

LANDSCAPE DESIGN PROPOSAL FOR HIGHWAY - BHOPAL BYPASS

Submitted

*In partial fulfillment of the requirements
For the award of the degree of*

MASTER OF ARCHITECTURE (LANDSCAPE)

By

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Declaration

I, *Roshni Agarwal*, Scholar No.2016MLA016 hereby declare that the thesis entitled “*Landscape Design Proposal for Highway -Bhopal Bypass*” submitted by me in partial fulfillment for the award of Master of Architecture (Landscape), in School of Planning and Architecture Bhopal, India, is a record of bonafide work carried out by me. The matter embodied in this thesis has not been submitted to any other University or Institute for the award of any degree or diploma.

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This is to certify that the declaration of Roshni Agarwal is true to the best of our knowledge and that the student has worked under the guidance of the following panel.

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UNDERTAKING

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ABSTRACT

Highway is an important public road that connects various towns and cities to each other. Rapid urbanization and development of cities is largely associated with mass transportation via different patterns of movement, leading to the construction of highways. Highway landscape is not just about scenic beauty but utility too, which should be created intentionally for a safe and efficient highway corridor. Nowadays, people spend most of their time travelling from one place to another which makes it even more important for the highway corridor to form a physical, cultural, ecological and visual relationship and considering the linear nature of the roadway as a movement in space and time. Highways constitute one – third of the land made up of asphalt and concrete, with growing demand of infrastructure more highways are being constructed and therefore making a continuous impact on the environment. These are directly and indirectly affecting the animal and human world by fragmentation. Environmental mitigation embraces a broad scope of activities dealing with issues of air and water quality, noise and vibration, and environmental justice. The project explores the multifunctional landscape through identifying various issues, needs, impacts and visual connectivity including functional, aesthetic, environmental, socio-cultural and economic components. The understanding of the geomorphology, topography and land-use provides the data for designing a better and improved highway by giving a planting palette suitable for the soil and weather and adapting to climate change, increased biodiversity and economic development with enhanced visual character which will help increase the visual experience of the driver as well as the scenic value of the highway.

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CHAPTER 1: INTRODUCTION

1.1 Background

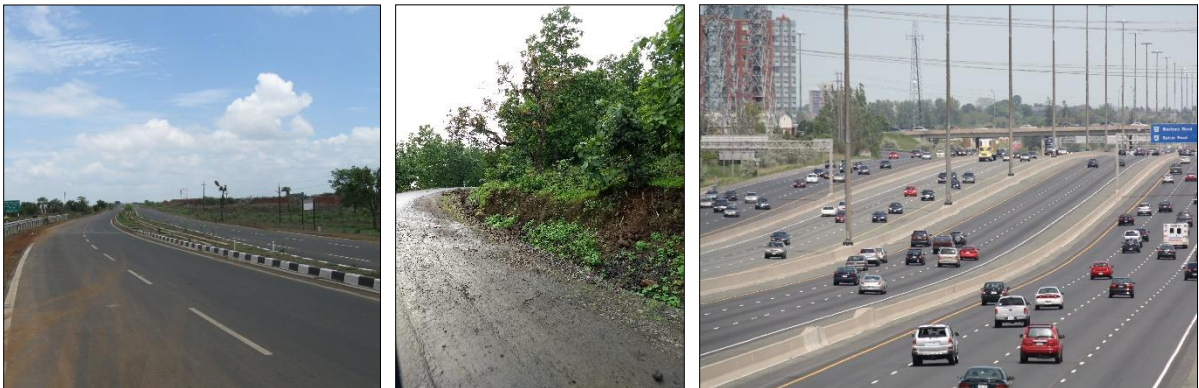
Roads are the world's lifeline, as they connects different cities, towns, states and countries together. They are of vital importance for a nation to grow and develop. Major transportation of goods and services and also people for jobs and better lifestyle is all provided by the means of the road network. Roads open up more areas by providing employment, social, health and educational services and encourage economic and social development. Hence road is the most important public infrastructure. Roads can be classified into various networks of Expressways, Highways, Arterial roads, Collector and Local roads. Road transportation is considered one of the most cost effective and preferred modes of transport for both freight and passengers. India has the second largest extensive road network in the world spanning over of 5.4 million km.¹ The total length of National Highways of India is 70,934 km making it the main road network system of the country. It is estimated that roads are handling more than 70 per cent of freight and 85 per cent of passenger traffic in the country. Only about 2% of the length of all roads is made up of the Highways and Expressways. The remaining are state highways, major district roads and rural roads that are considered as less capacity road in terms of traffic. Historically, people on foot or on horses used highways. Afterwards they started using carriages, bicycles and then eventually motor cars, enabled by advancements in road construction. The 20th century saw the development of modern highway systems as the automobile industry gained popularity and with it increased the number of highways as well. With gaining urbanization, the need for better connectivity to every small town and village has led to a dense road network that has led to the degradation and fragmentation of many landscapes around the world.

The development along the corridor is often facilitated by Highways, hence forming the economic backbone of the cities. They are considered as one of the major public investments, that not only affect the economy but also the way of life, health and

¹ Urban Ecology, Water Quality and Climate Change edited by Arup K.Sarma, Vijay P.Singh, Rajiv K.Bhattacharijya, Suresh A.Kartha

visual experience for the entire population within its sphere of influence.² Ribbon development is a major drawback of highways especially on city bypass roads. This development causes an urban sprawl due to increase in land values and easy access further impacting the environment and the quality of the surrounding landscape. The quality of visual experience of the driver reduces and leaves an unhealthy image of the city on his mind. The increase in speed limits have given way for better road infrastructure in terms of length, width and safety which has led to a linear source of pollution through human intrusion into previously untouched areas. The increase in traffic congestion is directly proportional to the construction of number of highways, which not only divide agricultural lands and communities but also forest landscape that have an adverse impact on wildlife and biodiversity.

Figure 1 : Examples of National Highways



1.2 Project Introduction

Landscape is an integration of nature, culture, social and functional aspects together forming an interrelationship amongst them. Landscape is an essential part of highway design, where the highway routes are generally cut through scenic, forested and agricultural landscapes. The highway and landscape is amalgamated together to form a visual and environmental relationship. With increasing development, these landscapes are facing adverse effects and diminishing at a faster rate with increase in number of linear connectivity on land. This is where landscape plays an important

² Design with nature, Ian Mcharg

role in conserving, enhancing and mitigating the effects of the highway construction as well as its future impacts on the overall environment and image of the city.

The capital city of Madhya Pradesh-Bhopal is a mesmerizing blend of picturesque beauty, old history and modern planning. An Afghan soldier called Dost Mohammed (1707-1740) established the present city, but the old of 11th century was called Bhojpal, that was founded by Raja Bhoj. The Bhopal city circles around its two dominate lakes. Bhopal's present profile is multi-faceted including the old city and the new changes. The Bhopal city is surrounded by many National and State highways connecting major cities: Sanchi, Vidisha, Raisen, Bhojpur, Narsingharh, Obedullaganj and Hoshangabad. These highways carry majorly trucks for transporting of goods and services and comprise of agricultural fields and forest landscape. The construction of highways has led to many ill effects on the environment like causing air, water and noise pollution. The major impact is on the habitat of wildlife and their biodiversity that has been fragmented due to these highways. The impacts are not just limited to the construction, but due to increase in traffic congestion, ribbon development, change in landscape, urban development, they all have a negative influence on the quality of air and water on the surroundings as well as reduce the visual quality of the corridor.

The Bhopal Bypass is one such State highway that poses many issues and landscape can play an essential role in overcoming them, enhancing the visual aesthetics of the corridor and eventually have an enduring image of the driving experience on the user. The water run-off from the highway is one of the major concerns today, where lakhs of liters of water is being drained off or directly percolating into the ground, contaminating the ground water as well as the adjacent crop. The embankments are unused and filled with invasive plants. Most of the left over spaces along the highway are mostly fragmented, narrow and thin, dense with shrubs and invasive plants and not many trees. Also due to absence of trees they add to the problem of carbon sequestration. Highways are increasing in numbers, decreasing the quantity of green areas and increasing the carbon footprint. In such scenarios, trees are important to reduce the noise and pollution level and screen

vehicular movement from the residential area along the highway. The project aims at creating a scenic highway - a highway that will help keep people aware and interested in their surroundings, and create an unfolding panorama of this Bypass.

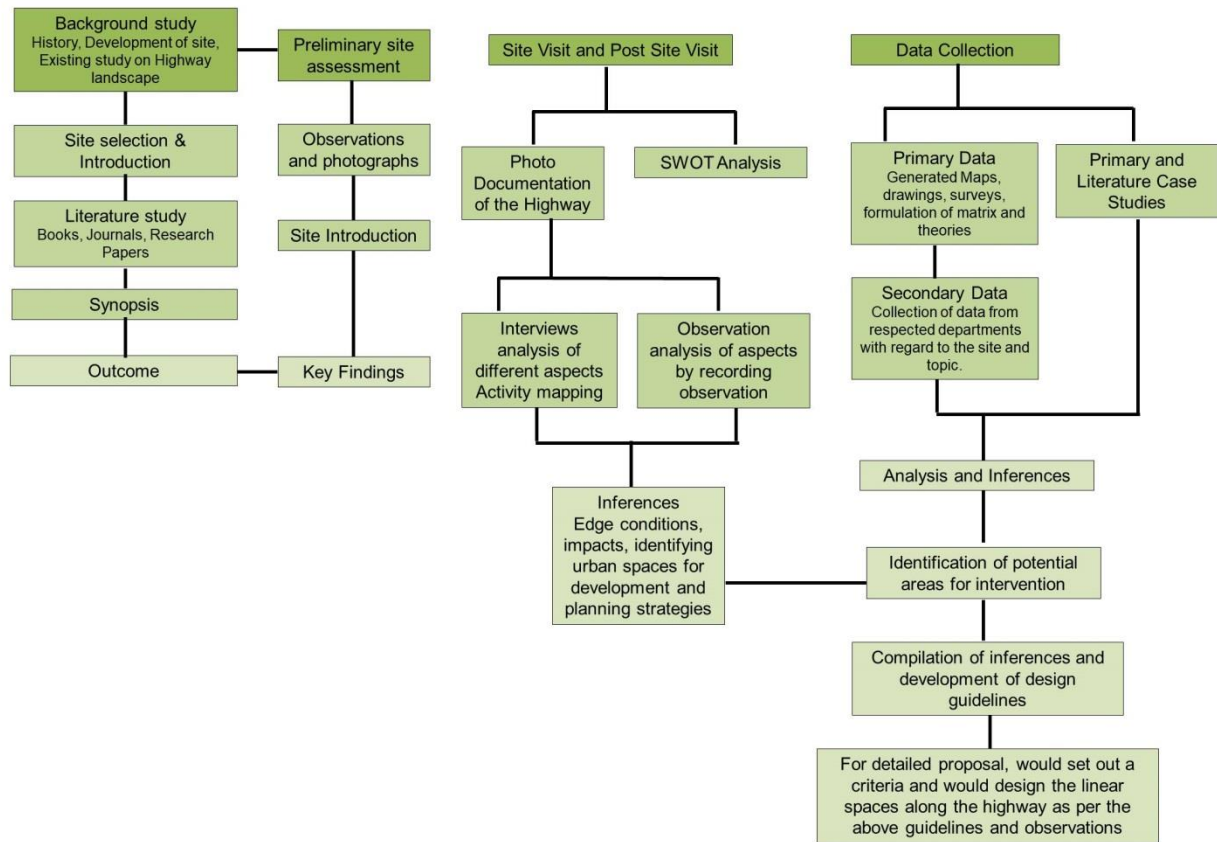
1.3 Aim

To propose an integrated landscape design proposal for Bhopal bypass state Highway.

1.4 Objectives

1. To analyze and study the landscape character of Bhopal Bypass Highway.
2. To find out the impacts of highway construction on the environment and how it is changing the landscape through formulating a matrix on various subjects ranging from anthropogenic activities to soil, water, air and climate.
3. To study changes in the land-use pattern and socio-economic aspects of the people along the highway and propose a multi-functional landscape design of the highway.
4. To study the topography, hydrology, drainage pattern and soil condition to provide a detailed landscape proposal.
5. To propose a green highway for reducing the impact of highway on the environment and further add opportunities for the highway as an essential part of the city design.
6. To improve the visual aesthetic qualities of the highway for a better driving experience and enhance the sequences of vision with socio-cultural elements without hindering the view of the driver.
7. Formulating a unique planting strategy specific to site conserving and restoring the biodiversity and ecology of the surrounding areas.

1.5 Methodology



1.6 Scope and Limitations

The scope of the design proposal will be limited to a 10 km highway stretch and its surrounding areas. Only management strategies would be proposed for this particular stretch of the Bhopal Bypass State Highway. The existing site conditions would be taken into considerations for designing.

1.7 Expected Outcome

The landscape design proposal will enhance the experience of the driver and passenger by increasing the quality and improving the visual complexity of the highway; also will become a piece of art and representative of the city's rich culture and ecology. Environmentally more suitable and restoring the surroundings by design solutions which will reduce the impact and effects of the highway construction and will add ecological value to the environment and the city as well.

CHAPTER 2: LITERATURE REVIEW

2.1 Definitions

2.1.1 Highway

A highway is any public or private road or other public way on land. A highway is a major and significant, well-constructed road that is capable of carrying medium, heavy to extremely heavy traffic. Highways are usually designated a route number by the state and central departments of transportation and run across the entire length and breadth of the country. National Highways are at-grade roads whereas Express Highways, commonly known as Expressways, are controlled-access highways, mostly six-lane or above, where entrance and exit is controlled by the use of slip roads (ramps) that are incorporated into the design of the highway.³ These are the arterial roads of the country for inter–state movement of passengers and goods. The National Highways Authority of India (NHAI) is the nodal agency responsible for building, upgrading, maintaining and development of most of the national highways network that operates under the Ministry of Road Transport and Highways. The National Highways Development Project (NHDP) is a major effort to expand and upgrade the network of highways. NHAI often uses a public-private partnership model for highway development, maintenance and toll-collection.⁵

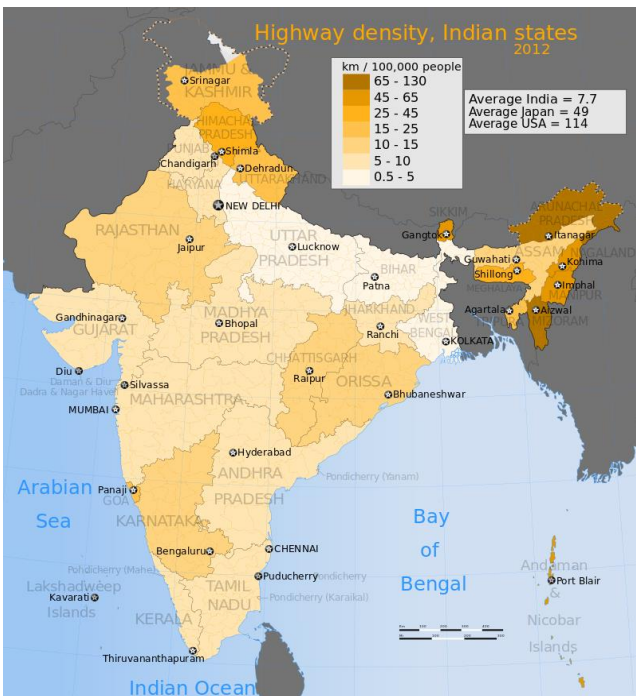
There are several projects associated with highway development started by the Government of India. One such project is Bharatmala – which is a centrally funded road and highway project having construction target of 83,677 kilometers for new highways at an projected cost of rupees 53,000 Cr. started in 2017. Recently, the Government of India at a summit meeting aimed at reducing its carbon emissions and proposed the Green Highway (Plantation, Transplantation, Beautification and Maintenance Policy) in 2015 to develop greening of highways across the country. Under the policy, 140,000 kilometers of National Highway will be planted with trees. The policy aims at lining the national highway of India with trees and shrubs in order to reduce the air pollution and to achieve the target of carbon sequestration by 2020.

³ [https://en.wikipedia.org/wiki/National-Highway-\(India\)](https://en.wikipedia.org/wiki/National-Highway-(India))

Figure 2: Major Highways, India



Figure 3: India highway density map in lane kilometers per 100,000 people as of 2012



Source: <https://en.wikipedia.org/wiki/Indian-road-network>

2.1.2 Bypass

A bypass is that road or highway which goes around a developed area, city and village, so that the traffic passing through the town does not have to go via the city center. Hence, the traffic flows without interference from local traffic, reducing congestion in the built-up area and improves road safety. The main reason for constructing the bypass roads in cities is to remove through-traffic from the center of a town /city to its periphery, hence improving the flow of traffic, reduction in travel times and reduction in road accidents.⁴

Bypasses are a better system as they help in reducing the amount of traffic in the city center where people work & live. These roadways allow fast moving traffic, hence reduce the time travel and improve the quality of journey for the people. Bypass construction are part of Highway improvements that are motivated by the need to improve the flow and safety of travel. However, they often affect local economy and quality of life.

These bypasses have many effects that include changes in property values, changes in the spatial distribution of residential housing and business activities of various types and changes in land use. They also establish a reference for understanding the processes involved in selecting locations for living premises and understanding the changes in vehicular and pedestrian commuting patterns which is a reaction to alterations in availability to homes, businesses and various activities resulting from bypass road construction.⁵

Since the absence of strict rules for controlling use of land, buildings are usually built in cities and towns along the bypass converting them to an ordinary and the bypass might at the end become as congested as the local streets, which initially it was intended to avoid. Petrol stations, shopping centers and other businesses are often built along the corridor for ease of access.

⁴ The influence of bypass road on urban development and residential location choice, WafaElias, YoramShifan, Israel Institute of Technology, TechnionCity, Haifa32000,Israel.

⁵ ECONOMIC IMPACT OF FREEWAY BYPASS ROUTE IN MEDIUM SIZED CITIES by Margaret Collins and GlenWeisbrod Economic Development Research Group, September2000

2.1.4 Scenic Highway

A Special designated road or waterway that routes through an area of natural/cultural beauty is termed as Scenic Byway. It is also known by other names like a scenic route, tourist road, tourist route, tourist drive, holiday route, theme route. Scenic roads built for recreational driving in the National Park System through scenic or historic areas are termed as National Parkways⁶

The scenic highways have six intrinsic values, which makes them different from any other road network. These qualities are:

- **Scenic quality** is a visual experience that any passerby gets while driving through natural landscapes that enhances the cognitive senses of the human.
- **Natural quality** are those ones which are related to natural forms such topography, water, landform and vegetation.
- **Historic quality** relates to any natural or man-made feature that has some importance dating back to history, which needs to be preserved as well as enhanced.
- **Cultural quality** is the evidence of any cultural influence such as some traditions, people or tribe and their local traditions reflected on the natural landscape.
- **Archeological quality** involves those characteristics of the scenic byways corridor that are physical evidence of historic or prehistoric human life or activity.
- **Recreational quality** is defined as outdoor activities for people, which are both in active and passive leisure forms. They contain natural, physical and cultural elements.

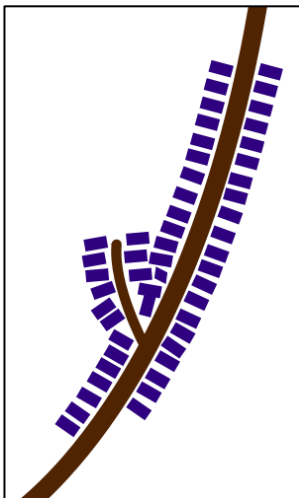
⁶ <https://en.wikipedia.org/wiki/Scenic-route>

2.1.5 Ribbon Development

Ribbon development is defined as building houses along the routes of communications radiating from a human settlement. The practice became as an inefficient use of resources and a precursor to urban sprawl. Due to the improvement in road design, surfaces and growth of motor traffic, this has become a regular practice for people to build as close to the road as possible for easy access and reduced traffic. The building activities expand along the corridor in a natural form of long ribbons of houses, factories, shops etc. The important aspect of the ribbon development is that people construct more structure along the highways or bypasses to avoid congestion but eventually end up causing more chaos and crowding of the area.

Ribbon development must be prevented to ensure congenial living conditions in the rest of the cities of the country. The methods for ensuring that ribbon development do not take place is to acquire extra land for fulfillment of the future requirement as well as proposing green belts⁷ and greenways, which will not allow the development to start from the edge of the highway corridor and will retain the character landscape.

Figure 4: Ribbon Development Figure 5: Ribbon Development along Arterial road



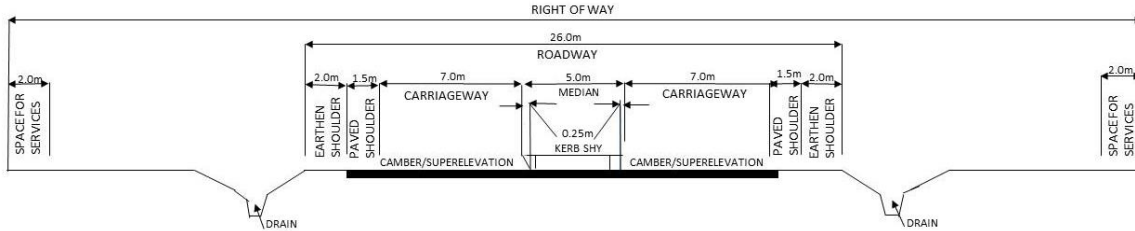
Source: https://en.wikipedia.org/wiki/Ribbon_development

⁷ <https://www.thedailystar.net/prohibit-ribbon-development-22007>

2.2 Highway Standards

The following highway standards for a 4-lane highway are:

Figure 6 : 4-Lane Highway Typical Section



Source: *Four-Laning of Highways through the Public Private Partnership, Manual of specifications and standards*

Table 1: Right of Way Standards

Recommended Standards for building and control lines are given in Table 4. For more details about measures for preventing

Road Classification	Plain and Rolling Terrain			Mountainous and Steep Terrain	
	Open Areas		Built-up Areas	Open Areas	Built-up Areas
	Overall width between Building lines(metres)	Overall width between Control lines(metres)	Distances between Building Lines and road boundary (set-back) (metres)	Distance between Building Line and road boundary(set-back) (metres)	
1	2	3	4	5	6
1. National and State Highways	80	150	3-6	3-5	3-5
2. Major District Roads	50	100	3-5	3-5	3-5
3. Other District Roads	25/30*	35	3-5	3-5	3-5
4. Village Roads	25	30	3-5	3-5	3-5

Notes: 1. * If the land width is equal to the width between building lines indicated in this column, the building lines should be set-back 2.5m from the road land boundary.

Source: *Four-laning of Highways through Public Private Partnership, Manual of specifications & standards*

Table 2 : Building and Control Lines Standards

Road Land , Building Lines and Control Lines

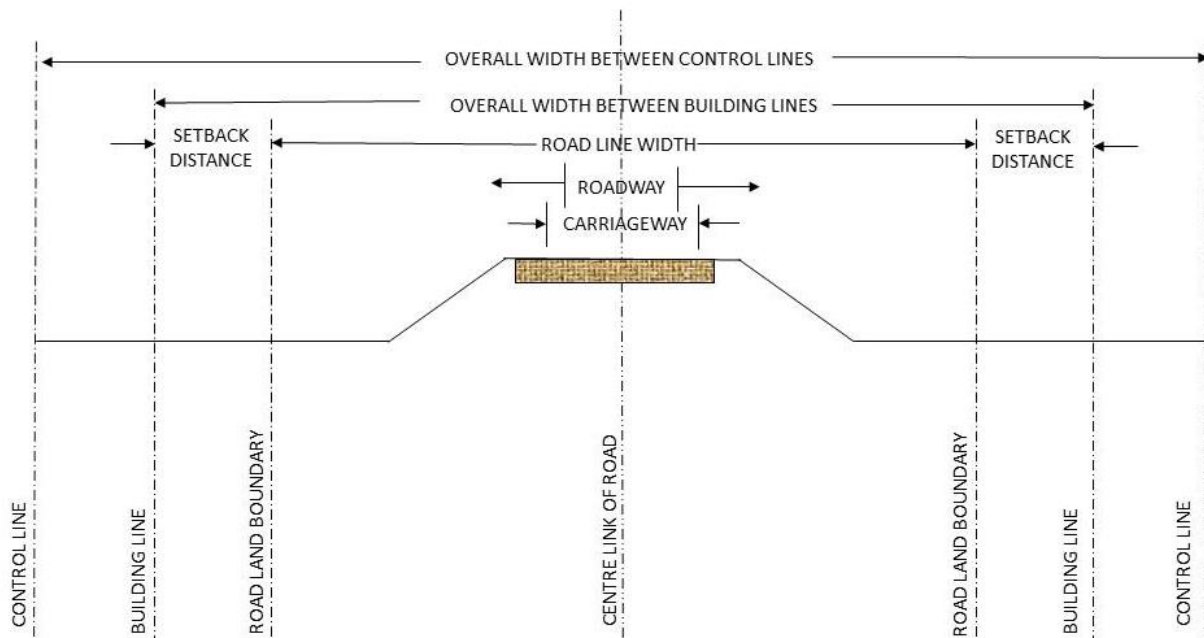
Road land width (also termed the right-of-way) is the land acquired for road purposes. Desirable land width for different classes of roads is indicated in Table 3.

Road Classification	Plain and Rolling Terrain				Mountainous and Steep Terrain (metres)	
	Open Areas		Built-up Areas		Open Areas	Built-up Areas
	Normal	Range	Normal	Range	Normal	Normal
1. National and State Highways	45	30-60	30	30-60	24	20
2. Major District Roads	25	25-30	20	15-25	18	15
3. Other District Roads	15	15-25	15	15-20	15	12
4. Village Roads	12	12-18	10	10-15	9	9

In high banks or deep cuts, the land width should be suitably increased. Similarly, a higher value should be adopted in unstable or landslide-prone areas. The need for a wider right-of-way at important road intersections should also be kept in view.

Source: Four-laning of Highways through Public Private Partnership, Manual of specifications & standards

Figure 7 : Building Lines and Control lines Standard



Source: Geometric Design Standards for Rural (Non –Urban) Highways, IRC 73-1980, the Indian Road Congress

2.3 Multifunctional Landscape

Landscapes that can provide many functions together are called Multifunctional landscapes. If multiple function on one definite area is possible, it's called as multifunctional land use. In other words, simultaneous use of a space or location for many purposes, an area that serves different functions/uses and combines a variety of qualities together.⁸ In the landscape-planning context, this means developing a landscape that can serve multiple planning goals and objectives or values. Multifunctional landscapes are perceived as tangible mixed natural and cultural systems interacting together. For example, a greenway is planned, designed and managed to achieve multiple objectives such as recreation, transportation, nature conservation and aesthetics.⁹

The sustainability of multifunctional landscapes has to do with interrelations and mutual impacts between different land uses and once again with management. But, it also depends on the spatial configuration of the different land use types composing the landscape. So monitoring the functionality of multiple land use requires that the particular spatial arrangement of individual land use types and their management can be described to.

Natural systems such as wetlands provide various ecological services that are multifunctional. A natural wetland area can provide various ecosystem services at once such as flood control, wildlife habitat, nutrient regulations and recreation as well as intentionally design or plan areas that would support multiple functions.

Hence, Multifunctional landscapes can be designed to provide range of environmental, social and economic functions while bearing in mind the interests of

⁸ Mapping and Modelling Multifunctional Landscapes Louise Willemen, Thesis submitted in requirement for the degree of doctor at Wageningen University by authority of the Rector Magnificus, Thesis, Wageningen University, Wageningen, The Netherlands (2010).

⁹ Multifunctional Landscapes as a basis for Sustainable Landscape Development, 2009 Sadahisa Kato, JackAhern, Department of Landscape Architecture and Regional Planning, University of Massachusetts, USA

landowners and users, through integrated multifunctional landscapes such as crops, trees, meadows and forest patches.¹⁰

2.4 Road Ecology

Road Ecology focuses on the relationship of the road network, the largest human artifact on the plane and the land on which the roads are built.¹¹ Road ecology or the interaction of organisms and the environment connected to roads and vehicles is explained through landscape and ecological concepts. The study of ecological impacts of roads and highways that are both positive and negative is called Road Ecology. Road ecology uses the science of ecology and landscape ecology for exploring, understanding and addressing the various interactions of roads and automobiles with the environment surrounding them. The road ecology focuses on various areas such as roads, vehicles, transportation planning, roadsides, vegetation, wildlife, and mitigation, water, sediment, chemicals, aquatic ecosystems, and the atmosphere and road systems, major landscape types, and other perspectives.¹²

Today we continue facing challenges about decreasing water resources, increased pollution and dust in the atmosphere, increasing temperatures around the world and diminishing wildlife habitat and biodiversity. Road ecology talks about the integration of ecological benefits and design ideas that can be interlinked and hence create an ecological corridor which not only benefit the world around but the communities and people living adjacent to them. Roads cover most of our land and hence needs us to focus on making it ecological rich in terms of preserving, conserving and enhancing both water and wildlife components of our landscape.

¹⁰ Nature conservation planning in Europe-developing ecological networks Rob H.G.Jongman European Centre for Nature Conservation (ECNC) P.O. Box 1352, BJ Tillburg,Netherlands Accepted on 4 January 1995.

¹¹ Forman, R.T. D.Sperling, etal.(2003). *Road Ecology-Science and Solutions*. Island Press,WashingtonD.C.

¹² *Road Ecology Science and Solutions*, Richard T. T. Forman, Daniel Sperling, 2002

Waste water management, collection of run-off from roads, retaining facilities, ecotype corridors, surface flow wetlands and stabilization ponds. Wildlife crossings, planting along the corridor, increasing biodiversity in terms of birds, and insects are some of the example of road ecology designs.

2.5 Green Highway

Integrating the transportation functionality and ecological sustainability is a recent concept of building roadway called a Green Highway. Basically green highway is beneficial to environmental problems such as pollution and health issues in urban areas.¹³

The main point of green highway is helping the environment, local communities, and in generating employment by planting trees all along the highways in the country including beautification of roadways. Ensuring that the balance between development and environment is maintained, it is intended to develop green corridors along upcoming and developed National Highways.

Green Highways are expected to contribute towards reduction in use of virgin materials, energy use reduction, moderation of environmental burden and promoting human health and safety. Optimizing habitat and land use, improving business and communication and most importantly is to re-affirm our commitment to future generations.

Benefits of green highway are social benefits, reduction and delay in storm water run-off volumes, enhancing groundwater recharge, reductions in storm water pollutants, reducing sewer overflow events, increasing carbon sequestration, urban heat mitigation and reducing energy demands. Improving air quality, adding to wildlife habitat and recreational space, improvement in human health and increased land value.¹⁴

¹³ <https://medium.com/@NGHMIndia/green-highway-project-a-tremendous-promotion-for-roadways-in-india-b45a44b5b7ed>

¹⁴ Green Highway: A Future Requirement, Manika Barar, Deptt of chemistry, SIMT College Meerut U.P, India, 2016 (International journal of technochem Research)

2.6 Visual Aesthetics

Visual aesthetics is the perception of the landscape. It is a relationship between the viewer and their environment and the perceived sense of coherence, mystery, legibility and complexity. Visual aesthetics of highway is the experience the person acquire while moving through the landscape on which the route is build. Form, character, detail, scale and proportions are the key concepts in aesthetics of the highway landscape. For years landscape architects have formulated research on the various concepts that should be used along these roads and highways to enhance the views of the commuter. Visual aesthetics is the perception of the person towards the landscape around him. How he orient himself to it and how his cognitive mind reacts to it, forms the aesthetics of the space. The integration of nature, environment and the highway also form an important visual aesthetics for the people using them.

Aesthetics involve many landscape element confined within the space, ranging from topography, water, terrain, vegetation, elements such as bridges, culverts, retaining walls, buildings, signage and lighting. Sense of place also is an important part of visual aesthetics.

2.7 Environmental Aspects

Highway poses the maximum threat to the existing environment around it. The topography, water streams and drainage pattern, noise levels, air pollution are some of the aspects that are affected the most due to the construction of roads and highways. The fragmentation of landscape resulting in biodiversity and ecological lost is the other major drawback of highways. The environment is the most important aspect to be dealt with in today's world with rising temperatures and disturbed weather patterns. The environment eventually is the key to a healthy life and ecosystem, which allows a co-existence of all species together living in harmony.

Damage to the environment also indirectly affects the cultural and economic aspects of the people and communities leading to a decline of rural population causing major challenge to the landscape integrity resulting in homogenous landscape all around.

2.8 Water from Roads

Roads have important consequences on hydrology, blocking and altering the flow of water both in surface and underground, re-organizing the distribution of water related hazards and resources among the population, with significant consequences on their livelihoods. Therefore, roads have the capacity to deeply change the agro-ecology of the places they cross. Roads associated with proper planning and simple engineering techniques – can be used to direct surface run-off, collect and retain water and recharge the groundwater system. Higher surface and ground water availability would benefit rural dwellers in many different ways, and together with the provision of roads could have a positive socio-economic impact and improve livelihoods. We define such infrastructures as multifunctional roads as they combine many functions such as transport, access, connection and also water harvesting.

A series of measures such as retaining water in small dams or storage ponds or harvesting run-off from road surface and culverts with deep trenches and rolling dips, retention facilities, ecotype corridors, surface flow wetlands and stabilization ponds can be used to conserve and harvest water and hence reduce the amount of pressure on villagers and farmers of the water scarcity.

2.9 Plant Selection Criteria

Tree species preferred are:

Indigestible or fenced, evergreen or remain green throughout the year, tolerance for seasonal drought and insect/pest harm, deep rooted to resist wind power and don't damage road, fast growing, not invasive, should have social and economic values like medicinal, food, fuel wood, feed and shade.

The main objectives of tree plantation or landscaping are:

Climatic amelioration. Air & noise pollution check. Soil erosion control and reduction of water logging. The effects of wind and incoming radiation is regulated. For shade, aesthetics and beautification. To enhance the visual experience while travelling along the highway. To define the Right of Way, especially by highlighting sharp

horizontal curves during night. To screen un-pleasant views from the road and screen the roadside communities from air & noise pollution. To enhance spots of natural and cultural importance while preventing the glare from the incoming vehicles.

2.10 Linear Park

A linear park is a park in an urban or suburban area that is considerably longer than it is wide. Some rail trail beds, bands of public land such as waterways, rivers, electrical lines, highways and seashores that are disused are converted into recreational use, ecological corridors. They are also described as greenways.

They typically result from historical features of a city such as roads that were replaced with green space. Linear parks are often ideal for activities such as walking and jogging. They also allow a large number of people to live within close proximity to a green space as they stretch through a city.

According to the urban planner, William H. Whyte in *The Last Landscape* (1968:173), "linear strips are probably the most efficient form of open space". People see and use the edges of park land most for recreation. Whyte felt that in urban areas where land is difficult to obtain, linear strips of open space could be developed on obsolete transportation rights-of-way. Converting these corridors to park land preserving the cultural and historic past, the scenic beauty, and the existing ecosystems as a living and working museum for the future (Burwell, 1986).¹⁵

Linear park goals are outlined for recreation, connections, accessibility, ecology, landscape character, and tourism. The benefits of linear parks are environmental awareness, landscape appreciation, fun, increased social connections, tourism, heritage and cultural awareness, decreased use of vehicles, fitness and health.

¹⁵ http://www.brucefreemanrailtrail.org/pdf/Thesis_Chap2.pdf

CHAPTER 3: CASE STUDY

3.1 Kalka – Shimla Highway, India

3.1.1 Introduction

In 1971-1972, the Himachal Pradesh State Government sponsored an extensive landscape planning project along the Kalka - Shimla Highway. For the time, it was a surprisingly enlightened initiative. The work was taken up by Landscape Architect Ram Sharma, a committed professional and academician. In practice, this required him and his assistants (Ranjit Singh and Rasik Bahl) to walk virtually every kilometer of the way.

3.1.2 Features

The Project entailed very intensive and detailed site studies of the regional ecology, together with a visual assessment of the scenic value along the entire stretch. The project involved designing of highway furniture such as parapets and signage. Regional landscape analysis was done and a planning proposal was formulated for a major planting outcome for the regional ecology.

Figure 8 : Towns and Services Enroute

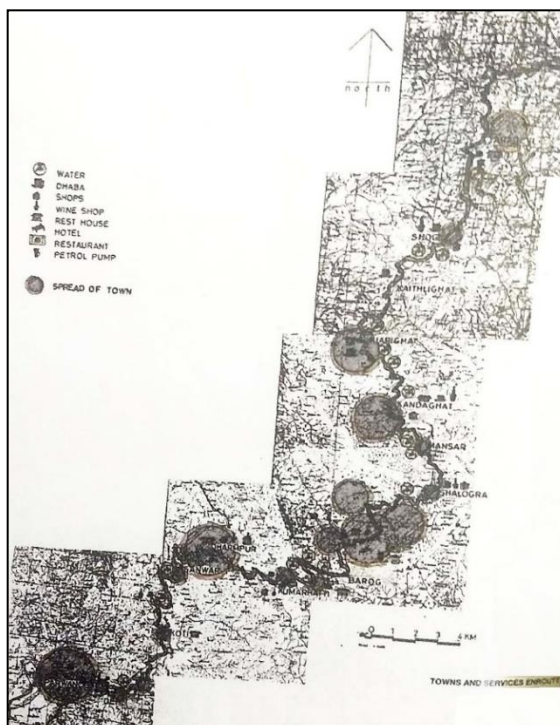


Figure 9 : Pedology

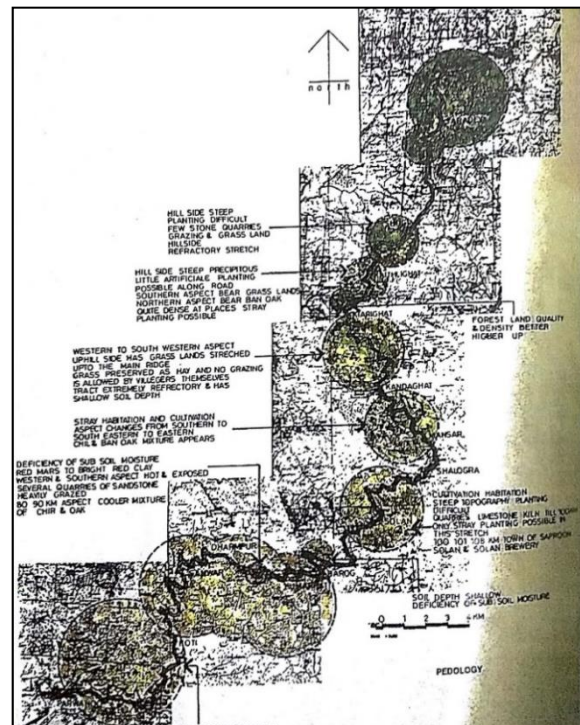


Figure10: Proposed Planting

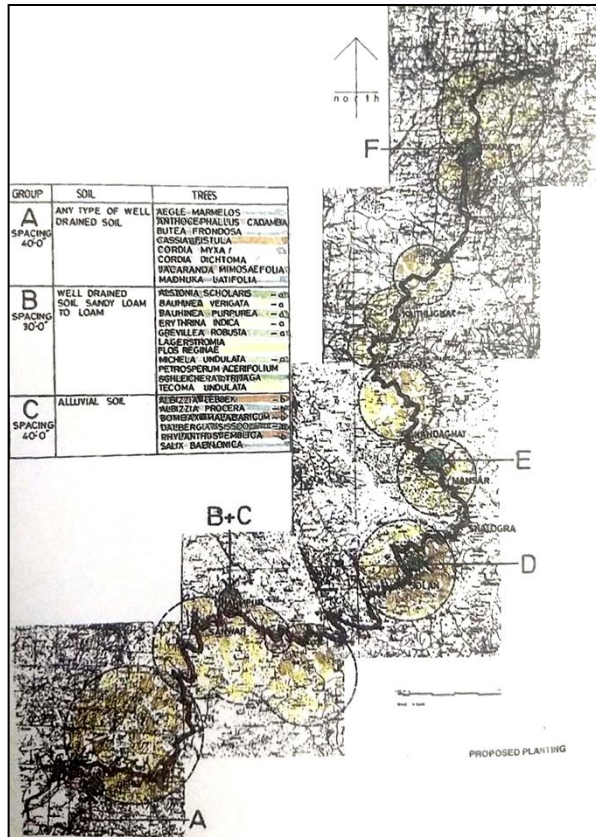


Figure 10 Geology and Vegetation

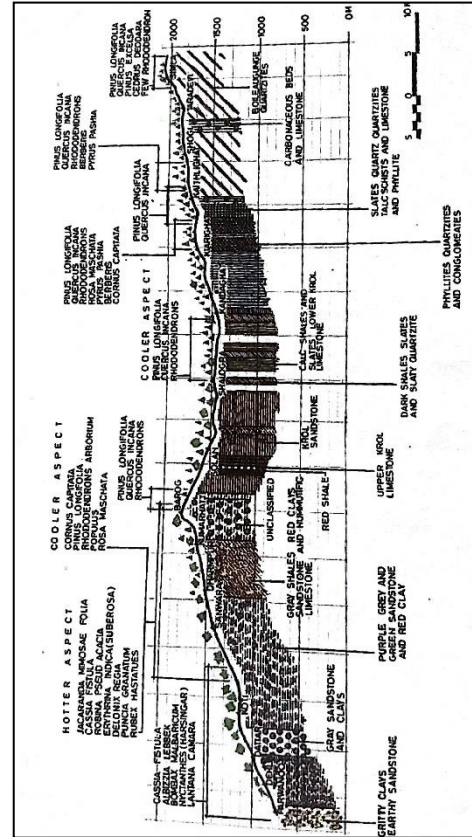


Figure 11 : Proposed planting list

TREES				SHRUBS		PLANTING SYSTEM
GROUP	SOIL	KEY NO	NAME	KEY NO	NAME	
A	ANY TYPE OF WELL DRAINED SOIL	1	AEGLE MARMELIOS	31	BANARSIWILGEEA	<p>KM64 TO KM 73 - 1ROW OF 23 AT 40'-0" CENTRES KM73 TO KM 78 - 1ROW OF 14 AT 30'-0" CENTRES</p> <p>1. TREES TO BE PLANTED ON VALLEY SIDE AT 30ft TO 40 ft CENTRES. PLANTING TO BE STAGGERED IN TWO OR MORE ROWS SUBJECT TO AVAILABILITY OF SPACE</p> <p>2. FLAT AND AREAS WITH EASY GRADIENT ON HILL SIDE TO BE PLANTED WITH FLOWERING SHRUBS AT 8 ft TO 10 ft CENTRES</p> <p>3. STEEP SLOPES ON BOTH SIDE OF THE ROAD TO BE PLANTED WITH CREEPERS AND GROUND COVERS AT 8 ft TO 10 ft CENTRES</p> <p>4. CLUSTUR OF PLANTING TO VARY IN ACCORDANCE WITH THE AVAILABILITY OF LAND</p> <p>5. SLOPE IN LOOSE SOIL AND STEEPER THAN 1:3 GRADIENT TO BE PROPERLY STABILISED BEFORE PLANTING TO AVOID EROSION</p>
		2	ANTHOEPHALLUS CADAMBA	32	GESTROMNOCTURNUM	
		3	BUTEA FRONDOSA	33	MIRBICUS ROSA SINENSIS	
		4	CASSIA FISTULA	34	LANTANA CAMARA	
		5	GORDIA MYXA /	35	NERIUM OBLANER	
		6	TACARANDA MIMOSAEPOLIA	36	NYCTANTHES ARBOR TRISTIS	
		7	MADHURA BATEOLA	37	FRONIA GRANATUM CANARY	
B	WELL DRAINED SOIL SANDY LOAM TO LOAM	11	MISTONIA SCHOLARIS	38	SARNOUS MUKROSSI	
		12	BAUHINEA VERGATA - a	39	UBERINUM	
		13	BAUHINEA PURPUREA - a			
		14	ERYTHRINA INDICA - a			
		15	GREVILLEA ROBUSTA			
		16	LAGERSTROMIA FLOS REGINAE			
C	ALLUVIAL SOIL	21	ALEZZIA FEBERK - b	41	ROSA MORGANA	
		22	BOHNERIA PANDURICA	42	BAUBINA VARIOLIA	
		23	BOHNERIA PANDURICA	43	VERBENA MONTANA	
		24	BOHNERIA PANDURICA	44	GUEMATIS BUCHANANIANA	
		25	BOHNERIA PANDURICA	45	BOHNERIA PANDURICA	
		26	SALIX BABINGTONIA	46	HEDERA RALIX	
				47	WILLOW PATRICIA	

3.1.3 Conclusion and Inferences

The Kalka - Shimla highway landscape project was one of its kinds around 40 years ago. It was a 2-lane highway, scenic and ecologically rich, where Landscape Architect Ram Sharma enhanced the entire stretch of 90 Kilometers through his understanding of a planting scheme. With time, it was encroached by local communities by constructing Dhabas, restaurants, service areas and rest areas. In last 20 years, many hotels and resorts have come up along the corridor, not only disturbing the ecology and topography of the sensitive zone but also the scenic quality of it.

Now, the highway is being expanded to a 4- lane highway and further has degraded the area with mountains sliding, erosion, and area filled with dust. Over a dozen landslides on the highway during the monsoon in June had exposed the fragile ecology of the mountainous road. The landslide and erosion in the hills has also resulted in cracks in the houses of the communities living along the highway.¹⁶

The lack of planning and no geological mapping with ignorance towards the ecology of the area has resulted in massive disturbance in the area. Hence, need for multifunctional landscape and detail planning of green buffers and green belts are required to put the focus now.

¹⁶ <http://indianexpress.com/article/india/an-uphill-task-kalka-shimla-highway-chandigarh-travel-time-road-widening-4902053/>

3.2 Blue Ridge Parkway, United States

3.2.1 Introduction

The Blue Ridge Parkway was the first national rural parkway to be conceived, designed, as a multiple-purpose corridor that would fulfill a variety of social, recreational, environmental and pragmatic functions. Its varied topography and numerous vista points offer easy public access to spectacular views of southern Appalachian rural landscapes and forested mountains.

Figure 12: Images showing the route of Blue Ridge Parkway



The Parkway is recognized throughout the world as an international example of landscape and engineering design achievements with a roadway that lies easily on the land and blends into the landscape.

The Parkway extends 469 miles through 29 Virginia and North Carolina counties linking the Shenandoah National Park to Great Smoky Mountains National Park. It is known for its spectacular mountains and valley vistas, quiet pastoral scenes, sparkling waterfalls, colorful flowers and foliage displays, and interpretation of mountain history and culture. Designed for recreational driving, the Parkway provides visitors with quiet, leisure travel, free from commercial traffic and the congestion of high-speed highways.¹⁷

¹⁷ Blue ridge parkway, longrange interpretive plan, 2002 by Department of Interior National Park Service, Blue Ridge Parkway Branch of Interpretation, Harpers Ferry Center of Interpretive Planning.

The Blue Ridge Parkway, unlike many national parks area, is a planned landscape, to the smallest detail in ways that most visitors do not notice at first instance. Landscape architects and engineers join their skills and creative minds for the benefit of the millions of people who have enjoyed the drive over seventy years. Stanley W. Abbott, a Cornell-educated landscape architect, was the first employee on the project in 1933, who was appointed to design the parkway.

3.2.2 Features

Stanley W. Abbott created a series of parks within parks strung along the roadway in bead-like fashion. The range of recreational choice would include not just pleasure driving and scenery appreciation, but also hiking, camping, fishing, and other outdoor recreational pursuits. At appropriate intervals along the roadway, there would be visitor centers, interpretive programs, lodges, restaurants, and other visitor services. Abbott believed that the parkway would function as an outdoor museum of rural life, telling the story of the mountain folk, their agricultural pursuits, and the mountain retreats of the wealthy. The parkway would speak to the visitor about life and lifestyles in the mountains. It would celebrate the blending of nature and culture.¹⁸

Figure 13 : Images showing different landscape along the parkway



¹⁸ Stanley W. Abbott, Wizard of Blue Ridge Parkway, By Bob Janiskee on October 10th, 2008
<https://www.nationalparkstraveler.org/2008/10/stanley-w-abbott-wizard-blue-ridge-parkway>

Figure 15 : Map showing extends of the Parkway

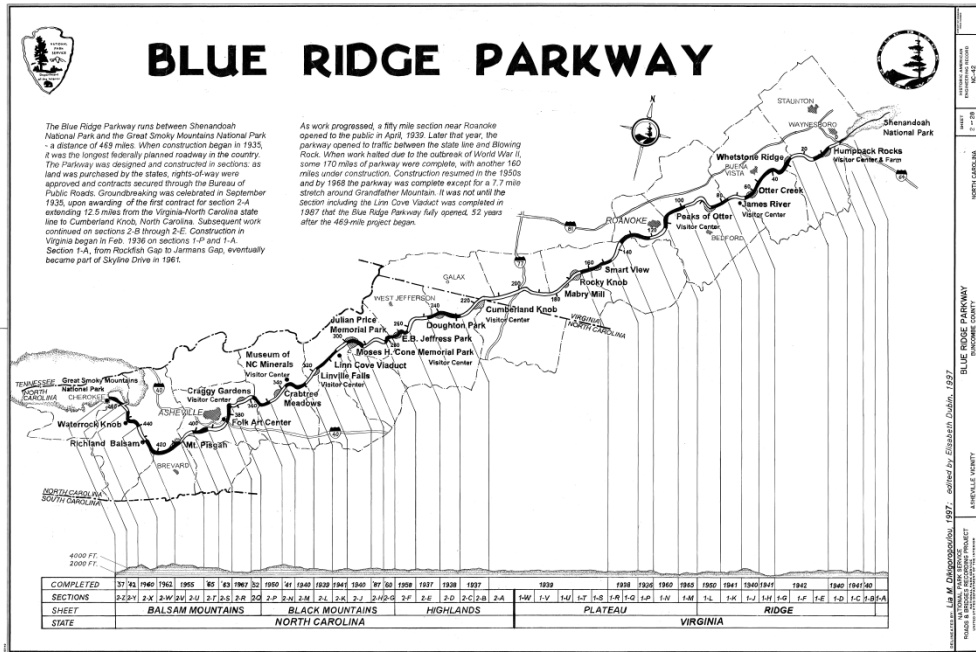


Figure 16 : Vegetation management of the Parkway

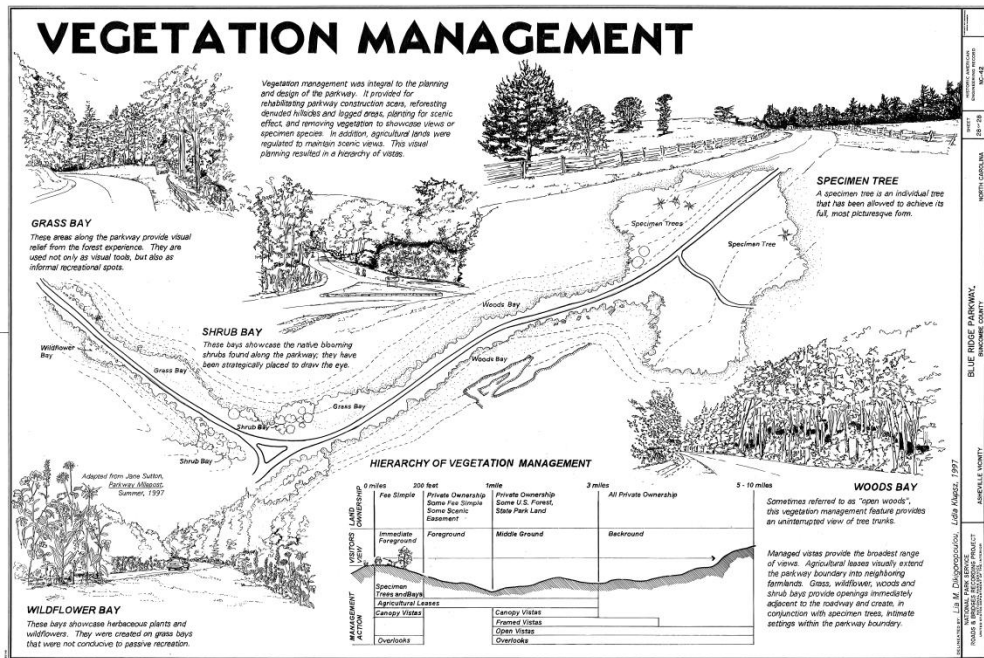
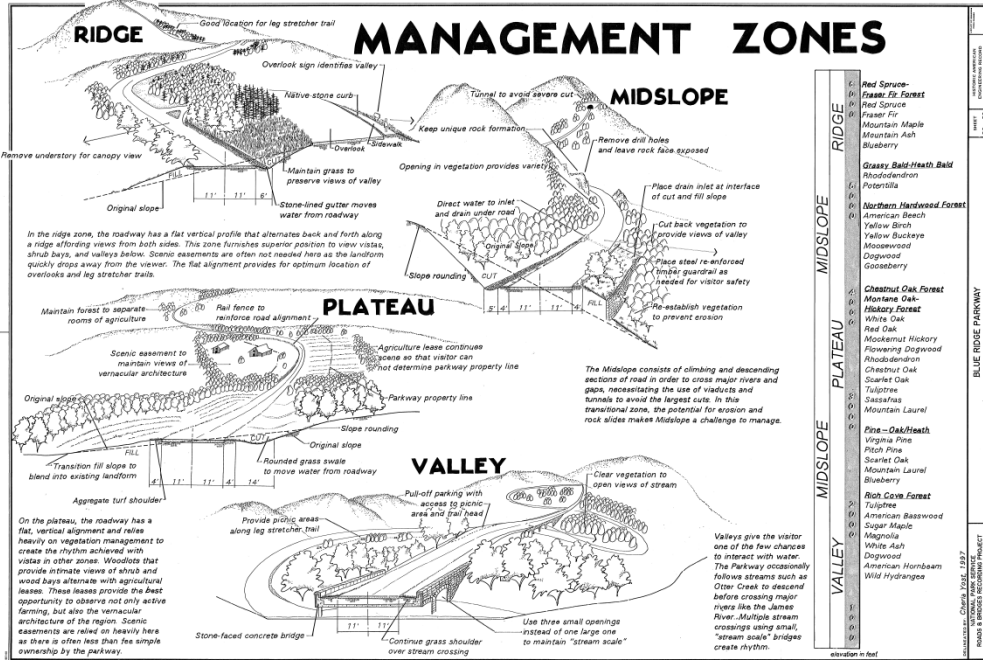


Figure 17 : Different Management Strategies along the Parkway



3.3.3 Conclusion and Inferences

The most important example of scenic highways is the Blue Ridge Parkway, a perfect amalgamation of nature and people through a linear corridor. The parkway is a leisure driving experience but also a unique case of how nature is formed around a road or highway, which not only provide a medium to travel but also connects oneself to the nature and ecology, both its utility and beauty aspects. The seasonal changes, the topography and water has been modeled in a way that enhances the road ecology as well as visual aesthetics of the highway letting the user experience and form a coherent image of the landscape.

CHAPTER 4: SITE ANALYSIS

4.1 Regional Study

4.1.1 Site Introduction and Location

The Bhopal Bypass Road is located around the Bhopal city. It is a Bypass which was constructed in 2013-2014 to reduce the traffic congestion of the city. It is maintained by MPRDC and was constructed by Transstroy Company, Hyderabad.

Figure 18 : Maps Showing Location of the Site

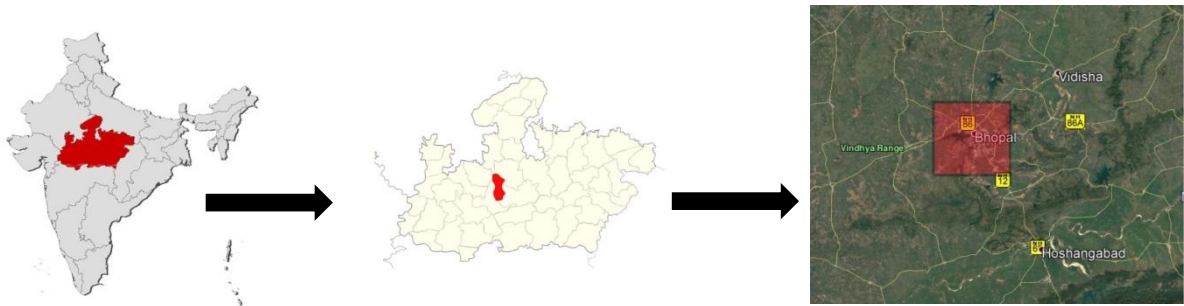
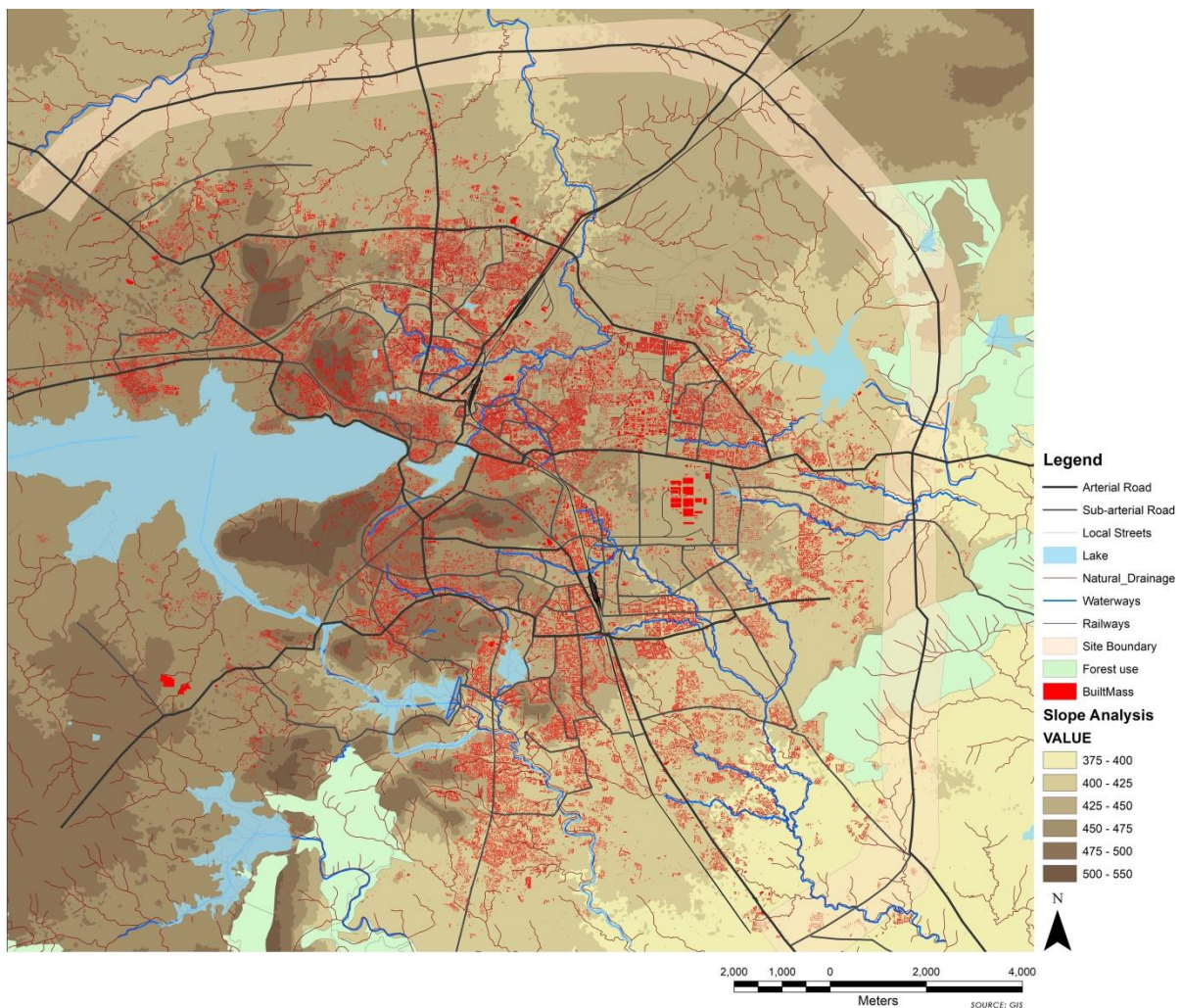


Figure 19 : Google Earth Map showing the Site



The Bhopal Bypass surrounds the city and is on the edge of the Municipal Boundary of Bhopal. The Bypass was constructed under the guidelines of 4-lane highway by Transstroy Company. The Stretch between two toll plazas is approx. 40 Kilometers. The radius covered by this bypass is around 13-18 Kms approximately from center to the city. The Bypass has 4 intersection points, each node important in terms of connecting cities such as Vidisha, Raisen, Narsinghgarh and Berasia. The land use is mainly under agricultural land.

Figure 20 : Bhopal City Map



The Bhopal bypass provides a bypass for the traffic to move around reducing the congestion within the city limits. The Bypass is cut through a simple scenic agricultural landscape providing few scenic visuals of the farmlands. Near the forest area the highway is seen with upcoming ribbon development with C.A.P.T housing.

There are many villages that come across along the highway whose major occupation is agriculture. The intersection or the nodes provide the major access to the highway and hence seen a lot of development like commercial, retail, residential and industrial.

The Bhopal Bypass State Highway provides ample opportunities to create a landscape design proposal to enhance the quality in both visual and environment aspects. It has the capability to form a strong image of the Bhopal city and a model for other such bypass in our country.

4.1.2 Geographical Data

Figure 21 : Relief Map

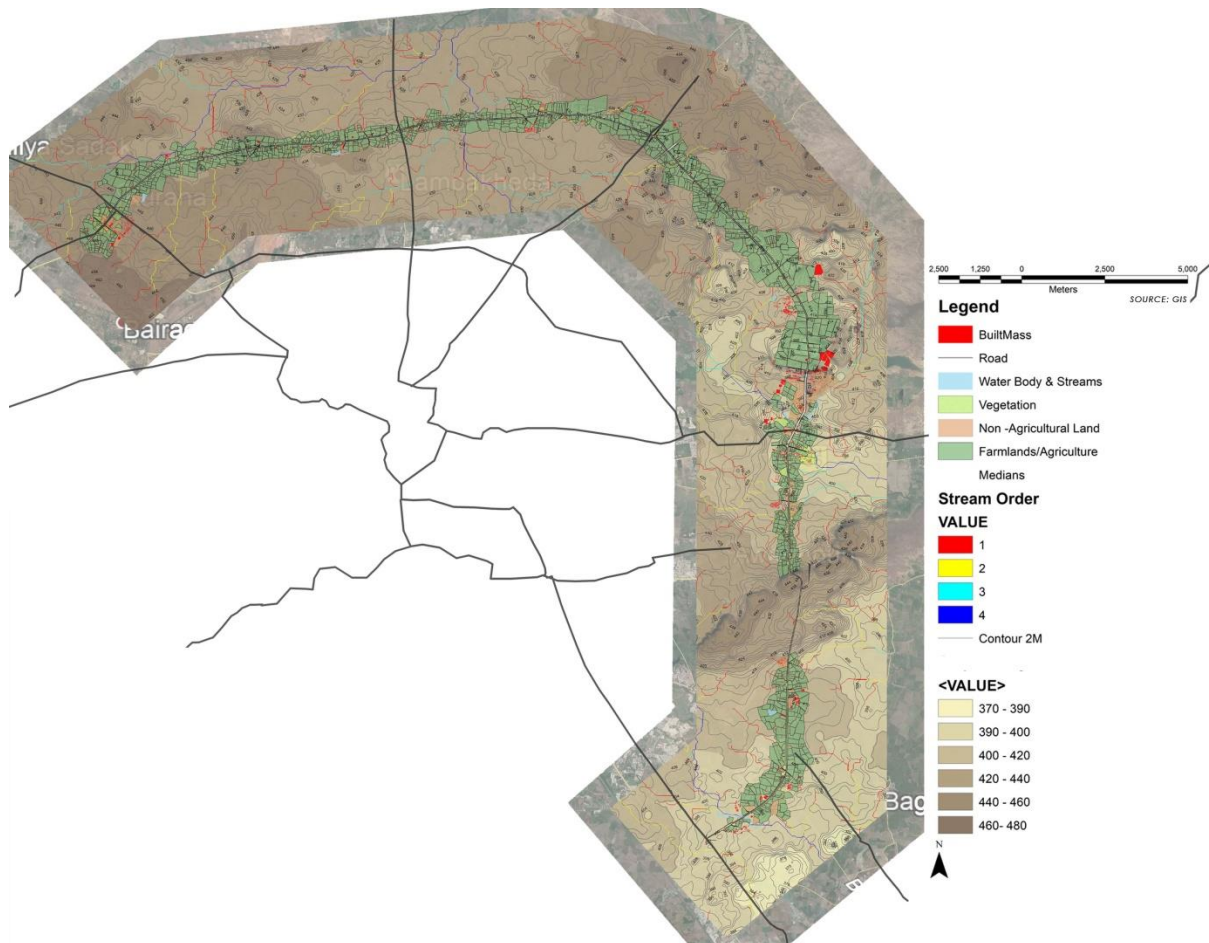
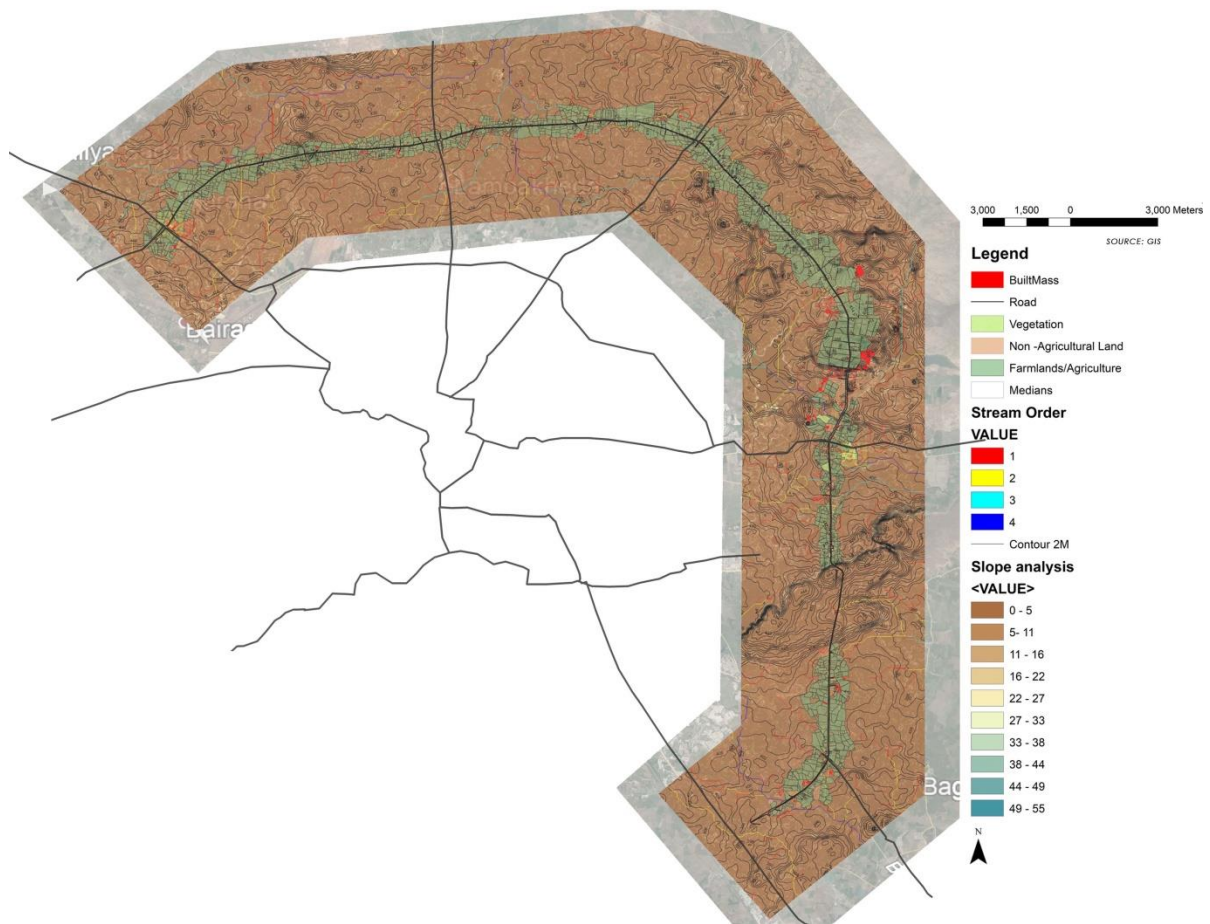


Figure 22 : Slope Analysis



4.1.3 Observation and Inferences

- The relief map generated through GIS (Geographic information system) software indicates the low point is 370 and high point is at 480 above mean sea level. The 40 kilometer stretch mostly composed of a flat terrain with few points providing a larger expanse of view shed.
- Slope analysis impart information regarding the slope which ranges from 0-5 %, indicating gradual slope throughout the Bypass, only when the highway crosses the hill in the forest landscape, the slope is above 5%.
- The soil map shows most of the entire highway stretch fall under the clayey soil, few areas have loamy and loamy skeletal texture. The clayey soil is very dense due to presence of fine particles and hence does not allow the water to percolate easily.

Figure 23 : Soil Map

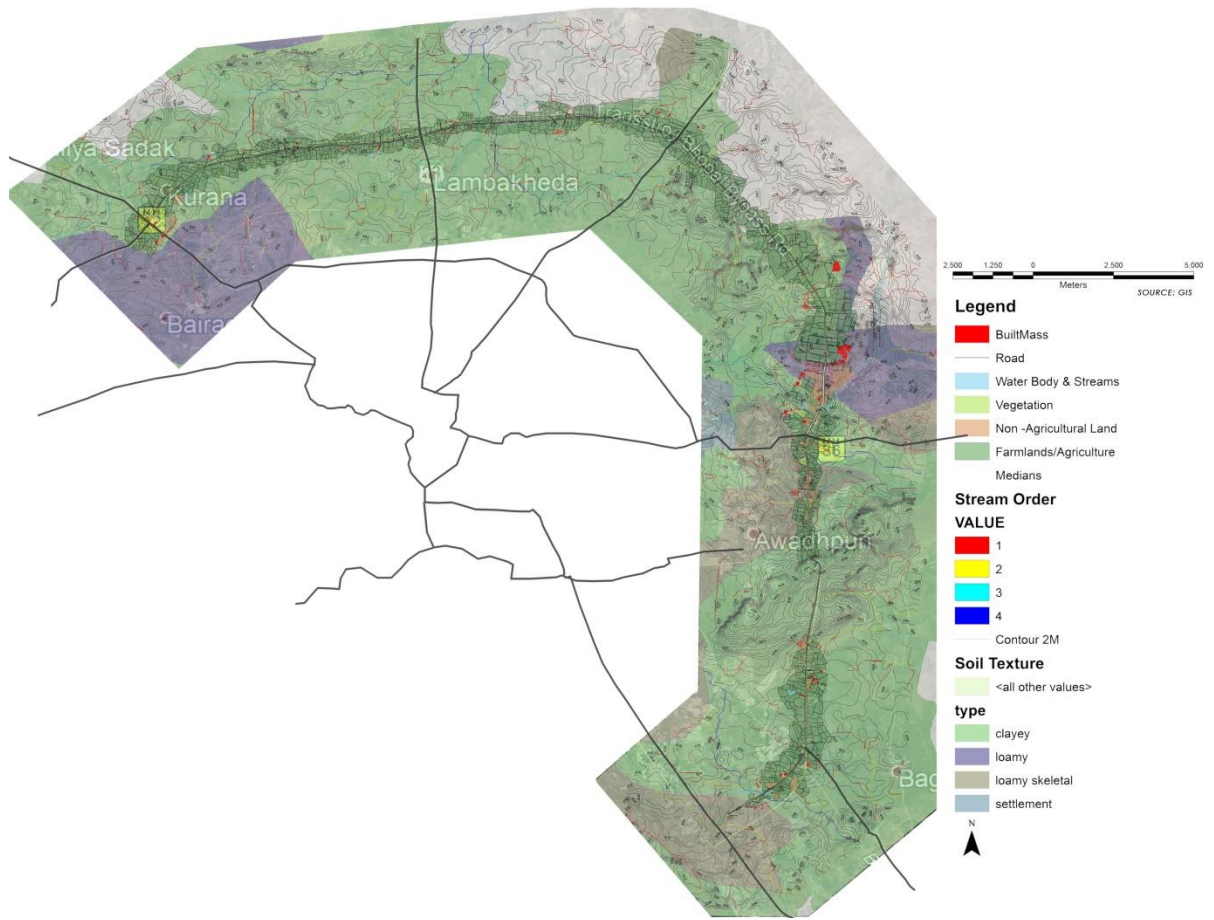
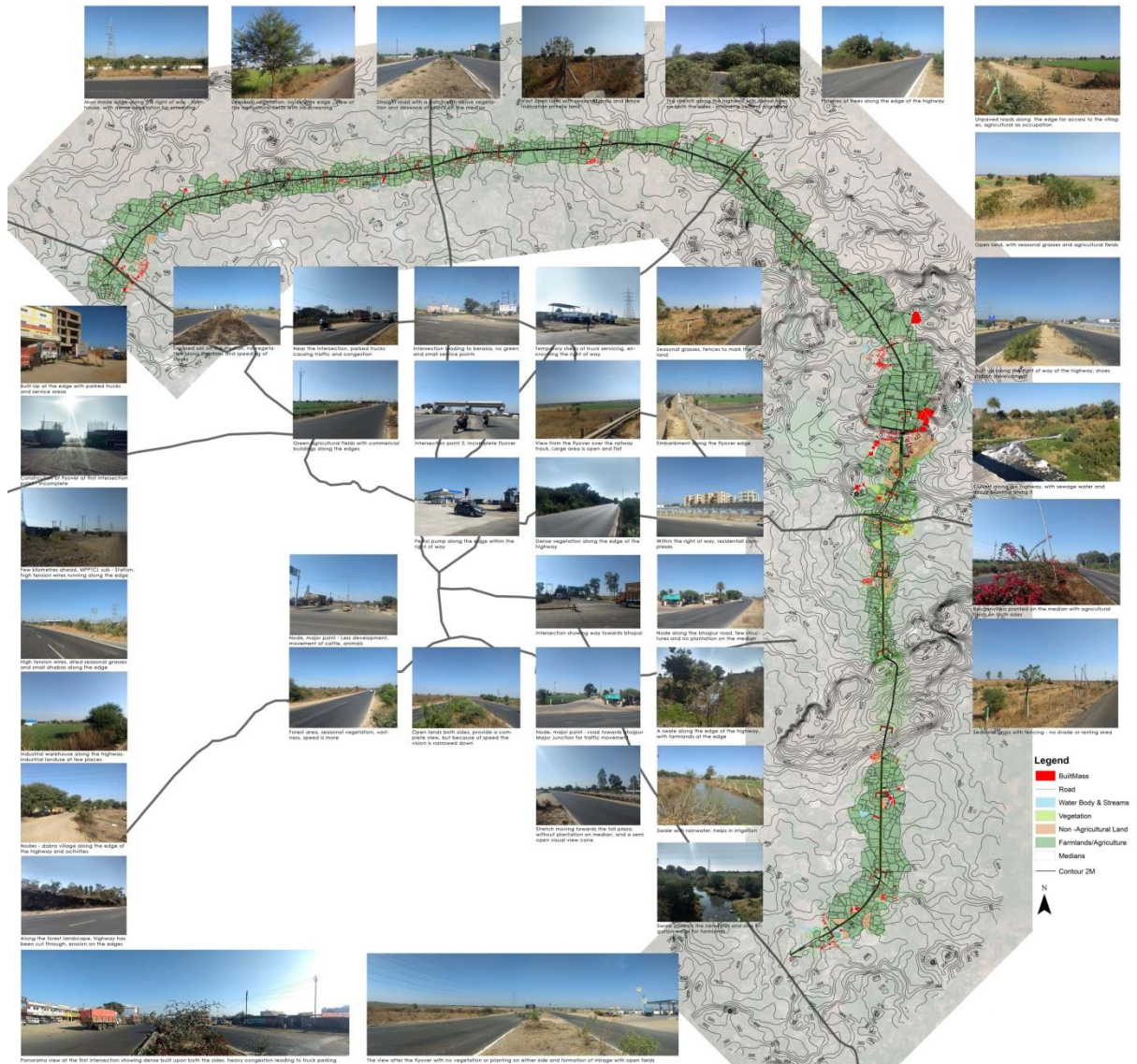
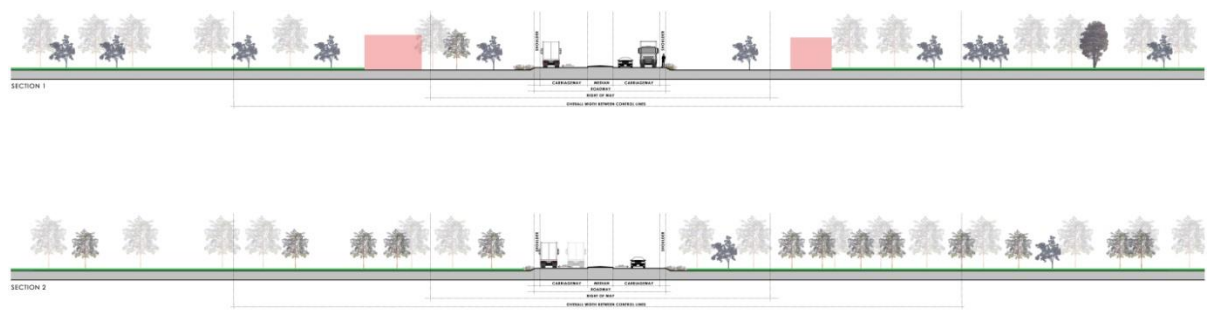
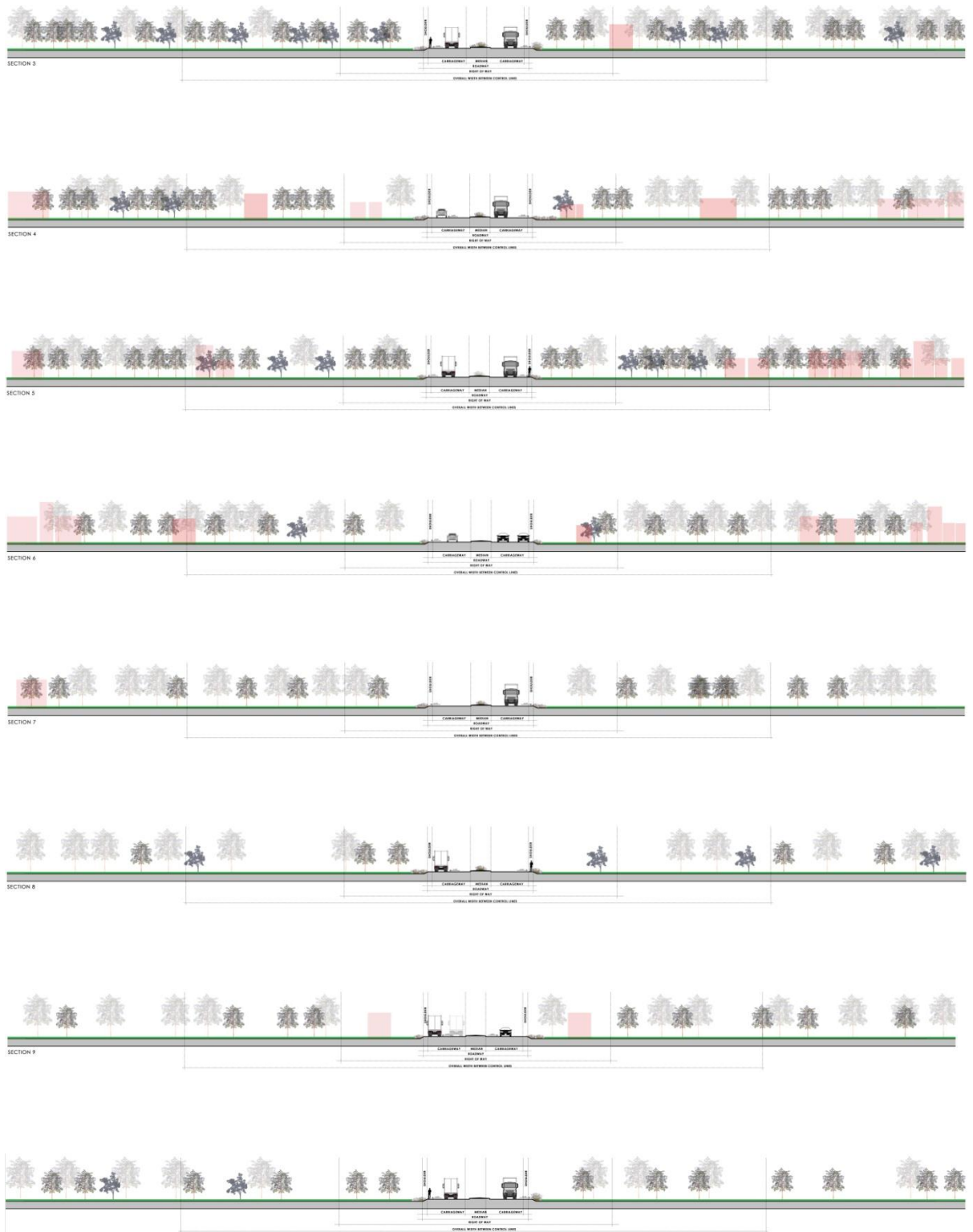


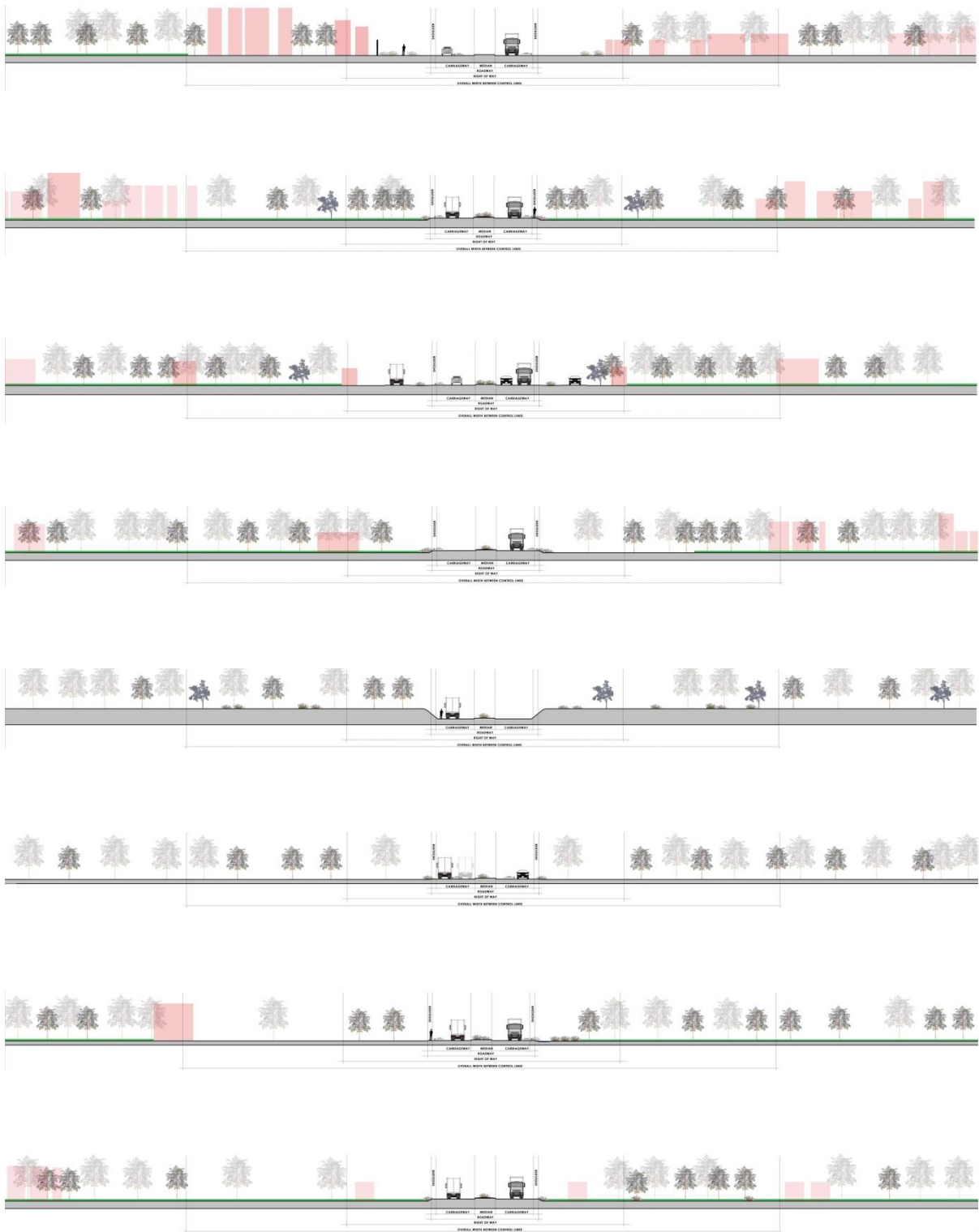
Figure 24 : Site Introduction - Bhopal Bypass



4.1.4 Site Sections







The site sections cut at every equal interval of 2kms provides us with the observation of the character of the highway and how it's changing along its length. The carriageway of the highway is same for the entire stretch except at a patch where an additional service road is provided separated from the carriageway through a depressed median. The highway passes through a forest area, which is part of the Vindhyan mountains ranges. The bypass passes through a stretch which comes under the wards of the Bhopal city and can see major development along it, majorly residential complexes.

4.1.5 Climate Analysis

Bhopal has a humid sub-tropical climate with hot summers, humid monsoon and cool winter seasons. Summer starts in end March and lasts till the Middle of June with an average temperatures around 30° degrees Celsius and peak temperatures can reach up to 40° degree Celsius in the month of May. The monsoon season starts in end June and continues upto September end. These months get about 40 inches of rainfall (1020 mm), frequent flooding & thunderstorms. The average temperatures are about 25 degree Celsius and humidity is high with strong winds. The annual rainfall in Bhopal is 1146 mm. The winters start around early November when the temperatures go down during the night time, with cool breeze during the day. The average temperatures around these months are 16 degree Celsius with temperature dropping in January to its lowest peak.

Figure 25 : Annual Rainfall Data for Last 7years

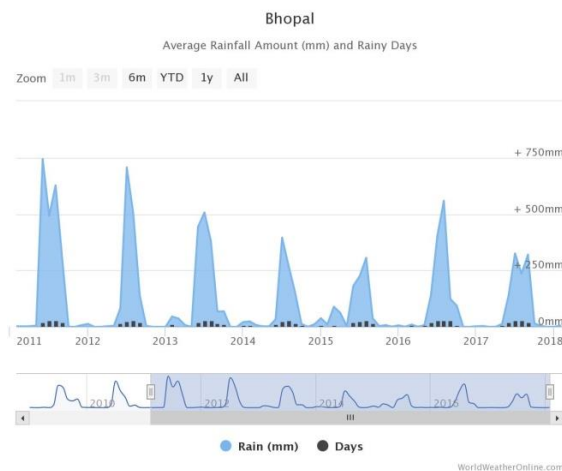
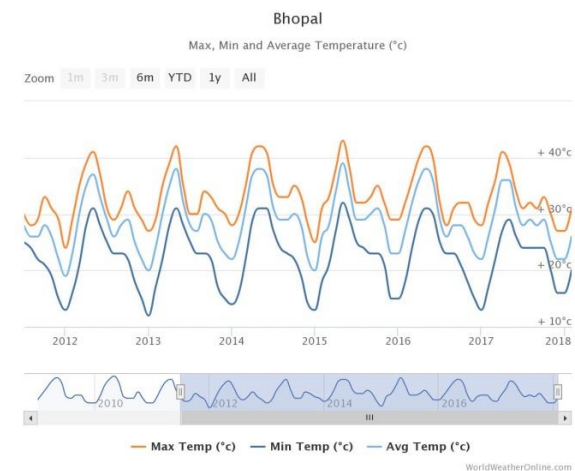


Figure 26 : Annual Temperatures for last 7years



4.1.6 Wind Analysis

The wind directions in Bhopal and its surrounding areas are majorly from two directions in the whole year. The summer winds are from the North-West and West direction and that of winters are from the North – East. The wind direction diagram clearly indicates the directions of the wind towards the city and its precincts. The wind speeds range from 10 km/hour to 20 km/hour. The rate of speed of summer winds is more as compared to that of winter season. Hence, needs to create wind breaks and buffers along the west direction of the highway for easy driving experience and also harness the wind power through wind turbines for the benefit of local people and communities.

Figure 27 : Wind Direction Diagram

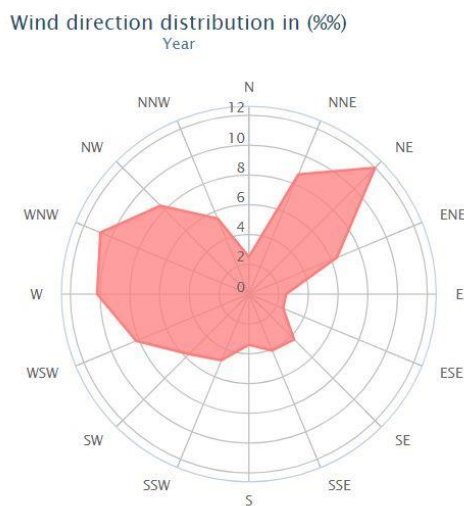
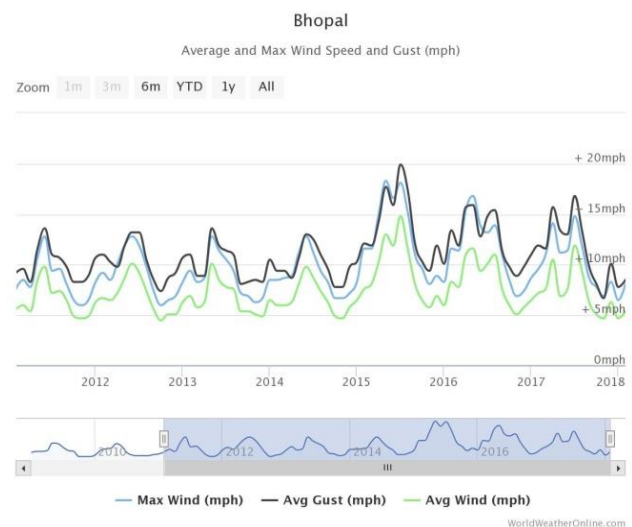


Figure 28 : Average Wind Speeds of 7years



SOURCE:

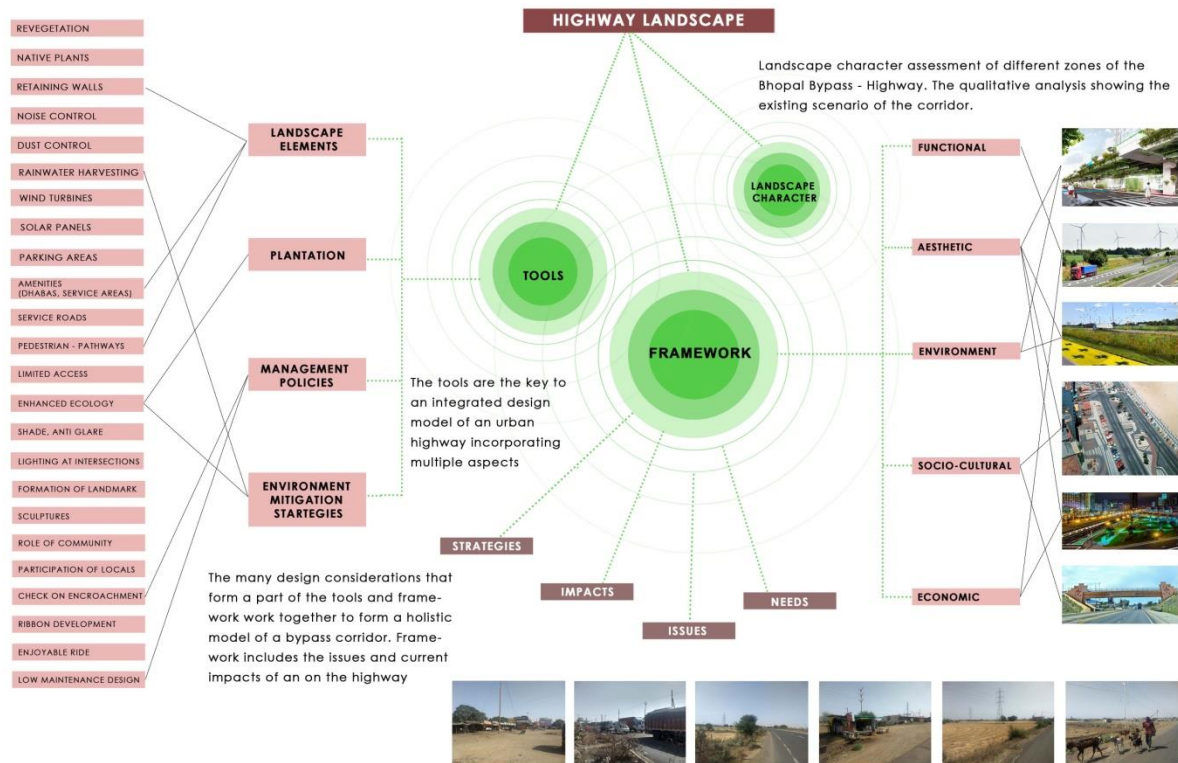
https://www.windfinder.com/windstatistics/raja_bhoj_airport_bhopal

4.1.7 Matrix

The matrix formulates a system of different parameters and aspects of highway landscape which informs about the various features about the highway landscape. The framework consists of strategies, impacts, issues and needs. The many tools comprise of landscape elements, plantation, management policies and environmental strategies. These tools further allows us to achieve various design consideration ranging from plantation to construction of barrier/retaining walls,

policies such as check on encroachment, role of communities and so on. Further the framework also includes parameters such as functional, aesthetics, environment, socio-cultural and economic aspects.

Figure 29 : Highway Landscape Matrix Diagram

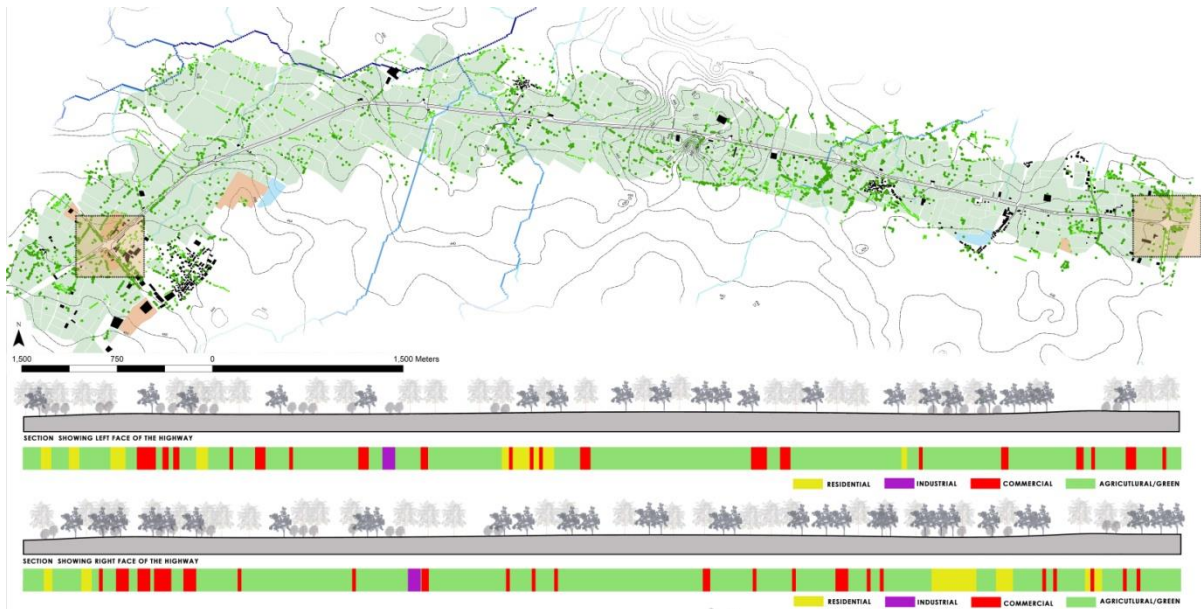


4.2 SITE STUDY

The 40 kilometer stretch of Bhopal Bypass, out of which 10 kilometer is being intervened through design proposals. The stretch starts from the first Toll Plaza towards the intersection at Ayodhya Bypass, further moving towards the second intersection. There are numerous villages that are present along the corridor such as Dobra, Arwalia, Parvaliya Sani, Shyampur, Imliya, Kalyanpur and so on.

The existing highway consists of many Dhabas, restaurants, services shops, storage and few houses. There are two industrial buildings on the ten kilometer stretch, a cement factory and a warehouse. There are two clusters of settlements close to the carriageway of the bypass. Also, there are many local roads that are connected directly from the highway to the villages causing congestion and risk of accidents.

Figure 30 : Site layout and Land Use Pattern

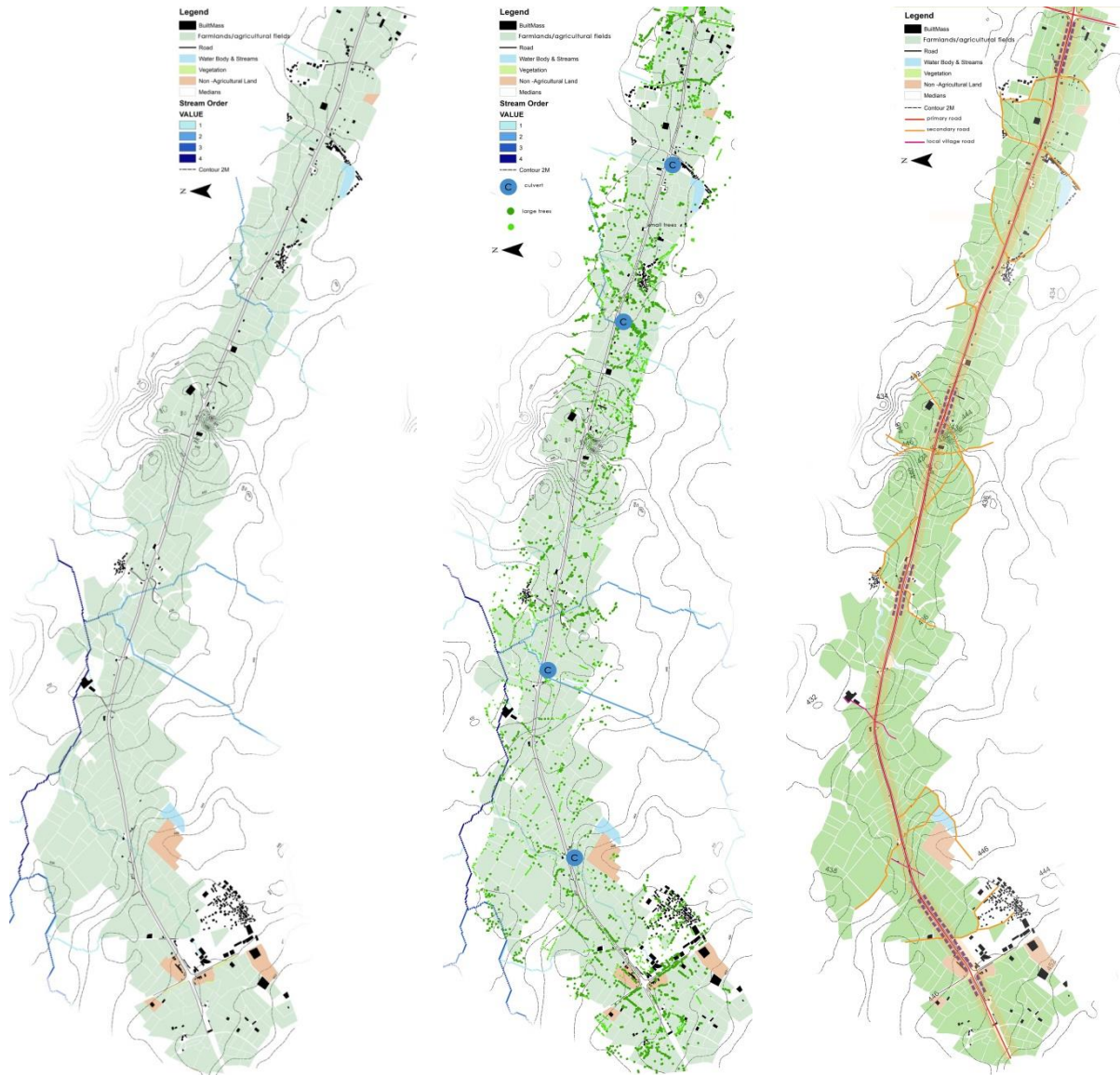


The linear section shows the terrain of the highway, which is plain and rolling with sparse to medium dense vegetation along the edge of the corridor. The linear graphical representation shows the pattern of the existing land use along the highway, which clearly shows the type of building use that is coming up and the density of the development is happening. The major four land uses are residential, commercial, industrial and agricultural/green.

The diagram indicates the concentration of development is more towards the intersection points of the highway, since they are closer to the Bhopal city and the influence of urbanization is more. The construction which is happening is more in clusters and few places the land use is overlapping, for example, near the Dobra village the settlement is few meters inside and the shops are at the edge of the highway showing the change in economic factors.

The introduction of the highway has led to a change in socio-economic aspects of the people, who are now readily selling their agriculture fields as well as constructing food stalls and service shops for better standard of lifestyle.

4.2.1 Circulation and Infrastructure



4.2.2 Observation and Inferences

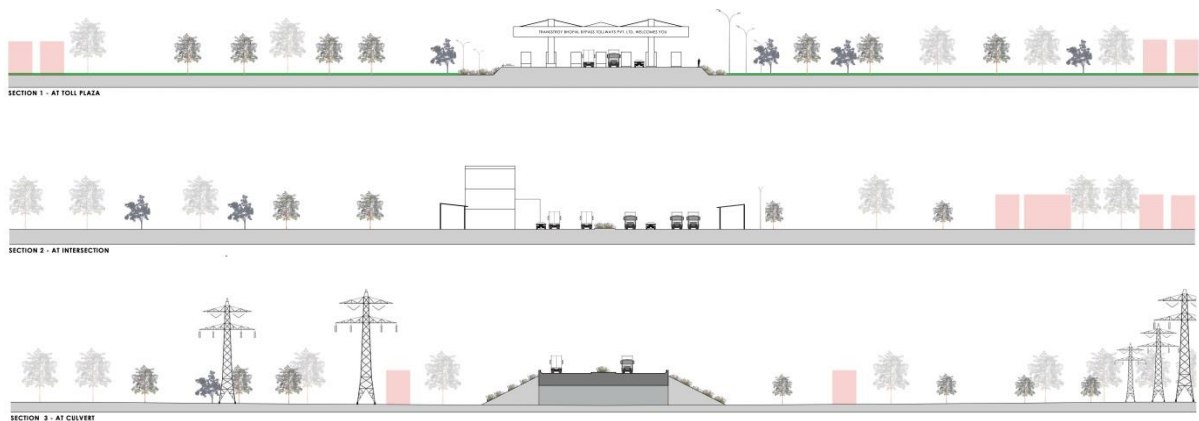
The first map shows the built open relationship, indicating the built up concentration near the intersections and many clusters along the highway. This stretch is still not developed as compared for other areas on the highway.

The vegetation along the edge of the Bypass is minimum, mostly invasive trees and seasonal grass, as shown in the second map, it shows that while construction, most of the trees were cut down and no efforts had been made to re-vegetate the area

after completion of the project. There are mostly Subabool trees and a few places Palaash tree, which have stunted growth due to the lack of water and proper nutrients. The median consists of Bougainvillea and Kaner shrubs, both which are in neglected state. The soil on the median is dry and eroded. There are four stream orders, with the fourth order stream meeting the Halali River. There are four culverts along the ten kilometer stretch out of which two were dried and other two were under the flow of sewage water. Such number of culverts clearly shows the amount of disturbance that have caused to these streams.

The third map shows the traffic density and the categories of roads on the site. The primary road is the four-lane carriageway, which connects to many secondary and tertiary roads connecting the villages and settlements. The major traffic congestion is seen around the intersections due to many activities happening together. Also, where there are dhabas and service shops, there also you find congestion due to truck parking along the shoulder.

4.2.3 Site Sections



The sections show the different character of the site as well as the various elements that are present along the highway such as culverts, dhabas, restaurants, service shops and toll plazas. The surrounding areas such as residential complexes, electrical substation and farmlands are along the sight line of the driver while driving.

4.2.4 Site Issues



The eroded and unmaintained edges - toll plaza



Absence of vegetation on median and lack of signages



Illegal hawkers, dilapidated condition of edges



Wide view of the power station amidst the farms



Encroached built structures, edge conditions



Absence of any vegetation, no shade and too much glare



Incomplete flyover, dust and noise



Edges are eroded, no trees, water contamination

4.2.5 PCU Analysis

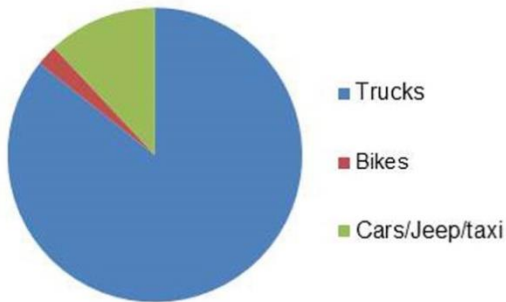
TYPE OF VEHICLE (TIME – 9:45 – 10:00 AM)	NO. OF VEHICLE	PCE / PCU	CONVERTED NO. OF VEHICLE OF PCU	% PCU
TRUCKS	60	3	180	85
2-WHEELER, MOTORCYCLE	50	0.1	5.0	2.3
CARS / JEEP/ TAXI	25	1	25	11.9
TOTAL	135		210.0	

RATE OF FLOW = 210 Vehicle/ 15min
 SERVICE FLOW RATE = RATE OF FLOW * 4
 = 210 * 4
 = 840 Vehicle / hour

DAILY EXPANSION FACTOR, DEF = 7.012
 WEEKLY VOLUME OF RAFFIC
 = DAILY VOLUME OF TRAFFIC * DEF
 = 14,374.4 * 7.012
 = 1,00,779.2 Vehicle / week

HOURLY EXPANSION FACTOR, HEF = 17.11
 DAILY VOLUME OF RAFFIC
 = SERVICE FLOW RATE * HEF
 = 840 * 17.11
 = 14,374.4 Vehicle / day

Vehicle Composition of Traffic Stream



4.2.6 SWOT Analysis

STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
THE HIGHWAY IS LINKING MAJOR CITIES SUCH AS RAISEN, VIDISHA , BERASIA AND SANCHI	MAJOR DEVELOPMENT ALONG THE CORRIDOR AFFECTING THE LAND USE AND THE VISUAL QUALITY OF THE HIGHWAY	EXISTING AMENITIES	NO LIGHTING AT THE NODES
EXISTING SCENIC VIEWS	ABSENCE OF TREES, VEGETATION ALONG THE HIGHWAY AS WELL ON THE MEDIAN AND POOR MAINTENANCE AS WELL.	CHANGING LANDSCAPE CHARACTER ALONG THE 40KM STRETCH OF THE BYPASS	NO LIMITED ACCESS
LARGE EXPANSE OF AGRICULTURE FIELDS ON BOTH SIDE OF THE HIGHWAY	NO DRAINAGE AND NO SIGNAGES.	CONSTRUCTION OF FLYOVER AT THE INTERSECTIONS	HUMAN WILDLIFE CONFLICT
THE CLOSE PROXIMITY OF THE HIGHWAY WITH THE BHOPAL CITY.	CONGESTION AT THE INTERSECTIONS DUE TO HEAVY TRAFFIC AND TOO MUCH COMMERCIAL ACTIVITY GOING ON	THE COMMUNITIES AND VILLAGES RESIDING ALONG THE HIGHWAY.	LACK OF MULTIFUNCTIONAL SPACES
HOMOGENOUS LANDSCAPE ELEMENTS	NEGLECTED EDGES ALONG THE HIGHWAY CORRIDOR	FEW PATCHES WITH MEDIUM DENSE TREES AND VEGETATION	DEVELOPMENT CLOSE TO THE EDGES
GOOD ACCESSIBILITY OF THE HIGHWAY FROM VARIOUS AREAS.	SOIL EROSION ALONG THE BYPASS ROUTE NEAR THE LAHARPUR FOREST AREA.	RIGHT OF WAY – 30-60 METRES AVAILABLE	POLLUTING WATER STREAMS , DEGRADED AIR QUALITY
	LACK OF MAINTENANCE OF PLANTATION ON MEDIAN AND ABSENCE OF VEGETATION AT MANY PATCHES.	MULTIMODAL TRANSPORTATION CORRIDOR	NO SHADE, SUN GLARE AS WELL AS HEADLIGHT GLARE IN THE NIGHT
	NO PROPER RESTING AREAS FOR THE DRIVERS OR PASSENGERS		
	LACK OF SAFETY FOR PEDESTRIAN AT THE NODE.		

CHAPTER 5: DESIGN DEVELOPMENT

5.1 Zoning

The entire stretch of the Bhopal Bypass is divided into different zones depending on various factors such as landscape character, nodes, pause points, speed and sightlines. The zones are further studied in detail according to the functional, environment and aesthetic perspective including economic and socio cultural factors. The stretch taken for design intervention for the purpose of this thesis is the first ten kilometers starting from the Toll plaza and ending on the second intersection, which connects Bhopal to Berasia City.

The stretch is further divided into zones through functional parameters and issues that the highway is facing right now. The available right of way of total of 150 meters including the roadway width provides with scope of planning and designing a green buffer, which are based on the many concepts and strategies of planting. Each zone is approximately of 700 – 1000 meters depending on the present requirements of the site.

Zone 1 – Near the second intersection towards the Berasia city, where a truck parking is provided with amenities such as food plaza, service shops and resting places. Presently, many trucks are parked on the highway edge for resting purposes and cause a great deal of congestion on the intersection. Along the truck parking, section consisting of shrubs, cluster of evergreen and deciduous trees and an orchard is provided. With near the intersection, bed of shrubs, retaining wall depicting art and culture and rows of trees in grid for dust and noise control are proposed.

Zone 2 – After the zone 1, a different section is proposed with a bed of shrubs, rows of trees, nursery and orchards.

Zone 3 – Another section of the highway includes planting strategy including of vertical stratification, with few meters of shrubs. Then medium sized trees and finally rows of large evergreen trees. This section provides a better visual for the driver at higher speed without obstructing his view completely.

Zone 4 – Driving on the highway, we come up to a patch of area, which is high in scenic quality. We specifically get the view of lush green fields during winter and brown colour texture during summers with a skyline of trees at the far end. The section includes complete planting of small to large shrubs for the entire width of the right of way. The planting will allow the driver to appreciate the natural scenic view keeping in view the ecological benefits of it.

Zone 5 – This zone will provide a pause point on the highway, a resting place with other important amenities and a linear park which will add a recreational element on the highway as well will act as a greenway along the highway corridor. The residential complexes constructing along the highway will benefit from this linear park which will keep in mind the requirements of all the users ranging from local people, commuters and people living nearby places.

5.2 Concept

Multifunctional

The highway constitutes of many functions such as providing a safe roadway for access of the people, proper alignment and sightlines. Amenities and utilities such as parking, fuel stations, rest places, areas designated for food and restaurants, public toilets, service shops in case of emergencies and then additional functions of aesthetics, shade, anti-glare, good visual experience. Maintaining the ecology and biodiversity of the area and keeping the safety of wildlife and cattle. The integration of all the functions help in achieving a complete and well thought of highway landscape design. Also, taking care of the needs of the local communities and villagers, designated space allocation for them to generate their living and improve their living standards as well taking into the ecology of the area into considerations.

Environment

An important factor that is taken into consideration is the road ecology. Highway provides ample opportunities to do the same. The amount of run-off is very high and when harvested can help cope with water scarcity as well as recharge the groundwater only to help the local communities and the people who eventually start urbanizing the corridor. Planting trees and shrubs will enhance the biodiversity of the

area by inviting and attracting insects, birds and butterflies. Further, the problem of dust, carbon emission from the vehicles and noise can all be curbed through intensive list of plants. Hence, eventually the quality of the environment will improve and increase health benefits and reduce diseases.

Aesthetic

The aesthetics are significant for the experience of the commuter since it helps to reduce stress, enhance cognitive abilities. Planting, installation of art, sculptures and barrier walls decorated with culture of the cities, tribes and villages. Lighting and use of different material at crossings, intersections and other activity areas will improve the overall appearance of the highway making it a reflection of the city image.

Socio –economic

Designing spaces along the corridor for the local communities to help them earn a living through designing haats, locating food plazas, building rest houses and other open spaces for them to interact with the public. These spaces in integration with the nature will enrich the quality of the highway corridor making more people travel through it ultimately increasing the economic factor.

5.3 Design

Nursery

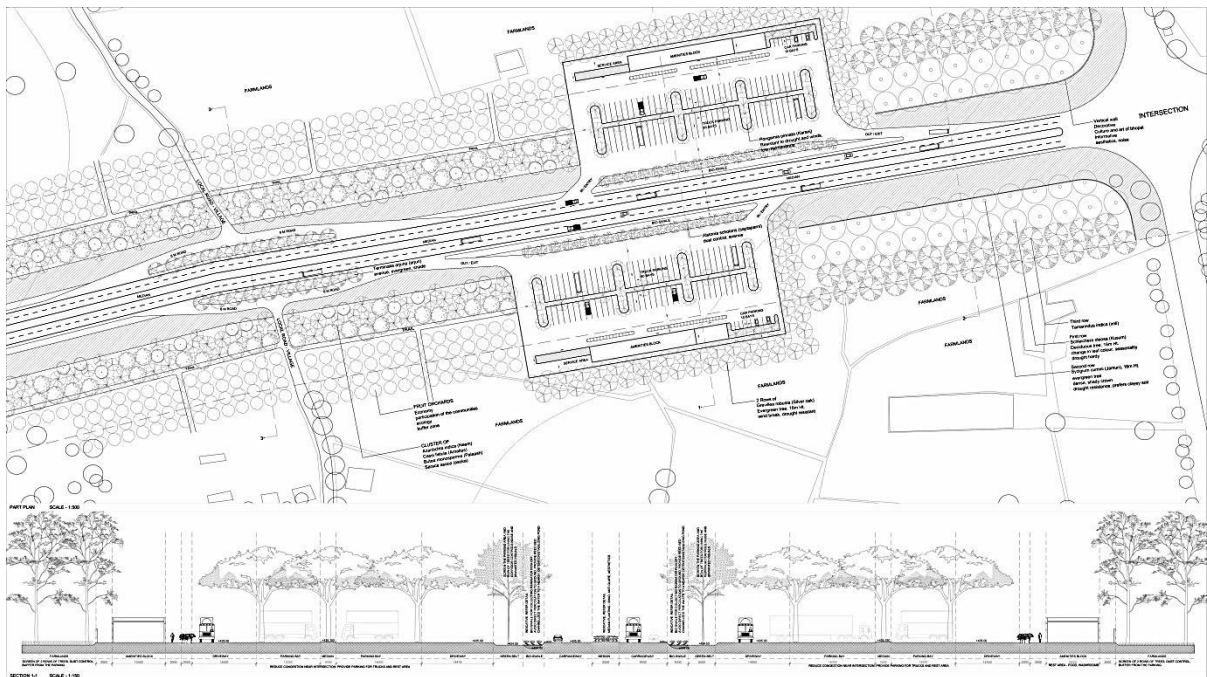
Nursery for economic and environment benefits is proposed after the layers of two buffers that is shrub and tree planting. The width of twenty five metres is taken for the development of nursery which will be looked after the local people and farmers. They will take care of the nursery and run it by themselves with the help of the government. After a certain amount of time the people will be able to generate economy and also will help in maintaining the highway landscape. The nursery will include medium size trees, small to medium and large shrubs, flowering and seasonal plants. The water from the carriageway will be stored and thus use it during the dry seasons.

Orchards

The orchards will provide economic benefit for the farmers and will act as a buffer between the highway and the farmlands. Rows of four fruit trees will be planted which will be maintained by the local people and villagers and sell them along the highway corridor for their living. The orchards have several benefits such as they become a focal point/gathering space, help regenerating degraded land, improve property values, reduce pollution, provide habitat for the wildlife, hold water and reduce erosion. Orchards are important for a healthy urban ecosystem.

Truck parking

Truck parking with amenities such as food plaza, rest rooms and service area is provided with few car parking. The existing issue of truck parking at the intersection has caused much chaos and congestion. With many small shops and eating stalls also open has degraded the quality of the area. Also, the flyover construction from Bhopal city to Berasia has disturbed the movement of traffic and also visually degraded the place. The parking is buffered by rows of trees which are evergreen in character from the adjacent farmlands to obstruct the view.



Amenities Area

A linear stretch is proposed as a pause point in the journey allowing the commuters to rest and take break in their long journey ahead. The area includes truck and car parking with few two-wheelers parking. A large food plaza consisting of small stalls allowing more people to set up their business. A large open space for outdoor seating and play area for children is provided. Around the parking area a fuel station and service shops are planned.

Linear Park

Along the amenities area a linear park is designed for the recreational activities for the people who will also act as a green belt helping in restoring the environment degradation. The linear park will include many activities ranging from play areas, jogging tracks, water body and picnic spots.

Planting Strategy

The planting of trees will be based on certain criteria such as the highway design which is the foremost important factor when considering lining the highway edge by trees and shrubs. Another factor is the soil and climate factor and also keeping in mind the availability of water. The trees that are drought resistant and resistant to wind pressure should be planted like a buffer. Additionally, trees that can absorb more quantity of dust and air pollutants should be used. Use of evergreen trees with deciduous can add texture, colour and form to the highway corridor. Flowering trees will add aesthetics, which will enhance the experience of the driver.

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