefits of mixed developments are:

- Convenient access to facilities.
- Greater opportunities for social interaction.
- Socially diverse communities.
- Visual stimulation of different building types within close proximity.
- Greater energy efficiency and more efficient use of space and buildings.
- More consumer choice in terms of lifestyle, location and building type.
- Urban vitality and bustling street life.

Combining the primary activities of living and working supports a greater variety of secondary facilities (whether commercial, entertainment, leisure or community-based). Grouping the main elements of land uses to be accommodated within integrated developments will help to make the place more livable.

5.4 Institution

In terms of total land take, this use will become the third largest constituent by Year 2031 (after residential and mixed uses), occupying **8%** of the total land area within the LPA (Figure 5.7).

The prominence placed on institutional uses is in line with the long-term strategy to achieve the vision of Banur as a knowledge-based economy. The development of new educational, medical and research-based institutions, as well as business parks, will:

- Integrate and further enhance existing educational and medical institutions within the LPA, as well as activities in the BZC;
- Shape and form the core characteristic and distinguishing feature of the LPA;
- Act as the main catalyst of economic growth for the LPA and as a major growth node for the entire GMR;
- Provide relevant skills and training to students, who will in turn become part of the future workforce and talent pool for Banur and the GMR; and
- Generate new employment opportunities in the secondary and tertiary sectors for locals and in-migrants.

The constituents of individual institution/campus may vary, depending on its respective nature, business and mode of operation. Generally, there will be the provision of the following facilities and services to meet the needs of users:

- Educational
- Research
- Medical and healthcare
- Accommodation
- Cultural
- Social
- Recreational
- Commercial (small-scale)

These facilities will help to make each institution/campus self-contained and self-sustaining.

For the case of Banur, it is strongly recommended that the presence of existing rivers and other water bodies be tapped upon to create campuses that are located within a green and park-like setting. These natural features are to be taken into consideration when planning the overall spatial layout of the various institutional buildings. In addition, these can be supplemented by new open spaces and recreational facilities.

5.4.1 Basic Elements and Characteristics

An institutional town – also known as a 'knowledge city' – is defined as "*a milieu which triggers and enables an intensive, ongoing, rich, diverse and complex flow of Knowledge Moments*"[1]. The basic elements of such a town are identified in Figure 5.8.

[1] Source:
Dvir, Ron (2006), "Knowledge City, seen as a collage of human Knowledge Moments", in Francisco Javier Carillo (ed.), *Knowledge Cities: Approaches, Experiences, and Perspectives*, Oxford, U.K.: Butterworth-Heinemann.

In essence, a Knowledge Moment occurs at the intersection of the following factors:
- People
- Place
- Process
- Purpose

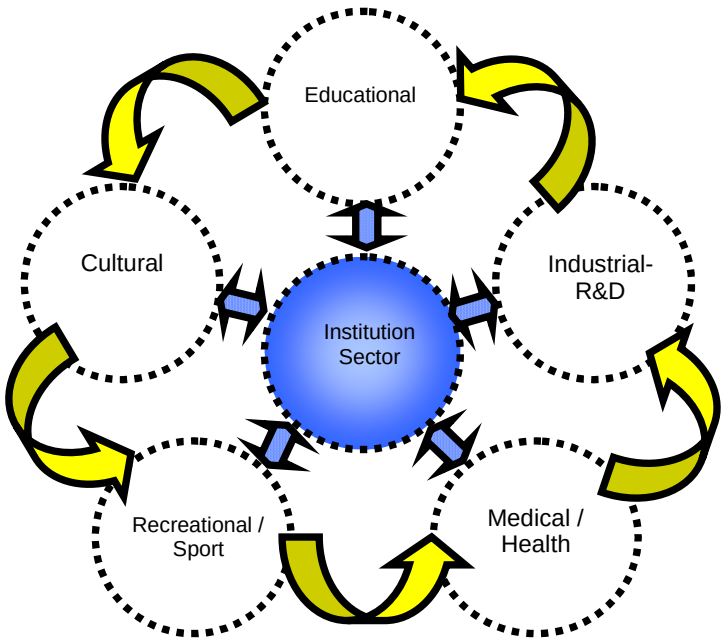

Figure 5.8: Elements of an institutional town

The environment of an institutional town has the following distinctive characteristics:

a) Education-based

Education and academic research form the foundation of a Knowledge City. Graduates of the various universities, colleges and institutes form the talent base for the companies and industries located in the vicinity.

b) R&D-oriented

This is driven by technology-intensive companies, whose focus is on the in-house development of new technologies and the subsequent transfer of these technologies to the creation of new products and services. Compared to a typical science park, there is a greater emphasis on development and production.

c) Innovation-oriented

This refers to other businesses that help to promote innovation and research. Examples include business consultants, financial brokers/advisors and trade associations. These provide supporting services in the technical aspects, as well as advice on finance, advertising and marketing.

Operationally, the three characteristics stated above can be found in separate – but strongly interconnected – companies/organisations located within the town, or stand-alone companies/organisations that have amalgamated two or all of the various characteristics in their operations.

Various examples of institutional towns/campuses are shown in Figure 5.9.

Source: Nanyang Technological University, Singapore

Source: ITE College Campus, Singapore

Figure 5.9: Examples of institutional towns/campuses

5.4.2 The Banur-Zirakpur Corridor (BZC)

The BZC, which links Banur and Zirakpur, predates the development of this draft master plan (see Figure 5.10).

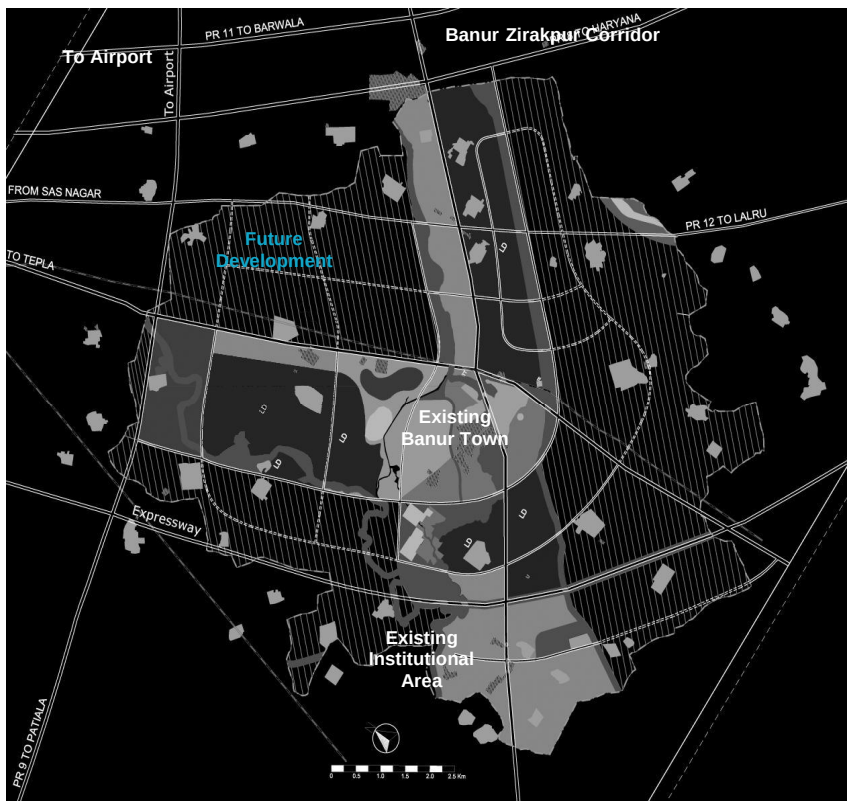

Figure 5.10: The Banur-Zirakpur Corridor

Tapping on the existing major transportation corridor running southwards from the airport extension, as well as the existing educational and medical institutions (some of which have set up joint programmes with established international institutions), the aim is to transform the BZC into a technological-knowledge-business belt.

Presently, the largest BZC project is an IT park being developed by Futuristic Technology Infrastructure Private Limited. It is expected to be completed within this year, at an estimated cost of INR 15.8 billion. This comprises 19.6% of the total planned investment amount (INR 80.8 billion) to create floor space for IT operations within the GMR.

It is foreseen that the physical integration of the proposed Banur institutional town with the greater BZC, together with the synergy created by the complementary activities of both areas, will help to ensure the long-term success of the former. This will in turn strengthen the position of the BZC within the GMR and beyond.

5.5 Industry

Industrial use will be the secondary engine of growth after institution use. It will occupy 254.5 hectares, or **2.4%** of the total land area of the LPA. The industrial plan for the LPA is shown in Figure 5.11.

The type of industrial use proposed is 'Industry & Warehouse', which belongs to the green category and complies with environmental standards.

General and heavy industries, which are pollutive (red category), will not be allowed within the LPA. These are to be located in the appropriate zones within the Dera Bassi LPA.

5.5.1 Industry & Warehouse Use

These comprise small- to medium-sized establishments that make use of small-scale plant and equipment that can be accommodated within a single or two-storey industrial building.

The related clean and light industrial activities – including processing, manufacturing, packaging and warehousing – have very minimal impact on the surrounding environment. Examples of such industries include the manufacture of food, electronic, paper and glass products.

In terms of spatial location, the main area for this use is on the eastern side of MDR A, where the existing Tangori Village is (see Figure 5.11). The other small industrial area (existing use) is located on the western side of the GMADA Expressway, to the north of the existing Gobinpura Village.

5.5.2 Planning Strategies

The following planning strategies were adopted in the detailed planning of industrial areas located within the LPA:

a) Environmental considerations;
b) Clustering;
c) Parcellation; and
d) Provision of amenity centre.

a) Environmental considerations

Environmental considerations are vital in the selection of areas to be zoned for industrial use. Specifically, the type

and category of industries have to be thoroughly assessed before land allocation is done.

Having taken into account the predominance of residential and institutional uses within the Banur LPA, as well as the proximity of industrial areas to these two uses, the planning approach was to allow only clean and light industries to be set up here.

Existing general and heavy industries that have negative impacts on the health of surrounding residents and/or the environment should be encouraged to relocate to the appropriate areas within the Dera Bassi LPA in the long term. Alternatively, if these industries wish to remain *in situ*, they should adopt newer and cleaner technologies in the short- to medium-term so as to upgrade and improve their production process.

b) Clustering

The same type of industries, which have similar production requirements, should be clustered within a defined area. This will allow the sharing of common facilities and provide opportunities for better linkages, thereby creating economies of scale. For example, companies that manufacture electronic components, which share specific water, sewerage and electrical requirements, should be accommodated within the same area.

c) Parcellation

The parcellation and size of individual industrial sites should be tailored to match the needs of the intended uses, i.e. clean and light industries.

d) Provision of amenity centre

An amenity centre is usually centrally-located within an industrial area to provide supporting facilities and services to the working population there. Ideally, it should be conveniently located within a 400-metre walking radius from the various industrial sites that it serves.

An amenity centre typically houses food and beverage outlets, eating places and facilities such as automated teller machines, postal outlets, convenience and sundry stores, the estate maintenance office, basic sports facilities etc.

5.6 Open Space

The various public open spaces proposed for the Banur LPA will provide spatial relief for the urban built-up areas and help to improve the quality of the environment (see Figure 5.12). In addition, these will help to enhance the residents' quality of life and promote community interaction.

Public open spaces and parks include a wide variety of recreational facilities, including:

- Jogging and cycling tracks
- Foot paths (for brisk walking and strolling)
- Exercise and fitness stations
- Children's playgrounds
- Rest areas
- Ponds
- Amphitheatres
- Small commercial facilities (such as drink and snack kiosks).

The following are the functions of the green and open spaces:

- To provide opportunities for recreation and outdoor social activities and gatherings;
- To serve as venues for community events and social interaction;
- To act as buffers against aural, visual and air pollution;
- To raise the overall quality of life for residents.

For the Banur LPA, this use will constitute about **6%** of the total land area and will comprise the following:

- *Active spaces:*
  - Main town park at the town center (Figure 5.11);
  - Various neighbourhood parks within the residential areas; and
  - Pedestrian walkways and cycling tracks along the roads.
- *Passive open spaces:*
  - Green buffers along the roads;
  - River reserves; and
  - Safety/pollution buffers for the industries and other utilities.

The green and open spaces should be linked to one another and to the various residential zones via walkways and connectors. This will increase their accessibility and correspondingly, their usage rate.

5.7 Transportation

The existing transportation infrastructure for the GMR has already been reviewed in the *GMADA Regional Plan Report – Transportation* (Figure 5.13). That report had also covered the provision of transportation infrastructure needed to meet the requirements for the projected development and population growth of the region until Year 2056.

This report uses the various macro proposals in the above-stated regional report as the blueprint to develop detailed proposals for the Banur LPA.

5.7.1 Proposed Road Network

The proposed transportation master plan for the LPA as at Year 2031, developed in tandem with the various land use proposals, can be seen in Figure 5.14.

The proposed road network has the following features:

- Built upon the existing road network, it aims to strengthen and improve the latter's effectiveness and coverage.
- It will have adequate capacity to cater to the projected increase in traffic volumes and flows.
- It will link up major destinations to facilitate the direct routing of trips, rather than have extraneous traffic routed through the various neighbourhoods and precincts.
- It permits the staging of construction works to tie in with future increases in the demand for road capacity. New roads will not be built, nor existing roads widened/extended, until there is actual demand for additional capacity.

Even though the development time frame for this master plan is Year 2031, the proposed road network was actually designed based on the traffic forecasts done for Year 2056 and at the Regional Plan level (i.e. for the entire GMR). The full right-of-way required for the long-term road reserves has also been safeguarded in the land use plans.

a) Proposed roads

The proposed transportation master plan for the LPA includes the following:

- The GMADA Expressway (PR 1):
  The proposed alignment runs close to Mullanpur, Kharar, S.A.S. Nagar, Lalru and along the southern boundary of this LPA. It will offer an alternative route to MDR A, linking the northern and southern parts of the GMR.
- NH 64
- MDR A
- PR 9:
  This proposed major arterial road will run in a north-south direction from the proposed new airport terminal building in the north to serve the proposed airport logistic park sited south of the airport. This road will then continue southwards to meet MDR A, the proposed GMADA Expressway and NH 1 outside the study area. This linkage will provide faster and direct access from many parts of the Punjab State to the airport. Located directly on the northern boundary of this LPA, this road – together with NH 64 – will provide an important gateway to Banur.
- PR 12:
  This proposed minor arterial road will run in a south-eastern direction, almost parallel to PR 8. This road is needed to cope with the forecasted high level of traffic flow from S.A.S. Nagar to Banur and beyond.

Aside from the major and minor arterial roads stated above, the LPA is also being served by a network of various unmade collector roads that are interwoven with the major road network (see Figure 5.14). These mostly run parallel to the major roads and help to provide access and connectivity to the smaller land parcels.

b) Cross-sections of proposed roads

The cross-sections of the various hierarchies of roads are shown in Figures 5.15, 5.16 and 5.17. These were adapted from the road cross-sections developed by the

Indian Road Congress (IRC) and have been suitably enlarged to incorporate additional provisions for the laying of underground utility service lines to serve the entire GMR.

Justifications for the road widening and details on the safeguarding of extra space for underground utility service lines can be found in the relevant chapters of the *GMADA Regional Plan Report – Infrastructure*.

No roads within the LPA shall be less than 12 m. If any existing roads are narrower than 12 m, proportional land shall be safeguarded on both sides of the roads for purpose of road-widening. On roads that are of 12 m width, there shall not be any building of height more than G+2 storeys.

c) Traffic management

There are ample opportunities within the LPA and GMR to improve the geometric layout of junctions, especially at the intersections of national highways and major arterial roads.

The introduction of various traffic management measures will further enhance traffic flow and safety. These include:

- Traffic segregation by vehicle types:
  - Wherever appropriate, service roads will be provided along arterial and primary access roads to separate slow-moving vehicles from the main thoroughfare. These service roads will directly lead to development frontages, thus doing away with multiple intersections and side roads. Roadside friction on the main roads will also be reduced.
  - Heavy goods vehicles, although an important mode of transport for freight services, are pollutive and often pose a challenge to road safety concerns. A good highway network should be implemented for them to move efficiently between origin(s) and destination(s), bypassing the towns and established residential areas. Other traffic management tools that can be used include the restriction of operating hours on local roads (only during off-peak hours) and/or an outright ban for certain roads within the urban areas.
- Ban on right-turn movements;
- Strict enforcement against on-street parking along major roads;
- Good lane markings to facilitate traffic channelisation; and
- Good advance directional signs to guide motorists.

For effective traffic management in the long-term, in addition to widening existing roads and building new ones, there should be a deliberate policy to promote the use of non-motorised and slower-moving vehicles, such as bicycles and rickshaws. These modes of transport are relatively cheap, environmentally-friendly, popular and commonly-used (especially for short trips).

To make the use of these vehicles a viable and safe alternative, proper provisions have to be made for them when planning the road network. Measures that could be introduced include the incorporation of dedicated bicycle lanes or service roads located within the road reserves. By separating the fast and slow-moving vehicles, there will be optimal utilisation of the road network, thereby increasing its capacity.

Last but not least, pedestrian facilities (especially at road intersections) should be improved. The following measures could be adopted:

- Provision of dedicated pedestrian crossings;
- Having special pedestrian phases at signalised junctions; and
- Construction of proper roadside foot paths and pedestrian walk ways.

Besides being relatively cheap and simple to implement, when properly enforced and regulated, these measures are very effective in enhancing road safety for all road users.

5.7.2 Safeguarding Right-of-way for Roads

Based on traffic analysis done for the entire GMR, the forecast traffic for the major roads in Year 2056 was estimated. Using that as the basis, the overall road

network, hierarchies of roads and the respective number of traffic lanes were developed to ensure that there is sufficient traffic capacity to meet the forecasted travel demand.

Operationally, the safeguarding of right-of-way (ROW) can be done through one of the following two methods:

- *Land acquisition:*
  The country's land acquisition law is used when a particular road has secured financial approval for implementation and the ROW has to be secured on an urgent basis. Land owners will be duly compensated based on the principles of the law. All encumbrances on site will be cleared prior to the implementation of the road-widening.
- *Development control process:*
  The planning approval process for building development is used as a mechanism to secure land for the ROW. A planning condition is imposed for the ROW plot to be vested in the state. Upon completion of the building, land subdivision will be carried out and the ROW plot will be assigned with a new and separate lot number. However, this process has to be implemented in a timely manner. If vesting of the ROW plot were not secured upfront, the state will have to spend time and costs to acquire the plot at a later stage.

Comparing the two methods, the former is more expeditious but costly to the state, whereas the latter is more cost-effective but takes time to implement.

For long-term road-widening projects which are planned in advance, it is advisable to use the development control process. In order for that process to work, it is first necessary to demarcate the ROWs of all major and minor roads onto lithographic plans that contain the cadastral boundaries of all lots of land.

In Singapore, such lithographic plans are called Road Line Plans [RLP] (Figure 5.18) and are sold by the Land Transport Authority [LTA].

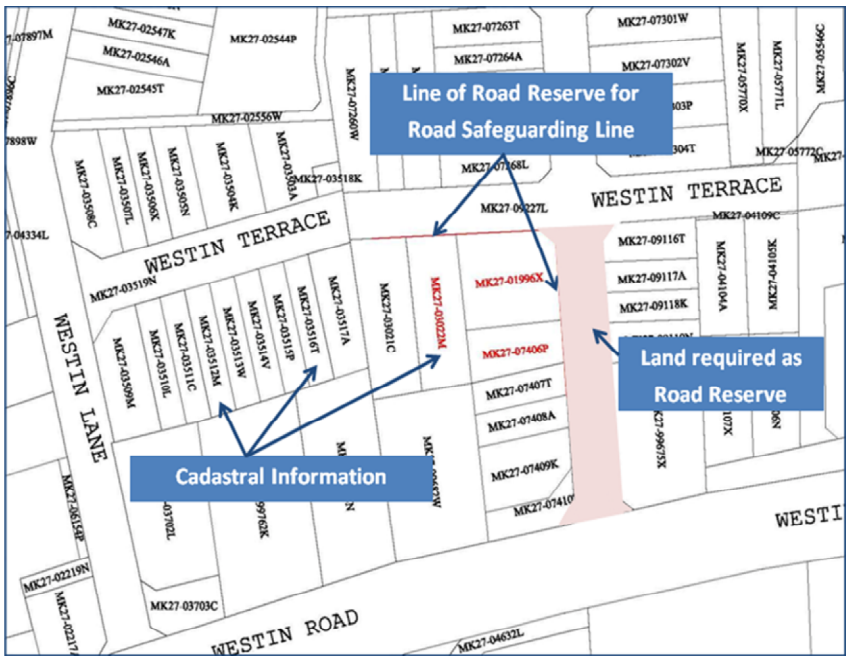

Figure 5.18: Example of a Road Line Plan

The RLPs can be conveniently downloaded from LTA's web site to guide land owners, developers and architects when planning the development of specific sites.

The preparation of RLPs is a major process involving the land survey, planning and road authorities. Even after the plans are completed, there must be continuous updating of information as and when the road network is being revised. Unfortunately, there is no simpler or faster way to implement the mechanism. Nevertheless, the computerisation of many land surveying and planning processes in recent years has made the process less laborious.

5.7.3 Public Transport System

a) Existing bus system

Buses form the most ubiquitous and basic mode of public transport within the LPA, although auto-trishaws and rickshaws are also widely-used. The latter is a cheap and convenient mode of public transport, especially popular for short trips.

The general absence of a reliable public transport system and commuter facilities (such as bus terminals and shelters at bus stops) within the GMR explains the widespread reliance on non-motorised vehicles for the purpose of daily commuting.

The general condition of the existing bus fleet is poor and spartan, barely meeting the basic daily needs of commuters. However, as the bus service is subsidised,

the fare is at a very low and affordable level of Rs 5, regardless of the travel distance.

b) Future of buses as a mode of public transport

As the income of the general population goes up, the expectations of bus commuters will rise. It is crucial to recognise early the travel needs of those residents who do not own private vehicles and subsequently, to develop and improve the public transport system to cater to those needs.

Not only that, it must be recognized that while the metro and LRT systems can be implemented along the heavier transport corridors, buses will still remain the basic mode of public transportation for residents to commute from one urbanized area to another.

Other than the trunk routes, buses can also ply the feeder routes, connecting the interchanges and transit hubs with the surrounding areas.

The main advantage of the bus system is its flexibility: Bus routes can be changed easily and schedules adjusted to meet changing demands. Buses also come in different capacities and performance standards to meet the different requirements of bus operators.

However, to make the experience of bus travel more comfortable and conducive, there are many areas of improvement to be considered. The bus commuter's total travel experience includes his wait at the bus interchange or bus stop, his ride on the bus and the distance he has to walk at the start and end of his journey. Improvements to all these facets will have to be properly addressed.

Following from the above, these proposals can be considered to improve the overall commuting experience:

- Upgrade the existing fleet and have newer and more comfortable buses.
- Provide better facilities for passengers waiting at bus terminals/interchanges.
- Provide bus shelters and seats at bus stops.
- Display bus arrival and departure schedules at bus terminals/interchanges and bus stops.
- Build covered pedestrian linkways from bus stops to nearby buildings.
- Improve bus routing and expand the coverage of existing routes.
- Improve bus operating schedules.
- Implement bus priority measures, for e.g., have bus-only lanes along the major roads.
- Adopt integrated ticketing system for the various commute and transit services.

Some of these measures are illustrated in Figure 5.19.

With the planned urbanisation of the GMR over the next few decades, it is foreseen that demand for bus travel will grow in tandem. As such, new bus terminals will need to be built in the newly-urbanized areas to serve the expanded bus services and routes.

When these terminals are being developed, the opportunity must be taken to integrate them vertically and horizontally with new commercial developments (such as offices, shops, department stores, supermarkets, food courts, medical suites, gymnasiums etc.) at the urban centres.

The presence of the terminals will greatly enhance the attractiveness of those commercial developments, helping to generate higher rental yields for property owners and landlords. The heavy movements of pedestrian traffic and bus commuters will improve prospects for business owners, while commuters will benefit from the convenience and accessibility to commercial facilities.

Eventually, a node will be formed, which will further boost the demand for public transport. This becomes a win-win situation for all parties: Commuters, business owners, land owners and public transport operators.

Within the Banur LPA, there is an existing truck terminus located near the intersection of NH 64 and MDR A. The proposal is to relocate it to the area near the Ramgarh Buta Singh Wala and develop the new site into a multi-modal transport interchange. This interchange is intended to serve the existing built-up area, as well as the surrounding land proposed for future developments. In future, both local and long-distance bus services can

operate from this safeguarded transport interchange site (see Figure 5.20).

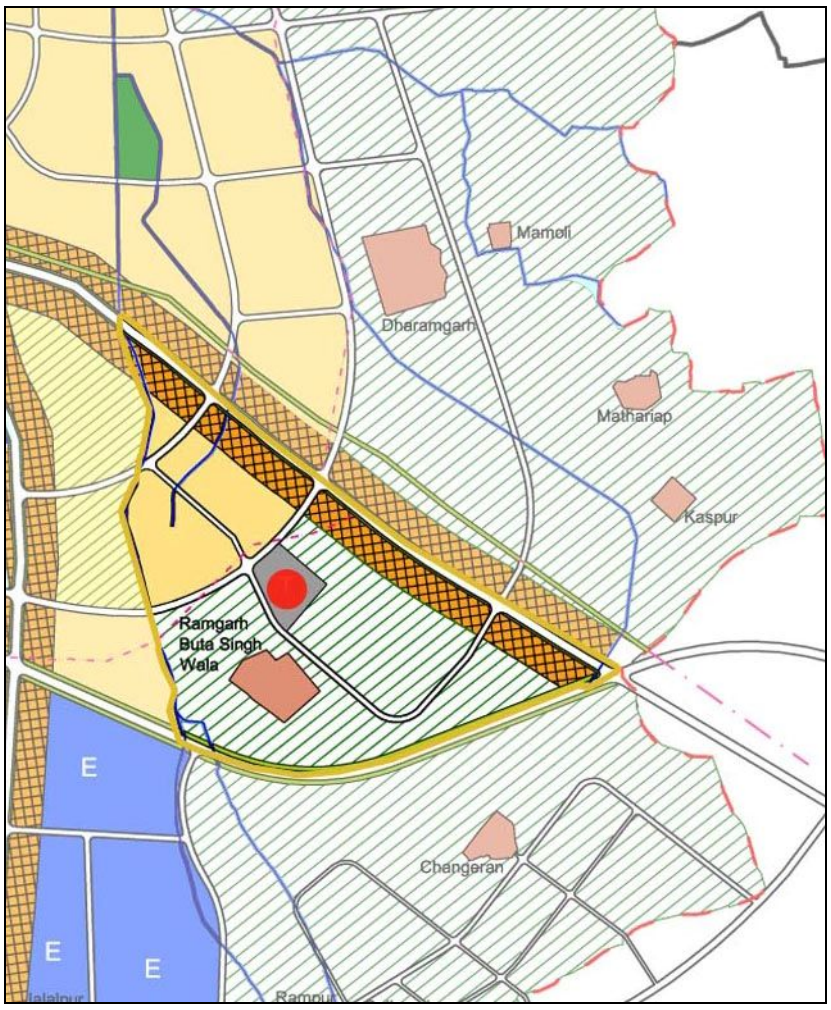

Figure 5.20: Proposed site for the multi-modal transport interchange

5.7.4 Provision of Vehicle Parking Facilities

The policy directing the management and operation of vehicle parking facilities in a city like Banur is very much an integral part of the overall transport policy. The policy should touch on the following:

- Standards of provision;
- Locations of vehicle parking facilities; and
- Cost of parking.

These facets have a strong cumulative influence on the choice of travel mode by motorists and commuters traveling to the city.

Arising from the above, the provisions standard of vehicle parking lots for different building types and land uses has to be clearly spelt out in the local legislation.

For the Banur LPA, it is not evident which authority(s) is responsible for regulating the following aspects of vehicle parking:

- Provision of vehicle parking facilities in new developments;
- Operation of vehicle parking facilities in existing buildings; and
- On-street/road-side parking.

Through observation of the older quarters and sectors of Chandigarh, it is apparent that generally, there is inadequate provision of vehicle parking facilities. Many of the older buildings do not have sufficient parking facilities, if any at all. As a result, vehicles are parked haphazardly along service roads, grass verges and open grounds.

Given that the level of car ownership in Chandigarh is already the highest in India, with future increases in income, vehicle ownership within the GMR as a whole is expected to rise further.

It is not clear whether studies have already been conducted to understand the impacts of the following, especially on the urban areas:

i) Rising car ownership in the foreseeable future
ii) Demand for vehicle parking facilities.

Even without the benefit of such studies, it is evident that the following pertinent issues require immediate attention and addressing:

- Need for a current set of vehicle parking provision standards to be applied for different developments and building classes;
- Need for a new set of provision standards for future residential developments, taking into account foreseeable increases in car ownership; and
- Introduction of a methodology under the purview of the planning and building by-laws, so that the development control process can be used to facilitate the systematic provision of vehicle parking facilities by building developers.

An important point to note is that the current parking situation within the GMR cannot be resolved in the short term (over the next year or two). The relevant policy(s) has to be established first, followed by the systematic application of the measures in a sustained fashion over the long term. Not only that, staff from the relevant local

authorities has to be trained to draw up parking standards and identify locations suitable for vehicle parking facilities when local development plans are prepared in future.

Over time, through the development control process, new buildings developed in the future will be self-sufficient in terms of vehicle parking facilities.

When that happens, on-street/road-side parking can be progressively phased out through relevant legislative measures and proper enforcement actions. Road space will then become maximised, allowing for smooth and optimal traffic flow. Eventually, the streetscape and urban fabric will become much more attractive, enhancing the quality of life for residents and the visiting experience for tourists.

ANNEX 1

PROVISION OF SOCIAL FACILITIES FOR THE BANUR LPA

Year 2031:
Projected overall population: **119,558**
Projected number of dwelling units (du): **23,912** (Family size for India is 5 persons per du)

Level of facilities:
Neighbourhood facilities: **5,000 du or less**
Regional / City facilities: **More than 5,000 du.**

		General		Specific (Banur LPA)	
S/No.	**Use**	**Provision standard**	**Site area (Ha)**	**Number to be provided**	**Total site area (Ha)**
1	**Education**				
1.1	Preparatory school	1 per 1,500 du	0.4	**16**	**6.4**
1.2	Primary school	1 per 2,500 du	1.8	**10**	**18**
1.3	Secondary school	1 per 5,000 du	3.0	**5**	**15.0**
2	**Social**				
2.1	Community centre	1 per 15,000 du	0.4	**2**	**0.8**
3	**Religion**				
3.1	Gurudwara	1 per 2,000 du	0.08	**12**	**0.96**
3.2	Hindu temple	1 per 2,000 du	0.08	**12**	**0.96**
4	**Medical and healthcare**				
4.1	Polyclinic	1 per 5,000 du	0.12	**5**	**0.6**
4.2	Nursing home	1 per 10,000 du	0.4	**3**	**1.2**
4.3	Family care center [1]	1 per 10,000 du	0.4	**3**	**1.2**
4.4	Hospital (100 beds)	1 per 20,000 du	0.4	**2**	**0.8**
4.5	Hospital (101 - 200 beds)	1 per 20,000 du	1.0	**2**	**2.0**
5	**Safety and security**				
5.1	Police post	1 per 20,000 du	0.1	**2**	**0.2**
6	**Communication**				
6.1	Postal outlet [2]	---	---	**---**	**---**
7	**Administration**				
7.1	Branch of various government offices and departments [3]	---	---	**---**	**---**

S/No.	Use	General: Provision standard	General: Site area (Ha)	Specific (Banur LPA): Provision (Nos.)	Specific (Banur LPA): Site area (Ha)
8	**Open Space / Park**				
8.1	Open space / plaza	1 per 1,000 du	0.5	**24**	**12.0**
8.2	Neighbourhood park	1 per 2,000 du	1.0	**12**	**12.0**
8.3	Town garden	1 per 10,000 du	10.0	**3**	**30.0**
9	**Sports and recreation**				
9.1	Multi-purpose hall	1 per 10,000 du	0.2	**3**	**0.6**
9.2	Recreation club [4]	1 per 10,000 du	0.45	**3**	**1.35**
9.3	Swimming complex	1 per 20,000 du	1.5	**2**	**3.0**
10	**Miscellaneous**				
10.1	Veterinary dispensary [5]	1 per 20,000 du	0.03	**2**	**0.06**

Notes:

[1] This category of facility includes welfare centers, pediatrics centers and maternity homes.

[2] The population size of the Banur LPA is too small to support a stand-alone post office. Post office counters or postal outlets can be located within commercial facilities in the mixed-use areas. The same approach can be taken for similar facilities such as telegraphic counters and courier services. For the same reason of population size, there will not be any stand-alone transport facility either.

[3] These can be co-located within commercial facilities in the mixed-use areas.

[4] These clubs provide opportunities for residents to participate in social and cultural activities.

[5] This facility, together with banking outlets, automatic teller machines and related financial facilities, can also be co-located within commercial facilities in the mixed-use areas.

Please note that facilities to be provided at the neighbourhood level are not indicated in the master plan of all the Local Planning Areas.

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6 Infrastructure Proposal

6.1 Water Supply and Distribution

Within the Banur LPA, there is already water service available to serve existing developments in the built-up areas and villages. However, that will not be able to support the various developments planned for the entire LPA. In order to realise the proposals put forth in the master plan, a centralised water supply and distribution system will be needed.

6.1.1 Water Demand Projection

Projection of future demand for water is a very crucial step needed in order to determine water resource allocation. In Chapter 5, the land use distribution and population projection (Year 2031) for the LPA have been elaborated upon. These figures form the primary basis for the water demand projection.

a) Water demand assumptions

The following assumptions have been adopted to derive the water demand requirement for the Banur LPA:

- *Unit water demand:*

Land Use	Unit Water Demand*
Residential	250 lpcd
Rural Settlements	100 lpcd
Industrial	45 cum/ha/d
Commercial, Institutional, Utilities	45 cum/ha/d
Roads	5 cum/ha/d
Green Area	60 cum/ha/d

* lpcd = litre per capita per day.
* cum/ha/d = cubic metre per hectare per day.

- *Fire fighting demand:*

  Fire demand in kilolitres per day is worked out using the formula **100√p**, where p = population in thousands.
- *Water transmission and distribution losses:*

  The total water loss of 15% comprises 5% of transmission loss and 10% of distribution loss.
- *Workforce consumption:*

  This has been incorporated into the respective unit demand.
- *Recycled water:*

  This will be used mainly for irrigation purposes.
- *Green area:*

  10% of each plot's area is to be set aside as green area. This applies for residential, commercial, industrial, institutional and utility uses. Recycled water will be used for watering the green and for gardening.
- *Water demand for agriculture land:*

  This has been excluded for the projection of water demand.

b) Water demand estimation

The estimated water demand requirement for the LPA by Year 2031 is **190 MLD**. This comprises 115 MLD of potable water and 75 MLD of recycled water.

Since the sewage treatment plant for Banur can only generate about 60 MLD of recycled water, the deficit of 15 MLD recycled water will have to come from the potable water source. Correspondingly, the potable water demand will be increased to 130 MLD (Table 6.1).

Table 6.1: Projected water demand (Year 2031*)

Potable	Recycled	Total
130	60	**190**

*: The projected population is 119,558.

6.1.2 Proposed Water Supply and Distribution System

The proposed water supply and distribution network have been designed in accordance with international standards, modified where appropriate to conform to local conditions in India.

The network is based on the grid-iron system, where all arterial and secondary mains are looped and interconnected to eliminate dead ends. This system will facilitate water circulation and prevent it from stagnating, so that it will not develop tastes and odours.

Specifically, two independent supply and distribution systems have been proposed: One is for potable water and the other, recycled water.

a) Potable water supply and distribution

To achieve sustainable development, various water sources have to be tapped upon, including:

- Surface water;
- Ground water; and
- Rainwater.

Among these, surface water will be the main source of potable water because of its availability and reliability. Ground water and rainwater collected act to supplement any shortages in supply.

Surface water will be treated at the raw water treatment works RWTW1 and RWTW2 before being supplied to the local water treatment & storage work LWTW 5 for further treatment and storage. The clear water from LWTW 5 will then be pumped to the proposed water works WW1 – WW9 for distribution within the LPA.

As the service corridor within the typical road sections does not include water supply lines, dedicated reserves are needed. The proposed potable water supply main is shown in Figure 6.1.

Each of the proposed water works will serve users located within its respective water distribution zone (Figure 6.2). Clear water will be channeled to these users via the potable water distribution main (see Figure 6.3).

b) Recycled water supply and distribution

As stated earlier, a separate system has been proposed for the supply and distribution of recycled water. Sewage generated from the LPA will be collected and sent to the sewage treatment plant STP 7 for treatment up to the tertiary level. This will meet the requirements for the purpose of irrigation.

The recycled water is then distributed to users in the respective zones via the same water works as that for potable water, i.e. WW1 – WW9. Doing so helps to reduce cost and improve efficiency.

The proposed recycled water supply main is shown in Figure 6.4. Figures 6.5 and 6.6 illustrate the proposed distribution zones and distribution main for recycled water respectively.

6.1.3 Proposed Water Utilities Facilities

Details of the various proposed potable & recycled water utilities facilities are shown in Table 6.2.

Table 6.2: Proposed water utilities facilities

Name	Land area (Ha)	Function
STP 7	52.0	Treatment & storage of recycled water
LWTW 5	26.0	Treatment & storage of potable water
WW 1	1.0	Storage of potable & recycled water
WW 2	1.5	
WW 3	1.5	
WW 4	2.0	
WW 5	1.0	
WW 6	1.5	
WW 7	1.0	
WW 8	2.0	
WW 9	1.5	

The land area requirement of the above-stated facilities has been worked out based on the projected demand and supply figures for Year 2056. However, these figures are indicative and may be subject to change. The same condition applies to the proposed locations of these facilities.

6.2 Surface Water Drainage

The proposed surface drainage system for the Banur LPA is based on projections up to Year 2031. It is designed to adhere to the existing terrain as much as possible, with existing rivers and canals serving as discharge outlet points. By channeling storm water and surface runoff from the roads and various development plots into the existing rivers, the risk of flooding is mitigated, especially during the wet season between July and September every year.

6.2.1 Existing Conditions

According to the GMADA Divisional Engineer, the amount of annual rainfall in the GMR varies between 900 mm to 1,000 mm. The wet season is typically from July to September each year.

The major flood-prone area within the LPA is a 552 ha site located to the north of the existing Banur town center, along the Nandialiwala Choe. This is actually one of the two major flood-prone areas within the GMR, with flood water rising to a depth of between 1 – 1.2 m for a few days each year.

The Shekhan Mazra Settlement is located within this area. Whenever it floods, residents living there would have to be relocated for up to 24 hours while awaiting the water to subside. Based on site observation, the platform level there is low compared to the surrounding areas, causing the accumulation of water. The problem of water stagnation is compounded by the lack of proper drainage facilities there.

In fact, the problem of lack of proper drainage facilities is prevalent throughout the entire LPA: The absence of roadside drains on both sides of the roads was noted through on-site observation.

6.2.2 Planning Strategy

A proper and effective drainage system is needed to remove and dispose of surface water within the LPA. The following planning strategies will be used to achieve that:

- Surface runoff shall be discharged as soon as possible to avoid flooding.
- A fully-gravitational storm water drainage system is to be achieved whenever possible.
- Surface runoff is to be discharged to existing nala/rivers and canals within the LPA. These include the Tangon Choe, Tangori Choe, Nandialiwala Choe and Banur Canal.
- The flow pattern of the drainage system shall adhere as much as possible to the existing terrain, which slopes from the north to the south and from the north-east to the south-west.
- Rain water harvesting facilities are to be integrated with the roofs of future developments.

To alleviate the situation at the flood-prone area, the proposal is to carry out a backfill using soil, up to a height of about 1 m. At the same time, surface runoff is to be discharged further downstream of this area.

The drainage system shall be designed and sized up to cater only for the runoff within the LPA up to Year 2031. Any runoff from outside the LPA shall not be loaded to the proposed drainage system. Similarly, surface runoff from individual developments within the LPA will not be allowed to discharge to neighboring developments.

Peripheral drains shall also be provided wherever necessary. These will further help to channel surface runoff to the proposed discharge outlet drains or existing nala/rivers.

For the future urbanisation areas within the LPA scheduled for development between Years 2031 and 2056, a separate drainage system with additional discharge outlets will have to be provided. The surface runoff from these areas shall not be loaded on the proposed Year 2031 drainage system.

6.2.3 Planning Criteria

The planning of surface water drainage system for the LPA is based on the following design parameters and formulas:

a) Peak Runoff

Peak runoff is computed based on the Rational formula:

$$Q_r = C\ I\ A\ .\ (1/360)$$

where Q_r = Quantity of runoff (m^3/s)

C = Coefficient of runoff

I = Intensity of rainfall (mm/hr)

A = Catchment area (Ha)

b) Coefficient of runoff (C)

Different runoff coefficients are adopted for different land uses. This is based on the permeability characteristic of each land use, as illustrated in Table 6.3.

Table 6.3: Runoff coefficient based on land use

Land use	Runoff Coefficient
Road	0.9
Built up	0.7
Green	0.2
Weighted Average	0.56

Subsequently, a weighted averaged runoff coefficient is derived and adopted for the design of the proposed storm water drainage system. For the Banur LPA, the weighted runoff coefficient is 0.61.

c) Intensity of rainfall (I)

There is no rainfall intensity data (mm/hr) available for the GMR. However, the rainfall intensity-frequency-duration (IDF) chart for the region can be derived from the data of Ambala, which is available from the National Data Center at Pune.

Ambala is located just to the south of the GMR planning boundary. The hourly records of the one-day highest rainfall in a year for Ambala is available for Years 1972 – 2005, with the exception of 1973, 1976, 1978, 1983, 1987 and 1993. These rainfall data is the closest available data that could be used as a reference base for the GMR.

The IDF chart for Ambala is shown in Figure 6.7. Similar data for Singapore have been included in the chart for comparison purposes.

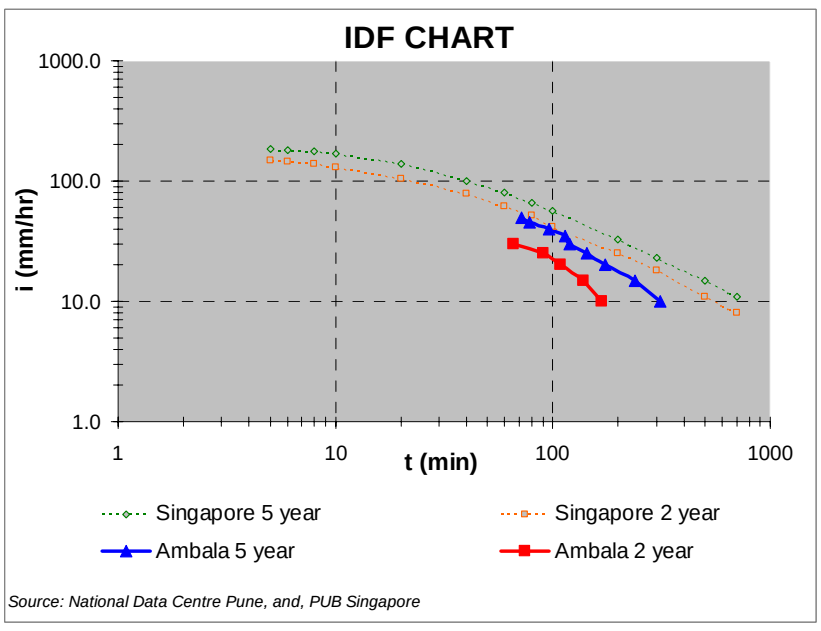


Figure 6.7: IDF chart for Ambala and Singapore

For a 1-hour rainfall, the rainfall intensity of the GMR (based on data for Ambala) works out to be about:

- **32mm/hr** for rainfall return frequency of 2 years
- **53mm/hr** for rainfall return frequency of 5 years

For rainfalls lasting less than 1 hour, the intensity could be estimated using the following formula from the Indian Road Congress:

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

where I_o = 1-hour rainfall intensity

t = Rainfall duration (less than 1 hour)

I = Rainfall intensity corresponding to t

d) Drain Discharge Capacity (Qc)

The size of drains has to cater adequately to the estimated peak runoff within the catchment area. Specifically, two types of drains are to be adopted and their respective design formulas are as follow:

i) *Pipe drain design (Colebrook's formula):*

$$Q_c = A.V$$

where A = Flow area of pipe (m^2)

V = Velocity (m/s)

and

$$V = -2\,(\sqrt{2gdI}).Log[(k/3.7d) + (2.51\upsilon)/(d*(\sqrt{2gdI})]$$

where L = Hydraulic gradient (%)

K = Roughness coefficient (m) (0.00003m)

υ = Kinematic viscosity (m^2/s) (0.0000009)

d = Internal diameter (m)

g = Acceleration due to gravity (9.81 m/s^2)

ii) *Box Drain design (Manning's formula):*

$$Q_c = 1/n \,.\, A.R^{2/3}\, S^{1/2}\ (m^3/sec)$$

where A = Flow area of drain (m^2)

R = Hydraulic mean radius (m)

S = Bed gradient

n = Roughness coefficient (0.015 for concrete)

e) Material of drainage pipes

Where the internal diameter of the drainage pipe is up to 1.80 m, reinforced cement concrete (RCC) is the recommended material to be used where it is commercially available.

Reinforced concrete box drains are recommended where the internal diameter of the drainage pipe is larger than 1.80 m. Open box drains should only be adopted when regular drain maintenance is available.

6.2.4 Planning Parameters

The following parameters are to be adopted for the drainage system:

- Minimum velocity = 1.0 m/s
- Maximum velocity = 3.0 m/s
- Free board = 15%

6.2.5 Proposed Drainage Scheme

The Banur LPA is traversed by the Tangon Choe, Tangori Choe, Nandialiwala Choe and Banur Canal. The presence of these existing rivers/canals and their tributaries had naturally subdivided the LPA into smaller parcels of land.

Since the individual catchment area is smaller, there are more options available when designating the storm water discharge outlet points. This in turn minimises the size needed for individual discharge outlet drains. Tapping on the existing system of rivers/canals also allows the drainage flow pattern to follow the existing terrain profile very closely.

To cater to the surface runoff within the LPA up to Year 2031, a total of thirty drainage catchments have been designated. Each catchment is indicated in a different color in Figure 6.8. The proposed network scheme and flow directions are illustrated in Figure 6.9.

Similar to the other LPAs, the proposed storm water drainage scheme consists of the following components:

a) Storm water collection & convey system

This system comprises road-side drains surrounding individual development plots. These serve to collect and convey the surface runoff from the development plots and their carriageways to the discharge outlet drains.

The road-side drains are generally smaller, with a proposed size of about 0.9 m. The pipe drain system is adopted, with the drains located along the lower-hierarchy roads that serve the smaller (up to 4 ha) development plots.

b) Network of discharge outlet drains

This network comprises road-side drains located along the major arterial road. The main function of these drains is to channel surface runoff (collected from the smaller drains around development plots) to the existing nala/rivers and canal.

Open rectangular drains are adopted for this network and their dimensions are generally larger. To illustrate, for Catchment 12, with a catchment size of 958.48 ha, the width of the discharge outlet drains will range from 1.5 m (upstream) to 7.5 m (downstream). Their depth will range from 1.5 m (upstream) to a maximum of 3 m (downstream).

Based on the drainage planning concept, extra land should be reserved to cater for the discharge outlet drains. In addition to the existing 2.5 m-wide reserve along major arterial roads, an additional drainage reserve ranging in width from 1.6 m to 11 m shall be safeguarded for the discharge outlet drains.

The maximum depth proposed at the point where the outlet drains discharge to the existing nala/rivers is 3 m. This figure was assumed because at the time of preparation of the local plan, detailed topographical information and invert level of the existing nala/rivers were not available.

At the detailed engineering stage, it is recommended that further studies be carried out by local consultants, using detailed information on the topography and invert levels to determine the most suitable depth.

To safeguard existing rivers, which serve as important discharge outlets for the drainage system, river reserves have been proposed along both sides of the rivers. These reserves range in width between 10 m – 30 m.

The river reserves perform the following functions:

i) Act as green buffers, which help to discourage trespassing.
ii) Accommodate future shifting of the alignment of the river courses.
iii) Allow for future widening of the edge of the river beds (if necessary).
iv) Allow for maintenance access.

6.2.6 Recommended Measures

The following measures should be adopted in order for the proposed drainage system to function effectively:

a) Peripheral drains

As explained earlier, the proposed drainage system is intended to cater only to the surface runoff generated within the LPA.

To prevent the runoff flowing into the neighbouring LPAs (and vice versa), peripheral drains may be needed along certain portions of the LPA's development boundary. However, the provision of peripheral drains will be subject to the LPA's final road network.

b) Rain water harvesting

It is recommended that rain water harvesting facilities be installed on the roof top of all buildings located within the LPA. The collected rain water will be stored for the purpose of re-use or for recharging into the ground. This will help to reduce the amount of surface runoff being discharged into the internal drainage system.

In addition, such harvesting facilities can also be installed on non-roof top areas. This will further reduce the amount of surface runoff.

c) Dredging/deepening of existing nala/rivers

The existing nala/rivers within the LPA serve as the main discharge outlets for all surface runoff. To ensure effective and timely discharge of surface runoff, there is a need to dredge/deepen the existing nala/rivers.

d) Pumping System

The alternative to dredging/deepening of the existing nala/rivers is to install a pumping system. When it rains, the pumps will continuously discharge surface runoff into the existing nala/rivers and canals.

For this system to work, appropriate retention tanks/facilities have to be put in place. These will act as temporary storage facilities before the runoff can be pumped out of the development area.

e) Maintenance

Regular and continuous maintenance is absolutely essential to the success of the proposed drainage system. Regular dredging and desilting work for all the proposed drains, lakes and existing nala/rivers are recommended.

6.2.7 Supplementary Measures

Although agriculture use occupies 37% of the total land area within the LPA, there is no official irrigation project by GMADA. For purpose of irrigation, farmers rely very heavily on rain water and ground water from bore wells. However, ground water has been over-exploited over the years to serve agricultural needs, leading to the rapid decline of the water table.

There are some local and private irrigation systems within the confines of the land owned by individuals. Village ponds also play a role in recharging ground water and contributing to the amount of water available in tube wells and open wells.

However, given the projected rapid rate of urbanisation within the LPA in the medium- to long-term, it is expected that the infiltration of water into the sub-soil will decrease drastically. With that, the rate of recharge of ground water will be further diminished, worsening the condition of the declining water table. Thus, immediate supplementary measures are needed on a large scale to prevent the ground water table from receding to non-viable levels.

a) Available Water Sources for Recharging

i) *Rainwater:*

The total amount of rainfall in GMADA (and by inference, the Banur LPA) averages 800 mm per year. Assuming that 50% of the surface runoff from open land can be harvested, the available amount of water for storage works out to a total of **42×10^6 cubic metres**.

Generally, if the rain water harvesting and collection system does not make use of a lined pond or constructed sump, then approximately 30% – 40% of the collected water will seep into ground, aiding the recharge of ground water locally. When the existing village pond system is strengthened, the entire area shall have a network of such ponds. This will help to increase the amount of ground water and raise the water table within the LPA.

ii) *River water:*

There are many small choes traversing the LPA before ultimately joining the Ghaggar River, a big rivulet within the GMR. The amount of water available in these choes depends very much on the prevailing weather conditions.

The choes generally act as highways for surface water runoff, causing leakage from the LPA to adjoining areas such as Lalru. Adding more check dams along these choes will help to increase the percentage of water retention within the LPA.

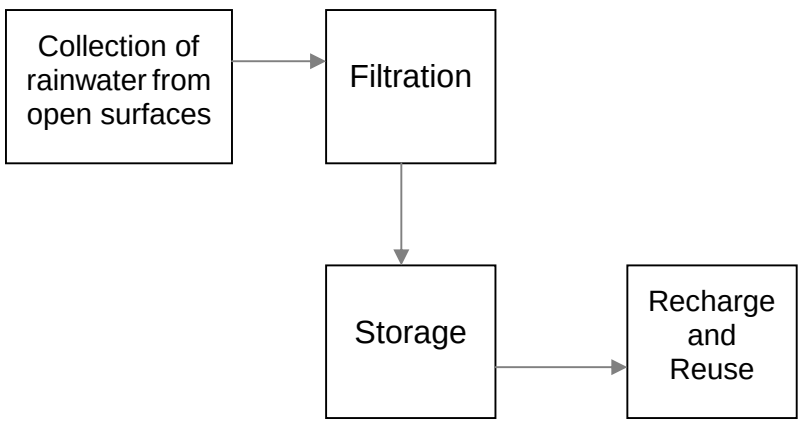
b) Available Systems

i) *Land surface catchments:*

The use of ground or land surface catchment areas is a relatively straightforward way of collecting rainwater. It involves improving the runoff capacity of the land surface through various techniques, including the collection of runoff with drain pipes and the storage of collected water.

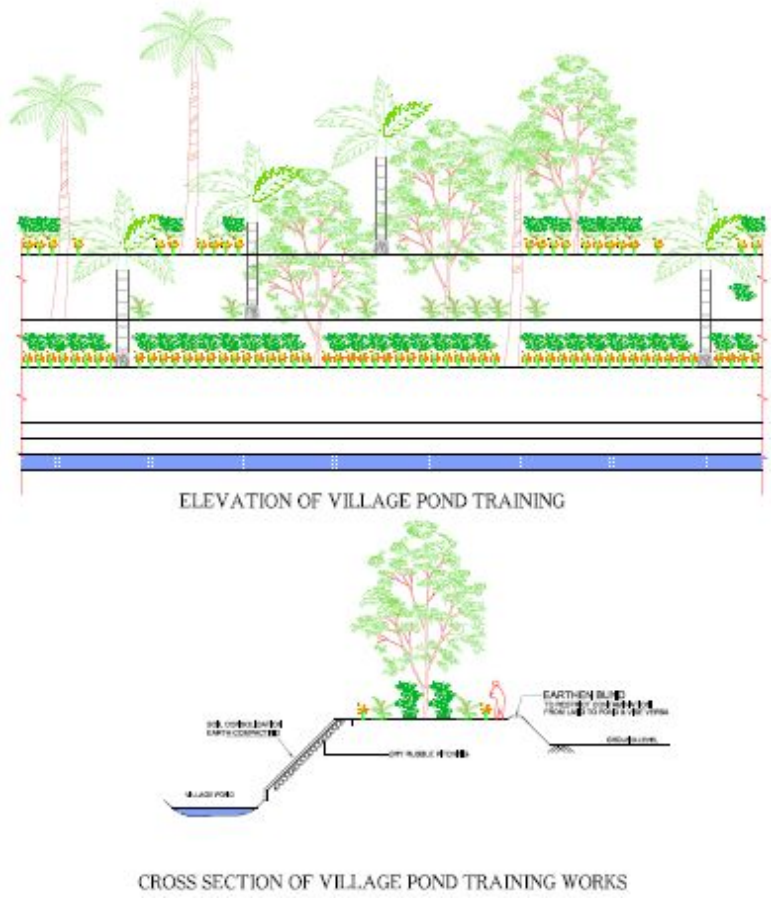
Compared to the use of roof-tops for the harvesting of rain water, the technique of using ground catchments allows for the collection of a greater amount of water because a larger surface area can be tapped upon. This technique is especially useful for meeting water demands during the initial dry period.

The process of collecting surface runoff within ground catchments is:



To collect rain water effectively, each village pond should have a defined command area. Figure 6.10 shows the classification of the approximate command area for each of the 40 – 45 village ponds found within the LPA.

All surface water shall be properly drained to the local village ponds via the storm water drains. To accommodate the volume of water, the village ponds have to be strengthened as shown in following illustration plan:



The village pond training works will allow for the collection of the maximum amount of rain water within each local area.

The storm water drains can also have properly-designed silt and debris traps constructed at every 500 or 750 metre interval. In addition, having vertical sand drains will allow routine water flows to naturally recharge the ground water. Such sand drains will act as local recharging points, allowing water collected from the immediate area to recharge the ground water of the same area. This will reduce the cross-sections of drains, as well as the capital cost of conveying water over long distances.

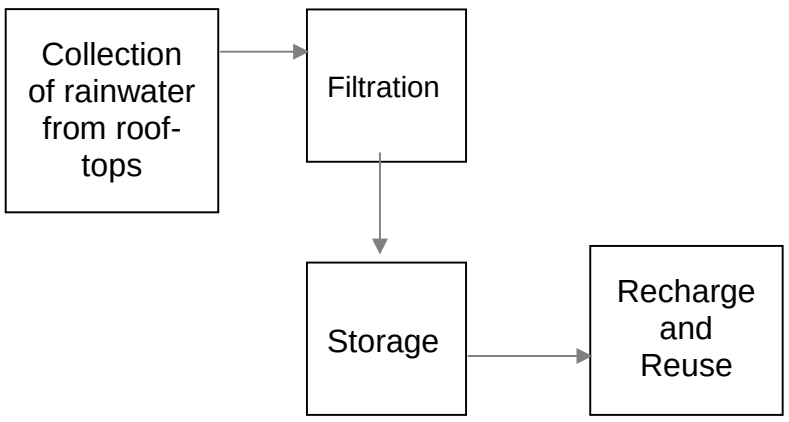
To maximise the amount of surface runoff collected, the following methods can be employed:

- Clearing or altering the ground vegetation cover: Clearance of vegetation can increase surface runoff but reversely, will induce more soil erosion. The use of dense vegetation cover such as grass is usually suggested as it helps to both maintain a high rate of runoff and minimise soil erosion.

- Increasing the slope of land with artificial ground cover: Steeper slopes allow more rapid runoff of rainfall to the collection area. However, the rate of runoff has to be controlled in order to minimise soil erosion at the catchment area. To further increase efficiency through the reduction of both evaporative losses and soil erosion, this method can be combined with the use of plastic sheets, asphalt or tiles.
- Reducing soil permeability through soil compaction: This involves smoothening and compacting of the soil surface using equipment such as graders and rollers. To increase the surface runoff and minimise soil erosion rates, conservation bench terraces can be constructed along the slope, in a direction perpendicular to the runoff flow.

ii) *Roof-top catchments:*

Incentives can be given to the owners of individual houses/buildings/properties to install roof-top facilities for rainwater harvesting. The process of collecting rain water from roof-tops is as follows:



The requirements for an effective roof-top catchment and conveyance system are:

- High levels of precision and workmanship are needed when installing the system, which includes the appropriate mode of rainwater collection, water-proofing treatment to be done to the terraces etc.
- Special roof treatments are needed to cater to the specifications of the requisite pumping and storage system (to be used for the supply and distribution of water).

iii) *Storm water from streets:*

Sump with sand traps shall be provided at intervals to the storm water drains to be located along the streets. These sumps will be designed in such a way that storm water will be collected and filter down to enrich the ground water table.

c) Suggested Norms

It is proposed that the three available systems stated above be deployed in the following manner:

- The land surface catchment method should be implemented in the villages and horticultural development areas.
- The roof-top catchment method should be adopted for the urbanized areas.
- The third method should be adopted to collect water from the streets and paved campuses.

6.2.8 Flood Control

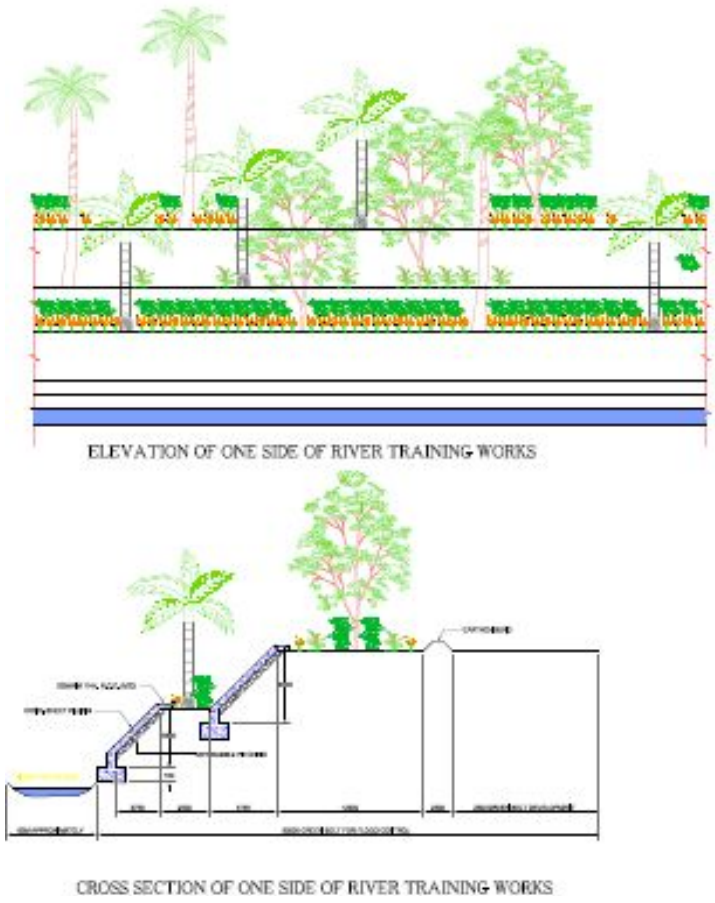
The aim of implementing flood control measures is to achieve the target set in the zero flood-damage plan. That plan demarcates the following no-damage zones (NDZ):

- Along the high flood potential area; and
- Along the perimeter of the river/canal.

One measure is to create 100% tree cover in the NDZs to serve the dual purpose of i) soil conservation and ii) prevention of encroachment in future.

Since the rivers are not perennial, the width of the green cover areas along the river banks has to be restricted to a maximum of 20 meters on each side (measured at the top of the bank).

The green cover areas are for bank protection and the introduction of control bunds. The bunds, which stand at the height of 2 – 2.5 metres, can be constructed at the outer edge of the proposed green cover areas (see illustration on the next page for the river training works). During the flood season (which is usually of a short duration), the bunds will provide additional capacity to cope with the increased volume of water.



ELEVATION OF ONE SIDE OF RIVER TRAINING WORKS

CROSS SECTION OF ONE SIDE OF RIVER TRAINING WORKS

River training works are essential to ensure stability of the river banks throughout the year (and especially during the monsoon seasons). These works will also increase the water conveying capacity of the rivers, while at the same time, act as demarcation zones for reservations located adjacent to the rivers.

6.3 Power Supply and Distribution

A power supply scheme comprises power source development, transmission, step-down to usable voltage and local distribution network.

The following is an elaboration of the power supply and distribution plan to meet the power consumption needs within the Banur LPA for the next 25 years (until Year 2031).

6.3.1 Present Status

The existing land use in the LPA is mainly rural in nature, which has a relatively low demand for power. Presently, the need is met by an existing 66/11 kV sub-station. Power at 66 kV reaches this sub-station via overhead cables and then, is stepped down to 11 kV for further distribution within the LPA.

Although there is an existing 220 kV overhead power line passing through the middle of the LPA on its way to S.A.S. Nagar, power (at 220 kV voltage) is not tapped from this line for usage within the LPA.

6.3.2 Projected Power Demand

Based on the analysis of the various land uses in the proposed draft master plan, the power demand for the Banur LPA up to Year 2031 is projected at **964 MW** (see Table 6.4).

Table 6.4: Estimation of power demand

Year	2011	2021	2031	2056
Estimated Power Demand (MW) (Cumulative)	290	723	**964**	1600

6.3.3 Future Power Supply

The Punjab State Electricity Board (PSEB) and/or GMADA will be the main power supply and distribution agency in the Banur LPA.

To perform this role effectively, PSEB will have to sign power-sharing agreements with the various power producers/sources to ensure a dedicated power supply to meet projected future demands. Potential sources include the enhancement of existing power stations and the tapping of power from new and upcoming power stations in the surrounding regions, including Ropar, Bhatinda, Ranjit and Talwandi Saboo at Rajpura.

On the long-term basis (for the next 50 years), a 400-ha site has been safeguarded in Lalru for a proposed gas-fired power station. This follows the recommendation made in the GMADA Regional Plan and is to ensure an additional and dedicated power supply for the GMR. The proposed site was chosen based on the possible gas supply line coming from Sonepath, located 80 km south of the GMR.

An alternative 400-ha site has also been reserved near Kurali/Kharar to tap on the possible gas line from Iran, which when constructed in the next five to ten years, will pass through the northern part of the Punjab state.

6.3.4 Power Transmission and Distribution

The proposed power transmission and distribution system to meet the demand by Year 2031 shall be based on a series of sub-stations to achieve step-down transformation as shown in Table 6.5.

Table 6.5: Proposed power distribution system

220 / 66 kV	**Locations**	**B1**	**B2**
	No. of sub-station (SS)	5	3
	Capacity of each SS	200	200
	Total capacity in MW	1000	600
66 / 11 kV	**No. of locations**	3	2
	No. of SS @ location	4	4
	Total no. of 66 KV SS	20	12
	Capacity of each SS	50	50

a) From 220 kV to 66 kV

The existing overhead 220 kV power line passing through the middle of the LPA shall be tapped upon as the main source to meet the projected power demand. However, the line will have to be upgraded to cater for the additional power supply. A 30 metre-wide corridor is proposed to act as the land reserve for this 220 kV line.

Two locations have been proposed for housing 220/66 kV sub-stations and are indicated as B1 and B2 in Figure 6.11. Locations B1 and B2 will house five and three 220/66kV sub-stations respectively, with a combined capacity of 1600 MW.

b) From 66 kV to 11 kV

After being stepped down from 220 kV to 66 kV, the power is then distributed via 66 kV cables to the 66/11 kV sub-stations. It is proposed that these cables be laid underground and along road corridors. When installed, these cables will replace the existing overhead lines.

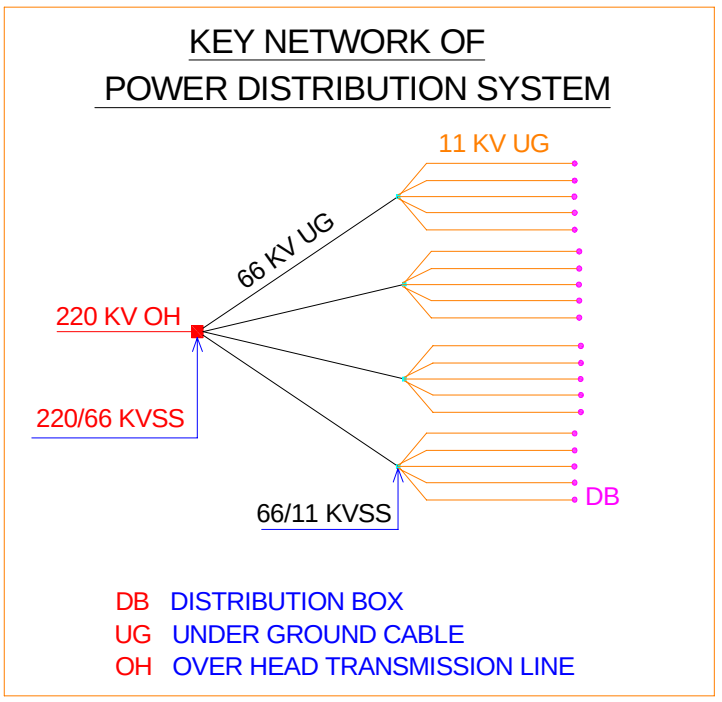
A total of five locations have been proposed for housing the 66/11 kV sub-stations. One of these is an existing sub-station, which shall be upgraded accordingly in terms of size and capacity. The command area served by the respective 66/11 kV sub-station is shown in Figure 6.11.

c) From 11 kV to 220 V

Power flows from the five 66/11 kV sub-stations to the various 11 kV sub-stations for local distribution. From the local sub-stations, electricity enters the local network of distribution boxes/cables and reaches each household at a voltage of 220 V.

The proposed power transmission and distribution network is illustrated in Figure 6.12.

Figure 6.12: Proposed power distribution system network



6.4 Sewerage

The sewerage system is a main infrastructure component that conveys used water to the plants for treatment before it is safely disposed of. It thus performs a crucial role in ensuring a clean and healthy environment.

For sustainable development and to enhance the quality of the environment, the proposed sewerage system has to provide adequate waste-water infrastructure to ensure that:

- Sewage is disposed of efficiently.
- The most cost-effective and efficient sanitary sewer service is provided, with maximum protection to the environment and public health.
- All urban properties have access to an efficient and affordable sewerage system.

- Treatment and disposal techniques used are able to conserve resources and minimize adverse environmental impacts (if any).
- The sewerage project is appropriately funded to meet future development needs.

6.4.1 Planning Objectives

The purpose of the proposed sewer infrastructure is to improve the quality of life for residents in the Banur LPA through the provision of an efficient and effective means of sewage collection, treatment and disposal.

The following approaches are adopted to achieve these objectives:

- Sufficient capacity is provided in the sewer service areas using the best environmental standards to meet demands for projected growth.
- Safe and sanitary waste-water treatment and disposal systems are critical for any community (including Banur) to function properly.
- The provision of sewerage systems protects the cultural well-being of the community by disposing of offensive matter efficiently.

6.4.2 Planning Criteria

The planning criteria adopted for the proposed sewerage system are as follows:

a) Sewage flow

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

Based on the land use distribution and population projection up to Year 2031, the sewage generated for the LPA will reach **90 MLD**. This figure does not include any FEZ areas outside the boundary of the LPA.

b) Design standards for sewerage network

The following general standards are recommended for adoption in the design of the gravity pipe network:

- Minimum velocity of 0.6 m/s at peak flow for self cleansing.
- Maximum velocity of 3.0 m/s to prevent scouring.
- Peak factor of 2.25 (based on the projected population).
- Manning's formula shall be used for the sizing of sewer pipes.
- Maximum depth of invert shall not be greater than 8 m.
- Maximum design depth of flow shall be 0.8 of pipe diameter at peak flow.
- Minimum diameter for a public sewer is 200 mm.

6.4.3 Existing Sewerage System

Presently, there is no (or negligible) sewerage network or sewage treatment plants provided within the LPA. Some of the sewage is discharged into soak pits/septic tanks.

6.4.4 Proposed Sewerage System

The sewerage network, being primarily a gravity network based on grading levels, is largely dependent on the topography of the area. The terrain varies across the LPA, with a general sloping of the land towards the south-east. The sewage will be conveyed to the sewage treatment plant via gravity pipes.

Five main sewerage catchments have been proposed within the LPA (see Figure 6.13). Each catchment may be further subdivided by the detailed engineering consultant during the detailed engineering stage. All five catchments will be served by one sewage treatment plant – STP 7.

At the current design stage, only the main lines have been proposed. These lines will collect the sewage generated by the various elements and discharge the load to STP 7. The proposed sewerage network for the LPA, as shown in Figure 6.14, may be subject to further refinements based on detailed soil data.

The proposed sewerage treatment system comprises both primary and biological treatments to ensure that the effluent complies with the requirements set by the Bureau of Indian Standards. The exact location of the discharge point for treated effluent shall be identified at the detailed engineering stage, in consultation with the relevant authorities.

Based on the projected demand up to Year 2031, the estimated capacity of STP 7 is **90 MLD**. However, in terms of land area, the ultimate requirement of **52 ha** has already been safeguarded. This allows for the provision of tertiary treatment of sewage by Year 2056.

The location and land area requirements of the proposed STP 7 are indicative and may be subjected to change arising from site verification.

Another factor that will affect the land area requirement is the type of treatment method to be adopted. The figure stated above was derived based on a 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 a substantial decrease (40% – 50%) in the land area requirement.

6.5 Solid Wastes Management

To actualise the vision of Banur as an institutional town within a park setting, it is vital to keep the environment pollution-free.

To tackle this challenge and to achieve a sustainable environment with a high quality of life for urban dwellers, it is essential to introduce a proper and efficient solid wastes management system.

6.5.1 Existing Conditions

Annex 3.1 of the *State of Environment, Punjab – 2007* report covers the status of land available within the state for the disposal of municipal solid wastes (MSW), as well as the quantity of MSW generated by the various municipal authorities. For the Banur LPA, it was stated that there is an existing 7-acre (2.8 ha) landfill site.

The amount of solid wastes generated in the current district is estimated to be about 1.5 ton per day, with the majority coming from the municipal source. The wastes are most likely not treated but disposed directly into the existing landfill. The accumulated garbage/wastes create an unpleasant sight and give off bad odours. These not only cause environmental pollution, but also pose as a hazard to public health.

In the short-term, the occupier (or the operator as the case may be) of the landfill has to be made responsible for the safe and environmentally-sound operation of the facility, as per the design approved under the rules stipulated by the State Pollution Control Board (SPCB). In the longer term, it is recommended that the site be closed permanently, similarly following the design approved by the SPCB.

6.5.2 Effective Management of Solid Wastes

An effective solid wastes management system is needed to:

- Prevent the spread of diseases;
- Ensure the safety of inhabitants; and
- Safeguard public health.

In addition, the system must be both environmentally- and economically-sustainable. The former refers to the reduction (as much as possible) of environmental impacts caused by the management process, while the latter refers to keeping costs at a level that is reasonable to and acceptable by the community.

The approach of an integrated solid wastes management system is usually considered to be more effective in terms of both environmental and economic sustainability. This approach deals with all types and sources of solid wastes. Comparatively, a multi-material, multi-source approach is usually less effective.

An effective solid wastes management system can make use of one or more of the following methods:

- Waste collection and transportation.
- Resource recovery through sorting and subsequent recycling of suitable materials (such as paper, glass, metal etc.)
- Resource recovery through:
  - Waste processing by compost; or
  - Recovery of energy through biological, thermal or other processes.
- Waste transformation (without recovery of resources) through the reduction of volume, toxicity

and/or other physical/chemical properties of the waste to make it suitable for final disposal.

- Disposal in a sanitary landfill site using an environmentally-safe and sustainable disposal method.

6.5.3 Wastes Generation

Within the Banur LPA, most of the wastes generated should be of the MSW category. Table 6.6 shows the broad estimates of solid wastes generation per capita (including recyclable wastes) by Year 2031.

Table 6.6: Estimated solid wastes generation rate

Use	Amount
Residential	0.8 kg / capita / day
Industrial	180 kg / ha / day
Institutional	60 kg / ha / day
Open Space	30 kg / ha / day
Transportation	
Existing built-up areas & villages	

The projected amount of wastes that will be generated by the respective uses over the same time period is listed in Table 6.7.

Table 6.7: Projected amount of solid wastes

Use	Ton per day [i)]	Percentage (%)
Residential	58	22.4
Mixed Use	52	20.1
Institutional	50	19.3 [ii)]
Industrial	46	17.8
Transportation	20	7.7
Open Space	19	7.3
Existing built-up areas & villages	14	5.4
TOTAL	**259**	**100**

i): This is based on the projected total population of 119,558 distributed over an area of 10,380 ha.

ii): This relatively-high percentage takes into account the realisation of the vision of Banur as an institutional town.

The wastes generated can be further classified into the following types of materials:

- Biodegradable
- Non-biodegradable
- Recyclable
- Organic

Each type of wastes material will have to be dealt with using different treatment and disposal methods.

6.5.4 Wastes at Source

Wastes at source are usually sorted and stored in containers for collection. Thereafter, the containers are transported to transfer stations for temporary storage.

The containment of wastes at source can be done using the following methods:

a) Litter bins

Litter bins can be provided along the streets and at markets, public places, tourist spots, bus and railway stations, large commercial complexes etc. to collect wastes disposed by the public. The bins can be placed at intervals ranging from 25 to 250 metres, depending on the local conditions for the collection of wastes.

Having litter bins placed at accessible and convenient locations will help to ensure that the streets and public places are not littered with wastes generated while on the move, such as used cans, drink cartons and bus tickets, chocolate and sweet wrappers, empty cigarette boxes and the like.

Removal of wastes from the litter bins has to be done regularly by road sweepers and cleaners during their daily street cleaning operations. Wastes from the litter bins should be transferred directly to the bulk bins.

b) Bin centres

A bin centre is a centralised point for wastes collection and storage. Types of developments that can be served by bin centres include domestic high-rise apartment blocks, commercial (shopping and office) complexes, markets and food centres. Typically, there is one bin centre provided for each precinct.

This method requires having separate groups of workers. One group is needed to transfer wastes from the various sources to the bin centre/collection point, where the wastes are stored in bulk containers or compactors. Another group is then needed to move the loaded containers to the transfer stations. This results in double handling of wastes.

c) Centralised wastes chutes

This system has the advantage of eliminating double handling of wastes and minimising the smell nuisance. Each block is installed with a common centralized wastes chute, with the discharge point located near the lift lobby of each floor. The chute terminates in a storage chamber on the ground floor, where an automated wastes handling facility is installed to serve the entire block.

The disadvantage of this method is the lack of efficiency compared to indirect collection from bin centres. This is because the wastes collector has to pick up the wastes from every block within the precinct instead of doing so collectively at the bin centre that serves the entire precinct.

6.5.5 Wastes Collection

The type of wastes collection method to use is determined by the nature, volume and source location of wastes, the disposal destination and relative costs of different methods.

One way to regulate the proper collection of wastes is the implementation of a licensing system. Only licensed wastes collectors/companies are allowed to collect wastes from source.

Implementation-wise, the developer or district solid waste regulator can invite companies to tender and compete for the license to provide wastes collection services for domestic households or trade, commercial and industrial premises on a daily basis.

Successful tenderers will be appointed as public wastes collectors (PWC) for the respective precincts for a fixed term (say, 5 years). During the course of work, licensed PWCs are required to comply with the guidelines stipulated by the Punjab SPCB and as stated in the *Environmental Public Health Regulations*.

Wastes can be collected using the following methods:

a) Direct collection

This method involves the removal of wastes directly from individual domestic premises within private landed housing estates and individual trade premises (such as shop houses).

A wastes truck (with its collection crew) moves from one premise to another to collect the bags of wastes placed outside. This method is labour-intensive, incurs a higher cost and is more time-consuming.

b) Indirect collection

This method involves the collection of wastes from designated centralised collection points (such as bin centres and centralised wastes chutes).

This method is generally more productive, efficient and cheaper as the bulk refuse is collected from centralised points only.

6.5.6 Sorting, Processing and Transformation of Solid Wastes

Sorting of co-mingled (mixed) wastes usually occurs at a transfer station. This often includes:

- Separation of bulky items and waste components by size using screens;
- Manual separation of waste components; and
- Separation of ferrous and non-ferrous metals.

Next, wastes processing is undertaken to recover conversion products and energy. The organic fraction of MSW can be transformed using a variety of biological and thermal processes. The most commonly-used biological and thermal transformation process is aerobic composting and incineration respectively.

Wastes transformation is undertaken to reduce the volume, weight, size and/or toxicity of the wastes without resource recovery. Transformation may be done using a variety of techniques, including:

- Mechanical (e.g. shredding);
- Thermal (e.g. incineration without energy recovery); or
- Chemical (e.g. encapsulation).

The recovery of sorted materials, followed by the processing and transformation of solid wastes, primarily occur in locations away from the sources of waste generation.

6.5.7 Transfer and Transport of Wastes

This is usually a two-step process:

- Transfer of wastes from the smaller collection vehicles to the larger transport equipment; and
- Subsequent transport of the wastes (usually over long distances) to a processing or disposal site.

Wastes consolidation and transfer usually take place at the transfer stations. Figure 6.15 shows the location of the various proposed solid wastes facilities within the Banur LPA. The transfer station is shown as TS 5, with an allocated land area of approximately 0.4 ha.

6.5.8 Wastes Disposal

This can be done through the use of sanitary landfills or incineration.

a) Sanitary landfills

The bulk of the solid wastes generated within the LPA will likely be disposed of using this method. For the balance amount, a considerable quantity can be disposed of using other methods such as composting and recycling.

Location of landfill:

Within the GMR, the locations of the various sanitary landfills (LFS 1, 2 and 3) have already been earmarked at the Structure Plan stage. The solid wastes generated within the Banur LPA, together with those from S.A.S. Nagar, are to be disposed of at LFS 2 (located near S.A.S. Nagar, at the western portion of the GMR).

The following planning considerations were taken into account before the location of LFS 2 was selected and finalised:

- There is to be no residential developments within 250 meters from the perimeter of the proposed landfill site.
- The proposed site should not be seen by residential neighborhoods located within 1 km-distance from the site.
- There are to be no wetlands of environmental significance or important biodiversity/reproductive values within the potential area of the proposed site.
- There are to be no perennial streams within 300 metres down-gradient of the proposed site.
- The proposed site should not be located in open areas with winds of high velocities. Otherwise, it will be difficult to manage the windblown litter.
- The seasonal-high (i.e. 10 year-high) level of the groundwater table should be at least 1.5 metres below the proposed base of any excavation or site preparation works for the development of the landfill.
- If the groundwater table has a seasonal-high level, there must a layer of soil (minimum 1 metre deep) above that level.
- There are to be solid geologic formations (at least 1.5 metres thick) below the proposed base of the landfill site to act as competent barriers against leachate and gas migration, which will affect sensitive groundwaters. Following from this consideration, the uppermost geologic unit should not comprise limestone, carbonate, fissured or any other porous rock formations.
- The proposed site shall not be located on floodplains that are subjected to 10-year floods. This is to eliminate the potential for washout of the wastes.
- The boundaries of the proposed site shall not fall within the 10-year groundwater recharge area for the development of existing or pending water supply.
- There are to be no known rare or endangered species or significant protected forests found within 500 metres of the landfill development area.
- The proposed site is to be at least 1 km away from culturally-sensitive areas (such as memorial sites, places of worship and schools), where public acceptance might be unlikely. Access roads that pass by such culturally-sensitive areas should also be avoided.
- There are to be no major infrastructure lines (for transmission of electricity, gas, sewer and water) crossing the site.

Size of landfill:

The total amount of wastes generated within the LPA by Year 2031 is projected to be about 259 tonnes per day (see Table 6.7).

That amount was derived using the following factors:

- Projected total population within the LPA: Assumed to be 119,558 (Year 2031) and 398, 526 (Year 2056 ultimate population).
- Solid wastes generation rate: As stated in Table 6.6.
- Ratio of solid waste for landfill: Assumed to be 0.70.
- Density and volume of compacted solid waste for landfill.
- Volume of compacted soil cover.
- Volume of compacted total landfill volume.
- Design life for the landfill: Assumed to be until Year 2056.
- Depth of landfill: Assumed to be 10 m (maximum) – 3 m below ground and 7 m above ground.
- Area of land needed for leachate treatment and evaporation ponds: Assumed to be 2 ha.
- Area of land needed for receiving solid wastes: Assumed to be 2 ha.
- Area of land needed as landscaped buffer zone: Assumed to be 10% of the total land area needed for the landfill, leachate treatment/evaporation ponds and receipt of solid waste.

Of the total area allocated for LFS 2, approximately 26 ha (28%) will have to be set aside to contain the amount of solid wastes generated within the Banur LPA up to Year 2031.

Types of wastes that can be disposed of at the landfill:

Prior to disposal at the landfill, wastes should have already been sorted and separated according to types. Only the following types of wastes can be disposed of at the landfill:

- Non-biodegradable wastes;
- Inert wastes; and
- Other wastes not suitable either for recycling or for biological processing.

Due to its hazardous nature, pathogenic wastes generated by biomedical institutions and research/medical centres should be treated and disposed of separately by a licensed and specialised hazardous wastes treatment company.

b) Incineration

The future growth and development of Banur as an institutional town will result in an increasing amount of solid wastes being generated in the long term. To dump wastes continuously in the landfill will only shorten the extent and lifespan of available land, which is not a sustainable practice.

To prevent having to continuously increase the area of the landfill site, a better alternative is to reduce the volume of wastes through incineration. This method can reduce wastes volume by as much as 90%, making it a more efficient, effective and sustainable way to cope with rapid increases in the quantity of solid wastes in the long run.

As with the case of the landfill sites, the location of the incineration plant has already been earmarked in the Structure Plan. Specifically, it is within the Lalru district, at the southern portion of the GMR. An alternative location for the incineration plant is at the western portion of the GMR, near Kharar and the alternative location of the gas fired power station.

6.5.9 Wastes Minimisation

It is not economical to rely entirely on landfill sites and incineration to deal with the issue of wastes disposal. In the long term, it is more essential to reduce the volume of wastes to a level where disposal can be carried out at a reasonable cost, within the assimilation capability of the environment and without threat to public health. Volume reduction will also help to limit the extent and prolong the life span of sanitary landfill sites.

To meet this challenge, district regulators or individual developers can set up units to promote and spearhead wastes minimisation programmes in public and private residential estates, schools, industrial estates, offices, hotels etc.

The programme can include clean and green campaigns, recycling awareness campaigns and talks in schools, industrial developments and various social and community institutions. Through these efforts, active public participation and support will be garnered.

To minimise wastes, the first step is to encourage the populace to reduce as much as possible the amount of wastes generated. In so doing, the amount of wastes to be disposed of will also be substantially minimised.

Next, the 3**R** waste management hierarchy should be followed:

- **R**educe: To avoid unnecessary wastes generation;
- **R**euse: To use the same materials more than one time; and
- **R**ecycle: To convert unwanted materials into useful and marketable products.

6.6 Information Technology and Communication

The proposed information technology and communication (ICT) infrastructure plan is based on the broad land uses proposed for the LPA, as well as the projected population figures. The ICT plan was prepared in tandem with the other infrastructure plans, particularly those for electricity, road, water and other utilities.

As stated previously, the projected population of the LPA by Year 2031 is 119,558. Due to the continued predominance of rural and agricultural land use at that time, the demand for telecommunications facilities is projected to be relatively low. The number of forecasted subscribers is 43,420. This number can be fine tuned when more detailed data become available.

6.6.1 Existing ICT Infrastructure

Presently, the telecommunications needs within the LPA are served by exchanges located in the neighbouring regions. The infrastructure was installed many years ago, and primarily provides voice services. Considering the relative expanse of the entire LPA and the poor infrastructure, it is not surprising that many places (particularly the rural areas) remain underserved or unserved in terms of telecommunications services.

For India as a whole, with the introduction of cellular technology in the mid-1990s, many unserved areas have since been able to enjoy basic telephone services, although broadband services penetration is still very low.

The huge growth in mobile voice services and the increasing demand for data services arising from the proliferation of computer usage over the past two decades mean that existing infrastructure can no longer meet newer demands for faster and better telecommunications services.

In order to close the digital divide between the rural and urban areas, it is important that all segments of society be given access to telecommunications services. This can be done through the provision of sufficient facilities within the LPA, both in terms of fixed and wireless infrastructure.

With the vast advancements in digital technology, as well as mass adoption and economies of scale, ICT infrastructure costs have been falling rapidly in recent years. Coupled with proper planning, it is now possible for even the remotest of villages to have access to ICT services at competitive prices. However, care has to be taken when doing ICT infrastructure planning, such that there is sufficient turn-around space for the eventual replacement of both internal and external parts of the system. Proper planning will also ensure that there is in-built flexibility in the system to cater for future growth and the adoption of the latest technologies, without having to incur prohibitive costs upfront.

As Banur embarks on its next phase of development, besides upgrading old and outdated ICT infrastructure, the relevant authorities should also take the opportunity to introduce eco-friendly ICT technologies. This will help the LPA (and the entire GMR) to cut down on energy consumption, reduce operational and maintenance costs and create a greener environment.

a) External Plants for Fixed Network Infrastructure

The telecommunications services industry has become more competitive in recent years, with existing players and new entrants fighting for a share of the consumers' market. In addition, there is the presence of other service providers, including cable vision companies, private network operators and internet service providers. All of them contribute to the growing demand for basic – and increasingly advanced – infrastructure and facilities in order to roll out and provide better services to their customers.

Following from the above, it is vital that the capacity of the supporting infrastructure and facilities be sufficient to cater to the needs of these various companies. Otherwise, there will have to be repeated digging and opening up of roads to lay new infrastructure, as well as the proliferation of road-side cabinets, which will mar the aesthetics of the environment.

Optic fibre technology is the standard method used as the backbone for fixed network services. The growing demands for broadband services for the transmission of image data and sound/video files have also necessitated the use of this technology for wired-line access networks.

In the urban areas, optic fibre cables for both the backbone and access networks should be laid and run in underground ducts and sub-ducts, instead of being buried in the ground directly or strung onto overhead poles. Wherever possible, these ducts should also be laid within the side table of roads.

The use of underground ducts has the following advantages:

- Reduces the visual impacts on the environment;
- Minimises maintenance cost; and
- Provides flexibility to cater for future needs and growth.

For the more remote areas, overhead plants can still be used until such time when it is no longer viable or cost-effective to do so. To minimise costs, the implementation timing for underground ducts and the laying of manholes can be co-ordinated with that for road works (construction and/or upgrading of roads), or in conjunction with the laying of other underground infrastructure (for e.g., power, gas, water and sewerage). Doing so entails good co-ordination amongst the various authorities over-seeing the provision of utilities.

Although the use of underground ducts is a more costly solution to implement, it will facilitate easier maintenance and enable faster repair times. In the longer term, the gains will more than offset the capital outlay since there is greater flexibility to cater for the replacement of plants and for future growth. This is especially pertinent since technology is evolving at such a fast pace and equipment and systems have to be upgraded and replaced at increasingly shorter intervals.

To minimise the frequency of road digging, which will have an impact on traffic flows, it is recommended that only one party (or one consortium) be appointed for the laying of underground ducts, sub-ducts and manholes. Upon completion, these facilities can then be leased to the respective service providers.

Wherever possible, all existing outdoor distribution cabinets and other telecommunications termination housings should be replaced by equipment rooms located within buildings. In cases where having an outdoor cabinet is the only solution, local guidelines over its location and construction should be adhered to for safety and environmental reasons.

In addition, it should be mandated that all major new buildings should each have a main distribution frame (MDF) room of the appropriate size. This room is for the termination of cables and storage of equipment to serve customers in the building, as well as those in the surrounding areas. Diversity routing should also be provided to ensure a more resilient network in order to properly serve the needs of important customers and those located within major buildings.

To minimise operating costs for telecommunications providers, it is recommended that existing exchanges be reused where applicable. Within each exchange, different providers should be encouraged to co-locate their equipment so as to optimise the use of land.

b) External Plants for Mobile Network Infrastructure

Nowadays, cellular technology is the standard used for wide-area mobile and wireless services. That is complemented by short-range wireless networks such as Wi-fi, Bluetooth, Femtocell and other WLAN technologies.

Due to relatively lower costs and ease of implementation, mobile networks are increasingly being used to meet not only the need for narrow-band voice services, but also those of broadband services. Although current mobile networks do not have the bandwidth capacity to cope with the high-level demands of a large customer base, they

still have the advantage over fixed networks in that they can be deployed quickly. With better coding techniques, future generations of wireless networks are expected to be able to provide larger bandwidths.

Each mobile network, however, requires the use of multiple radio base station sites, which makes the environment unsightly. This is made worse with competition, where all the operators vie for as many base station sites as possible, in order to improve radio coverage and increase capacity.

To reduce the visual impacts caused by these base stations, each of these should be shared and used by multiple service providers. The need for co-location becomes more critical with increasing number of services being met by mobile networks using higher frequency bands, which in turn require more base stations to be deployed. To further ameliorate the situation, base stations should be integrated as much as possible with existing building structures and the surrounding environment. This can be achieved through the use of colour-matching schemes or proper screening and camouflaging.

To meet the increasing demand for mobile services in the long run, more frequencies would have to be freed up. Actions being taken by other countries to address this issue include:

- Replacement of inefficient analogue broadcasting services with digital technology; and
- Planned migration of 2G to 3G networks to free up frequencies for future wireless services.

As more and more offices and homes look for better and cheaper ways to meet their telecommunication needs, short-range wireless networks like Wi-fi and Femtocells are increasingly being used to complement wide-area networks. Wimax is another technology which has been used to provide wide-area wireless broadband services, especially in areas where it is costly to lay wired lines.

Even as newer technologies are being deployed, older equipment that is no longer (or not as) energy-efficient should be replaced. To achieve environmental sustainability, another option is the use of base stations that are powered by wind or solar energy. Although these technologies are still in the nascent stage, their feasibility and costs should be tracked so that eventually, these types of base stations can be deployed when it is cost-efficient to do so.

c) Internal Plants for Mobile Network Infrastructure

The owner(s) of each new and large building should be required by legislation to provide a room for the housing of wireless equipment to serve the needs of users within that building and its surrounding areas.

For large shopping malls and office buildings, a common indoor wireless coverage system for use by all telecommunications operators should be considered. Similarly, a shared radio coverage system should be considered for common facilities such as road tunnels.

d) Satellite Services Infrastructure

To cater for the telecommunications needs of big companies and MNCs who may want to install their own satellite dishes, guidelines should be put in place (if they are not already in existence) to facilitate the installation of such equipment in designated teleport areas.

Doing so has the following advantages:

- Multiple satellite antennas that are sited in the same area can make use of a common back-up power system and security facilities, thereby reducing costs for individual companies.
- There will be fewer restrictions on the construction of new buildings. If satellite antennas are found all over the region, the likelihood of new buildings blocking the line of sight of these antennas is higher. This makes the imposition of remedial measures necessary, which will means additional costs for property developers.

6.6.2 New Services and Applications

Additional new services that facilitate the sharing of data and audio/video files and the playing of interactive games by multiple players are being introduced regularly. These services tap on peer-to-peer connections made over IP and internet networks. With improvements in technology and better costs structure, these services have become more affordable, resulting in more households making use

of them. Correspondingly, the demand for increasingly larger bandwidth also keeps growing.

For planning purposes, it was assumed that all homes in the urban areas will be equipped with a bandwidth capacity of between 100 megabytes and 1 gigabyte by Year 2031. This entails equipping individual households with fibre optic connection.

Presently, the passive optical network (PON) is the preferred technology to use because of its better costs structure. However, it is foreseen that the PON will take some time to be rolled out. In the meantime, it is proposed that DSL and cable modems be deployed to meet demands. The need for mobility within offices and homes can also be met through complementing fixed networks with short-range, low-power wireless networks.

Wireless technologies – including 3G, 3.5G, LTE, Wimax and the future 4G – will continue to be the important means of meeting demands for broadband services. This is especially so in areas where it will be too costly (or will take too long) to roll out wired-line broadband services. Even in urban areas where fibre optic connection to the home is readily available, wireless services will still be in demand because of the high level of mobility.

A major application for broadband services is the use of ICT to provide quality education for all, irrespective of social status or wealth. Better ICT applications can also improve productivity and in so doing, reduce consumption of energy. Examples include better use of e-governance applications and teleconference facilities to reduce traveling and green house emissions.

6.6.3 Ducts Routing

The proposed telcom trunk and distribution plans are shown in Figures 6.16 and 6.17 respectively. The laying of ducts should be in accordance with the practices laid down by the local licensing authority.

Existing exchanges should be upgraded to house new equipment, where practical. The alternative is to have multiplexing equipment room.

6.7 Gas Supply and Distribution

Although there is no gas supply in the LPA presently, it is expected to be available in the GMR in the coming five to ten years. Hence, it is recommended that a gas network be planned for and maintained.

6.7.1 Gas Demand

Based on the land uses proposed in the draft master plan, gas consumption in the LPA is projected to be **53,800 Standard Cubic Metres per day** by Year 2031.

Since there is no gas distribution network in the region presently, there is no nodal agency that caters to such a facility. In its absence, the Gas Authority of India Limited (GAIL) can be considered as the nodal agency.

GAIL shall be responsible for the planned implementation of gas pipelines to bring gas to the GMR. Subsequently, GMADA will have to establish either a PPP or a government nodal agency, which will be responsible for gas procurement and distribution within the region.

6.7.2 Gas Supply

There are two possible sources of gas supply for the GMR:

i) Possible future gas pipe line tapping on India's gas line located at Sonepath, 80 km south of the GMR.
ii) Possible future gas pipe line running from Iran-Pakistan and passing through the northern part of the GMR.

Taking the above into consideration, the proposed trunk gas line can reach the LPA from the proposed city gate station (CGS) located at either Lalru or near Kharar/Kurali (see Figure 6.18).

In addition, it is proposed that a CGS be built in the same site reserved for the proposed gas-fired power station. This is because the latter is heavily dependent on gas supply for its operations.

This CGS shall be responsible for controlling the entry of gas into the GMR. From there, each of the six LPAs can be provided with individual dedicated trunk pipe lines.

6.7.3 Gas Distribution Network

Within each LPA, the trunk gas supply will be channeled to the zonal regulating station (ZRS), where the pressure of the gas is reduced from 4 bar to 100 mbar. The ZRS also ensures that the flow of gas is maintained at a constant pressure at all times.

It is proposed that the gas distribution network between the ZRS and the individual plots be laid along the service corridors located on either side of the roads. For secondary and inside roads, the width reserved for the laying of gas pipes is restricted to 0.5 metres. For the main roads, the maximum width allowed is 1.5 metres. This service corridor shall be the main core of the network for gas distribution.

Upon reaching the individual plots, the Service Regulator will reduce the gas pressure from 4 bar to 100 mbar and ensure that the flow of gas is maintained at a constant pressure at all times. Thereafter, buried pipes will provide low-pressure gas (100 mbar) to serve individual buildings. The meter regulator in the buildings will further reduce the gas pressure from 100 mbar to 21 mbar.

6.8 Overall Infrastructure Plan

The locations and safeguarded land area for the various proposed infrastructure and utilities within the Banur LPA – including water, sewerage, solid waste, power, telecom and gas – to meet the projected demand up to Year 2031 are shown in Figure 6.19.

The location of Utilities shall be decided by the experts as per demand and their locations shall be permissible in all land use zones and in agriculture / rural zone within or outside LPA.

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7 Implementation and Phasing

7.1 Land Acquisition

It is proposed that a market-oriented, entrepreneurial approach be adopted for the development of the Banur LPA. Apart from the provision of essential services, it is recommended that the bulk of development projects within the LPA be undertaken and carried out by the private sector.

An appropriate framework for land acquisition and rehabilitation has to be set up and adopted so that development projects undertaken through private sector investments can be implemented (see Table 7.1). Having that framework will also help to minimise the risks undertaken by individual private investors.

Table 7.1: Land use acquisition framework

Land use	Mode of Acquisition	Develop-ment	Operations & Maintenance
Residential	Private [Through sale of site process or auction]	Private	
Commercial	Private [Through sale of site process or auction]	Private	
Institution (Regional Scale)	Public/ Private [Depending on the type of facility]	Public/Private	
Institution (Neighborhood Scale)	Public/ Private	Public/ Private (BOOT/BOO)	Public/ Private
Open Space/ Green Areas	Public/ Private	Private	
Road/ Transport Infrastructure	Public	Public/ Private (BOOT/BOO)	Private

For important infrastructure and other strategic public projects, any private land needed for development can be obtained through compulsory acquisition. Social and community uses that are deemed crucial include hospitals, police stations, fire stations, major roads, highways and infrastructure for the provision of public utilities.

Compulsory acquisition should be handled sensitively and carried out only when there is absolutely no other option or alternative available. The basis for computing the compensation amount to be made to affected private land owners also has to be updated regularly to reflect the true market value of the land to be acquired.

Besides compulsory acquisition, the other options available to obtain land for planning and development purposes or for value enhancement include:

- Conversion of ribbon developments into corridor developments.
- Provision of public services through implicit acquisition (such as plot-shrinking under the TP scheme).
- Use of the transfer of development rights (TDR) mechanism. TDRs can also be used to ensure that the process of town planning and corridor development is fair to all beneficiaries, including those who have to give up their land.

It is envisioned that the role of local development authorities evolve from control/management to the facilitation of economic growth. In addition, relevant departments should aim to make full use of market mechanisms and growth drivers to achieve public goals.

Even when private developers were to proceed with their own land acquisitions, it is important for the state development authorities to still play an active role in the process and help to obtain the necessary approvals. This will eliminate any hurdles faced by private developers in the acquisition process.

7.2 Development Phasing

It is neither feasible nor desirable to develop the entire 10,380.2 ha of land within the LPA at the same time. To achieve development that is cost-effective and sustainable, it is advisable to do so in phases.

7.2.1 Principles of Development Phasing

To guide the phasing of development over time, the following principles can be applied:

- Allowance for growth to take place incrementally over time. This is done in order to minimise the

need for concentrated investments or mega-form solutions at any stage of development. In addition, incremental growth provides flexibility in terms of phasing and size of individual phased packages. Heavy front-end costs will also be minimised or even done away with.

- Recognition that resources are limited and that growth can only take place when the requisite resources are available.
- Provision of a range of choices of site layout at each stage of growth.
- Promotion of variety and plurality in investment opportunities, thereby increasing participation by both the public and private sectors in the development of the town. This can be achieved by having projects covering a spectrum of sizes at any one time, ranging from those involving just one block to others involving several blocks. This will create the opportunity for both large and small developers/investors to actively participate in the process of urban growth.

7.2.2 Sequence of Development Phases

In line with the principles stated above, it is proposed that the LPA be developed over two main phases:

a) Phase 1 (By Year 2031)

4,764 ha of land will be developed, comprising almost **46%** of the total land area within the LPA (see Figure 7.1).

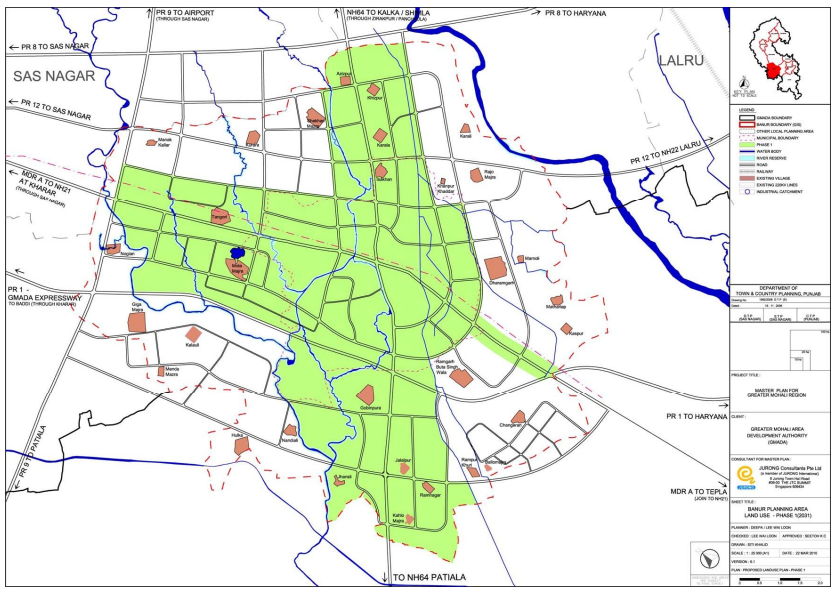

Figure 7.1: Phase 1 development

The boundary of the start-up area was drawn up taking into consideration the mix of land use types, proximity to existing highways and built-up areas, as well as ease of infrastructure connections.

Next, for the selection of developments to be incorporated under Phase 1, the planning rationale includes:

- Comprehensive integration of existing and committed developments with the new proposals.
- Utilisation of existing major roads and public infrastructure as growth corridors.
- Realisation of the long-term vision of Banur as an institutional town. This includes the prioritisation of developments within the Banur-Zirakpur Corridor and the educational institution cum medical hub at the southern portion of the LPA.

Following from the above, Phase 1 shall specifically comprise the following:

- Existing villages and built-up areas (including the town center).
- Developments along the two existing major roads NH 64 and MDR A.
- Committed/approved residential, industrial and institutional developments.
- Land parcels located within the Banur-Zirakpur Corridor.

Due to the long lead time of one to two years needed for implementation, basic infrastructure and utilities (including roads, electrical substations, sewers, bridges etc.) should be built and laid first. However, these should be scheduled to tie in with the surrounding new developments that are being constructed. This will help to reduce the amount of initial capital outlay and holding cost.

It is foreseen that the development projects implemented under Phase 1 will kick-start and fuel the growth of the entire LPA. As such, residential developments, provision of commercial space (for retail, leisure and entertainment) and other supporting facilities within the rest of the LPA will have to keep pace with the overall growing demand.

b) Phase 2 (By Year 2056)

An additional 1,663.6 ha of land will be developed under this phase. When fully implemented, **62%** of the total land area within the Banur LPA will become urbanised (Figure 7.2).

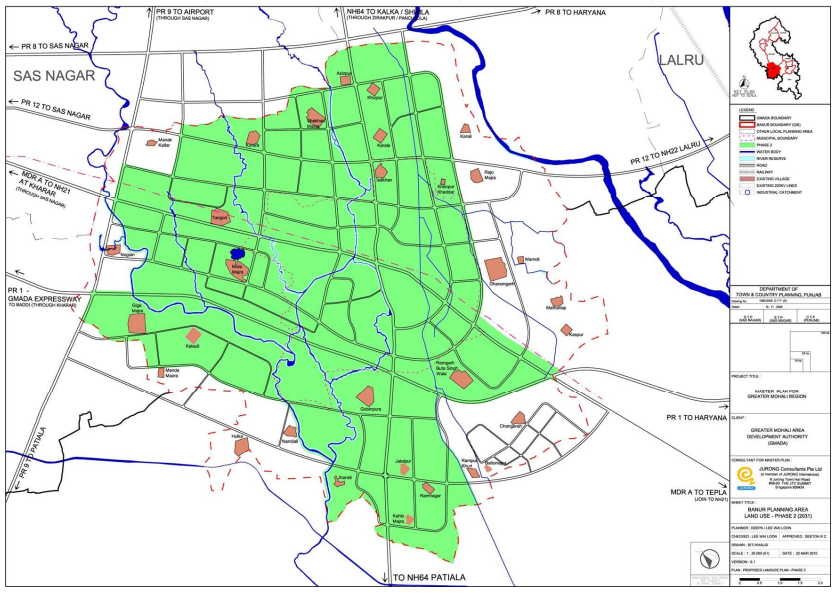

Figure 7.2: End of Phase 2 development

In the draft land use master plan (Year 2031), the areas to be developed under Phase 2 are designated ‘Rural and Agriculture’.

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8 Special and Detailed Controls

The purpose of the Development Control Regulations (DCR) is to assist developers and end-users within the Banur LPA to strive for a more quality and environmentally-friendly development.

In addition to the common development control parameters applicable to the entire Greater Mohali Region (GMR), there are certain special and detailed controls that are applicable specifically within the Banur LPA.

These DCRs are applicable to new and future developments, and developers are requested to abide by the zoning and planning intentions of the master plan. However, development proposals that have been granted approval by the Competent Authority previously will continue to be honoured and shall not be affected by these controls.

8.1 Development Controls

Banur is located to the south of S.A.S. Nagar and west of Zirakpur, and is being planned with the vision of becoming an institutional town. Two land uses that are pertinent specifically to the Banur LPA will be discussed in this section:

1. Residential
2. Institution
3. Mixed Use

8.1.1 Development Controls – Residential

Residential developments within the Banur LPA are subjected to the development controls as stipulated below.

a) Minimum road width

The minimum width of roads within residential zones shall be 10 m (35 feet). If the width of the existing road is less than the minimum width, a proportionate amount of land shall be safeguarded on both sides of the road for future road-widening, so as to comply with this requirement. Residential buildings located along these roads shall not exceed the storey height of ground plus two (G+2).

b) Group housing projects / Flatted developments

Group housing projects and flatted developments are allowed only if the existing or proposed road in front of the development is of the minimum width of 18 m (60 feet). The maximum permissible floor area ratio (FAR) and height of these developments along the 18 m-wide roads are 1:1.75 per acre and 22.5 m respectively.

Construction of residential houses sold by promoters on floor basis shall also be included under this category, with the parking requirement as per the norm for group housing.

Since the proposals in the master plan are very detailed and down to the zonal level, separate Zonal Development Plans shall not be prepared for the Banur LPA.

Outside the municipal limit, residential developments shall be allowed subject to compliance with the following conditions:

- The minimum development plot size is 25 acres;
- Development plot is compact and regularly-shaped; and
- There is proper and adequate access to social infrastructure and services.

c) Parking provisions

For flatted/group housing residential developments, the requisite parking provision is 1.5 ECS per 100 sqm of covered area. The maximum provision allowable for group housing projects/flatted developments is 3 ECS per dwelling unit. Separate parking requirements for plotted developments are shown in Table 8.1.

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Table 8.1: Parking requirements for plotted developments

Plot Size *	Parking Requirement
85 sqm and less 100 sq. yd. and less	2 scooter parking spaces
86 – 168 sqm 101 – 200 sq. yd.	1.5 car parking spaces within plot area
169 – 425 sqm 201 – 500 sq. yd.	2 car parking spaces within plot area
425 sqm and more 500 sq. yd. and more	3 car parking spaces within plot area

*: Deviation of up to 10% of this control is allowed if it is arising from site conditions/constraints.

There is no control on the size of the main gate along the front boundary wall of plotted developments. In addition, the construction of the front boundary wall is optional for purpose of meeting the parking requirements.

d) Non-residential activities

i) Commercial/Mixed Use within Residential zones

Within Municipal Limits

Commercial uses in residential zones located within the municipal limits shall be allowable along 80 feet-wide roads. Frontage and area requirements for such commercial developments shall be as per the Municipal rules and regulations.

For stand-alone commercial complexes with height greater than three storeys within as well as outside the Municipal limits, the additional criteria listed in Table 8.2 shall apply.

Table 8.2: Additional criteria for stand-alone commercial complexes (more than three storeys)

Para-meter	Criteria
Parking	For projects with no multiplexes, the minimum parking shall be 2 ECS per 100 sqm of covered area (including circulation area).
	For projects with multiplexes/cinemas/theatres, the minimum parking shall be: ▪ 3 ECS per 100 sqm of covered area, in respect of the covered area of the multiplex component + 30% of the total covered area of that component; and ▪ 2 ECS per 100 sqm of covered area, in respect of the balance commercial component and circulation area.
	Parking norms within the municipal limits shall be the same as that notified by the Department of Local Government.
	Total parking requirement shall be provided in the compulsory front set back and within the development site boundary or in the basement.
Land-scaping	If the development site area is more than one acre, a minimum 15% of the total area is to be reserve for landscaping purposes.
For move-ment of fire tender	The minimum setback distance is to comply with the existing norms and standards.
Ground Coverag e	Ground Coverage shall not exceed 40% of plot area.

At Local Level

There will be provisions for small-scale, single-storey or commercial on ground floor ~~facilities~~ at the local level within as well as outside the Municipal limits, subject to these abutting roads with a minimum width of 18 m (60 feet) in residential area.

These commercial facilities are intended to serve the needs of local residents only, and will not be shown separately on the draft master plan. Instead, they are subsumed under the predominant residential land use.

Outside Municipal Limits

Within residential zones located outside the municipal limits, commercial developments shall be allowed subject to compliance with the following conditions:

- Minimum development plot size of 2.5 acres;
- Development plot is compact and regularly-shaped;
- Minimum frontage of 20 m (70 feet); and
- Development plot abuts a road with a minimum width of 24 m (80 feet).

If part of the development plot is affected by a proposed road in the master plan, such that the development plot size does not meet the minimum requirement of 2.5 acres, the permissible built area or FAR shall be computed based on the land available after deducting the land area intended for road use.

If the promoter/developer wishes to include the permissible FAR for the land under the master plan road as part of the overall FAR for his development, he must first agree not to claim any compensation for the affected land.

Vehicular Access

Vehicular access to all properties within and outside the municipal limits that abut national highways shall be via service lanes with a minimum width of 9 m (30 feet).

The front setback for these properties is:

- Within municipal limits: 10 m;
- Outside municipal limits: 30 m (of which 15 m towards the road side shall form the greenbelt).

ii) Industrial Use within Residential Zones

There are two government-approved developments within the Banur LPA – M K Technology Industrial Park and super Mega Mixed Use Integrated Industrial Park of M/s PACL India Ltd.

Despite the predominant industrial/IT use, the land use zoning for these two developments is reflected as 'Residential' in the land use master plan. This is so that if necessary, the respective owner/developer has the flexibility to develop a pure residential development to better meet market demands.

Industries that are permitted within these two developments shall be restricted to IT, light, clean and non-pollutive industries only.

iii) Institutional Use within Residential Zones

Stand-alone educational and social institution (10+2 level) developments are allowed within residential zones. However, the width of the road fronting these developments (with the exception of nurseries and primary schools) shall not be less than 18 m (60 feet).

8.1.2 Development Controls – Institution

This is the major land use that will bring out the distinctive character of the Banur LPA.

Some development control parameters are common to all institutional developments. These include:

- Width of road
- Width of road buffer
- Setback controls
- Parking provision

These requirements are framed to ensure that the users in each development will enjoy a conducive environment and will have proper amenity against noise and air pollution from roads and adjoining developments.

a) Width of Road

As stated in Section 1.1.3 d), the minimum width of the road in front of institutional developments is 18 m (60 feet). The only exceptions are nurseries and primary schools. If existing road width is less than 18m, it shall be widened to 18m proportionally on both sides.

b) Width of Road Buffer

Buffers are building setback requirements from public roads, which typically include a tree-planting strip. The rationale for the imposition of buffers within individual developments fronting roads is to provide uniform building setbacks. This will create rows of buildings with aligned facades, which will in turn provide critical vistas and neat streetscapes.

The minimum width of the buffer – which determines the building setback – varies with the hierarchy (width) of the road that the development site fronts, as well as the height and type of the development. Table 8.3 shows the details on road buffer requirements for institutional developments.

Table 8.3: Road buffer requirements for institutional developments

Road Category	Minimum width of buffer (width on site)	Minimum width for sub-zones *
Expressway	15 m	5 m green & 10 m physical
Major arterial road (NH 64 and MDRA)	7.5 m	3 m green & 4.5 m physical
Minor arterial road	5 m	3 m green & 2 m physical
Collector road	2.3 m	2 m green & 0.3 m physical
Primary access road	2 m	2 m green

*: Does not include the width of the right-of-way.

c) Setback Controls

For institution developments, the setback controls are as follows (see Figure 8.1):

- From the development boundary facing roads: Road buffer
- From the other development boundaries: 4.5 m (minimum)
- No buildings or developments are allowed to encroach into the buffer zone. However, selected light ancillary structures, such as bin centres, guard houses, small substations, sign boards, lamp posts, letter boxes etc., may be allowed to be placed within the buffer zone.
- There should be a stipulation that planting within the development site is required, making it mandatory for developers to plant trees and scrubs within their site. The intention is for the planting to help soften the environment. Exemption can only be granted if the planting will become a fire hazard for the proposed development and/or it is a civil defense requirement.
- Within the buffer, there are two sub-zones, namely the green buffer and the physical buffer.
- All buildings are to be setback from roads as per the buffer guidelines.

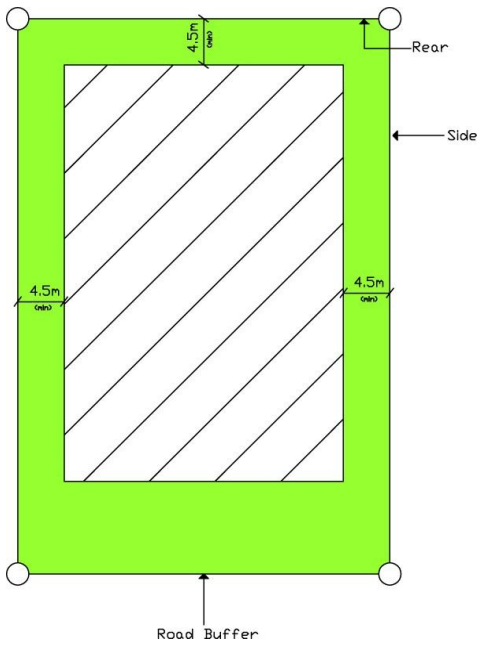

Figure 8.1: Setback controls for institutional developments

d) Parking Provision

For institutional developments, the requisite parking provision is 1 ECS per 100 sqm of covered area.

8.2 Development Controls for Educational Institutions

Educational institution zones are proposed in the western part of Banur (see Figure 8.2).

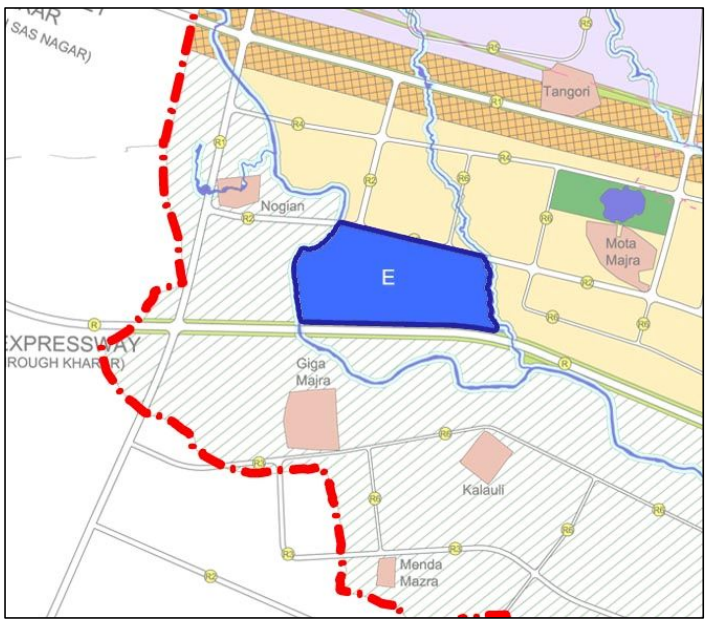

Figure 8.2: Proposed educational institution zones

a) Definition

An educational institution is a development used or intended to be used mainly for educational purposes. Educational institutions include:

- Kindergarten
- Primary school
- Secondary school

- Polytechnic
- Junior college
- Technical training institute
- Vocational institute
- Training institute
- Colleges – Medical, Technical, Arts & Science Institutes etc.
- University
- International school
- Foreign school
- Special schools (e.g. school for the disabled).

b) Use Quantum

The predominant educational institution use should not be less than 80% of the total GFA. 5% of the total GFA can be used for residential purposes, specifically, to cater to the provision of staff accommodation/housing. This quantum is on top of the standard provision for student accommodation such as hostels and dormitories.

Pure commercial uses (such as commercial schools and tuition centres) are strictly not allowed. The only exception to the rule forbidding pure commercial uses is the large educational institution cum medical hub proposed at the southern part of Banur.

c) Educational Institution cum Medical Hub

The vision for the proposed educational institution cum medical hub (Figure 8.3) is akin to that of the Dubai Knowledge Village, which was established in 2003 to attract international higher educational bodies, as well as regional and international training institutes.

The proposed site contains an existing medical school and a hospital, which will be integrated into the future larger development. The planning intention is for the hub to specialise in medical and pharmaceutical education at the tertiary level, research and development in the medical and pharmaceutical fields, medical tourism and holistic/wellness treatments.

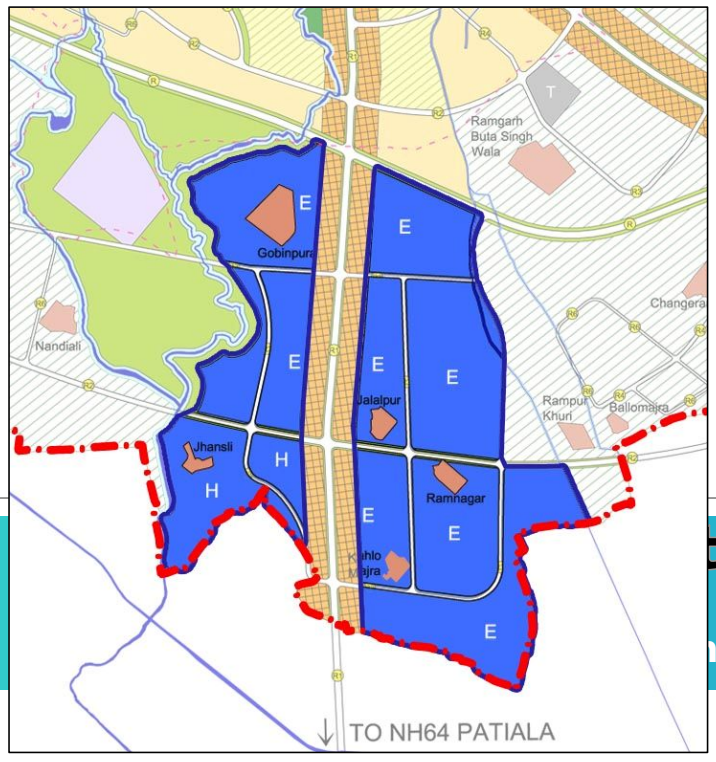

Figure 8.3: Proposed educational institution cum medical hub

The population catchment for this hub – in terms of students, staff and tourists – goes beyond the Banur LPA itself. Rather, it includes the entire GMR, the Punjab state and beyond (India and other countries).

The typical size for a university is 10 ha, while that for a technical college or polytechnic is 7 ha, or as per the norms of the affiliating authority such as AICTE etc. Additionally, given the unique character of this proposed hub, a separate set of detailed land use quantum controls is proposed.

Specifically, the predominant institutional use – including academic complexes, lecture theatres/halls, tutorial/discussion/class rooms, research and scientific laboratories, libraries, faculty and department offices etc. – shall not be less than 70% of the total GFA.

Allowable ancillary and supporting facilities for the predominant institutional use include:

- Central administration building
- Student hostels/halls of residence
- Graduate housing

- Student activities and services centre (for e.g. student unions, societies and faculty clubs)
- Health, medical and dental centre
- Counseling centre
- Sports and swimming complex
- Arts and cultural centre
- Recreational facilities
- Security posts
- Car parking facilities
- Residential use: This caters to the housing and accommodation needs for full-time staff, guest lecturers and visiting fellows. The quantum control remains at 5% of the overall GFA.

The central administration building can house the offices of the university's management and other administrative departments, such as finance, registrar, students' liaison, alumnus relations, career counseling and guidance etc. In addition, it can serve as the landmark for the hub.

A suitable site for such a landmark building is the land parcel near the Ramgarh Buta Singh Wala Village (see Figure 8.3). Located to the south of the existing built-up area, a landmark building sited on this land parcel can help to demarcate the entrance of – and gateway into – the future hub.

As mentioned earlier, supporting commercial uses are allowed within this hub to meet the needs of future users and to ensure self-sufficiency. However, only 5% (maximum) of the total GFA will be permitted for such commercial uses.

The bulk of these commercial uses can be consolidated within a centralised building, for example, an amenities centre. This centre can provide one-stop services and will facilitate informal social interactions and regular exchange of information among and between students, staff and faculty members.

Examples of allowable commercial uses within the educational institution cum medical hub include:

- F&B outlet: This includes canteen, food court, restaurant, cafe and fast food outlet. Each school or faculty should have at least one canteen each so that students and staff can have their meals conveniently. The other F&B outlets can be located within the amenities centre.
- Retail outlet (for e.g. shops selling books, magazines, stationery, computers and IT-related products)
- Mini-mart
- Convenience store
- Bank branch
- Postal outlet
- Travel agency
- Medical clinic
- Dental clinic
- Hair and beauty salon
- Barber shop
- Student-run business
- Co-operative

Within the hub, low-rise buildings (four to six storeys), interesting architecture, generous provision of open spaces and proper landscaping design will help to create a conducive human-scale environment within a park-like setting. Pedestrian linkages (preferably covered) connecting different buildings and parts of the campus should also be built to facilitate student movements. These features will create and reinforce the predominant character of Banur as an institutional town.

8.1.3 Development Controls – Mixed Use

The Mixed use Zone within Banur LPA is on both sides of the major roads NH 64 and MDR A. These are 200-metre wide linear corridors with a minimum size requirement of 2.5 acres. Commercial uses, including shopping malls, multiplexes, offices, cinemas and hotels, are allowed in this zone. To prevent this zone from being converted to pure residential areas only high-end residential developments are allowed on the upper floors of the integrated developments.

8.3 Other Development Guidelines

a) Green reserves along waterbodies

Green reserves are to be provided along both sides of rivers and waterbodies. The requisite widths are:

- Major rivers/'choes': 30 m (minimum) each side.

- Minor rivers/'choes': 10 m (minimum) each side.

Realignment of existing waterbodies shall be permissible, wherever feasible, subject to the certification by the Engineering Department to ensure free flow of storm water.

After any such realignment, the river mouth, river bed and green strip on both sides of the waterbody shall be maintained at least to the minimum prescribed level for this waterbody prior to realignment.

Golf course and sports and recreational activities are allowed within the green reserves. The permissible FAR, ground coverage, height, number of storeys and hard surface regulations shall be as prescribed in the periphery policy notified vide dated 20-1-2006.~~master plan report.~~

b) Transferable Development Rights

To facilitate development, it is necessary to accord top priority to the implementation of public utilities and infrastructure (such as roads, parks, green belts etc.), which will in turn encourage urbanization.

However, the respective technical agency or authority will not be able to proceed with its implementation programmes until the ownership of private land affected by these public utilities and infrastructure has been transferred to the state and/or the relevant authority(s).

Acquisition of private land for this purpose can be carried out through one of the following options:

- Cash compensation can be made to affected land owners based on fair market value of the land to be acquired.
- A government-approved land pooling scheme can be implemented.
- Transferable Development Rights (TDR) from the private land owner(s) to the state and/or relevant authority can be used, based on the precedence set in Maharashtra, Mumbai.

Of these options, TDR is recommended because:

1. It is relatively simple and straightforward to implement and execute;
2. The requisite public infrastructure projects can be implemented quickly, thus facilitating rapid urban development; and
3. Most importantly, the interests of affected land owners will be protected.

Under the TDR scheme, the affected land owner(s) shall be entitled to additional FAR for the development of the balance of his land parcel, at a rate of 1:1. The additional FAR will not be subjected to any CLU, EDC or licence/permission fees. The land owner(s) also has the option to sell it in total or in parts to a third party.

All records of transactions administered under the TDR scheme shall be maintained by the state and/or relevant authority(s), based on the precedence set in Maharashtra, Mumbai.

The current practice to determine the market value for TDR (for purpose of computing additional FAR or monetary compensation), vide notification no. 17/17/01-5HG2/7623 dated 19 September 2007, shall continue for all areas under the jurisdiction of GMADA until 31 Jul 2011.
New detailed guidelines on the operation and implementation of the TDR scheme shall be prepared and announced by GMADA in due course.

The TDR scheme shall be restricted to development projects for public infrastructure and facilities, which shall be announced from time to time. The additional FAR shall not be transferable from one LPA to another.

Mega projects with an FAR of 1.75 or more that have been approved for group housing projects and/or commercial developments, or for which such land uses are permissible, shall have to purchase additional FAR from suitable land owners after 31 Jul 2011. However, the additional FAR shall only be purchased from within the same LPA in which it is to be used.

Non-mega projects shall also be entitled to the purchase of additional FAR based on the procedure stated above.

8.4 Proposed Land Use Legend and Zoning Interpretation for the Banur LPA

S/No.	Land Use	Uses	Permitted developments
1	**Residential**	These are areas used or intended to be used predominantly for residential development. Serviced apartments and student hostels may also be allowed. Commercial and institutional uses are allowed within residential areas if these comply with the stipulated criteria.	Residential developments include: 1. Flats 2. Public housing 3. Apartment 4. Townhouse 5. Semi-detached house 6. Detached house 7. Strata-landed housing 8. Group housing project 9. Flatted development 10. Plotted residential development 11. Retirement housing 12. Serviced apartment 13. Hostel (for working women, students, youths etc.) 14. IT Parks and Industrial Parks with non-polluting industries only. 15. Educational and Social Institutions Allowable commercial developments within residential zones include: 1. Single-storey commercial 2. Double-storey commercial 3. Ground plus two (G+2) storey commercial 4. Stand-alone commercial complexes with height more than three storeys
2	**Mixed Use 1**	Commercial/Residential use is allowed, subject to a minimum plot size of 2.5~~5~~ acres.	1. Shopping malls 2. Multiplex 3. Offices 4. Hotels 5. Serviced Apartments 6. Flatted and Cluster housing 7. Retail and convenient shopping
3	**Industry and Warehouse**	These are areas used or intended to be used for clean industry, light industry and warehouse.	1. Computer software development 2. Knowledge Park 3. Assembly and repair of computer hardware and electronic equipment 4. Printing, publishing and allied industries 5. Packing of dried foodstuff 6. Warehouse except for storage of chemicals
4	**Institution**	**Health & Medical Care**	1. Hospital 2. Polyclinic 3. Clinic 4. Dental clinic 5. Veterinary clinic 6. Nursing home 7. Maternity home 8. Family welfare centre 9. Dispensary
		Educational Institution	1. Kindergarten 2. Primary school 3. Secondary school 4. Junior college 5. Technical institute 6. Polytechnic 7. University

S/No.	Land Use	Uses	Permitted developments
			8. Religious school/institute 9. Foreign school 10. International school 11. Special education school (e.g. School for the Disabled)
		Place of Worship	1. Gurudwaras 2. Temple 3. Mosque 4. Church
		Civic & Community Institution	**<u>Civic Institutions</u>** 1. Courts 2. Government offices 3. Foreign mission/Chancery 4. Police station 5. Fire station 6. Prison 7. Reformative centre 8. Disaster management center **<u>Community Institutions</u>** 9. Association premises 10. Community centre/club 11. Community hall 12. Welfare home 13. Child care centre 14. Home for the aged 15. Home for the disabled 16. Workers' dormitory 17. Facility centre **<u>Cultural Institutions</u>** 18. Television/filming studio/complex 19. Performing arts centre 20. Library 21. Museum 22. Arts centre 23. Science centre 24. Concert hall 25. Socio-cultural complex
5	**Open Space**	These areas are used or intended to be used as open space and no commercial activity is allowed.	1. Forest reserve 2. Wooded area 3. Swamp area 4. Natural open space 5. Public promenades
6	**Park**	These are areas used or intended to be used mainly for parks or gardens for the enjoyment of the general public. It includes pedestrian linkages.	1. National park 2. Regional park 3. Community park 4. Neighborhood park 5. Park connector 6. Zoological garden 7. Botanic garden
7	**Water body**	These are areas used or intended to be used for drainage purposes and water areas (such as reservoirs, ponds, rivers and other water channels).	1. River 2. Major drain 3. Canal 4. Water channel 5. Reservoir 6. Pond

S/No.	Land Use	Uses	Permitted developments
8	**River Reserve**	These are areas safeguarded for the river/water channels during the wet season. It includes a strip of open space on both sides of the river, ranging in width from 10~~20~~ m to 30~~40~~ m.	1. Open space 2. Maintenance access road
9	**Road**	These are areas used or intended to be used for existing and proposed roads.	1. Expressway 2. Major arterial road 3. Minor arterial road 4. Collector road 5. Primary access road
~~11~~10	**Transport Facilities**	These are areas used or intended to be used mainly for the parking of vehicles and transport facilities.	1. Car Park 2. Garage 3. Heavy vehicle park 4. Trailer park 5. Bus depot/terminal 6. Transport depot 7. Train marshalling yard/depot 8. Driving circuit/test centre 9. Petrol station/kiosk
~~12~~11	**Rural & Agriculture**	These are areas used or intended to be used mainly for agricultural purposes. It includes areas that are to be left rural and not needed for development by Year 2031.	1. Agro-technology park 2. Aquaculture farm (e.g. aquarium fish) 3. Plant nursery 4. Hydroponics farm 5. Agriculture research/experimental station 6. Floral mile (i.e., nursery cum wholesale centre) 7. Utilities
~~13~~12	**Existing Built-up**	This refers to the pre-existing built-up area that comprises a variety of mixed uses.	1. Urbanised area
~~14~~13	**Existing Village**	These are the existing village-abadi areas.	1. Farm house 2. Rural settlement 3. Pond
~~15~~14	**Existing 220 KV Lines**	These are above-ground power lines on pylons. It includes a strip of open space reserved on both sides of the base of the pylons, on which no other structure or development is allowed.	1. Open space (with existing pylons)

S/No.	Land Use	Uses	Permitted developments
15	Utility	These are areas used or intended to be used mainly for public utilities and telecommunications infrastructure, including water works, sewage disposal works and other public installations such as electric substations.	1. Electric sub-station 2. Electric grid station 3. Gas-fired power station 4. Raw & local water treatment works 5. Sewage treatment plant 6. Sewage pumping station 7. Sewage disposal work 8. Incineration plant 9. Landfill site 10. Transfer stations 11. Treatment storage & disposal facility 12. Telecommunications station

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Other annotations (To be used in conjunction with the land use zones)	
Subject planning area boundary	
Other planning area boundary	
Plot ratio (intensity) boundary	
2.8	Maximum Permissible Plot Ratio/ Floor Space Index
Conservation area	C
Monument	1

9 Conclusion

The vision for the Banur LPA is to develop it into an institutional town and the education cum medical hub of the GMR. If the plan for the LPA were to be successfully implemented and realised, the economy and standard of living within the GMR will be greatly enhanced.

The specific development aims for the LPA are outlined as follows:

- To actualise the concept of an institutional town within a green and park-like environment.
- To serve the institutional and educational needs of the entire community within the GMR.
- To provide a comprehensive spectrum of facilities, services and activities for residents and visitors.
- To further develop and leverage on the Banur-Zirakpur Corridor for economic growth.
- To create greater employment opportunities for locals and in-migrants.

The land use, transportation and infrastructure plans/proposals outlined in the preceding chapters of this report provide GMADA with the necessary information and tools to achieve the vision and aims stated above.

While it is JURONG's aim to equip GMADA with a comprehensive list of planning and development guidelines for Banur's growth in the next few decades, we have also incorporated flexibility in the various plans and proposals to ensure that GMADA will be able to meet changing demands and expectations within the LPA and the GMR in the years to come.

Following from the above, the draft master plan is not actually intended to be the final blue print for Banur's long-term development. Rather, it serves as a broad base plan to facilitate innovative developments within the LPA, which will in turn attract investments from both the public and private sectors.

Moving forward, it is proposed that a micro-level study of the individual LPAs be carried out. This will help to fine-tune the broad land use proposals for each of the LPA. In addition, this will also facilitate an integrated development approach for the entire GMR, ensuring that the plans for the various LPAs complement one another.

Last but not least, the critical and vital role played by the government and related agencies cannot be further stressed. Specifically, a coordinated approach must be adopted by the different agencies such that infrastructure facilities are implemented in tandem with – and support – the various land use proposals. Co-ordination will still be needed at the later stage, when it comes to the servicing and maintenance of the various infrastructure facilities.

With a strong and effective public-private partnership, the vision for Banur will most certainly become a reality, making it a truly great place to live, work and play in.

Figure 6.1: Proposed Potable Water Supply Main

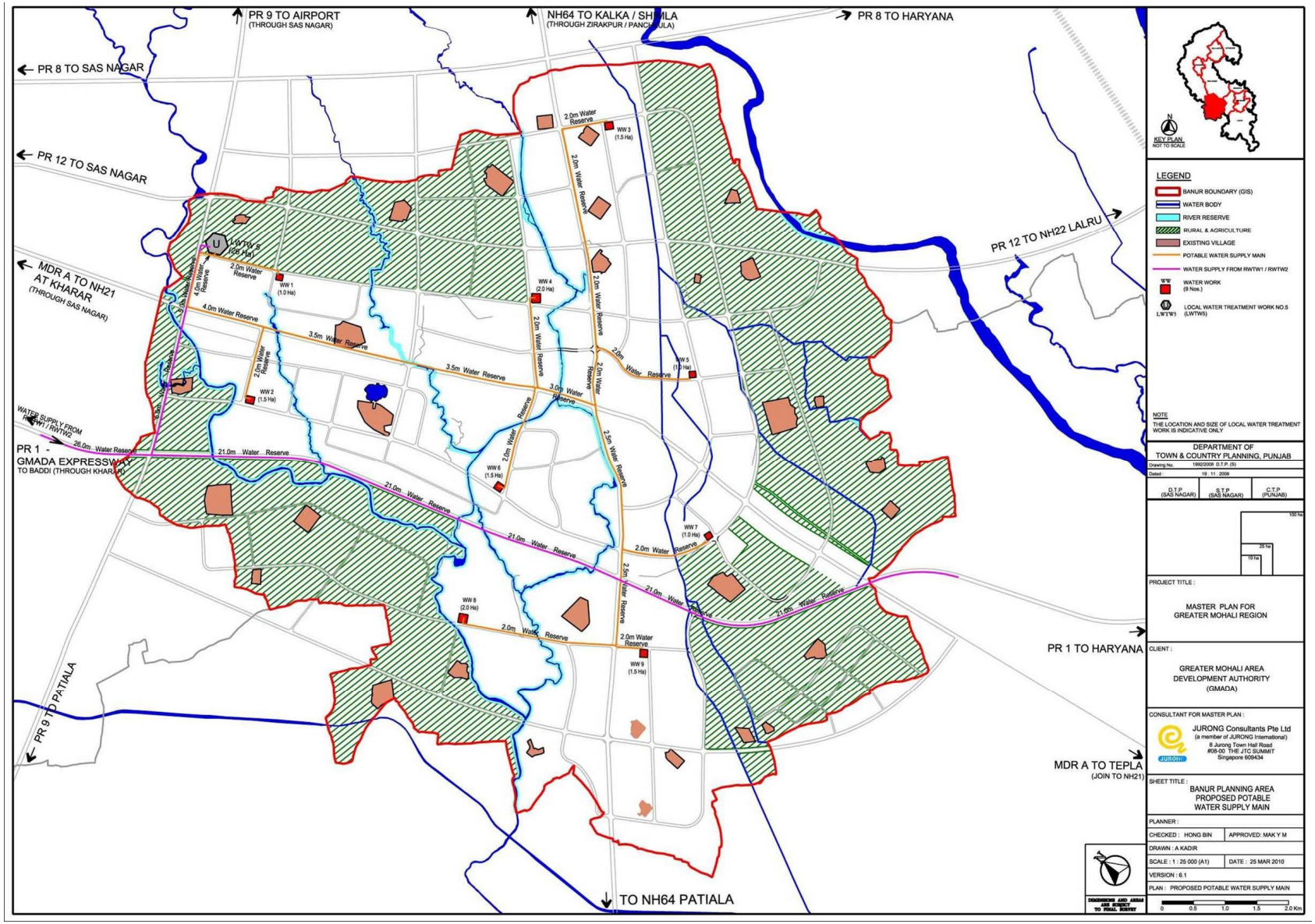


Figure 6.2: Proposed Potable Water Distribution Zone

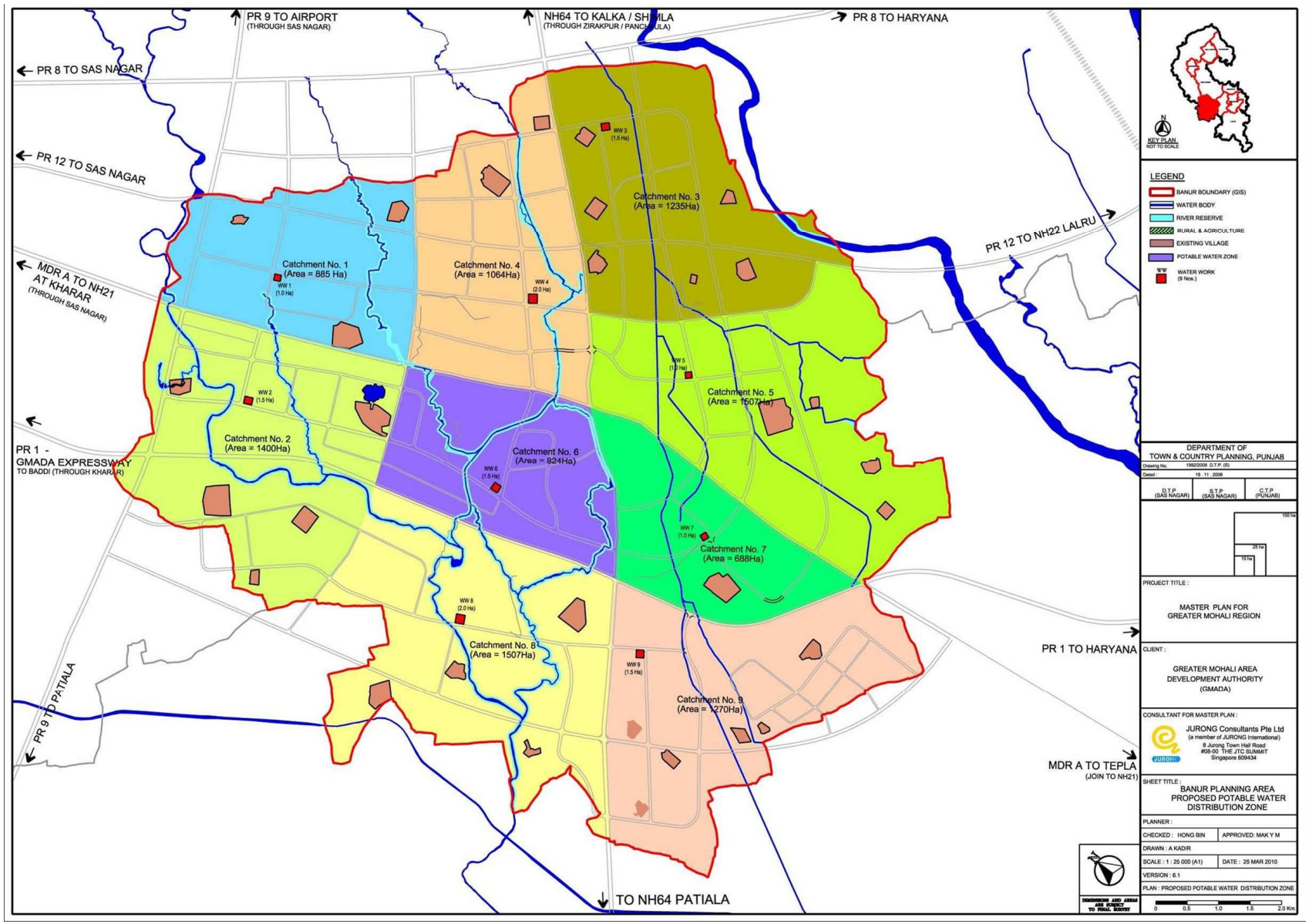


Figure 6.3: Proposed Potable Water Distribution Main

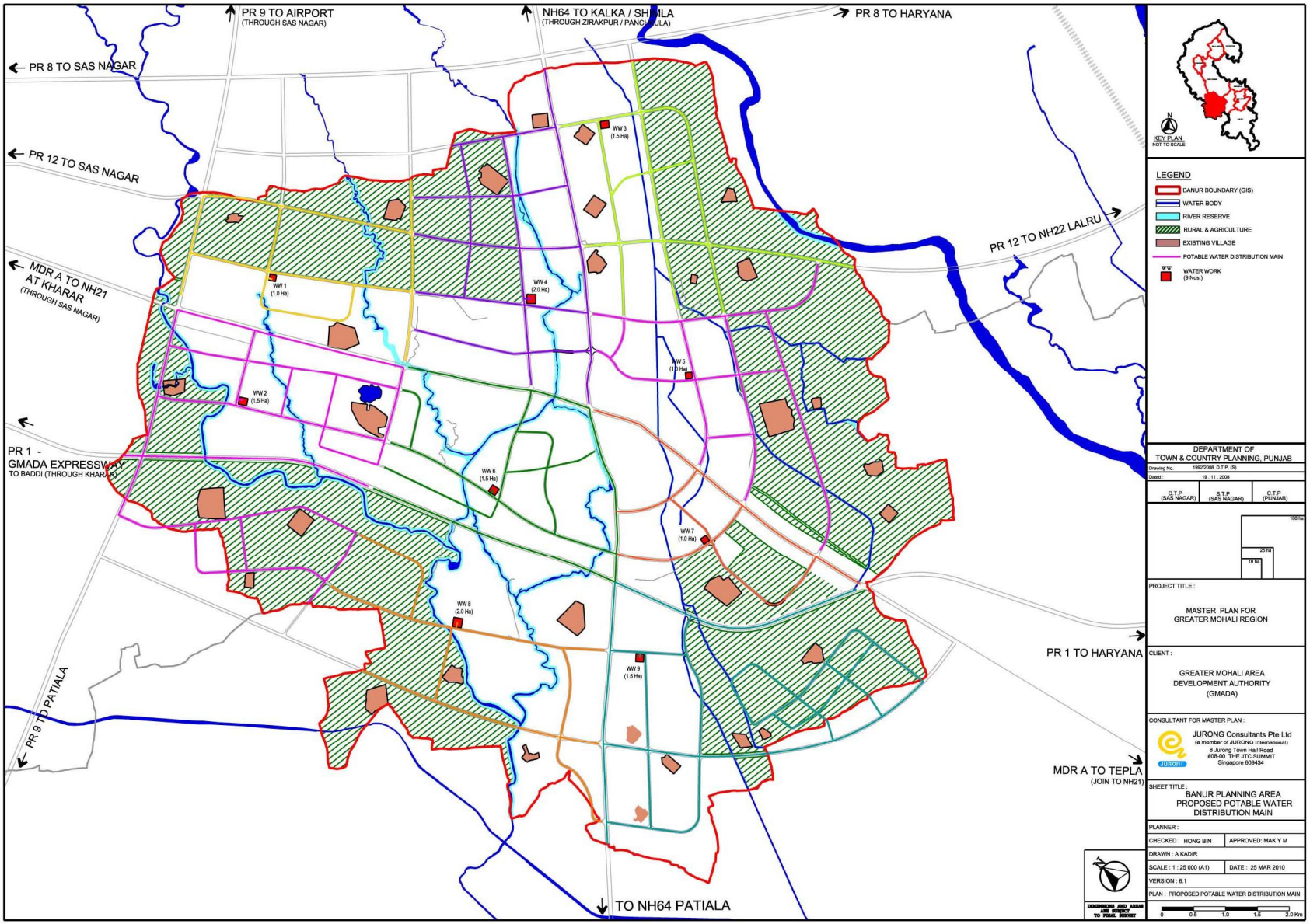


Figure 6.4: Proposed Recycled Water Supply Main

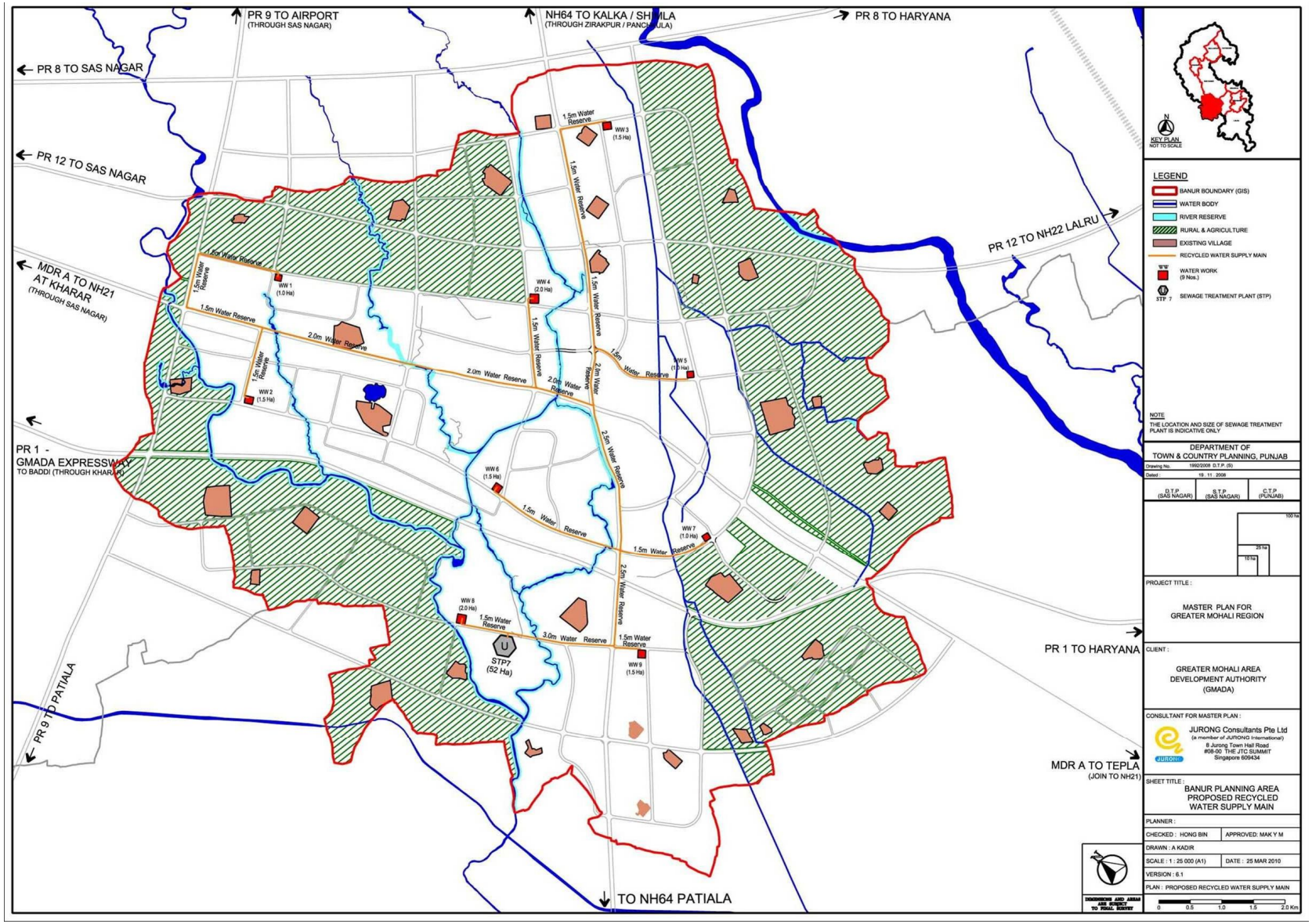


Figure 6.5: Proposed Recycled Water Distribution Zone

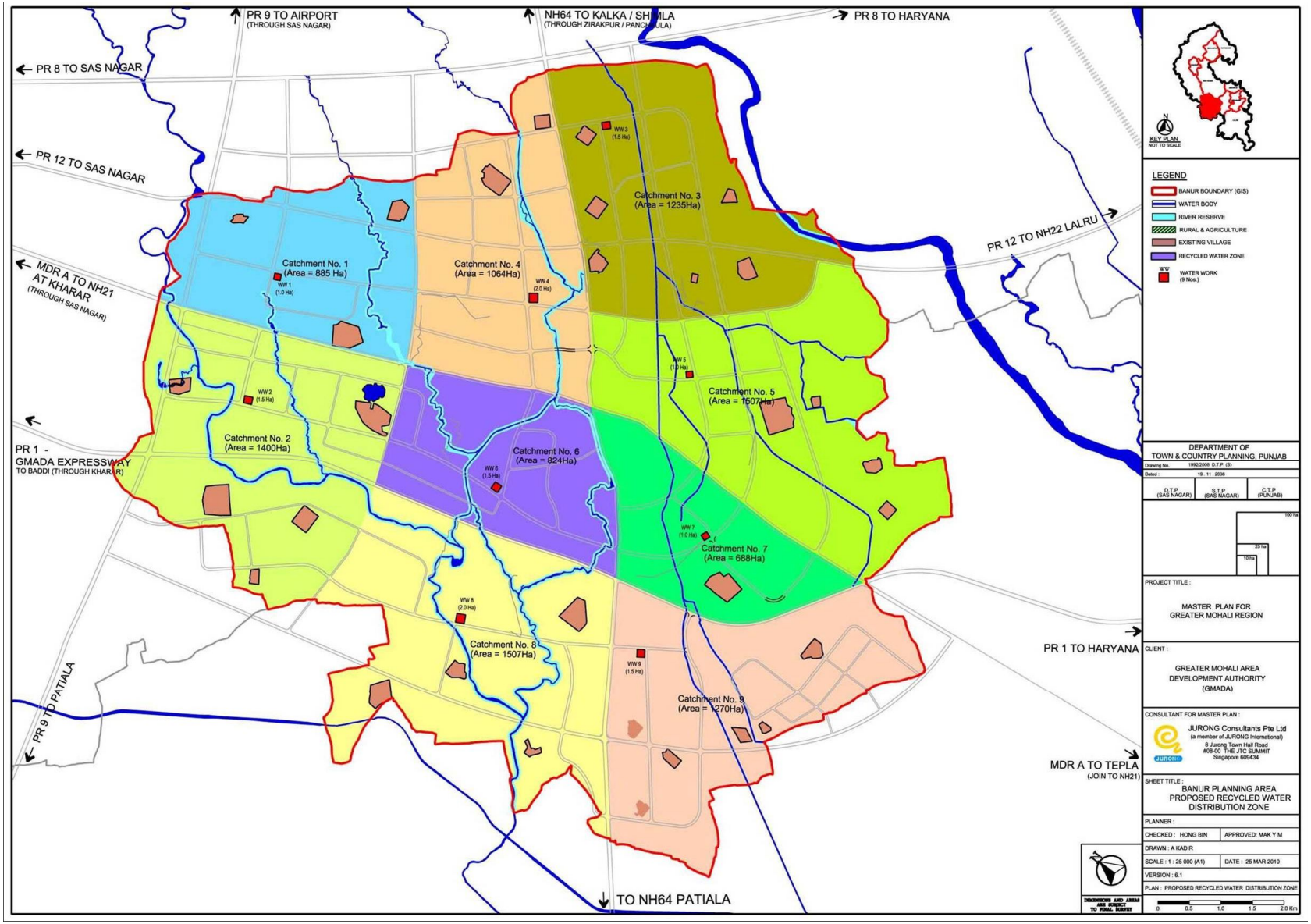


Figure 6.6: Proposed Recycled Water Distribution Main

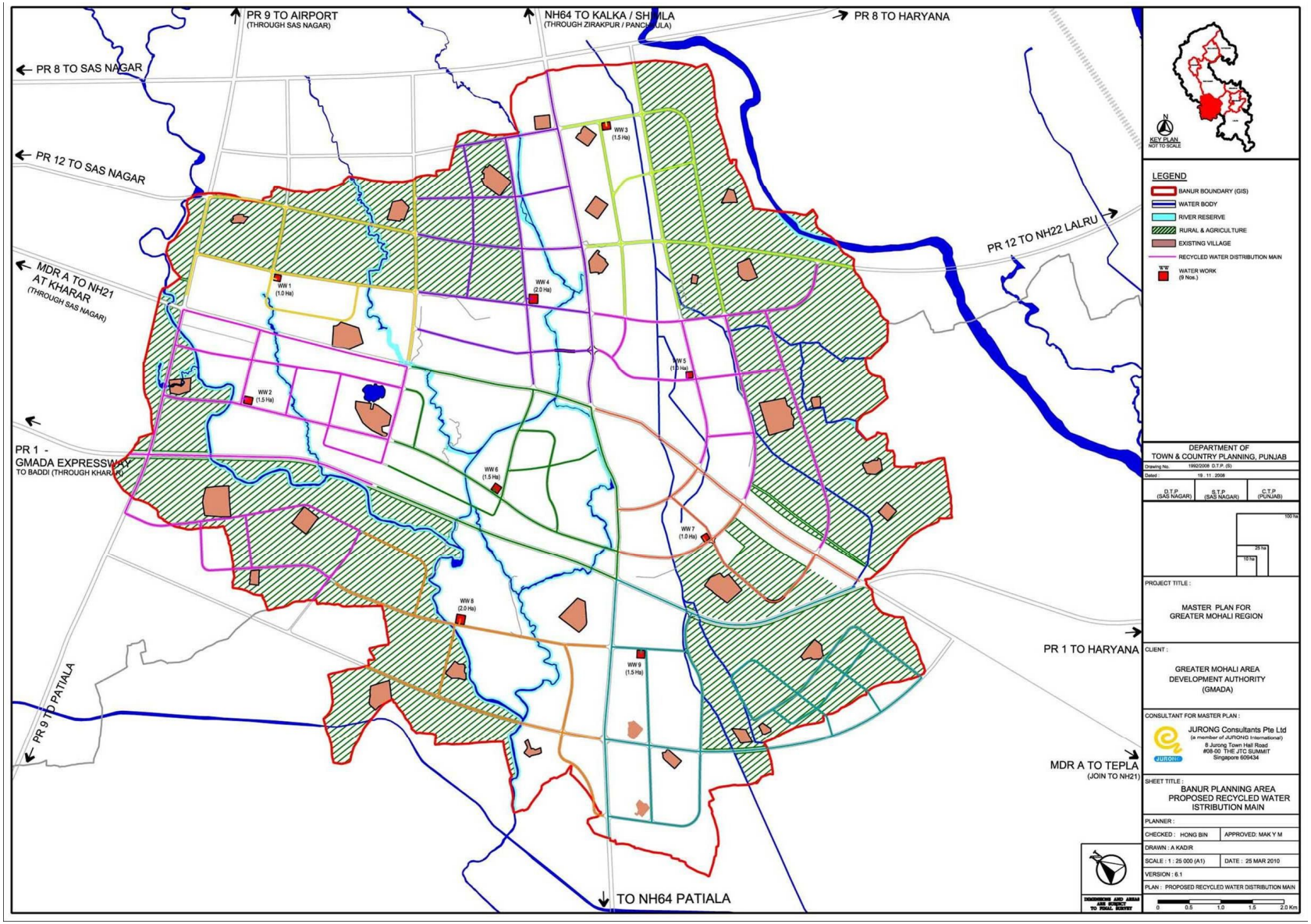


Figure 6.8: Proposed Storm Water Catchment Areas

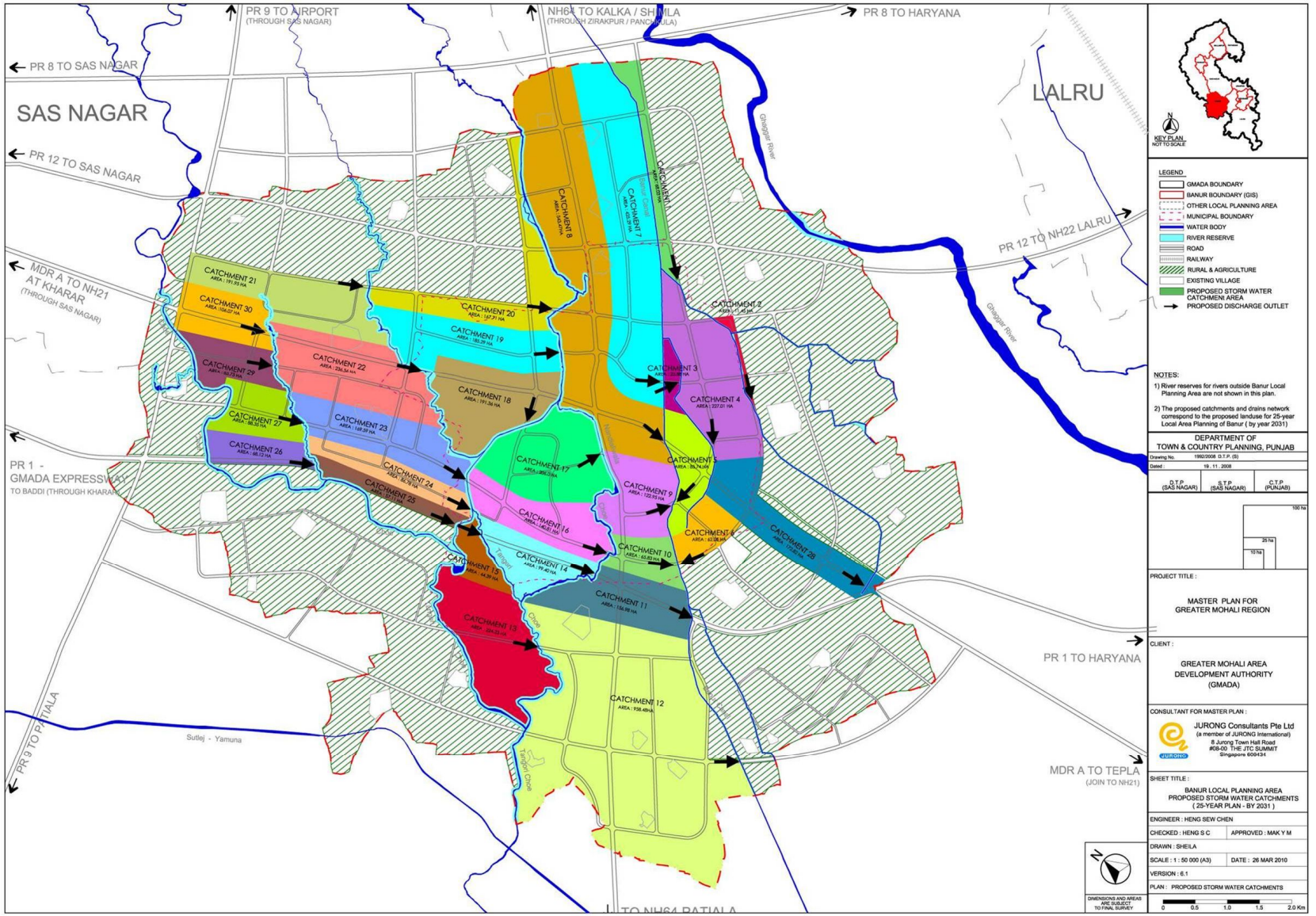


Figure 6.9: Proposed Storm Water Drainage Network Scheme

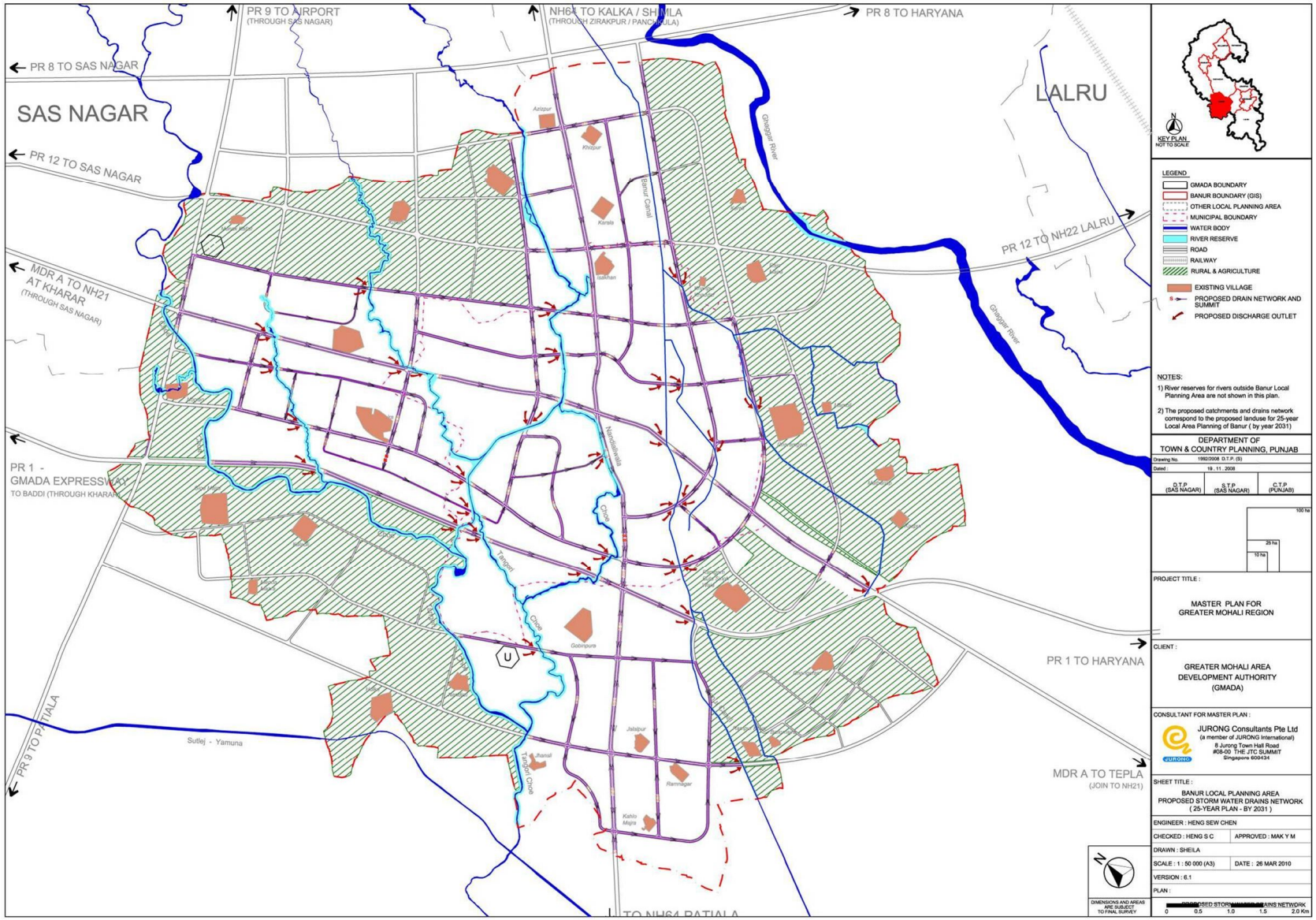


Figure 6.10: Proposed Pond Command Areas

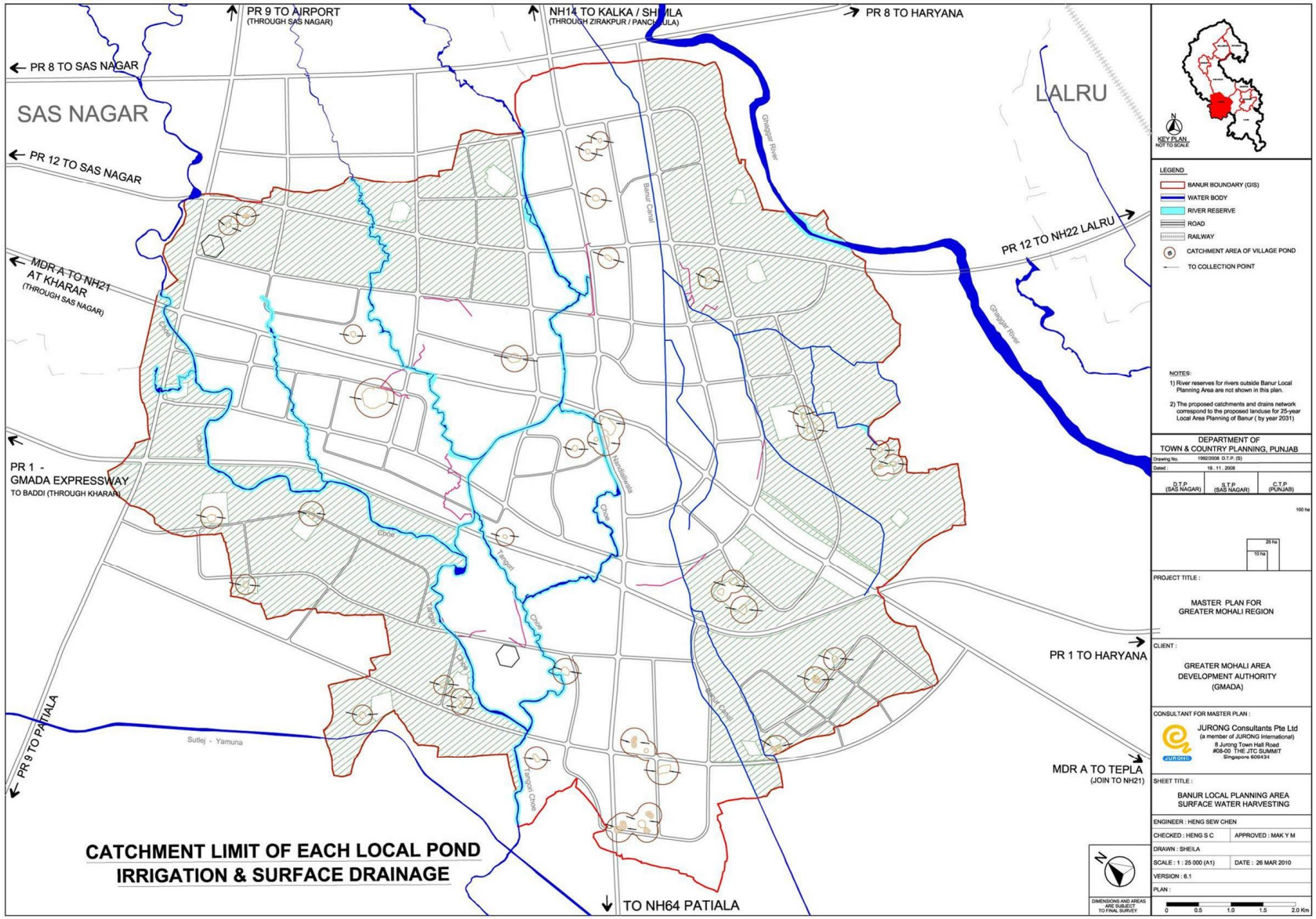
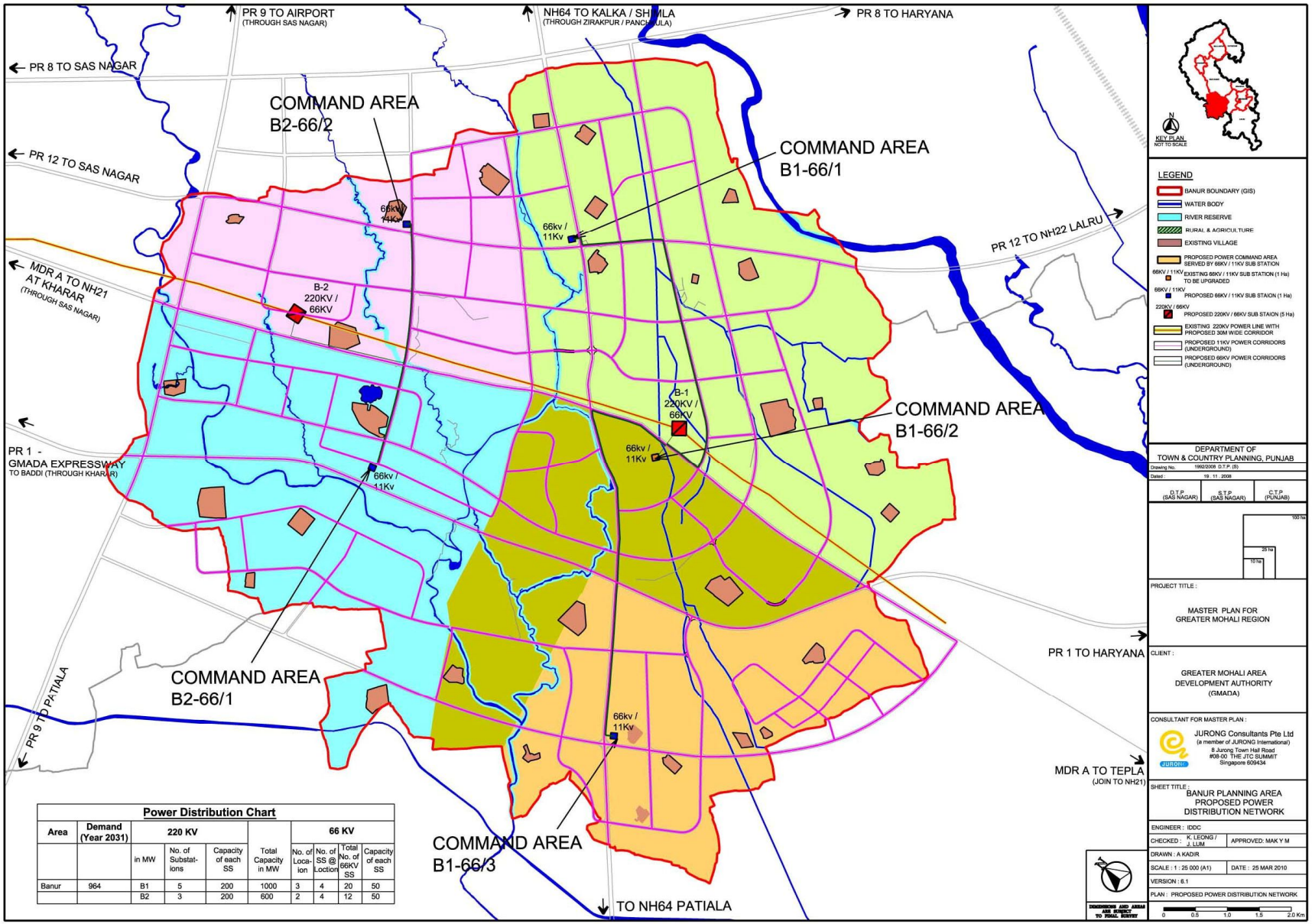


Figure 6.11: Proposed Power Supply and Distribution Plan



Power Distribution Chart

Area	Demand (Year 2031)	220 KV			Total Capacity in MW	66 KV			
		in MW	No. of Substat-ions	Capacity of each SS		No. of Loca-ion	No. of SS @ Loction	Total No. of 66KV SS	Capacity of each SS
Banur	964	B1	5	200	1000	3	4	20	50
		B2	3	200	600	2	4	12	50

Figure 6.13: Proposed Sewerage Catchment

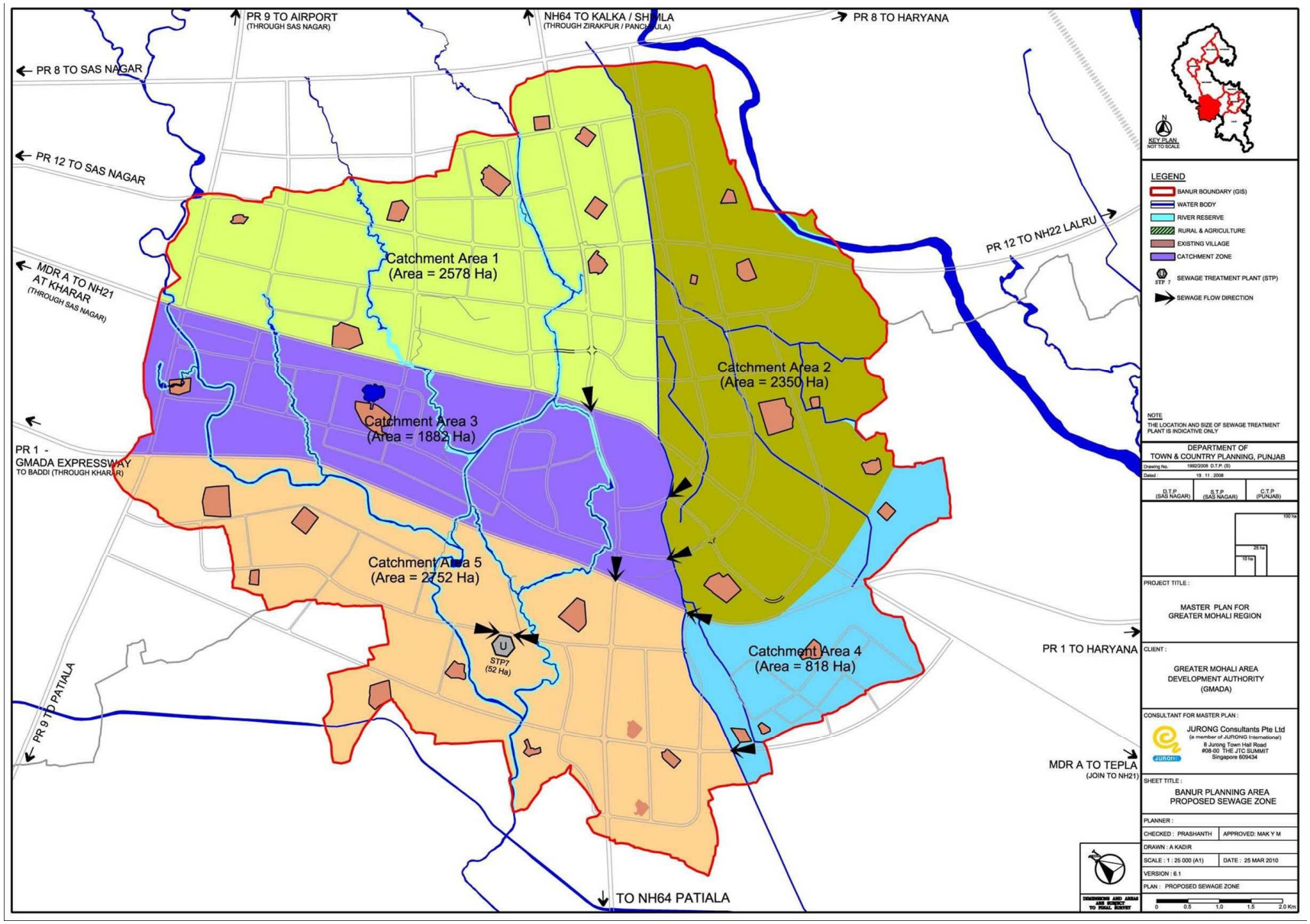


Figure 6.14: Proposed Sewerage Network

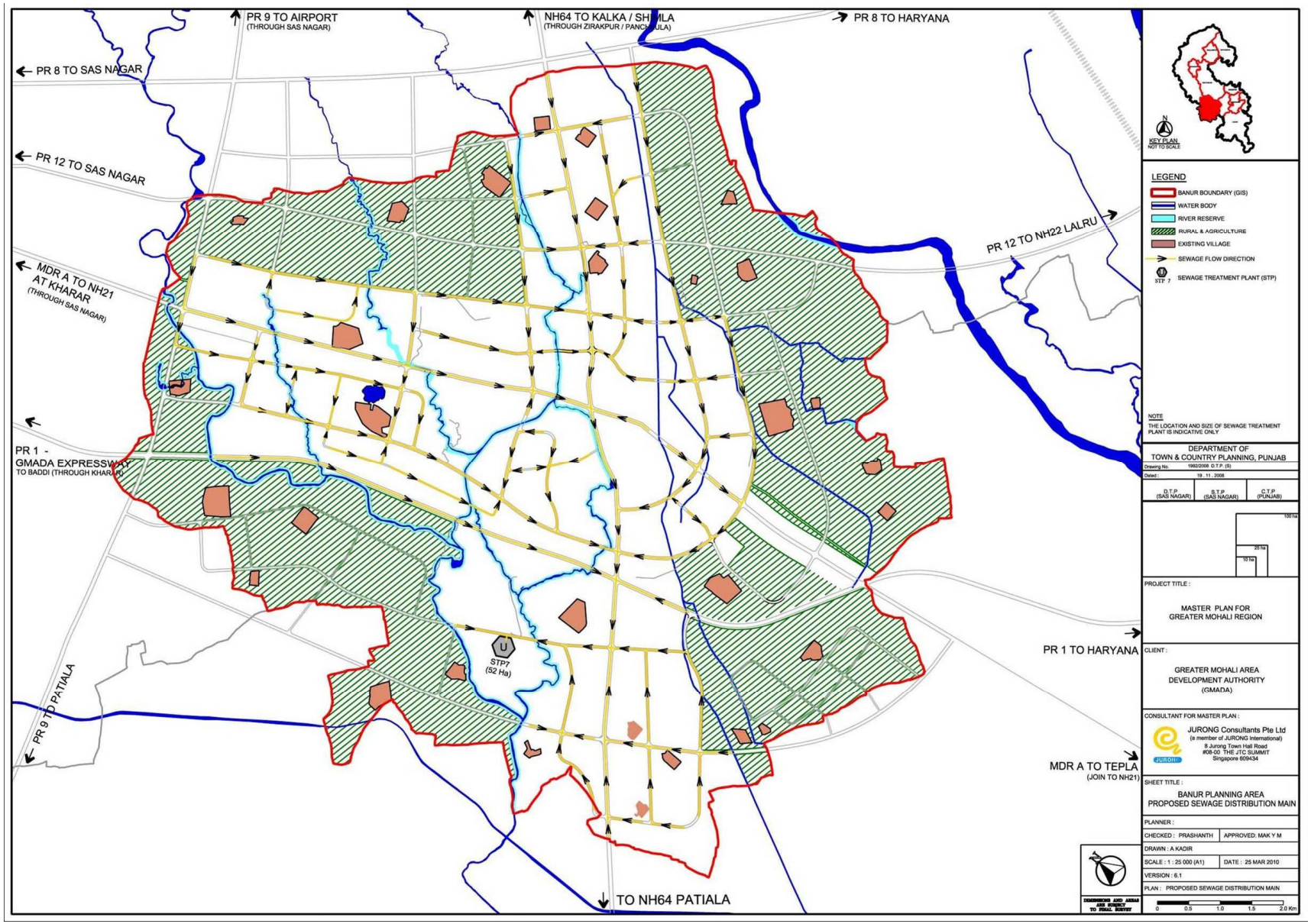


Figure 6.15: Proposed Solid Wastes Facilities

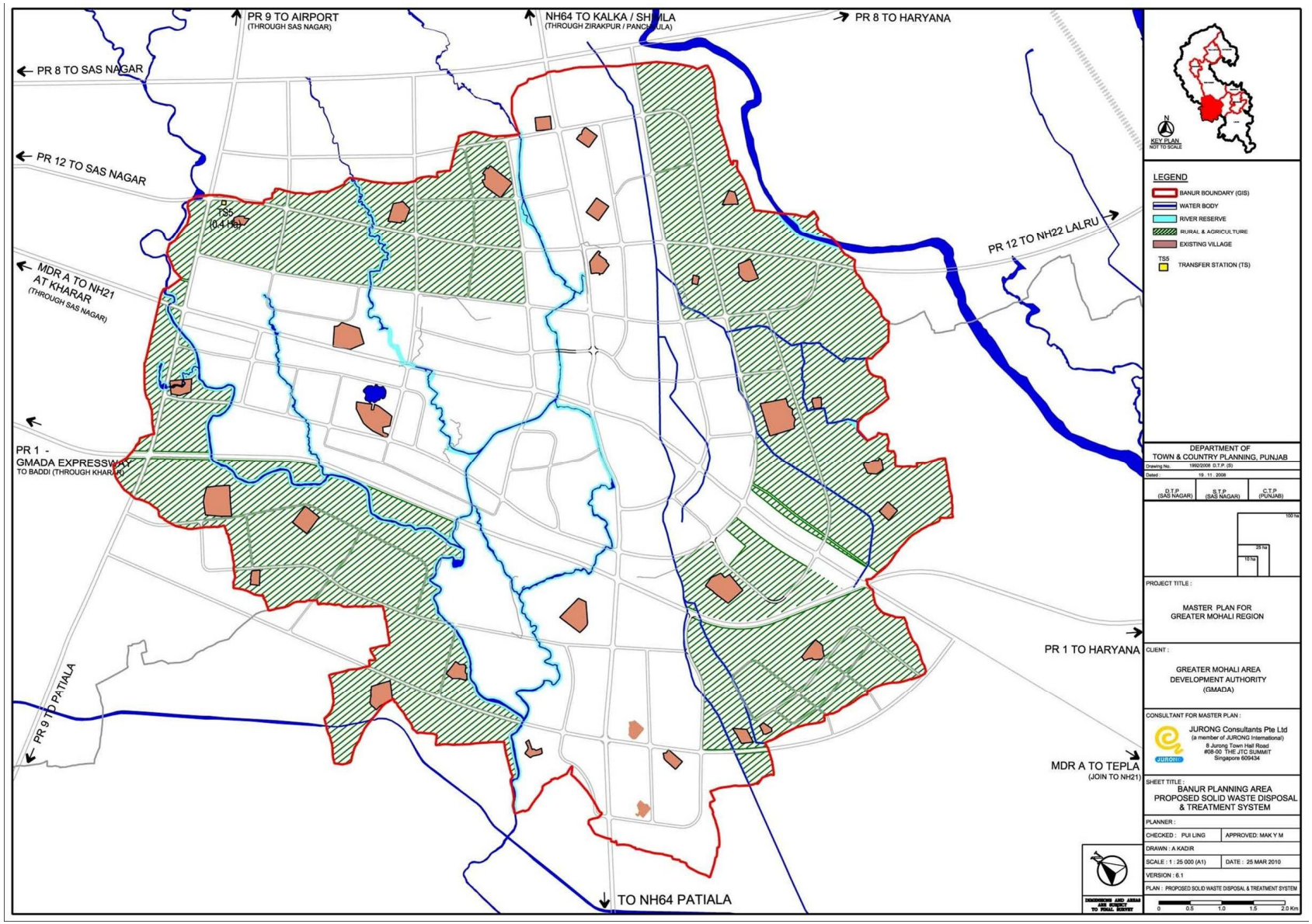


Figure 6.16: Proposed Telecom Trunk Network

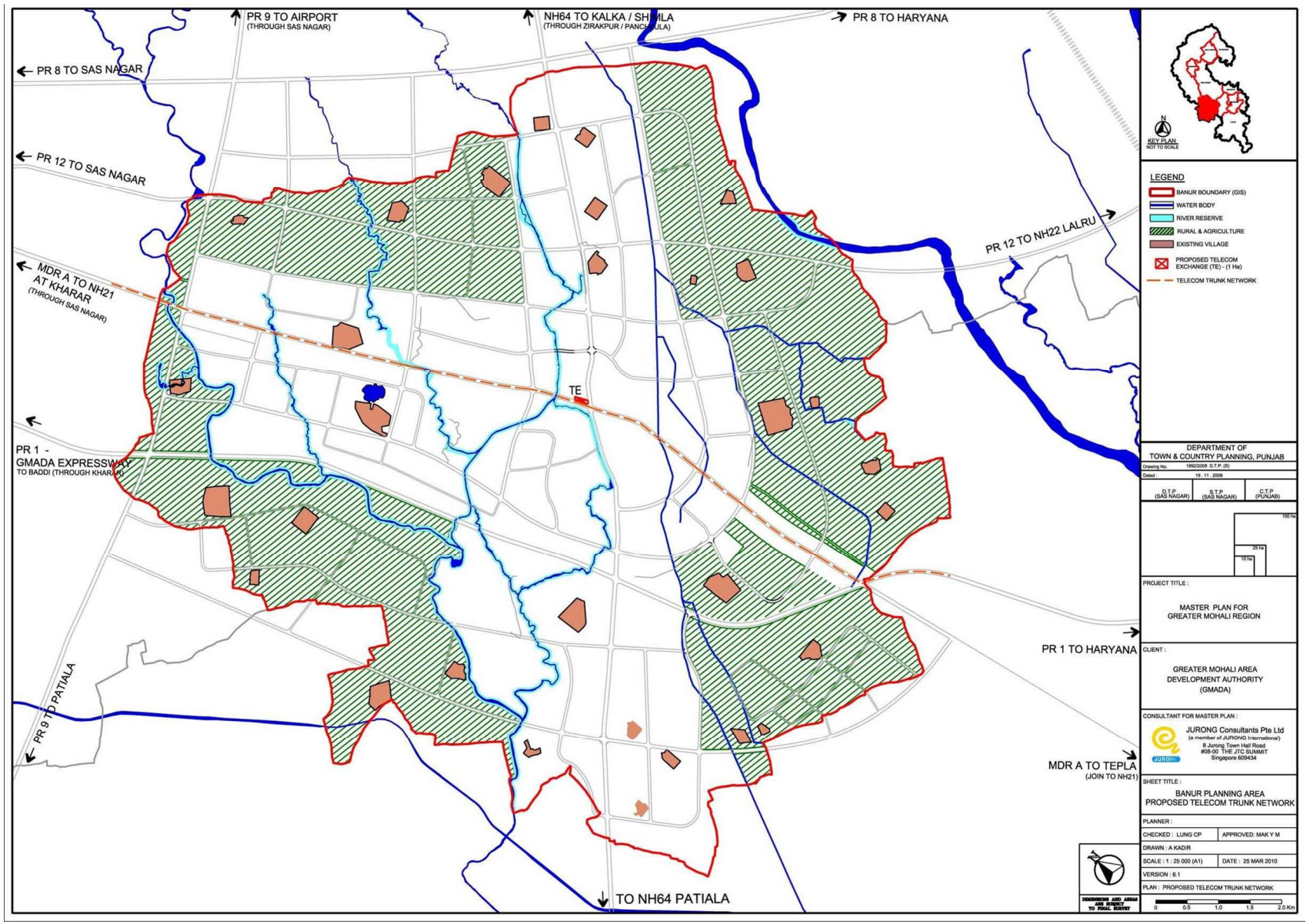


Figure 6.17: Proposed Telecom Distribution Network

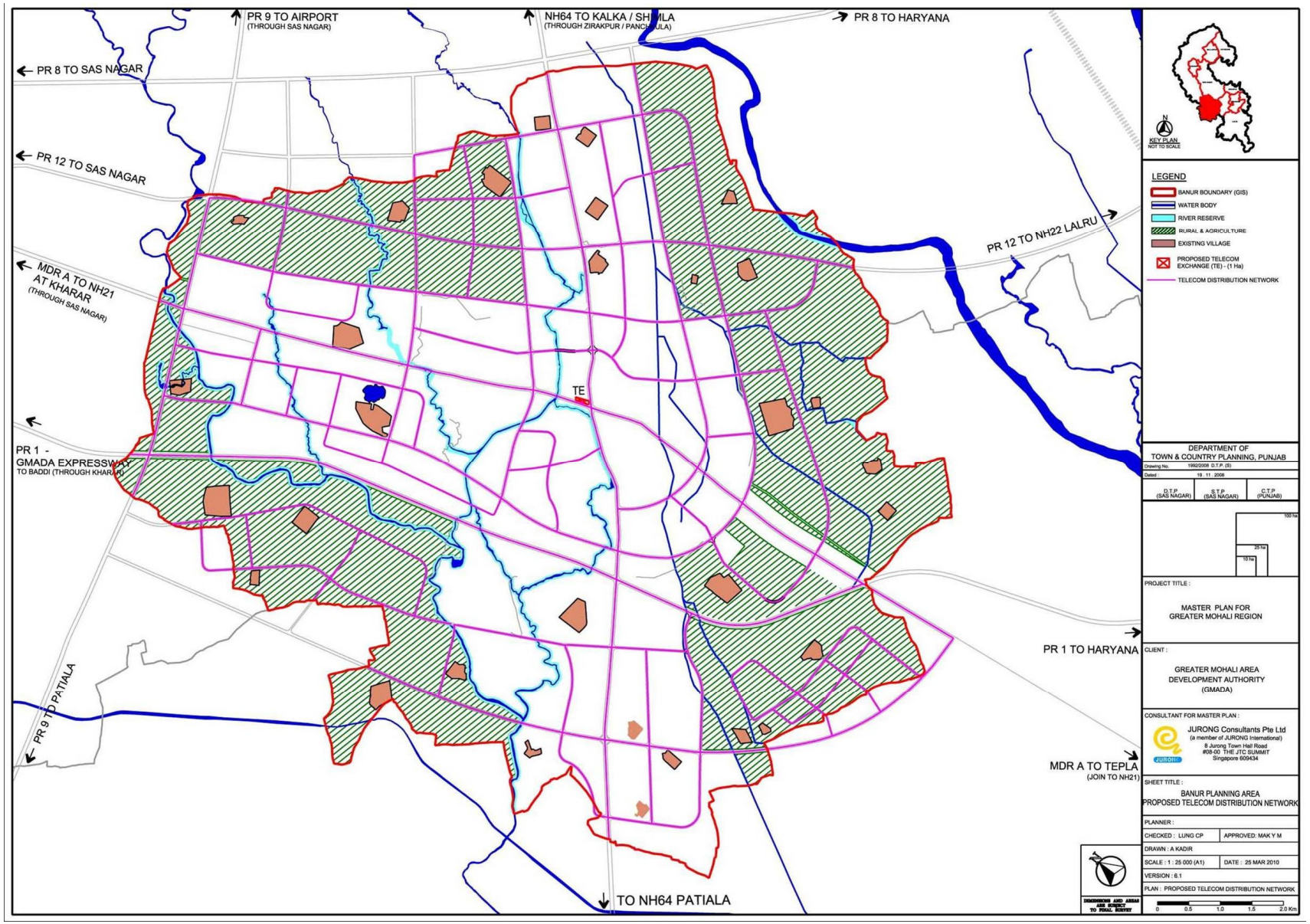
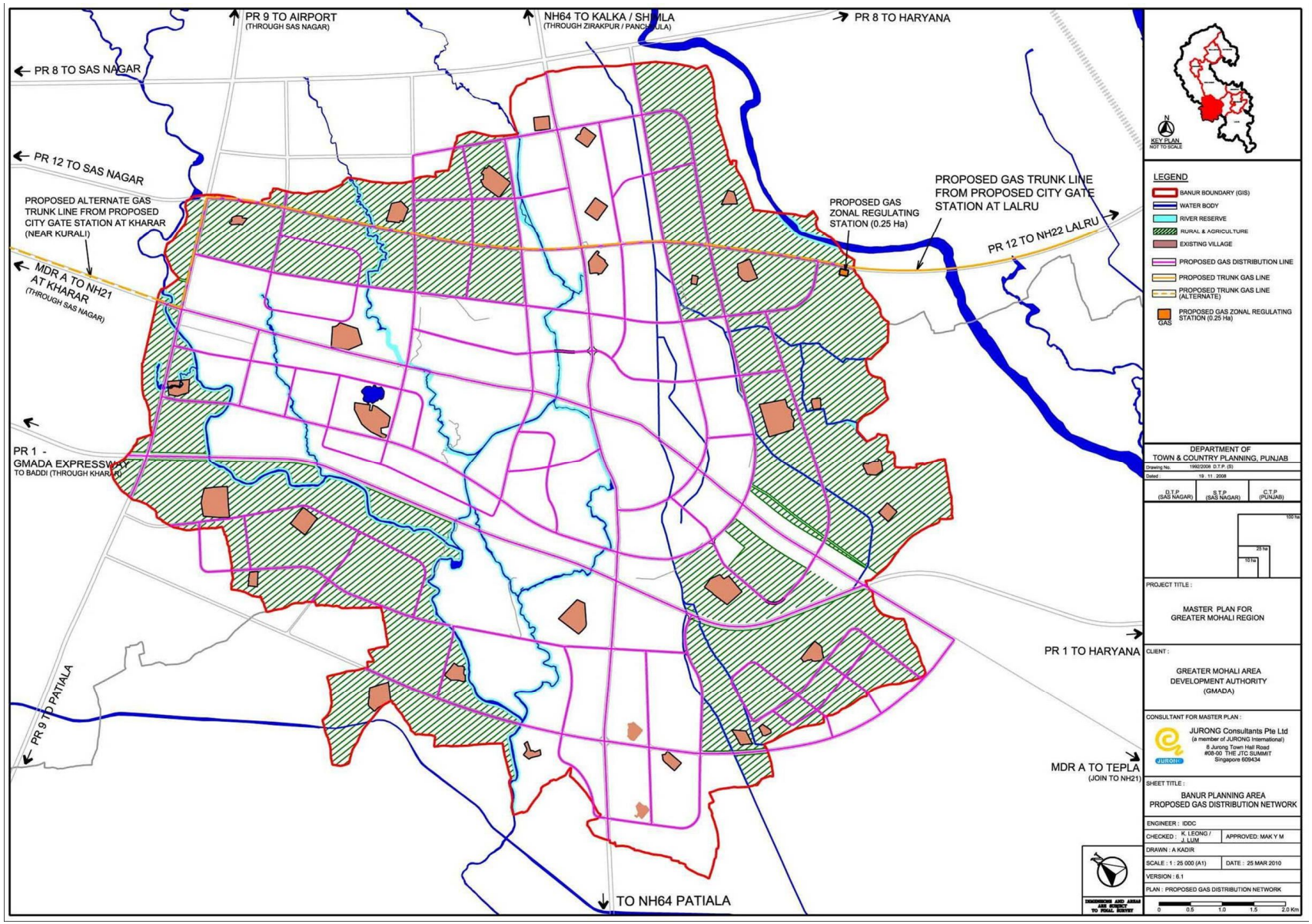


Figure 6.18: Proposed Gas Reticulation Scheme



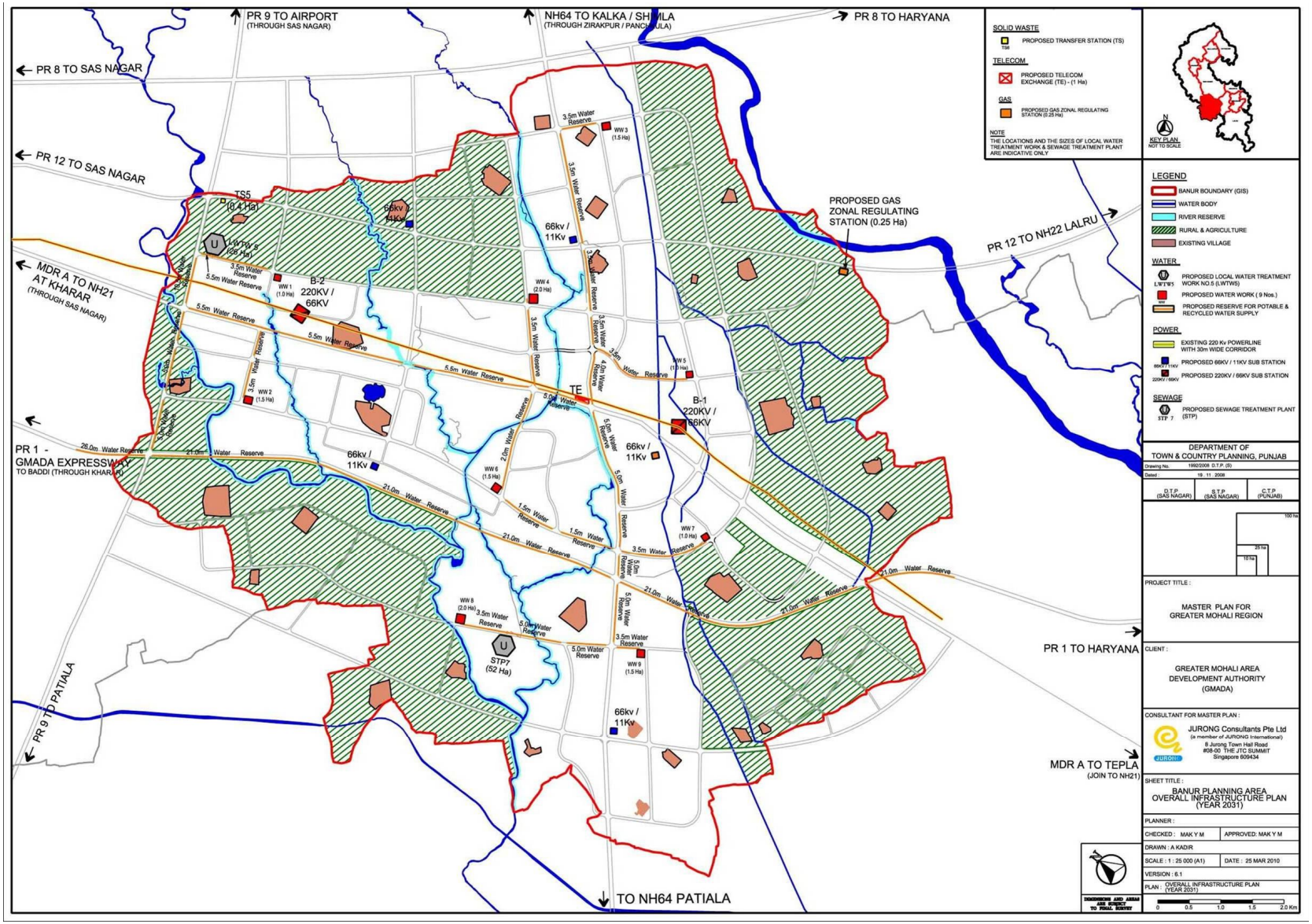

PR 9 TO AIRPORT
(THROUGH SAS NAGAR)
NH64 TO KALKA / SHIMLA
(THROUGH ZIRAKPUR / PANCHKULA)
PR 8 TO HARYANA
PR 8 TO SAS NAGAR
PR 12 TO SAS NAGAR
MDR A TO NH21
AT KHARAR
(THROUGH SAS NAGAR)
PR 1 -
GMADA EXPRESSWAY
TO BADDI (THROUGH KHARAR)
PR 9 TO PATIALA
TO NH64 PATIALA
PR 12 TO NH22 LALRU
PR 1 TO HARYANA
MDR A TO TEPLA
(JOIN TO NH21)
PROPOSED GAS
ZONAL REGULATING
STATION (0.25 Ha)
TS5
(0.4 Ha)
LWTW 5
(55 Ha)
STP7
(52 Ha)
B-2
220KV /
66KV
B-1
220KV /
66KV
TE
WW 1 (1.0 Ha)
WW 2 (1.5 Ha)
WW 3 (1.5 Ha)
WW 4 (2.0 Ha)
WW 5 (1.5 Ha)
WW 6 (1.5 Ha)
WW 7 (1.0 Ha)
WW 8 (2.0 Ha)
WW 9 (1.5 Ha)
66kv / 11Kv
3.5m Water Reserve
5.5m Water Reserve
5.0m Water Reserve
4.0m Water Reserve
2.0m Water Reserve
1.5m Water Reserve
21.0m Water Reserve
26.0m Water Reserve
SOLID WASTE
TS PROPOSED TRANSFER STATION (TS)
TELECOM
PROPOSED TELECOM EXCHANGE (TE) - (1 Ha)
GAS
PROPOSED GAS ZONAL REGULATING STATION (0.25 Ha)
NOTE
THE LOCATIONS AND THE SIZES OF LOCAL WATER TREATMENT WORK & SEWAGE TREATMENT PLANT ARE INDICATIVE ONLY
KEY PLAN
NOT TO SCALE
LEGEND
BANUR BOUNDARY (GIS)
WATER BODY
RIVER RESERVE
RURAL & AGRICULTURE
EXISTING VILLAGE
WATER
PROPOSED LOCAL WATER TREATMENT WORK NO.5 (LWTW5)
PROPOSED WATER WORK (9 Nos.)
PROPOSED RESERVE FOR POTABLE & RECYCLED WATER SUPPLY
POWER
EXISTING 220 Kv POWERLINE WITH 30m WIDE CORRIDOR
PROPOSED 66KV / 11KV SUB STATION
PROPOSED 220KV / 66KV SUB STATION
SEWAGE
PROPOSED SEWAGE TREATMENT PLANT (STP)
DEPARTMENT OF
TOWN & COUNTRY PLANNING, PUNJAB
Drawing No. 1992/2008 D.T.P. (S)
Dated 19 . 11 . 2008
D.T.P. (SAS NAGAR)
S.T.P. (SAS NAGAR)
C.T.P. (PUNJAB)
100 Ha
25 Ha
10 Ha
PROJECT TITLE :
MASTER PLAN FOR
GREATER MOHALI REGION
CLIENT :
GREATER MOHALI AREA
DEVELOPMENT AUTHORITY
(GMADA)
CONSULTANT FOR MASTER PLAN :
JURONG Consultants Pte Ltd
(a member of JURONG International)
8 Jurong Town Hall Road
#08-00 THE JTC SUMMIT
Singapore 609434
SHEET TITLE :
BANUR PLANNING AREA
OVERALL INFRASTRUCTURE PLAN
(YEAR 2031)
PLANNER :
CHECKED : MAK Y M
APPROVED: MAK Y M
DRAWN : A KADIR
SCALE : 1 : 25 000 (A1)
DATE : 25 MAR 2010
VERSION : 6.1
PLAN : OVERALL INFRASTRUCTURE PLAN (YEAR 2031)
DIMENSIONS AND AREAS ARE SUBJECT TO FINAL SURVEY
0 0.5 1.0 1.5 2.0 Km

Figure 2.3: Existing Land Use Plan

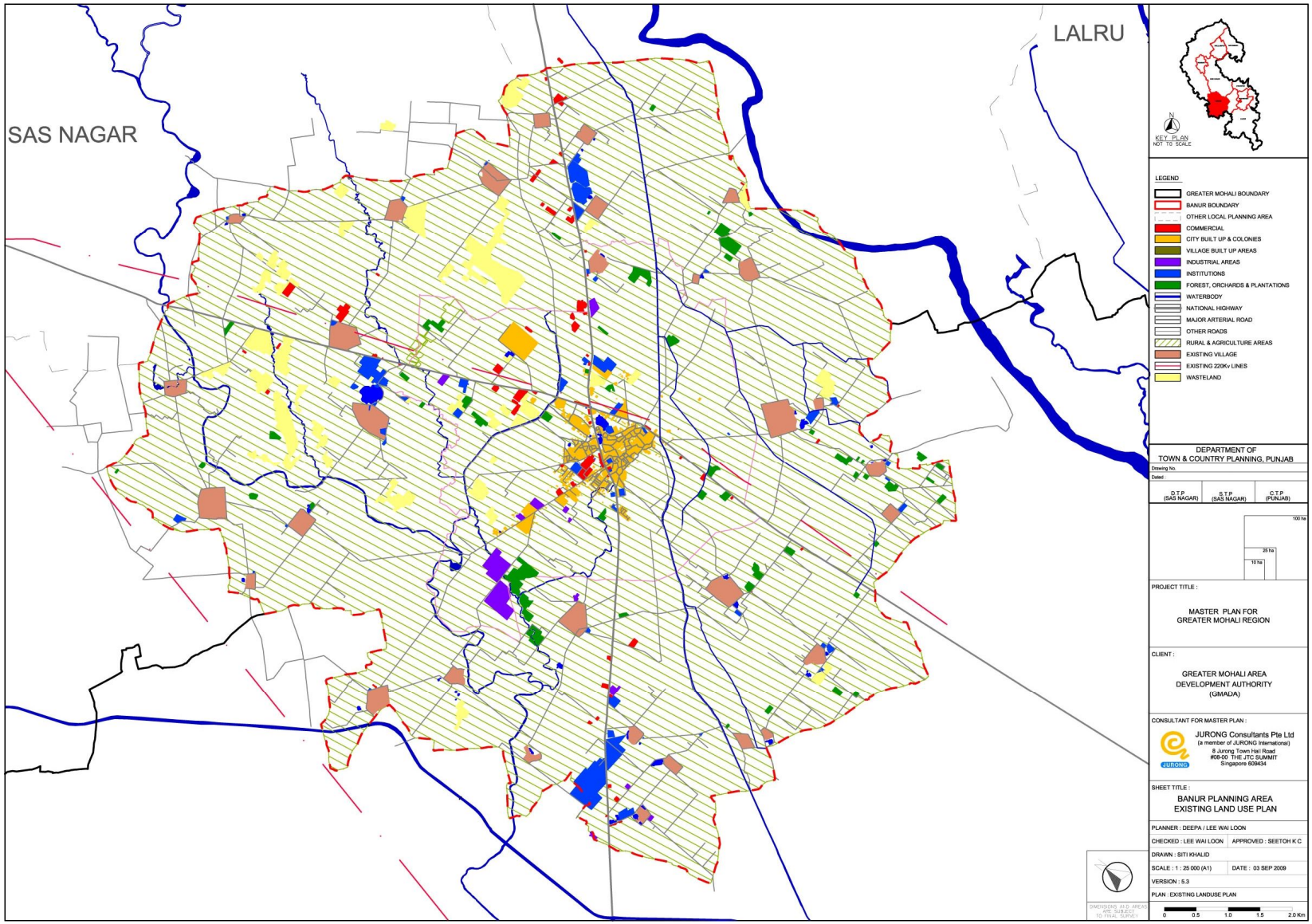


Figure 5.13: Proposed transport Network for GMR

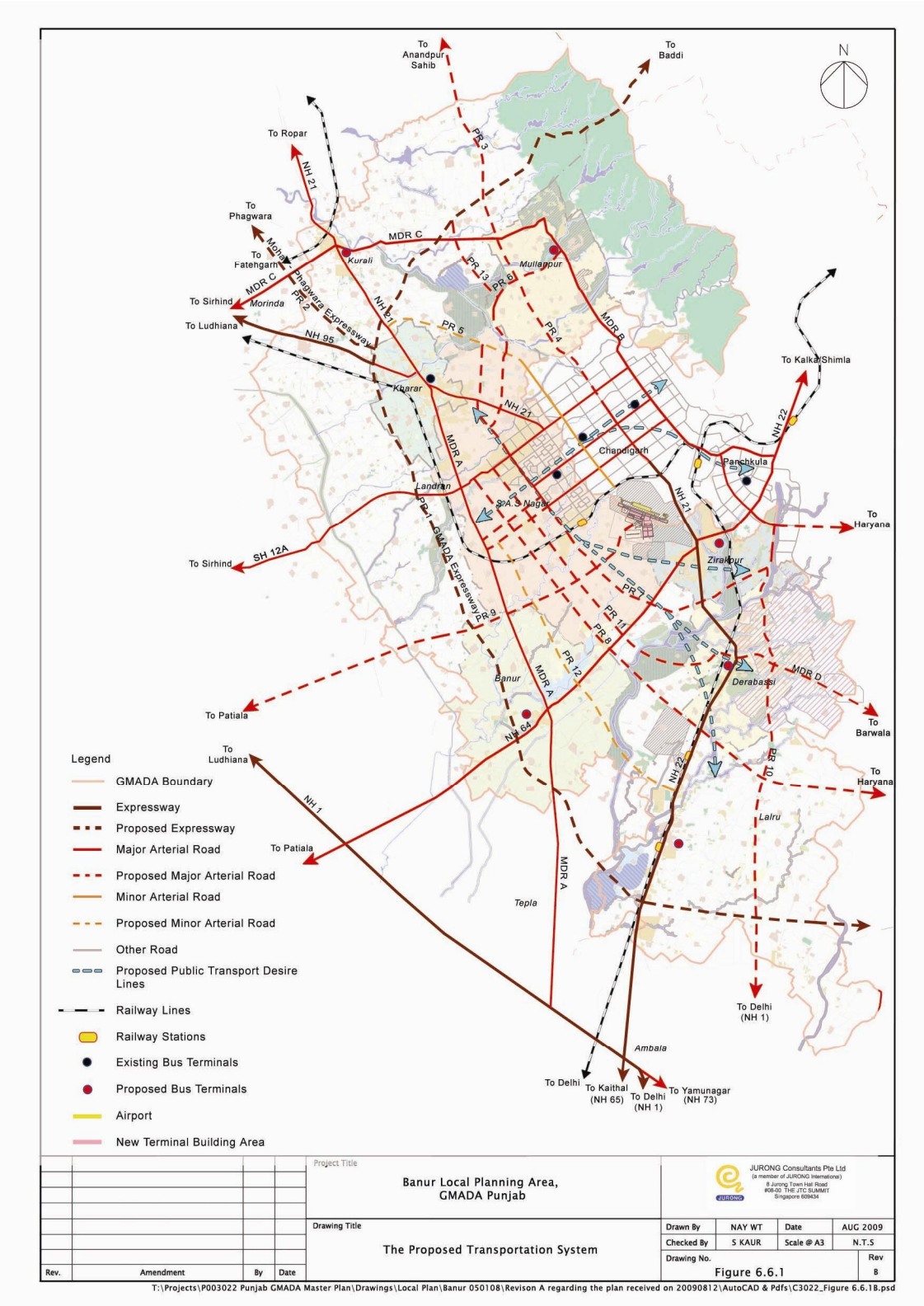
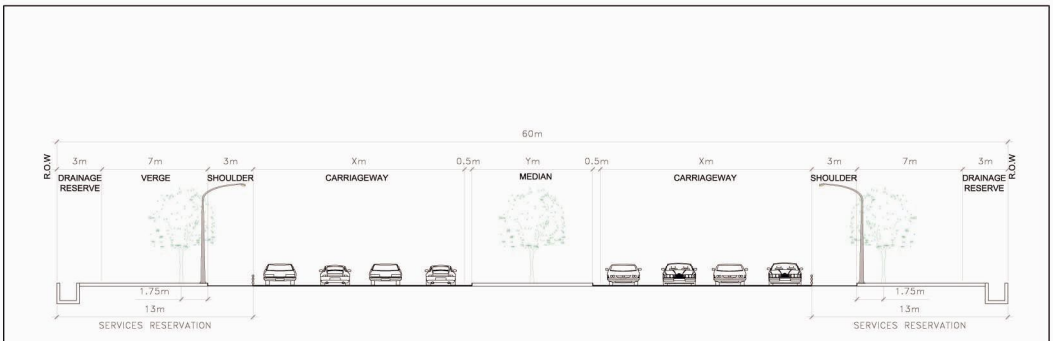
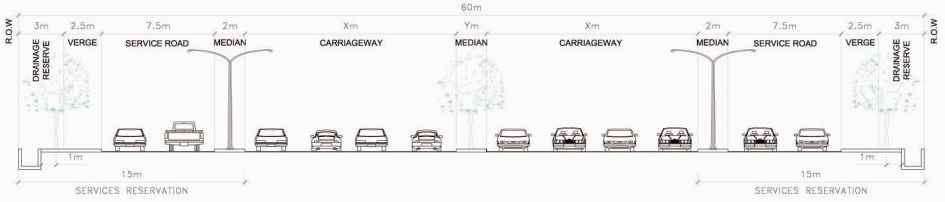


Figure 5.15: Cross Section of the Various Hierarchies of Roads (I)



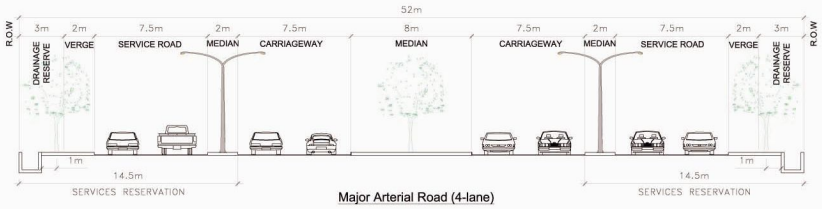
Expressway (National Highway / State Highway)

Road Type	Traffic Lanes	X (m)	Y (m)	ROW (m)
Dual 4-Lane	8	14.0	5.0	60
Dual 3-Lane	6	10.5	12.0	60



Major Arterial Road (State Highway / Major District Road)

Road Type	Traffic Lanes	X (m)	Y (m)	ROW (m)
Dual 4-Lane	8	14.0	2.0	60
Dual 3-Lane	6	10.5	9.0	60



Major Arterial Road (4-lane)

NOTES:
1. SERVICES RESERVATION PROVIDED EXCLUDE TRANSMISSION MAINS OF WATER & POWER.
2. REFER TO INFRASTRUCTURE PLANS FOR DETAILS ON SERVICES RESERVATION.

0 5 10 Metres
Scale 1:250

Rev.	Amendment	By	Date

Project Title: Banur Local Planning Area GMADA Punjab

Drawing Title: Typical Proposed Road Cross Sections (Sheet 1 of 3)

JURONG Consultants Pte Ltd
(a member of JURONG International)
8 Jurong Town Hall Road
#08-00 THE JTC SUMMIT
Singapore 609434

Drawn By	NAY WT	Date	JUNE 2009
Checked By	L K L	Scale @ A3	AS SHOWN
Drawing No.	Figure 6.6.4A		REV A

T:\Projects\P003022 Punjab GMADA Master Plan\Drawings\Local Plan\Banur 050108\Revison A in accord with the proposed plan received on 20090428\Figures\C3022_Figure 6.6.4A_Rev A.dwg

Figure 5.16: Cross Section of the Various Hierarchies of Roads (II)

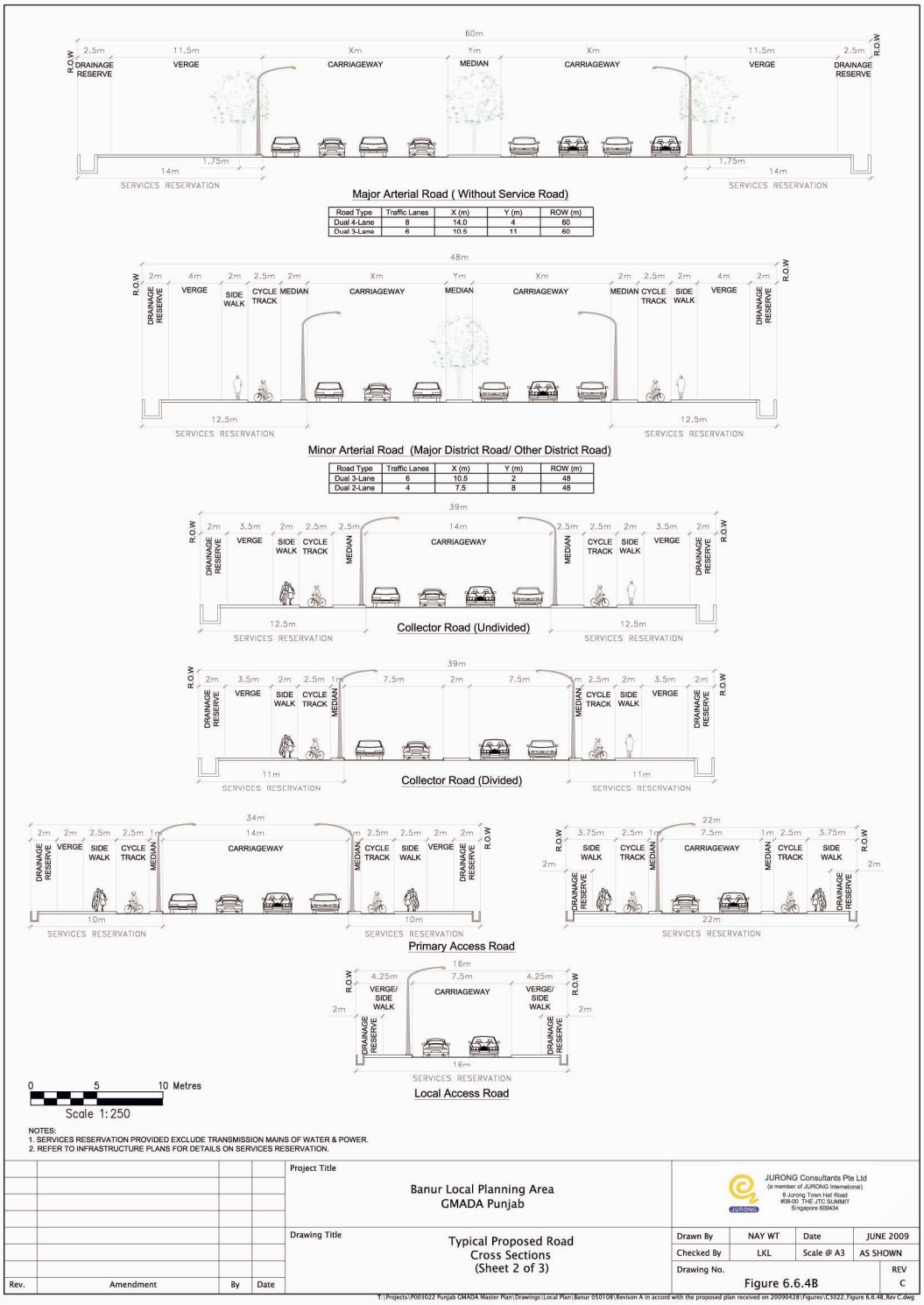


Figure 5.17: Cross Section of the Various Hierarchies of Roads (III)

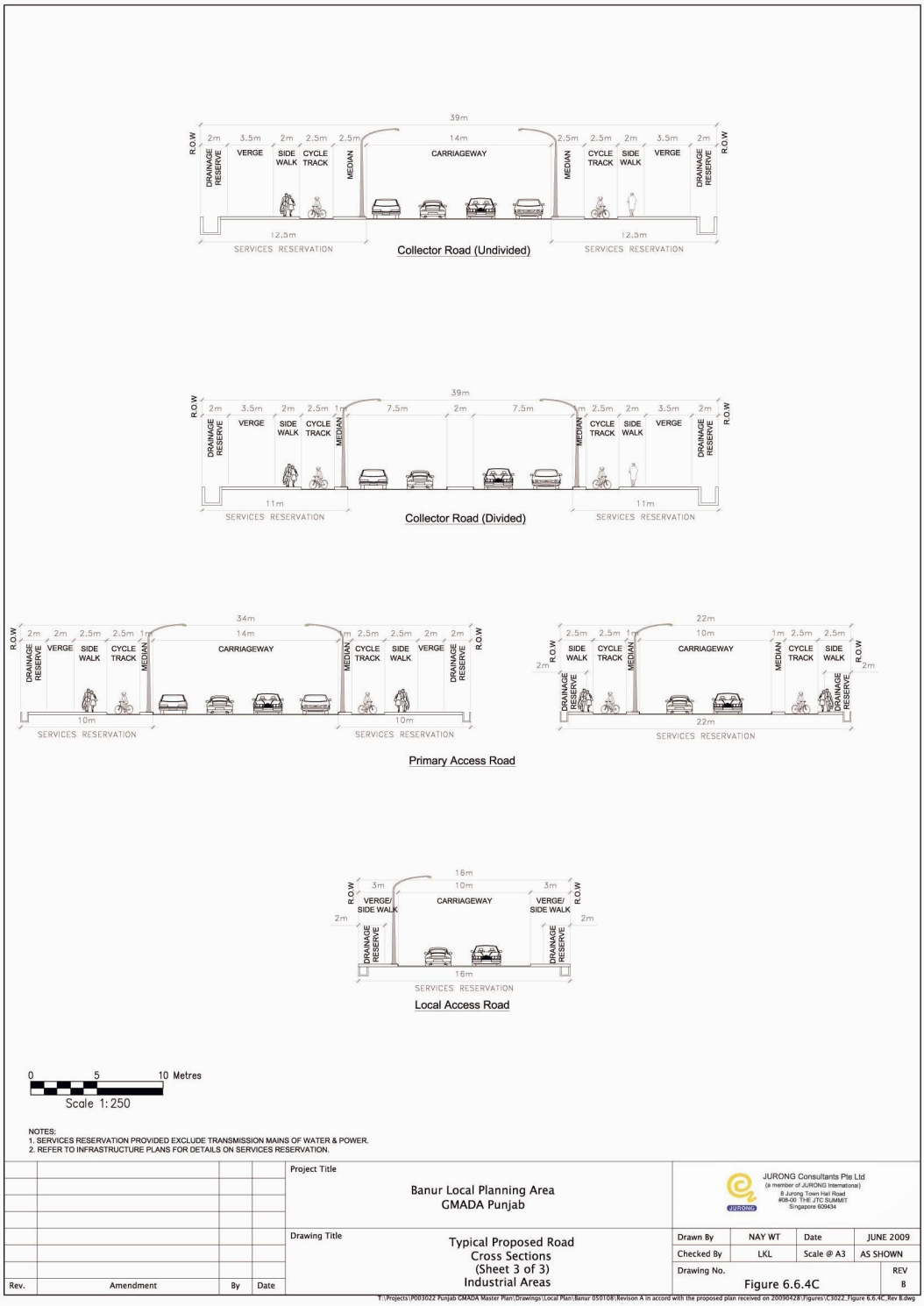


Figure 5.19: Proposed Measures to improve the overall bus commuting experience

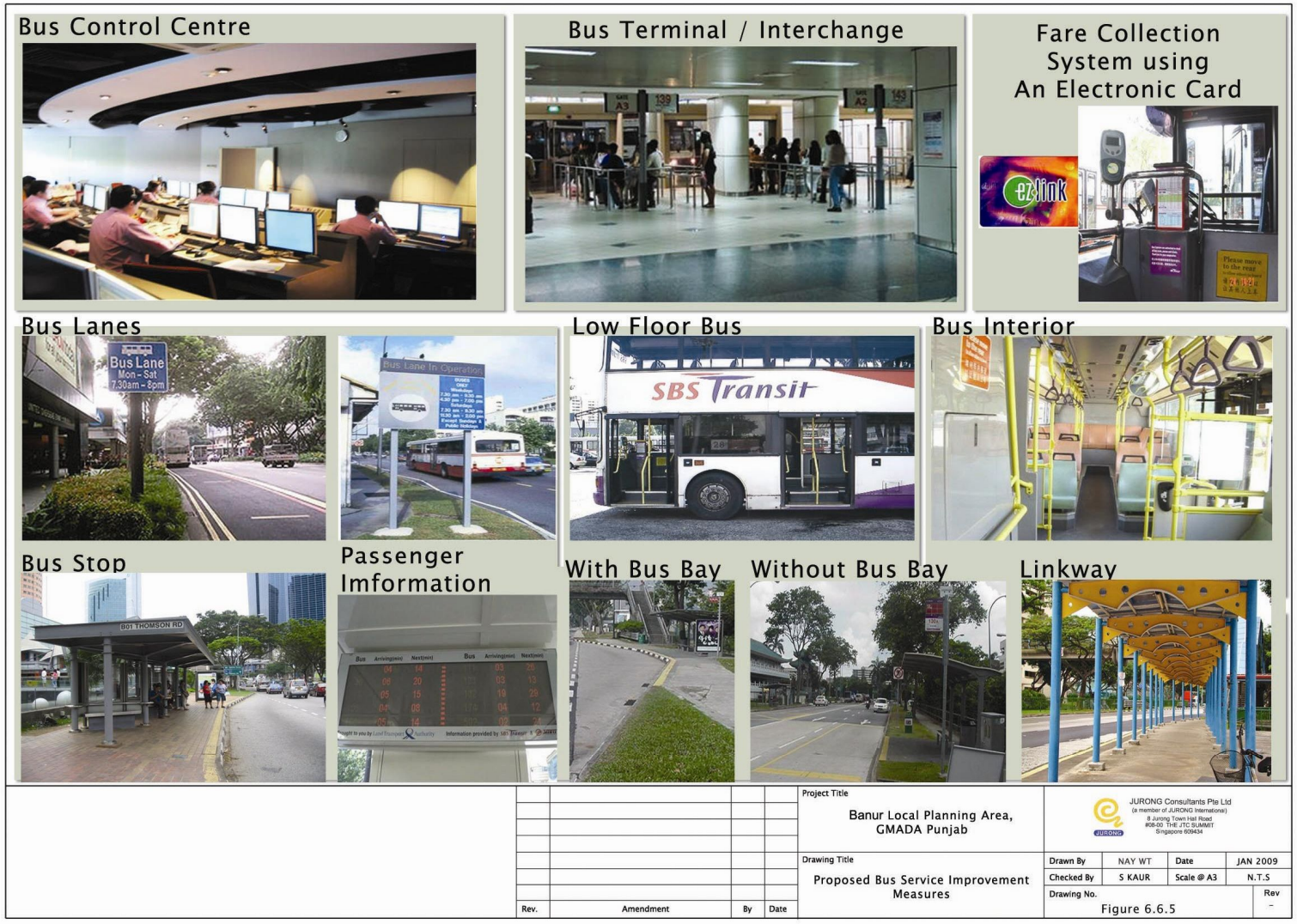


Figure 2.5: Existing Road Network Plan

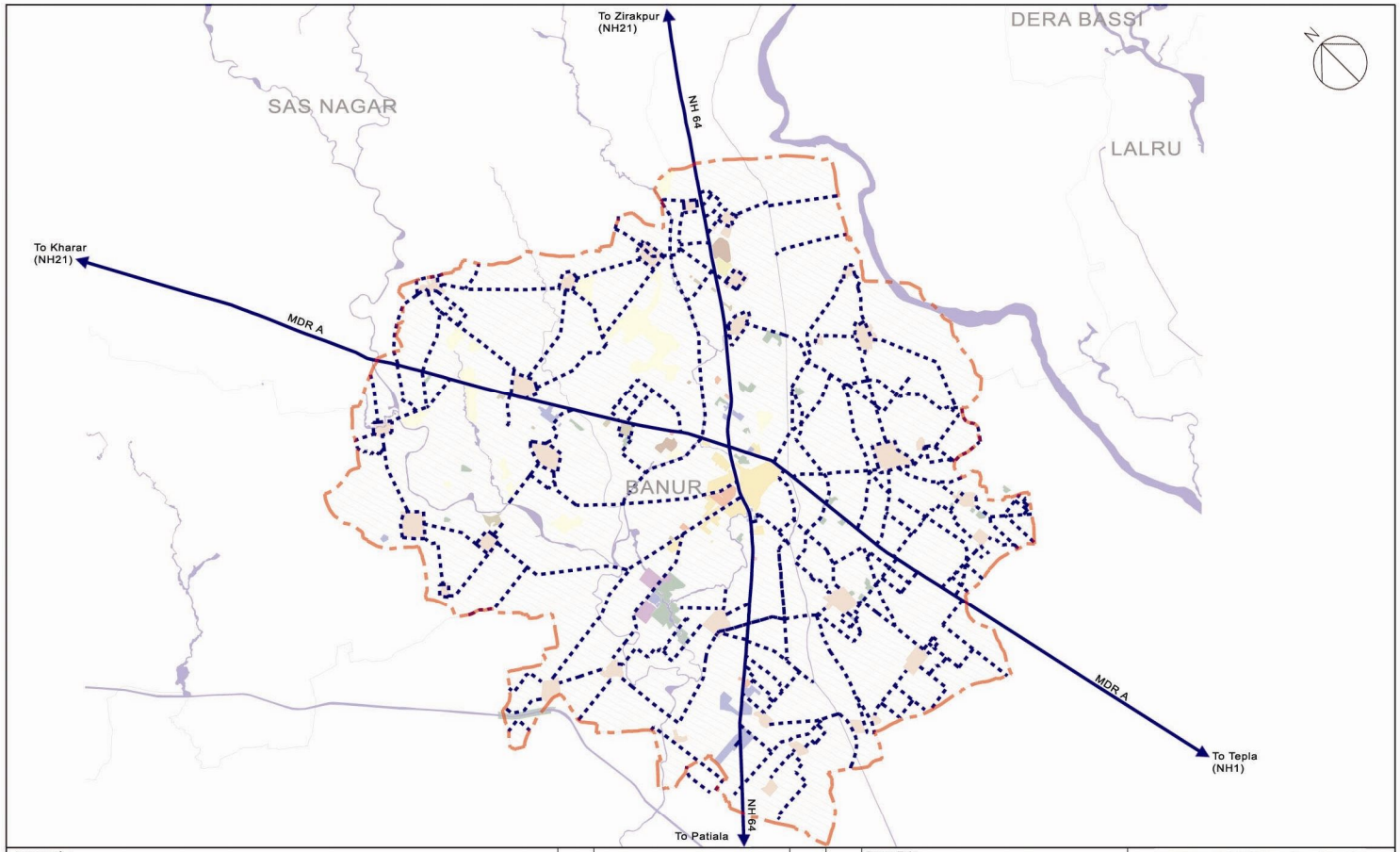


Figure 5.2: Proposed Land Use Master Plan for the Banur LPA (Year 2031)

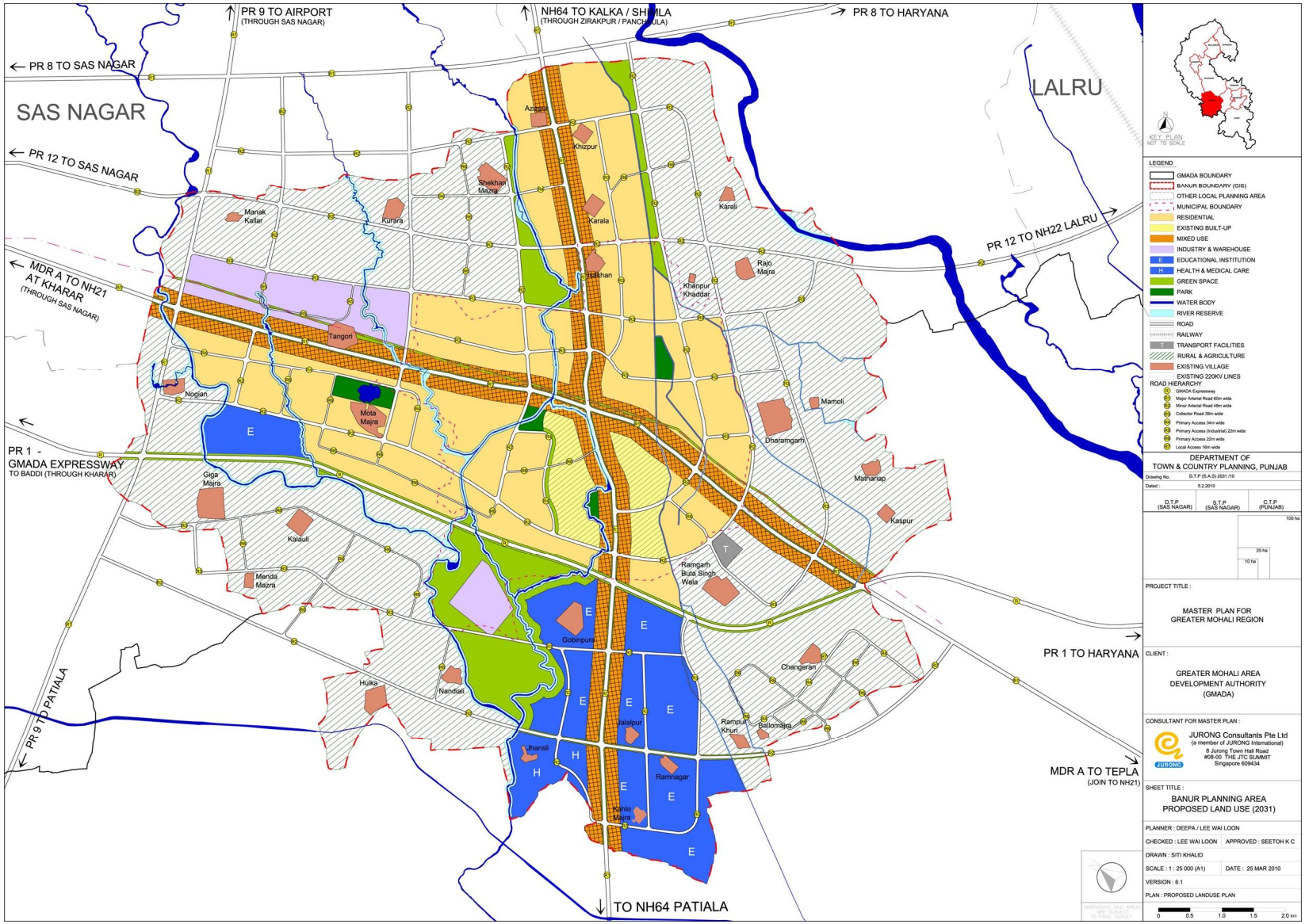


Figure 5.5: Proposed Residential Areas

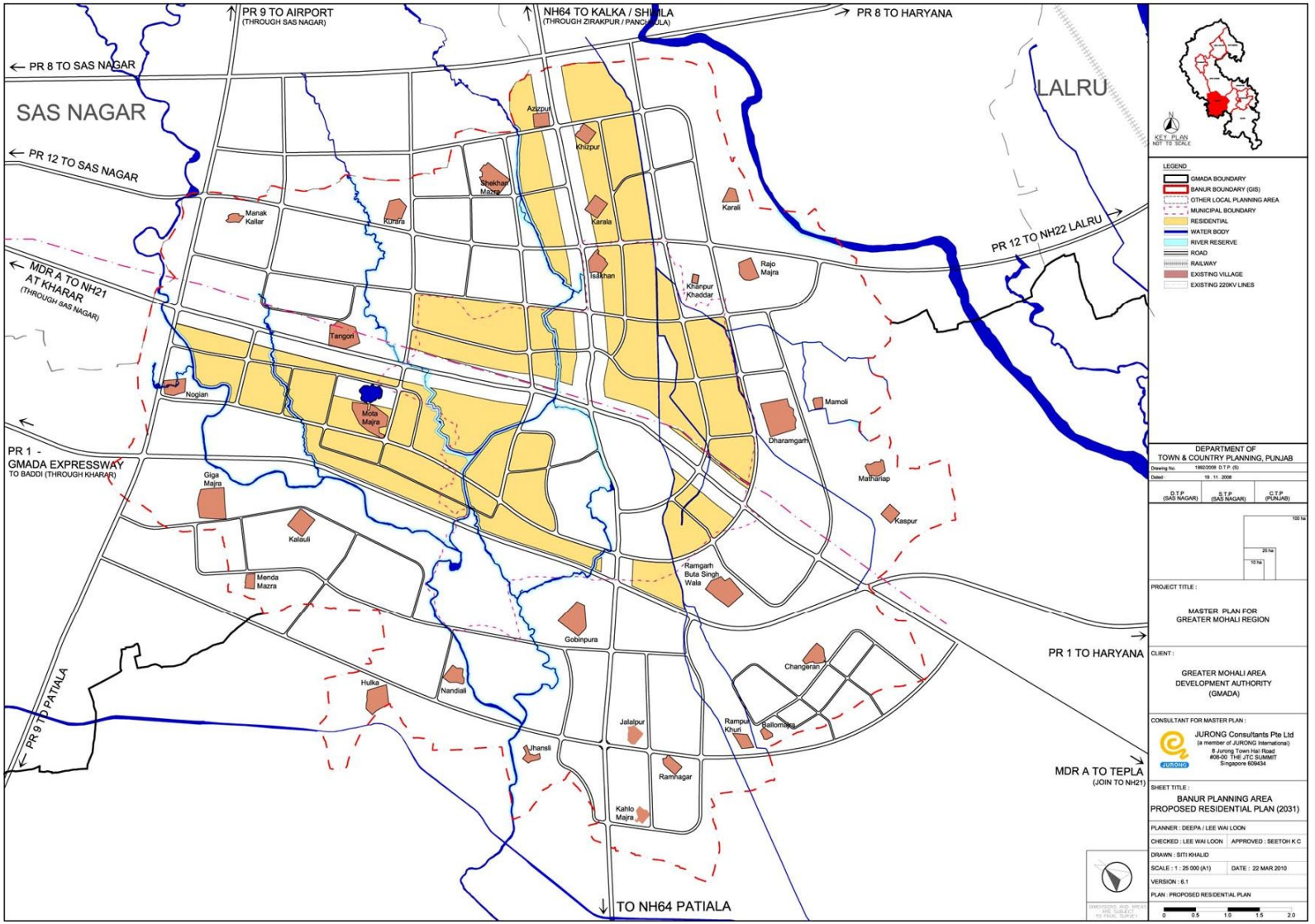


Figure 5.6: Proposed Mixed Use Areas

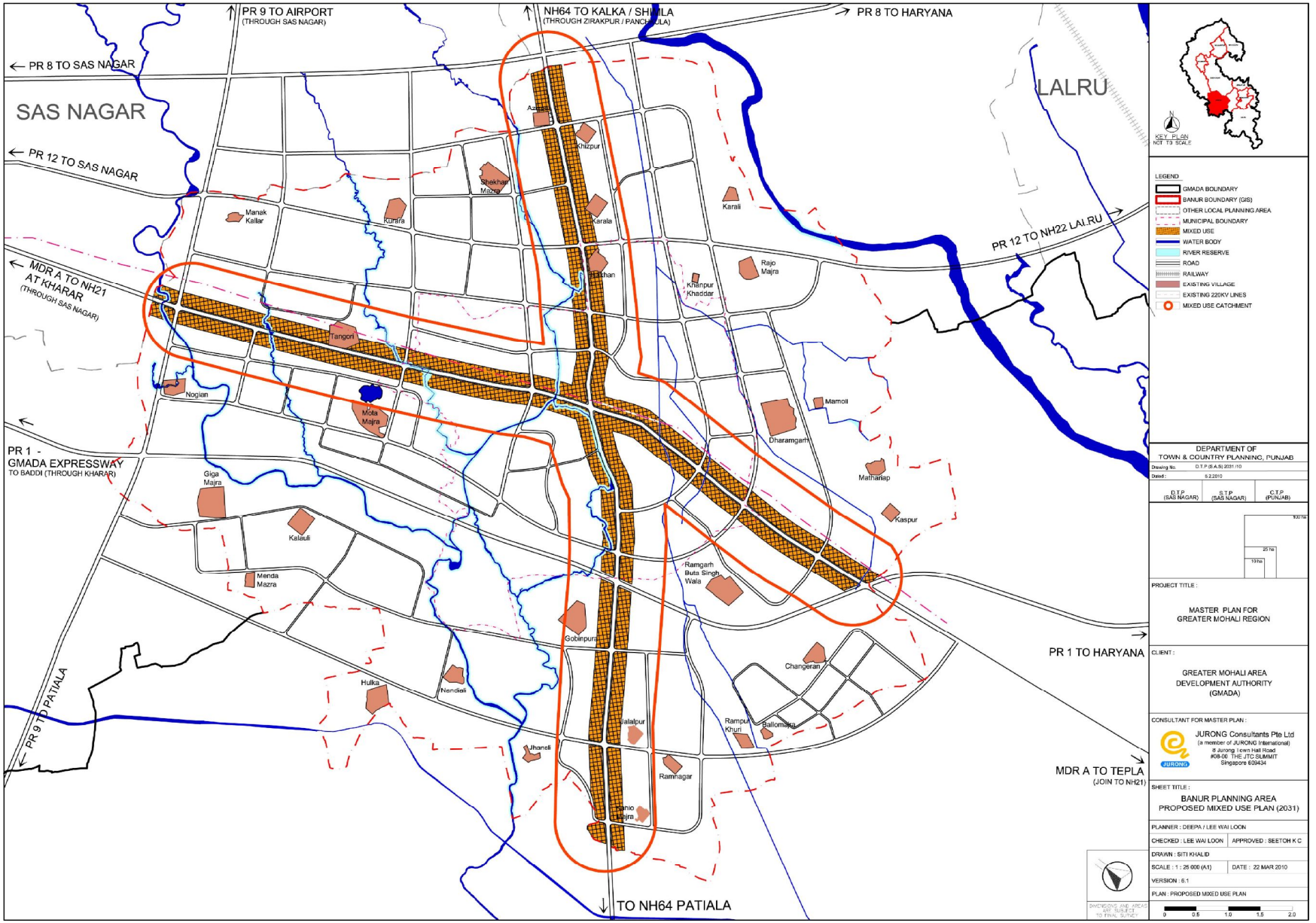


Figure 5.7: Proposed Institutional Areas

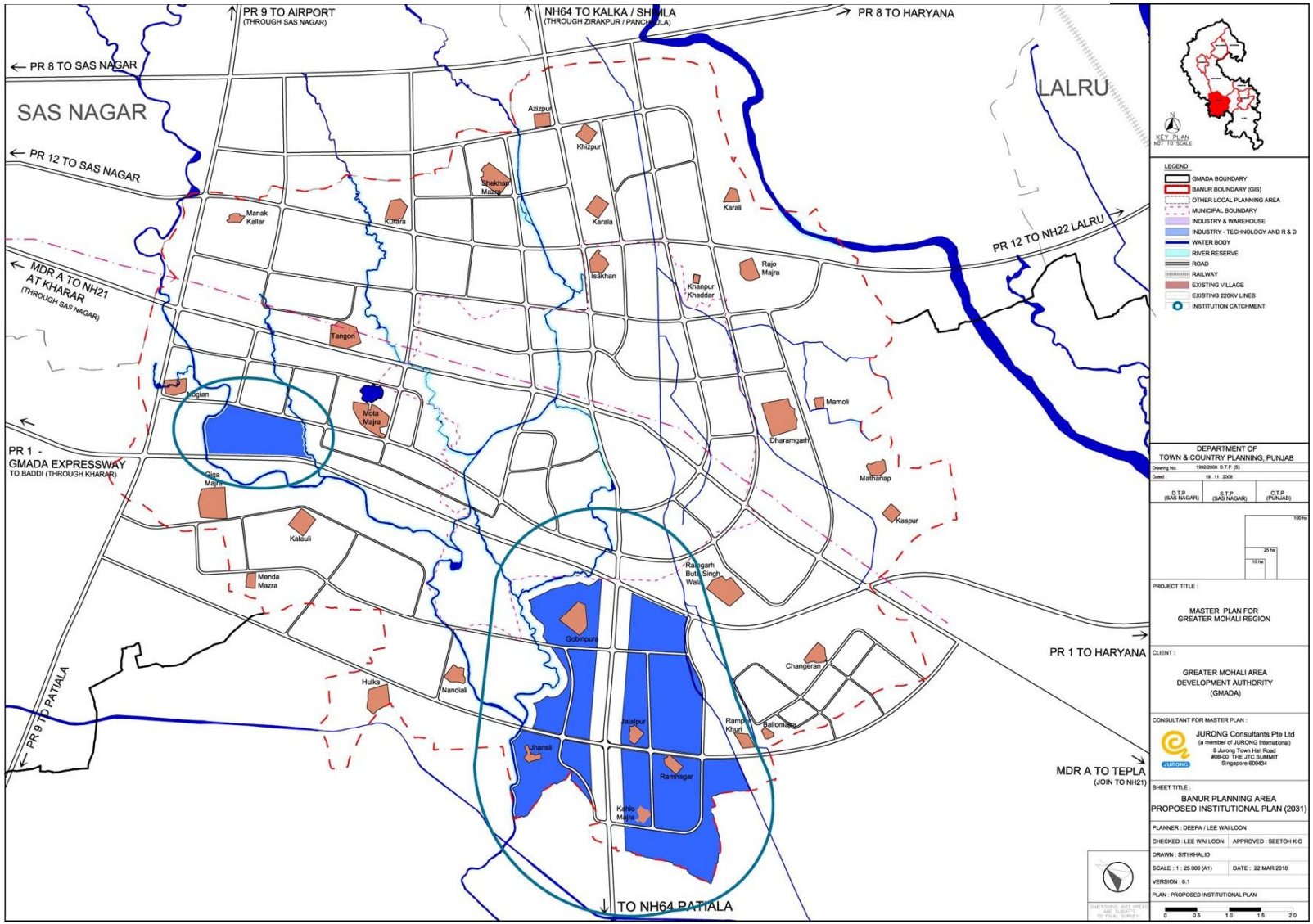


Figure 5.11: Proposed Industrial Areas

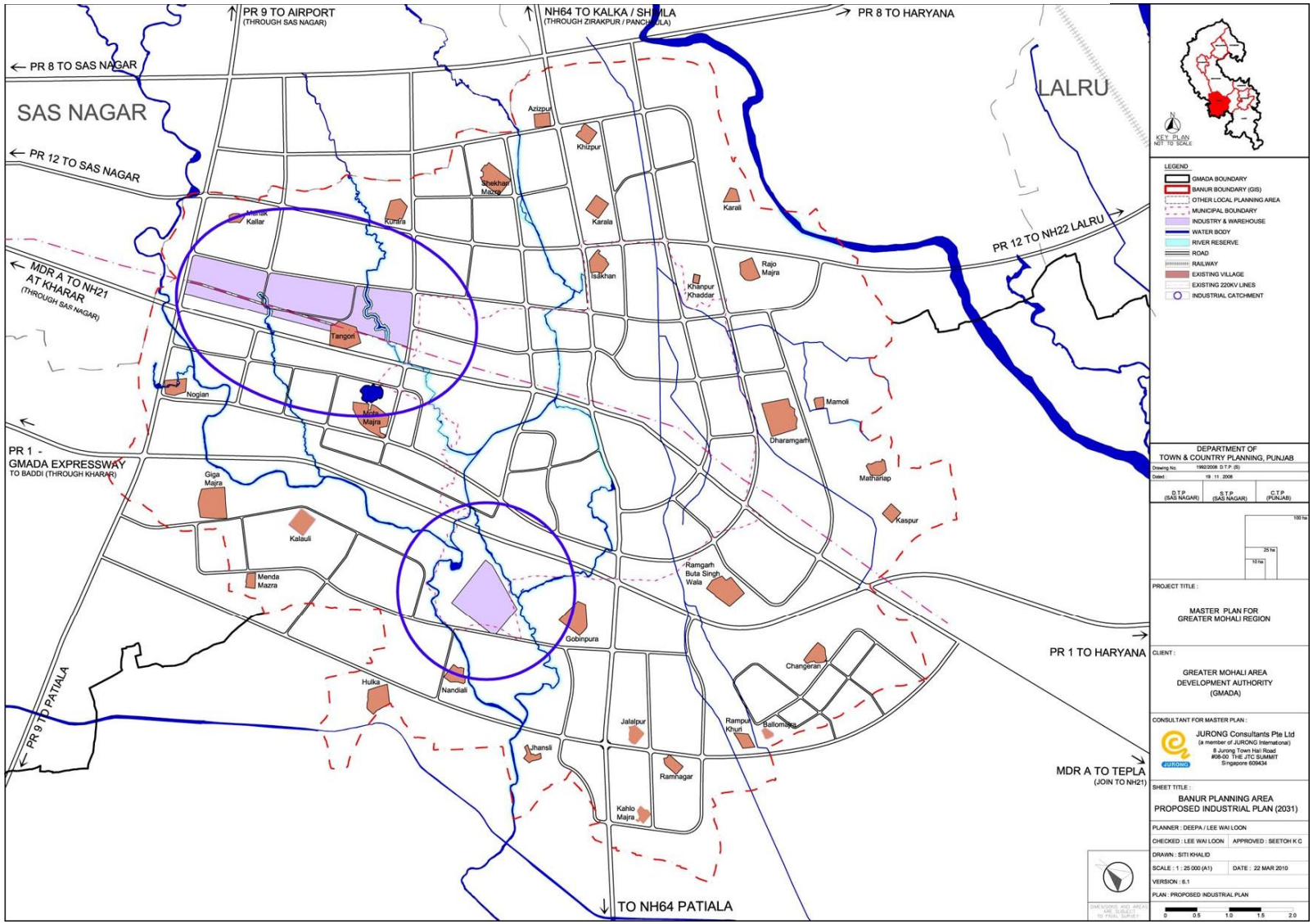


Figure 5.12: Proposed Open Spaces

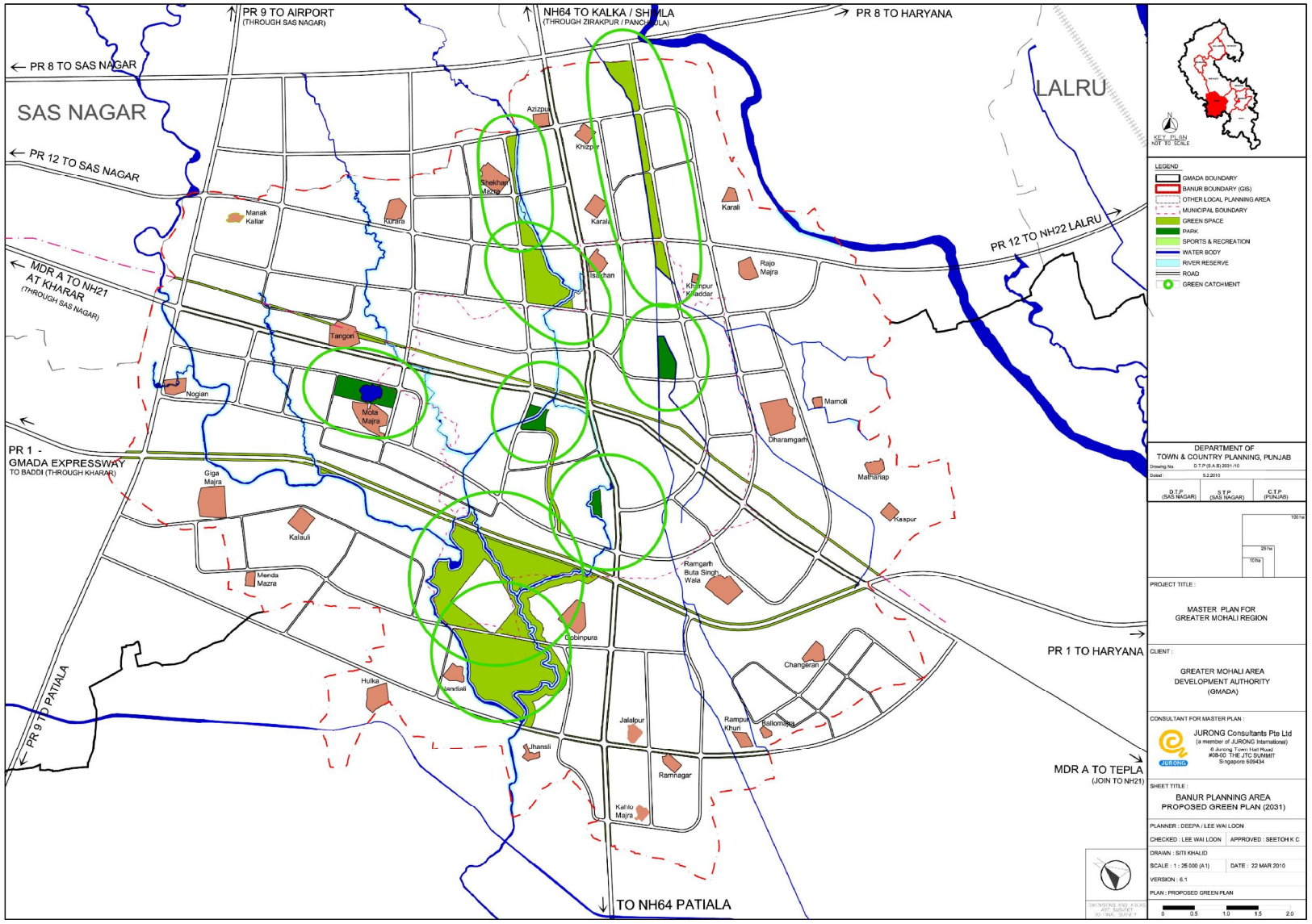


Figure 5.14: Proposed Road Network for Banur LPA